LNG Power Plant (Ahlone) Project in Yangon, Myanmar

ESIA Report

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ESIA Report

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Acronyms and Abbreviations

µg	Microgram
A.I.P.T	Ahlone International Port Terminal
ACS	Auxiliary Cooling Water Supply
ADB	Asian Development Bank
AERMOD	USEPA AERMOD Dispersion Model Software
Ag	Silver
AIDs	Acquired Immune Deficiency Syndrome
ALARP	as low as reasonably practicable
ANSI	American National Standards Institute
AoI	Area of Influence
API	American Petroleum Institute
AQIA	Air Quality Impact Assessment
AQM	Air Quality Monitoring
AQS	Air Quality Standard
AR	Assessment Report
As	Arsenic
ASEAN	The Association of Southeast Asian Nations
ASME	The American Society of Mechanical Engineers
ASRs	Air Sensitive Receivers
ASTM	American Society for Testing and Materials
AWP	Asia World Port
AY	Academic Year
AZE	Alliance for Zero Extinction
BANCA	Biodiversity and Nature Conservation Association
BAT	Best Avaliable Technology
BCG	Bacillus Calmette-Guerin
Be	Beryllium
BOD	Biochemical Oxygen Demand
BOG	Boil-off gas
BOT	Build-Operate-Transfer
BREEZE	BREEZE Incident Analyst Modelling Software
Ca	Calcium
CAPEX	Capital Expenditure
CCGT	Combined Cycle Gas Turbine
CCPP	Combined Cycle Power Plant
CCR	Central Control Room
CCTV	Closed Circuit Television
CCW	Closed Circuit Water
Cd	Cadmium

CEDAW	Convention on Elimination of All Forms of Discrimination against Women
CEMS	Continuous Emission Monitoring system
CFR	Code of Federal Regulations
CGS	China Geological Survey
CH_4	Methane
CIA	Cumulative Impact Assessment
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
Cl	Chloride
CLO	Community Liaison Officer
CN	Cyanide
COD	Chemical Oxygen Demand
COD	Commercial Operation Date
CORMIX	Cornell Mixing Zone Expert System
Cr	Chromium
CR	Critically Endangered
Cu	Copper
CW	Cooling Water
DA	Degraded Airshed
DAS	Data Acquisition System
dB	Decibel
dB(A)	A-weighted Decibel
DC	Direct Current
DCIS	Distributed Control and Information System
DCMA	Double Counter weighted Marine Arm
DD	Data Deficient
DDD	Dichloro-Diphenyl-Dichloroethane
DDE	Dichloro-Diphenyl-Dichloroethylene
DDT	Dichloro-Diphenyl-Trichloroethane
DEA	Decommissioning Environmental Assessment
DEDE	Department of Alternative Energy Development and Efficiency Ministry of Energy
DEFRA	Department of Environment, Food and Rural Affairs
DEPP	Department of Electrical Power Planning
DLN	Dry Low NOx
DM	Demineralized
DMP	Dust Management Plan
DO	Dissolved Oxygen
DTP	Diphtheria and Tetanus Toxoids and Pertussis
DWT	Deadweight Tonnage
EA	Environmental Assessment
EBRD	European Bank for Reconstruction and Development

ECC	Environmental Compliance Certificate
ECCDI	Ecosystem Conservation and Community Development Initiative
ECD	Environmental Conservation Department
ECe	Electrical Conductivity
ECLOF	Environmental Conservation and Livelihood Outreach Foundation
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EN	Endangered
ENSO	El Niño/Southern Oscillation
EPA	United States Environmental Protection Agency
EPAS	Environmental Perimeter Air Station
EPC	Engineering, Procurement, and Construction
EPGE	Electric Power Generation Enterprise
EPPRPs	Emergency Prevention, Preparedness and Response Plans
ERL	Corresponds to Effects Range-Low
ERM	ERM-Siam Company Limited
ERM	Corresponds to Effects Range-Medium
ERP	Emergency Response Plan
ESG	Environmental, Social and Governance
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
EU	European Union
F	Fluoride
FAO	Food and Agriculture Organization of the United Nations
Fe	Iron
FGDs	Focus Group Discussions
FHWA	Federal Highway Administration
FPIC	Free, Prior and Informed Consent
FSRUs	Floating Storage Regasification Unit
GAD	General Administration Department
GCMs	General Circulation Model
GDP	Gross Domestic Product
GEG	Gas Engine Generator
Gg	Gigagram
GHG	Greenhouse Gas
GIIP	Good International Industry Practice
GIS	Gas Insulated Switchyard
GISD	Global Invasive Species Database
GN	Guidance Note

GPS	Global Positioning System
GRT	Gross Registered Tonnage
GT	Gas Turbine
GWPs	The global warming potentials
h	hour
HDD	Horizontal Directional Drilling
Hg	Mercury
HIV	Human Immunodeficiency Virus Infection
HP	High Pressure
HPGE	Hydropower Generation Enterprise
HRSG	Heat Recovery Steam Generator
HSE	Health, Safety, and Environment
IA	Impact Assessment
IAQM	Institute of Air Quality Management
IBA	Important Bird Areas
IBAT	The Integrated Biodiversity Assessment Tool
ICAO	International Civil Aviation Organization
ICP	Informed Consultation and Participation
IFC	International Finance Corporation
IFR	Incidence frequency rates
IFV	Intermediate fluid vaporizers
ILO	International Labour Organisation
INDC	Intended Nationally Determined Contribution
IP	Industrial Processes
IPA	Important Plant Areas
IPCC	Intergovernmental Panel on Climate Change
IPs	Indigenous People
ISO	International Organization for Standardization
ISQG	Interim Sediment Quality Guidelines
ISR	Incidence severity rates
ITD	Italian-Thai Development Public Company Limited
ITTA	International Tropical Timber Agreement
IUCN	International Union for Conservation of Nature
JICA	Japan International Cooperation Agency
K	Potassium
KBAs	Key Biodiversity Areas
Kg	Kilogram
KIIs	Key Informant Interviews
km	Kilometre
kV	Kilovolt

kW	Kilowatt
kWh	Kilowatt Hour
L	Litre
L&FS	Life and Fire Safety
LAeq	A-weighted equivalent continuous sound level in decibels
LC	Least Concern
LNG	Liquefied Natural Gas
LNGC	Liquefied Natural Gas Carrier
LOA	Length Overall
LP	Low Pressure
LPG	Liquefied Petroleum Gas
LTSA	Long Term Service Agreement
LUCF	Land Use Change and Forestry
m	Meter
M&E	Monitoring and Evaluation
m^3	Cubic Metre
MALI	Ministry of Agriculture, Livestock and Irrigation
MARPOL	The International Convention for the Prevention of Pollution from Ships
MERN	Myanmar Environment Rehabilitation-Conservation Network
mg	Milligrams
Mg	Magnesium
MIC	Myanmar Investment Commission
MIMU	Myanmar Information Management Unit
MIP	Myanmar Industrial Port
MITT	Myanmar International Terminal Thilawa
MLIP	Ministry of Labour, Immigration and Population
mm	Millimetre
MMSCFD	Million Standard Cubic Feet per Day
Mn	Manganese
MNPED	Ministry of National Planning and Economic Development
MOECAF	Ministry of Environmental Conservation and Forestry
MOEE	Ministry of Electricity and Energy
MOGE	Myanmar Oil &Gas Entreprise
MONREC	Ministry of Natural Resources and Environmental Conservation
MPA	Myanmar Port Authority
MPN	Most Probable Number
MSDS	Material Safety Data Sheet
MSS	Manufacturers Standardization Society
MSWRR	Ministry of Social Welfare, Relief and Resettlements
$MtCO_2e$	million metric tons of carbon dioxide equivalent

MUPA	Myanmar United Power Asia Public Company Limited
MW	Megawatt
MWth	Megawatt Thermal
N	Nationally Significant
N/A	Not applicable
Na	Sodium
NCEA	National Commission for Environmental Affairs
NCV	Net Calorific Value
NCV	Net Calorific Value
NDA	Non Degraded Airshed
NE	Not Evaluated
NEMC	National Energy Management Committee
NEP	National Environment Policy
NEQEG	National Environmental Quality Emission Guideline
NFPA	National Fire Protection Association
NG	Natural Gas
Ni	Nickel
NL	Not Listed
Nm^3	Normal Cubic Meter
NO_2	Nitrogen Oxide
NO_3	Nitrate
NOAA	National Oceanic and Atmospheric Administration
NO_x	Oxides of Nitrogen
NPi	Australian National Pollution Inventory
NSDS	National Sustainable Development Strategy
NSRs	Noise Sensitive Receivers/Receptors
NTP	Notice to Proceed
NYDC	New Yangon Development Company Limited
O&M	Operation and Maintenance
O_2	Oxygen
OBE	Operating Basis Earthquake
OECD	Organization for Economic Cooperation and Development
OHS	Occupational Health and Safety
OHSMP	Construction Occupational Health and Safety Management Plan
OPEX	Operational Expenditure
PAHs	Polycyclic Aromatic Hydrocarbons
PAP	Project Affected People
PAs	Protected Areas
Pb	Lead
PC	Process Contribution

PCBs	Polychlorinated Biphenyl
PEC	Predicted Environmental Concentration
PFD	Process Flow Diagram
PM	Particulate Matter
PM_{10}	Particulate Matter <10 micrometres
POPs	Stockholm Convention on Persistent Organic Pollutants
PPA	Power Purchase Agreement
PPE	Personal Protective Equipment
PPM	Part per Million
PPR	Project Proposal Report
PS	IFC Performance Standards
PS6	IFC Performance Standard 6
PVC	Poly Vinyl Chloride
R	Regional Significance
ROW	Right of Way
RU	Regasification Unit
SAoI	Social Area of Influence
Sb	Antimony
SCADA	Supervisory Control And Data Acquisition
SCOD	Scheduled Commercial Operating Date
Se	Selenium
SEM	Sustainable Environment Myanmar Company Limited
SEP	Stakeholder Engagement Plan
Sn	Tin
SO_2	Sulphur Dioxide
SO_4	Sulphate
SPS	Safety Policy Statement
SSPC	The Society for Protective Coatings
STG	Sciences, Technology and Globalization
SW	Surface Water
TB	Tuberculosis
TDS	Total Dissolved Solid
TEC	Toyo Engineering Corporation
Ti	Titanium
TJ	Terajoules
TPMC	TTCL Power Myanmar Company Limited
TSP	Total Suspended Particulate
TSS	Total Suspended Solid
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development

UNDHR	Universal Declaration of Human Rights
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
UN-HABITAT	United Nations Human Settlements Programme
UNICEF	United Nations International Children's Emergency Fund
UPS	Uninterruptible power supply
USEPA	United States Environmental Protection Agency
VEC	valued environmental and social component
VKT	Vehicle kilometre Travelled
VU	Vulnerable
WBG	World Bank Group
WHO	World Health Organization
WMP	Waste Management Plan
WRI CAIT	World Resources Institute Climate Analysis Indicators Tool
WWF	World Wildlife Fund
YCDC	Yangon City Development Committee
YESC	Yangon City Electricity Supply Cooperation
Zn	Zinc

1. EXECUTIVE SUMMARY

1.1 Introduction

TTCL Power Myanmar Company Limited ('TPMC' and/or 'the Project Proponent') is planning to develop the **LNG Power Plant (Ahlone) Project** (also referred to as 'the Project'). The Project will consist of three main components; the LNG Power Plant (Ahlone) (hereafter referred to as 'Power Plant'), LNG Receiving Terminal (hereafter referred to as 'LNG Receiving Terminal' which include Jetty, LNG Storage Tank(s) and Regasification Unit), and the Natural Gas Pipeline (hereafter referred to as 'Pipeline'). The Pipeline will have an approximate length of 24.9 km connecting the Regasification Unit at the LNG Receiving Terminal to the Power Plant. The Project Proponent has planned to use imported Liquefied Natural Gas (LNG) as the fuel source. The selected technology for the Power Plant, combined cycle power plant (CCPP), is an efficient form of power generation, proven and acknowledged as a clean form of natural gas power generation due to its efficient gas utilisation and lower environmental impact.

The Project Proposal Report (PPR) was submitted to Ministry of Electricity and Energy (MOEE), and Ministry of Natural Resources and Environmental Conservation (MONREC) on 14th December 2017 and the Project received the Notice to Proceed from the Myanmar Government in January 2018.

Under *Section 7 of the Environmental Conservation Law and Articles 52* and *53* of the *Environmental Conservation Rules* of the Republic of the Union of Myanmar, TPMC is required to undertake an Initial Environmental Evaluation (IEE) Study OR an Environmental Impact Assessment (EIA) Study to obtain an Environmental Compliance Certificate (ECC) for the proposed Project. The PPR recommended that the Project Proponent shall prepare and submit the EIA Study (this Report) to the relevant authorities for appropriate approval.

The Project Proponent may seek international financing for the Project development phase from international lenders. Therefore, this EIA Study, also referred to as Environmental and Social Impact Assessment (ESIA) study, is developed in compliance with Myanmar EIA requirements and in line with International Standards, namely IFC PS and Associated Guidelines.

ERM-Siam Company Limited ('ERM' and/or 'the Consultant') has been proposed by TPMC as third party consultant to undertake the EIA study as proposed in the PPR report. This EIA will focus on the LNG Receiving Terminal, Natural Gas Pipeline, and the LNG Power Plant (Ahlone). A separate Initial Environmental Examination (IEE) report will be developed for the 230 kV transmission line connecting the Power Plant to a sub-station in Hlaingthayar Township.

1.2 Context of the Project

TPMC is planning to develop a Power Plant in Yangon, Myanmar. A Combined Cycle Power Plant (CCPP) (installed capacity 388MW) will be developed to supply the power to the Republic of the Union of Myanmar.

In January 2018, the Ministry of Electricity and Energy (MOEE) hosted the 'Notice to Proceed' (NTP) signing ceremony for four (4) projects, which included the LNG Power Plant (Ahlone) Project and the NTP was signed between the Myanmar Government and TPMC. The Project Proponent has prepared and submitted the Project Proposal Report (PPR) to MOEE and ECD on 14th December 2017. The PPR recommended that TPMC shall proceed with an Environmental Impact Assessment (EIA) Study of the Project and prepare an Environmental Management Plan (EMP) to put forward its commitments for environmental and social mitigation and management measures.

In addition, the Scoping Report has also been prepared and submitted to MOEE and ECD on 9th January 2019. ECD has provided the comments on the Scoping Report on 9th April 2019. The comments from ECD are addressed in this EIA Report, please refer to ***Appendix C*** for further details.

This Environmental and Social Impact Assessment (ESIA) will only cover the LNG Receiving Terminal, Pipeline, and Power Plant; while an Initial Environmental Examination (IEE) for the Transmission Line has been prepared as a separate document.

1.3 Background of Project Proponent

TPMC is a project company set up by TTCL Public Company Limited and the main Project Proponent for the proposed Project. TPMC was established in 2018 to carry out the development, operation and maintenance of the Project.

TTCL Public Company Limited (TTCL), the first integrated Engineering, Procurement and Construction (Integrated EPC) company in Thailand, was incorporated on 24 April 1985 with a start-up capital of 20 Million Baht. TTCL was formed by a joint venture between two (2) leading international engineering and construction companies from Japan and Thailand. TTCL has experience and expertise in providing integrated design and engineering, procurement of machinery & equipment, and construction (Integrated EPC) of turnkey projects for industrial and process plants, mainly in energy, petrochemical, chemical and power industries.

TTCL has set up TTPMC in 2012 for the development of a 120 MW Gas-fired power plant in Ahlone Township, Yangon, the Republic of the Union of Myanmar.

Details of the main Project Proponent are as follows:

Company Name:	TTCL Power Myanmar Company Limited (TPMC)
Address:	16B, 16th Floor, Centre Point Tower, NO. 65, Corner of Sule Pagoda Road and Merchant Street. Kyauktada Township, Yangon, Myanmar
Contact Person:	Ms. Nini San
Telephone:	+95 [0] 9 254 311058 +95 [0] 1 371 962
Fax:	+95 [0] 1 371 963
Email:	nini.s@ttcl.com

1.4 Policy, Legal and Institutional Framework

Under *Section 7 of the Environmental Conservation Law and Articles 52* and *53* of the *Environmental Conservation Rules* of the Republic of the Union of Myanmar, TPMC is required to undertake an Initial Environmental Evaluation (IEE) Study OR an Environmental Impact Assessment (EIA) Study to obtain an Environmental Compliance Certificate (ECC) for the proposed Project.

The Project will be undertaken in line with national regulation and international standards. Local laws relating to the ESIA include: Environmental Conservation Law (2012); Environmental Conservation Rules (2014); National Environmental Quality (Emission) Guidelines (2015); and the Environmental Impact Assessment (EIA) Procedure (2015).

With the release of the final Myanmar EIA Procedure in December 2015, the National Environmental Quality (Emissions) Guidelines were also released. These Guidelines provide the basis for regulation and control of noise and air emissions and effluent discharges from projects in order to prevent pollution and protect the environment and public health. These standards are equivalent to the World Bank Group General Environmental Health & Safety (EHS) Guidelines (2007).

1.5 Project Description

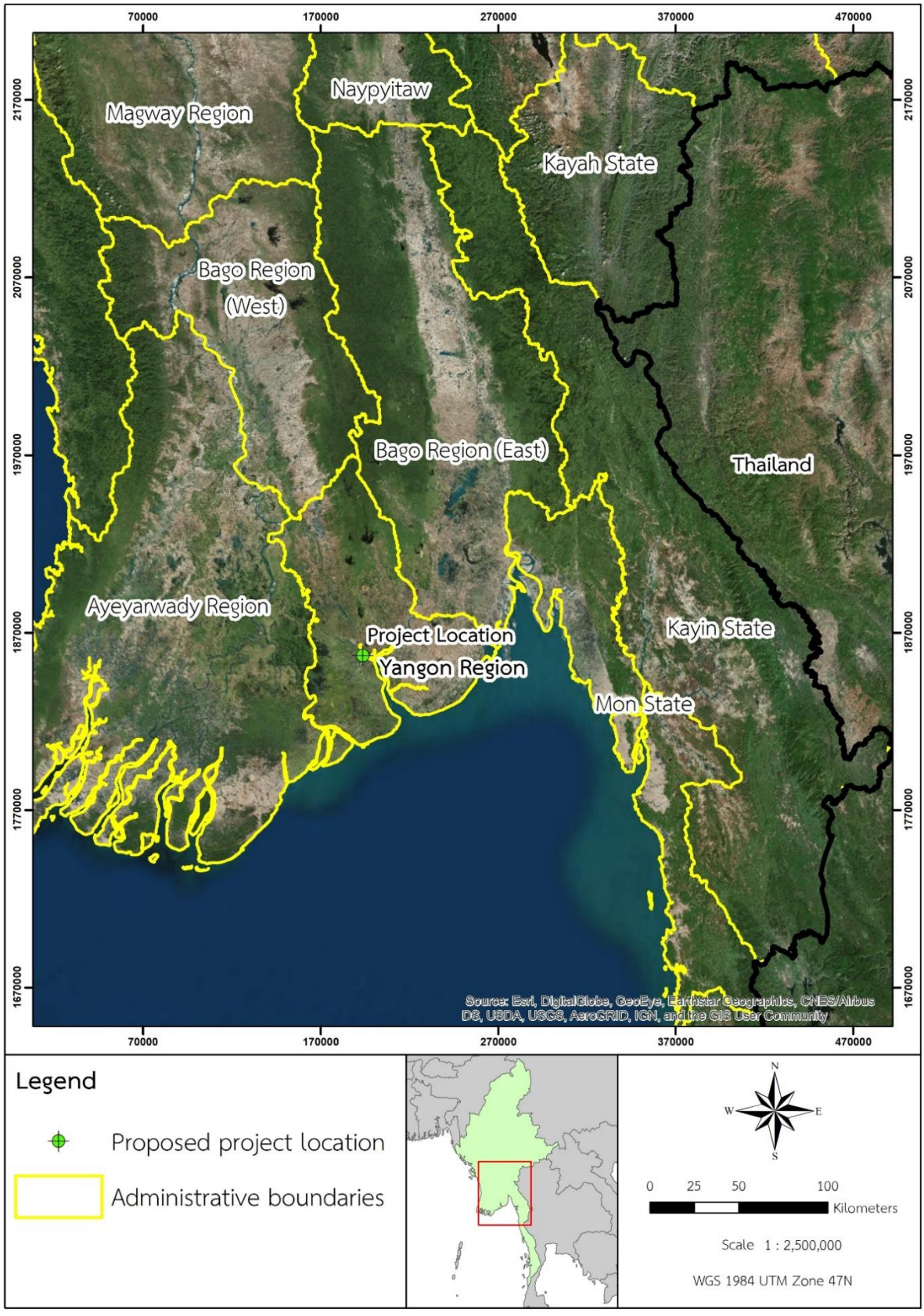
1.5.1 Project Location

The Project location is located within the Yangon Region, in Myanmar. The LNG Receiving Terminal is located on the west bank of the Yangon River, in the southeastern regions of Dala Township. The Power Plant is located along the east bank of the Yangon River, in the southern regions of Ahlone Township, beside Toyo Thai Power Myanmar Co. Ltd (TTPMC) existing 120 MW Natural Gas Power Plant. The Natural Gas Pipeline, which will transfer natural gas (NG) from the LNG Receiving Terminal to the Power Plant, will run through Dala, Seikgyikanaungto, and Ahlone Townships. The pipeline will need to cross two (2) waterways, which include the Twante Canal, and the Yangon River. The general location for the Project, on a regional scale, is shown in ***Figure 1.1***. The location for all three main components is presented in ***Figure 1.2***. The coordinates for the LNG Receiving Terminal, Pipeline, and Power Plant are listed in ***Table 4.1***.

Table 1.1: Main Project Facility Coordinates

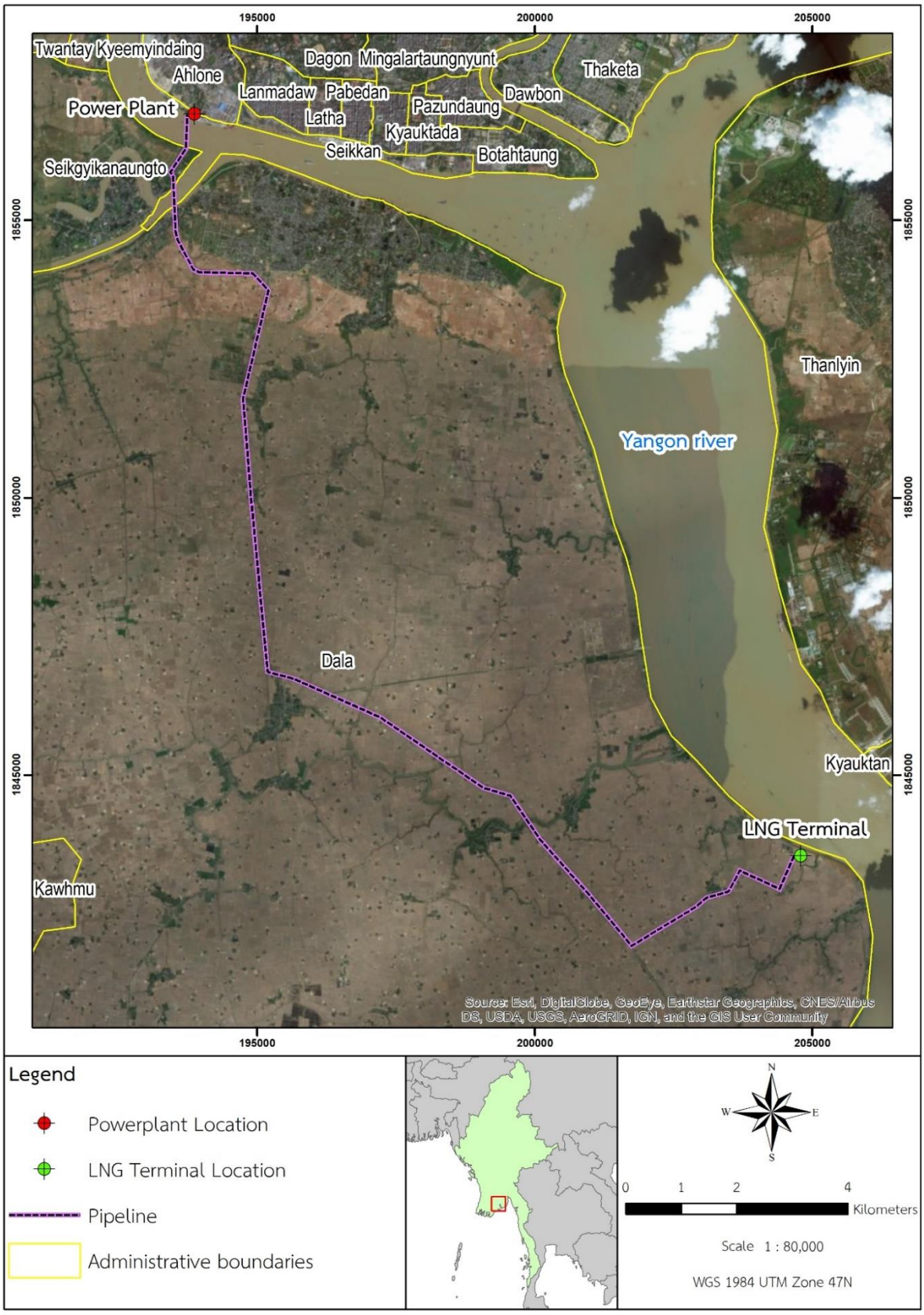
Project Main Facilities	Coordinates
LNG Receiving Terminal	16°39'22.62"N, 96°13'56.82"E
Pipeline	Shown in ***Figure 1.3***
Power Plant	16°46'31.46"N, 96° 7'42.27"E

Figure 1.1: Project Location



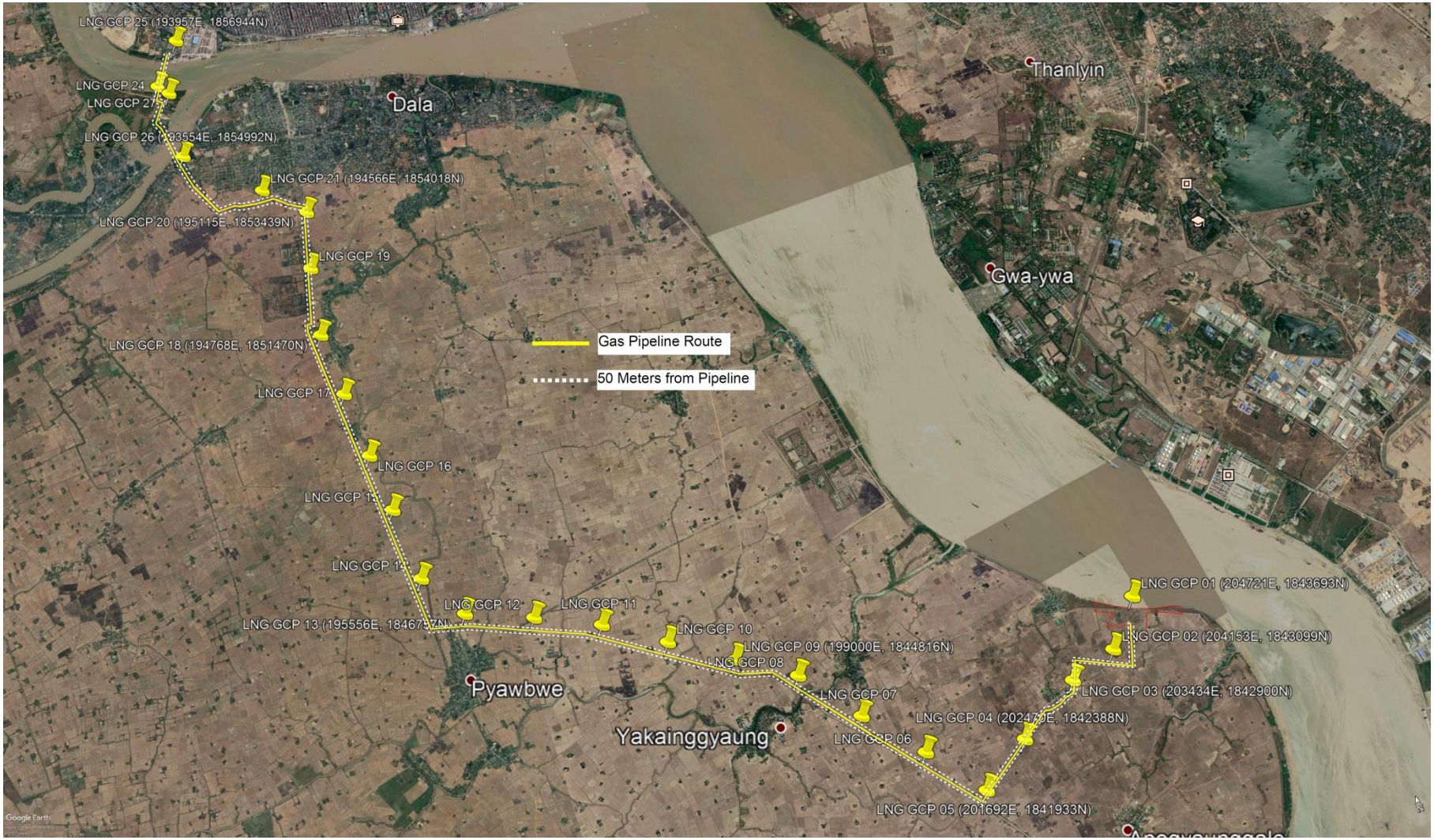
Source: TPMC, 2018. (Modified by ERM)

Figure 1.2: Location of the Three Main Components



Source: TPMC, 2019. (Modified by ERM)

Figure 1.3: Pipeline Alignment with Coordinates



Source: TPMC, 2020.

1.5.2 LNG Receiving Terminal

1.5.2.1 Key Components

The LNG Receiving Terminal is a facility for unloading liquefied natural gas (LNG) from the LNG Carrier (LNGC), LNG storage, and regasification of LNG to NG. The LNG Receiving Terminal components are listed in ***Table 1.2***.

Table 1.2: LNG Receiving Terminal Key Components

Component	Details
Number of LNG Carrier per month (frequency)	2-4 LNGCs per month
LNG Carrier Capacity	16,000 ton (approx.)
LNG Carrier Type	Moss, Membrane
LNG Consumption (per day)	1,300 ton (approx.) @ 100% Load
LNG Unloading Jetty	Centre Platform with walkway, mooring dolphin and Trestle, 100 metres from river shore line Concrete Structure
LNG Unloading Arms	Two (2) liquid Unloading Arms + One(1) vapour return loading arm at the Unloading Jetty
LNG Cryogenic Pipeline	■ Stainless steel pipe with cold insulation; ■ 291 metres (approx.); from unloading arm to a LNG storage tank; ■ 160 metres (approx.); from LNG storage tank to the BOG recondenser; ■ 86 metres (approx.); from BOG recondenser to regasification unit.
LNG Storage Tanks (onshore)	Two (2) Full containment tanks with 25,000 m^3 capacity each (working volume)
Regasification Unit	Appx. 63 million standard cubic feet per day (MMSCFD), Heating source by river water Intermediate fluid vaporizers (IFV)
Vent Stack	One (1) HP Vent Stack One (1) Cold Vent Stack
Cold Water Discharge Arrangement	336 mm pipe diameter Pipe resting on the channel bottom Flow rate 1,300 m^3/h
Gas Engine Generator	Four (4) natural Gas Engine Generators (GEG) total Three (3) GEG continuous operation, one (1) GEG on standby 1,160 kW Continuous capacity each
Area of land where the LNG Storage Tanks and RU are to be set up and operated	15.0 acres (approx.)
General Arrangement	■ Electrical room; ■ Control room building; ■ Main gate guard house; and ■ Jetty guard house.

Source: TPMC, 2019.

1.5.2.2 Construction Phase

The construction phase will take approximately 23 months for the LNG Receiving Terminal. The EPC Contractor will prepare the site for construction, erection and installation of the Project components. All emissions, discharges, and other releases from construction, design and testing will adhere to the guideline limits set out in the Myanmar NEQ (Emission) Guidelines and WB/IFC EHS Guidelines. Site preparation will include, but not be limited to, the following activities:

- Earthwork
  - Earthworks will include clearing of vegetation and grading of the Project site. It is expected that the subsoil, which will be stripped and removed from the Project site, shall be utilised for levelling/ backfilling; the amount of fill material required is 100,000 m^3. The terminal construction site, being partially in an area subjected to flooding will require careful study of potential placement of elevation and flood barriers.
- River Work
  - The existing roads do not support the types of vehicles required for the LNG Receiving Terminal construction phase; therefore, all construction materials, equipment, and workforce will be transported to and from the construction site via transport barge.
  - Installation of Project facilities that extend from onshore and are located alongside the waterfront; the unloading jetty will require pilling activities prior to topside installation.
  - Establishing a safety zone around the construction area will be required to ensure safety among the construction vessels
- Mobilization
  - The existing roads do not support the types of vehicles required for the LNG Receiving Terminal construction phase; therefore, all construction materials, equipment, and workforce will be transported to and from the construction site via transport barge.
- Utilities
  - Water consumption during terminal construction period will be approximately 900m^3 per month, outsourcing by barge.

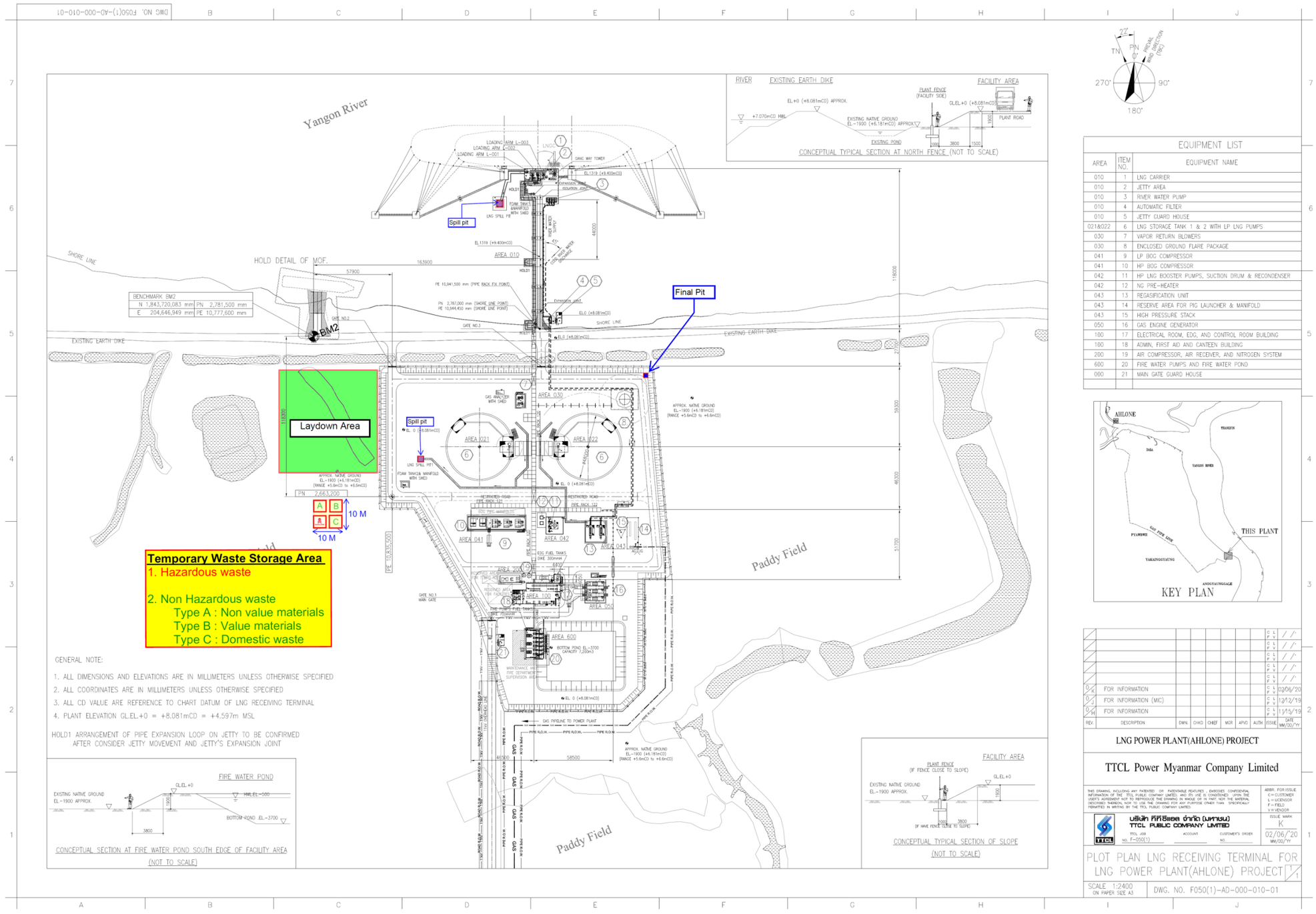
Supporting Facilities

In addition to the above, the following will be required during the construction phase:

- Laydown Area
  - The laydown area will be used for storing construction materials and equipment prior to actual usage. This will be located within the LNG Receiving Terminal construction area.
- Construction Camp
  - A temporary construction camp will also be placed within the LNG Receiving Terminal construction area, to accommodate the construction workforce, and other applicable staff. This construction camp will also accommodate the pipeline construction workforce, since the area is located nearby each other.

The layout of the LNG Receiving Terminal with the indicated laydown area is shown in ***Figure 1.4***.

Figure 1.4: LNG Receiving Terminal Laydown Area



AREA	ITEM NO.	EQUIPMENT NAME
010	1	LNG CARRIER
010	2	JETTY AREA
010	3	RIVER WATER PUMP
010	4	AUTOMATIC FILTER
010	5	JETTY GUARD HOUSE
021&022	6	LNG STORAGE TANK 1 & 2 WITH LP LNG PUMPS
030	7	VAPOR RETURN BLOWERS
030	8	ENCLOSED GROUND FLARE PACKAGE
041	9	LP BOG COMPRESSOR
041	10	HP BOG COMPRESSOR
042	11	HP LNG BOOSTER PUMPS, SUCTION DRUM & RECONDENSER
042	12	NG PRE-HEATER
043	13	REGASIFICATION UNIT
043	14	RESERVE AREA FOR PIG LAUNCHER & MANIFOLD
043	15	HIGH PRESSURE STACK
050	16	GAS ENGINE GENERATOR
100	17	ELECTRICAL ROOM, EDG, AND CONTROL ROOM BUILDING
100	18	ADMIN, FIRST AID AND CANTEEN BUILDING
200	19	AIR COMPRESSOR, AIR RECEIVER, AND NITROGEN SYSTEM
600	20	FIRE WATER PUMPS AND FIRE WATER POND
000	21	MAIN GATE GUARD HOUSE

Source: TPMC, 2020.

1.5.2.3 Operation Phase

Operation activities associated with the LNG Receiving Terminal include scheduled delivery of LNG via LNGC, unloading of LNG from the LNGC to the storage tanks, and regasification of LNG to NG, which will then be sent to the Power Plant via the pipeline.

The regasification process will require continuous water intake from the Yangon River as a heat exchanger, approximately 1,300 m^3 per hour. Gas Engine Generators (GEG) will utilize natural gas as fuel to produce electricity for the LNG Receiving Terminal facility; a total of four (4) units will be installed, and each with a capacity of 1,160 kW continuous. The expected operation period is 25 years from Commercial Operation Date (COD).

1.5.3 Pipeline

1.5.3.1 Key Components

The natural gas supply pipeline will transfer the natural gas (NG) from the LNG Receiving Terminal (from the send-out facility after regasification unit) to the Power Plant. The pipeline will be designed as per The American Society of Mechanical Engineers (ASME) B31.8: Gas Transmission and Distribution Systems. In addition, Cathodic Protection will be placed for the buried section of the pipeline. The brief specification for the Pipeline are included in ***Table 1.3***. The pipeline alignment and coordinates for sections along the pipeline are shown in ***Figure 1.5***.

Table 1.3: Gas Pipeline Key Components

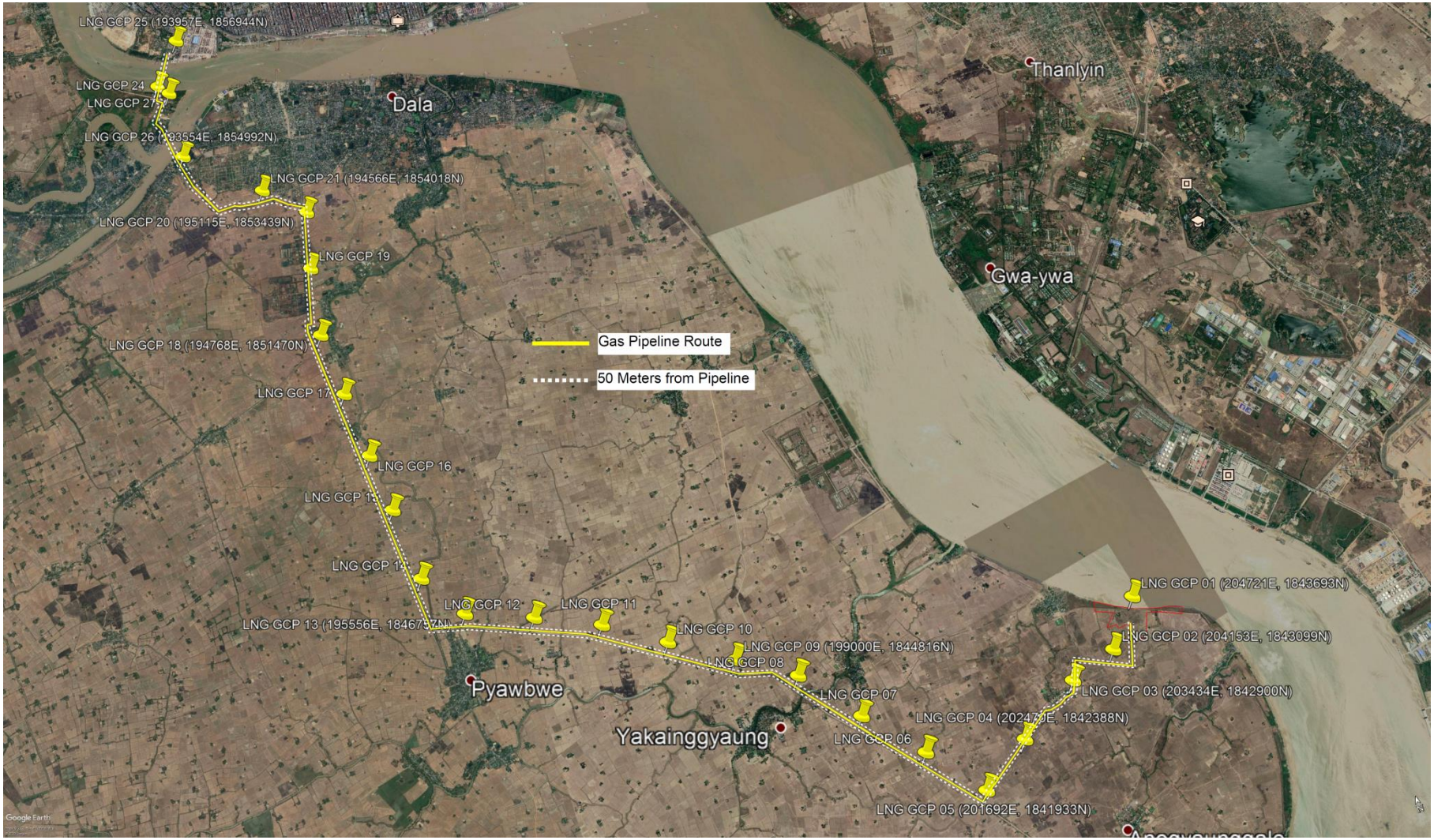
Component	Details
Length	24.9 km
Diameter	20 inches
Pipe Wall Thickness	≥ 9.53 mm
Material	Carbon steel
Design Pressure	Appx. 64 barG
Minimum Yield Strength	4,481.6 barG
Coating	API 5L X65 with 3LPE coating
Minimum Design Temperature	0.0 °C
Operating Design Temperature	10 °C
Maximum Design Temperature	55.0 °C
Design Standard	ASME B31.8 ASME B31.8s ASME B31.3
Material Design	ANSI[a] / ASME / ASTM[b] API SSPC[c] MSS[d]
Design Location Class	3, and 4 (Design factor 0.5, and 0.4 respectively)
Coating	3 Layer Polyethylene
Cathodic Protection	Impressed current cathodic protection
Block Valves	Two (2) Valves (at each extremity)
Operation Period	25 years from COD

Source: TPMC, 2019.

Note: [a] *American National Standards Institute*
[b] *American Society for Testing and Materials*
[c] *The Society for Protective Coatings*
[d] *Manufacturers Standardization Society*

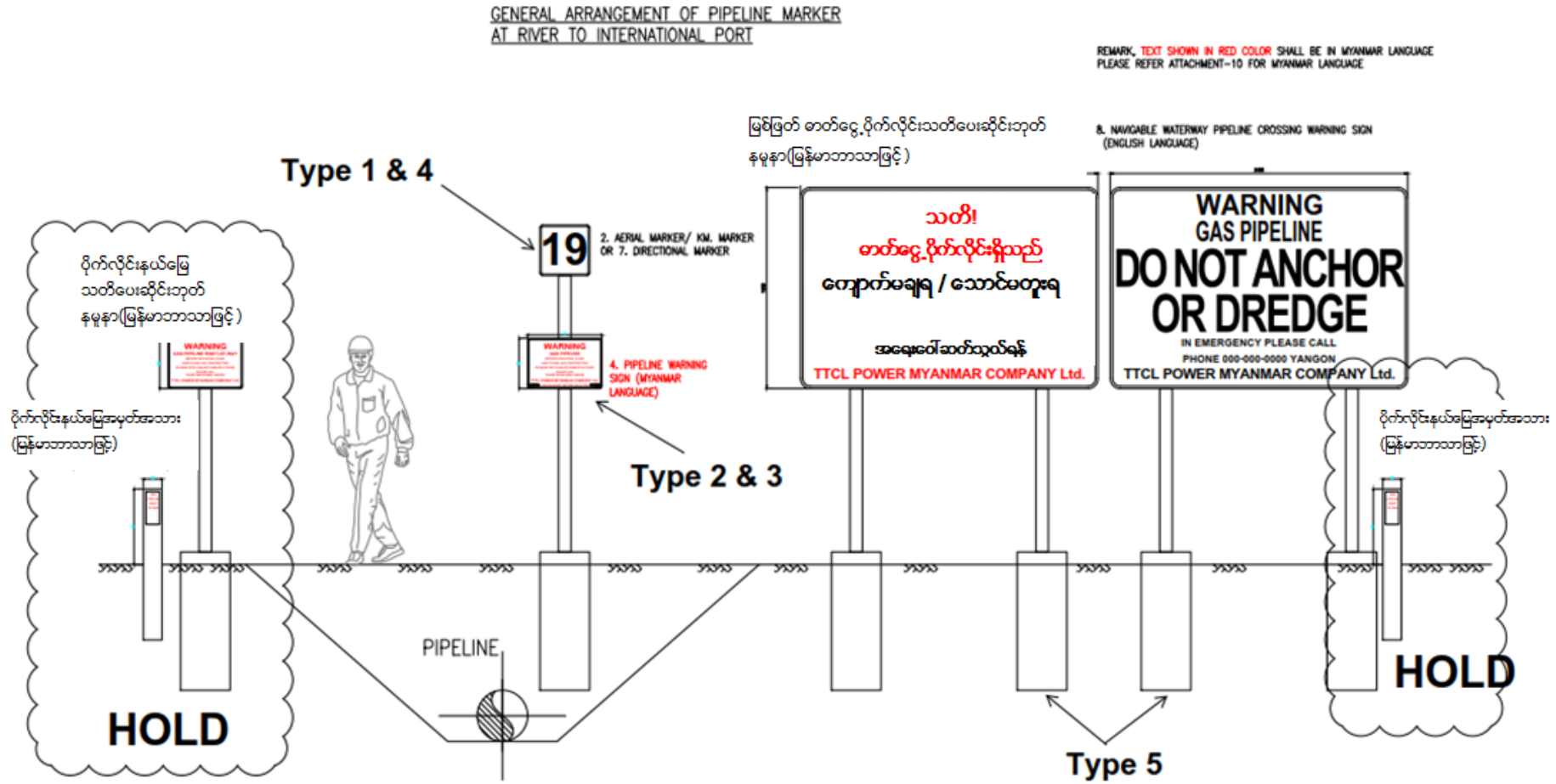
The design for each sign post is shown in ***Figure 1.6***; note that some sign post type may share identical designs, and differ only with placement requirements.

Figure 1.5: Pipeline Alignment with Coordinates



Source: TPMC, 2020.

Figure 1.6: Sign Post Design



Source: TPMC, 2019. (Modified by ERM)

1.5.3.2 Construction Phase

The construction phase will take approximately 18 months for the pipeline. The EPC Contractor will prepare the site for construction, and installation of the Project component. All emissions, discharges, and other releases from construction, design and testing will adhere to the guideline limits set out in the Myanmar NEQ (Emission) Guidelines and WB/IFC EHS Guidelines. The key construction activities will include, but not be limited to, the following:

- Earthwork
  - Earthworks will include clearing of vegetation and grading for the ROW of the pipeline. The subsoil located directly in the pipeline alignment will be excavated to the designed depth of the pipeline, once the pipeline is in place, the excavated soil will be backfilled. The amount of soil that will be cut and filled is approximately 75,000 m^3 and 56,000 m^3 respectively.
- Horizontal Directional Drilling (HDD)
  - Horizontal directional drilling (HDD) is a method of installing pipeline without having to cut and fill soil. This method is particularly advantageous in areas where excavation is not practical; for this Project's case, an open-cut method will not be practical for pipeline sections that will cross two (2) points, the Twante Canal (1,000 m), and the Yangon River (700 m), as shown in ***Figure 4.45***, and ***Figure 4.46***.
  - Bentonite, specifically known as Sodium Bentonite, is a liquid solution that is used as drilling fluid to assist the drilling of boreholes. During HDD method, bentonite will be used as drilling fluid for the HDD rig. It is expected that the amount of bentonite produced from HDD activities is approximately 1,000 m^3.
- Hydrostatic Testing
  - Hydrostatic testing involves pumping liquid into pressure system (such as a pipeline) to perform strength test and identify leak points. Once the Pipeline has been constructed, the Pipeline system will need to undergo Hydrostatic testing before proceeding with operation. Once pipeline installation reaches 3 – 5 km completion length, hydrostatic testing will commence; once testing is completed and passed, soil is then backfilled. There will be no chemical inject in hydrotest water. Fresh Water will be outsource. The amount of hydrostatic testing fluid required for testing is approximately 2,500 m^3.

Supporting Facilities

In addition to the above, the following will be required during the construction phase:

- Laydown Area
  - The laydown area will be used for storing construction materials and equipment prior to actual usage. The laydown area will be located near a HDD location for the Twante Canal.
- Construction Camp
  - The construction workforce for the pipeline construction will share the same temporary construction camp with the LNG Receiving Terminal; therefore, the location of the pipeline construction camp is located within the LNG Receiving Terminal construction area.

1.5.3.3 Operation Phase

Operation activities associated with the pipeline include constant gas shipping and gas compressing at scheduled intervals. No land disturbance or waste generation is expected from pipeline alone during operation phase. After the construction of the pipeline is completed, operation and maintenance will be carried out by TPMC; therefore, there will be no Operation and Maintenance (O&M) contract with any third party operator. The expected operation period is 25 years from COD.

1.5.4 Power Plant

1.5.4.1 Key Components

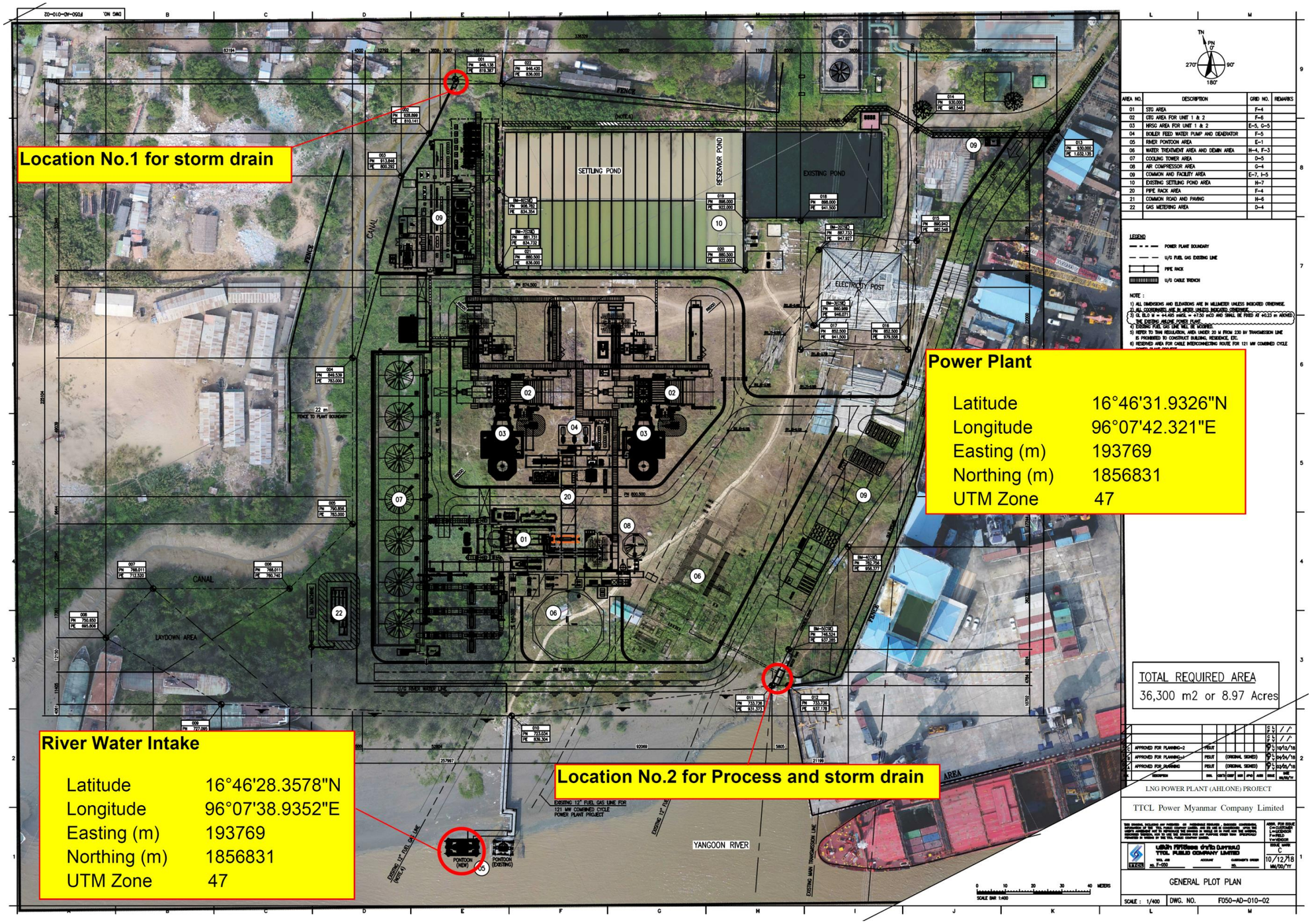
The proposed Power Plant type is a Combined Cycle Power Plant (CCPP). During normal combined cycle operation, electricity will be generated by the gas turbines; additionally, the heat of gas turbine exhaust gas will be admitted to the Heat Recovery Steam Generator (HRSG) where superheated steam will be produced, which will drive the steam turbine to generate electrical power. The key components and details are listed below in ***Table 1.4***. The layout of the Power Plant is shown in ***Figure 1.7***.

Table 1.4: Power Plant Key Components

Component	Details
Land Area	8.97 acres (approx.)
Power Plant Installed Capacity	388 MW
Plant Configuration	Two (2) Gas Turbines, two (2) HRSGs, and one (1) steam turbine
Steam Turbine	Condensing Steam Turbine (single casing turbine)
HRSG	Horizontal Drum Units
Cooling System	Cell Type Wet Cooling Tower (with induced draft)
Electrical Generators	Three (3) Totally Enclosed Water to Air Cooled Electrical Generators (One for each Turbine)
Step Up Transformers	2 Winding Transformers Preferred (1 Transformer for 1 generator)
Switchyard	Gas Insulated Switchyard (GIS) (Single Busbar Configuration, operated by MOEE)
Embedded Environmental Control	■ Multi-chambers combustion system ■ Single gas fuel combustion system with DLN combustors ■ Ignition system with spark plugs and U.V. flame detectors
Stacks	■ Diameter 5 meters appx. ■ Height 40 meters appx. ■ Carbon Steel with internal painting
Operation Period	25 years from COD

Source: TPMC, 2019.

Figure 1.7: Power Plant Layout



Source: TPMC, 2020.

1.5.4.2 Construction Phase

The construction phase will take approximately 28 months for the Power Plant. The EPC Contractor will prepare the site for construction, erection and installation of the Project components. All emissions, discharges, and other releases from construction, design and testing will adhere to the guideline limits set out in the Myanmar NEQ (Emission) Guidelines and WB/IFC EHS Guidelines. Site preparation will include, but not be limited to, the following activities:

- Earthwork
  - Earth works will include clearing of vegetation and grading of the Project site. It is anticipated that the subsoil, which will be stripped and removed from the Project site, shall be utilised for levelling/ backfilling. The amount of soil that is expected to be excavated then backfilled is approximately 29,600 m^3. Grading of the site will be done by the design team, considering sufficient height to protect the power plant from potential water and tidal/ flood damage.
- River Work
  - The project will involve the construction of a new pontoon and walkway to connect the pontoon to an existing walkway. Given the size of the pontoon and walkway that is required to be constructed, land based equipment will be used to install the walkway, whereas the crane barge will install the pontoon and steel piles.

Supporting Facilities

In addition to the above, the following will be required during the construction phase:

- Laydown Area
  - The laydown area will be used for storing construction materials and equipment prior to actual usage. The laydown area will be located at two (2) separate location, one near the entrance to TPMC's existing Power Plant compound, and the second located within the Power Plant construction area.
- Construction Camp
  - The temporary construction camp for the Power Plant construction will be located within Yangon City, to accommodate the construction workforce, and other relevant staff.

1.5.4.3 Operation Phase

Operation activities associated with the Power Plant include continuous combustion of natural gas (NG) fuel to generate electricity. NG will be provided by the LNG Receiving Terminal, which is sent via the pipeline. Continuous water intake is expected for cooling water. Heat generated from the gas turbines' exhaust will be sent through a heat recovery steam generator (HRSG) to produce steam, which is then sent through a steam generator to produce electricity. The expected operation period is 25 years from COD.

1.5.5 Schedule

The construction schedule is detailed in ***Table 1.5***.

Table 1.5: Tentative Project Schedule

Pre-EPC Phase	Tentative Date
Completion of Feasibility Study	Dec 2017
Site Preparation	Apr-Jun 2018
Stakeholder Engagement 1	Dec 2018
Scoping	Jan 2019
Stakeholder Engagement 2	Feb-Mar 2019
Final EIA submission to MONREC	Aug 2019
Detail Engineering	Jun 2019 – Sep 2020
Procurement	Oct 2020 – April 2021
LNG Terminal Construction	Nov 2020 – Aug 2022
Pipeline Construction	Nov 2020 – May 2022
Power Plant Construction	Nov 2020 – Oct 2022
Power Plant Commissioning	Nov 2022 – Mar 2023
Power Plant COD	Mar 2023

Source: TPMC, 2020.

It is noted the above Project Schedule is tentative and subject to be changed and updated

The operation of all three (3) components are expected to last 25 years in total.

1.5.6 Workforce

The indicative number of workers estimated to be working on-site during the construction phase of each main component for the Project is shown in ***Table 1.6***.

Table 1.6: Anticipated Workforce during Construction

Workforce Origin	Average No. of Skilled Workers	Average No. of Semi-Skilled Workers	Average No. of Unskilled Workers	Total Average Workforce (per day)	Total Peak Workforce (per day)
LNG Receiving Terminal + Unloading Jetty					
Local Workforce	83	22	220	440	650
Migrant Workforce	42	11	0		
Pipeline					
Local Workforce	35	36	32	81	117
Migrant Workforce	14	60	0		

Workforce Origin	Average No. of Skilled Workers	Average No. of Semi-Skilled Workers	Average No. of Unskilled Workers	Total Average Workforce (per day)	Total Peak Workforce (per day)
Power Plant + Pontoon					
Local Workforce	80	12	200	400	600
Migrant Workforce	40	6	0		
Total	**294**	**147**	**452**	**921**	**1,367**

Source: TPMC, 2019.

1.5.7 Project Alternatives

1.5.7.1 LNG Receiving Terminal

There were three (3) LNG Receiving Terminal locations that were considered, two locations were located along the shoreline of Thanlyin Township (which can be categorized as North, and South options), and one location along the Southeast shoreline of Dala Township. The three locations are shown in ***Figure 1.8***.

A significant disadvantage of the Thanlyin options is that pipelines will need to be installed using HDD method. The North option will require a pipeline length of approximately 3.14 km to be installed using HDD method, and the South option will require approximately 4.4 km. Although it is possible to use HDD method for these distances, this may increase costs significantly, and limit maintenance capabilities. In addition, the land was not available for use for this Project, due to ongoing land use.

Therefore, the location along the southeast shoreline of Dala Township was considered as the only option.

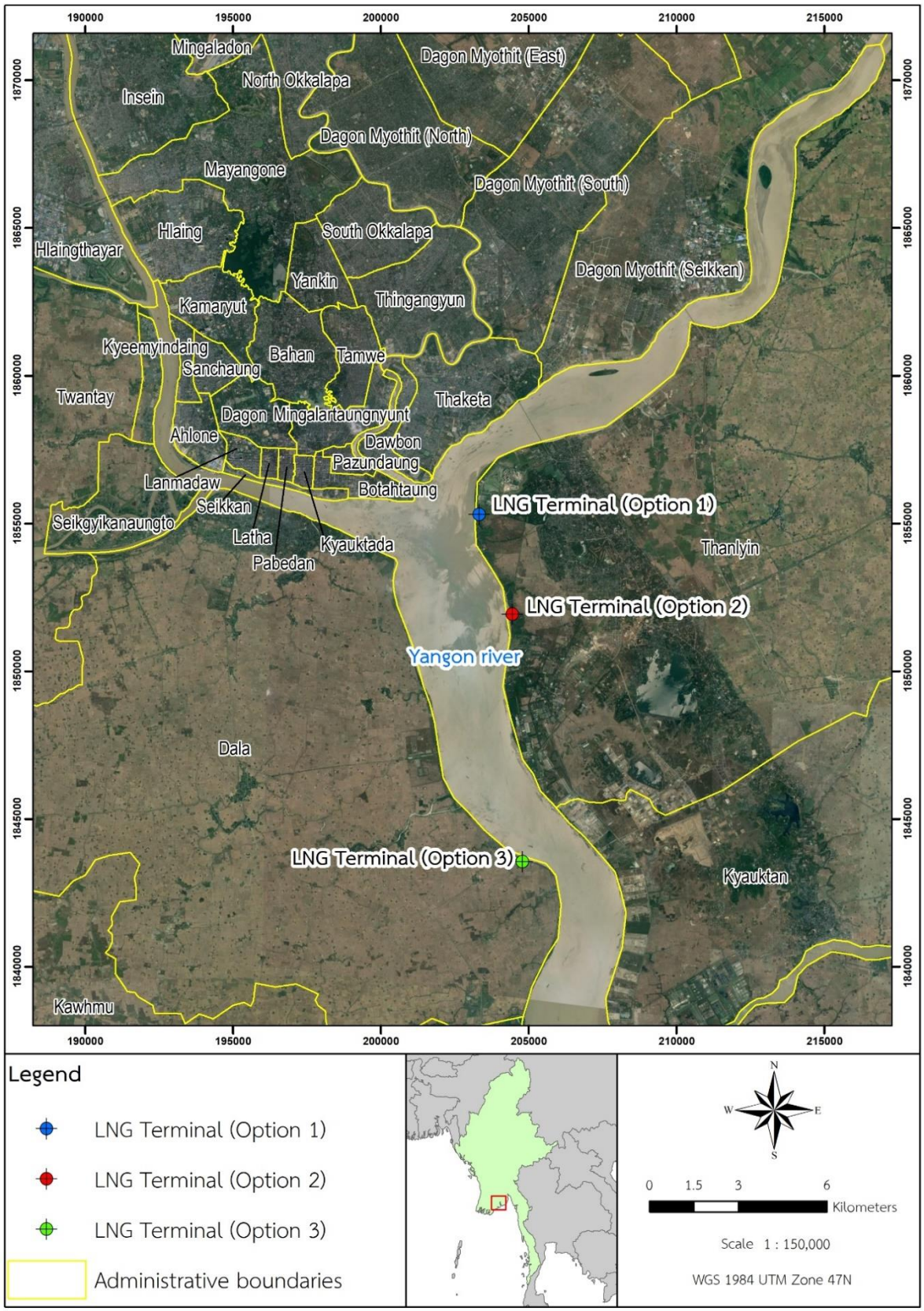
1.5.7.2 Pipeline

Two (2) routes for the pipeline were initially considered, one route going in parallel with a road in the centre of Dala Township, whereas the second route going along the east shoreline. Since the second route is expected to have impact on more sensitive receptors, the first route was considered as best option.

1.5.7.3 Power Plant

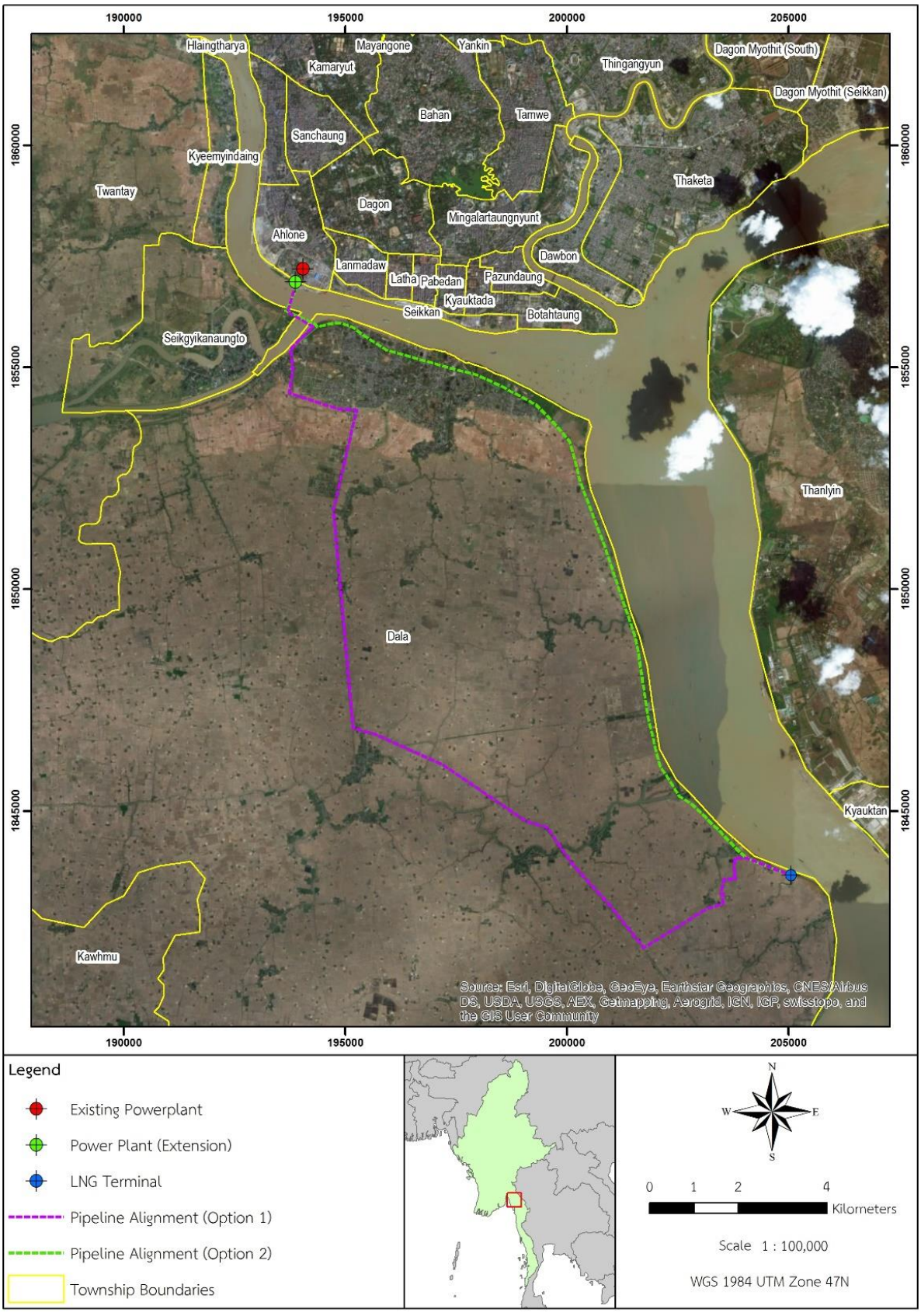
Although options for selecting the Power Plant site can be explored, the plan to implement the proposed Power Plant next to the existing Power Plant is currently the best scenario. Placing the proposed power plant at this location will allow for the facilities and other utilities to be shared between the proposed and existing power plants, specifically the switchyard; therefore, construction of certain facilities will not be needed, which lowers costs. Given that construction of the existing Power Plant has already taken place, experience acquired from construction activities in the same area will allow for factors such as cost, logistics and access roads to be easily considered and planned.

Figure 1.8: LNG Receiving Terminal Placement Options



Source: TPMC, 2018. (Modified by ERM)

Figure 1.9: Pipeline Route Options



Source: TPMC, 2018. (Modified by ERM)

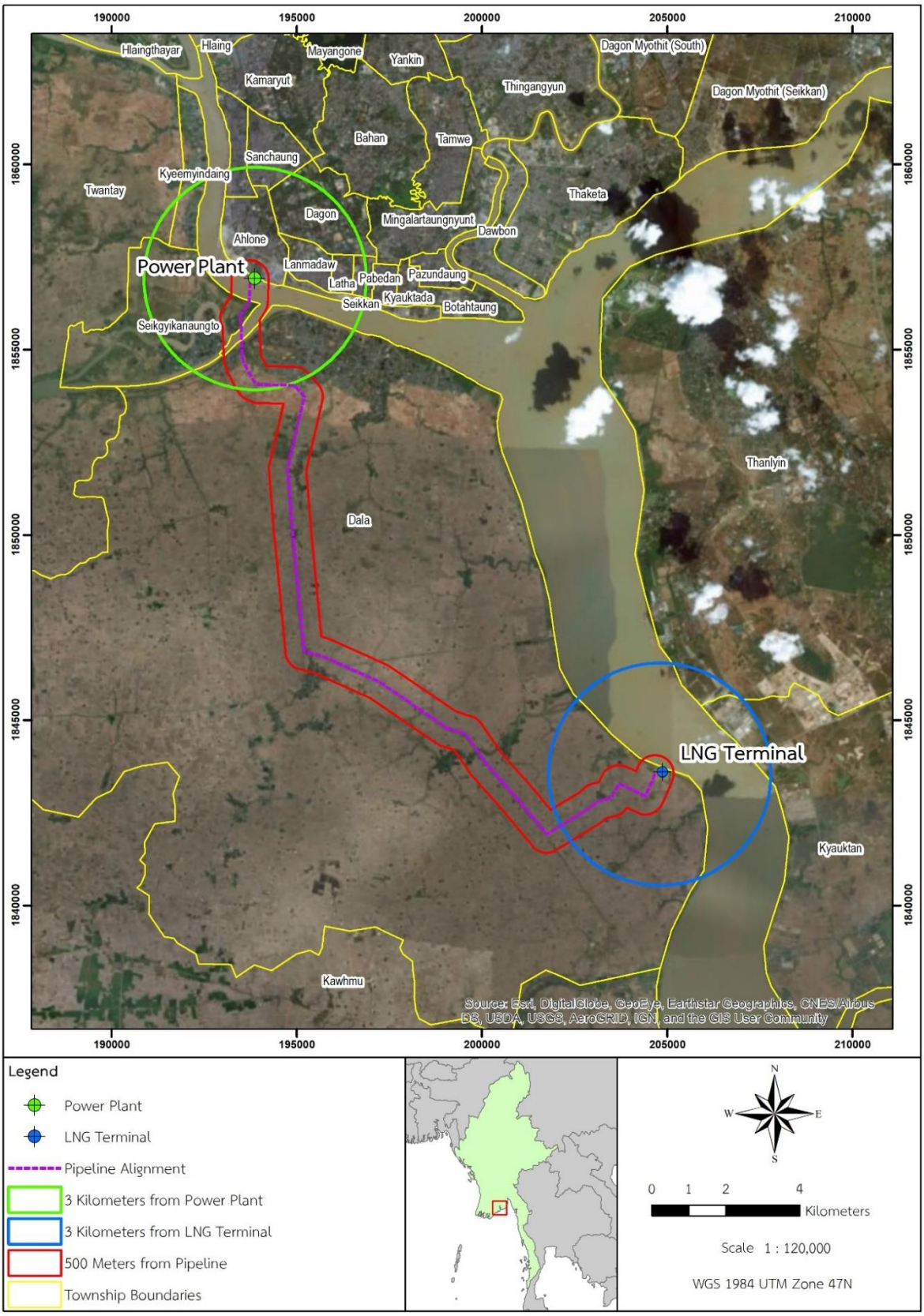
1.6 Description of the Environment

The establishment of the Area of Influence (AoI) for the Project (and thus the appropriate Project Study Area) is intended to ensure that the Impact Assessment (IA) focuses on those issues that are most important for design, decision-making and stakeholder interest.

An AoI of 5 km from the Project site boundary has been established for Power Plant and for the LNG Receiving Facilities, in particular air quality receptors or social receptors. For the natural gas pipeline a buffer area of 500 m from each side of the centre line of the pipeline has been consider, in particular for social receptors.

The Project Study Area (hereinafter also referred to as 'Study Area') refers to the area that needs to be studied in order to adequately understand and describe the baseline conditions likely to be affected by the Project. With the AoI established, the Study Area (see ***Figure 1.10***) comprises a 5 km radius of the Project site (Power Plant, and LNG Receiving Terminal) as well as a 500 m from each side of the Natural Gas Pipeline. There are no set guidelines on the sphere of influence; however, this is in line with best practices in the industry and is designed to include all potentially impacted sensitive receivers during both construction and operation phases. The Study Area encompasses the entire Area of Influence of the Project (i.e. area potentially impacted by the Project) for environmental and biodiversity component of the environment. It also covers all social receptors that might be directly impacted by the Project; nevertheless, the social baseline covered a larger area in order to ensure inclusiveness of all potential socioeconomic, health and cultural heritage components present in the Project's AoI. The Study Area is shown in ***Figure 1.10***.

Figure 1.10: Project Study Area



Source: ERM, 2019.

1.6.1 Biophysical Baseline

1.6.1.1 Climate and Meteorology

Most of Myanmar is located in the tropical region characterised by a tropical monsoon climate with three well-defined seasons: summer, rainy and cold seasons. The summer months are from March to Mid-May. The rainy season typically lasts from mid-May to the end of October and the cold season starts in November and lasts until the end of February. These data are relevant for the Study Area.

The southwest monsoon starts in late March or early April with local turbulence that includes tornados and cyclones, bringing winds that can reach up to 200 – 300 km/h. From October to mid-March, the northeast monsoon brings a dry and cool climate. Due to widely differing topographical profiles throughout Myanmar and its range of latitudes, its climate conditions differ widely from one place to another (UNCCD, 2005).

1.6.1.2 Air Quality

Monitoring of NO_2 was conducted in 13 monitoring locations. Passive diffusion tubes were deployed in triplicate at three locations from 27 February to 2 May 2018 and from 12 to 26 June 2018. The automatic Haz-Scanner Environmental Perimeter Air Station (EPAS) was deployed at a further 10 locations in the Study Area for a continuous 72-hour period in both the wet and dry season.

Air quality monitoring for both dry and wet seasons indicates at least three different parameters ($PM_{2.5}$, PM_{10}, and SO_2) exceed the Myanmar Emission Quality Guidelines (NEQG) in some locations. This is consistent with other air quality monitoring previously carried out in the region.

1.6.1.3 Noise

Noise level measurements were conducted according to the relevant methods of the International Organization for Standardization (ISO), which include ISO 1996-1:2003, and ISO 1996-2:2007. The equipment used for measurement is a Model SL-4023SD sound level meter. Ten (10) sampling stations were carried-out by SEM during a baseline survey conducted 2 to 14 May 2018, which are located at the same sampling station as air quality. The survey was conducted for 48 hours consecutively for each location.

According to the noise baseline results, nine out of ten noise monitoring stations exceeded the Myanmar standard for at least one time period. Possible sources of high noise levels include the existing Power Plant, traffic activities, human activities, and rain/weather events.

1.6.1.4 Surface Water

Dry season surface water samples were collected by ERM-Siam and SEM from 3 to 4 May 2018, in fourteen (14) locations, and wet season surface water samples were collected from 27 to 28 June 2018, in fourteen (14) locations. For sampling sites located in the Yangon River and the Twante Canal, a local boat was used to travel between shore and sampling site; sampling equipment was brought on-board and samples were collected directly on the boat. For sampling sites located in-land, a vehicle was used to travel to each site, and samples were collected on the sides of the river, or from a bridge. Water samples were taken by an Alpha horizontal water sampler and collected in plastic and sterilized glass sample containers. All sampling was conducted in strict accordance with recognized standard procedures

Total Dissolved Solid (TDS) concentrations at all sampling locations (4,052 – 12,760 mg/L) exceeded the United States Environmental Protection Agency (EPA) Standard (250 mg/L). Manganese concentrations at all sampling locations (0.22 – 1.40 mg/L), excluding SW9 and SW10, exceeded the EPA Standard (0.05 mg/L).

All other parameters are found to be within the Myanmar, IFC, and EPA Standards.

1.6.1.5 Soil

Soil samples were collected from nine (9) sample points in the Study Area on 3 and 4 May 2018, and were tested for several types of parameters that are listed together with the results below. The soil samples were collected using a manual hand auger tool; the samples were collected from top soil (30 cm – 50 cm depth) and sub soil (80 cm – 100 cm depth).

Sampling site SO 2 exceeded the target value for copper in top soil, and sampling site SO 4 exceeded the Dutch Standard for copper in subsoil (between 37.44 and 38.29 mg/kg). Sub-soil at site SO 2 also exceeded the target value for mercury (1.04 mg/kg).

Other remaining sampling sites and parameters were found to be within the Dutch Standard.

1.6.1.6 Groundwater

The productivity of aquifers near the Study Area can be classified as “Strong Pore Water”, or “Weak Fissure Water”, and groundwater quality is considered “Fresh Groundwater”. The groundwater type ranges from “Pore Water” to “Fractured Water”. Groundwater resources classifications consist of "Discontinuous Aquifer in Hilly Area" and "Continuous Aquifer in Plain and Intermontaine Basin", with Natural Recharge Modulus ranging from 200,000 - 500,000 m^3/km^2-yr.

Groundwater samples were collected by SEM and ERM-Siam on 3 and 4 May 2018, at three (3) locations. Groundwater samples were taken by an Alpha horizontal water sampler for some wells and collected in plastic and sterilized glass sample containers. All sampling was conducted in strict accordance to recognized standard procedures as listed together with the sampling results below. The parameters pH, temperature, dissolved oxygen (DO), electrical conductivity (EC), total dissolved solids, odour, and colour were measured at each site in-situ. The parameters that were measured by laboratory analysis are listed together with the results below.

Parameters that exceeded the relevant standards/guidelines include Total Dissolved Solids (TDS), Nitrate (NO_3), Iron (Fe), Manganese (Mn), and Chloride (Cl).

All other parameters were found to be within the Myanmar standards, EPA, and WHO guidelines.

1.6.1.7 Sediment

Sediment samples were collected by SEM and ERM-Siam from 3 to 5 May 2018, at six (6) locations. Sediment samples were collected using a Grab Sampler. At each station, sediment was collected in an amber glass bottle. Each benthic sample was then slowly sieved through a mesh size of 2.0 mm, 1 mm, and 0.5 mm. Firstly, benthic samples were sieved by 2.0 mm and 1.0 mm mesh size, next the samples were sieved by a 0.5 mm mesh. Finally, the benthic samples caught in the 1.0 mm and 0.5mm mesh were collected. The specimens were preserved in 10% formalin solution.

Mercury has been found to exceed the Low level standards, but still within the High level standards. This result indicates that the level of concentration can cause adverse effects on aquatic life; however, the occurrence is still considerably low.

Nickel has been found to exceed both low and high level standards; however, concentrations were found to be lower than that of the dry season. This difference may be due to a higher flow rate.

All other parameters are found to be within the Australian and New Zealand interim sediment quality guidelines.

1.6.1.8 Landscape and Visual

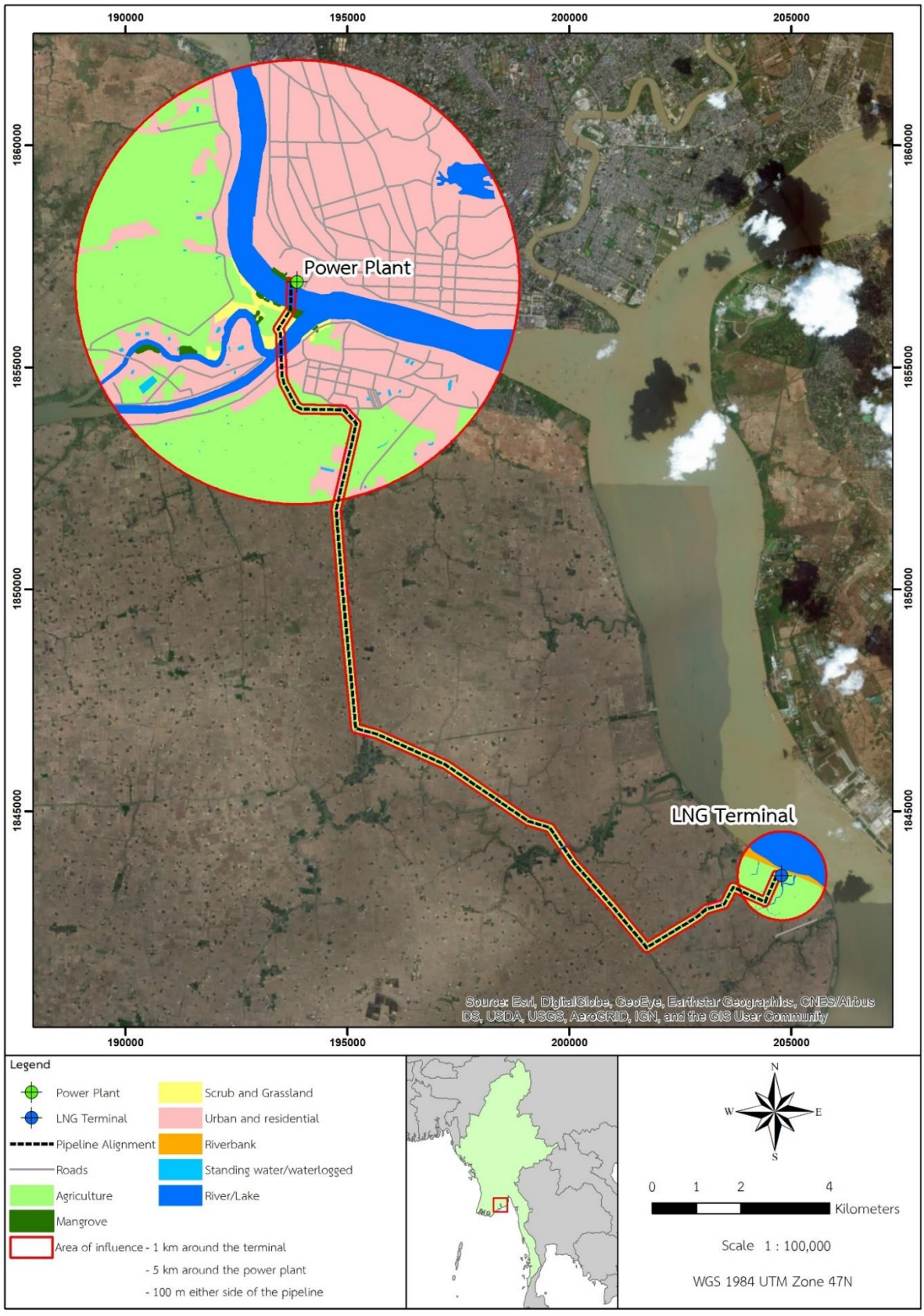
The centre part of Myanmar, specifically within the Yangon Region and Ayeyarwady Region mainly consists of plains with little to no elevation. Although this characteristic is normal for land located near coastal areas, other northern regions of Myanmar have a large range of mountainous areas, and varying degrees of elevation, which are particularly pronounced in the Kayah State, and Shan State.

The topography at the LNG Receiving Terminal suggests no elevation. The area surrounding the facility consists mainly of agricultural land (172.50 ha). Across the Yangon River, directly opposite of the LNG Receiving Terminal is the Myanmar Integrated Port Limited Terminal. Potential sensitive visual receivers are located nearby the LNG Receiving Terminal, such as Thet Kei Kwin (1.2 km, northwest), and Shan Kaw (1.6 km, west) villages.

The topography along the Natural Gas Pipeline alignment suggests no elevation. The area along the pipeline alignment will mainly consist of agricultural land (405.15 ha) and villages (27.51 ha).

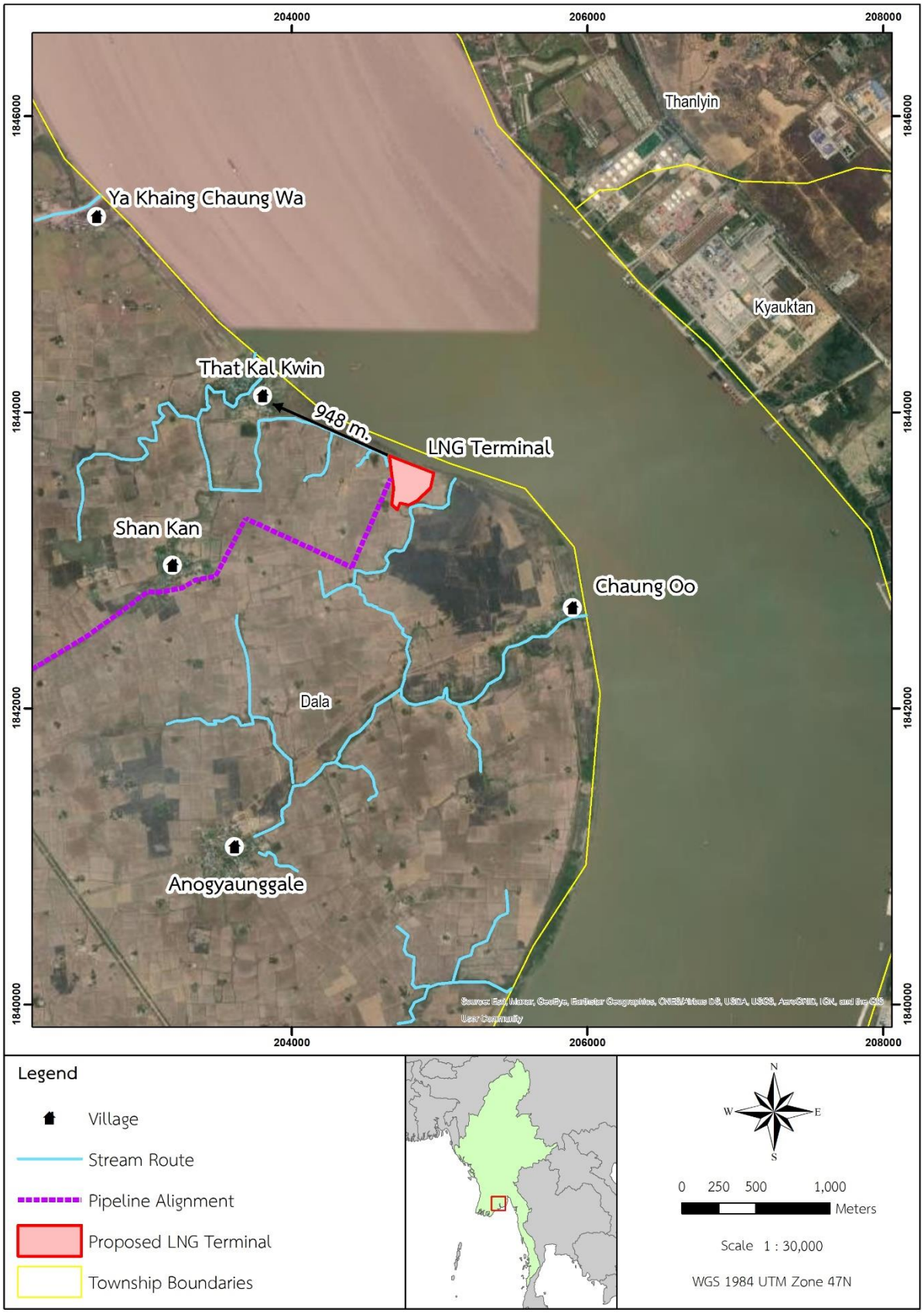
The topography at the Power Plant is primarily flat land with no noticeable elevations; however, towards the northeast of the Power Plant, there are high elevations leading up to the highest point exactly where the Shwedagon Pagoda is located (approximately 57 – 62 metre elevation). Land allocated for the Power Plant currently consists of grasslands and small patches of mangrove, and is currently surrounded by the existing Power Plant and the Ahlone Shipyard. Landclass within the Project's AoI is presented in ***Figure 1.11***. The location of villages that are nearby the LNG Terminal, and Pipeline are shown in ***Figure 1.12***, and ***Figure 1.13*** respectively.

Figure 1.11: Land Class within the Project AoI



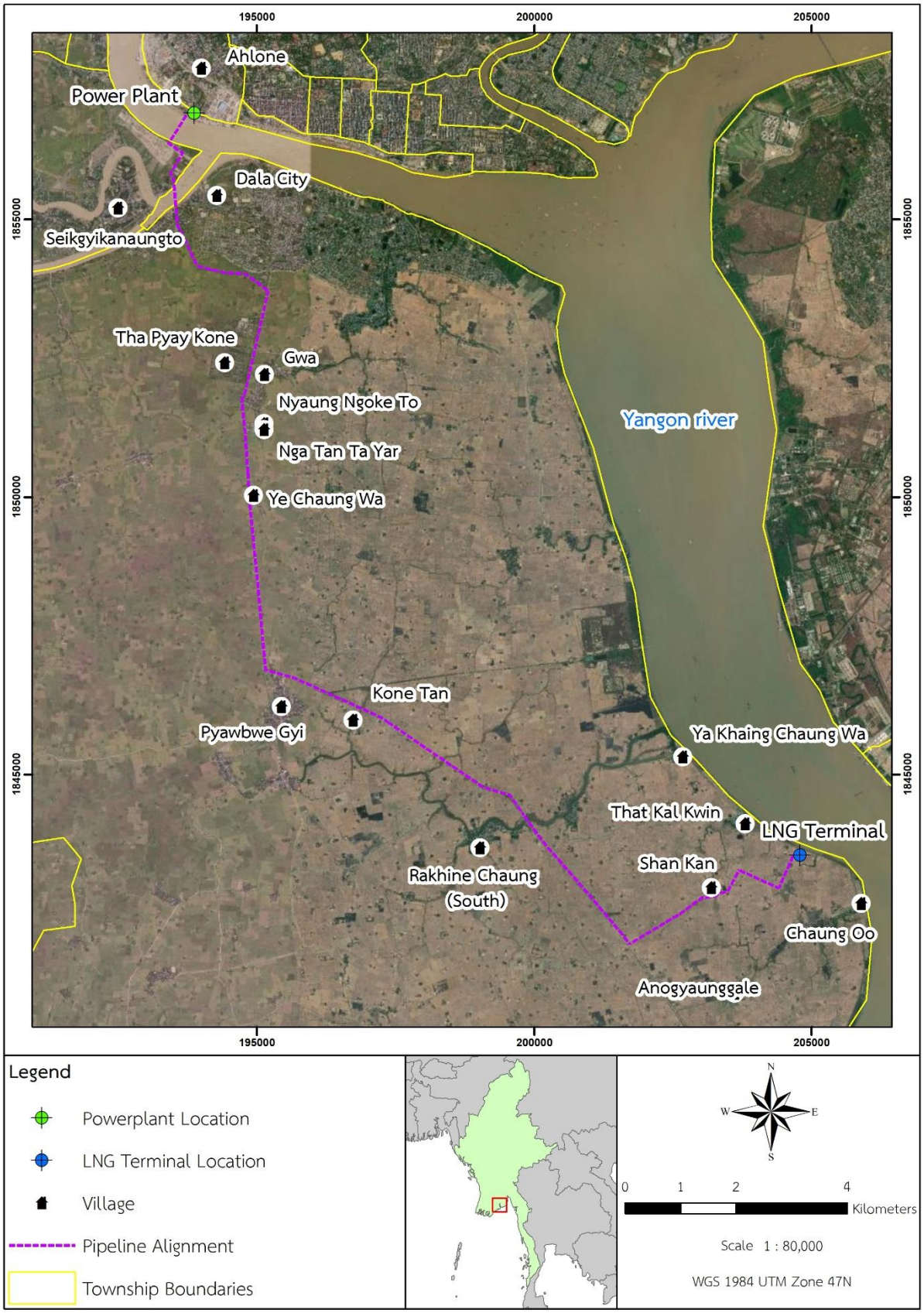
Source: ERM, 2020.

Figure 1.12: Villages Nearby the LNG Receiving Terminal



Source: ERM, 2020.

Figure 1.13: Villages Along or Nearby the Pipeline



Source: ERM, 2020.

1.6.1.9 Waste

Solid waste generation in Myanmar was 5,616 tonnes/day and is anticipated to increase to 21,012 tonnes/day by 2025. Mandalay, Yangon and Nay Pyi Taw generate the majority of Myanmar's produced waste (55%); Yangon produces most of the waste (1,981 tonnes/day).

The country's municipal solid waste is generated from households (60%), markets (15%), commercial (10%), hotel (2%), garden (5%) and others (8%). In areas outside of Yangon, Mandalay and Nay Pyi Taw, where waste collection is the responsibility of local municipal authorities, the respective Township Development Committees under the local government typically manage municipal waste collection and disposal.

According to the Yangon City Development Committee (YCDC), the major landfill sites in Yangon currently operating and their respective capacities are shown in ***Table 1.7***.

Table 1.7: Major Landfill Sites in Yangon

Location	Capacity (tonnes/day)
Hteinpin	1,080
Dawai Chang	843
Shwepyithar	61
Mingalardon	43
Dala	33
SeikyiKhanaungato	4

Source: YCDC, 2016.

1.6.1.10 Terrestrial and Aquatic Biodiversity

The Myanmar EIA Procedures (2015) requires the assessment of biodiversity values, although the Procedure does not include guidance on the approach to assess those values. ERM has used the International Finance Corporation (IFC) *Performance Standard 6 Biodiversity Conservation and Sustainable Management of Living Natural Resources* (PS6) to guide the approach of assessment.

The main findings of each biological aspects are as follows:

EcoRegion

The Project Study Area resides within the Myanmar Coastal Mangrove [IM1404] EcoRegion. This ecoregion, specifically the Irrawaddy (Ayeyarwady) mangrove region, would naturally be dominated by mangrove flora but has been seriously degraded in recent history. Mangrove forest are salt tolerant ecosystems that survive in brackish water around the intertidal zone, particularly in estuaries. They are some of the most exploited natural systems in the world, under pressure from land clearance for farming, aquaculture, land reclamation and development.

The EcoRegion is currently classified as Critical/Endangered; however, this is a generalization of a large area (21,238 km^2) and may not represent specific differences in habitat types and conditions within the area. The proposed Project is located in areas that do not contain any important natural habitat that defines the characteristics of this EcoRegion, considering the area has been considerably degraded by human activities.

Key Biodiversity Areas

In Myanmar, Key Biodiversity Areas (KBAs) fall in different land management categories including protected areas, public protected forests, community-conserved forests, community forests, reserve forests and other resource and land use areas. Therefore, they accommodate different management

systems such as government, private, community-led and joint management. Within the last decade, KBAs were reviewed and updated in order to identify and prioritize investment opportunities for biodiversity conservation in Myanmar.

Key Biodiversity Areas (KBA) include Important Bird Areas (IBA), Alliance for Zero Extinction (AZE), Important Plant Areas (IPA) and Important Sites for Freshwater Biodiversity.

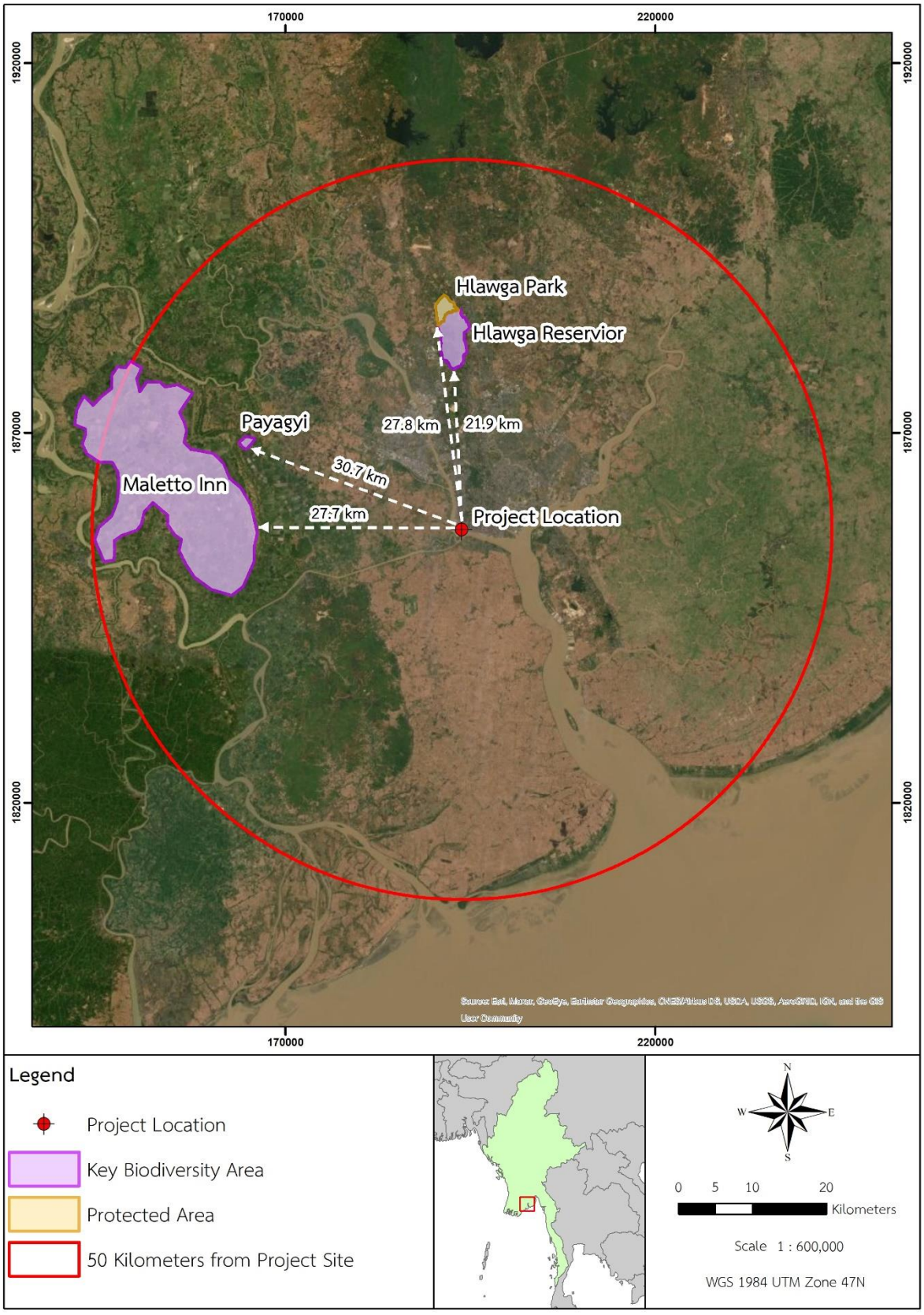
Three (3) Key Biodiversity Areas are located within 30 km from the Project Site. These sites are the Hlawga Reservoir, Maletto Inn and Payagyi KBAs which contain critically endangered, endangered and vulnerable species of conservation concern. These KBAs are located considerably far from the Project, approximately 21km, 27km and 31km respectively to the north and east of the Project Area. The KBAs are shown in ***Figure 1.14***.

Protected Area

Currently, Myanmar there is a total of 58 Protected Areas (PAs), which account for 6.37% of the country's total surface area.

One (1) protected area lies within 50 km of the Study Area, The Hlawga Park, which is located 28 km to the north of the Project. The PAs are shown in ***Figure 1.14***.

Figure 1.14: Key Biodiversity Areas and Protected Areas adjacent to the Study Area



Source: ERM, 2018.

Species of Conservation Significance

Species of conservation significance found within the species grid location from the Integrated Biodiversity Assessment Tool (IBAT) include 19 bird species, 40 fish species, 50 invertebrate species, 11 mammal species, 3 plant species, and 5 reptile species. These species are evaluated as either Vulnerable (VU), Endangered (EN), or Critically Endangered (CR), according to the IUCN Red List. The full list of identified species is shown in ***Table 5.50***.

Invasive Species

Invasive species are any species that are non-native to a particular ecosystem and whose introduction and spread causes, or are likely to cause, socio-cultural, economic or environmental harm or harm to human health (FAO, 2013). Invasive species have the capacity to exacerbate their role in ecosystem degradation through combination threats by habitat change, climate change over-exploitation of ecosystem resources and pollution, which further enhances their threat to biodiversity and the human condition (Emerton and Howard, 2008).

According to the Global Invasive Species Database (GISD) (2015), 97 species have been identified as invasive species in Myanmar. A checklist of invasive species is provided in ***Appendix R***. However, the database does not specifically mention on which part of Myanmar the invasive species are being introduced.

Area of Influence for Biodiversity Value

The Project Area of Influence (AoI) was defined based on a 5 km radius of the Study Area, 500 m either side of the pipeline and 1 km radius of the LNG terminal. The radius was determined based on the nature of the activities of the Project during construction and operation as well as identified natural areas within the vicinity of the Study Area and is consistent with the Project Study Area.

Biodiversity Survey

ERM undertook site surveys during the dry season, between 4 and 5 May 2018. These surveys were conducted to determine the location of any priority biodiversity values within the Study Area and Area of Influence. These priority values focused on Critical Habitat triggers as well as species of conservation significance. The surveys were conducted after a desktop assessment to identify species and habitats to be prioritised for survey; identification of sampling locations (including local villager interviews); field survey targeted major flora and fauna groups; and taxonomy and mapping of flora and fauna records identified. Habitat assessments were also undertaken to inform Natural Habitat and Modified Habitat mapping as required by IFC PS6.

Land Class Mapping

Satellite imagery was used to map the land classes identified within the Study Area and Area of Influence. These land classes were field verified during the field visit. The major land classes identified include agriculture, mangrove, scrub land and grassland, Urban and residential, standing water/waterlogged and riverine.

Natural Habitat and Modified Habitat

IFC PS6 requires the assessment of the distribution of Natural Habitat and Modified Habitat in order to identify risks and mitigations to biodiversity values during the impact assessment phase. There is currently no methodology within IFC PS6 and the associated Guidance Note (GN) on the approach to assess the distribution of these habitat types.

Given the desktop and field information available on the land classes identified, a categorization of the land classes has been made based on the understanding of the history of land use, and species assemblages within each habitat. The justification for the classification is shown in ***Table 5.53***.

The total area of natural habitat and modified habitat within the study area and area of influence is shown in ***Table 1.8***.

Table 1.8: Areas of Natural Habitat and Modified Habitat within the Study Area and AoI

Habitat Type	Study Area (ha)	Area of Influence (ha)
Natural Habitat	0.20	1,028.16
Modified Habitat	3.02	7,457.86

Source: ERM, 2018.

Flora

A Global Positioning System (GPS) was used to navigate and mark coordinates between sample plots around the AoI. In each location, plant species were listed with particular attention to the identification of invasive species, threatened species, Critical Habitat triggers and the extent of Natural Habitat. Identification of any areas of habitats of concern that may contain species of conservation interest were noted.

Twenty-three (23) flora species were identified during the surveys. The majority of other flora identified was identified as Least Concern (LC), Data Deficient (DD) or Not Evaluated (NE). No species of conservation significance were detected that would trigger a Critical Habitat assessment. The full list of recorded species is shown in ***Table 5.55***. During the flora survey, seven (7) invasive species were identified within the Area of Influence.

Fauna

Observations of bird species were undertaken during the dry season survey. Observations were made opportunistically using binoculars. Where possible, birds were identified from calls heard during the surveys. Total of fourteen (14) bird species were detected during the survey. All species were identified as Least Concern on the IUCN Red list.

Records of mammals were taken opportunistically during the site survey using binoculars and observation of tracks and field signs. One mammal species was recorded during the survey, the delta pigmy rice rat (*Oligoryzomys nigripes*). The common grey mongoose (*Herpestes edwardsii*) is known to be in the vicinity of the site but was not recorded during the survey. No species were determined to be conservation significant and would hence trigger a Critical Habitat assessment.

Records of herpetofauna were taken opportunistically during the site survey. A total of two (2) species of reptile and no amphibian species detected during the surveys. All species were classed as Least Concern or Not Evaluated under the IUCN Red List.

Fish species were taken from ERM's in-house database. Three (3) species have been identified as commonly caught fish species by fishermen in Dala, which includes the soldier croaker (Nibea soldado), truncated estuarine catfish (Cryptarius truncatus), and the paradise threadfin (Polynemus paradiseus). None of these species has been assessed on the IUCN Red List (2016). Aquatic habitat in the vicinity of the Project Site appears to have negligible ecological value.

Critical Habitat Screening Assessment

The Critical Habitat assessment comprised an analysis of biodiversity values within the project area and area of influence, habitats of high biodiversity value, species of conservation concern and general flora and fauna assemblages. This involved GIS analysis; desk based data collection including a review of previous EIAs, and targeted field surveys at karst surface and cave habitats. Critical Habitat criteria are defined in PS6 Guidance Note 6 (GN6), Paragraphs GN69 to 97.

Critical Habitat Triggers (Criterion 1-3)

The five criteria are 'triggers' in that if an area of habitat meets any one of the criteria, it will be considered Critical Habitat irrespective of failing to meet any other criterion. Therefore, Critical Habitat can be determined through a single criterion or where a habitat holds biodiversity meeting all five criteria. This approach is generally more cautious but is used more widely in conservation. Critical Habitat criteria therefore have two distinctive characteristics. First, components of biodiversity are essentially assigned to only two levels of conservation significance, those that trigger Critical Habitat and those that do not. Second, each criterion is applied separately and not in combination, meaning that the scores are not cumulative.

Critical Habitat Candidate Species

No species were identified from surveys that would trigger assessment under Criterion 1 to 3.

Potential Critical Habitat Species (Criterion 1 to 3)

No species have been identified to be potential CH species under Criterion 1 to 3.

Criterion 5 – Key Evolutionary Processes

No key evolutionary processes have been identified within the ecosystems within the Area of Influence or Study Area.

1.6.2 Social-Economic Baseline

1.6.2.1 Data Collection

Settlements located closest to the Project infrastructure are likely to experience negative and positive impacts because of the Project activities, including economic opportunities, social and environmental changes, lifestyle changes, and changes to community health and safety. Other social receptors located further from the Project may also benefit or experience negative impacts from the Project.

The Social Area of Influence (SAoI), where data collection has been conducted to help establish the socioeconomic baseline, is defined as the area inhabited or used by stakeholders and likely to be positively or negatively affected by the Project.

The information presented in this Section was gathered through a desktop review of publicly available sources. To provide a more precise understanding of the social, socioeconomic, health and cultural heritage conditions in the Project area, primary data have been collected just after the first Public Consultation session from November 15th to the 19th, 2018. The methods for gathering primary data are comprised of household questionnaires, face-to-face interview with key informants and focus group discussions with designated interviewees. Key stakeholder groups includes village leader, women, fisherman, nurse/ medical/ health officers and famers within the local villages. A total of 150 household questionnaires, 11 Focus Group Discussions, and Key Informant Interviews were conducted in Dala, Seikgyikanaungto and Ahlone townships.

Social Receptors

Myanmar is divided into a number of States and Regions (also referred to as Divisions), which are further divided into Townships for governance purposes. The Project site is located in Yangon, Seikgyikanaungto, and Dala Township in the Yangon region. The baseline focuses on the receptors that may be impacted or influenced by the Project due to their proximity to the Project site and/ or Project associated facilities, which include the following:

- Dala village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline;

- Tha Pyay Kone village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline, and within 3 km of the Power Plant;
- Nyaung Ngoke To village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline, and within 3 km of the Power Plant;
- Ye Chaung Wa village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline;
- Pyawbwe Gyi village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline;
- Shwe Hlay Chaung village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline;
- Tone Tin Gan (North) village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline;
- Tone Tin Gan (South) village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline and within 3 km of LNG Terminal;
- Rakhin Chaung (North) village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline, and within 3 km of LNG Terminal;
- Nyaung Chaung village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline, and at location of LNG Terminal;
- Seikgyikanaungto village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline, and within 3 km of the Power Plant;
- Ahlone village tract. The village tract is where the Power Plant is located;
- Htaw (Lower) village tract. The village tract is within 3 km of the Power Plant;
- Gyaung Waing village tract. The village tract is within 3 km of the Power Plant;
- Kyun Ka Lay village tract. The village tract is within 3 km of the Power Plant;
- Ah Lat Chaung village tract. The village tract is within 3 km of the Power Plant;
- Kyeemyindaing village tract. The village tract is within 3 km of the Power Plant;
- Sanchaung village tract. The village tract is within 3 km of the Power Plant;
- Dagon village tract. The village tract is within 3 km of the Power Plant;
- Kamaryut village tract. The village tract is within 3 km of the Power Plant;
- Bahan village tract. The village tract is within 3 km of the Power Plant;
- Mingalartaunginyung village tract. The village tract is within 3 km of the Power Plant;
- Lathat village tract. The village tract is within 3 km of the Power Plant;
- Lanmadaw village tract. The village tract is within 3 km of the Power Plant;
- Seikkan village tract. The village tract is within 3 km of the Power Plant;
- Pabedan village tract. The village tract is within 3 km of the Power Plant;
- Kyaukatada village tract. The village tract is within 3 km of the Power Plant;
- Pazundaung village tract. The village tract is within 3 km of the Power Plant;
- Botahtaung village tract. The village tract is within 3 km of the Power Plant; and
- Bahan village tract. The village tract is within 3 km of the Power Plant.

1.6.2.2 Demographics

The region covers an area of approximate 10,171.30 sq. km, which is divided into 4 districts (Yangon North, Yangon East, Yangon West and Yangon South), 33 townships, 742 wards and 2,170 villages. The total population is around 7 million people, with 52.2% female. Citizens are mostly aged between 15 – 64 years old.

The majority of the population in the Study Area are Bamar people; Bamar people are the dominant ethnic group in Myanmar, with a population of more than 30,110,000 people. There are, however, small numbers of Kayin, Mon, and Rakhine living in the Study Area.

1.6.2.3 Livelihood and Economy

In the agricultural field, rice, beans and pulses are the main crops, produced. Other agricultural activities consist of jute, rubbers, groundnut and sugarcane. Along the Yangon River, rice mills and sawmills can be found.

Small-scale artisanal fishing takes place in the Yangon River, including around the Project sites. It is reported that fishermen make around 20,000 kyats (~17 USD) daily from fishing which is conducted using traditional cast-nets. Yangon is a main landing site for fish in Myanmar with a fish market at San Pya in Ahlone Township near the Project Site. It shall be noted that the Pipeline construction and operation will not restrict fishing boat access at San Pya Market.

In the Yangon region, unemployment rate between men (4.3%) and women (3.9%) in Yangon is almost similar, and the percentage of men in labour force (81.8%) is significantly larger than percentage of women (46.4%). This is because Yangon is the main centre for trading and handling for many foreign commerce in Myanmar

1.6.2.4 Utilities

Electricity

It is reported that in 2017, 8% of households in Yangon region did not have access to public grid, while 13% had access to electricity without being connected to the grid, and 79% had access and were connected to the grid.

The majority of Yangon conventional households use electricity as source of lighting. Among them, Ahlone has highest percentage of use of electricity for lighting. In Dala, there is a significant gap of electricity usages between urban area (62.8%) and rural area (18.7%), since households in rural area use mainly battery as source of lighting (27.6%).

Water for Irrigation

The Irrigation Department of the Ministry of Agriculture and Irrigation has identified three main sources of water in Yangon, including reservoirs, Irrawaddy River and ground water aquifers (Union of Myanmar Ministry of Agriculture and Irrigation, Irrigation Department, 2010). Approximately 90% of the water source of the system is surface water from reservoirs and the rest is ground water from tube wells supplemented by the water supply system.

Non-Drinking Water

Non-drinking water or non-potable water are rainwater, reclaimed/ recycled water, and grey water. This water is not appropriate for human consumption, but it can be used for laundry, toilet, urinal flushing, or watering plants. In Yangon region, households mainly access non-drinking water via tube well or borehole.

Drinking Water

MIMU data, from 2014, indicate that Yangon is one of the regions in Myanmar that has the highest percentage of people who can access to source of drinking water on premise (82%). At the same time, to reach water source, 14% of Yangon citizens spend less than 10 minute, while 3% and 1% of them spend 11 to 20 minute, and more than 20 minute respectively.

Sanitation and Toilet Facilities

In Yangon, 68% of total households have access to basic sanitation, which is referred to improved non-shared toilet and hand washing facilities. In 2014, water seal (improved pit latrine) was the most common toilet facility type in Yangon region. Moreover, more than 90% of population have access to a place in which they can wash hands with soap and water.

1.6.2.5 Transportation

Yangon has varied transport infrastructure, including various large to small concrete, paved or dirt roads, five bridges over the Yangon river, one international airport with two terminals and a domestic terminal, railway lines, four ports, buses lines and local taxi services.

Around 100 boats travel across the river to Yangon daily between 5:30 am to 8:00 pm between Dala and Seikgyikanaungto to Yangon. The journey takes around 15 minutes from Seikgyikanaungto to Yangon. Travelling from Dala or Seikgyikanaungto to Yangon by car can take around 2 hours (depending on traffic).

1.6.2.6 Cultural Heritage

Yangon Region has a number of culturally significant areas, particularly Buddhists sites. Pagodas and monasteries found in these areas are considered as important cultural centres for the local communities. There are a number of important designated heritage buildings within 5 km of the Project Site such as the Shwedagon or Sule Pagoda. There is no cultural heritage in the footprint of the Project sites.

1.6.2.7 Education

Basic education system in aforementioned areas is identical to other parts of Myanmar and in compliance with the national education system. Eleven is the number of schooling years and the education system is called 5-4-2. It is comprised of 5 years of primary school, 4 years of lower secondary school and 2 years of upper secondary school. In 2017, Myanmar had a plan to change this education system to be 5-4-3 system in order to be in the same line with most ASEAN countries. This plan extends years of schooling from 11 years to 12 years.

Data from 2014 shows that, in Yangon region, literacy rate of citizens aged of 15 years old and above is 96.6%, which is calculated from literacy rate in men (98%) and women (95.5%). The total number of schools is 2,717, which includes 198 high schools, 225 middle schools and 2,264 primary schools. MIMU data from 2014 show that majority of citizens accomplished primary schools.

1.6.2.8 Health, Health Facilities, and Security

In 2016, in Yangon region, there were 85 hospitals, 11,610 sanctioned beds, 12,260 available beds, 527,308 admissions, 525,851 discharges and deaths, 3,537,276 patient days, 16,656 numbers of death, hospital death rate at 3.2%, and 2,516,767 outpatient attendance. Here, hospital death rate is the calculation between number of deaths, and number of discharges and deaths. Sanctioned bed is the official bed capacity of the hospital. Regarding to health facilities and hospitals, almost 70 percent of children in Yangon are born in health facilities.

1.6.2.9 Infrastructure, and Amenities

Yangon has various transport infrastructures, including port, Thilawa deep-water port, airport, roads, bridges, flyovers, highway and Twantay Canal, which connects Yangon River with Irrawaddy River. Importantly, Yangon is the terminus of five railway lines. There are number of roads, connecting Yangon region with other regions in Myanmar as well. In addition, it is reported that rural access index of Yangon is 60%. According to Asian Development Bank, the Rural Access Index (RAI) is “an internationally used indicator that shows the portion of the rural population that lives less than 2 km away from an all-season road”.

1.7 Key Environmental and Social Impact Assessment

All construction and operation activities likely to cause environmental and social impacts were identified and evaluated to assess their magnitude, duration, and potential receptors. The environmental and social impact assessment for the LNG Receiving Terminal, pipeline, and Power Plant, is assessed in ***Chapter 7***, 8, and 9.

1.7.1 LNG Receiving Terminal

The significance of impact for all physical and social receptors are summarized in ***Table 1.9***.

Table 1.9: Summary of the Significance of Impact for Physical and Social Receptors

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
Air	Dust soiling	Construction	Minor	Negligible
	Human health	Construction	Minor	Negligible
	Ecology	Construction	Moderate-Major	Negligible
	Dust soiling	Operation	Minor	Negligible
	Human health	Operation	Minor	Negligible
	Ecology	Operation	Moderate	Negligible
GHG	GHG Emissions	Construction	Negligible	Negligible
	GHG Emissions	Operation	Minor	Minor
Noise	Transportation	Construction	Minor	Negligible
	Foundation and construction	Construction	Negligible	Negligible
	Operation	Operation	Negligible	Negligible
Surface Water	Water intake requirement	Construction	Negligible	Negligible
	Water intake requirement	Operation	Negligible	Negligible
	Wastewater	Operation	Negligible	Negligible
	Cold water discharge	Operation	Negligible	Negligible
	Sedimentation caused by erosion	Construction	Negligible	Negligible
	Sedimentation caused by piling	Construction	Negligible	Negligible
Soil and Groundwater	Accidental leaks of cold water	Operation	Negligible	Negligible
	Loss of soil due to improper management during site clearance and excavation	Construction	Negligible	Negligible
Waste	Improper biomass management	Construction	Minor	Negligible
	Generation and Management of Hazardous Waste	Construction	Moderate	Minor
	Generation and Management of Hazardous Waste	Operation	Minor	Negligible
	Generation and Management of Non-Hazardous Waste	Construction	Moderate	Minor
	Generation and Management of Non-Hazardous Waste	Operation	Minor	Negligible
	Generation and Management of Domestic Solid Waste	Operation	Moderate	Minor

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
	Generation and Management of Domestic Liquid Waste	Operation	Minor	Negligible
Visual	Construction	Construction	Minor	Negligible
	Operation	Operation	Minor	Negligible
Biodiversity	Permanent and Temporary Habitat Loss	N/A	Minor	Negligible
	Temporary disturbance or displace of fauna	N/A	Negligible	Negligible
	Degradation of Habitat	N/A	Negligible to Minor	Negligible
	Mortality of resident species	N/A	Negligible to Minor	Negligible
Social	Employment	Construction	Positive	-
	Employment	Operation	Positive	-
	Fishing	Construction	Negligible	Negligible
	Fishing	Operation	Negligible	Negligible
	Economical displacement	Construction	Minor	Negligible
	Existing facilities and utilities	Construction	Moderate	Minor
	Existing facilities and utilities	Operation	Moderate	Negligible
	Environmental emission	Construction	Minor	Negligible
	Community health and safety	Construction	Moderate	Minor
	Community health and safety	Operation	Negligible	Negligible
	Occupational health and safety	Construction	Moderate	Minor
	Occupational health and safety	Operation	Minor	Minor
	Navigation	Construction	Minor	Negligible
	Navigation	Operation	Negligible	Negligible
	Traffic and Transport	Construction	Negligible	Negligible
	Cultural Heritage	Construction	Negligible	Negligible
Unplanned Event	Vessel Collision	All	Moderate	Minor
	Chemical Spill or Leak	All	Minor	Negligible
	Fire and Explosion	All	Major	Minor
	Seismic and Earthquake	All	Major	Major
	Tropical Storm and Extreme Weather Conditions	All	Moderate	Minor
	Loss of Containment of Chemical Storage Facilities On-site	All	Minor to Moderate	Negligible to Minor

1.7.2 Pipeline

The significance of impact for all physical and social receptors are summarized in ***Table 1.10***.

Table 1.10: Summary of the Significance of Impact for Physical and Social Receptors

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
Air	Dust soiling	Construction	Major	Negligible
	Human health	Construction	Major	Negligible
	Ecology	Construction	Major	Negligible
	Dust soiling	Operation	N/A	N/A
	Human health	Operation	N/A	N/A
	Ecology	Operation	N/A	N/A
GHG	GHG Emissions	Construction	Negligible	Negligible
Noise	Transportation	Construction	Minor	Negligible
	Excavation work	Construction	Minor	Negligible
Surface Water	Water intake requirement	Construction	Negligible	Negligible
	Hydrostatic Testing Discharge	Construction	Negligible	Negligible
	Sedimentation	Construction	Negligible	Negligible
Soil and Groundwater	Hydrostatic Testing Water Leakage	Construction	Negligible	Negligible
	Loss of containment of the sending and receiving station for HDD	Construction	Negligible	Negligible
Soil and Groundwater	Loss of containment of waste bentonite storage	Construction	Negligible	Negligible
	Loss of soil due to improper management during site clearance and excavation	Construction	Negligible	Negligible
Waste	Improper biomass management	Construction	Minor	Negligible
	Generation and Management of Hazardous Waste	Construction	Minor	Negligible
	Generation and Management of Non-Hazardous Waste	Construction	Minor	Negligible
	Generation and Management of Domestic Solid Waste	Construction	Minor	Negligible
	Generation and Management of Domestic Liquid Waste	Construction	Minor	Negligible
Biodiversity	Permanent and Temporary Habitat Loss	N/A	Minor	Negligible

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
	Temporary disturbance or displace of fauna	N/A	Negligible	Negligible
	Degradation of Habitat	N/A	Negligible to Minor	Negligible
	Mortality of resident species	N/A	Negligible to Minor	Negligible
Social	Employment	Construction	Positive	-
	Fishing and navigation	Construction	Negligible	Negligible
	Economical displacement	Construction	Major	Minor
	Economical displacement	Operation	Negligible	Negligible
	Traffic and transportation	Construction	Negligible	Negligible
	Existing facilities and utilities	Construction	Negligible	Negligible
	Environmental emission	Construction	Minor	Negligible
	Community health and safety	Construction	Moderate	Minor
	Occupational health and safety	Construction	Moderate	Minor
	Cultural Heritage	Construction	Negligible	Negligible
Unplanned Event	Fire and Explosion	All	Major	Major
	Seismic and Earthquake	All	Major	Moderate
	Loss of Containment of Chemical Storage	All	Minor to Moderate	Negligible to Minor

1.7.3 Power Plant

The significance of impact for all physical and social receptors are summarized in ***Table 1.11***.

Table 1.11: Summary of the Significance of Impact for Physical and Social Receptors

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
Air	Dust soiling	Construction	Minor	Negligible
	Human health	Construction	Minor	Negligible
	Ecology	Construction	Moderate	Negligible
	Dust soiling	Operation	Minor	Negligible
	Human health	Operation	Minor	Negligible
	Ecology	Operation	Moderate	Negligible
GHG	GHG Emissions	Construction	Negligible	Negligible
	GHG Emissions	Operation	Moderate	Moderate

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
Noise	Transportation	Construction	Minor	Negligible
	Foundation and construction	Construction	Moderate	Negligible
	Pre-commissioning, commissioning and testing	Construction	Minor	Negligible
	Operation	Operation	Moderate	Negligible to Minor
Surface Water	Water intake requirement	Construction	Negligible	Negligible
	Water intake requirement	Operation	Negligible	Negligible
	Demineralized plant neutralized water discharge	Operation	Negligible	Negligible
	Cooling water discharge	Operation	Negligible	Negligible
	Sedimentation caused by erosion	Construction	Negligible	Negligible
	Sedimentation caused by piling	Construction	Negligible	Negligible
Soil and Groundwater	Accidental leaks of demineralized plant neutralized water	Operation	Negligible	Negligible
	Accidental leaks of cooling water	Operation	Negligible	Negligible
	Loss of soil due to improper management during site clearance and excavation	Construction	Negligible	Negligible
Waste	Improper biomass management	Construction	Moderate	Minor
	Generation and Management of Hazardous Waste	Construction	Moderate	Minor
	Generation and Management of Hazardous Waste	Operation	Moderate	Minor
	Generation and Management of Non-Hazardous Waste	Construction	Moderate	Minor
	Generation and Management of Non-Hazardous Waste	Operation	Minor	Negligible

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
	Generation and Management of Domestic Solid Waste	Operation	Minor to Moderate	Negligible
	Generation and Management of Domestic Liquid Waste	Operation	Minor	Negligible
Visual	Construction	Construction	Minor	Negligible
	Operation	Operation	Minor	Negligible
Biodiversity	Permanent and Temporary Habitat Loss	N/A	Minor	Negligible
	Temporary disturbance or displace of fauna	N/A	Negligible	Negligible
	Degradation of Habitat	N/A	Negligible to Minor	Negligible
	Mortality of resident species	N/A	Negligible to Minor	Negligible
Social	Employment	Construction	Positive	-
	Employment	Operation	Positive	-
	Navigation	Construction	Negligible	Negligible
	Traffic and transport	Construction	Negligible	Negligible
	Existing facilities and utilities	Construction	Moderate	Negligible
	Environmental emission	Construction	Minor	Negligible
	Community health and safety	Construction	Moderate	Minor
	Community health and safety	Operation	Negligible	Negligible
	Occupational health and safety	Construction	Moderate	Minor
	Occupational health and safety	Operation	Minor	Minor
	Navigation	Construction	Negligible	Negligible
	Cultural Heritage	Construction	Negligible	Negligible
Unplanned Event	Chemical Spill or Leak	All	Minor	Negligible
	Fire and Explosion	All	Major	Negligible
	Tropical Storm and Extreme Water Conditions	All	Moderate	Minor
	Loss of Containment of	All	Minor to Moderate	Negligible to Minor

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
	Chemical Storage			

1.8 Environmental and Social Management Plan

1.8.1 Mitigation Measures

Many of the mitigation measures suggested during the construction phase of the Project associated with good construction and housekeeping practices and are included in the Environmental and Social Management Plan (ESMP).

Mitigation measures for the operation phase (such as those for air emissions and noise generation) of the Project are part of the design and will be incorporated into the Project design specifications.

The construction phase of the LNG Receiving Terminal, pipeline, and Power Plant is anticipated to be 23 months, 18 months, and 28 months respectively; whereas the operation phase of the all three (3) components is 25 years.

A summary of mitigation measures identified for the construction and operation phases of the LNG Receiving Terminal, pipeline, and Power Plant is presented in the ESMP (***Section 12.5.2.1***, ***Section 12.5.2.2***, and ***Section 12.5.2.3*** respectively). This also identifies lead responsibility for implementing of the mitigation measures and its verification along with reporting requirements and sources of funds for such implementation.

The Sponsor will ensure that the mitigation measures stated in the ESMP are implemented throughout the life span of the Project.

1.8.2 Monitoring Program

Key roles and responsibilities of the Sponsor and the appointed EPC contractor have been defined for implementation and monitoring of environmental and social impacts. For environmental monitoring, physical, biological and social environmental management components of particular significance have been identified as performance indicators. A comprehensive monitoring plan for each performance indicator will be prepared for all phases of the Project which gives parameters to be measured, methods to be used, sampling locations, frequency of measurements, detection limits, cost and responsibilities for implementation and supervision. A summary of the monitoring program for the construction and operation phases of the LNG Receiving Terminal, pipeline, and Power Plant is presented in the ESMP (***Section 12.5.2.4***, ***Section 12.5.2.5***, and ***Section 0*** respectively).

1.8.3 Training Program

Prior to commencement of construction activities at site, a suitably qualified in-house/ external expert will be appointed by the EPC contractor in consultation with the Sponsor to develop and deliver a training programme on implementation of the ESMP. Environmental and social monitoring program and reporting will be implemented in line with the applicable reference framework for the Project.

Prior to the commencement of the Plant operation, a suitably qualified in-house/ external environmental expert will be engaged by the Sponsor to develop and deliver a training programme on operation phase environmental monitoring and reporting. The topics will be mostly same as that during the construction phase. The reporting and verification will be semi-annual during construction phase and annual during operation phase (unless specify otherwise in the ESMP) and the reports will be submitted to the relevant authorities (i.e. MOEE, MONREC, etc.) and the Lenders.

1.8.4 Budget

The EPC Contractor and the Project Proponent 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 Corporate Social Responsibility (CSR) activities, which will be conducted by the Sponsor for community development. The budget for the ESMP is shown in ***Table 1.12***.

Table 1.12: ESMP Budget for Construction and Operation Phase

Environmental Monitoring Activity	Frequency	Terminal (Monitoring Cost USD/ time)	Gas Pipeline (Monitoring Cost USD/ time)	Power Plant (Monitoring Cost USD/ time)	Total Budget / Year
Site Preparation and Construction Phase					
Air Quality		EPC contractor cost	EPC contractor cost	EPC contractor cost	
Soil Quality	To be defined on a case by case basis	5,000	5,000	5,000	15,000
Surface Quality	Every 6 months	2,500	2,500	2,500	15,000
Groundwater	Every 6 months	2,500	2,500	2,500	15,000
Noise	Every 3 months	3,000	3,000	3,000	36,000
Biodiversity	Monthly	EPC contractor cost	EPC contractor cost	EPC contractor cost	-
Waste	Monthly	EPC contractor cost	EPC contractor cost	EPC contractor cost	-
				Total ESMP Budget for Construction Phase	**81,000**
Operation Phase					
Air Quality	Yearly	-	-	5,000	5,000
Soil Quality and Groundwater	To be defined on a case by case basis	O&M Cost	-	2,500	2,500
Surface Quality	Every 3 months	2,500	-	Operation Cost	10,000
Noise	Yearly	-	-	2,000	5,000
Biodiversity	Monthly	O&M Cost	-	O&M Cost	-
Waste	Monthly	O&M Cost	-	O&M Cost	-
Social	Every 2 year	5,000	5,000	Operation Cost	5,000
				Total ESMP Budget for Operation Phase	**27,500**

Source: TPMC, 2020.

1.9 Public Consultation and Disclosure

Stakeholder Engagement, the process of engaging with people who may be affected by or interested in the Project, has been undertaken throughout the ESIA process. Stakeholder views have been considered to improve the proposed Project and mitigation measures where possible. Stakeholder Engagement was conducted in a culturally appropriate manner by the Project proponent with the support from ERM, open to all people, especially those who will be affected by the proposed Project.

The engagement process has been designed to meet both Myanmar legal requirements (per the Environmental Impact Assessment Procedure No. 616/2015) for public participation, and international requirements for engagement as outlined by the IFC Performance Standards.

The first step in establishing a dialogue was identifying the Project stakeholders. Stakeholders are persons or groups who are directly or indirectly affect by a project, and those who may have interest in and/or the ability to influence a project's outcomes (either positively or negatively).

The Project team committed to undertake a process that delivers an inclusive and continuous dialogue with the Project stakeholders during the ESIA. The objectives of the engagement were to:

- Identify all those affected or interested in the Project to ensure they were included in the engagement process;
- Ensure understanding through an open, inclusive culturally appropriate and transparent engagement process. Information has been disclosed as early and as comprehensively as possible;
- Involve stakeholders in the assessment of impacts, the generation of mitigation and management measures and the finalization of IEE Report. Stakeholders also played an important role in providing local knowledge and information for the baseline to inform the impact assessment;
- Build relationships and trust through open dialogue and engagement. Establish transparency of TPMC activities to build trust with stakeholders;
- Engage vulnerable people and groups by having an inclusive approach to consultation. Some stakeholders need special attention in such a process due to their vulnerability;
- Manage expectations with respect to proposed Project benefits. The engagement process served as a mechanism for understanding and managing stakeholder and community expectations, where the latter will be achieved disseminating accurate information in an accessible way; and
- Ensure compliance. The process was designed to ensure compliance with both Myanmar regulatory requirements and international best practice.

According to Article 50 and 61 of the EIA procedure (2015), the Project proponent shall ensure that public consultation and participation process are carried out during the Scoping exercise, and the EIA investigations. The public consultation for the Scoping exercise and EIA investigations are summarized in ***Section 1.9.1***, and ***Section 1.9.2*** respectively.

1.9.1 Summary of Scoping Process Consultation Activities (Public Consultation 1)

The meetings were conducted from October 30th to December 11st, 2018. Various stakeholders were invited including Chief Minister and State Government, concerned Regional level ECD and GAD, Members of Parliament, Township GAD, village administrators, and local communities.

Representatives from 17 Townships and villages were invited to attend public consultation meeting – Thanlyin, Kyauk Tan, Shwe Pyi Thar, Ahlone, Lanmadaw, Seik Kan, Dagon, Mingalardon, Pazundaung, Kamaryut, Tarmwe, Dala, Seikgyikanaungto, Shwe Pyi Thar, Pu Zun Daung, Tha Ke Ta, and Tha Khin Ba Thaung.

The date, time, location, stakeholder and number of participants of each meeting is provided in ***Table 1.13***.

Table 1.13: Consultation Activities Undertaken during Public Consultation 1

Date	Location	Stakeholder	Number of Participants
29/10/2018	Ahlone Township hall	GAD (Forestry and Fire Department), Parliament Member (Regional Gov't), Regional ECD, Village Leader, Elder people, Villagers, Journalist, Reporter, Yangon Electricity Supply Corporation (YESC), Corporations, and Engineering Procurement Construction (EPC)	182
10/12/2018	Dala Township hall	Parliament Member, GAD, Concerned Departments, Ward Administrator, Village Leader, Villagers, Ministry of Sports and Physical Education, YESC, Journalists, Reporters, and Yangon City Development Committee (YCDC)	211
11/12/2018	Thanlyin Township hall	GAD, Concerned Departments, Village Leader, Elder people, Villagers, Journalist, EPC, and Corporation	208

Some examples of key concerns and questions raised during public consultation 1, and responses taken to address these concerns and questions are listed in ***Table 1.14***. The full list of key concerns and questions can be found in ***Section 13.2.3***.

Table 1.14: Key Concerns and Question Raised during Public Consultation 1

Questions	Response	Reference/Response in ESIA
How will you prevent accidents?	ERM: Within the ESIA, accidents are referred to as unplanned events. ESIA will study what types of unplanned events are likely to occur, and how the Project can manage them properly. In addition, emergency response training sessions are included in the management plan. The mitigation measures for unplanned events are included as a part of the ESIA report. TTCL has a separate EHS organization for safety management. The organization has the function in developing risk assessment and identifying risk factors. The safety management plan will always be developed in cooperation with international safety organization and specialist. TTCL Company holds ISO-9001 and ISO-14001 certificates	Project Description Chapter Unplanned Event Chapter Environmental and Social Management Plans (ESMP) Chapter.
In my experience, local farmers were not able to carry on their plantation due to construction material deposit in farmland during gas pipe construction. Moreover, leakage from old gas pipeline are noticed	TPMC: We are working on selection of proper gas pipeline right of way. Once we have concluded the gas pipe right of way with relevant ministries, we will directly engage with impacted landowner. In addition, using quality material for gas pipe is also mandatory for our company. If there is fuel shortage occur, we will also have to suffer for not meeting promised power capacity. Therefore, we are fully aware of this matter.	Project Description Chapter Unplanned Event Chapter

Questions	Response	Reference/Response in ESIA
during wet season.		
How will you manage compensation to affected community?	TPMC: We will need to conduct the compensation process, if there are any impacts, especially impacts generated from the natural gas pipeline construction. Nevertheless, our compensation for stakeholders will be provided in accordance with Myanmar Laws and guidelines from relevant authorities.	Social Impact Assessment (SIA) chapter
How will you control for the noise, air & water pollution? We are experiencing constantly the noise from one of the power plant from Thilawa Zone.	ERM: To determine impacts from project, we have to collect the existing soil, air quality and noise data from study area as well as need to study the potential impact from project. Depends on the existing air, soil , water quality and potential impact study, mitigation measures and monitoring plan will proposed if necessary. ESIA report including monitoring plan have to submit to MONREC for approval. Project proponent company have to comply with our proposed impact management plan. Environmental monitoring report is required to submit to MONREC department minimum every six month. If after the Project is running and mitigation are implemented, you still experience impact; you have access to the grievance mechanism to report issues to TPMC.	Impact Assessment Chapters

1.9.2 Summary of ESIA Presentation Consultation Activities (Public Consultation 2)

The meetings held were conducted from June 12nd to the 14th, 2019. Various stakeholders were invited including Chief Minister and State Government, concerned Regional level ECD and GAD, Members of Parliament, Township GAD, village administrators, and local communities.

Representatives from 32 Townships and Villages were invited to attend public consultation meeting – Dala, Thingangyung, Thanlyin, Pardagyi, Sin Kan, Kyauktan, Oak Pho Su, Bauk Htaw Twin, Myoma (South & North), Bago Su, Nyaung Thone Pin, Myo Haung (West, East, and Middle), Shwe Pyout, Nyaung Wine, Shwe Pyi Thar Yar, Shwe Kone, Thidar Myine, Phayar Kone, Oak Pho, Amhuhtan, Thout Taw Twin, A Lwan Swut, Yaynan, Htan Pin Kone, Myo Thit (west), Kyaung Oak Sake, A Lwan Swut, Thar Kya Ta, Aungmingalar, Ahlone, Latha, Thuwana, and Dagon.

The date, time, location, stakeholder and purpose of each meeting is provided in ***Table 1.15***.

Table 1.15: Consultation Activities Undertaken during draft ESIA presentation

Date	Location	Stakeholder	Number of Participants
12/06/2019	Ahlone Township hall, Ahlone Township	GAD (Project), ECD, Village Leader, CSOs, Elder people, Villagers, MOGE, Ministry of Education, Ministry of Agriculture, Livestock and Irrigation , Ministry of Electricity & Energy , Reporter, Myanmar Industrial Port, YCDC, NGO, Corporations, and EPC	187
13/06/2019	Thardana Beikmann Hall, Thanlyin Township	GAD (Health Care, Finance, MONREC, Fire service Department), Ministry of Agriculture, Livestock and Irrigation, EPC, YCDC, Parliament Member, ECD, Ward Administrator, Village Leader, and Villagers	180

Date	Location	Stakeholder	Number of Participants
14/06/2019	Thin Zaya Naw Ya Htar Hall, Dala Township	GAD (Construction, Project, Health Care, Piping, Agriculture, Administration, Fire service, Water and Sanitation, MONREC, and Ward Administration Department), MOE, Parliament Member (Regional Gov't), Regional ECD, Red Cross Society, Village Leader, Elder people, and Villagers	143

Some examples of key concerns and questions raised during public consultation 2, and the responses taken to address these concerns and questions are listed in ***Table 1.16***. The full list of key concerns and questions can be found in ***Section 13.3.3***.

Table 1.16: Key Concerns and Question Raised during Public Consultation 2

Questions	Response	Reference/Response in ESIA
What sort of impacts are expected from LNG operation?	LNG unloading and storage process will be complied with the International fire prevention and safety guideline such as NFPA. Equipment such as fire prevention and leakage detection sensors will be equipped in terminal to prepare for the immediate actions of any event. In the case of unplanned event, LNG storage layout is properly designed to handle the impact within the terminal area only.	Impact Assessment Chapters
How will the company activities will be verified or monitor? What would be the punishment and penalties if Project Company does not follow the ESIA law?	There are Myanmar Environmental conversation law, Environmental Conversation Rule & Environment Impact Assessment procedure 2015. ECD department will determined the necessary level of environmental assessment for the proposed project. Project proposed company is responsible to comply with the applicable environmental law. If company fail to follow environmental management, the company is punishable to pay fine or other severe punishment according to law.	ESMP Chapter
What are the measures in the case of gas leakage?	Detection system is implemented in gas pipeline design to detect the gas leakage. Block valve stations located between terminal and power plant will also implemented for emergency response. When the gas leakage is detected, company will be able to take immediate action to prevent the people and environment	ESMP Chapter
Suggested the impact to public road should be repair by the company	Our gas pipeline route is currently designed to be along the Dala-Danote main road. However, it is subjected to change depending to detail survey that we are about to do with the cooperation from relevant government departments. In the case of road damage occurred by Machinery/Vehicles used in pipeline construction, company will be responsible to repair.	SIA Chapter ESMP Chapter

1.9.3 Grievance Mechanism

Grievance mechanism is established to ensure that stakeholders affected by the proposed Project can present their feedback (opinions, concerns, requests, and suggestions) to the ESIA or Project team for consideration and redress, if required. The grievance mechanism will actively manage and track feedback associated with the proposed Project, and will be used to identify and resolve potential issues at the earliest possible time and ensure that appropriate actions are taken and resolutions achieved that will be in the interest of all parties concerned (***Section 13.6*** and ***Appendix V Stakeholder Engagement Plan (SEP)***).

1.10 Conclusion

The ESIA process undertaken has identified and assessed a range of potential physical, biological and socioeconomic impacts associated with the proposed LNG Receiving Terminal, Pipeline, and Power Plant in Myanmar; however, given that the mitigation/management measures provided in this ESIA are implemented, *the majority of these impacts will be reduced to a minor to negligible level of significance*. The effective implementation of the ESMP and adherence with the Myanmar NEQ, and IFC guidelines will assist in minimising the environmental impacts to acceptable levels.

Although a number of potential environmental, social and health impacts were identified, the assessments found that impacts are typically short term in duration and have minor residual significance after implementation of mitigation measures. The potential for impacts is well understood with little or no evidence of adverse consequences on the majority of environmental, social or health receptors provided that adequate in-place controls and/or mitigation measures are implemented. The suggested mitigation measures in the ESMP are well established amongst international practice, and proven to be effective in managing any impacts that might occur to acceptable levels, including for similar projects in similar settings.

In terms of social aspects, the results from initial stakeholder engagement indicate that the Project has received favourable support from local people and other stakeholders. 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, potential employment (direct and indirect) and that the negative impacts can be mitigated, provided the Project proponent implement all the proposed mitigation measures.

Provided that all the social and environmental mitigation/management measures provided in this ESIA are implemented, it is the opinion of ERM that there are no environmental or social fatal flaws that prevent authorisation of the proposed LNG Power Plant (Ahlone) Project in Myanmar.

Since this ESIA is completed based on the mid-stage of the design and planning phase, changes to the project sitting, construction methods, and operations may occur in the later phases of design and planning. In addition, since the EPC for construction has not been appointed for all three main components, further studies on actual conditions at final project locations, extensive stakeholder engagement and hands-on training of the appointed EPC will be required during the later planning phase and throughout construction and operation phases. TPMC will be responsible for the implementation of all recommended mitigations and management methods, including the conduct of additional surveys and studies, and for reporting on performances to the relevant stakeholders and authorities.

2. INTRODUCTION

2.1 Project Background and Overview

TTCL Power Myanmar Company Limited (**'TPMC'** or **'the Project Proponent'**) is planning to develop a Power Plant in Yangon, Myanmar. A Combined Cycle Power Plant (CCPP) (installed capacity 388MW) will be developed to supply the power to the Republic of the Union of Myanmar (the 'Project').

The Project (also referred to as **'LNG Power Plant (Ahlone) Project'**), will consist of three main components; the LNG Ahlone Power Plant (hereafter referred to as 'Power Plant'), LNG Receiving Terminal (hereafter referred to as 'LNG Receiving Terminal' including Jetty, LNG Storage Tank(s) and Regasification Unit), and the Natural Gas Pipeline (hereafter referred to as 'Pipeline'). The Pipeline will have an approximate length of 24.4 km connecting the Regasification Unit at the LNG Terminal to the Power Plant. The Project Proponent has planned to use imported Liquefied Natural Gas (LNG) as the fuel source. The selected technology for the Power Plant, combined cycle power plant (CCPP), is an efficient form of power generation, proven and acknowledged as a clean form of natural gas power generation due to its efficient gas utilisation and lower environmental impact.

The Project Proponent has prepared and submitted the Project Proposal Report (PPR) on 14th December 2017 to the Ministry of Electricity and Energy (hereinafter referred to as 'MOEE') and the Ministry of Natural Resources and Environmental Conservation (hereinafter referred to as 'MONREC') and had several discussions with MOEE, and the Government of the Republic of the Union of Myanmar to develop the Project. The electricity generated by the Project will be sold to MOEE via a new 230kV Transmission Line going from the Power Plant to the Hlaingtharya sub-station.

At the end of January 2018, the MOEE hosted the Notice to Proceed' (NTP) signing ceremony for four (4) projects, which included the LNG Power Plant (Ahlone) Project and the NTP, was signed between the Myanmar Government and TPMC.

The Project Proponent has prepared and submitted the Project Proposal Report (PPR) to MOEE and (MONREC) on 14th December 2017. The PPR recommended that TPMC shall proceed with an Environmental Impact Assessment (EIA) Study of the Project and prepare an Environmental Management Plan (EMP) to put forward its commitments for environmental and social mitigation and management measures. The submission letter of the PPR is attached in ***Appendix A*** for reference.

As per the Environmental Impact Assessment (EIA) Procedure and promulgated on 29th December 2015, it is understood that proposed Project requires the Scoping Study and the EIA Study to be conducted and submitted to the Ministry of Natural Resources and Environmental Conservation (MONREC) in order to obtain an Environmental Compliance Certificate (ECC).

In addition, the Scoping Study (prepared by ERM) for this Project has been submitted to MOEE and MONREC on 9th January 2019. The submission letter of the Scoping Report is attached in ***Appendix B*** for reference.

The comments from the Environmental Conservation Department (hereinafter referred to as 'ECD') of MONREC on Scoping Report have been received on 10 April 2019, and ECD's comments have been addressed and incorporated into the ESIA report (this report), as attached in ***Appendix C***.

2.1.1 Project Name

LNG Power Plant (Ahlone) Project

2.1.2 Project Sponsor / Project Proponent

TPMC, the main Project Proponent for the proposed Project, is a project company set up by TTCL Public Company Limited (TTCL). TPMC was established in 2018 to carry out the development, operation and maintenance of the Project.

TTCL, the first integrated Engineering, Procurement and Construction (Integrated EPC) company in Thailand, was incorporated on 24 April 1985 with a start-up capital of 20 Million Baht. TTCL was formed by a joint venture between two (2) leading international engineering and construction companies from Japan and Thailand. TTCL has experience and expertise in providing integrated design and engineering, procurement of machinery & equipment, and construction (Integrated EPC) of turnkey projects for industrial and process plants, mainly in energy, petrochemical, chemical and power industries.

TTCL has set up TTPMC in 2012 for the development of a 120 MW Gas-fired power plant in Ahlone Township, Yangon, the Republic of the Union of Myanmar.

Details of the main Project Proponent are as follows:

Company Name: TTCL Power Myanmar Company Limited
Address: 16B, 16th Floor, Centre Point Tower,
NO. 65, Corner of Sule Pagoda Road and Merchant Street. Kyauktada Township, Yangon, Myanmar
Contact Person: Ms. Nini San
Telephone: +95 [0] 9 254 311058
+95 [0] 1 371 962
Fax: +95 [0] 1 371 963
Email: nini.s@ttcl.com

TTCL's key facts are highlighted in ***Table 2.1***.

Table 2.1: Key Facts of TTCL

Key Facts	Description
Year of Incorporation	Founded on 24th April, 1985 listed in 2009
Listing	The Stock Exchange of Thailand
Market Capitalisation	896 million Baht in 2018
Major Shareholders	SOJITZ CORPORATION; GLOBAL BUSINESS MANAGEMENT CO., LTD.
Key Business	Engineering, Procurement, and Construction (EPC), and Power
Global Presence	Thailand, Myanmar, Singapore, Malaysia Philipines

Source: TTCL, 2019.

2.2 Project Site and Location

2.2.1 Proposed Project Facilities

The proposed Project is located in Ahlone Township for the Power Plant with the gas pipeline running along the Dala and Seikgykanaungto Townships, Yangon Region in the Republic of the Union of Myanmar.

The LNG Receiving Terminal will be located on the West bank of the Yangon River near the Yakainggyaung village in the Dala Township on the Yangon River downstream of the Power Plant. It I will also be located within agricultural land; therefore, it is understood that the current land belongs to TPMC after purchase from private landowners.

A total of 8.97 acres of land is allocated for the proposed Power Plant and 15 acres for the LNG Receiving Terminal (23.97 acres total).

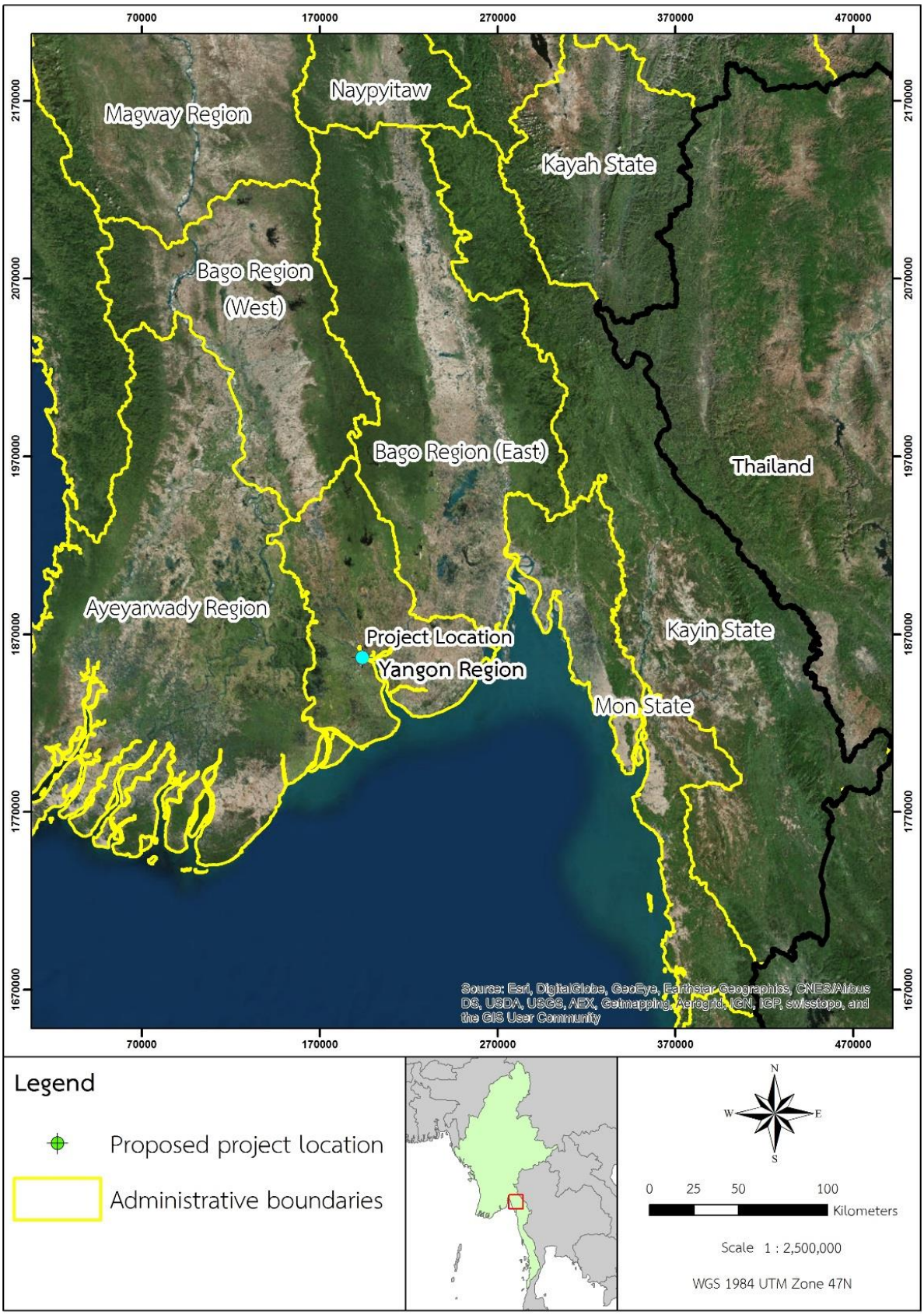
The Natural Gas Pipeline will start from the LNG Receiving Terminal in Dala Township, follows the existing road before passing to Dala Township, cross the Twante canal to Seikgykanaungto Township and cross the Yangon River again to the landfall at Ahlone Township, connecting with the Power Plant.

The proposed Power Plant is located near a shipwreck area and within the existing Power Plants (Ahlone TPMC CCPP and MOEE Power Plant) to the North, Yangon port to the East, the Yangon River to the South and a shipwreck/unused area to the West. It is understood that the current land belongs to MOEE. Land Lease Agreement between the Project Proponent and MOEE is being proceeded.

The proposed Transmission Line is located in Ahlone, Seikgykanaungto, Twantay and Hlaingthayar Townships, which will mainly run in parallel with the existing 230 kV transmission line transferring power for the existing Ahlone CCPP to the existing sub-station in Hlaingthayar for a total length of approximately 28 km.

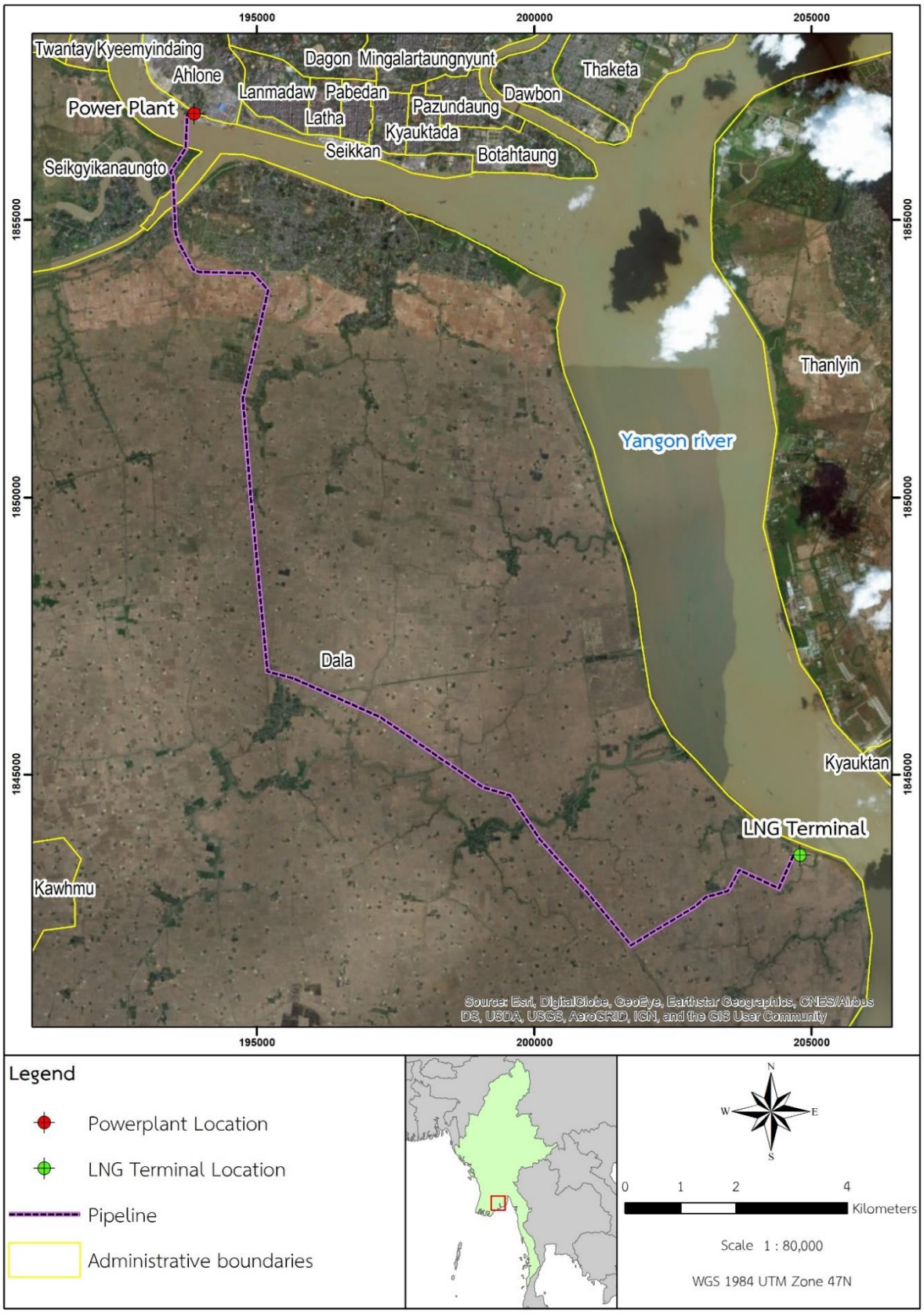
The proposed Project locations are shown in ***Figure 2.1***, and ***Figure 2.2***. The proposed Power Plant in relation to the existing power plant is shown in ***Figure 2.4***. The proposed Transmission Line is shown in ***Figure 2.4***.

Figure 2.1: Proposed Project Location within Myanmar



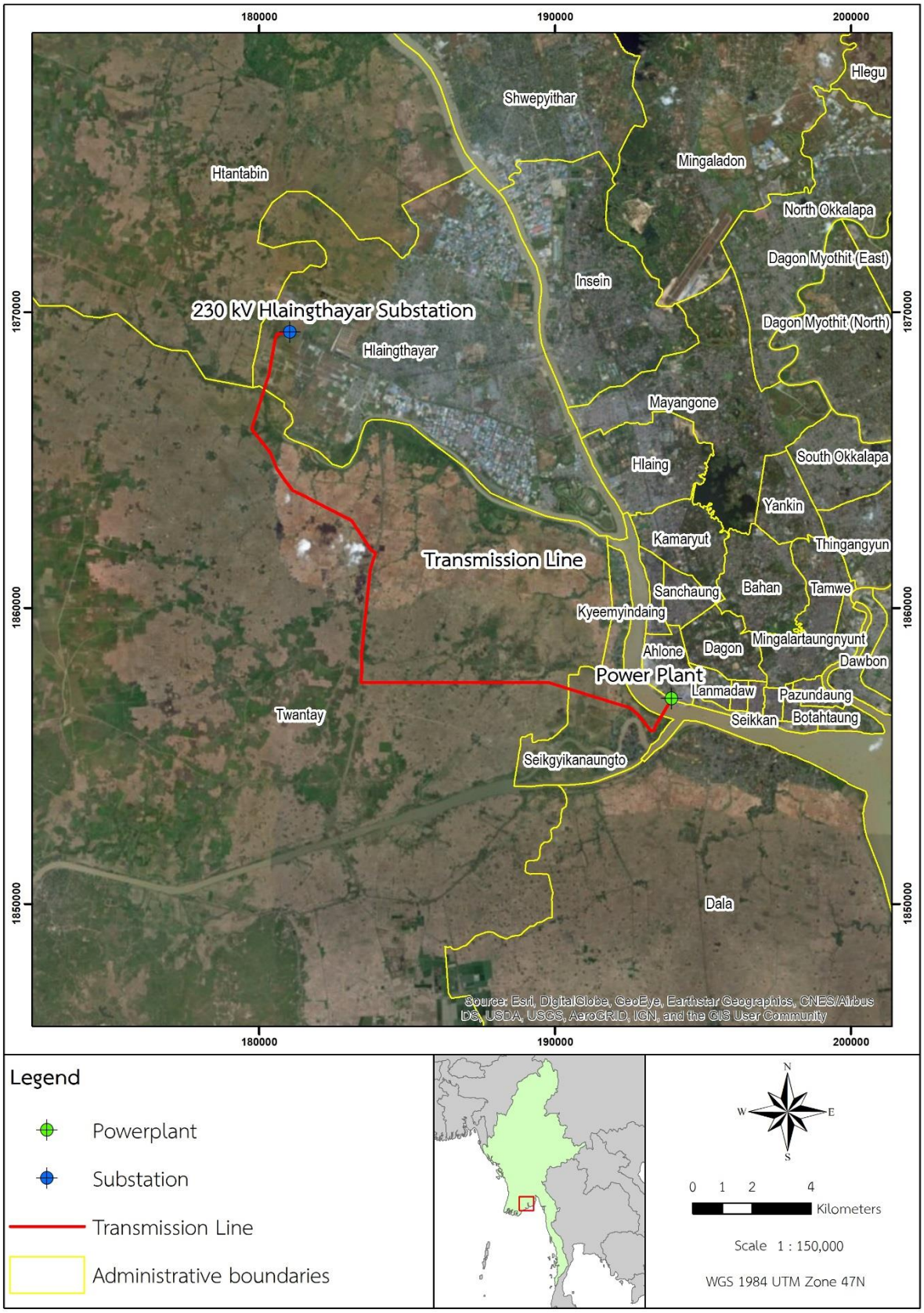
Source: TPMC, 2018. (Modified by ERM)

Figure 2.2: Indicative Project Components Locations



Source: TPMC, 2019. (Modified by ERM)

Figure 2.3: Proposed Transmission Line Location



Source: TPMC, 2018. (Modified by ERM)

2.2.2 Existing Natural Gas Power Plant

There is an existing 120 MW natural gas power plant located within the Project site boundary (see ***Figure 2.4***) currently operated and owned by the Project Proponent, which began operation in April 2013.

The existing CCPP was given a 30-year concession period for Build-Operate-Transfer (BOT) with the Myanmar Electric Power Enterprise; the generated power is supplied to the Hlaingthayar sub-station via a 230 kV overhead transmission line.

Between the existing CCPP and the proposed location for the new Power Plant, there is a MOEE own combined cycle power plant producing 154.2 MW with 3 gas turbine and 1 steam turbine. Commercial running date started between 1995 and 1999.

Figure 2.4: Proposed Power Plant Project Site and Existing Power Plant Locations

Source: TPMC, 2018. (Modified by ERM)

Note: Green Outline: Existing Natural Gas Power Plant
Yellow Line: Proposed Natural Gas Pipeline
Red line: Existing MOEE CCPP
Purple Outline: Proposed Power Plant

2.3 Purposes and Objectives of this ESIA Report

This **Environmental and Social Impact Assessment (ESIA) Report (also referred to as 'Environmental Impact Assessment (EIA) Study')** presents an assessment of the potential environmental and social impacts associated with the proposed Power Plant, LNG Receiving Terminal, and Natural Gas (NG) Pipeline in Yangon Region, Myanmar ('the Project').

The specific objectives of this ESIA report are as follows:

- Facilitate an understanding of the elements of the existing baseline conditions that are relevant to resources/receptors that could be potentially impacted by the Project;
- Identify the aspects of the Project that could potentially result in significant environmental and social impacts on resources/receptors;
- Document how stakeholders have been engaged during the ESIA Process, and how stakeholder feedback has been considered in the ESIA study;
- Predict and evaluate the significance of the potential environmental and social impacts of the Project;
- Identify the 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.

2.3.1 Environmental, Social and Health Experts

ERM-Siam Company Limited has been assigned by TPMC to conduct an Environmental and Social Impact Assessment (ESIA) Study for the Project. ERM has been approved by the Environment Conservation Department (ECD) of the Ministry of Natural Resources and Environmental Conservation (MONREC) as third party consultant on the 24th of August 2018 (***Appendix D***). The outcomes of the ESIA Study will be submitted to relevant Myanmar authorities for assessment in order to inform the decision for the Project Proponent to obtain an ECC.

ERM is a leading global provider of environmental, health, safety, risk, social consulting and sustainability related services. ERM has more than 5,000 employees in over 40 countries and territories working out of more than 150 offices.

ERM is committed to providing a service that is consistent, professional and of high quality. ERM are approved by the Ministry of Natural Resources, Environment and Conservation (MONREC), and have recently registered our Company as a separate ERM Myanmar entity and opened an office in Yangon.

ERM has high international standing, and an unrivalled track record in preparing successful ESIAs for high profile and often controversial development projects. ERM has over 20 years' experience undertaking ESIA Studies for the power sector worldwide, including many high profile power projects.

ERM has been working in Myanmar since 1994 and has already been involved in the development of several power plant in Myanmar.

The key personnel from ERM involved in the preparation of this ESIA Study are presented in ***Table 2.2***.

Table 2.2: ERM Key Personnel involved in Preparation of the ESIA Study (and Scoping Study)

Name	Project Role
Ms Kamonthip Ma-oon	Partner in Charge
Dr Robin Kennish	Project Technical Director
Mr Vincent Lecat	Project Manager and Social Specialist
Mr Chris Brown	Soil / Water Specialist
Mr David Nicholson	Biodiversity Specialist
Mr Edmund Taylor	Air Quality Specialist
Ms Sarinya Rangsipatcharayut	GHG Specialist
Ms Sylvia Jagerroos	Marine Specialist
Ms Mandy To	Noise Specialist
Ms Peggy Wong	Cultural Heritage Specialist
Ms Kanokphorn Chaivoraphorn	Health Specialist
Ms Khinsusu Naing	Social Expert
Ms AyeMya Thinzar	Social Consultant
Ms Sutawan Chittham	Visual and Unplanned Events Specialist
Mr Aung Myowin	Environmental Consultant
Mr Shwet Prakash	Thermal Discharge and Sedimentation Specialist/ Modeller
Mr Aniket Jalgaonkar	Flooding Risks Specialist

Note: CVs of all ERM staff have been provided in the third party registration letter

For this Project, ERM has selected the qualified sub-consultant, **Sustainable Environment Myanmar Co., Ltd (SEM)**, who has experience in carrying out the environmental and social baseline survey and public consultation meetings in the local context. Note that all the works provided by SEM are under ERM supervision.

SEM is a leading resource and environmental consultancy firm based in Myanmar, consisting of former and current university faculty members of various disciplines relating to environmental and social management.

They have worked extensively across Myanmar undertaking Environmental Impact Assessment related works including terrestrial biodiversity surveys, habitat and land use mapping, health and social impact surveys and development of post project monitoring surveys.

SEM has been involved in all the field activities related to environmental baseline data collection, in particular the biodiversity study, air quality and noise data collection, surface / ground water and soil sampling. SEM also supported ERM in the socioeconomic and cultural heritage data collection and the stakeholder engagement process.

The key personnel from SEM involved in the Project are presented in ***Table 2.3***.

Table 2.3: SEM Key Personnel involved in Preparation of the ESIA Study (and Scoping Study)

Name	Project Role
Mr Zaw Naing Oo	Managing Director
Mr Maung Chit	Project Manager
Ms Nan Cherry	Social Specialist
Daw Naing Naing Win	Local Ecology Expert

Note: CVs of all SEM staff have been provided in the third party registration letter

2.4 Structure of this ESIA Report

Following the Executive Summary in Myanmar language and English are presented as ***Chapter 1***, the remainder of this ESIA Report is presented as follows:

- ***Chapter 3*** presents an overview of the environmental and social policy, legal and institutional framework related to the proposed Project;
- ***Chapter 4*** provides details on the Project description and alternatives considered;
- ***Chapter 5*** provides a description of the existing biophysical and socioeconomic environment;
- ***Chapter 6*** presents the Impact Assessment Methodology used for this study;
- ***Chapter 7*** presents the key potential environmental and social impacts, and potential mitigation measures for the LNG Receiving Terminal;
- ***Chapter 8*** presents the key potential environmental and social impacts, and potential mitigation measures for the Pipeline;
- ***Chapter 9*** presents the key potential environmental and social impacts, and potential mitigation measures for the Power Plant;
- ***Chapter 10*** presents the key potential biodiversity impacts, and potential mitigation measures for all three (3) main components (LNG Receiving Terminal, Pipeline, and Power Plant);
- ***Chapter 11*** presents the Cumulative Impact Assessment (CIA);
- ***Chapter 12*** provides the Environmental and Social Management Plan (ESMP);
- ***Chapter 13*** highlights the stakeholder identification, stakeholder engagement activities, including Project disclosure and results from Public Consultation meetings;
- ***Chapter 14*** provides conclusions and recommendations, and the Statement of Commitment; and
- ***Chapter 16*** present the references used for the study.

The supporting documents are inserted as Appendices, as follows:

- ***Appendix A***: PPR Submission Letter;
- ***Appendix B***: Scoping Report Submission Letter;
- ***Appendix C***: ECD Comments on Scoping Report;
- ***Appendix D***: Third party Confirmation Letter;
- ***Appendix E***: TPMC's HSE Plan Procedure;
- ***Appendix F***: Preliminary Project Master Schedule;
- **Error! Reference source not found.**: Fire Prevention Plan for the LNG Receiving Terminal;

- ***Appendix I***: Project Incident and Emergency Response Plan;
- ***Appendix J***: Site Security Procedure;
- ***Appendix K***: Personale Protective Equipment Procedure;
- ***Appendix M***: Physical In-Situ Sampling During Dry Season from SEM;
- ***Appendix N***: Physical Baseline Data Analysis for Dry Season from STS Green;
- ***Appendix O***: Physical In-Situ Sampling During Wet Season from SEM;
- ***Appendix P***: Physical Baseline Data Analysis for Wet Season from STS Green;
- ***Appendix R***: Invasive Species in Myanmar;
- ***Appendix S***: Example Tools used for Social Baseline Primary Data Collection;
- ***Appendix T***: Full Air Quality Impact Assessment (AQIA);
- ***Appendix U***: CORMIX Modelling Report;
- ***Appendix II***: Public Participation No.1 Presentation (Burmese);
- ***Appendix JJ***: Business Information Document (Burmese);
- ***Appendix KK***: Public Consultation Minutes of Meeting (Scoping Process);
- ***Appendix LL***: Public Participation No.2 Presentation (English);
- ***Appendix MM***: Public Consultation Minutes of Meeting (Draft ESIA Presentation);
- ***Appendix NN***: High Level Flood Likelihood Evaluation (FLE); and
- ***Appendix OO***: ESIA Study Terms of Reference.

3. POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

3.1 Introduction

This chapter summarises the relevant legal and policy context in Myanmar and documents the environmental and social standards with which the Project will achieve compliance. It also includes the international standards that the Project will follow as well as applicable international treaties and conventions, and internal guidelines and standards voluntarily committed to by the Project Proponent.

3.2 TPMC Health, Safety, and Environment (HSE) Plan Procedure

The purpose of the HSE Plan is to provide the necessary rules, regulations, and guidelines to prevent incidents and injuries from occurring, and minimizing adverse environmental impacts.

It is stated by TPMC's HSE Plan Procedure that the Project HSE objectives are as follows:

1. TPMC shall carry out project management and construction management activities in compliance with the applicable regulatory and other related HSE requirements as specified in the contract.
2. TPMC shall perform and manage construction work in safe manner to achieve the safety target of "No Lost time Accident"
3. Project incidence rates should not exceed the following values;

   IFR (incidence frequency rates), 3.7

   ISR (incidence severity rates), 37
4. TPMC shall perform construction work by taking into account for the Environmental impact protection and complaint from the community shall be "Zero".

TPMC's HSE Plan Procedure is shown in ***Appendix E***.

3.3 Overview of Myanmar Regulatory Framework

3.3.1 Myanmar Regulatory Authorities

Matters pertaining to Health, Safety and Environmental (HSE) requirements for this Project are under the jurisdiction of the ministries and state-owned enterprises in the electricity and energy sector, environment and port authorities. Key ministries, agencies and state-owned enterprises that have jurisdiction over environment, port, electricity and energy matters are included in ***Table 3.1***.

Table 3.1: Key Ministries, Agencies and State-Owned Enterprises Involved in HSE for this Project

Ministry/Agency	Responsibility
Ministry of Natural Resources and Environmental Conservation (MONREC)	The Environmental Conservation Department (ECD) of MONREC has ultimate responsibility in the review and approval, or otherwise, of submissions under the ESIA process.
Ministry of Electricity and Energy (MOEE)	Primary responsible for electricity planning, generating and transmission. MOEE is also the sole supplier of natural gas for power generation and is responsible for issuing regulations on the generation, transmission and delivery of electric power in Myanmar.
Electric Power Generation Enterprise (EPGE)	Responsible for purchasing power from public and private power producers, including Build, Operate Transfer (BOT) project companies and reselling that power. In addition, the EPGE controls all transmission lines and substations.
Myanma Oil & Gas Enterprise (MOGE)	Responsible for overseeing the Oil & Gas sector in Myanmar and involved in the import of LNG in the country.

Ministry/Agency	Responsibility
Myanmar Investment Commission (MIC)	MIC is a government agency responsible for coordinating with ministries (such as the MOEE) and other state entities to facilitate foreign investment in Myanmar. The MIC is also responsible for granting MIC permits, which enable foreign investors to carry out business activities under the Myanmar Investment Law (18 October 2016).
Department of Electrical Power Planning (DEPP)	Formed in 2012 from a combination of the Power Department, and the Ministry for Planning Policies Mission planning. Main responsibilities are implementing Power Projects on behalf of the Ministry.
Myanmar Port Authority (MPA)	Created in 1989, the Myanmar Port Authority is a government agency vested with the responsibility to regulate and administer the coastal ports of Myanmar. It is a department of the Ministry of Transport and Communications (MOTC) and is located in Yangon
Department of Power Transmission and System Control (DPTSC)	Specifically the Department of Power Transmission Projects Department (PTP), under the DPTSC, are responsible for overseeing transmission lines and substation projects in Myanmar.
Ministry of Labour, Immigration and Population (MOLIP)	Department of Factories & General Labour Laws Inspection under Ministry of Labour, Immigration and Population are currently supervised the occupational safety and health of labours in accordance with The Factories Act (1951), of which will be supervised in accordance with OSH law, in the future.
Ministry of Health and Sports (MOHS)	Responsible for Public health and medical survices resources, including COVID-19 surveillance and control.

Source: ERM, 2019.

3.3.2 Myanmar Legislation Potentially Relevant

Laws related to environmental and social issues and hence potentially relevant to the ESIA Study for the proposed Project are included in ***Table 3.2***.

Table 3.2: Myanmar Legislation Relevant to the Project

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
POLICIES AND STRATEGIES		
The National Environment Policy, 2019	-	This new National Environmental Policy provides long-term, strategic guidance for government organizations, civil society, the private sector and development partners on the achievement of environmental protection and sustainable development objectives in Myanmar. It requires the mainstreaming of environmental protection into planning and decision-making at all levels of government and in all sectors. Its detailed principles respect livelihood needs and development objectives while at the same time recognizing the full value of our ecosystems and the implications of our changing climate. This Policy ensures that environmental protection continues to be a central objective in Myanmar's sustainable development without losing sight of the importance of a pragmatic approach based on an awareness of the constantly evolving world around us. This National Environmental Policy will serve as a guide in mapping out detailed action plans for environmental protection and sustainable development, and set the direction for the on-going implementation and enhancement of relevant laws and policies. The Project Proponent commits to comply and implement the project as per this policy requirement and to ensure the project set this policy up as a guiding principle for the project's environment policy.
National Sustainable Development Strategy for Myanmar, 2009	-	This MSDP provides the long-term strategic vision of the country including Sustainable Management of Natural Resources; Integrated Economic Development; and Sustainable Social Development. It proposes the preventive measures, besides traditional reactive policies, to address the emerging environmental issues, man - made disasters and the climate change. The Project Proponent commits to contribute to the achievement of the Strategy.
Myanmar Climate Change Policy, 2019	-	The purpose of the policy is to provide guidance on promoting climate change adaptation and mitigation actions, integrating these actions in national and sectoral priorities and taking decisions on enhancing business opportunities for sustainable, low carbon and climate resilient development in Myanmar. To achieve the purpose, Myanmar will be guided, inter alia, by the following guiding principles: a. Sustainable development - Develop sustainably to meet the needs of the present

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		without compromising the ability of future generations to meet their own needs, by ensuring the promotion of an economically, socially and environmentally sustainable future and a fair and equitable society; b. Precaution - Take cost-effective measures to avoid, minimise and protect from environmentally harmful consequences where there are threats of serious or irreversible damage even if there is a lack of full scientific certainty; c. Prevention - Take anticipatory action to prevent or minimise environmental damage before it occurs by avoiding, prohibiting or controlling threatening activities; d. Environmental integrity - Promote, protect and conserve the natural environment and recognise its complete and intrinsic value, whether tangible or non-tangible, economic or non-economic, to the natural, cultural and spiritual heritage of Myanmar; e. Shared responsibility and cooperation - Encourage, support and embrace the common and shared responsibility of all people for the protection, conservation, and equitable sharing of benefits and resources of the environment, and encourage wide cooperation across sectors and stakeholders at all levels, including the private sector. f. Inclusiveness - Engage all people at all levels in decision-making and action, by supporting and embracing their diverse social, economic and cultural perspectives, participation and contributions without discrimination, particularly with respect to gender, ethnicity and age, in order to equitably share the benefits and opportunities of climate change adaptation, mitigation and low-carbon, climate-resilient development; g. Good governance - Adopt transparent, participatory, and responsive processes to ensure that decision-making at all levels is inclusive, equitable, and accountable to all people in Myanmar, in accordance with the rule of law; h. Climate justice and equity - Promote and protect the rights of the people of Myanmar, in particular the poorest, most vulnerable and marginalised segments of society, including indigenous peoples, all ethnic groups, local communities, women, children, the elderly, and persons with disabilities to live in a healthy environment and a fair, equitable and sustainable society; i. Gender equality and women's empowerment - Promote and protect gender equality

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		and women's equal rights through strengthening gender-responsive climate change policy concerning adaptation, mitigation, finance, technology development and transfer and capacity building, and ensuring full and equal participation of women in decision-making. The Government of the Republic of the Union of Myanmar will take sector-relevant measures to implement this Policy and achieve its purpose by taking the comprehensive actions primarily in the six sectoral clusters. Among them, the following are related to the Project. **Healthy ecosystems;** a. Ensure that actions undertaken under Myanmar's national polices on environment, land use and forestry, including Myanmar's National Environmental Policy integrate climate change adaptation and mitigation considerations and are complementary to and/or support actions under this Policy; b. Promote sustainable natural resource management, preserve, conserve, and rehabilitate biodiversity and natural ecosystems in order to ensure the provision of ecosystem services, recognising their contribution to climate change adaptation and mitigation, the benefits they generate to the people and Myanmar's high dependence on the quality and availability of ecosystem services; c. Adopt environmentally sound technologies and good management practices, including ecosystem-based adaptation interventions, to improve and maintain the health and resilience of all ecosystems, including forest, water, land, coastal ecosystems and air quality in the face of future climate change impacts; d. Enhance greenhouse gas sinks and reservoirs, and promote the reduction of greenhouse gas emissions from deforestation and forest degradation through sustainable management of forests and land use planning, based on the best available science; **Low-carbon and resilient growth;** a. Ensure that actions undertaken under Myanmar's Green Economy Framework and energy policies integrate climate change adaptation and mitigation considerations,

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		are complementary to and/or support actions under this Policy, and encourage public-private partnerships to support a green economy; b. Ensure that the energy, transport and industry sectors, including infrastructure, are well-integrated among each other, reliable, sustainable and resilient to current and future climate change impacts, recognising that they are vital to Myanmar's economic growth; c. Decouple Myanmar's continued growth from increasing greenhouse gas emissions and contribute to the global climate change mitigation effort through sustainable, low-carbon energy, transport, industrial, and waste management systems, while ensuring that Myanmar's social and economic development needs are met; iv. Promote and prioritise sustainable and renewable energy sources and energy efficiency, in order to meet Myanmar's growing energy needs and ensure energy security in a low-carbon manner; d. Ensure equitable access to affordable, reliable, sustainable, and modern energy for all as a pathway to inclusive and sustainable development and eradicating poverty; e. Promote sustainable natural resource extraction through transparent and responsible investments which are consistent with climate change adaptation and mitigation priorities, while generating local employment and economic benefits and protecting the environment and public health; f. Ensure that urban and inter-city transportation networks and infrastructure are sustainable, low carbon and climate-resilient for all modes of transport, in particular for mass transit; g. Increase the productivity and resource-efficiency of the industrial sector, an important sector for Myanmar's economy, through low-carbon growth and by developing competitive and innovative green industries, recognising the relative importance of this sector for Myanmar's economy, including its potential for job creation

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		Resilient urban and rural settlements: a. Ensure that actions undertaken under Myanmar's national, sub-national, and local policies and plans on urban and rural settlements, including national building regulations, township and local development plans and land-use plans, integrate climate change adaptation and mitigation considerations and are complementary to and/or support actions under this Policy; b. Ensure that human settlements are planned and developed in a climate-resilient manner and incentivise low-carbon approaches, while promoting long-term inclusivity, liveability, economic development and a high quality of life in rural and urban areas, recognising the interdependencies between urban and rural areas and the potential impact of climate change on rural urban migration, food security, water supply and livelihoods; c. Ensure the active involvement of city, township and village stakeholders in identifying climate change challenges at local level, and devise plans, strategies and practical actions to adapt to climate change, mitigate its effects, and develop in a sustainable low carbon manner; d. Ensure that territorial spatial planning at regional, district, city, township and village level fully addresses current and future climate-related risks and opportunities, and regularly assess and mitigate these risks in a timely and equitable manner through inclusive and participatory assessment and planning processes which take into account and strengthen local knowledge and capacities, including in land-use planning, rural and urban planning and city or township specific disaster risk management plans and actions. e. The Project Proponent commits to comply and implement the project as per this policy requirement and to ensure the project set this policy up as a guiding principle for the project's environment policy.
Myanmar's National Biodiversity Strategy and Action Plan 2015-2020	-	The Proponent should be aware of the legislation. This is relevant to national government.
Myanmar Climate Change Strategy and Action Plan (MCCSAP)	-	The Proponent should be aware of the legislation. This is relevant to national government.
Waste Management Strategy and	-	The Project Proponent will follow the below guiding principles: ■ Zero Waste: Emphasise waste prevention as opposed to end of-pipe waste

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
Action Plan for Myanmar (2017-2030)		management. ■ Waste Hierarchy: Prioritises actions for waste management. This consists of the 3Rs including Reduce - reducing waste that is generated and which is directed to the landfill (including composting); Reuse - repairing products that can be repaired, or finding alternative uses for waste; and Recycle - returning waste with recoverable value for re-processing. ■ Resource Conservation: Promoting the most efficient use of resources, including resource recovery and waste avoidance. ■ Polluter-pays Principle: Those responsible for causing pollution or generating solid waste should pay the cost for dealing with the pollution, or managing the solid waste (collection and disposal) in order to maintain ecological health and diversity ■ Precautionary Principle: A lack of scientific data/information certainty should not be used as a reason for not acting to prevent serious or irreversible environmental damage or degradation. ■ Proximity Principle: Waste should be dealt with as close to the source of generation as possible. This reduces transportation costs, as well as risks of contamination of the environment during transport. ■ Consultation principle: The importance of all levels of Government consulting and working with people and organisations throughout the development and implementation of waste management strategies and action plans. ■ Shared Responsibility: Zero Waste is a shared responsibility and requires partnerships and collaborations between all sectors of government, industry, research institutions, NGO's, and the general community
Disaster Management Laws and Rules, 2013	Section 13 - 18	The Project Proponent commits: ■ To undertake functions after laying down the plan in accord with the natural disaster management plans in order to reduce damage and losses that are likely to be caused by disaster ■ To provide preparatory measures for natural disaster risk reduction before natural disaster ■ To provide preparatory measures to be organised before natural disaster in the area where is likely to strike natural disaster ■ To provide preventive measures to be carried out in the area where is likely to strike natural disaster before it happens ■ To carry out emergency response actions including search and rescue ■ To carry out rehabilitation and reconstruction activities after disaster
Yangon Region Earthquake Preparedness and Response Plan, 2019	-	The Project Proponent commits: ■ To Assess the physical vulnerability of infrastructure ■ Identify safe havens and areas susceptible to liquefaction and / or ground subsidence

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		■ Enact bylaws to enhance resilience ■ Train and equip ■ Evaluate and take corrective actions
National Land Use Policy, 2016	-	The Project Proponent commits to comply the key provisions: ■ To recognise and protect customary land tenure rights and procedures of the ethnic nationalities ■ To complete an EIA before considering a grant for individual land use right or lease of land; ■ To protect natural resources and ecological system that provide shared livelihood and socioeconomic development benefits to the surrounding communities; ■ To conduct, through public consultation, negotiation and participatory decision making if physical displacement is to be undertaken. It should be noted that the provisions of this policy serve as a set of rules that guide the government and are not legally binding as other laws, such as the Land Acquisition Act. However, one of the aims of this policy was to guide the development and enactment of a National Land Law and allow for harmonization and implementation of the existing laws related to the land.
National Energy Policy, 2014	Chapter 3, Section 4	The national energy policy aims to systematically explore the available energy resources of the county in order to supply the demand of the country and to export as value added products for surplus resources, thus ultimately targeting to sustainably improve the living standard of the country people. It mentions national energy policy, energy sector development plan, energy and electric power sector restructuring program, energy sector framework and strategy and work program. The Project Proponent shall commit to implement the project to support this policy.
The Constitution of the Republic of the Union of Myanmar, 2008	Section 37 (a)(b) , 45, 390	The Constitution of the Union of Myanmar is the supreme law of the country and has provisions regarding the protection of the environment in Myanmar. The Project Proponent commits to comply as these following three Articles in the Constitution provide a basis for legalising and institutionalising environmental health impact assessment and social impact assessment. There stipulates that: ■ The Union is the ultimate owner of all lands and all natural resources above and below the ground, above and beneath the water and in the atmosphere in the Union; The Union shall enact necessary law to supervise extraction and utilization of State owned natural resources by economics forces;

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		■ The Union shall protect and conserve natural environment; ■ Every citizen has the duty to assist the Union in carrying out the following matters: ○ preservation and safeguarding of cultural heritage; ○ environmental conservation; ○ striving for development of human resources; and ○ protection and preservation of public property.
ENVIRONMENTAL LAWS		
Environmental Conservation Law, 2012	Section 7(o), 14,15, 24, 29	The Project Proponent commits to comply with the following: ■ That MONREC has the right to manage a proponent to (1) provide compensation for environmental impact and contribute funds, (2) the need for prior permission from MONREC for businesses that have been categorized for potentially causing impact on the environment and (3) the right to issuing permit with terms and conditions relating to environmental conservation. ■ To treat, emit, discharge and deposit substances which cause pollution in the environment in accordance with stipulated environmental quality standards. That the owner or occupier of any business, material or place which causes a point source of pollution have to install or use an on-site facility or controlling equipment in order to monitor, control, manage, reduce or eliminate environmental pollution. If it is impracticable, it has to be arranged to dispose the wastes in accordance with environmentally sound methods. ■ To not violate any prohibition contained in the rules, notifications, orders, directives and procedures under the Environmental Conservation Law.
Environmental Conservation Rules, 2014	Section 69(a) (b)	The Project Proponent commits: ■ Not to emit, cause to emit, dispose, by any means, the pollutants and the hazardous waste or material (stipulated as such under the Law) at any place which may affect the public directly or indirectly. ■ Not to damage the ecosystem and the natural environment which is changing due to such system, except for carrying out with the permission of MONREC in the interest of the people.
Environmental Impact Assessment Procedure, 2015	Section 87, 102(a)(b),103, 104, 105, 106, 107, 108, 110, 113, 115, 117	The EIA Procedure sets out the procedures for completing an IEE, EIA and/or EMP in Myanmar. This includes information on project categorisation, responsibilities of project developers and ministries, EIA review, monitoring and auditing, amongst other issues. The Project Proponent commits to bear full legal and financial responsibility: ■ For their actions and omissions and those of its contractors, subcontractors, officers, employees, agents, representatives, and consultants employed, hired, or authorised by the Project acting for or on behalf of the Project, in carrying out work on the Project; and ■ To support programs for livelihood restoration and resettlement in consultation with the

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		PAPs, related government agencies, and organizations and other concerned persons for all Adverse Impacts until PAPs have achieved socio-economic stability at a level not lower than that in effect prior to the commencement of the Project. **For EMP**, the Project Proponent commits to: ■ implement the EMP, all Project commitments, and conditions, ensure that all contractors and subcontractors of the Project comply fully with all applicable Laws, the Rules, this Procedure, the EMP, Project commitments and conditions when providing services to the Project. ■ be responsible for, and fully and effectively implement the requirements and conditions set forth in ECC, applicable Laws, Rules, EIA Procedure and standards. ■ maintain the Project commitments and conditions when providing services to the Project and inform the Ministry with detailed information as to the propose project's potential adverse impacts. **For monitoring and reporting**, Project Proponent commits to: ■ notify and identify in writing to the Ministry, providing detailed information as to the proposed Project's potential Adverse Impacts. ■ engage in continuous, proactive, and comprehensive self-monitoring of the Project and activities related thereto, all Adverse Impacts, and compliance with applicable laws, Rules, EIA Procedure, standards, the ECC, and the EMP during all phases of the Project (pre-construction, construction, operation, decommissioning, closure and post-closure). ■ notify and identify in writing to the Ministry for any breaches of his obligations or other performance failures or violations of the ECC and EMP as soon as reasonably possible and in any event, in respect of any breach which would have a serious impact or where the urgent attention of the Ministry is or may be required, to undertake within not later than twenty-four (24) hours, and in all other cases within seven (7) days of the Project Proponent becoming aware of such incident. ■ submit monitoring reports to the Ministry not less frequently than every six (6) months, as provided in a schedule in the EMP, or periodically as prescribed by the Ministry. ■ make sure the monitoring report publicly available on the Project's website, at public meeting places (e.g. libraries, community halls) and at the Project offices within ten (10) days of completing a monitoring report as contemplated in Article 97 and Article 98 in accordance with the EMP schedule ■ submit a digital copy of a monitoring report within ten (10) days upon receiving the request from an organization or a person, via email or as may otherwise be agreed upon with the requestor for the request of any organisation or person. **For the purposes of monitoring and inspection, the event of emergency**, the Project Proponent commits to: ■ grant the ministry and/or its representatives, at any time during normal working hours, access to the Project's offices and to the Project site and any other location at which the

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		Project activities or activities related to the Project are performed; ■ grant, from time to time as and when the Ministry may reasonably require, the Ministry access to the Project's offices and to the Project site and any other location at which the Project activities or activities related to the Project are performed. ■ grant full and immediate access to the Ministry at any time as may be required by the Ministry in the event of an emergency, or where, in the opinion of the Ministry, there is or may exist a violation or risk of violation of the compliance by the Project with all applicable environmental and social requirements. Ensure that the Ministry's rights of access can extend to access by the Ministry to the Project's contractors and subcontractors. **For the Conditions and Revisions to Conditions prescribed in Environmental Compliance Certificate**, the Project Proponent commits to commence the implementation of the Project in accordance with the conditions attached to the ECC and including the EMP, within such time as may be prescribed by the Ministry upon receipt of the written approval from the relevant authority.
Environmental Quality (Emissions) Guidelines (EQEG), 2015	-	The Project Proponent commits to comply with the EQEG guidelines and its setting out for emission standards for air, noise, and effluent discharges for sector specific operations. The Project Proponent considers this emissions standards in its environment impact assessment and environmental management plan.
Development Committee Law, 1993	-	This law provides provisions relating to environmental sanitation, pollution of air and water, and public health. The Proponent needs to consider any respective township development committee laws. Within this remit, state and region governments have the authority to pass their own Development Affairs Laws as the guiding basis. Starting in late 2012, all 14 state and region governments developed their own Development Affairs Laws, which can effectively be considered their 'municipal laws'. Considering this common origin, the 14 state and region laws are quite similar in terms of basic structure and provisions. The only notable differences concern TDAC (Township Development Affairs Committee) structures and processes and fines and penalties.
Conservation of Water Resources and Rivers Law, 2006, amended in 2017	Section 10, 11(a), 19, 21, 24	The Project Proponent commits to comply prohibitions for the following activities: ■ No person shall anchor the vessels where vessels are prohibited from anchoring in the rivers and creeks. ■ No person shall dispose of engine oil, chemical, poisonous material and other materials which may cause environmental damage, or dispose of explosives from the bank or from a vessel which is plying, vessel which has berthed, anchored, stranded or sunk.

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		■ No one shall dispose of any substance into the river creek that may cause damage to waterway or change of watercourse from the bank or vessel which is plying, vessel which has berthed, anchored, stranded or sunk. ■ No one shall build lavatories unsuitable to the urban and rural community lifestyle in the bank area and watercourse area, and drill well or pond or dig earth without the permission of the Directorate. ■ No one shall violate the conditions relating to navigation of vessels in rivers and creeks prescribed by the Directorate for conservation of water resources, rivers and creeks, and violate the conditions prescribed by the Directorate so as not to cause water pollution and change of watercourse in rivers and creeks.
Conservation of Water Resources and River Rule, 2013, amended in 2015	Section 8(a), 9	The Project Proponent commits to comply the prohibitions; ■ Anyone who transport goods by the rivers shall take the preventive measures according to the international practices, so as not to flow in, seep out or fall the hazardous substances into the rivers. ■ As per section (9), the polluter or the organization commits to cause pollution to rivers or streams must pay to the department all the cost accrued for protection of water pollutions and conservations.
Protection of Biodiversity and Protected Areas Law, 2018	Section 39 (d) (e),	The Project Proponent commits to comply the stipulation that there may be charge with fine or imprisonment or both if guilty of: ■ polluting soil, water and air intentionally, ■ damaging the watercourse or poisoning water, ■ electrification, using chemical or explosive materials with a Protected Area; ■ Disposing or handling chemical waste and poisoning materials in the conservation area.
AQUATIC RESOURCES		
Marine Fisheries law,1990, amended 1993	Section 33, 34, 39, 40	The Project Proponent commits: ■ not to engage in inshore and offshore fishery without a licence. ■ not to dispose of living aquatic creatures or any material into the Myanmar Marine Fisheries Waters to cause pollution of water or to harass fishes and other marine organisms. ■ not to search for and collect marine products without a license.
The Law related to Aquaculture, 1989		The law aims at propagation of fish species, and the breeding of fish through different stages of growth in natural or artificial waters. The law states that no person shall obstruct navigation and flowing of water or pollute the water within the fisheries' waters or abet such acts.
The Myanmar Coastal and Inland Water	Section 33 and 34	This law is related to water transport service in coastal and inland water ways.

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
Transport Service License Law, 2015		The person who desires to carry out any water transport service or all shall apply to the relevant Regional Supervising Body to obtain service license in accord with the stipulations. If the person who obtains the service license issued by the Central Supervising Body or the Regional Supervising Body fails to comply with any rules, orders or directives made under this Law or any terms and conditions contained in service license, he may be made any of the following administrative actions: a. warning and causing to pay the stipulated fine; b. suspending the service license by stipulating the period; c. cancelling the service license. No one shall discharge the dangerous goods, hazardous chemical, oil or mixing oil or other material into the inland water to pollute water environment except emergency measure for safety of vessel which will be endangered or life of a person.
Inland Water Transport Law, 2017	-	The law is aimed for the implementation of safe and secure passengers and cargo transport in navigable waterways of rivers, creeks and along the coast in Myanmar; for implementation of the administrative and financial system of the inland Water Transport as a sustainable state-owned enterprise effectively and efficiently in accordance with the market economy system; The inland water transport board law (2014) is repealed by this law. This law is mainly intended for organizing, managing a state-owned enterprise.
Myanmar Port Authority Law, 2015	Section 19(a)(b), 23(b), (74), (78(b), 80(a,c), 83	The Project Proponent commits; ■ not to build or operate any kind of wharf, shipyard, dry dock and slip way without an operation license within a port limit. (section 74) ■ not to operate any business of supplying fuels and other requirements to vessels by a private vessel businessman without an operation licence permitted under this law; ■ not to carry out the business of towing, tugging, dredging or salvaging of a vessel by a private businessman without an operation licence permitted under this law; **Concerning water pollution or destruction to the environmental resources:** ■ not to cause oil spill or discharge of sludge from the petroleum tanker, oil tanker and chemical tanker navigated within a port limit, or from oil test wells, oil wells and oil pipelines or from collision or grounding of vessels; ■ not to discharge, dispose or cause to fall dangerous materials, toxic materials, garbage, sludge and waste from the vessels, above and underwater natural resource exploration rigs and structures within a port limit; ■ not to discharge, dispose or cause to fall other materials which cause obstacle to the

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		navigation, from the vessels, into a port; ■ not to fail to comply with any order or directive issued by the Myanmar Port Authority, by the person assigned duty by the Myanmar Port Authority or by the port conservator.
Myanmar Territorial Sea and Maritime Zones Law, 2017	Section 10(a) (b), 30, 31	The Proponent needs to comply with the following: Section (10) (a)The ships that carried the petroleum, ships that are operated by nuclear power or by mean of nuclear in any way , ships that carried the hazardous or toxic materials, shall pass the route being set aside by the State. (b) As per passage as by sub-section (a), the ship shall carry the necessary documents and comply the plans being assigned by the precautionary management by international agreements. Section (30) No one without the prior approval from the Government, shall move antiques objects and historical objects present on the sea bed in Contiguous Zone. Section (31) In the exclusive economic zone, no one, without the approval of Union government, is allowed to undertake; (a) Exploration (b) Drilling or Production of natural resources (c) Research (d) production or drilling with what purposes it may be (e) constructing, maintain or using artificial island; offshore base; infrastructure and related facilities,
Freshwater Fisheries Law, 1991	Section 40	The Project Proponent commits to comply the law by not causing harassment of fish and other aquatic organisms or pollution of the water in a freshwater fisheries waters.
TERRESTRIAL RESOURCES		
Forest Law, 2018	Section 12	The Forest Law empowers, to declare for the reserved forest for the maintaining a sustained yield of the forest produce, to manage the forest land. The Project Proponent commits to comply the stipulation of requiring prior approval from the Ministry if desirous to implement the development or economic project within a forest land and forest covered land. Whoever desirous to undertake such activities has also to comply the Environmental Conservation Law and the stipulations from respective Laws.
Forest Rules, 1995	Section 27, 30, 32	The Project Proponent commits to comply: ■ not to cut, mark, lop, perforate or damage by fire or any other means the teak and any reserved trees grown in the forest land and the land at the disposal of the government

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		except for doing so with permission. ■ not to fell, cut or dissect the trees which are not reserved trees for commercial purpose in the forest area and land at the disposal of the government, ■ not to make firewood or charcoal, without the permission of the State, division or district forest office.
Reserved Trees under Forest Law	-	Gives an overview of reserved trees under the Forest Law. The Proponent should not fell any of the reserved trees under this Law.
Protection of Wildlife and Protected Areas Rule, 1995	-	Provisions for the protection of biodiversity through the protection of natural habitats and wildlife. The new rule is in the draft. If the new rules is enacted, this will be repealed. This rules list a number of protected species in Myanmar.
SECTOR SPECIFIC AND INDUSTRY		
Myanmar Investment Law, 2016	Section (50)(d), (51), (65), 73	The stipulation to register the land lease contract at the office of Registry of Deeds in accordance with the Registration Act. To mention appointment, replacement, providing employment of staff and workers, ensuring to comply the entitlements and rights in the labour laws and rules, settling dispute regarding human rights issues. The stipulation: ■ To respect and comply with the customs, traditions, and traditional culture of the ethnic groups; ■ To inform the Commission if natural mineral resources or antique objects are found that are not related to the investment permitted; ■ Not to make any significant alteration of topography or elevation of the land on which is entitled to lease or to use, without the approval of the Commission; ■ To abide by applicable laws, rules, procedures and best standards practiced internationally for this investment so as not to cause damage, pollution, and loss to the natural and social environment and not to cause damage to cultural heritage; ■ To list and keep proper records of books of account and financial statement and necessary financial matters relating to the investments performed by permit or endorsement in accordance with internationally and locally recognised accounting standards; ■ To close and discontinue the investment only after the payment of compensation to employees in accordance with applicable laws for any breach of employment contracts, closure of investment, sale and transfer of investment, discontinuation of investment, or reduction of workforce; ■ To pay wages and salaries to employees in accordance with applicable laws, rules, procedures, directive and so forth during the period of suspension of investment for a credible reason;

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		■ To pay compensation and indemnification in accordance with applicable laws to the relevant employee or his successor for injury, disability, disease or death due to the work; ■ To supervise foreign experts, supervisors and their families, who employ in their investment, to abide by the applicable laws, rules, orders and directives, and the culture and traditions of Myanmar; ■ To respect and comply with the labour laws; ■ To have the right to sue and to be sued in accordance with the laws; ■ To pay effective compensation for loss incurred to the victim, if there are damage to the natural environment and socioeconomic losses caused by logging or extraction of natural resources which are not related to the scope of the permissible investment, except from carrying out the activities required to conduct investment in a permit or an endorsement; ■ To allow the Commission to inspect in any places, when the Commission informs the prior notice to inspect the investment; ■ To take in advance permit or endorsement of the Commission for the investments which need to obtain prior approval under the Environmental Conservation Law and the procedures of environmental impact assessment, before undertaking the assessment, and shall submit the situation of environmental and social impact assessment to the Commission along the period of activities of the investments which obtained permit or endorsement of the Commission. The stipulation: The investor shall insure the types of insurance stipulated in the provision of the rules at any insurance enterprise which is entitled to carry out insurance business within the Union.
Myanmar Investment Rules, 2017	Section 202, 203, 206, 212,	■ To comply with all terms and conditions in the permit and other applicable laws when the investment is carried out. ■ To fully assist while negotiating with the Authority for settling the grievances of the local community that have been effected due to Investments. ■ To appoint expert foreigner as senior manager, technical and operational expert or advisor according to subsection (a) of the section 51 of the Law. ■ To obtain the permit or tax exemption or relief to insure the relevant insurance out of the following types of the insurance at any insurance business entitled to carry out insurance business within the Union based on the nature of the business: Property and Business Interruption Insurance; Engineering Insurance; Professional Liability Insurance; Bodily Injury Insurance; Marine Insurance; or Workmen Compensation Insurance; Life Insurance; Fire Insurance.
The Import and Export Law, 2012	Section 7	The Project Proponent, as a license holder, commits to comply not to violate the conditions contained in the license.

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
Myanmar Insurance Law, 1993 (amended in 2015)	Section 15, 16, 18, 19	■ Owners of motor vehicles shall effect compulsory Third Party Liability Insurance with the Myanma Insurance. ■ An entrepreneur or an organization operating an enterprise which may cause loss to State-owned property or which may cause damage to the life and property of the public or which may pollution to the environment shall effect compulsory General Liability Insurance with the Myanma Insurance. ■ State Organizations and enterprises which have fifty percent and above of the capital investment subscribed by the State, shall effect insurance only with the Myanma Insurance, if the class of Insurance they desire to effect is of the class which is accepted by the Myanma Insurance ■ Economic Organizations which have been formed under a permit under the Union of Myanma Foreign investment Law shall effect only with the Myanma Insurance the classes of insurance which the Myanma Insurance determines from time to time. However from amongst the classes of insurance which the said Economic Organizations are to effect the Ministry of Finance and Revenue may exempt from effecting insurance of any class or more than one class, in the interest of the State.
Myanmar Companies Law, 2017	Section 43(a), 49	The Project Proponent commits: ■ To register as per requirements for an overseas corporation. ■ To comply as per requirements for the registration of overseas corporation
Myanmar Engineering Council Rules (2013)	Section 20, 24, 25, 37, 31 (a)	The Project Proponent shall acknowledge: ■ Engineering Discipline Accreditation Working Committee- The executive committee shall form the Working Committee with a member of the executive committee as chairman and the Council Members not more than 15 as members and shall assign the duties to the Committee ■ Working Committee for Sustainable Engineering Teaching Program-The executive committee shall form this Working Committee with an executive member as a chairman and the Council Members not more thanl5 as members and shall assign the duties to the Committee ■ Working Committee for Accreditation and Assessment of Engineering Companies and Organizations- The executive committee shall form the Working Committee with an executive member as a chairman and the Council Members not more than 15 as members and shall assign the duties to the Committee. ■ Working Committee Meeting - The coordination meetings of the Working Committee shall be convened as and when necessary.
Petroleum and Petroleum Product Law, 2017	Section 7(a) (c),8(a)(c)(e)(f)(j)(k), 9(a)(d), 10(a)(b)(d), 13, 32, 33	The Ministry of Commerce shall carry out, among others, the following functions relating to any Petroleum and Petroleum product: ■ issuing licences relating to import or export;

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		■ determining procedures, and conditions relating to import or export; The Ministry shall carry out, among others, the following functions relating to any Petroleum and Petroleum product: ■ issuing licences relating to refining, transit, transport by pipeline, sale and distribution, inspection, and testing; issuing joint licence or compound licence for carrying out more than a type of business activities; ■ determining procedures and conditions, relating to refining, transit, transport by pipeline, sale and distribution, inspection and testing; ■ determining standard and quality of receptacles for transport, and procedures and conditions for the pipelines; ■ determining and prohibiting portion and volume of toxic chemicals and metal chemicals that may damage the machineries, to be contain in any petroleum and petroleum product, which do not contain in the prohibition and restrictions under the existing laws; ■ determining procedures and conditions to have correctness in standard, quality and measurement; ■ determining procedures and conditions necessary to appropriately supervise petroleum and petroleum product business activities; The Ministry of Transport and Communications shall carry out, among others, the following functions relating to any petroleum and petroleum product; ■ issuing licence to vehicles, vessels and barges that carry any petroleum and petroleum product; ■ taking action, as necessary, in accordance with the existing laws if it occurs spill or accident in carrying out import, export, transport, and sale and distribution of petroleum and petroleum product by water; The Project Proponent commits to comply by displaying a danger warning sign in the shape of easily visible words or signs on a pipeline which is used for the transportation of petroleum or petroleum products, receiving the inspection of the petroleum or petroleum products business or container or transportation vehicle, machine, watercraft and pipeline by an authorized officer or organization. The Project Proponent commits also to comply to immediately notify and give the necessary information of the accident if there is an explosion or fire caused by any types of petroleum and petroleum products business or there is potential cause for a fire near the storage place of petroleum and petroleum products.
Prevention from Danger of Hazardous Chemical and Associated Materials Rule (notification No 85/2015-2016)	Section 61 (a)	For organizations and licence holders who store the chemical and related substances to abide by the following facts for safety: ■ installing the fire protection system in building to be stored in accordance with prescribed

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		provisions of the Department of Fire Brigade and being the building which is constructed to correspond for storing the chemical and related substances; ■ sticking the warning sign according to hazard class, and keeping the safety equipment at the stored places; ■ storing only after checking certainly to the chemical and related substances which are kept completely with the pictogram, and packing system by the importers and possessors; Regarding the safety, the Project Proponent commits to: ■ use only the registered restricted or conditional chemical and related substances; ■ not use the unregistered, without labelled, unknown, damaged or expired chemical and related substances.
Prevention from Danger of Hazardous Chemical and Associated Materials Law	Section 8, 13, 15, 16, 17, 20, 22, 23, 27	■ For Any person, who wants to do the business of chemical and associated materials, to apply to the central body for the acquisition of the license, attached with the management plan for the environmental conservation in accord with the stipulations". ■ For License holder to apply to the central supervising body in accord with the stipulation for the relevant chemicals and associated materials using for his chemicals and associated materials business" for a certificate. ■ For the registered certificate holder to abide by the regulations contained in the registered certificate and shall follow the order and directives issued from time to time by the central supervising body". ■ For the requirements: ○ before works, license holder to be inspected by the relevant supervising and inspection team for safety and machinery/equipment check and ○ The persons who are discharging the duty to be asked to attend foreign training or preventative trainings conducted by government departments and organizations. ■ For License holders to; ○ follow the license regulations, ○ follow directives on safe handling and shall ask workers to strictly follow ○ shall provide necessary safety equipment and issue free personal protective equipment to workers, ○ provide training in occupational safety ○ determine the hazard to the environment, people and animals ○ provide fit for work medical check-up and keep records ○ send permission letter to Department of Township Administration if the chemicals and associated material are permitted to store ○ acquire in advance guidance and agreement from fire service department if using inflammable materials or explosives ○ transport only the permitted amount of chemicals in accordance with prescriptive stipulations

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		○ obtain approval of central supervising body if transporting chemical and associated material from the permitted region to any other region ○ abide and operate in accordance with related environmental laws to avoid impacts and damage to the environment. ■ For the license holder to have insurance in accordance with stipulations in case of compensation is required for losses related to people, animals and environment. ■ For the registered certificate holder shall apply again for using chemical which are not in the registered list. ■ For the license holder to: ○ classify the hazard level of chemicals and related substances in advance ○ show Material Safety Data Sheet and warning signage ○ provide safety equipment, personal protective equipment and training on their use ○ possess, transport, store, use and discharge chemicals and related materials in accordance with stipulations, ○ not import or export chemicals and related materials banned by the central supervising board.
The Water Power Act, 1927	Section 3	Prohibitions on the pollution of public water; and provisions for the use of water in the pursuit of energy production and mining in a manner which does not harm land, watersheds or "localities". This law states that there is a license requirement for the use of public water for mining activity or energy; ■ When rules made under this Act prescribe licenses for the use of any public water for obtaining energy or for mining operations, no person shall use, or attempt to use, any such water for any such purpose, or pollute or obstruct the flow of any such water, or discharge therein any mining refuse, except under and in accordance with the terms of such license or any grant, lease, or license from the President of the Union of, or in respect of, any land.
Factories Act, 1951 (amended in 2016)	Chapter 3, 4 and 5	This law lays down the provisions for the proper disposal of waste and effluents in factories; treatment of waste water; regulations for health and cleanliness in factories, and the prevention of hazards. ■ For Health (Chapter 3): to arrange clean and free from any odors, solid waste and any seepage, to provide temperate and good ventilations, to well manage the particulate matters and emissions, to set up a moisture level that may be comfortable, not to populate in the factory, to get enough light, to provide clean drinking water, to provide toilets, ■ For Safety (Chapter 4): to arrange protection for machinery, to care and assign duty to operate the running machines, to obey the direction for appointing youth in high risk machines, to arrange precautionary measure relating to emission that may harm, to prepare plan for fire, to maintain, re-build, re-assemble the factory and machine for the

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		safety. ■ For worker accommodation (Chapter 5), to support first aid kids, to create a better environment for living, shops for worker, rest rooms, and nursery.
Industrial Zone Law, 2020	Chapter 7, 9, 10,11, 12 and 13	The Project Proponent commits to make sure that include: ■ 60-70% Industrial Area ■ 1-5% Commercial Area ■ 20-25% Public Utilities and Assistance Area ■ 9-10% Green Belt Area The Project Proponent (the Developer) shall: ■ obtain approval from the Central Committee through the Regional Committee for the proposal to implement development work; ■ shall sublease to other investors and building infrastructure; ■ shall implement maintenance work under the supervision of the Management Committee; ■ shall complete construction within the proposed period; ■ shall comply with the relevant government if it provides a service related to infrastructure beyond the border of the Industrial Zone; ■ shall comply with the relevant laws and regulations when it comes to environmental protection, occupational health and safety and fire hazards; ■ shall pay all the payable on one time or in instalment for land use right and the permit for doing business, as per the contract signed with the Regional Committee. ■ shall comply with Union Tax Law (2019) and other related regulations when establishing the Bonded Warehouse System; ■ shall implement in accordance with the environmental conservation law during the establishing of an industrial business; ■ shall arrange and include facilities for the storage, treatment and disposal of waste products; ■ shall create and implement pollution control and energy management measures and annual environmental conservation plan under the supervision of the Regional Committee; ■ shall pay the fees as specified by the Management Committee for the safe collective storage and disposal of waste products and ■ shall install their own arrangement if the collective system of storage and disposal of waste products cannot be implemented. The Project Proponent (the Investor) shall: ■ shall apply to the Regional Committee through the Management Committee to implement the business; ■ shall complete construction within the proposed period; ■ shall register with relevant departments;

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		■ shall report the implementation status to the Management Committee; ■ shall comply with the laws related to the hazardous raw materials, environment conservation, occupation safety and health care matters; ■ shall notify to the relevant departments and Management Committee for the transferring of the whole or part of the share of his/her business, closure or liquidation of the business and report the employment status of both international and domestic workers to the Management Committee; ■ shall notified the Committee if underground natural resources or unique treasure are found; ■ shall pay income tax as per the law whenever the investor has to pay the foreigner who has the right to make investment in the industrial zone but not staying in Myanmar, for the intellectual property; ■ shall withhold tax at the rates specified by the Income Tax law if the investor is a foreigner who permitted the intellectual property; and ■ shall collect and pay the income tax for the employees as per the Income Tax Law, regardless of local or international.
Control of Smoking and Consumption of Tobacco Product Law, 2006	Section 6 (a) (b) (j) (l), Section 9 (a) (b) (c)	The Project Proponent commits: ■ To comply with the following non-smoking areas; ○ Hospital buildings, offices, compounds and other buildings in the compound except staff houses and apartments in the hospital compound; ○ Medical treatment centres and clinics; ○ Elevators and escalators; ○ Air-conditioned public room ■ To comply with the following duties ○ To keep the caption and mark referring that it is a non-smoking area at the place mentioned in section 6 in accordance with the stipulations. ○ Arrange the specific place where smoking is allowed as mentioned in section 7, and keep the caption and mark also referring that it is a specific place where smoking is allowed, in accordance with the stipulations. ○ To accept the inspection when the supervisory body comes to the place for which he is responsible
The Law amending the Narcotic Drugs and Psychotropic Substances Law, 2018	-	The Proponent should be aware of this guidelines in terms of employment.
Myanmar Fire Force Law, 2015	Section 25	The Project Proponent commits: ■ To obtain the opinion of the Fire Services Department for the purpose of fire precaution and prevention, when laying down plans for construction for town, village and downtown

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		or village development plans. ■ To comply the stipulations for the factory, workshop, highway bus, airport, jetty, hotel, motel, guest house, collective-owned building, market, work-site or business exposed to fire hazard of the owner or manager; ■ Not fail to form a reserve fire brigade ■ Not fail to provide materials and apparatuses for fire safety; in conformity with the directive of the Fire Services Department.
Motor Vehicle Law, 2015	Chapter 1, 2(v)	The Project Proponent commits to comply the stipulations: ■ for reducing environmental pollution caused by motor vehicles ■ for the right of the Department to issue directives, the standards, guidelines for the purposes of importing, manufacturing, assembling, maintaining to be safe in accident and environment conservation. ■ To take actions to conserve the green environment and the reduction in pollution of air, water, land and noises caused by motor vehicles.
Yangon City Development Committee Law, 2014 (amended in 2018)	-	It has stated that the committee has the right to: ■ To corporate for the inspection with the concerning authority and ■ To stipulate orders for the carriage, storage of chemical and related substances for not harming to public health and life ■ To manage the waste regarding for the hazardous. There it has been prohibited for disposing chemical and its related substances in areas, which are not being allowed in the City Development area and mentioned offenses and penalties. The Project Proponent commits to comply the stipulations and undertake the necessary proceeding as per this law and notification issued by the committee.
The Electricity Law, 2014	Section 3(e) (f) (h), 8(a), 11, 14, 22(a), 30, 37, 41, 42, 44, 45, 48	The Project Proponent commits to comply with the stipulations: ■ That with the approval of the Union Government, the Ministry shall have the right to carry out businesses related to the large scale electric power exploration, construction, generation, transmission, distribution, trading and exchanging which the Union have the right to manage; ■ For carrying out the electrical business, the Ministry, relevant Region or State Government and Leading Bodies of Self-Administered Division or Self-Administered Zones have the right to obtain the required amount of land to use in accord with the existing laws; ■ For the person from local or foreign who desires to invest and operate in any electrical business to apply to obtain the permit to the authorized person to issue permit in accord with the stipulations.

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		■ For the right of the Ministry allow or refuse an application after scrutinizing, if the permit holder desires to sell electric power to the national grid. ■ For the permit holder to be liable for causing any damage or loss due to the negligence by him to any person or entity. ■ For the right of Ministry to inspect of electrical business and electrical equipment. ■ For the right of Ministry to issue required standardizations and techniques of inspection for electrical business. ■ That the Ministry has the right to determine regarding the specification of rates of electric power fee and service charges from the users of electric power the appropriate rates of respective region with the approval of the Union Government. Such rates of electric power fee may be adjusted from time to time. ■ For any person not to operate the electrical business without permit. ■ For permit holder not to operate any other electrical business except the business contained in the permit. ■ For any person not to operate the importing, manufacturing in the country, exporting, distributing and selling of the electrical equipment which are not consistent with the prescribed norm and standard.
The Boiler Law, 2015	Article 5+6+7+12, 12(a) , 14(a), 15, 18, 19(a), 19(b), 19(c) +14(b), 21 , 24(a), 24(b), 26, 29(b) + 31, 40+38	The Project Proponent commits to comply with the stipulations: ■ to acquire boilers which are consistent with Myanmar standards or international standards; ■ not to be damaged and lost the State and public by preventing the risk of boiler accident; ■ to use the boiler in accord with Myanmar standards or international standards in the Union; ■ to advance the boiler technologies and to develop competent persons who are able to manufacture, repair and maintain boilers; ■ to enable to use the boiler with full capacity by using fuel energy effectively; ■ to enable to use the boilers for maximum span of life and to reduce the impact on natural social health environment due to such use of boiler.
CULTURAL HERITAGE		
Protection and Preservation of Cultural Heritage Regions Law, 2019	Section 46	Section 46. For the National interest, concerning the exploration for oil, natural gas, gemstones and minerals: (a) It is prohibited to undertake in the area being confirmed for world cultural heritage region and national cultural heritage region. (b) Apart from the region prescribed in sub-section (a), it can undertake in other cultural heritage region with the approval of government. (c) In undertaking in a region as per sub-section(b), it needs to resettle cultural heritage

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		object (monuments) that can be impacted in accordance with the international good practice.
Protection and Preservation of Antique Objects Law, 2015	Section 12, 13	For person who finds any object which has no owner or custodian, needs to inform the relevant Ward or village-tract administrator if he knows or it seems reasonable to assume that the said object is an antique object. For a procedure to inform and the responsibility to inspect whether it is a real ancient monument or not and keep or cause to protect as may be necessary in accordance with the stipulation
Protection and Preservation of Ancient Monuments Law, 2015	Section 12, 13, 15, 20	Project Proponent commits to comply with the stipulations: ■ For a person who finds an ancient monument over one hundred years old under the water or above ground to promptly inform the relevant Ward or Village-Tract Administrative Office. ■ For procedure to inform and the responsibility to inspect whether it is a real ancient monument or not and keep or cause to protect as may be necessary in accordance with the stipulation. To apply prior permission from the Department before implementing extending towns, wards and villages; ■ constructing or extending or repairing new buildings including hotels, factories and residential buildings or fencing or extending a fence; ■ digging to search petroleum, natural gas, gem or mineral, piping petroleum and natural gas, constructing factories, connecting national grid, constructing communication tower, constructing or extending infrastructures such as road, bridge, airfield, irrigation and embankment; ■ connecting underground electric cable, communication cable and other underground works; ■ digging or extending wells, lakes, cannels and ponds; ■ gold sieving, digging, burning bricks, digging well, lake, creek, ditch, gully, pit digging, refilling, levelling, mining, quarry, gravel digging and unearth sand, removing the mounds and hills which can damage the physical feature of the land; ■ placing and fencing ancient monuments in a private compound and area; ■ constructing a building which is not consistent with the terms and conditions stipulated according to the region by the Ministry near and at the surrounding of an ancient monument. For prohibitions not to damage to an ancient monuments within the specified area of an ancient monument without a written prior permission by carrying out: ■ taking photo, video, film or copying and modelling an ancient monument stipulated as a

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		listed ancient monument for commercial purposes; ■ using machines which causes vibration within the specified place of an ancient monument and running various types of vehicles; ■ cultivating, gardening, breeding, fencing by blocking nearby an ancient monument or doing any other act which can affect an ancient monument; ■ emission of gas such as hot-air balloon which can affect an ancient monument; ■ landing and taking off and, flying airplane and helicopter which can directly or indirectly affect an ancient monument; ■ discarding chemical substance and rubbish which can affect an ancient monument and the environment.
PUBLIC HEALTH		
Public Health Law, 1972	Section 3, 5	The Project Proponent commits to cooperate with the authorized person or organization in line with the stipulations: ■ To abide by any instruction or stipulation for public health. ■ To accept any inspection, anytime, anywhere if it is needed.
Protection and Prevention of Communicable Disease Law, 1995	Section 3, 4(a), 9, 11	This law is for the Department of Health to carry out immunisations and health education activities related to communicable diseases. ■ The public shall abide by the measures undertaken by the Department of Health in case when a Principal Epidemic Disease or a Notifiable Disease occurs. ■ For all responsible persons, to prepare report for an outbreak of a communicable disease to the nearest Health Officer. ■ For Health Officer, to undertake investigations and medical examinations to prevent the control the spread of Principal Epidemic Disease.
LABOUR LAW		
Labour Organisation Law, 2011	Section 17, 18, 19, 20, 21, 22	This Law was enacted, to protect the rights of the workers, to have good relations among the workers or between the employer and the worker, and to enable to form and carry out the labour organizations systematically and independently. ■ That Labour Organisations are free to organise and negotiate workers' rights when not meeting labour laws. ■ That Labour Organisations may demand re-appointment of worker if cause of dismissal is related to labour organisation membership or activities or not conform to labour laws. ■ That Labour Organisations have the right to send representatives to conciliation tribunals. ■ That Labour Organisations have the right to participate and discuss workers' rights and interests with government and employers

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		■ That Labour Organisation have the right to participate in collective bargaining in accordance with labour laws. ■ That Labour Organisation may take collective actions in accordance with the relevant procedures, regulations and law.
Minimum Wages Law, 2013	Section 12 (a-e), 13 (a-g)	This Law was enacted to meet with the essential needs of the workers, and their families, who are working at the commercial, production and service, agricultural and livestock breeding businesses and with the purpose of increasing the capacity of the workers and for the development of competitiveness. ■ For the employer not to pay wage less than the minimum wage stipulated, do not have the right to deduct any other wage ■ For the employer to inform rates of minimum wage relating to the business, allow the entry and inspection of the inspection officer, give the sick worker holiday for medical treatment in accord with stipulation and give holiday for the matter of funeral of the family of worker without deducting from the minimum wage.
Employment and Skill Development Law, 2013	Section 5, 14, 15, 30	For the agreement, training and probation period as prescribed in: ■ If the employer has appointed the employee to work for an employment, the employment agreement shall be made within 30 days. But it shall not be related with government department and organization for a permanent employment. ■ If pre training period and probation period are stipulated before the appointment the said trainee shall not be related with the stipulation of sub-section (1). For particulars to be included in the employment agreement: ○ the type of employment; ○ the probation period; ○ wage, salary; ○ location of the employment; ○ the term of the agreement; ○ working hour; ○ day off, holiday and leave; ○ overtime; ○ meal arrangement during the work hour; ○ accommodation; ○ medical treatment; ○ ferry arrangement to worksite and travelling; ○ regulations to be followed by the employees; ○ if the employee is sent to attend the training, the limited time agreed by the employee to continue to work after attending the training; ○ resigning and termination of service; ○ termination of agreement;

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		○ the obligations in accord with the stipulation of the agreement; ○ the cancellation of employment agreement mutually made between employer and employee; ○ other matters; ○ specifying the regulation of the agreement, amending and supplementing; ○ Miscellaneous. ■ For the worksite regulations contained in the employment agreement to be in compliance with any existing law and the benefits of the employee not to be less than those of the any existing law. ■ For the employment agreement, the Ministry can issue the notification for paying the stipulated compensation to the employee by the employer, if the work is completed earlier than the stipulated period or the whole work or any part of it have to be terminated due to unexpected condition or the work has to be terminated due to various conditions. ■ For the employment agreement made under sub-section (a) to be related with daily wage workers, piece rate workers who are appointed temporarily in the government department and organization. ■ For the worksite regulations and benefits contained in the employment agreement mutually made between the employer and employee or among the employees to be amended as necessary, in accord with the existing law. ■ For the employer to send a copy of the employment agreement made between the employer and employee, to the relevant employment and labour exchange office within the stipulated period and to get the approval of it. ■ For the employment agreement made before the enforcement of this law has to be confirmed up to the end of the term of the original agreement. ■ To carry out the training program in accordance with the work requirement in line with the policy of the skill development team to develop the skill relating to the employment for the workers who are proposed to appoint and working at present. ■ To carry out the training for each work or compounding the work individually or group-wise by opening on-job training, training systematically at worksite, sending outside training and training by using information technology system, for arranging the training program to enhance the employment skill of the workers; ■ For appointing the youths of 16 years as apprentices, to arrange the training for technology relating to the employment systematically in accord with the regulations prescribed by the skill development team. ■ For the employer of the industry and service business to put in to the fund monthly as put in fees without fail for the total wages of the subordinates and the supervisors' salary for not less than 0.5%; ■ To put in money paid under the previous sub-section not to be deducted from the wage and salary of the employees.

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Settlement of Labour Dispute Law, 2012	Section 38, 39, 40, 51	The Project Proponent commits to comply: ■ Not to fail to negotiate and coordinate in respect of a complaint within the prescribed period without sufficient cause ■ Not to alter the conditions of service of workers involved in disputes prior to investigation by tribunals ■ For no party to strike or lock-out without negotiation, conciliation and arbitration by Arbitration Body. For the employer if commits acts without sufficient cause, to be liable to pay full compensation to workers as determined by Arbitration Body or Tribunal.
Workmen Compensation Act, 1923 (amended in 1955, 1957, 2005)	Section 3	The Project Proponent commits to comply with the stipulations: ■ For the payment by certain classes of employers to their workmen of compensation for injury by accident. ■ For the liability for compensation of employer's, amount of compensation, compensation to be paid when due and penalty for default, method of calculating wages, review, commutation of half-monthly payments, payment of a lump sum amount, distribution of compensation, compensation not to be assigned, attached or charged, notice and claim, power to require from employers statements regarding fatal accidents, reports of fatal accidents and serious bodily injuries, medical examination, contracting, remedies of employer against stranger, compensation to be first charge on assets transferred by employer, special provisions relating to masters and seamen. ■ For any updating for revising the monetary amount as per the amendment law.
Payment of Wages Law, 2016	Section 3, 4, 5, 7 (ii), 8, 9, 10, 14	That salaries are to be paid at the end of the month or, depending on the size of the employing enterprise, between 5-10 days before the end of the month. The employer is permitted and required to withhold income tax and social security payments. Other deductions, e.g. for absence, may only be withheld in accordance with the law. For the employer ■ to pay for salary either Myanmar Kyats or Foreign Cash permitted by National Bank of Myanmar. When delivery the salary ■ If the employer needs to pay the other opportunities or advantages, he can pay cash together with other materials according employee's attitude. ■ For finishing the contract, employer need to pay the salary (not more than one month) to employees. For the permanent worker, need to pay per monthly. If more than 100 employees, need to pay within the 5 days from the end of month. If fire the employees, need to pay salary within two days after fire. When employee dies due to the accident, need to pay money as an insurance to employee's family within two days. ■ For the employer to report to the Department with evidence of payment at later date agreed with the employee if the employer has difficulties to pay wages on time because of significant events (e.g. natural disaster).

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		■ For the employer to deduct expense which are allowance for accommodation and ferry service arranged by the employer, meal allowance, electricity charges, water service charges and income taxes liable to be paid by workers and cash paid in excess under mistake, which are not included in the expression of wages under this Law and not to deduct from the wages of the worker except the deduction as per Section 7. ■ For any deducting from the salary due to the employees' absence, the total cut salary not to be more than 50 % of his salary. ■ For overtime work, to allow the presiding overtime rate as set by the Law.
Leaves and Holidays Act, 1951	Section 4	■ For employee to be granted to pay public holidays as announced by the Government in the Myanmar Gazette. On average, Myanmar has 26 public holidays per year, depending on the date of the variable holidays. ■ For additional rules to apply in accordance with other laws, such as the Social Security Law (2012) for employees contributing to the Social Security Fund. ■ To grant earned leave with average wages or average pay for a period of ten consecutive days by his employer during the subsequent period of twelve months to every employee who has completed a period of twelve months continuous service.
Social Security Law, 2012	Section 11 (a)(b), 15(a), 16 (a), 18(b), 48(a), 49(a)(b), 51(a)(b), 53(a), 54(a)(b), 75	For compulsory registration for social security system and benefits, the following establishments can be applied if they employ minimum number of workers and above determined by the Ministry of Labour in co-ordination with the Social Security Board: ■ production industries doing business whether or not they utilize mechanical power or a certain kind of power, works of production, repairing or services, or engineering works, mills, warehouses, establishments; ■ Government departments, Government organizations and regional administrative organizations doing business; ■ development organizations; ■ financial organizations, ■ companies, associations, organizations and their subordinate departments and branch offices doing business; ■ shops, commercial establishments, public entertaining establishments; ■ Government departments and Government organizations doing business or transport businesses owned by regional administrative body, and transport businesses carried out with the permission of such department, body or in joint venture with such department or body; ■ construction works carried out for a period of one year and above under employment agreement; ■ works carried out with foreign investment or citizen investment or joint ventured businesses; ■ works relating to mining and gemstone contained in any existing law;

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		■ works relating to petroleum and natural gas contained in any existing law; ■ ports and out-ports contained in any existing law; ■ works and organizations carried out with freight handling workers; ■ Ministry of Labour and its subordinate departments and organizations; Establishments determined by the Ministry of Labour from time to time, in co-ordination with the Social Security Board and with the approval of the Union Government; that they shall be applied with the provisions of compulsory registration for Social Security System and benefits contained in this Law. For provisions of compulsory registration under sub-section (a) to continue to be applied by this Law even though any of the following situations occurs if it continues to carry out such work: ■ carrying out work by employing under stipulated minimum number of workers but more than one worker; ■ changing the employer or changing the type of business. ■ For the Social security fund, to include the funds for health and social care, family assistant, invalidity benefit, superannuation benefit and survivors' benefit, unemployment benefit, other social security fund for social security system of compulsory registration and contribution stipulated by the Ministry of labour, other social security fund and social security housing plan fund. ■ For arranging insurance for the workers to enable to enjoy social security benefits by contributing to the social security fund. ■ For the employer to deduct contributions to be paid by worker from his wages together with contribution to be paid by him and pay to the social security fund and in such case he can incur the expense. ■ For the employer to effect insurance by registering for employment injury benefit insurance system contained in section 45 at the relevant township social security office and pay contribution to employment injury benefit fund in accord with stipulations in order that workers applied to provisions of compulsory registration may obtain the employment injury benefits. ■ For the inapplicability to the Workmen's compensation act. ■ For the employer (a) to pay contribution monthly to Employment Injury Benefit Fund at the rates stipulated under section 50. Moreover he shall also bear the expenses for paying as such; (b) to pay defaulting fee stipulated under section 88, in addition to the contribution if fails to contribute after effecting insurance for employment injury benefit. ■ For the employers and workers (a) to co-ordinate with the Social Security Board or insurance agency in respect of keeping plans for safety and health in order to prevent employment injury, contracting disease and decease owing to occupation and in addition to safety and educational work of the workers and accident at the establishment; ■ For the employer (a) to report to the relevant township social security office immediately

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		if a serious employment accident occurs to his insured worker. There shall not be any delay without sufficient cause to report as such. (b) A team of officers and other staff who inspect the establishments, if it is found out the employment injury, death, and contracting disease, shall report to the relevant township social security office in accord with the stipulations. ■ For keeping records of work and lists.
Occupational Safety and Health Law, 2019	Section 12(a) (b), 16, 17, 18, 19, 20, 21, 22, 23, 26, 27, 34, 36	The Project Proponent commits: ■ to appoint the occupational safety and health responsible person in order to closely inspect for the safe and health of workers as per types of business defined by Ministry of Labour, Immigration and Population.. ■ to organize the Safety and Health Committee in accordance with the stipulations of the Ministry including the equal numbers of representative from employees and employers for the purposes to implementing the working environment, which is in safe and healthy for the business where the number of workers are not less than the number stipulated by the Ministry. In this case, the committee will be formed for the considerations. ■ to support the inspection officer responsible for occupational safety and health and comply the instructions. ■ to comply and care the right and responsibilities of the inspection officer as per section 17, 18, 19, 20, 21, 22 and 23) ■ to arrange properly, manage as per requirement for accessing potential hazard, provide the physicians, supports the personnel protective covering, material in free. ■ not to dismiss or demote for the complains concerning the potential health and occupational hazards, undertaking the duty for the occupational health and safety committee, not working for the unsafe in health ■ to undertake to inform the heavy accident arising, to submit the report of approved physicians and inform to the department in case of infected the occupation disease or toxic due to the materials use or operations process. ■ to care the responsibilities of inspection officers and prohibitions for not removing, adding, altering without the approval of inspection officer for the occupational accident outbreak
NATIONAL RACE		
Law protecting Ethnic Right, 2015	Section 5	For the Equal right between the Ethnics living in Myanmar. It enacted that if an ethnic loose the right, he can complain to the Regional or State Government to get the equal chance and find the equal right. That project matters shall be informed, coordinated and undertaken in consultation with ethnic groups if projects are in areas with ethnic groups.

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		The Project Proponent also commits to comply the Succeeding laws to protect the right of Myanmar nationals. **Monogamy Law (2015):** Concerning all those who are living in Myanmar, Myanmar Citizens who live outside of Myanmar, and foreigners who marry Myanmar citizens while living in Myanmar for preventing misconducting marriages. **Buddhist Women Special Marriage Law (2015):** Concerning the marriage between Buddhist Woman and other religious man. There prescribed the legal procedure, the conditions to be complied by non-Buddhist husband, the customs for dividing property when divorcing. **Religious Conversion Law (2015):** This is enacted for the freedom to convert from one religion to another, or a person without a religion has the freedom to convert to a religion. There prohibited to apply for a religious conversion with an intent to insult, disrespect, destroy, or abuse a religion. **Population Control Healthcare Law (2015);** this is for alleviate poverty, provide adequate quality healthcare, and ensure that family planning improves maternal and child health in the country. This Empowers region or state government that concerned with the special zone for healthcare to form region or state population control healthcare group to implementing the task as per the directives of the Ministry and region or state government and the Union Territory Governing body
LAND USE		
Farmland Law and rule, 2012, amended 2018	Section 9(f), 12(g),	The Project Proponent acknowledges that: ■ The farmers who has the right to use the farmland right to use common interest the farmland in accord with the Foreign Investment Law of the Republic of the Union of Myanmar by cooperating with the foreigner or the organization in which the foreigner is included. ■ The person who has the right to use the farmland shall not sell, mortgage, lease, exchange or gift on the whole or part of the right to use the farmland without permission of the Government to any foreigner or any organization in which the foreigner is included. ■ Shall not use the farmlands by other purposes without permission

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
The Administration of Vacant, Fallow and Virgin Land Management Law and Rules , 2012, amended 2018	Section 16, 22(d)	The person who has the right to cultivate or utilize vacant, fallow and virgin lands shall; ■ carry out only the type of business permitted and affiliated economic enterprises. ■ reclaim and carry out the permitted land until the completion of business according to the stipulation within 4 years starting from the day of permission. For the lapse of the prescribed period due to natural disasters or unstable situation, central committee may revise the stipulated term. ■ not mortgage, gift, sell, lease or transfer by other means or divide the permitted Vacant, Fallow and Virgin Lands without the permission of the Union Government. ■ pay up the land revenue for vacant, fallow and virgin lands, which he has the right to cultivate or utilize . ■ comply with the conditions relating to the right to cultivate or utilize the vacant, fallow and virgin lands prescribed by the Central Committee. ■ not extract other natural resources above or below the ground except the permitted business. ■ when acquiring the required land area from the land permitted in the event of finding the natural resources within the permitted land and the Government is desirous to extract commercially, shall return as directed by the Union Government. If it is found the failure of carrying out the business in accord with the stipulated terms and conditions or the violation of terms and conditions within the original permitted period, security fees shall be confiscated as the State finance and the right to cultivate or utilize vacant, fallow and virgin lands shall be revoked.
Land Acquisition Act, 1894		The Project Proponent commits to comply with the stipulations laid down in the Act. The Yangon Regional Government formed a land acquisition committee composed of nominated individuals from relevant government departments. This committee will lead the land acquisition and compensation process for the land required for the Project's pipeline.
The Land Acquisition, Resettlement and Rehabilitation Law, 2019 (Not in force yet)	Section 71	As per section 71 of this law, the enforcement of Land Acquisition Act 1894 will cease as soon as this new law enter into force. The new law will enter in force with official notification. The Proponent should comply with the following: ■ To comply as per procedures and guidelines issued under this law, ■ To pay compensation as per prescription in chapter (8), ■ To meet the requirements of chapter (9) for Resettlement and Rehabilitation. The Yangon Regional Government formed a land acquisition committee composed of nominated individuals from relevant government departments. This committee will lead the land acquisition and compensation process for the land required for the Project's pipeline.
The Land and Revenue Act	-	The Proponent should familiarise themselves with the articles of the legislation and work

Relevant Laws, Rules and Regulations	Relevant Sections	Commitments
		with the relevant government agency (MOGE) on land and revenue issues.
The Law of Protection of the Farmer Rights and Enhancement of their Benefits, 2013	Clause 20 (f)	The Project Proponent commits to comply the stipulation for the Leading Body, in respect of agriculture and livestock breeding, to carry out the following: ■ To guarantee in production, import, preparation, package, and sales of fertiliser and pesticides that they meet with the standards and are safe for use and to aware farmers the defects of fertiliser and pesticides without guarantee in time.

Source: ERM, 2020.

3.4 National Administrative Requirements

3.4.1 Overview of Myanmar Legislation

3.4.1.1 The Constitution

The latest enacted Constitution (May 2008) provides information on governing laws and regulations in Myanmar. The Constitution takes precedence over any other national legislation or international agreements. The general provisions of the Constitution that relate to the Project are the requirement for Myanmar citizens to assist in:

- Preservation and safeguarding of cultural heritage;
- Environmental conservation;
- Striving for development of human resources; and
- Protection and preservation of public property.

3.4.1.2 Administrative Divisions of Myanmar

Myanmar is divided into twenty-one (21) main administrative subdivisions, which include:

- Seven states;
- Seven regions (note that regions were previously referred to as “divisions”, prior to August 2010);
- Five self-administered zones;
- One self-administered division; and
- One union territory.

The administrative subdivisions are detailed in ***Table 3.3***, and an administrative map is presented in ***Figure 3.1***.

Table 3.3: Administrative Regions of Myanmar

Name	Capital	Population	Area (km^2)
Ayeyarwady Region	Pathein	6,184,829	35,032
Bago Region	Bago	4,867,373	39,402
Chin State	Hakha	478,801	36,019
Kachin State	Myitkyina	1,689,441	89,041
Kayah State	Loikaw	286,627	11,732
Kayin State	Pa-an	1,574,079	30,383
Magway Region	Magwe	3,917,055	44,821
Mandalay Region	Mandalay	6,165,723	37,946
Mon State	Mawlamyaing	2,054,393	12,297
Rakhine State	Sittwe	3,188,807	36,778
Sagaing Region	Sagaing	5,325,347	93,705
Shan State	Taunggyi	5,824,432	155,801
Tanintharyi Region	Dawei	1,408,401	43,345

Name	Capital	Population	Area (km^2)
Yangon Region	Yangon	7,360,703	10,277
Naypyidaw Union Territory	Naypyidaw	1,160,242	N/A
Danu Self-Administered Zone	Pindaya	N/A	N/A
Kokang Self-Administered Zone	Laukkai	N/A	N/A
Naga Self-Administered Zone	Lahe	N/A	N/A
Pa-O Self-Administered Zone	Hopong	N/A	N/A
Pa Laung Self-Administered Zone	Namhsan	N/A	N/A
Wa Self-Administered Division	Hopang	N/A	N/A

Source: The Union Report: Census Report Volume 2. The 2014 Myanmar Population and Housing Census. Nay Pyi Taw: Ministry of Immigration and Population. 2015. p. 12.

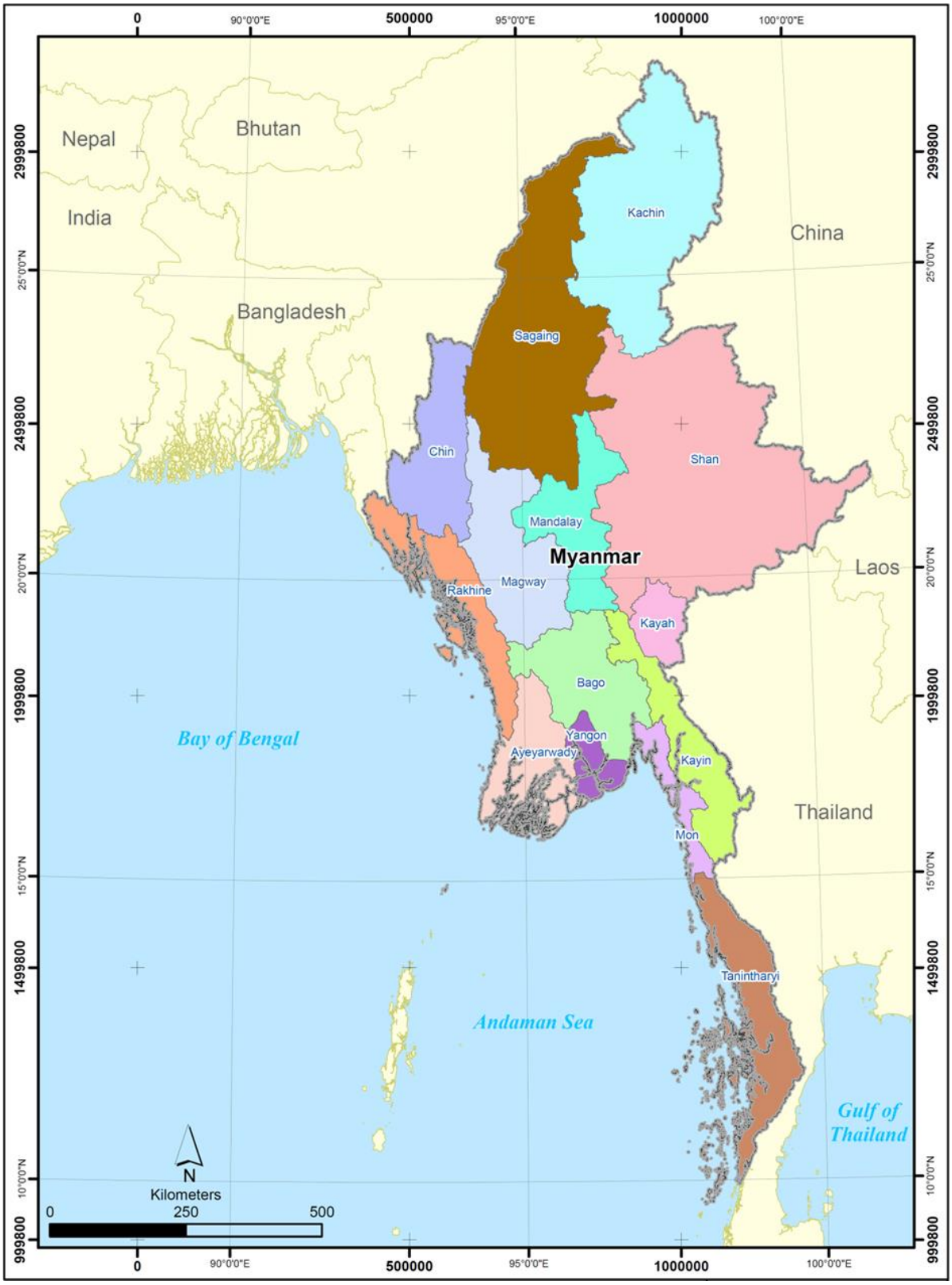
States and regions are divided into districts. Districts consist of townships, which are composed of towns, wards and village-tracts. Village-tracts are groups of adjacent villages. The administrative structure of the states, regions and self-administering bodies is defined in the Constitution.

Each region and state has a Regional/State Government, consisting of a Chief Minister, Ministers and an Advocate General. Legislative authority resides with the State/Regional “Hluttaw” (a parliament or legislative body), which are made up of elected civilian members and representatives of the military.

The Constitution states that Naypyidaw is a Union Territory under the direct administration of the President. The Naypyidaw Council, led by a Chairperson, carries out general functions on behalf of the President. The Chairpersons of the Naypyidaw Council are appointed by the President, and include civilians and representatives of the military.

Self-Administered Zones and Self-Administered Divisions are administered by a Leading Body, which is headed by a Chairperson, and has executive and legislative powers. The Leading Body consists of elected State/Regional Hluttaw members and military personnel.

Figure 3.1: Myanmar States/Regions and Townships



Source: ERM, 2017.

Articles in the Constitution relevant to environmental protection are Articles 37, 42 and 390. These three Articles in the Constitution provide a basis for legalizing and institutionalizing environmental health impact assessment and social impact assessment. They are quoted below in ***Table 3.4.***

Table 3.4: Articles in the Constitution Relevant to Environmental Protection.

Article	Content
Article 37	(a) The Union is the ultimate owner of all lands and all natural resources above and below the ground, above and beneath the water and in the atmosphere in the Union; The Union shall enact necessary law to supervise extraction and utilization of State owned natural resources by economics forces;
Article 42	The Union shall protect and conserve natural environment.
Article 390	Every citizen has the duty to assist the Union in carrying out the following matters: (a) preservation and safeguarding of cultural heritage; (b) environmental conservation; (c) striving for development of human resources; (d) protection and preservation of public property.

Source: ERM, 2018.

3.4.1.3 EIA Requirements in Myanmar

Laws in Myanmar related to EIA requirements are as follows:

Environmental Policy, 1994; Myanmar Agenda 21, 1997; and National Sustainable Development Strategy, 2009.

Myanmar issued an Environmental Policy in 1994, which was as follows:

"…. The wealth of the nation is its people, its cultural heritage, its environment and its natural resources. The objective of Myanmar's Environment Policy is aimed at achieving harmony and balance between these, through the integration of environmental considerations into the development process to enhance the quality of life of all its citizens. Every nation has the sovereign right to utilize its natural resources in accordance with its environmental policies, but great care must be taken not to exceed its jurisdiction or infringe upon the interests of other nations. It is the responsibility of the State and every citizen to preserve its natural resources in the interest of present and future generations. Environmental protection should always be the primary objective in seeking development".

With a view to implementing a National Environment Policy (NEP), the National Commission for Environmental Affairs (NCEA) formulated Myanmar Agenda 21 in 1997 under the guiding principles established at the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992. The Agenda 21 provided the first framework for integrating environmental considerations into national development plans in Myanmar. The purpose of Agenda 21 is to mobilize and focus national efforts to achieve sustainable development, and is intended to have the following functions:

1. To define the choices, set the goals and targets, and establish the standards for sustainable development in Myanmar;
2. To illuminate the environmental and ethical dimensions underlying the choices to be made and goals to be achieved in sustainable development;
3. To analyse the ecological, economic and social issues in the country in a comprehensive and integrated fashion, clarifying the links between them, identifying the policy gaps, and showing how to reduce conflicts between environment and development;

4. To identify and evaluate options for addressing priority issues, problems and opportunities, including the identification of appropriate programmes for legal reform, development of economic instruments, institutional development, capacity-building and other measures;
5. To set out sectoral and cross-sectoral policies and plans which rationalize the responsibilities for sustainable development, reduce duplication, close gaps, prevent or reduce conflicts, and take advantage of compatibilities and synergies among sectors and interest groups;
6. To improve decision-making and policy formulation through better information and analytical techniques, and by enabling those most affected by decisions to participate in the decision-making process;
7. To develop understanding and build consensus so that decisions have strong support;
8. To identify, promote and support actions leading to sustainable development and to reduce, abate and put a stop to actions impeding sustainable development;
9. To identify and apply practices which sustain the resource base of the economy, achieve sustainable levels of resource use, restore degraded natural resources, make use of unused or under-used resource potential, improve the efficiency of existing resource use, and diversify the use or seek substitution of existing resources;
10. To determine priorities for action, evaluating costs and benefits and the trade-offs between the different concerns affecting all levels of society;
11. To provide a basis for the allocation and optimal use of limited resources;
12. To develop and strengthen institutions for sustainable development; and
13. To build up the capacity of institutions and the population of the country to handle complex and inter-related issues through frameworks which integrate environmental concerns with planning.

Subsequently in 2007, the NCEA developed the National Sustainable Development Strategy (NSDS) for Myanmar. It incorporated the aspirations of the Agenda 21 as well as Myanmar's Millennium Development Goals. The NSDS was approved in 2009 and served as the main guiding principal on environmental protection in the country.

Specific strategies are outlined under each goal. For example, the goal for Sustainable Management of Natural Resources suggests strategies for forest resource management, sustainable energy production and consumption, biodiversity conservation, sustainable freshwater resources management, sustainable management of land resources, sustainable management for mineral resources utilization, etc.

The aim of NSDS is to achieve sustainable development through three sectors, focused on natural resource management, economic development, and social development. Relevant government ministries are expected to institutionalize NSDS principles into their sectoral development through short-term, medium-term and long-term actions.

Although much of the NSDS guidelines are for adoption and integration into the government legislation and regulation body, some are targeted at the private sector, such as the polluter pay principle, and reduction of energy consumption and greenhouse gas emission from industries.

The Environmental Conservation Law, 2012

The legal mechanism for EIA has been put in place with the 2012 Environmental Conservation Law. The Pyidaungsu Hluttaw enacted this law by Law No. 9 of 2012 on the date of 30 March 2012. The legal mechanism for EIA has been described in this law. According to the text of The Environmental Conservation Law, the main objectives of the Law are as follows:

1. to enable to implement the Myanmar National Environmental Policy;

2. to enable to lay down the basic principles and give guidance for systematic integration of the matters of environmental conservation in the sustainable development process;
3. to enable to emerge a healthy and clean environment and to enable to conserve natural and cultural heritage for the benefit of present and future generations;
4. to reclaim ecosystems as may be possible which are starting to degenerate and disappear;
5. to enable to manage and implement for decrease and loss of natural resources and for enabling the sustainable use beneficially;
6. to enable to implement for promoting public awareness and cooperation in educational programmes for dissemination of environmental perception;
7. to enable to promote international, regional and bilateral cooperation in the matters of environmental conservation;
8. to enable to cooperate with Government departments, Government organizations, international organizations, non-government organizations and individuals in matters of environmental conservation.

The following articles are particularly relevant to EIA requirements and this project:

"7. The duties and powers relating to the environmental conservation of the Ministry are as follows:

(m) causing to lay down and carry out a system of environmental impact assessment and social impact assessment as to whether or not a project or activity to be undertaken by any Government department, organization or person may cause a significant impact on the environment;"

Also in this law, Article 14 and Article 15 are related with waste disposal in accordance with environmental standards:

"14. A person causing a point source of pollution shall treat, emit, discharge and deposit the substances which cause pollution in the environment in accord with stipulated environmental quality standards.

15. The owner or occupier of any business, material or place which causes a point source of pollution shall install or use an on-site facility or controlling equipment in order to monitor, control, manage, reduce or eliminate environmental pollution. If it is impracticable, it shall be arranged to dispose the wastes in accord with environmentally sound methods."

Article 19 is related to maintenance of cultural heritage:

"19. The Ministry shall cooperate with the relevant Government departments and Government organizations in the matters of environmental conservation for perpetual existence of cultural heritage sites and natural heritage sites, cultural monuments and natural areas stipulated under any existing law."

For violations of bylaws, regulations and directives issued under this law, punishment is not more than one year or fine (unspecified amount), or both, under Article 32.

Environmental Conservation Rules (2014)

The Ministry of Natural Resources and Environmental Conservation, in exercise of power conferred under sub-section (a) of section 42 of the Environmental Conservation Law, issues this rules by No. 50 of 2014 on the date of 5 June 2014, as shown in ***Table 3.5***.

Table 3.5: Section 42 of the Environmental Conservation Law

Rule	Content
Rule 51	The Ministry shall assign duty to the Department for enabling to adopt and carry out the environmental impact assessment system.
Rule 52	The Ministry shall determine the categories of plan, business or activity which shall carry out environmental impact assessment
Rule 53	The Ministry shall to scrutinize whether or not it is necessary to conduct environmental impact assessment, determine the proposed plans, businesses or activities which do not include in stipulation under rule 52
Rule 56	The person who carries out any project, business or activity shall arrange and carry out for conducting the environmental impact assessment for any project, business or activity by a qualified third person or organization accepted by the Ministry.
Rule 58	The Ministry shall form the Environmental Impact Assessment Report Review Body with the experts from the relevant Government departments, Government organizations.
Rule 61	The Ministry may approve and reply on the EIA report or IEE or EMP with the guidance of the Committee
Rule 69	Any person shall not emit, cause to emit, dispose, cause to dispose, pile and cause to pile, by any means, the pollutants and the hazardous waste or hazardous material stipulated by notification under the Law and any of these rules at any place which may affect the public directly or indirectly. Any person shall not carry out to damage the ecosystem and the natural environment which is changing due to such system, except for carrying out with the permission of the Ministry for the interest of the people.

Source: ERM, 2018.

Foreign Investment Law, 2012, Foreign Investment Rules, 2013, and Notifications for Investment, 2013

Myanmar passed a new Foreign Investment Law on 2 November 2012, which replaced the Myanmar Foreign Investment Law of 1988. The recently enacted rules require EIA for large projects according to the rules of MONREC.

Although the law does not specifically define legislation for EIAs, Notification 1/2013 provides a categorization of the business activities in which foreigners will be allowed to engage. Under this, “Electrical power production” projects fall under “Category 3.3: activities allowed only following an Environmental Impact Assessment”. Specifically, electrical power production projects “must conduct Environmental Impact Assessment and obtain and follow MONREC’s terms and conditions”.

Environmental Impact Assessment Procedures 2015

The Environmental Impact Assessment Procedure was promulgated on December 29th, 2015, and sets out the procedures for completing an IEE, EIA and/or EMP in Myanmar. This includes information on project categorization, responsibilities of project developers and ministries, IEE/EIA review, monitoring and auditing, among other issues, under the Environmental Conservation Law 2012 and Environmental Conservation Rules 2014 of the National Environmental Policy for Myanmar 1994. The Procedure states that:

“….all Projects and Project expansions undertaken by any ministry, government department, organization, corporation, board, development committee and organization, local government or authority, company, cooperative, institution, enterprise, firm, partnership or individual (and/or all Projects, field sites, factories and businesses including expansions of such Projects, field sites, factories and businesses identified by the Ministry, which may cause impact on environmental quality and are required to obtain Prior Permission in accordance with Section 21 of the Law, and Article 62

of the Rules) having the potential to cause Adverse Impacts, are required to undertake IEE or EIA or to develop an EMP, and to obtain an ECC in accordance with this Procedure."

According to the EIA Procedure, based on the criteria indicated in Annex 1 'Categorization of Economic Activities for Assessment Purposes', natural gas power plants with an installed capacity of equal to or greater than 50 MW requires an EIA.

The EIA Procedure also outlines requirements for Scoping for all EIA Projects, which are required to be undertaken according to Article 49 and Article 50, as follows:

"49. The Scoping shall, in respect of the proposed Project:

a. define the study area, area of influence, time boundaries, project phases, and potential stakeholders;

b. start the process of understanding the applicable regulations and standards, and their context for Project design and completion of the EIA;

c. make a provisional identification of Environmental Impacts, focusing on the environmental, social and health issues that need to be addressed in subsequent EIA studies;

d. provide an indication of the depth and breadth of subsequent EIA investigations including what baseline data and information are required, what further studies and investigations must be carried out, and how such data collection, studies and investigations shall be undertaken;

e. provide an opportunity for consultants, relevant authorities, project developers, and interested and affected parties to express their views and concerns regarding the proposal before an EIA proceeds;

f. enable an efficient and comprehensive assessment process that saves time, resources, costs and delays; and

g. identify potentially affected communities and other stakeholders with an interest in the Project.

50. As part of the Scoping, the Project Proponent shall ensure that the following public consultation and participation process is carried out:

a. disclose information about the proposed Project to the public and civil society through posting on the Project or Projects Proponent's website(s) and local media, including by means of the prominent posting of legible sign boards and advertising boards at the Project site which are visible to the public; and

b. arrange the required complement of consultation meetings as advised by the Ministry, with local communities, potentially PAPs, local authorities, community based organizations, and civil society, and provide appropriate and timely explanations in press conferences and media interviews."

Furthermore, EIA Investigation shall encompass the requirements of Article 56 through 61:

"56. An EIA investigation shall consider all biological, physical, social, economic, health, cultural and visual components of the environment, together with all pertinent legal matters relating to the environment, people and communities (including land use, resources use, and ownership of and rights to land and other resources) that may be affected by the Project during all project phases including pre-construction, construction, operation, decommissioning, closure, and post-closure; and shall identify and assess all Adverse Impacts, risks, Cumulative Impacts and Residual Impacts for environment, social and, if relevant, health that potentially could arise from the Project.

57. The investigations shall include all necessary data collection, technical studies, modelling, field surveys, field sampling, laboratory analysis, engineering designs and calculations, and consultations to determine and document that all feasible measures are taken to ensure that all

Residual Impacts are within standards and are acceptable to the Ministry and interested and affected persons.

58. *The investigation shall also include an analysis of Alternatives. Such analysis shall include a description of each Alternative, and an assessment and comparison of the Adverse Impacts, required mitigation measures and Residual Impacts of the Alternatives.*

59. *The Project Proponent is obliged to use, comply with and refer to applicable national standards, international standards adopted by the Union Government and/or the Ministry, or, in the absence of relevant national or adopted international standards, such standards as may be agreed with the Ministry.*

60. *The EIA shall consider the views, concerns, and perceptions of stakeholders, communities and individuals that could be affected by the Project or who otherwise have an interest in the Project. The EIA should include the results of consultations with the public, affected population and other stakeholders on the environmental and social issues. The concerns raised during such consultations shall be considered in assessing impacts, designing mitigation measures, and in the development of management and monitoring plans.*

61. *As part of the EIA investigations, the Project Proponent shall undertake the following consultation process:*

    a. *timely disclosure of all relevant information about the proposed Project and its likely Adverse Impacts to the public and civil society through local and national media, the website(s) of the Project or Project Proponent, at public places such as libraries and community halls, and on sign boards at the Project site visible to the public, and provide appropriate and timely explanations in press conferences and media interviews;*

    b. *arrange consultation meetings at national, regional, state, Nay Pyi Taw Union Territory and local levels, with PAPs, authorities, community based organizations, and civil society;*

    c. *consultations with concerned government organizations including the Ministry, the concerned sector ministry, regional government authorities, and others; and*

    d. *field visits for the Ministry and concerned government organizations."*

3.4.1.4 Myanmar Protected Areas

The first legal instrument related to protected areas, which designated a wildlife sanctuary in the environs of the Royal Mandalay City, was promulgated in 1859. The first piece of wildlife legislation to be enacted was the Wild Elephant Protection Act of 1879. The Forest Act of 1902 gave responsibility for wildlife management to the Forest Department. Legislation specific to wild animals followed in 1927, and broader legislation followed nine years later with The Burma Wildlife Protection Act 1936 and The Burma Wildlife Protection Rules 1941 (Burma Act No. Vii of 1936). This provided for designation of wildlife sanctuaries with species-specific conservation objectives. Legislation was revised in 1994 with issue of the Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law. The 1994 Law, which was issued by the State Law and Order Restoration Council, provides for:

- A Committee for the Protection of Wildlife and Wild Plants and Conservation of Natural Areas, which is to serve as an advisory body to the Minister of Forestry; supervise implementation of the Law; give guidance in matters of research, conserving species in danger of extinction and international cooperation;
- Categories of 'natural areas' and zoological and botanical gardens, their declaration and uses;
- Categories of protected wild animals (almost the same as provided for under earlier law): completely protected, normally protected and seasonally protected;
- Hunting licenses;

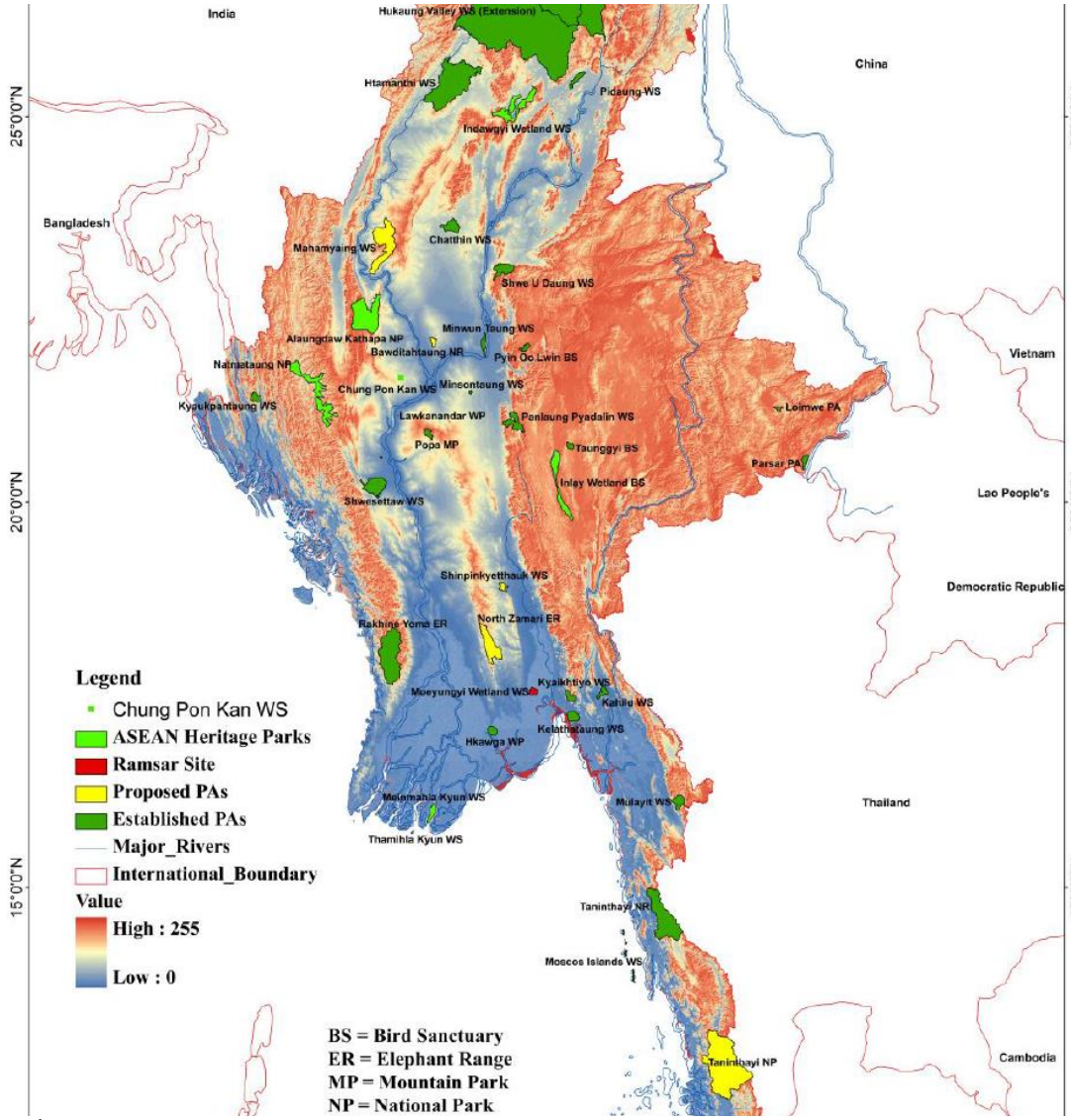
- Establishment of zoological and botanical gardens;
- Registration of ownership of completely protected animals or trophies thereof;
- Administrative actions;
- Appeals; and
- Offences and penalties.

The categories of so-called 'natural areas' are defined in the Law described above as:

- Scientific Nature Reserve;
- National Park;
- Marine National Park;
- Nature Reserve;
- Wildlife Sanctuary;
- Geo-Physically Significant Reserve; and
- Other Nature Reserve Determined by the Minister.

A total of 43 protected areas have been established or proposed in Myanmar, and are shown in ***Figure 3.2.*** The nearest protected area to the Project is the Hkawga wildlife park, which is located approximately 16 km North of the Project.

Figure 3.2: Protected Areas in Myanmar and Project Location



Source: Taw, N.P., 2014.[1]

[1] Taw, N.P. (2014). Fifth National Report to the United Nations Convention on Biological Diversity. Ministry of Environmental Conservation and Forestry of the Republic of the Union of Myanmar. Retrieved from https://www.cbd.int/doc/world/mm/mm-nr-05-en.pdf

3.4.2 Rules on Protection of Wildlife, and Protected Area Conservation Law (2003) and the Protection of Wildlife, and Wild Plant and Conservation of Natural Areas Rules (2002)

The objectives of this Law are as follows:

1. to implement the Government policy for wildlife protection;
2. to implement the Government policy for natural areas conservation;
3. to carry out in accordance with the International Conventions acceded by the State in respect of the protection and conservation of wildlife, ecosystems and migratory birds;
4. to protect endangered species of wildlife and their natural habitats.

Article 15 states that:

The Director General shall, with the approval of the Minister:

a. determine and declare endangered species of wild animal which are to be protected according to the following categories:
    i. completely protected species of wild animals;
    ii. normally protected species of wild animals;
    iii. seasonally protected species of wild animals;
b. determine and declare the endangered species of wild plants and their nature habitats thereof;
c. lay down and carry out measures for the preservation of protected wildlife species;

Moreover, article 31 that a Forest Officer may pass an administrative order causing a fine that may extend to Kyat 10,000 to be paid, on a person who kills, hunts, wounds or raises a seasonally protected wild animal without permission during the closed season.

3.4.3 Myanmar Legislation Specific to the Electricity and Energy Sector

The existing legislation governing electricity and energy in Myanmar is Electricity Law (2015) Pyidaungsu Hluttaw Law No. 44/2014 dated 27th October 2014.

The objectives of this Law are as follows:

1. *To systematically manage, in accordance with the present policies of the Union government, electricity activities in order to better develop the electric power sector, to satisfy the country's need for electric power and to supervise and control electricity activities;*
2. *To encourage more large-scale electric power generation and distribution projects which the Union may manage, and mid-sized and small-scale electric power generation and distribution projects in the regions and states;*
3. *To enable the wider use of electric power without the occurrence of electrical hazards;*
4. *To perform electricity activities in conformity with the prescribed standards and norms;*
5. *To increase foreign and local investments in electricity activities;*
6. *To write and promulgate equitable, transparent and reasonable rules and regulations for fixing electric power rates depending on the area;*
7. *To enable power consumers to use electric power with a voltage and frequency conforming to the standards and norms, and to prevent damage and loss to their electrical appliances due to electric power which is not in conformity with the standards and norms;*

8. *To respect and comply with the international conventions on environmental conservation, approved and signed by Myanmar.*

Chapter (5) Right to engage in electricity activities states that:

11. *Any local or foreign person desirous to invest in any electricity activity must, in accordance with the stipulations, apply to the person authorized to issue the license in order to acquire it.*
12. *The relevant ministry which is authorized to issue the license may, with the consent of the Union government, issue the license to any local or foreign person or organization desirous to invest in large-scale power projects, which may only be managed by the Union.*
13. *The region or state government which is authorized to issue the license may issue the license in accordance with the existing laws to any local or foreign person or organization desirous to invest in mid-size or small-scale electricity generation and distribution projects which may only be managed by the Union.*
14. *A license holder may apply to the ministry if he wants to sell electric power to the national grid. The ministry may allow or refuse the application after scrutinizing.*
15. *The head ("oozi") of the relevant self-administered division or zone may, after having negotiated with the relevant region or state government, issue licenses to any local or foreign person or organization desirous to invest in the electrification of the towns and villages situated in his area in accordance with the existing laws.*
18. *The license holder has the right to engage in electric power generation and distribution only after having received the electrical hazards safety certificate from the chief inspector.*
19. *(a) The license holder must apply to the relevant authorized ministry or organization if he desires to cooperate, with regard to the entire licensed project or some portion thereof, with other organizations, or transfer, sell, mortgage, lease or exchange licensed project or some portion thereof;*

    (b) The authorized ministry may, after having received the application under sub-section (a) and having scrutinized it, grant the application or refuse it.
20. *The license holder abide by the rules, regulations, notifications, orders, directives and procedures issued by the relevant ministry relating to the licensed electricity activities.*
21. *(a) The license holder shall, if he fails to comply with the law, rules, regulations, procedures, orders and directions or the specified quality, standards and norm, be responsible in accordance with the law if any person or organization is affected of suffers a loss as a result.*

    (b) The relevant ministry must stipulate the rules and procedures for taking action relating to the matters under sub-section (a)
22. *(a) The license holder shall be responsible in accordance with the law if any person or organization is affected or suffers a loss due to his negligence in performance;*

    (b) The relevant ministry must stipulate the rules and procedures for taking action relating to the matters under sub-section (a)
23. *(a) The license holder shall not be responsible in accordance with the law if any person or any enterprise is affected or suffers a loss due to any force majeure event due to natural disaster including damages and losses to electricity activities;*

    (b) The relevant ministry must stipulate the rules and procedures relating to force majeure events with regard to electricity activities.
24. *A power consumer must, if damage or loss occurs to other electric power consumers or any electricity activities due to his negligence, pay compensation calculated in accordance with the specified method of the ministry.*

25. *The license holder shall, upon expiry of the term of license, transfer the project to the concerned part in accordance with the agreement or the regulations in place at the time of receiving the license.*

26. *The license holder must comply with the following-*

    (a) Electricity exploration must be done in accordance with the law;

    (b) In electric power generation, transmission and distribution-

    i. Electrical power must be generated as specified in the license;

    ii. Instruments for measuring electric power and protective equipment must be systematically used and *maintained in accordance with the stipulations.*

27. *The license holder and the authorized person must inform the chief inspector and the relevant department in charge immediately if an electrical hazard has accidentally occurred when generating, transmitting, distributing or consuming electric power.*

Chapter (10) Electrical power rates and service charges states that:

41. *The relevant ministry shall, with the consent of the Union government, have the right to fix suitable electric power rates that are to be changed to the power consumers according to the region. The electric power rates may be changed from time to time.*

42. *The governments of the regions and states and the heads ("oozi") of the self-administered divisions and self-administered zones shall have the right to fix, after consultation with the relevant ministry, suitable electric power rates that are to be charged for electric power under their own management in the electric power system of their area. The electric power rates may be changed from time to time.*

Those who violate a specific section under Chapter (12) Prohibition can be punished with a fine ranging from 50,000 to 3,000,000 kyats, and/or imprisoned for 1 year at least up to 3 years at most.

3.4.3.2 Government Administration of Myanmar Electricity and Energy

The electricity and energy sector in Myanmar is governed primarily by the Ministry of Electric and Energy (MOEE). MOEE supervises the sector and governs power generation, transmission and distribution. Various other ministries play a role, as follows:

- **Ministry of Electricity and Energy (MOEE)** – primary responsible for electricity planning, generating and transmission. MOEE is also the sole supplier of natural gas for power generation and is responsible for issuing regulations on the generation, transmission and delivery of electric power in Myanmar.
- **Electric Power Generation Enterprise (EPGE)** – solely responsible for purchasing power from public and private power producers, including Build, Operate Transfer (BOT) project companies, and reselling that power on to the Electricity Supply Enterprise (ESE) and the Yangon Electricity Supply Board (YESB). In addition, the EPGE controls all transmission lines and substations.
- **Hydropower Generation Enterprise The Hydropower Generation Enterprise (HPGE)** – government partner for all hydro-generation BOT projects, and operates and maintains all large-scale public sector hydro-generation facilities.
- **Yangon City Electricity Supply Cooperation (YESC)** – plans, develops and maintains the Yangon electricity distribution system.
- **National Energy Management Committee (NEMC)** – recently implemented body that will, among other duties, coordinate with the Privatization Commission and the Myanmar Investment Commission in order to facilitate development of the energy and electricity sectors through private investments.

- **Ministry of Planning and Finance (the successor of Ministry of National Planning and Economic Development (MNPED))** – oversees the Directorate of Investment and Company Administration (DICA) and its sub-agency, the Myanmar Investment Commission (MIC). DICA oversees the process of company registration in Myanmar, and oversees the Foreign Investment Department (FID), who has a role in reviewing applications and is responsible for issuing the relevant licenses and permits after MIC and DICA approval. MIC is responsible for interfacing with foreign investors incorporated under the FIL.

3.4.4 Other Project-Relevant Legislation in Myanmar

Table 3.6 provides a list of major laws relevant to the Project, which forms part of the Project commitments.

Table 3.6: Project-Relevant Legislation in Myanmar

Laws and Regulations	Description
NEQ Guidelines (2015)	
The NEQ sets out emission standards for air, noise and effluent discharges for oil and gas operations. The project shall consider emissions standards in its environment impact assessment and environmental management plan.	
Myanmar Investment Law (2016)	
3. The objectives of this Law are as follows: a. To develop responsible investment businesses which do not cause harm to the natural; b. Environment and the society for the benefit of the Union and its citizens; c. To protect the investors and their investments in accordance with the law; d. To create job opportunities for the people; e. To develop human resources; f. To develop high functioning production, service, and trading sectors. g. To develop technology and the agriculture, livestock and industrial sectors; h. To develop various professional fields including infrastructure across the Union; i. To enable the citizens to be able to work alongside with the international community; and j. To develop businesses and investments that meet international standards.	
Conservation of Water Resources and Rivers Law (2006)	
Section 6 outlines prohibitions for the following activities: ■ "No person shall anchor the vessels where vessels are prohibited from anchoring in the rivers and creeks. ■ No person shall dispose of engine oil, chemical, poisonous material and other materials which may cause environmental damage, or dispose of explosives from the bank or from a vessel which is plying, vessel which has berthed, anchored, stranded or sunk. No one shall dispose of any substance into the rivercreek that may cause damage to waterway or change of watercourse from the bank or vessel." The aims of this Law are as follows: ■ to conserve and protect the water resources and river systems for beneficial utilization by the public; ■ to smooth and enhance safety of waterways navigation along rivers and creeks; ■ to contribute to the development of State economy through improving water resources and river systems; and ■ to protect environmental impact. The empowerment of this Law is provided to the Ministry of Transport for controlling navigation of vessels in the rivers and creeks as well as communicating with local and foreign government and organizations for conservation of water resources, rivers and creeks. Also, to carry out conservation works for water resources, rivers and creeks, in accordance with the relevant international conventions, regional agreements and bilateral agreements for environmental conservation.	
The Forest Law (1992)	
The State Law and Order Restoration Council had enacted the following Law in 3rd November, 1992 as Forest Law	
Chapter II: Basic Principles	3. This Law shall be implemented in accordance with the following basic principles: a. to implement the forestry policy of the Government; b. to implement the environmental conservation policy of the Government; c. to promote the sector of public co-operation in implementing the forestry policy and the environmental conservation policy of the Government.

Laws and Regulations	Description
Chapter IV: Management of Forest Land	9. The functions and responsibilities of the Forest Department are as follows:- a. implementation of the forestry policy of the Government; b. implementation of the plans relating to conservation of water, bio-diversity and environment, sustained yield of forest produce and protection of forest covered land; c. management of forest land in accordance with the provision of this Law; d. submitting proposals to the Minister for the determination, alteration or cancellation of reserved forest, protected public forest and species of reserved trees; Whoever, within a forest land and forest covered land at the disposal of the Government: is desirous of carrying out any development work or economic scheme shall obtain the prior approval of the MONREC.
Chapter XII: Offences and Penalties	40. Whoever commits any of the following acts shall, on conviction be punished with fine which may extend to Kyat 5,000 or with imprisonment for a term which may extend to 6 months or with both: a. trespassing and encroaching in a reserved forest; b. pasturing domestic animals or permitting domestic animals to trespass in a reserved forest; c. breaking up any land, clearing, digging or causing damage to the original condition of the land without a permit in a reserved forest; d. causing damage to a water-course, poisoning in the water, using chemicals or explosives in the water in a reserved forest; e. catching animals, hunting or fishing in a reserved forest; f. kindling, keeping, carrying any fire or leaving any fire burning which may set fire to the forests in a reserved forest; g. violating any provision of the rule, procedure, order, directive or notification issued under this Law.
The Burma Wildlife Protection Act 1936 and The Burma Wildlife Protection Rules 1941 (Burma Act No. Vii Of 1936)	
This legislation makes provision for the establishment of sanctuaries (game sanctuaries) on any land at the disposal of the government or, subject to the consent of the owner, any land which is private property. It also provides for the protection of a number of named species outside sanctuaries and reserved forests.	
The Protection and Preservation of Cultural Heritage Regions Law (1998)	
The State Peace and Development Council Law enacted this law by Law No. 9/ 98 on the date of 10 September, 1998. The Ministry of Culture may, with the approval of the Government issue notification for the protection of cultural heritage areas are categorized as following kinds of zones / region: a. Ancient monumental zone; b. Ancient site zone. **Objectives:** a. to implement the protection and preservation policy with respect to perpetuation of cultural heritage that has existed for many years; b. to protect and preserve the cultural heritage regions and the cultural heritage therein so as not to deteriorate due to natural disaster or man-made destruction;	

Laws and Regulations	Description

c. to uplift hereditary pride and to cause dynamism of patriotic spirit of citizens by protecting and preserving the cultural heritage regions;
d. to promote public awareness and will as to the high value of the protection and preservation of the cultural heritage regions;
e. to protect the cultural heritage regions from destruction;
f. to carry out protection and preservation of the cultural heritage regions in conformity with the International Convention approved by the State.

The Conservation of Antique Objects Law (2016)

The objectives of this law are as follows:
a. to implement the policy of protection and preservation for the perpetuation of antique objects;
b. to protect and preserve antique objects so as not to deteriorate due to natural disaster or man-made destruction;
c. to uplift hereditary pride and to cause dynamism of patriotic spirit by protection and preservation of antique objects;
d. to have public awareness of the high value of antique objects;
e. to carry out in respect of protection and preservation of antique objects in conformity with the International Convention and Regional Agreement ratified by the State.

The Protection and Preservation of Ancient Monuments Law (2016)

3. The objectives of this law are as follows:
   a. To implement the protection and preservation policy for the perpetuation of ancient monuments which have existed for many years;
   b. To protect and preserve cultural heritage regions and ancient monuments so that they are not destroyed by natural disaster or man;
   c. To uplift hereditary pride and to cause dynamism of patriotic spirit of citizens by protecting and preserving cultural heritage regions;
   d. To promote public awareness and will as to the high value of the protection and preservation of cultural heritage regions;
   e. To explore and preserve new ancient monuments;
   f. To protect cultural heritage regions from destruction;
   g. To implement protection and preservation of ancient monuments in conformity with international conventions and regional agreements.

15. Every person desirous to engage in the following within the area of certain ancient monuments has to apply for the permission of the administration department:
   (d) (e) digging a **well**, **pond** or fish-breeding pond;
   (f) (f) **mining** for gold, producing sand, digging stones, brickworks and other works which can impact the soil density and ground structure;

The Private Industrial Enterprise Law (1990)

The State Law and Order Restoration Council enacted this law by Law No.22/90 on 26th November, 1990.According to this law; all private industrial enterprises shall avoid or reduce the use of polluting technology. The Supervisory Body supervises and inspects the enterprise to ensure the following:

- No health threats from the industrial enterprise to the nearby residence;
- No fire threats or hazards;
- No source of nuisance or pollution originating from the enterprise;
- No occupational hazard to the workers and Compliance with the existing law.

Myanmar Fire Force Law (2015)

The objectives of Myanmar Fire Force Law are:
a. To take precautionary and preventive measure and loss of state own property, private property, cultural heritage and the lives and property of public due to fire and other natural disasters
b. To organize fire brigade systemically and to train the fire brigade

Laws and Regulations	Description
c. To prevent from fire and to conduct release work when fire disaster, natural disaster, epidemic disease or any kind of certain danger occurs d. To educate, organize an inside extensively so as to achieve public corporation e. To participate if in need for national security, peace for the citizens and law and order The relevant Government Department or organization shall, for the purpose of precaution and prevention, obtain the approval of the Fire force Department before granting permission for the following cases: a. Constructing three-storied and above buildings market and condominium buildings, b. Operating hotel ,motel, guest house enterprise c. Constructing factory, workshop ,storage facilities and warehouse d. Operating business expose to fire hazard by using in inflammable materials or explosive materials e. Producing and selling fire-extinguishing apparatuses Doing transport business, public utility vehicles train, airplane, helicopter, vessel, ship, etc. The relevant government department or organization shall obtain the opinion of the Fire Services Department for the purpose of fire precaution and prevention, when laying down plans for construction for town, village and downtown or village development plans.	
Underground Water Act (1930)	
The underground water act enacted on the date of 21st June in 1930 whereas it is expedient to conserve and protect underground sources of water supply in the Union of Myanmar. This act prohibits sinking of a tube for the purpose of obtaining underground water except under and in accordance with the terms of a license granted by the water officer. Township Officer or sub-divisional officer had power to close a license tube after exercising jurisdiction over the local area concerned and the expense of such closure shall be recoverable from the owner of the tube as if it were an arrear of land-revenue.	
Land Acquisition Act (1984)	
To determine how land is acquired for projects and how compensation is paid for the land. This includes compensation for things attached to the earth or permanently fastened.	
Public Health Law (1972)	
Purpose: to ensure the public health include not only employees but also resident people and cooperation with the authorized person or organization of health department. It is concerned with the protection of people' health by controlling the quality and cleanliness of food, drugs, environmental sanitation, epidemic diseases and regulation of private clinics. The project owner will cooperate with the authorized person or organization in line with the section 3 and 5 of said law. Section 3: The project owner will abide by any instruction or stipulation for public health. Section 5: The project owner will accept any inspection, anytime, anywhere if it is needed.	
The Protection and Prevention of Communicable Disease Law (1995)	
Chapter 5 of this law states that all persons are responsible for reporting an outbreak of a communicable disease to the nearest Health Officer.	
The Control of Smoking and Consumption of Tobacco Product Law (2006)	
3. The objectives of this Law are as follows; a. to convince the public that health can be adversely affected due to smoking and consumption of tobacco product and to cause refraining from the use of the same; b. to protect from the danger which affects public health adversely by creating tobacco smoke-free environment; c. to obtain a healthy living style of the public including child and youth by preventing the habit of smoking and consumption of tobacco product; d. to uplift the health, economy and social standard of the public through control of smoking and consumption of tobacco product; e. to implement measures in conformity with the international convention ratified by Myanmar to control smoking and consumption of tobacco product;	

Laws and Regulations	Description

The Development of Employees and Expertise (Skill) (2013)

5. (a)(1) If the employer has appointed the employee to work for an employment, the employment agreement shall be made within 30 days. But it shall not be related with government department and organization for a permanent employment.
   (2) If pre training period and probation period are stipulated before the appointment the said trainee shall not be related with the stipulation of sub- section (1).
   (b) The following particulars shall be included in the employment agreement:
   (1) the type of employment;
   (2) the probation period;
   (3) wage, salary;
   (4) location of the employment;
   (5) the term of the agreement;
   (6) working hour;
   (7) day off, holiday and leave;
   (8) overtime;
   (9) meal arrangement during the work hour;
   (10) accommodation;
   (11) medical treatment;
   (12) ferry arrangement to worksite and travelling;
   (13) regulations to be followed by the employees;
   (14) if the employee is sent to attend the training, the limited time agreed by the employee to continue to work after attending the training;
   (15) resigning and termination of service;
   (16) termination of agreement;
   (17) the obligations in accord with the stipulation of the agreement;
   (18) the cancellation of employment agreement mutually made between employer and employee;
   (19) other matters;
   (20) specifying the regulation of the agreement, amending and supplementing;
   (21) miscellaneous.
   (c) The worksite regulations contained in the employment agreement shall be in compliance with any existing law and the benefits of the employee shall not be less than those of the any existing law.
   (d) According to the employment agreement, the Ministry shall issue the notification for paying the stipulated compensation to the employee by the employer, if the work is completed earlier than the stipulated period or the whole work or any part of it have to be terminated due to unexpected condition or the work has to be terminated due to various conditions.
   (e) The employment agreement made under sub- section (a) shall be related with daily wage workers, piece rate workers who are appointed temporarily in the government department and organization.
   (f) The worksite regulations and benefits contained in the employment agreement mutually made between the employer and employee or among the employees shall be amended as necessary, in accord with the existing law.
   (g) The employer shall send a copy of the employment agreement made between the employer and employee, to the relevant employment and labour exchange office within the stipulated period and shall get the approval of it.
   (h) The employment agreement made before the enforcement of this law shall be confirmed up to the end of the term of the original agreement.
14. The employer shall carry out the training program in accord with the work requirement in line with the policy of the skill development team to develop the skill relating to the employment for the workers who are proposed to appoint and working at present.
15. The Employer:
   (a) shall carry out the training for each work or compounding the work individually or group- wise by opening on- job training, training systematically at worksite, sending outside training and training by

Laws and Regulations	Description
	using information technology system, for arranging the training program to enhance the employment skill of the workers; (b) appointing the youths of 16 years as apprentice, shall arrange the training for technology relating to the employment systematically in accord with the regulations prescribed by the skill development team. 30. (a) The employer of the industry and service business shall put in to the fund monthly as put in fees without fail for the total wages of the subordinates and the supervisors' salary for not less than 0.5%; (b) Put in money paid under sub- section (a) shall not be deducted from the wage and salary of the employees.
The Settlement of Labour Dispute Law (2012)	
The Pyidaungsu Hluttaw hereby had enacted this Law for safeguarding the right of workers or having good relationship between employer and workers and making peaceful workplace or obtaining the rights fairly, rightfully and quickly by settling the dispute of employer and worker justly.	
The Workmen Compensation Act (1923), (amended 2005)	
In the Workmen's compensation Act, 1923, the expression" Kyats 2,160 and Kyats 7,200" contained in clause A (i) of sub-section (1) of section 4, the expression "two hundred Kyats" contained in clause A (ii) of sub-section (1) of section 4, the expression "Kyats 3,024and Kyats 10,080" contained in clause B (i) of sub-section (1) of section 4, the expression "twelve hundred Kyats" contained in clause B (ii) of sub-section (1) of section 4, the expression "one hundred Kyats" contained in the proviso of sub-section (1) of section 8 shall be substituted respectively by the expression "the amount of compensation prescribed by notification by the Ministry of Labour, with the approval of the Government." The expression “subject to a maximum of thirty Kyats" contained in clause D (ii) of sub-section (1) of section 4 of the Workmen's Compensation Act, 1923 shall be deleted. The expression "ten Kyats" contained in sub-section (2) of section 8, the expression "twenty five Kyats" contained in sub-section (4) of section 8, the expression "three hundred Kyats" contained in the first proviso of sub-section (1) of section 30 of the Workmen's Compensation Act, 1923 shall be substituted respectively by the expression "the amount of money prescribed by notification by the Ministry of Labour, with the approval of the Government. The expression "shall be punishable with fine which may extend to one hundred Kyats" contained in sub-section (1) of section 18 A of the Workmen's Compensation Act, 1923 shall be substituted by the expression "shall be punishable with fine which may extend to Kyats 10,000."	
Labour Organization Law (2012)	
This Law was enacted, to protect the rights of the workers, to have good relations among the workers or between the employer and the worker, and to enable to form and carry out the labour organizations systematically and independently.	
Minimum Wages Law (2013)	
This Law was enacted to meet with the essential needs of the workers, and their families, who are working at the commercial, production and service, agricultural and livestock breeding businesses and with the purpose of increasing the capacity of the workers and for the development of competitiveness.	
Payment of Wages Law (2016)	
Salaries are to be paid at the end of the month or, depending on the size of the employing enterprise, between 5-10 days before the end of the month. The employer is permitted and required to withhold income tax and social security payments. Other deductions, e.g. for absence, may only be withheld in accordance with the law. **Section 3** The employer (a) will pay for salary either Myanmar Kyats or Foreign Cash permitted by National Bank of Myanmar. When delivery the salary (b) If the employer needs to pay the other opportunities or advantages, he can pay cash together with other materials according employee’s attitude. **Section 4** When the contract finish, employer need to pay the salary (not more than one month) to employees.	

Laws and Regulations	Description

For the permanent worker, need to pay per monthly. If more than 100 employees, need to pay within the 5 days from the end of month. If fire the employees, need to pay salary within two days after fire. When employee dies due to the accident, need to pay money as an insurance to employee's family within two days.
Section 9 When cut the salary due to the employees' absence, total cut salary not more than 50 % of his salary.
Section 10 Employer need to approval form the department as a penalty and cannot more than actual ravage rate when cut salary. No cut salary from the employees under 16 age.

Social Security Law (2012)

The Establishments Applied
Section 11.
(a) The following establishments shall be applied with the provisions for compulsory registration for social security system and benefits contained in this Law if they employ minimum number of workers and above determined by the Ministry of Labour in co-ordination with the Social Security Board:

i. production industries doing business whether or not they utilize mechanical power or a certain kind of power, works of production, repairing or services, or engineering works, mills, warehouses, establishments;
ii. Government departments, Government organizations and regional administrative organizations doing business;
iii. development organizations;
iv. financial organizations,
v. companies, associations, organizations and their subordinate departments and branch offices doing business;
vi. shops, commercial establishments, public entertaining establishments;
vii. Government departments and Government organizations doing business or transport businesses owned by regional administrative body, and transport businesses carried out with the permission of such department, body or in joint venture with such department or body;
viii. construction works carried out for a period of one year and above under employment agreement;
ix. works carried out with foreign investment or citizen investment or joint ventured businesses;
x. works relating to mining and gemstone contained in any existing law;
xi. works relating to petroleum and natural gas contained in any existing law;
xii. ports and out-ports contained in any existing law;
xiii. works and organizations carried out with freight handling workers;
xiv. Ministry of Labour and its subordinate departments and organizations;
xv. establishments determined by the Ministry of Labour from time to time, in co-ordination with the Social Security Board and with the approval of the Union Government; that they shall be applied with the provisions of compulsory registration for Social Security System and benefits contained in this Law.

(b) Any establishment which is applied with the provisions of compulsory registration under sub-section (a) shall continue to be applied by this Law even though any of the following situations occurs if it continues to carry out such work:

xvi. carrying out work by employing under stipulated minimum number of workers but more than one worker;
xvii. changing the employer or changing the type of business.

Section 48
(a) The employer shall effect insurance by registering for employment injury benefit insurance system contained in section 45 at the relevant township social security office and pay contribution to employment injury benefit fund in accord with stipulations in order that workers applied to provisions of compulsory registration may obtain the employment injury benefits.
Section 51
The employer (a) shall pay contribution monthly to Employment Injury Benefit Fund at the rates stipulated under section 50. Moreover he shall also bear the expenses for paying as such; (b) shall pay defaulting fee

Laws and Regulations	Description
stipulated under section 88, in addition to the contribution if fails to contribute after effecting insurance for employment injury benefit. **Section 53** (a) The employers and workers shall co-ordinate with the Social Security Board or insurance agency in respect of keeping plans for safety and health in order to prevent employment injury, contracting disease and decease owing to occupation and in addition to safety and educational work of the workers and accident at the establishment; **Section 54** (a) The employer shall report to the relevant township social security office immediately if a serious employment accident occurs to his insured worker. There shall not be any delay without sufficient cause to report as such. (b) A team of officers and other staff who inspect the establishments, if it is found out the employment injury, death, and contracting disease, shall report to the relevant township social security office in accord with the stipulations.	
Leaves and Holidays Act (1951)	
Under the Leave and Holidays Act (1951), every employee shall be granted paid public holidays as announced by the Government in the Myanmar Gazette. On average, Myanmar has 26 public holidays per year, depending on the date of the variable holidays. Myanmar law recognizes various types of leave. Leave is governed by the Leave and Holidays Act (1951), but additional rules may apply in accordance with other laws, such as the Social Security Law (2012) for employees contributing to the Social Security Fund.	
The Import and Export Law (2012)	
7. A person who obtained any license shall not violate the conditions contained in the license.	

Source: ERM, 2018.

3.4.5 Institutional Framework

3.4.5.1 Central EIA Authority

MONREC is the authority that is responsible for implementing EIA. In 2011, MONREC became the coordinating agency responsible for the country environmental management.

3.4.5.2 Other Governmental Parties Involved in EIA

MONREC has assigned responsibilities with regards to EIA to the Environmental Conservation Department (ECD), which is one of the 6 departments of the MONREC. The ECD was set up in October 2012 and is mainly responsible for implementing the National Environmental Policy, strategy, framework, planning and action plan for the integration of environmental consideration into the national sustainable development process.

In addition, an EIA Report Review Body, consisting of individual experts and/or experts from relevant government departments and organizations, may support MONREC with the review process.

The Myanmar Investment Commission (MIC) has responsibility for making decisions regarding project approval. MIC is a government-appointed body under the Ministry of National Planning and Economic Development, formed in 1994, that appraises investment proposals in Myanmar.

3.4.5.3 EIA Review and Approval Process

Based on the EIA Procedure, articles relevant to the submission and approval of an EIA Report are presented below. In addition, an overview of the process (from the EIA Procedure) is shown in ***Figure 3.3***.

Submission of EIA Report

64. *After completing all investigations and public consultation and participation processes required for EIA Type Projects, the Project Proponent shall submit the EIA Report to the Department in both digital form and complete paper copies, together with the required service fee as prescribed by the Department.*

65. *Not later than fifteen (15) days after submission of the IEE Report to the Department, the Project Proponent shall disclose the EIA Report to civil society, PAPs, local communities and other concerned stakeholders: (i) by means of national media (i.e. newspapers), (ii) the website(s) of the Project or Project Proponent, (iii) at public meeting places (e.g. libraries, community halls); and (iv) at the offices of the Project Proponent.*

66. *Upon receipt of the EIA Report, the Department will make the EIA Report publically available.*

Review and Approval Process for EIA Report

67. *Upon receipt of the EIA Report from the Project Proponent, the Department shall:*

    a. *submit the EIA Report to the EIA Report Review Body for comment and recommendations;*

    b. *invite comments and suggestions on the EIA Report from all relevant parties including relevant government organizations, institutions, civil society organizations, and PAPs, as appropriate;*

    c. *arrange public consultation meetings at national, regional, state, Nay Pyi Taw Union Territory and local levels where the Project Proponents shall present the EIA Report; and*

    d. *collect and review all comments and recommendations received, and forward the same to the Ministry to enable it to make a final decision on approval of the EIA Report.*

68. *If it is determined by the Ministry that the EIA Report does not satisfy requirements, then the Project Proponent shall be called upon by the Department to undertake necessary amendments as directed by the Ministry. The Ministry shall deliver its final decision within ninety (90) working days of receipt of the EIA Report. In case of Complex Projects, or if the Ministry requires the EIA Report to be amended, then the timeline will be extended accordingly.*

69. *All costs incurred in completing the EIA Report disclosure and review, including the public consultation process, shall be borne by the Project Proponent.*

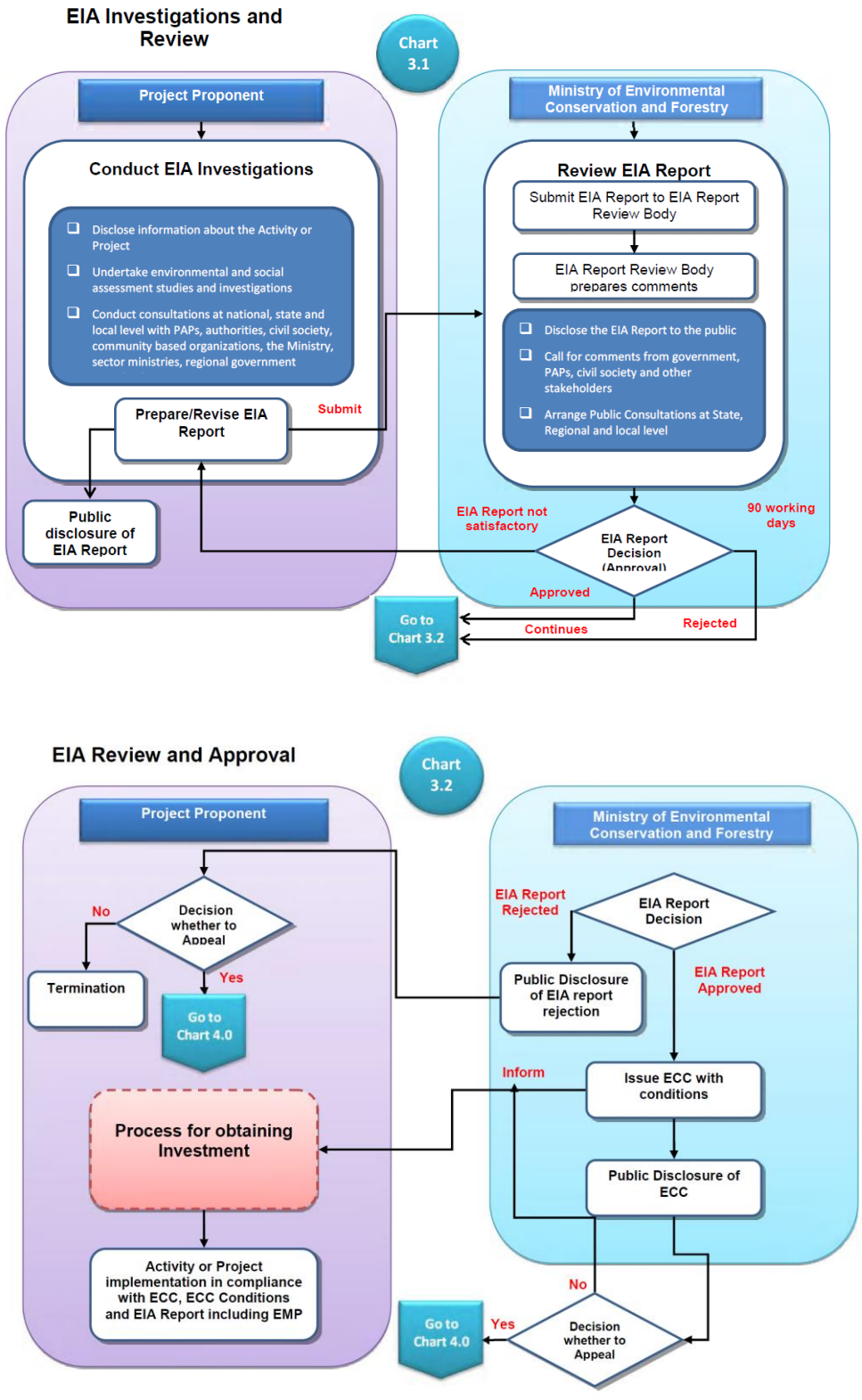
70. *Upon completion of its review of the EIA Report, the Ministry shall;*

    a. *approve the EIA Report with the guidance of the Committee, subject to any conditions as may be prescribe, and issue an ECC; or*

    b. *inform the Project Proponent of its decision to reject the EIA and cite reasons for doing so (grounds for rejection of and EIA Report shall be in accordance with guidance from the Ministry); and, in either case*

    c. *publicly and timely disclose its decision by appropriate means.*

Figure 3.3: EIA Investigations, Review and Approval Process (from EIA Procedures)



Source: MOECAF, 2015.[2]

[2] MOECAF (2015) Environmental Impact Assessment Procedure. Ministry of Environmental Conservation and Forestry Notification No. 616 / 2015.

3.4.6 Summary of Applicable Standards and Project Commitments

3.4.6.1 National Environmental Quality (Emission) Guidelines

Myanmar's National Environmental Quality (Emission) Guidelines (NEQG) (hereafter referred to as "the Myanmar Standard") were promulgated on December 29th, 2015. The Guidelines are largely based on International Finance Corporation (IFC) Environmental Health and Safety (EHS) Guidelines, and provide the basis for regulation and control of various environmental parameters, including noise and vibration, air emissions, and effluent discharges, from various sources. The Project is committed to comply with the emission standards presented in this section.

Relevant excerpts from the guidelines are as follows:

"6. Provisions of the general and applicable industry-specific Guidelines shall be reflected in project EMP and ECC and together constitute a project's commitment to take necessary measures to avoid, minimize and control adverse impacts to human health, safety, and the environment through reducing the total amount of emissions generation; adopting process modifications, including waste minimization to lower the load of pollutants requiring treatment; and as necessary, application of treatment techniques to further reduce the load of contaminants prior to release or discharge.

7. Further reference should be made by projects to applicable industry-specific IFC EHS guidelines for advice on means of achieving limit values specified in Annex 1.

8. These Guidelines supersede any existing national guideline or standard provision relating to regulation and control of noise, air, and water emissions from activities and projects subject to the EIA Procedure.

9. As specified in Article 56 of the EIA Procedure, all projects are obliged to use, comply with and refer to applicable national guidelines or standards or international standards adopted by the Ministry.

These Guidelines will henceforth be applied by the Ministry in satisfying this requirement until otherwise modified or succeeded by other guidelines or standards.

12. As specified in Article 95 of the EIA Procedure, projects shall engage in continuous, proactive and comprehensive self monitoring of the project and comply with applicable guidelines and standards. For purposes of these Guidelines, projects shall be responsible for the monitoring of their compliance with general and applicable industry-specific Guidelines. Projects shall be responsible for ensuring compliance at the point of compliance specified in the applicable Guidelines.

13. To demonstrate compliance with these monitoring requirements as specified in articles 97 and 98 of the EIA Procedure, projects shall submit monitoring reports to the Ministry at least every six months or more frequently as provided in the EMP and ECC. Monitoring reports shall inter alia document compliance, difficulties encountered in complying with EMP and ECC conditions, number and type of non-compliance with EMP and ECC, and monitoring data of prescribed environmental parameters as detailed in the EMP and ECC."

General

Air Emissions

"Projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that: (i) emissions do not result in pollutant concentrations that reach or exceed ambient quality guidelines and standards, or in their absence the current World Health Organization (WHO) Air Quality Guidelines; and emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards (i.e. not exceeding 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed."

The Government of Myanmar has established numerical standard for ambient air quality in the Myanmar National Environmental Quality (NEQ) (Emission) Guidelines (2015) based on the IFC's Environmental, Health and Safety Guidelines: Air Emissions and Ambient Air Quality (2007) which adopted the WHO Ambient Air Quality Guidelines (2005). The Myanmar NEQ Guidance Values shown in ***Table 3.7*** have been adopted as the ambient air quality guidelines for this Project.

Table 3.7: Ambient Air Quality Guidelines

Parameter	Averaging Period (mean)	Myanmar NEQ Guidance Value (µg/m^3)[(a)]	WHO Guidance Value (µg/m^3)[(b)]
Nitrogen dioxide	1-year 1-hour	40 200	40 (guideline) 200 (guideline)
Ozone	8-hour daily maximum	100	160 (Interim target-1) 100 (guideline)
Particulate matter PM_{10}	1-year	20	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)
	24-hour	50	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate matter $PM_{2.5}$	1-year	10	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)
	24-hour	25	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Sulphur dioxide	24-hour	20	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)
	10-minute	500	500 (guideline)

Note: (a) Extracted from Myanmar's National Environmental Quality (Emission) (NEQ) Guidelines (2015)
(b) Extracted from WBG EHS General Guidelines, Environmental Chapter, Section 1.1, Table 1.1.1 based on World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile.

Emission guidelines used in this study include the Myanmar's NEQ Guidelines (2015) as well as the IFC (2007) Environmental, Health and Safety Guidelines for Thermal Power Plant. ***Table 3.8*** shows the criteria included in these guidelines.

Table 3.8: Criteria Levels for Emissions

Combustion Technology/Fuel	Particulate Matter (PM)		Sulphur Dioxide (SO2)		Nitrogen Oxides (NOx)		Dry Gas, excess O_2 content (%)
Combustion Turbine	NDA(1)	DA(2)	NDA(1)	DA(2)	NDA(1)	DA(2)	
Natural Gas (all turbine types of unit > 50MWth)	n/a		n/a	n/a	51 mg/Nm^3 (3) 100 mg/Nm^3 (4)		15%

Source: ERM, 2018.

Note: (1) Non-degraded airshed
(2) Degraded airshed
(3) International Finance Corporation (IFC) (2007) Environmental, Health and Safety Guidelines for Thermal Power Plant
(4) Myanmar National Environmental Quality (NEQ) Emission Guidelines (2015)

Wastewater and Effluent

The relevant guidelines for properly managing the wastewater generated from the construction of the Project are the *Myanmar NEQ Emission Guidelines (2015)* for site runoff and wastewater discharges (construction phase) and the *IFC General EHS Guidelines: Environmental – Wastewater and Ambient Water Quality* (*2007*) shown in ***Table 3.9.***

In addition, IFC Effluent Guidelines Standards for Thermal Power Plants (2008) in ***Table 3.10*** have been included.

Table 3.9: Site Runoff and Wastewater Discharges

Pollutants	Units	Guideline Value
pH	pH	6 – 9
Biochemical Oxygen Demand (BOD)	mg/l	30
Chemical Oxygen Demand (COD)	mg/l	125
Total Nitrogen	mg/l	10
Total Phosphorous	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50
Total coliform bacteria	MPN[a]/100 ml	400

Source: IFC General EHS Guidelines: Wastewater and Ambient Water Quality.

Note: [(a)] MPN = Most Probable Number

Table 3.10: IFC Effluent Guidelines Standards for Thermal Power Plants

Parameter	mg/L, except pH and temp.
pH	6 -9
Total Suspended Solid (TSS)	50
Oil and Grease	10
Chromium – Total (Cr)	0.5
Copper (Cu)	0.5
Iron (Fe)	1
Zinc (Zn)	1
Lead (Pb)	0.5
Cadmium (Cd)	0.1
Mercury (Hg)	0.005
Arsenic (As)	0.5
Temperature increase by thermal discharge from cooling system	Site specific requirement to be established by the Environmental Assessment (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.

Source: IFC Environmental, Health, and Safety Guidelines for Thermal Power Plants.

Noise Levels

The Myanmar NEQ (Emission) Guidelines (2015) for noise, IFC General EHS Guidelines: Environmental – Noise Management (2007) and the IFC General EHS Guidelines: Construction and Decommissioning (2007) are relevant to the Project. ***Table 3.11*** below presents the prescribed standards on noise impacts in the surrounding industrial and residential areas of the Project.

Table 3.11: Myanmar NEQ and IFC General EHS Guidelines for Noise Levels at Receptors

Area	Maximum Allowable Noise Level (1 hour) [a] dB(A)	
	Daytime 0700 – 2200 hours	Night-time 2200 – 0700 hours
Residential, institutional, educational	55	45
Industrial/commercial areas	70	70

Source: Myanmar's National Environmental Quality (Emission) (NEQ) Guidelines (2015).

Note: *[a] Equivalent continuous sound level in decibels*
Noise impacts should not exceed the levels presented in this table, or result in a maximum increase in background levels of 3 dB(A) at the nearest receptor location off-site.

Odour

"Point and diffuse source odours from industries should be minimized using available prevention and control techniques as described in the IFC EHS industry-specific guidelines. Point source activities are those that involve stack emissions of odour and which generally can be controlled using waste reduction, waste minimization and cleaner production principles or conventional emission control

equipment. Diffuse source activities are generally dominated by area or volume source emissions of odour (e.g. intensive agricultural activities) and which can be more difficult to control. Projects should control odours to ensure that odours that are offensive or unacceptable to neighbours do not occur. Generally, odour levels should not exceed five to ten odorant units at the edge of populated areas in the vicinity of a project. Projects with multiple odorous point or diffuse releases, or emitting complex odours should conduct an odour impact assessment to determine ground-level maximum concentrations taking into account site-specific factors including proximity to populated areas."

Industry Specific Standards for Thermal Power Projects

The *Myanmar National (NEQ) Guidelines (2015)* specify effluent guidelines in relation to "Thermal Power". In addition, the *IFC Effluent Guidelines Standards for Thermal Power Plants (2008)* are applicable to the Project. The operational effluent standards for the Project are shown in ***Table 3.12***.

Table 3.12: Effluent Standards for Thermal Power

Parameter	Unit	NEQ Guideline Value	IFC EHS Guideline
Arsenic	mg/L	0.5	0.5
Cadmium	mg/L	0.1	0.1
Chromium (total)	mg/L	0.5	0.5
Copper	mg/L	0.5	0.5
Iron	mg/L	1	1
Lead	mg/L	0.5	0.5
Mercury	mg/L	0.005	0.005
Oil and grease	mg/L	10	10
pH	S.U.[a]	6-9	6-9
Temperature increase	°C	<3[b]	Elevated temperature areas should be minimized by adjusting intake and outfall design through the project specific EA depending on the sensitive aquatic ecosystems around the discharge point.
Total residual chlorine	mg/L	0.2	0.2
Total suspended solids	mg/L	50	-
Zinc	mg/L	1	1

Source: Myanmar's National Environmental Quality (Emission) (NEQ) Guidelines (2015).

Note: [a] *Standard Unit*
[b] *Temperature increase due to discharge of once-through cooling water.*
Applicability of heavy metals should be determined in the EA. Guideline limits in the Table are from various references of effluent performance by thermal power plants

Myanmar's air emission standards shown in ***Table 3.13*** are for non-degraded air sheds and are less stringent than the IFC Emissions Guidelines for Combustion Turbines shown in ***Table 3.14***. Therefore, the Project will adopt the IFC Emission Guidelines for Combustion Turbines (highlighted in bold) shown in ***Table 3.14.***

Table 3.13: Myanmar NEQ Air Emission Standards for Thermal Power (applicable to non-degraded airsheds)

Combustion Technology/Fuel	Parameter/Guideline Values		
	Particulate Matter PM_{10}[a]	Sulfur Dioxide	Nitrogen Oxides
Combustion Turbine			
Natural gas (all turbine types; unit > 50 MW)	N/A	N/A	100 mg/Nm^3

Source: Myanmar's National Environmental Quality (Emission) (NEQ) Guidelines (2015).

Note: [a] Particulate matter 10 micrometres or less in diameter.

Table 3.14: IFC Emission Guidelines for Combustion Turbine (in mg/Nm3 or as indicated) (a)

Combustion Technology /Fuel	Particulate Matter (PM)		Sulphur Dioxide (SO_2)		Nitrogen Oxides (NO_x)	Dry Gas, Excess O_2 Content (%)
	NDA [(b)]	DA [(b)]	NDA/DA	NDA/DA	NDA/DA	NDA/DA
Natural Gas (all turbine types of Unit > 50MWth)	N/A	N/A	N/A	N/A	**51 (25 ppm)**	15%

Notes: (a) Extracted from IFC EHS General Guidelines for Thermal Power Plant, Table 6(B), p21 dated December 19, 2008.
(b) NDA: Non Degraded Airshed
DA: Degraded Airshed (poor air quality)
Airshed should be considered as being degraded if nationally legislated air quality standards are exceeded or, in their absence, if WHO Air Quality Guidelines are exceeded significantly. For detailed notes and explanation refer to IFC EHS General Guidelines for Thermal Power plants, Table 6(B).

Table 3.15: IFC Emission Guidelines for Liquefied Natural Gas Facilities

Parameter	IFC Guideline
Hydrotest Water	Treatment and disposal as per guidance in Section 1.1 of this document (IFC Guideline Environmental, Health, and Safety Guidelines Liquefied Natural Gas Facilities). For discharge to surface waters or to land: ■ Total hydrocarbon content: 10 mg/L ■ pH: 6-9 ■ BOD: 25 mg/L ■ COD: 125 mg/L ■ TSS: 35 mg/L ■ Phenols: 0.5 mg/L ■ Sulfieds: 1 mg/L ■ Priority pollutant metals[a] (total): 5 mg/L Chlorides:[b] 600 mg/L (average), 1200 mg/L (maximum)
Contaminated storm water drainage	Contaminated storm water runoff should be treated through an oil/water separation system able to achieve oil & grease concentration not exceeding 10 mg/L.
Cooling or cold water	The effluent should result in a temperature change of no more than 3°C at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors, and assimilative capacity. Free chlorine (total residual oxidant in estuarine/marine water) concentration in cooling/cold water discharges (to

Parameter	IFC Guideline
	be sampled at point of discharge) should be maintained below 0.2 parts per million (ppm).
Sewage	Treatment as per guidance in the General EHS Guidelines, including discharge requirements. Provision of facilities to receive LNG tanker effluents may be required (see EHS Guidelines for Ports and Harbors).

Notes:[a] These are: Ag, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Ti, Zn.
[b] For discharge to freshwater.

Source: IFC, 2017.[3]

3.5 International Standards and Guidelines

In addition to national legislation, the Project will be undertaken to comply with a range of international standards, including IFC Performance Standards (IFC PS), and the World Bank Guidelines. These standards are set to complement and reinforce national legislation and ensure the Project is conducted under best practices in a way that minimizes risks, impacts and ensures compliance and fair practices. The international performance standards and guidelines provide guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities.

The applicable guidelines and standards for the Project are as follows:

- The IFC's Performance Standards (IFC's PSs) (2012);
- IFC/World Bank Group (WBG) EHS Guidelines, WBG EHS Guidelines for Thermal Power (2007 and 2008) IFC/World Bank Group (WBG) EHS Guidelines for Gas Distribution Systems and IFC/World Bank Group (WBG) EHS Guidelines for Liquefied Natural Gas Facilities (2017);
- IFC's Stakeholder engagement handbook and other relevant Good Practice Notes;
- IFC's Handbook for Preparing a Resettlement Action Plan (if applicable)
- Kyoto Protocol to the UNFCC on Climate Change (1997);
- United Nations Convention on Biological Diversity (1992);
- Basel Convention (1989);
- Ramsar Convention on Wetland (1971); and
- International Union for Conservation of Nature and Natural Resources, Red List of Threatened Species (1964).

3.5.1 International Finance Corporation (IFC) and World Bank Performance Standards

The IFC updated its Sustainability Framework in January 2012. This included revising the Performance Standards; which replace the previous safeguard policies and will be used to evaluate any project seeking funding through the IFC.

The Performance Standards represent the 'policy framework' for the ESIA and sustainable social and environmental management for the Project, whereas the IFC EHS Guidelines provide guidance on general and industry best practice as well as recommended numerical limits for emissions to the

[3] IFC. (2017). Environmental, Health, and Safety Guidelines for Liquefied Natural Gas Facilities. International Finance Corporation. World Bank Group. Retrieved from https://www.ifc.org/wps/wcm/connect/edb102c5-ca61-4561-8b8e-8124fa2060af/20170406-FINAL+LNG+EHS+Guideline_April+2017.pdf?MOD=AJPERES

atmosphere, noise, liquid and solid wastes, hazardous wastes, health and safety, and other aspects of industrial facilities and other types of development projects. The relevant IFC Performance Standards are listed in ***Table 3.16*** and the EHS Guidelines are discussed further in ***Section 3.5.1.***

Table 3.16: IFC Performance Standards

Performance Standards	Objectives
Performance Standard 1 - Assessment and Management of Environmental and Social Risks and Impacts underscores the importance of managing social and environmental performance throughout the life of a project (any business activity that is subject to assessment and management).	■ *Impact identification and assessment*. To identify and assess social and environmental impacts, both adverse and beneficial, in the project's area of influence ■ *Mitigation*. To avoid, or where avoidance is not possible, minimize, mitigate, or compensate for adverse impacts on workers, affected communities, and the environment ■ *Stakeholder engagement*. To ensure that affected communities are appropriately engaged on issues that could potentially affect them ■ *Effective management*. To promote improved social and environment performance of companies through the effective use of management systems.
Performance Standard 2 - Labour and Working Conditions recognizes that the pursuit of economic growth through employment creation and income generation should be balanced with protection for basic rights of workers.	■ To promote fair treatment, non-discrimination and equal opportunity of workers, and compliance with national labor and employment laws ■ To establish, maintain and improve the worker management relationship. ■ To promote compliance with national employment and labour laws. ■ To protect the workforce by addressing child labor and forced labor. ■ To promote safe and healthy working conditions, and to protect and promote the health of workers.
Performance Standard 3 - Resource Efficiency and Pollution Prevention recognizes that increased industrial activity and urbanization often generate increased levels of pollution to air, water, and land that may threaten people and the environment at the local, regional, and global level.	■ To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities ■ To promote more sustainable use of resources, including energy and water. ■ To reduce project –related GHG emissions.
Performance Standard 4 - Community Health, Safety and Security recognizes that project activities, equipment, and infrastructure often bring benefits to communities including employment, services, and opportunities for economic development.	■ To anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non routine circumstances ■ To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities.

Performance Standards	Objectives
Performance Standard 5 - Land Acquisition and Involuntary Resettlement outlines that involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or means of livelihood) as a result of project-related land acquisition	■ To avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs. ■ To avoid forced eviction ■ To anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by (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. ■ To improve, or restore, the livelihoods and standards of living of displaced persons. ■ To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.
Performance Standard 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources recognizes 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	■ To protect and conserve biodiversity ■ To maintain the benefits from ecosystem services ■ To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities
Performance Standard 7 - Indigenous People recognizes that Indigenous People, as social groups with identities that are distinct from dominant groups in national societies, are often among the most marginalized and vulnerable segments of the population.	■ To ensure that the development process fosters full respect for the dignity, human rights, aspirations, cultures and natural resource-based livelihoods of Indigenous People ■ To anticipate and avoid adverse impacts of projects on communities of Indigenous People, or when avoidance is not feasible, to minimize, mitigate, or compensate for such impacts, and to provide opportunities for development benefits, in a culturally appropriate manner ■ To promote sustainable development benefits and opportunities for Indigenous People in a culturally appropriate manner. ■ To establish and maintain an ongoing relationship based on Informed Consultation and Participation (ICP) with the Indigenous People (IPs) affected by a project throughout the life of the project ■ To ensure the Free, Prior and Informed Consent (FPIC) of the Affected Communities of the IPs when the circumstances described in this Performance Standard are present. ■ To respect and preserve the culture, knowledge and practices of Indigenous People
Performance Standard 8 - Cultural Heritage recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to ensure that clients protect cultural heritage in the course of their project activities.	■ 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 recognizes 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

Performance Standards	Objectives
	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.

Source: IFC, 2012.[4]

3.5.2 International Finance Corporation (IFC)/World Bank Environmental, Health, and Safety (EHS) Guidelines

The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent.

Due to the technical nature of the standards, the limits and levels are not included here in the regulatory review. However the standards, where applicable, will be assessed and complied with as per the technical requirements set out in the original document.

Applicable IFC General EHS Guidelines are shown in ***Table 3.17*** and IFC/World Bank EHS Guidelines for Thermal Plants are shown in ***Table 3.21.***

Table 3.17: Applicable IFC General EHS Guidelines

Applicable IFC EHS Guidelines
General Environmental Guidelines
1.1 Air Emissions and Ambient Air Quality
1.2 Energy Conservation
1.3 Wastewater and Ambient Water Quality
1.4 Water Conservation
1.5 Hazardous Materials Management
1.6 Waste Management
1.7 Noise

[4] IFC. (2012). Performance Standards on Environmental and Social Sustainability. International Finance Corporation. World Bank Group. Retrieved from https://www.ifc.org/wps/wcm/connect/115482804a0255db96fbffd1a5d13d27/PS_English_2012_Full-Document.pdf?MOD=AJPERES

Applicable IFC EHS Guidelines
1.8 Contaminated Land
General Occupational Health and Safety Guidelines
2.1 General Facility and Design and Operation
2.2 Communications and Training
2.3 Physical Hazards
2.4 Chemical Hazards
2.5 Biological Hazards
2.6 Radiological Hazards
2.7 Personal Protective Equipment (PPE)
2.8 Special Hazards Environments
2.9 Monitoring
General Community Health and Safety
3.1 Water Quality and Availability
3.2 Structural Safety and Project Infrastructure
3.3 Life and Fire Safety (L&FS)
3.4 Traffic Safety
3.5 Transport of Hazardous Materials
3.6 Disease Prevention
3.7 Emergency Preparedness and Response
General Construction and Demolition Guidelines
4.1 Environment
4.2 Occupational Health and Safety
4.3 Community Health and Safety
Sectors Specific EHS Guidelines
EHS Guidelines for Thermal Power Plants

Source: IFC, 2007.[5]

[5] IFC. (2007). Environmental, Health, and Safety (EHS) General Guidelines. International Finance Corporation (IFC). World Bank Group. Retrieved from https://www.ifc.org/wps/wcm/connect/554e8d80488658e4b76af76a6515bb18/Final%2B-%2BGeneral%2BEHS%2BGuidelines.pdf?MOD=AJPERES

Where different standards are prescribed by the different agencies, the most stringent of the national and international standards will apply to the Project:

"When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment." (IFC General EHS Guidelines, page 1).

In general, the IFC's EHS Guidelines are the more comprehensive and stringent. Compliance with national standards is always required. It should be noted that the IFC's EHS Guidelines are now under revision and the first batch of revised guidelines (including the General EHS Guidelines), will tentatively be finalised in 2016.

3.5.3 International Finance Corporation (IFC)/Environmental, Health, and Safety Guidelines for Liquefied Natural Gas Facilities

The EHS Guidelines for Liquefied Natural Gas (LNG) Facilities include information relevant to LNG base load liquefaction plants, transport (by sea and land), storage, regasification (including floating storage regasification units), peak shaving terminals, and LNG fuelling facilities. For coastal LNG facilities-including harbors, jetties, and in general coastal facilities (e.g., coastal terminals, marine supply bases, loading/offloading terminals), additional guidance is provided in the EHS Guidelines for Ports, Harbors, and Terminals. For EHS issues related to vessels and floating storage units, additional guidance is provided in the EHS Guidelines for Shipping. EHS issues associated with road transportation of LNG are addressed in the General EHS Guidelines. Issues related to liquefied petroleum gas/condensate production and storage in liquefaction plants are not covered in this Guideline.

The EHS guidelines for liquefied natural gas facilities are listed in ***Table 3.18***.

Table 3.18: IFC/World Bank EHS Guidelines for Liquefied Natural Gas Facilities

EHS Guidelines for Liquefied Natural Gas Facilities	
1	Industry-Specific Impacts and Management
1.1	Environment
■ Hazardous material management ■ Wastewater discharges ■ Air emissions ■ Waste management ■ Noise generation ■ LNG transport related issues ■ LNG fueling related issues	
1.2	Occupational Health and Safety (OH&S)
■ Fire and Explosion ■ Roll-over ■ Contact with cold surfaces ■ Chemical hazards ■ Confined spaces	
1.3	Community Health and Safety
■ Security	
2	Performance Indicators and Monitoring
2.1	Environment
■ Emission and Effluent Guidelines ■ Resource Use and Energy Consumption ■ Environmental Monitoring	
2.2	Occupational Health and Safety (OH&S)
■ OH&S Guidelines ■ Accident and Fatality Rates ■ OH&S Monitoring	

Source: Environmental, Health and Safety Guidelines for Liquefied Natural Gas Facilities.[6]

[6] IFC. (2017). Environmental, Health, and Safety Guidelines for Liquefied Natural Gas Facilities. International Finance Corporation (IFC). World Bank Group. Retrieved from https://www.ifc.org/wps/wcm/connect/edb102c5-ca61-4561-8b8e-8124fa2060af/20170406-FINAL+LNG+EHS+Guideline_April+2017.pdf?MOD=AJPERES

3.5.4 International Finance Corporation (IFC)/Environmental, Health, and Safety Guidelines for Ports, Harbours, and Terminals

The EHS Guidelines for Ports, Harbors, and Terminals are applicable to marine and freshwater ports, harbors, and terminals for cargo and passengers. Shipping (including repair and maintenance of ships), fuel terminals, and railways are addressed in the ***EHS Guidelines for Shipping****;* ***Crude Oil*** *and* ***Petroleum Product Terminals****; and* ***Railways****, respectively. Annex A provides a summary of industry sector activities.*

The EHS guidelines for liquefied natural gas facilities are listed in ***Table 3.19***.

Table 3.19: IFC/World Bank EHS Guidelines for Ports, Harbours, and Terminals

EHS Guidelines for Ports, Harbours, and Terminals	
1	Industry-Specific Impacts and Management
1.1	Environment
■ Terrestrial and aquatic habitat alteration and biodiversity ■ Climate change resilience ■ Water quality ■ Air emissions ■ Waste management ■ Hazardous materials and oil management ■ Noise and vibration (including underwater)	
1.2	Occupational Health and Safety (OH&S)
■ Physical hazards ■ Chemical hazards ■ Confined spaces ■ Exposure to organic and inorganic dust ■ Exposure to noise	
1.3	Community Health and Safety
■ Port marine safety ■ Port security ■ Visual impacts	
2	Performance Indicators and Monitoring
2.1	Environment
■ Emission and Effluent Guidelines ■ Environmental Monitoring	
2.2	Occupational Health and Safety (OH&S)
■ OH&S Guidelines ■ Accident and Fatality Rates ■ OH&S Monitoring	

Source: Environmental, Health and Safety Guidelines for Ports, Harbours, and Terminals.[7]

With regards to industry activities that apply to this guideline, the guideline states that *"A harbor is a stretch of water where vessels can anchor or secure to buoys or alongside wharves to obtain*

[7] IFC. (2017). Environmental, Health, and Safety Guidelines for Ports, Harbours, and Terminals. International Finance Corporation (IFC). World Bank Group. Retrieved from https://www.ifc.org/wps/wcm/connect/d2f2cf88-ce22-4a48-86fc-45ee3b8e9e45/20170201-FINAL_EHS+Guidelines+for+Ports+Harbors+and+Terminals.pdf?MOD=AJPERES

protection (by natural or artificial features) from storms and rough water. A port is a commercial harbor or commercial part of a harbor with terminals, quays, wharves, enclosed docks, and facilities for transferring cargo from shore–to-vessel or vessel-to-shore. This includes onshore facilities and structures for receiving, handling, storing, consolidating, and loading or delivering waterborne shipments or passengers. Ports may include terminals, which generally serve a specific function, such as for containers, bulk shipments of cement, iron ore, grain, etc., and these terminals maybe be operated by a third party. Ports also may provide ship support facilities and services, including waste management and effluent discharge facilities, maintenance of vehicles and equipment, painting and other vessel maintenance."

3.5.5 International Finance Corporation (IFC)/Environmental, Health, and Safety Guidelines for Shipping

The EHS Guidelines for Shipping include information relevant to the operation and maintenance of ships used for the transport of bulk cargo, and goods. Cargo handling, vessel maintenance, and other in-port activities are covered under the EHS Guidelines for Ports and Harbors while issues specific to the transfer and storage of bulk fuels are covered in the EHS Guidelines for Crude Oil and Petroleum Product Terminals. The EHS Guidelines for Shipping apply to vessels operated with fossil fuels and do not address issues specific to nuclearpowered vessels.

The EHS guidelines for liquefied natural gas facilities are listed in .

Table 3.20: IFC/World Bank EHS Guidelines for Shipping

EHS Guidelines for Shipping
1 Industry-Specific Impacts and Management
1.1 Environment
1.1.1 Marine Operations
■ Petroleum and Hazardous Materials Management - Hazardous Materials and Oil Spill Prevention - Packaged Harmful Substances - Antifouling Paint ■ Wastewater and Other Effluents - Ballast water - Domestic Wastewater and Sewage - Other Wastewater ■ Air Emissions - Engine Exhaust - Shipboard Incineration - Ozone Depleting Substances ■ Waste - General Solid Waste - Hazardous Waste - Ship Breaking Wastes
1.1.2 Ship Maintenance

EHS Guidelines for Shipping
■ Air emissions ■ Wastewater and Other Effluents ■ Waste Management ■ Hazardous Materials Management
1.2 Occupational Health and Safety
1.2.1 Marine Operations
■ Crew accomodations and working spacesPort security ■ Physical hazards ■ Confined spaces ■ Chemical hazards (including risk of fire and explosions) ■ Security issues
1.2.2 Ship Maintenance
1.3 Community Health and Safety
■ General Safety ■ Life Safety ■ Fire Safety ■ Security
2 Performance Indicators and Monitoring
2.1 Environment
■ Emission and Effluent Guidelines ■ Environmental Monitoring
2.2 Occupational Health and Safety (OH&S)
■ OH&S Guidelines ■ Accident and Fatality Rates ■ OH&S Monitoring

Source: Environmental, Health and Safety Guidelines for Ports, Harbours, and Terminals.[8]

3.5.6 Projects Located in Degraded Airsheds

To determine whether the airshed of the Project Location is degraded or not, appropriate air monitoring will be required. The result will then be compared against relevant and available standards. However, Myanmar NEQ (2015) does not provide any description or guidelines for a Non-Degraded Airsheds and therefore this Project will adopt IFC General EHS Guideline instead. The IFC's General EHS Guidelines state that *'Facilities or projects located within poor quality airsheds should ensure that any increase in pollution levels is as small as feasible, and amounts to a fraction of the applicable short-term and annual average air quality guidelines or standards as established in the project-specific environmental assessment. Suitable mitigation measures may also include the relocation of significant sources of emissions outside the airshed in question, use of cleaner fuels or technologies, application of comprehensive pollution control measures, offset activities at installations controlled by the project sponsor or other facilities within the same airshed, and buy-down of emissions within the same airshed. Specific provisions for minimizing emissions and their impacts in poor air quality airsheds should be established on a project-by-project or industry-specific basis.*

[8] IFC. (2007). Environmental, Health, and Safety Guidelines for Shipping. International Finance Corporation (IFC). World Bank Group. Retrieved from https://www.ifc.org/wps/wcm/connect/32efb42e-d54b-4e30-81c1-086b290f49bd/Final%2B-%2BShipping.pdf?MOD=AJPERES&CVID=jqezIpJ&id=1323152475418

Offset provisions outside the immediate control of the project sponsor or buy-downs should be monitored and enforced by the local agency responsible for granting and monitoring emission permits. Such provisions should be in place prior to final commissioning of the facility / project.' (IFC General EHS Guidelines, page 5).

Table 3.21: IFC/World Bank EHS Guidelines for Thermal Power Plants

EHS Guidelines for Thermal Power Plants	
1.0	Industry-Specific Impacts and Management
1.1	Environment
■ Air emissions ■ Effluents ■ Solid wastes ■ Hazardous Materials and Oil ■ Noise	
1.2	Occupational Health and Safety (OH&S)
■ Non-ionizing radiation ■ Heat ■ Noise ■ Confined Spaces ■ Electrical Hazards ■ Fire and Explosion Hazards ■ Chemical Hazards ■ Dust	
1.3	Community Health and Safety
■ Water consumption ■ Traffic Safety	
2.0	Performance Indicators and Monitoring
2.1	Environment
■ Emission and Effluent Guidelines ■ Environmental Monitoring	
2.2	Occupational Health and Safety (OH&S)
■ OH&S Guidelines ■ Accident and Fatality Rates ■ OH&S Monitoring	

Source: Environmental, Health and Safety Guidelines for Thermal Power Plants.[9]

3.5.7 Australian and New Zealand Interim Sediment Quality Guidelines

Considering there are no national sediment quality guidelines in Myanmar, sediment quality will be compared against the Australian and New Zealand interim sediment quality guidelines[10] (hereafter referred to as "the ISQG"). As stated in the guidelines, "*Sediments are important, both as a source and as a sink of dissolved contaminants, as has been recognised for some time. As well as influencing surface water quality, sediments represent a source of bioavailable contaminants to benthic biota and hence potentially to the aquatic food chain. Therefore it is desirable to define situations in which contaminants associated with sediments represent a likely threat to ecosystem health. While costly remediation or restoration might not represent a management option, sediment guidelines can usefully serve to identify uncontaminated sites that are worthy of protection. Sediment quality guidelines are being actively considered by regulatory agencies worldwide.*"

The Sediment Quality Guidelines will serve three purposes:

- *To identify sediments where contaminant concentrations are likely to result in adverse effects on sediment ecological health;*
- *To facilitate decisions about the potential remobilisation of contaminants into the water column and/or into aquatic food chains; and*
- *To identify and enable protection of uncontaminated sediments.*

The recommended guideline values for metals, metalloids, organometallic and organic sediment contaminants are shown in ***Table 3.22***. For the purposes of analysing sediment quality from baseline sampling, the results will be compared to the ISQG-Low (Trigger value); values that exceed ISQG-High values can be discussed further.

Table 3.22: Recommended Sediment Quality Guidelines[a]

Contaminant	ISQG-Low (Trigger value)	ISQG-High
Metals (mg/kg dry weight)		
Antimony	2	25
Cadmium	1.5	10
Chromium	80	370
Copper	65	270
Lead	50	220
Mercury	0.15	1
Nickel	21	52
Silver	1	3.7
Zinc	200	410
Metalloids (mg/kg dry weight)		

[9] IFC. (2008). Environmental, Health, and Safety Guidelines for Thermal Power Plants. International Finance Corporation (IFC). World Bank Group. Retrieved from https://www.ifc.org/wps/wcm/connect/dfb6a60048855a21852cd76a6515bb18/FINAL_Thermal%2BPower.pdf?MOD=AJPERES&id=1323162579734

[10] ANZECC, & ARMCANZ. (2000). Sediment Quality Guidelines. National Water Quality Management Strategy: Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Retrieved from http://www.waterquality.gov.au/anz-guidelines/Documents/ANZECC-ARMCANZ-2000-guidelines-vol1.pdf

Contaminant	ISQG-Low (Trigger value)	ISQG-High
Arsenic	20	70
Organometallics		
Tributyltin (µg Sn/kg dry weight)	5	70
Organics (µg/kg dry weight)[b]		
Acenaphthene	16	500
Acenaphthalene	44	640
Anthracene	85	1,100
Flourene	19	540
Naphthalene	160	2,100
Phenanthrene	240	1,500
Low Molecular Weight PAHs[c]	552	3,160
Benzo(a)anthracene	261	1,600
Benzo(a)pyrene	430	1,600
Dibenzo(a,h)anthracene	63	260
Chrysene	384	2,800
Fluoranthene	600	5,100
Pyrene	665	2,600
High Molecular Weight PAHs[c]	1,700	9,600
Total PAHs	4,000	45,000
Total DDT	1.6	46
p.p'-DDE	2.2	27
o,p'- + p,p'-DDD	2	20
Chlordane	0.5	6
Dieldrin	0.02	8
Endrin	0.02	8
Lindane	0.32	1
Total PCBs	23	-

Note: a - Primarily adapted from Long et al. (1995);
b - Normalised to 1% organic carbon;
c - Low molecular weight PAHs are the sum of concentrations of acenaphthene, acenaphthalene, anthracene, fluorene, 2-methylnaphthalene, naphthalene and phenanthrene; high molecular weight PAHs are the sum of concentrations of benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, fluoranthene and pyrene.

3.5.8 International Organization for Standardization (ISO) 14001

The ISO is a non-governmental organization that develops voluntary international standards to ensure the quality, safety, and efficiency of products, services, and systems. ISO certification allows for companies to voluntary follow a set of standards that are recognised and adopted internationally. ISO 14001 defines the criteria for an Environmental Management System (EMS), its objective is to identify, manage, monitor, and control environmental issues. TPMC currently holds the ISO 14001 certificate.

3.6 International Conventions

Myanmar has ratified several international conventions. Highlights of key conventions are provided below.

3.6.1 The Kyoto Protocol on Climate Change (UNFCC)

Myanmar achieved full accession to the UNFCC in 2003. This obligates Myanmar to assure that future development in the country meets the conditions of the Convention. Relevant to this Project are the requirements associated with the potential generation of greenhouse gas from the operation of the coal-fired power plant; further conditions of relevance include:

- Enhancement of energy efficiency in relevant sectors;
- Protection and enhancement of sinks and reservoirs of greenhouse gases;
- Promotion of sustainable forest management practices, afforestation and reforestation;
- Promotion of sustainable forms of agriculture;
- Implementation of measures to limit and/ or reduce emissions of greenhouse gases; and
- Limitation and/ or reduction in methane emissions.

3.6.2 The United Nations Convention on Biodiversity 1992

This Convention seeks to conserve biodiversity and promote its sustainable use. It requires the identification and monitoring of the biodiversity in an area and adopting the necessary conservation measure. Myanmar became party to this Convention in 1994.

3.6.3 The Basel Convention 1989

This was developed under the auspices of the United Nations Environmental Programme (UNEP) in response to the growing worldwide awareness of the problem of international traffic in hazardous waste. The Basel Convention 1989 is the first and foremost global environmental treaty that strictly regulates the trans-boundary movement of hazardous wastes. It obligates parties to ensure environmentally sound management, especially during the disposal process.

The objectives of the Convention are to:

- Ensure that waste is disposed of as near as possible to the place or source of its generation;
- Reduce trans-boundary waste and where it cannot be avoided, to be disposed of in an environmentally sound and efficient manner; and
- Provide assistance to developing countries in the management of hazardous waste and the generation.

The Convention places a ban on the export of hazardous waste from Organization for Economic Cooperation and Development (OECD) countries to non-OECD countries.

3.6.4 International Labour Organisation (ILO)

Myanmar ratified several ILO Fundamental and Technical conventions relevant to the Project. This includes:

- C1 Hours of Work (Industry), relative to the maximum working hours for the industrial sector (private and public) and the exceptions that can be applied to the maximum of 8 hours per day and 48 hours per week stated in this convention and under what conditions.
- C14 Weekly Rest (Industry), relative to the minimum of 24 consecutive hours of rest every period of seven days and the exceptions that can be applied and under what conditions.

- C17 Workmen's Compensation (Accidents), relative to compensation to be provided to workmen who suffer personal injury due to an industrial accident, or their dependants.
- C19 Equality of Treatment (Accident Compensation), relative to the equality of treatment for compensation between citizen of every country that has ratified this Convention.
- C26 Minimum Wage Fixing Machinery, relative to the creation or maintenance of machinery whereby minimum rates of wages can be fixed for workers employed in certain of the trades or parts of trades in which no arrangements exist for the effective regulation of wages by collective agreement or otherwise and wages are exceptionally low.
- C29 Forced Labour Convention, relative to the suppression in the shortest possible delay of every kind of forced or compulsory labour.
- C42 Workmen's Compensation (Occupational Diseases) Revised 1934, relatives to the payment of compensation to workmen, or their relatives in case of death, incapacitated by occupational diseases. The convention also includes a list of diseases and toxic substances and corresponding trades.
- C52 Holidays with Pay, relative to the minimum of 6 working days of paid holiday due to employee having work a minimum of one year of continuous service. The convention includes a list of exceptions that can be applied and under what conditions.
- C87 Freedom of Association and Protection of the Right to Organize, relative to the right of workers and employees to establish and join organisations of their own choosing without previous authorisation and the rights of these organisations.

A list of Project-relevant international treaties of which Myanmar is a signatory are provided in ***Table 3.23***.

3.6.5 International Gas Carrier Code (IGC Code)

The International Code for Construction and Equipment of Ships Carrying Liquefied Gases in Bulk adopted by International Maritime Organization (IMO) by resolution MSC.5(48). The IGC Code applies to ships regardless of their size, including those of less than 500 gross tonnage, engaged in carriage of liquefied gases having a vapour pressure exceeding 2.8 bar absolute at a temperature of 37.8°C, and certain other substances listed in chapter 19 of the Code. The aim of the Code is to provide an international standard for the safe carriage by sea in bulk of liquefied gases and the substances listed in chapter 19, by prescribing the design and construction standards of ships involved in such carriage and the equipment they should carry so as to minimize the risk to the ship, to its crew and to the environment, having regard to the nature of the products involved.

3.6.6 International Safety Guide for Oil Tankers and Terminals (ISGOTT)

ISGOTT was first published in 1978 by combining the Tanker Safety Guide (Petroleum) published by the International Chamber of Shipping (ICS) and the International Oil Tanker and Terminal Safety Guide published on behalf of the Oil Companies International Marine Forum (OCIMF). The guide cover various issues, such as gas detection, the toxicity and the toxic effects of petroleum products (including benzene and hydrogen sulphide), the generation of static electricity and stray currents, fire protection and the growing use of mobile electronic technology.

Table 3.23: International Conventions Ratified by Myanmar

No.	Conventions	Year (Ratified/Acceded/Accepted)
Environment		
1	Plant Protection Agreement for the Southeast Asia and Pacific Region, Rome 1956	1959 (Ratified)
2	MARPOL: International Convention for the Prevention of Pollution from Ships 1973 and MARPOL Protocol of 1978	1988 (Accession)
3	ICAO: ANNEX 16 to the Convention on International Civil Aviation Environmental Protection Vol. I and II, Aircraft Noise and Aircraft Engine Emission	Accession
4	Agreement on the Networks of Aquaculture Centres in Asia and the Pacific, Bangkok 1988	1990 (Accession)
5	Vienna Convention for the Protection of the Ozone Layer, Vienna 1985	1993 (Ratification)
6	Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal 1987	1993 (Ratification)
7	London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, London 1990	1993 (Ratification)
8	United Nations Framework Convention on Climate Change (UNFCCC), New York 1992	1994 (Ratification)
9	Convention on Biological Diversity, Rio de Janeiro 1992	1994 (Ratification)
10	The Convention Concerning the Protection of the World Cultural and Natural Heritage, Paris 1972	1994 (Acceptance)
11	International Tropical Timber Agreement (ITTA), Geneva 1994	1996 (Ratification)
12	United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought, Paris 1994	1997 (Accession)
13	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Washington DC 1973; and as amended in Bonn, Germany 1979	1997 (Accession)
14	ASEAN Agreement on Conservation of Nature and Nature Resources, Kuala Lumpur, 1985	1997 (Signatory)
15	Kyoto Protocol to the Convention on Climate Change, Kyoto 1997	2003 (Accession)
16	ASEAN Agreement on Trans-boundary Haze Pollution	2003 (Ratification)
17	Stockholm Convention on Persistent Organic Pollutants (POPs), 2001	2004 (Accession)
18	Ramsar Convention on Wetlands of International Importance	2005 (Accession)
19	Establishment of ASEAN Regional Centre for Biodiversity	2005 (Signatory)
20	Declaration on ASEAN Heritage Parks	2003 (Signatory)
21	International Treaty on Plant Genetic Resources for Food and Agriculture, 2001	2004 (Ratification)
22	Catagena Protocol on Biosafety, Cartagena, 2000	2001 (Signatory)
23	Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas,	1994 (Acceptance)

No.	Conventions	Year (Ratified/Acceded/Accepted)
	Rome, 1973	
24	United Nations Convention on the Law of the Sea, Montego Bay, 1982	1996 (Ratified)
25	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	1996 (Accession)
26	Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and their Destruction, Paris, 1993	1993 (Signatory)
27	Treaty on the Prohibition of the Emplacement of Nuclear Weapons and other Weapons of Mass Destruction on the Sea Bed and Ocean Floor and in the Subsoil there of, London, Moscow, Washington, 1971	1971 (Signatory)
Social, Labour and Health		
28	Universal Declaration of Human Rights (UNDHR)	signed
29	Convention on the Rights of the Child	1991 (acceded)
30	Convention on Elimination of All Forms of Discrimination against Women (CEDAW)	1997 (acceded)
31	Relevant ILO Conventions in force in Myanmar: ■ C1 Hours of Work (Industry) ■ C14 Weekly Rest (Industry) ■ C17 Workmen's Compensation (Accidents) ■ C19 Equality of Treatment (Accident Compensation) ■ C26 Minimum Wage Fixing Machinery ■ C29 Forced Labour Convention ■ C42 Workmen's Compensation (Occupational Diseases) Revised 1934 ■ C52 Holidays with Pay ■ C87 Freedom of Association and Protection of the Right to Organize	Ratified: ■ 1921 ■ 1923 ■ 1956 ■ 1927 ■ 1954 ■ 1955 ■ 1957 ■ 1954 ■ 1955

4. PROJECT DESCRIPTION AND ALTERNATIVES

4.1 Introduction

This Chapter presents an overview of the Project description as relevant for the understanding and implications of potential impacts on the environmental and socioeconomic components. The information provided by TPMC is the main source of information at this stage of the ESIA report.

4.2 Project Background

TTCL Power Myanmar Company Limited (TPMC) as 'the Project Proponent' is planning to develop a Power Plant in Yangon, Myanmar. A 388 MW Combined Cycle Power Plant ('CCPP' and/or 'LNG Ahlone CCPP) will be developed to supply the power to the Republic of the Union of Myanmar.

The Project Proponent is planning to use the Liquefied Natural Gas (LNG) as fuel supply for the proposed CCPP. The LNG supply will be imported from oversea LNG sources (LNG sources will be determined at a later stage). The LNG Receiving Terminal (including Jetty, LNG Storage Tank(s) and Regasification Unit) will be installed on the Yangon River bank in order to convert the LNG to Natural Gas (NG) and provide NG as fuel supply to Ahlone CCPP through a Natural Gas Pipeline ('the Project').

It shall be noted that the Project Proponent has prepared and submitted the Project Proposal Report (PPR) to MOEE and MONREC on 14th December 2017. The PPR recommended that TPMC shall proceed with an Environmental and Social Impact Assessment (ESIA) Study (also referred to as "Environmental Impact Assessment (EIA) Study") of the Project and prepare an Environmental Management Plan (EMP) to put forward its commitments for environmental and social mitigation and management measures. Furthermore, the Scoping Study has also been prepared and submitted to MOEE and MONREC on 9th January 2019.

In addition, as per the Environmental Impact Assessment (EIA) Procedure, promulgated on 29th December 2015, it is understood that proposed Project requires the Scoping Study and the ESIA Study to be conducted and submitted to the Ministry of Natural Resources and Environmental Conservation (MONREC) in order to obtain an Environmental Compliance Certificate (ECC).

The Project consist of three main components as follows:

- the LNG Receiving Terminal including Jetty, LNG Storage Tank(s) and Regasification Unit;
- the Natural Gas Pipeline with an approximate length of 24.9km connecting the Regasification Unit to the LNG Power Plant (Ahlone) to transfer the NG as fuel supply for the proposed 388 MW CCPP; and
- the LNG Ahlone Power Plant (388MW CCPP), which consists of 2 x 128.5MW Gas Turbines and 1 x 131 MW Steam Turbine (2 on 1 Configuration).

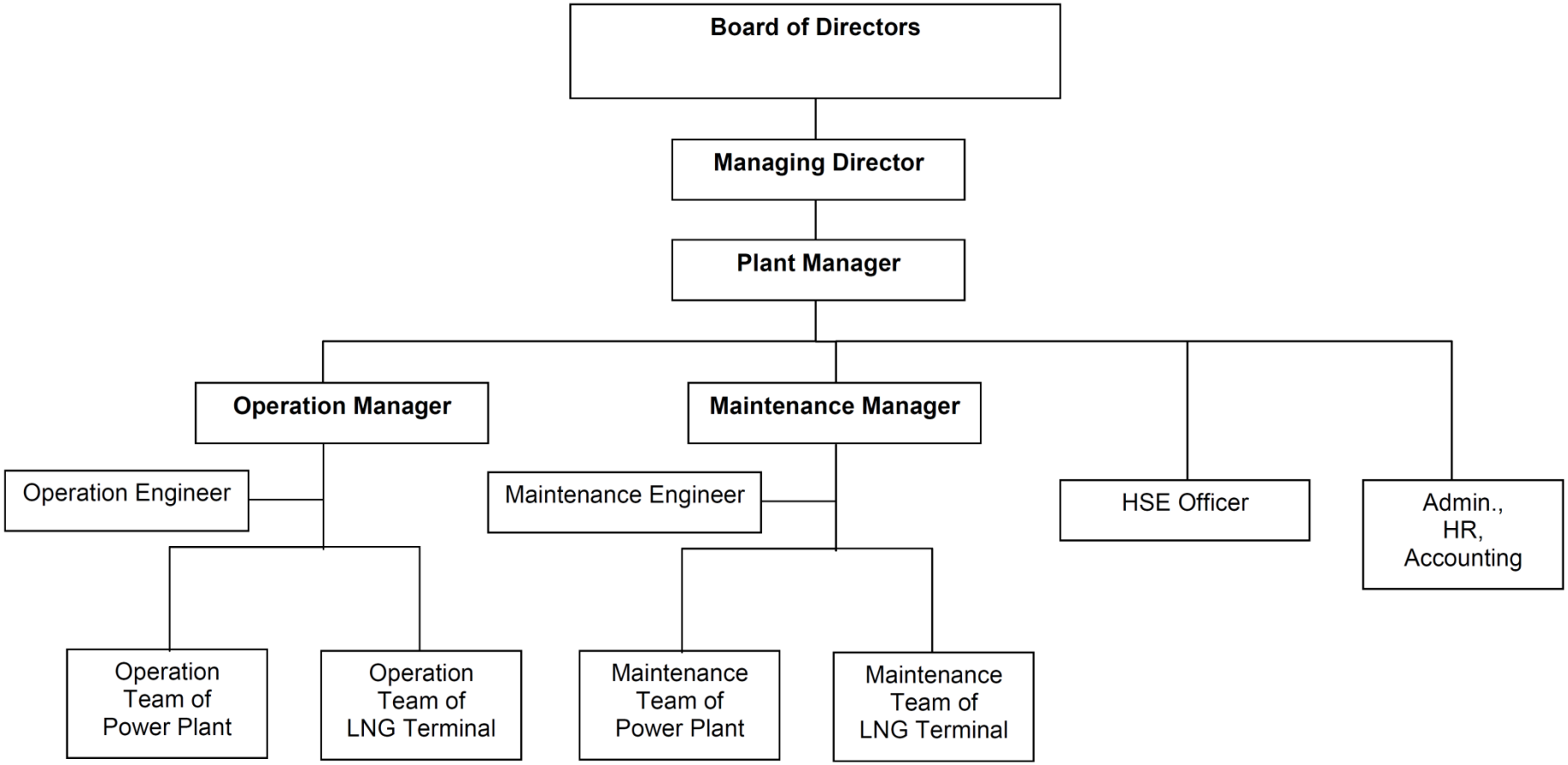
The electricity generated by the Project will be sold to MOEE via Myanmar National Grid using the existing Ahlone Power Plant sub-station.

It should be noted that the proposed overhead transmission line from the Project Site connecting to the Hlaingthayar Sub-Station is outside the scope of this ESIA Study. A separate IEE study will be prepared for the proposed transmission line.

The technology of the Project is an efficient form of combined cycle power generation, which was designed for high reliability and efficiency operation with lower environmental impact. The Project will operate on natural gas as its only fuel.

The electrical capacity and electricity generated will be sold under a 25 year PPA, as agreed with Electric Power Generation Enterprise (EPGE). The organizational structure for the Project Proponent, is shown in ***Figure 4.1***.

Figure 4.1: TPMC's Typical Project Organizational Structure



Source: TPMC, 2018.

Note that the Pipeline team will be shared with the LNG Receiving Terminal team during both construction and operation and therefore will use the same Organisation Chart.

4.3 Project Facilities

The Project components are presented below and include Project Facilities and Associated Facilities. A total are of approximately 23.97 acres of land is allocated for the Project Facilities. The LNG Receiving Terminal will be located on the West bank of the Yangon River in the Dala Township, Yangon Region, Myanmar, as shown in ***Figure 4.4***. A total of 15 acres of land is allocated for the proposed LNG Receiving Terminal. The site layout of the LNG Receiving Terminal is shown in ***Figure 4.10***.

4.3.1 Project Main Facilities

The Project will consist of three (3) main components, namely LNG Receiving Terminal, the Natural Gas Pipeline and the CCPP. The high level information of the main facilities are provided below.

The **LNG Receiving Terminal** consists of the following main components:

- LNG Unloading Jetty including LNG Unloading Arms;
- LNG Cryogenic Pipeline;
- LNG Storage Tanks; and
- Regasification Unit.

The **Natural Gas Pipeline** connecting the LNG Receiving Terminal to the Ahlone CCPP with approximately 24.9 km in length and two (2) Block Valves (one at each extremity)

The **Combined Cycle Power Plant** (CCPP) consists of the following main components:

- Main power plant area with two (2) units of Gas Turbine (128.5 MW each) and one (1) unit of Steam Turbine (131 MW);
- Two (2) units of Heat Recovery Steam Generation;
- Raw Water Treatment Facility;
- River Water Intake Pumping Station; and
- Seven (7) Cooling Towers.

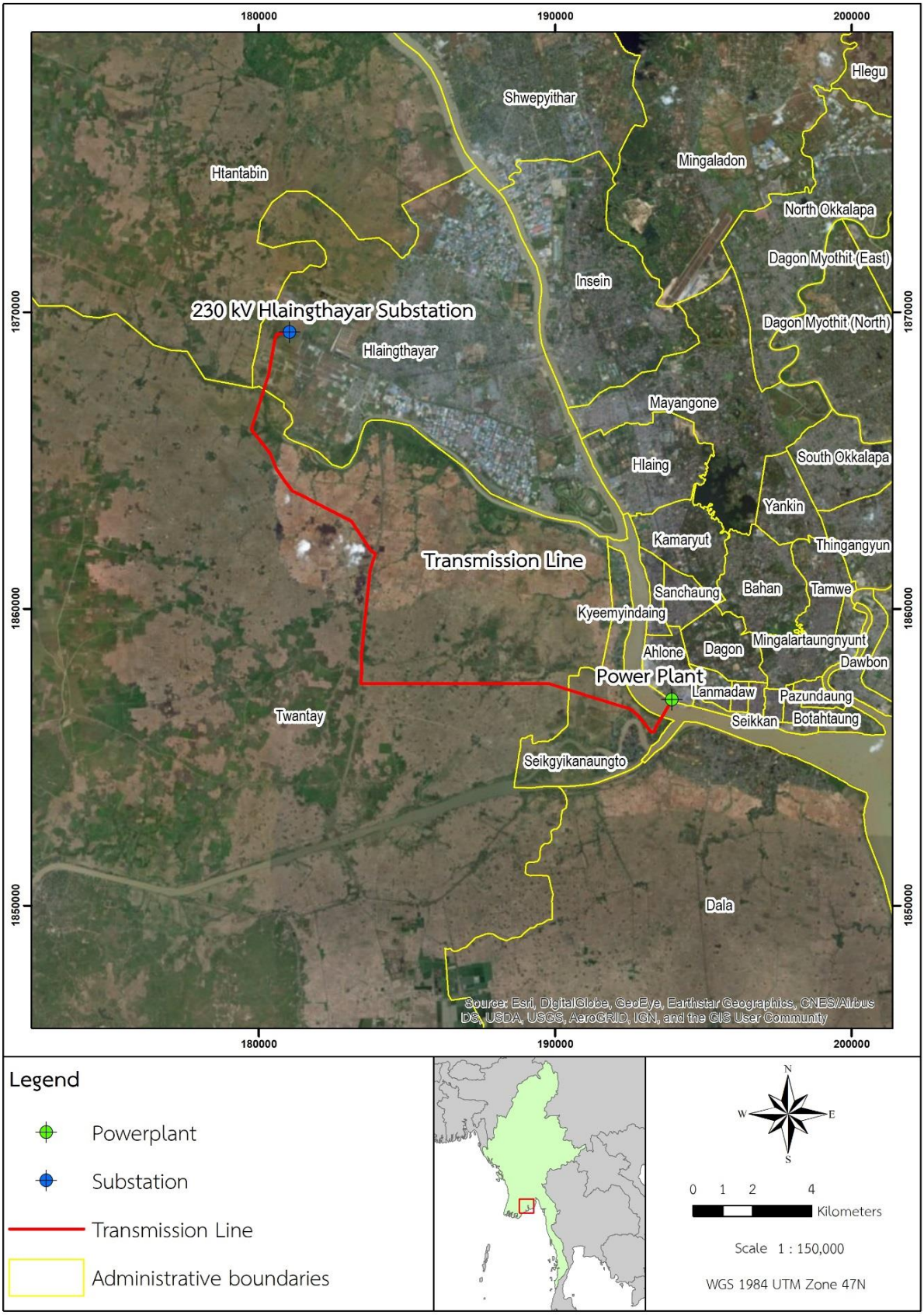
4.3.2 Associated Facilities

4.3.2.1 Transmission Line

The electricity generated by the proposed Power Plant will be transferred to a sub-station in Hlaingthayar via a 230 kV transmission line which will mainly run in parallel with the existing 230 kV transmission line transferring power for the existing Ahlone CCPP. However, the mid-section of the proposed transmission line will deviate away from the existing transmission line and will follow a proposed road of the New Yangon City Project (located at the east of Twantay Township), driven by the New Yangon Development Company Ltd. (NYDC). The length of the proposed transmission line is approximately 28 km as shown in ***Figure 4.2***. Given the Myanmar EIA Procedures (2015), a 230 kV transmission line will require an Initial Environmental Examination (IEE) Study.

It should be noted that the IEE Study for the 230 kV transmission line connecting the proposed Power Plant to the Hlaingthayar sub-station will be prepared as a separate document, and will not be included in this ESIA report.

Figure 4.2: Proposed Transmission Line Route



Source: TPMC, 2018. (Modified by ERM)

For the purposes of this ESIA Study, the remaining of the sub-section within this Chapter is organised as follows:

- ***Section 4.4***: Overall Project Location;
- ***Section 4.5***: Project Life Cycle Overview;
- ***Section 4.6***: LNG Terminal and Associated Facilities;
- ***Section 4.7***: Natural Gas (NG) Pipeline;
- ***Section 4.8***: Power Plant; and
- ***Section 4.9***: Overall Project Alternatives.

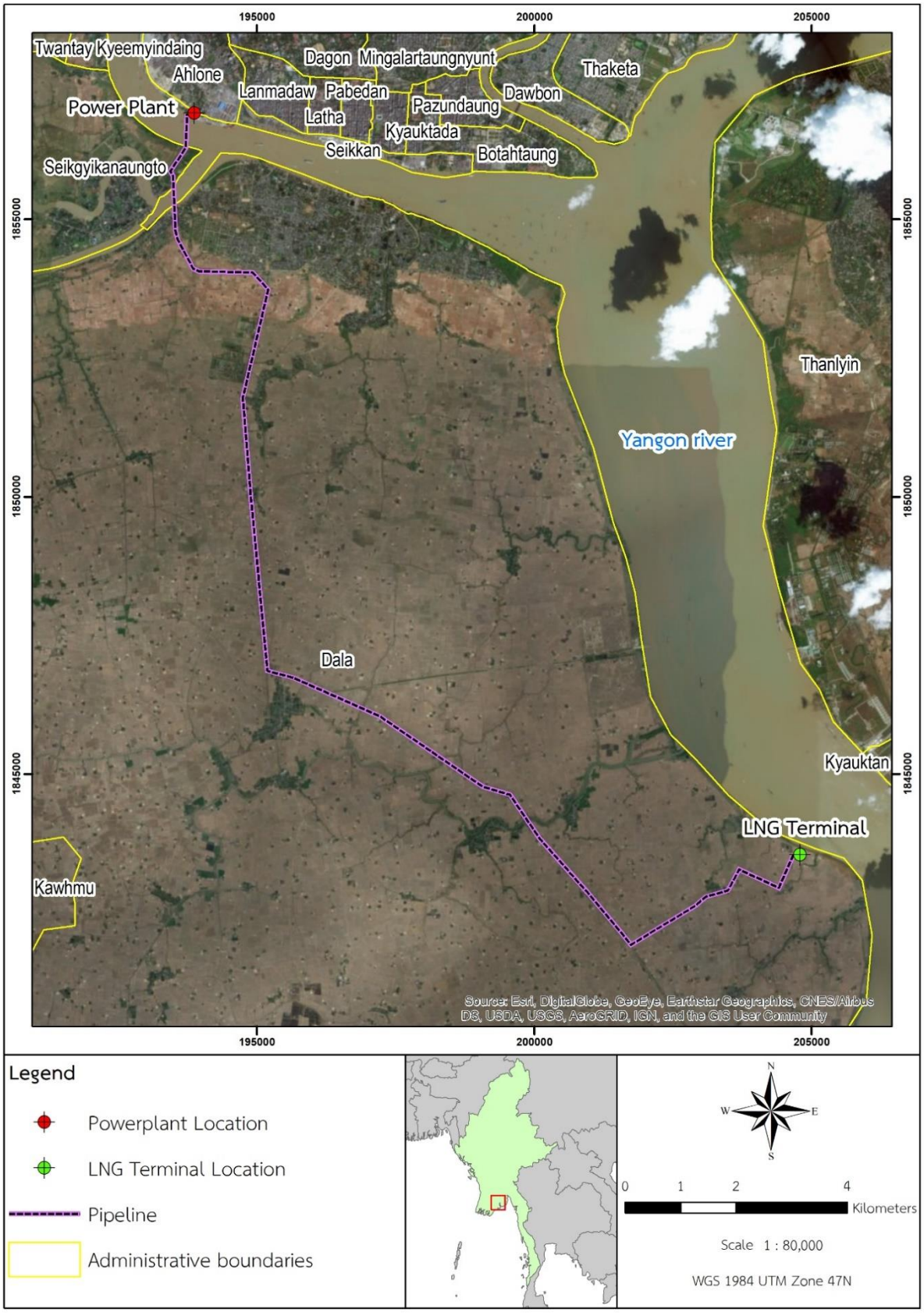
4.4 Overall Project Location

The overall Project is located across three (3) townships, which include Ahlone, Seikgykanaungto, and Dala; the overall location of the Project is shown in ***Figure 4.3***. The LNG Receiving Terminal is located southeast of Dala Township, on the West bank of Yangon River; the location of the LNG Receiving Terminal is shown in ***Figure 4.4***. The NG Pipeline, connecting the LNG Receiving Terminal to the proposed Power Plant, stretches across all three township; the pipeline location is shown in ***Figure 4.3***. The Power Plant is located on the North bank of the Yangon River, next to the Myanmar Industrial Port in the south of Ahlone Township; the Power Plant location is shown in ***Figure 4.5***. The coordinates for the LNG Receiving Terminal, Pipeline, and Power Plant are listed in ***Table 4.1***.

Table 4.1: Main Project Facility Coordinates

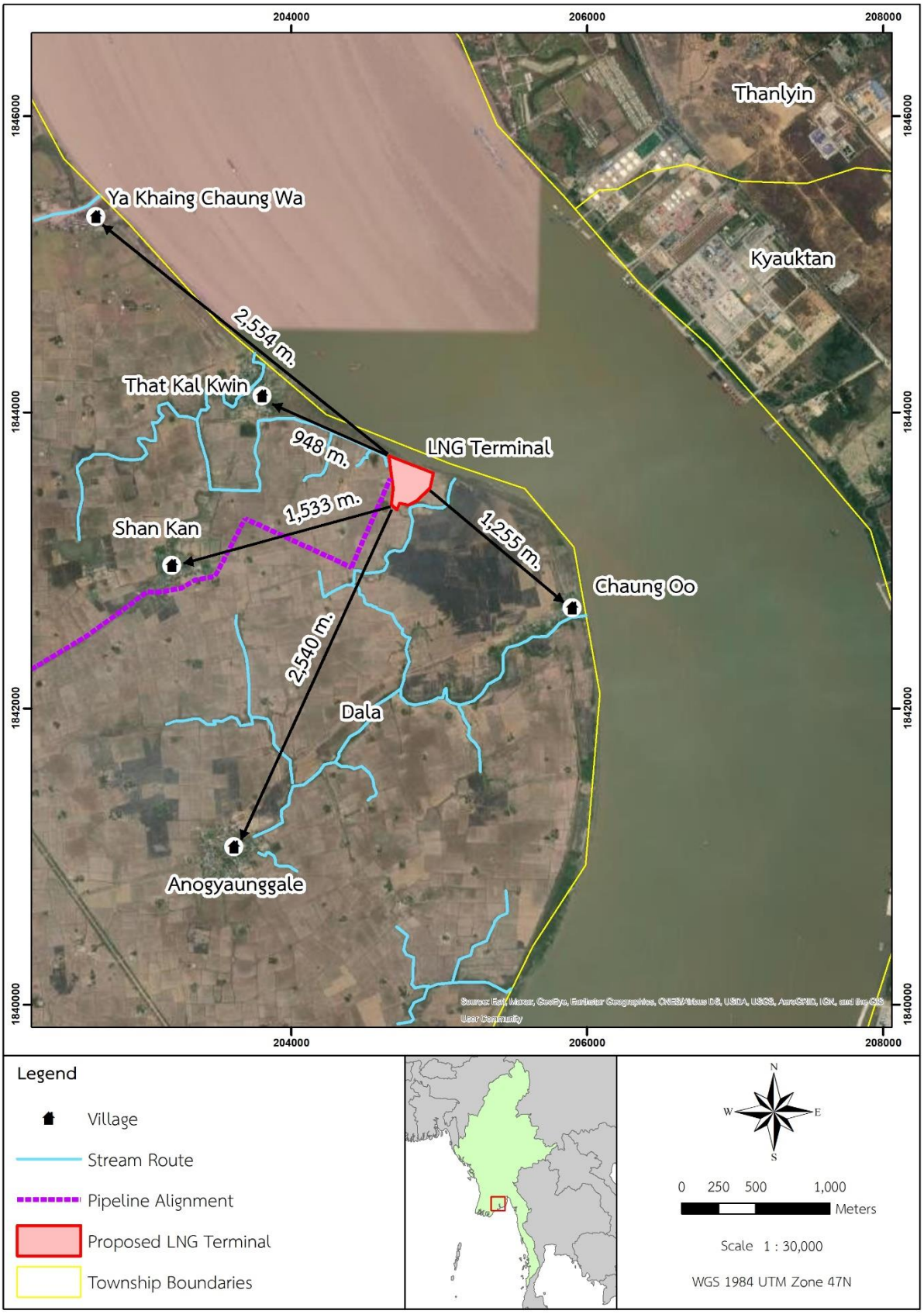
Project Main Facilities	Coordinates
LNG Receiving Terminal	16°39'22.62"N, 96°13'56.82"E
Pipeline	Shown in ***Figure 4.6***
Power Plant	16°46'31.46"N, 96° 7'42.27"E

Figure 4.3: Overall Project Location



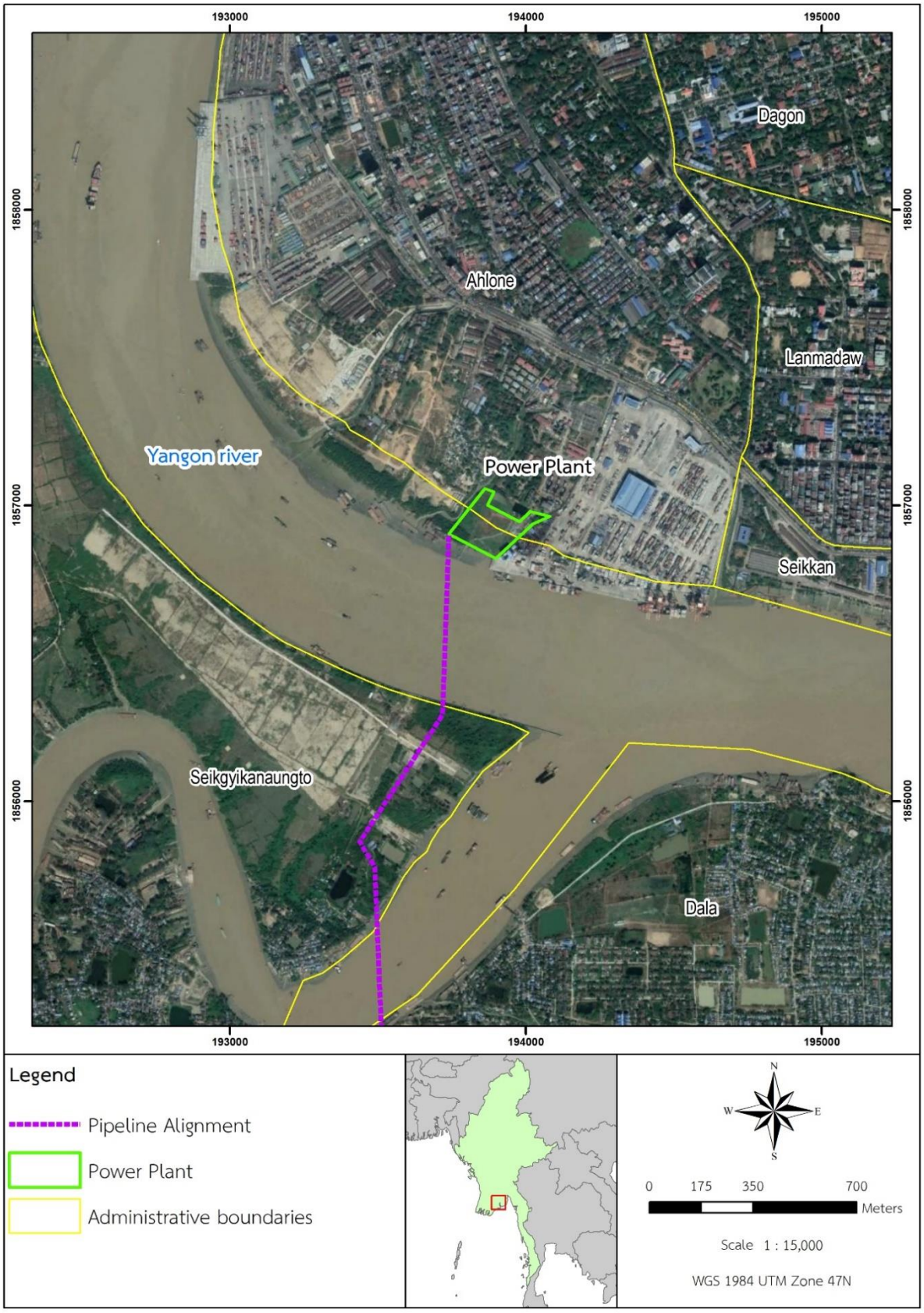
Source: TPMC, 2019. (Modified by ERM).

Figure 4.4: LNG Receiving Terminal Location



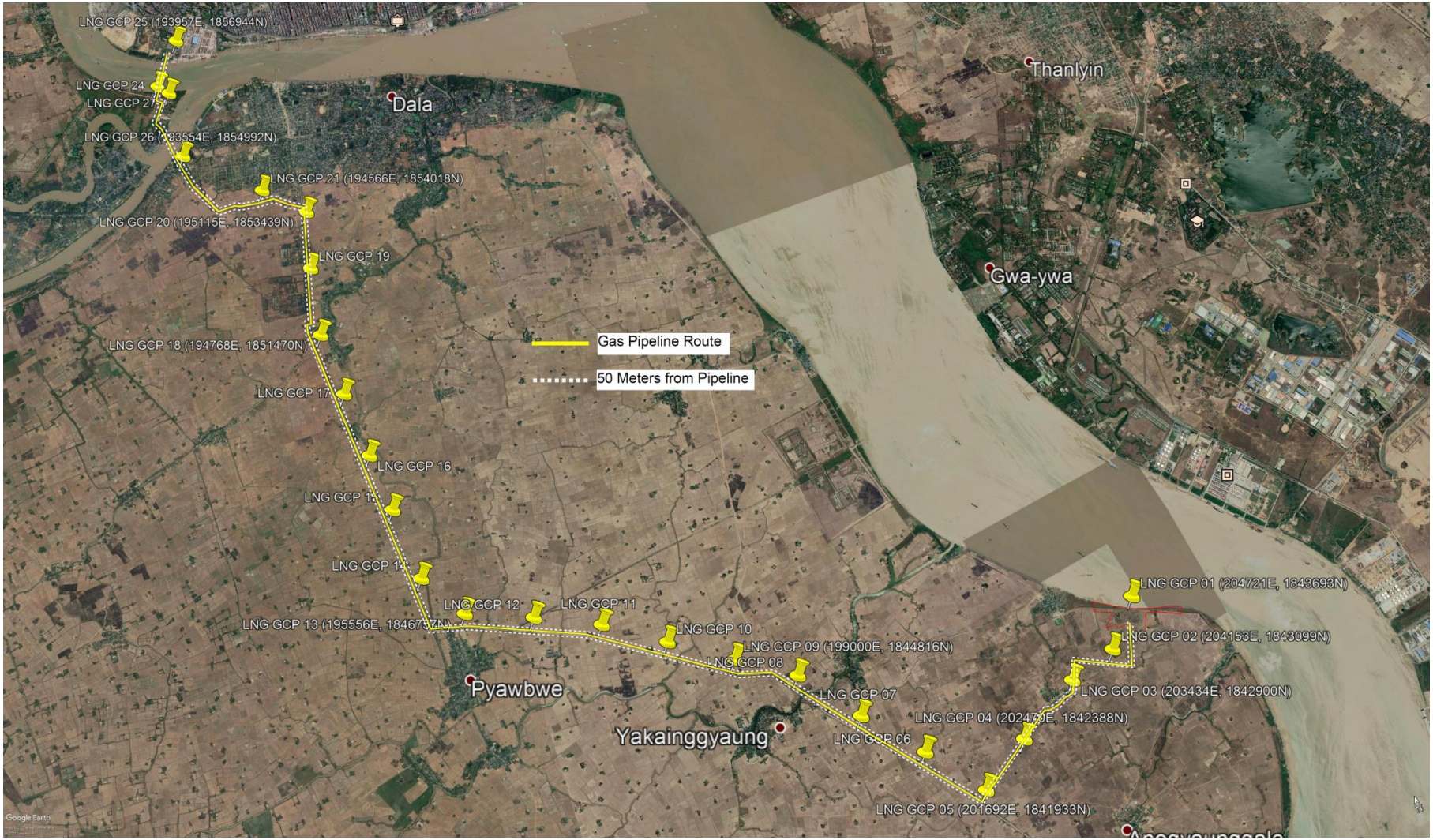
Source: TPMC, 2019. (Modified by ERM)

Figure 4.5: Power Plant Location



Source: TPMC, 2019. (Modified by ERM)

Figure 4.6: Pipeline Alignment with Coordinates



Source: TPMC, 2020.

4.5 Project Life Cycle Overview

Project life cycle analysis 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 construction, operation and maintenance, and decommissioning. These issues have been considered in this ESIA, prior to any irreversible actions being undertaken by the Project Proponent, Contractors and other Project associates. The structure of this Chapter will place the Project's three (3) main components into their individual sections; each component section will be further categorized on four (4) sub-sections, which include, Key Components, Construction, Operation, and Decommissioning. The following sub-sections identify the key activities to be completed and facilities to be constructed and operated over the lifetime of the Project.

4.5.1 Overall Project Schedule

Based on the information from the feasibility study report, the Schedule Commercial Operation Date is planned for first quarter of 2023(see ***Table 4.2***).

The necessary implementation had been scheduled and summarised below:

- Notice to Proceed signed by the Myanmar Government on 30th January 2018;
- Submission of PPR and Scoping Report on 14th December 2017 and 9th January, 2019 respectively;
- The EIA Study is submitted to the relevant authorities in August 2019;
- The Engineering & Procurement Contractor (EPC) Execution Phase is anticipated to commence from Oct 2020 on the detailed design and procurement process only. The initial activities will include pre-engineering/ detailed design, verification of geo-mechanical information. The EPC activities are expected to be completed byOct 2022; and
- Commercial operation date of LNG Power Plant (Ahlone) Project assumed to be fromMar 2023.

The preliminary Project master schedule is shown in ***Appendix F***.

Table 4.2: Tentative Project Schedule

Project Schedule	Tentative Date
Completion of Feasibility Study	Dec 2017
Site Preparation	Apr – Jun 2018
Stakeholder Engagement 1	Dec 2018
Scoping	Jan 2019
Stakeholder Engagement 2	June 2019
Final EIA submission to MONREC	Aug 2019
Detail Engineering	Jun 2019 – Sep 2020
Procurement	Oct 2020 – April 2021
LNG Terminal Construction	Nov 2020 – Aug 2022
Pipeline Construction	Nov 2020 – May 2022
Power Plant Construction	Nov 2020 – Oct 2022
LNG Terminal COD (Initial Acceptance)	Nov 2022
Pipeline COD (Initial Acceptance)	Nov 2022
Power Plant Commissioning	Nov 2022 – Mar 2023
Power Plant COD	Mar 2023

Source: TPMC, 2020.

It is noted the above Project Schedule is tentative and subject to be changed and updated

4.6 LNG Receiving Terminal and Associated Facilities

4.6.1 Key Components

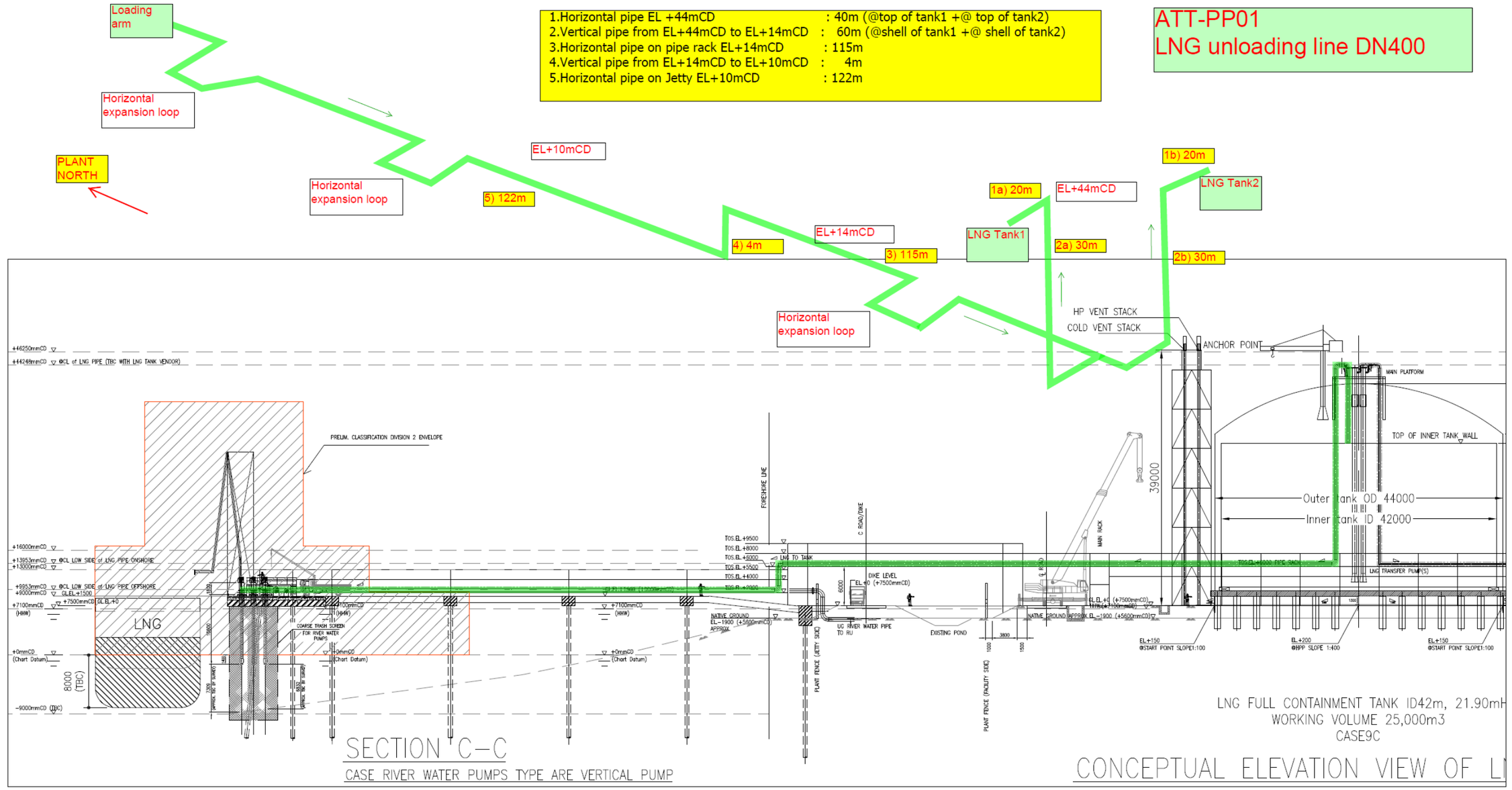
The LNG Receiving Terminal is a facility that is responsible for unloading LNG from the LNG Carrier (LNGC), providing LNG storage, and regasification process to convert LNG to NG. The indicative layout for the LNG Receiving Terminal is shown in ***Figure 4.10***. The LNG Receiving Terminal components are listed in ***Table 4.3***.

Table 4.3: LNG Receiving Terminal Key Components

Component	Details
Number of LNG Carrier per month (frequency)	2-4 LNGCs per month
LNG Carrier Capacity	16,000 ton (approx.)
LNG Carrier Type	Moss, Membrane
LNG Consumption (per day)	1,300 ton (approx.) @ 100% Load
LNG Unloading Jetty	Centre Platform with walkway, mooring dolphin and Trestle, 100 metres from river shore line Concrete Structure
LNG Unloading Arms	Two (2) liquid Unloading Arms and One(1) vapour return loading arm at the Unloading Jetty
LNG Cryogenic Pipeline	■ Stainless steel pipe with cold insulation; ■ 291 metres (approx.); from unloading arm to a LNG storage tank; ■ 160 metres (approx.); from LNG storage tank to the BOG recondenser; ■ 86 metres (approx.); from BOG recondenser to regasification unit.
LNG Storage Tanks (onshore)	Two (2) Full containment tanks with 25,000 m^3 capacity each (working volume)
Regasification Unit (RU)	Appx. 63 million standard cubic feet per day (MMSCFD), Heating source by river water Intermediate fluid vaporizers (IFV)
Vent Stack	One (1) HP Vent Stack One (1) Cold Vent Stack
Cold Water Discharge Arrangement	336 mm pipe diameter Pipe resting on the channel bottom Flow rate 1,300 m^3/h
Gas Engine Generator	Four (4) natural Gas Engine Generators (GEG) Three (3) GEG continuous operation, one (1) GEG on standby 1160 kW Continuous capacity each
Area of land where the LNG Storage Tanks and RU are to be set up and operated	15.0 acres (approx.)
General Arrangement	■ Electrical room; ■ Control room building; ■ Main gate guard house; and ■ Jetty guard house.

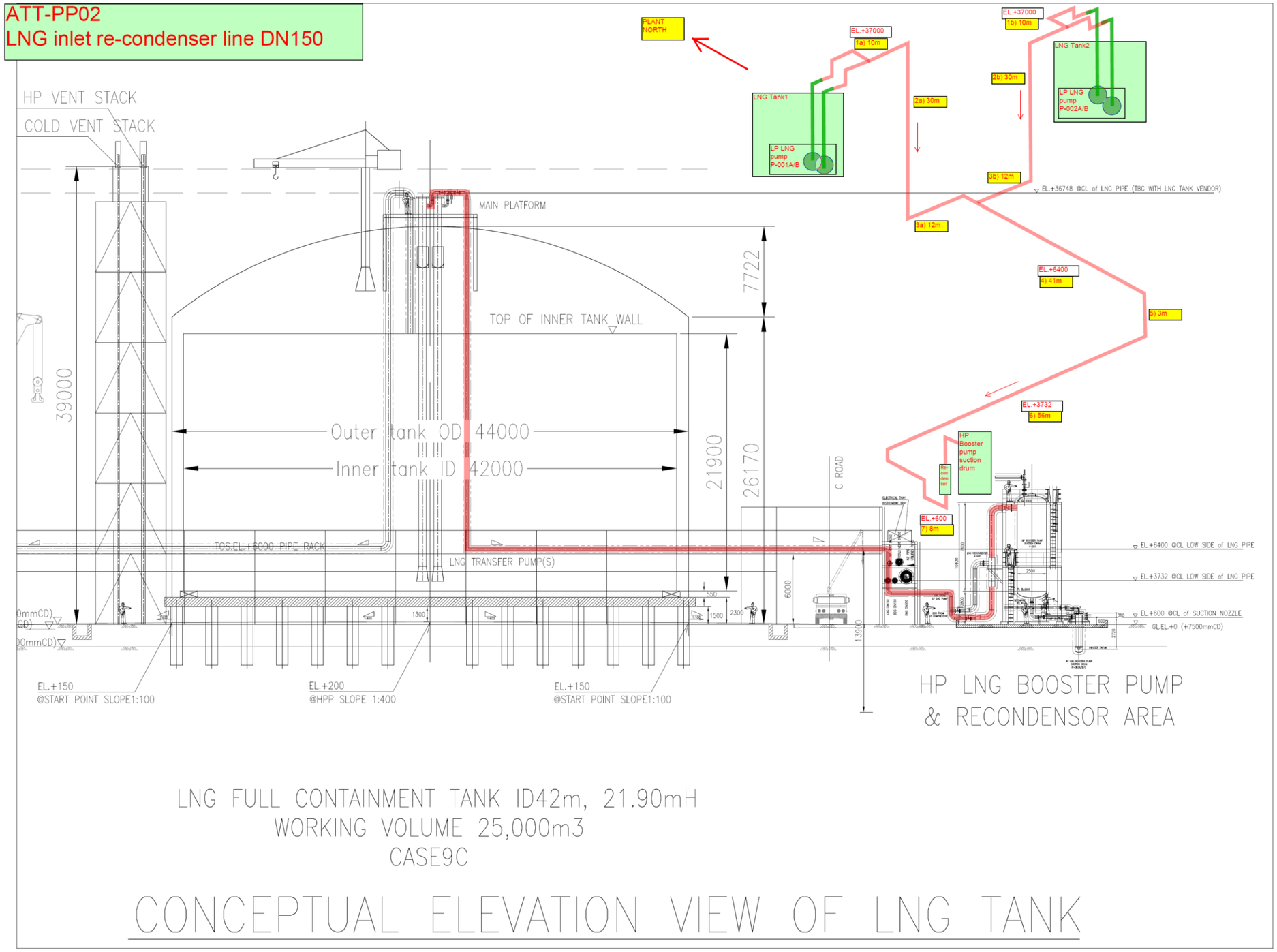
Source: TPMC, 2019

Figure 4.7: Pipeline Route from Unloading Arm to LNG Storage Tanks



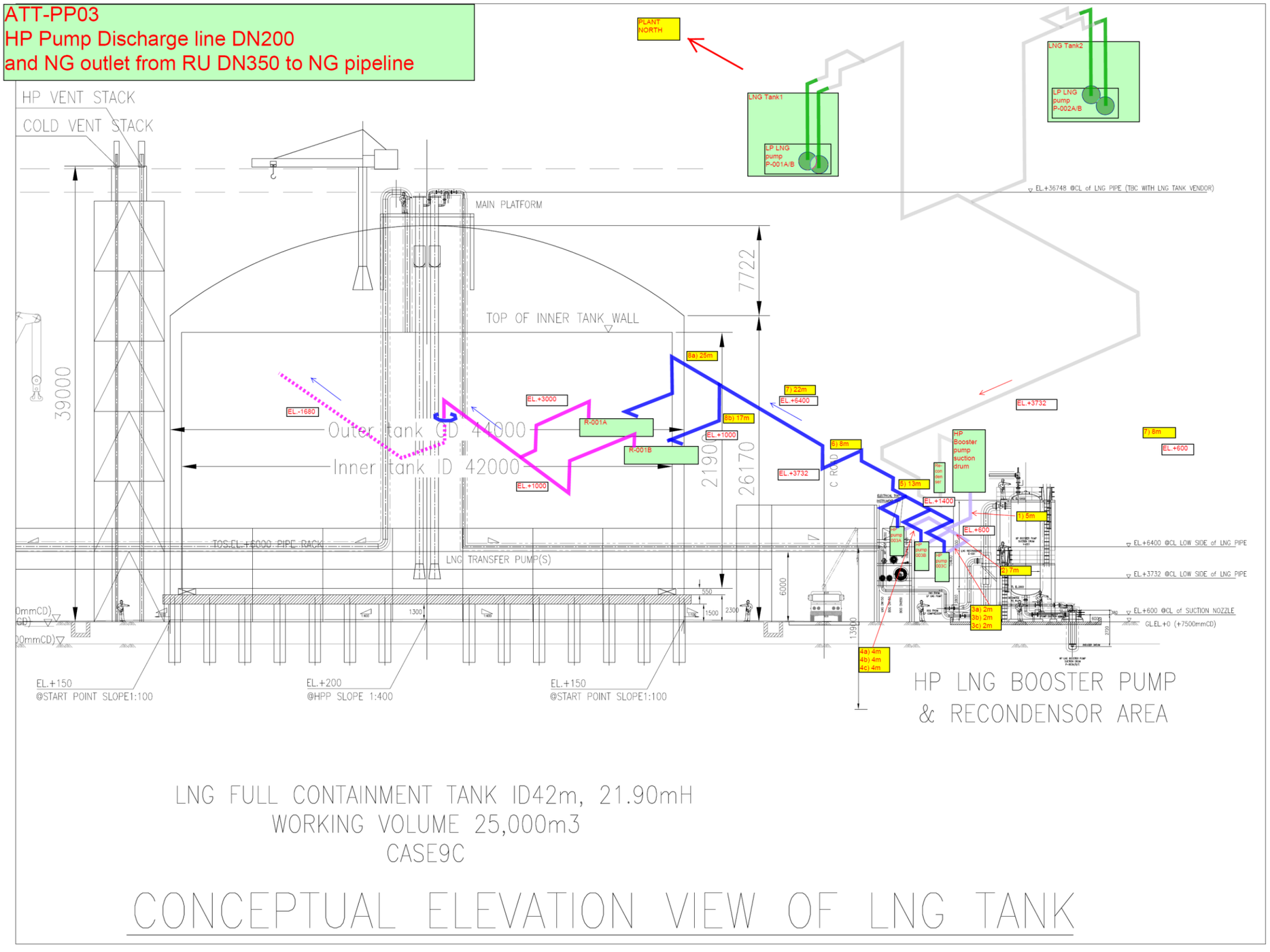
Source: TPMC, 2019.

Figure 4.8: Pipeline Route from LNG Storage Tanks to BOG Recondenser



Source: TPMC, 2019.

Figure 4.9: Pipeline Route from BOG Recondenser to Regasification Units

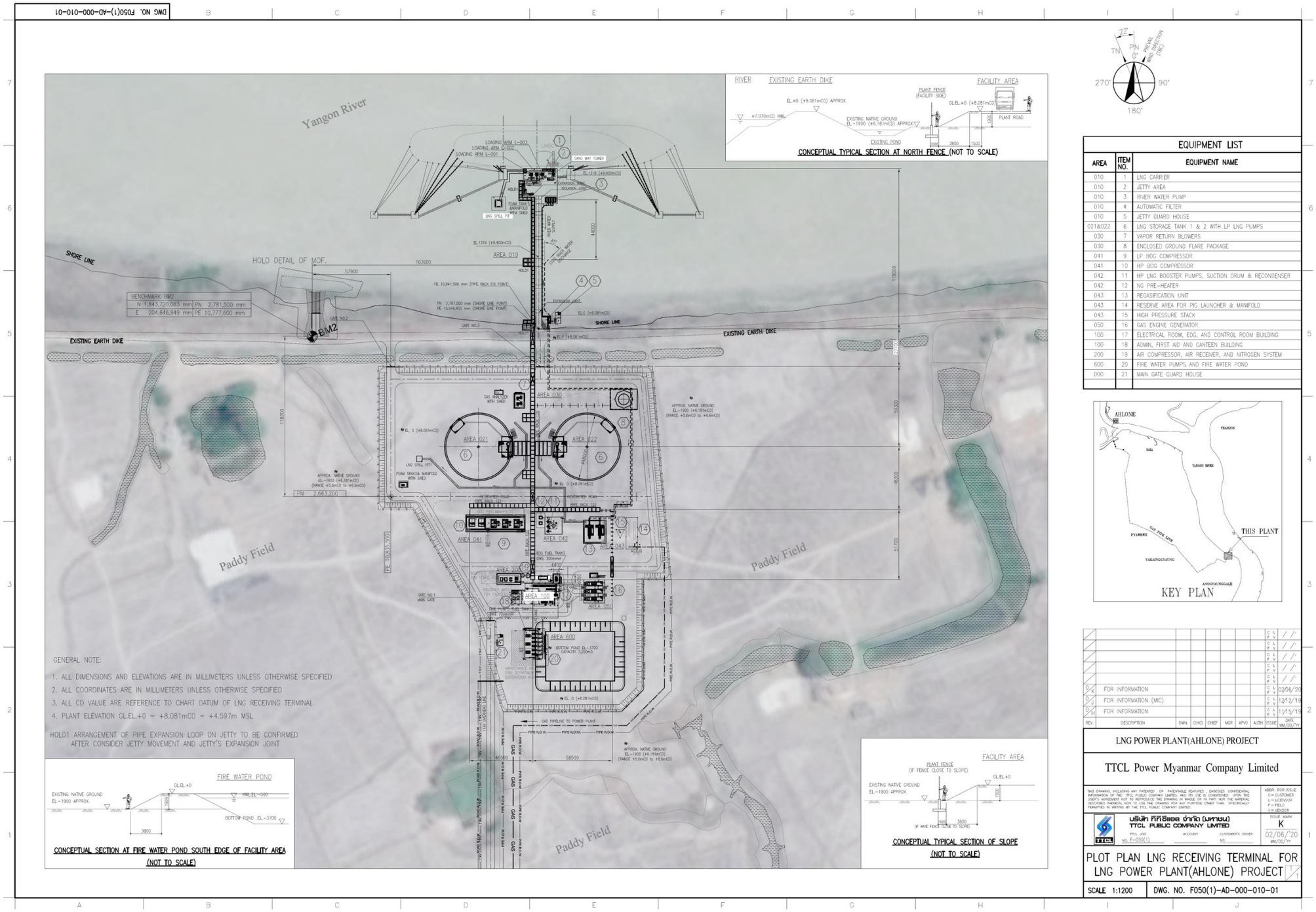


Source: TPMC, 2019.

4.6.1.1 LNG Receiving Terminal

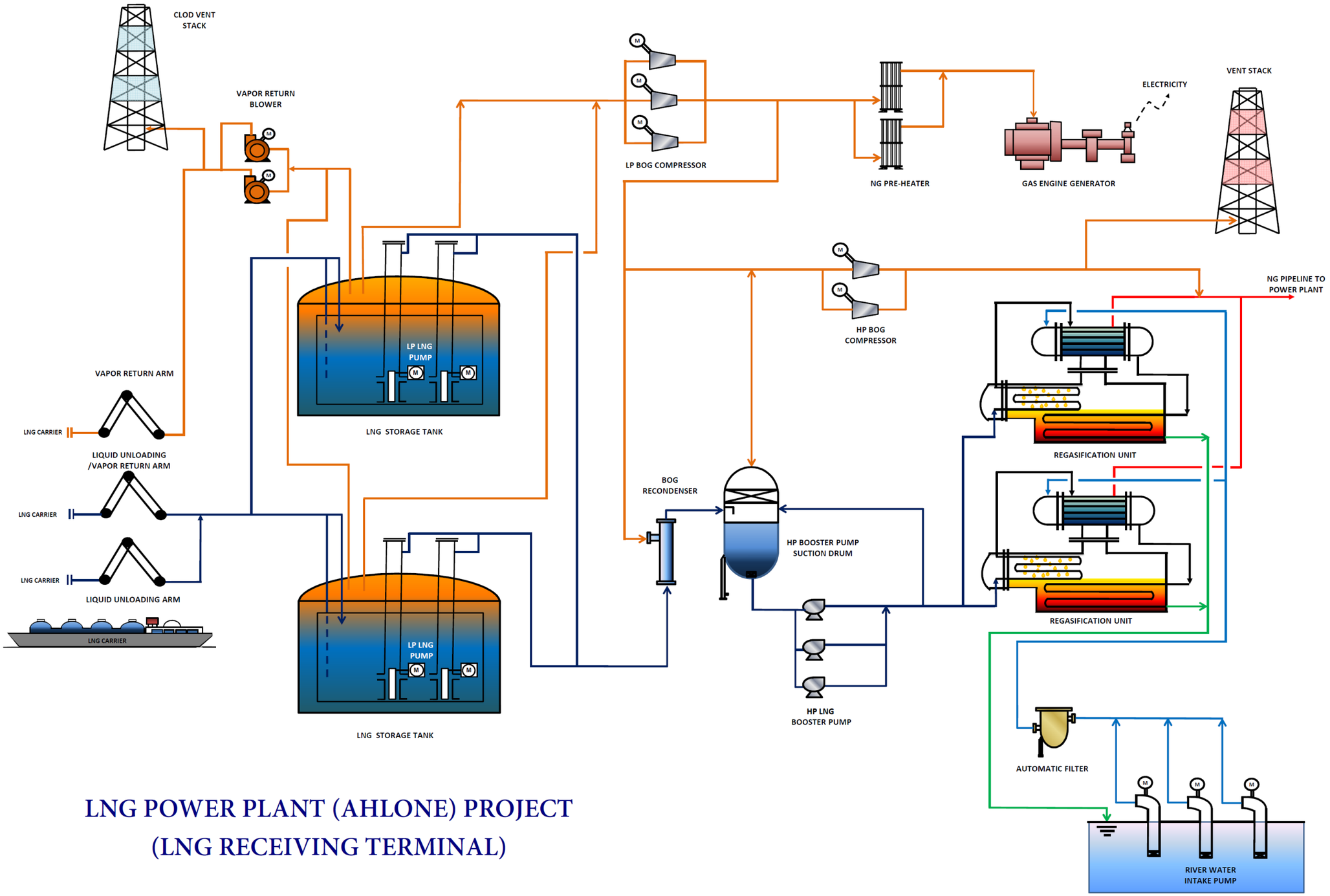
This section will describe the main components of the LNG Receiving Terminal, the layout of the LNG Receiving Terminal is shown in ***Figure 4.10***. The Process Flow Diagram (PFD) for the LNG Receiving Terminal is shown in ***Figure 4.11***.

Figure 4.10: Layout of LNG Receiving Terminal



Source: TPMC, 2020.

Figure 4.11: Process Flow Diagram of LNG Receiving Terminal



Source TPMC, 2019.

4.6.1.2 LNG Unloading Jetty

The unloading jetty is a single berthing type with two (2) breasting dolphins, and four (4) mooring dolphins. The size of the jetty is approximately 20 m long, and 15 m wide. The depth of the river at the jetty and the LNG Carrier (LNGC) docking location is approximately 10-15 m deep. The width of the Yangon River from the shoreline point of the jetty to the other side is approximately 1.93 km.

The Jetty structure will consist of a concrete slab, with topside equipment. The LNGC docking method is expected to use a minimum of two (2) standard tugboats for push and pull operations. The rubber fenders will be used to prevent the LNGC from making direct hull contact with the Jetty. An example of the Unloading Jetty is shown in ***Figure 4.13***.

The Unloading Jetty is comprised of the following equipment, required for safe LNG unloading:

- Two (2) LNG unloading arms;
- One (1) vapour return-loading arm;
- Unloading/Loading arm power packs and controls;
- LNG and vapour transfer piping and manifolds;
- Gas detection, fire monitor towers, and firefighting facilities;
- Foam Tank;
- Life-saving equipment;
- Telecommunications equipment;
- Access Gangway; and
- Small Crane.

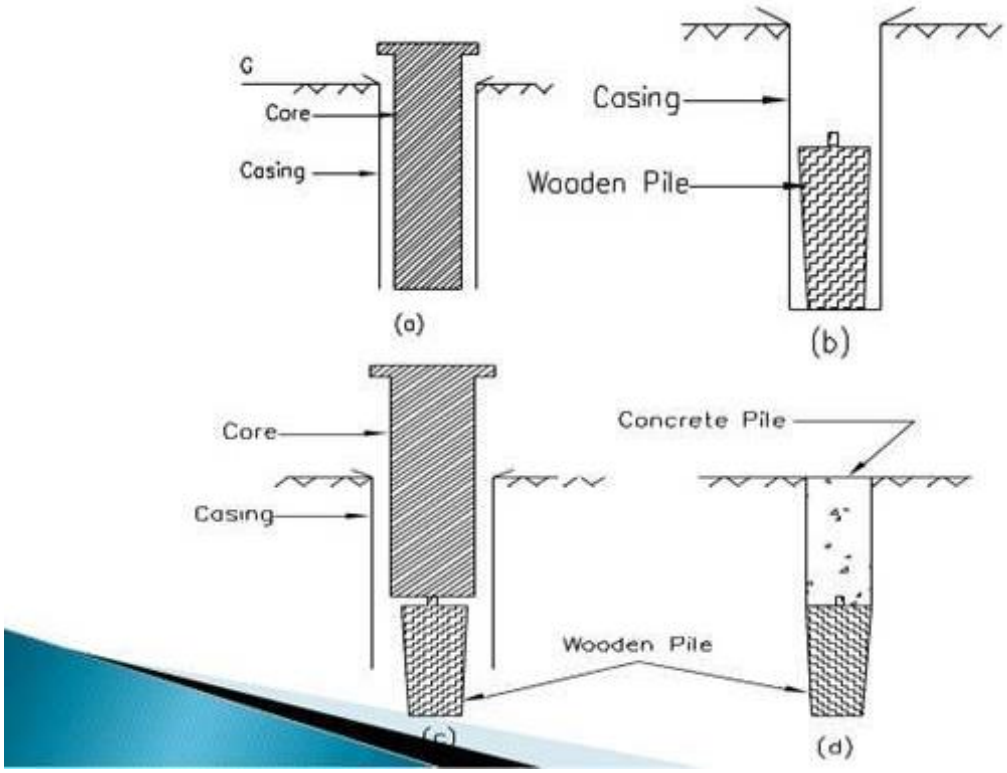
The unloading and vapour return arms will have a diameter of 10 inches, and will utilize a Double Counter weighted Marine Arm (DCMA). The arm structure will be attached to the jetty, near the edge where the berthing point for the LNGC is located.

The pile specifications are as follows:

- Material: Steel Jacket, Concrete pile;
- Diameter 0.8 – 1.0 m; and
- Length: 38 m (total), 25 m beneath sediment.

The Unloading Jetty is expected to require approximately 70 – 80 piles. The different types of pile composites are shown in ***Figure 4.12***.

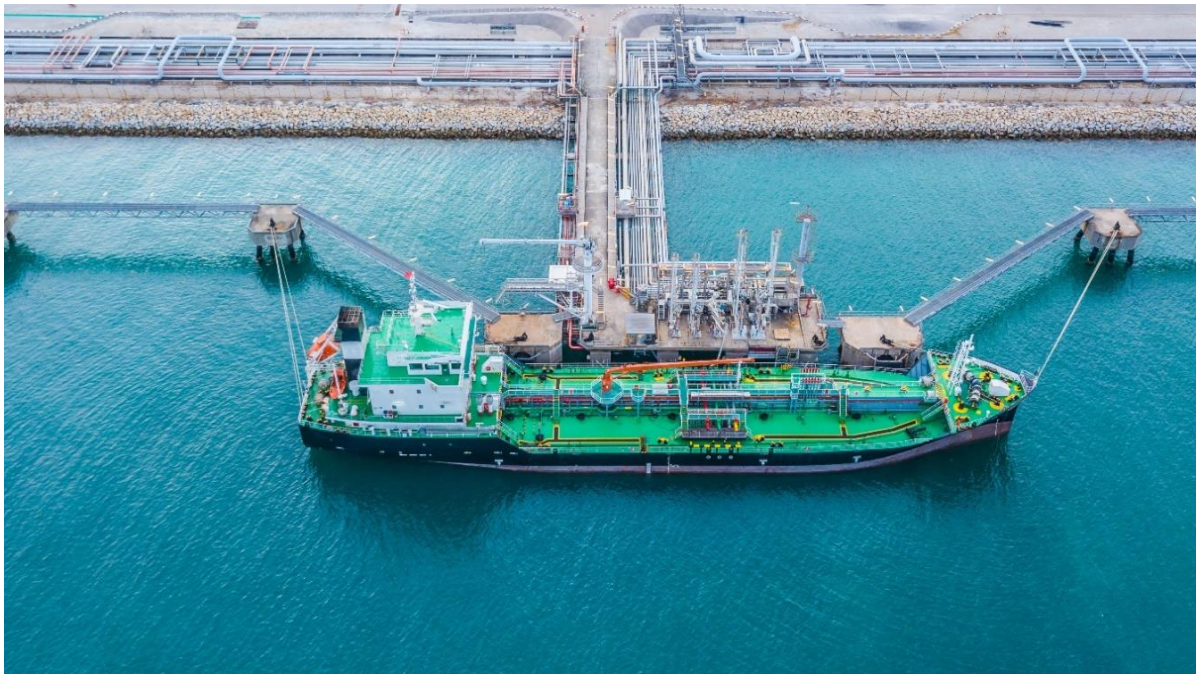
Figure 4.12: Types of Pile Composites



Source: TPMC, 2018.

Examples of an Unloading Jetty is shown in ***Figure 4.13***. An example of an LNG Unloading arm is shown in ***Figure 4.14***. The technical drawing of the Unloading Jetty is shown in ***Figure 4.15***, ***Figure 4.16***, and ***Figure 4.17***.

Figure 4.13: Unloading Jetty Examples

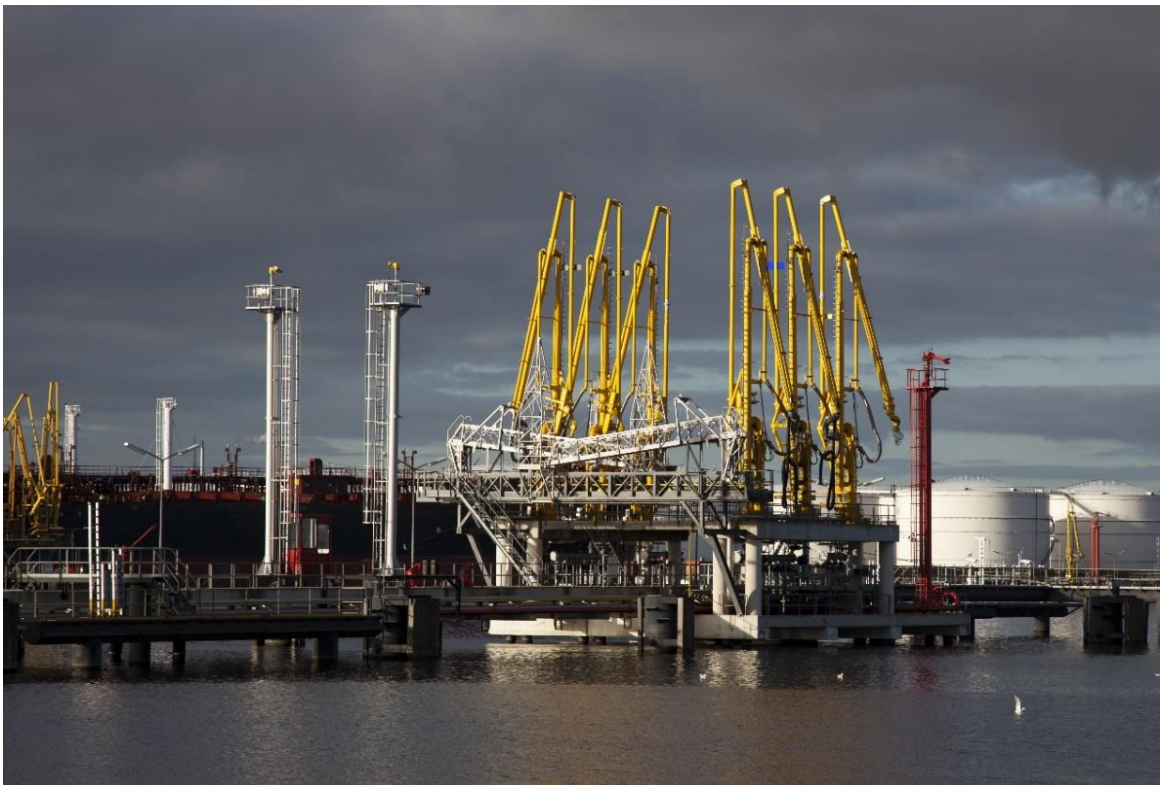


Source: Avigator Thailand / Shutterstock.com; Retrieved January 16th, 2019.

Source: Chris Gaborit / Shutterstock.com; Retrieved September 21st, 2018.

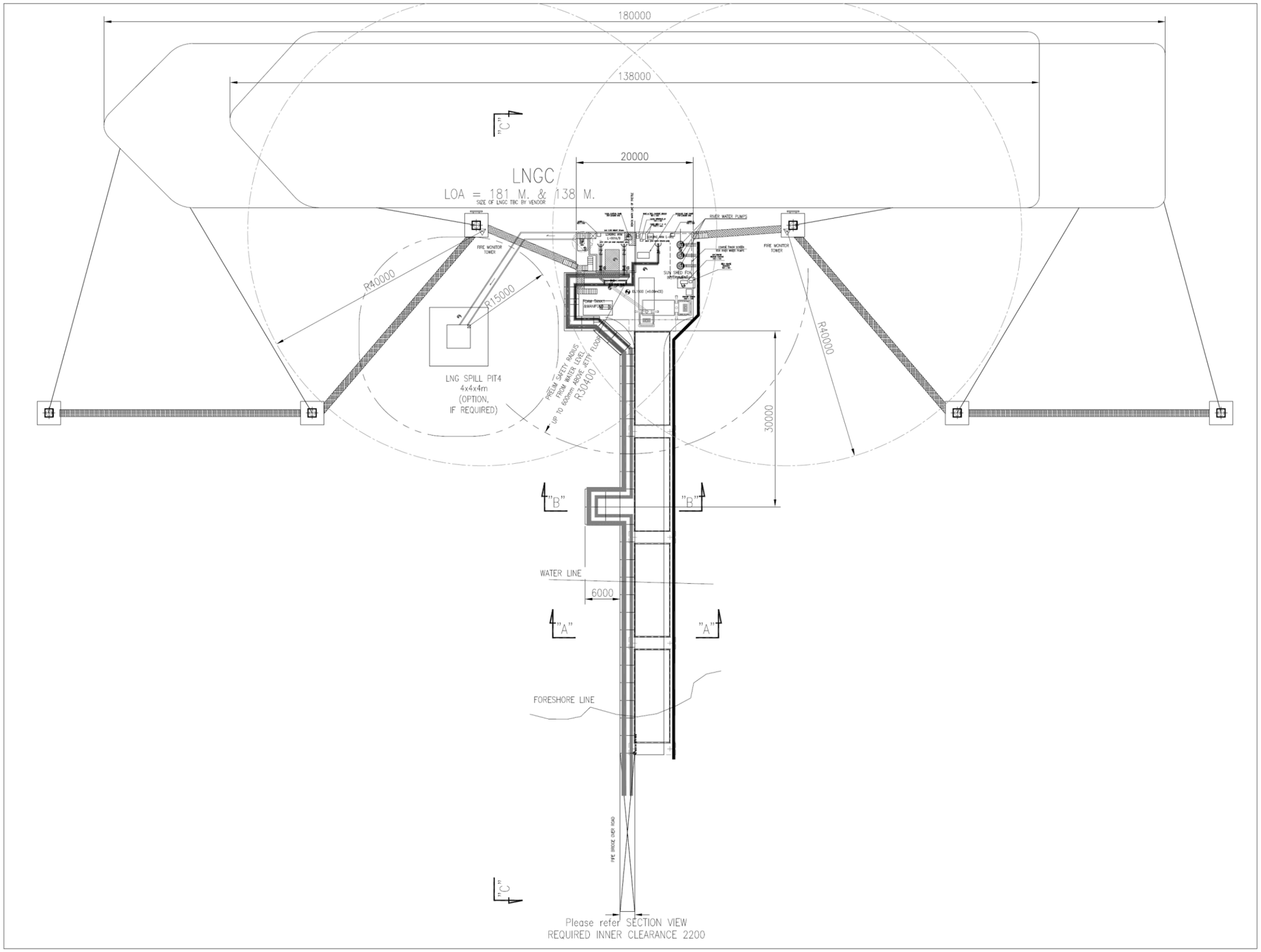
Figure 4.14: LNG Unloading Arm Examples

Source: Oleksandr Kalinichenko / Shutterstock.com; Retrieved January 16th, 2019.



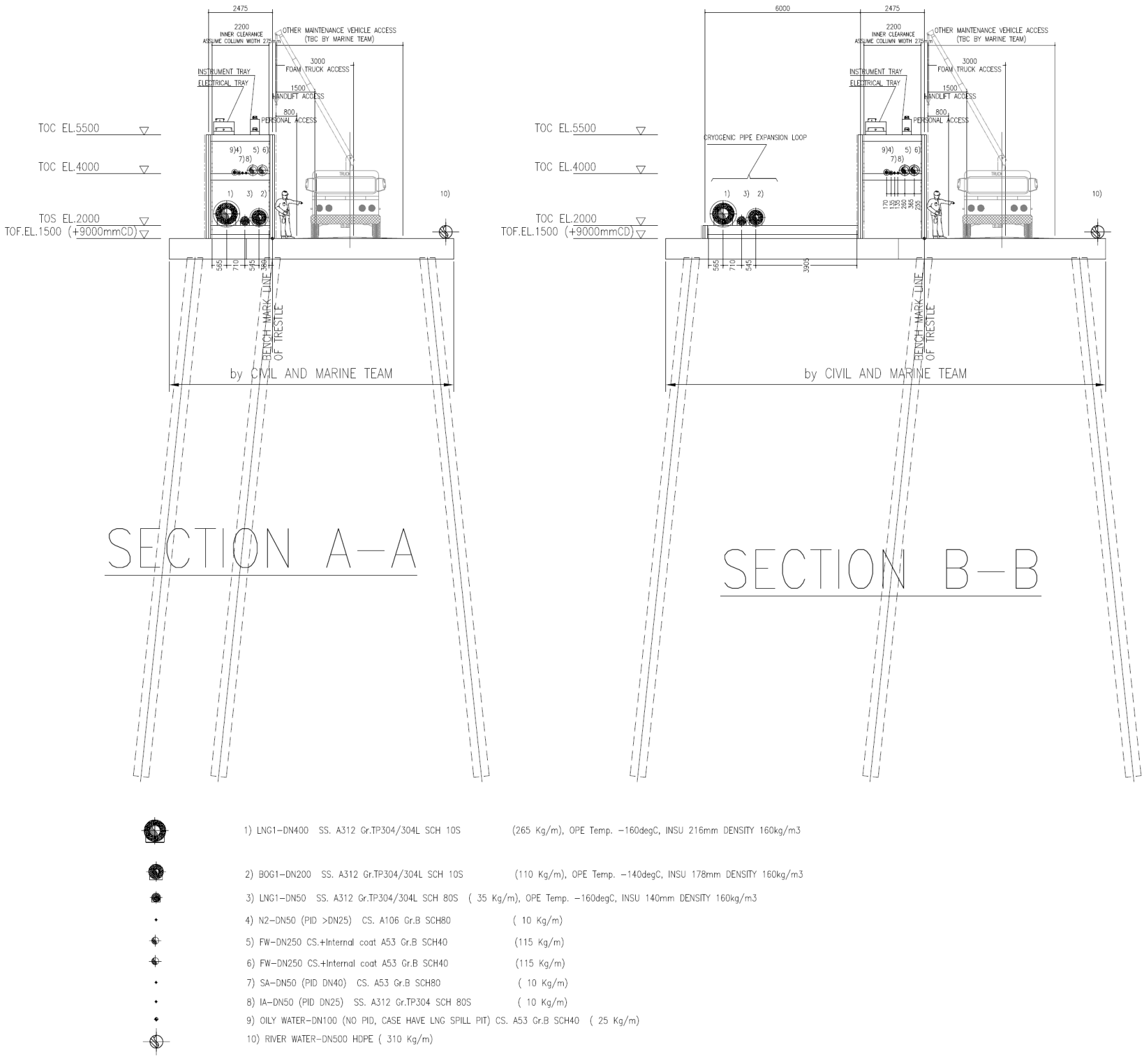
Source: Rob Bouwman / Shutterstock.com; Retrieved January 16th, 2019.

Figure 4.15: Technical Drawing of Unloading Jetty (Top view)



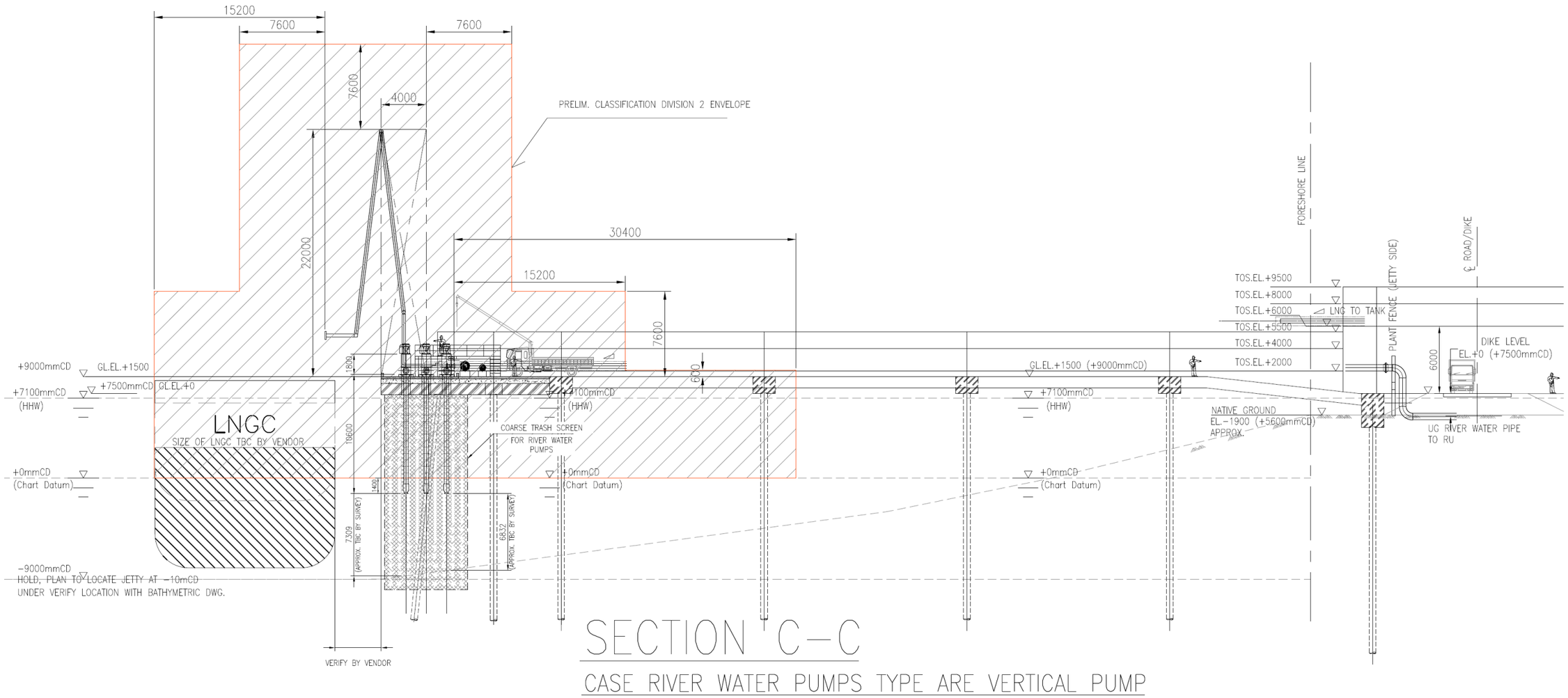
Source: TPMC, 2019.

Figure 4.16: Technical Drawing of Unloading Jetty (Section view)



Source: TPMC, 2019.

Figure 4.17: Technical Drawing of Unloading Jetty (Side view)



Source: TPMC, 2019.

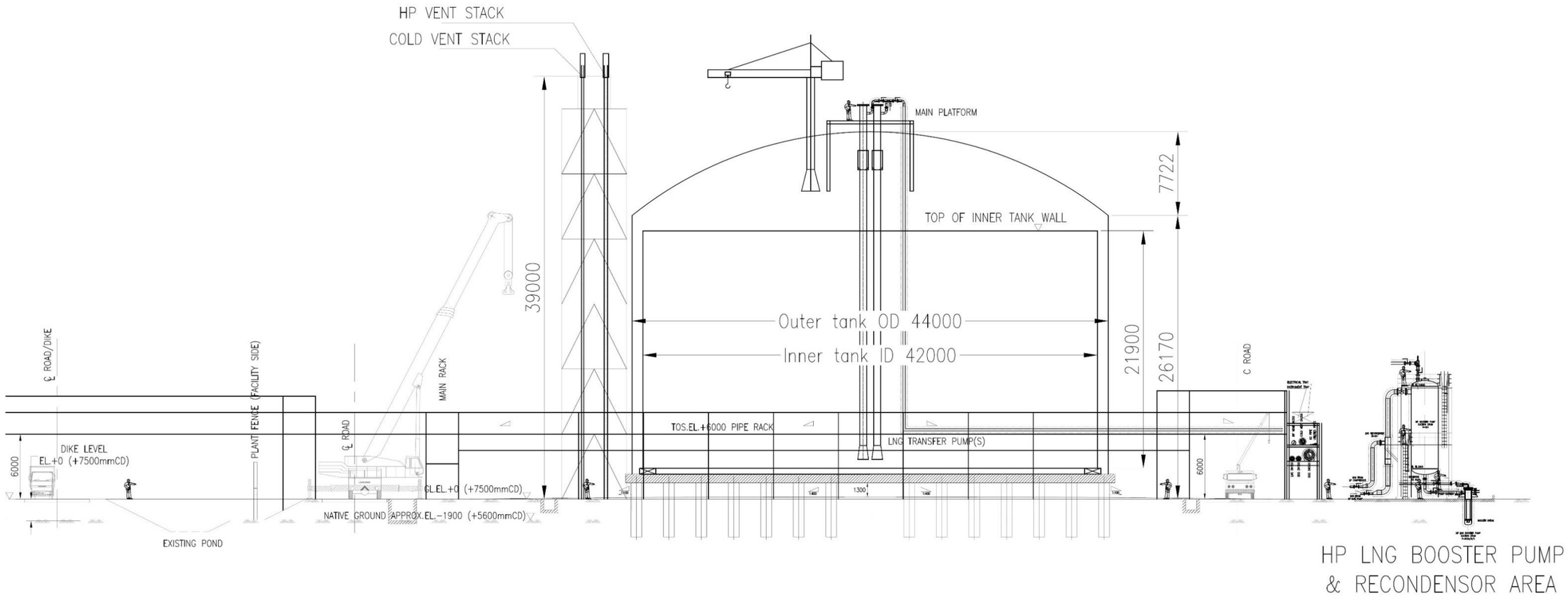
LNG Storage Tank

The LNG Receiving Terminal will contain two (2) Full-containment LNG storage tanks, each with a working volume of 25,000 m^3. Each tank can hold enough LNG to serve the Power Plant for 12-17 days. Both storage tanks will store LNG at a temperature of -160 °C, at atmospheric pressure. Each storage tank consists of the following layers:

- Layer 1: Stainless steel primary barrier constructed of chromium nickel stainless steel; the primary barrier would be corrugated to allow for expansion and contraction associated with heat changes;
- Layer 2: A secondary barrier comprised of laminated glass cloth and aluminium foil; as well as chromium nickel stainless steel barrier filled with perlite insulation, designed to contain LNG in case of leakage through the primary barrier.

Each storage tank is equipped with two (2) LNG transfer pumps to transfer LNG from the storage tank to the LNG re-condenser, before proceeding to the regasification unit. Both storage tanks are connected to a High Pressure Vent Stack and a Cold Vent Stack. This system is used instead of a flare system for emergency case only. The LNG storage tank materials, testing procedures, and component manufacturers will be in accordance with the API 620 Annex Q and API 625. The technical drawing for the LNG Storage Tank is shown in ***Figure 4.18***.

Figure 4.18: Technical Drawing of LNG Storage Tank



Source: TPMC, 2019.

Regasification Unit (RU)

The regasification unit is responsible for vaporizing the LNG in order to provide natural gas for the proposed Power Plant as fuel.

The regasification unit consists of two (2) Intermediate fluid vaporizers (IFV) units, each with 63 million standard cubic feet per day (MMSCFD), and utilizes river water from the Yangon River to warm up the LNG, in order to transform it to a gaseous state. Three (3) water pumps located on the LNG Unloading Jetty will pump river water to the regasification units. An example of an IFV is shown in ***Figure 4.19***.

River water that is used for the regasification process may have small particulates or debris that may potentially damage the internal components of the regasification units. To prevent damage of this nature, a debris filter is connected to the system, and will filter out debris from the river water before feeding through the RU. Consumption of river water will be 1,300 m^3 per hour for the regasification process.

Once the LNG has undergone regasification, the natural gas will be sent through the Pipeline connecting the LNG Receiving Terminal to the Power Plant. Cold water will be release into the Yangon River. The water will be released 10 degrees Celsius below the Yangon River water average temperature at a flow rate of 1,300 m^3 per hour.

The specifications for the regasification unit are shown in ***Table 4.4***.

Table 4.4: Specifications for Regasification Unit

Features	Specifications
Type	Intermediate Fluid Vaporizer (IFV)
Design Capacity	56.9 T/hr

Source: TPMC, 2019.

Figure 4.19: Example Intermediate Fluid Vaporizer (IFV) for RU

Example of IFV

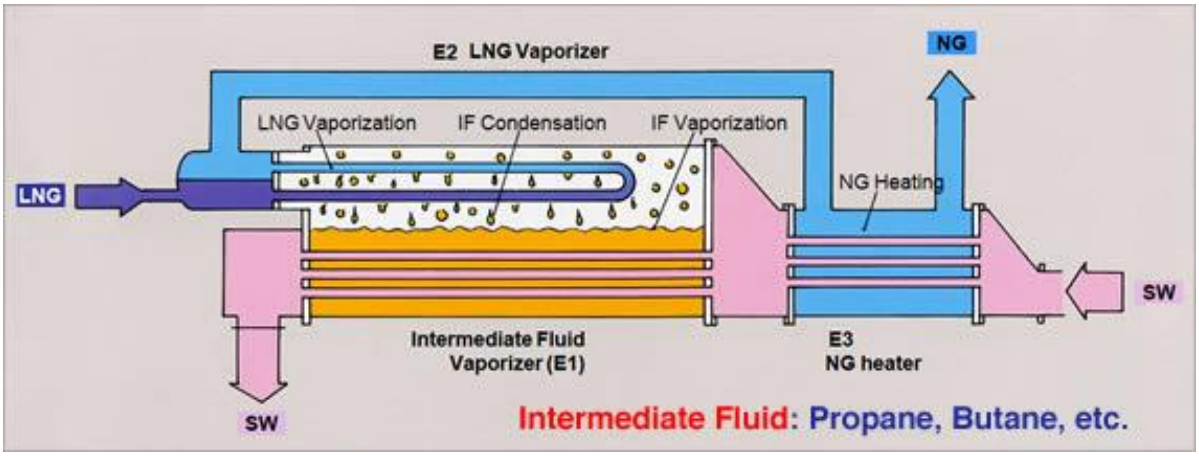


Diagram of IFV (Example)

Source: Kobelco, 2019.[11]

[11] Kobelco (2019) IFV (Intermediate Fluid Vaporizer). Kobe Steel Limited.

Gas Engine Generator (GEG)

The LNG Receiving terminal is expected to have four (4) GEGs to produce electricity for in-house operations. The specification for the GEG is listed in ***Table 4.5***.

Table 4.5: Specifications for Gas Engine Generator

Features	Specifications
Fuel system	Natural gas single fuel
Capacity	1160 kW Continuous
Gross Engine Power Output, kWm (hp)	1196 (1603)
Displacement, L (cu.in)	60.3 (3683)
Configuration	V16
Aspiration	Turbocharged
Starting Means	Electric Starter, 24 volts
Air filtration	Static type
BMEP (Brake Mean Effective Pressure, bar (psi)	16.1 (233)
Exhaust System	Vertical Stack
Emissions Control	Gas – Dry Low Emission (3rd Generation)
Fire Detection	Smoke Detectors
Gas Leak Detection	Gas detectors
Fire Protection	Fire extinguishing CO2
On-Base Acoustic Enclosure	Lube oil and Gas module Compartments

Source: TPMC, 2019.

Figure 4.20: Example of Natural Gas Engine Generator

Source: MTU Onsite Energy Corp.

Source: Cummins Power Generation Limited.

BOG Recondenser

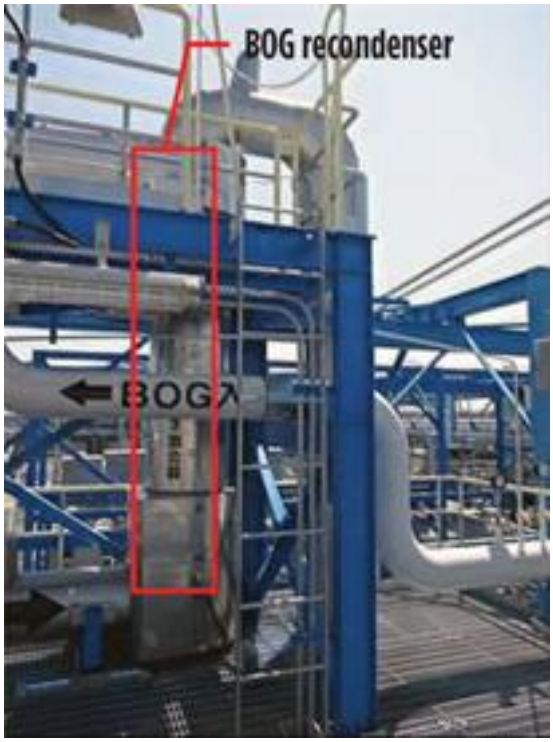
Boil-off gas (BOG) is LNG that evaporates into vapour due heat leakage from the outer environment into the system, during storage and transportation of LNG. BOG, if left alone, will cause increase in pressure, which can lead to potential damage to internal systems. A BOG Recondenser is a machine that recondenses BOG back into LNG and recirculates it back into the LNG system. The specifications of the BOG recondenser is shown in ***Table 4.6***. An example and size comparison of an In-Line BOG Recondenser compared to other conventional types is shown in ***Figure 4.21***.

Table 4.6: Specifications for BOG Recondenser

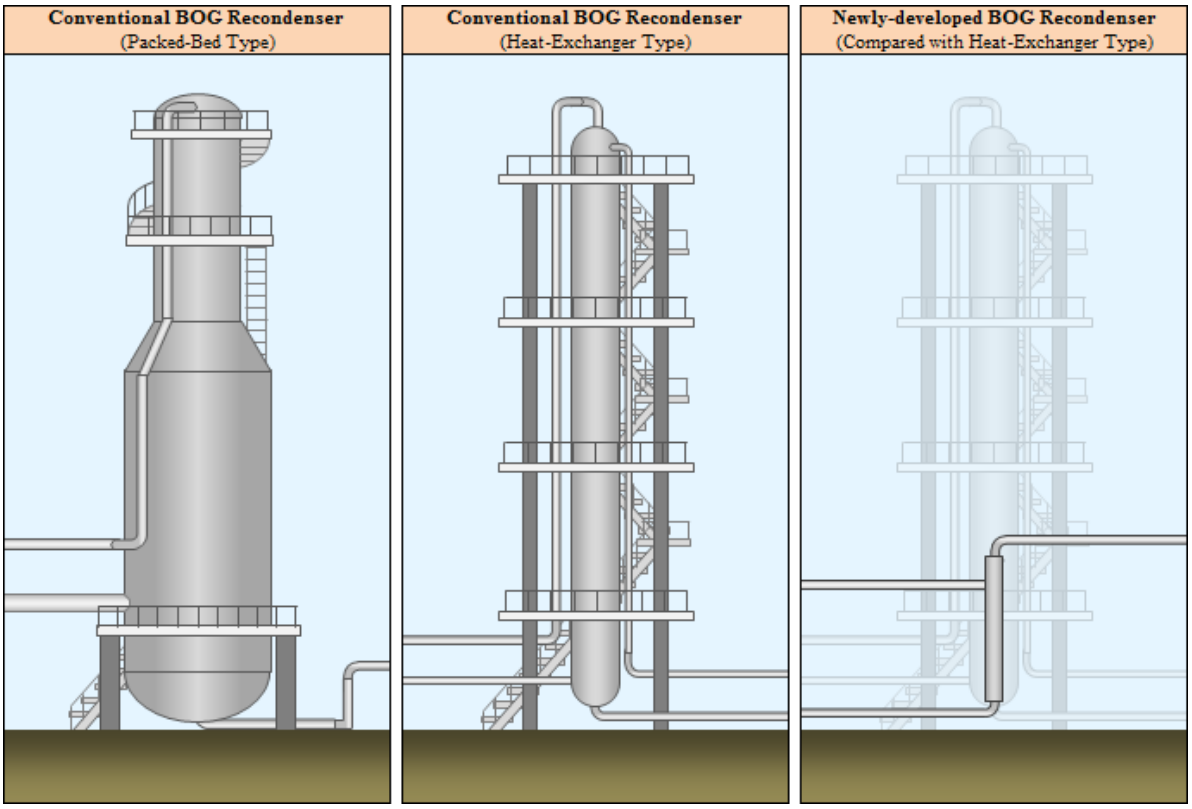
Features	Specifications
Model/Type	Static Mixer
Material	Stainless Steel
Capacity	Maximum flow rate of BOG 3,600 Kg/hr
Noise	N/A

Source: TPMC, 2019.

Figure 4.21: Example and Size Comparison of an In-Line BOG Recondenser



An In-Line BOG Recondenser designed by JFE Engineering Corp.



Size Comparison between Conventional and New In-Line BOG Recondenser

Source: JFE, 2017.

4.6.1.3 LNG Carrier (LNGC)

The LNGC is a LNG transport vessel and consists of a LNG containment system that is comprised of a series of layers, which also depend on the specifications of the LNGC. On-board the LNGC are also equipped with necessary equipment for storing LNG, such as the cargo monitoring, and control and safety systems.

There are three (3) common types of LNGC designs that are currently being used, which include Moss Tank, Membrane Tank and Type C Tank. A Moss Tank uses a spherical tank design that is comprised of an unstiffened, spherical, aluminium alloy tank. A Membrane Tank utilizes the ship's outer hull as the outer tank wall, the inner membrane tank and the outer tank wall is separated by insulation. A Type C Tank are normally spherical or cylindrical pressure vessels having design pressures higher than 2 barg. It is expected that a type C tank LNGC with a capacity of 35,000 m^3 will be used to import LNG to the LNG Receiving Terminal. The LNGC is equipped with four (4) cargo tanks, and two (2) pumps, each with a capacity of 850 m^3/h.

Currently LNGC with capacity range of 18,000 -45000 m^3 being considered for this Project

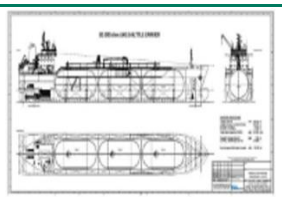
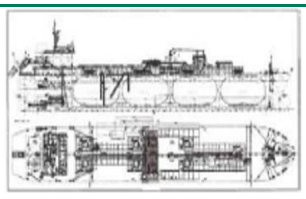
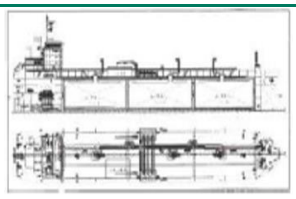
Each LNGC shall have the following maximum dimension and capacities:

1. **Operating draft (arrival)**: up to nine (9) metres;
2. **Beam**: up to 40 metres;
3. **Length overall**: up to two hundred (200) metres;
4. **DWT**: twenty thousand (20,000)

The types of vessels and their specifications are listed in ***Table 4.7***.

Regardless of the LNGC type used, the containment system is expected to be a double-hulled design, which greatly increase containment reliability during a grounding or collision event. Examples of different types of LNGCs is shown in ***Figure 4.22***.

Table 4.7: Vessel Layout and Specifications (For Reference)

Specification	Vessel Type and Details		
General Arrangement			
Cargo Capacity	20,000 m^3	30,000 m^3	30,000 m^3
Length Overall (LOA)	148 m	181 m	173 m
Beam	25.3 m	28.0 m	27.0 m
Moulded Depth	17.6 m	19.0 m	17.5 m
Draft	7.8 m	7.8 m	8.5 m
Deadweight Tonnage (DWT)	12,500 tonnes	16,200 tonnes	16,500 tonnes

Source: TPMC, 2019.

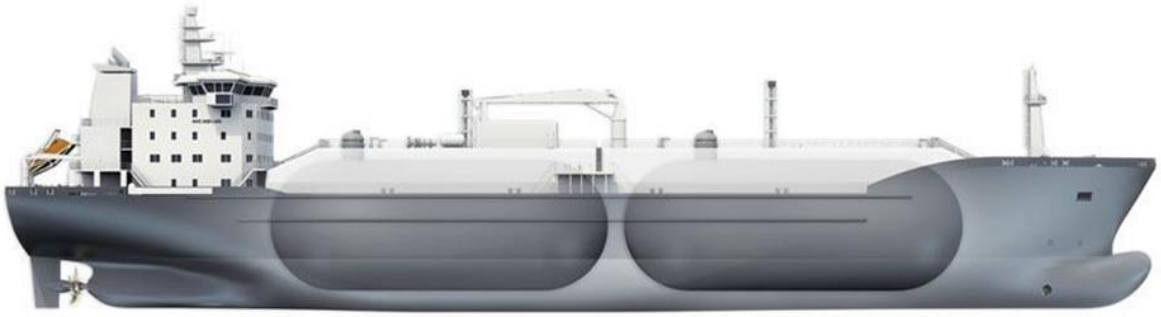
Figure 4.22: Example of Different LNGC Types

Moss Tank

Source: VladSV / Shutterstock.com; Retrieved January 16th, 2019.

Membrane Tank

Source: Oleksandr Kalinichenko / Shutterstock.com; Retrieved January 16th, 2019.



Type C Tank

Source: The Rolls-Royce Marin, Retrieved from: www.skipsrevyen.no/article/rolls-royce-lng-carrier-design/, 2019.

4.6.2 Construction Phase

4.6.2.1 Construction Schedule

The construction phase of the LNG Receiving Terminal is expected to take approximately 23 months. The EPC Contractor will prepare the site for construction, erection and installation of the Project facilities, which will include earthwork activities, such as site clearing and soil excavation, and River work activities, such as the piling, installation of the underground structure and installation of the over ground component of the Jetty. The construction, design and testing will be undertaken in accordance with the appropriate construction standards and Myanmar NEQ (Emission) Guidelines and WB/IFC EHS Guidelines.

4.6.2.2 Mobilization

Site construction work will start once civil design of sites preparation is finalised. All work will be conducted in accordance with the detailed master construction schedule, provided by the EPC Contractor. Prior to commencement of work, all contractors would be required to provide detailed site specific plans related to:

- Equipment use;
- Excavation and backfilling management;
- Soil erosion management;
- Traffic management (including vessels operation/ movement);
- Storm water pollution prevention plan;
- Dust prevention plan;
- Environmental and Social Management Plan;
- Waste Management Plan; and
- Plan drawings of laydown, traffic flow, parking, trash storage, and recycling areas.

It is assumed that as a part of the mobilisation phase the Project site including laydown areas, etc. will be fenced and a construction worker camp(s) will be located inside the Project boundary.

Considering that the LNG Receiving Terminal does not have any suitable access roads, all materials, equipment, workers, etc. will be transported to the LNG Receiving Terminal site by landing barges. Some workers may travel to the construction site by motorcycles, in which the existing access road is capable of supporting this type of vehicle.

4.6.2.3 LNG Receiving Terminal

Earthwork

Earthworks will include clearing of vegetation and grading of the Project site. It is expected that the subsoil, which will be stripped and removed from the Project site, shall be utilised for levelling/ backfilling. The LNG Receiving Terminal construction site, being partially in an area subjected to flooding will require careful study of potential placement of elevation and flood barriers.

Grading of the site will be done by the design team, considering sufficient height to protect the terminal from potential water and tidal/ flood damage. Such elevation will be studied further as part of the detailed design stage in order to confirm that the site elevation does not pose a flood threat to the surrounding areas.

Considering no soil will be excavated, and additional fill soil is required for site elevation, the addition fill soil will be provided by a local supplier in Myanmar. Site preparation work will include sand

sourcing from the Yangon River to be used as filling material. Two (2) locations have been selected for vessels to extract sand, as shown in ***Figure 4.23***. Sand supply boats, each with a total volume of 90 m3, will make two (2) delivery trips per day, it is expected that a total of 20 sand supply boats will be used. The sand supply vote will transport materials directly to the LNG Receiving Terminal. The Site Preparation Method Statement can be found in ***Appendix G***.

The anticipated amount of soil that will be cut and filled during the LNG Receiving Terminal construction phase is listed in ***Table 4.8***. The amount of earthwork machinery that will be used during the LNG earthworks is listed in ***Table 4.9***.

Table 4.8: Indicative Earthworks Estimated for the LNG Receiving Terminal

Area	Cut (m^3)	Fill (m^3)	Balance (m^3)
Onshore LNG Terminal	-	80,000	80,000

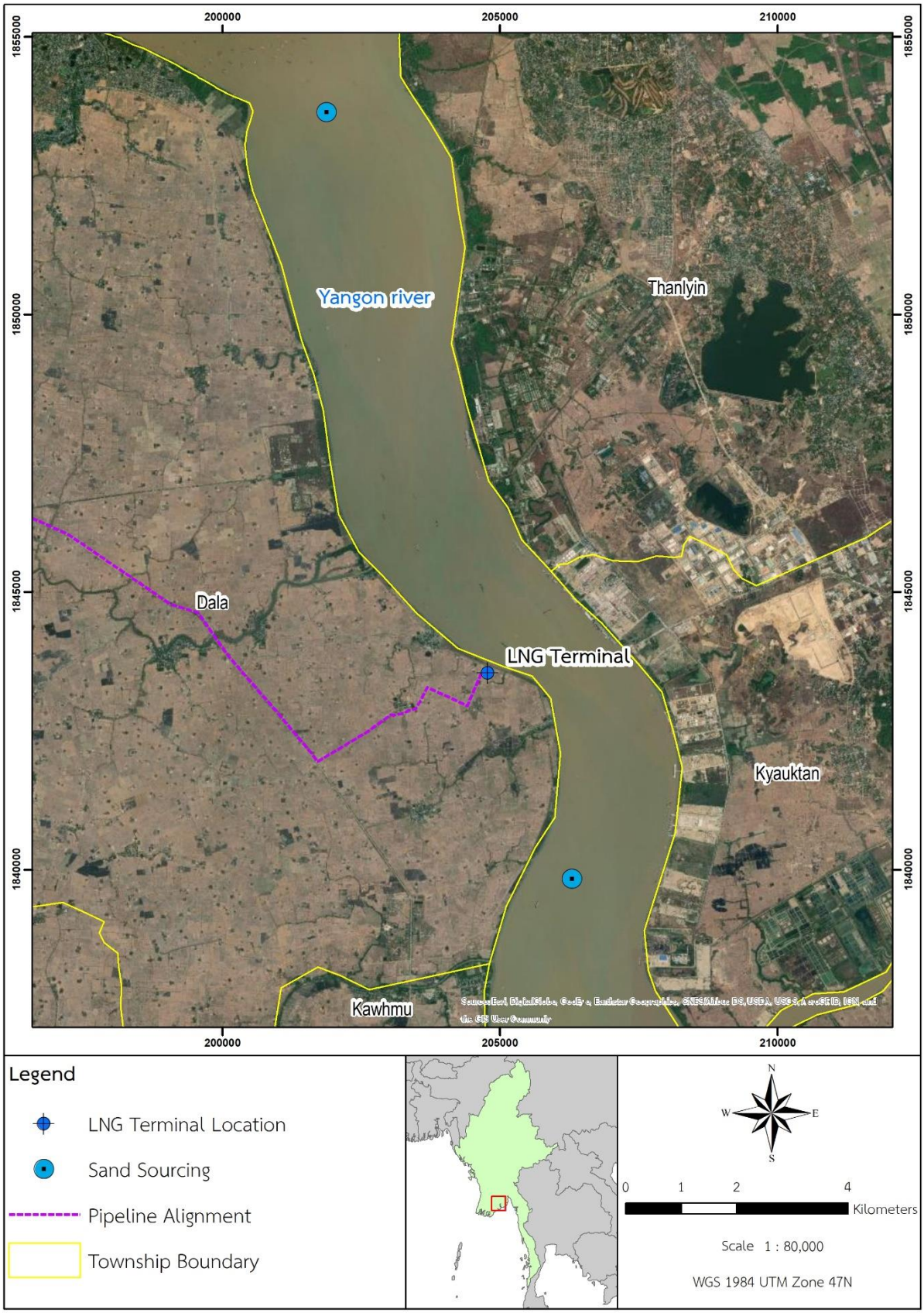
Source: TPMC, 2019.

Table 4.9: Amount of Earthwork Machinery

Machinery Type	Amount
Piling Rig	3
Excavator	3
Bulldozer	2
Scraper	1
Light-duty vehicle	2
Water truck	2
Cranes	2
Transit mixer	500 Trips
Air Compressor	1
Diesel Generator	10
Compactor	2
Tipper trucks/trailer	3
Fuel and lube track	1
Pump	3

Source: TPMC, 2019.

Figure 4.23: Location for Sand Sourcing



Source: ERM, 2020.

Site Foundation

The geological conditions of the Project site will be studied in the detailed design stage however, it is proposed that lightly loaded structures with equipment not sensitive to settlement may be supported on spread footings and/or mat foundations, provided the sub grade is adequately compacted. Other structures and/or settlement sensitive equipment shall be supported on piles; pile drivers will be used to install the piles at the required points. Piling will be required approximately 880 piles for LNG storage tanks foundation.

4.6.2.4 Unloading Jetty

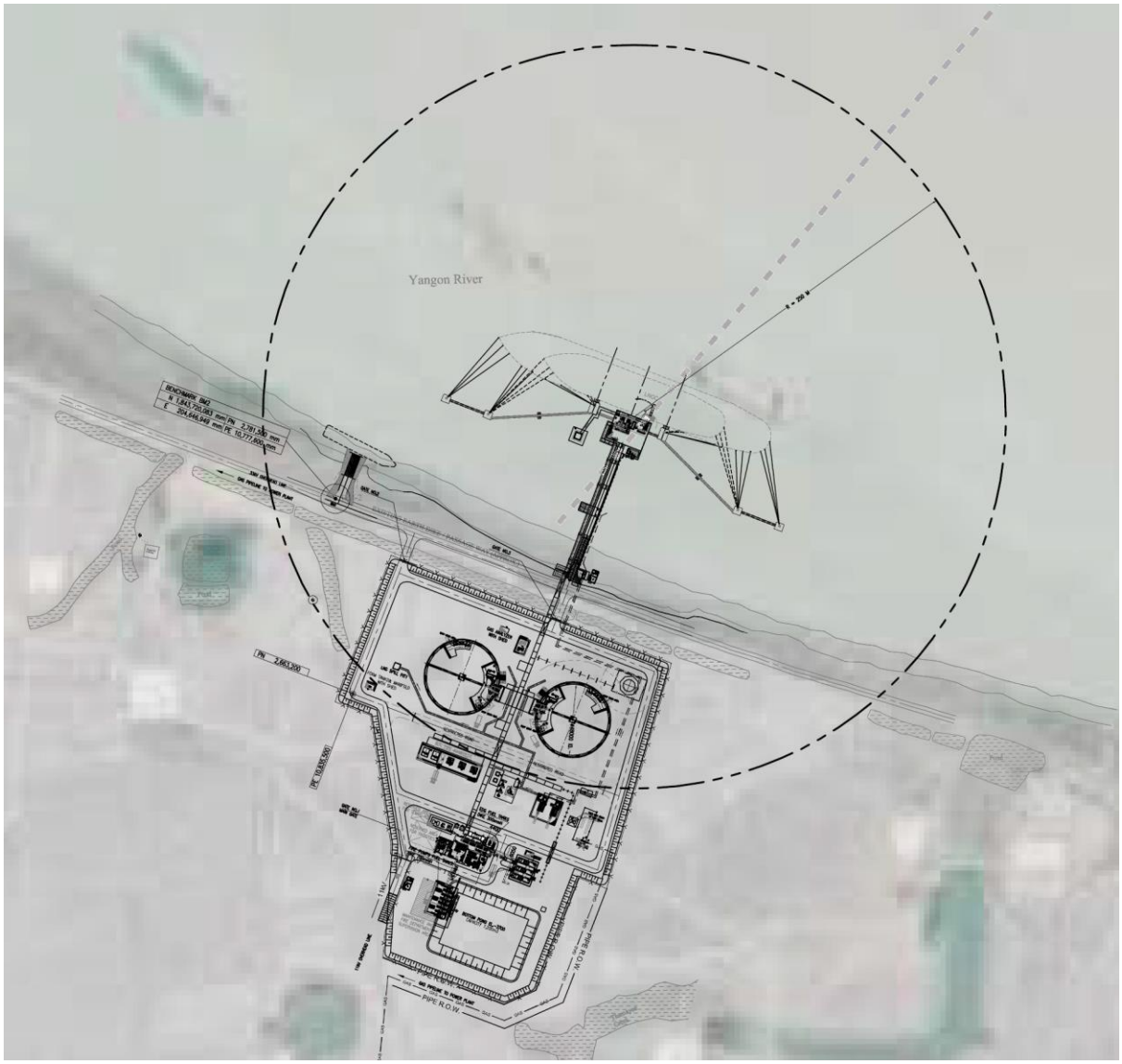
River Work

River works will include the installation of Project facilities that extend from onshore and are located alongside the waterfront. During the construction of the Unloading Jetty, specific types of vessels will be used to install the various structures and components. During these activities, establishing a safety zone around the construction area will be required to ensure safety among the construction vessels, and other non-project related vessels that navigate the Yangon River. Dredging of the Yangon River at the location of the Unloading Jetty will not be require as the water depth is suitable for vessels to operate in the area. Further details regarding river works will be mentioned under Jetty Construction (***Section 4.6.2.9***). Considering the Unloading Jetty will be constructed using concrete, piling will be required approximately 70-80 piles for jetty and trestle. The construction safety zone for the unloading jetty is 250 m, as shown in ***Figure 4.24***.

Unloading Arms

The complete set of hydraulics and electronics part of the unloading arm can be either barge crane or mobile crane (Stand on jetty platform) depending on the access and the capacity of the crane with regards to lifting load and operating radius.

Figure 4.24: Unloading Jetty Construction Safety Zone



Source: TPMC, 2020.

4.6.2.5 Major Project Works

Table 4.10 presents major Project works to be undertaken as a part of the construction phase.

Table 4.10: Major Project Works for the LNG Receiving Terminal

Item	Description
Electrical and Control Building	■ Concrete structure construction for Electrical room. ■ Reinforced concrete construction for Control room.
Fire pump	■ Concrete Foundation with Steel Structure Roof
Gas Engine Generator	■ Reinforced concrete frame construction
Administration	■ Reinforced concrete frame structure
LNG unloading Jetty	■ Centre Platform with walkway, mooring dolphin and Trestle
LNG Cryogenic Pipeline	■ Stainless steel pipe with cold insulation
LNG Storage Tanks	■ Full containment, steel primary and steel secondary containment
Regasification Unit	■ Equip on Reinforced concrete foundation

Source: TPMC, 2018

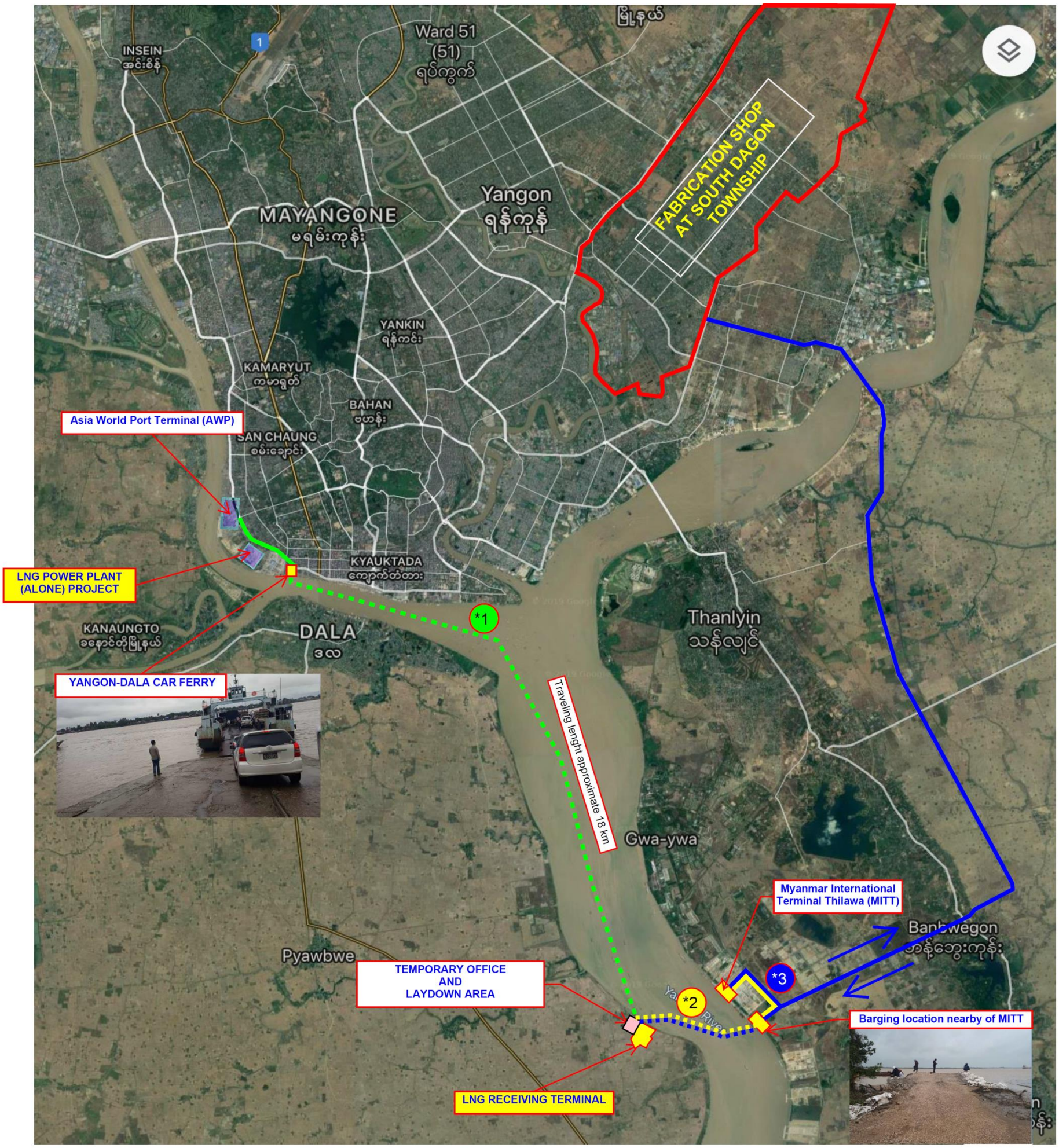
Reinforced concrete structures shall be used for primary terminal facilities and facilities exposed to an aggressive environment. These facilities are primarily low-rise buildings/structures that have a large footprint area relative to their height. Conversely, steel is used for large expansive structures. The construction methods will be provided by the EPC Contractor.

The LNG Receiving Terminal will be built alongside with the waterfront to unload the imported LNG with sufficient space to cater for 16,000 tonnes LNG Carriers as shown in ***Figure 4.10***. From the LNG Carrier(s), the LNG will be transferred to the LNG storage tanks before moving to the regasification unit.

4.6.2.6 Construction Material

TPMC will utilize ready mixed concrete from a local supplier in Myanmar. Piping material and steel structures will be imported to the Asia World Port Terminal (AWP), which will then be transported to the laydown area via trucks, which will also utilize public ferries, and contracted ferries (by a transportation service company) to transport the trucks from Ahlone-Dala car ferry to the laydown area. Other materials will be delivered to the Myanmar International Terminal Thilawa (MITT), which will then be transported by trucks to a barging location nearby and then to the laydown area by barges. Finally, piping material will be delivered to MITT, transported by trucks to the fabrication shops in South Dagon, transported back to the barge loading area and then to the laydown area. The transportation plan for materials used for the LNG Receiving Terminal is shown in ***Figure 4.25***. It is estimated the total number of trips required for piping material transportation is approximately 115 trips, which includes piping material for both LNG Receiving Terminal, and Pipeline.

Figure 4.25: Transportation Plan for LNG Terminal



Source: TPMC, 2019.

*Note: *1 Transportation route from AWP to Yangon-Dala car ferry via trucks or trailers and delivery to laydown area at the LNG Receiving Terminal by barge;*
**2 Transportation route from MITT to barging location nearby of MITT and delivery to laydown area at LNG Receiving Terminal by barge;*
**3 Transportation route from MITT to fabrication shop at South Dagon Township (piping material), then send back to barging location nearby of MITT for delivery to laydown area at the LNG Receiving Terminal by barge.*

LNG Receiving Terminal

The majority of materials will be transported by vehicles from ports or local supplier using the existing local roads. Cranes, forklifts, trucks and trailers will also be mobilized at site, from the existing local roads. Transportation of heavy, large volume and super-sized materials such as Regasification Units, generators, transformers, etc. will be made by river transportation using barges from a nearby port/shore base. A small barge/ferry vessel loading jetty will be constructed as part of the LNG Receiving Terminal (as shown in ***Figure 4.10***); the barge will transport heavy, large volume materials to this jetty.

Unloading Jetty

Considering the unloading jetty will first be pre-fabricated at the Thilawa Industrial zone, the required construction materials will be transported by vehicles from local suppliers or ports, by using the existing roads and barges transportation. Other machines/equipment, such as cranes, trucks, and forklifts will be mobilized at site. Once pre-fabrication is complete, barges will transport the unloading jetty to the designated location to be installed.

4.6.2.7 Construction Workforce

The anticipated workforce for LNG Receiving Terminal construction is shown in ***Table 4.11***, and the anticipated workforce for the Unloading Jetty construction is shown in ***Table 4.12***. The anticipated number of vessels used for the Unloading Jetty Construction is shown in ***Table 4.13***.

Wastewater management systems of all construction vessels will comply the International Convention for the Prevention of Pollution from Ships (MARPOL).

Table 4.11: Anticipated Workforce for Onshore LNG Receiving Terminal Construction

Workforce Origin	Average No. of Skilled Workers	Average No. of Semi-Skilled Workers	Average No. of Unskilled Workers	Total Average Workforce (per day)	Total Peak Workforce (per day)
Local Workforce	80	12	200	400	600
Migrant Workforce	40	6	0		

Source: TPMC, 2018

Table 4.12: Anticipated Workforce for Unloading Jetty Construction

Workforce Origin	Average No. of Skilled Workers	Average No. of Semi-Skilled Workers	Average No. of Unskilled Workers	Total Average Workforce (per day)	Total Peak Workforce (per day)
Local Workforce	3	10	20	40	50
Migrant Workforce	2	5	0		

Source: TPMC, 2018

Table 4.13: Anticipated Number of Vessels during Construction

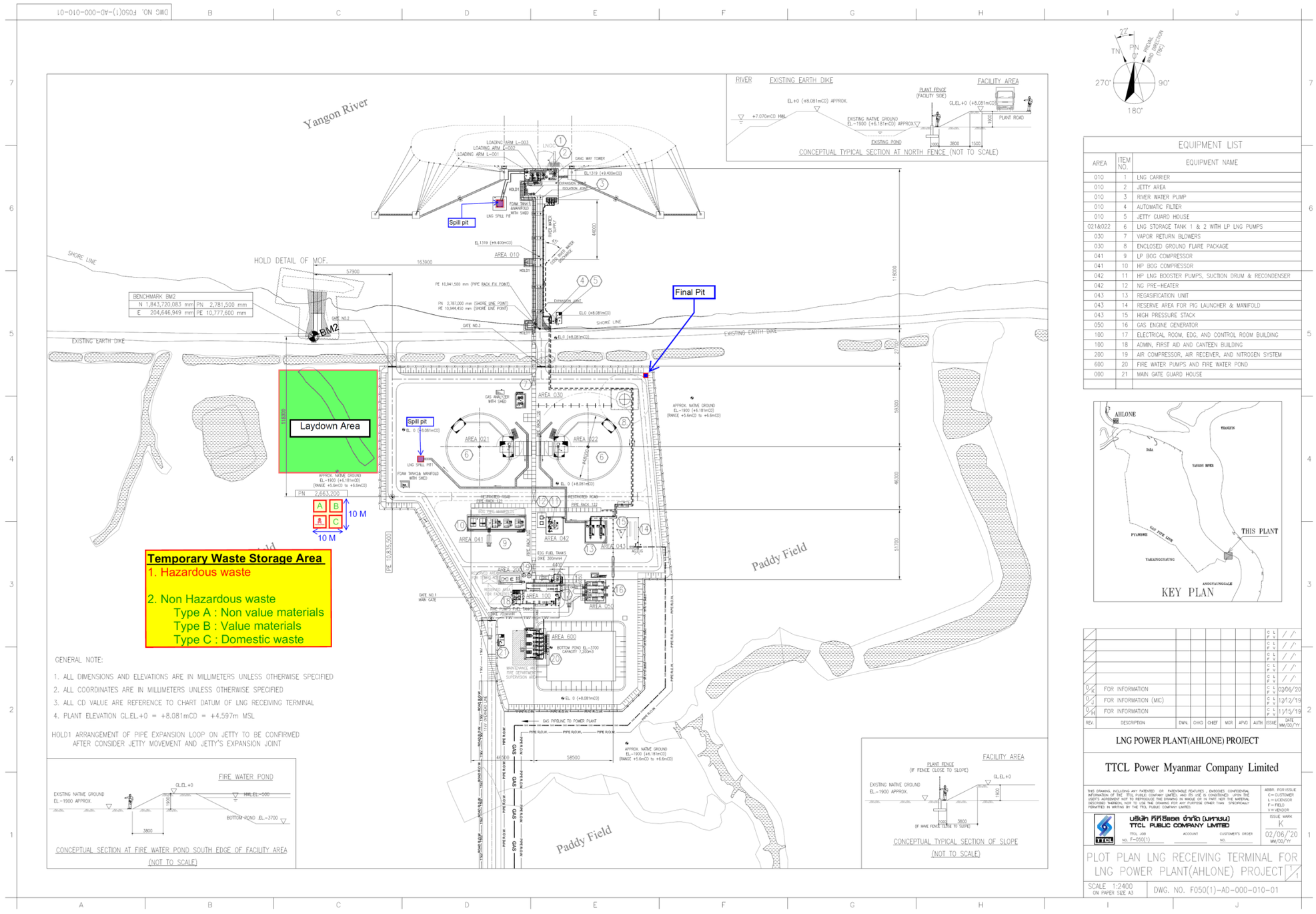
Type of Vessel	Number of Vessels	Number of Workers per Vessel
Crane Barge	1	3
Transport Barge	2	20-25
Support Tug	2	These vessels will be provided by the Myanmar Port Authority

Source: TPMC, 2018

4.6.2.8 Temporary Construction Camp and Laydown Area

The EPC contractor is expected to provide temporary work camps and other necessary facilities to accommodate construction personnel. Construction personnel that live nearby are allowed to travel to work by public transportation, or other means of safe transport. The location of the temporary construction camp for the LNG Receiving Terminal will be located within the construction boundaries of the LNG Receiving Terminal. The layout of the LNG Receiving Terminal with the indicated laydown area is shown in ***Figure 4.26***.

Figure 4.26: LNG Receiving Terminal Laydown Area



AREA	ITEM NO.	EQUIPMENT NAME
010	1	LNG CARRIER
010	2	JETTY AREA
010	3	RIVER WATER PUMP
010	4	AUTOMATIC FILTER
010	5	JETTY GUARD HOUSE
021&022	6	LNG STORAGE TANK 1 & 2 WITH LP LNG PUMPS
030	7	VAPOR RETURN BLOWERS
030	8	ENCLOSED GROUND FLARE PACKAGE
041	9	LP BOG COMPRESSOR
041	10	HP BOG COMPRESSOR
042	11	HP LNG BOOSTER PUMPS, SUCTION DRUM & RECONDENSER
042	12	NG PRE-HEATER
043	13	REGASIFICATION UNIT
043	14	RESERVE AREA FOR PIG LAUNCHER & MANIFOLD
043	15	HIGH PRESSURE STACK
050	16	GAS ENGINE GENERATOR
100	17	ELECTRICAL ROOM, EDG, AND CONTROL ROOM BUILDING
100	18	ADMIN, FIRST AID AND CANTEEN BUILDING
200	19	AIR COMPRESSOR, AIR RECEIVER, AND NITROGEN SYSTEM
600	20	FIRE WATER PUMPS AND FIRE WATER POND
000	21	MAIN GATE GUARD HOUSE

Source: TPMC, 2020.

4.6.2.9 Jetty Construction

The Unloading Jetty construction is expected to take approximately twelve (12) months, and will be installed alongside with the waterfront to unload the imported LNG with sufficient space to cater for 16,000 tons LNG Carriers as shown in ***Figure 4.10***. From the LNG Carrier(s), the LNG will be transferred to the LNG storage tanks before moving to the regasification unit.

Prior to any river construction activities, an exclusion zone of 200 meters and a safe zone of 250 metres from the LNG unloading jetty will be established to ensure safety among the Project vessels. This is to reduce the impact towards river navigation and potential ship collisions. Signalling buoys will be installed around the alignment of the safe zone to indicate the restricted area to other vessels. If a vessel enters the safe zone, the support tug vessels will assist to warn off the vessel.

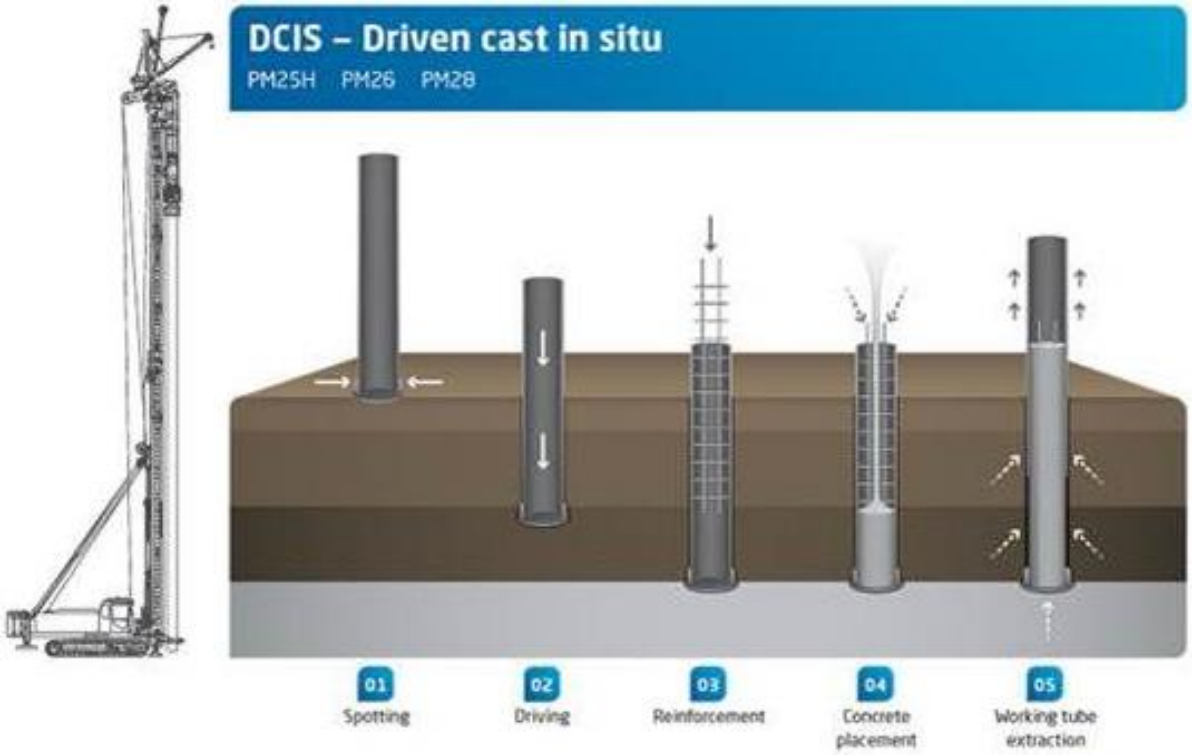
It is expected that the Unloading Jetty structure will be constructed using steel jackets, and concrete and steel reinforcements for cast in-situ. The process for constructing piles are as follows:

1. A pile driver will position the jacket at the intended location for installing the pile (Spotting);
2. A pile driver will bore the jacket vertically down into the sediment (Driving);

    a. Any excavated sediment will be discharge onshore, and will not be discharged back into the river, or riverbank.
3. Once the jacket is in position, steel reinforcements will be lowered into the casing to provide structural integrity (Reinforcement);
4. Concrete is poured into the casing and is left to solidify (Concrete placement);
5. Once the concrete has been solidified, the jacket will be removed by pulling it out vertically (Working tube extraction).

A visual process for conducting cast in-situ piling is shown in ***Figure 4.27***; to note, this method is currently tentative during this stage.

Figure 4.27: Cast In-situ Pilling Method (Tentative)



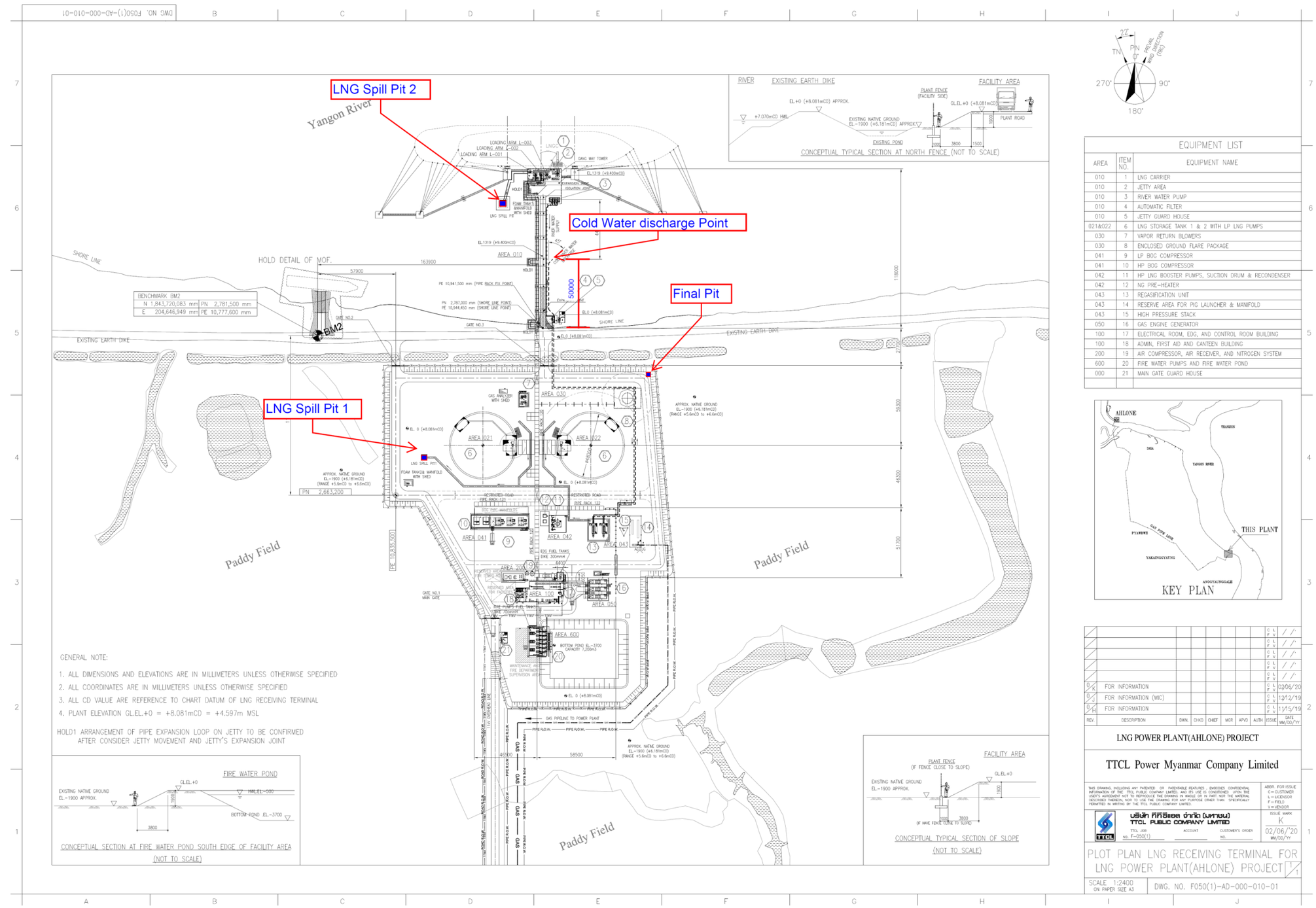
Source: TPMC, 2018.

Once the piles and top foundation for the jetty is complete, construction can proceed with installation of topside equipment, such as unloading/vapour arms, river water pumps, foam tank, pipelines, etc. The topside equipment will be installed using truck loader crane or barge crane depend on access lifting load and lifting radius, which will transport the equipment from onshore to the Unloading Jetty, and moved into place using the truck's built in crane. TPMC expects prefabrication activities to occur in Myanmar, potential locations for prefabrication includes South Dagon Township, and Thilawa Township.

The design of the Unloading Jetty is shown in ***Figure 4.15***.

Other components such as the breasting/mooring dolphins and LNG spill pit will also be pre-fabricated onshore, then installed in-place with the crane barges. There are two (2) spill pits and one (1) final pit located in the LNG Receiving Terminal area, as shown in ***Figure 4.28***. All construction vessels will comply with MARPOL 73/78, developed by the International Maritime Organization for pollution prevention from ships.

Figure 4.28: LNG Receiving Terminal Spill Pit, Final Pit, and Cold Water Discharge Location



AREA	ITEM NO.	EQUIPMENT NAME
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043	14	RESERVE AREA FOR PIG LAUNCHER & MANIFOLD
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050	16	GAS ENGINE GENERATOR
100	17	ELECTRICAL ROOM, EDG, AND CONTROL ROOM BUILDING
100	18	ADMIN, FIRST AID AND CANTEEN BUILDING
200	19	AIR COMPRESSOR, AIR RECEIVER, AND NITROGEN SYSTEM
600	20	FIRE WATER PUMPS AND FIRE WATER POND
000	21	MAIN GATE GUARD HOUSE

Source: TPMC, 2020.

4.6.2.10 Ancillary Structures

In addition to the main infrastructure on site, and as described above, the following ancillary buildings will be constructed:

- Admin, First aid and canteen building;
- Electrical room, GEG, and control room building;
- Gatehouse at the main gate of the site;
- Jetty guard house
- Staff canteen; and
- Firefighting pumps.

4.6.2.11 Power and Water Supply

Approximately 3,000 kW of electricity will be required during the peak construction period, with an average consumption rate of 300 MWh/month. The electricity will be sourced from the existing 33kV distribution line. The Contractor shall provide 33 kV/380 V box-type transformer and 300 kW diesel generator for emergencies.

During construction, water supply is required for both construction worker consumption and for other construction activities. The maximum number of workers onsite during construction is anticipated to be 600 persons and each worker is estimated to consume approximately 33.3 litres of water per day[12]. Prefabricated concrete activities are estimated to consume 180 litre of water per day per litre of concrete and take another 50 litre for washing of concrete work 1 cubic meter. Average 18.42 cubic meter of concrete work per day shall consume water 4,236 litres per day.

The average water consumption rate during construction is anticipated to be 900 m^3 per month (approximately 30 m^3 (30,000 L) per day).

The raw water required during construction will be obtained from YCDC or other local water supplier, and will be transported by water trucks. The raw water will be treated and purified to supply for construction.

4.6.2.12 Construction Waste

Solid Waste

During the construction phase, non-hazardous solid waste material is likely to be produced from concrete, steel pipes, steel plates, structural steel and wooden crates. Opportunities will be explored for selling any waste steel plates, structural steel, wood, and other valuable scrap. It is anticipated that the amount of non-hazardous waste produced during the construction phase is approximately 2,450 kg.

There will also be biomass waste associated with the clearance of tree, shrubs and grass. Approximately 4,680 m^3 of biomass waste is anticipated during construction. Biomass waste will either be disposed of by an appropriate or a licensed waste contractor, or by burying on-site.

Appropriate storage and disposal facilities for waste shall be constructed on-site. Bunded, hardstand and roofed areas are a general requirement for hazardous waste such as waste oils, paints and chemicals.

[12] Tchobanoglous, G., Burton, F. L., & Metcalf & Eddy. (1991). Wastewater engineering: Treatment, disposal, and reuse. New York: McGraw-Hill.

Table 4.14 presents details of domestic waste and approximate capacities anticipated during construction. TPMC will utilize services from the Yangon City Development Committee (YCDC) for domestic waste disposal.

Table 4.14: Domestic Waste during LNG Receiving Terminal Construction

Waste Type	Anticipated Quantity	# Workers	Total Solid Waste
Domestic Solid Waste	1.65kg per employee per week	600	990 kg/week

There will also be minimal other waste such as wood crates which will be provided to the local community as firewood.

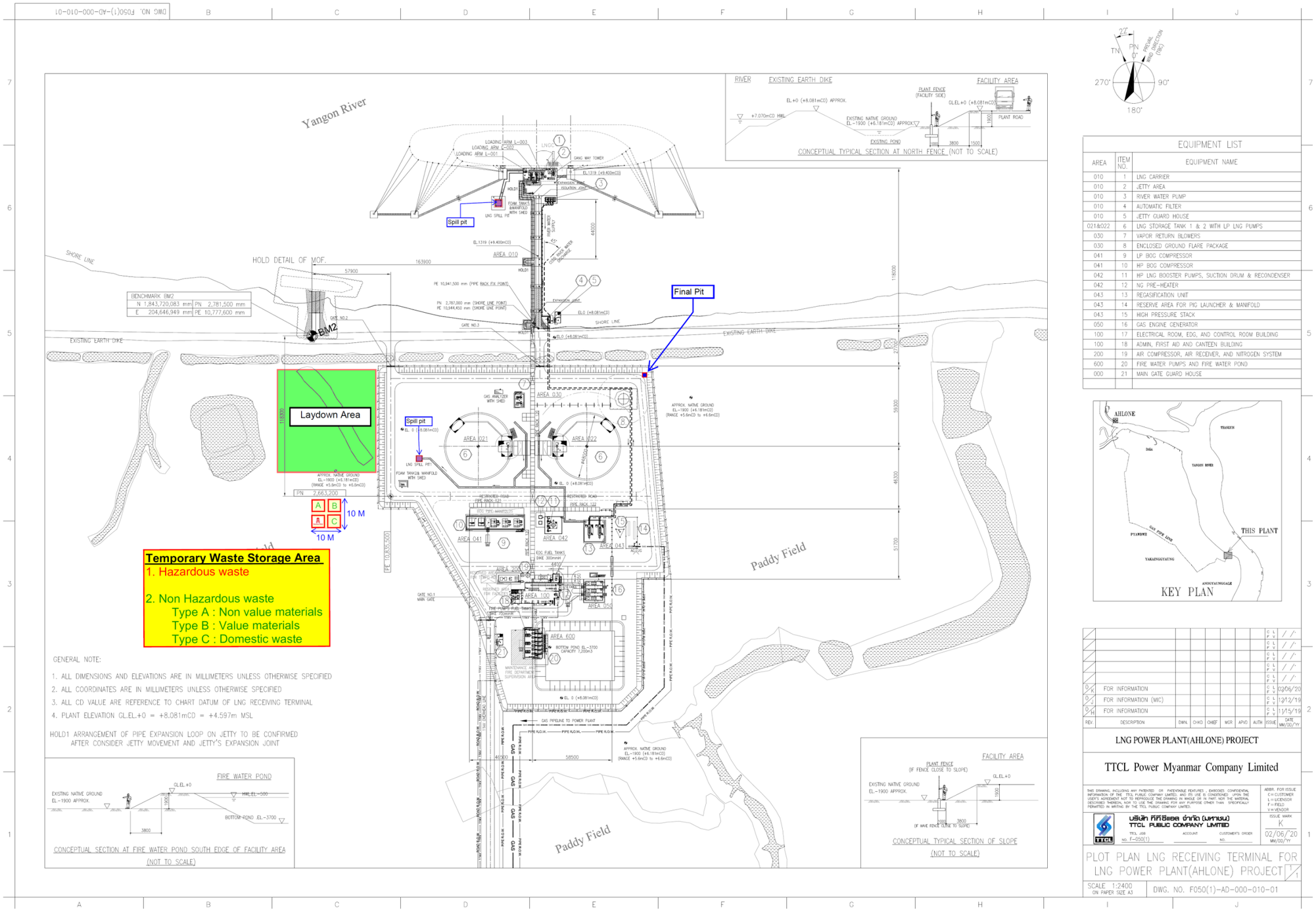
Table 4.15 presents details of the construction waste and approximate capacities anticipated during construction. All waste will be disposed according to TPMC's Waste Management Plan (***Appendix H***). The location of non-hazardous and hazardous waste storage is shown in ***Figure 4.29***.

Table 4.15: Construction Waste during LNG Receiving Terminal Construction

Waste Type	Amount
Concrete	720 Tons
Steel Pipes	6 Tons
Steel Plates	6 Tons
Structural Steel	2 Tons
Wooden Crates	30 Tons

Source: TPMC, 2019.

Figure 4.29: LNG Receiving Terminal Non-Hazardous and Hazardous Waste Storage Area



Source: TPMC, 2020.

Wastewater

Wastewater typically produced during construction includes sanitary/domestic wastewater, cement wash down, other plant cleaning/rinsing effluents, vehicle maintenance and the mixing of oils/lubricants in the wastewater (i.e. as a result of equipment washing).

Non-Hazardous wastewater will be generated from the toilet facilities and workers accommodation (sewage). Non-hazardous wastewater will also be generated from the canteen. The sewage generated onsite will be treated in a septic tank before being discharged.

The increased presence of the labour force in the local areas may also place pressure upon any existing sewage systems and wastewater treatment systems or may result in additional untreated discharges of sanitary and domestic wastewater to the local environment.

Sewage/Sanitary Wastewater

During construction, it is anticipated that the maximum number of workers will peak at 600. The quantities of sanitary wastewater can be estimated as an average of 50 litres/person/day, and considering sanitary wastewater production to be 80% of water consumption per person (for non-continuous use), this equates to a predicted 24,000 litres of sanitary wastewater per day at peak construction periods. The EPC contractor will establish a management system for sanitary wastewater before construction.

Hazardous Waste

During the construction phase, hazardous waste material can originate from used paint, engine oils, hydraulic fluids, spent solvents, spent batteries, etc. It is anticipated that the amount of hazardous waste produced during the construction phase is listed in ***Table 4.16***.

Table 4.16: Hazardous Waste Quantities

Hazardous Material	Amount
Diesel oil	10 L per day
Hydraulic fluids	5 L per day
Paint	10 L per day (painting work period 90 days)
Battery	1 kg per day
Concrete	1 m^3 per day

Source: TPMC, 2019.

Hazardous wastewater will be generated from chemical cleaning of the equipment during the pre-commissioning process. Hazardous wastewater from chemical cleaning will be disposed by a contractor certified by TPMC.

4.6.2.13 Health and Safety

Emergency Response Plan

TPMC has in place a Project Incident and Emergency Response Plan to provide the necessary course of action during an unplanned event, during the construction and operation phase.

The potential emergency scenarios that apply to this plan are as follows:

- Person(s) fall from height – on land;
- Material fall from height;
- Vehicle collision with plant/equipment/pedestrian(s);
- Vehicle incident offsite;

- Collapse of scaffold – no person(s) present/person(s) present;
- Collapse of structure – no person(s) present/person(s) present;
- Collapse of deep excavations – person(s) present;
- Fire/Explosion – electrics, substances;
- Chemical spillage – on land;
- Medical emergency – mass food poisoning/bird flu;
- Medical emergency – contagious disease;
- Uncontrolled flammable/toxic release;
- Adverse weather conditions (flooding, lighting strike);
- Loss of services (water, sewerage, electricity);
- Radiation (Radiation Source Exposition); and
- Other (Earthquake, terrorist act, bomb threat, trespassers).

The full Project Incident and Emergency Response Plan is shown in ***Appendix I***.

Site Security Procedure

The site security procedure is designed to provide a secure environment for employees that are on site, during the construction phase.

The main topics that this procedure covers are as follows:

- Physical barriers (Fence, Gates);
- Badge (Personal access control);
- Mobilization and demobilization of employees;
- Asset control;
- Guards;
- Vehicle policy;
- Security supervision; and
- Photography control.

The full Site Security Procedure is shown in ***Appendix J***.

Personnel Protective Equipment Procedure

The purpose of this procedure is to establish specifications, decision criteria, and guidance for Personal Protective Equipment (PPE) to ensure the proper level of safety is met and to protect workers from injuries and occupational health illnesses, during the construction phase. The full Personnel Protective Equipment Procedure is shown in ***Appendix K***.

4.6.3 Operation Phase

The main features of the LNG Receiving Terminal have been summarised in ***Section 4.6.1***.

For the LNG Receiving Terminal, TPMC will proceed with an Own Operation and Maintenance (O&M) contract with a third party specialist Operation support.

O&M staff with relevant experience of operating similar facilities and with adequate knowledge of comparable technology will be deployed prior to commercial operation date (COD) to commission and take over the Project from the EPC Contractor. Approximately 30 staff will work on the operational phase of the Project.

The below sections will discuss further the key activities during Operation Phase.

The fuel supply for this Project will be based on imported LNG from overseas. The LNG will then be re-gasified to NG (gas form) using the proposed Regasification units. The amount of NG required from the Power Plant is 440,000 tonnes per year, and the capacity of the LNG Receiving Terminal to store LNG is 30,000 m^3 plus 20,000 m^3 (buffer storage).

The LNG will be transported via 16,000 tonne (approx.) LNG Carrier to the proposed LNG Receiving Terminal. Once re-gasified, the NG will then be transported by the proposed NG pipeline to the

proposed Power Plant. It is expected that the LNG Carrier will arrive at the LNG facilities (unloading jetty) approximately every 12 days (approximately 2-4 LNG Carriers per month).

4.6.3.1 LNG Carrier (LNGC)

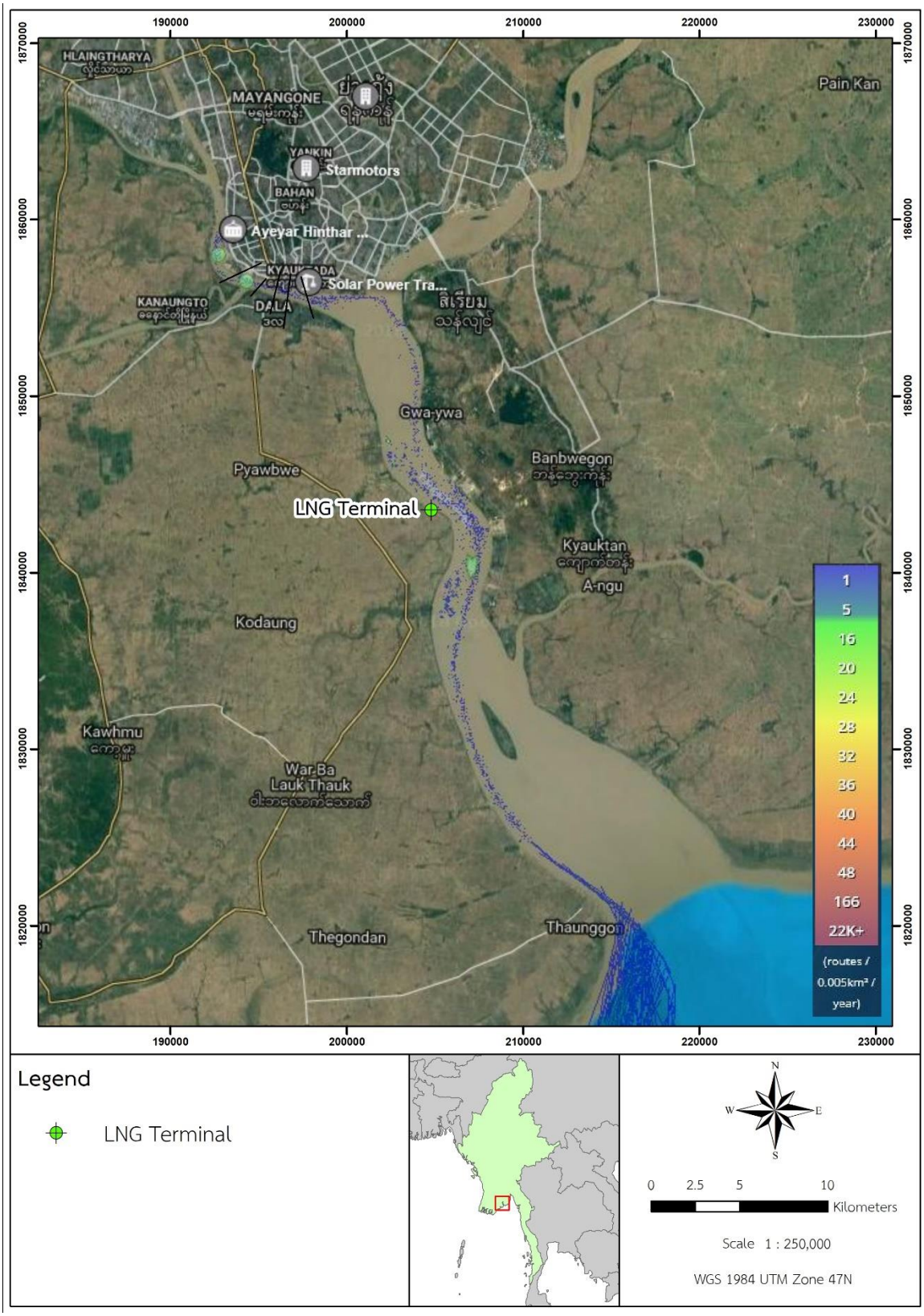
LNG will be transported to the receiving terminal by LNG carriers. The transit of the LNG carrier to the receiving terminal will be from pilot embarkation at the mouth of Yangon River. It is envisaged, based on preliminary terminal throughput, that one LNG carrier will berth at the terminal approximately every twelve (12) days (approximately 2-4 LNG Carriers per month).

The LNG carrier will be self-propelled when entering or leaving the Yangon River, and two (2) support tug boats will assist in LNG carrier's docking. The vessel traffic of the Yangon River is shown in ***Figure 4.30***, vessel traffic is also indication of the common navigation routes that vessels take; therefore, the LNGC will also follow the same traffic route when entering or leaving. Given the large width of the Yangon River at the LNG Receiving Terminal location (approximately 1.9 km), a turning basin is not required. At the jetty, the LNG carrier will be connected with the receiving terminal through the unloading arms. Two (2) unloading arms will unload LNG from the LNGC to the storage tanks at a rate of approximately 2,500 m^3/hr, using the carrier's own pumps, at the same time, one (1) vapour arm will send vapour from the storage tank back into the LNGC; this is to counteract the increase in pressure from unloading.

The unloading of LNG from the carrier takes approximately 12-16 hours. In addition, approximately 3 hours for mooring, cool down, connecting unloading arms, and cargo measurement, and approximately 3 hours for cargo measurement, arm purging, disconnecting arms, and unmooring; therefore, it is expected that the overall process will require 18-22 hours.

During the LNG unloading operation, ballast water will be taken on-board from the surrounding water into the double hull compartments to compensate for cargo discharge. No ballast water will be discharged in the Yangon River waters.

Figure 4.30: Vessel Traffic of the Yangon River



Source: MarineTraffic, 2017.[13] (Modified by ERM)

[13] MarineTraffic (2017) https://www.marinetraffic.com/

4.6.3.2 LNG Receiving Terminal

The LNG Receiving Terminal will serve as fuel storage and regasification.

Operation of the terminal facilities will include the following significant process operations:

- LNG carrier approach, berthing and departure;
- LNG unloading from LNG carriers at the LNG Unloading Jetty via unloading arms and transfer to onshore LNG Storage Tanks via Cryogenic pipeline;
- LNG storage in onshore LNG Storage Tanks;
- Re-gasification of the LNG to Natural Gas (NG) ; and
- Final send out of natural gas via a NG pipeline.

At the receiving terminal, the LNG will be stored at near atmospheric pressure in cryogenic full containment LNG storage tanks and, when required, brought back to a gaseous state prior to being dispatched via pipeline to the proposed Power Plant.

4.6.3.3 Control of LNGC Berthing Operations and Safety Zone

The LNG unloading jetty will be designed to accommodate the size and type of LNG carrier that are required to meet the cargo volume requirements. Each LNG carrier will be compared against predetermined acceptance criteria before being approved for the terminal. Once berthed, staff will complete various safety checks collectively and unloading operations will not commence until the Ship/Shore Safety Checklist included in the ”International Guide for Oil Tankers and Terminals” has been completed satisfactorily. In addition, the requirements of the carrier's security plan shall be implemented consistent with the "International Ship & Port Facility Security Code".

While an LNG carrier is moored, the waters and waterfront facility located within a defined boundary to be constituted as a safety zone to avoid potential collision from passing traffic. The extent of this area is under examination and will depend on the findings of detailed design studies to be conducted under separate permitting exercises.

4.6.3.4 LNG Storage Tanks

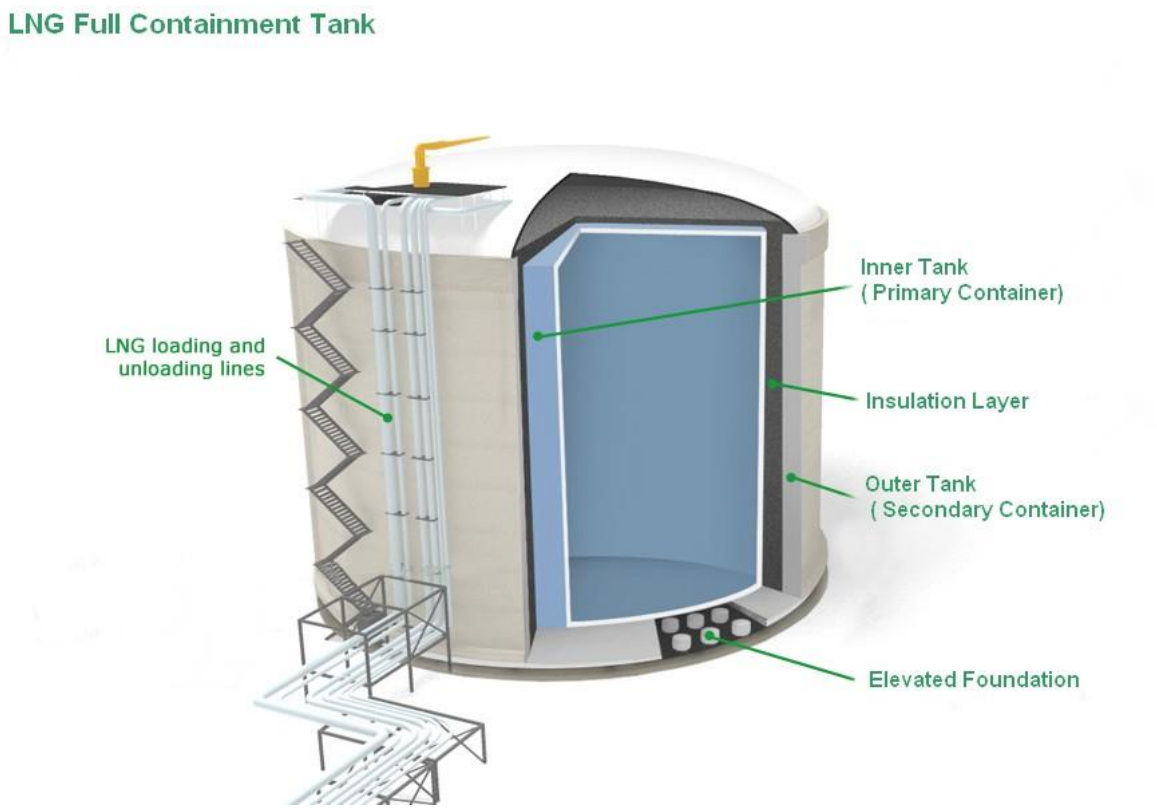
The storage of Liquefied Natural Gas is a specialised Storage tank, the storage type to be used for this Project are full containment tanks, where the inner contains LNG and the outer container contains insulation materials. The common characteristics of LNG Storage tanks is the ability to store LNG at the very low temperature, approximately -160 °C. In the event where the natural gas quality is below standard, or if pressure within the storage tanks / vaporizers increases unusually due to a malfunction, the HP / Cold vent stacks will vent out LNG.

At working volume, the stored LNG in both storage tanks is capable of supplying natural gas to the Power Plant for 17.6 days. In order to maintain the required temperature within the storage tanks, the minimum volume of LNG that remains in each storage tank is approximately 1,600 m^3.

As such, two (2) tanks of full containment type, each with a working capacity of 25,000 m^3 will be considered for the Project. The secondary liquid container is designed to hold all the liquid contents of primary container in the event of leaks from the primary container. The indicative design of the LNG Storage Tank is shown in ***Figure 4.18***. An example of a 3D sketch of the LNG Storage Tank is shown in .

In a situation where LNG is not supplied on-time, the storage tanks can provide a supply buffer for seven (7) days to maintain the operation of the proposed Power Plant.

Figure 4.31: Typical Full Containment Tank



Source: GNL Quintero, 2014.

4.6.3.5 Re-gasification Units

Firstly, LNG transfer pumps (two (2) pumps attached to each storage tank) will pump LNG from the storage tanks, through the BOG recondenser, then into the Booster Pump Suction Drum, while simultaneously pumping Boil-off Gas (BOG) from the storage tanks through the BOG compressor, and the In-Line BOG recondenser, then into the Booster Pump Suction Drum. Next, three (3) booster pumps will pump LNG within the Booster Pump Suction Drum directly to the two (2) Regasification Units.

River water will be used as cooling water for the regasification process, three (3) pumps will pump water through the debris filter, then into the RU.

Re-gasification is a process of converting liquefied natural gas (LNG) at −160 °C temperature back to natural gas at atmospheric temperature and its capacity is 63 MMSCFD.

A Vaporizer is a heat exchanger in Re-gasification unit that uses river water as the source of heat. The Intermediate Fluid Vaporizers (IFV) types of vaporizers are used for LNG re-gasification.

4.6.3.6 Water Supply

The main freshwater supply source will be taken from Yangon River. However, the use of surface water will be determined and assessed at the later stage to ensure no disruption to the local communities.

River water supply for the LNG Receiving Terminal will be used for heat transfer during regasification, and for domestic water use.

Table 4.17 presents the water requirements and their volumes during operation.

Table 4.17: Water Requirement during Operation

Water Requirement	Situation	Volume
Regasification heat transfer	Normal Operation	1300 m^3/hr
Domestic water (local authorized)	Normal Operation	4 m^3/h
Fire water	Normal Operation (Annual fire drill)	Fire water = 2,896 m^3/h (≤2 hours) Foam = 0.382 m^3
	Emergency (Largest fire scenario)	3,450 m^3/h (≤2 hours)

Source: TPMC, 2018

The raw water will be taken from Yangon River, using the Water Intake Pumping station at the flow rate of approximately 1,300 m^3/hr. Intake river water will be used for regasification unit. Regasification Unit is equipped with debris filter. Water treatment process is not requried .

The lowest flow rate estimated from flow velocity measurements in the dry season in the intake location of the Yangon River, where the Project will withdraw from, is estimated to be 28.5 m^3/s (based on lowest flow velocity of 0.9 m/s, shallowest depth of 1.9 m, and average width of river of 150 m at intake location), which would be equivalent to 102,600 m^3/hr. The maximum intake requirement for the Project is expected to be1,300 m^3/hr. This is equivalent to approximately 0.83% of the lowest dry season flow in the river at the intake location. This is based on a worst case scenario, comparing the Project's maximum expected water withdrawal requirements, with a constant withdrawal over a 24-hour period, during the lowest measured flow rate in the dry season.

Based on the above comparison of the Project's water intake requirements with the estimated flow rates of the river during the dry season, it is expected that there will be adequate flow to support the

Project's water withdrawal, and the Project is not expected to have any significant impacts on current water users for the Yangon River.

4.6.3.7 Electricity Supply

The LNG Receiving Terminal will be connected to an 11 kV transmission line that runs parallel along the access road and the pipeline. The LNG Receiving Terminal is expected to consume 1.6 MW; however, considering a portion of electricity will be provided by the GEGs, the amount of electricity that will be consumed from the 11 kV transmission line is approximately 10 KW.

4.6.3.8 Anticipated Workforce

The anticipated workforce during operation is shown in ***Table 4.18***, and the anticipated number of vessels during operation is shown in ***Table 4.19***.

Table 4.18: Anticipated Workforce for LNG Receiving Terminal

Description	Staff Number
Permanent Staff	30 (O&M + Back Office)
Security (external)	12
Contract staff: Cleaners, Gardeners and helpers	10
Contract staff: Technical hands	10
Maintenance (once every 3 years)	90 for 30 days

Source: TPMC, 2018

Table 4.19: Anticipated Number of Vessels during Operation

Type of Vessel	Number of Vessels	Amount of Workers per Vessel
LNG Carrier	1 (every 12 days)	2
Navigation Boat	1	These vessels will be provided by the Myanmar Port Authority
Support Tug	2	

Source: TPMC, 2018

Workforce Shift Structure

The Operational and Maintenance (O&M) working will use 4 shift teams to provide 24/7 coverage for plant operation and 8 hours per day, 7 days per week for general corrective and preventive maintenance work.

The shift structure will be as follows:

- 8 hours per shift (3 shift operate and 1 shift off)
- 2 days shift (D,7am- 4pm), 2 days shift (A,4 pm-12pm), 2 night shift (N-12 pm-7am) and 1 day off (O) (DDNNAAO shift patterns); the shift pattern will change every 14 days;
- 1 shift charge, 1 unit controller and 2 field technicians per shift; and
- 32 staffs will be in the shift roaster

The mentioned shift patterns with proven record of rotational shift work should reduce circadian rhythm impacts and mental health impacts of shift work.

The rotational shift work between operation staffs and maintenance staffs are required for every 24-week cycle. Additionally, special non-allowable vacation 4-week period reserve for plant major outage

is also provided; this is with accordance to a set schedule to equally distribute workload and average 1,488 working hours for every O&M staff for a 52-week cycle.

4.6.3.9 Operational Waste

Operational Solid Waste

During operation the re-use, recycle and minimization of waste ethic shall be adopted. A waste management plan will incorporate strategies for the re-use, recycle and minimization of waste on Site. Management strategies for regulated and hazardous waste shall also be included, including a methodology for tracking regulated/hazardous waste generation and disposal.

Appropriate storage and disposal facilities for waste shall be constructed on Site. Bunded, hardstand and roofed areas are a general requirement for hazardous waste such as waste oils, paints and chemicals.

Table 4.20 presents details of the solid waste and approximate capacities anticipated during operation.

Table 4.20: Solid Waste during LNG Receiving Terminal Operation

Waste Type	Anticipated Quantity	# Employees	Total Solid Waste
Domestic Solid Waste	1.65kg per employee per week	62	102.3 kg/week

The solid waste generated during the operation phase will be collected and segregated for recycle and non-recycle waste (i.e. paper, plastic). Project will use incineration on site and compost.

There will also be minimal other waste such as wood crates from maintenance activities which will be provided to the local community as firewood.

Operational Hazardous Materials

The hazardous materials to be stored on site during operation are presented in ***Table 4.21***. The chemicals will be transported appropriately to the Project site and Material Safety Data Sheets (MSDS) will be prepared from chemical suppliers in Myanmar.

Table 4.21: Hazardous Materials during Operation

Hazardous Material	Use of Hazardous Materials	Storage Location Onsite	Quantities to be Stored Onsite*
Diesel oil	Liquid fuel for emergency diesel engine generator, emergency diesel generator	Storage Tank	Estimate at 2 x 7200 litres x 3 days for fuel tank = 43,200 litres.

*Note: *Estimated figures only for 2 months in chemical storage house*

4.6.3.10 Operational Wastewater and Cold Water Discharge

The LNG Receiving Terminal will be equipped with a septic tank to treat domestic wastewaters. During maintenance, oils and lubricants will be collected in sump pits and later pumped into small storage drums to be disposed by a licensed waste contractor.

Table 4.22 presents details of the wastewater and approximate capacities which will be generated during operation.

Table 4.22: Wastewater during Operation

Item	Timing of Wastewater Generation	Capacity*
Cold water discharge from LNG Receiving Terminal		
Regasification Unit	Normal Operation	1,300 m^3/h (Difference in temperature between discharged cooling and river water is 10 °C (only at discharge point))
Domestic Wastewater		
Sanitary/ Sewage Wastewater	Normal Operation	4 m^3/ hour
Storm Water	Normal Operation/During Rainfall	1,000 m^3/h

*Note: *estimate figures only*

4.6.3.11 Storm Water

Storm water will be collected with the appropriate placement of drainage systems to prevent contaminated direct discharge of storm water into the surrounding environment; drainage systems will be installed around the LNG Receiving Terminal and on the Unloading Jetty. Non- contaminated storm water will be discharge directly to storm water drainage. The drainage system for storm water at areas where lubricating oils are handled will be connected to an oil and grease pit (interceptor). The contaminants will be captured in the pit and removed manually. Contaminated storm water will be sent to the oil-water separator system before discharge to the final checking pond while uncontaminated storm water will be discharged offsite via a overflow pipe into the small water channel, the discharge point is located at the final pit (***Figure 4.28***). The estimated amount of discharge storm water is shown in ***Table 4.22***.

4.6.3.12 Gas Engine Generator (GEG)

The four GEGs will operate continuously to generate electricity for in-house operations. The GEGs will use BOG that is generated from storage tanks and other processes as fuel to operate. All four (4) generators are expected have a total capacity of 1,800 kW (1,160 kW each at 60%), enough to operate all functions within the LNG Receiving Terminal, this is equivalent to approximately 10,369.59 tCO_2eq/year.

4.6.3.13 Fire Protection System

The LNG Receiving Terminal's fire protection system will provide personnel safety and plant protection through prompt detection, alarm and suppression of a fire. The system will be designed for any single design basis fire and will be in accordance with all local applicable codes and standards. Fire and leakage detection systems will be installed appropriately to ensure fast response. The primary source of water for the system shall be from a firewater pond within the LNG Receiving Terminal, firewater monitor will be installed around various points of the LNG Receiving Terminal and Unloading Jetty. Six (6) diesel fire pumps will pump water from the firewater pond to the necessary fire protection systems such as the firewater monitor, and will ensure adequate water pressure for water fire suppression. Foam fire extinguisher systems is also used to suppress the spread of leaked LNG in the LNG spill pit, there are two (2) foam storage tanks in total, one located on the unloading Jetty and another close by the BOG compressor, as shown in ***Figure 4.10***.

The fire protection system will be designed in accordance with the national fire protection association (NFPA) code and standards. The specific NFPA codes that TPMC will follow are as follows:

- NFPA 10: Standard for Portable Fire Extinguishers;
- NFPA 11: Standard for Low-, Medium-, and High-Expansion Foam;
- NFPA 15: Standard for Water Spray Fixed Systems for Fire Protection;
- NFPA 20: Standard for the Installation of Stationary Pumps for Fire Protection;
- NFPA 24: Standard for the Installation of Private Fire Service Mains and their Appurtenances; and
- NFPA 59A: Standard for the Production, Storage and Handling of Liquefied Natural Gas (LNG).

Different types of fire protection systems will be used throughout the LNG Receiving Terminal. A summary of the systems used in specific locations are shown in ***Table 4.23***.

Table 4.23: Preliminary Summary Table of active Fire Protection System for Building and Equipment

Fire Hazardous Source	Fire Water Hydrant	Fire Water Hydrant with Monitor	Fixed Water Spray System	Fixed Foam System	Fire Alarm Detector	Fire Extinguisher
Jetty						
Jetty Platform		X		X		X
Walkway & Mooring Dolphin						
Loading Arm(s)			X			X
River Intake Pump						X
Other (if any)						
Process Area						
LNG Storage Tank(s), transfer pump(s), LNG spill pit		X	X[a]	X[b]		X
BOG Compressor(s)	X					X
Regasification Unit(s)	X		X			X

Fire Hazardous Source	Fire Water Hydrant	Fire Water Hydrant with Monitor	Fixed Water Spray System	Fixed Foam System	Fire Alarm Detector	Fire Extinguisher
HP LNG Booster pump suction drum	X		X			X
NG pre-heater	X					X
Vent Stack	X					X
Gas Engine Generator	X					X
Air Compressor and Nitrogen System	X					X
Fire Water Pumps	X					X
Central Control Building						
Electrical Room					X	X
Control Room					X	X
Transformer			X			X
Common Facility Area						
Administration, First Aid and Canteen Building	X				X	X
Main Gate Guardhouse	X				X	X
Jetty Guardhouse	X				X	X

Source: TPMC, 2019.

Note: [a] *Water spray system applies for roof and shell of LNG storage tanks.*
[b] *Fixed foam system applies only on LNG spill pit for any LNG spillage.*

The detailed fire prevention plan can be found in ***Appendix L***.

4.6.3.14 Health and Safety

TPMC has in place a Project Incident and Emergency Response Plan to provide the necessary course of action during an unplanned event.

The potential emergency scenarios that apply to this plan are as follows:

- Person(s) fall from height – on land;
- Material fall from height;
- Vehicle collision with plant/equipment/pedestrian(s);
- Vehicle incident offsite;
- Collapse of scaffold – no person(s) present/person(s) present;
- Collapse of structure – no person(s) present/person(s) present;
- Collapse of deep excavations – person(s) present;
- Fire/Explosion – electrics, substances;
- Chemical spillage – on land;
- Medical emergency – mass food poisoning/bird flu;
- Medical emergency – contagious disease;
- Uncontrolled flammable/toxic release;
- Adverse weather conditions (flooding, lighting strike);
- Loss of services (water, sewerage, electricity);
- Radiation (Radiation Source Exposition); and

- Other (Earthquake, terrorist act, bomb threat, trespassers).

The full Project Incident and Emergency Response Plan is shown in ***Appendix I***.

4.6.3.15 Maintenance

During operation, maintenance will be associated with the following:

- Routine Maintenance;
- Planned Preventive Maintenance; and
- Breakdown Maintenance.

4.6.4 Decommissioning

Decommissioning is the term used to describe all the stages involved in the closure and rehabilitation of the power plant site. The process can generally be categorized into three (3) key phases as follows:

- Pre-decommissioning activities: includes the detailed planning (development of the decommissioning plan) and approval procedures;
- Decommissioning activities: removal of plant machinery & equipment and demolition, decommissioning of facilities, turbines and infrastructure, decontaminated land assessment and rehabilitation; and
- Post-decommissioning activities: site survey, close-out report and field monitoring as necessary.

4.6.4.1 Decommissioning Phase of the Project

At present, there are no plans or schedule for decommissioning of the proposed Project. It is likely that the Project facilities will only be decommissioned/ abandoned once it is no longer economical to continue operation, the plant is rendered redundant and/or no longer required for various reasons or is unsafe to operate. As the development process of the site is yet to fully begin, detailed decommissioning plans have not yet been formulated.

The Project facilities will be designed with decommissioning in mind. In general, facilities and machinery will be designed so that they can be isolated and decommissioned in steps which are in reverse of the installation procedure or which are most convenient to do so. The decommissioning phase activities will therefore be similar to those associated with the excavation/foundation work, installation and civil construction phases. The decommissioning plant will also take into account environmental rehabilitation, which includes the removal of all surface facilities and excess hydrocarbon waste, as well as re-vegetation of localized natural flora.

Associated decommissioning activities in accordance with environmental measures and standards of good practice are as follows:

- Removal of site infrastructure and waste;
- All civil structures and associated infrastructure will be removed;
- All remaining materials and hydrocarbons and hazardous waste will be removed;
- All pilings and trestles will be removed;
- All waste will be disposed of in an appropriate manner; and
- Reusable materials to be resold or recycled.

Hazardous Waste Clean Up and Transport:

- When decommissioned, all products within piping and storage infrastructure shall be removed from said system along with all associated infrastructure and possible contaminated soils; and
- All hazardous wastes shall be transported to approved hazardous waste storage facilities or disposal sites.

Site Rehabilitation:

- all disturbed areas due to ROWs, transmission lines, etc. shall be rehabilitated and revegetated;
- native flora shall be used to re-vegetate the rehabilitated sites;
- Roadways will be scarified; and
- Natural drainage patterns will be reinstated where practical.

4.7 Natural Gas (NG) Pipeline

4.7.1 Key Components

The natural gas supply pipeline will be designed as per ASME B31.8: Gas Transmission and Distribution Systems. The natural gas pipeline will cover approximately 483 ha of grassland, villages, agricultural, and water area (***Figure 5.33***, ***Table 5.52***). In addition, Cathodic Protection will be placed for the buried section of the pipeline. The brief specification for the Pipeline are included in ***Table 4.24*** below.

Table 4.24: Gas Pipeline Key Components

Component	Details
Length	24.9 km
Diameter	20 inches
Pipe Wall Thickness	≥ 9.53 mm
Material	Carbon steel
Design Pressure	Appx. 64 barG
Minimum Yield Strength	4481.6 barG
Coating	API 5L X65 with 3LPE coating
Minimum Design Temperature	0.0 °C
Operating Design Temperature	10 °C
Maximum Design Temperature	55.0 °C
Design Standard	ASME B31.8 ASME B31.8s ASME B31.3
Material Design	ANSI / ASME / ASTM API SSPC MSS
Design Location Class	3, and 4 (Design factor 0.5, and 0.4 respectively)
Coating	3 Layer Polyethylene
Cathodic Protection	Impressed current cathodic protection
Block Valves	Two (2) Valves (at each extremity)
Operation Period	25 years from COD

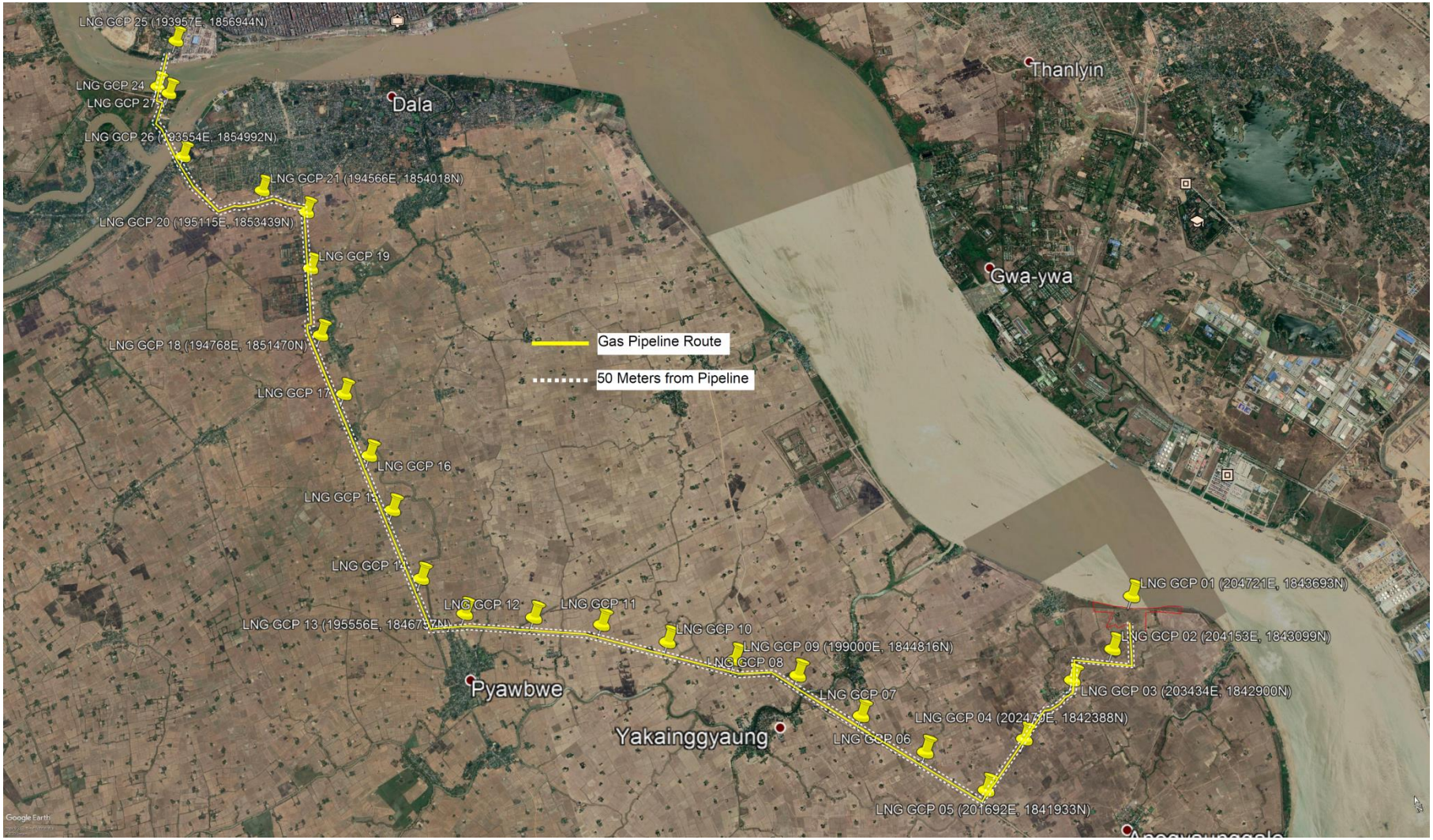
Source: TPMC, 2019

A natural gas supply and treatment system will be installed at the Power Plant to meet the required gas quality specified by the gas turbine manufacturer. The natural gas system will include equipment and all necessary gas filter-separators, isolation and safety valves, and other equipment.

Pipeline sections that are expected to be aboveground are located at block valves (maximum of 15 – 30 metres of aboveground pipeline length at each block valve), and small canal crossings which do not require pipelines to be routed underground.

The pipeline alignment and coordinates for sections along the pipeline are shown in ***Figure 4.32***.

Figure 4.32: Pipeline Alignment with Coordinates



Source: TPMC, 2020.

4.7.1.1 Open-Cut Pipeline Sections

Pipelines sections will utilize an open-cut method. To provide protection from non-project related drilling/excavating activities from damaging the pipeline, two (2) protection layers are applied. The first protective layer is a PVC Pipeline warning sign, which will advise not to drill/excavate any further, an example of the warning sign is shown in ***Figure 4.33***. The second layer is a concrete slab, which protects the pipeline from any drilling/excavation that pass the first layer. An example image of the concrete slab is shown in ***Figure 4.34***. The open-cut design for the pipeline is shown in ***Figure 4.36***. In addition the pipeline will be marked on the surface with sign posts clearly indicating the restriction in that area. These sign posts will be installed along the pipeline.

Figure 4.33: Example of PVC Pipeline Warning Sign

Source: TPMC, 2018.

Figure 4.34: Example of Concrete Slab

Source: TPMC, 2018.

4.7.1.2 Horizontal Directional Drilling (HDD) Pipeline Sections

HDD pipeline sections will not have PVC pipeline warning signs, and concrete slabs. The pipeline sections that will utilize HDD to cross the Twante Canal will have a length of approximately 500 metres, whereas sections that cross the Yangon River will have a length of approximately 550 metres. The pipeline installation using the HDD method will be located under the river bed.

4.7.1.3 Above Ground Pipeline Sections

Although the majority of the pipeline will be placed below ground, small sections of the pipeline will be placed above ground. These include sections located at each extremity of the pipeline where each block valve is located, this is to allow easier access to the block valve that will also be placed above ground; it is expected that only approximately 15 – 30 m of pipeline will be above ground, at each block valve. Some sections of the pipeline is expected to cross above small canals as the size of these canals allow for an above ground crossing; each of these sections are not expected to be over 30 m in length.

4.7.1.4 Anti-Corrosion Coating

All pipeline sections will be coated with a suitable anti-corrosion material to prevent corrosion from occurring. Any pipeline sections that are located above ground will be designed to withstand higher temperatures of up to 55 °C; both underground and above ground pipeline sections will be applied with a 3 Layer Polyethylene as an external protection. The parts of NG pipeline that are aboveground are:

- at transition between aboveground pipe to underground pipe at block valves near RU at LNG terminal and around block valve at Power plant. Each section should not be more than 30 m in length.
- at some small canal crossing in Dala Township. Each section should not be more than 30 m in length.

4.7.1.5 Block Valve

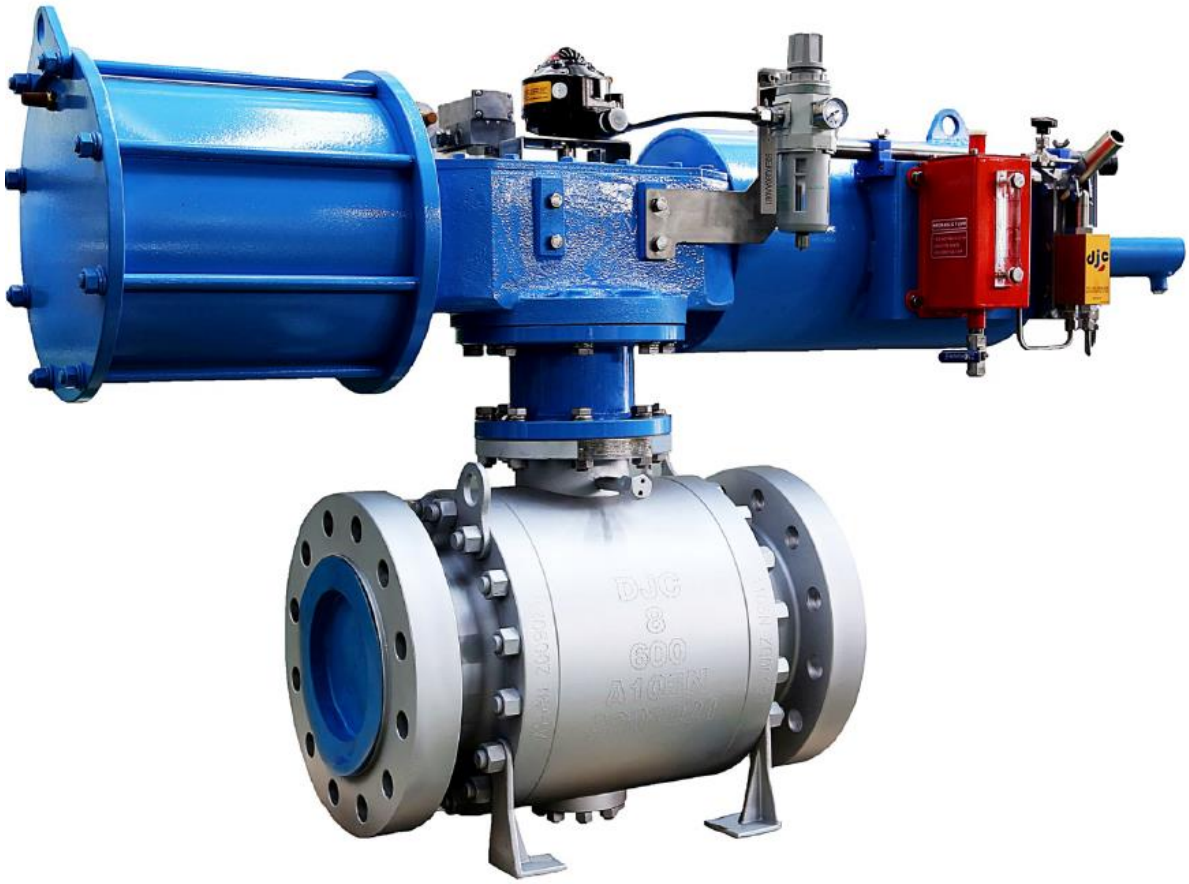
Block valves are used to stop the flow of natural gas through the pipeline during maintenance, or a leakage. There will be two (2) block values located on each end of the pipeline; therefore, one block valve will be located at the LNG terminal, near the regasification unit, and the other will be located at the Power Plant. Both block valves will utilize a ball valve design with an electric valve actuator. The valve will communicate with the LNG Receiving Terminal/Power Plant control room, when a leak is detected or maintenance is required. The block valve specifications are shown in ***Table 4.25***. An example of a block valve is shown in ***Figure 4.35***. An operator from the control room can issue a command to close the value when required.

Table 4.25: Block Valve Specifications

Components	Details
Model/Type	Ball Valve
Communication	Hardwire
Material	Carbon Steel, Stainless Steel
Design Standard	API 6D/6A
Fire Safe Standard	ISO 10497/API 6FA, API 607

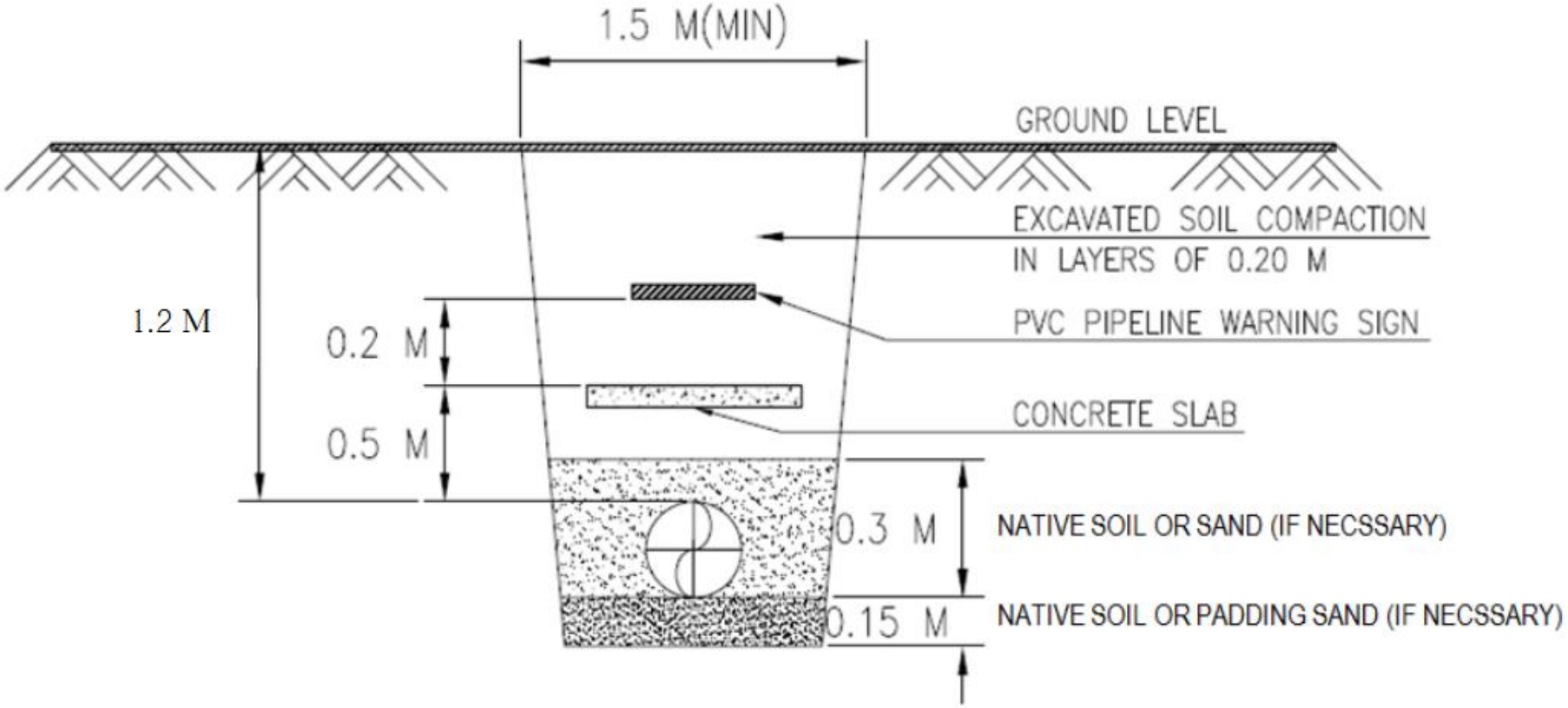
Source: TPMC, 2019.

Figure 4.35: Example of Block Valve



Source: TPMC, 2019.

Figure 4.36: Pipeline Backfill Open Cut Design



Source: TPMC, 2018.

4.7.1.6 Sign Post

Sign posts are used for providing information, guidance, or warning. Throughout the pipeline alignment, specific types of sign post will be installed to protect public health and safety and pipeline integrity.

There are five (5) sign post configurations, each differ from each other with regards design and/or placement. Each sign post is listed and described in ***Table 4.26***.

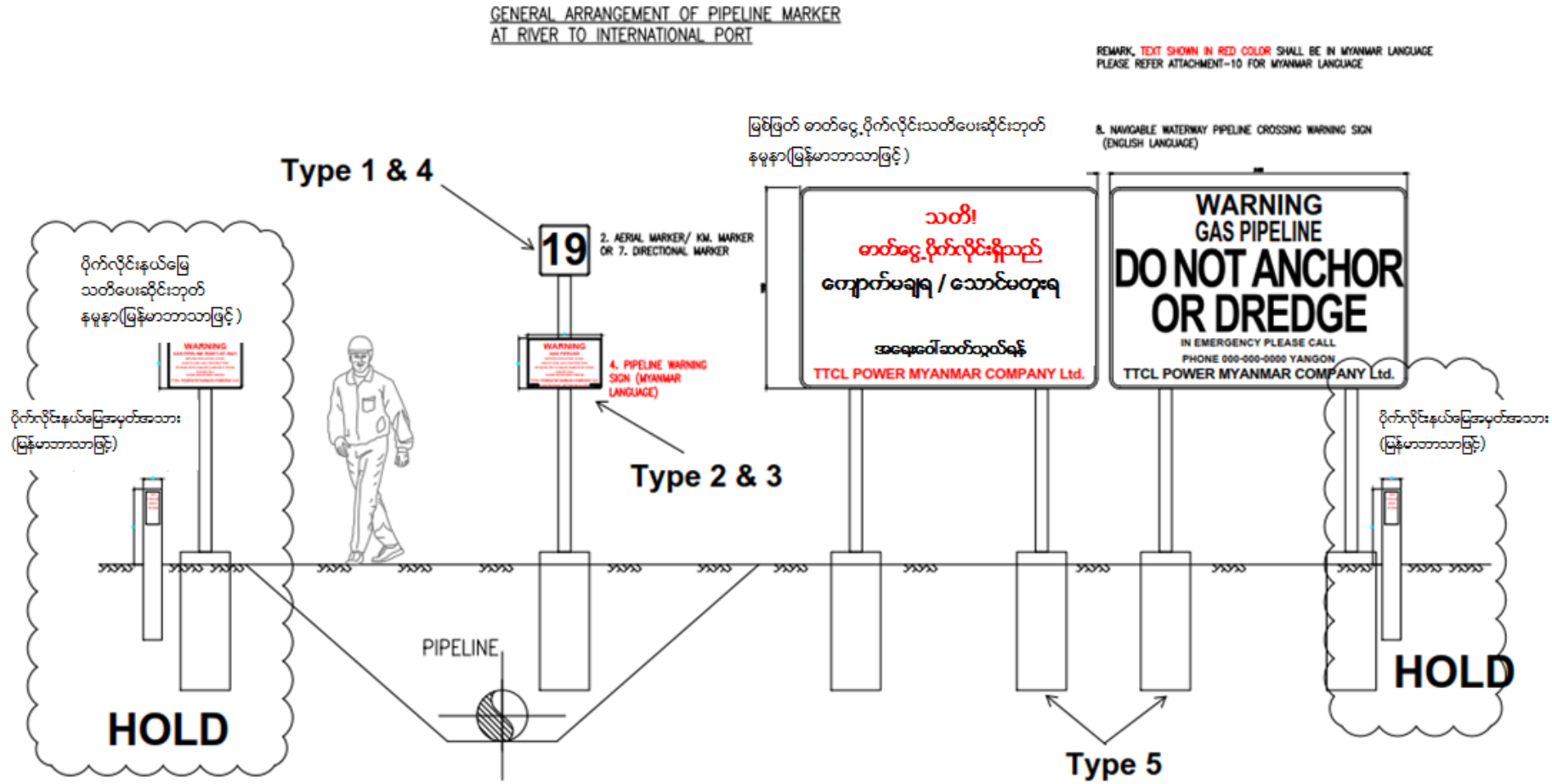
Table 4.26: Sign Post Type

Type No.	Sign Post Type	Description
1	Aerial marker	Aerial marker for every kilometre of pipeline.
2	Pipeline & Facility Warning Sign (A)	Warning sign on each end of a crossing (which include roads, water way, property line/fence owned by others). Placed 300 mm from pipeline Outside Diameter.
3	Pipeline & Facility Warning Sign (B)	Warning sign for remaining part of pipeline. Placed 300 mm from pipeline Outside Diameter.
4	Direction marker	Used for indicating any changes in pipeline direction.
5	Navigable Waterway Pipeline	Sign placed on each end of a navigable waterway pipeline crossing.

Source: TPMC, 2018.

The design for each sign post is shown in ***Figure 4.37***; note that some sign post type may share identical designs, and differ only with placement requirements.

Figure 4.37: Sign Post Design



Source: TPMC, 2019. (Modified by ERM)

Figure 4.38: Sign Post Placement

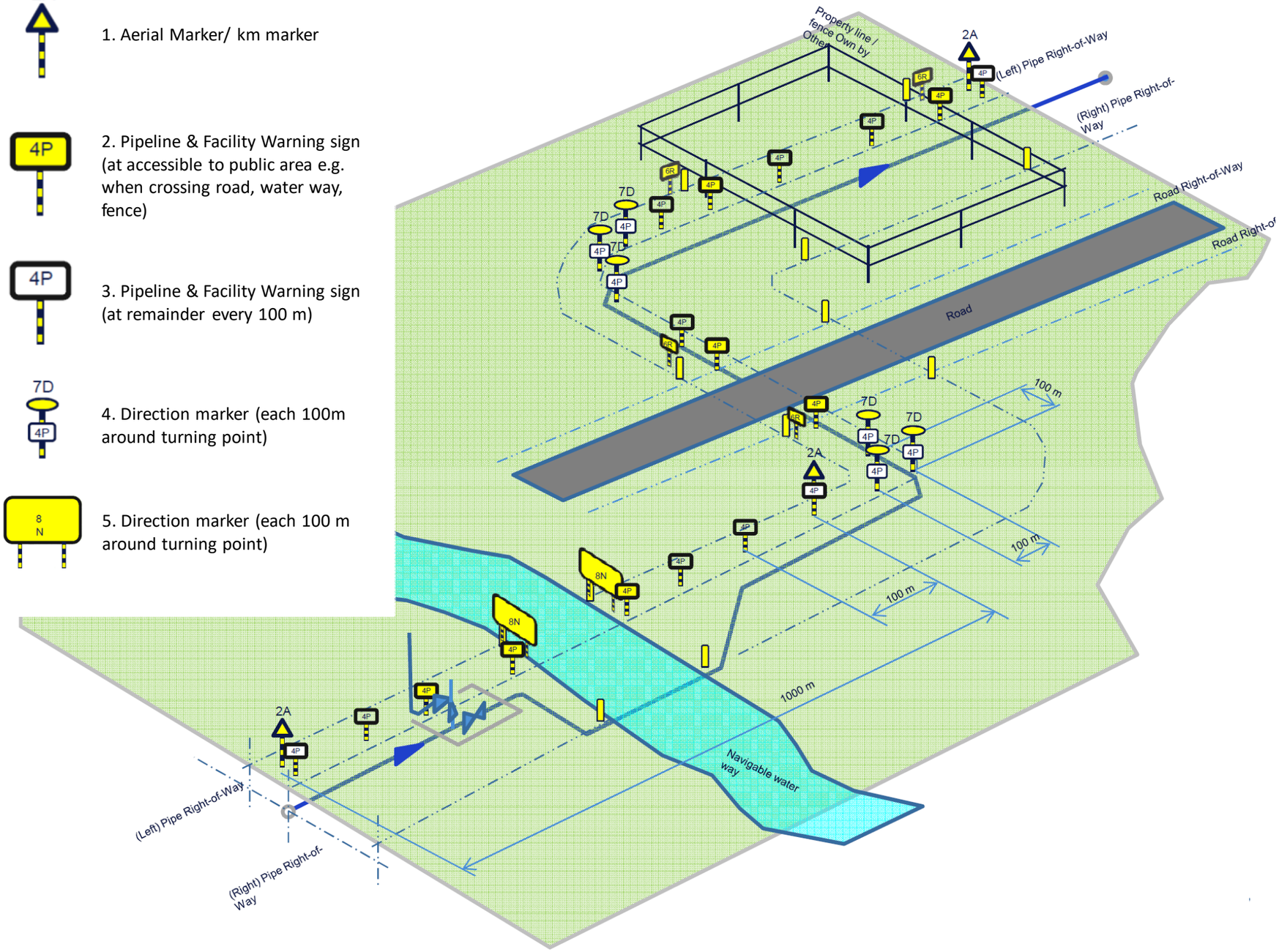
1. Aerial Marker/ km marker

2. Pipeline & Facility Warning sign (at accessible to public area e.g. when crossing road, water way, fence)

3. Pipeline & Facility Warning sign (at remainder every 100 m)

4. Direction marker (each 100m around turning point)

5. Direction marker (each 100 m around turning point)



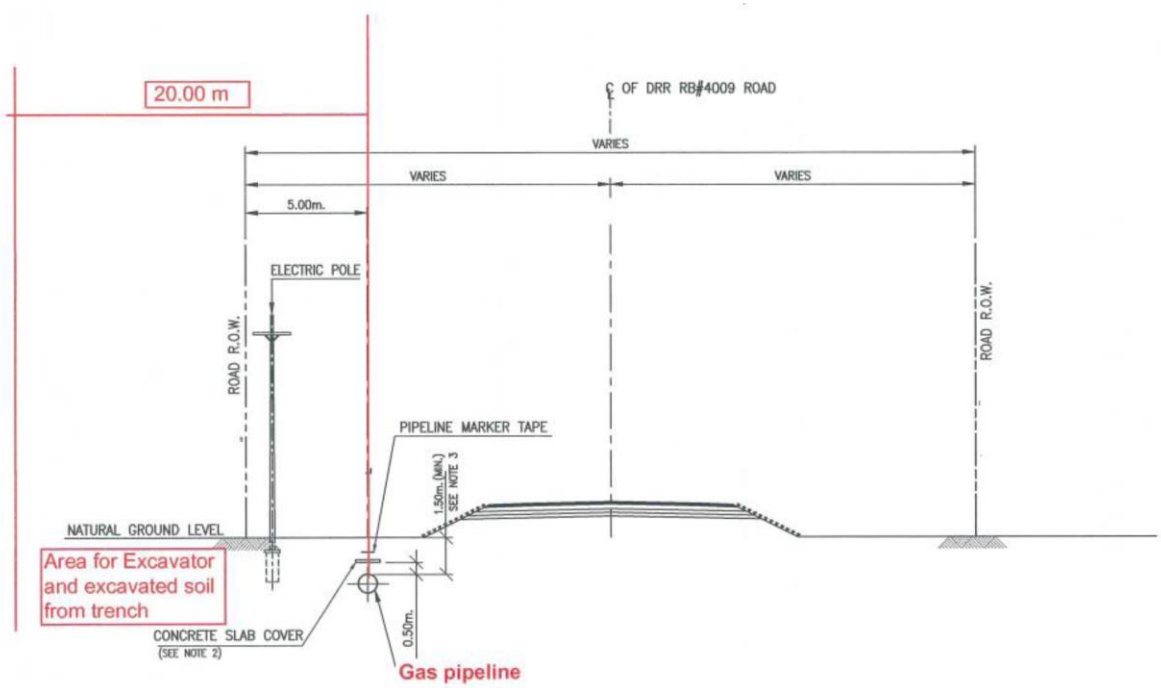
Source: TPMC, 2018. (Modified by ERM)

4.7.1.7 Right of Way (ROW)

ROW is a specific area of land of various widths, surrounding a specific components, such as pipelines. The purpose of the ROW, with regards to the pipeline is to allow for the construction of the pipeline, allow workers to adequately inspect, provide maintenance and testing, or provide a level of safety during an emergency. The ROW is also used to identify areas which will prohibit certain activities, to ensure public health & safety, and pipeline integrity.

According to the Myanma Oil and Gas Enterprise (MOGE); the requirements for the pipeline ROW is specified at 20 m on each side of the pipeline, for the construction ROW. The Project Propoenent will not retain the permanent ROW, as land will be returned to the land owners after construction is complete. The Construction right of way required for the construction of the pipeline is shown in ***Figure 4.39***.

Figure 4.39: Construction Right of Way



Source: TPMC, 2019.

4.7.2 Construction Phase

4.7.2.1 Construction Schedule

The construction phase for the Natural Gas Pipeline installation is expected to take 18 months. The EPC Contractor will prepare the site for construction, erection/burying and installation of the Project facilities. The construction, design and testing will be undertaken in accordance with the Myanmar NEQ (Emission) Guidelines and WB/IFC EHS Guidelines.

4.7.2.2 Mobilization

Site construction work will start once civil design of pipeline route and installation method is finalised. All work will be conducted in accordance with the detailed master construction schedule, provided by the EPC Contractor. Prior to commencement of work, all contractors would be required to provide detailed site specific plans related to:

- Equipment use;
- Excavation and backfilling management;
- Soil erosion management;
- Traffic management (including vessels operation/ movement, during material and equipment transportation);
- Storm water pollution prevention plan;
- Dust prevention plan;
- Environmental and Social Management Plan;
- Waste Management Plan; and
- Plan drawings of laydown, traffic flow, parking, trash storage, and recycling areas.

All materials, equipment, and workers will be transported to the construction site.

4.7.2.3 Earthwork

Earthworks will include clearing of vegetation and grading for the ROW of the pipeline. The subsoil located directly in the pipeline alignment will be excavated to the designed depth of the pipeline, once the pipeline is in place, the excavated soil will be backfilled. The amount of soil that will be removed due to excavation activities for the pipeline and then backfilled is approximately 75,000 m^3. The pipeline construction site, being partially located under water channels will require careful study of construction method, specifically during horizontal directional drilling (HDD). Other sections of the pipeline that are located near other public utilities will also require careful planning.

The anticipated amount of soil that will be cut and filled during the pipeline construction phase is listed in ***Table 4.27***. The amount of earthwork machinery that will be used during the pipeline earthworks is listed in ***Table 4.28***.

Table 4.27: Indicative Earthworks Estimated for the Pipeline

Area	Cut (m^3)	Fill (m^3)	Balance (m^3)
Onshore Pipeline	75,000	56,000	19,000

Source: TPMC, 2019.

Table 4.28: Number of Earthwork Machinery

Machinery Type	Number
Horizontal Directional Drilling Rig	1
Excavator	4
Auger Drill	2
Bulldozer	1
Light-duty vehicle	8
Water truck	2
Cranes	2
Diesel Generator 200KW	1
Diesel Generator 100KW	1
Diesel Generator 50KW	2
Tipper trucks/trailer	14
Fuel and lube truck	1
Pump	6

Source: TPMC, 2019.

4.7.2.4 Major Project Works

Table 4.29 presents major Project works to be undertaken as a part of the construction phase.

Table 4.29: Major Project Works for the Pipeline

Item	Description
NG Pipeline	■ HDD for underwater sections in Yangon River/ canals ■ Boring for small water crossing or road/ junction crossing ■ Open cut pipeline sections will have a minimum depth of 1.5 metres ■ Pipeline diameter of 20 inches ■ Block Valves

Source: TPMC, 2018.

4.7.2.5 Construction Material

During the pipeline construction phase, materials that will be used to construct the pipeline is listed in ***Table 4.30***. All carbon steel pipes will be imported to the AWP and will be transported by trucks to the Yangon-Dala car ferry. Public ferries, and contracted ferries (by a transportation service company) will then transport the trucks 2.6 km from Yangon over to Dala, approximately 15 minutes; once the trucks have arrived at Dala, the trucks will travel alongside the Yangon River to the laydown area, as shown in ***Figure 4.40***. It is estimated the total number of trips required for piping material transportation is approximately 115 trips, which includes piping material for both LNG Receiving Terminal, and Pipeline.

Table 4.30: Construction Materials for Pipeline

Material	Specification/Standard
Carbon Steel Pipe	API 5L,(PSL2)45 edition Base on ASME B31.8
Coating	**Internal** -API RP 5L2 **External** -CAN/CSA Z245.20-M92 or DIN30670 Base on ASME B31.8
Concrete Slab	Pre-cast concrete Base on ASME B31.8
PVC Pipeline Warning Sign	PVC plastic Base on ASME B31.8 / ASME B31.8S
Sign Posts + Markers	**Sign Post** -Steel :A36 / SS400 /A283 or equivalent material with Galv. Coating -Foundation : Concrete **Marker** Concrete Base on ASME B31.8/ API RP 1102 / API RP 1109

Source: TPMC, 2019.

Figure 4.40: Transportation Plan for the Pipeline

Source: TPMC, 2019.

4.7.2.6 Open-Cut Construction Method

An open cut construction method for the pipeline will involve primarily earthworks, which consists of excavating soil from the planned pipeline alignment. Once the soil has been excavated to the designed depth, the proper native soil or padding sand (if necessary) will be filled at the bottom. Backhoes, or other appropriate machinery will then lower the pipeline on top of the bottom layer; once aligned, proper native soil or sand (if necessary) will be used to cover the entire pipeline. Soil will gradually be backfilled, this is to allow placement of the concrete slab, and PVC pipeline warning sign at the appropriate depth, as shown in ***Figure 4.36***.

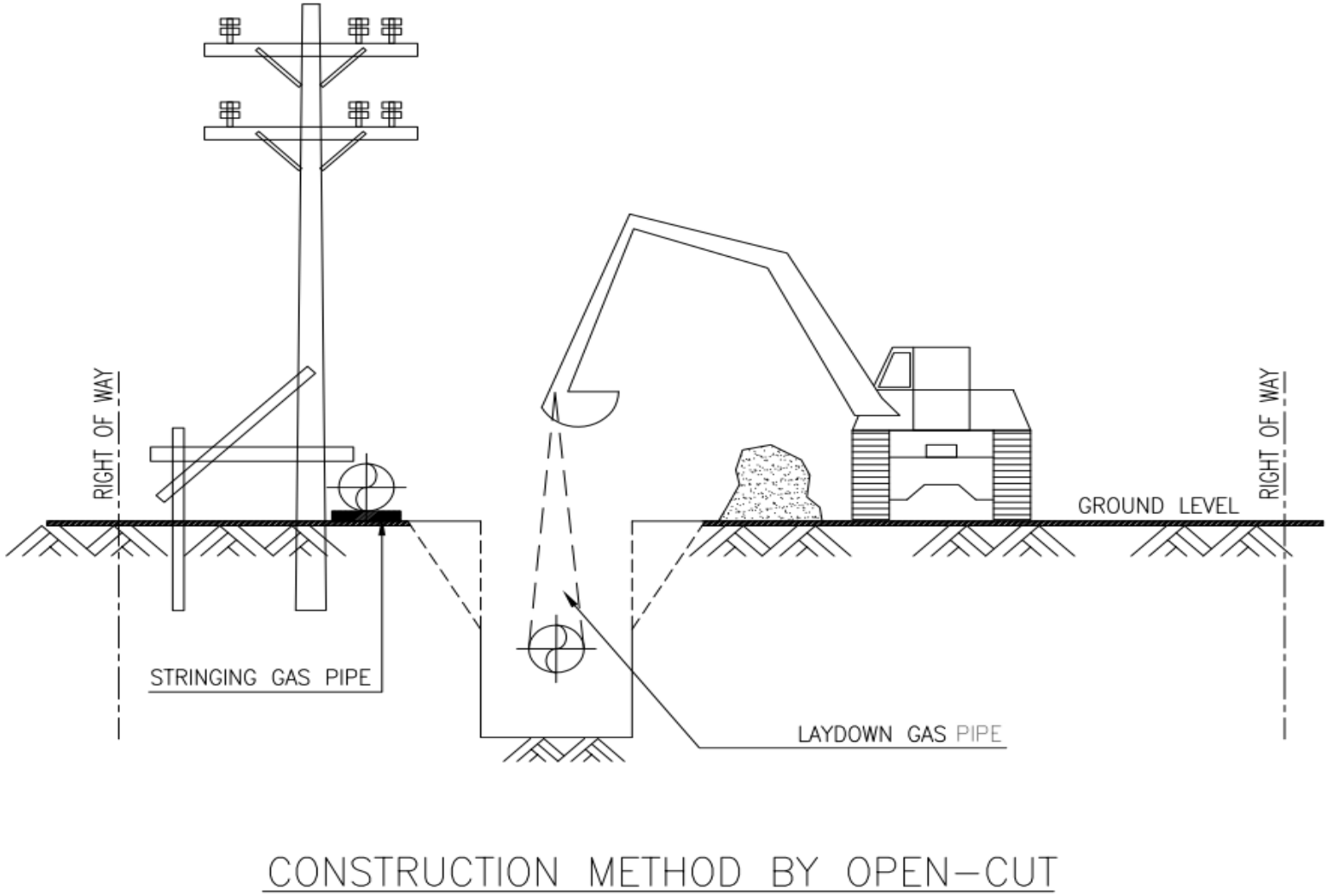
Example images of open-cut construction is shown in ***Figure 4.41***. The open-cut construction method for the pipeline is shown in ***Figure 4.42***.

Figure 4.41: Example of Open-Cut Construction Method for Pipeline

Source: Photo ID: 531889711; shinobi / Shutterstock.com; Retrieved September 21st, 2018.

Source: Photo ID: 1202070952; RachenStocker / Shutterstock.com; Retrieved January 31st, 2019.

Figure 4.42: Pipeline Construction Method by Open-Cut



Source: TPMC, 2018.

4.7.2.7 Horizontal Directional Drilling (HDD)

HDD Method

Horizontal directional drilling (HDD) is a method of installing pipeline without having to cut and fill soil. This method is particularly advantageous in areas where excavation is not practical; for this Project's case, an open-cut method will not be practical for pipeline sections that will cross two (2) points, the Twante Canal, and the Yangon River.

The HDD method follows three (3) principle phases, which are listed below:

1. Pilot Hole Directional Drilling: A small diameter hole is drilled within the intended path of the pipeline, from one surface point to another each side of the water body;
2. Prereaming: The small diameter hole is then enlarged to a diameter in which the hole can facilitate the pipeline; and
3. Pull Back Process: The pipeline is pulled from one opening to another.

During the Pilot Hole Directional Drilling process, location and guidance of the drill head is required to drill accurately and prevent damage towards other underground utilities/infrastructure. The system that will be used for this process will be a Gyro-base locating system, which is fully autonomous and offers the best drilling accuracy.

Given the pipeline distance that will require HDD method is approximately 700, and 1,000 metres, at each cross point of the Yangon River, and Twante Canal respectively, the HDD method will require a HDD rig; compared to a directional boring unit, a HDD rig is intended for large diameter drilling, and distances of several hundred meters. An example of a HDD rig is shown in ***Figure 4.43***.

The construction of the pipeline will also include the use of HDD method, in order to install pipelines that cross under the Yangon River, as shown in ***Figure 4.44***. Considering pipeline sections that will undergo HDD method, and sections that will cross over short width canals (in parallel to road bridges), river work activities, such as dredging, will not take place during the Pipeline construction.

The locations and coordinates for pipeline that will undergo HDD method are shown in ***Figure 4.45***, and ***Figure 4.46***. The layout of the HDD is shown in ***Figure 4.47***.

Bentonite

Specifically known as Sodium Bentonite, this liquid solution is used as drilling fluid to assist the drilling of boreholes. During HDD method, bentonite will be used as drilling fluid for the HDD rig. It is expected that the amount of bentonite produced from HDD activities is approximately 1,000 m^3. The produced bentonite will first be stored in appropriate containers located nearby the HDD rig (the drill/entry side), to await for treatment and disposal offsite; a tank truck will be used to transport the bentonite off-site to the appropriate or licensed Hazardous Waste Treatment facilities, available in Myanmar. The amount of produced bentonite is listed in ***Section 4.7.2.12***, under the ***Hazardous Waste*** subsection. The location of the bentonite storage is shown in the HDD Equipment Layout (***Figure 4.47***).

Drill Cutting

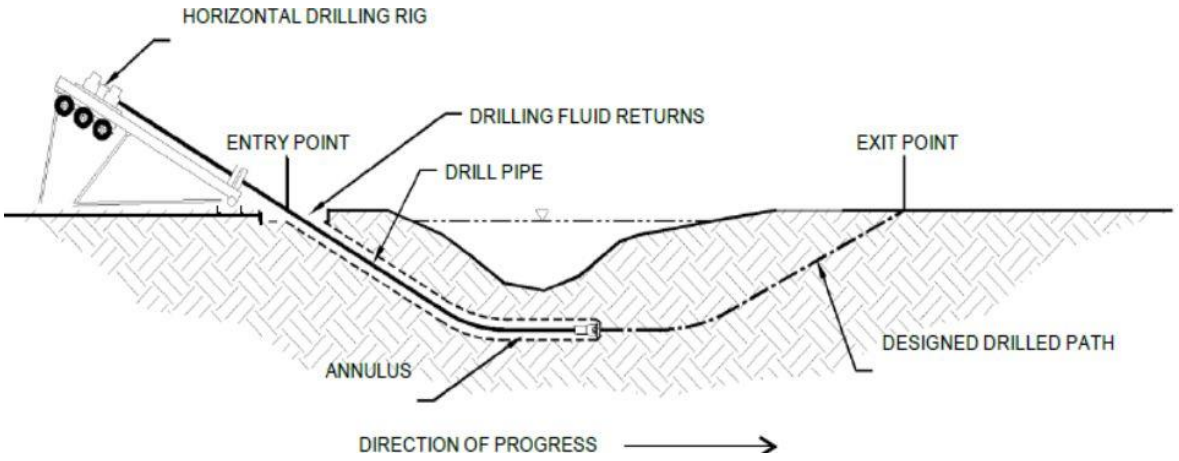
Drill cutting produced from the HDD activity will be stored in cutting pits at both entry and exit sides. It is expected that the amount of drill cuttings produced from HDD activities is approximately 280 m^3. Similar with bentonite management, the stored drill cuttings will be collected and disposed offsite to a license waste facility. The location of the drill cutting pits are shown in ***Figure 4.47***.

Figure 4.43: Horizontal Directional Drilling Rig Example

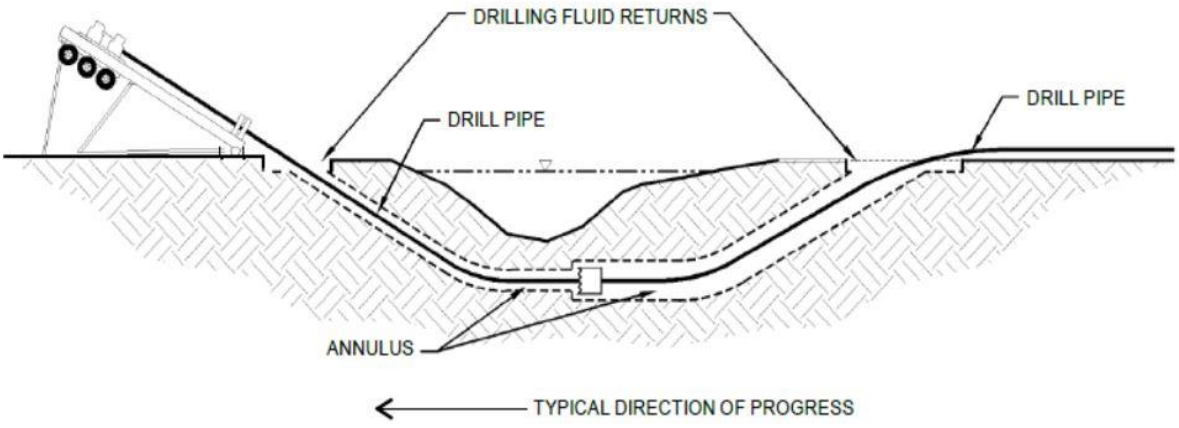
Source: Vermeer Corporation, 2019.

Source: Power Dynamics Innovations Limited Liability Company, 2019.

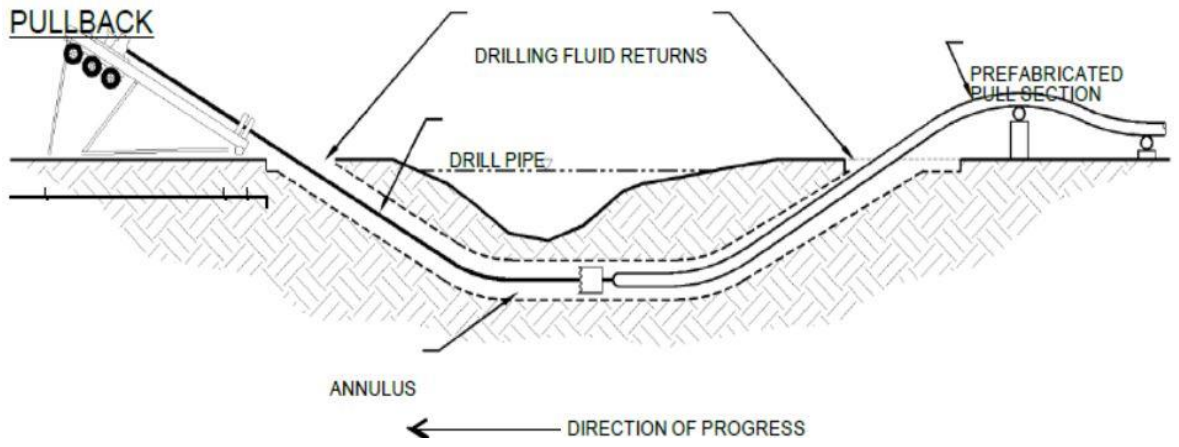
Figure 4.44: HDD Construction Method



Pilot Hole Directional Drilling



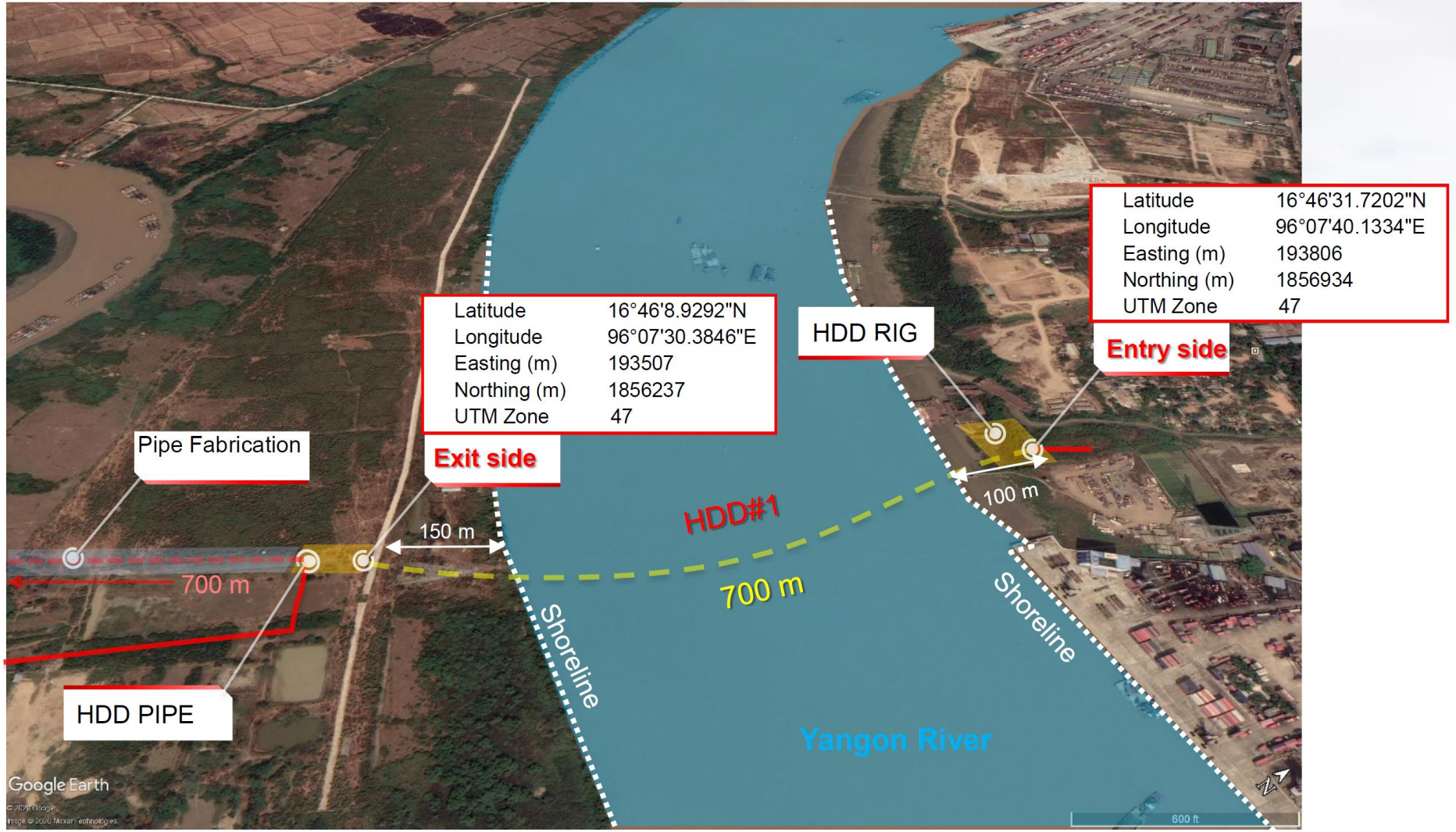
Prereaming



Pull Back Process

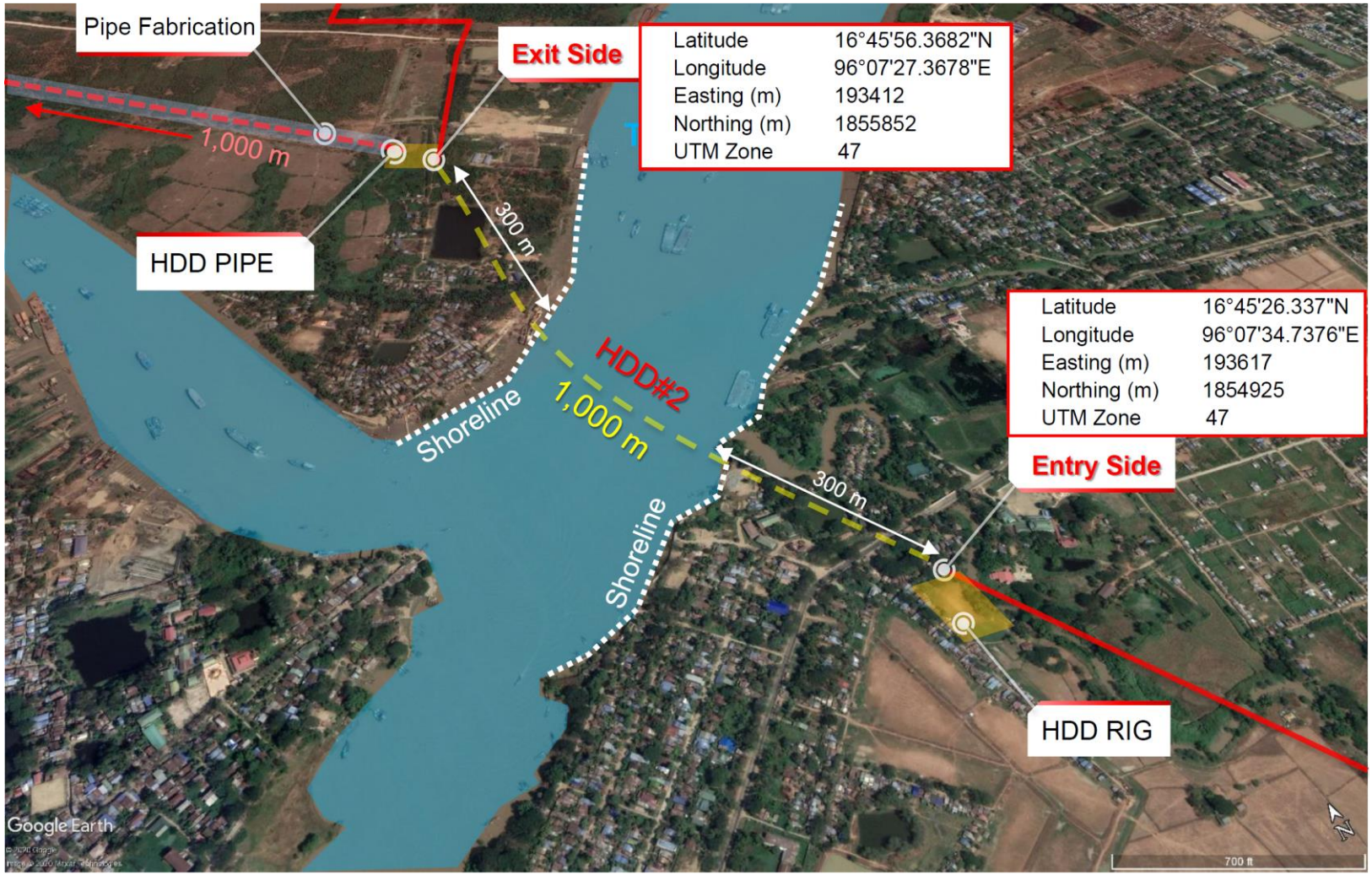
Source: TPMC, 2018.

Figure 4.45: HDD Location Yangon Crossing



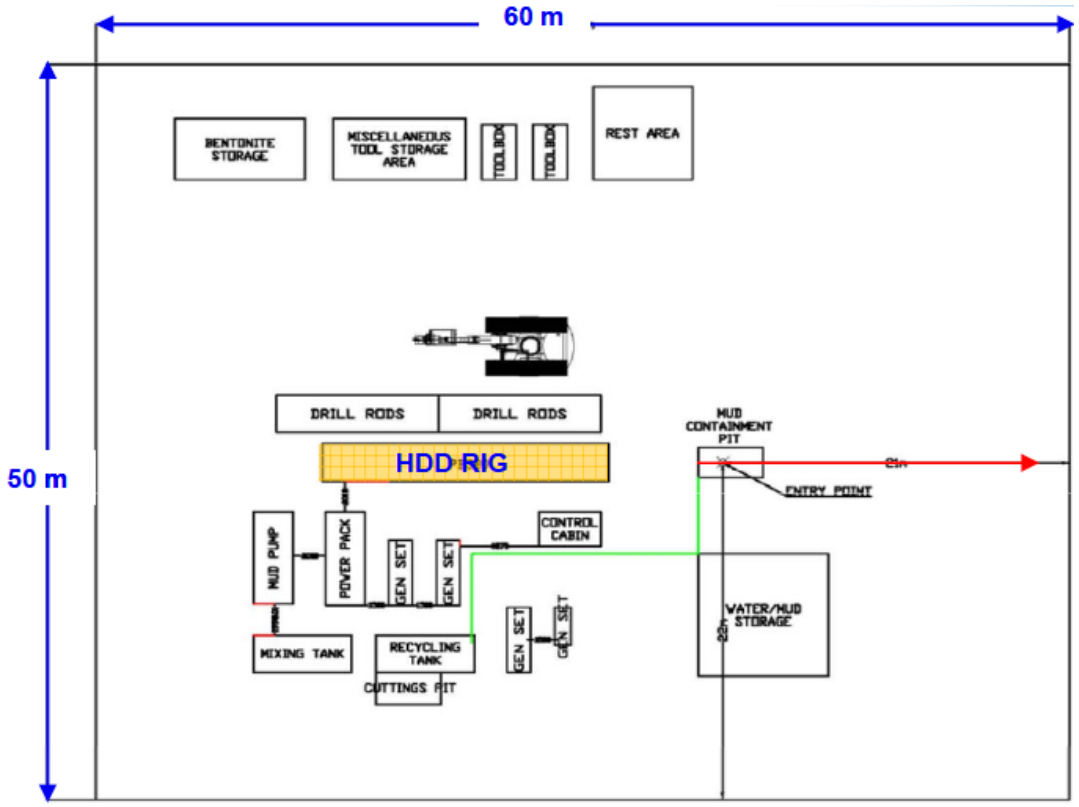
Source: TPMC, 2020.

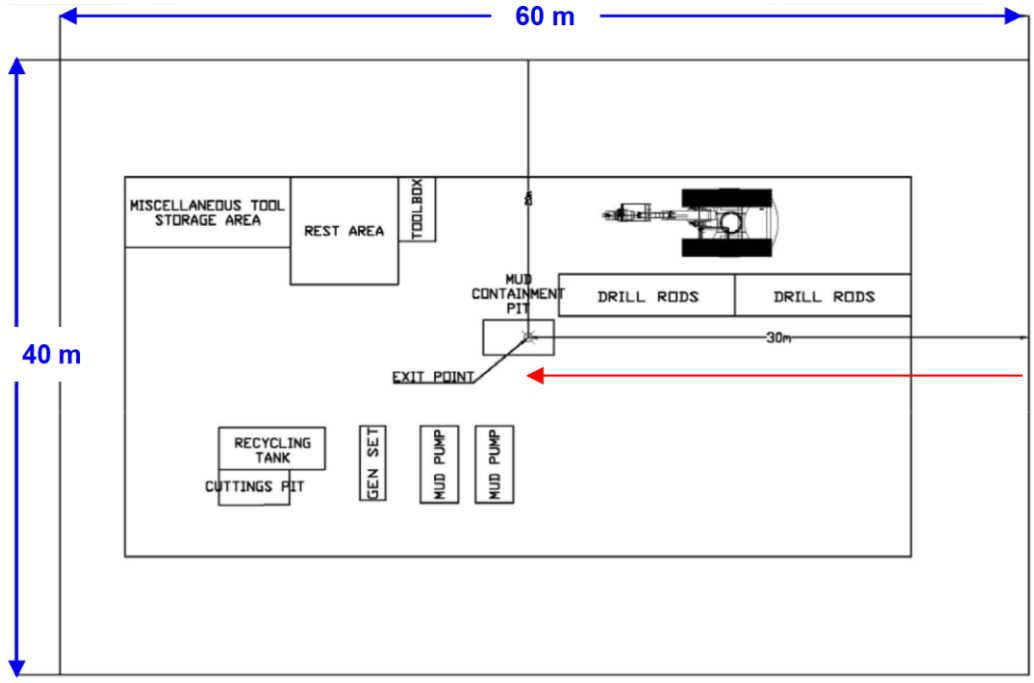
Figure 4.46: HDD Location Twante Crossing



Source: TPMC, 2020.

Figure 4.47: HDD Equipment Layout





Source: TPMC, 2020.

4.7.2.8 Hydrostatic Testing

Once pipeline installation reaches 3 – 5 km completion length, hydrostatic testing will commence; once testing is completed and passed, soil is then backfilled. This is to allow visual identification of leak points along the pipeline.

Hydrostatic testing involves pumping liquid into pressure system (such as a pipeline) to perform strength test and identify leak points. Once the Pipeline has been constructed, the Pipeline system will need to undergo Hydrostatic testing before proceeding with operation.

The hydrostatic test will involve placing a water feeder and pressure gauge system at the header of the Pipeline, and a water outlet channel at the receiving end of the Pipeline. The water feeder will pump liquid into the Pipeline and the gauge system will detect the water pressure during testing. Once both ends of the Pipeline are sealed, liquid is pumped into the system until the pressure within the system is approximately 1.5 times of the Pipeline's design pressure. The Pipeline is left in this condition for at least 2 hours for strength test, and another 24 hours for leak test; if pressure does not drop, or still within acceptable pressure range, the testing is complete.

The hydrostatic testing fluid will utilize water provided from the river or canal near the construction site location, chemicals will not be added to the hydrostatic testing fluid before or after testing; therefore, the fluid is considered non-hazardous. The amount of hydrostatic testing fluid required for testing is approximately 1,000m^3 for 5 km completion length. The hydrostatic testing fluid will be collected in the lined pond and tested for any contaminants. If the collected hydrotest liquid quality is suitbale to reuse, EPC contractor shall reuse as much as possible. If the hydrostatic testing fluid is not contaminated, and the quality also conforms with land discharge standards then the water can be discharged onto land in small quantities.

4.7.2.9 Construction Workforce

The overall anticipated workforce for pipeline construction is shown in ***Table 4.31***. The anticipated workforce per main construction activity is shown in ***Table 4.32***.

Table 4.31: Anticipated Workforce for Pipeline Construction

Workforce Origin	Average No. of Skilled Workers	Average No. of Semi-Skilled Workers	Average No. of Unskilled Workers	Total Average Workforce (per day)	Total Peak Workforce (per day)
Local Workforce	35	36	32	81	117
Migrant Workforce	14	60	0		

Source: TPMC, 2019.

Table 4.32: Anticipated Workforce for HDD, Open Cut, and Hydrostatic Testing

Activity	Workforce
HDD	64
Open Cut	39
Hydrostatic Testing	14

Source: TPMC, 2019.

4.7.2.10 Temporary Construction Camp and Laydown Area

In addition, the EPC contractor shall utilize the laydown area indicated in ***Figure 4.40*** to receive construction material, as well as utilize the available space along to pipeline (Construction Right of way) as a laydown area for each ongoing pipeline section construction. Trucks will be used to transport materials from the supplier to the laydown area. The laydown area is used for storage of materials and equipment that will be used for the construction Project. Trucks will be used to transport material/equipment from the laydown area to the pipeline construction area.

4.7.2.11 Power and Water Supply

It is expected that most machinery/equipment used during pipeline construction phase will have their own power source and will not require an external supply from nearby public utilities. Other machinery/equipment that requires an external power supply will be sourced from the existing 11 kV distribution line. The Contractor shall provide 11 kV/380 V box-type transformer and 450 kW diesel generator for emergency. Approximately 450 kW of electricity will be required during the peak construction period, with an average consumption rate of 80 MWh/month.

During construction, water supply is required for both construction worker consumption and for other construction activities. The maximum number of workers onsite during construction is anticipated to be 117 persons and each worker is estimated to consume approximately 33.3 litres of water per day[14]. Cover Slab concrete are estimated to consume 230 litres of water per day per m^3 of concrete/ total water volume 143.75 m^3. All construction activities including the ones described above, are estimated to consume 3 m^3 of water per day.

The average water consumption rate during construction is anticipated to be 78 m^3 per month (approximately 3 m^3 (3,000 L) per day).

The raw water required during construction will be obtained from YCDC or other local water supplier, and will be transported by water trucks. The raw water will be treated and purified to supply for construction.

4.7.2.12 Construction Waste

Solid Waste

During the construction phase, non-hazardous solid waste material is likely to be produced from concrete, steel pipes, and wooden crates. Opportunities will be explored for selling the steel pipes. The wooden crates will be disposed of by an appropriate or a licensed waste contractor. It is anticipated that the amount of non-hazardous waste produced during the construction phase is approximately 92,000 kg.

There will also be biomass waste associated with the clearance of tree, shrubs and grass for the pipeline's ROW. Approximately 2,500 m^3 of biomass waste is anticipated during construction. Opportunities for providing biomass waste to the local community will be explored or biomass waste will be disposed of by an appropriate or a licensed waste contractor.

All excavated material will be backfilled with no surplus.

Appropriate storage and disposal facilities for waste shall be constructed at the laydown area. Bunded, hardstand and roofed areas are a general requirement for hazardous waste such as waste oils, paints and chemicals.

Table 4.33 presents details of domestic waste and approximate capacities anticipated during construction.

[14] Tchobanoglous, G., Burton, F. L., & Metcalf & Eddy. (1991). Wastewater engineering: Treatment, disposal, and reuse. New York: McGraw-Hill.

Table 4.33: Domestic Waste during Pipeline Construction

Waste Type	Anticipated Quantity	# Workers	Total Solid Waste
Domestic Solid Waste	1.65kg per employee per week	117	193.05 kg/week

The solid waste generated during the construction phase will be collected and segregated for recycle and non-recycle waste (i.e. paper, plastic). Project will use incineration on site and compost.

There will also be minimal other waste such as wood crates which will be provided to the local community as firewood.

All waste will be disposed according to TPMC's Waste Management Plan (***Appendix H***).

Table 4.34 presents details of the construction waste and approximate capacities anticipated during construction.

Table 4.34: Construction Waste during Pipeline Construction

Waste Type	Amount
Concrete	75,000 kg
Steel Pipes	17,000 kg
Bentonite	1,000 m^3 total

Source: TPMC, 2019.

Hazardous Waste

During the construction phase, hazardous waste material can originate from used paint, engine oils, hydraulic fluids, spent solvents, spent batteries, etc. Hazardous wastewater will be generated from chemical cleaning of the equipment during the pre-commissioning process.

The hazardous solid waste, and wastewater from construction activities will be transported off-site to the appropriate or licensed Hazardous Waste Treatment facilities, available in Myanmar.

Table 4.35 presents the details of the hazardous construction waste and approximate capacities anticipated during construction.

Table 4.35: Hazardous Waste Quantities

Hazardous Material	Amount
Diesel oil	2 L per day
Hydraulic fluids	2 L per day
Paint	0.2 L per day
Battery	0.05 kg per day

Source: TPMC, 2019.

Wastewater

Wastewater typically produced during construction includes sanitary/domestic wastewater, cement wash down, other plant cleaning/rinsing effluents, vehicle maintenance and the mixing of oils/lubricants in the wastewater (i.e. as a result of equipment washing).

Non-Hazardous wastewater will be generated from the toilet facilities and workers accommodation (sewage). Non-hazardous wastewater will also be generated from the canteen. The sewage generated onsite will be collected through underground pipes into a holding tank, from where the

sewage will be routed to an onsite sewage treatment plant or alternatively transported periodically by vacuum trucks and transferred to a septic tank or discharge to common drain.

The increased presence of the labour force in the local areas may also place pressure upon any existing sewage systems and wastewater treatment systems or may result in additional untreated discharges of sanitary and domestic wastewater to the local environment.

Wastewater will be managed according to TPMC's Waste Management Plan (***Appendix H***).

Sewage/Sanitary Wastewater

During construction, it is anticipated that the maximum number of workers will peak at 117. The quantities of sanitary wastewater can be estimated as an average of 50 litres/person/day, and considering sanitary wastewater production to be 80% of water consumption per person (for continuous use), this equates to a predicted 4,680 litres of sanitary wastewater per day at peak construction period. The EPC contractor will establish a management system for sanitary wastewater before construction.

Hydrostatic Testing

Hydrostatic testing fluid is comprised of river water from the Yangon River, and there will not be any chemical dosing. Once hydrostatic testing is completed, the fluid will be discharged back into the Yangon River. The fluid will not contain any chemical dosing; therefore, it will not be considered hazardous. It is expected that the amount of discharged hydrostatic testing fluid is approximately 2,500 m^3.

4.7.2.13 Health and Safety

Emergency Response Plan

TPMC has in place a Project Incident and Emergency Response Plan to provide the necessary course of action during an unplanned event, during the construction and operation phase.

The potential emergency scenarios that apply to this plan are as follows:

- Person(s) fall from height – on land;
- Material fall from height;
- Vehicle collision with plant/equipment/pedestrian(s);
- Vehicle incident offsite;
- Collapse of scaffold – no person(s) present/person(s) present;
- Collapse of structure – no person(s) present/person(s) present;
- Collapse of deep excavations – person(s) present;
- Fire/Explosion – electrics, substances;
- Chemical spillage – on land;
- Medical emergency – mass food poisoning/bird flu;
- Medical emergency – contagious disease;
- Uncontrolled flammable/toxic release;
- Adverse weather conditions (flooding, lighting strike);
- Loss of services (water, sewerage, electricity);
- Radiation (Radiation Source Exposition); and
- Other (Earthquake, terrorist act, bomb threat, trespassers).

The full Project Incident and Emergency Response Plan is shown in ***Appendix I***.

Site Security Procedure

The site security procedure is designed to provide a secure environment for employees that are on site, during the construction phase.

The main topics that this procedure covers are as follows:

- Physical barriers (Fence, Gates);
- Badge (Personal access control);
- Mobilization and demobilization of employees;
- Asset control;
- Guards;
- Vehicle policy;
- Security supervision; and
- Photography control.

The full Site Security Procedure is shown in ***Appendix J***.

Personnel Protective Equipment Procedure

The purpose of this procedure is to establish specifications, decision criteria, and guidance for Personal Protective Equipment (PPE) to ensure the proper level of safety is met and to protect workers from injuries and occupational health illnesses, during the construction phase. The full Personnel Protective Equipment Procedure is shown in ***Appendix K***.

4.7.3 Operation

The main features of the pipeline have been summarised in ***Section 4.7.1***.

After the construction of the pipeline is completed, operation and maintenance will be carried out by TPMC; therefore, there will be no Operation and Maintenance (O&M) contract with any third party operator, as the Project will be owned and operated by the Project Proponent.

O&M staff with relevant experience of operating similar Project component and with adequate knowledge of comparable technology will be deployed prior to commercial operation date (COD) to commission and take over the Project from the EPC Contractor.

During normal operations, the pipeline will transfer natural gas from the RU (located at the LNG Receiving Terminal) to the Power Plant.

4.7.3.1 Maintenance

Given that TPMC will follow ASME B31.8, and other standards for the Pipeline, the following maintenance criteria and procedures will be followed to ensure safe operations:

- ASME B31.8 Chapter V – Operating and Maintenance Procedures;
- ASME B31.8 Chapter VI – Corrosion Control;
- ASME B31.8 Appendix K – Criteria for Cathodic Protection;
- ASME B31.8 Appendix L – Determination of Remaining Strength of Corroded Pipe; and
- ASME B31.8 Appendix M – Gas Leakage Control Criteria.

The indicative pipeline maintenance plan is listed in ***Table 4.36***.

Table 4.36: Indicative Pipeline Maintenance Plan

Maintenance Description	Standard	Frequency
Conduct internal cleaning, using a Pigging System	ASME B31.8, 860.2, 864.1	Once every 1 year
Inline inspection for corrosion (internal and external) and pipeline alignment	ASME B31.8, 860.2, 863.2	Once every 5 years
Pipeline warning sign condition	ASME B31.8, 851.7	Four (4) times per year
Pipeline Settlement and Soil Erosion	ASME B31.8, 841.1.10, 841.1.11	Once every 1 year
Pipeline Leakage Surveys	ASME B31.8, 851.3, 852.2, Appendix M	Once every 1 year
Pipe to Soil Potential Survey	ASME B31.8, 62.1, Appendix K, NACE RP-0169 If corrosion is found: ASME B31G and ASME B31.8, 863	Two (2) times per year
Close Interval Pipe to Soil Survey	NACE RP-0169	Two (2) times per year (Only significant areas)
Coating Defect Survey	ASME B31.8, 852.6.1	Once every 10 years

Source: TPMC, 2019.

4.7.3.2 Operational Workforce

The only personnel expected to be involved with pipeline operation, are those within the control room supervising the SCADA system, and those involved with maintenance. Given that the control room is located at the Power Plant, and maintenance planning/scheduling will be given from the control room; all personnel involved with pipeline operations will be considered in the Power Plant workforce section.

4.7.3.3 Health and Safety

TPMC has in place a Project Incident and Emergency Response Plan to provide the necessary course of action during an unplanned event.

The potential emergency scenarios that apply to this plan are as follows:

- Person(s) fall from height – on land;
- Material fall from height;
- Vehicle collision with plant/equipment/pedestrian(s);
- Vehicle incident offsite;
- Collapse of scaffold – no person(s) present/person(s) present;
- Collapse of structure – no person(s) present/person(s) present;
- Collapse of deep excavations – person(s) present;
- Fire/Explosion – electrics, substances;
- Chemical spillage – on land;
- Medical emergency – mass food poisoning/bird flu;
- Medical emergency – contagious disease;
- Uncontrolled flammable/toxic release;
- Adverse weather conditions (flooding, lighting strike);
- Loss of services (water, sewerage, electricity);
- Radiation (Radiation Source Exposition); and
- Other (Earthquake, terrorist act, bomb threat, trespassers).

The full Project Incident and Emergency Response Plan is shown in ***Appendix I***.

4.7.3.4 Block Valves

During normal operation, the block valves will remain open to allow uninterrupted flow of NG from the Regasification Unit to the Power Plant. During any unplanned events, particularly pipeline leakage, the block valves will close the pipeline, preventing any NG from passing through; therefore, limiting the amount of leaked NG.

4.7.4 Decommissioning

Decommissioning is the term used to describe all the stages involved in the closure and rehabilitation of the Pipeline. The process can generally be categorized into three (3) key phases as follows:

- Pre-decommissioning activities: includes the detailed planning (development of the decommissioning plan) and approval procedures;
- Decommissioning activities: removal of plant machinery & equipment and demolition, decommissioning of facilities, turbines and infrastructure, decontaminated land assessment and rehabilitation; and
- Post-decommissioning activities: site survey, close-out report and field monitoring as necessary.

4.7.4.1 Decommissioning Phase of the Project

At present, there are no plans or schedule for decommissioning of the proposed Project. It is likely that the Project facilities will only be decommissioned/ abandoned once it is no longer economical to continue operation, the plant is rendered redundant and/or no longer required for various reasons or is unsafe to operate. As the development process of the site is yet to fully begin, detailed decommissioning plans have not yet been formulated.

The Project facilities will be designed with decommissioning in mind. In general, facilities and machinery will be designed so that they can be isolated and decommissioned in steps which are in reverse of the installation procedure or which are most convenient to do so. The decommissioning phase activities will therefore be similar to those associated with the excavation/foundation work, installation and civil construction phases. The decommissioning plant will also take into account environmental rehabilitation, which includes the removal of all surface facilities and excess hydrocarbon waste, as well as re-vegetation of localized natural flora.

Associated decommissioning activities in accordance with environmental measures and standards of good practice are as follows:

- Removal of site infrastructure and waste;
- All civil structures and associated infrastructure will be removed;
- All remaining materials and hydrocarbons and hazardous waste will be removed;
- All pilings and trestles will be removed;
- All waste will be disposed of in an appropriate manner; and
- Reusable materials to be resold or recycled.

Hazardous Waste Clean Up and Transport:

- When decommissioned, all products within piping and storage infrastructure shall be removed from said system along with all associated infrastructure and possible contaminated soils; and
- All hazardous wastes shall be transported to approved hazardous waste storage facilities or disposal sites.

Site Rehabilitation:

- all disturbed areas due to ROWs, transmission lines, etc. shall be rehabilitated and revegetated;
- native flora shall be used to re-vegetate the rehabilitated sites;
- Roadways will be scarified; and
- Natural drainage patterns will be reinstated where practical.

4.8 Power Plant

4.8.1 Key Components

The Power Plant is designed to operate continuously, in combined cycle mode, this type of power plant is known as a Combined Cycle Power Plant (CCPP). During normal combined cycle operation, the heat of Gas Turbine exhaust gas will be admitted to the Heat Recovery Steam Generator (HRSG) where superheated steam will be produced which will drive the steam turbine to generate electrical power. The Gas Turbine, equipped with a generator, is generating electrical power as well. The exhaust gas from the HRSG will be released from the main stack of the HRSG to the atmosphere. It is anticipated that the Power Plant will operate at full load for the majority of the time.

The HRSG is designed for dual pressures steam generation (High Pressure (HP) and Low Pressure (LP)) used to maximize energy transfer from the exhaust gas of the gas turbine. The HP steam generated by the HRSG will be fed to the HP steam turbine and the LP steam will be fed to the LP steam turbine. The power output is net 388 MW during combined cycle operation. The Power Plant will use natural gas as the only fuel.

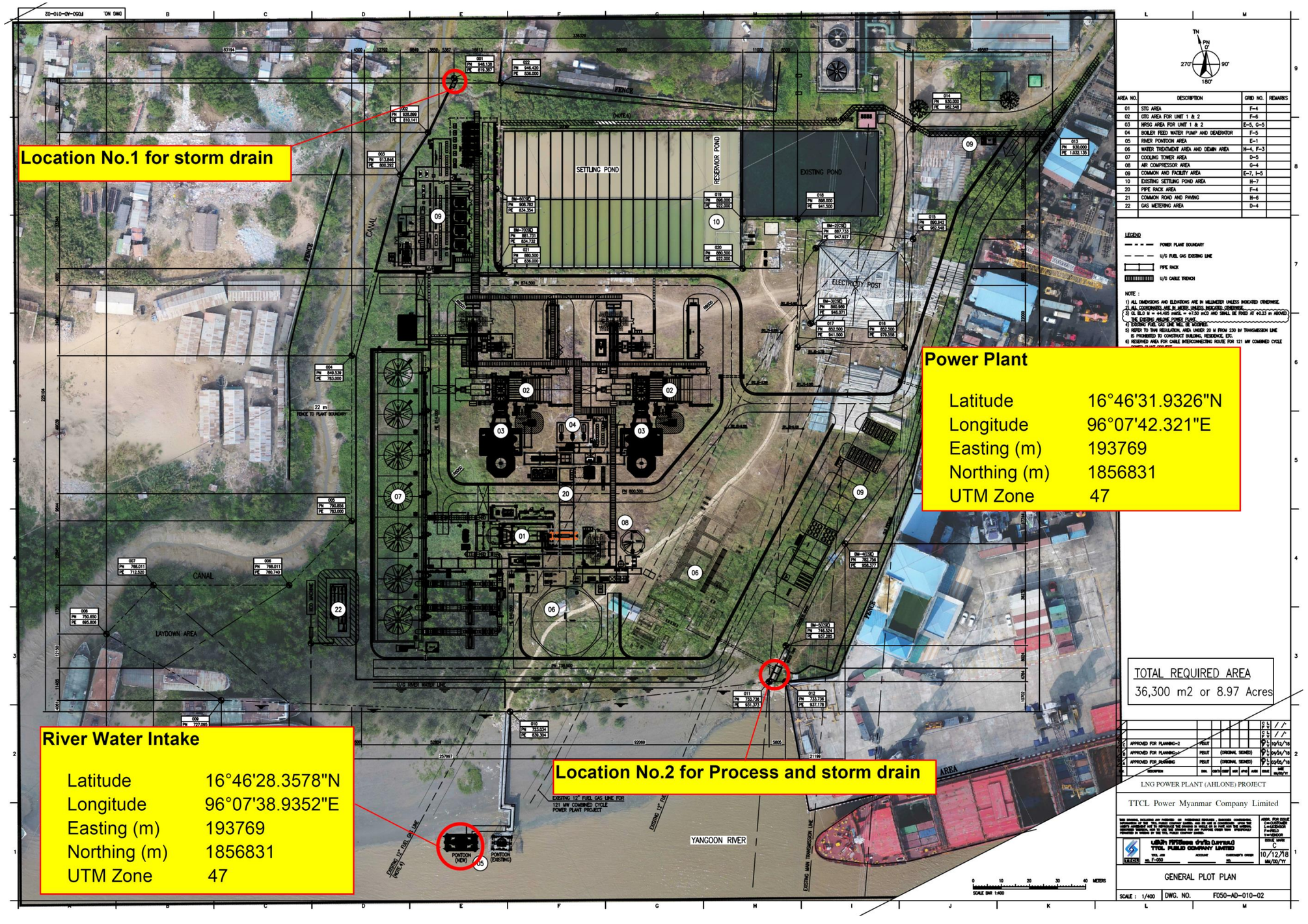
The indicative general layout of the Power Plant is shown in ***Figure 4.48***. In addition, the Power Plant's Process Flow Diagram (PFD) is shown in ***Figure 4.49***.The project components and details are listed below in ***Table 4.37***.

Table 4.37: Power Plant Key Components

Component	Details
Land Area	8.97 acres (approx.)
Power Plant Installed Capacity	388 MW
Plant Configuration	Two (2) Gas Turbines, two (2) HRSGs, and one (1) steam turbine
Steam Turbine	Condensing Steam Turbine (single casing turbine)
HRSG	Horizontal Drum Units
Cooling System	Cell Type Wet Cooling Tower (with induced draft)
Electrical Generators	Three (3) Totally Enclosed Water to Air Cooled Electrical Generators (One for each Turbine)
Step Up Transformers	2 Winding Transformers Preferred (1 Transformer for 1 generator)
Switchyard	Gas Insulated Switchyard (GIS) (Single Busbar Configuration, operated by MOEE)
Embedded Environmental Control	■ Multi-chambers combustion system ■ Single gas fuel combustion system with DLN combustors ■ Ignition system with spark plugs and U.V. flame detectors
Stacks	■ Diameter 5 meters appx. ■ Height 40 meters appx. ■ Carbon Steel with internal painting
Operation Period	25 years

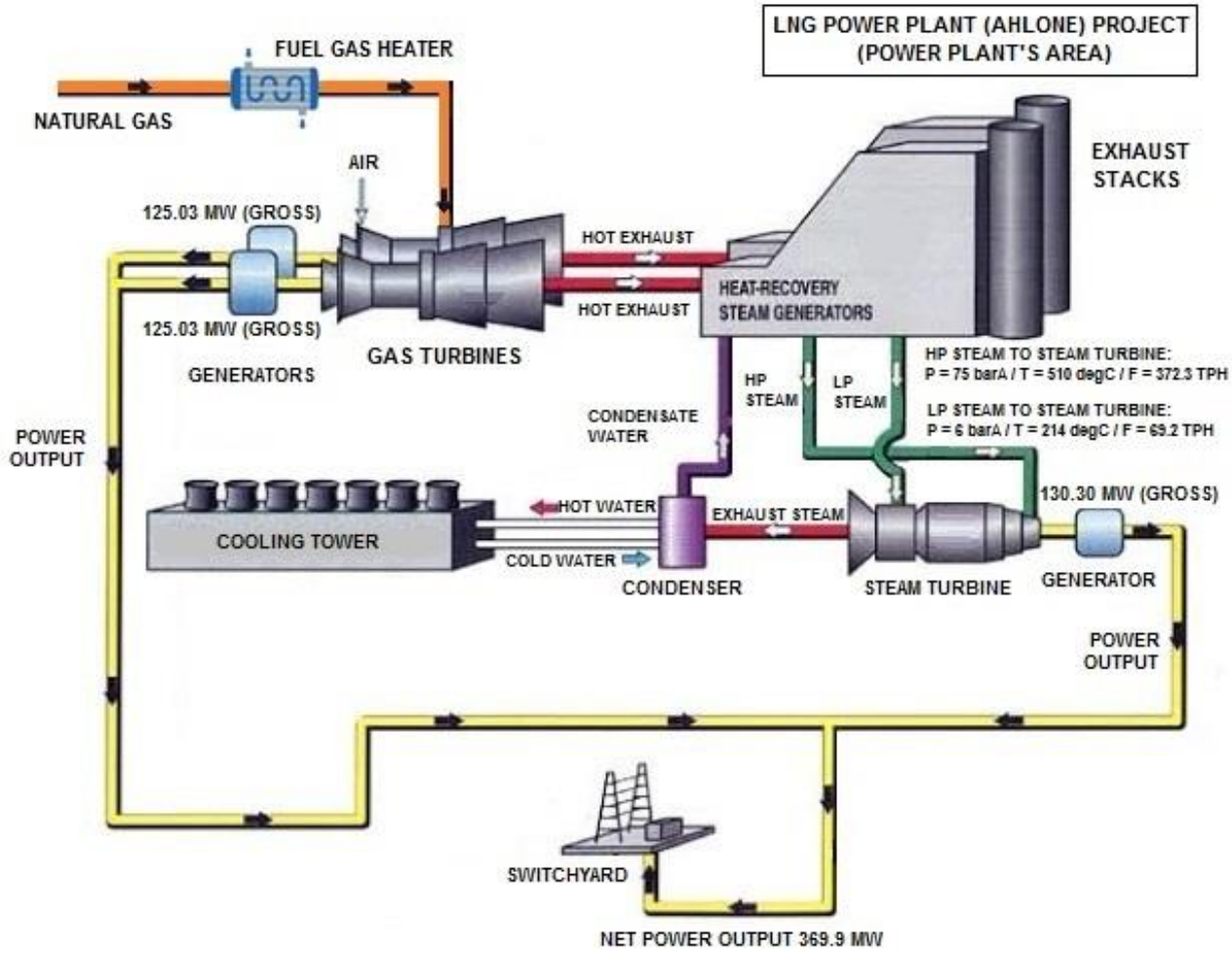
Source: TPMC, 2019.

Figure 4.48: Power Plant Layout



Source: TPMC, 2020.

Figure 4.49: Process Flow Diagram (PFD) of the Power Plant



Source: TPMC, 2019.

4.8.1.1 Land Ownership

EPGE is the landowner of the Power Plant area (8.97 acres) in Ahlone Township, Yangon. EPGE intends to lease the land to TPMC under a long term land lease agreement.

4.8.1.2 Gas Turbine

Two (2) gas turbine units will be installed for the Project. The gas turbine will be installed within an acoustic, ventilated enclosure with fire detection and protection systems. The gas turbine will have all associated ancillary equipment and systems required for the safe, efficient and reliable operation of the unit under combined cycle operation. The gas turbine specification for each unit is shown in ***Table 4.38***.

Table 4.38: Gas Turbine Specification

Features	Specifications
Fuel system	Gas only
Starting Means	Medium Voltage starting AC motor with Hydraulic torque converter
Air filtration	Static type
Compressor/Turbine Cleaning	On and Off-line Compressor Water Wash
Exhaust System	Side
Emissions Control	Gas – Dry Low Emission
Fire Detection	Heat Detectors
Gas Leak Detection	Gas detectors
Fire Protection	High pressure CO_2 System

Source: TPMC, 2018.

The gas turbine will be capable of operation with its exhaust gases passing into the associated heat recovery steam generator, located on the exhaust ducting upstream of the heat recovery boiler.

All cooling requirements for the turbine shall be met using heat exchangers, fed from the Closed Circuit Water (CCW) system.

Control of emissions of NOx will be achieved by Dry Low NOx (DLN) burners. The detailed of embedded emission controls are described in a subsequent section.

4.8.1.3 Heat Recovery Steam Generator (HRSG)

The HRSG shall be a dual pressure drum type. The HRSG shall be designed to match the gas turbine which fires natural gas. The HRSG shall be able to follow load changes of the gas turbine. Given that one (1) HRSG unit is designed to be paired with one (1) gas turbine, and the Project is designed to have two (2) gas turbines, the Project is also designed to have two (2) HRSG units.

The HRSG and associated equipment shall be designed for base load operation, but with provision for cyclic operation. The heating surfaces shall be optimised to achieve a high and economical steam output without creating any operation problems such as evaporation in the economisers or unstable conditions in the evaporators.

The HRSG consists of an economizer, evaporator, and super-heater tube bank section(s) with finned tubing, as appropriate, to maximize heat transfer. No supplemental firing facilities will be installed.

All pressure parts will be designed, manufactured and tested in accordance with “ASME Boiler and Pressure Vessel Code, Section 1, Power Boilers” or equivalent standards.

The HRSG specification is provided in ***Table 4.39***.

Table 4.39: HRSG Specification (at design condition)

Feature	Specifications
HP steam flowrate	187 t/h (to be determined)
HP steam pressure	77.5 bar(a) (to be determined)
HP steam temperature	513°C (to be determined)
LP steam flowrate	37 t/h (to be determined)
LP steam pressure	6.5 bar(a) (to be determined)
LP steam temperature	217°C (to be determined)

Source: TPMC, 2018.

4.8.1.4 Steam Turbine

Given that the Project is designed to have two (2) gas turbines, and two (2) HRSG units, to achieve optimal efficiency from this configuration, the Project is also designed to have one (1) steam turbine.

Steam turbine is a single casing, axial exhaust, direct drive turbine. The steam turbine will be of proven design and complete with all auxiliary oil and steam systems. The steam turbine specification is outlined in ***Table 4.40***.

The steam turbine shall be designed with provisions to enable the combined cycle plant. The cooling system for the steam turbine condenser will be a mechanical draft cooling tower cooling system using river water as cooling medium.

Table 4.40: Steam Turbine Specifications

Feature	Specifications
Rated out power	131 MW (to be determined)
Rated power factor	0.85 (lagging)
Rated rotation	3000 r/min
Rated frequency	50 Hz
Phase number	3
Cooling mode	TEWAC (Totally Enclosed Water-To-Air Cooled)
Insulation class	Class F (temperature rise as per Class B)
Exciting mode	Brushless Excitation System

Source: TPMC, 2018.

4.8.1.5 Condensers and Auxiliaries

The condensate system, which consists of the condensate extraction pump, returns the exhaust steam from the steam turbine to be condensed and returned back into the water-steam cycle. When the condensate extraction pump is operated, the recirculation control valve regulates the minimum flow required for the condensate extraction pump, and the condensate level control valve regulates the condensate level in hotwell of the main condenser.

The condensate flow is passed through the gland condenser, HRSG external heat exchanger, and make up to the deaerator and storage tank.

4.8.1.6 Feed Water System

The feed water system will provide sufficient and reliable feed water to the HRSG from the demineralization plant. The HP/LP Boiler Feed water flow rate shall be approximately 445.7 t/h and the quality shall be in accordance with STG and HRSG Original Equipment Manufacturer recommendations.

The feed water system will include necessary feed water heaters, de-aerators, feed water pumps, control valves and auxiliaries. Oxygen scavengers will be used to remove dissolved oxygen from the condensate feed water system. Ammonia will be added to maintain the pH balance of the boiler feed water, and phosphate wil be added to control the pH at the HP/LP drum.

4.8.1.7 Circulating Water System

A wet evaporative cooling system shall be provided with Cooling Water (CW) flow to remove heat from the condenser to the atmosphere using a cooling tower. The main CW system shall incorporate the condenser, CW pumps, one cold CW supply pipe feeding the condenser and one hot CW return pipe to return the water to a single mechanical draught wet cooling tower. All valves, instruments and controls shall be included. The layout of the system shall facilitate unrestricted airflow into the cooling tower and access for lifting equipment for maintenance.

The auxiliary cooling water supply (ACS) shall be an integral part of the main CW system. Cooling of auxiliary equipment is through a closed cycle cooling water heat exchanger. The ACS shall be operated for start-up period and shut down period. During normal operation, after the main condenser is ready for operation, the main CW pump will supply cooling water to the closed cycle cooling water heat exchanger and HRSG Blowdown tanks, instead of the Auxiliary cooling water pump by switching the manual valve. A complete water management diagram shall be provided showing CW, ACW and CCCW systems during the design review phase of the Project.

A make-up water system, blowdown system and automatic chemical dosing system shall be provided to maintain CW quality and concentrations of controlled chemicals.

4.8.1.8 Closed Cooling Water System

The Closed Cooling Water System is designed to provide reliable cooling water (demineralized water) to the CCPP over the range of ambient and operating condition. The closed cooling water system is of the closed type with indirect coolers. The heat is transferred to the closed loop cooling water by typical heat exchanger equipment and is removed from the closed system by an exchanger with aux circulating cooling water. Normally, closed cooling water will supply to the following users;

- ST Generator Air Coolers
- ST Lube Oil Coolers
- ST Vacuum Unit Heat Exchanger
- Sampling Coolers Unit
- HP/LP Boiler Feed Water Pumps
- GT Generator Air Coolers
- GT Lube Oil Coolers
- Air Compressors

The system shall have a make-up line which is connected from the demineralized water supply header. The closed cooling water head tank provided as part of the closed cooling water system shall be fitted with overflow vent and drain valve. A closed cooling water system will significantly reduce discharge temperature as compared to a once-through cooling system

4.8.1.9 Water Intake Pumping Station

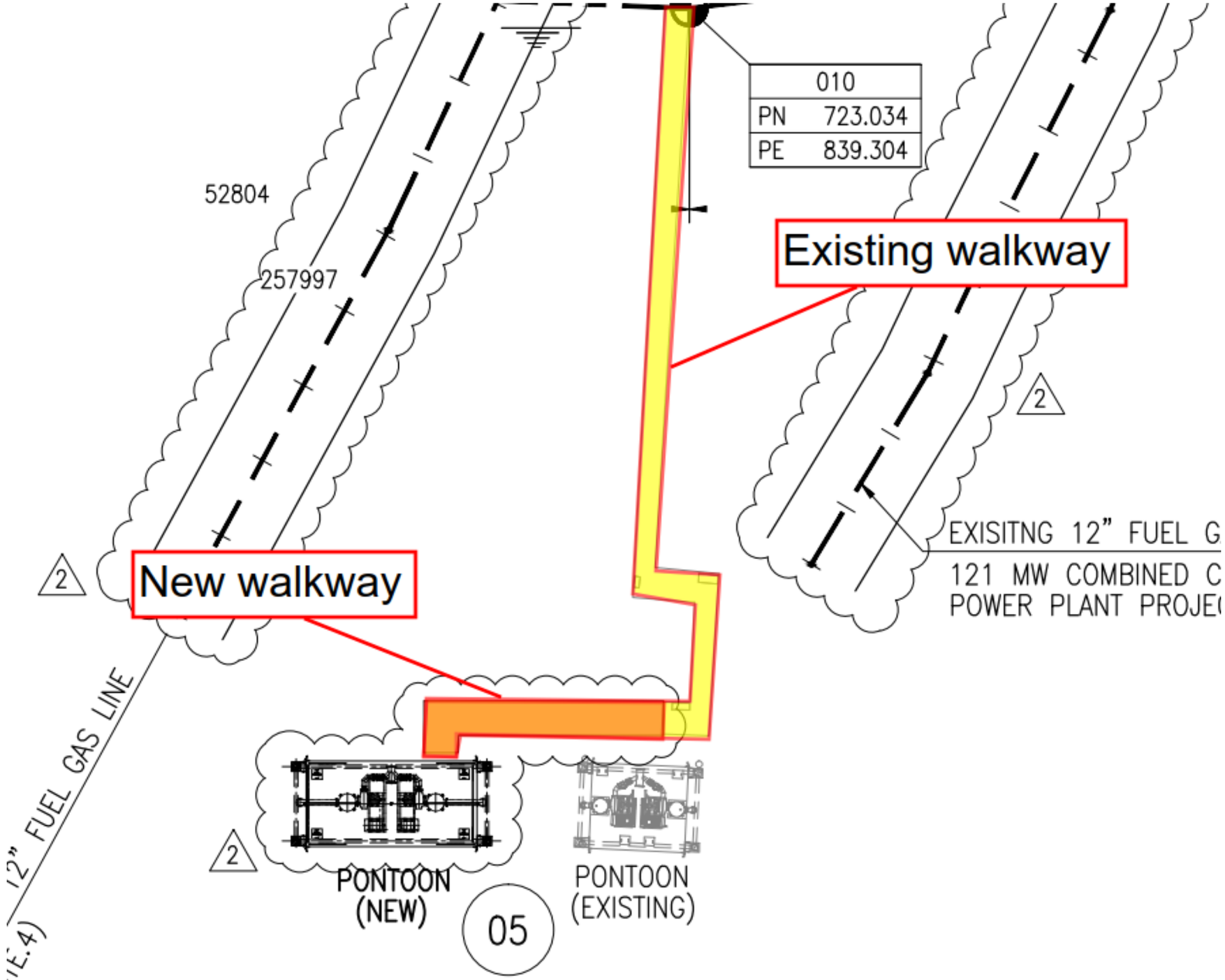
The raw water will be taken from the Yangon River, using the Water Intake Pumping station at the flow rate of approximately 916 m3/hr. There are existing water intake pumps located on the existing pontoon, which supplies water to the existing 121 MW Ahlone Power Plant. A pontoon is a floating structure that is anchored to a specific location; however, it is allowed to move vertically, depending on water level. For this Project, an additional pontoon and walkway will be constructed, with the new walkway to be connected to the existing walkway. The materials that will be used for the construction of the pontoon and walkway is listed in ***Table 4.41***. The proposed, and existing pontoon and walkway is shown in ***Figure 4.50***. The proposed pontoon is approximately 8 m long, and 5 m wide. The location of the water intake is shown in ***Figure 4.48***.

Table 4.41: Pontoon and Walkway Material

Structure	Material
Pontoon	Steel Flooring, PVC Floatation Device
Piles (for Pontoon Anchor)	Steel
Walkway	Wood

Source: TPMC, 2019.

Figure 4.50: Pontoon Walkway Layout



Source: TPMC, 2019.

4.8.1.10 Water Treatment System

Water treatment system shall be located within the CCPP. Service water supply from raw water treatment plant shall be stored in one carbon steel welded construction. Service water storage tank shall be sufficient to allow continuous operation of the CCPP at Maximum Power Output Cogeneration for a period of at least 16 hours under all conditions, and still contain minimum fire water reserve volume for the time required for firefighting purposes.

Service water shall be used to further produce treated water and demineralized water. EPC Contractor shall be responsible for providing and connecting the facilities required for water treatment including any required equipment until sending the treated water to store at the storage tank (e.g. treated water storage tank and demineralized water storage tank).

A demineralized water treatment system and storage tank shall be provided with adequate capacity to supply the CCPP for a minimum of 20 m^3 of treated water consumption. The treated water storage and pumping systems shall be of adequate capacity to ensure secure supply to all users without disruption.

Electrodeionization process shall be applied for demineralized water treatment system. It shall be provided to supply demineralized make-up water to the steam cycle and the closed circuit cooling water as required. The system shall be capable to produce of demineralized water without any limitation on the fresh water compositions delivered to the water treatment plant for processing into demineralized water. Quality of demineralized water produced shall be such that it meets the quality requirements for water and steam after chemical dosing in accordance with recognized international codes and operation and maintenance guidelines for HRSG and steam turbines.

A demineralized water storage tank shall be provided with adequate capacity to supply the CCPP for a minimum of 72 hours of demineralized water consumption under highest consumption operating conditions. The demineralized water storage and pumping systems shall be of adequate capacity to ensure secure supply to the CCPP for all CCPP operating conditions.

The location of the Water Storage Tank is shown in the Indicative Site Layout (***Figure 4.48***).

4.8.1.11 Wastewater Treatment System

The wastewater system will collect and dispose of the following plant wastes:

- HRSG blowdown;
- Water treatment plant(s) wastewater;
- Other contaminated water including, but not limited to, contaminated rainwater, process water and spillages, plant and equipment wash water, water with oily substances; and
- Domestic sewage.

Continuous monitoring equipment for the continuous monitoring of key parameters in the wastewater discharge stream will be installed as well as manual sampling equipment to allow daily laboratory analysis of other parameters in the waste water discharge stream. The wastewater effluent quality of pH, temperature and flow shall be monitored by on-line analyser while others shall be by laboratory analysis using laboratory equipment. Wastewater effluent pH, temperature and flow will be measured in waste water effluent piping immediately upstream of waste water terminal point. HRSG blowdown shall be supported to make up cooling water system to minimize service water consumption. Cooling water blowdown can be discharge directly to natural floodway.

Waste from the water treatment plant shall be treated as required prior to being sent to the final pit.

All site drainage from the main plant area shall be piped to a “contaminated drains” area for treatment. Other contaminated water shall also be treated as required and collected in the final pit.

Where contaminated water includes oily substances such as oily water from the transformer area, etc. oil interceptors shall be included in the drains of the proposed development. The oily water shall then be sent to an oil collection pit. After douched from raining (15 minutes), the operator will switch the bypass valve (open), and valve to oil collection pit (closed) respectively for change direction of rain water to storm drain. The separated oil will form at the top of the oil collection pit and will be removed and disposed by the operator accordingly.

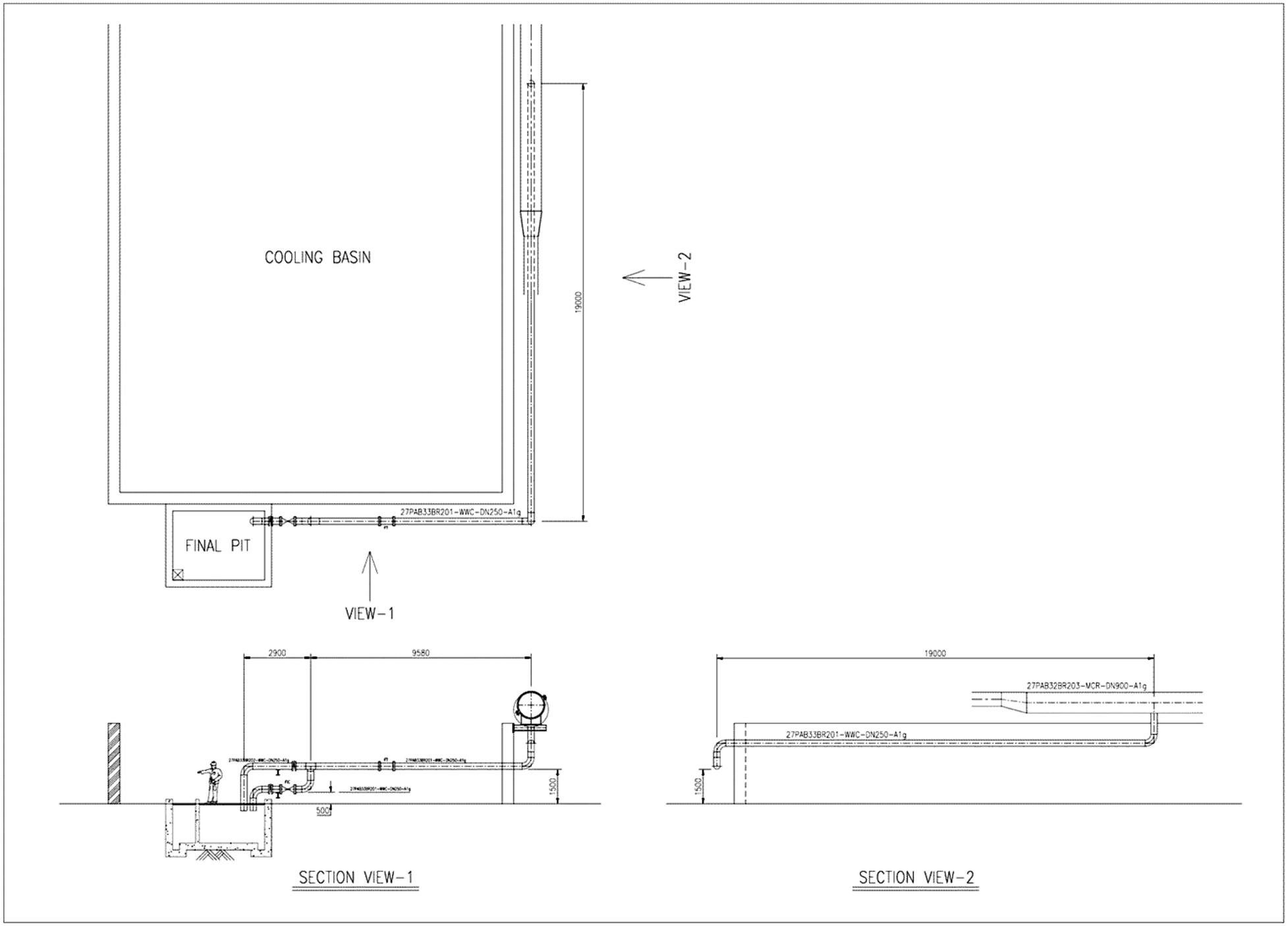
On Site sewage shall be collected separately from the uncontaminated storm water and contaminated water streams and discharged into a standalone septic tank system.

The EPC Contractor will ensure that all wastewater streams meet the discharge requirements stipulated in the effluent level guideline limit. The EPC Contractor will address in the design review phase of the project the means in which it achieves compliance with the wastewater discharge in respect to discharge temperature, flows and qualities for all ambient temperatures and CCPP operating conditions.

The Project will be equipped with a fully operational wastewater treatment plant capable of treating all process effluents and other wastewater streams. A septic tank will also be installed for domestic wastewaters.

The Power Plant will has one (1) discharge location for both storm drainage and continuous process drain, as shown in ***Figure 4.48***. A section view of the discharge pipe design is shown in ***Figure 4.51***.

Figure 4.51: Section View of Discharge Pipe Design



Source: TPMC, 2018.

4.8.2 Construction Phase

4.8.2.1 Construction Schedule

The construction phase for the Power Plant will take approximately 28 months. The EPC Contractor will prepare the site for construction, erection and installation of the Project facilities. Site preparation may include additional earthwork activities after the site is levelled like installation of circulating water intake structure. The construction, design and testing will be undertaken in accordance with the Myanmar NEQ (Emission) Guidelines and WB/IFC EHS Guidelines.

4.8.2.2 Mobilization

Site construction work will start once civil design of sites preparation is finalised. All work will be conducted in accordance with the detailed master construction schedule, provided by the EPC Contractor. Prior to commencement of work, all contractors would be required to provide detailed site specific plans related to:

- Equipment use;
- Excavation and backfilling management;
- Soil erosion management;
- Traffic management (including vessels operation/ movement);
- Storm water pollution prevention plan;
- Dust prevention plan;
- Environmental and Social Management Plan;
- Waste Management Plan; and
- Plan drawings of laydown, traffic flow, parking, trash storage, and recycling areas.

It is expected as a part of the mobilisation phase the Project sites will be fenced and a construction camp will be located inside the Project boundary.

4.8.2.3 Earthwork

Earth works will include clearing of vegetation and grading of the Project site. It is anticipated that the subsoil, which will be stripped and removed from the Project site, shall be utilised for levelling/ backfilling, it is also anticipated that the amount of soil that will be removed due to excavation activities and then backfilled is approximately 29,600 m^3. The Plant construction site, being partially in an area subjected to flooding will require careful study of potential placement of elevation and flood barriers.

Grading of the site will be done by the design team, considering sufficient height to protect the power plant from potential water and tidal/ flood damage. Such elevation will be studied further as part of the detailed design stage in order to confirm that the site elevation does not pose a flood threat to the surrounding areas.

4.8.2.4 River Work

The Project will involve the construction of a new pontoon and walkway to connect the pontoon to an existing walkway. Given the size of the pontoon and walkway that is required to be constructed, land based equipment will be used to install the walkway, whereas the crane barge will install the pontoon and steel piles. Dredging will not be required for the construction of the pontoon. Further details regarding the pontoon and walkway will be discussed further in ***Section 4.8.2.9***.

4.8.2.5 Site Foundation

The geological conditions of the Project site will be studied in the detailed design stage however, it is proposed that lightly loaded structures with equipment not sensitive to settlement may be supported on spread footings and/or mat foundations, provided the sub grade is adequately compacted. Other structures and/or settlement sensitive equipment shall be supported on piles.

4.8.2.6 Major Project Works

Table 4.42 presents major Project works to be undertaken as a part of the Project construction.

Table 4.42: Major Project Works for the Power Plant

Item	Description
Gas turbine and generators (GTGs)	■ Separate structure for both units ■ Separate acoustic enclosure with ventilation of turbine and generator ■ Removable panels for maintenance access
Heat Recovery steam generators (HRSGs)	■ Separate structures for each unit ■ Deaerator is common for both unit
Steam turbine and generator (STG)	■ Common weather enclosure of turbine and generator ■ Removable panels for maintenance access
Electrical and Control Building	■ Steel structure construction for Electrical room ■ Reinforced concrete construction for Control room.
Stacks	■ Diameter 5 meters appx. ■ Height 40 meters appx. ■ Carbon Steel with internal painting
Cooling water intake system	■ Make up water for cooling tower will be service water. Raw water will be sourced from Yangon River pass through existing settling pond and Raw water treatment package for cooling tower make and for all the other uses in the power plant. Demineralise water will be needed for feed water make up.
Water treatment facility	■ Demineralised unit ■ Designed to house the pre-treatment and associated equipment
Fire pump	■ Steel structure construction
Diesel generator building	■ Reinforced concrete frame construction
Equipment control building	■ Separate structures for gas turbine package
Environmental Embed control (Low NOx Burner)	■ Multi-chambers combustion system ■ Single gas fuel combustion system with DLN combustors ■ Ignition system with spark plugs and U.V. flame detectors
CEMS	■ Monitor: SOx as SO2, NOx as NO2, O2, and CO
Support facilities	■ Workshop
Administration	■ Reinforced concrete frame structure
Operator housing	■ Constructed of 4 buildings within the Project area to accommodate approximately 250 person
Pontoon	■ Steel pontoon, with steel piles for anchoring pontoon. ■ Wooden walkway linking proposed pontoon to existing walkway.

Source: TPMC, 2018.

Reinforced concrete structures shall be used for primary plant facilities and facilities exposed to an aggressive environment. These facilities are primarily low-rise buildings/structures that have a large

footprint area relative to their height. Conversely, steel is used for large expansive structures. The construction methods will be provided by the EPC Contractor.

4.8.2.7 Construction Workforce

The overall anticipated workforce during construction is shown in ***Table 4.43***. The anticipated work for Power Plant and Pontoon area is shown in ***Table 4.44***. The anticipated number of vessels used for the pontoon is shown in ***Table 4.45***.

Wastewater management systems of all construction vessels will comply the International Convention for the Prevention of Pollution from Ships (MARPOL).

Table 4.43: Anticipated Workforce during Construction

Workforce Origin	Average No. of Skilled Workers	Average No. of Semi-Skilled Workers	Average No. of Unskilled Workers	Total Average Workforce (per day)	Total Peak Workforce (per day)
Local Workforce	80	12	200	400	600
Migrant Workforce	40	6	0		

Source: TPMC, 2019.

Table 4.44: Anticipated Workforce for Power Plant, and Pontoon Construction

Component	Workforce
Power Plant	580
Pontoon	20

Source: TPMC, 2019.

Table 4.45: Anticipated Number of Vessels during Construction

Type of Vessel	Number of Vessels	Number of Workers per Vessel
Crane Barge	1	3

Source: TPMC, 2019.

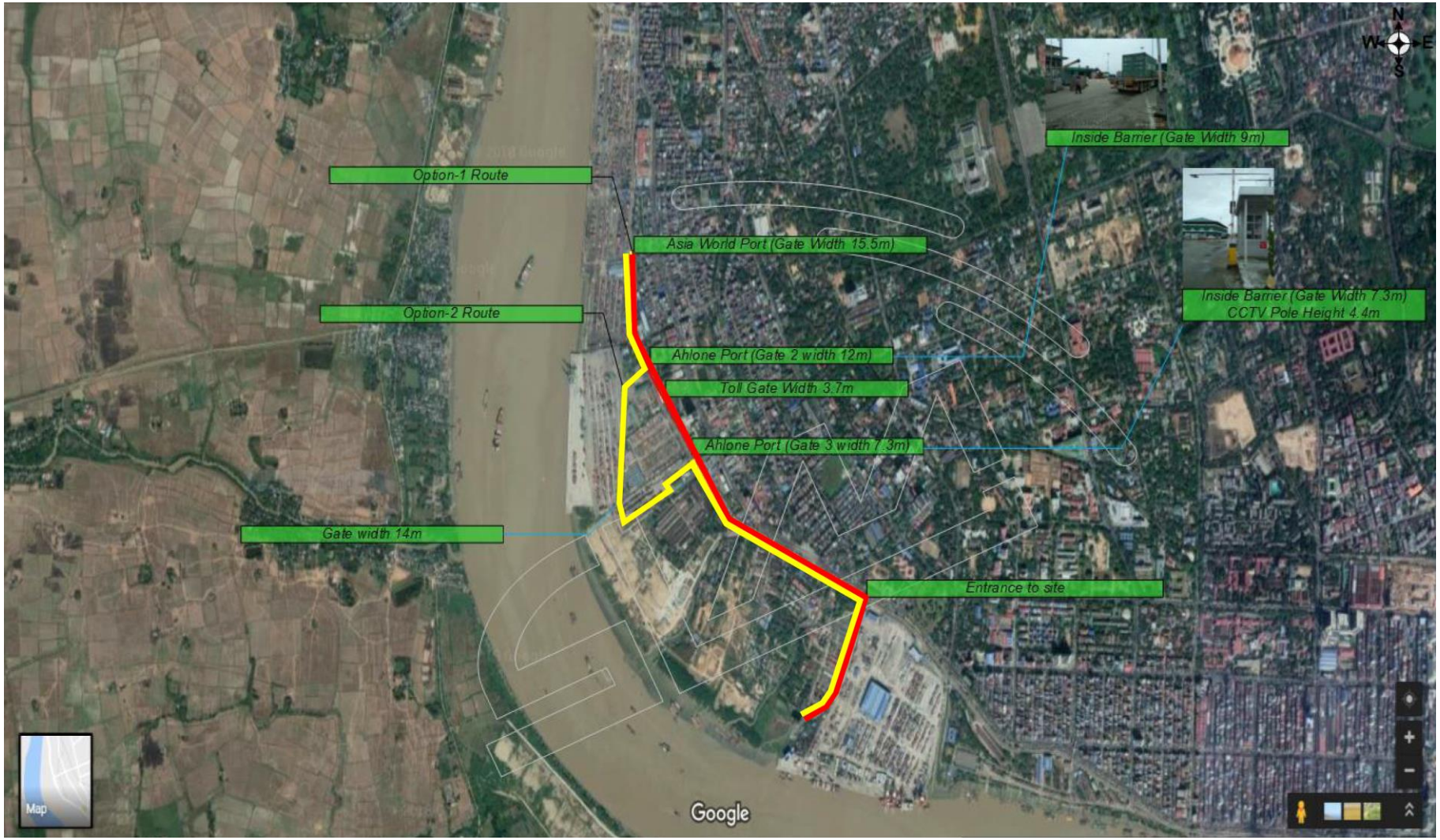
4.8.2.8 Temporary Construction Camp and Laydown Area

The EPC contractor has selected available space within the Ahlone Power Plant compound to use for the laydown area for the Power Plant construction. Imported materials is expected to shipped to the AWP; Trucks will be used to transport the materials from the AWP to the laydown area. The laydown area is used for storage of materials and equipment that will be used for the construction Project. Trucks will be used transport material/equipment from the laydown area to the Power Plant construction area. The laydown area for the construction of the Power Plat is shown in ***Figure 4.52***. The transportation route from the AWP to the laydown area is shown in ***Figure 4.53***.

Figure 4.52: Laydown Area Location for Power Plant Construction

Source: TPMC, 2019.

Figure 4.53: Power Plant Transportation Route



Source: TPMC, 2020.

4.8.2.9 Pontoon and Walkway Construction

The pontoon and walkway construction is expected to take approximately three (3) months, and will be installed alongside with the waterfront for placement of the water intake pumps.

The warning light shall be installed on Pontoon and walkway structure. A crane barge will be used to install the piles and pontoon structure; whereas the walkway will be constructed by land-based tools and equipment.

Once the piles and pontoon is complete, installation of the water intake pumps, and other topside equipment will proceed; a crane barge will lower the pumps directly onto the pontoon. Other topside equipment such as the electrical boxes will be installed by moving the equipment from onshore directly onto the walkway.

All construction vessels will comply with MARPOL 73/78, developed by the International Maritime Organization for pollution prevention from ships.

4.8.2.10 Power and Water Supply

Approximately 3,000 kW of electricity will be required during the peak construction period, with an average consumption rate of 300 MWh/mth. The electricity will be sourced from the existing 33 kV distribution line. The Contractor shall provide 33 kV/380 V box-type transformer and 300kW diesel generator for emergency.

During construction, water is required for construction worker activities and prefabricated concrete activities. The maximum number of workers onsite during construction is anticipated to be 600 persons and each worker is estimated to consume approximately 33.3 litres of water per day[15]. Prefabricated concrete activities are estimated to consume 40 m^3 of water per day per litre of concrete. All construction activities are estimated to consume 65 m^3 of water per day.

The average water consumption rate during construction is anticipated to be 624 m^3 per month (approximately 30 m^3 (30,000 L) per day).

The raw water required during construction will be obtained from YCDC or other local water supplier, and will be transported by water trucks. The raw water will be treated and purified to supply for construction.

4.8.2.11 Construction Waste

Solid Waste

During the construction phase, non-hazardous solid waste material is likely to be produced from concrete, steel pipes, steel plates, structural steel and wooden crates. Opportunities will be explored for selling the steel plates and structural steel. The wooden crates will be disposed of by an appropriate or a licensed waste contractor. It is anticipated that the amount of non-hazardous waste produced during the construction phase is approximately 4,437 tons.

There will also be biomass waste associated with the clearance of tree, shrubs and grass. Approximately 10,560 m^3 of biomass waste is anticipated during construction. Opportunities for providing biomass waste to the local community will be explored or biomass waste will be disposed of by an appropriate or a licensed waste contractor.

All excavated material will be backfilled with no surplus.

Appropriate storage and disposal facilities for waste shall be constructed on Site. Bunded, hardstand and roofed areas are a general requirement for hazardous waste such as waste oils, paints and

[15] Tchobanoglous, G., Burton, F. L., & Metcalf & Eddy. (1991). Wastewater engineering: Treatment, disposal, and reuse. New York: McGraw-Hill.

chemicals. The waste will then be disposed in designated disposal areas provided by the YCDC Pollution Control and Cleansing Department.

Table 4.14 presents details of domestic waste and approximate capacities anticipated during construction.

Table 4.46: Domestic Waste during Power Plant Construction

Waste Type	Anticipated Quantity	# Workers	Total Solid Waste
Domestic Solid Waste	1.65kg per employee per week	600	990 kg/week

The solid waste generated during the construction phase will be collected and segregated for recycle and non-recycle waste (i.e. paper, plastic).

There will also be minimal other waste such as wood crates which will be provided to the local community as firewood.

Table 4.15 presents details of the construction waste and approximate capacities anticipated during construction.

Table 4.47: Construction Waste during Power Plant Construction

Waste Type	Amount
Concrete	4,331 Tons
Steel Pipes	11.6 Tons
Structural Steel	3.9 Tons
Wooden Crates	90 Tons

Source: TPMC, 2019.

Hazardous Waste

During the construction phase, hazardous waste material can originate from used paint, engine oils, hydraulic fluids, spent solvents, spent batteries, etc. It is anticipated that the amount of hazardous waste produced during the construction phase is listed in ***Table 4.48***.

Table 4.48: Hazardous Waste Quantities

Hazardous Material	Amount
Diesel oil	10 L per day
Hydraulic fluids	5 L per day
Paint	10 L per day
Battery	0.2 kg per day

Source: TPMC, 2019.

The hazardous waste from chemical cleaning will be transported off-site to the appropriate or licensed Hazardous Waste Treatment facilities, available in Myanmar. Solid hazardous waste from the construction phase will be properly contained and transported off-site to an appropriate or licensed waste disposal contractor.

Wastewater

Wastewater typically produced during construction includes sanitary/domestic wastewater, cement wash down, other plant cleaning/rinsing effluents, vehicle maintenance and the mixing of oils/lubricants in the wastewater (i.e. as a result of equipment washing).

Non-Hazardous wastewater will be generated from the toilet facilities and workers accommodation (sewage). Non-hazardous wastewater will also be generated from the canteen. The sewage generated onsite will be collected through underground pipes into a holding tank, from where the sewage will be routed to an onsite sewage treatment plant or alternatively transported periodically by vacuum trucks and transferred to a septic tank or discharge to common drain.

The increased presence of the labour force in the local areas may also place pressure upon any existing sewage systems and wastewater treatment systems or may result in additional untreated discharges of sanitary and domestic wastewater to the local environment.

Hazardous wastewater will be generated from chemical cleaning of the equipment during the pre-commissioning process.

The hazardous wastewater from chemical cleaning will be transported off-site to the appropriate or licensed Hazardous Waste Treatment facilities, available in Myanmar. Solid hazardous waste from the construction phase will be properly contained and transported off-site to an appropriate or licensed waste disposal contractor.

Sewage/Sanitary Wastewater

During construction, it is anticipated that the maximum number of workers will peak at 600. The quantities of sanitary wastewater can be estimated as an average of 50 litres/person/day. Considering the expected amount of sanitary wastewater produced is approximately 80% of the total water consumption per person (for non-continuous use), this equates to a predicted 24,000 litres of sanitary wastewater per day at peak construction periods. The EPC contractor will establish a management system for sanitary wastewater before construction.

4.8.2.12 Health and Safety

Emergency Response Plan

TPMC has in place a Project Incident and Emergency Response Plan to provide the necessary course of action during an unplanned event, during the construction and operation phase.

The potential emergency scenarios that apply to this plan are as follows:

- Person(s) fall from height – on land;
- Material fall from height;
- Vehicle collision with plant/equipment/pedestrian(s);
- Vehicle incident offsite;
- Collapse of scaffold – no person(s) present/person(s) present;
- Collapse of structure – no person(s) present/person(s) present;
- Collapse of deep excavations – person(s) present;
- Fire/Explosion – electrics, substances;
- Chemical spillage – on land;
- Medical emergency – mass food poisoning/bird flu;
- Medical emergency – contagious disease;
- Uncontrolled flammable/toxic release;
- Adverse weather conditions (flooding, lighting strike);
- Loss of services (water, sewerage, electricity);
- Radiation (Radiation Source Exposition); and
- Other (Earthquake, terrorist act, bomb threat, trespassers).

The full Project Incident and Emergency Response Plan is shown in ***Appendix I***.

Site Security Procedure

The site security procedure is designed to provide a secure environment for employees that are on site, during the construction phase.

The main topics that this procedure covers are as follows:

- Physical barriers (Fence, Gates);
- Badge (Personal access control);
- Mobilization and demobilization of employees;
- Asset control;
- Guards;
- Vehicle policy;
- Security supervision; and
- Photography control.

The full Site Security Procedure is shown in ***Appendix J***.

Personnel Protective Equipment Procedure

The purpose of this procedure is to establish specifications, decision criteria, and guidance for Personal Protective Equipment (PPE) to ensure the proper level of safety is met and to protect workers from injuries and occupational health illnesses, during the construction phase. The full Personnel Protective Equipment Procedure is shown in ***Appendix K***.

4.8.3 Operation Phase

The main features of the power plant have been summarised in ***Section 4.8.1***.

There will be no Operation and Maintenance (O&M) contract with any third party operator, as the Project will be owned and operated by the Project Proponent. The O&M of the Project will be undertaken by the Project Proponent with the support of a long term service agreement (LTSA) for the GT with the manufacturer and external expertise on each function to counterpart and provide the intensive in house training during commission until 3 years after SCOD. The LTSA will cover the supply of spare parts, supervision and specialized technicians for inspections, major and minor overhauls.

O&M staff with relevant experience of operating similar plants and with adequate knowledge of comparable technology will be deployed prior to commercial operation date (COD) to commission and take over the Project from the EPC Contractor. Approximately 50 staff will work on the operational phase of the Project.

The below sections will discuss further the key activities during Operation Phase.

4.8.3.1 Water Supply

The main freshwater supply source will be taken from Yangon River. However, the use of surface water will be determined and assessed at the later stage to ensure no disruption to the local communities. In addition, the pre-water treatment plant will be installed to provide freshwater for operation phase.

The raw water will be passed through a coagulation mixer, flocculation tank and clarifier prior to collection in Service water and Firefighting storage tank as service water. Service water is majority of the water will be supplied to meet the plant water users and demineralized water requirement.

Table 4.49 presents the water requirements and their volumes during operation.

Table 4.49: Water Requirement during Operation

Water Requirement	Volume
Cooling water system	601 m^3/h
Domestic water (local authorized)	4 m^3/h

Source: TPMC, 2018.

The raw water will be taken from Yangon River, using the Water Intake Pumping station at the flow rate of approximately 916 m^3/hour.

The lowest flow rate estimated from flow velocity measurements in the dry season in the intake location of the Yangon River. The maximum intake requirement for the Project is expected to be 916 m^3/hr. This is equivalent to approximately 0.83% of the lowest dry season flow in the river at the intake location. This is based on a worst case scenario, comparing the Project's maximum expected water withdrawal requirements, with a constant withdrawal over a 24-hour period, during the lowest measured flow rate in the dry season.

Based on the above comparison of the Project's water intake requirements with the estimated flow rates of the river during the dry season, it is expected that there will be adequate flow to support the Project's water withdrawal, and the Project is not expected to have any significant impacts on current water users for the Yangon River.

4.8.3.2 Storm Water

The rainwater, if not contaminated will be discharge directly to storm water drainage.

The Power Plant drain for storm water at areas of where lubricating oils are handled will be connected to an oil and grease pit (interceptor). The contaminants will be captured in the pit and removed manually. Contaminated storm water will be sent to the oil-water separator system before discharge to the final checking pond while uncontaminated storm water will be discharged offsite into the small water channel discharge point to the North West side of the Project Site. The estimated amount of discharge storm water is shown in ***Table 4.53***.

The Power Plant will have two (2) discharge locations. The first discharge point is for storm drainage, with a total flow rate of 271 m^3/h (intermittent) at ambient temperature. The second discharge point is for continuous process drain and storm drainage (intermittent), with a total flow rate of 210 m^3/h (continuous) at 42 °C, and a total flow rate of 630 m^3/h (intermittent) at ambient temperature.

4.8.3.3 The Anticipated Workforce

The anticipated workforce during operation is shown in ***Table 4.50***.

Table 4.50: Anticipated Workforce for the Power Plant

Description	Staff Number
Permanent Staff	50 (O&M + Back Office)
Security (external)	12
Contract staff: Cleaners, Gardeners and helpers	10
Contract staff: Technical hands	10
Maintenance (once every 3 years)	90 for 30 days

Source: TPMC, 2018.

The Operational and Maintenance Workforce

The Operational and Maintenance (O&M) working will use 4 shift teams and additional daywork team to provide 24/7 coverage for plant operation and 8 hours per day.

The shift structure will be as follows:

- 8 hours per shift
- 32 staffs will be in the shift roster

Maintenance staffs are typically not rostered on shift work except for planned maintenance period.

4.8.3.4 Operational Waste

Operational Solid Waste

During operation the re-use, recycle and minimization of waste ethic shall be adopted. A waste management plan will incorporate strategies for the re-use, recycle and minimization of waste on Site. Management strategies for regulated and hazardous waste shall also be included, including a methodology for tracking regulated/hazardous waste generation and disposal.

Appropriate storage and disposal facilities for waste shall be constructed on Site. Bunded, hardstand and roofed areas are a general requirement for hazardous waste such as waste oils, paints and chemicals.

Table 4.51 presents details of the solid waste and approximate capacities anticipated during operation.

Table 4.51: Solid Waste during Operation

Waste Type	Anticipated Quantity	# Employees	Total Solid Waste
Domestic Solid Waste	1.65kg per employee per week	50	82.5 kg/week

Source: TPMC, 2019

The solid waste generated during the operation phase will be collected and segregated for recycle and non-recycle waste (i.e. paper, plastic). Project will use incineration on site and compost.

There will also be minimal other waste such as wood crates from maintenance activities which will be provided to the local community as firewood.

Operational Hazardous Materials

The hazardous materials to be stored on site during operation are presented in ***Table 4.52***. The chemicals will be transported appropriately to the Project site and Material Safety Data Sheets (MSDS) will be prepared from chemical suppliers in Myanmar. The EPC contractor will follow TPMC's Waste Management Plan as mentioned in ***Section*** *Error! Reference source not found.*.

Table 4.52: Hazardous Materials during Power Plant Operation

Hazardous Material	Use of Hazardous Materials	Storage Location Onsite	Quantities to be Stored Onsite*
Oxygen Scavenger	Chemical Dosing System	Chemical Storage House	Estimate 1 m^3
Phosphates	Chemical Dosing System	Chemical Storage House	Estimate 1 m^3
Condensate Treatment	Chemical Dosing System	Chemical Storage House	Estimate 1 m^3
Corrosion Inhibitor	Chemical Dosing System	Chemical Storage House	Estimate 4 m^3
Biocides	Chemical Dosing System	Chemical Storage House	Estimate 34 m^3
Sulfuric Acid	Chemical Dosing System	Chemical Storage House	Estimate 103 m^3
Scale Inhibitor	Chemical Dosing System	Chemical Storage House	Estimate 4 m^3
Sodium Hydroxide	Water Treatment System and Demineralised Water System	Chemical Storage House	Estimate 58 m^3
Sulfuric Acid	Water Treatment System and Demineralised Water System	Chemical Storage House	Estimate 2 m^3
Sodium Hypochlorite	Water Treatment System	Chemical Storage House	Estimate 115 m^3
Poly Aluminium Chloride	Water Treatment System	Chemical Storage House	Estimate 39 tonne
Anion Polymer	Water Treatment System	Chemical Storage House	Estimate 2 tonne
RO Antiscalant	Water Treatment System and Demineralised Water System	Chemical Storage House	Estimate 1 m^3
Sodium metabisulfite	Water Treatment System and Demineralised Water System	Chemical Storage House	Estimate 1 ton
Citric Acid	Water Treatment System and Demineralised Water System	Chemical Storage House	Estimate 1 ton
Diesel oil	Liquid fuel for emergency diesel engine generator, emergency diesel generator	Storage Tank	Estimate at 2 x 7200 litres x 3 days for fuel tank = 43,200 litres.

*Note: *Estimated figures only for 2 months in chemical storage house*

4.8.3.5 Operational Wastewater

The Power Plant will be equipped with a fully operational wastewater treatment plant capable of treating all process effluents and other wastewater streams. A septic tank will also be installed for domestic wastewaters.

Table 4.53 presents details of the wastewater and approximate capacities which will be generated during operation.

Table 4.53: Wastewater during Operation

Item	Timing of Wastewater Generation	Capacity*
Wastewater from Power Plant		
Sludge cake from river water pre-treatment	Normal Operation	3,000 m^3/day (Intermittent)
DM plant neutralized water	Normal Operation	Estimate 20 m^3/ hour
Cooling tower blowdown	Normal Operation	210 m^3/ hour (Intermittent)
Storm water	Normal Operation	**Power Plant (Intermittent):** Discharge Point 1: 271 m^3/h Discharge Point 2**: 630 m^3/h
Washing water from Main Block	Normal Operation	Intermittent
Fire protection system	Emergency	-
Domestic Wastewater		
Kitchen	Normal operation	-
Wash room	Normal operation	-
Plant control room	Normal operation	-
Condensate polisher / safety shower	Emergency	-
Battery room/eye wash	Emergency	-
Water treatment plant/safety shower	Emergency	-
Sanitary/ Sewage Wastewater	Normal Operation	4 m^3/ hour

Note: **estimate figures only*
***Value also contains process flow drain of 210 m^3/h (continuous)*

Wastewater from the plant process will be treated with pH control within a pH range of 6 to 9 in the neutralization treatment system and oil-water separator system. The treated wastewater will be discharge into final checking pond before discharge to the small water channel. Sewage will be treated in a package sewage treatment and discharged into the wastewater discharge system to the North West side of the Project site. The sludge will be dewatered and disposed off-site by an appropriate waste contractor.

4.8.3.6 Ancillary Structures

In addition to the main infrastructure on site, and as described above, the following ancillary buildings will be constructed:

- Administration building (incorporated of the Central Control Room);
- Gatehouse at the main gate of the site;
- Staff canteen; and
- Firefighting pump.

4.8.3.7 Emergency / Black Start Diesel Generators

The Power Plant will have combined emergency/black start diesel generator with a capacity 9,600 kW (to be determined) that will only be used during plant safe shutdown as well as for black start. The diesel will be transported appropriately to the Project site from diesel suppliers in Myanmar. Material

Safety Data Sheets (MSDS) will be completed for the diesel to ensure appropriate transportation. The diesel generator will be the stationary emergency type and will consist of control gear, lubricating oil system, fuel day tank, cooling system, direct current (DC) starting power and synchronizing equipment, and electrical protection system equipment. Following an emergency shutdown of the power plant, the diesel generators will provide electrical power to maintain the turbine generator unit and its auxiliaries in safe conditions. During area-wise blackout, the diesel generators will provide electrical power to start the CCPP.

4.8.3.8 Fire Protection System

The Power Plants fire protection system will provide personnel safety and plant protection through prompt detection, alarm and suppression of a fire. The system will be designed for any single design basis fire and will be in accordance with all local applicable codes and standards. The primary source of water for the system shall be from the plant's water system.

4.8.3.9 Health and Safety

TPMC has in place a Project Incident and Emergency Response Plan to provide the necessary course of action during an unplanned event.

The potential emergency scenarios that apply to this plan are as follows:

- Person(s) fall from height – on land;
- Material fall from height;
- Vehicle collision with plant/equipment/pedestrian(s);
- Vehicle incident offsite;
- Collapse of scaffold – no person(s) present/person(s) present;
- Collapse of structure – no person(s) present/person(s) present;
- Collapse of deep excavations – person(s) present;
- Fire/Explosion – electrics, substances;
- Chemical spillage – on land;
- Medical emergency – mass food poisoning/bird flu;
- Medical emergency – contagious disease;
- Uncontrolled flammable/toxic release;
- Adverse weather conditions (flooding, lighting strike);
- Loss of services (water, sewerage, electricity);
- Radiation (Radiation Source Exposition); and
- Other (Earthquake, terrorist act, bomb threat, trespassers).

The full Project Incident and Emergency Response Plan is shown in ***Appendix I***.

4.8.3.10 Power Plant Maintenance

During operation, maintenance will be associated with the following:

- Routine Maintenance;
- Planned Preventive Maintenance; and
- Breakdown Maintenance.

4.8.3.11 Embedded Controls included in the Project Design to Control Impacts

The Project intends to include the additional emission control technologies to reduce air pollutant emissions to comply with applicable international standards; these are summarised in turn below:

4.8.3.12 Dry Low NOx Burners

The proposed power plant will be equipped with Dry Low NOx burners developed to achieve low NOx emissions.

The Project will provide Dry Low NOx burners which are Best Available Technology (BAT) for CCPP to guarantee NOx emission levels at the exhaust chimney of 25ppm by volume (dry) at 15% O2 levels (at base load of gas turbine).

4.8.3.13 Continuous Emissions Monitoring Systems (CEMS)

In addition to the emission reduction technologies, the proposed power plant will be installed with both manual stack sampling facilities and Continuous Emission Monitoring System (CEMS) including thermocouple and manual sampling ports.

Both manual stack sampling facilities and Continuous Emission Monitoring system (CEMS) shall be provided across the HRSG stack for continuous on-line monitoring the flue gas at CCR. The CEMS shall measure emissions from the flue gas at each HRSG stack.

The CEMS controller, Data Acquisition System (DAS) and report generation terminal shall be provided to collect and store the CEMS data and log alarms, generate periodic report, perform and edit CEMS functions, communicate with plant DCIS. All information, alarm and reporting functions shall be available through DCIS System.

The CEMS system will be common use for both HRSG stack and should be located adjacent to the HRSG stack and sized to contain all the analysers the DCIS interface. The CEMS system shall be completed with an environment control lighting and electrical distribution system. Electric power for all CEMS equipment shall be supplied from a UPS system. Power will be provided to the CEMS system container at 220 VAC 50 Hz.

All equipment in CEMS system shall be completely accessible. The CEMS shall be in accordance with the requirements of the US Environmental Protection Agency as stated in Title 40 Code of Federal Regulations (40 CFR) Part 60 "Standards of Performance for New Stationary Sources," and 40 CFR Part 60 Appendix B "Performance Specifications 1, 2, 3, 4 and 6" and Myanmar Local Regulation of Pollution and Environment.

The power plant shall furnish the oxides of nitrogen (NOx) analysers as per IFC and Myanmar NEQ Guidelines (2015). All equipment necessary to draw, filter, condition, or transport samples, or to periodically purge sample lines and probes shall be furnished

The emission data received from each analysing equipment via the data acquisition station shall be calculated and converted into the required values such as ppm, etc.

Its software shall be especially designed for emission evaluation. Reports shall be printed on dedicated printers.

4.8.4 Decommissioning

Decommissioning is the term used to describe all the stages involved in the closure and rehabilitation of the power plant site. The process can generally be categorized into three (3) key phases as follows:

- Pre-decommissioning activities: includes the detailed planning (development of the decommissioning plan) and approval procedures;
- Decommissioning activities: removal of plant machinery & equipment and demolition, decommissioning of facilities, turbines and infrastructure, decontaminated land assessment and rehabilitation; and
- Post-decommissioning activities: site survey, close-out report and field monitoring as necessary.

4.8.4.1 Decommissioning Phase of the Project

At present, there are no plans or schedule for decommissioning of the proposed Project. It is likely that the Project facilities will only be decommissioned/ abandoned once it is no longer economical to continue operation, the plant is rendered redundant and/or no longer required for various reasons or is unsafe to operate. As the development process of the site is yet to fully begin, detailed decommissioning plans have not yet been formulated.

The Project facilities will be designed with decommissioning in mind. In general, facilities and machinery will be designed so that they can be isolated and decommissioned in steps which are in reverse of the installation procedure or which are most convenient to do so. The decommissioning phase activities will therefore be similar to those associated with the excavation/foundation work, installation and civil construction phases. The decommissioning plant will also take into account environmental rehabilitation, which includes the removal of all surface facilities and excess hydrocarbon waste, as well as re-vegetation of localized natural flora.

Associated decommissioning activities in accordance with environmental measures and standards of good practice are as follows:

- Removal of site infrastructure and waste;
- All civil structures and associated infrastructure will be removed;
- All remaining materials and hydrocarbons and hazardous waste will be removed;
- All pilings and trestles will be removed;
- All waste will be disposed of in an appropriate manner; and
- Reusable materials to be resold or recycled.

Hazardous Waste Clean Up and Transport:

- When decommissioned, all products within piping and storage infrastructure shall be removed from said system along with all associated infrastructure and possible contaminated soils; and
- All hazardous wastes shall be transported to approved hazardous waste storage facilities or disposal sites.

Site Rehabilitation:

- all disturbed areas due to ROWs, transmission lines, etc. shall be rehabilitated and revegetated;
- native flora shall be used to re-vegetate the rehabilitated sites;
- Roadways will be scarified; and
- Natural drainage patterns will be reinstated where practical.

4.9 Project Alternatives

IFC Performance Standard 1 (Assessment and Management of Environmental and Social Risks and Impacts) (“PS1”) requires an assessment process that identifies the risk and potential impacts associated with a project. Specifically, “the process may comprise a full scale environmental and social impact assessment, a limited or focused environmental assessment or straight forward application of environmental siting, pollution standards, design criteria or construction standards”. PS1 states that for greenfield developments or large expansions with specifically identified physical elements, aspects and facilities that are likely to generate potential environmental or social impacts, the client will conduct a comprehensive ESIA, including an examination of alternatives, where appropriate.

This section presents an overview of the alternatives considered as part of the ESIA study. The main design criteria, plant technology, Project type, and Project Location were determined by MOEE, and

the Project Proponent will have to comply with MOEE requirements are therefore beyond the remit of this ESIA study, and are not included in this review.

4.9.1 Alternatives of Different Power Generation Options

4.9.1.1 Overview

Electricity generation may be achieved from renewable and non-renewable sources. Renewable sources include solar, wind, hydroelectric sources, and biomass while non-renewable sources include fossil fuels such as coal and natural gas. The following section describes the energy mix in Myanmar.

4.9.1.2 Hydroelectric

Myanmar has 25 grid-connected hydroelectric power plants; all operated by Hydropower Generation Enterprise (HPGE). Their installed combined capacity is 3,151 MW (2016). Off-grid supply from mini hydropower stations is provided by ESE and IPPs and contributes 33 MW.

Table 4.54 shows the existing hydroelectric power plant in Myanmar (> 50 MW).

Table 4.54: Existing Hydroelectric Power Plant in Myanmar (> 50 MW)

Station	Installed Capacity (MW)
Yeywa	790
Shweli-1	600
Paunglaung	280
Dapein-1	240
Baluchaung-2	168
Thauk-ye-khat	120
Mone	75
Shwegyin	75
Kyee on Kyee wa	74
Kun	60
Kinda	56
Keng Taung	54
All Others	559
Total	**3,151**

Source: IHA, 2016.[16]

During the wet season (June-September), the power plants are capable of generating more electricity than the maximum estimates from the MOEE, which amount to approximately 2,000 kWh per capita; although less than Thailand's current generation, it is equivalent to Vietnam's per capita generation. Given the prolonged construction time for hydro projects, it is important to negotiate the ability to purchase significant amounts of power for domestic use, even from dams invested with foreign capital and initially destined for export.

Another 46 GW of potential electricity capacity, derived from 302 potential sites which has been identified so far, and a number of these projects are now under construction or at the advanced planning stage. The potential Myanmar Hydropower resources are illustrated in (***Table 4.55***).

[16] IHA. (2016). Myanmar. International Hydropower Association (IHA). Retrieved from https://www.hydropower.org/country-profiles/myanmar

Table 4.55: Myanmar Hydropower Resources

Capacity	Number of Potential Sites	Potential Capacity (MW)
Less than 10 MW	210	231.25
Between 10 MW and 50 MW	32	806.30
More than 50 MW	60	45,293.00
Total	302	46,330.55

Source: WEF et al, 2013.[17]

4.9.1.3 Gas Fired

Myanmar has 10 gas-fired power plants; all operated by EPGE. Their installed capacities of 996 MW account for 20.5% of national grid capacity. Ahlone is the biggest plant with a capacity of 275 MW. These plants use gas produced in the offshore fields of Yadana and Yetagun, and onshore fields operated by the MOEE. The output from these plants has been below expectations owing to low calorific value of local gas (high Nitrogen content) and low pressure without compression.

The gas-fired power plants in Myanmar use both liquefied petroleum gas (LPG) and liquefied natural gas (LNG) as fuels, however, the differences between LPG and LNG are not always clear. LPG is propane or butane gas under slight pressure which turns into a liquid at normal temperatures. It is often used for household cooking and delivered in small cylinders, but can be used in place of natural gas in many generators. It currently sells for 15 to 16 USD per million BTU (import price) and can be delivered in small ships of 10-30 thousand tons. It does not require elaborate or costly ports or handling equipment. LPG is a plausible transition fuel for gas-fired generators that will be commissioned in 2015-2018 but not able to use domestic natural gas until a few years later when extra domestic gas supplies should become available. LPG is also cheaper than kerosene or diesel alternatives.

LNG is super-cold natural gas which has turned into a liquid. It is typically delivered in specialized ships which are essentially floating thermos bottles, specially designed to handle the very cold liquid. Recently, most LNG tankers have been very large – up to 12 meters (39 feet) in draft and require costly specialised storage facilities on shore, which take several years to build. Due to the cost of the ships and the onshore facilities that need to be repaid over an extended period, most LNG contracts are for many years, usually at least twenty. If Myanmar will produce more domestic natural gas for its own use starting in 2020, the cost of domestic natural gas would be less than that of LNG. This would make the large onshore investment in equipment unattractive. Besides this, there are no deep water ports capable of handling large LNG ships close to population centres where electricity is needed.

Table 4.56 shows the existing gas-fired power plants in Myanmar.

Table 4.56: Existing Gas-Fired Power Plants in Myanmar

Station	Installed Capacity (MW)
Kyungchaung	54.3
Mann	36.9
Shwedaung	55.3
Mawlamyaing	12.0
Myanaung	34.7
Hilawga	208.7

[17] WEF, ADB, & Accenture. (2013). New Energy Architecture: Myanmar. World Economic Forum (WEF). Retrieved from http://www3.weforum.org/docs/WEF_EN_NewEnergyArchitecture_Myanmar_2013.pdf

Station	Installed Capacity (MW)
Ywama	122.3
Ahlone	275.2
Thaketa	145.6
Thaton	51.0
Total	**996**

Source: Vikas Sharma, 2013

4.9.1.4 Coal-Fired

Currently, Myanmar has one coal-fired power plant named Tigyit with an installed capacity of 120 MW. Efficiency of the power plant is low, generating power at an average capacity factor of approximately 30%.

Historically, coal-fired power plants emitted significant amounts of soot and sulphur, and sulphur may led to acid rain. In addition, certain coals are also high in mercury, which can be toxic and cause pollution. However, technology has evolved considerably and new coal-fired power plants can be designed to use low-sulphur coal and catch almost all of the ash particles generated from burning. Processing of coal before burning can also remove over half of the mercury.

A single coal unit has a usual capacity of 400 to 600 MW and most coal stations have at least two units. A typical station has a capacity of 1,000 MW (1 million kilowatts) and operates for 6,000 hours a year, producing six billion kWh a year. Since a ton of good steam coal produces approximately 3,000kWh, the annual coal consumption of one station is in the order of two million tons a year or 5-6 thousand tons a day. If the coal is of lower thermal quality, even larger amounts must be used. Handling such large amounts of coal requires ocean transport on large ships that need deep channels and ports with specialised unloading facilities. These are major investments and there is the potential for significant impact on the area in which they operate.

It should be noted that coal-fired plants in general have higher CO_2 emissions compared to gas turbines. Gas turbines have relatively low CO_2 compared with other fossil fuel energy generation technologies. The Project has employed a CCPP technology which was designed for high reliability and efficiency operation with lower environmental impact. CCPP plant offer half as much CO_2 per kWh compared to other power generation technology. Natural gas provides more efficiency than coal because of higher operating temperatures, and when used together with the more efficient combined-cycle results in even higher efficiencies (IEA, 2006).[18]

4.9.1.5 FRSU (Floating Storing Regasification Unit)

FSRU can be termed as a special type of ship used for LNG transfer. Transported in a semi-cooled state of -160 C°, it needs to be heated up to its original gaseous state. This reheating needs to be carried out before the gas is pumped into its storage systems. The whole process of freezing and then re-heating the fuel is extremely expensive and time-consuming. FSRU vessels can be classified either as ships or offshore installations depending upon the design they incorporate. Floating Storage Regasification Unit (FSRUs) can be equipped in two ways:

- either they can be installed as a separate unit aboard the LNG carrier itself or,
- an old gas carrier can be converted into an independent unit and placed in a particular destination as an offshore installation

[18] IEA, 2006a: Energy Technology Perspectives 2006: Scenarios and strategies to 2050. International Energy Agency, Paris, 484 pp.

When the FSRU unit is installed in the ship itself, the major advantage of such installation is that the heating and liquefaction process can be carried out within the vessel itself without having to unload the fuel in its semi-frozen state. For the 2nd method, an old LNG tanker is modified with offshore installations as floating LNG unit, which can be either with the propulsion unit (mobile) or without the propulsion unit (fixed offshore unit). The former gives the flexibility to operate the unit as a floating storage unit and as an LNG tanker when required.

In case of the former, the process can be carried out within the vessel itself without having to unload the fuel in its semi-frozen slushy state, whereas in the latter option, however, promises to be more viable as docking a refurbished regasification unit would ensure that the supply and demand chains are adequately balanced. Since the refurbished Floating Storage Regasification Unit (FSRU) would also be able to provide storing feasibilities of LNG, constant transference of the LNG cargo from LNG vessels would ensure that there is no storage depletion whatsoever. Generally, such kinds of Floating Storage Regasification Unit or FSRUs are found near the harbor to prevent time-consumption. But while utilising a refurbished gas carrier as a Floating Storage Regasification Unit, care needs to be taken to suitably positioning these refurbished vessels to prevent any emergency arising near a particular port or harbor.

In addition, seawater is generally used as a heat source. This system is known as an open loop system. Strict environmental regulations must be followed for the cold seawater discharged after the heat exchange with LNG.

However, it shall be noted that at the time of preparing this ESIA Report, there is no FSRU operating in Myanmar.

4.9.1.6 Non-hydro Renewable Sources

Using non-hydro renewable sources for power generation is still in its infancy in Myanmar and constitutes a small percentage of total installed capacity and generation. While Myanmar is rich in renewable resources, the development remains severely limited by availability of funds to support the research and development, lack of a clear renewable energy policy and lack of talented manpower.

The following provides a brief summary of the limited publically available information concerning non-hydro renewable projects in Myanmar.

4.9.1.7 Biomass

Biomass is a process of generating energy from organic matter, which can be derived from a few different methods, such as burning, chemical conversion, and biochemical conversion. Burning biomass is the most common method for generating energy. There are 265 MW of biomass power projects in operation in Myanmar in 2015.

4.9.1.8 Wind Energy

Wind power projects in Myanmar are either in experimental phase or undergoing feasibility studies. There are some very small operational projects off the grid (Dattaw Mountain in Kyauske, and Government Technical High School in Ahmar, Ayeyarwaddy). Gunkul Engineering Public Company Limited and China Three Gorges Corporation, both foreign, signed a MOU with the MOEE in 2011 to conduct feasibility studies for the development of 4,032 MW of wind energy in Myanmar.

4.9.1.9 Solar Energy

Some pilot PV cell projects financed by the MOEE and university research departments are underway in rural areas; being used to charge batteries and pump water for irrigation. Another example is the installation of 3 kW PV systems in remote schools by Mandalay Technological University. Overall, however, at current costs, solar energy is unaffordable and only have a production capacity of 10.94 GWh in from 2015-2016 (MOEE, 2017).

4.9.2 Alternative Layouts, Process Technology and Supply Source

4.9.2.1 Layout

The Project Proponent has considered a number of different layouts for the Project. The main issues influencing the Project layout include:

- The availability of land;
- Road access and access arrangements;
- Connection to water supply;
- Provisions to minimise environmental impacts;
- Occupational and Public Health and Safety;
- Technical requirements; and
- Financial considerations.

The layout which has been assumed for the purposes of the EIA has been developed through preliminary engineering studies and has also considered different plant configurations.

The Project Proponent has selected a layout with: two (2) gas turbines, one (1) HRSG's and one (1) steam turbine i.e. 2-2-1. Therefore, this 2-on-1 plant configuration will be used for the purposes of this EIA Study. If there are changes to the configuration/layout, this will be notified to the ECD.

4.9.2.2 Selection between LNG Receiving Terminal and FSRU

A Floating Storage Regasification Unit (FSRU) can be termed as a special type of ship used for LNG transfer. Transported in a semi-cooled state of -160º, it needs to be heated up to its original gaseous state. This reheating needs to be carried out before the gas is pumped into its storage systems. The whole process of freezing and then re-heating the fuel is extremely expensive and time-consuming. FSRU vessels can be classified as either ships or offshore installations depending upon the design they incorporate. FSRUs can be equipped in two ways:

- Installed as a stand-alone unit aboard the LNG carrier itself; or
- Overhauling an old gas carrier into an independent unit and placed at a particular destination as an offshore installation.

When the FSRU unit is installed in the ship itself, the major advantage of such installation is that the heating and liquefaction process can be carried out within the vessel itself without having to unload the fuel in its semi-frozen state. For the 2nd method, an old LNG tanker is modified with offshore installations as floating LNG unit, which can be either with the propulsion unit (mobile) or without the propulsion unit (fixed offshore unit). The former gives the flexibility to operate the unit as a floating storage unit and as an LNG tanker when required.

In case of the former, the process can be carried out within the vessel itself without having to unload the fuel in its semi-frozen slushy state, whereas in the latter option, however, promises to be more viable as docking a refurbished regasification unit would ensure that the supply and demand chains are adequately balanced. Since the refurbished Floating Storage Regasification Unit (FSRU) would also be able to provide storing feasibilities of LNG, constant transference of the LNG cargo from LNG vessels would ensure that there is no storage depletion whatsoever. Generally, such kinds of Floating Storage Regasification Unit or FSRUs are found near the harbour to prevent time-consumption. But while utilising a refurbished gas carrier as a Floating Storage Regasification Unit, care needs to be taken to suitably positioning these refurbished vessels to prevent any emergency arising near a particular port or harbour.

In addition, seawater is generally used as a heat source. This system is known as an open loop system. Strict environmental regulations must be followed for the cold seawater discharged after the heat exchange with LNG.

The selection between these two options are often based upon factors such as location, land availability and economics. Location is most likely the important factor for this Project; given the proposed Power Plant is located within Ahlone Township, next to the existing CCGT Power Plant, the river width at this location is only approximately 500 meters. To take into consideration the length required for the jetty, potential FSRU, and the area to berth the LNGC to the FSRU, the river width at this location would be too narrow to allow for the proposed layout, as well as prevent any impacts to existing river navigation.

Considering the Project operational period is expected to be longer than ten (10) years, it is more economically feasible to select the LNG Receiving Terminal option[19]. This is because compared to a FSRU, a LNG Receiving Terminal does not have any charter costs for storage and regasification, which is considered part of the Capital Expenditure (CAPEX). A FSRU will have a lower CAPEX; however, given the long-term operational period, the Operation Expenditure (OPEX) of a FSRU will out-weigh a LNG Receiving Terminal's cost; therefore, making a LNG Receiving Terminal a cheaper option for long-term projects.

A LNG Receiving Terminal offers expandability, as it is possible to expand the capacity of the LNG Receiving Terminal if required. The FSRU on the other hand will have a fixed capacity; increasing an FSRU capacity will require either refitting/overhauling or constructing a new FSRU.

A LNG Receiving Terminal also has the advantage of multi-functionality. In addition to LNG off-loading, it may also be capable of LNG reloading, bunkering of vessels, and LNG truck loading; this allows for multiple options to compliment other land-based infrastructures that currently exists, or for future developments.

4.9.2.3 LNG Receiving Terminal Location Options

There were three (3) LNG Receiving Terminal locations that were considered, two locations were located along the shoreline of Thanlyin Township (which can be categorized as North, and South options), and one location along the Southeast shoreline of Dala Township. The three locations are shown in ***Figure 4.54***. The two options in Thanlyin propose to utilize existing infrastructure at the location, this can allow for reduced construction costs. Although the North option has more existing facilities than the South option, the South option is located at a part of the Yangon River which curve inland; this allows for the jetty and LNGC to have less impact towards the river navigation. The land use at the option in Dala only consists of agriculture; there are no existing facilities that can contribute as a LNG Receiving Terminal facility. The Thanlyin options are located closer to the proposed Power Plant, which reduces the length of the pipeline needed to connect the LNG Receiving Terminal to the proposed Power Plant.

One significant disadvantage of the Thanlyin options is that pipelines will need to be installed using HDD method. The North option will require a pipeline length of approximately 3.14 km to be installed using HDD method, and the South option will require approximately 4.4 km. Although it is possible to use HDD method for these distances, this may increase costs significantly, and limit maintenance capabilities. In addition, the land was not available for use for this Project, due to ongoing land use. The summary comparison between the three (3) LNG Receving Terminal options are shown in ***Table 4.57***.

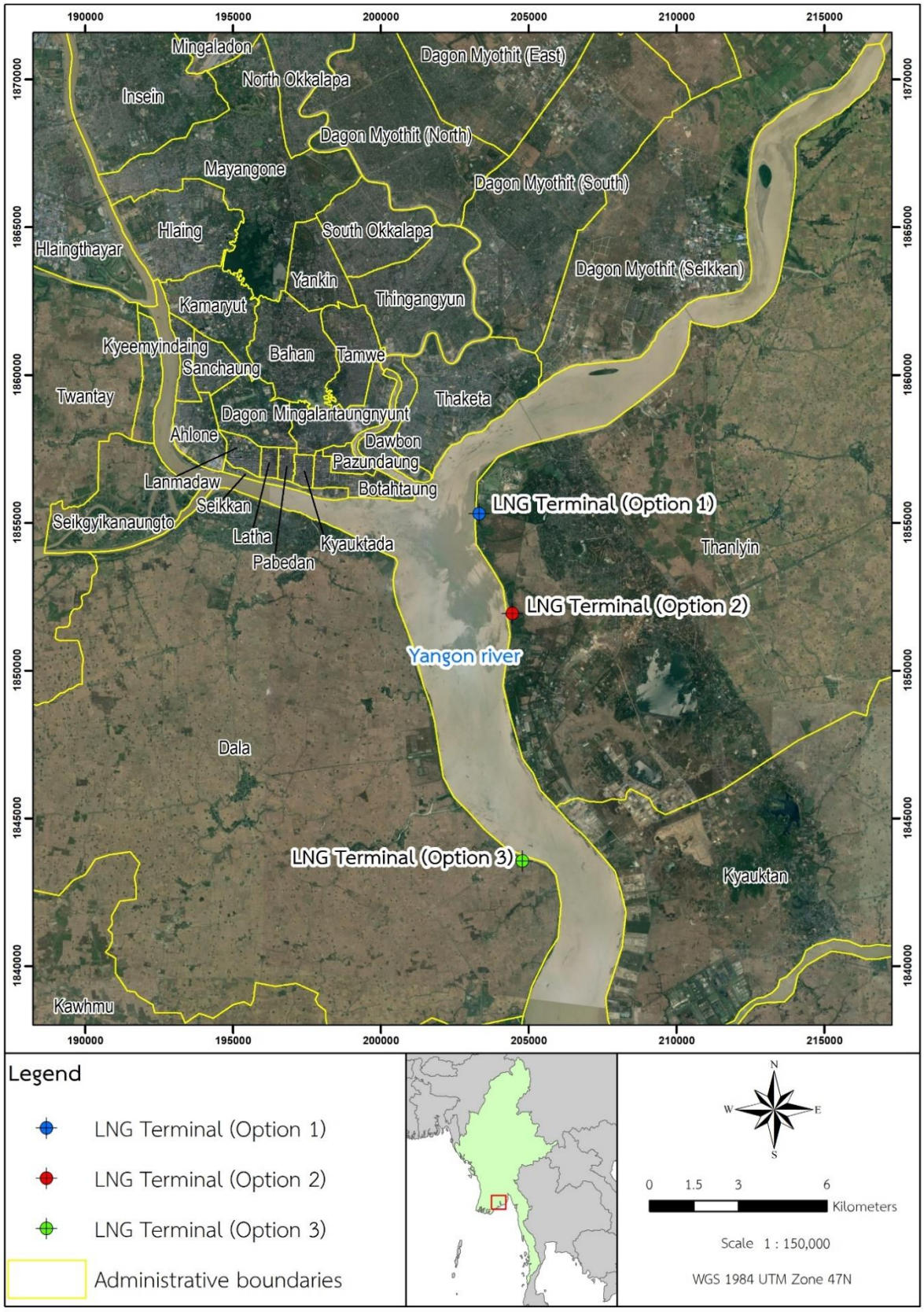
[19] Norrgård, J. (2018). LNG terminals – land-based vs. floating storage and regasification technology. Wartsila. Retrieved from https://www.wartsila.com/twentyfour7/in-detail/lng-terminals-land-based-vs-floating-storage-and-regasification-technology

Table 4.57: Summary Comparison of LNG Receiving Terminal Options

Aspect	Option 1	Option 2	Option 3
Existing Facilities	Contains existing facilities which may help reduce cost.	Contains existing facilities which may help reduce cost.	No existing facilities. Require procurement of new equipment.
Displacement from Power Plant	9.5 km	11.6 km	17.2 km
HDD	3.14 km	4.4 km	1.7 km
Land Use	Existing facilities currently in use	Existing facilities currently in use	Agricultural Land
Navigation	Requires going further into Yangon River, as compared to option 3.	Requires going further into Yangon River, as compared to option 3.	Located at a part of the Yangon River which curve inland, which reduces impact to navigation lanes and requires shorter travel distance.

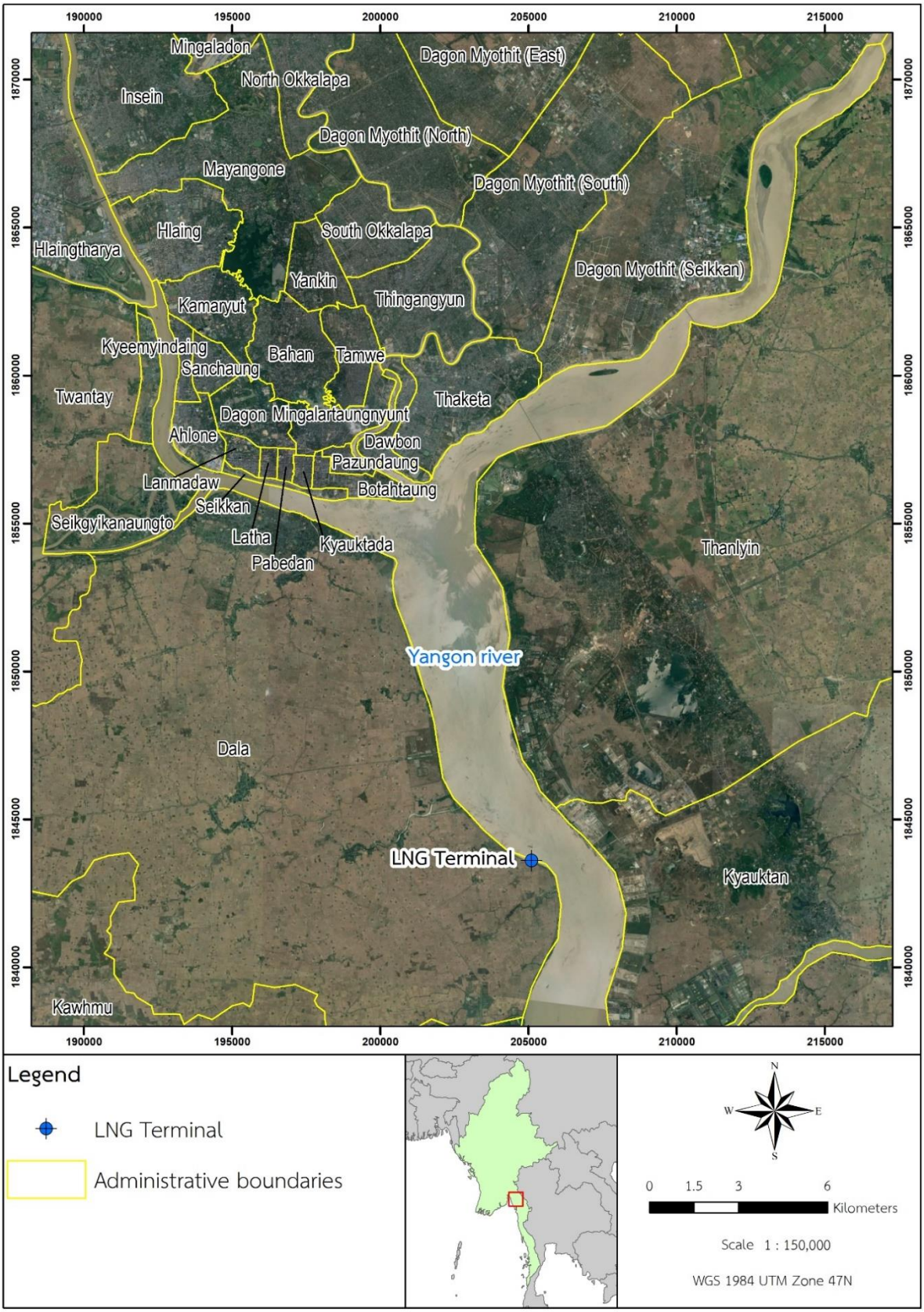
TPMC has selected Option 3 as the final location for the LNG Receiving Terminal as shown in ***Figure 4.55***.

Figure 4.54: LNG Receiving Terminal Placement Options



Source: TPMC, 2018. (Modified by ERM)

Figure 4.55: Selected Location for LNG Receiving Terminal



Source: TPMC, 2019. (Modified by ERM)

4.9.2.4 Pipeline Route Options

The two (2) available options for the natural gas pipeline route is shown in ***Figure 4.56***. The purple option indicates a route that goes in-land and follows the existing road network towards the proposed Power Plant. The green option follows the shoreline along the west side of the Yangon River until reaching the same river crossing point as with the purple route.

The green route currently has an advantage with regards to pipeline length at approximately 19.29 km, compared to the purple route with a length of approximately 24.9 km; however, the purple route does have other advantages which out-weigh the benefits of the green route.

The purple route is located along the existing road network, this allows for the pipeline to be accessed easier, with regards to construction and maintenance. The green route partially follows existing roads; however, there are some areas that will require crossing agricultural land, this will require constructing access roads during the construction and maintenance of the pipeline.

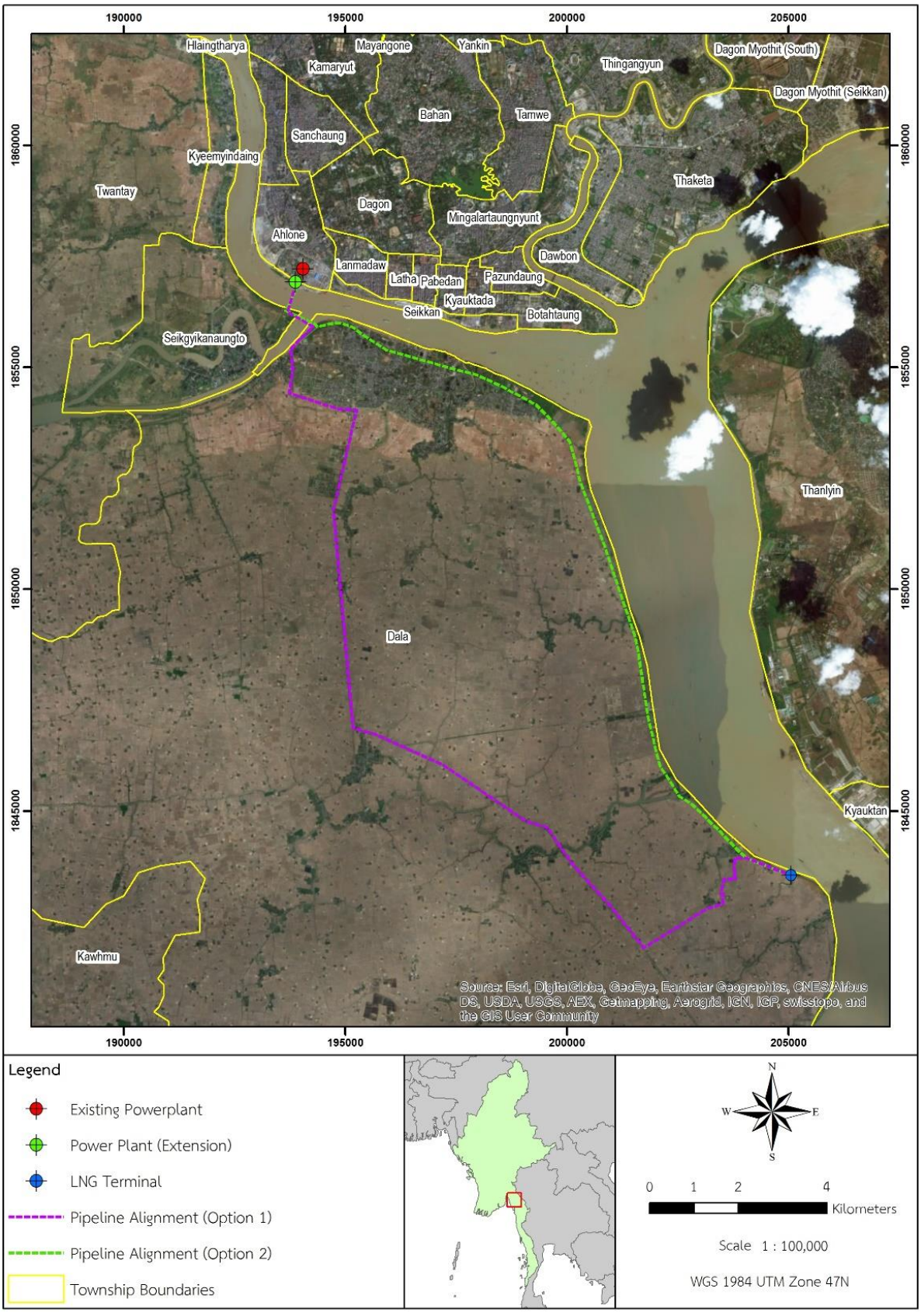
The purple route will only cross a small section of the dense populated area of Northern Dala to reduce the impacts towards the community; whereas the green route will cross the entire area of Northern Dala. The green route will have a bigger social impact towards the community, and may lead to increased public disputes.

Although the cost of implementing the green route is potentially lower than the purple route, public opinion and concerns of the impacts towards the community limit the feasibility of the green route; increased mitigation measures, or compensation may further increase the cost of implementing the green route. The summary comparison between the two (2) Pipeline options are shown in ***Table 4.58***. The purple route is preferable as it has lower potential impacts; therefore, the selected pipeline route is shown in ***Figure 4.57***.

Table 4.58: Summary Comparison of Pipeline Route Options

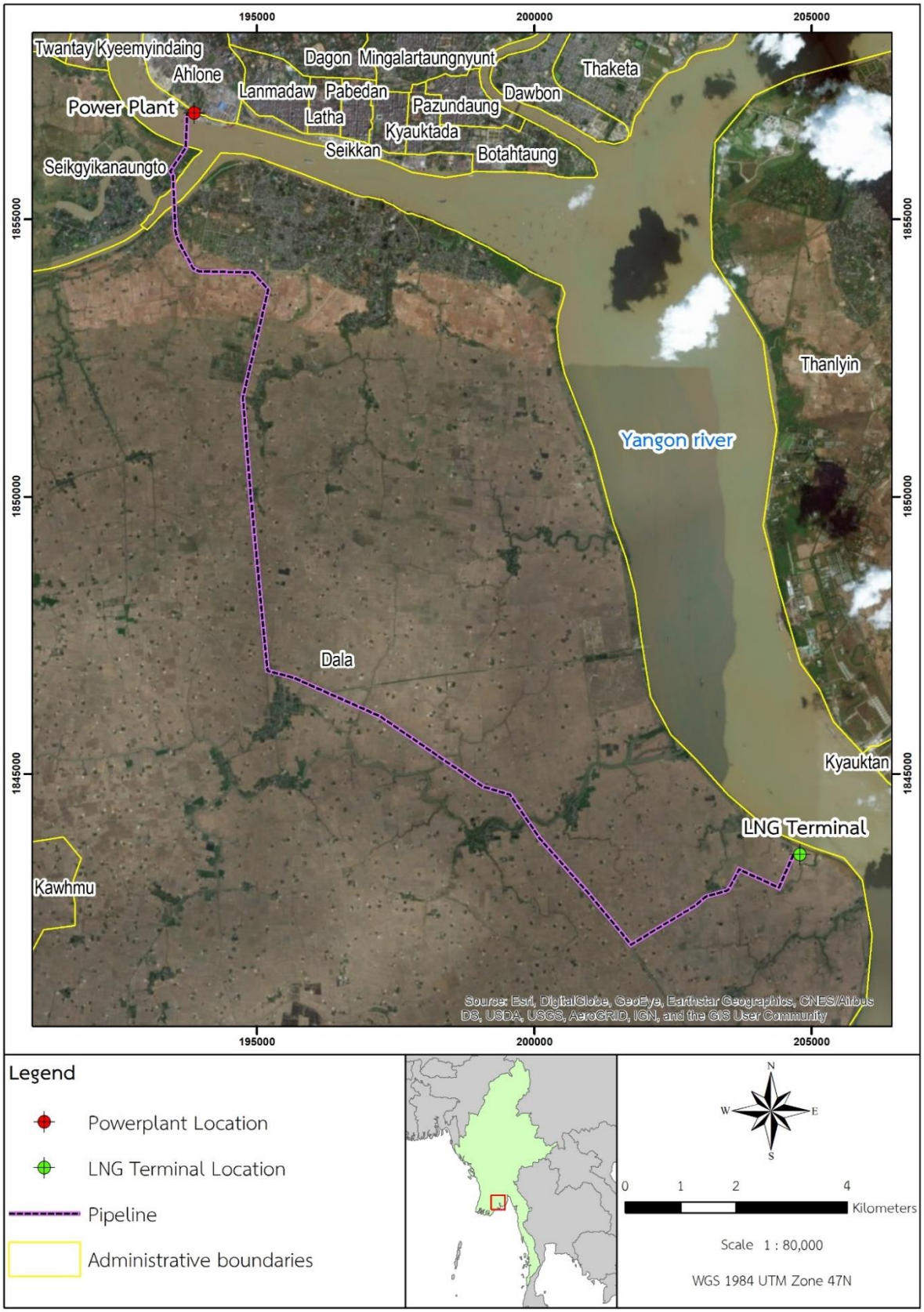
Aspect	Option 1	Option 2
Length	24.9 km	19.29 km
Land Use	Primarily parallel to existing roads. Allows for better access.	Some sections parallel to existing roads, some section are on agricultural land.
Communities	Small sections are nearby community areas.	A large section intersects with the dense populated area in Northern Dala. Public opinion and concerns of the impacts towards the community limit the feasibility of this option. Increased mitigation measures, or compensation may further increase the cost of implementing this option.

Figure 4.56: Pipeline Route Options



Source: TPMC, 2018. (Modified by ERM)

Figure 4.57: Selected Pipeline Route



Source: TPMC, 2019. (Modified by ERM)

4.9.2.5 Power Plant Location and Technology Options

Although options for selecting the Power Plant site can be explored, the plan to implement the proposed Power Plant next to the existing Power Plant is currently the best scenario. The layout of the proposed Power Plant and the existing Power Plant is shown in ***Figure 4.58***.

Placing the proposed power plant at this location will allow for the facilities and other utilities to be shared between the proposed and existing power plants, specifically the switchyard; therefore, construction of certain facilities will not be needed, which lowers costs. Given that construction of the existing Power Plant has already taken place, experience gained from construction activities in the same area can allow for certain factors, such as cost, logistics, access roads, to be easily considered and planned.

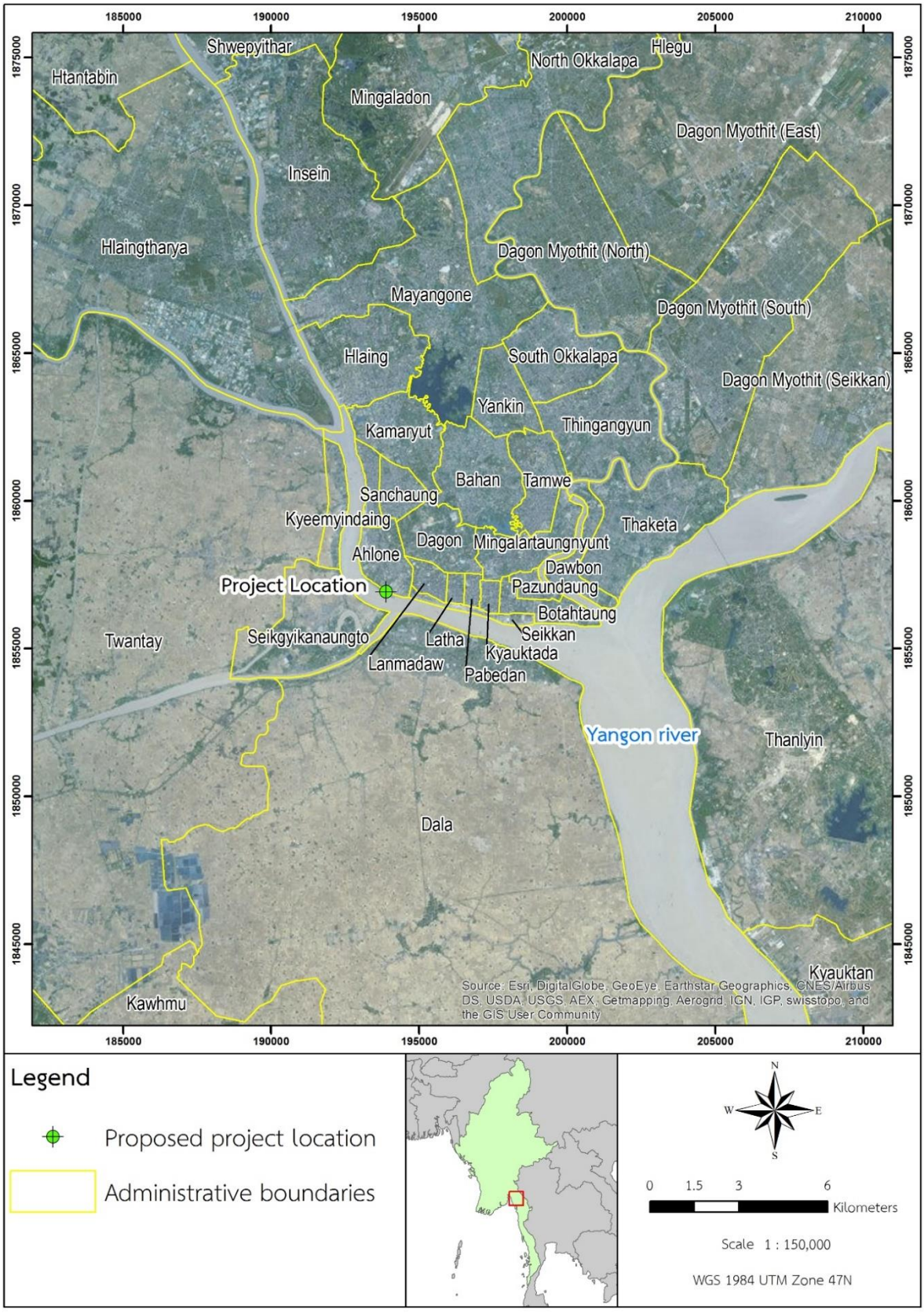
Considering the existing Power Plant uses CCGT technology, it is also appropriate to utilize the same technology for the proposed Power Plant. A CCPP can reach thermal efficiency of approximately 50-60%, which compared to a single cycle of approximately 35-42%, a CCPP has improved overall efficiency, and reduces fuel costs. Having the same technology can also allow for the interchangeable operating knowledge/experience between the employees from the proposed and existing Power Plants.

Placing the proposed Power Plant at this location allows for better convenience and lowered costs, compared to any other location outside the existing area. The final location for the proposed Power Plant is shown in ***Figure 4.59***.

Figure 4.58: Layout of Proposed (Purple) and Existing (Green) Power Plants

Source: TPMC, 2018. (Modified by ERM)

Figure 4.59: Selected Location for Power Plant



Source: TPMC, 2019. (Modified by ERM)

4.9.2.6 Supply Source

The supply from domestic gas production will be unable to meet the needs of the Ahlone CCPP, as such, it is anticipated that the fuel supply for this Project will be based on imported LNG from overseas. The imported fuel supply from oversees is also part of Myanmar's Power Development objectives.

4.9.2.7 Conclusion

For the LNG Receiving Terminal, the final location is located towards the southeast of Dala Township, along the west-bank of the Yangon River (option 3). This option has been selected over options 1 and 2 because the area are not available for use, the construction cost is potentially higher, and the additional HDD activities may potentially cause more environmental and social impacts.

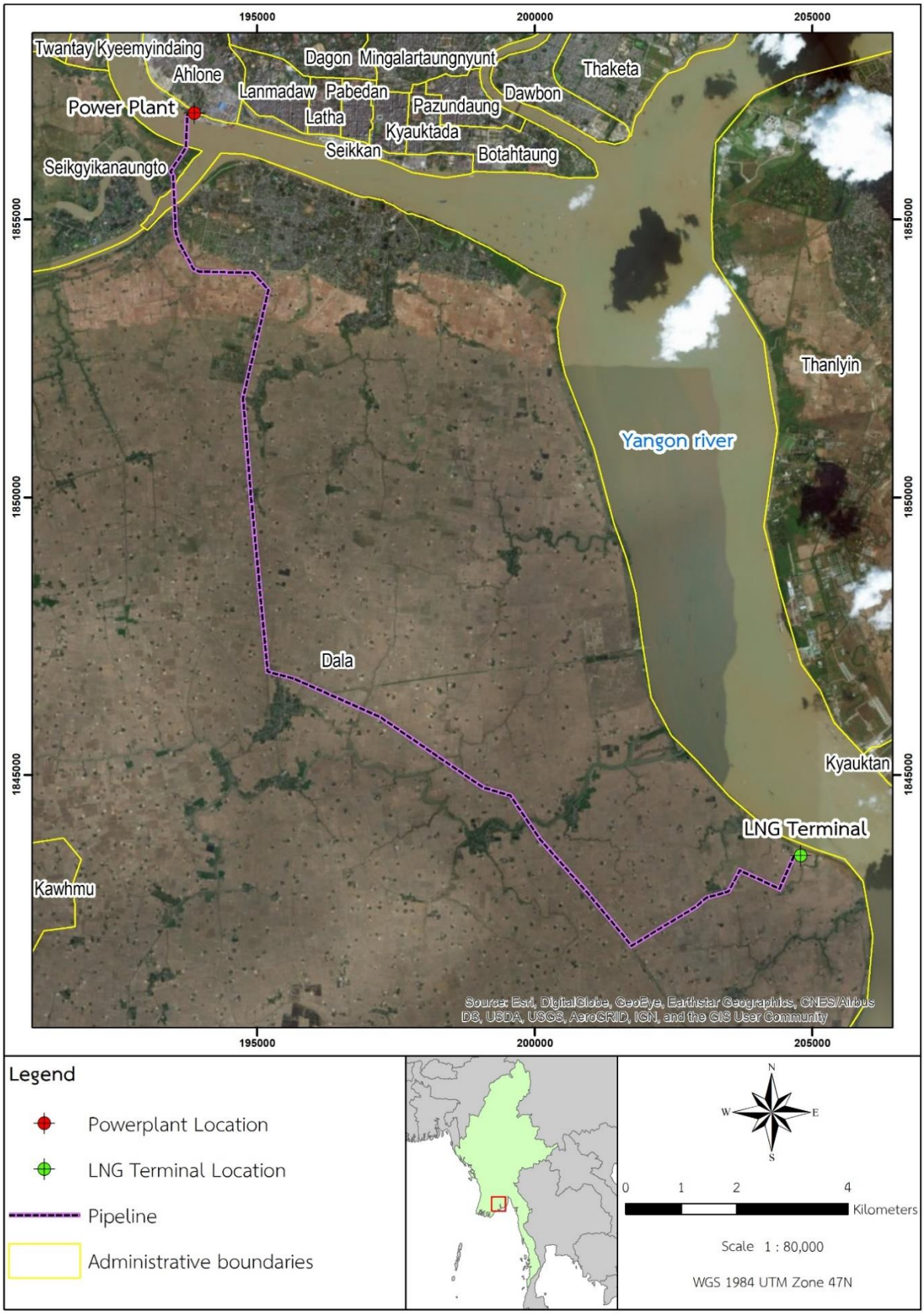
For the Power Plant, the final location will be located next to the existing Power Plant in Ahlone Township, along the east-bank of the Yangon River. This location has been selected because of the convenience of sharing utilities with the existing facilities, and no additional requirements for land procurement, which subsequently eliminates any resettlement and economic displacement on the Power Plant area.

The pipeline alignment will follow the first option that connects the LNG Receiving Terminal and the Power Plant through the centre of Dala Township, along the existing road, and cross under the Twante Canal and Yangon River; the second option that runs along the river back will lead to more social impacts.

The selected technology that will be used for unloading LNG from the LNGC will be a land-based LNG Receiving Terminal; this is to allow for lowered OPEX over time and allows for potential ease in expansion of the facility.

Given the environmental and social factors involved, as well as the processing technology that has been discussed, the location for each main component is shown in ***Figure 4.60***.

Figure 4.60: Selected Option for each Main Component



Source: TPMC, 2019. (Modified by ERM)

4.9.3 Alternative Cooling Technologies

CCPP utilise the heat from the exhaust gases leaving the gas turbine to generate steam in a heat recovery steam generator (HRSG). This steam is then used in a steam turbine to generate further electricity. The steam leaving the steam turbine is condensed by either water or air, producing condensate that is then reused in the HRSG. Potential cooling techniques for the condensing of steam leaving the steam turbine equipment include:

- Wet Cooling Systems:
  - Once Though Cooling System – power stations with an open cooling system (once through cooling) take cooling water from the river/sea. Cooling water is pumped via an intake pipe through the condenser and after heat transfer via a pipe back to the source. If the water source is close enough this is considered the most economical option and also provides the best plant performance due to the low cooling water temperature. As large water quantities are required this can only be used where large water sources are available. Furthermore, the cooling water intake and outlet need to be located far enough from each other to avoid heated water re-entering the cooling cycle. The discharged water will need to comply with the applicable standards regarding water quality.
  - Closed Cycle Wet Cooling Towers – Cooling water is recirculated between a surface type condenser and a cooling tower where it is sprayed into air which cools the water droplets by evaporating a part of the water. This option is preferable where the required volumes of water are not available near the power plant site, or are in sufficient amount.
  - Hybrid Cooling System – these towers are an improved on forced draft wet cooling towers and are characterised by a heat exchange between air and water without direct contact before the water is sprayed in the tower. This option reduces the visibility of the emitted plume from the tower and is often used where the visual impact of the plume on inhabited areas must be avoided. The hybrid option also reduces water consumption by an approximately 10 – 15%.
- Wet / Dry Parallel Cooling Systems – this system uses a mix of wet and dry cooling technologies and is implemented at sites where water is partially or seasonally available. This has advantages over the wet and hybrid towers as the towers and plume emitted are smaller and so has less visual impact.
- Dry Cooling Systems:
  - Direct Dry Cooling System – these cooling systems are used in remote dry areas without economic water supplies where the heat transfer is performed by air to finned tubes. This method is affected by the ambient air temperature and so is only used where the availability of cooling water is limited. This option also requires significant land space for cooling and therefore is not applicable in areas where land availability is limited, such as the CCPP Project.
  - Indirect Cooling Systems – these systems can either be used with a surface condenser or with a direct contact jet condenser. The process involves cooled condensate water coming from the cooling tower and being in direct contact with the jet condenser to condensate the exhaust steam of a steam turbine.

The induced draft cell type with wet cooling tower has been selected for further investigation during the EIA Study. This type of cooling system has been selected based on the requirements for water consumption, plant output and efficiency, operation and maintenance costs and land availability.

5. DESCRIPTION OF THE ENVIRONMENT

5.1 Biophysical Baseline

5.1.1 Introduction

This Chapter provides an overview of the environment-biophysical baseline conditions within the Project Study Area based on secondary data from published sources as well as primary data collected to fill data gaps. This Section of the ESIA (Environmental and Social Impact Assessment) Report is organized by different biophysical parameters and also includes a discussion of the baseline conditions and any additional methods used to fill in the gaps during primary data gathering at the Project Study Area.

5.1.1.1 Project Study Area

The establishment of the Area of Influence (AoI) for the Project (and thus the appropriate Project Study Area) is intended to ensure that the Impact Assessment (IA) focuses on those issues that are most important for design, decision-making and stakeholder interest.

This Project covers the activities associated with the construction, operation and decommissioning of the proposed Ahlone Combined Cycle Thermal Power Plant (CCPP), Liquefied Natural Gas (LNG) Receiving Facilities and Natural Gas Pipeline in Yangon Region, Myanmar. The AoI for this Project consists of the following aspects:

- Construction of Power Plant and associated infrastructure;
- Construction of the Natural Gas Pipeline;
- Construction of the LNG Receiving Terminal and associated infrastructures;
- Operation of the Power Plant and associated infrastructure;
- Operation of the Natural Gas Pipeline; and
- Operation of the LNG Receiving Terminal.

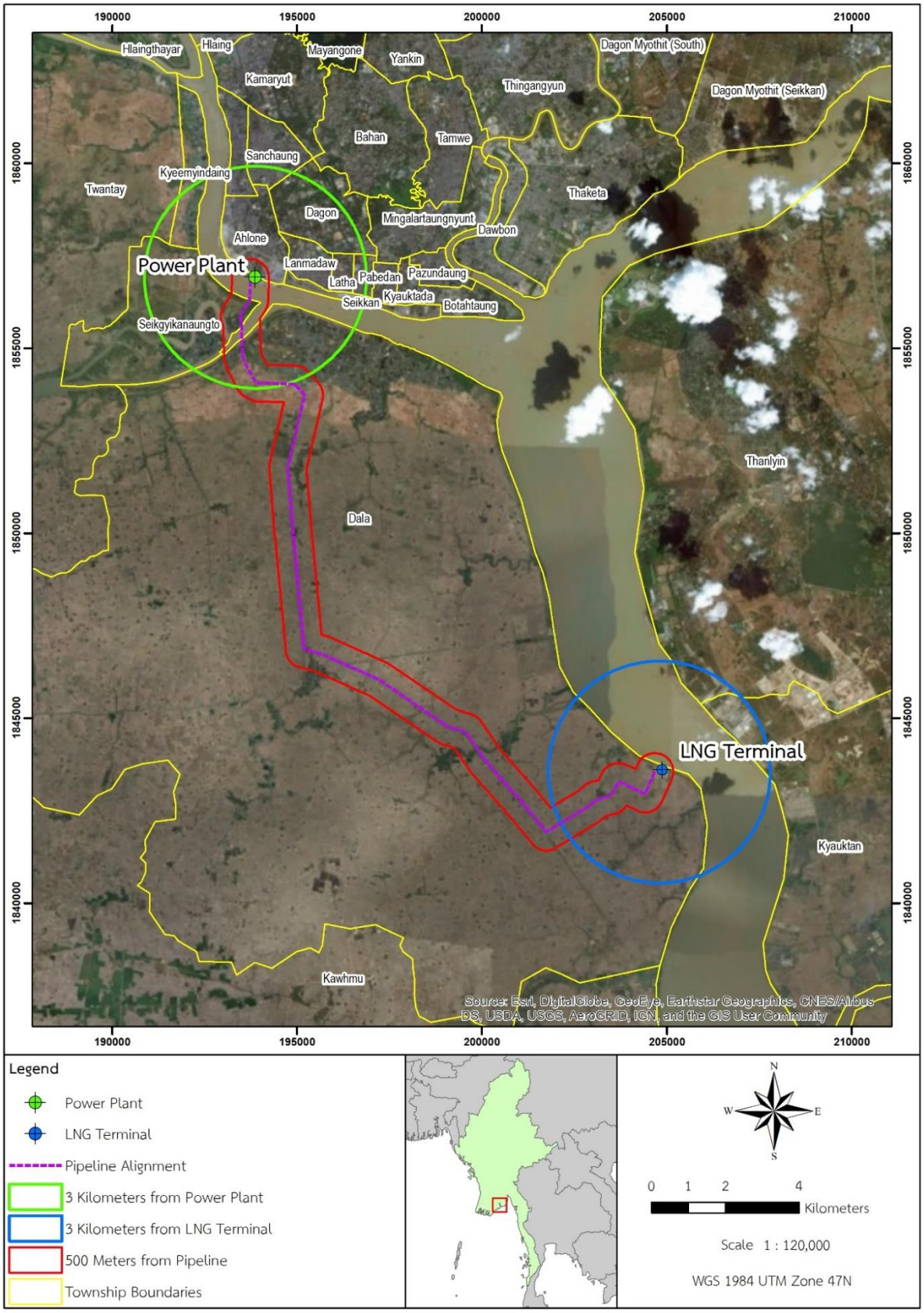
An AoI of 3 km from the Project site boundary has been established for Power Plant and for the LNG Receiving Facilities, in particular air quality receptors or social receptors. For the natural gas pipeline a buffer area of 500 m from each side of the centre line of the pipeline has been consider, in particular for social receptors.

The AoI for a particular resource/receptor may vary depending on the nature of the change caused by the Project activities and the type of effect being considered, but in each case it is defined to include all the area within which it is likely that significant impacts could result.

The Project Study Area (hereinafter also referred to as ‘Study Area’) refers to the area that needs to be studied in order to adequately understand and describe the baseline conditions likely to be affected by the Project. With the AoI established, the Study Area (see ***Figure 5.1***) comprises a 3 km radius of the Project site (Ahlone CCPP expansion, and LNG Receiving Terminal) as well as a 500 m from each side of the Natural Gas Pipeline.

There are no set guidelines on the sphere of influence; however, taking into account the nature of activities during the construction and operation phases, a Study Area of 500 m and 3,000 m has been established for the respective assessments. The Study Area has been determined so that all potentially impacted sensitive receivers during both construction and operation phase have been identified.

Figure 5.1: Project Study Area



Source: ERM, 2019.

Since the summer months are from March to Mid-May and the rainy season typically lasts from mid-May to the end of October the baseline sampling for dry season was planned in the beginning of May 2018 while wet season baseline sampling was taken place in the end of June 2018. However, some parameters were only required to be sampled during one season (such as noise levels) and therefore will only show result for one season.

5.1.2 Ambient Air Quality

5.1.2.1 Overview

A critical part of the ESIA is to establish the state of the existing environment (referred to as the baseline). In accordance with IFC guidelines[20], measurement of existing air quality is required for emissions associated with the Project processes that have the potential to affect the surrounding land use. As discussed in ***Appendix M***, the primary focus of the Air Quality Impact Assessment (AQIA) relates to NO_x emissions resulting from the combustion of natural gas. On this basis, a project specific monitoring survey was commissioned to provide an indication of ambient concentrations of NO_2 in the Study Area and to inform the AQIA presented in ***Appendix M***.

5.1.2.2 Monitoring Methodology

Monitoring of NO_2 was conducted at 13 monitoring locations. Passive diffusion tubes were deployed in triplicate at three locations between the 27 February 2018 and the 2 May 2018, and again from the 12 June 2018 to the 26 June 2018. The automatic Haz-Scanner Environmental Perimeter Air Station (EPAS) was deployed at a further 10 locations in the Study Area for a continuous 72-hour period in both the wet and dry season.

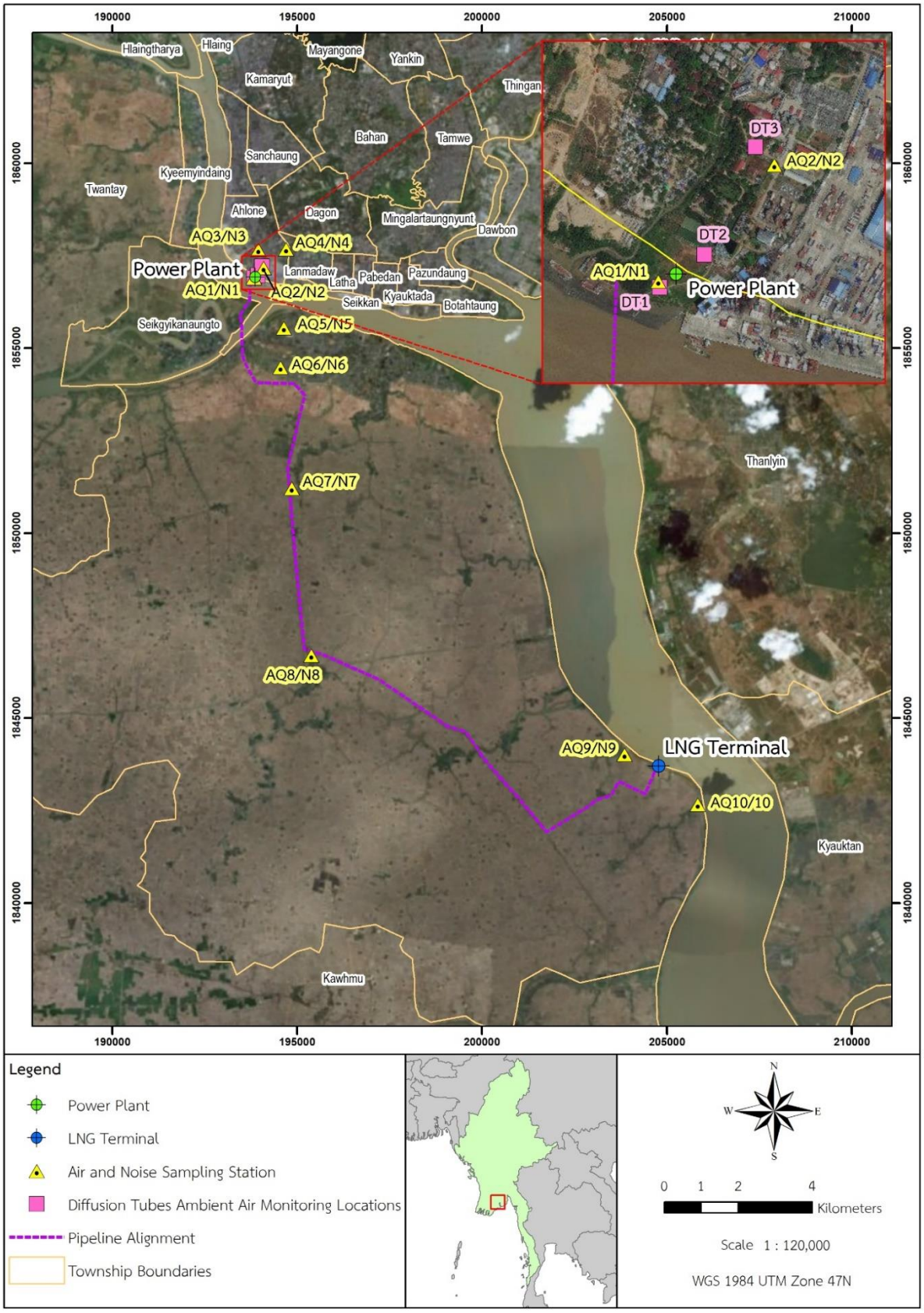
The detailed monitoring methodology is provided in ***Appendix M***.

5.1.2.3 Monitoring Locations

Monitoring locations were chosen to determine general background concentration levels. Monitoring locations were initially selected using aerial photography, local available knowledge about villages, accessibility and security to determine the location of operations and nearby sensitive receptors. The final decision on locations was then made while in the field to determine the most suitable and representative locations for monitoring equipment to be deployed. The monitoring locations are presented in ***Figure 5.2***, and a detailed summary is provided in ***Appendix M***.

[20] International Finance Corporation (IFC) (2007) Environmental, Health and Safety Guideline: Air Emissions and Ambient Air Quality [Online] Available at: https://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/Sustainability-At-IFC/Policies-Standards/EHS-Guidelines/ [Accessed 07 February 2019]

Figure 5.2: Ambient Air Quality Monitoring Locations



Source: ERM, 2018.

5.1.2.4 Baseline Monitoring Results and Discussion

The ambient air quality data collected for the Project has been reviewed and interpreted and the detailed findings are presented in ***Appendix M*** for dry season and in ***Appendix O*** for wet season. ***Figure 5.3*** shows photos of field team setting up air quality monitoring stations during dry season.

Figure 5.3: Photos of Air Quality and Noise Level Monitoring Machine Setup during Dry Season

AQ1/N1

AQ2/N2

AQ3/N3

AQ4/N4

AQ5/N5

AQ6/N6

AQ7/N7

AQ8/N8

AQ9/N9

AQ10/N10

Source: SEM, 2018.

Figure 5.4 shows photos of field team setting up air quality monitoring stations during wet season.

Figure 5.4: Photo of Air Quality and Noise Level Monitoring Machine Setup during Wet Season

AQ1/N1

AQ2/N2

AQ3/N3

AQ4/N4

AQ5/N5

AQ6/N6

AQ7/N7

AQ8/N8

AQ9/N9

AQ10/N10

Source: SEM, 2018.

Figure 5.5 shows photos of field team collecting diffusion tubes during wet season.

Figure 5.5: Photo of Diffusion Tube Collection during Wet Season

Source: SEM, 2018.

The maximum 1-hour average baseline concentration recorded at each monitoring site using the automatic EPAS is compared to the National Environmental Quality Emission Guideline (NEQEG) 1-hour air quality standard and the findings are presented in ***Table 5.1*** and ***Figure 5.6***. The data indicates that the maximum 1-hour average concentration at any monitoring location is below the NEQEG air quality standard. On this basis, the air shed is considered non-degraded with regard to the short-term standard.

The diffusion tube data is considered indicative of the long-term NO_2 concentration at the monitoring locations. The diffusion tube results presented in ***Table 5.2*** are below the annual mean air quality standard and suggest that the air shed is non-degraded.

Table 5.3 to ***Table 5.12*** shows continuous air quality monitoring measured over 72 hours at the 10 selected site during the dry season. The detailed study of air quality is presented in the ***Appendix N***, and ***Appendix P***.

Table 5.1: EPAS Monitoring Summary

Site	NO_2 1-hour Maximum (µg/m³)		1-hour Mean Air Quality Standard (AQS) (µg/m³)	NO_2 Maximum as % of AQS
	Wet Season	Dry Season		
AQM1	170	68.5	200	85%
AQM2	22.8	68.6	200	34%
AQM3	144	108	200	72%
AQM4	26.4	97.9	200	49%
AQM5	25.9	128	200	64%
AQM6	9.30	74.3	200	37%
AQM7	35.5	35.9	200	18%
AQM8	33.5	129	200	65%
AQM9	41.2	106	200	53%
AQM10	23.3	100	200	50%

Figure 5.6: NO_2 1-Hour Maximum Baseline Concentration Summary

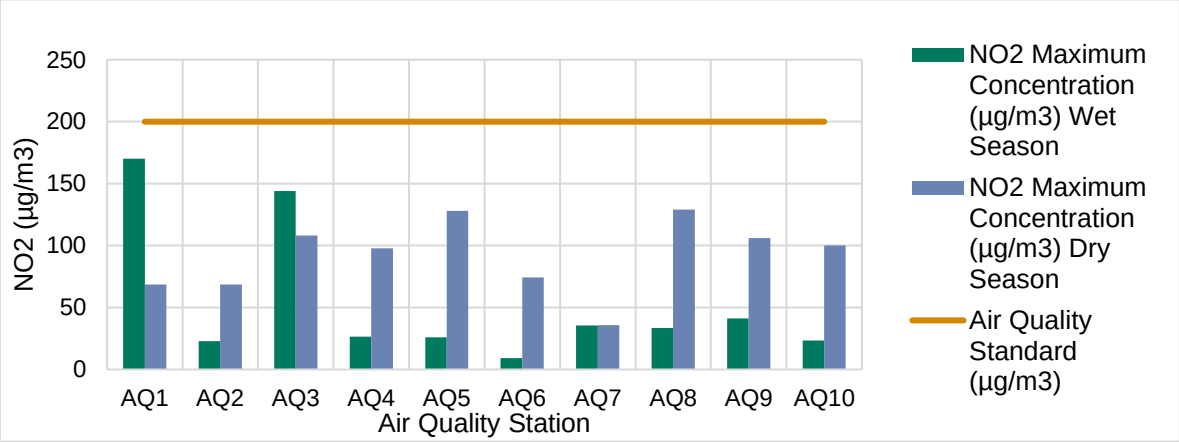


Table 5.2: Diffusion Tube Monitoring Summary

Location	Season	Tube Number	Date on	Date off	NO_2 (µg/m³)	Annual Mean AQS [a]	% of AQS
DT1	Dry	1	27/02/2018	02/05/2018	19.0	40	48%
		2	27/02/2018	02/05/2018	18.9	40	47%
		3	27/02/2018	02/05/2018	17.6	40	44%
	Wet	1	12/06/2018	26/06/2018	3.02	40	7.6%
		2	12/06/2018	26/06/2018	0.853	40	2.1%
		3[b]	12/06/2018	26/06/2018	-	40	-
DT2	Dry	1	27/02/2018	02/05/2018	24.6	40	61%
		2	27/02/2018	02/05/2018	21.6	40	54%
		3	27/02/2018	02/05/2018	22.4	40	56%
	Wet	1	12/06/2018	26/06/2018	2.48	40	6.2%
		2	12/06/2018	26/06/2018	2.27	40	5.7%

Location	Season	Tube Number	Date on	Date off	NO_2 ($\mu g/m^3$)	Annual Mean AQS [a]	% of AQS
		3	12/06/2018	26/06/2018	3.24	40	-
DT3	Dry	1	27/02/2018	02/05/2018	19.8	40	50%
		2	27/02/2018	02/05/2018	15.3	40	38%
		3	27/02/2018	02/05/2018	15.7	40	39%
	Wet	1	12/06/2018	26/06/2018	0.960	40	8.1%
		2	12/06/2018	26/06/2018	1.54	40	2.4%
		3[b]	12/06/2018	26/06/2018	-		-

Note: [a] *National Environmental Quality (Emission) Guidelines (NEQEG) (2015)*
[b] *Tubes 1177604 & 1177610 could not be analysed as they did not contain any grids upon arrival in the laboratory.*

Table 5.3: Daily Ambient Air Quality Results at AQ1 during Dry Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	%	µg/m³	°C
2-3 May, 2018	24	61.16	20.94	0.01	11.78	17.91	79.28	12.18	28.60
3-4 May, 2018	24	60.26	28.58	0.01	**30.04**	41.39	83.57	4.52	29.56
4-5 May, 2018	24	110.66	25.79	0.01	**47.44**	49.14	82.41	9.52	29.30
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

Table 5.4: Daily Ambient Air Quality Results at AQ2 during Dry Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	%	µg/m³	°C
2-3 May, 2018	24	60.15	20.93	15.32	8.38	9.16	68.07	5.96	28.99
3-4 May, 2018	24	59.36	28.34	13.93	**25.79**	30.15	74.12	4.49	29.26
4-5 May, 2018	24	80.28	25.64	18.71	**35.76**	42.63	73.62	8.66	28.60
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

Table 5.5: Daily Ambient Air Quality Results at AQ3 during Dry Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	%	µg/m³	°C
2-3 May, 2018	24	230.34	71.42	0.00	24.36	29.24	74.19	12.54	28.62
3-4 May, 2018	24	291.27	62.96	0.05	2.25	7.28	80.48	19.88	27.51
4-5 May, 2018	24	313.26	43.47	0.06	2.20	7.69	73.45	**28.03**	28.47
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

Table 5.6: Daily Ambient Air Quality Results at AQ4 during Dry Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	%	µg/m³	°C
12-13 May, 2018	24	344.42	47.60	0.00	2.24	7.21	84.04	**27.68**	25.77
13-14 May, 2018	24	183.65	56.95	0.0004	2.45	8.57	74.62	10.36	28.08
14-15 May, 2018	24	224.91	60.19	0.036	2.12	7.57	82.28	14.89	26.76
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

Table 5.7: Daily Ambient Air Quality Results at AQ5 during Dry Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	%	µg/m³	°C
6-7 May, 2018	24	121.72	50.59	0.018	2.15	7.10	73.13	8.77	29.55
7-8 May, 2018	24	143.51	58.58	0.025	2.38	9.45	71.73	5.94	30.11
8-9 May, 2018	24	147.02	59.53	0.026	2.44	7.65	71.52	6.50	30.25
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

Table 5.8: Daily Ambient Air Quality Results at AQ6 during Dry Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	%	µg/m³	°C
6-7 May, 2018	24	58.92	19.94	22.13	20.59	22.06	70.36	12.82	30.72
7-8 May, 2018	24	80.74	26.89	21.70	21.05	22.62	66.67	11.36	30.16
8-9 May, 2018	24	77.61	26.67	19.98	**25.08**	26.74	68.06	8.78	31.95
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

Table 5.9: Daily Ambient Air Quality Results at AQ7 during Dry Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	%	µg/m^3	°C
6-7 May, 2018	24	114.96	58.86	0.010	24.36	29.24	75.99	2.77	32.23
7-8 May, 2018	24	129.54	59.82	0.569	24.18	24.89	74.43	5.15	33.17
8-9 May, 2018	24	144.84	74.29	0.012	21.73	29.09	74.01	7.48	33.68
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

Table 5.10: Daily Ambient Air Quality Results at AQ8 during Dry Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	%	µg/m^3	°C
9-10 May, 2018	24	109.20	63.04	0.02	2.12	8.63	79.19	6.63	28.28
10-11 May, 2018	24	128.88	59.94	0.01	2.35	7.33	85.17	5.51	26.07
11-12 May, 2018	24	152.42	76.32	0.01	2.94	8.51	89.38	6.43	25.00
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

Table 5.11: Daily Ambient Air Quality Results at AQ9 during Dry Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	%	µg/m^3	°C
9-10 May, 2018	24	69.01	40.10	0.01	20.63	25.93	72.89	9.09	35.41
10-11 May, 2018	24	111.79	23.69	0.01	**25.82**	40.89	84.30	11.51	29.17
11-12 May, 2018	24	66.81	41.46	0.00	22.47	26.46	86.00	3.42	29.72
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

Table 5.12: Daily Ambient Air Quality Results at AQ10 during Dry Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	%	µg/m^3	°C
9-10 May, 2018	24	60.90	36.20	15.75	**28.10**	27.31	71.55	15.64	30.28
10-11 May, 2018	24	48.27	24.16	13.20	20.86	26.63	75.56	4.94	28.42
11-12 May, 2018	24	54.16	43.83	13.09	**25.22**	31.68	74.12	10.50	28.60
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

Table 5.13 to ***Table 5.22*** shows continuous air quality monitoring measured over 72 hours at the 10 selected site during the wet season.

Table 5.13: Daily Ambient Air Quality Results at AQ1 during Wet Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	%	µg/m^3	°C
27-28 June, 2018	24	107.81	111.79	0.02	5.38	14.42	85.07	8.37	25.26
28-29 June, 2018	24	106.83	50.56	0.03	10.65	11.53	72.40	1.83	28.21
29-30 June, 2018	24	37.30	26.99	0.01	24.94	16.61	79.44	6.84	27.78
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

Table 5.14: Daily Ambient Air Quality Results at AQ2 during Wet Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	%	µg/m^3	°C
27-28 June, 2018	24	42.16	8.072	11.86	24.36	29.24	81.24	4.65	25.73
28-29 June, 2018	24	56.02	10.63	12.93	15.34	19.54	73.99	8.67	28.37
29-30 June, 2018	24	51.18	6.35	28.82	15.96	24.69	76.16	**28.79**	26.88
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

Table 5.15: Daily Ambient Air Quality Results at AQ3 during Wet Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	%	µg/m^3	°C
27-28 June, 2018	24	127.06	53.13	0.03	**26.26**	29.50	84.45	10.04	26.33
28-29 June, 2018	24	150.23	40.52	0.04	**28.15**	29.05	76.17	11.74	27.56
29-30 June, 2018	24	201.10	59.36	0.08	19.93	21.31	77.79	11.63	27.67
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

Table 5.16: Daily Ambient Air Quality Results at AQ4 during Wet Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	%	µg/m^3	°C
6-7 July, 2018	24	155.50	27.34	0.0028	2.06	6.66	97.27	8.29	23.42
7-8 July, 2018	24	117.24	14.33	0.0120	2.13	8.17	94.18	12.41	23.81
8-9 July, 2018	24	139.70	14.12	0.0011	2.21	8.08	93.39	8.62	24.16
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

Table 5.17: Daily Ambient Air Quality Results at AQ5 during Wet Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	%	µg/m^3	°C
30-1 June, 2018	24	123.51	13.55	0.0376	2.27	7.63	87.48	22.88	26.35
1-2 June, 2018	24	135.33	15.21	0.0161	2.10	6.55	95.29	12.00	24.56
2-3 June, 2018	24	123.13	14.20	0.0280	2.15	8.41	88.80	13.91	25.99
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

Table 5.18: Daily Ambient Air Quality Results at AQ6 during Wet Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	%	µg/m^3	°C
30-1 June, 2018	24	33.93	3.88	14.52	5.354	11.01	86.45	8.93	26.91
1-2 June, 2018	24	34.30	5.35	11.10	12.37	15.10	85.54	8.04	26.41
2-3 June, 2018	24	21.53	3.54	7.82	9.26	**59.72**	93.21	5.09	25.64
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

Table 5.19: Daily Ambient Air Quality Results at AQ7 during Wet Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	%	µg/m³	°C
30 June- 1 July, 2018	24	41.53	20.04	0.0083	24.36	29.24	86.51	9.84	28.42
1 - 2 July, 2018	24	38.95	17.96	0.0158	17.81	19.85	90.50	5.90	24.29
2 - 3 July, 2018	24	51.78	18.68	0.0116	24.81	**70.65**	89.48	4.38	27.61
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

Table 5.20: Daily Ambient Air Quality Results at AQ8 during Wet Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	%	µg/m³	°C
3-4 June, 2018	24	49.85	13.56	0.0081	19.34	36.46	94.64	5.45	25.34
4-5 June, 2018	24	71.30	21.63	0.0044	21.92	20.33	94.71	6.64	25.63
5-6 June, 2018	24	65.37	15.28	0.0030	3.62	23.63	98.64	0.0052	24.24
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

Table 5.21: Daily Ambient Air Quality Results at AQ9 during Wet Season

Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	%	µg/m^3	°C
3-4 July, 2018	24	25.09	8.00	3.14	24.36	29.24	97.72	1.22	24.72
4-5 July, 2018	24	21.39	1.29	5.42	8.08	17.89	98.05	2.11	24.65
5-6 July, 2018	24	4.53	30.35	0.399	19.35	32.57	88.21	0.51	25.06
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

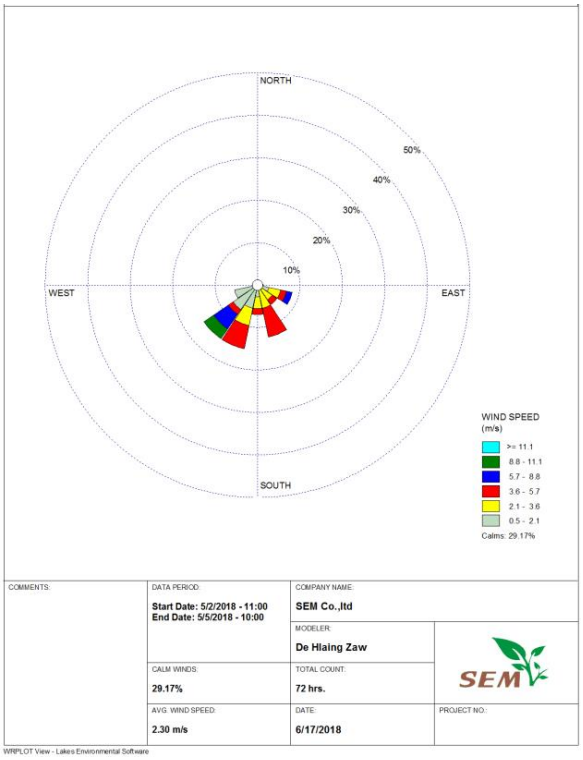
Source: SEM, 2018.

Table 5.22: Daily Ambient Air Quality Results at AQ10 during Wet Season

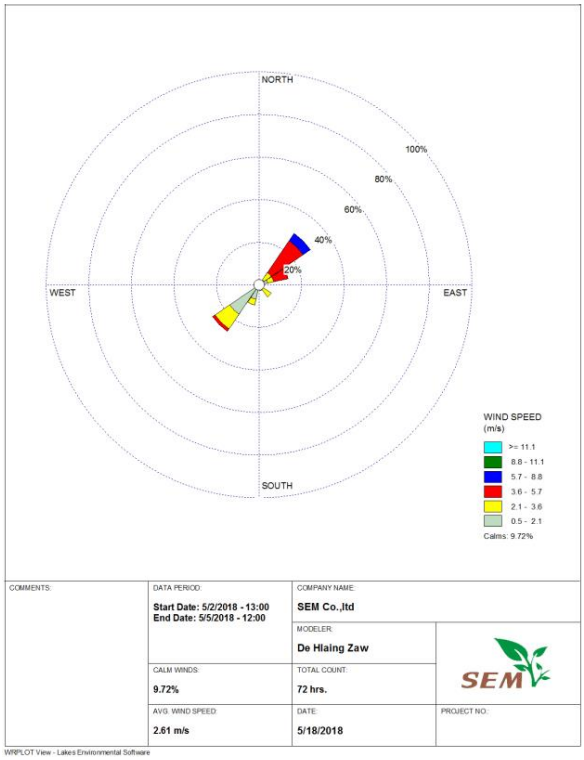
Date	Time	CO	NO_2	NO	$PM_{2.5}$	PM_{10}	RH	SO_2	Temp.
D.M.Y	Hours	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	%	µg/m^3	°C
3-4 July, 2018	24	67.18	15.20	0.0269	24.36	29.24	92.99	5.70	25.11
4-5 July, 2018	24	71.02	16.93	0.0081	2.36	8.91	95.50	3.66	24.56
5-6July, 2018	24	68.89	14.21	0.0077	2.37	7.69	98.90	2.79	23.63
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

Source: SEM, 2018.

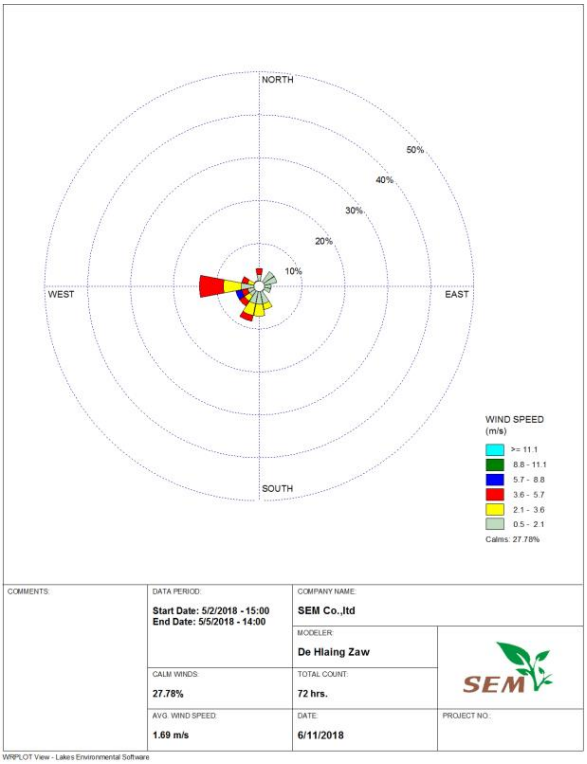
Figure 5.7: Wind Speed and Direction at AQ1 to AQ10 during Wet Season



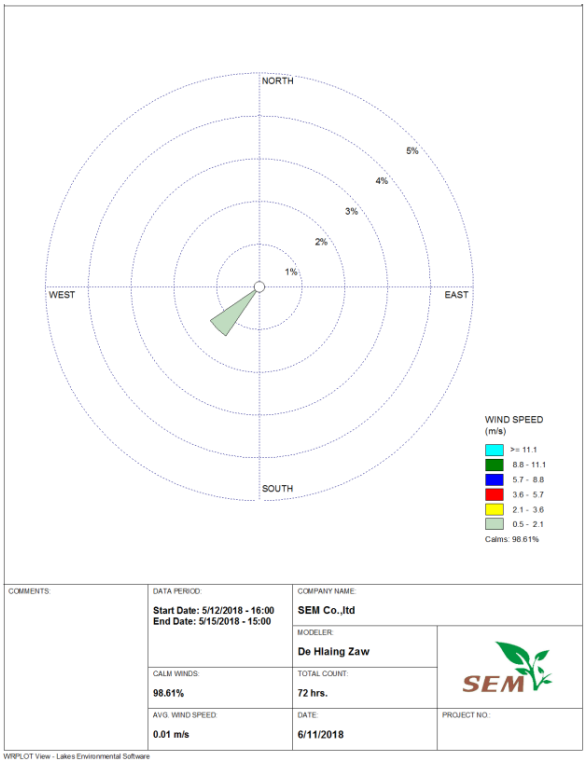
AQ1



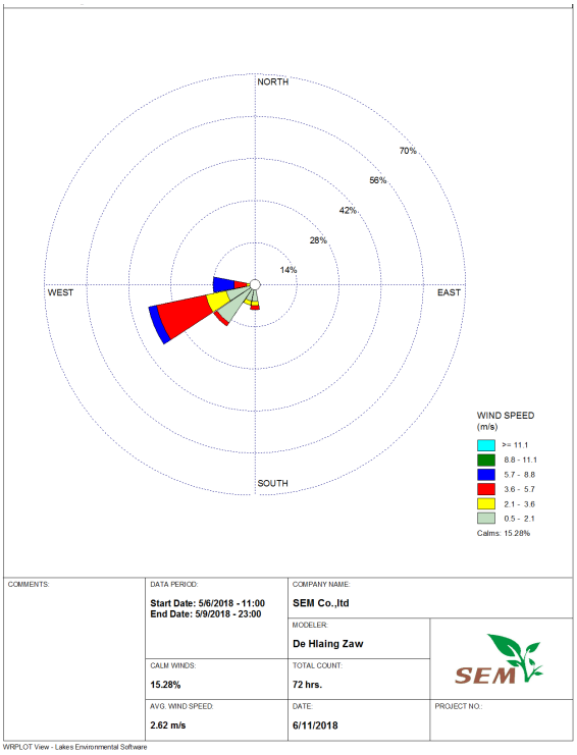
AQ2



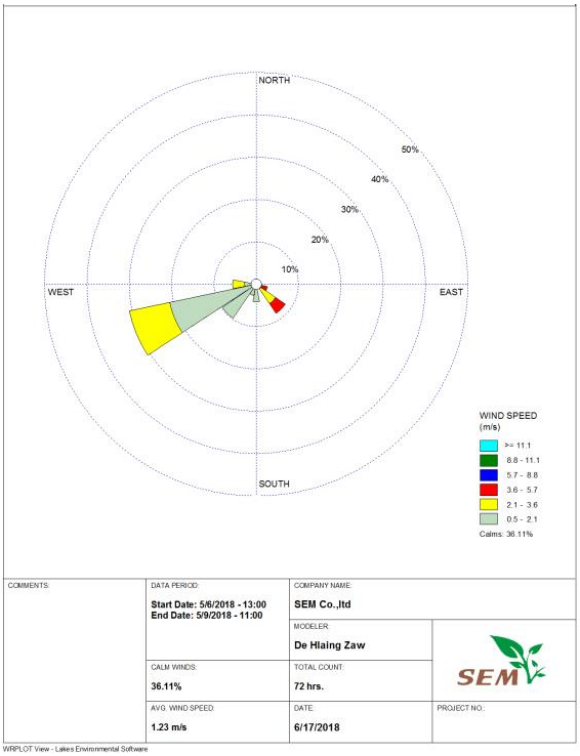
AQ3



AQ4



AQ5



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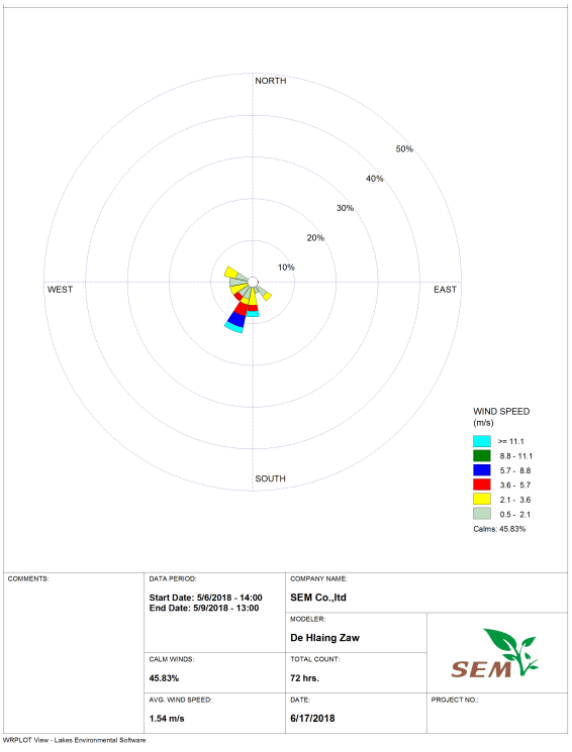

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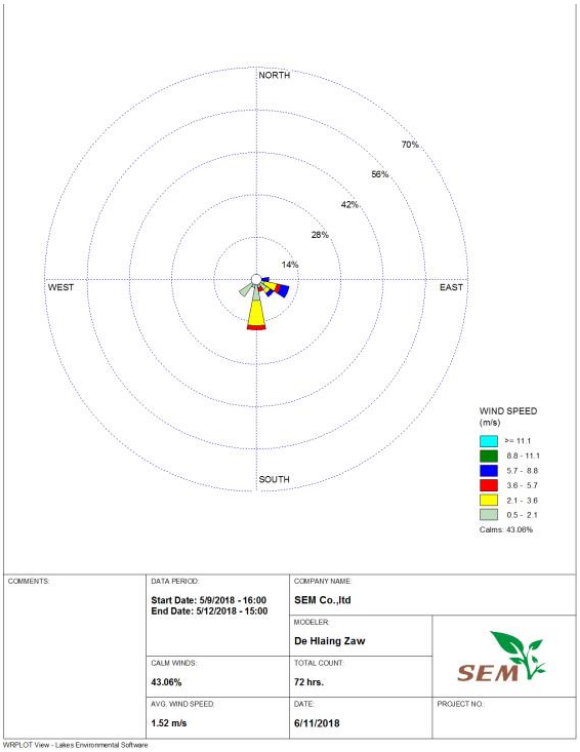
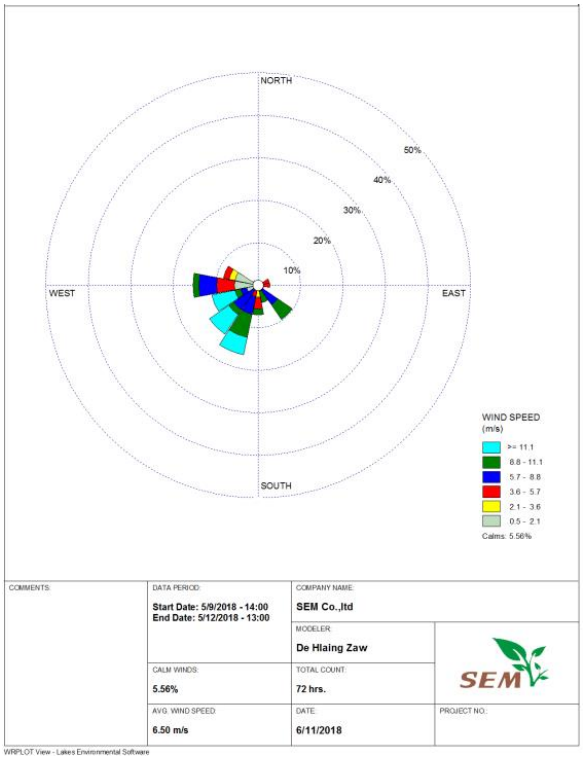
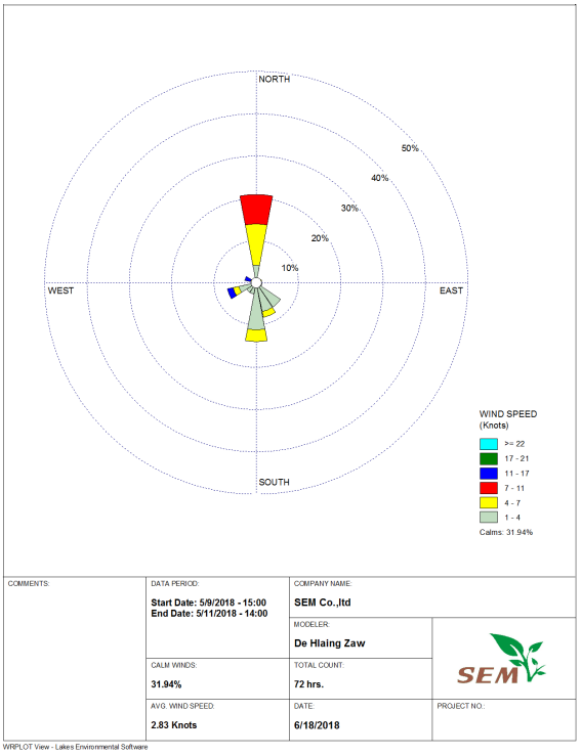


AQ8



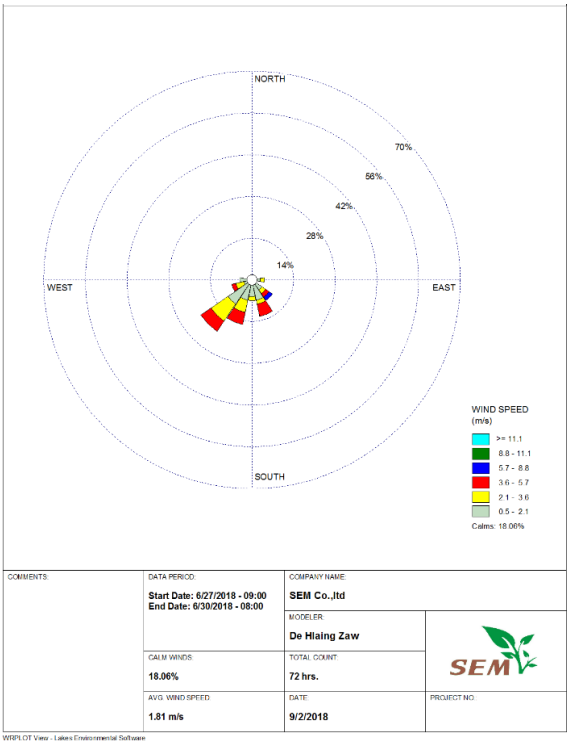
AQ9



AQ10

Source: SEM, 2018.

Figure 5.8: Wind Speed and Direction at AQ1 to AQ10 during Wet Season



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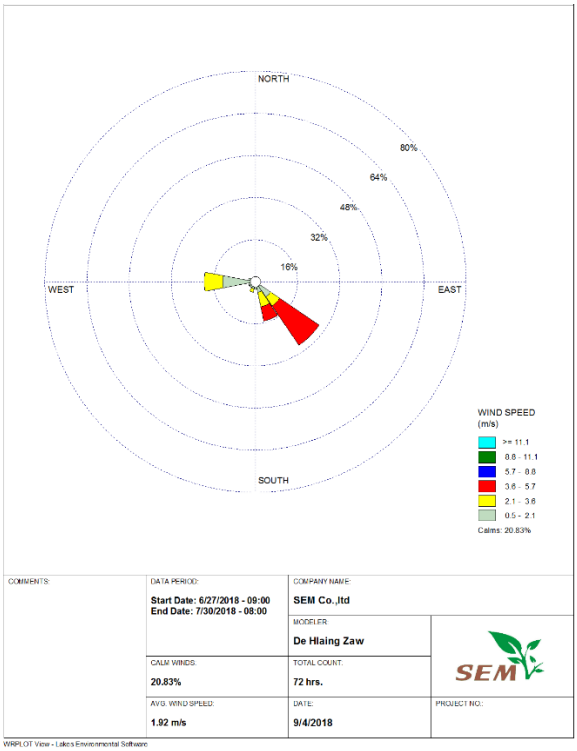
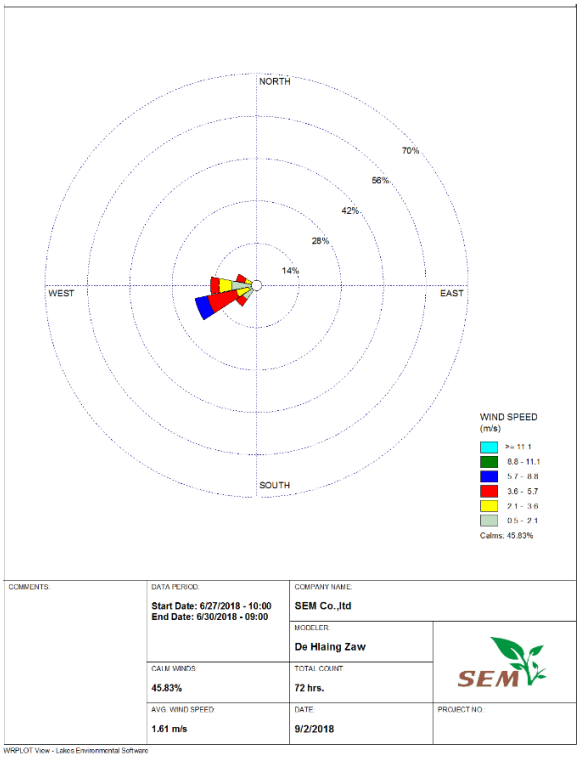


AQ2



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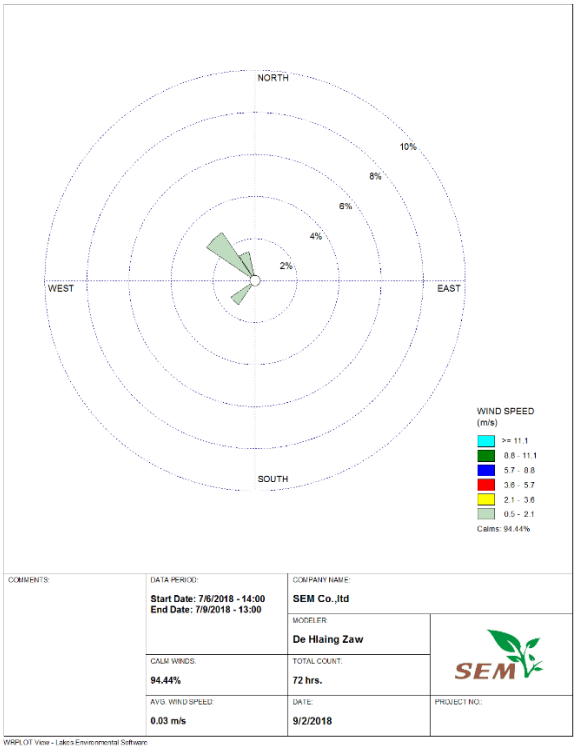

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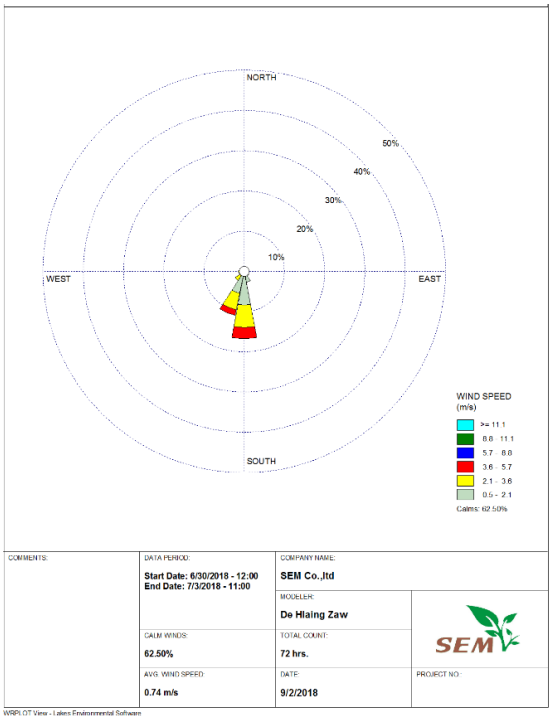
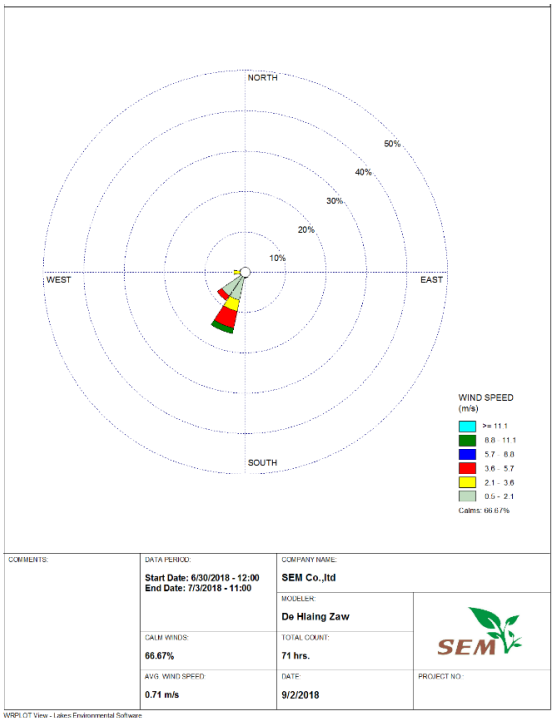
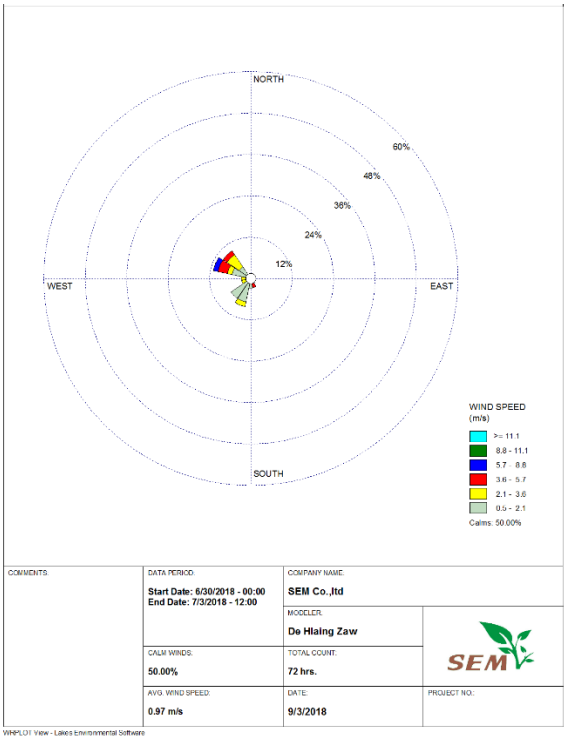


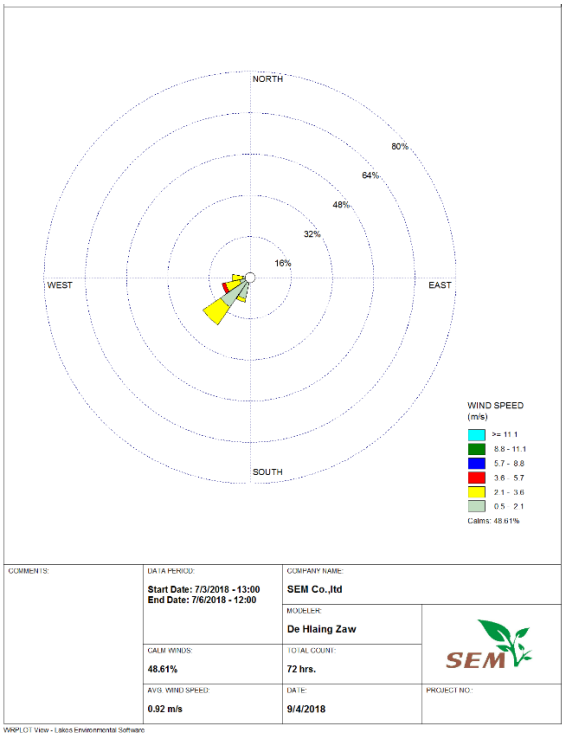
AQ5



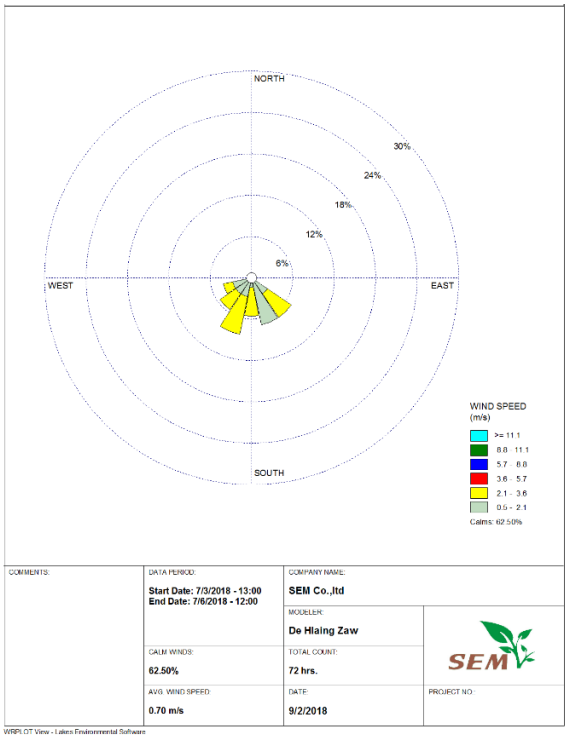
AQ6



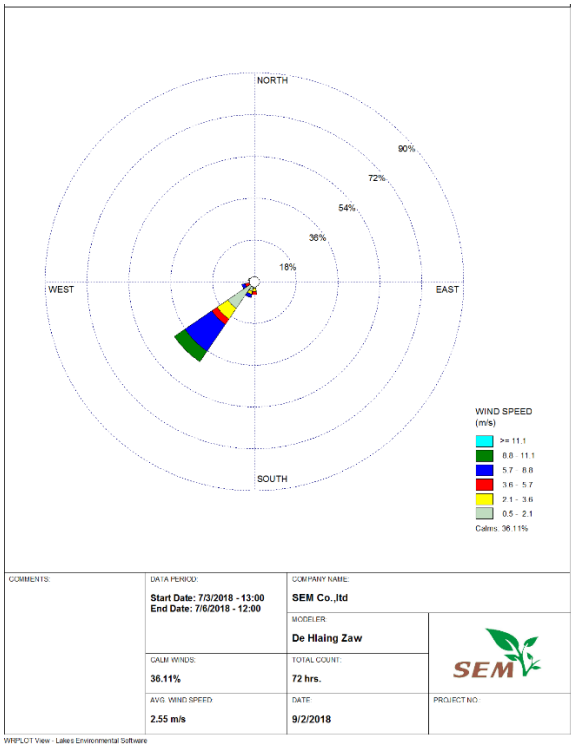
AQ7



AQ8



AQ9



AQ10

Source: SEM, 2018.

5.1.3 Climate and Meteorology

Most of Myanmar belongs to the tropical region characterised by a tropical monsoon climate with three well-defined seasons: summer, rainy and cold seasons. The summer months are from March to Mid-May. The rainy season typically lasts from mid-May to the end of October and the cold season starts in November and lasts up to the end of February.

The southwest monsoon starts in late March or early April with local turbulence that includes tornados and cyclones, bringing winds that can reach up to 200 – 300 km/h. From October to mid-March the northeast monsoon brings a dry and cool climate. Due to widely differing topographical profiles throughout Myanmar and its range of latitudes, its climate conditions differ widely from one place to another (UNCCD, 2005).

The weather and climate of Myanmar is primarily influenced by the northeast and the southwest monsoons and the short transitional periods between them. The southwest monsoon (June to September) is characterised by extensive cloud cover, light rain almost daily, interspersed with rain squalls or thunderstorms. The northeast monsoon (December to April) brings less cloud, scant rainfall, mild temperatures and lower humidity during winter (Suwannathatsa, et al, 2012).

The spring and autumn transition periods between the monsoons (April and May, October and November) are generally hot with very variable weather and heavy squalls. The transition periods are governed by the Inter-Tropical Convergence Zone (ITCZ), which separates the main wind streams of the northern and southern hemispheres. The ITCZ moves seasonally over the area (northwards in spring and southwards in autumn), with no well-defined weather pattern (Suwannathatsa, et al, 2012).

In Yangon, the average annual temperature is 27.3 °C while the average annual rainfall is 2,370 mm. The warmest month of the year is April with an average temperature of 30.5 °C while the coolest month of the year is January with an average temperature of 24.7 °C. January is also the driest month with 3 mm of rainfall. The wettest month is August with an average precipitation of 602 mm

(Climatemps, 2017). The predominant annual wind direction is south westerly (Windfinder Website). Relative humidity ranges approximately from 52 to 89% (Climate Data Website).

5.1.3.1 Climate Change Projections

Projected climate changes across Myanmar have been studied based on both General Circulation Model (GCMs) used in the Intergovernmental Panel on Climate Change (IPCC's) fourth assessment, and using dynamic downscaling with regional climate models forced by the GCMs[21].

Myanmar has been witnessing changing weather events in almost every year during the last two three decades. These include the onset, withdrawal, duration and intensity of monsoon, and the frequency of the monsoon depressions[22]. The frequency of hot days and nights is expected to increase, while the frequency of cold days/nights will decrease.

According to data from the World Resources Institute (2014), Myanmar's total GHG emissions (excluding land use change and forestry) in 2013 were 98.75 million tons of CO2 equivalent ($MtCO_2$)[23]. The major sectors producing CO_2 emissions are agriculture (65%) and energy (22%).

Climate Vulnerability Assessment

A Climate Vulnerability Assessment was conducted to understand climate threats and vurnerability of the Project, as well as to provide primary adaptation recommendations. The full assessment is shown in ***Appendix Q***.

The rapid assessment methodology employed in this study is adapted from climate change adaptation and mitigation methodology (CAM) developed by International Centre for Environmental Management (ICEM, 2011) and recognized by Asian Development Bank (ADB, 2012b). Three major steps includes climate threats analysis, project vulnerability assessment and adaptation recommendation formulation. In the first step, climate threats analysis, trends and future climate projections of each climate threat are reviewed.

Based on Climate Change Adaptation and Mitigation methodology (CAM), four climate threats are identified: air temperature rise and heat waves, storms, flooding and drought. Vulnerability assessment was carried out against four project components of Ahlone development project including Power Plant, LNG receiving terminal, Pipeline and Transmission line. The result highlights that Power Plant and LNG receiving terminal are particularly vulnerable to storms and flooding.

[21] IPCC. (2007). Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp. Retrieved from https://www.ipcc.ch/site/assets/uploads/2018/02/ar4_syr_full_report.pdf

[22] Tun Lwin, Khin and Cho Cho Shein., 2006. Hydrology and Meteorology report of Myanmar.

[23] WRI. (2014). Myanmar. CAIT Climate Data Explorer. World Resources Institute (WRI). Retrieved May 15, 2017 from http://cait.wri.org/profile/Myanmar

5.1.4 Noise

5.1.4.1 Overview

Information on the ambient noise conditions for the Study Area is not publicly available. The background noise levels are expected to be typical of an urban and/or semi-urban environment in Myanmar. Sources of noise are likely to include local traffic (e.g. motorbikes, scooters and less so private cars), human activity (e.g. schools, barangay halls, local markets) and animals (e.g. dogs, cockerels).

Potential noise sensitive receivers in the area will include settlements and schools. These receivers will be sensitive to noise from both the construction and operation activities of the Project.

In accordance with IFC General EHS Guidelines, noise monitoring was carried out for the purpose of establishing existing ambient noise levels around the Study Area in the absence of the facility or other noise sources. The baseline noise levels are compared with noise level guidelines to characterize the baseline noise in the Study Area. This information will then be used to assess the significance of the Project's impact at the noise sensitive receivers (NSR) during construction and operational phases in ***Chapter 7***, ***Chapter 8***, and ***Chapter 9***.

5.1.4.2 Baseline Noise Methodology

Noise level measurements were conducted according to the relevant methods of the International Organization for Standardization (ISO), which include ISO 1996-1:2003, and ISO 1996-2:2007. The equipment used for measurement is a Model SL-4023SD sound level meter. Measurements were carried-out by SEM during a baseline survey between the dates of May 2 and May 14, 2018. The survey was conducted for 48 hours consecutively for each location. The sampling periods are shown in ***Table 5.23***.

Table 5.23: Noise Sampling Period

Sampling Station	Period
N1, N2, N3	May 2nd – 4th, 2018 (48 hours)
N5, N6, N7	May 6th – 8th, 2018 (48 hours)
N9	May 10th – 12nd, 2018 (48 hours)
N8, N10	May 9th – 11st, 2018 (48 hours)
N4	May 12nd – 14th, 2018 (48 hours)

5.1.4.3 Baseline Noise Monitoring Locations

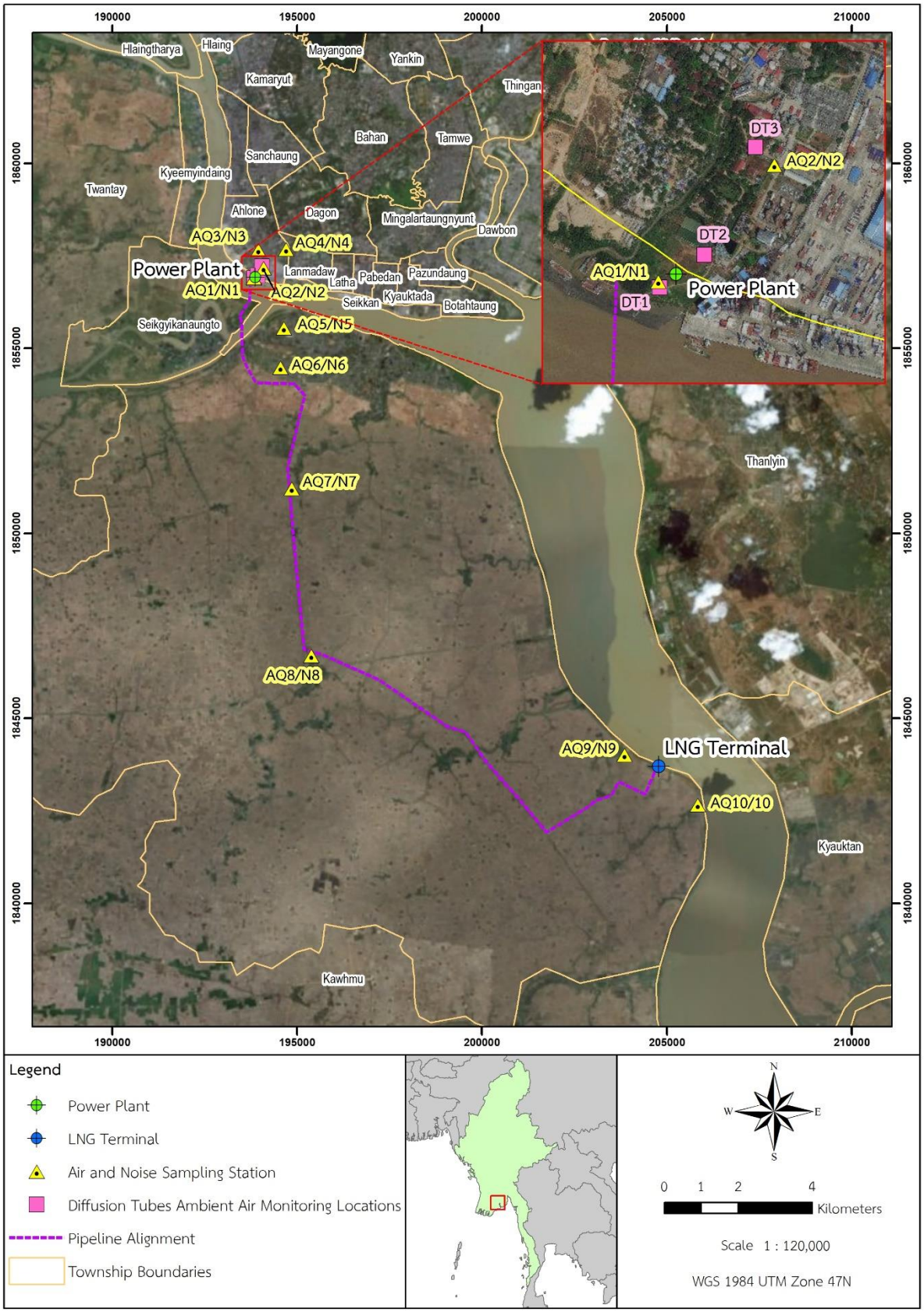
Noise monitoring was undertaken at ten (10) locations, at the same location as the air quality sampling stations. Details of the noise monitoring stations are shown in ***Table 5.24***. The locations of each noise monitoring station is shown in ***Figure 5.9***.

Table 5.24: Ambient Air and Noise Monitoring Locations

Sampling Station	Coordination	Location Description
AQ1/N1	16°46'30.69"N 96° 7'41.11"E	In the compound of Combined Cycle Power Plant (at project area) located in Ahlone Township, Yangon Region
AQ2/N2	16°46'39.33"N 96° 7'49.79"E	Same as AQ1/N1 sampling point
AQ3/N3	16°46'55.17"N 96° 7'44.70"E	In the compound of Aung Mingalar Monastery (near the Kannar Road) located in Ahlone Township, Yangon Region

Sampling Station	Coordination	Location Description
AQ4/N4	16°46'56.00"N 96° 8'10.00"E	In the compound of Church (near the Thakhinmya Park) which located in Ahlone Township, Yangon Region
AQ5/N5	16°45'46.67"N 96° 8'8.97"E	In the compound of No. (22) Basic Education Primary School which located in Dala Township, Yangon Region
AQ6/N6	16°45'11.99"N 96° 8'6.46"E	In the compound of Yadanarayeyeikthar Monastery located in Kyansitthar Ward, Dala Township, Yangon Region
AQ7/N7	16°43'26.10"N 96° 8'18.40"E	In the Nuaung Ngok To Village, in Dala Township, Yangon Region
AQ8/N8	16°40'59.48"N 96° 8'38.41"E	In the compound of Pyasu Monastery which located in Pyaw Bwe Gyi Village, Dala Township, and Yangon Region
AQ9/N9	16°39'36.00"N 96°13'25.32"E	In the compound of Aung Mingalar Monastery which located in That Kai Kwin Village, Dala Township, and Yangon Region
AQ10/N10	16°38'53.04"N 96°14'32.48"E	In the Chaung Oo Village which located in Dala Township, Yangon Region

Figure 5.9: Air Quality (AQ), Diffusion Tubes (DT), and Noise (N) Sampling Stations for Dry and Wet Seasons



Source: ERM, 2018.

5.1.4.4 Baseline Monitoring Results and Discussion

According to the noise baseline results, as shown in ***Table 5.25***, stations that exceeded the Myanmar standard for at least one time period, includes station N1, N2, N3, N4, N5, N6, N8, N9, and N10. Photos of the noise level monitoring station is shown in ***Figure 5.3*** and ***Figure 5.4***.

Possible sources of high noise levels include the existing Power Plant, traffic activities, human activities, and rain/weather events.

With regards to the noise station at the existing Power Plant and other nearby sampling stations, as shown in ***Figure 5.10***, the existing power plant (N2) has the highest noise measurement. The noise station at the Project site (N1) has relatively lower noise emissions; however, transportation activities by river and the existing power plant may still contribute to the station exceeding the standard. Station N3 has relatively high noise levels, averaging just below N2; this is likely due to traffic activities from the main road. Station N4 has lower noise levels, as the station is located within residential areas.

With respect to monitoring station within the Pipeline Study Area (including monitoring station N1, N2, N5, N6, N7, N8 and N9). The lowest noise levels trend is evident to be at N7 with the reasoning of the station being situated in the green field and agricultural area with a small community settlements located within 50 meters from the station. The loudest recorded station is found at N2 station whereby the station is located in partial industrial and residential area with high traffic activities.

For noise monitoring station within LNG Receiving Terminal Study Area (N9 and N10), the noise level (LAeq) during daytime and night-time both exceed the NEQG standard. The highest noise level monitored was recorded at 69 dBA while the lowest noise level recorded at 44 dBA where both are located at N10. The sources of these noises are potentially from surrounding traffics with the closest receptors located approximately 1 km southeast of the LNG Terminal.

The detailed study of noise level monitoring is presented in the ***Appendix M*** and ***Appendix O***.

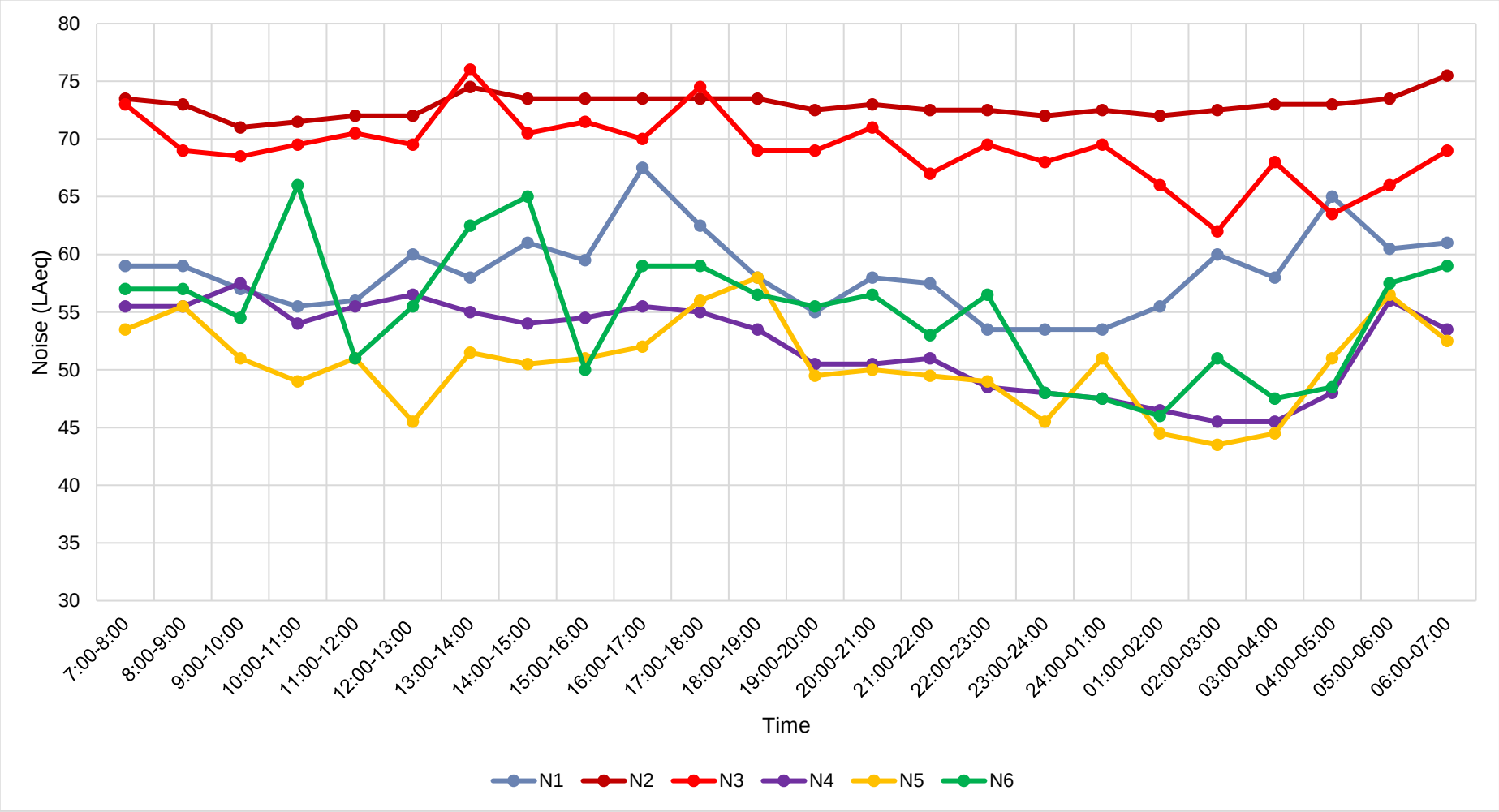
Table 5.25: Results of A-Weighted Loudness Equivalent (LAeq) Level

Time Period	A-Weighted Loudness Equivalent (LAeq) Level	
	Day time	Night time
N1 (2nd -3rd, May 2018)	**59**	**57**
N1 (3rd - 4th, May 2018)	**59**	**59**
N2 (2nd -3rd, May 2018)	**74**	**73**
N2 (3rd - 4th, May 2018)	**72**	**73**
N3 (2nd -3rd, May 2018)	**71**	**66**
N3 (3rd - 4th, May 2018)	**70**	**67**
N4 (12th -13th, May 2018)	55	**49**
N4 (13th -14th, May 2018)	54	**48**
N5 (6th -7th, May 2018)	**51**	**49**
N5 (7th -8th, May 2018)	**52**	**48**
N6 (6th -7th, May 2018)	**58**	**53**
N6 (7th -8th, May 2018)	**57**	**49**
N7 (6th -7th, May 2018)	48	45
N7 (7th -8th, May 2018)	46	40
N8 (9th -10th, May 2018)	54	**47**
N8 (10th -11st, May 2018)	**58**	**55**
N9 (10th -11nd, May 2018)	**60**	**53**
N9 (11th -12nd, May 2018)	**60**	**54**
N10 (9th -10th, May 2018)	**63**	**47**
N10 (10th -11st, May 2018)	**63**	**51**
NEQG standard	55	45

Source: SEM, 2018.

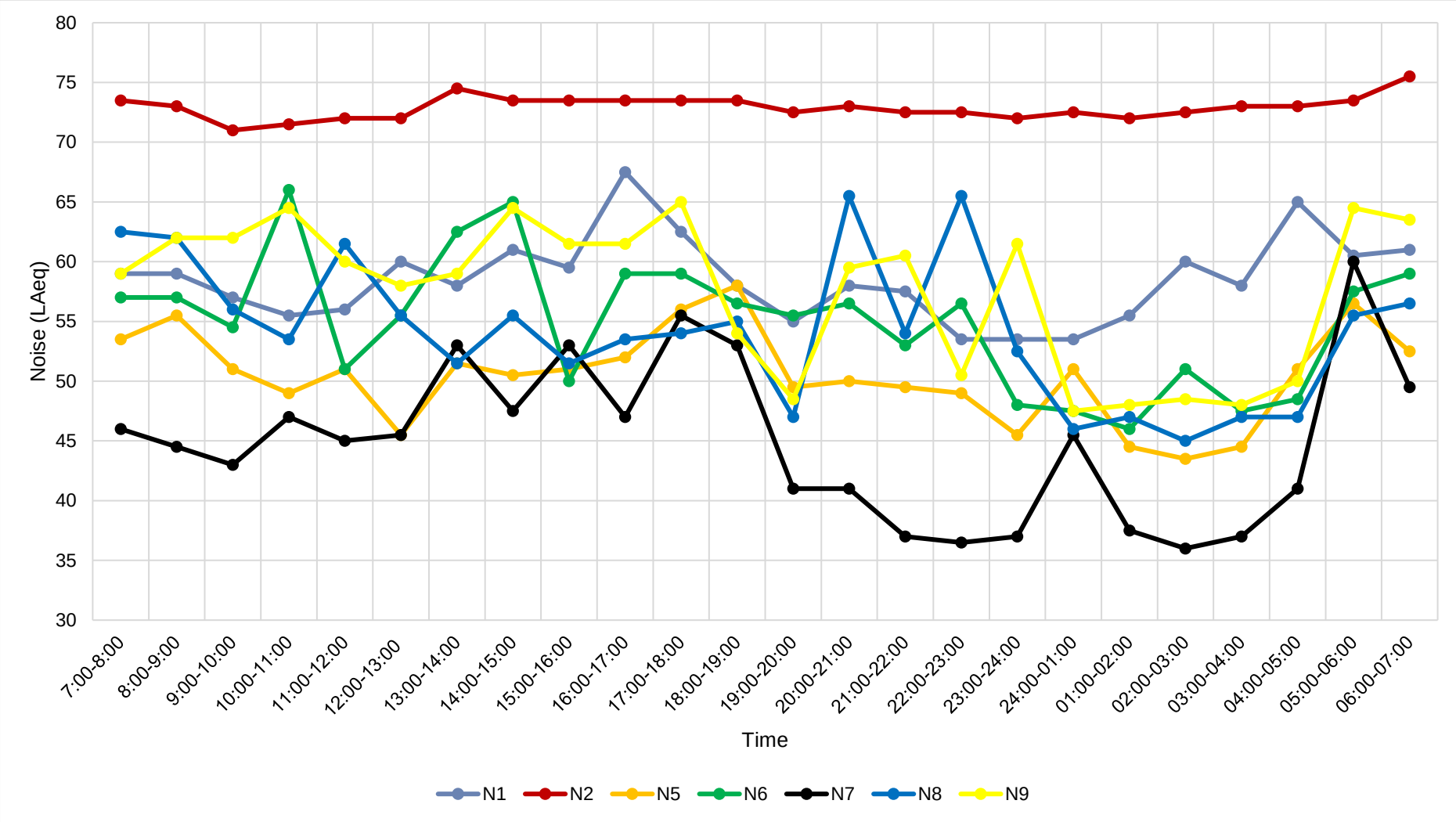
*Note: **Bold** indicates values above the NEQG standard.*

Figure 5.10: Noise Measurement Graph of Station N1, N2, N3, N4, N5 and N6 (Monitoring Stations That Are Within Power Plant Study Area)



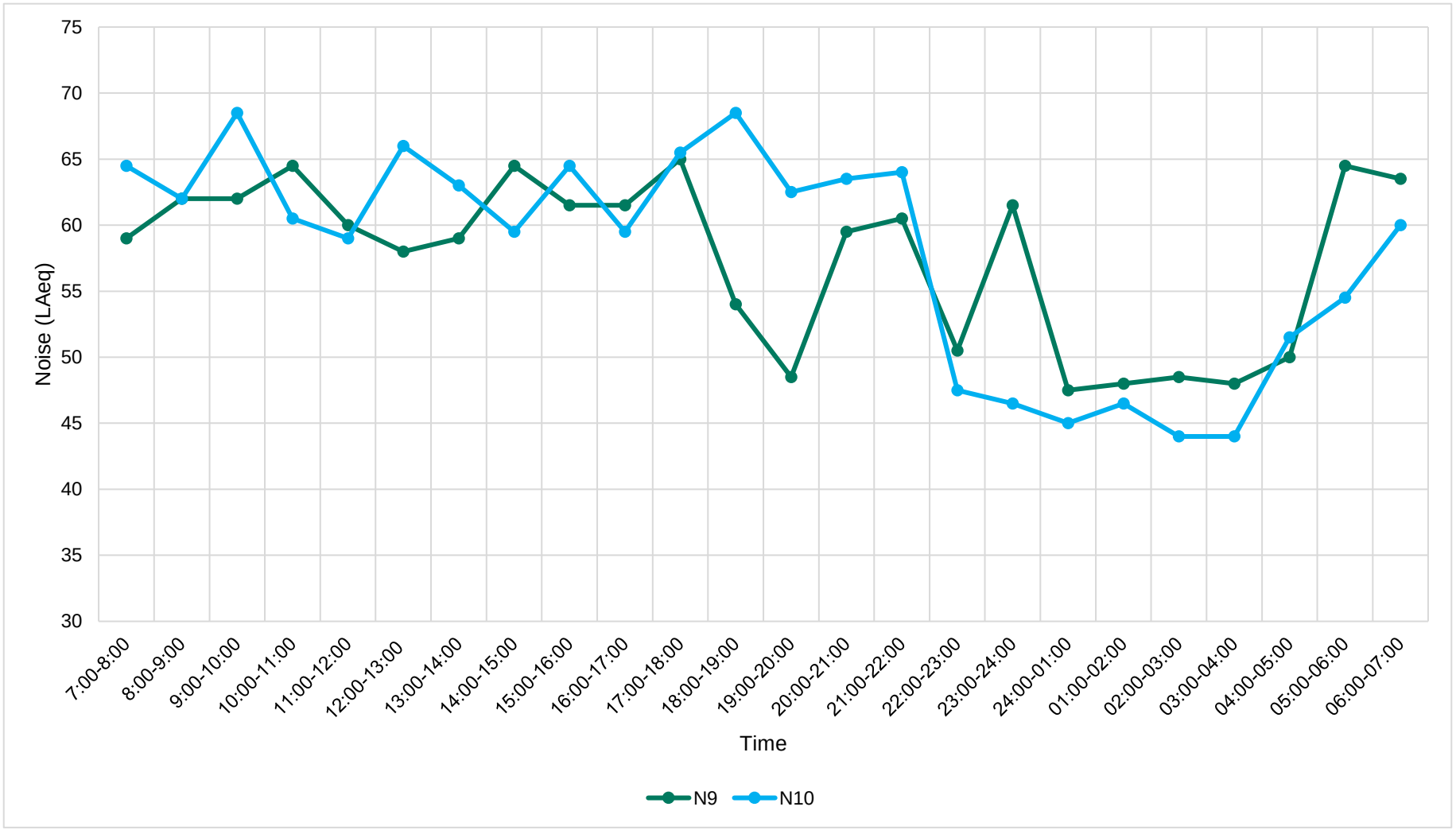
Source: SEM, 2018. (Modified by ERM)

Figure 5.11: Noise Measurement Graph of Station N1, N2, N5, N6, N7, N8 and N9 (Monitoring Stations That Are Within Pipeline Study Area)



Source: SEM, 2018. (Modified by ERM)

Figure 5.12: Noise Measurement Graph of Station N9 and N10 (Monitoring Stations That Are Within LNG Receiving Terminal Study Area)



Source: SEM, 2018. (Modified by ERM)

5.1.5 Surface Water

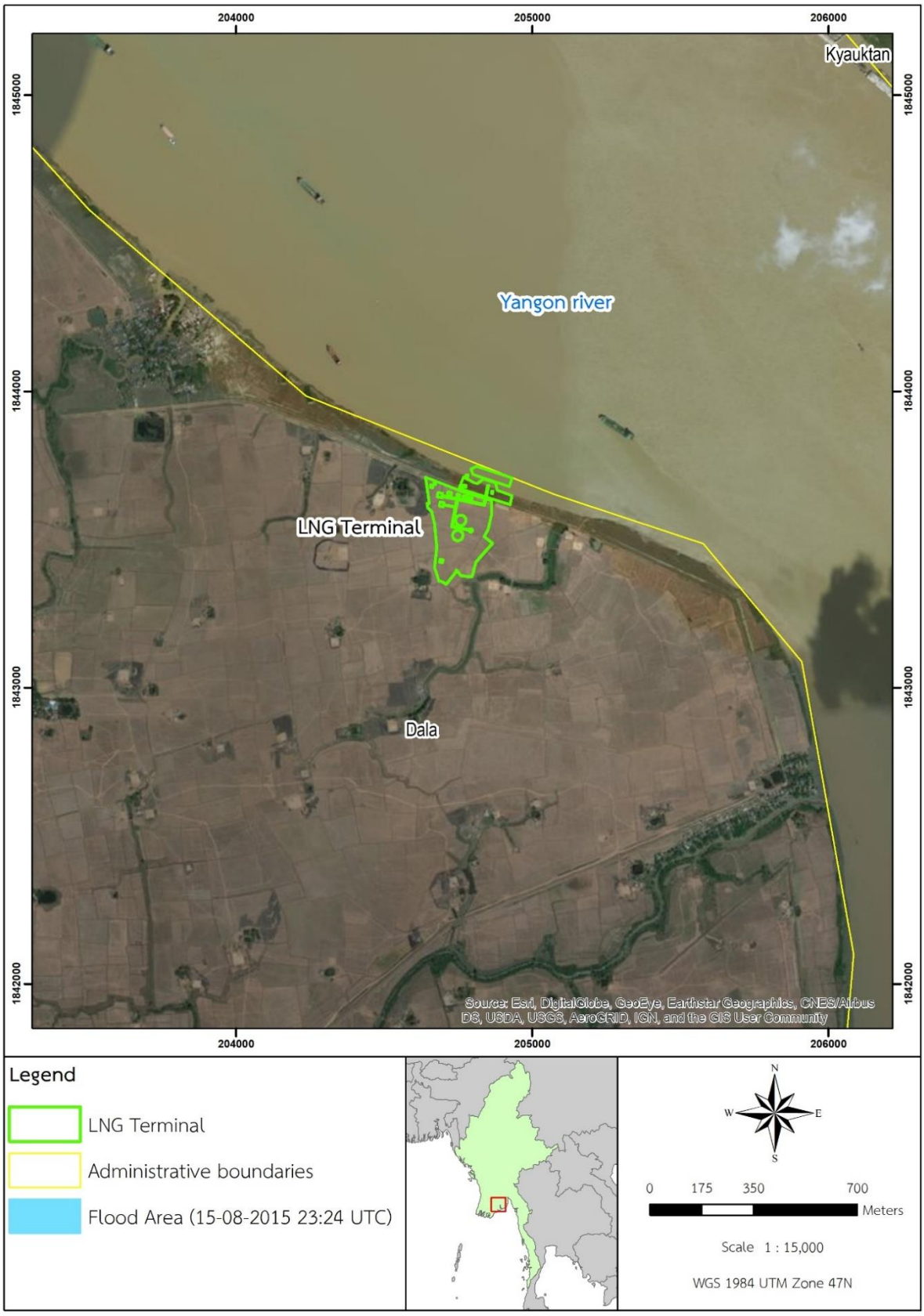
5.1.5.1 Hydrology

The Study Area is located 40 km upstream from the mouth of the Yangon River. The average tidal range of the Yangon River is about 5.85 m at spring tide and 2.55 m at neap tide. Modelling of the discharge of Yangon River indicates discharges ranging from < 500 m^3/s in April to approximately 7,000 m^3/s in August, with tidal water level variations of ~1 m to ~6 m based on water level measurements at Monkey Point downstream of Project Site (De Koning & Janssen, 2015)[24]. In the Irrawaddy Delta which includes the Yangon River, drainage, salt intrusion and flood protection are major concerns (EO Earth Website, 2016). According to mapping of the August 2015 floods in Yangon (Yangon Delineation Overview)[25], the riverbanks adjacent to the Power Plant as well as part of the pipeline were impacted by the flooding (***Figure 5.14*** and ***Figure 5.15***), while LNG Terminal is located on flood-free zone (***Figure 5.13***).

[24] De Koning, R.J. & Janssen, M.P.J. (2015) Delft3D-FLOW Model of the Yangon Port Area. Delft University of Technology.

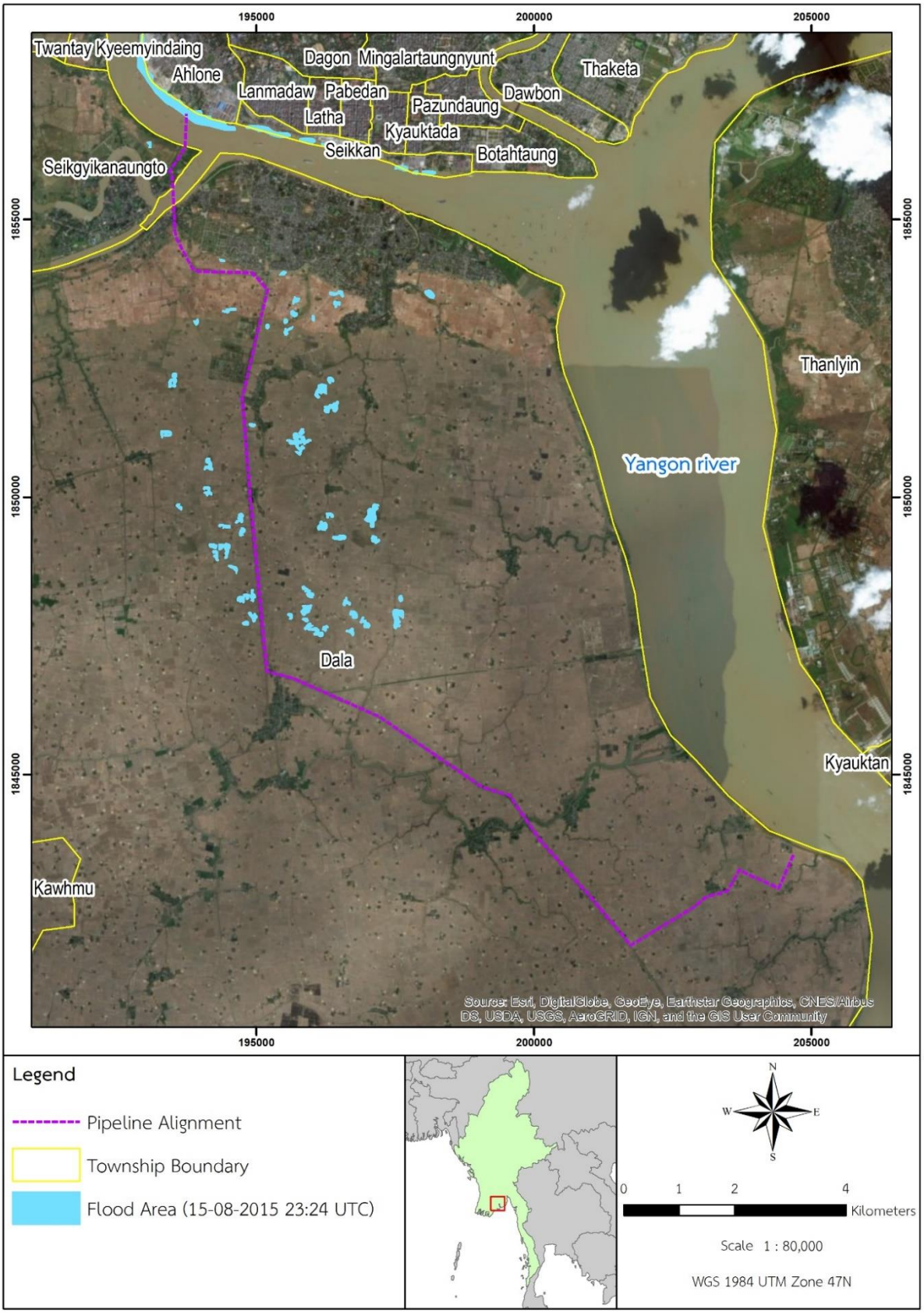
[25] Copernicus. (2015). EMSR130: Flood in Myanmar. Copernicus: Emergency Management Service – Mapping. European Commission. Retrieved from https://emergency.copernicus.eu/mapping/list-of-components/EMSR130

Figure 5.13: Yangon River Flood Area near the LNG Terminal



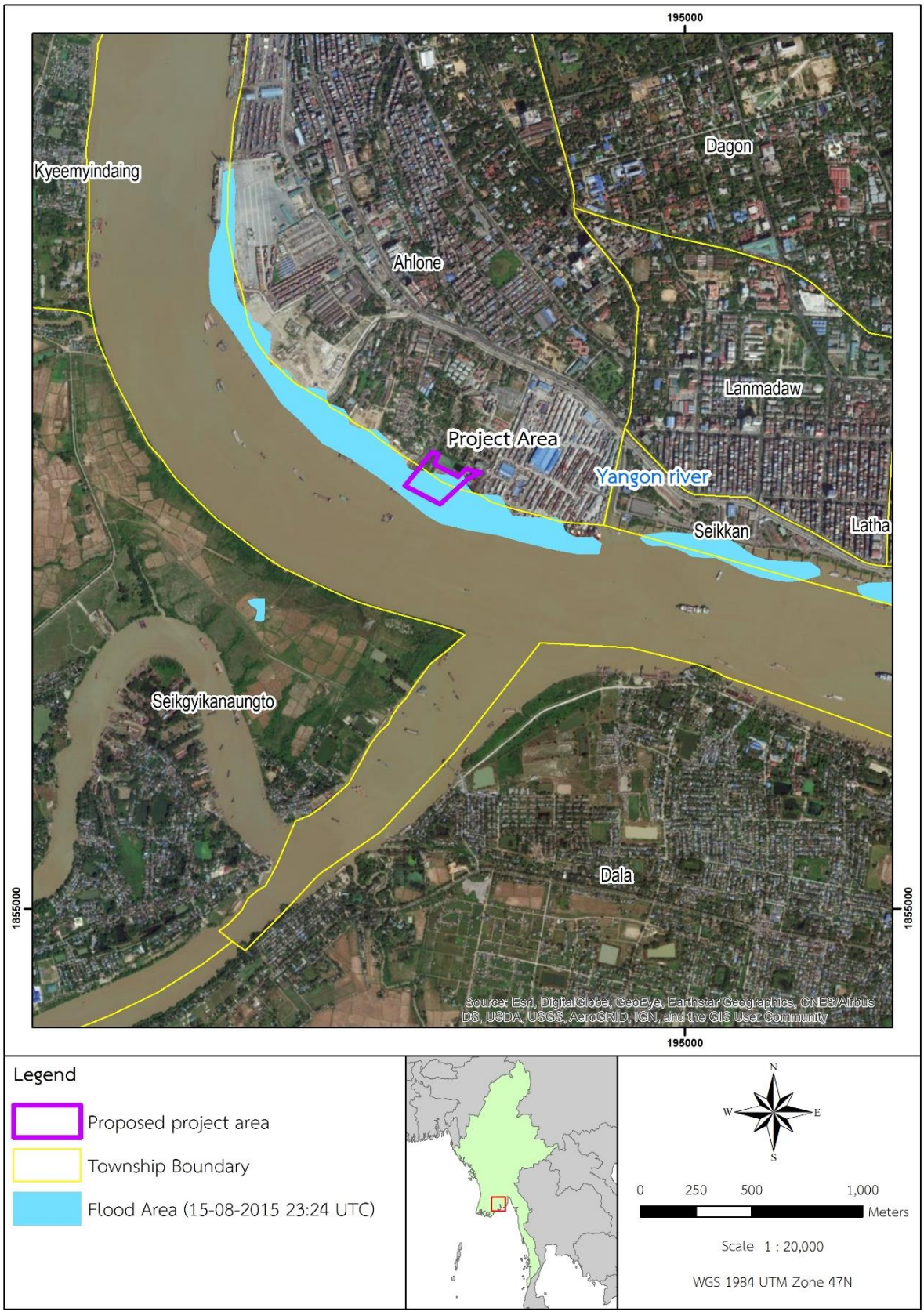
Source: Copernicus, 2015.[25] (Modified by ERM)

Figure 5.14: Yangon River Flood Area near the Pipeline



Source: Copernicus, 2015.[25] (Modified by ERM)

Figure 5.15: Yangon River Flood Area near the Power Plant



Source: Copernicus, 2015.[25] (Modified by ERM)

5.1.5.2 Surface Water Quality

A number of baseline surface water quality sampling surveys have been conducted in the Study Area as part of this ESIA report. An overview of the surveys and their results are presented in this section.

Baseline Surface Water Sampling Methodology

For sampling sites located in the Yangon River, and the Twante Canal, a local boat was used to travel between shore and sampling site; sampling equipment was brought on-board and samples were collected directly on the boat. For sampling sites located in-land, a vehicle was used to travel to each site, and samples were collected on the sides of the river, or from a bridge. Water samples were taken by an Alpha horizontal water sampler and collected in plastic and sterilized glass sample containers. All sampling was conducted in strict accordance with recognized standard procedures, as listed together with the sampling results in ***Appendix M*** and ***Appendix O***. Surface water sampling has been conducted for both dry and wet seasons; parameters that were selected for sampling are listed below.

The parameters mentioned above were selected to align with both the Myanmar NEQG Standards and IFC General EHS guideline. Please refer to ***Appendix M***, ***Appendix N***, ***Appendix O***, and ***Appendix P*** for the testing parameters.

All samples were kept in iced boxes and were transported to the laboratory within 24 hours (under all recommended holding time). Additionally, flow rate, width and depth of river were measured using a Vale port Flow Meter equipment and depth sounder.

The in-situ parameters have been measured using equipment listed in ***Table 5.26***.

Table 5.26: Field Equipment for Surface Water Quality Survey

No.	Equipment	Manufacturer	Originate Country	Model/Serial No.
1	SMART TROLL MP _Multi parameter for water	In Situ Inc.	USA	SN - 346054
2	Multi Parameters for water quality	HANNA	USA	H17609823 (Turbidity Sensor)
3	Alpha Bottle (Water Sampler)	Wildlife Supply Company	Indonesia	Wildco P/N-1120-G45
4	Flow meter	GLOBAL WATER 800-876-1172	USA	FB211 Serial -1449006336
5	Depth Sounder	Japan	Japan	FP211/1136160536

Source: SEM, 2018.

Baseline Surface Water Sampling Locations

Dry season surface water samples were collected by ERM-Siam and SEM from the 3rd - 4th May, 2018, at fourteen (14) locations, and wet season surface water samples were collected from the 27th to the 28th June 2018 at fourteen (14) locations. The description for each of the sampling locations is shown in ***Table 5.27***, and the locations of each sampling site is shown in ***Figure 5.16***. In-situ testing was conducted on site by the data collection team (SEM and ERM), and samples were sent for laboratory testing, which was conducted by STS Green in Bangkok.

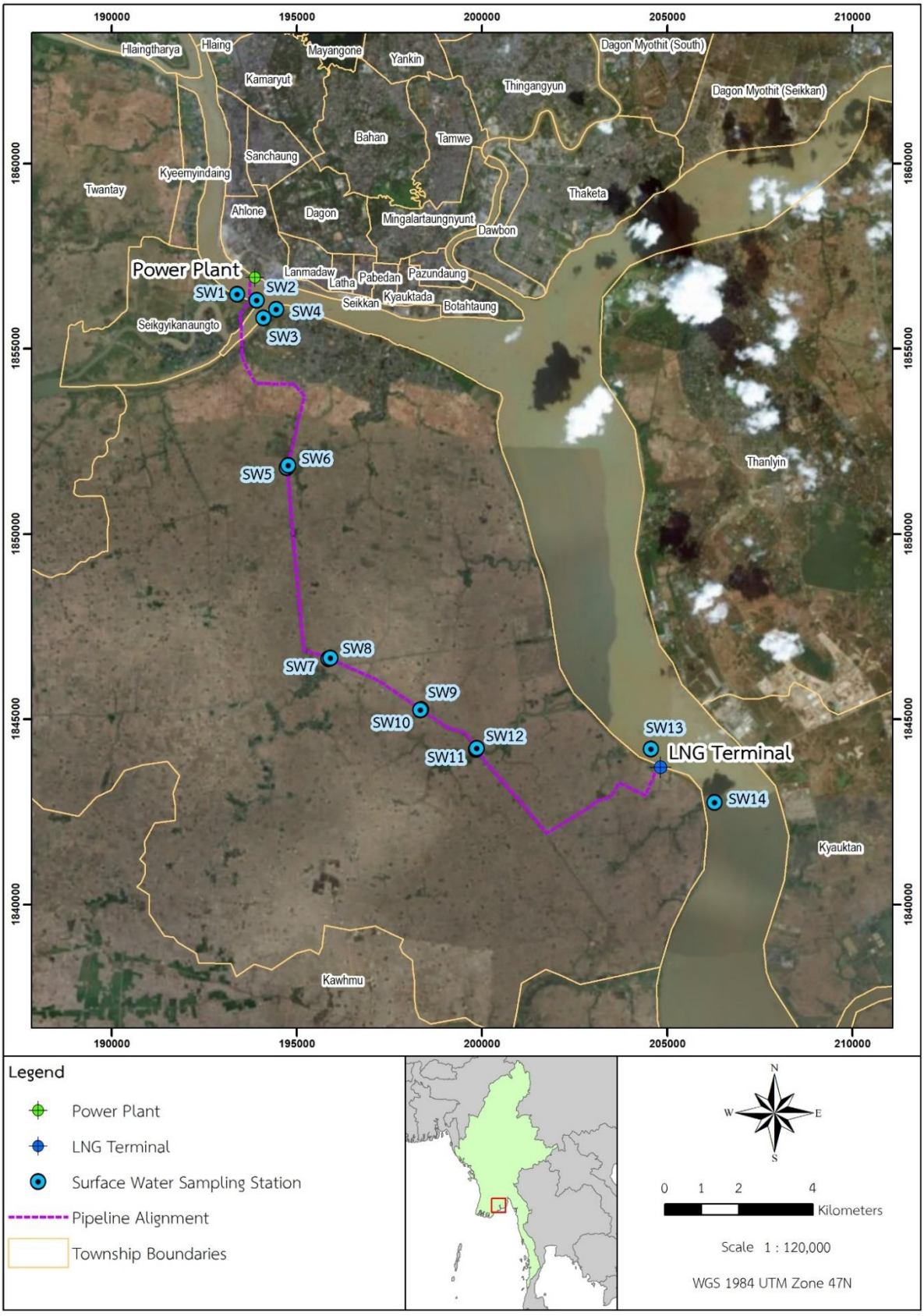
Table 5.27: Surface Water Sampling Locations

Sampling Point	Coordinates	Description of Sampling Points
SW 1	16°46'16.39"N 96° 7'26.42"E	Upstream of Project, Yangon River, and approximately 0.25 kilometres west of the proposed pipeline and south of project area. The Yangon River width at SW 1 is approximately 512.47 meters (measured in Google Earth). Visual observation indicated that the turbidity is high.
SW 2	16° 46' 11.25"N 96° 7' 44.26"E	Upstream of Gas Turbine, Yangon River, about 0.3 kilometres east of the proposed pipeline. SW 2 is near the mouth of Twantae Canal and the turbidity was high.
SW 3	16° 45' 55.62"N 96° 7' 50.73"E	At the mouth of Twantae Canal and near the proposed pipeline. The canal width of SW 3 is approximately 387.95 meters and the sampling point is located downstream of Thandwe Canal. The turbidity is high.
SW 4	16° 46' 3.46"N 96° 8' 2.27"E	Downstream of Twantae Canal, near the proposed pipeline. The channel width of SW 4 is approximately 459.09 meters.
SW 5	16°43'44.85"N 96° 8'14.10"E	Downstream of Naung Ngok To Chaung, near the proposed pipeline. The canal width of SW 5 is approximately 5.36 meters in the dry season. The turbidity is moderate to high.
SW 6	16°43'46.82"N 96° 8'15.25"E	Upstream of Nyaung Ngok To Chaung, and near the pipeline. The sampling point is located up stream of proposed pipeline and beside the road. There are many waste disposal sites near the sampling point. The turbidity is moderate and transparency is low to medium.
SW 7	16°40'57.67"N 96° 8'54.64"E	Downstream of Pyaw Bwe Chaung, and near the pipeline (Pyaw Bwe Gyi village). The channel width of SW7 is approx. 5.56 meters and the sampling point is located 0.01 kilometre from the proposed pipeline. The water has medium transparency and turbidity is moderate.
SW 8	16°40'58.36"N 96° 8'56.10"E	Upstream of Pyaw Bwe Chaung, near the pipeline (Pyaw Bwe Gyi village). It is located approximately 20 meters southeast of the proposed pipeline. Width is approximately 5.56 meters (measured in Google Earth).The turbidity is moderate and the transparency of water is medium.
SW 9	16°40'14.17"N 96°10'19.41"E	Upstream from pipeline alignment in Tha Nat Pin Chaung, near the Tha Nat Pin bridge. The width is approximately 5.56 meters (measured in Google Earth), near Tha Net Pin bridge. The turbidity is moderate.
SW 10	16°40'14.04"N 96°10'18.72"E	Downstream from pipeline alignment in Tha Nat Pin Chaung, near the Tha Nat Pin bridge. It is located just after SW 9.The turbidity is moderate and the transparency of water is medium.

Sampling Point	Coordinates	Description of Sampling Points
SW 11	16°39'39.81"N 96°11'9.78"E	Upstream of Ya Kaing Chaung, approximately 20 metres southwest of the pipeline. SW 11 was sampled at the middle of the Ya Khaing Chaung river, from the Ya Khaing Chaung Bridge. The turbidity is moderate and transparency is medium.
SW 12	16°39'40.99"N 96°11'10.60"E	Downstream of Ya Kaing Chaung, approximately 0.02 kilometers noutheast of pipeline. The Ya Khaing Chaung width at SW 12 is approximately 45.87 meters width (measured in Google Earth). The turbidity is high and transparency is low.
SW 13	16°39'42.26"N 96°13'49.15"E	Upstream of LNG Receiving Terminal and approximately 1.05 kilometres north of the pipeline, in Yangon River. The Yangon River width of SW 13 is approximately 2,171.77 meters (measured in Google Earth). The turbidity is high.
SW 14	16°38'56.46"N 96°14'47.50"E	Downstream of LNG Receiving Terminal and approximately 250 metres from the pipeline, in Yangon River. The location of SW14 is located near Chaung Oo village, and the turbidity and transparency of water are high and low

Source: SEM, 2018.

Figure 5.16: Surface Water Sampling Locations (Dry and Wet Season 2018)



Source: ERM, 2018.

Summary of Baseline Sampling Results

Dry Season Survey

According to the dry season results from STS Green, Total Suspended Solid (TSS) was found at levels above the Myanmar NEQG standards (50 mg/L) at SW1, SW2, SW3, SW4, SW13, and SW14 (between 55.9 and 1,211 mg/L); this is likely due to soil erosion and sediment carried down from upstream. Considering that the Ayeyarwaddy River deposits more than 360 million tons of sediment onto the continental shelf of the Northern Andaman Sea each year, it is a likely cause for the Yangon River (an eastern branch of the Ayeyarwaddy River) to have a significantly high background TSS[26]. Iron was also found to have exceeded the Myanmar NEQG Standard (3.5 mg/L), and/or IFC Standard (1.0 mg/L) at SW1, SW2, SW3, SW4, SW5, SW6, SW7, SW8, SW9, SW10, SW13, and SW 14 (between 1.18 and 75.29 mg/L). According to soil quality in ***Section 5.1.6.2***, given that iron content in soil are considerably high, the high iron content is surface water is most likely due to soil erosion.

Given that the wet season also has high TSS concentrations, this can be a natural reoccurring condition for the Yangon River, or a condition that has been established for quite some period.

Total Dissolved Solid (TDS) concentrations at all sampling locations (4,052 – 12,760 mg/L) exceeded the United States Environmental Protection Agency (EPA) Standard (250 mg/L). Manganese concentrations at all sampling locations (0.22 – 1.40 mg/L), excluding SW9 and SW10, exceeded the EPA Standard (0.05 mg/L)

All other parameters are found to be within the Myanmar NEQG Standard, IFC Standards, and EPA Standards.

Photographs of the baseline sampling operations are shown in ***Figure 5.17***.

The results from in-situ sampling is shown in ***Table 5.28***, and ***Table 5.29***. The summary of laboratory results is shown in ***Table 5.30***; the full results with individual station results is shown in ***Appendix N***.

[26] Aung, T.T., Shimozono, T. & Okayasu, A. (2013) Numerical simulation on sedimentation in Yangon River and its navigation channel. Mer. 51. 91-104.

Figure 5.17: Photographs of Surface Water Sampling during Dry Season





Source: SEM, 2018.

Table 5.28: In-Situ Results of Surface Water Dry Season Sampling (1 of 2)

No.	Sample No./ Physical Parameter	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8	Myanmar Standards	EPA Standards[a]
1	Location	Up stream of Yangon River	Downstream of Yangon River	At mouth of Twantae Canal (up)	At mouth of Twantae Canal (below)	Nuaung Ngok To Chaung (down)	Up stream of Nuaung Ngok To Chaung	Downstream of Pyaw Bwe Chaung	Up stream of Pyaw Bwe Gyi Chaung	-	-
2	Date/Time	4/5/2018 8:17	4/5/2018 9:30	3/5/2018 15:30	4/5/2018 10:17	5/5/2018 15:10	5/5/2018 15:20	5/5/2018 15:30	5/5/2018 15:35	-	-
3	Weather	Sunny	Sunny	Sunny	Sunny	Slightly Cloud	Slightly Rain	Sunny	Sunny	-	-
4	Transparency	Low	Low	Low	Low	Low to Medium	Low to Medium	Medium	Medium	-	-
5	Colour	Buff	Buff	Buff	Buff	Yellowish Brown	Yellowish Brown	Light Green	Light Green	-	-
6	Water Depth (m)	10.5	3.5	11.5	5.5	-	-	-	-	-	-
7	Depth (of sample taken) (m)	1	1	1	1	-	-	-	-	-	-
-	Flow rate/velocity (m/s)	0.069	0.15	0.057	0.135	-	-	-	-	-	-
9	Tem (°C) (air & water)	30.7	30.9	31.8	31.0	34.7	35.4	34	34.2	-	-
10	pH	7.73	7.65	7.53	7.75	7.5	7.74	7.55	7.76	6-9	5-9
11	DO (mg/l)	5.2	5.19	4.02	5.01	3.38	5.18	8.02	8.05	-	-
12	EC (µs/m)	1,061.3	1,053.4	662.6	1,087.3	11,861.7	12,502.4	23,615.9	24,067.1	-	-
13	TDS (ppm)	1,229.3	1,152.7	383.9	1,078.8	6,559.64	6,864.89	13,087.5	13,240.85	-	-
14	Turbidity (FNU)	30.14	30.62	33.00	32.72	-	-	-	-	-	-

No.	Sample No./ Physical Parameter	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8	Myanmar Standards	EPA Standards[a]
15	Remark	Sampling and Insitu test	Sampling and Insitu test	Sampling and Insitu test	Sampling and Insitu test	Sampled on 3/5/2018 14:45	Sampled on 3/5/2018 15:00	Sampled on 3/5/2018 13:40	Sampled on 3/5/2018 14:00	-	-

Table 5.29: In-Situ Results of Surface Water Dry Season Sampling (2 of 2)

No.	Sample No./ Physical Parameter	SW 9	SW 10	SW 11	SW 12	SW 13	SW 14	Myanmar Standards	EPA Standards[a]
1	Location	Up stream of Tha Nat Pin Chaung	Downstream of Tha Nat Pin Chaung	Up stream of Ya Kaing Gyaung	Downstream of Ya Kaing Gyaung	Near FSRU Option 2, Yangon River	Near FSRU Option 2, Yangon River	-	-
2	Date/Time	5/5/2018 14:05	5/5/2018 14:18	5/5/2018 13:10	5/5/2018 13:30	3/5/2018 11:17	3/5/2018 12:00	-	-
3	Weather	Sunny	Sunny	Sunny	Sunny	Sunny	Slightly Cloud	-	-
4	Transparency	Medium	Medium	Medium	Medium	Low	Low	-	-
5	Colour	Light Green	Light Green	Light Green	Light Green	Buff	Buff	-	-
6	Water Depth (m)	-	-	-	-	8.9	7.1	-	-
7	Depth (of sample taken) (m)	-	-	-	-	1	1	-	-
8	Flow rate/velocity (m/s)	-	-	-	-	0.25	0.27	-	-
9	Tem (°C) (air & water)	34.1	34.5	33.2	34.2	31.9	31.7	-	-
10	pH	8.14	8.13	7.83	7.65	7.5	7.4	6-9	5-9
11	DO (mg/l)	5.32	5.19	5.21	5.31	5.68	5.87	-	-
12	EC (µs/m)	22,858.8	23,091.6	22,626.7	22,885.5	2,365	1,373	-	-
13	TDS (ppm)	12,702.8	12,817.4	12,724.7	12,802.45	1,370	1,306	-	-
14	Turbidity (FNU)	-	-	-	-	38	36	-	-

No.	Sample No./ Physical Parameter	SW 9	SW 10	SW 11	SW 12	SW 13	SW 14	Myanmar Standards	EPA Standards[a]
15	Remark	Sampled on 3/5/2018 12:40	Sampled on 3/5/2018 12:20	Sampled on 3/5/2018 12:00	Sampled on 3/5/2018 12:10	Sampling and Insitu test	Sampling and Insitu test	-	-

Source: SEM, 2018.

Note: [a] United States Environmental Protection Agency (EPA), National Primary Drink Water Regulations & National Secondary Drinking Water Regulation, 2009.

Table 5.30: Summary of Surface Water Dry Season Sampling Laboratory Results

Parameter	Unit	LOQ	Results	Myanmar Standards	IFC Standards[a]	EPA Standards[b]
Alkalinity	mg/L as $CaCO_3$	1.0	82.1 – 149	-	-	-
Biochemical Oxygen Demand (BOD)	mg/L	-	0.2 – 3.0	50	30	-
Total Suspended Solids (TSS)	mg/L	10.0	<10.0 – **1,211**	50	50	-
Total Dissolved Solids (TDS)	mg/L	50.0	**4,052 – 12,760**	-	-	250
Turbidity	NTU	0.02	4.32 – 646	-	-	-
Hardness as $CaCO_3$	mg/L as $CaCO_3$	5.0	703 – 1,945	-	-	-
Cyanide (CN)	mg/L	0.005	<0.005	0.1 (Free) 1.0 (Total)	-	0.004
Fluoride (F)	mg/L	0.1	<0.1 – 0.4	20	-	-
Sulphide	mg/L	1.0	<1.0	1	-	-
Total Organic Carbon	mg/L	0.05	1.63 – 6.86	-	-	-
Ammonium-Nitrogen	mg/L	0.010	0.035 – 0.499	10	-	-
Sulphate (SO_4)	mg/L	1.0	105 – 579	-	-	-
Nitrate (NO_3)	mg/L	0.005	<0.040 – 2.38	-	-	10
Chromium (Cr)	mg/L	0.0005	0.0007 – 0.0391	0.1 (Cr^{6+}) 0.5 (Total)	0.5 (Total)	0.1 (Total)

Parameter	Unit	LOQ	Results	Myanmar Standards	IFC Standards[a]	EPA Standards[b]
Calcium (Ca)	mg/L	0.02	59.90 – 185.98	-	-	-
Magnesium (Mg)	mg/L	0.003	92.04 – 386.15	-	-	-
Sodium (Na)	mg/L	0.01	836.20 – 2,651	-	-	-
Potassium (K)	mg/L	0.01	37.89 – 123.68	-	-	-
Mercury (Hg)	mg/L	0.0003	<0.0003 - 0.0006	0.01	0.005	-
Lead (Pb)	mg/L	0.0020	<0.0020 – 0.0079	0.1	0.5	-
Cadmium (Cd)	mg/L	0.00005	<0.00005 – 0.00014	0.1	0.1	0.005
Copper (Cu)	mg/L	0.05	<0.05 – 0.06	0.5	0.5	1.3
Iron (Fe)	mg/L	0.10	0.036 – **75.29**	3.5	1.0	-
Tin (Sn)	mg/L	0.0001	<0.0001 – 0.001	-	-	-
Manganese (Mn)	mg/L	0.04	0.05 – **1.40**	-	-	0.05
Total Nitrogen	mg/L	1.0	<1.0	-	-	-
Total Phosphorous	mg/L	0.005	0.005 – 0.347	2	2	-
Zinc (Zn)	mg/L	0.02	<0.02 – 0.17	2	1.0	7.4
Nickel (Ni)	mg/L	0.0005	0.0014 – 0.0275	0.5	-	0.61
Chloride (Cl)	mg/L	1.0	2,094 – 6,511	-	-	-
Oil and Grease	mg/L	2.0	3.9 – 7.0	10	10	-
Chemical Oxygen Demand (COD)	mg/L	5.0	13.0 – 81.0	250	125	-

Source: STS Green, 2018.

Note: [a] *World Health Organization (WHO), Guidelines for Drinking-Water Quality, Fourth Edition Incorporating the First Addendum, Annex 3: Chemical summary tables.*
[b] *United States Environmental Protection Agency (EPA), National Primary Drink Water Regulations & National Secondary Drinking Water Regulation, 2009.*

Wet Season Survey

According to the wet season results from STS Green, TSS and iron was found at levels (between 117-904 mg/L) above Myanmar NEQG Standard and IFC Standards (50 mg/L) at all sampling stations. This is most likely due to soil erosion that occurs upstream from the sampling locations; however, compared to dry season there are more sampling locations in the wet season that exceeded the standard. This variation is most likely due to increased precipitation during the wet season, resulting in increased soil erosion.

It should also be noted that mercury at SW9 (0.0053 mg/L) slightly exceeds the IFC standards (0.005 mg/L); however, is still within the Myanmar NEQG Standards (0.01 mg/L). Manganese concentrations at all sampling locations (0.14 – 0.85 mg/L) exceed the EPA Standard (0.05 mg/L).

All other parameters were found to be within the Myanmar NEQG Standards, IFC Standards, and EPA Standards.

Photographs of the baseline sampling operations are shown in ***Figure 5.18***.

The results from in-situ sampling is shown in ***Table 5.31***, and ***Table 5.32***. The summary of laboratory results is shown in ***Table 5.33***; the full results with individual station results is shown in ***Appendix P***.

Figure 5.18: Photographs of Surface Water Sampling during Wet Season

Source: SEM, 2018.

Table 5.31: In-Situ Results of Surface Water Wet Season Sampling (1 of 2)

No.	Sample No./ Physical Parameter	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8	Myanmar Standards	EPA Standards[a]
1	Location	Up stream of Yangon River	Downstream of Yangon River	At mouth of Twantae Canal (up)	At mouth of Twantae Canal (below)	Ka Ma Aung Stream (down)	Up stream of Ka Ma Aung Stream	Downstream of Pyaw Bwe Stream	Up stream of Pyaw Bwe Stream	-	-
2	Date/Time	27/6/2018 13:04	27/6/2018 12:35	27/6/2018 11:30	27/6/2018 11:15	29/6/2018 13:20	29/6/2018 13:20	29/6/2018 12:10	29/6/2018 12:15	-	-
3	Weather	Rainy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Sunny	Sunny	-	-
4	Transparency	Medium to high	Medium to high	Medium to high	Medium to high	Medium	Medium	Medium	Medium	-	-
5	Colour	-	-	-	-	Light Yellow	Light Yellow	Light Yellow	Light Yellow	-	-
6	Water Depth (m)	14	8.1	8.6	8.0	-	-	-	-	-	-
7	Depth (of sample taken) (m)	1	1	1	1	-	-	-	-	-	-
8	Flow rate/velocity (m/s)	0.2	0.1	1.5	0.2	-	-	-	-	-	-
9	Tem (°C) (air & water)	27.54	27.49/31.20	29.82/32	27.61/32	33.00/30.05	32.30/31.59	37.50/29.95	37.60/30.43	-	-
10	pH	7.53	7.50	7.86	7.11	6.58	6.68	6.71	6.39	6-9	5-9
11	DO (mg/l)	7.14	7.26	7.11	76.01	1.29	1.22	3.45	3.65	-	-
12	EC (µs/m)	121.0	126.23	241.7	135.51	190.8	129.0	66.4	54.1	-	-
13	TDS (ppm)	75.02	76.85	154.74	121.62	113.26	74.33	39.44	31.83	-	-
14	Remark	Sampling and In-situ test	Sampling and In-situ test	Sampling and In-situ test	Sampling and In-situ test	Sampled on 28/6/2018 13:15	Sampled on 28/6/2018 13:30	Sampled on 28/6/2018 12:35	Sampled on 28/6/2018 12:50	-	-

Table 5.32: In-Situ Results of Surface Water Wet Season Sampling (2 of 2)

No.	Sample No./ Physical Parameter	SW 9	SW 10	SW 11	SW 12	SW 13	SW 14	Myanmar Standards	EPA Standards[a]
1	Location	Up stream of Pyaw Bwe Stream	Downstream of Pyaw Bwe Stream	Up stream of Ya Kaing Gyaung Stream	Downstream of Ya Kaing Gyaung Stream	Near FSRU Option 2, Yangon River	Near FSRU Option 2, Yangon River	-	-
2	Date/Time	29.6.2018 12:00	29.6.2018 11:50	29.6.2018 11:30	29.6.2018 11:40	28.6.2018 12:41	3.5.2018 12:00	-	-
3	Weather	Sunny	Sunny	Sunny	Sunny	Cloudy	Cloudy	-	-
4	Transparency	Medium	Medium	Medium	Medium	Medium to high	Medium to high	-	-
5	Colour	Light Yellow	Light Yellow	Light Yellow	Light Yellow	-	-	-	-
6	Water Depth (m)	-	-	-	-	10.5	7.9	-	-
7	Depth (of sample taken) (m)	-	-	-	-	1	1	-	-
8	Flow rate/velocity (m/s)	-	-	-	-	0.5	1.2	-	-
9	Tem (°C) (air & water)	39.00/29.44	37.90/29.29	40.10/29.37	39.50/29.10	32/28	31/28.1	-	-
10	pH	6.41	6.54	6.25	6.38	7.58	7.12	6-9	5-9
11	DO (mg/l)	3.76	4.18	3.65	3.45	6.38	5.65	-	-
12	EC (µs/m)	122.1	125.0	221.7	230.4	125.6	135	-	-
13	TDS (ppm)	73.19	75.11	132.93	138.89	77.20	64	-	-
14	Remark	Sampled on 28/6/2018 11:15	Sampled on 28/6/2018 11:30	Sampled on 28/6/2018 10:25	Sampled on 28/6/2018 10:47	Sampling and Insitu test	Sampling and Insitu test	-	-

Source: SEM, 2018.

Note: [a] *United States Environmental Protection Agency (EPA), National Primary Drink Water Regulations & National Secondary Drinking Water Regulation, 2009.*

Table 5.33: Summary of Surface Water Wet Season Sampling Laboratory Results

Parameter	Unit	LOQ	Results	Myanmar Standards	IFC Standards[a]	EPA Standard[b]
Alkalinity	mg/L as CaCO3	1.0	8.2 – 49.3	-	-	-
Biochemical Oxygen Demand (BOD)	mg/L	-	0.5 – 2.8	50	30	-
Total Suspended Solids (TSS)	mg/L	10.0	**117 – 904**	50	50	-
Total Dissolved Solids (TDS)	mg/L	50.0	76.0 – 246	-	-	250
Turbidity	NTU	0.02	295 – 968	-	-	-
Hardness as CaCO3	mg/L as CaCO3	5.0	15.2 – 70.0	-	-	-
Cyanide (CN)	mg/L	0.005	<0.005	0.1 (Free) 1.0 (Total)	-	0.004
Fluoride (F)	mg/L	0.1	<0.1	20	-	-
Sulphide	mg/L	1.0	<1.0	1	-	-
Total Organic Carbon	mg/L	0.05	3.12 – 9.61	-	-	-
Ammonium-Nitrogen	mg/L	0.010	0.047 – 0.621	10	-	-
Sulphate (SO4)	mg/L	1.0	<1.0 – 14.4	-	-	-
Nitrate (NO3)	mg/L	0.005	0.420 – 2.40	-	-	10
Chromium (Cr)	mg/L	0.0005	0.02 – 0.0798	0.1 (Cr^{6+}) 0.5 (Total)	0.5 (Total)	0.1 (Total)
Calcium (Ca)	mg/L	0.02	<0.02 – 10.56	-	-	-
Magnesium (Mg)	mg/L	0.003	2.01 – 14.85	-	-	-
Sodium (Na)	mg/L	0.01	4.43 – 18.61	-	-	-
Potassium (K)	mg/L	0.01	1.46 – 3.25	-	-	-
Mercury (Hg)	mg/L	0.0003	0.0019 – **0.0053**	0.01	0.005	-
Lead (Pb)	mg/L	0.0020	0.0062 – 0.0155	0.1	0.5	-
Cadmium (Cd)	mg/L	0.00005	<0.00005 – 0.00031	0.1	0.1	0.005
Copper (Cu)	mg/L	0.05	<0.05	0.5	0.5	1.3

Parameter	Unit	LOQ	Results	Myanmar Standards	IFC Standards[a]	EPA Standard[b]
Iron (Fe)	mg/L	0.10	**22.15 – 44.89**	3.5	1.0	-
Tin (Sn)	mg/L	0.0001	<0.0001 – 0.0008	-	-	-
Manganese (Mn)	mg/L	0.04	**0.14 – 0.85**	-	-	0.05
Total Nitrogen	mg/L	1.0	<1.0 – 1.6	-	-	-
Total Phosphorous	mg/L	0.005	0.155 – 0.456	2	2	-
Zinc (Zn)	mg/L	0.02	<0.02 – 0.10	2	1.0	7.4
Nickel (Ni)	mg/L	0.0005	0.0160 – 0.1297	0.5	-	0.61
Chloride (Cl)	mg/L	1.0	3.3 – 31.5	-	-	-
Oil and Grease	mg/L	2.0	<2.0 – 5.0	10	10	-
Chemical Oxygen Demand (COD)	mg/L	5.0	18.9 – 81.9	250	125	-

Source: STS Green, 2018.

Note: [a] *World Health Organization (WHO), Guidelines for Drinking-Water Quality, Fourth Edition Incorporating the First Addendum, Annex 3: Chemical summary tables.*
[b] *United States Environmental Protection Agency (EPA), National Primary Drink Water Regulations & National Secondary Drinking Water Regulation, 2009.*

5.1.6 Soil

5.1.6.1 Soil Type

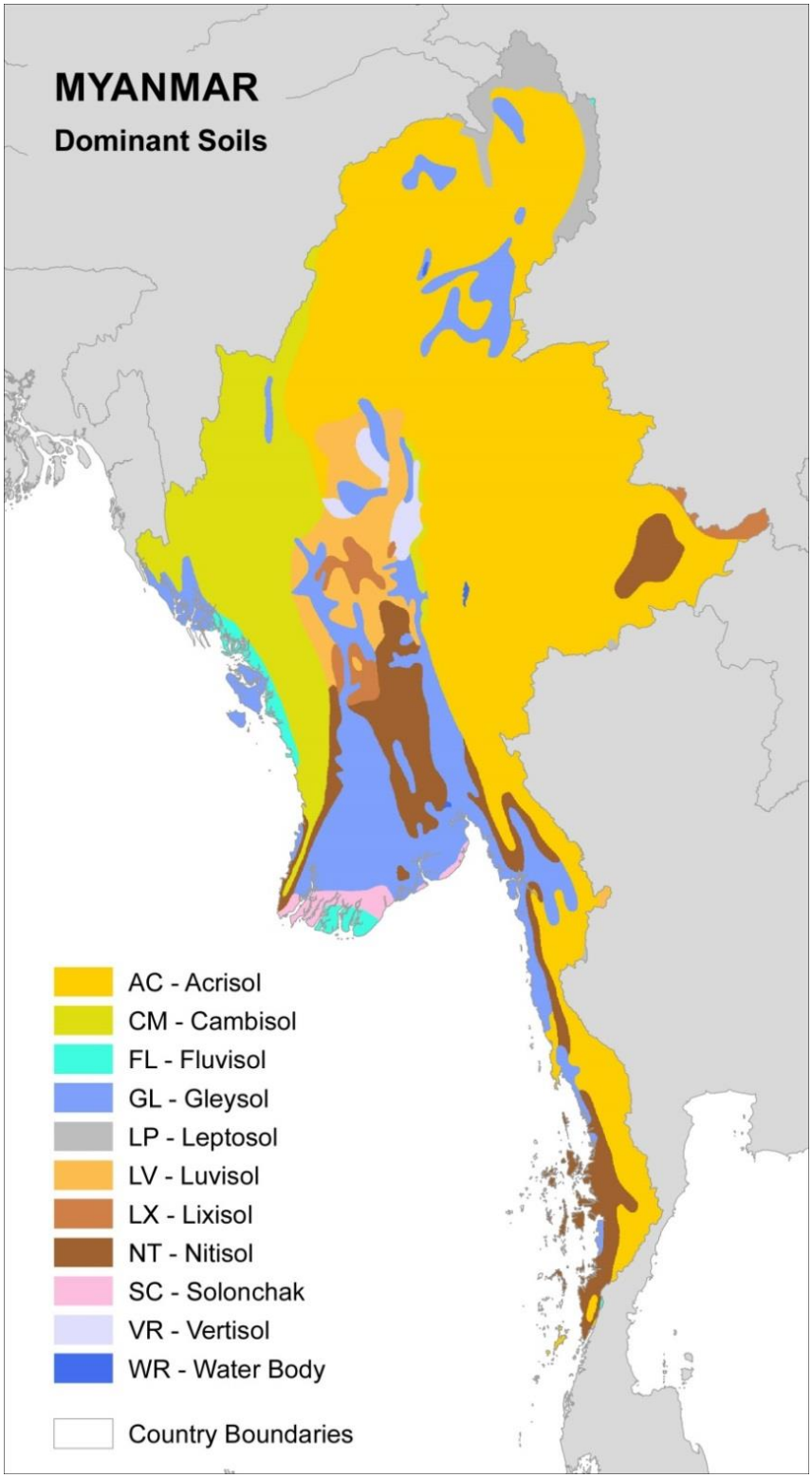
The Study Area is located on Meadow (Gleysol) and Meadow Alluvial soil (Fluvic Gleysols). The Meadow soil distributes near the river plains where occasional tidal floods occur and are typically non-carbonate, and they usually contain large amount of salts. Meadow Alluvial soil can be found in the flood plains. They have the texture of silty clay loam and are rich in plant nutrients (Union of Myanmar, 2009).

The soil types in Myanmar can generally be divided into ten (10) dominant subsoil types as presented in ***Figure 5.19***. The Project is located on soil identified as Gleysol. This soil type is described as follows[27]:

- Hydromorphic properties within 50 cm of the surface; and
- No diagnostic horizons other than (unless buried by 50 cm or more new material) an A horizon, an H horizon, a cambic B horizon, a calcic or a gypsic horizon.

[27] FAO. (1974). Key to the FAO Soil Units (1974). Food and Agriculture Organization of the United Nations (FAO). Retrieved April 12, 2017 from http://www.fao.org/soils-portal/soil-survey/soil-classification/fao-legend/key-to-the-fao-soil-units/en/

Figure 5.19: Soil Types and Distribution in Myanmar



Source: FAO, 2008.[28]

[28] FAO. (2008). Geographical distribution of 10 dominant soil types in Myanmar. Myanmar – FAO/NR Data, Tools and Maps (General). Food and Agriculture Organization of the United Nations (FAO). Retrieved from http://www.fao.org/nr/myanmar/page4_en.htm

5.1.6.2 Soil Quality

Baseline Soil Sampling Methodology

Soil samples were collected from nine (9) sample points in the Study Area on the 3rd – 4th May 2018, and were tested for several types of parameters which are listed together with the results below. All sampling was conducted in strict accordance with recognized standard procedures, as listed together with the sampling results in ***Appendix N***. Soil sampling has been conducted during dry season; parameters that were selected for sampling are listed below.

The soil samples were collected using a manual hand auger tool, and the samples were collected from top soil (30 cm – 50 cm depth) and sub soil (80 cm – 100 cm depth). The location of each sampling point is shown in ***Figure 5.20***. The results of the analysis are presented in ***Table 5.36*** and ***Table 5.37***, and have been compared against USEPA Regional Screening Levels (RSL), which are risk-based concentrations derived from standardized equations combining exposure information with EPA toxicity data.

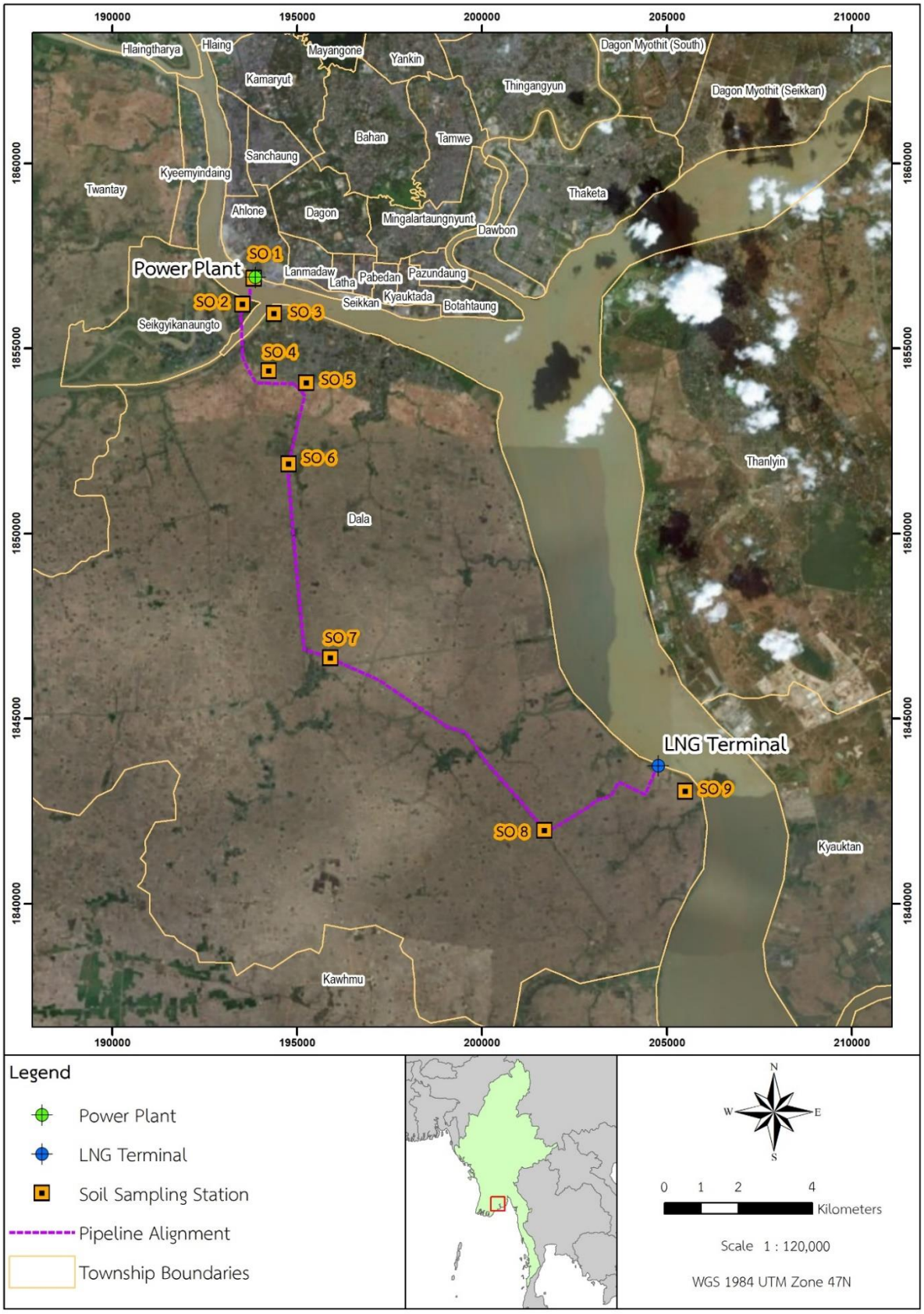
Baseline Soil Sampling Locations

The description of the soil sampling locations can be found in ***Table 5.34***. The location of each soil sampling site is shown in ***Figure 5.20***.

Table 5.34: Soil Sampling Locations

Sampling Point	Coordinates	Description of Sampling Point
SO 1	16°46'29.86"N 96° 07'41.17"E	Located within the Combined Cycle Power Plant, in AhloneTownship, Yangon Region. Area mainly covered by shrub land mangrove forest.
SO 2	16°46'7.14"N 96° 7'31.01"E	Located within Seikgyikanaungto Township, on the corner of Yangon River and Twan Te Canal. Approximately 60 meters southeast of the proposed gas pipeline.
SO 3	16°45'59.11"N 96° 8'0.06"E	Located within Dala Township, on the right back of the left bank of Twan Te Canal. Approximately 100 meters northeast of the proposed gas pipeline.
SO 4	16°45'9.01"N 96° 7'55.77"E	Beside the street which is located in Kyansitthar Ward, Dala Township, Yangon Region. Approximately 30 meters west of the proposed gas pipeline.
SO 5	16°44'59.06"N 96° 8'30.30"E	Beside the road (near the paddy field), in Tapinshwehtee Ward, Dala Township, Yangon Region. Approximately 20 meters southwest of the proposed gas pipeline.
SO 6	16°43'47.49"N 96° 8'15.41"E	In the paddy field which located west of Gwa & Nuaung Ngok To Village, Dala Township, Yangon Region. Approximately 30 meters East of the proposed gas pipeline.
SO 7	16°40'57.68"N 96° 8'55.93"E	In the paddy field (near Pyaw Bwe Gyi Village) which located in Dala Township, Yangon Region. The location has a flat terrain, consisting of agricultural land.
SO 8	16°38'28.81"N 96°12'13.19"E	In the stream (the stream was run dry for now) which located in Shan Gan Village, Dala Township, Yangon Region. Approximately 10 meters southwest of the proposed gas pipeline.
SO 9	16°39'4.89"N 96°14'20.95"E	In the paddy field (near FSRU Option 2), right bank of river, Chaung Oo Village, Dala Township, Yangon Region. This location has a flat terrain, consisting of agricultural land.

Figure 5.20: Soil Sampling Locations



Source: ERM, 2018.

Summary of Baseline Sampling Results

There are no Myanmar regulations/standards for ambient soil or groundwater quality. In the absence of local country standards, it is ERM's practice to use globally recognized 'Dutch Target and Intervention Values, 2000 (the New Dutch List)' (hereafter referred to as "the Dutch Standard") to assess soil quality and to determine the need, if any, for remedial action.

According to the soil sampling results, sampling site SO 2 exceeded the target value for copper in top soil, and SO 4 exceeded the Dutch Standard for copper in subsoil (between 37.44 and 38.29 mg/kg). Sub-soil at site SO 2 also exceeded the target value for mercury (1.04 mg/kg).

Other remaining sampling sites and parameters were found to be within the Dutch Standard.

SEM also conducted in-situ observations and analysis of soil characteristics at each sampling site, and the results are shown in ***Table 5.35***.

Table 5.35: Soil Characteristics

Sampling Site	Soil Characteristics
SO 1	The top soil and sub soil are mainly composed of organic materials and mud with dark grey colour. The typical soil type is clayey soil.
SO 2	The top soil and sub soil colour are light grey to reddish brown and mainly composed of residual organic materials. The soil type is silty clay.
SO 3	The top soil and sub soil are brownish grey colour, and the soil type is clay.
SO 4	The top soil and sub soil are light brown colour, and the soil type is silty clay.
SO 5	The top soil and sub soil are greyish brown colour, and the soil type is clayey soil.
SO 6	The top soil and sub soil are light brown colour, and the soil type is silty clay.
SO 7	The top soil and sub soil are light brown colour, and the soil type is silty clay.
SO 8	The top soil and sub soil are dark brown colour, and the soil type is clayey soil.
SO 9	The top soil and sub soil colour are light brown colour, and the soil type is silty clays.

Source: SEM, 2018.

Table 5.36, and ***Table 5.37*** presents the baseline results for laboratory analysis from the surveys conducted in May 2018.

Table 5.36: Results from Soil Quality Sampling for Dry Season Survey (Station SO 1-SO 5)

Parameter	Unit	Results										Dutch Standard[a]	
		SO 1		SO 2		SO 3		SO 4		SO 5		Target values	Intervention Value
		Top Soil	Sub Soil	Top Soil	Sub Soil	Top Soil	Sub Soil	Top Soil	Sub Soil	Top Soil	Sub Soil		
pH	-	7.3	7.2	7.7	7.3	7.6	7.2	8.0	7.8	7.4	7.4	-	-
Arsenic (As)	mg/kg	0.30	<0.04	<0.04	<0.04	<0.04	<0.04	3.80	5.90	<0.04	<0.04	29	55
Cadmium (Cd)	mg/kg	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	0.8	12
Chromium (Cr)	mg/kg	47.54	36.82	74.99	73.34	63.39	71.71	66.66	70.60	56.20	56.87	100	380
Copper (Cu)	mg/kg	25.13	9.03	**38.29**	27.29	36.07	34.78	35.12	**37.44**	27.74	23.70	36	190
Iron (Fe)	mg/kg	35,912	25,382	67,059	62,391	62,995	57,391	7,449	6,942	8,684	6,068	-	-
Lead (Pb)	mg/kg	31.59	8.53	25.51	26.92	26.04	25.62	26.84	33.20	28.74	<5.00	85	530
Manganese (Mn)	mg/kg	461.10	229.01	894.26	873.51	1,209	1,448	1,039	536.19	947.18	737.08	-	-
Mercury (Hg)	mg/kg	<0.10	<0.10	**1.04**	0.12	0.13	0.15	0.10	0.10	<0.10	0.10	0.3	10
Zinc (Zn)	mg/kg	70.30	39.10	103.96	107.18	105.59	101.36	101.81	100.64	84.50	70.81	140	720

Source: STS Green, 2018.

Note: [a] Earth Intervention value, Dutch Target and Intervention Values, 2000

Table 5.37: Results from Soil Quality Sampling for Dry Season Survey (Station SO 6-SO 9)

Parameter	Unit	Results								Standard[a]	
		SO 6		SO 7		SO 8		SO 9		Target values	Intervention Value
		Top Soil	Sub Soil	Top Soil	Sub Soil	Top Soil	Sub Soil	Top Soil	Top Soil		
pH	-	6.8	8.1	6.7	7.5	7.6	7.8	7.8	7.5	-	-
Arsenic (As)	mg/kg	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	29	55
Cadmium (Cd)	mg/kg	<1.00	<1.00	<0.10	<1.00	<1.00	<1.00	<1.00	<1.00	0.8	12
Chromium (Cr)	mg/kg	64.97	68.02	60.84	64.10	63.83	64.62	72.61	74.00	100	380
Copper (Cu)	mg/kg	29.34	31.95	30.01	29.04	<1.50	29.26	33.64	31.93	36	190
Iron (Fe)	mg/kg	11,140	9,738	5,703	9,995	59,965	53,394	54,513	55,400	-	-
Lead (Pb)	mg/kg	24.56	22.94	23.81	24.05	16.43	21.16	32.49	26.95	85	530
Manganese (Mn)	mg/kg	1,196	1,662	651.12	829.18	783.22	628.56	641.31	566.36	-	-
Mercury (Hg)	mg/kg	0.12	<0.10	<0.10	0.12	0.10	0.10	0.12	<0.10	0.3	10
Zinc (Zn)	mg/kg	87.05	93.86	83.44	84.73	79.25	86.06	96.16	89.28	140	720

Source: STS Green, 2018.

Note: [a] Earth Intervention value, Dutch Target and Intervention Values, 2000

5.1.7 Groundwater

5.1.7.1 Hydrogeology

On the basis of stratigraphy, there are 13 different types of aquifers in Myanmar, namely Alluvium, Irrawaddian, Peguan, Limestone, Igneous (or Volcanic) and Other Minor Aquifers. The Study Area is underlain by Alluvium aquifers (***Figure 5.21***).

In general, groundwater aquifers are prone to leaching during the monsoon periods, especially on impervious surfaces, e.g. clay seams, clay layers, bedrocks, etc. Rising groundwater can cause saturation of the soil and can cause very high pore-water pressure in slopes in sedimentary deposits.

The estimated groundwater potential in the Ayeyarwady (Lower) Region, where the Project is located, is 153.25 km^3, as shown in ***Table 5.38***.

Table 5.38: Estimated Groundwater Potential across Myanmar

River Basin	Catchment Area (km^2)	Groundwater Potential (km^3)
Chiuindwin	115,300	57.58
Ayeyarwady (Upper)	193,300	92.60
Ayeyarwady (Lower)	95,600	153.25
Sittoung	48,100	28.40
Rivers in Rakhine State	58,300	41.77
Rivers in Tanintharyi Region	40,600	39.28
Thanlwin (within Myanmar)	158,000	74.78
Mekong (within Myanmar)	28,600	7.05
Total	**737,800**	**494.71**

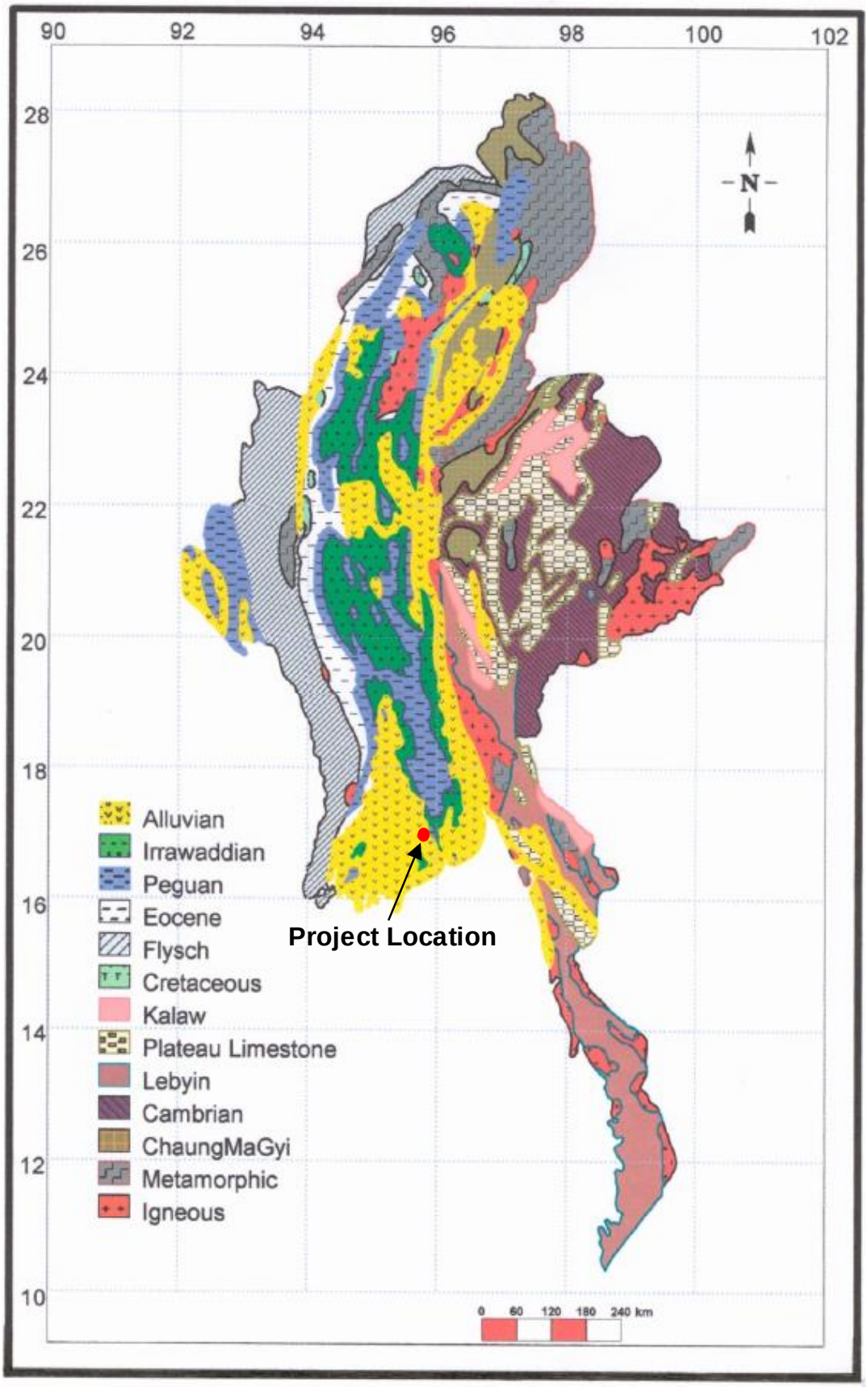
Source: Zaw et al, 2017.[29]

The China Geological Survey has organized the publication of a document titled “Groundwater Serial Maps of Asia”, which was compiled by the Institute of Hydrogeology and Environmental Geology of CAGS in 2012, and summarizes research on groundwater systems in Asian countries, including Myanmar. Excerpts of two useful maps from this document, a Hydrogeological Map, and Groundwater Resources Map, are presented in ***Figure 5.22*** and ***Figure 5.23***, respectively.

Based on these maps, the productivity of aquifers near the Study Area can be classified as “Strong Pore Water”, or “Weak Fissure Water”, and groundwater quality is considered “Fresh Groundwater”. The groundwater type ranges from “Pore Water” to “Fractured Water”. Groundwater resources classifications consist of "Discontinuous Aquifer in Hilly Area" and "Continuous Aquifer in Plain and Intermontaine Basin", with Natural Recharge Modulus ranging from 200,000-500,000 m^3/km^2-yr.

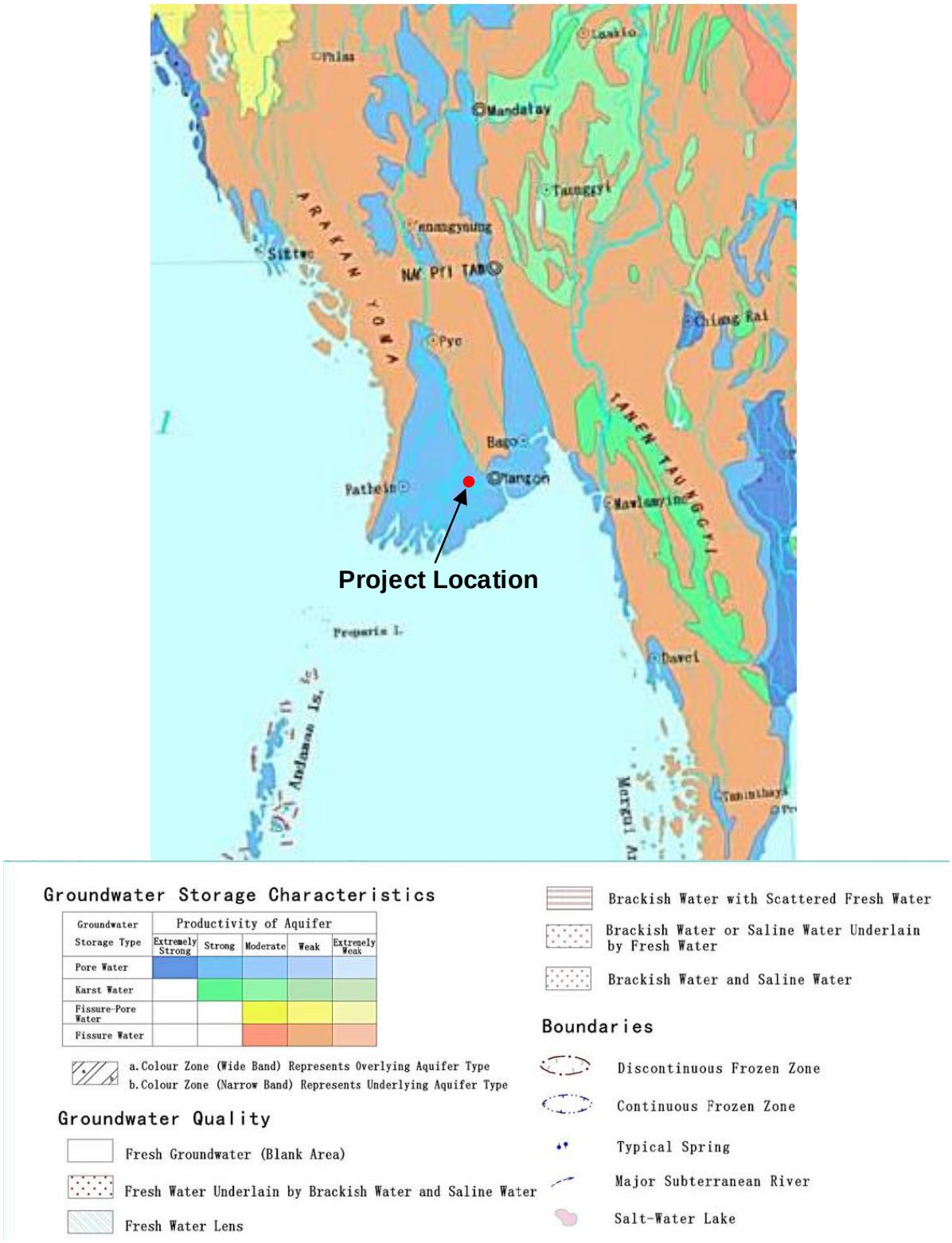
[29] Zaw, T., Than, M.M. (2017). Climate change and groundwater resources in Myanmar. Journal of Groundwater Science and Engineering. Retrieved from http://gwse.iheg.org.cn/EN/abstract/abstract260.shtml#

Figure 5.21: Major Aquifers of Myanmar



Source: Zaw, 2017.[29]

Figure 5.22: Hydrogeological Map of Myanmar



Source: CGS, 2012.[30]

[30] CGS. (2012). Groundwater Serial Maps of Asia. China Geological Survey (CGS). Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000220768

Figure 5.23: Groundwater Types in Myanmar

Source: Adapted from Groundwater Serial Maps of Asia", which was compiled by the Institute of Hydrogeology and Environmental Geology of CAGS in 2012.

5.1.7.2 Groundwater Use

Exploitation of Myanmar's aquifers has thus far been limited to municipal water supply and intensive irrigation of vegetables and other high value crops from hand-dug wells[31]. Water use in Myanmar has been increasing, particularly in the agricultural and industrial sectors. ***Table 5.39*** shows the water use in different sectors for the year 2008-09. As much as 89% of water use is tapped for irrigation purposes, while about 8% is for domestic consumption and 3% is for industry.

Table 5.39: Water Use by Different Sectors in Myanmar

Sector	Surface Water	Groundwater	Total
Domestic	1.15 (3%)	2.55 (68%)	3.7 (8%)
Industrial	1.17 (3%)	0.33 (9%)	1.5 (3%)
Irrigation	41.97 (94%)	0.85 (23%)	42.82 (89%)
Total	**44.29**	**3.73**	**48.02**

Source: FAO, 2012.[32]

5.1.7.3 Groundwater Quality

Baseline groundwater quality sampling surveys in the Study Area have been conducted, as part of this ESIA study. An overview of the surveys and their results are presented in this section.

Baseline Groundwater Sampling Methodology

Groundwater samples were taken by an Alpha horizontal water sampler for some wells and collected in plastic and sterilized glass sample containers. All sampling was conducted in strict accordance to recognized standard procedures as listed together with the sampling results below. The parameters pH, temperature, dissolved oxygen (DO), electrical conductivity (EC), total dissolved solids, odour, and colour were measured at each site in-situ. The parameters that were measured by laboratory analysis are listed together with the results below.

Full detail of sampling methods and in-situ measurement results is shown in ***Appendix M*** and ***Appendix O***. Groundwater sampling has been conducted for both dry and wet seasons; parameters that were selected for sampling are listed below.

According to the sample's storage requirements as instructed by STS Green, some samples were preserved using appropriate preservation chemicals. All samples were kept in iced boxes and were transported to the laboratory within 24 hours. The detailed study of groundwater quality is presented in the ***Appendix N*** and ***Appendix P***.

The equipment that were used to collect groundwater quality samples are listed in ***Table 5.40***.

[31] FAO. (1999), AQUASTAT Country-profile: Myanmar. Retrieved from http://www.fao.org/nr/myanmar/aquastat-myanmar.pdf

[32] FAO. (2012). Myanmar: Water use. Food and Agriculture Organization of the United Nations (FAO). Retrieved from http://www.fao.org/nr/water/aquastat/countries_regions/MMR/

Table 5.40: Field Equipment for Groundwater Quality Survey

No.	Equipment	Manufacturer	Originate Country	Model/Serial No.
1	SMART TROLL MP _Multi parameter for water	In Situ Inc.	USA	SN - 346054
2	Multi Parameters for water quality	HANNA	USA	H17609823 (Turbidity Sensor)
3	Alpha Bottle (Water Sampler)	Wildlife Supply Company	Indonesia	Wildco P/N-1120-G45

Source: SEM, 2018.

Baseline Groundwater Sampling Locations

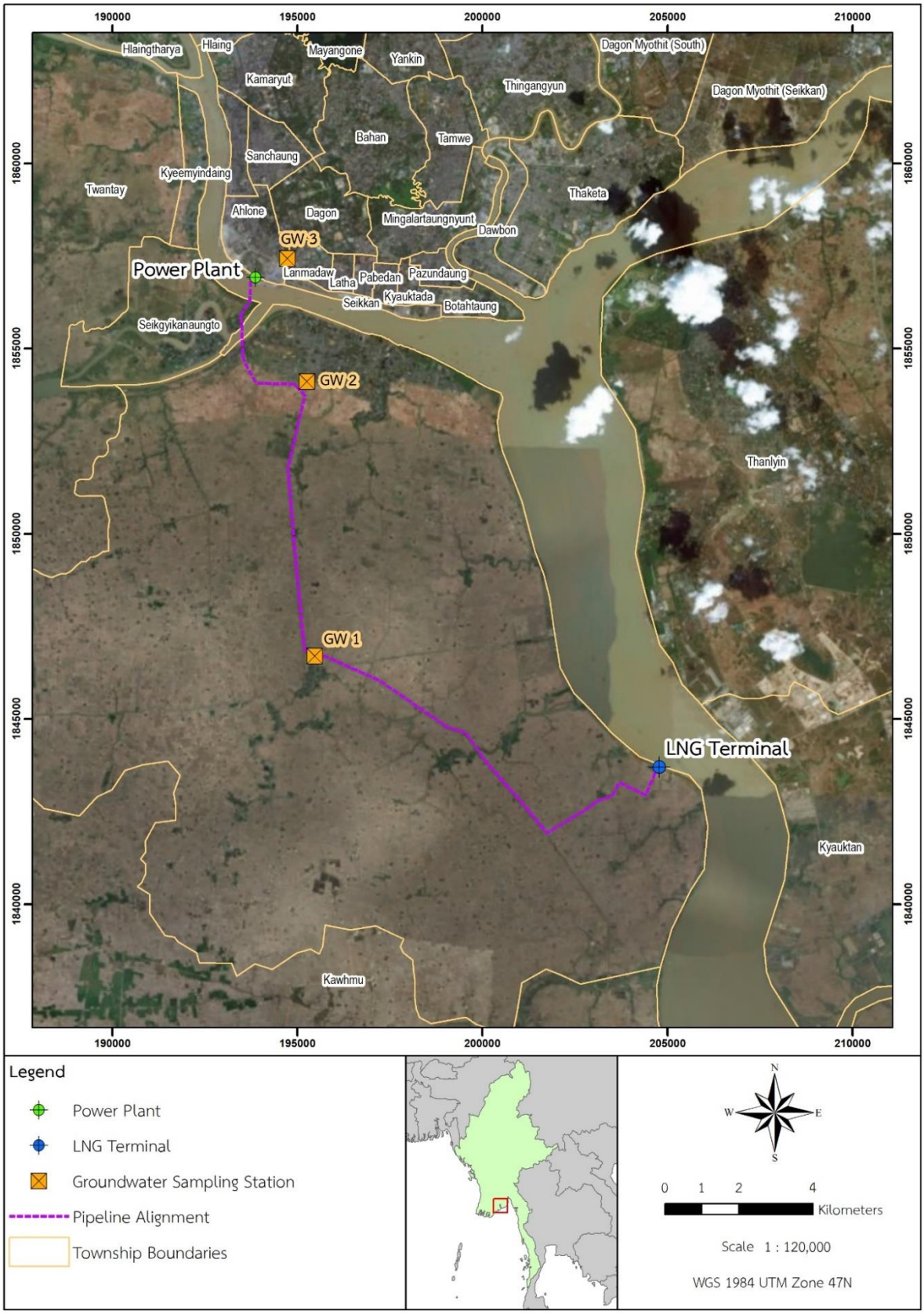
Groundwater samples were collected by SEM and ERM-Siam on the 3rd - 4th May, 2018, at three (3) locations as shown in ***Figure 5.24***, and each location is described in ***Table 5.41***.

Table 5.41: Groundwater Sampling Locations

Sampling Point	Coordinates	Description of Sampling Point
GW 1	16°40'59.81"N 96° 8'41.28"E	The sampling point is a domestic well within Pyaw Bwe Gyi Village, and is located 90 meters south of the proposed pipeline. Although there are rice mills and houses surrounding the sampling point, the well is only used for domestic, non-drinking use. The sample from this point has been collected from a depth of 6 m and the transparency of the water is high.
GW 2	16°45'0.67"N 96° 8'30.66"E	The sampling point is a well located beside the Botaza road, in Dala Township, and approximately 40 meters south of the pipeline. The well is only used for domestic purpose and not for drinking. The well has a depth of approximately 15 metres. Water samples collected from the well was colourless; however, after a few minutes it turned yellowish.
GW 3	16°46'48.11"N 96° 8'11.26"E	The sampling point is a well located in Tha Khin Mya park, in Ahlone Township, and approximately 1.01 km northeast of the Power Plant. It is also positioned at the corner of Lower Kyeemyindaing Road and Aung Yadana Street. This well is mainly used for domestic purposes. Water samples were collected from a depth of approximately 13.7 metres. The water sample has high transparency.

Source: SEM, 2018.

Figure 5.24: Groundwater Sampling Locations



Source: ERM, 2018.

Summary of Baseline Sampling Results

Dry Season Survey

The dry season sampling results are shown in ***Table 5.42***, and ***Table 5.43***.

The iron (Fe) concentration at GW1 (9.68 mg/L), and GW2 (3.86 mg/L) exceeds the Myanmar Standard (1 mg/L) and EPA Standard (0.3 mg/L). This is most likely due to the natural process of leaching.

The TDS concentrations at GW1 (14,170 mg/L), and GW2 (3,242 mg/L) exceeded the EPA Standard (500 mg/L). This correlation may also explain the noticeably high Electrical Conductivity (EC) values in GW1.

Although the Myanmar Standard does not specify any limits to Nitrate (NO_3), the standards specified by the World Health Organization (WHO), and/or the EPA Standard indicates that Nitrate (NO_3) exceeds the limit for all three sampling locations.

The Manganese concentration at GW1 (0.4 mg/L), and GW2 (2.94 mg/L) exceeds the EPA Standard (0.05 mg/L). Chloride concentrations at GW1 (7,103 mg/L), and GW2 (1,438 mg/L) exceeds the EPA Standard (250 mg/L).

All other parameters were found to be within the Myanmar standards, EPA, and WHO guidelines.

It should also be noted that most parameters follow a trend whereby GW1 has the highest concentration of the measured parameters, followed by GW2, with GW3 having the lowest concentration of the three measured stations.

Table 5.42: Results of In-situ Groundwater Quality Measurement and Analysis for Dry Season

No.	Sample No./ Physical Parameter	GW1	GW2	GW3	Myanmar Standards	EPA Standards[a]
1	Location	Pyaw Bwe Gyi Village	Beside the Botaza Road, Dala	Tha Khin Mya Park	-	-
2	Date/Time	5/5/2018 14:45	5/5/2018 15:32	5/5/2018 17:10	-	-
3	Weather	Sunny	Slightly Cloud	Slightly Sunny	-	-
4	Transparency	High	Low to High	High	-	-
5	Colour	Colourless	Slightly Yellow	Colourless	-	-
6	Water Depth (m)	6	15	34	-	-
7	Depth (of sample taken) (m)	-	-	-	-	-
8	Flow rate/velocity (m/s)	-	-	-	-	-
9	Tem (°C) (air & water)	30.4	28.4	25.1	-	-
10	pH	7.37	6.7	7.04	6-9	6.5-8.5
11	DO (mg/l)	1.25	1.15	2.32	-	-
12	EC (µs/m)	25,986.5	5,599.5	184	-	-
13	TDS (ppm)	15,266.76	3,367.46	111.41	-	-
14	Turbidity (FNU)	-	-	-	-	-
	Remark	Sampled on 3/5/2018 14:15	Sampled on 3/5/2018 15:15	Sampled on 4/5/2018 14:30		

Source: SEM, 2018.

Note: [a] *United States Environmental Protection Agency (EPA), National Primary Drink Water Regulations & National Secondary Drinking Water Regulation, 2009*

Table 5.43: Results from Groundwater Quality Analysis for Dry Season Survey

Parameter	Unit	Method Analysis	LOQ	Results			Myanmar Standards	WHO Guidelines[a]	EPA Standards[b]	Laboratory
				GW1	GW2	GW3				
Sampling Date				3/5/2018	3/5/2018	4/5/2018				
Alkalinity	mg/L as $CaCO_3$	5-Day BOD Test, Azide Modification Method	1.0	650	152	17.1	-	-	-	STS Green Co., Ltd.
Biochemical Oxygen Demand (BOD)	mg/L	Dried at 103-105 ^oC Method	-	0.2	0.4	0.2	50	-	-	STS Green Co., Ltd.
Total Suspended Solids (TSS)	mg/L	Dried at 180 ^oC Method	10.0	48.6	<10.0	<10.0	50	-	-	STS Green Co., Ltd.
Total Dissolved Solids (TDS)	mg/L	Nephelometric Method	50.0	**14,170**	**3,242**	291	-	-	500	STS Green Co., Ltd.
Turbidity	NTU	EDTA Titrimetric Method	0.02	94.5	47.2	1.01	-	-	-	STS Green Co., Ltd.
Total Hardness as $CaCO_3$	mg/L as $CaCO_3$	APHA (2012), 4500-CN (C),(E)	5.0	2,117	511	80.4	-	-	-	STS Green Co., Ltd.
Cyanide (CN)	mg/L	APHA (2012), 4110B	0.005	<0.005	<0.005	<0.005	0.1	-	0.2	ALS Laboratory Group (Thailand)
Fluoride (F)	mg/L	Iodometric Method	0.1	<0.1	<0.1	<0.1	20	1.5	4.0	ALS Laboratory Group (Thailand)
Sulphide	mg/L	Based on APHA	1.0	<1.0	<1.0	<1.0	1	-	-	STS Green

Parameter	Unit	Method Analysis	LOQ	Results			Myanmar Standards	WHO Guidelines[a]	EPA Standards[b]	Laboratory
				GW1	GW2	GW3				
Sampling Date				3/5/2018	3/5/2018	4/5/2018				
		(2012), 5310 B								Co., Ltd.
Total Organic Carbon	mg/L	Phenate Method	0.05	4.65	0.55	0.09	-	-	-	ALS Laboratory Group (Thailand)
Ammonium-Nitrogen	mg/L	Turbidimetric Method	0.010	2.85	2.32	0.151	10	-	-	STS Green Co., Ltd.
Sulphate (SO_4)	mg/L	Cadmium Reduction Method	1.0	320	15.0	8.7	-	-		STS Green Co., Ltd.
Nitrate (NO_3)	mg/L	Electrothermal AAS Method	0.005	**0.293**	**0.222**	**18.61**	-	0.05	10	STS Green Co., Ltd.
Chromium (Cr)	mg/L	Direct Nitrous Oxide-Acetylene Flame Method	0.0005	<0.0005	<0.0005	0.0042	0.5	0.05	0.1	STS Green Co., Ltd.
Calcium (Ca)	mg/L	Direct Air-Acetylene Flame Method	0.02	206.05	18.35	11.14	-	-	-	STS Green Co., Ltd.
Magnesium (Mg)	mg/L	Direct Air-Acetylene Flame Method	0.003	153.65	74.94	12.46	-	-	-	STS Green Co., Ltd.
Sodium (Na)	mg/L	Direct Air-Acetylene Flame Method	0.01	3,198	644.80	17.90	-	-	-	STS Green Co., Ltd.
Potassium (K)	mg/L	Cold-Vapour AAS Method	0.01	177.57	59.95	3.69	-	-	-	STS Green Co., Ltd.
Mercury (Hg)	mg/L	Electrothermal AAS Method	0.0003	<0.0003	<0.0003	<0.0003	0.005	0.006	0.002	STS Green Co., Ltd.
Lead (Pb)	mg/L	Electrothermal AAS Method	0.0020	<0.0020	<0.0020	<0.0020	0.5	0.01	0.015	STS Green Co., Ltd.

Parameter	Unit	Method Analysis	LOQ	Results			Myanmar Standards	WHO Guidelines[a]	EPA Standards[b]	Laboratory
				GW1	GW2	GW3				
Sampling Date				3/5/2018	3/5/2018	4/5/2018				
Cadmium (Cd)	mg/L	Direct Air-Acetylene Flame Method	0.00005	<0.00005	0.00010	0.00005	0.1	0.003	0.005	STS Green Co., Ltd.
Copper (Cu)	mg/L	Direct Air-Acetylene Flame Method	0.05	<0.05	<0.05	<0.05	0.5	2	1.3	STS Green Co., Ltd.
Iron (Fe)	mg/L	Based on APHA (2012), 3125	0.10	**9.68**	**3.86**	<0.10	1	-	0.3	STS Green Co., Ltd.
Tin (Sn)	mg/L	Direct Air-Acetylene Flame Method	0.0001	<0.0001	<0.0001	<0.0001	-	-	-	ALS Laboratory Group (Thailand)
Manganese (Mn)	mg/L	Based on APHA (2012), Calculated	0.04	**0.40**	**2.94**	<0.04	-	-	0.05	STS Green Co., Ltd.
Total Nitrogen	mg/L	Acid Digestion/Ascobic Acid Method	1.0	12.7	1.3	5.1	-	-	-	ALS Laboratory Group (Thailand)
Total Phosphorous	mg/L	Direct Air-Acetylene Flame Method	0.005	0.405	0.051	0.030	-	-	-	STS Green Co., Ltd.
Zinc (Zn)	mg/L	Electrothermal AAS Method	0.02	0.02	0.07	<0.02	1	-	5	STS Green Co., Ltd.
Nickel (Ni)	mg/L	Mercuric Nitrate Method	0.0005	<0.0005	0.0079	0.0141	0.5	0.07	-	STS Green Co., Ltd.
Chloride (Cl)	mg/L	5-Day BOD Test, Azide Modification Method	1.0	**7,103**	**1,438**	16.0	-	-	250	STS Green Co., Ltd.

Source: STS Green, 2018.

Note: [a] *World Health Organization (WHO), Guidelines for Drinking-Water Quality, Fourth Edition Incorporating the First Addendum, Annex 3: Chemical summary tables.*
[b] *United States Environmental Protection Agency (EPA), National Primary Drink Water Regulations & National Secondary Drinking Water Regulation, 2009*

Wet Season Survey

The wet season sampling results are shown in ***Table 5.44***, and ***Table 5.45***.

The pH level at GW3 (pH 5.24) exceeds the Myanmar Emission Standard (pH 6 – 9), and additionally, both GW2 (pH 6.19), and GW3 exceed the EPA Standard (pH 6.5 – 8.5); this can be a result of rock / sediment weathering; considering the increased precipitation during the wet season, the weathering process may also increase.

Nitrate (NO_3) concentrations at GW1 (0.612 mg/L), GW2 (0.280 mg/L), and GW3 (18.65 mg/L) exceed the WHO Drinking Water Guidelines (0.05 mg/L), and EPA Standard (10 mg/L). Iron (Fe) concentrations for GW1 (0.31 mg/L), and GW2 (1.28 mg/L) also exceed the Myanmar Emission Standard (1.00 mg/L) and EPA Standard (0.3 mg/L).

Manganese concentrations at GW1 (0.41 mg/L), and GW2 (1.90 mg/L) exceed the EPA Standard (0.05 mg/L). Chloride concentrations at GW1 (6,861 mg/L), and GW2 (1,516 mg/L) exceed the EPA Standard.

All other parameters were found to be within the Myanmar standards and WHO guidelines.

Table 5.44: Results of In-situ Groundwater Quality Measurement and Analysis for Wet Season

No.	Sample No./ Physical Parameter	GW1	GW2	GW3	Myanmar Emission Standards	EPA Standards[a]
1	Location	Pyaw Bwe Gyi Village	Beside the Botaza Road, Dala	Tha Khin Mya Park	-	-
2	Date/Time	30.6.2018 14:21	29.6.2018 13:30	29.6.2018 14:53	-	-
3	Weather	Sunny	Slightly Rain	Cloudy	-	-
4	Transparency	High	High	High	-	-
5	Colour	Colourless	Colourless	Colourless	-	-
6	Water Depth (m)	6	15	13.7	-	-
7	Depth (of sample taken) (m)	-	-	-	-	-
8	Flow rate/velocity (m/s)	-	-	-	-	-
9	Tem (°C) (air & water)	30.71/34.30	28.63	28.31/31.70	-	-
10	pH	6.93	**6.19**	**5.24**	6-9	6.5-8.5
11	DO (mg/l)	0.00	1.98	0.00	-	-
12	EC (µs/m)	26,022.6	5,459.5	368.0	-	-
13	TDS (ppm)	15,249.64	3,318.18	224.99	-	-
14	Turbidity (FNU)	-	-	-	-	-
15	Remark	Sampled on 28/6/2018 12:15	Sampled on 28/6/2018 13:50	Sampled on 27/6/2018 11:20		

Source: SEM, 2018.

Table 5.45: Results from Groundwater Quality Analysis for Wet Season Survey

Parameter	Unit	Method Analysis	LOQ	Results			Myanmar Standards	WHO Guidelines[a]	EPA Standards[b]	Laboratory
				GW1	GW2	GW3				
Sampling Date				28/6/2018	28/6/2018	27/6/2018				
Alkalinity	mg/L as $CaCO_3$	5-Day BOD Test, Azide Modification Method	1.0	596	199	11.5	-	-	-	STS Green Co., Ltd.
Biochemical Oxygen Demand (BOD)	mg/L	Dried at 103-105 °C Method	-	0.1	0.2	0.2	50	-	-	STS Green Co., Ltd.
Total Suspended Solids (TSS)	mg/L	Dried at 180 °C Method	10.0	42.2	12.4	<10.0	50	-	-	STS Green Co., Ltd.
Total Dissolved Solids (TDS)	mg/L	Nephelometric Method	50.0	**14,440**	**3,722**	246	-	-	500	STS Green Co., Ltd.
Turbidity	NTU	EDTA Titrimetric Method	0.02	265	236	0.36	-	-	-	STS Green Co., Ltd.
Total Hardness as $CaCO_3$	mg/L as $CaCO_3$	APHA (2012), 4500-CN (C),(E)	5.0	2,816	417.0	75.9	-	-	-	STS Green Co., Ltd.
Cyanide (CN)	mg/L	APHA (2012), 4110B	0.005	<0.005	<0.005	<0.005	0.1	-	0.2	ALS Laboratory Group (Thailand)
Fluoride (F)	mg/L	Iodometric Method	0.1	<0.1	<0.1	<0.1	20	1.5	4.0	ALS Laboratory Group (Thailand)
Sulphide	mg/L	Based on APHA	1.0	<1.0	<1.0	<1.0	1	-	-	STS Green

Parameter	Unit	Method Analysis	LOQ	Results			Myanmar Standards	WHO Guidelines[a]	EPA Standards[b]	Laboratory
				GW1	GW2	GW3				
Sampling Date				28/6/2018	28/6/2018	27/6/2018				
		(2012), 5310 B								Co., Ltd.
Total Organic Carbon	mg/L	Phenate Method	0.05	4.79	0.90	0.32	-	-	-	ALS Laboratory Group (Thailand)
Ammonium-Nitrogen	mg/L	Turbidimetric Method	0.010	2.51	1.91	0.081	10	-	-	STS Green Co., Ltd.
Sulphate (SO_4)	mg/L	Cadmium Reduction Method	1.0	322	11.6	17.6	-	-		STS Green Co., Ltd.
Nitrate (NO_3)	mg/L	Electrothermal AAS Method	0.005	**0.612**	**0.280**	**18.65**	-	0.05	10	STS Green Co., Ltd.
Chromium (Cr)	mg/L	Direct Nitrous Oxide-Acetylene Flame Method	0.0005	<0.0005	<0.0005	0.0049	0.5	0.05	0.1	STS Green Co., Ltd.
Calcium (Ca)	mg/L	Direct Air-Acetylene Flame Method	0.02	150.77	19.91	13.57	-	-	-	STS Green Co., Ltd.
Magnesium (Mg)	mg/L	Direct Air-Acetylene Flame Method	0.003	494.94	66.97	6.21	-	-	-	STS Green Co., Ltd.
Sodium (Na)	mg/L	Direct Air-Acetylene Flame Method	0.01	3,694	780.63	29.43	-	-	-	STS Green Co., Ltd.
Potassium (K)	mg/L	Cold-Vapour AAS Method	0.01	111.62	33.63	3.49	-	-	-	STS Green Co., Ltd.
Mercury (Hg)	mg/L	Electrothermal AAS Method	0.0003	<0.0003	<0.0003	<0.0003	0.005	0.006	0.002	STS Green Co., Ltd.
Lead (Pb)	mg/L	Electrothermal AAS Method	0.0020	<0.0020	<0.0020	<0.0020	0.5	0.01	0.015	STS Green Co., Ltd.

Parameter	Unit	Method Analysis	LOQ	Results			Myanmar Standards	WHO Guidelines[a]	EPA Standards[b]	Laboratory
				GW1	GW2	GW3				
Sampling Date				28/6/2018	28/6/2018	27/6/2018				
Cadmium (Cd)	mg/L	Direct Air-Acetylene Flame Method	0.00005	0.00006	<0.00005	<0.00005	0.1	0.003	0.005	STS Green Co., Ltd.
Copper (Cu)	mg/L	Direct Air-Acetylene Flame Method	0.05	<0.05	<0.05	<0.05	0.5	2	1.3	STS Green Co., Ltd.
Iron (Fe)	mg/L	Based on APHA (2012), 3125	0.10	**0.31**	**1.28**	<0.10	1	-	0.3	STS Green Co., Ltd.
Tin (Sn)	mg/L	Direct Air-Acetylene Flame Method	0.0001	0.0002	<0.0001	<0.0001	-	-	-	ALS Laboratory Group (Thailand)
Manganese (Mn)	mg/L	Based on APHA (2012), Calculated	0.04	**0.41**	**1.90**	<0.04	-	-	0.05	STS Green Co., Ltd.
Total Nitrogen	mg/L	Acid Digestion/Ascobic Acid Method	1.0	12.1	1.1	5.2	-	-	-	ALS Laboratory Group (Thailand)
Total Phosphorous	mg/L	Direct Air-Acetylene Flame Method	0.005	1.63	0.036	0.036	-		-	STS Green Co., Ltd.
Zinc (Zn)	mg/L	Electrothermal AAS Method	0.02	<0.02	0.53	0.02	1	-	5	STS Green Co., Ltd.
Nickel (Ni)	mg/L	Mercuric Nitrate Method	0.0005	<0.0005	0.0036	0.0191	0.5	0.07	-	STS Green Co., Ltd.
Chloride (Cl)	mg/L	5-Day BOD Test, Azide Modification Method	1.0	**6,861**	**1,516**	73.6	-	-	250	STS Green Co., Ltd.

Source: STS Green, 2018.

*Note: * World Health Organization (WHO), Guidelines for Drinking-Water Quality, Fourth Edition Incorporating the First Addendum, Annex 3: Chemical summary tables.*

5.1.8 Sediment

A number of baseline sediment quality sampling surveys in the Study Area have been conducted, as part of this ESIA report. An overview of the surveys and their results are presented in this section.

5.1.8.1 Baseline Sediment Sampling Methodology

Sediment samples were collected by SEM and ERM-Siam on the 3rd - 5th May, 2018, at six (6) locations. Sediment samples were taken by a Grab Sampler. At each station, sediment was collected in an amber glass bottle. Each benthic sample was then slowly sieved through a mesh size of 2.0 mm, 1 mm, and 0.5 mm. Firstly, benthic samples were sieved by 2.0 mm and 1.0 mm mesh size, then the samples were sieved by a 0.5 mm mesh. Finally, the benthic samples caught in the 1.0 mm and 0.5mm mesh were collected. The specimens were preserved in 10% formalin solution.

All sampling was conducted in strict accordance with recognized standard procedures, as listed together with the sampling results in ***Appendix N*** and ***Appendix P***. Sediment sampling has been conducted during both wet and dry seasons; parameters that were selected for sampling are listed below.

The Myanmar Guidelines does not contain ambient standards for sediment quality; therefore, the baseline sampling results will be compared to the Australian and New Zealand interim sediment quality guidelines[33]. Parameters that were measured by laboratory analysis are listed together with the results below.

5.1.8.2 Baseline Sediment Sampling Locations

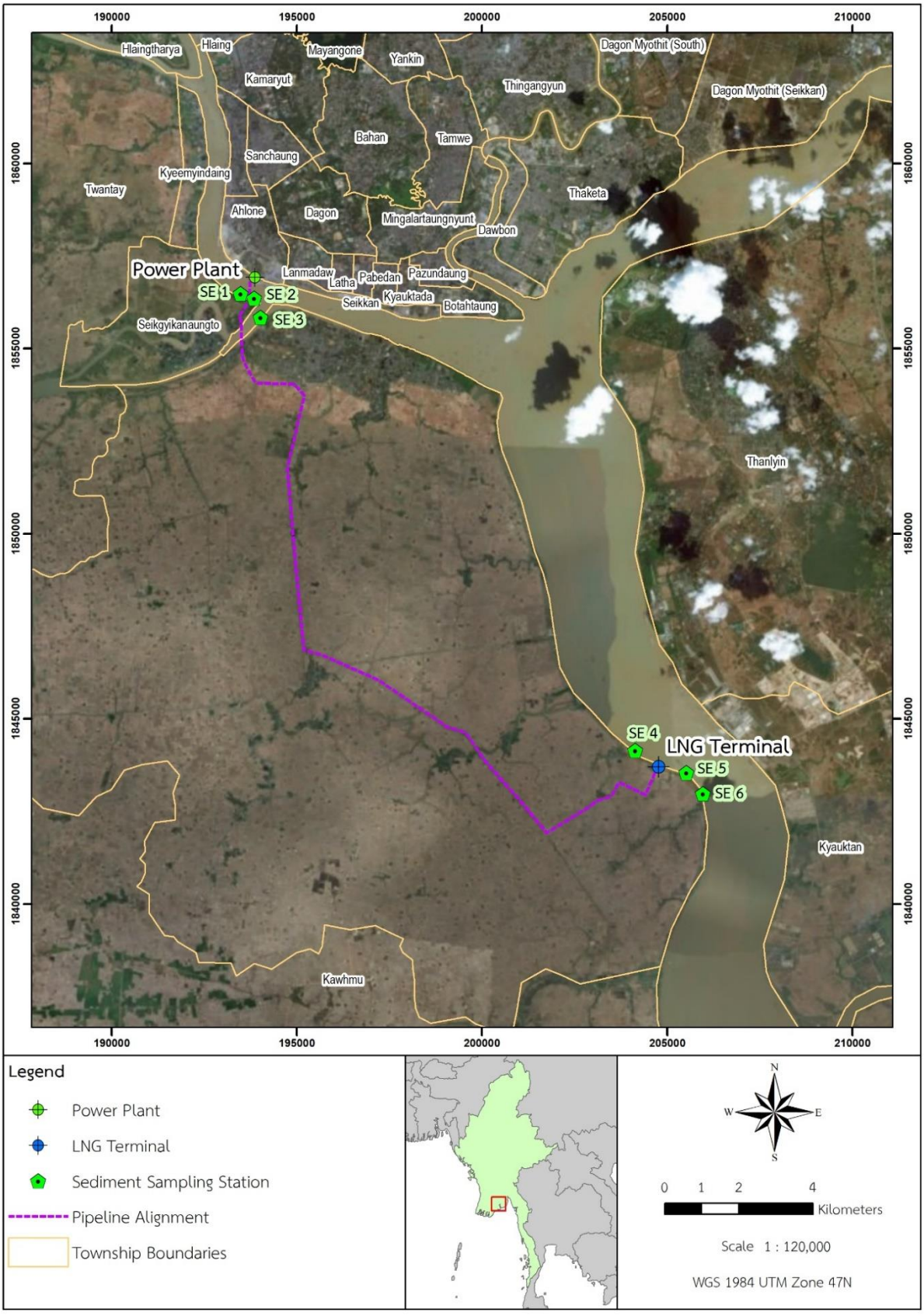
Sediment samples were collected by SEM and ERM-Siam on the 3rd - 5th May, 2018, at six (6) locations, which are shown in ***Figure 5.25***, and each location is described in ***Table 5.46***.

Table 5.46: Sediment Sampling Locations

Sampling Point	Coordinates	Description of Sampling Point
SE 1	16°46'16.68"N 96° 7'29.64"E	Approximately 0.16 kilometres away from the left bank of Yangon River (Upstream), Dala Township, Yangon Region. It is located at south of project area and southwest of Asia Terminal port.
SE 2	16°46'12.72"N 96° 7'41.88"E	Approximately 0.22 kilometres away from the left bank of Yangon River (Downstream), Dala Township, Yangon Region.
SE 3	16°45'56.19"N 96° 7'47.98"E	Approximately 0.19 kilometres away from the right bank of Twantae Canal, which is located near the mouth of Twantae Canal, Dala Township, Yangon Region.
SE 4	16°39'40.66"N 96°13'34.87"E	Approximately 0.05 kilometres away from the left bank of Yangon River, which is located near That Kai Kwin Village, Dala Township, Yangon Region.
SE 5	16°39'21.60"N 96°14'21.48"E	Approximately 0.09 kilometres away from the left bank of Yangon River, which is located in Dala Township, Yangon Region.
SE 6	16°39'3.28"N 96°14'36.81"E	Approximately 0.03 kilometres away from the left bank of Yangon River, which is located near Chaung Oo Village, Dala Township, Yangon Region.

[33] ANZECC, & ARMCANZ. (2000). Sediment Quality Guidelines. National Water Quality Management Strategy: Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Retrieved from http://www.waterquality.gov.au/anz-guidelines/Documents/ANZECC-ARMCANZ-2000-guidelines-vol1.pdf

Figure 5.25: Baseline Sediment Sampling Locations



Source: ERM, 2018.

5.1.8.3 Summary of Baseline Sampling Results

Dry Season Survey

According to the dry season results for sediment quality, as shown in ***Table 5.47***, two (2) parameters exceeded the standard, which include mercury for sampling stations SE3, SE5, and SE6; and Nickel at all sampling stations.

Mercury has been found to exceed the Low level standards, but still within the High level standards of the Interim Sediment Quality Guidelines (ISQG). Values that are below the ISQG-low indicates that the frequency of adverse effects is expected to be very low; where as concentrations above ISQG-high indicates a level of concentration where adverse biological effects are expected occur more frequently[34]. This result indicates that the level of concentration can cause adverse effects; however, the occurrence is still considerably low.

Nickel has been found to exceed both low and high level standards. Although iron in sediment was not measured, surface water quality indicates high iron concentrations, which could contribute to high concentrations of Nickel in the surface water (and therefore also potentially the nearby sediment), as studies have found Nickel to attach to particles containing iron.

All other parameters were found to be within the Australian and New Zealand interim sediment quality guidelines.

Wet Season Survey

According to the dry season results for sediment quality, as shown in ***Table 5.48***, two (2) parameters exceeded the standard: Mercury for sampling stations SE2 to SE6; and Nickel at all sampling stations.

Mercury has been found to exceed the Low level standards, but still within the High level standards. This result indicates that the level of concentration can cause adverse effects on aquatic life; however, the occurrence is still considerably low.

Nickel has been found to exceed both low and high level standards; however, concentrations were found to be lower than that of the dry season. This difference may be due to a higher flow rate.

All other parameters are found to be within the Australian and New Zealand interim sediment quality guidelines.

[34] DEC. (2010). Contaminated Sites Management Series: Assessment levels for Soil, Sediment and Water. Department of Environment and Conservation (DEC), Government of Western Australia. Version 4, Revision 1, Pp 26. https://www.der.wa.gov.au/images/documents/your-environment/contaminated-sites/guidelines/2009641_-_assessment_levels_for_soil_sediment_and_water_-_web.pdf

Table 5.47: Results of Sediment Quality Analysis for Dry Season Survey

Parameter	Unit	Method of Analysis	LOQ	Results						Standard (ISQG)[1]		Laboratory
				SE1	SE2	SE3	SE4	SE5	SE6	Low[a]	High[b]	
Particle Size Distribution												
Sand	%	Hydrometer Analysis	-	43.7	48.2	1.2	2.3	5.3	7.1	-	-	STS Instrument Co., Ltd.
Silt	%		-	32.1	27.6	61.8	44.5	42.6	39.9	-	-	
Clay	%		-	.242	24.2	37.0	53.2	52.1	53.0	-	-	
Total Organic Carbon (TOC)	%	Based on US EPA, Method 9060	0.01	0.16	<0.10	0.25	0.20	0.27	0.47	-	-	ALS Laboratory Group (Thailand)
TPH (C10 – C36)												
C10-C14	mg/kg	Based on US EPA, Method 3570 and 8015B	5	<5	<5	<5	<5	<5	<5	-	-	ALS Laboratory Group (Thailand)
C15-C28	mg/kg		10	<10	<10	<10	<10	<10	<10	-	-	
C29-C36	mg/kg		10	<10	<10	<10	<10	<10	<10	-		
Total Oil	mg/kg	Soxhlet Extraction Method	20.0	508	358	105	443	419	132	-	-	STS Green Co., Ltd.
Arsenic	mg/kg	Hydride Generation AAS Method	0.04	<0.04	<0.04	<0.04	0.10	<0.04	<0.04	20	70	STS Green Co., Ltd.
Barium	mg/kg	Direct Nitrous Oxide-Acetylene Flame Method	5.00	23.17	35.09	39.70	51.17	38.05	49.10	-	-	STS Green Co., Ltd.
Cadmium	mg/kg	Direct Air-Acetylene Flame Method	1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	1.5	10	STS Green Co., Ltd.
Chromium	mg/kg	Direct Air-Acetylene Flame Method	2.50	34.44	48.33	53.98	75.67	64.86	67.65	80	370	STS Green Co., Ltd.
Copper	mg/kg	Direct Air-Acetylene Flame Method	1.50	15.28	22.68	23.55	31.14	30.24	31.47	65	270	STS Green Co., Ltd.

Parameter	Unit	Method of Analysis	LOQ	Results						Standard (ISQG)[1]		Laboratory
				SE1	SE2	SE3	SE4	SE5	SE6	Low[a]	High[b]	
Lead	mg/kg	Direct Air-Acetylene Flame Method	5.00	<5.00	7.17	<5.00	7.23	12.70	15.58	50	220	STS Green Co., Ltd.
Mercury	mg/kg	Cold-Vapour AAS Method	0.10	0.12	0.14	**0.18**	0.14	**0.16**	**0.16**	0.15	1	STS Green Co., Ltd.
Nickel	mg/kg	Direct Air-Acetylene Flame Method	2.00	**68.12**	**85.75**	**101.11**	**131.96**	**114.52**	**127.78**	21	52	STS Green Co., Ltd.

Source: STS Green, 2018.
[1] ANZECC / ARMCANZ, 2000.

Note: [1] *Interim Sediment Quality Guidelines (ISQG)*
[a] *Corresponds to Effects Range-Low (ERL)*
[b] *Corresponds to Effects Range-Medium (ERM)*

Table 5.48: Results of Sediment Quality Analysis for Wet Season Survey

Parameter	Unit	Method of Analysis	LOQ	Results						Standard (ISQG)[1]		Laboratory
				SE1	SE2	SE3	SE4	SE5	SE6	Low[a]	High[b]	
Particle Size Distribution												
Sand	%	Hydrometer Analysis	-	51.7	6.5	2.4	1.3	1.0	5.7	-	-	STS Instrument Co., Ltd.
Silt	%		-	27.4	69.4	60.6	61.7	49.2	38.2	-	-	
Clay	%		-	20.9	24.1	37.0	37.0	49.8	56.1	-	-	
Total Organic Carbon (TOC)	%	Based on US EPA, Method 9060	0.01	0.15	0.19	0.30	0.29	0.37	0.63	-	-	ALS Laboratory Group (Thailand)
TPH (C10 – C36)												
C10-C14	mg/kg	Based on US EPA, Method 3570 and 8015B	5	<5	<5	<5	<5	<5	<5	-	-	ALS Laboratory Group (Thailand)
C15-C28	mg/kg		10	<10	<10	<10	<10	<10	<10	-	-	
C29-C36	mg/kg		10	<10	<10	<10	<10	<10	<10	-		
Total Oil	mg/kg (Wet)	Soxhlet Extraction Method	20.0	34.97	264	125	145	200	232	-	-	STS Green Co., Ltd.
	mg/kg (Dry)		20.0	70.72	431	198	273	321	410	-	-	
Arsenic	mg/kg	Hydride Generation AAS Method	0.04	0.34	0.40	0.35	0.39	0.30	0.42	20	70	STS Green Co., Ltd.
Barium	mg/kg	Direct Nitrous Oxide-Acetylene Flame Method	5.00	12.65	24.39	25.72	24.99	17.06	12.41	-	-	STS Green Co., Ltd.
Cadmium	mg/kg	Direct Air-Acetylene Flame Method	1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	1.5	10	STS Green Co., Ltd.
Chromium	mg/kg	Direct Air-Acetylene	2.50	16.49	26.96	30.99	32.74	31.47	31.04	80	370	STS Green Co.,

Parameter	Unit	Method of Analysis	LOQ	Results						Standard (ISQG)[1]		Laboratory
				SE1	SE2	SE3	SE4	SE5	SE6	Low[a]	High[b]	
		Flame Method										Ltd.
Copper	mg/kg	Direct Air-Acetylene Flame Method	1.50	14.12	21.61	27.21	24.04	26.09	28.99	65	270	STS Green Co., Ltd.
Lead	mg/kg	Direct Air-Acetylene Flame Method	5.00	14.57	20.84	23.96	24.08	21.92	26.50	50	220	STS Green Co., Ltd.
Mercury	mg/kg	Cold-Vapour AAS Method	0.10	0.14	**0.18**	**0.23**	**0.21**	**0.24**	**0.27**	0.15	1	STS Green Co., Ltd.
Nickel	mg/kg	Direct Air-Acetylene Flame Method	2.00	**47.63**	**68.88**	**81.12**	**78.37**	**80.58**	**78.57**	21	52	STS Green Co., Ltd.

Source: STS Green, 2018.
[1] ANZECC / ARMCANZ, 2000.

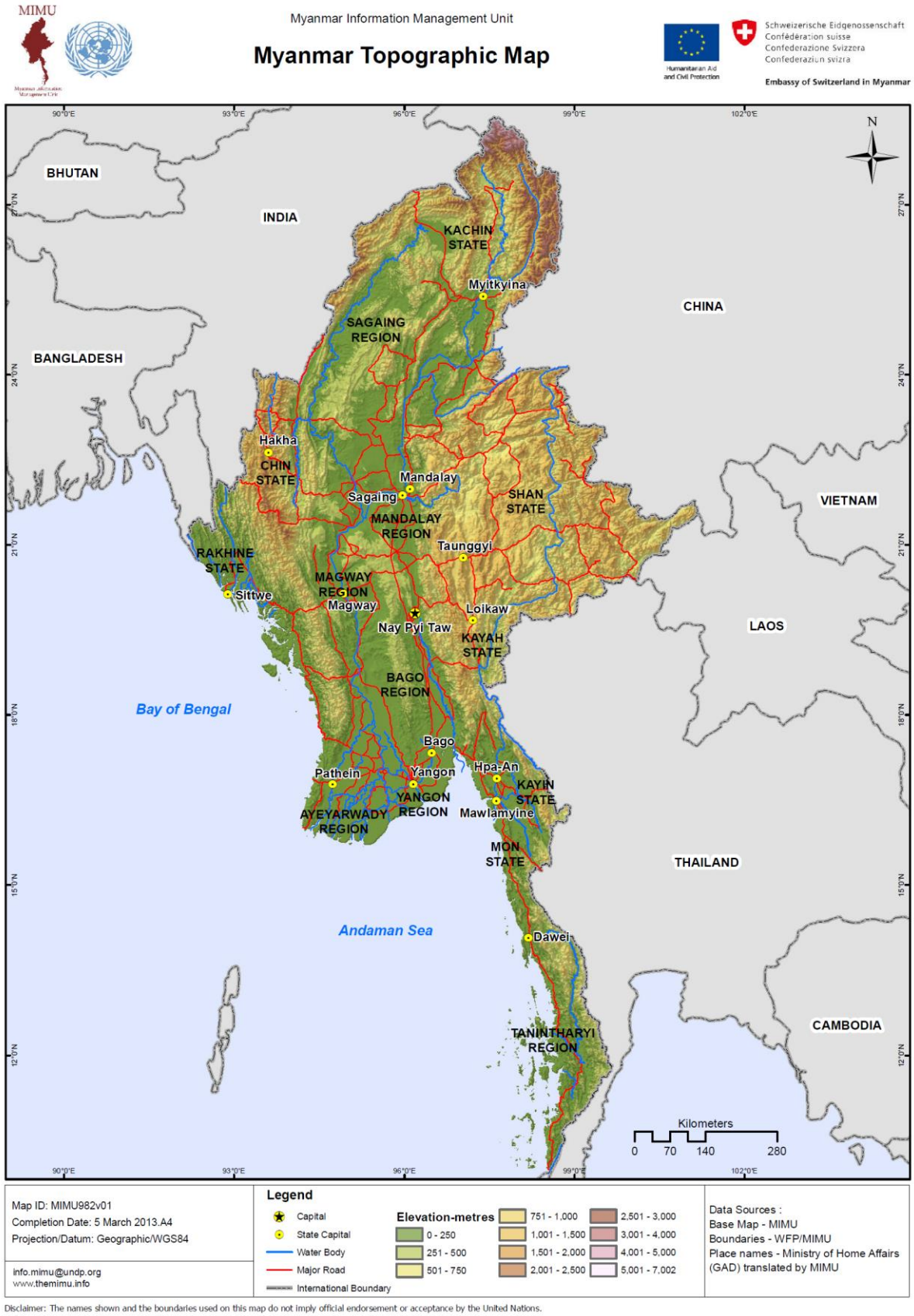
Note: *[1] Interim Sediment Quality Guidelines (ISQG)*
[a] Corresponds to Effects Range-Low (ERL)
[b] Corresponds to Effects Range-Medium (ERM)

5.1.9 Landscape and Visual

According to ***Figure 5.26***, the centre part of Myanmar, specifically within the Yangon Region and Ayeyarwady Region consists of mainly plains with little to no elevation. Although this characteristic is normal for land located near coastal areas, other northern regions of Myanmar have a large range of mountainous areas, and varying degrees of elevation, which are particularly pronounced in the Kayah State, and Shan State.

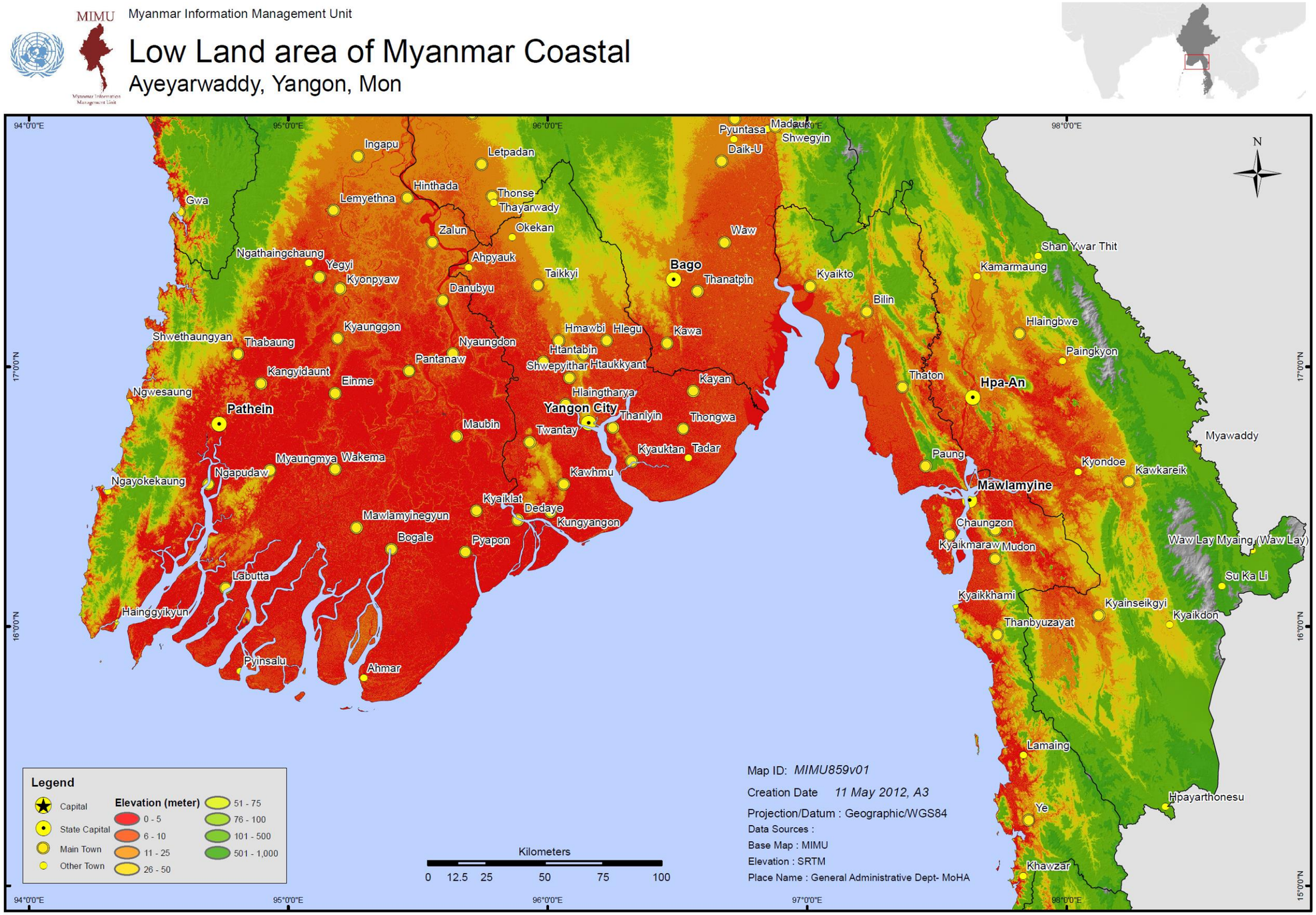
Look at the low land areas of Myanmar, it is possible to see that Yangon primarily consists of plains with low elevation; however, the Northern Region of Yangon contains mountainous areas with high elevation of approximately 500 – 1,000 meters, as shown in ***Figure 5.27***. It is also possible to notice the slight elevation the stretches from the northern region down to Yangon City, this will be further discussed in ***Section 5.1.9.1***.

Figure 5.26: Topographic Map of Myanmar



Source: MIMU, 2013.

Figure 5.27: Topographic Map of Myanmar Coastal Low Land Area



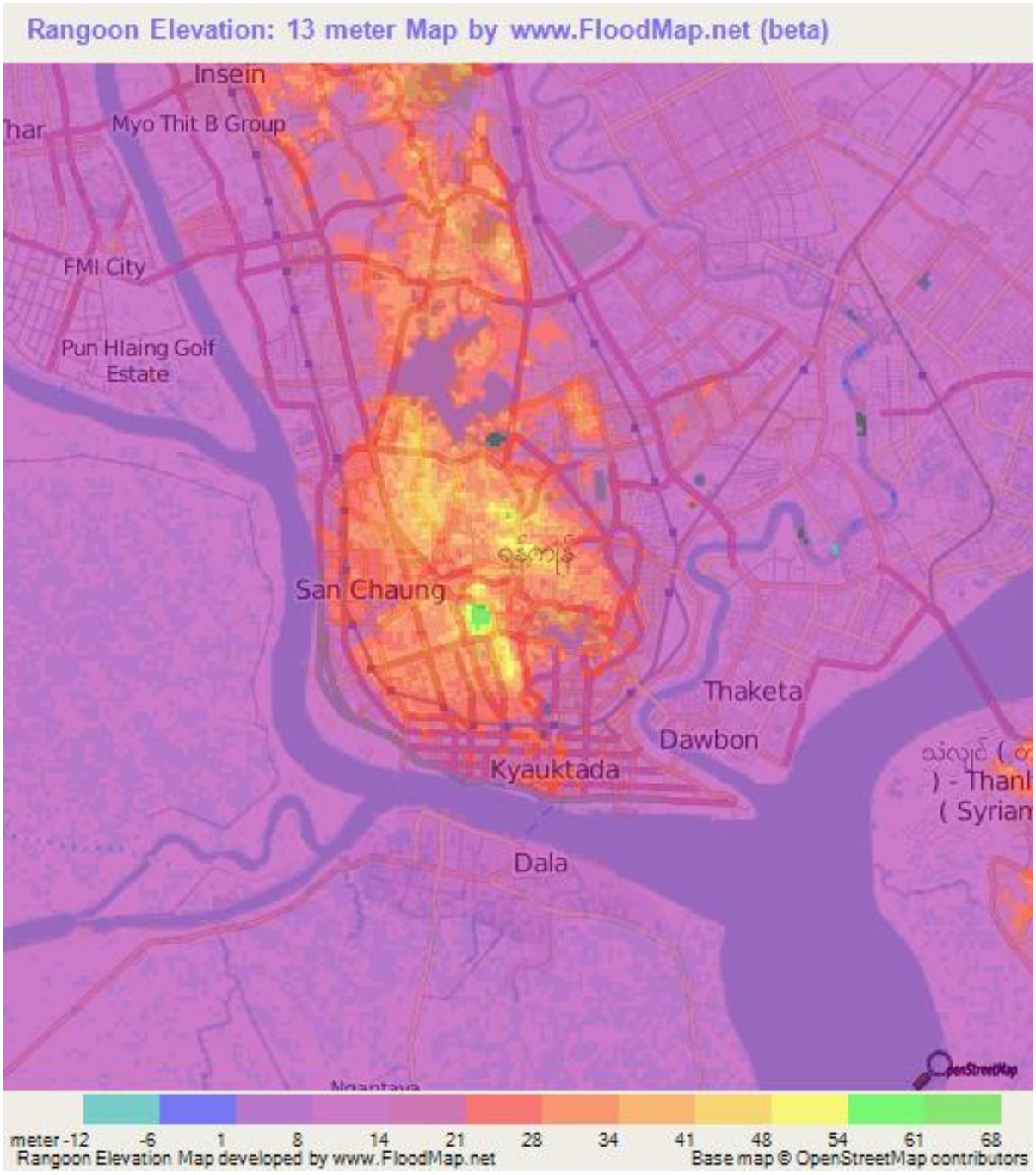
Disclaimer: The names shown and the boundaries used on this map do not imply official endorsement or acceptance by the IASC membership.

Source: MIMU, 2012.

5.1.9.1 Power Plant

The topography at the Power Plant are primarily flat land with no noticeable elevations; however, towards the northeast of the Power Plant, there is high elevations that lead up the highest point exactly where the Shwedagon Pagoda is located (approximately 57 – 62 metre elevation), as shown in ***Figure 5.28***. Land allocated for the Power Plant currently consists of grasslands and small patches of mangrove, however the land is surrounded by the existing Power Plant and the Ahlone Shipyard, as shown in ***Figure 5.29***. The closest receptor to the Power Plant is a small household area approximately 80 metres north of the Power Plant; and the medium density residential area approximately 670 metres northeast of the Power Plant, within Ahlone Township.

Figure 5.28: Elevation of Yangon City



Source: FloodMap.net, 2018.

Figure 5.29: Landscape In and Around the Power Plant Area

Source: ERM, 2018.

Note: Photograph taken in the proposed Power Plant area, viewing southwest towards the Yangon River.

Source: ERM, 2018.

Note: Photograph taken from the Yangon River, viewing northeast towards the proposed Power Plant shoreline and existing Transmission Line connected to the existing Power Plant.

5.1.9.2 LNG Receiving Terminal

The topography at the LNG Receiving Terminal suggests no elevation. The area surrounding the facility consists of mainly agricultural land and nearby villages. Across the Yangon River, directly opposite of the LNG Receiving Terminal is the Myanmar Integrated Port Limited Terminal. Potential sensitive visual receivers are located nearby the LNG Receiving Terminal, such as Thet Kei Kwin (1.2 km, northwest), and Shan Kaw (1.6 km, west) villages.

5.1.9.3 Natural Gas Pipeline

The topography along the Natural Gas Pipeline alignment suggests no elevation. The area along the pipeline alignment will mainly consist of agricultural land and other small villages; however, the northern section of the pipeline will be located near the dense residential area of Dala, Seikgyikanaungto, and Ahlone Townships.

5.1.10 Waste

According to the World Bank[35] in 2012, the solid waste generation in Myanmar was 5,616 tonnes/day, and is anticipated to increase to 21,012 tonnes/day by 2025. Mandalay, Yangon and Nay Pyi Taw generate the majority of Myanmar's produced waste (55%); Yangon produces most of the waste (1,981 tonnes/day).

The country's municipal solid waste is generated from households (60%), markets (15%), commercial (10%), hotel (2%), garden (5%) and others (8%). In areas outside of Yangon, Mandalay and Nay Pyi Taw, where waste collection is the responsibility of local municipal authorities, the respective Township Development Committees under the local government typically manage municipal waste collection and disposal[36].

In 1995, the government made efforts to encourage the industrial sector to minimize impacts on the environment from industrial waste by issuing the Water and Air Pollution Control Plan (Standing Order No.3) which stated that actions to control, reduce and eliminate waste must be developed and carried out. However, Myanmar today faces substantial challenges with regard to managing their industrial waste with high volumes transported to landfill sites without prior treatment[37].

According to the Yangon City Development Committee (YCDC), the major landfill sites in Yangon that are currently in operation and their respective capacities are shown in ***Table 5.49***.

According to IGES[38], solid waste is segregated into wet and dry. Wet waste consists of kitchen waste, left-overs, and other waste that have a high moisture content, and are stored in blue colored bags. Dry waste consists of paper, cork, plastic, metal, wires, etc., and are stored in green bags. Both types of waste are collected together on the same vehicle by the Pollution Control and Cleansing Department (PCCD) and are then transported to the nearby landfills.

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[35] Hoornweg, D., & Bhada-Tata, P. (2012). What a Waste: A Global Review of Solid Waste Management. Word Bank. Urban Development & Local Government Unit. Retrieved from http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1334852610766/What_a_Waste2012_Final.pdf

[36] Premakumara, D.G.J., & Hengesbaugh, M. (2016). Quick Study on Waste Management in Myanmar. Institute for Global Environmental Strategies (IGES). Retrieved from https://www.iges.or.jp/files/research/scp/PDF/20160613/17_Quick_study_Web.pdf

[37] Theilen-Willige, B., & Pararas-Carayannis, G. (2009). Natural Hazard Assessment of SW Myanmar – A Contrubution of Remote Sensing and GIS Methods to the Detection of Areas Vulnerable to Earthquakes and Tsunami / Cyclone Flooding. Tsunami Society. Retrieved from http://tsunamisociety.org/282ThielenGPCa.pdf

[38] IGES. (n.d.). Present Situation of Solid Waste Management in Yangon City. Institute for Global Environmental Strategies. Retrieved from https://www.iges.or.jp/en/publication_documents/pub/presentation/en/3616/Waste_management_in_Yangon-30_July.pdf

Table 5.49: Major Landfill Sites in Yangon

Location	Capacity (tonnes/day)
Hteinpin	1,080
Dawai Chang	843
Shwepyithar	61
Mingalardon	43
Dala	33
SeikyiKhanaungato	4

Source: YCDC, 2016.

5.1.11 Terrestrial and Aquatic Biodiversity

The Myanmar EIA Procedures (2015) requires the assessment of biodiversity values however the Procedure does not include guidance on the approach to assess those values. ERM has used the International Finance Corporation (IFC) *Performance Standard 6 Biodiversity Conservation and Sustainable Management of Living Natural Resources* (PS6) to guide the approach of assessment. Reference is therefore made to certain requirements of IFC PS6 in this Chapter.

5.1.11.1 EcoRegion Description

The Project Study Area resides within the Myanmar Coastal Mangrove [IM1404] EcoRegion. This ecoregion, specifically the Irrawaddy (Ayeyarwady) mangrove region, would naturally be dominated by mangrove flora but has been seriously degraded in recent history.

Mangrove forest are salt tolerant ecosystems that survive in brackish water around the intertidal zone, particularly in estuaries. They are some of the most exploited natural systems in the world, under pressure from land clearance for farming, aquaculture, land reclamation and development. The mangrove forests in this ecoregion are some of the most degraded or destroyed mangrove systems in the Indo-Pacific area[39]. The Irrawaddy mangroves consists primarily of *Rhizophora mucronata*, *R. conjugata*, *Bruguiera parviflora*, *B. gymnorhiza*, *B. cylindrica*, *Heritiera formes*, *Sonneratia apetala*, *S. griffithii*, *S. caseolaris*, *Xylocarpus granatum*, *X. molluccensis*, *Ceiops roxburghiana*, *C. mimosoides*, *Avicennia officinalis*, *Kanddelia rheedii*, and *Excoecaria agallocha*.

The larger mammals historically found in this ecoregion have been extirpated including the Asian elephant *Elephas maximus* and tiger *Panthera tigris*. A few wild elephants survive in the neighbouring Rakhine mangrove region to the north. Other large mammals including leopard *Panthera pardus*, wild dog *Cuon apinus*, and otter *Lutra spp.* are largely absent. Sambar *Cervus unicolor*, hog deer *Cervus porcinus*, mouse deer *Tragulus javanicus*, barking deer *Muntiacus muntjak*, tapir *Tapirus malayanus*, and wild boar *Sus scrofa*, are abundant only in reserved forests.

Mangrove habitats are rich in migrants and resident waterbirds including the oriental darter *Anhinga melanogaster*, little cormorant *Phalacrocorax nigers*, reef heron *Egretta sacra*, dusky gray heron *Ardea sumatrana*, ruddy shelduck *Tadorna ferruginea*, bronze-winged jacana *Metopidius indicus*, lesser sand plover *Charadrius mongolus*, great stone plover *Esacus magnirostris*, black-winged stilt *Himantopus himantopus*, spotted greenshank *Tringa guttifer*, lesser black-back gull *Larus fuscus*, and common moorhen *Gallinula chloropus*.

Among reptiles, the southern part of the Ayeyarwady Delta contains the last population of crocodiles (*Crocodylus porosus*) in the ecoregion. The river terrapin (*Batagur baska*) now exists only in small isolated populations on offshore islands.

[39] WWF. (2019). Southern Asia: Along the coasts of India, Myanmar, Malaysia, and Thailand. World Wildlife Fund (WWF). Retrieved from https://www.worldwildlife.org/ecoregions/im1404

The EcoRegion is currently classified as Critical/Endangered.

5.1.11.2 Key Biodiversity Areas

In Myanmar, Key Biodiversity Areas (KBAs) fall in different land management categories including protected areas, public protected forests, community-conserved forests, community forests, reserve forests and other resource and land use areas. Therefore, they accommodate different management systems such as government, private, community-led and joint management. Within the last decade, KBAs were reviewed and updated in order to identify and prioritize investment opportunities for biodiversity conservation in Myanmar.

A total of 132 KBAs were identified for Myanmar and prioritized based on Species-based Vulnerability and Site-based Vulnerability. A total of three KBAs were identified under Alliance for Zero Extinction (AZE), one as a Ramsar site, 53 important bird areas, and six ASEAN Heritage Parks.

Key Biodiversity Areas (KBA) include Important Bird Areas (IBA), Alliance for Zero Extinction (AZE), Important Plant Areas (IPA) and Important Sites for Freshwater Biodiversity. Three (3) Key Biodiversity Areas are located within 30km from the Project Site. These sites are the Hlawga Reservoir, Maletto Inn and Payagyi KBAs which contain critically endangered, endangered and vunerable species of conservation concern. These KBAs are located approximately 21km, 27km and 31km respectively to the north and east of the Project Area. The location of the KBA in relation to the Project Site is shown in ***Figure 5.30***.

5.1.11.3 Protected Area

Myanmar currently has a total of 58 Protected Areas (PAs), which account for only 6.37% of the country's total surface area (Protected Planet, 2018)[40].

One (1) protected area lies within 50km of the Study Area, The Hlawga Park 28km to the north.

5.1.11.4 Species of Conservation Significance

Species of conservation significance found within the species grid location from the Integrated Biodiversity Assessment Tool (IBAT) are outlined in ***Table 5.50***.

Table 5.50: Species of Conservation Significance (IBAT species grid)

Taxonomic group	Species	Common name	IUCN Red List Category
Birds	*Aquila nipalensis*	Steppe Eagle	EN
Birds	*Asarcornis scutulata*	White-winged Duck	EN
Birds	*Calidris pygmaea*	Spoon-billed Sandpiper	CR
Birds	*Chrysomma altirostre*	Jerdon's Babbler	VU
Birds	*Ciconia episcopus*	Asian Woollyneck	VU
Birds	*Clanga clanga*	Greater Spotted Eagle	VU
Birds	*Emberiza aureola*	Yellow-breasted Bunting	CR
Birds	*Gallinago nemoricola*	Wood Snipe	VU
Birds	*Gracula robusta*	Nias Hill Myna	CR
Birds	*Gracula venerata*	Tenggara Hill Myna	EN

[40] UNEP-WCMC. (2019). Protected Area Profile for Myanmar from the World Database of Protected Areas. Protected Planet. Retrieved from https://www.protectedplanet.net/country/MM

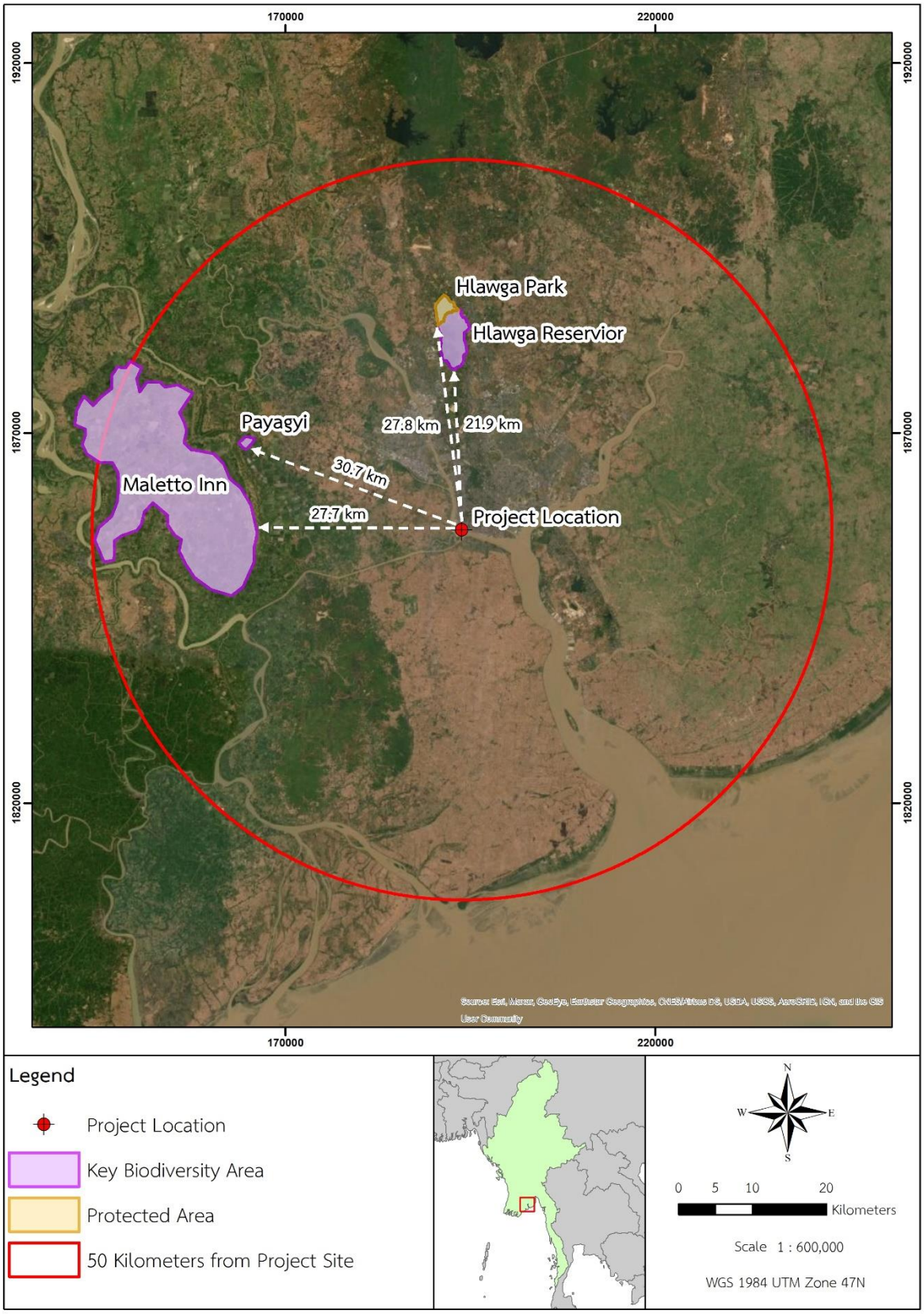
Taxonomic group	Species	Common name	IUCN Red List Category
Birds	*Gyps bengalensis*	White-rumped Vulture	CR
Birds	*Gyps tenuirostris*	Slender-billed Vulture	CR
Birds	*Haliaeetus leucoryphus*	Pallas's Fish-eagle	EN
Birds	*Heliopais personatus*	Masked Finfoot	EN
Birds	*Leptoptilos dubius*	Greater Adjutant	EN
Birds	*Leptoptilos javanicus*	Lesser Adjutant	VU
Birds	*Pavo muticus*	Green Peafowl	EN
Birds	*Rynchops albicollis*	Indian Skimmer	VU
Birds	*Sarcogyps calvus*	Red-headed Vulture	CR
Fish	*Aetobatus ocellatus*	Spotted Eagle Ray	VU
Fish	*Aetomylaeus maculatus*	Mottled Eagle Ray	EN
Fish	*Aetomylaeus nichofii*	Banded Eagle Ray	VU
Fish	*Alopias pelagicus*	Pelagic Thresher	VU
Fish	*Alopias superciliosus*	Bigeye Thresher Shark	VU
Fish	*Alopias vulpinus*	Common Thresher Shark	VU
Fish	*Anoxypristis cuspidata*	Narrow Sawfish	EN
Fish	*Carcharhinus falciformis*	Silky Shark	VU
Fish	*Carcharhinus hemiodon*	Pondicherry Shark	CR
Fish	*Carcharhinus longimanus*	Oceanic Whitetip Shark	VU
Fish	*Carcharias taurus*	Sand Tiger Shark	VU
Fish	*Carcharodon carcharias*	Great White Shark	VU
Fish	*Glaucostegus granulatus*	Sharpnose Guitarfish	VU
Fish	*Glaucostegus obtusus*	Widenose Guitarfish	VU
Fish	*Glaucostegus typus*	Giant Shovelnose Ray	VU
Fish	*Glyphis siamensis*	Irrawaddy River Shark	CR
Fish	*Hemigaleus microstoma*	Sickelfin Weasel Shark	VU
Fish	*Hemipristis elongata*	Snaggletooth Shark	VU
Fish	*Himantura uarnak*	Reticulate Whipray	VU
Fish	*Hippocampus histrix*	Thorny Seahorse	VU
Fish	*Hippocampus kelloggi*	Great Seahorse	VU
Fish	*Hippocampus spinosissimus*	Hedgehog Seahorse	VU
Fish	*Hippocampus trimaculatus*	Three-spot Seahorse	VU
Fish	*Isurus oxyrinchus*	Shortfin Mako	VU
Fish	*Isurus paucus*	Longfin Mako	VU

Taxonomic group	Species	Common name	IUCN Red List Category
Fish	*Lamiopsis temminckii*	Broadfin Shark	EN
Fish	*Maculabatis gerrardi*	Whitespotted Whipray	VU
Fish	*Manta birostris*	Giant Manta Ray	VU
Fish	*Mola mola*	Ocean Sunfish	VU
Fish	*Omobranchus smithi*	None	VU
Fish	*Pateobatis jenkinsii*	Jenkins' Whipray	VU
Fish	*Pateobatis uarnacoides*	Bleeker's Whipray	VU
Fish	*Rhina ancylostoma*	Bowmouth Guitarfish	VU
Fish	*Rhincodon typus*	Whale Shark	EN
Fish	*Rhinoptera javanica*	Javanese Cownose Ray	VU
Fish	*Sphyrna lewini*	Scalloped Hammerhead	EN
Fish	*Sphyrna mokarran*	Great Hammerhead	EN
Fish	*Taeniurops meyeni*	Blotched Fantail Ray	VU
Fish	*Urogymnus asperrimus*	Porcupine Ray	VU
Fish	*Urogymnus polylepis*	None	EN
Invertebrates	*Acropora aculeus*	None	VU
Invertebrates	*Acropora acuminata*	None	VU
Invertebrates	*Acropora aspera*	None	VU
Invertebrates	*Acropora dendrum*	None	VU
Invertebrates	*Acropora donei*	None	VU
Invertebrates	*Acropora echinata*	None	VU
Invertebrates	*Acropora hoeksemai*	None	VU
Invertebrates	*Acropora horrida*	None	VU
Invertebrates	*Acropora listeri*	None	VU
Invertebrates	*Acropora lovelli*	None	VU
Invertebrates	*Acropora multiacuta*	None	VU
Invertebrates	*Acropora palmerae*	None	VU
Invertebrates	*Acropora rudis*	None	EN
Invertebrates	*Acropora turaki*	None	VU
Invertebrates	*Acropora vaughani*	None	VU
Invertebrates	*Acropora verweyi*	None	VU
Invertebrates	*Actinopyga echinites*	Deep Water Redfish	VU
Invertebrates	*Actinopyga miliaris*	Harry Blackfish	VU
Invertebrates	*Alveopora allingi*	None	VU

Taxonomic group	Species	Common name	IUCN Red List Category
Invertebrates	*Astreopora moretonensis*	None	VU
Invertebrates	*Euphyllia ancora*	None	VU
Invertebrates	*Galaxea astreata*	None	VU
Invertebrates	*Goniopora burgosi*	None	VU
Invertebrates	*Goniopora planulata*	None	VU
Invertebrates	*Heliopora coerulea*	Blue Coral	VU
Invertebrates	*Holothuria fuscogilva*	None	VU
Invertebrates	*Holothuria lessoni*	Golden Sandfish	EN
Invertebrates	*Holothuria scabra*	Golden Sandfish	EN
Invertebrates	*Isopora cuneata*	None	VU
Invertebrates	*Leptastrea aequalis*	None	VU
Invertebrates	*Lobophyllia diminuta*	None	VU
Invertebrates	*Montipora angulata*	None	VU
Invertebrates	*Montipora crassituberculata*	None	VU
Invertebrates	*Pachyseris rugosa*	None	VU
Invertebrates	*Pavona cactus*	None	VU
Invertebrates	*Pavona decussata*	Cactus Coral	VU
Invertebrates	*Pavona venosa*	None	VU
Invertebrates	*Pectinia alcicornis*	None	VU
Invertebrates	*Pectinia lactuca*	Lettuce Coral	VU
Invertebrates	*Physogyra lichtensteini*	None	VU
Invertebrates	*Pocillopora ankeli*	None	VU
Invertebrates	*Porites aranetai*	None	VU
Invertebrates	*Porites nigrescens*	None	VU
Invertebrates	*Stichopus herrmanni*	Curryfish	VU
Invertebrates	*Symphyllia hassi*	None	VU
Invertebrates	*Thelenota ananas*	Prickly Redfish	EN
Invertebrates	*Turbinaria mesenterina*	None	VU
Invertebrates	*Turbinaria peltata*	None	VU
Invertebrates	*Turbinaria reniformis*	None	VU
Invertebrates	*Turbinaria stellulata*	None	VU
Mammals	*Arctonyx collaris*	Greater Hog Badger	VU
Mammals	*Balaenoptera musculus*	Blue Whale	EN
Mammals	*Cuon alpinus*	Dhole	EN

Taxonomic group	Species	Common name	IUCN Red List Category
Mammals	*Dugong dugon*	Dugong	VU
Mammals	*Lutrogale perspicillata*	Smooth-coated Otter	VU
Mammals	*Neophocaena phocaenoides*	Indo-Pacific Finless Porpoise	VU
Mammals	*Nycticebus bengalensis*	Bengal Slow Loris	VU
Mammals	*Physeter macrocephalus*	Sperm Whale	VU
Mammals	*Rusa unicolor*	Sambar	VU
Mammals	*Sousa chinensis*	Indo-Pacific Humpback Dolphin	VU
Mammals	*Trachypithecus phayrei*	Phayre's Leaf-monkey	EN
Plants	*Halophila beccarii*	Ocean Turf Grass	VU
Plants	*Heritiera fomes*	None	EN
Plants	*Sonneratia griffithii*	None	CR
Reptiles	*Enhydris vorisi*	None	EN
Reptiles	*Eretmochelys imbricata*	Hawksbill Turtle	CR
Reptiles	*Lepidochelys olivacea*	Olive Ridley	VU
Reptiles	*Ophiophagus hannah*	King Cobra	VU
Reptiles	*Python bivittatus*	Burmese Python	VU

Figure 5.30: Key Biodiversity Areas and Protected Areas adjacent to the Study Area



Source: ERM, 2018.

5.1.11.5 Invasive Species

Invasive species are any species that are –non-native to a particular ecosystem and whose introduction and spread causes, or are likely to cause, socio-cultural, economic or environmental harm or harm to human health (FAO, 2013). Invasive species are naturalized species that reproduce often in large numbers and are spread over a large area, damaging native species (FAO, 2005).

Invasive species have the capacity to exacerbate their role in ecosystem degradation through combination threats by habitat change, climate change over-exploitation of ecosystem resources and pollution, which further enhances their threat to biodiversity and the human condition (Emerton and Howard, 2008).

According to the Global Invasive Species Database (GISD) (2015), 97 species have been identified as invasive species in Myanmar. A checklist of invasive species is provided in ***Appendix R***. However, the database does not specifically mention on which part of Myanmar that the invasive species are being introduced.

5.1.11.6 Area of Influence for Biodiversity Value

The Project Area of Influence (AoI) was defined based on a 5 km radius of the Study Area, 500 m either side of the pipeline and 1 km radius of the LNG terminal. The radius was determined based on the nature of the activities of the Project during construction and operation as well as identified natural areas within the vicinity of the Study Area and is consistent with the Project Study Area defined earlier in this report (***Figure 5.1***). From satellite imagery interpretation, the Study Area is mostly disturbed land classes (Agriculture and urban areas). Some remnant or successional mangrove patches are located within the 5km radius of the Study Area and may contain habitat for species of conservation significance. The Area of Influence for biodiversity values is shown in ***Figure 5.31***.

5.1.11.7 Biodiversity Surveys

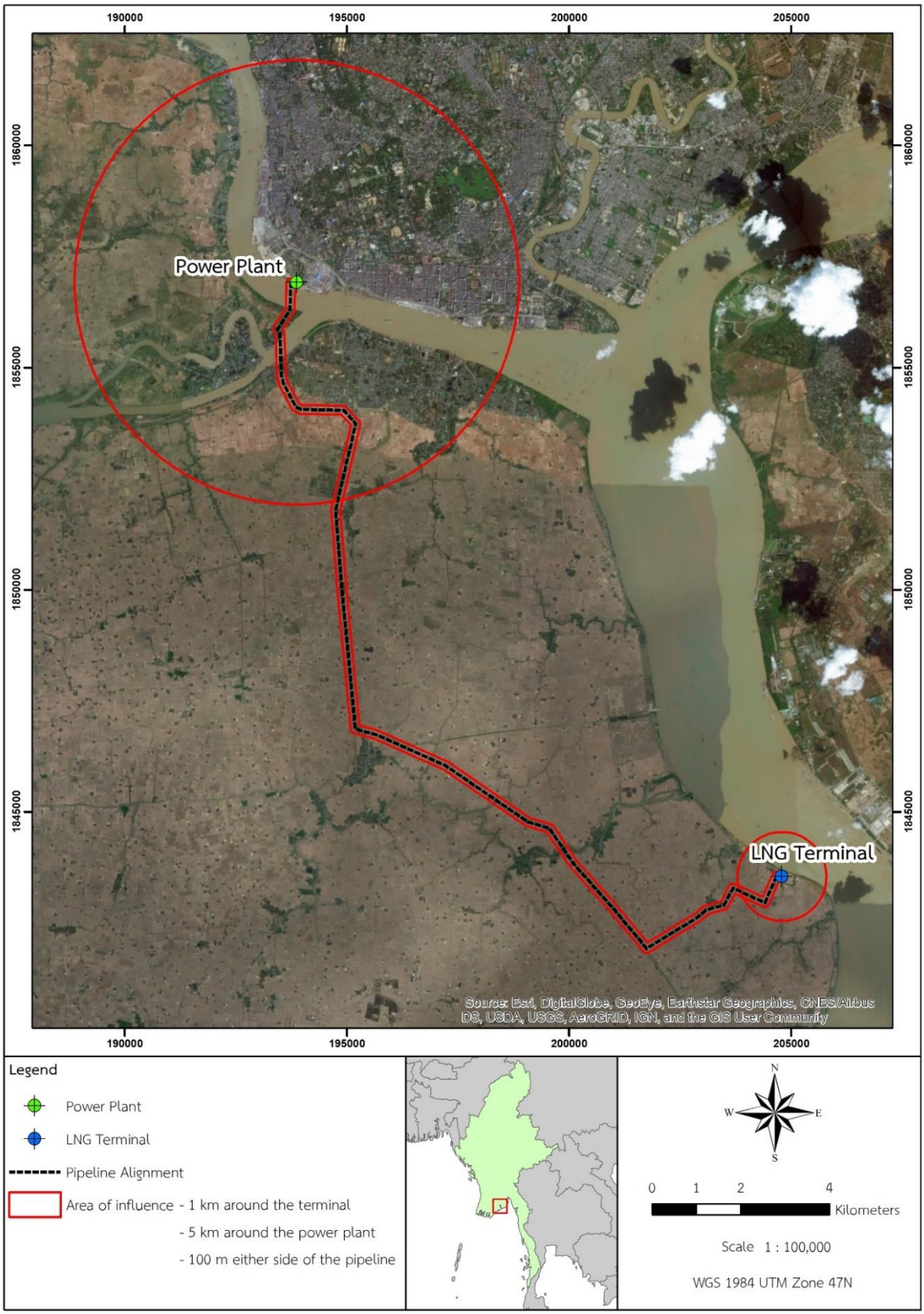
ERM undertook site surveys during the dry season on the 4th to the 5th May 2018. These surveys were conducted to determine the location of any priority biodiversity values within the Study Area and Area of Influence. These priority values focused on Critical Habitat[41] triggers as well as species of conservation significance. The surveys were conducted after a desktop assessment to identify species and habitats to be prioritised for survey; identification of sampling locations (including local villager interviews); field survey targeted major flora and fauna groups; and taxonomy and mapping of flora and fauna records identified. Habitat assessments were also undertaken to inform Natural Habitat[42] and Modified Habitat[43] mapping as required by IFC PS6. ***Figure 5.32*** shows the areas where surveys were conducted.

[41] Critical Habitats are areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregator species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes

[42] Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.

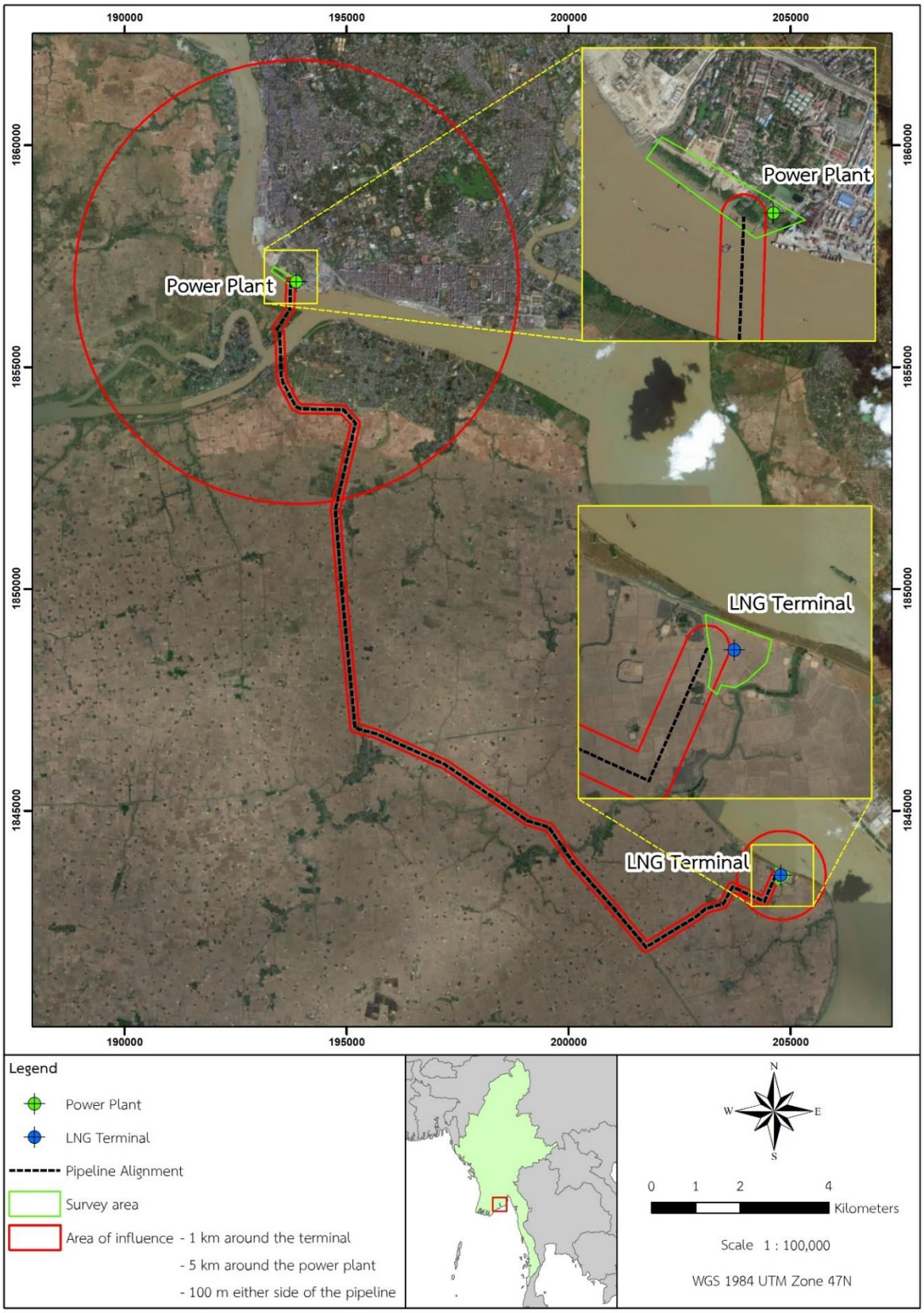
[43] Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition.

Figure 5.31: Biodiversity Area of Influence



Source: ERM, 2019.

Figure 5.32: Biodiversity Survey Area



Source: ERM, 2019.

Pre-Field Desktop

Publicly available sources of information as well as ERM in-house data were analysed to determine likely priority biodiversity values within the Study Area and Area of Influence. Aerial imagery was used to provide a spatial understanding of the pattern of vegetation communities and human uses on the site, and to map access routes and internal tracks.

Consultation occurred with local ecologists with experience of the Area of Influence to obtain information about species known to be present or previously recorded from the site, and other ecological values considered to be relevant.

Sampling Site

A site reconnaissance was carried out over two sampling areas at the proposed Power Plant and Terminal and along the proposed pipeline route and is detailed in ***Figure 5.32***. The site reconnaissance targeted the following specific ecological objectives:

- Identification of invasive species,
- Identification of threatened species,
- Critical Habitat triggers,
- The extent of Natural Habitat

Identification of any areas of habitats of concern that may contain species of conservation interest (e.g. species protected by local legislation, endemic to Myanmar, listed in international conventions for conservation of habitat or listed in International Union for Conservation of Nature (IUCN) Red Data Book.

- Field survey will use techniques including:
- Spot observation,
- Flora survey of all representative vegetation communities; and
- Villager/ stakeholder engagement to determine the local experience in sighting of species (secondary records as part of the socioeconomic survey)
- Fishermen consultations to establish, if any, fishing activity is undertaken in the water body (as part of the socioeconomic survey).

In addition, where possible local people were consulted about the species known to utilize the Study Area, and how the Study Area is affected by seasonal variations (e.g. flooding levels, whether water bodies dry up in driest seasons, etc.).

Land Class Mapping

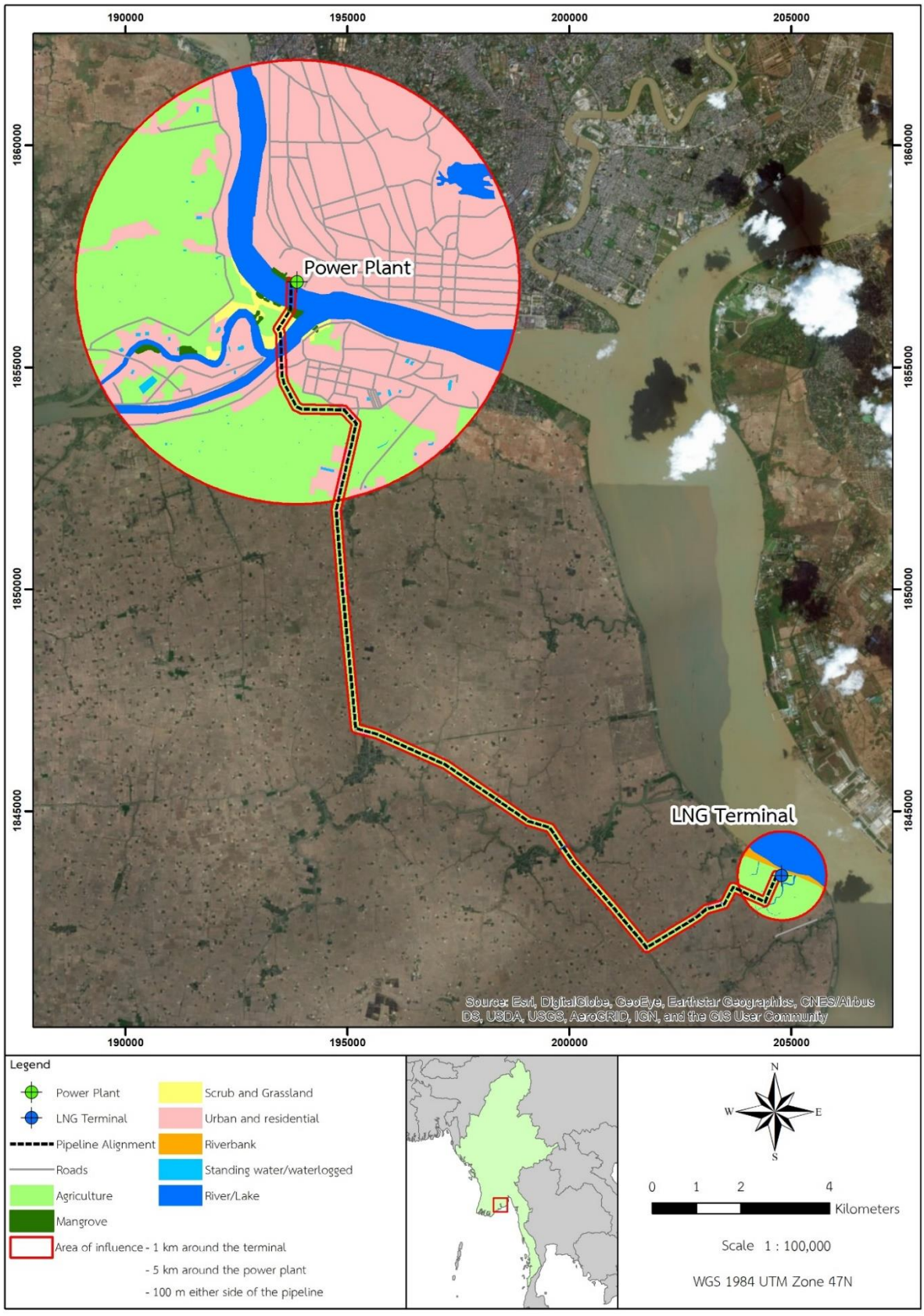
Satellite imagery was used to map the land classes identified within the Study Area and Area of Influence. These land classes were field verified during the field visit. The major land classes identified include agriculture, mangrove, scrub land and grassland, Urban and residential, standing water/waterlogged and riverine. ***Table 5.51*** and ***Table 5.52*** outline the area and description by land class within the AoI. ***Figure 5.33*** shows the distribution of the land classes within the AoI.

Table 5.51: Land Class within the Project AoI

Land Class	Description	Photograph
Roads	Roads consist of bare areas that have been cleared of vegetation to facilitate the movement of vehicles between residential and agricultural areas. Small tracks have also been constructed for use by motorbikes within the project area.	
Agricultural land	Agricultural land is area that has been predominately cleared and is used for agricultural production. The agricultural land use identified with the project area is mainly rice farming with some grazing areas for livestock such as cattle and goats and lotus ponds.	
Mangrove	A riparian forest or riparian woodland is a forested or wooded area of land adjacent to a body of water such as a river, stream, pond, lake, marshland, estuary, canal, sink or reservoir. Plant habitats and communities along the river margins and banks are called riparian vegetation, characterized by hydrophilic plants. The Natural riparian habitat in the Study Area is mangrove with dominant salt water tolerant species including *Sonneratia caseolaris* and *Sonneratia apetala.*	
Scrub land, grassland and disturbed land	Scrub land habitats contain thickets of shrubs and young trees mixed with scattered grasses and wildflowers. A proportion of the site can be classed as disturbed habitat associated with derelict urban sites. Vegetation communities are varied, consisting of taller ruderal plants and lower (often grazed) grasses and herbs.	

Land Class	Description	Photograph
Urban and residential areas	Residential areas are used by local people and contain dwellings, gardens and small agricultural patches. Some natural vegetation including large trees may be exist for shade cover for houses. Areas around the project site contain residential areas associated with Yangon City to the north and Dala village on the southern bank of the Yangon river. The rest of the area around the site consists of small villages and isolated rural dwellings.	
Standing water/waterlogged areas	Ditches and depressions in and around the site contain standing water or are permanently waterlogged. Vegetation present is characterised by aquatic plants including the invasive *Eichhornia crassipes* and *Alternanthera philoxeroides.*	
The Yangon River (and its associated tributaries) and river bank	The Yangon River is an open water riverine aquatic environment located to the South of the Study Area. The river at the location of the Project Site is a tidal, estuarine system with mangrove (see above), mud banks and scrub (see above) along its banks. The photograph on the right shows the project site from the opposite river bank.	

Figure 5.33: Land Class within the Project AoI



Source: ERM, 2019.

Table 5.52: Land Class in the AoI, by Area

Land use	Area of Influence (AoI) (ha)		CCPP		Pipeline		LNG Receiving Terminal	
	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
Agricultural land	3,202.90	37.08%	2,625.25	33.55%	405.15	83.97%	172.50	54.97%
Urban and residential areas	4,122.86	0.49%	4,095.35	52.34%	27.51	5.70%	0.00	0.00%
Standing water/waterlogged areas	1,088.81	1.10%	936.16	11.97%	30.63	6.35%	122.02	38.88%
Scrub land	109.56	11.85%	92.19	1.18%	17.37	3.60%	0.00	0.00%
The Yangon River (and its associated tributaries)	19.30	0.71%	0.00	0.00%	0.00	0.00%	19.30	6.15%
Mangrove	23.64	37.08%	22.21	0.28%	1.43	0.30%	0.00	0.00%
Roads	53.31	48.50%	52.93	0.68%	0.38	0.08%	0.00	0.00%
Total	**8,620.38**	**100%**	**7,824.09**	**100%**	**482.47**	**100%**	**313.83**	**100%**

Source: ERM, 2018.

Natural Habitat and Modified Habitat

IFC PS6 requires the assessment of the distribution of Natural Habitat and Modified Habitat in order to identify risks and mitigations to biodiversity values during the impact assessment phase. There is currently no methodology within IFC PS6 and the associated Guidance Note (GN) on the approach to assess the distribution of these habitat types.

Given the desktop and field information available on the land classes identified, a categorization of the land classes has been made based on the understanding of the history of land use, and species assemblages within each habitat. Each land class has been assigned habitat classifications according to the definitions of IFC PS6. The justification for the classification is shown in ***Table 5.53*** below. The results of the Natural Habitat and Modified Habitat assessment are detailed in ***Figure 5.34***. The areas of Natural Habitat and Modified Habitat within the AoI and Study Area are shown in ***Table 5.54***.

Table 5.53: Natural and Modified Habitats within the Study Area and Area of Influence

Land Class	IFC PS Habitat Classification	Justification
Roads	Modified Habitat	Roads are considered to be modified habitat. The ecological functions of the areas have been totally removed.
Agricultural land	Modified Habitat	Agricultural land is considered modified habitat. Little if any natural vegetation remains in these areas with predominately rice paddies or grazing land. Human use has substantially modified the condition of the habitat.
Mangrove	Natural Habitat	There are small areas of mangrove on the Yangon River and small waterways within the Study Area which are in a predominately natural state. The structure of vegetation remains, however human disturbance has modified the ground level vegetation in places and the faunal diversity is heavily impacted from its natural state.
Scrub land, grassland and disturbed land	Modified Habitat	Scrub land and grassland is considered to be modified habitat in the Study Area. Historic clearing of the mid storey and canopy has removed the forest structure. The habitat is in a substantially modified state. On recently disturbed land, pioneer vegetation communities (including invasive species) have recently colonised areas of human disturbance.
Urban and residential areas	Modified Habitat	Urban and residential areas are considered as modified habitat. Human use has substantially modified the condition of the habitat.
Standing water/waterlogged areas	Modified Habitat	Standing/waterlogged areas around the site remain wet for the majority of the year. Man-made ditches for drainage, heavily modified watercourses and waterlogged depressions within the disturbed site which are considered to be modified habitat.
The Yangon River (and its associated tributaries)	Natural Habitat	The Yangon River and its associated tributaries are considered to be natural habitat. Although containing sediment loads, the aquatic ecosystem contains naturally occurring species and is not in a substantially modified state.

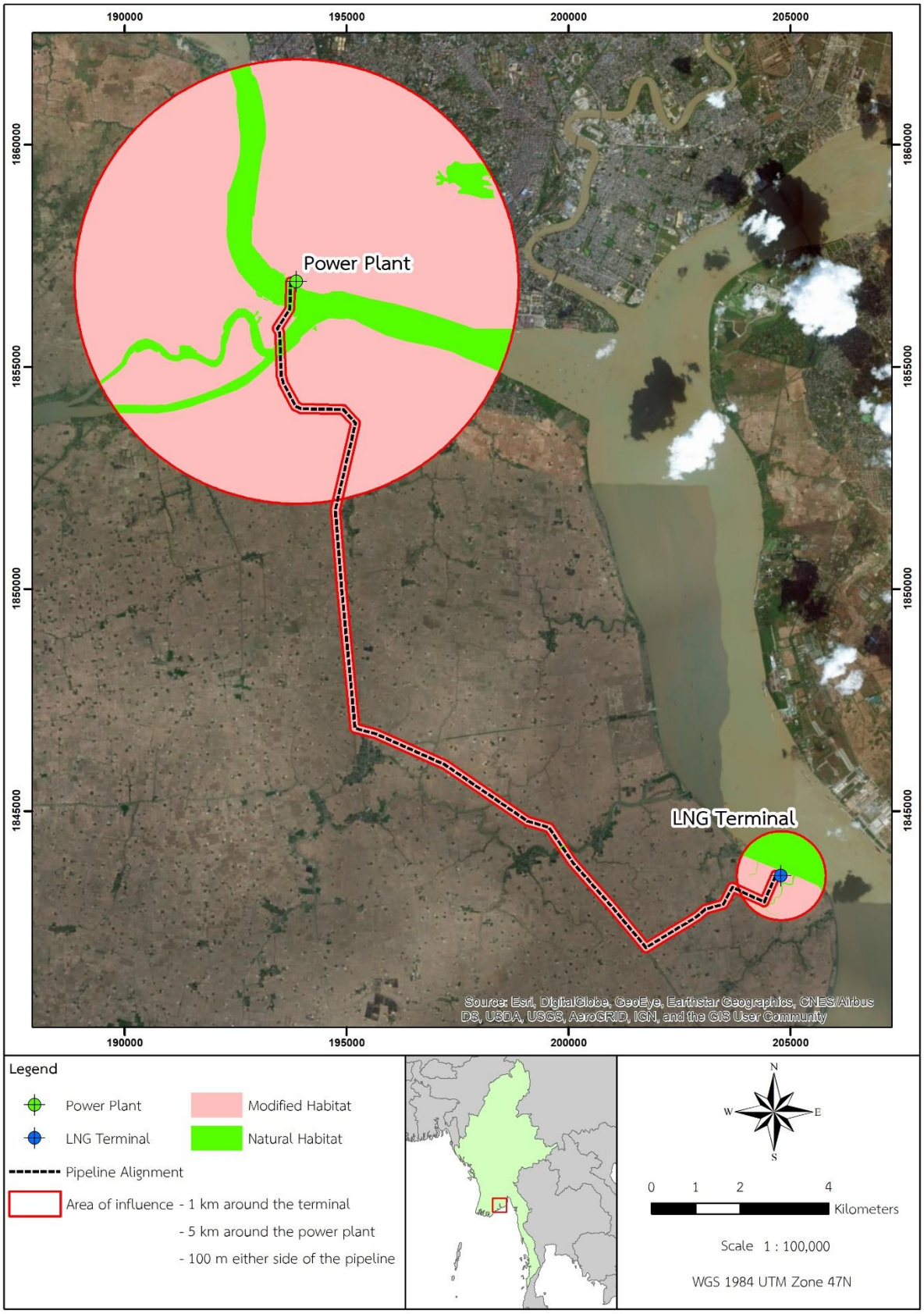
Source: ERM, 2018.

Table 5.54: Areas of Natural Habitat and Modified Habitat within the Study Area and AoI

Habitat Type	Study Area (ha)	Area of Influence (ha)
Natural Habitat	0.20	1,028.16
Modified Habitat	3.02	7,457.86

Source: ERM, 2018.

Figure 5.34: Natural Habitat and Modified Habitat within the Study Area and Area of Influence



Source: ERM, 2018.

Flora

Survey Method

A Global Positioning System (GPS) was used to navigate and mark coordinates between sample plots around the AoI.

In order to obtain ecological data for predicting flora of shrubs and herbs a site reconnaissance was conducted in the locations detailed in ***Figure 5.32***. In each location, plant species were listed with particular attention to the identification of invasive species, threatened species, Critical Habitat triggers and the extent of Natural Habitat. Identification of any areas of habitats of concern that may contain species of conservation interest were noted.

Results

Twenty-three (23) flora species were identified during the surveys.

The majority of other flora identified was identified as Least Concern (LC); Data Deficient (DD) or Not Evaluated (NE). No species of conservation significance were detected that would trigger a Critical Habitat assessment.

Table 5.55 lists the flora species identified during field surveys in the AoI and Study Area.

Table 5.55: Flora Species Recorded

No.	Family Name	Scientific Name	Common Name	IUCN Listing
1	Myrsinaceae	*Aegiceras corniculatum*	Black mangrove	LC
2	Amaranthaceae	*Alternanthera sessilis*	Sessile joyweed	LC
3	Poaceae	*Arundo donax*	Giant reed	LC
4	Poaceae	*Chloris barbata*	-	NE
5	Combretaceae	*Terminalia catappa*	Indian almond, Badan	NE
6	Verbenaceae	*Volkameria inermis (Clerodendrum inerme)*	Glory bower	NE
7	Tiliaceae	*Corchorus olitorius*	Jute, Jew's Mallow	NE
8	Cyperaceae	*Cyperus corymbosus*	-	LC
9	Moraceae	*Ficus benghalensis*	Banyan tree	NE
10	Heliotropiaceae	*Heliotropium ovalifolium*	-	LC
11	Verbenaceae	*Lantana trifolia*	Common lantana	NE
12	Arecaceae	*Nypa fruticans*	Nipa palm	LC
13	Fabaceae/ Mimosaceae	*Pithecellobium dulce*	Madras thorn, Jerusalem thorn	NE
14	Lythraceae	*Sonneratia apetala*	-	LC
15	Lythraceae	*Sonneratia caseolaris*	-	
16	Malvaceae	*Hibiscus tiliaceus*	Sea hibiscus	NE
17	Convolvulaceae	*Argyreia nervosa*	Elephant creeper	NE
18	Acanthaceae	*Acanthus ilicifolius*	Sea holly	LC
19	Fabaceae	*Albizia lebbeck*	Black siris, Kokko	NE

No.	Family Name	Scientific Name	Common Name	IUCN Listing
20	Musaceae	*Musa sanguinea*	Red banana, Nget-pyaw	NE
21	Fabaceae	*Albizia saman*	Rain tree	NE
22	Asteraceae	*Enhydra fluctuans*	-	NE
23	Mimosaceae	*Acacia auriculiformis*	Ear-leaf acacia	LC

Notes: NE – Not Evaluated
VU – Vulnerable
DD – Data Deficient
LC – Least Concern
NL – Not Listed

Invasive Species

During the flora survey, seven (7) invasive species were identified within the Area of Influence. These species are shown in ***Table 5.56*** below.

Table 5.56: Invasive Species Identified found within the Area of Influence

No.	Scientific Name	Common Name	Origin	Threat Level
1	*Ficus religiosa* L.	Bo tree, Lagat, Pipal, Bawdi-nyaung	India/ Native	N
2	*Mimosa invisa* Martius ex Colla M.pigra M.pudica	Senstitive plant, Tigayon	South America. Mexico, Amazon. Tropical America	N
3	*Alternanthera philoxeroides*	Alligator weed	Temperate South America	N
4	*Leucaena leucocephala*	white leadtree, jumbay, river tamarind, subabul,white popinac, Bawza-gaing, Awai-yar	Mexico and northern Central America	N
5	*Eichhornia crassipes*	common water hyacinth	Amazon Basin	N
6	*Acacia auriculiformis*	Ear-leaf acacia	Papua New Guinea, Indonesia and Australia	N
7	*Albizia saman*	Rain tree	Central America, northern South America	N

Notes: R: Regional Significance
N: Nationally Significant

Fauna

Birds

Methods

Observations of bird species were undertaken during the dry season survey. Observations were made opportunistically using binoculars. Where possible, birds were identified from calls heard during the surveys.

Results

A total of fourteen (14) bird species were detected during the survey. All species were identified as Least Concern on the IUCN Red list. No species were determined to be conservation significant and hence would trigger a Critical Habitat assessment.

The results of the mammal survey are shown in ***Table 5.57***.

Table 5.57: Bird Species Identified within Sample Areas

No.	Scientific Name	Common Name	Family	IUCN Status
1	*Corvus splendens*	House Crow	Covidae	LC
2	*Aegithina tiphia*	Common Iora	Aegithinidae	LC
3	*Passer domesticus*	House Sparrow	Passeridae	LC
4	*Lonchua punctulata*	Scaly-Breasted Munia	Ploceidae	LC
	Streptopelia chinensis	Spotted Dove	-	-
5	*Acridotheres tristis*	Common Myna	Sturnidae	LC
6	*Columba livia*	Rock Pigeon	Columbidae	LC
7	*Pycnonotus blanfordi*	Streak Eared Bulbul	Pycnonotidae	LC
8	*Lanius bucephalus*	Bull-Headed Shrike	Laniidae	LC
9	*Riparia paludicola*	Plain Martin	Hirundinidae	LC
10	*Cypsiurus balasiensis*	Asian Palm Swift	Apodidae	LC
11	*Haliastur indus*	Brahminy Kite	Accipitridae	LC
12	*Milvus migrans*	Black Kite	Accipitridae	LC
13	*Egretta garzetta*	Little Egret	Ardeidae	LC
14	*Ardeola grayii*	Indian Pond Heron	Ardeidae	LC

Notes: NE – Not Evaluated
VU – Vulnerable
DD – Data Deficient
LC – Least Concern
NL – Not Listed

Mammals

Methods

Records of mammals were taken opportunistically during the site survey using binoculars and observation of tracks and field signs.

Results

One mammal species was recorded during the survey, the delta pigmy rice rat *Oligoryzomys nigripes.* The common grey mongoose (*Herpestes edwardsii*) is known to be in the vicinity of the site but was not recorded during the survey. No species were determined to be conservation significant and would hence trigger a Critical Habitat assessment.

Herpetofauna

Methods

Records of herpetofauna were taken opportunistically during the site survey.

Results

A total of two (2) species of reptile and no amphibian species detected during the surveys. All species were classed as Least Concern or Not Evaluated under the IUCN Red List. No species were determined to be conservation significant and hence would trigger a Critical Habitat assessment.

The results of the survey are shown in ***Table 5.58***.

Table 5.58: Herpetofauna Species Recorded

No.	Family Name	Scientific Name	Common Name	Observation	IUCN status
1	Squamata	Gekkonidae	Hemidactylus frenatus	Asian house Gecko	LC
4	Squamata	Agamidae	Calotes versicolor	Garden fence lizard	NE

Notes: LC – Least Concern (IUCN)
NE – Not Evaluated

Fish

Methods

The ERM in-house database was consulted; Fish surveys involved interviews with local fishers and trapping of fish during February and March of 2019.[44]

Results

During the survey, 51 fish species were identified with some examples provided in ***Figure 5.35*** and ***Figure 5.36***. A full list of all fish species and their associated IUCN red list status are provided in ***Table 5.59***. The surveys identified three (3) Near Threatened species, 42 Least Concern species, one (1) Data Deficient species and five (5) Not Yet Assessed species on the IUCN Red List. According to FishBase (2019), a global species database of fish species, there are 26 migratory fish species out of total of 51 species reported are classified as migratory. Four (4) species recorded are endemic species (i.e., native and restricted to a certain place) (Living International Treasure, 2019).

Boal (*Wallago attu*), Indian Butter-catfish (*Ompok bimaculatus*) and Manipur Osteobrama (*Osteobrama belangeri*) are listed as Near Threatened species. Boal (*Wallago attu*) is a fast growing catfish and a good market demand species for its high nutritional value and protein content (Gupta, S., 2015). Boal inhabit at both flowing water and still water and is widely distributed in India, Bangladesh, Pakistan, Sri Lanka, Nepal, Afghanistan, Indonesia, Myanmar, Thailand, Vietnam and Cambodia (Chondar, S. L., 1999) (Pethiyagoda, R., 1991). The population of Boal is decreasing due to over harvesting, environmental degradation, pollution, and improper watercourse management (Patra, M., K., et al., 2005).

Indian Butter-catfish is widely distributed in the plains and submontane regions of India, Pakistan, Bangladesh, Myanmar, Sri Lanka, and Afghanistan (Raizada, S., et al., 2013). The population of this

[44] ERM Myanmar Company Limited. (2020). Environmental Impact Assessment for the Development of New Yangon City Phase 1 Masterplan – Bridges.

species has declined in last five decades to more than 50% (Sridhar, S., et al., 1998); fishing and harvesting aquatic resources are main factors of the decline (IUCN, 2019). Manipur Osteobrama is a carp endemic to Manipur of India, Myanmar, and Yunnan province of China. The species has been critically endangered in Manipur Region of India likely by a result of blockage of reproductive migration after construction of barrage (Basudha, C., 2007), whereas there is still sizeable sub-population in Myanmar (Living International Treasures , 2019).

Table 5.59: Fish Species Recorded during Surveys

No	Common Name	Family	Scientific Name	IUCN [a]	Migratory [b]	Endemic [c]
1	Angra Labeo	Cyprinidae	*Labeo angra*	LC	Po	-
2	Asiatic Snakehead	Channidae	*Channa orientalis*	LC	-	-
3	Back-line Rasbora	Cyprinidae	*Rasbora daniconius*	LC	Po	-
4	Banana Fish	Cobitidae	*Acantopsis choirorhynchos*	LC	-	-
5	Batchwa Vacha	Schilbeidae	*Eutropiichthys vacha*	LC	Po	-
6	Blyth's Loach	Cobitidae	*Botia berdmorei*	NE	-	-
7	Boal	Siluridae	*Wallago attu*	NT	Po	-
8	Boga Labeo	Cyprinidae	*Labeo boga*	LC	Po	-
9	Burmese Carplet	Cyprinidae	*Amblypharyngodon atkinsonii*	LC	-	Y
10	Burmese Erethistes	Sisoridae	*Erethistes maesotensis*	LC	-	-
11	Burmese Loach	Cobitidae	*Botia histrionica*	LC	-	-
12	Burmese River Shad	Clupeidae	*Gudusia variegata*	LC	Am	-
13	Burmese Spinyeel	Mastacembelidae	*Macrognathus zebrinus*	LC	-	Y
14	Catla	Cyprinidae	*Catla catla*	NE	Po	-
15	Chola Barb	Cyprinidae	*Puntius chola*	LC	Po	-
16	Climbing Perch	Anabantidae	*Anabas testudineus*	DD	Po	-
17	Cunma Osteobrama	Cyprinidae	*Osteobrama cunma*	LC	-	-
18	Freshwater Garfish	Belonidae	*Xenentodon cancila*	LC	Am	-
19	Gangetic Mystus	Bagridae	*Mystus cavasius*	LC	Am	-
20	Giant Snakehead	Channidae	*Channa marulius*	LC	Po	-
21	Grey Feather-back	Notopteridae	*Notopterus notopterus*	LC	Po	-
22	Indian Butter-catfish	Siluridae	*Ompok bimaculatus*	NT	Po	-
23	Indian Gagata	Sisoridae	*Gagata cenia*	LC	-	-
24	Indian Glass-barb	Cyprinidae	*Chela laubuca*	NE	-	-
25	Indian Glassy fish	Ambassidae	*Parambassis ranga*	LC	Po	-
26	Indian Potasi	Schilbeidae	*Neotropius acutirostris*	LC	-	-
27	Karnataka Labeo	Cyprinidae	*Labeo calbasu*	LC	Po	-

No	Common Name	Family	Scientific Name	IUCN [a]	Migratory [b]	Endemic [c]
28	Magur	Clariidae	*Clarias batrachus*	LC	Po	-
29	Malabar Loach	Cobitidae	*Lepidocephalus thermalis*	LC	-	-
30	Manipur Osteobrama	Cyprinidae	*Osteobrama belangeri*	NT	-	Y
31	Morar	Cyprinidae	*Aspidoparia morar*	LC	-	-
32	Moulmein Labeo	Cyprinidae	*Labeo stoliczkae*	NE	-	Y
33	Mrigal	Cyprinidae	*Cirrhinus mrigala*	LC	-	-
34	Murree Labeo	Cyprinidae	*Labeo microphthalmus*	LC	-	-
35	-	Bagridae	*Mystus corsula*	LC	-	-
36	-	Balitoridae	*Acanthocobitis rubidipinnis*	LC	-	-
37	Ocellated Pufferfish	Tetraodontidae	*Tetraodon cutcutia*	LC	Po	-
38	One-stripe Spinyeel	Mastacembelidae	*Macrognathus aral*	LC	-	-
39	Pulcher Mystus	Bagridae	*Mystus pulcher*	LC	-	-
40	Rice Swampeel	Synbranchidae	*Monopterus albus*	LC	Po	-
41	Rohu	Cyprinidae	*Labeo rohita*	LC	Po	-
42	Sittang Mystus	Bagridae	*Mystus leucophasis*	LC	-	-
43	Slender Barb	Cyprinidae	*Rasbora daniconius*	LC	Po	-
44	Snakeskin Gourami	Belontiidae	*Trichogaster pectoralis*	NE	Po	-
45	Spotted Snakehead	Channidae	*Channa punctatus*	LC	Po	-
46	Stinging Catfish	Heteropneustidae	*Heteropneustes fossilis*	LC	-	-
47	Stripled Gourami	Belontiidae	*Colisa labiosa*	LC	-	-
48	Tank Goby	Gobiidae	*Glossogobius giuris*	LC	Am	-
49	Ticto Barb	Cyprinidae	*Puntius ticto*	LC	Po	-
50	Tilapia	Cichlidae	*Oreochromis spp*	LC	-	-
51	Tire-track Spinyeel	Mastacembelidae	*Mastacembelus armatus*	LC	Po	-

Note *[1] =IUNC (2019): DD = Data Deficient, LC = Least Concerned, NE = Not Evaluated, NT = Near Threatened,*
[2] =Fishbase (2019): Y=Yes
[3] =Living International Treasure (2019):
Oc = Oceanodromous fish, which occur widely throughout the world's oceans, live and migrate wholly in the sea
Am = Amphidromous, which refers to fishes that regularly migrate between freshwater and the sea (in both directions), but not for breeding, as in anadromous and catadromous species.
Po = Potamodromous, refers to a fish that migrates within fresh water only.

Figure 5.35: Rohu (*Labeo rohita*)

Source: ERM Field Survey (2019)

Figure 5.36: Snakeskin gourami (*Trichogaster pectoralis*)

Source: ERM Field Survey (2019)

5.1.11.8 Critical Habitat Screening Assessment

Criterion for Critical Habitat

The Critical Habitat assessment comprised an analysis of biodiversity values within the project area and area of influence, habitats of high biodiversity value, species of conservation concern and general flora and fauna assemblages. This involved GIS analysis; desk based data collection including a review of previous EIAs, and targeted field surveys at karst surface and cave habitats.

Critical Habitat criteria are defined in PS6 Guidance Note 6 (GN6), Paragraphs GN69 to 97. ***Table 5.60*** provides detail of the qualifying requirements for Criteria 1 to 3 (i.e. thresholds), while details of the likely qualifying interests for Criterion 4 and 5 will be defined based on research and expert opinion. The criteria listed have been used to complete this assessment (IFC, 2018).

Table 5.60: Criteria Habitat Criteria

Criteria	Tier 1[(1)]
Criterion 1: Critically Endangered (CR) / Endangered (EN) species:	(a) Areas that support globally-important concentrations of an IUCN Red-listed EN or CR species (0.5% of the global population AND 5 reproductive units15 of a CR or EN species); (b) Areas that support globally-important concentrations of an IUCN Red-listed VU species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in (a). (c) As appropriate, areas containing nationally/regionally-important concentrations of an IUCN Red-listed EN or CR species.
Criterion 2: Habitat of significant importance to endemic and/or restricted-range species;	(a) areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.
Criterion 3: Habitat supporting globally significant concentrations of migratory species and/or congregatory species;	(a) areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle. (b) areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.
Criterion 4: Highly threatened and/or unique ecosystems; and/or	(a) areas representing ≥ 5% of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN. (b) other areas, not yet assessed by IUCN, but determined to be of high priority for conservation by regional or national systematic conservation planning.
Criterion 5: Areas associated with key evolutionary processes	No set criteria

Note: [(1)] No Tier system is in place for Criterion 5

Critical Habitat Triggers (Criterion 1-3)

The five criteria are 'triggers' in that if an area of habitat meets any one of the criteria, it will be considered Critical Habitat irrespective of failing to meet any other criterion[45]. Therefore, Critical Habitat can be determined through a single criterion or where a habitat holds biodiversity meeting all five criteria. This approach is generally more cautious but is used more widely in conservation[46]. Critical Habitat criteria therefore have two distinctive characteristics. First, components of biodiversity are essentially assigned to only two levels of conservation significance, those that trigger Critical Habitat and those that do not. Second, each criterion is applied separately and not in combination, meaning that the scores are not cumulative.

Critical Habitat Candidate Species

No species were identified from surveys that would trigger assessment under Criterion 1 to 3.

Potential Critical Habitat Species (Criterion 1 to 3)

No species have been identified to be potential CH species under Criterion 1 to 3.

Ecosystems at Risk of Significantly Decreasing in Area or Quality

The ecosystems in the AoI are generally widely distributed. The habitat within the Area of Influence and Study Area are not considered to be significant and hence would not trigger Critical Habitat under Criterion 4.

Ecosystems with a Small Spatial Extent

All ecosystems present within the AoI and Study Area are generally widely spread throughout Myanmar.

Ecosystems Containing Unique Assemblages of Species Including Assemblages or Concentrations of Biome-Restricted Species

All ecosystems present within the AoI and Study Area are not unique or contain assemblages of biome restricted species.

Criterion 5 – Key Evolutionary Processes

Criterion 5 recognises the attributes of a region that that can influence evolutionary processes and give rise to regional configuration of species and ecological properties. Examples can include isolated areas where populations are phylogenetically distinct, areas of high endemism, environment gradients or ecotones and biological corridors.

No key evolutionary processes have been identified within the ecosystems within the Area of Influence or Study Area.

5.1.12 Natural Hazards

Myanmar is exposed to multiple natural hazards including cyclones, earthquakes, and flooding. These are discussed in the following sections. The accidental events impact assessment and the relevant mitigation measures are further discussed in this Section.

[45] The Biodiversity Consultancy (TBC) (2013) Getting through PS6: Critical Habitat and its requirements. Case Studies from Guinea and Mongolia.Whitmore, T.C. (1984) Tropical Rain Forests of the Far East. Oxford University Press. Second Edition.
[46] McDonald-Madden, E. Gordon, A. Wintle, B. Walker, S. Grantham, H. Carvalho, S. Bottrill, M. Joseph, L. Ponce, R. Stewart, R. & Possingham, H. P. (2009). "True" Conservation Progress. Science 323: 43-44.

5.1.12.1 Storms and Cyclones

Gale force winds (17.2 m s^{-1} or over) are mainly associated with local rain squalls and with severe tropical storms or cyclones. The central region off the coast receives the worst buffeting during the summer monsoon. The threat of cyclones with winds above 32.7 m s^{-1} affects different areas at different times of the year, affecting all areas though the major tracks do not pass over the Andaman Sea (OCHA, 2011). Cyclones are most frequent from mid-May to early December.

5.1.12.2 Flooding

Areas within the New Yangon City are prone to flooding due to the low elevation relative to its surroundings. Pluvial flood can occur due to runoff to low lying areas with limited drainage capacity. Fluvial flooding can occur when the surroundings are lower than the water in the surrounding river or canal (Royal Haskoning DHV, 2019).

The average tidal range of the Yangon River is about 6 m at spring tide and 3 m at neap tide. Modelling of the discharge of Yangon River indicates discharges ranging from <500 m^3/s in April to approximately 7,000 m^3/s in August, with tidal water level variations of around 1 to 6 m based on water level measurements at Monkey Point located downstream of the Study Area (De Koning and Janssen, 2015). In the Ayeyarwady Delta, which includes the Yangon River, drainage, salt intrusion, and flood protection are key concerns (EO Earth Website, 2016).

Two main forces dominate the Yangon River system that can result in fluvial floods (Royal Haskoning DHV, 2019):

- **Increased water levels from the sea:** there is a strong tide from the Gulf of Martaban. The spring tide range is approximately 5.4 m in the Hlaing River, and the neap tide range is approximately 2 m. In addition, storm surges can increase offshore water levels.
- **Increased discharges during the monsoon period:** the Irrawaddy River feeds the Yangon River with rainfall from the Irrawaddy River Basin and water levels increase by an additional approximate 0.7 m during the monsoon period.

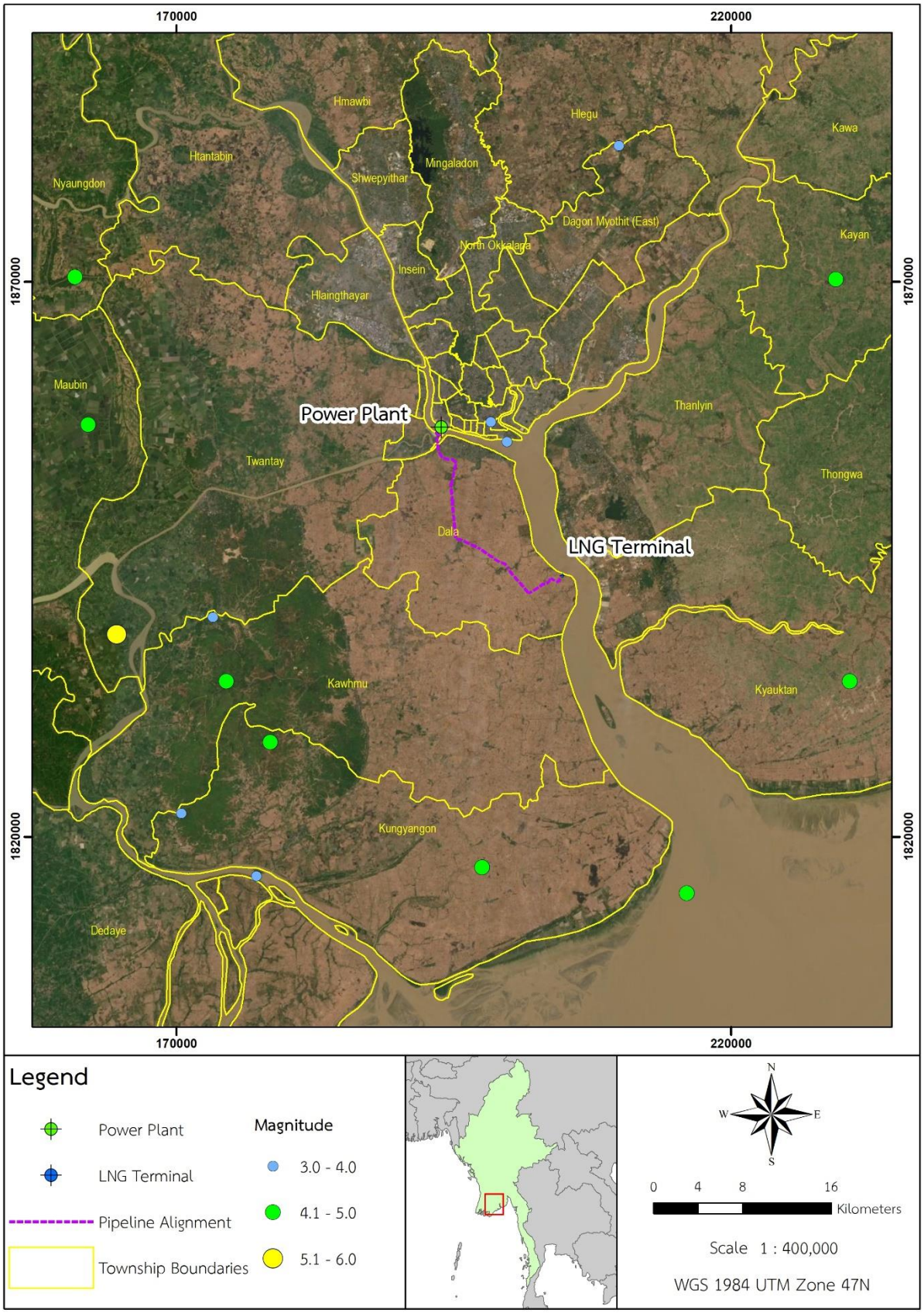
As part of the Phase 1 development NYDC initiated a Strategic Flood Risk Assessment to ensure that the proposed development takes account of flood risk. Royal Haskoning DHV (RHDHV) was selected as the consultant to provide professional services to contribute to the development New Yangon City's flood risk assessment services for Phase 1. The following are some of the main conclusions from the Strategic Flood Risk Assessment.

- The New Yangon City is prone to flooding due to the following three flood sources: tide and storm surge (coastal), river discharge (fluvial) and rainfall (pluvial). Among the three flood sources, coastal floods (in terms of days) are usually shorter in duration than fluvial flood (in terms of weeks).
- The flood risk profile for New Yangon City shows that the existing flood risk without flood protection is high. Sea level rise will strongly influence the flood risk profile of New Yangon City in terms of economic risk as well as loss-of life. Implementation of flood risk reduction measures is recommended. (Royal Haskoning DHV, 2019).

5.1.12.3 Earthquake Risk

A review of available literature has shown that Myanmar is seismologically unstable and vulnerable to earthquakes due to its location in the active Alpide seismotectonic belt and the young Alpine Himalayan-Sumatran orogenic belt (Willige et al., 2009). Historic records show that at least 15 major earthquakes with magnitudes M≥7.0 Richter scale (RS) have occurred in Myanmar in the last hundred years. These earthquakes occurred within Myanmar in the last century, in Yangon Region, these include on 27 March, 16 May, and 21 May 1931 and in 1970. ***Figure 5.37*** presents the locations of historic earthquakes in Yangon taken from United States Geological Survey (USGS) data from 2017.

Figure 5.37: Historic Earthquakes in Yangon



Source: USGS, 2020.

5.2 Socioeconomic Baseline

The following chapter provides an overview of the social, socioeconomic, health and cultural heritage conditions of the Project area.

5.2.1 Data Collection

Settlements located closest to the Project infrastructure are likely to experience negative and positive impacts as a result of the Project activities, including economic opportunities, social and environmental changes, lifestyle changes, and changes to community health and safety. Other social receptors located further from the Project may also benefit or experience negative impacts from the Project.

The Social Area of Influence (SAoI), where data collection has been conducted to help establish the socioeconomic baseline, is defined as the area inhabited or used by stakeholders and likely to be positively or negatively affected by the Project. This includes short, long term or permanent changes, as well as direct, induced or indirect impacts. The SAoI includes:

- The Project site(s) and related facilities developed or controlled by TPMC and the additional areas in which aspects of the environment could conceivably experience significant impacts.
- Associated facilities that are not developed and funded as part of the proposed Project, but are essential for the Project and without which the Project cannot proceed, and the associated areas in which the environment could conceivably experience significant impacts.
- Areas potentially affected by cumulative impacts resulting from other developments known at the time of the ESIA, further planned phases of the Project or any other existing circumstances.
- Areas potentially affected by impacts from predictable (but unplanned) developments as a result of the proposed Project (i.e., induced activities), occurring at a later stage or at a different location.

The information presented in this Section was gathered through desktop review of publicly available sources. To provide a more precise understanding of the social, socioeconomic, health and cultural heritage conditions in the Project area, primary data have been collected just after the first Public Consultation session, from 15 to 19 November 2018. The methods for gathering primary data are comprised of household questionnaires, face-to-face interview with key informants and focus group discussions with designated interviewees. Key stakeholder groups include village leaders, women, fishermen, health care professionals and famers from the local villages. A total of 150 household questionnaires as well as 11 Focus Group Discussions and Key Informant Interviews have been administered in Dala, Seikgyikanaungto and Ahlone townships. Examples of the tools used for primary data collection for social baseline are included in ***Appendix S***.

The collection of secondary and primary data provided an opportunity to triangulate the data to confirm the accuracy of the information presented. Given the limited secondary data available at the local level, it also ensured a more robust baseline against which the likely impacts associated with the Project could be assessed. The data at local level indicated without specific footnote that refers to publicly available sources is extracted from ERM's interview processes, which were conducted in November 2018.

The Project Site and its surrounding area will be referred to as the 'study area', which will have a radius of 3 km from the LNG Receiving Terminal and Power Plant. The natural gas pipeline will have a study area that stretches 500 m perpendicular on each side, and along the entire pipeline alignment.

Figure 5.38: Social Baseline Data Collection in the Project SAoI

5.2.2 Social Receptors

The baseline focuses on the receptors that may be impacted or influenced by the Project due to their proximity to the Project site and/ or Project associated facilities. As shown in (***Figure 5.39***), this includes people living in:

- Dala village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline;
- Tha Pyay Kone village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline, and within 3 km of the Power Plant;
- Nyaung Ngoke To village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline, and within 3 km of the Power Plant;
- Ye Chaung Wa village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline;
- Pyawbwe Gyi village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline;
- Shwe Hlay Chaung village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline;
- Tone Tin Gan (North) village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline;
- Tone Tin Gan (South) village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline and within 3 km of LNG Terminal;

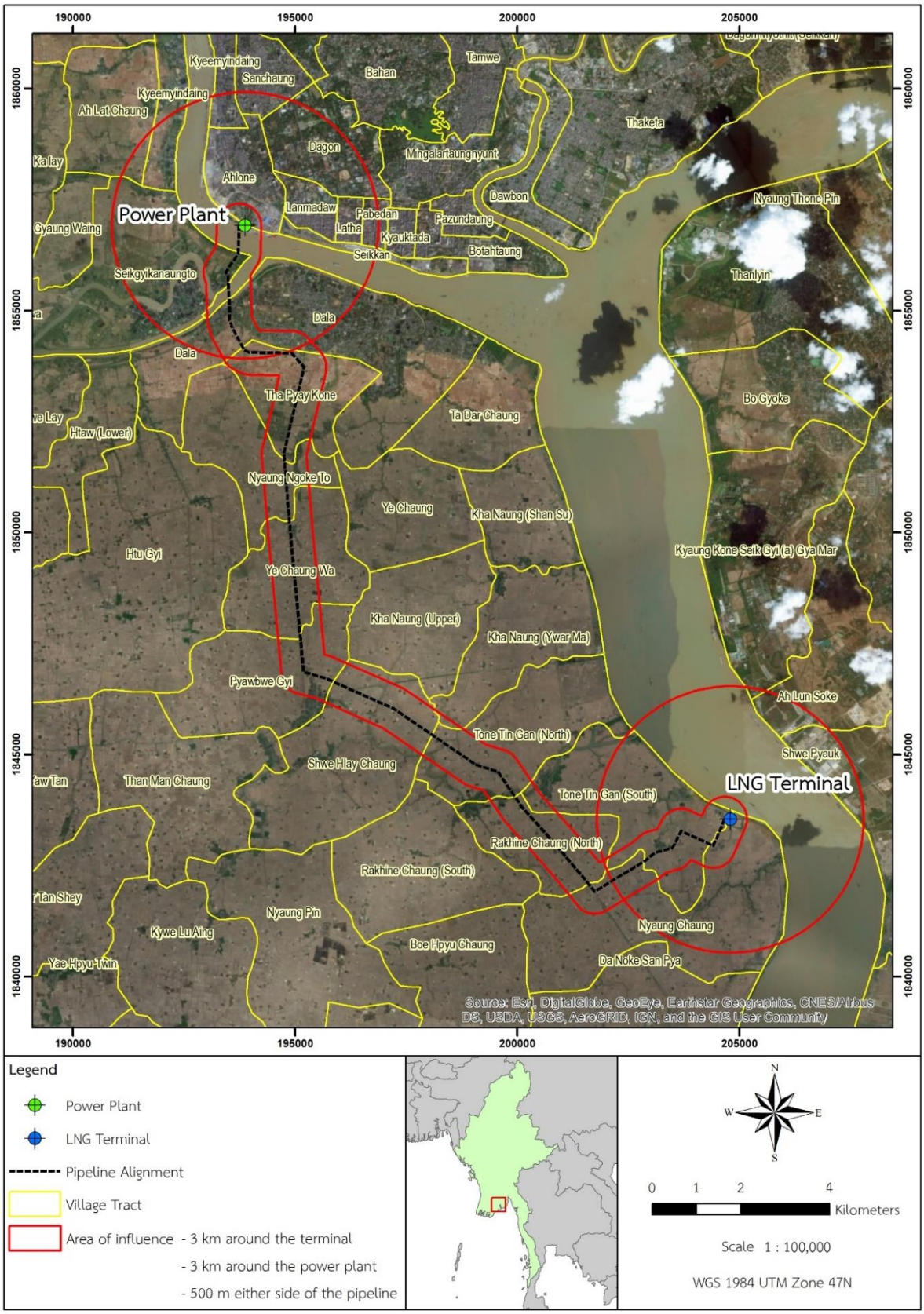
- Rakhin Chaung (North) village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline, and within 3 km of LNG Terminal;
- Nyaung Chaung village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline, and at location of LNG Terminal;
- Seikgyikanaungto village tract. The village tract is located within 500 m perpendicular on each side of the Pipeline, and within 3 km of the Power Plant;
- Ahlone village tract. The village tract is where the Power Plant is located;
- Htaw (Lower) village tract. The village tract is within 3 km of the Power Plant;
- Gyaung Waing village tract. The village tract is within 3 km of the Power Plant;
- Kyun Ka Lay village tract. The village tract is within 3 km of the Power Plant;
- Ah Lat Chaung village tract. The village tract is within 3 km of the Power Plant;
- Kyeemyindaing village tract. The village tract is within 3 km of the Power Plant;
- Sanchaung village tract. The village tract is within 3 km of the Power Plant;
- Dagon village tract. The village tract is within 3 km of the Power Plant;
- Kamaryut village tract. The village tract is within 3 km of the Power Plant;
- Bahan village tract. The village tract is within 3 km of the Power Plant;
- Mingalartaunginyung village tract. The village tract is within 3 km of the Power Plant;
- Lathat village tract. The village tract is within 3 km of the Power Plant;
- Lanmadaw village tract. The village tract is within 3 km of the Power Plant;
- Seikkan village tract. The village tract is within 3 km of the Power Plant;
- Pabedan village tract. The village tract is within 3 km of the Power Plant;
- Kyaukatada village tract. The village tract is within 3 km of the Power Plant;
- Pazundaung village tract. The village tract is within 3 km of the Power Plant; and
- Botahtaung village tract. The village tract is within 3 km of the Power Plant.

The study area of the Project covers 29 village tracts and 3 townships (Ahlone, Dala and Seikgyikanaungto). There are 6 overlapped village tracts and 3 overlapped townships from 3 project components.

Table 5.61: Conclusion on Number of Townships and Village Tracts in the Study Area

	LNG Terminal (within 3 km)	Power Plant (within 3 km)	Natural Gas Pipeline (within 100 m perpendicular on each side)
Total Township	1	1	3
Total Village Tract	3	22	11

Figure 5.39: Social Receptors



Source: ERM, 2018.

5.2.3 Overview of Project Area and Study Area

5.2.3.1 Myanmar

Myanmar is located in Southeast Asia. The country is bordered to the east by Thailand and Laos, to the north by China and to the west by India and Bangladesh. Myanmar has a lengthy coastline that extends for approximately 2,400 km along the Andaman Sea and Bay of Bengal.

There are a number of mountain ranges and river systems, which run north to south through the country – creating natural divisions. There are four distinct seasons in Myanmar. The cold and dry season runs from November to February, while the hot season is March and April, and the rainy season extends from May to October. During the rainy season, monsoons can occur, causing flooding and landslides.

Myanmar is divided into States and Regions (also referred to as Divisions), which are further divided into Townships for administrative or governance purposes. Yangon or Rangoon, former capital of Myanmar, is divided into 33 townships. The Project site is located within the Ahlone, Seikgyikanaungto and Dala Townships of Yangon. Therefore, the information presented hereafter will cover both primary and secondary data of these three townships.

5.2.3.2 Yangon region

Yangon, formerly known as Rangoon, is the most urbanized region of Myanmar. The region is located in the southern central part of Myanmar on the west bank of Hlaing River. It was the administrative capital of Myanmar until 2006 when government proclaimed Nay Pyi Taw has the new administrative capital of Myanmar[47]. In the city, structures of building are mixed between old colonial and modern structures. Although most buildings are constructed with bricks, wooden places can be commonly found in outskirt and distant areas.

5.2.3.3 Seikgyikanaungto Township

This township is located in the Southern district of Yangon[48], and isolated from the main Yangon area by the Yangon River, with less tourists and transport infrastructures[49]. In 2017, this township was awarded with the cleanest township award[50]. In this township, land is used for industrial area (2%), under development area (2%), open space (14%), water surface (15%), residential area (21%), and agricultural area (47%)[51].

5.2.3.4 Ahlone Township

Ahlone Township is located in the Western district of Yangon on the left bank of the Yangon River. This township is home to industrial activities (Yangon Port) and city like business as well as residential areas. The area of the proposed power plant is an unused area, subject to flooding. Ahlone can be reached by taking trains, buses and special buses from Yangon[52]. Land use in Ahlone Township

[47] Yangon (Myanmar). Accessed on 24 October 2018 at https://www.britannica.com/place/Yangon

[48] The 2014 Myanmar Population and Housing Census (Seikgyikanaungto Township). Accessed on 24 October 2018 at https://themimu.info/sites/themimu.info/files/documents/TspProfiles_Census_Seikkyi-Khanaungto_2014_ENG.pdf

[49] 7 day trip ideas for getting out of Yangon. Accessed on 24 October 2018 at https://frontiermyanmar.net/en/7-day-trip-ideas-for-getting-out-of-yangon

[50] Volunteers determined to clean up Yangon. Accessed on 24 October 2018 at https://www.mmtimes.com/lifestyle/26332-volunteers-determined-to-clean-up-yangon.html

[51] The Project for the Strategic Urban Development Plan of the Greater Yangon (Final Report I). Accessed on 31 October 2018 at http://open_jicareport.jica.go.jp/pdf/12122529_02.pdf

[52] Ahlone, Yangon, Myanmar (Burma). Accessed on 24 October 2018 at https://www.latlong.net/place/ahlone-yangon-myanmar-burma-24788.html

consists of water surface (1%), public facilities area (3%), business area (5%), open space (9%), industrial area (20%), and residential area (62%)[51].

5.2.3.5 Dala Township

Dala Township is located in the Southern district of Yangon Region south of the Yangon River, Dala's land use consists of under development area (1%), open space (1%), water surface (2%), residential area (8%), and agricultural area (87%)[51].

5.2.4 Demographic Profile

5.2.4.1 Yangon Region

The region covers an area of approximately 10,171.30 sq. km[53], divided into 4 districts (Yangon North, Yangon East, Yangon West and Yangon South), 33 townships, 742 wards and 2,170 villages[54] Total population is around 7 million people, with 52.2% female. (***Table 5.62***). Citizens are mostly aged between 15 – 64 years old (***Table 5.63***). More than 3 million of Yangon citizens are married (***Table 5.64***). Out of the total Yangon population, approximately 1,869,787 people (25%) are considered vulnerable population[55].

The majority of the population in the Study Area are Bamar people; Bamar people are the dominant ethnic group in Myanmar, with a population of more than 30,110,000 people. There are, however, small numbers of Kayin, Mon, and Rakhine living in the Study Area. ***Figure 5.40*** shows that in Yangon, ethnic groups also comprise Indians, Chinese, Kayin, Rakhine and Mon. The Myanmar Government recognizes Mon. Kayin and Rakhine as national ethnic group[56]. The dominant religion is Buddhism, although Christianity, Islam and Hinduism are also present.[57]

As shown in ***Table 5.65***, majority of Yangon population lives in conventional households (a place where one or more persons share living quarter and meals, regardless of whether they are related or unrelated), which are mostly headed by men[54]. Many of them generally own conventional type of houses[54], which are mostly wooden houses (***Table 5.66***). The utmost popular materials for constructing households in Yangon consist of brick/ tile/ concrete for wall, wood for floor, and corrugated sheet for roof (***Table 5.67***). The average size of a household is 4 persons[54].

Table 5.62: Population in Yangon Region

Region	Total	Male	Female	Gender ratio
Yangon	7,360,703	3,516,403 (47.77%)	3,844,300 (52.23%)	92 males per 100 females

[53] Yangon Region, A Snapshot of Child Wellbeing. Accessed on 24 October 2018 at https://www.unicef.org/myanmar/Yangon_Region_Profile_30-07-15.pdf

[54] The 2014 Myanmar Population and Housing Census (Yangon Region). Accessed at 24 October 2018 at http://www.dop.gov.mm/sites/dop.gov.mm/files/publication_docs/yangon_region_census_report_-_english.pdf

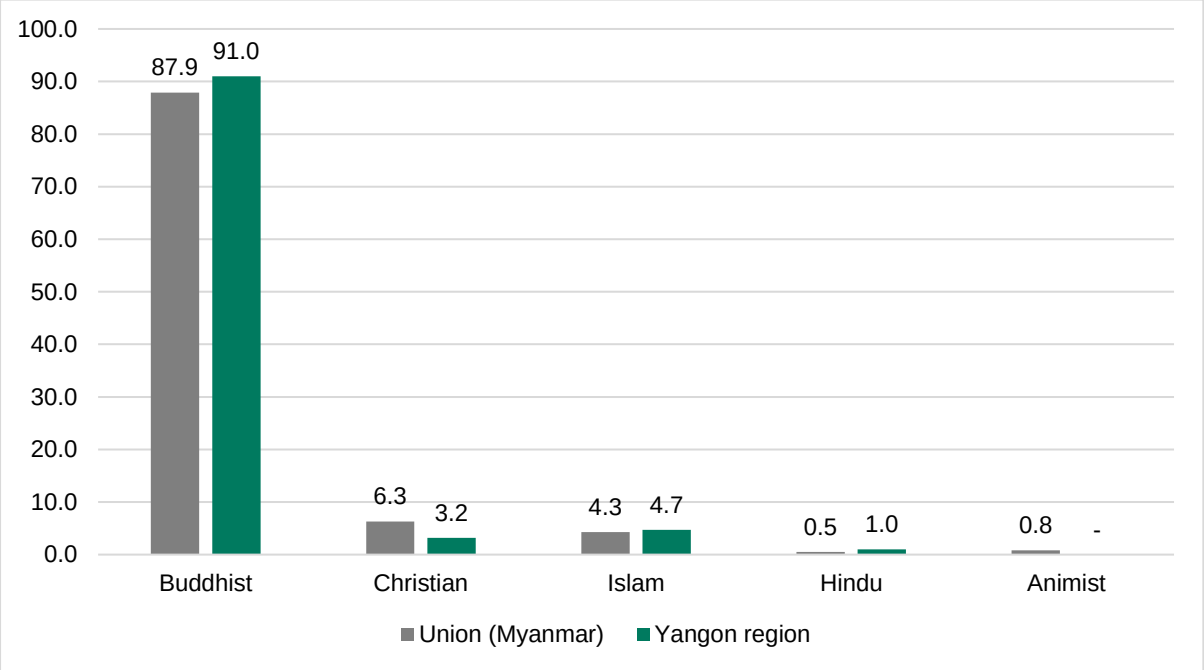
[55] Vulnerability in Myanmar. Accessed on 24 October 2018 at https://themimu.info/sites/themimu.info/files/documents/Report_Vulnerability_in_Myanmar_HARP-MIMU_Jun2018_ENG_Print_version.pdf. Note: the "approximate number of vulnerable population" is the number of persons in the area particularly affected by some of the aspect/aspects of vulnerability covered in the Vulnerability Index, namely low levels of literacy, sanitation, electricity, access to improved drinking water, housing quality, access to services/opportunities requiring identity documents, and high child dependency.

[56] The State of Local Governance: Trends in Yangon. Accessed on 25 October 2018. At https://www.themimu.info/sites/themimu.info/files/documents/Report_Local_Governance_Mapping_Yangon_UNDP_Feb2015.pdf

[57] The 2014 Myanmar Population and Housing Census (Dala Township). Accessed on 24 October 2018 at https://themimu.info/sites/themimu.info/files/documents/TspProfiles_Census_Dala_2014_ENG.pdf

Source: The 2014 Myanmar Population and Housing Census (Yangon Region), May 2015.[54]

Figure 5.40: Religions in Myanmar and Yangon Region



Source: The 2014 Myanmar Population and Housing Census (Dala Township).[57]

Table 5.63: Population Sizes, Categorized by Age

Types of population	Yangon region
Children (0 – 14 years)	23.4%
Adults (15 – 64years)*	70.9%
Elders (65+ years)	5.7%

Source: The 2014 Myanmar Population and Housing Census (Yangon Region).[54]

Note: Adults are referred to economically productive group of people in the source.

Table 5.64: Marital Status in Yangon Region

Region/ districts	Region/ townships	Total (person)			
		Single	Married	Widowed	Divorced / separated
Region	Yangon	2,040,730	3,066,094	361,796	103,934

Source: The 2014 Myanmar Population and Housing Census (Yangon Region).[54]

Table 5.65: Numbers of Citizens in Conventional Households and Institutional Households in Yangon Region

Types of dwellings	Total (person)
	Yangon region
Conventional households	6,949,440
Institutional households	411,263

Source: The 2014 Myanmar Population and Housing Census (Yangon Region).[54]

Table 5.66: Housing Units of Conventional Households in Yangon Region

Housing Units	Total (household)
	Yangon region
Wooden houses	659,423
Bamboo	344,419
Apartment/condominium	266,864
Semi-pacca house	150,641
Bungalow/brick house	117,047
Hut 2 – 3 years	17,039

Source: The 2014 Myanmar Population and Housing Census (Yangon Region).[54]

Table 5.67: Material for House Structures in Yangon Region

Materials	Percentage (%)		
	Yangon region		
	Wall	Floor	Roof
Brick/Tile/ Concrete	32	30.7	5.2
Wood	24	52	5.2
Bamboo	31.8	15.6	0.2
Dhani/Theke/ In leaf	9.2	-	17.8
Corrugated sheet	1.5	-	76.3
Earth	Less than 0.1	0.5	-
Other	1.5	1.2	0.3

Source: The 2014 Myanmar Population and Housing Census (Yangon Region).[54]

5.2.4.2 Seikgyikanaungto Township

Seikgyikanaungto Township covers an area of approximate 7.9 sq. km, divided into 9 wards[48]. ***Table 5.68*** shows that there are 34,003 citizens of which 17,068 are males and 16,935 are females. Majority of them are aged between 15 – 64 years old[54], similar to the rest of Yangon. Based on ***Table 5.69***, 14,461 persons are married (under 50%). The largest ethnic group in this township is also Bamar (***Table 5.70***).

In this township, most people (33,251 persons) lives in conventional households (***Table 5.71***), which are largely male-headed and a majority of people live in conventional houses[48], mostly wooden houses (***Table 5.72***). ***Table 5.73*** illustrates the most popular materials used for construction (wall, floor and roof): bamboo for wall, wood for floor, and corrugated sheet for roof. Primary data indicates that the average size of a household in Seikgyikanaungto Township is five people.

Limited number of people present vulnerability in term of physical disability, chronic or critical diseases, or paralytic stroke (***Table 5.74***).

5.2.4.3 Ahlone Township

Ahlone Township covers an area of approximately 2.7 sq. km, divided into 11 wards[58]. As shown by ***Table 5.68***, there are 55,482 people living in the Township, of which 29,931 are females, and 25,551 are males. Majority of them are aged between 15 – 64 years old[54]. ***Table 5.69*** shows that majority of Ahlone population are married. In addition, the majority of Ahlone citizens is Bamar (***Table 5.70***).

As shown in ***Table 5.71***, in Ahlone Township, most people (48,612 persons) live in conventional households, which are mostly headed by males[58]. The majority of Ahlone citizens have ownerships over conventional households[58], such as apartment/ condominium (***Table 5.72***). ***Table 5.73*** shows that brick/ tile/ concrete are mostly used for wall and floor, but corrugated sheet is utmost used for roof. Primary data indicates that the average size of a household in Ahlone Township is five people.

5.2.4.4 Dala Township

Dala Township covers an area of approximately 2,24.1 sq. km, divided into 23 wards and 23 village tracts.[57] ***Table 5.68*** shows that in these areas, there are 172,857 persons , of which 88,186 persons are females and 84,671 are males, who are mostly aged between 15 – 64 years old.[54] Majority of Dala citizens are married (***Table 5.69***) and the majority of people is Bamar (***Table 5.70***).

Majority of Dala citizens (170,363 persons) are living in conventional households (***Table 5.71***), which are mostly male-headed.[57] The majority of Dala citizens have ownerships over conventional houses,[57] which are mostly wooden houses (***Table 5.72***). ***Table 5.73*** illustrates the most popular materials used for construction (wall, floor and roof): bamboo for wall, wood for floor, and corrugated sheet for roof. Primary data indicates that the average size of a household in Dala Township is four people.

[58] The 2014 Myanmar Population and Housing Census (Ahlone Township). Accessed on 24 October 2018 at https://themimu.info/sites/themimu.info/files/documents/TspProfiles_Census_Ahlone_2014_ENG.pdf

Table 5.68: Population in Dala, Seikgyikanaungto and Ahlone Townships

District	Township	Male	Female	Total	Gender ratio
Southern District	Dala Township	84,671 (48.5%)	88,186 (51%)	172,857	96 males per 100 females
Southern District	Seikgyikanaungto Township	17,068 (50.2%)	16,935 (49.8%)	34,003	101 males per 100 females
Western District	Ahlone Township	25,551 (46.1%)	29,931 (53.9%)	55,482	85 males per 100 females

Source: The 2014 Myanmar Population and Housing Census. (Modified by ERM)

Table 5.69: Marital Status in Dala, Seikgyikanaungto and Ahlone Townships (2014)

Districts	Townships	Total (person)			
		Single	Married	Widowed	Divorced / separated
Southern District	Dala Township	37,446	72,464	8,965	3,064
Southern District	Seikgyikanaungto Township	6,761	14,461	1,775	652
Western District	Ahlone Township	20,995	21,868	2,578	554

Source: The 2014 Myanmar Population and Housing Census (Yangon Region).[54]

Table 5.70: Ethnicity in Dala, Seikgyikanaungto and Ahlone Townships

Ethnicity	Percentage (%)		
	Dala township	Seikgyikanaungto Township	Ahlone Township
Bamar	92.3	96.6	79.4
Rakhine	0.3	0.2	1.3
Kachin	-	-	1
Shan	-	-	0.8
Kayah	-	-	0.2
Kayin	1.5	0.3	5.7
Indian and Chinese	3.8	0.1	-
Chin	-	-	0.7
Mon	0.1	0.6	1
Other	2	2.2	9.9

Source: ERM, 2018.

Table 5.71: Numbers of Citizens in Conventional Households and Institutional Households in Dala, Seikgyikanaungto and Ahlone Townships

Types of dwellings	Total (person)		
	Dala township	Seikgyikanaungto Township	Ahlone Township
Conventional households	170,363	33,251	48,612
Institutional households	2,494	752	6,870

Source: The 2014 Myanmar Population and Housing Census (Yangon Region).[54]

Table 5.72: Housing Units of Conventional Households in Dala, Seikgyikanaungto and Ahlone Townships

Housing Units	Dala township	Seikgyikanaungto Township	Ahlone Township
Wooden houses	18,949	5,153	1,770
Bamboo	15,198	2,246	366
Apartment/condominium	421	22	7,556
Semi-pacca house	1,278	186	652
Bungalow/brick house	636	43	531
Hut 2 – 3 years	489	32	12

Source: The 2014 Myanmar Population and Housing Census (Yangon Region).[54]

Table 5.73: Materials for House Structures in Dala, Seikgyikanaungto and Ahlone Townships

Materials	Percentage (%)								
	Dala township			Seikgyikanaungto Township			Ahlone Township		
	Wall	Floor	Roof	Wall	Floor	Roof	Wall	Floor	Roof
Brick/Tile/ Concrete	5.6	5	0.6	2.9	2.9	0.2	77.9	77.3	28.1
Wood	30.8	61.1	0.1	25.9	72.6	0.2	13.2	19.3	0.3
Bamboo	37.2	32.5	0.2	43.3	23.5	0.1	4.5	2.5	less than 0.1
Dhani/Theke/ In leaf	22.4	-	32.1	19.3	-	19	0.4	-	2
Corrugated sheet	2.5	-	66.8	6.2	-	80.3	1.7	-	28.1
Earth	0.1	-	0.4	0.1	0.2	-	less than 0.1	0.2	less than 0.1
Other	1.4	1	0.2	2.4	0.8	0.2	0.4	0.7	0.4

Source: The 2014 Myanmar Population and Housing Census. (Modified by ERM)

Table 5.74: Vulnerabilities of Households in Project Study Area (2018)

Type of vulnerability	Dala township	Seikgyikanaungto Township	Ahlone Township
No vulnerability	99.4%	96.4%	100%
Autism	0.3%	-	-
Kidney	0.3%	-	-
Physically disabled	-	0.7%	-
Paralytic stroke	-	1.4%	-
Chronic or critical disease	-	1.4%	-

Source: ERM, 2018.

5.2.5 Livelihood and Economy

5.2.5.1 Income

Yangon Region

In urban areas of Yangon, many citizens are hired to work in industrial, commercial and trading sectors, while those living in rural areas work in the livestock rearing, fisheries and agricultural fields. Yangon main exports are rice, teak, and metal ores[47]. Revenue and expenditure for 2017-2018 fiscal year in Yangon are 382,585.316 million Kyats and 424,280.667 million Kyats respectively[59].

Poverty incidence in Yangon region is 16%, estimated by UNICEF (United Nations International Children's Emergency Fund[59]. In 2014, UN-HABITAT (United Nations Human Settlements Programme). It is also estimated that around 2.38 million of Yangon citizens were poor or extremely poor and living in substandard housing or illegal dwellings. Ten percent of them were also estimated to live in slum dwellings[53].

During the initial site visit, the primary human use and occupancy of the site was examined. Although Dala and Seikgyikanaungto Townships are within the Yangon Region, the business development rate in these townships is slow compared to the city across the river. Their businesses include agriculture, river transportation and casual workers who work in Yangon. In addition, in the Study Area there are small scale fishing and dredging activities. Communities in those townships raise livestock mostly for domestic consumption, including chicken, pig and goat. Information on agriculture, sand dredging and fishing is presented in the next subsections.

Seikgyikanaungto Township

In Seikgyikanaungto Township, the highest monthly income is 1,300,000 Kyats, but the lowest monthly income is at zero (no income) Kyats. Based on ***Table 5.75***, average household's income per year is approximately 3,802,439 Kyats, which is mostly generated by businesses. However, as shown in ***Table 5.76***, average household's expenditure per year is approximately 809,864 Kyats. Regarding to negative net income, 58% of interviewees stated that housing expense creates negative income (***Figure 5.41***). In the last 12 month, 23.3% of interviewees borrow money mostly from microfinance (i.e. BNK microfinance).

[59] Budget information for 2017-2018 Fiscal Year (Citizen's budget). Accessed on 24 October 2018 at https://themimu.info/sites/themimu.info/files/documents/Core_Doc_Citizens_Budget_Information_for_2017-2018_31May2017.pdf

Ahlone Township

According to primary data, the highest monthly income is at 5,000,000 Kyats, but the lowest monthly income is at 200 Kyats. According to ***Table 5.75***, average household's income per year is approximately 4,617,461.5 Kyats, which is largely generated by businesses. Primary data shows that average household's expenditure per year is around 950,216 Kyats (***Table 5.76***). When interviewees were asked about underlying causes of negative net income, housing expense is referred by 72.7% of interviewees (***Figure 5.41***). In the last 12 month, 13% of Ahlone interviewees borrow money mostly from either friends or neighbours.

Dala Township

From primary data, the highest monthly income is at 2,000,000 Kyats, but the lowest monthly income is at 30,000 Kyats. ***Table 5.75*** shows that average household's income per year is approximately 6,947,756.5 Kyat, which is generated significantly by part-time job. However, average household's expenditure per year is around 1,244,464 Kyats (***Table 5.76***). For causes of negative net income, 59.2% of interviewees referred to housing expense (***Figure 5.41***). In the last 12 month, 23% of Dala interviewees borrowed money, mostly from banks (i.e. agricultural bank or agricultural development bank).

Table 5.75: Average Household's Income Per Year in Dala, Seikgyikanaungto, and Ahlone townships

Source of household's income	Average households' income per year (Kyats)		
	Dala Township	Seikgyikanaungto Township	Ahlone Township
Crop farming	955,217.4	-	-
Fishing/ fish farming	158,260.9	-	-
Livestock raising	37,043.5	-	-
Forestry	-	-	-
Business	1,174,434.8	2,066,341.5	3,117,307.7
Local wage employment	857,843.5	980,000	1,248,076.9
Part-time job	2,161,130.4	703,414.6	83,230.8
Government assistance	53,217.4	-	88,076.9
Other	1,550,608.7	52,682.9	80,769.2
Total	**6,947,756.5**	**3,802,439**	**4,617,461.5**

Source: ERM, 2018.

Note: government assistance is referred to pension or other government benefits

Table 5.76: Average Household's Expense Per Year in Dala, Seikgyikanaungto, and Ahlone townships

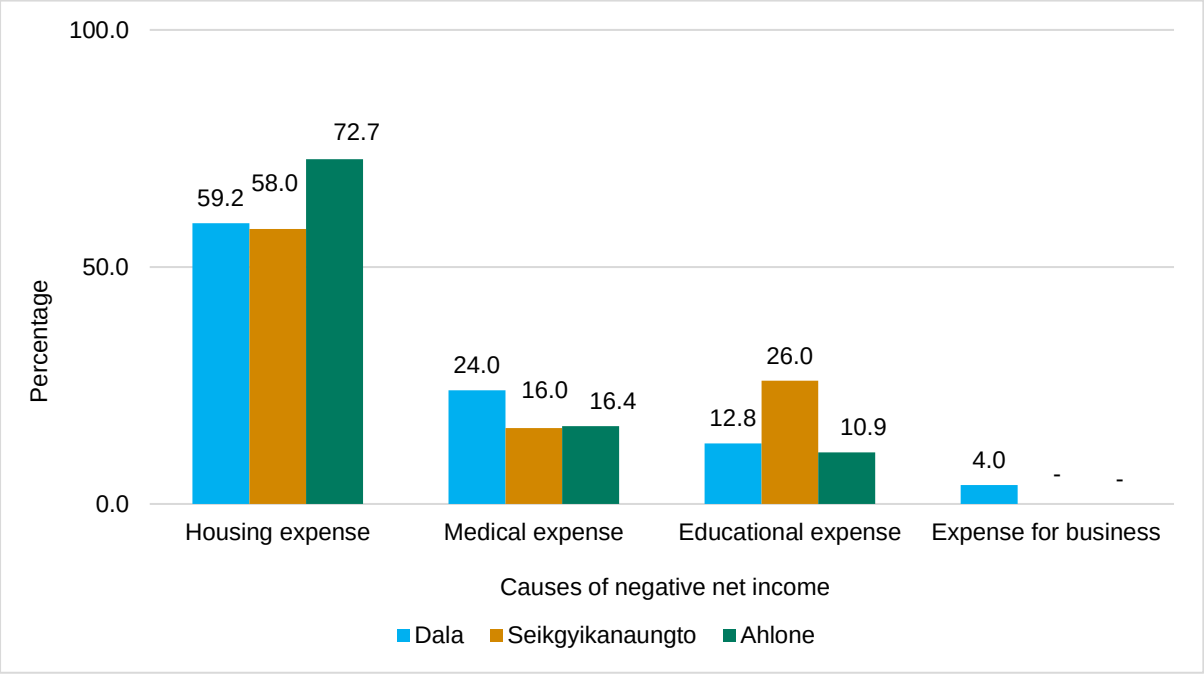
Source of household's expenditure	Average households' income per year (Kyats)		
	Dala Township	Seikgyikanaungto Township	Ahlone Township
Farming cost	187,543.4	-	-
Fishing costs	8,436.7	-	-
Livestock input	5,836.2	-	

Source of household's expenditure	Average households' income per year (Kyats)		
	Dala Township	Seikgyikanaungto Township	Ahlone Township
Business costs	74,044.7	80,536.9	58,111.1
Housing	6,639.2	6,555.7	35,600
Medical care	58,148.9	43,892.6	42,311.1
Education	40,657.6	100,503.4	67,000
Family ceremonies	16,265.5	17,583.9	14,833.3
Transportation	57,053.3	80,389.3	31,722.2
Food	734,069.5	448,187.9	663,611.1
Donations	40,880.9	32,214.8	30,361.1
Others	14,888.3	-	6,666.7
Total	**1,244,464.2**	**809,864.5**	**950,216.6**

Source: ERM, 2018.

Note: farming cost includes fertilizer, pesticides, feeds, seeds, irrigation etc.

Figure 5.41: Underlying Reasons of Negative Net Income



Source: ERM, 2018.

5.2.5.2 Agriculture

Yangon Region

In the agricultural field, rice, beans and pulses are the main crops, produced. Other agricultural activities consist of jute, rubbers, groundnut and sugarcane[56]. Along the Yangon River, rice mills and sawmills can be found[47].

Seikgyikanaungto Township

In Seikgyikanaungto Township, none of interviewees own land resource or participate in collection of forest products, but village leader from Seikgyikanaungto Township stated that small number of households engage in cultivation of monsoon paddy outside the village. Paddy was the main crop and was grown only during the rainy season.

Small number of interviewees raise livestock, which is chickens (***Figure 5.42***). They are raised for both meat production and household consumption.

Ahlone Township

None of Ahlone interviewees own land resources, raise livestock, participate in collection of forest products, or engage in agriculture. None of the interviewees mentioned revenues from agricultural activities. These results are not surprising as Ahlone is located in the urban part of Yangon and people's livelihoods are based on administrative, services, industrial and business sector employment.

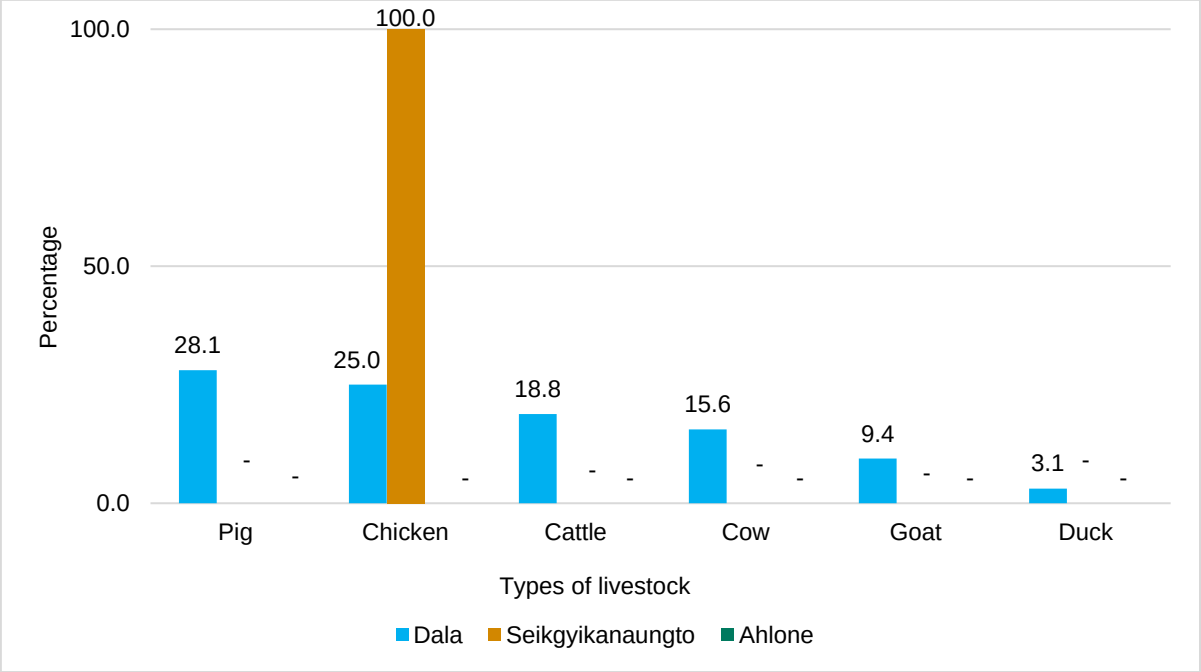
Dala Township

In Dala Township, the LNG Receiving Terminal will be located in an agricultural area, mainly paddy fields. Primary data shows that 64% of interviewees own paddy fields with legal title to the land that they occupy. According to Dala's village leader, most crops grown outside the village consist of monsoon paddy and summer paddy.

Farmers mentioned that rice is cultivated during July to November, with sewing period in July and harvesting in November. The average size of paddy fields is 16.3 acres; 62.5% of interviewees said that there is no irrigation system in their lands. As displayed in ***Table 5.75***, average annual income from crop farming is around 955,217.4 Kyats.

A few interviewees in Dala Township (1.25%) go into the nearest forest every few day to collect fuelwood. ***Figure 5.42*** shows that 33.8% of interviewees raise livestock such as pig (28.1%), chicken (25%) and cattle (18.8%). They are mainly raised for meat production. The livestock is then used for commercialization (57.1%), self-consumption (14.3%), farming (14.3%), working (9.5%), both commercialization and self-consumption (4.8%). Average annual income from sale of livestock products is 445,454.5 Kyats.

Figure 5.42: Livestock in Dala, Seikgyikanaungto and Ahlone



Source: ERM, 2018.

5.2.5.3 Fisheries

Yangon Region

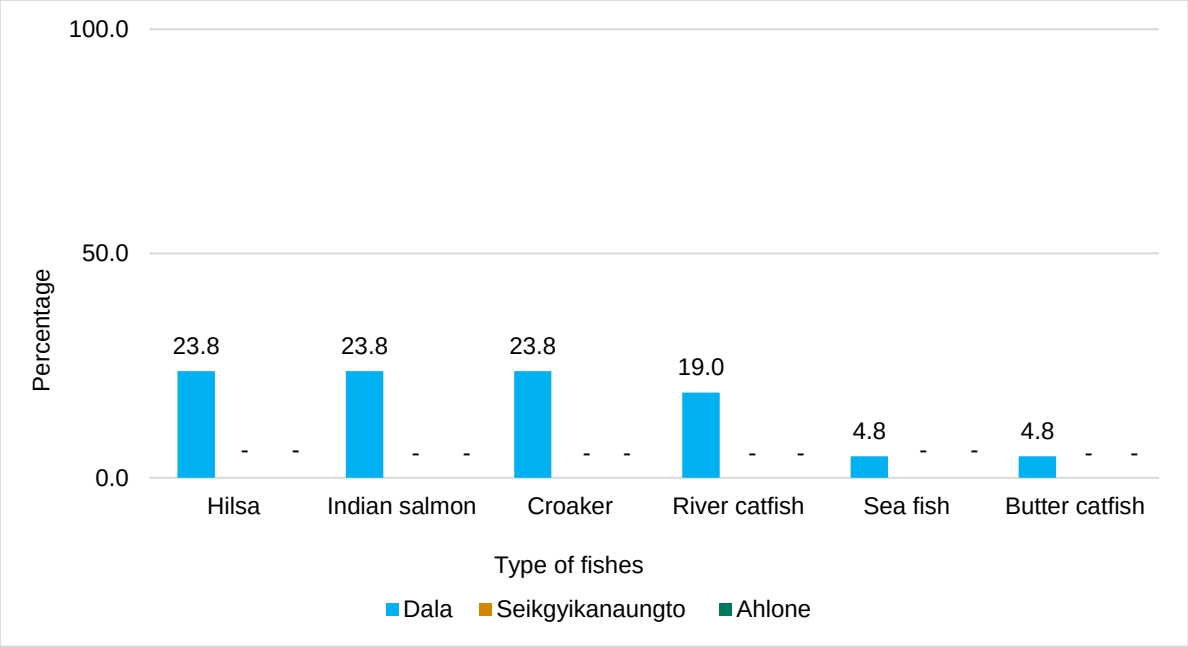
Small scale artisanal fishing takes place in the Yangon River, including around the Project sites. It is reported that fishermen make around 20,000 kyats (~17 USD) daily from fishing, which is conducted using traditional cast-nets. Yangon is a main landing site for fish in Myanmar with a fish market at San Pya in Ahlone Township near the Project Site. It shall be noted that the Pipeline construction and operation will not restrict fishing boat access at San Pya Market.

Dala Township

According to Dala's village leader, 518 households engage in fishing activities by using small boats. Only 7.6% of people interviewed in Dala catch fish in the Yangon River for self-consumption and commercialization. He majority catches fishes daily, while some go fishing every few days. Dala fishermen stated that fishes can be caught throughout the year. The months with maximum fish catch are August, September, October and November, and the months with less fish catch are January, February, March and April. As imposed by the Fisheries Department, there are restricted days for fishing in April, May and June. Restricted species for being caught is butter catfish. As shown in ***Figure 5.43***, Dala interviewees catch hilsa (23.8%), Indian salmon (23.8%) and croaker (23.8%) by using drift netting or seine net. Average fish caught per season is 1,068.4 Kg. Also, average annual income from fishing activities is approximately 158,260.9 Kyats (***Table 5.75***).

None of the interviewees in Ahlone and Seikgyikanaungto townships engages in fishing activities.

Figure 5.43: Type of Fish Caught



Source: ERM, 2018.

5.2.5.4 Market

Seikgyikanaungto Township

All of interviewees stated that they normally go to Myoma Market, located in the township, and where more than one hundred shops are located[60]. More than 73% of interviewees go to the market daily, while 13.3% go every few days and 13.3% once a week.

Ahlone Township

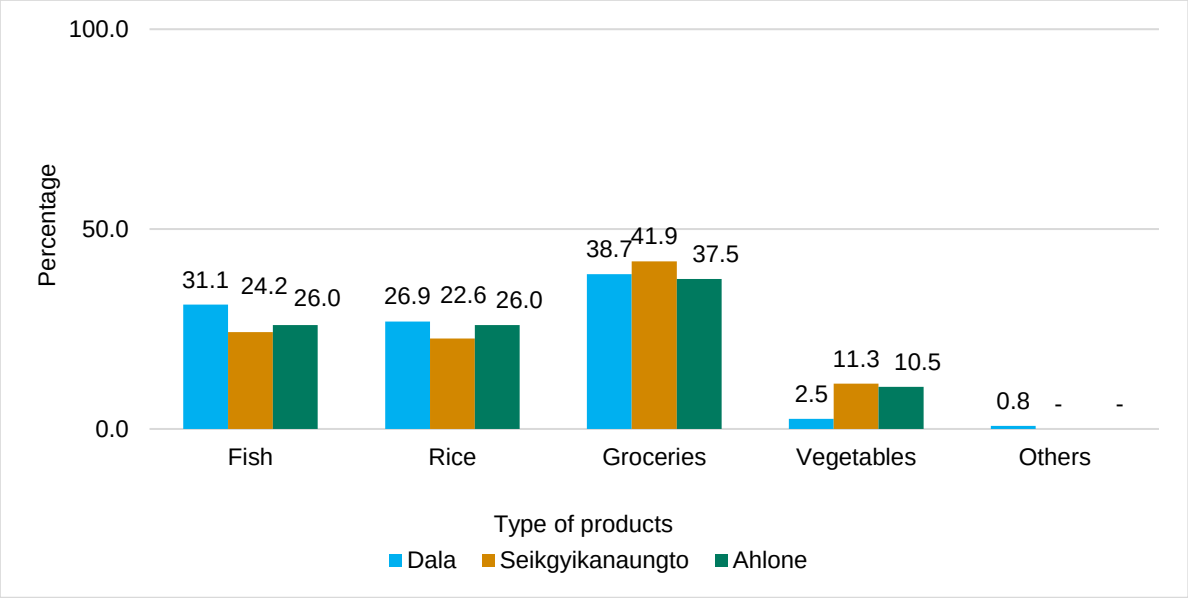
Based on primary data, 97.5% of interviewees usually go to Ahlone market, while the remaining 2.5% go to Sinmin market. On frequency, 62.5% go to the market on a daily basis and 35% once a week.

Dala Township

Interviewees normally go to Dala market (93.5%), Nyaung Pin Lay Market in Yangon (2.6%), Kyansisthar (2.6%), and Khamarkasit (1.3%). On frequency, 52% go to the market every few days and 18.7% once a week.

[60] Travel Naypyitaw. Accessed on 24 October 2018 at http://travelnaypyitaw.org/index.php/ar/destinations/shopping/201-myoma-market

Figure 5.44: Products Purchased at the Market



Source: ERM, 2018.

5.2.5.5 Private Business

Yangon Region

In Yangon, there are three types of business ownerships, including state-owned, private-owned and cooperative-owned types. Whilst small industries in food processing, and clothing manufacturing are owned privately or cooperatively, major industries that manufacture soap, rubber, aluminium, iron, steel sheet and textiles are owned by the state[47].

Seikgyikanaungto Township

In Seikgyikanaungto Township, ***Figure 5.45*** shows that majority of interviewees are operating small-scale businesses shop/ market in the village/ ward. Average annual income from business operation is 2,066,341.5 Kyats (***Table 5.75***).

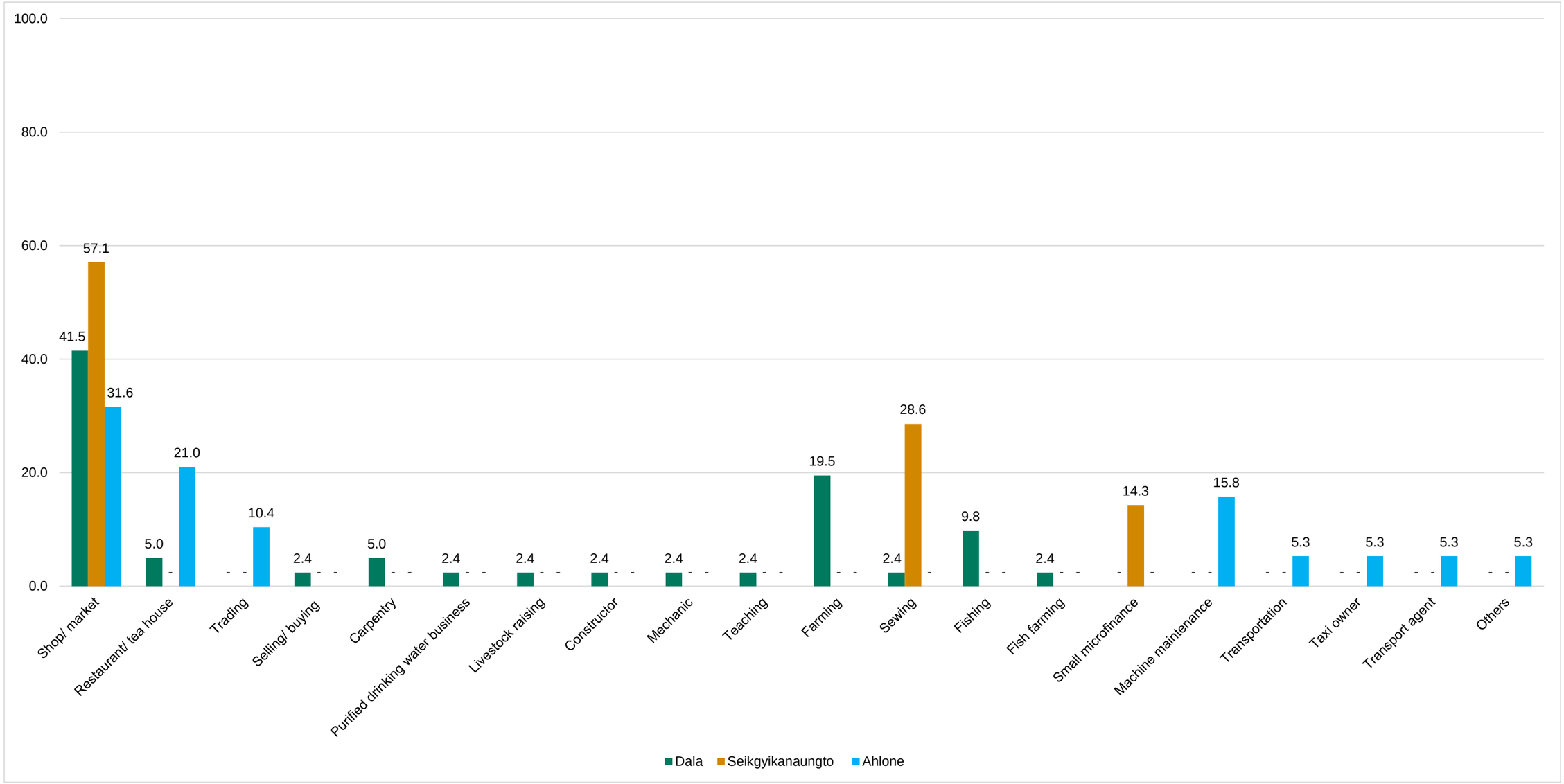
Ahlone Township

Majority of Ahlone interviewees are operating shop/ market (***Figure 5.45***) in the township or in the village/ ward. As shown in ***Table 5.75***, average annual income from business operation is 3,117,307.7 Kyats.

Dala Township

Figure 5.45 shows that in Dala Township, majority of interviewees are operating shop/ market. Their businesses are located in the village/ ward or in the township. The average annual income from business operation is 1,174,434.8 Kyats (***Table 5.75***).

Figure 5.45: Type of Private Businesses in Dala, Seikgyikanaungto and Ahlone



Source: ERM, 2018.

5.2.5.6 Employment, Skill and Qualification

Yangon Region

Unemployment rate between men (4.3%) and women (3.9%) in Yangon is almost similar, however, percentage of men in labour force (81.8%) is significantly larger than percentage of women (46.4%) (***Table 5.77***). Yangon is the main centre for trading and handling for many foreign commerce in Myanmar[47], and the most popular job industry is wholesale and retail trade[61] (***Table 5.78***).

Table 5.77: Labour Force Participation and Unemployment

Region	Percentage of Population aged between 15 – 64 years old					
	Labour Force Participation (%)			Unemployment Rate (%)		
	Total	Men	Women	Total	Men	Women
Yangon Region	63.1	81.8	46.4	4.1	4.3	3.9
Dala Township	58.6	82.4	36.1	7.8	6.7	10
Seikgyikanaungto Township	62.3	87.4	37.1	4.6	4.8	4.2
Ahlone Township	63	79.2	49.4	4.8	4.8	4.8

Source: The 2014 Myanmar Population and Housing Census. (Modified by ERM)

Seikgyikanaungto Township

Unemployment rate of men and women in this township is under 5% (***Table 5.77***). Percentage of men in labour force (87.4%) is larger than percentage of women (37.1%). Among participants in labour force, majority of Seikgyikanaungto workers are aged of 20 – 24 years old.[48] MIMU data from 2014 states that the most people were services and sales workers (***Table 5.79***). Primary data reveals that 21.8% of interviewees are operating business or participating in dependent occupations (***Table 5.80***). They are working within the village/ ward (***Figure 5.46***) with average working months at approximately 10.7 months. The longest duration for working is 12 months and the shortest duration for working is 3 months.

As provided in ***Table 5.80***, some of Seikgyikanaungto interviewees are vulnerable because they are day labour (16.8%) or unemployed (13.9%).

With regards to formal vocational training and qualification, 25% have computer certificate (***Table 5.81***), and 19.7% have skill/ experience in trading and shop keeping (***Table 5.82***).

Ahlone Township

Table 5.77 shows that unemployment rate of men and women in this township is under 5%, but percentage of men in labour force (79.2%) is significantly larger than percentage of women (49.4%). Among those in labour force, majority of them are aged of 25 – 29 years old.[58] In Ahlone Township, MIMU data show in 2014 that the largest number of citizens were services and sales worker (***Table 5.79***). ***Table 5.80*** relatively points out that 23.9% of interviewees are wage employees. They are working within township (***Figure 5.46***) with average working months at approximately 12 months, which is also the longest duration of working in this township. ***Table 5.80*** illustrates that vulnerability in terms of employment can be observed because 18.1% and 7.7% of interviewees are unemployed and working as day labor respectively.

[61] The 2014 Myanmar Population and Housing Census (Occupation and Industry). Accessed on 24 October 2018 at http://www.burmalibrary.org/docs22/2B_Occupation_and_Industry_EN.pdf

Based on ***Table 5.81***, majority of interviewees (31.3%) have a driver license and 20.2% of total interviewees have skill/ experience in trading and shop keeping ***Table 5.82***.

Dala Township

Table 5.77 showns that unemployment rate of men and women in this township is above 5%. Percentage of men in labour force (82.4%) is significantly larger than percentage of women (36.1%). Among those in labour force, majority of them are aged of 25 – 29 years old[57]. Based on MIMU data, in 2014 the largest number of Dala citizens were services and sales workers (***Table 5.79***). As shown in ***Table 5.80***, 24.8% of interviewees are operating businesses. They are mostly working within the village tract/ ward (***Figure 5.46***) with average working months at approximately 11.4 months. The longest duration for working per year is 12 months, but the shortest duration for working per year is 6 months.

Based on ***Table 5.80***, vulnerability in terms of employment can be observed in Dala because some of Dala interviewees are unemployed (19.7%), day labor (15.7%), or lackf work capacity (1.6%).

According to ***Table 5.81***, 30.4% of Dala interviewees own teacher certification. However, majority of interviewees (14.4%) have skill/ experience in carpentry (***Table 5.82***).

Table 5.78: Job Industries in Yangon Region

Industries	Number of Population (persons)
Wholesale and retail trade; repair and motorcycles of motor vehicles and motorcycles	476,047
Manufacturing	445,401
Agriculture, forestry and fishing	444,420
Accommodation and food service activities	282,883
Transportation and storage	274,751
Construction	263,880
Administrative and support service activities	150,777
Public administration and defence; compulsory social security	138,229
Other service activities	97,453
Education	64,680
Human health and social work activities	32,670
Activities of households as employers; undifferentiated goods- and services	32,399
Information and communication	26,799
Electricity gas steam and air conditioning supply	22,270
Arts entertainment and recreation	19,976
Financial and insurance activities	17,554
Professional scientific and technical activities	10,758
Water supply; sewerage waste management and remediation activities	8,234
Real estate activities	7,065
Mining and quarrying	3,955
Activities of extraterritorial organizations and bodies	1,598

Source: The 2014 Myanmar Population and Housing Census (Occupation and Industry).[61]

Table 5.79: Types of Occupation

Occupations	Number of population		
	Dala Township	Seikgyikanaungto Township	Ahlone Township
Services and Sales Workers	18,378	3,754	5,859
Craft and Related Trades Workers	11,689	3,533	2,145
Elementary Occupations	11,106	1,844	1,527
Skilled Agricultural, Forestry and Fishery Workers	6,847	306	286
Plant and Machine Operators and Assemblers	5,429	2,019	1,998
Clerical Support Workers	2,939	522	2,435
Technicians and Associate Professionals	1,348	297	1,747
Professionals	1,197	253	2,115
Managers	277	96	1,112

Source: The 2014 Myanmar Population and Housing Census. (Modified by ERM)

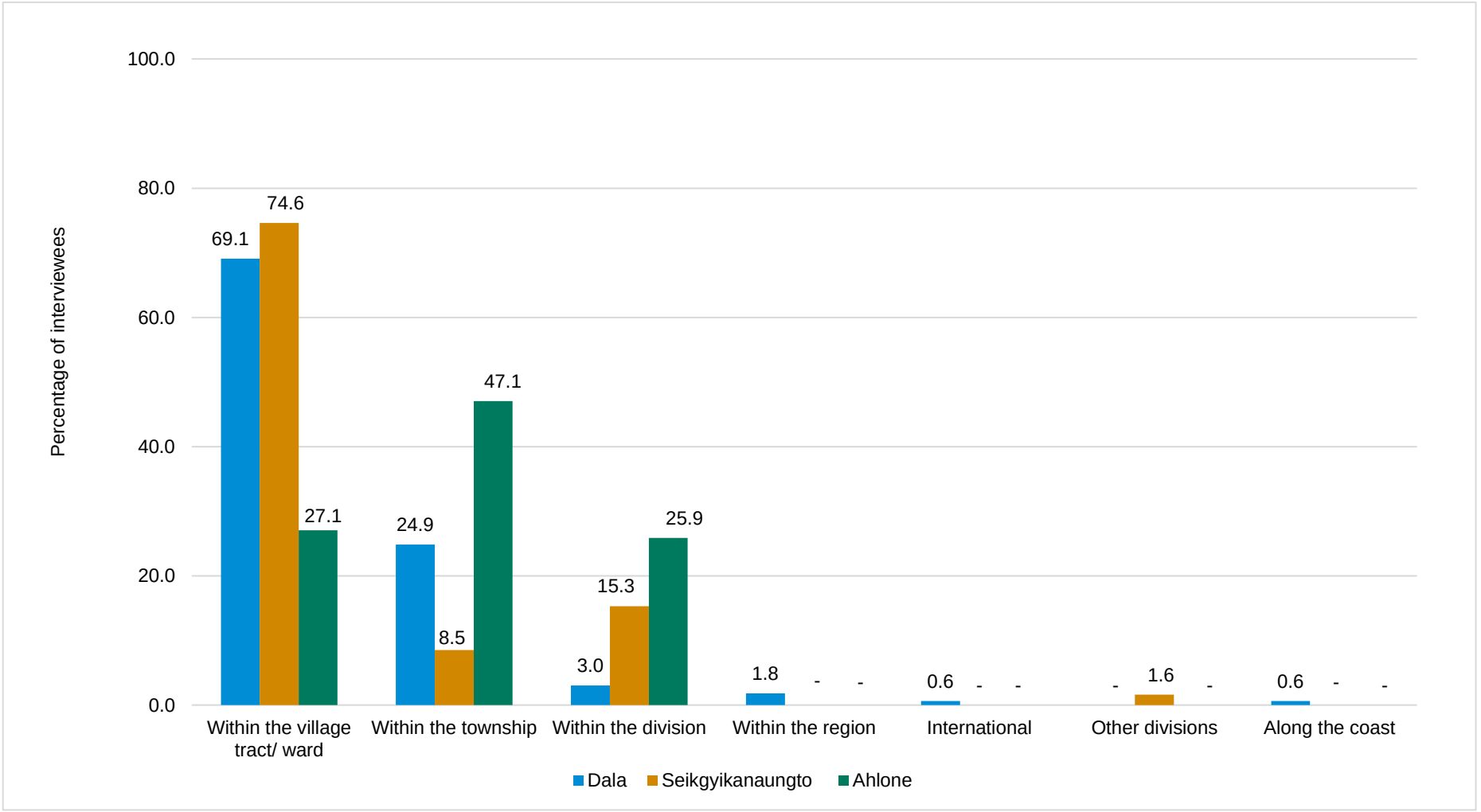
Table 5.80: Specific Occupations

Occupations	Percentage (%)		
	Dala Township	Seikgyikanaungto Township	Ahlone Township
Wage employee	7.5%	18.8%	23.9%
Unemployed	19.7%	13.9%	18.1%
Own business	24.8%	21.8%	23.2%
Dependent	17.7%	21.8%	23.2%
Day labour	15.7%	16.8%	7.7%
Waiter	-	-	0.6%
Student	2%	4%	2.6%
Farmer	6.7%	-	-
Retired	0.8%	-	0.6%
Sale	0.4%	-	-
Fisherman	3.1%	-	-
N/A	1.6%	3%	-

Source: ERM, 2018.

Note: N/A is referred to those, who are aged above 18 years old without capacity to work.

Figure 5.46: Location of Employment of Citizens in the Study Area



Source: ERM, 2018.

Table 5.81: Formal Vocational Training and Qualification

Formal vocational training/ qualification	Percentage (%)		
	Dala Township	Seikgyikanaungto Township	Ahlone Township
Teacher certificate	30.4	25	6.2
Computer certificate	17.4	25	18.8
Accountant certificate	-	-	12.5
Diver license	4.3	-	18.8
Driver license	4.3	-	31.3
Shipping	0	-	6.2
Welding certificate	13	-	-
Nurse license	21.7	-	-
Handicraft	4.3	-	-
Mechanic	4.3	-	-
Sewing certificate	-	-	6.2

Source: ERM, 2018.

Table 5.82: Skills and Experiences

Skill/experience	Percentage (%)		
	Dala Township	Seikgyikanaungto Township	Ahlone Township
Government staff	-	-	2
Driver	1.1	-	12.1
Shop keeping	8	19.7	20.2
Cooking	0	1.3	1
Teaching	1.1	-	1
Manual labour	10.2	6.6	10.1
Retired	0.5	-	1
Cleaning	-	1.3	3
Waiter/waitress in restaurant or supermarket	4.8	3.9	8.1
Taxi driver	-	-	2
Trading	8	19.7	16.2
Shipper	0.5	-	1
Government officer	-	3.9	9.1
Vehicle/ machinery maintenance	-	1.3	1
Hair dressing	-	-	1
Bank	0.5	1.3	1

Skill/experience	Percentage (%)		
	Dala Township	Seikgyikanaungto Township	Ahlone Township
Office staff	-	1.3	1
Teacher	4.8	-	1
Machinery maintenance	-	2.6	3
Private staff	1.6	1.3	3
Carpentry	14.4	3.9	2
Sewing	4.3	2.6	-
Selling	4.8	-	-
Film	0.5	-	-
Security	1.1	-	-
Welding	0.5	3.9	-
Others	1.1	6.6	-
Cycle carried/carry	1.1	2.6	-
Purified water business	0.5	-	-
Livestock	1.6	-	-
Construction	1.1	-	-
Mechanic	0.5	-	-
Nurse	1.1	-	-
Municipal staff	1.1	-	-
Painter	0.5	-	-
Clerk	1.6	-	-
Agriculture	8	-	-
Buying	1.1	-	-
Furniture	1.1	-	-
NGO	0.5	-	-
Shipment	0.5	-	-
General construction	1.1	1.3	-
Shop	1.6	0	-
Administrator	0.5	2.6	-
Fishing	4.8	-	-
Fireman	0.5	-	-
Seaman	0.5	-	-
Farmer	1.1	-	-
Village head	0.5	-	-
Company staff	1.1	-	-
Accountant	-	1.3	-
Agent	-	1.3	-
Household leader	-	1.3	-

Skill/experience	Percentage (%)		
	Dala Township	Seikgyikanaungto Township	Ahlone Township
Tourist guide	-	1.3	-
Small microfinance	-	1.3	-
Beauty salon	-	1.3	-
Sell ticket	-	1.3	-
Trishaw driver	-	1.3	-
Fisherman	-	1.3	-

Source: ERM, 2018.

5.2.6 Utilities

5.2.6.1 Electricity

Yangon Region

It is reported that in 2017, 8% of households in Yangon region did not have access to public grid, while 13% had access to it without being connected, and 79% had access and were connected to it[56].

As shown in ***Table 5.83***, majority of Yangon conventional households use electricity as source of lighting. Among them, Ahlone has highest percentage of using electricity for lighting[58]. However, Dala is the only township that was reported about the gap of electricity usages between urban area (62.8%) and rural area (18.7%) since in rural area, households mainly use battery as source of lighting (27.6%)[57].

Table 5.84 shows that nine sources of fuel are used for cooking. In Yangon, majority of households use electricity as main fuel for cooking.

Seikgyikanaungto Township

In this township, majority of conventional households use electricity as source of lighting (***Table 5.83***), and fuel for cooking (***Table 5.84***).

Village leader from Seikgyikanaungto Township stated that there are 10,941 households utilizing government electricity/ national grid. In this township, all interviewees can access to grid generation during 24 hours (***Figure 5.47***).

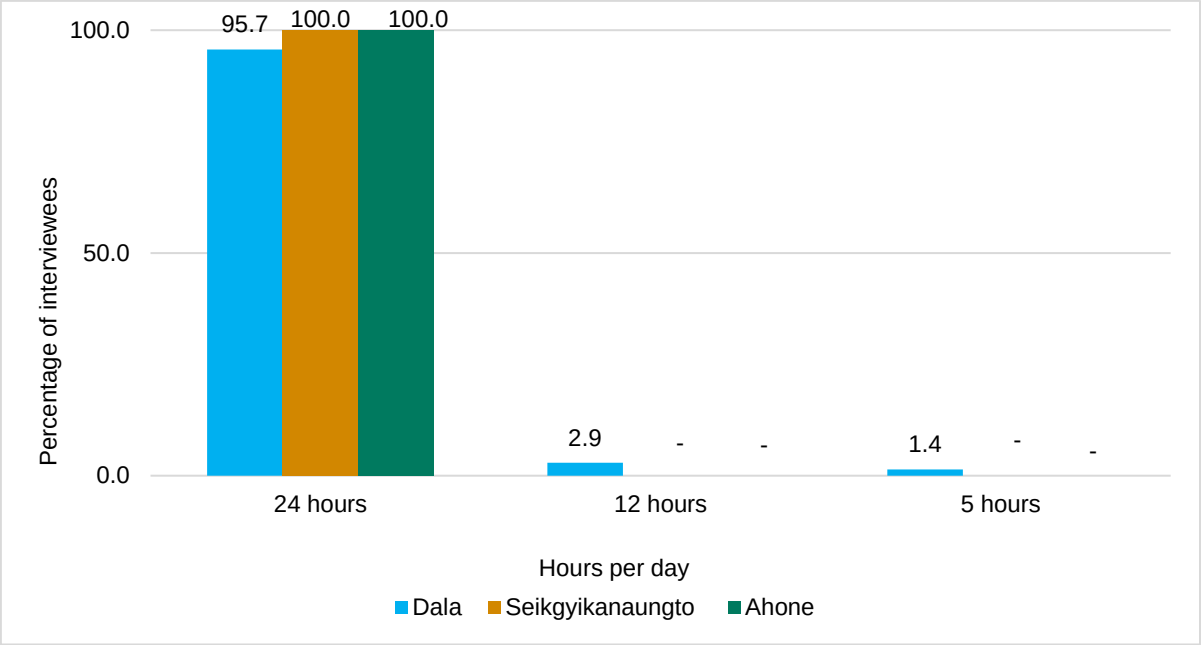
Ahlone Township

In Ahlone Township, electricity is not only utmost used by conventional households as source of lighting (***Table 5.83***), but also as fuel for cooking (***Table 5.84***). All Ahlone interviewees can access to grid generation during 24 hours (***Figure 5.47***).

Dala Township

In Dala Township, majority of conventional households use electricity as source of lighting (***Table 5.83***). However, majority of them use charcoal as a fuel for cooking (***Table 5.84***). Moreover, village leader from Dala Township stated that 21,897 households are utilizing government electricity/ national grid. As shown in ***Figure 5.47***, 88.8% of interviewees have access to grid generator, and 95.7% have access to it during the whole day. Monthly household energy consumption in Dala is approximately 455 kWh/month.

Figure 5.47: Duration of Accessibility to Grid Generation



Source: ERM, 2018.

Table 5.83: Sources of Energy for Lighting

Sources of energy for lighting	Yangon region	Dala township	Seikgyikanaungto Township	Ahlone Township
Electricity	69.3%	48.2%	76.4%	99%
Battery	11.8%	20%	5.5%	0.6%
Candle	7.2%	10.3%	17.4%	0.2%
Kerosene	5.7%	3%	0.2%	0.1%
Generator (private)	4%	16.4%	0.2%	-
Solar system/energy	1.6%	1.7%	0.2%	less than 0.1%
Other	0.4%	0.3%	0.2%	less than 0.1%
Water mill (private)	less than .1%	0.2%	-	-

Source: The 2014 Myanmar Population and Housing Census. (Modified by ERM)

Table 5.84 Sources of Energy for Cooking

Sources of energy for cooking	Yangon region	Dala township	Seikgyikanaungto Township	Ahlone Township
Electricity	47.1%	21.8%	47.8%	82.4%
Firewood	26.2%	25.9%	24.6%	1%
Charcoal	21%	45.3%	27%	8.9%
Other	2.6%	6.2%	0.3%	0.5%
LPG	2%	0.2%	less than 0.1%	0.4
Biogas	0.5%	0.2%	0.1%	0.8%
Coal	0.4%	0.4%	0.2%	0.2%
Kerosene	0.1%	0.1%	-	-
Straw/Grass	less than 0.1%	-	-	-

Source: The 2014 Myanmar Population and Housing Census. (Modified by ERM)

5.2.6.2 Water

Water for Irrigation

Yangon Region

The Irrigation Department of the Ministry of Agriculture and Irrigation has identified three main sources of water in Yangon, including reservoirs, Irrawaddy River and ground water aquifers (Union of Myanmar Ministry of Agriculture and Irrigation, Irrigation Department, 2010). As shown in ***Table 5.85***, about 90% of the water source of the system is surface water from reservoirs and the rest is ground water from tube wells supplemented by the water supply system.

Most households on the south bank of the Yangon River purchase drinking water. Local people use ponds and lakes for domestic water.

Seikgyikanaungto Township

In the summer (especially around March to April), nearly all households in Seikgyikanaungto depend on the Aung Mingalar Lake due to the scarcity of water. Some poor households use water from the lakes/ ponds within Seikgyikanaungto Township' area in the rainy seasons as well. Result of interviews also shows that there is no availability of irrigation water in Seikgyikanaungto Township.

Ahlone Township

As there is no agricultural activity in the Township, primary data confirm that there is no irrigation system in place.

Dala Township

Some poor households use water from the lakes/ ponds within Dala Township' area in the rainy seasons. Moreover, result of interviews shows that there is no availability of irrigation water in Dala Township.

Table 5.85: Current Water Sources of Yangon City Water Supply System

Water Sources	Daily Capacity	Water Source	Start-up Year
Hlawga Reservoir	14 MGD	Surface water	1904
Gyobyu Reservoir	27 MGD	Surface water	1940
Phugyi Reservoir	54 MGD	Surface water	1992
Ngamoeyeik WTP (Phase 1)	45 MGD	Surface water	2005
Ngamoeyeik WTP (Phase 2)	45 MGD	Surface water	2014
Yangon Pauk	1 MGD	Ground water	2000
South Dagon	2 MGD	Ground water	2009
Thaephyu	1 MGD	Ground water	2009
YCDC tube wells	16 MGD	Ground water	-
Total	**205 MGD**	**90% Surface Water + 10% Groundwater**	

Source: Zaw Win Aung, 2014.[62]

Non-Drinking Water

Non-drinking water or non-potable water are rainwater, reclaimed/ recycled water, and grey water. This water is not appropriate for human consumption, but it can be used for laundry, toilet, urinal flushing, or watering plants[63].

Yangon Region

In Yangon region, households mainly access non-drinking water via tube well or borehole (***Table 5.86***).

Seikgyikanaungto Township

In Seikgyikanaungto Township, ***Table 5.86*** points out that pond and lake are popular sources of non-drinking water. Moreover, primary data provides that 73.3% of interviewees use sources of purified drinking water as source of water for domestic use, but 26.7% of them use rainwater as non-drinking water. 62.5% of interviewees stated that water from rainwater is sufficient and of good quality, but 37.5% of them said that water from rainwater is insufficient and has only a fair quality. Periods of insufficient water are February (11.2%), March (33.3%), April (33.3%) and May (22.2%).

Ahlone Township

Table 5.86 shows that tube well or borehole is the main sources for non-drinking water in Ahlone Township. Based on primary data, 15% of interviewees use sources of purified drinking water as source of non-drinking water, but 85% of interviewees access other sources for non-drinking water, which are tube well, tap water, and well. These sources contain sufficient water. For quality of water, majority of interviewees (76.5%) stated that quality of water is good, but 20.6% of them stated that water is salty and 3% of them think that quality of water is fair.

[62] Water Supply Options For The Growing Megacity Of Yangon - Scenarios With The WEAP Model. Accessed on 24 October 2018 at https://www.weap21.org/Downloads/Yangon.pdf

[63] Online Piping and Usage Specification (System Non-potable Water). Accessed on 12 March 2019 at http://opus.mcerf.org/application.aspx?id=-6228344935996635278

Dala Township

In Dala Township, ***Table 5.86*** illustrates that majority of Dala population access non-drinking water via pond and lake. In addition, result of interviews shows that 91.3% of interviewees use source of purified drinking water as source of non-drinking water, but 8.7% of interviewees access non-drinking water via rainwater, well, and tap water. These sources contain sufficient water with good quality.

Table 5.86: Sources of Non-Drinking Water of Households in Yangon, Dala, Seikgyikanaungto and Ahlone Townships

Sources of non-drinking water	Yangon region[1]	Dala township[2]	Seikgyikanaungto Township[3]	Ahlone Township[4]
Pool/pond/lake	15.7%	85.8%	99%	-
Tap water/piped	24.4%	10.2%	0.1%	19.9%
Tube well/borehole	51.1%	3%	0.7%	79.6%
Protected well/spring	4.3%	0.5%	0.1%	0.1%
Unprotected well/spring	1.9%	0.1%	0.1%	-
Waterfall/rainwater	less than 0.1%	0.1%	0.1%	-
River/stream/canal	1.5%	0.1%	0.1%	less than 0.1%
Other	0.9%	0.1%	-	0.1%
Bottled/purifier water	0.2%	less than 0.1%	less than 0.1%	0.2%

Source: The 2014 Myanmar Population and Housing Census. (Modified by ERM)

Drinking Water

Yangon Region

Yangon is one of the regions in Myanmar with the highest percentage of people with access to source of drinking water on premise (82%). At the same time, to reach water source, 14% of Yangon citizens spend less than 10 minutes, while 3% and 1% of them spend 11 to 20 minutes, and more than 20 minutes respectively[64].

Households in Yangon access drinking water through two main sources (improved sources and unimproved sources); the percentage of people's usages for each type of source fluctuates based on seasonality. Both in dry and rainy seasons, bottled water is the main source of drinking water; during the rainy season, rainwater collection increases significantly, as shown in ***Table 5.87.***

[64] The 2017 Myanmar Living Conditions Survey. Accessed on 24 October 2018 at https://themimu.info/sites/themimu.info/files/documents/Report_Myanmar_Living_Conditions_Survey_2017_Jun2018.pdf

Table 5.87: Sources of Drinking Water of Households in Yangon Region, Based on Seasonality

	Sources of Drinking Water	Yangon region
Dry Season		
Improved Sources	Bottled water	49.7%
	Tube well or borehole	19.2%
	Piped water into yard	4.6%
	Tanker/truck	4.2%
	Piped water into dwelling	3.4%
	Rain water collection	2.3%
	Protected dug-well	1.9%
	Public tab	0.5%
Unimproved Sources	Pool	10.8%
	Other	2.8%
	River	0.6%
	Unprotected well	0.2%
Rainy Season		
Improved Sources	Bottled water	45.7%
	Tube well or borehole	17.3%
	Piped water into yard	3.6%
	Tanker/truck	3.3%
	Piped water into dwelling	3.1%
	Rain water collection	20.8%
	Protected dug-well	1.1%
	Public tab	0.5%
Unimproved sources	Pool	1.7%
	Other	2.3%
	River	0.4%
	Unprotected well	0.2%

Source: The 2017 Myanmar Living Conditions Survey.[64]

Seikgyikanaungto Township

In this township, majority of citizens access drinking water via pool, pond or lake, which is unimproved source of drinking water (***Table 5.88***). In 2018, 73.3% of interviewees used rainwater as drinking water (***Figure 5.48***); 68.2% of them thought that quality of drinking water was good, and 31.8% of them perceived that quality of water as fair. Although 81.8% of interviewees stated that water is sufficient, 18.2% of them stated that water is insufficient during January, February, March, April and May (***Figure 5.49***). When water is not supplied to households, the next water source is the donation by associations.

Ahlone Township

MIMU data show in 2014 that Ahlone citizens mainly consumed drinking water via bottled/purifier water (***Table 5.88***). ***Figure 5.48*** shows that in 2018, 80% of Ahlone interviewees accessed drinking water via purified drinking water, but some of interviewees accessed it via other sources: well (5%), tap water (7.5%) and tube well (7.5%). These sources contain sufficient amount of water with good quality.

Dala Township

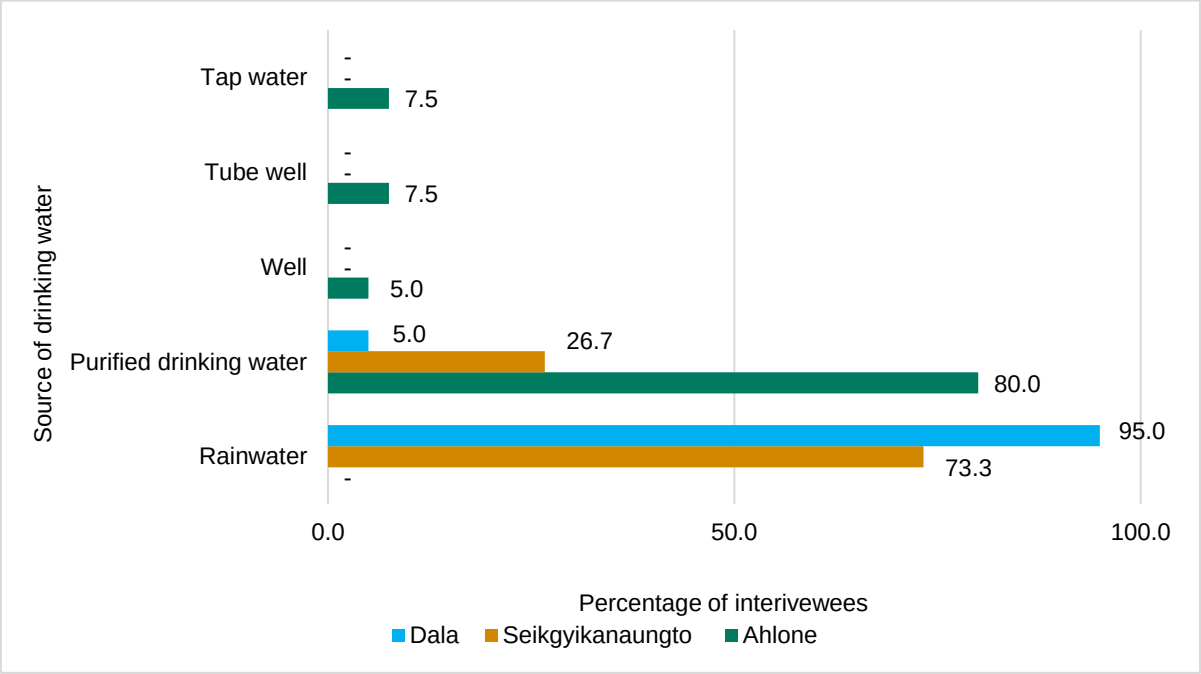
According to the data in ***Table 5.88***, majority of Dala citizens accessed drinking water via pool, pond or lake, which is unimproved source of drinking water. However, ***Figure 5.48*** shows that in 2018, 95% of Dala interviewees use rainwater as drinking water with belief that quality of drinking water is good. Moreover, 73.7% of interviewees stated that amount of water is sufficient, and 26.3% stated that water is insufficient in March, April and May (***Figure 5.49***). When water is not supplied to households, the nearest water source is the donation by association.

Table 5.88: Sources of Drinking Water of Households in Dala, Seikgyikanaungto and Ahlone Townships

	Sources of Drinking Water	Dala Township	Seikgyikanaungto Township	Ahlone Township
Improved Source	Bottled/purifier water	5.8%	3.2%	72.6%
	Tap water/piped	1.7%	less than 0.1%	3.7%
	Tube well/borehole	0.2%	0.1%	23.2%
	Protected well/spring	0.1%	less than 0.1%	0.1%
Unimproved Source	Pool/pond/lake	85.4%	91.9%	0.1%
	Waterfall/rainwater	5.7%	0.9%	-
	Other	0.9%	3.9%	0.3%
	River/stream/canal	0.1%	-	less than 0.1%

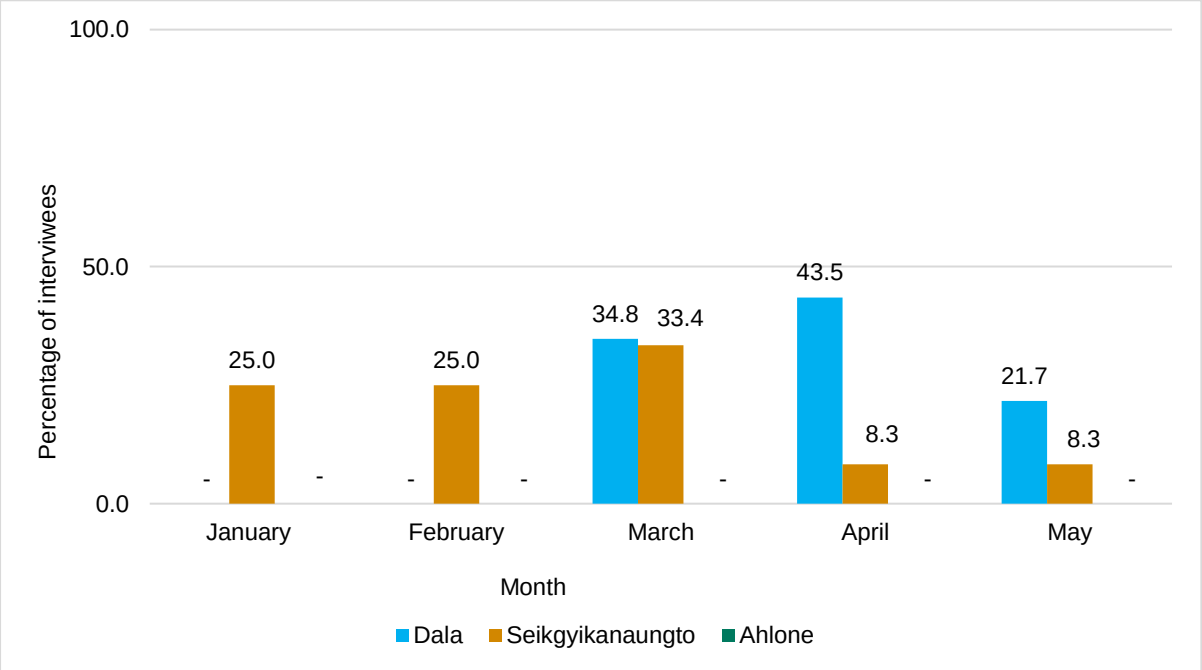
Source: The 2014 Myanmar Population and Housing Census. (Modified by ERM)

Figure 5.48: Source of Drinking Water in Dala, Seikgyikanaungto, and Ahlone Townships



Source: ERM, 2018.

Figure 5.49: Period of Insufficiency of Drinking Water



Source: ERM, 2018.

5.2.6.3 Sanitation and Toilet Facilities

Yangon Region

In Yangon, 68% of households have access to basic sanitation, which is referred to improved, non-shared toilet and hand washing facilities[64]. ***Table 5.89*** shows that in 2014, water seal (improved pit latrine) was the most common toilet facility type in Yangon region. Moreover, more than 90% of population have access to a place in which they can wash hand with soap and water[64].

Seikgyikanaungto Township

As shown in ***Table 5.89***, in 2014, the majority of citizens had water seal (improved pit latrine). Primary data shows that in 2018, all of interviewees had flush toilet that confirm local people's access to improved toilet facilities.

Ahlone Township

Table 5.89 shows that in 2014, majority of Ahlone citizens have water seal (improved pit latrine). Result of interviews shows that in 2018, all of interviewees had flush toilet, highlighting Ahlone citizens' access to improved toilet facilities.

Dala Township

Based on ***Table 5.89***, in 2014, majority of population had water seal (improved pit latrine). Primary data shows that in 2018, 98.75% of interviewees had flush toilet, which confirm Dala population' access to improved toilet facilities.

Table 5.89: Toilet Facilities

Types of toilet facilities	Yangon region	Dala township	Seikgyikanaungto Township	Ahlone Township
Water seal (improved pit latrine)	84.8%	84.3%	86.1%	72%
Flush	6.3%	0.6%	0.2%	25.6%
None	3.3%	6.9%	3.9%	0.4%
Bucket (surface latrine)	2.7%	5.7%	9%	1.6%
Pit (traditional pit latrine)	2.6%	2.3%	0.8%	0.1%
Other	0.3%	0.2%	less than 0.1%	0.3%

Source: The 2014 Myanmar Population and Housing Census. (Modified by ERM)

5.2.7 Transportation

5.2.7.1 Yangon Region

Yangon has a varied transport infrastructure, including many large to small concrete, paved or dirt roads, five bridges over the Yangon river, one international airport with two terminals and a domestic terminal, railway lines, four ports, buses lines and local taxi services. Details are provided in ***Section 5.2.11***.

Approximately 100 boats travel across the river to Yangon daily, between 5:30 am to 8:00 pm, from Dala and Seikgyikanaungto to Yangon. The journey takes around 15 minutes from Seikgyikanaungto

to Yangon. Travelling from Dala or Seikgyikanaungto to Yangon by car can take around 2 hours (depending on traffic). In 2014, there are seven types of transportations, which households had and used for travelling from place to place. Among these types, bicycle was utmost available in Yangon (***Table 5.90***).

5.2.7.2 Seikgyikanaungto Township

During a previous study conducted in January 2017, nearly 500 boats were observed in Seikgyikanaungto Township alone. Given the difficulty to use car and the relatively cheap cost and ease of use of boat transport, local community depends on boat transport to reach Yangon City.

Table 5.90 shows that in 2014, bicycle was the main owned and used transport by population in this township. However, primary data shows that, in 2018, motorbike became the most popular in Seikgyikanaungto (***Table 5.91***). Interviewees in this township also stated that walking is another mode of transportation often used.

It was raised during focus group discussion with women that the main problem they are encountering is related to security issue due to poor transportation system.

5.2.7.3 Ahlone Township

In 2014, majority of population in Ahlone Township used and owned car, truck or van (***Table 5.90***). Primary data in 2018 indicates that majority of citizens still use and own car (***Table 5.91***). Walking is another mode of transportation, referred by Ahlone interviewees.

5.2.7.4 Dala Township

The 2014 data shows that from seven types of transportation, bicycle was the most popular transport mode in Dala Township (***Table 5.90***), but motorbike becomes the highest popular transport mode in 2018 (***Table 5.91***). Dala interviewees also referred walking as another mode of transportation.

Table 5.90: Types of Transportation in Yangon, Dala, Seikgyikanaungto and Ahlone Townships

Types of transportation	Percentage of households			
	Yangon region	Dala township	Seikgyikanaungto Township	Ahlone Township
Bicycle	46.2%	42.4%	45.7%	16.3%
Motorcycle/moped	13.6%	17.7%	8.3%	1.3%
Car/truck/van	7.8%	1%	0.5%	22.9%
Cart (bullock)	4.8%	6.2%	0.7%	Less than 0.1%
Canoe/boat	1.2%	1.2%	2.9%	Less than 0.1%
4-wheel tractor	1.2%	1.6%	Less than 0.1%	Less than 0.1%
Motor boat	1%	1.7%	0.5%	0.2%

Source: The 2014 Myanmar Population and Housing Census. (Modified by ERM)

Table 5.91: Types of Transportation in Dala, Seikgyikanaungto and Ahlone Townships

Types of transportation	Percentage of households		
	Dala Township	Seikgyikanaungto Township	Ahlone Township
Motorbike	84.8	100	12.5
Tractor	12.6	-	-
Car	1.3	-	87.5
Van/ truck	1.3	-	-

Source: ERM, 2018.

5.2.8 Cultural Heritage

5.2.8.1 Yangon Region

Yangon Region has a number of culturally significant areas, particularly Buddhists sites. Pagodas and monasteries found in these areas are considered as important cultural centres for the local communities. There are a number of important designated heritage buildings within 5 km of the Project Site such as the Shwedagon or Sule Pagoda. There is no cultural heritage in the footprint of the Project sites.

The most important and closest cultural heritages are Shwedagon pagoda and Sule pagoda. Shwedagon pagoda is constructed on the west bank of the Royal Lake on 114-acre Singuttara Hill in Yangon. Covered with number of gold plates and diamonds, this pagoda is representing architectures 2,500 years ago, and being recognized by Myanmar citizens as the most sacred Buddhist site in the country[65]. Shwedagon Pagoda is located approximately 3.37 km from the proposed Power Plant site.

[65] Shwedagon Pagoda. Accessed on 24 October 2018 at http://www.shwedagonpagoda.com/

Figure 5.50: Shwedagon Pagoda

Source: Shwedagon Pagoda.[65]

Sule pagoda was founded 2,500 year ago in the centre of Yangon, and is connected to two main roads: Sule Pagoda road and the Mahabandoola road. There is belief that a powerful Nat spirit, named Sularata is dwelling in this place. Historically, this cultural area was a highly crucial location, which was used as meeting point of notable movements of activists in Myanmar such as, 1988 uprising and the Saffron Revolution in 2007[66]. Sule Pagoda is located approximately 3.23 km from the proposed Power Plant site.

[66] Sule Pagoda. Accessed on 24 October 2018 at https://www.bestpricevn.com/travelguide/destinations-1/Sule-Pagoda-421.html

Figure 5.51: Sule Pagoda

Source: Sule Pagoda.[66]

5.2.8.2 Dala Township

According to interview with a village leader from Dala Township, there are two heritage and sacred sites. Danot pagoda is located three miles away out of the village; and Ah Nar Gan Sayar Thetgyi, meditation station, is located two miles away out of the village.

5.2.9 Education

5.2.9.1 Yangon Region

Basic education system in aforementioned areas is identical to other parts of Myanmar in compliance with the national education system. Thus, years of schooling of people are 11 years, which is so-called 5-4-2 education system. 5-4-2 education system is comprised of 5 years of primary school, 4 years of lower secondary school and 2 years of upper secondary school. However, Myanmar had a 2017 plan to change this education system to be 5-4-3 system in order to be in the same line with most ASEAN countries. This plan extend years of schooling from 11 years to 12 years. Due to this plan, starting age for schools has changed from 5 years old to 6 years old because students aged 6 – 10 will be in primary school, while those aged 11 – 14 years old will be in lower secondary school, and aged 15 – 17 years old will be in high or upper secondary schools[67]. This new educational system started from the academic year (AY) 2016-2017[68].

The 2014 data shows that in Yangon region, literacy rate of citizens aged of 15 years old and above was 96.6%, which is calculated from literacy rate in men (98%) and women (95.5%)[54]. The total

[67] The 2014 Myanmar Population and Housing Census (Thematic report on education). Accessed on 24 October 2018 at https://reliefweb.int/sites/reliefweb.int/files/resources/4G_Labour%20Force%209JUNE_forWEB.pdf

[68] Reform of the Education System: Case Study of Myanmar. Accessed on 24 October 2018 at https://www.pic.org.kh/images/2017Research/20170523%20Education_Reform_Myanmar_Eng.pdf

number of schools is 2,717 schools, which include 198 high schools, 225 middle schools and 2,264 primary schools[69]. MIMU data show, in 2014, that majority of citizens accomplished primary schools (***Table 5.92***).

5.2.9.2 Seikgyikanaungto Township

In 2014, literacy rate was recorded at 97%, consisting of literacy rate of men (98.5%) and of women (95.6%)[48]. In this township, there were 17 schools, comprising 14 primary schools, 2 middle schools and 1 high school[70]. The majority of population in this township achieved primary education (***Table 5.92***). Primary data shows that in 2018, majority of interviewees also finished high school (***Table 5.93***). Data from focus group discussion with women shows that they perceived that girls are more educated than boys.

5.2.9.3 Ahlone Township

In 2014, literacy rate of men and of women were 99.2% and 97.9% respectively. In combination, literacy rate is 98.5%[58]. In Ahlone, there were 17 schools, comprising of 9 primary schools, 2 middle schools, and 6 high schools[70]. As provided in ***Table 5.92***, in this township, majority of citizens graduated from university/ college. Based on information from focus group discussion with women, girls are perceived to be more educated than boys.

5.2.9.4 Dala Township

In 2014, literacy rate was recorded at 93.1%, comprising of literacy rate of men (95.6%) and of women (90.8%). In Dala, there were 73 schools, comprising of 61 primary schools, 8 middle schools and 4 high schools[70]. As shown in ***Table 5.92***, the majority of Dala citizens accomplished primary schools. ***Table 5.93*** indicates, in 2018, that majority of interviewees in Dala accomplished middle school. Data from focus group discussion with women show that they perceive girls are more educated than boys.

Table 5.92: Levels of Education Completed by Population (2014)

Levels of education completed	Yangon region	Dala Township	Seikgyikanaungto Township	Ahlone Township
None	243,812	10,048	805	718
Primary school (Grade 1 – 5)	1,324,522	42,801	8,103	4,995
Middle school (Grade 6 – 9)	978,392	20,560	4,832	6,365
High school (Grade 10 – 11)	751,724	9,743	2,270	8,052
Diploma	18,254	144	19	242
University / college	729,473	6,407	1,292	12,420
Post-graduate and above	43,947	187	73	969

[69] Total Number of Government Schools in States/Regions. Accessed on 24 October 2018 at https://reliefweb.int/sites/reliefweb.int/files/resources/Sector_Map_Edu_Government_Schools_in_ST-RGN_2014_MIMU1479v01_7Nov2016_A4.pd

[70] Number of Basic Education School in Yangon Region. Accessed on 24 October 2018 at https://reliefweb.int/sites/reliefweb.int/files/resources/Number%20of%20Basic%20Education%20School%20in%20Yangon%20Region.pdf

Levels of education completed	Yangon region	Dala Township	Seikgyikanaungto Township	Ahlone Township
Vocational training	9,746	62	8	142
Others	42,723	556	371	166

Source: The 2014 Myanmar Population and Housing Census (Yangon Region)[54]

Note: The number in the table represents number of population aged 25 years old and over.

Table 5.93: Level of Education Completed by Population (2018)

Levels of education completed	Dala Township	Seikgyikanaungto Township	Ahlone Township
None	6.5%	9.4%	9.9%
Illiterate	-	-	0.5%
Kindergarten	2.9%	2.1%	0.5%
Primary school (Grade 1 – 5)	25%	21.6%	15.4%
Middle school (Grade 6 – 9)	30%	27.3%	18.8%
High school (Grade 10 – 11)	21.2%	30.2%	31.7%
University / college	10.9%	9.4%	23.3%
Monastery	3.5%	-	-

Source: ERM, 2018.

Notes: In questionnaire, senior high school and junior high school choices are given instead of middle school and high school. Percentage for university/ college is the result of combination between percentage of university, graduate and college as selected by interviewees in questionnaires.

5.2.10 Health, Health Facilities, and Security

5.2.10.1 Myanmar

The Department of Health in Myanmar is responsible for providing health services to all population in the country[71]. In 2013, the Irrawaddy published in an article that "patients in the government's public hospitals have been forced to foot the bill" by giving Yangon General Hospital as an example for requiring patients to pay a bill for equipment, used during their treatment[72]. UNDP (United Nations Development Programme) similarly reports that citizens in Yangon bear more than 80% of costs on health services at public health care facilities[56]. Consequently, many citizens tend to fly to other countries in order to receive accurate diagnosis and treatment since they cannot get correct diagnosis and treatment at hospitals and health care centres in the country[72]. Moreover, in Myanmar, main

[71] Health in Myanmar 2012. Accessed on 24 October 2018 at http://mohs.gov.mm/ckfinder/connector?command=Proxy&lang=en&type=Main&currentFolder=%2FPublications%2FHealth%20In%20Myanmar%2F&hash=a6a1c319429b7abc0a8e21dc137ab33930842cf5&fileName=Health%20in%20Myanmar%20(2012).pd

[72] Myanmar Patients Pays The Price. Accessed on 24 October 2018 at https://www.irrawaddy.com/news/environment/myanmar-patients-pay-the-price.html

diseases and health problems consist of tuberculosis, underweight in children, malnutrition, Malaria, and AIDs[73].

5.2.10.2 Yangon Region

In 2016, in Yangon region, there were 85 hospitals, 11,610 sanctioned beds, 12,260 available beds, 527,308 admissions, 525,851 discharges and deaths, 3,537,276 patient days, 16,656 numbers of death, hospital death rate at 3.2%, and 2,516,767 out-patient attendance. Here, hospital death rate is the calculation between number of deaths, and number of discharges and deaths[74]. Sanctioned bed is the official bed capacity of the hospital[75]. Regarding to health facilities and hospitals, almost 70 percent of children in Yangon are born in health facilities[53]. ***Table 5.94*** shows that in 2016, there were fifteen health conditions that caused Yangon citizens to use hospital services.

Table 5.94: Causes of Hospitalization in Yangon Region

Causes of hospitalization	Number of population
Single spontaneous delivery	36,567
Other cataract	19,352
Other and unspecified injuries of head	18,080
Single delivery by caesarean section	15,662
Diarrhoea and gastroenteritis of presumed infectious origin	14,713
Mental and behavioural disorders due to use of alcohol	12,418
Viral infection of unspecified site	11,160
Neonatal jaundice from other and unspecified causes	10,107
Gastritis and duodenitis	8,079
Unspecified abortion	7,324
Pneumonia, organism unspecified	7,165
Stroke, not specified as haemorrhage or infarction	6,911
Unspecified mood [affective] disorder	6,608
Respiratory tuberculosis, not confirmed bacteriologically or histologically	6,135
Acute appendicitis	5,795
All other Causes	339,775

Source: Hospital Statistics Report 2014-16[74]

Most of health problems in Yangon region are related to the aforementioned national health issues. In 2017, number of Yangon patients with tuberculosis and being treated under the National Tuberculosis Programme, was more than 32,000 persons[76].

[73] Health, Health Care and Diseases in Myanmar. Accessed on 24 October 2018 at http://factsanddetails.com/southeast-asia/Myanmar/sub5_5f/entry-3118.html
[74] Hospital Statistics Report 2014-16. Accessed on 24 October 2018 at https://themimu.info/sites/themimu.info/files/documents/Report_Hospital_Statistics_Report_2014-16_MOHS_Jun2018.pdf
[75] Hospital Statistics. Accessed on 24 October 2018 at https://www.slideshare.net/zulfiquer732/hospital-statistics-79835548
[76] TB Still A Serious Threat, Says Doctors. Accessed on 24 October 2018 at https://www.mmtimes.com/news/tb-still-serious-threat-say-doctors.html

UNICEF reports that in 2015, 24% of children in Yangon region experienced stunting, while 20% and 8% of them were underweight and wasting respectively[53]. WHO wrote, "stunting is the impaired growth and development that children experience from poor nutrition, repeated infection, and inadequate psychosocial stimulation"[77]. Wasting is "a symptom of acute undernutrition, usually as a consequence of insufficient food intake or a high incidence of infectious diseases, especially diarrhoea"[78].

Apart from that, 5.7% of Yangon households had at least one insecticide-treated net.

In Yangon region, HIV prevalence was 24.6%, causing this region to be recognized as one of locations with the highest percentage of HIV prevalence in the Southeast Asia Pacific region[79]. The study shows that even though 76.4% of women and 81.7% of men in Yangon acknowledge where they can get diagnosis for HIV, 76.6% of women and 67.3% of men never tested for HIV. They also have knowledge, regarding to HIV/AIDs-preventative methods, including of using condoms and limiting sexual intercourse to one uninfected partners[79].

In 2015, Yangon region was one of locations with the lowest rate in infant mortality in the country – 44 per 1000 live births[54]. Only 67% of total children aged of 12 to 23 year old in Yangon received all basic vaccinations, which are referred to one dose each of BCG and measles, and three doses each of DPT-containing vaccine and polio[80]. Around 18% of admissions in the Yangon Children's Hospital is due to diarrhoea[81]. During FGD with health officer, senior nurse and medical officer, it was found that in Dala, Seikgyikanaungto, and Ahlone townships, most of citizens are vaccinated at childbirth.

Moreover, in this region, there are four forms of disabilities (***Table 5.95***). Among them, visual issues was the most dominant type of disability.

Table 5.95: Disabilities

Types of disabilities	Yangon region	Dala Township	Seikgyikanaungto Township	Ahlone Township
Visual	125,844	3,574	825	484
Locomotion	109,976	2,974	665	807
Memory	78,895	2,045	425	470
Hearing	62,748	1,634	381	432

Source: The 2014 Myanmar Population and Housing Census (Yangon Region).[54]

5.2.10.3 Seikgyikanaungto Township

In Seikgyikanaungto Township, based on ***Table 5.95***, majority of disabled people are dealing with visual disability. However, ***Figure 5.52*** shows that 84.5% of interviewees have a good health status. In addition to dengue fever outbreaks during rainy season, fever is the disease that most of interviewees have dealt with (***Table 5.96***). None of interviewees had diarrhea last year. Women in Seikgyikanaungto faced several main problems, including cervical cancer, diabetes and hypertension.

[77] Nutrition (Stunning In A Nutshell). Accessed on 12 March 2019 at https://www.who.int/nutrition/healthygrowthproj_stunted_videos/en/

[78] Country Profile Indicators (Interpretation Guide). Accessed on 12 March 2019 at https://www.who.int/nutrition/nlis_interpretation_guide.pdf

[79] HIV and AIDs in Myanmar. Accessed on 24 October 2018 at https://www.avert.org/professionals/hiv-around-world/asia-pacific/myanmar

[80] Myanmar 2015-16 Demographic and Health Survey (Key Findings). Accessed on 24 October 2018 at https://dhsprogram.com/pubs/pdf/FR324/FR324.pdf

[81] Diarrhea Among Children Under Five In Myanmar: A Systematic Review. Accessed on 12 March 2019 at https://tci-thaijo.org/index.php/jhealthres/article/download/78346/62760/

In the township, traditional/ private/ mobile clinics can be found. Interviewees travel to these clinics by walking because average distance between their houses and clinics is around 0.6 km. Moreover, township/ station hospitals are available in this township. Citizens reach there by riding a bike or using trishaw with average distance of 0.8 km. Some of interviewees visit doctors at Yangon Child Hospital by using boat services.

5.2.10.4 Ahlone Township

In Ahlone Township, ***Table 5.95*** shows that from four types of disability, the main one is locomotion issues. ***Figure 5.52*** shows that 94.1% of interviewees have a good health conditions, but some of them experience diabetes ***Table 5.96***. It was also found that none of the interviewees had dealt with diarrhea last year.

In this township, there are three hospitals, consisting of the Academy Hospital, the West Yangon General Hospital[82] and the Yangon Children Hospital[83]. Apart from this, traditional/ private and mobile clinics can also be found. Interviewees walk, drive a car or use bus services to see a doctor in these clinics. Average distance between their houses and those places is approximately 0.9 km. In addition, township/ station hospitals are also available in the township. To see a doctor at these hospitals, interviewees walk around 1 km.

5.2.10.5 Dala Township

Table 5.95 indicates that the largest number of disabled people are dealing with visual disability. As shown in ***Figure 5.52***, 95.3% of interviewees have good health condition. Among various diseases occurring, fever is the main disease that most of them have encountered (***Table 5.96***). Moreover, main health problems, faced by women in Dala Township consist of cancer, sexually transmitted infections (HIV and AIDs), and lack of nutrition. Dengue fever outbreak have been experienced from June until July. However, none of interviewees experienced with diarrhea last year.

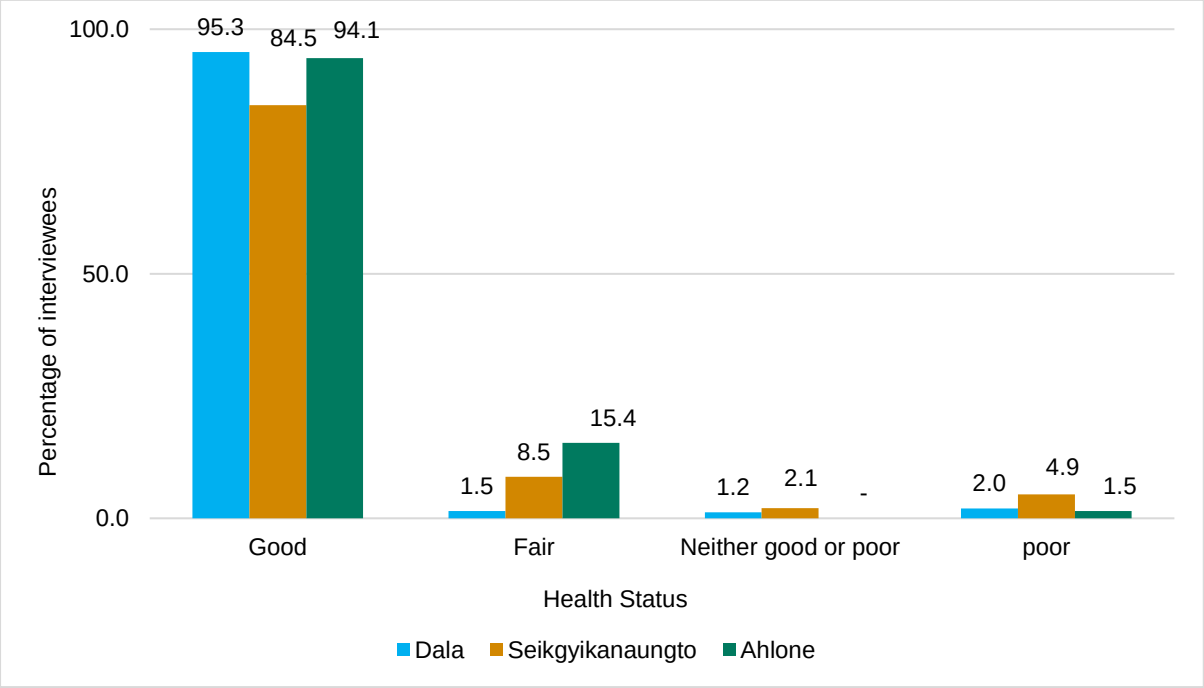
In this township, rural/ sub-rural health centers can be found. Interviewees go there by walking, and riding motorbike in order to see a doctor. Average distance between their houses and those centers is approximately 0.4 km. There are also traditional and private clinics, where interviewees visit by riding motorbike/ motorcycle or walking. Average distance between their houses and those clinics is approximately 2.7 km. Moreover, township/ station hospital is another alternative that interviewees ride motorbike in order to go to those hospitals. Average distance between their houses and those hospitals is around 10.4 km. Other hospitals in Yangon region consist of Yangon hospital, Parrami clinic, SSC hospital and N/Oak hospital, where interviewees use bus services and transport via waterway to visit those places. Average distance between their houses and those hospitals is approximately 9.1 km.

Based on primary data, the main problem that women in the township experience is related to security issue from drunkard persons as there are many pubs in the surrounding areas, beer restaurants and market of illegal drugs. Another cause of insecurity is the lack of facilities, including lighting infrastructure, and bridge. Concurrently, causes of deaths in men are diseases associated with drinking alcohol, which leads to other impacts including income issues and conflict between family members. However, causes of deaths in women are breast cancer and cervical cancer.

[82] Healthcare. Accessed on 24 October 2018 at https://www.myanmore.com/2015/02/healthcare/

[83] Medical Assistance. Accessed on 24 October 2018 at https://mm.usembassy.gov/u-s-citizen-services/doctors/

Figure 5.52: Health Status



Source: ERM, 2018.

Table 5.96: Diseases in the Last 6 Months

Name of disease	Percentage (%)		
	Dala Township	Seikgyikanaungto Township	Ahlone Township
High blood pressure	16.7	8.3	-
Women disease	2.8	-	-
Kidney	2.8	-	-
Diabetes	5.6	-	30.8
Respiratory tract infection	5.6	8.3	-
Autism	2.8	-	-
Neutral	2.8	-	-
Fever	38.9	16.7	15.4
Gout	5.6	4.2	7.7
Bronchitis	5.6	4.2	-
Heart disease	5.6	8.3	15.4
Stomach	2.8	8.3	-
Diarrhea	-	4.2	-
Eye disease	-	8.3	-
Tuberculosis	-	4.2	7.7
Paralytic stroke	-	12.5	-

Name of disease	Percentage (%)		
	Dala Township	Seikgyikanaungto Township	Ahlone Township
Indigestion	-	4.2	-
Cancer	-	4.2	-
Critical disease	-	4.2	-
Skin rash/ itches	-	-	15.4
Hepatitis	-	-	7.7
Others	2.8	-	-

Source: ERM, 2018.

5.2.11 Infrastructure, and Amenities

5.2.11.1 Infrastructure

Yangon Region

Yangon has various transport infrastructures, including port, Thilawa deep-water port, airport, roads, bridges, flyovers, highway and Twantay Canal, which connects Yangon River with Irrawaddy River. Importantly, Yangon is the terminus of five railway lines[56]. There are number of roads, connecting Yangon region with other regions in Myanmar as well[84]. In addition, it is reported that rural access index of Yangon is 60%. According to Asian Development Bank, the rural access Index (RAI) is “an internationally used indicator that shows the portion of the rural population that lives less than 2 km away from an all-season road”[85].

Seikgyikanaungto Township

In Seikgyikanaungto Township, there is one road connecting to the rest of city. This road starts from Hlaingtharyar Township and passes through Twantay Township. There is also the bridge, allowing citizens to cross from Seikgyi to Kanaungto. Harbour where boats from other areas, including Maw Tin Harbour or Wardan Jetty will dock can also be found[49]. Moreover, ***Figure 5.53*** shows that majority of interviewees (60%) stated that type of road surface is concrete. Some of them have paved road connecting to their houses. Overall quality and condition of transportation system of this township is mostly good.

Ahlone Township

In Ahlone Township, there are four main roads – Baho Road, Heavy-Duty Vehicle Commercial Bypass Road, Kyimyindine Kannar Road, and Ahlone Road[86].Yangon circular train can be also found on Ahlone road[87]. Along the road, there are total five bus stops. Ahlone Post Office is located near to Ahlone post office bus stop[52]. Ahlone Township also has nine streets as listed below:

1. Min Street;
2. Pa-Day-Thar Street;

[84] Myanmar Road Network. Accessed on 24 October 2018 at https://dlca.logcluster.org/display/public/DLCA/2.3+Myanmar+Road+Network

[85] Rural Road And Access. Accessed on 24 October 2018 at https://www.adb.org/sites/default/files/publication/189079/mya-rural-roads.pdf

[86] Ahlone Street. Accessed on 24 October 2018 at https://myanmar-streets.openalfa.com/streets?q=AHLONE

[87] Circular Train, The Cheapest Way to See Yangon. Accessed on 24 October 2018 at http://yangon-rangoon.com/yangon-circular-train.html

3. Shan Yeik Thar Street;
4. Sin Yae Kan Street;
5. Tha-Mar-Daw Street;
6. Thakhin Mya Garden Street;
7. Theint De Street;
8. U Lu Maung Street; and
9. Yama Street[86].

As shown in ***Figure 5.53***, majority of interviewees (72.5%) stated that type of road surface is concrete. Some of them have paved road that connects to their home. Overall quality and condition of transportation system of this township is good.

In the area of Ahlone, three ports can be found near to the Yangon River. Those ports are Asia World Port Terminal[88], Myanmar Industrial Port (MIP)[89] and Ahlone International Port Terminal (A.I.P.T)[90]. Four wharfs can also be discovered as well[89].

Dala Township

Within Dala Township, there is a road and Dala pier, in which ferries from Pansodan Pier of Yangon will dock, and passenger will embark[91]. Dala pier can be also called as Dala Ferry Terminal, in which ferries transport approximately 30,000 passengers daily[92]. There is a plan for bridge construction in Dala Township, which is being on process since 2016 until 2020[93]. ***Figure 5.53*** shows that majority of interviewees (92.5%) stated that type of road surface is concrete. Some of them have paved road that connects to their houses. Overall quality and condition of transportation system of this township is good.

[88] Asia World Port Terminal. Accessed on 24 October 2018 at http://www.yangondirectory.com/en/categories-index/yangon-region/ahlone/716-ports/L456_000000000_asia-world-port-terminal_16851

[89] Yangon port. Accessed on 24 October 2018 at http://www.mpa.gov.mm/yangon-port

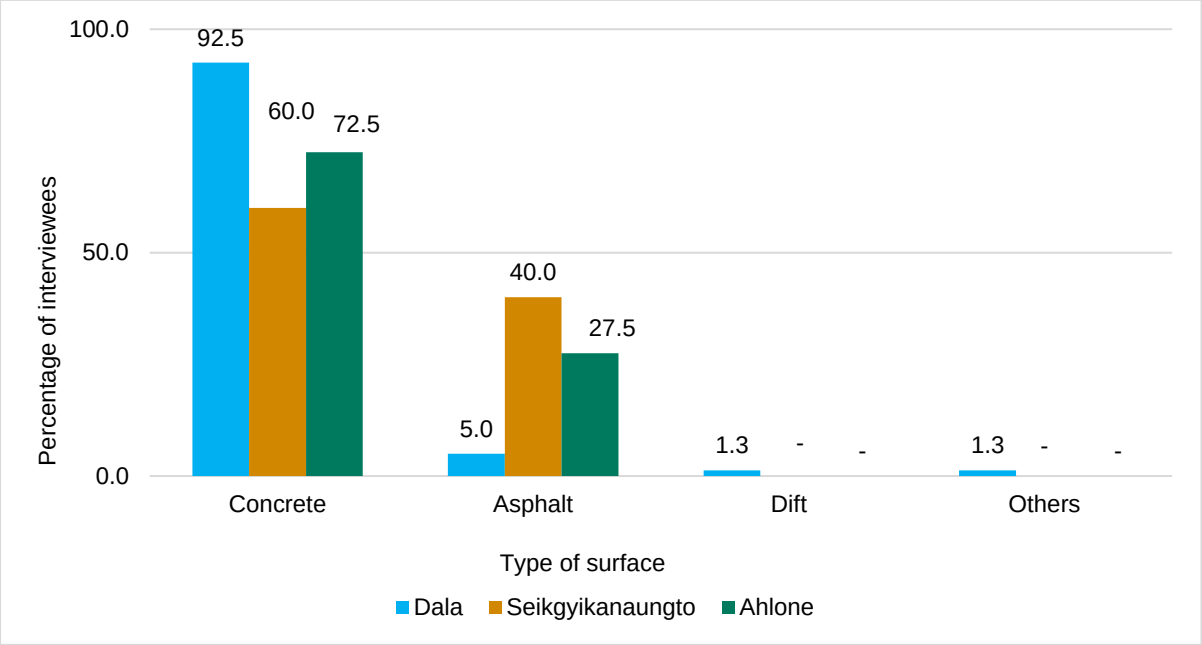
[90] Ports in Yangon, Myanmar. Accessed on 24 October 2018 at http://www.globalmarsshipping.com/ports-in-ygn.htm

[91] Day Trip to Dala Village near Yangon, Myanmar. Accessed on 24 October 2018 at https://drifterplanet.com/dala-village-near-yangon-myanmar/

[92] The Project for the Strategic Urban Development Plan of the Greater Yangon (Final Report I). Accessed on 24 October 2018 at http://open_jicareport.jica.go.jp/pdf/12122529_03.pdf

[93] The Survey Program for the National Transport Development Plan in the Republic of the Union of Myanmar (Final Report). Accessed on 24 October 2018 at http://open_jicareport.jica.go.jp/pdf/12230728_02.pdf

Figure 5.53: Road Surface



Source: ERM, 2018.

5.2.11.2 Amenities

Yangon Region

From certain proportions of Myanmar citizens, who are aged of 15 and above have access to internet, those in Yangon access internet more frequently than those in other regions because 42% of Yangon population used internet in last 7 days, but 37% of them used internet daily in last 7 days[64]. As shown in ***Table 5.97***, majority of Yangon households widely own smartphones.

Among various regions of Myanmar, Yangon is the location with the highest percentage of households, owing computers (10.9%)[64].

Seikgyikanaungto Township

53.3% of interviewees have access to the internet. ***Table 5.98*** shows that in this township, cell phone is the widest available amenity in households.

Ahlone Township

In this township, 80% of interviewees have access to the internet. Based on ***Table 5.98***, majority of households own cell phone.

Dala Township

73.42% of interviewees have access to the internet. Cell phone is widely owned by majority of Dala citizen (***Table 5.98***).

Table 5.97: Amenities in Yangon

Types of amenities	Households in Yangon region
Smart phone	91%
Television	75%
Rice cooker	73%
Electric fan	68%
Refrigerator	43%
Charcoal stove	42%
Gas stove	17%
Air conditioner	16%
Keypad phone	11%
Car	10%

Source: The 2017 Myanmar Living Conditions Survey.[64]

Note: above percentage for each type of amenity is individually calculated from total percentage of households

Table 5.98: Amenities in Dala, Seikgyikanaungto, and Ahlone Townships

Types of amenities	Percentage (%)		
	Dala township	Seikgyikanaungto Township	Ahlone Township
Digital TV	22.1	20.1	16.7
Cell phone	52.9	51.5	54
Landline	0.6	1.5	2.5
Air Conditioner	0.9	3	6.3
Laundry Machine	2.1	5.2	4.2
Sewing Machine	6.6	5.2	1.7
Gas Cooker	5.1	1.5	2.5
Refrigerator	9.7	11.9	12.1

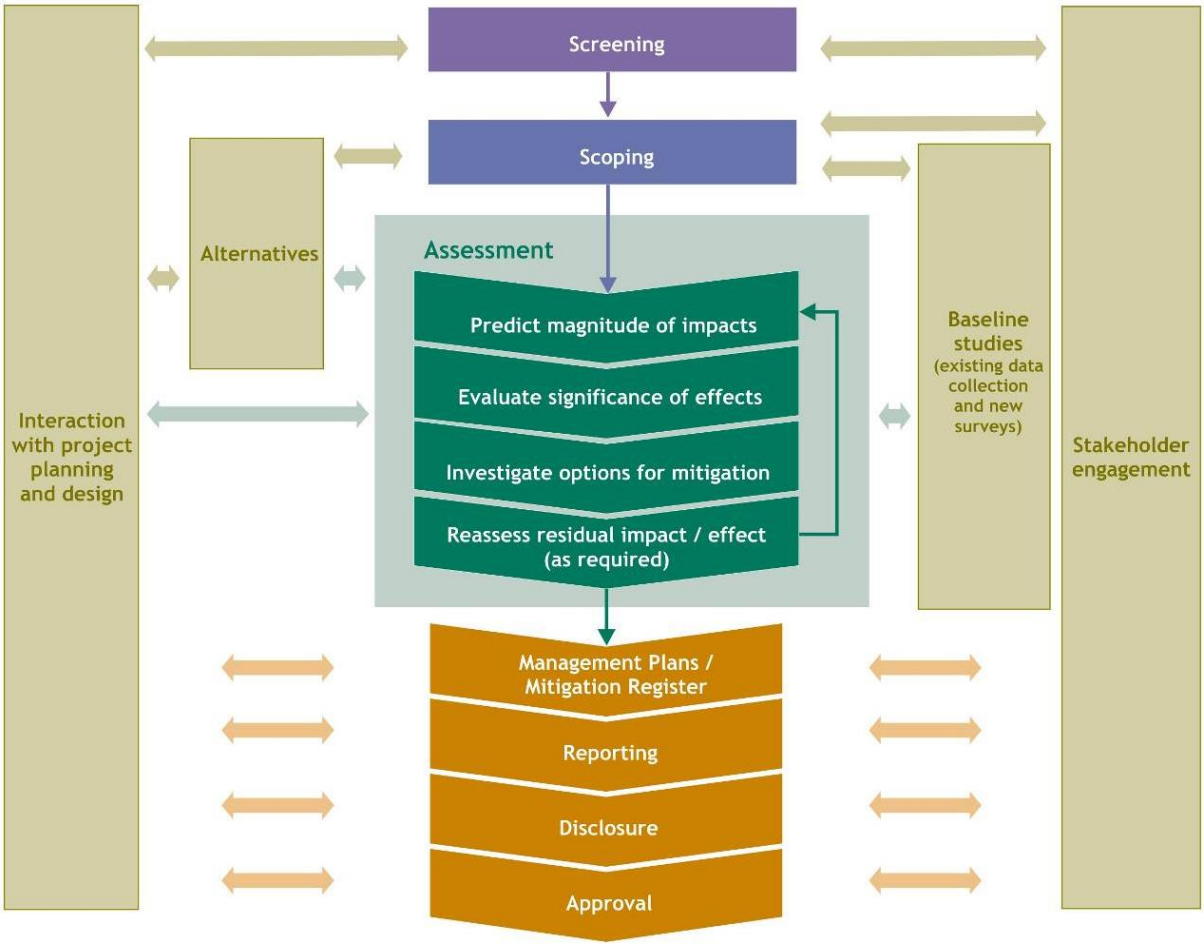
Source: ERM, 2018.

6. IMPACT ASSESSMENT METHODOLOGY

6.1 Introduction

This Chapter presents the methodology used to conduct the ESIA. The ESIA methodology follows the overall approach illustrated in ***Figure 6.1***. The ESIA has been undertaken following a systematic process that evaluates the potential impacts the Project could have on aspects of the physical, biological, social/ socioeconomic and cultural environment; identifies preliminary measures that the Project will take to avoid, minimise/reduce, mitigate, offset or compensate for potential adverse impacts; and identifies measures to enhance potential positive impacts where practicable.

Figure 6.1: Overall Impact Assessment Process



Source: ERM, 2019.

This section also details the methodology applied in the collection and analysis of primary and secondary data used in this report. Primary and secondary information from TPMC, government sources, non-government organizations (NGOs) and other Project-related stakeholders have been collected to support the preparation of this report.

6.2 Screening

At the initial stage of the ESIA, preliminary information was provided 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.

6.3 Scoping

The Scoping study was undertook as a means to ensure that there is a focus on the issues that are most important for Project planning, decision-making and stakeholder interests. During the scoping study, potential interactions between the Project, environmental and human resources/receptors were identified, and prioritised in terms of their potential to cause impacts of concern. ***Table 6.1*** presents the resources/receptors considered in the scoping stage, together with the changes that might indicate a potential Project-related impact.

In addition, it shall be noted that the Scoping Report for this Project has been prepared and submitted to ECD on 27th January 2019.

Table 6.1: Resources/Receptors and Potential Impacts Considered in Scoping

Resources/Receptors	Changes that May Indicate Potential Impacts
Environmental	
Geology	Changes to geology, geomorphology, topography
Soil	Changes to physical and chemical properties and soil ecology
Surface Water	Changes to physical, chemical or biological quality of rivers and other surface water bodies; Introduction of exotic species, changes in habitat quality, abundance, diversity; Effluent discharge
Groundwater	Contamination of shallow or deep groundwater resources, change in ground water resources
Fisheries	Changes in fisheries productivity
Vegetation	Changes to vegetation population, health, species abundance and diversity and impact on endangered and economic species, food chain effects
Wildlife	Changes to wildlife assemblages, impact on endangered and economic species, food chain effects
Air	Emissions of NOx, SOx, PM, CO, VOC, greenhouse gases (CO_2, CH_4, and N_2O), ozone, TSP etc.
Noise and Vibration	Change in noise or vibration levels
Aesthetics	Physical presence of facilities, increased night time light
Waste	Generation of wastes – hazardous and non-hazardous
Social / Socioeconomic	
Population and physical displacement	Changes in total population, gender ratio, age distribution. Physical displacement from residence as a result of Project land take, or activities
Social and Cultural Structure	Disruption in local authority and governance structure; change in social behaviours; alterations to social and cultural networks; intra and inter-ethnic conflict
Economy and employment	Change in national/local economy, employment,

Resources/Receptors	Changes that May Indicate Potential Impacts
	standard of living, occupation
Resource ownership and use	Temporary or permanent restriction for accessing or using land or water, changes in livelihood activities based on natural resources; changes in ownership of such resources.
Cultural Resources	Physical disturbance of shrines, burial grounds, archaeological resources or other desecration or change in access to cultural resources, rituals or celebrations carried out in their premise.
Education and skills	Change in availability or quality of education or skills provision, supply and demand in certain skill sets etc.
Infrastructure and public services	Improvement or pressure on existing urban/rural infrastructure or services including: transportation; power, water, sanitation, security, waste handling facilities etc.
Community Health and Safety	
Mortality and Key Health Indicators	Change in the mortality profile of the community; changes in life expectancy, birth rates, death rates, maternal mortality rates etc.
Environmental Change	Decreased air quality (e.g. NOx, SOx, VOC, CO, PM), contamination of surface waters and potable ground water, increased vibration and noise, increased night time light beyond acceptable limits, changes to the visual environment.
Communicable and Non Communicable Diseases	Change in incidence and /or prevalence of communicable and non-communicable diseases or disease causing factors
Vector Borne Diseases	Changes in the incidence and or prevalence of vector borne diseases, the density of these vectors and their breeding grounds.
Sexually Transmitted Diseases	Changes in the incidence and /or prevalence of sexually transmitted diseases and the factors that contribute to this (external workforce, transport routes etc.)
Nutritional Status	Changes to nutritional status and food security
Health Care/ Recreational Facilities	Changes in availability of and access to health care and recreational facilities including green space
Psychosocial /Lifestyle Factors	Drug use/abuse, prostitution, communal violence, crime, suicide and depression; changing expectations of quality of life
Community Safety	Risk to community safety from gas leaks from the gas supply pipeline

Table 6.2: Scoping Matrix

Project Activity/ Hazards \ Resource/ Receptors	Physical											Ecology					Socio-economic								
	Climate Change (including GHG)	Air Quality	Riverbed Features/ Profile	Sediment Quality/ Composition	River Water Quality	Hydrodynamic Regime	Groundwater	Landscape and Visual	Soil Erosion	Soil Contamination	Noise and Vibration	Terrestrial Ecology	Freshwater/ Aquartic Ecology	Mangroves	Flora & Fauna	Avifauna	Fishing Activities	Navigation/ Traffic & Transport	Public Health and Safety	Occupational Health and Safety	Land Use / River Use	Existing facilities and utilities	Physical Displacement	Cultural Heritage	Employment
General Construction																									
Worker / Equipment / Material Transport	■	■			▒						■		▒					■	■	■		■			■
Worker Accomodation					■		■	■		▒	■	■	■		■	■	■		■	■	▒	■		■	■
Unplanned Events (spills and uncontrolled releases)				■	■		■			■		■	■		■				■	■					
Air Emissions from heavy machines	▒	■										▒							■	■					
Lighting for night work/ navigational safety												■			■	■	▒	■	■	■					
Waste storage and disposal (non-hazardous)				▒	■		■			■									■			■			
Waste storage and disposal (hazardous)				■	■		■			■									■			■			
Power Plant Construction																									
Excavation and Foundation Work and Civil Construction	■	■			■		■	■	■	■	■	■	■	■	■	▒	▒	▒	■	■	■	■	■	■	■
Water Intake Construction			■	■	■			▒					■	■			■	■	■	■					
Pre-commisionning and Testing	▒	■								▒	■	■				■			■	■	■				
Waste Water Discharges and Run-off			▒	▒	■								■						■			■			
Waste Management and Disposal (non Hazardous)				▒	■		■			■									■			■			
Waste Management and Disposal (Hazardous)				■	■		■			■									■			■			
Gas Pipeline Construction																									
Right of Way Clearance & Access Roads		▒						■	■		▒	■	▒	▒	■	▒		■	■	■	■	■	■	■	■
Excavation and Foundation work	■	■			■		■	■	■	■	■	■	■	■	■	■	▒	▒	■	■	■	■	■	■	■
HDD	■	▒	■	■	■	■					▒		■				■	■	■	■					
Boring	■	▒	■	■	■	■					▒		■				■	■	■	■					
Open cut	■	■			▒		▒	▒	■	■	■	■			■			▒	■	■	■	■	■	■	■
Hydrostatic Testing					■							■					■		■						
Rehabilitation on surface									■									■			■	■			
LNG Receiving Facilities Construction																									
Equipment/ material/ worker transport	■	■			▒						■		▒					■	■	■		■			■
Vessel operational discharges					■								■				■	■	■	■	■				■
Vessel anchoring			▒	▒	▒	▒							■				▒	■	▒	▒	■				
Construction exclusion zone																	■	■	■	■	■				
Berth construction (eg piling, dredging, reclamation)		▒	■	■	■	■		■			▒		■	■			■	■		■					
Disposal of dredged materials			▒	▒	▒	▒							▒	▒			▒					■			
Labour, equipment & services supply																		■	■	■		■			■
Power Plant Operation																									
Operation of power plant/ turbine	■	■			■		▒	■	▒	▒	■	■	■		■	■	▒		■	■	■	■			■
Waste Storage and Disposal				▒	■		■			■									■			■			
Storm water discharge and run-off on site			▒	▒	■								■						■						
Structure at site								■													■		■		
Unplanned events (spill, uncontrolled releases)		■		■	■		■			■		■	■		■				■	■					
Cooling water withdrawal													■				■								
Operation & Cooling Water Discharge to River				▒	■								■	■			■		■						
Gas Pipeline Operation																									
Regular Maintenance																			■	■					
Unplanned events (Leaks, uncontrolled release)							■			■		■	■	▒	■				■	■					
LNG Receiving Facilities Operation																									
Flaring, venting & fugitive emissions																									
River Water Intake (for Re-gasification process)																									
Operational of LNGC - River traffic	▒	▒			■						▒		■	■			■	■	■	■	■	▒			
LNGC Vessel operational discharges					■								■				■	■	■	■	■				■
LNGC Vessel anchoring			▒	▒	▒	▒							■				▒	■	▒	▒	■				
FLNG discharges to River (ie. produced water, cooling water etc)					■								■				■		■						
Facilities presence at site and Safety Zone								■										■			■				
Lighting for night time operation / navigational safety												■			■	■	▒	■	■	■					
Labour, equipment & services supply																		■	■	■		■			■
Waste storage and disposal (non-hazardous)				▒	■		■			■									■			■			
Waste storage and disposal (hazardous)				■	■		■			■									■			■			
Unplanned events/ spills/ dropped objects							■			■		■	■	▒	■				■	■					

Key

□ An interaction is not reasonably expected (white)

▒ An interaction is reasonably possible but the resulting impact is unlikely to lead to significant effects (grey)

■ An interaction is reasonably possible and the resulting impact is likely to lead to an effect that is significant (black)

Source: ERM, 2018.

6.4 Project Description

In order to set out the scope of the Project features and activities, with particular reference to the aspects which have the potential to impact the environment, a Project Description has been prepared. Details of the Project facilities' design characteristics, as well as planned and possible unplanned Project activities, are provided in ***Chapter 4*** of this ESIA Report.

6.5 Baseline Conditions

To provide a context within which the impacts of the Project can be assessed, a description of physical, biological, social / socioeconomic and cultural conditions that would be expected to prevail in the absence of the Project is presented. The Baseline includes information on all resources/receptors that were identified during scoping as having the potential to be significantly affected by the Project.

The baseline characterization is reported in ***Chapter 5*** of this Report.

6.6 Stakeholder Engagement

An effective ESIA Process requires engagement with relevant stakeholders throughout the key stages. This assists in understanding stakeholder views on the Project and in identifying issues that should be taken into account in the prediction and evaluation of impacts.

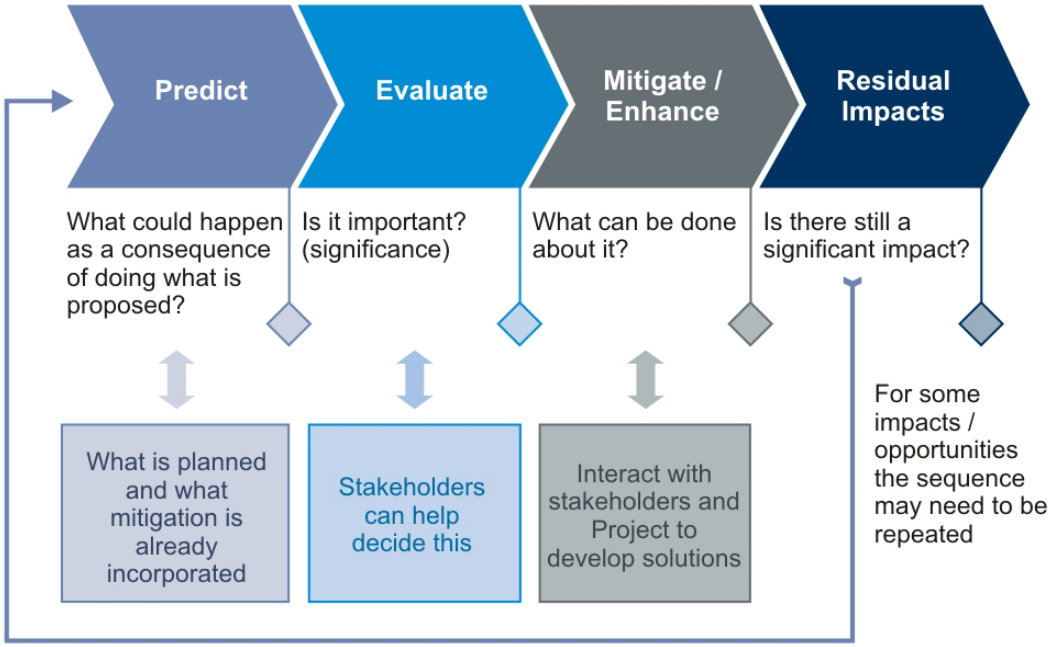
Stakeholder Engagement activities have been undertaken for this Project and these are presented in ***Chapter 13*** of this Report.

6.7 Impact Assessment

Impact identification and assessment starts with scoping and continues through the remainder of the ESIA Process covering all phases of the Project from Pre-construction to Post-closure. The principal ESIA steps are summarized in ***Figure 6.2*** and comprise:

- 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 potential negative impacts and enhance potential positive impacts; and
- Residual Impact Evaluation: to evaluate the significance of potential impacts assuming effective implementation of mitigation and enhancement measures.

Figure 6.2: Impact Assessment Process



6.7.1 Prediction of Impacts

Prediction of impacts is essentially an objective exercise to determine what is likely to happen to the environment as a consequence of the Project and its associated activities. From the potentially significant interactions identified in Scoping, the impacts to the various resources/receptors are elaborated and evaluated. The diverse range of potential impacts considered in the ESIA process typically results in a wide range of prediction methods being used, including quantitative, semi-quantitative and qualitative techniques.

6.7.2 Evaluation of Impacts

Once the prediction of potential impacts is complete, each potential impact is described in terms of its various relevant characteristics (e.g., type, scale, duration, frequency, extent). The terminology and designations used to describe impact characteristics are shown in ***Table 6.3.***

Table 6.3: Impact Characteristics Terminology

Characteristic	Definition	Designations
Type	A descriptor indicating the relationship of the potential impact to the Project (in terms of cause and effect).	■ Direct ■ Indirect ■ Induced
Extent	The “reach” of the potential impact (e.g., confined to a small area around the Project Footprint, projected for several kilometres, etc.).	■ Local ■ Regional ■ International
Duration	The time period over which a resource / receptor is potentially affected.	■ Temporary ■ Short term ■ Long term
Scale	The size of the potential impact (e.g., the size of the area with the potential to be damaged or impacted, the fraction of a resource that could potentially be lost or affected, etc.).	[no fixed designations; intended to be a numerical value or a qualitative description of “intensity”]

Characteristic	Definition	Designations
Frequency	A measure of the constancy or periodicity of the potential impact.	[no fixed designations; intended to be a numerical value or a qualitative description]

The definitions for the *type* designations are shown in ***Table 6.4.*** Definitions for the other designations are resource/receptor-specific, and are discussed in the resource/receptor-specific impact assessment chapters presented later in this Report.

Table 6.4: Impact Type Definitions

Type	Definition
Direct	Potential impacts that result from a direct interaction between the Project and a resource/receptor (e.g., between occupation of a plot of land and the habitats which are affected).
Indirect	Potential impacts that follow on from the direct interactions between the Project and its environment as a result of subsequent interactions within the environment (e.g., viability of a species population resulting from loss of part of a habitat as a result of the Project occupying a plot of land).
Induced	Potential impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project (e.g., influx of camp followers resulting from the importation of a large Project workforce).

The above characteristics and definitions apply to planned and unplanned events. An additional characteristic that pertains only to unplanned events is *likelihood*. The *likelihood* of an unplanned event occurring is designated using a qualitative scale, as described in ***Table 6.5***.

Table 6.5: Definitions for Likelihood Designations

	Likelihood	Definitions
1	**Incidental**	Very unlikely, not known in the industry.
2	**Minor**	Unlikely to occur but known of in the industry.
3	**Moderate**	Likely to occur once or more in life of the Project.
4	**Major**	Likely to occur once or twice per year.
5	**Severe**	Will likely occurs more than twice per year, or is continuous or certain to occur.

Once impact characteristics are defined, the next step in the impact assessment phase is to assign each potential impact a ‘magnitude’. Magnitude is typically a function of some combination (depending on the resource/receptor in question) of the following impact characteristics:

- Extent;
- Duration;
- Scale; and
- Frequency.

For unplanned events, impact ‘consequence’ is used instead of Magnitude. Although determining the Consequence uses the same impact characteristics as of Magnitude, additional characteristics are considered based on the definitions provided for the physical, biological, and social environment, as shown in ***Table 6.6***.

Table 6.6: Impact Scale of Consequence for Unplanned Events

	Incidental	Minor	Moderate	Major	Severe
Physical Environment	Impacts such as localised or short term effects or environmental media, meeting all environmental standards	Impacts such as widespread, short-term impacts to environmental media, meeting all environmental standards	Impacts such as widespread, long-term effects on environmental media, meeting all environmental standards	Impacts such as significant, widespread and persistent changes in environmental media OR Exceedance of environmental standards	Exceedance of environmental standards and fine/ prosecution
Biological Environment	Impacts such as localised or short term effects on habitat or species	Impacts such as localised, long term degradation of sensitive habitat or widespread, short-term impacts to habitat or species	Impacts such as localised but irreversible habitat loss or widespread, long-term effects on habitat or species	Impacts such as significant, widespread and persistent changes in habitat or species	Impacts such as persistent reduction in ecosystem function on a landscape scale or significant disruption of a sensitive species.
Social Environment	Slight, temporary, adverse impact on a few individuals	Temporary (<1 year), adverse impacts on community which are within international health standards	Adverse specific impacts on multiple individuals that can be restored in <1 year OR One or more injuries, not lost-work injuries.	Adverse long-term, multiple impacts at a community level, but restoration possible. OR One or more lost-work injuries to a member of the public including permanently disabling injuries.	Adverse long-term, varied and diverse impacts at a community level or higher – restoration unlikely. OR Fatalities of public.

Source: ERM.

Magnitude essentially describes the intensity of the change that is predicted to occur in the resource/receptor as a result of the potential impact. The magnitude designations themselves are universally consistent, but the definitions for these designations vary depending on the resource/receptor. The universal magnitude designations are:

- Positive;
- Negligible;
- Small;
- Medium; and
- Large.

In the case of a potential positive impact, no magnitude designation (aside from 'positive') is assigned. It is considered sufficient for the purpose of the ESIA to indicate that the Project is expected to result in a potential positive impact, without characterizing the exact degree of positive change likely to occur.

In the case of potential impacts resulting from unplanned events, the same resource/receptor-specific approach to concluding a magnitude designation is utilized. However, the 'likelihood' factor is considered, together with the other impact characteristics, when assigning a magnitude designation.

In addition to characterizing the magnitude of impact, the other principal impact evaluation step is definition of the sensitivity/vulnerability/importance of the impacted resource/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 physical, biological, cultural or human. Other factors may also be considered, such as legal protection, government policy, stakeholder views and economic value. As in the case of magnitude, the sensitivity/vulnerability/importance designations themselves are universally consistent, but the definitions for these designations vary on a resource/receptor basis.

The sensitivity/vulnerability/importance designations used herein for all resources/ receptors are:

- Low;
- Medium; and
- High.

Once magnitude of impact and sensitivity/vulnerability/importance of resource/receptor have been characterized, the significance can be assigned for each impact. Impact significance is designated using the matrix shown in ***Table 6.7***. Whereas for unplanned events, impact significance is designated with a different matrix, shown in ***Table 6.8***.

Table 6.7: Impact Significance

		Sensitivity/Vulnerability/Importance of Resource/Receptor		
		Low	**Medium**	**High**
Magnitude of Impact	**Negligible**	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

Table 6.8: Impact Significance for Unplanned Events

		Likelihood of Occurrence				
		1	**2**	**3**	**4**	**5**
Consequence	**Incidental**	Negligible	Negligible	Negligible	Negligible	Negligible
	Minor	Negligible	Minor	Minor	Minor	Moderate
	Moderate	Minor	Minor	Moderate	Moderate	Major
	Major	Moderate	Moderate	Major	Major	Major
	Severe	Major	Major	Major	Major	Major

Source: ERM.

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. ***Box 6.1*** provides a context for what the various impact significance ratings signify.

It is important to note that impact prediction and evaluation take into account any embedded controls (i.e., physical or procedural controls that are already planned as part of the Project design, regardless of the results of the ESIA Process). This avoids the situation where an impact is assigned a magnitude based on a hypothetical version of the Project that considers none of the embedded controls.

The evaluation of impacts, as discussed above, are to be conducted within an Impact Assessment Table; a template is shown in ***Table 6.9***; however, Impact Assessments conducted for unplanned events are to follow a different template, as shown in ***Table 6.10***.

Table 6.9 Impact Assessment Table Template

Significance of Impact					
Impact	A descriptor indicating the activity and the resource/receptor that may potentially be impacted.				
Impact Nature	**Negative**	Positive	Neutral		
	A descriptor indicating the basic characteristics of the potential impact towards the resource/ receptor.				
Impact Type	**Direct**	Indirect	Induced		
	A descriptor indicating the relationship of the potential impact to the Project (in terms of cause and effect).				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	The time period over which a resource / receptor is potentially affected.				
Impact Extent	**Local**	Regional	International		
	The "reach" of the potential impact (e.g., confined to a small area around the Project Footprint, projected for several kilometres, etc.).				
Impact Scale	The size of the potential impact (e.g., the size of the area with the potential to be damaged or impacted, the fraction of a resource that could potentially be lost or affected, etc.).				
Frequency	A measure of the constancy or periodicity of the potential impact.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Magnitude essentially describes the intensity of the change that is predicted to occur in the resource/receptor as a result of the potential impact. The magnitude designations themselves are universally consistent, but the definitions for these designations vary depending on the resource/receptor. Magnitude is a function of the following impact characteristics: ■ Extent ■ Duration ■ Scale ■ Frequency				
Receptor Sensitivity	**Low**	Medium	High		
	There are a range of factors to be taken into account when defining the sensitivity/ vulnerability/ importance of the resource/ receptor, which may be physical, biological, cultural or human. Other factors may also be considered, such as legal protection, government policy, stakeholder views and economic value. As in the case of magnitude, the sensitivity/vulnerability/importance designations themselves are universally consistent, but the definitions for these designations vary on a resource/receptor basis.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The significance of the impact is determined by the designation given to Impact Magnitude, and Receptor Sensitivity. The method to determine the designation for Impact Significance is shown in ***Table 6.7***.				

Table 6.10: Impact Assessment Table Template for Unplanned Events

Significance of Impact					
Impact	A descriptor indicating the activity and the resource/receptor that may potentially be impacted.				
Impact Nature	**Negative**	Positive	Neutral		
	A descriptor indicating the basic characteristics of the potential impact towards the resource/ receptor.				
Impact Type	**Direct**	Indirect	Induced		
	A descriptor indicating the relationship of the potential impact to the Project (in terms of cause and effect).				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	The time period over which a resource / receptor is potentially affected.				
Impact Extent	**Local**	Regional	International		
	The "reach" of the potential impact (e.g., confined to a small area around the Project Footprint, projected for several kilometres, etc.).				
Impact Scale	The size of the potential impact (e.g., the size of the area with the potential to be damaged or impacted, the fraction of a resource that could potentially be lost or affected, etc.).				
Frequency	A measure of the constancy or periodicity of the potential impact.				
Impact Consequence	**Incidental**	Minor	Moderate	Major	Severe
	Indicative levels of consequence for potential impacts from unplanned events. Consequence is a function of the following impact characteristics: ■ Extent ■ Duration ■ Scale ■ Frequency The function also includes the definitions provided in ***Table 6.6***.				
Likelihood	**Very Unlikely**	Unlikely	Likely to occur once or more in life of the Project	Likely to occur once or twice per year	Will likely occurs more than twice per year, or is continuous or certain to occur
	Likelihood is estimated on the basis of experience and/or evidence that such an outcome has previously occurred. It is important to note that likelihood is a measure of the degree to which the unplanned event is expected to occur, not the degree to which an impact or effect is expected to occur as a result of the unplanned event.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The significance of the impact is determined by the designation given to Impact Consequence, and :Likelihood. The method to determine the designation for Impact Significance is shown in ***Table 6.7***.				

Box 6.1: Context of Impact Significances

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.

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.

An impact of **moderate** significance has an impact magnitude that is within applicable standards, 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. Clearly, to design an activity so that its' effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.

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 EIA 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). An example might be the visual impact of a facility. It is then the function of regulators and stakeholder to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.

6.7.3 Identification of Mitigation and Enhancement Measures

Once the significance of a potential impact has been characterised, the next step is to evaluate what mitigation and enhancement measures are warranted. For the purposes of this ESIA, ERM has adopted the following Mitigation Hierarchy:

- **Avoid at Source, Reduce at Source**: avoiding or reducing at source through the design of the Project (e.g., avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity);
- **Abate on Site**: add something to the design to abate the impact (e.g., pollution control equipment, traffic controls, perimeter screening and landscaping);
- **Abate at Receptor**: if an impact cannot be abated on-site then control measures can be implemented off-site (e.g., noise barriers to reduce noise impact at a nearby residence or fencing to prevent animals straying onto the site);
- **Repair or Remedy**: some impacts involve unavoidable damage to a resource (e.g. agricultural land and forestry due to creating access, work camps or materials storage areas) and these impacts can be addressed through repair, restoration or reinstatement measures; and
- **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 (e.g., planting to replace damaged vegetation, financial compensation for damaged crops or providing community facilities for loss of fisheries access, recreation and amenity space).

The priority in mitigation is to first apply mitigation measures to the source of the potential impact (i.e., to avoid or reduce the magnitude of the potential 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).

6.7.4 Residual Impact Evaluation

Once mitigation and enhancement measures are declared, the next step in the EIA Process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the implementation of the proposed mitigation and enhancement measures.

6.8 Management, Monitoring and Audit

The final stage in the EIA Process is definition of the basic 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 Register of Commitments, 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 this report (***Chapter 14***). The Register of Commitments includes mitigation measures, compensatory measures and offsets and management and monitoring activities.

6.9 Decommissioning

The design lifespan of the Project is estimated to be 30 years. The Project facilities will be designed with decommissioning in mind. In general, facilities and machinery will be designed so that they can be isolated and decommissioned in steps which are in reverse of the installation procedure or which are most convenient to do so. The decommissioning phase activities will therefore be similar to those associated with the excavation/foundation work, installation and civil construction phases.

The decommissioning phase will consider three potential options for the method of decommissioning a facility. Which include the following:

- Left in Place – All components/facilities of concern will be left as is, without any removal off-site.
- Total Removal – All components/facilities of concern will be removed, none shall be left in place.
- Partial Removal – The Components/facilities of concern will undergo selection of which will be left in place or removed.

At present, there are no plans or schedule for decommissioning the proposed LNG Receiving Terminal, Pipeline, and Power Plant components. It is likely that the Project components will only be decommissioned/ abandoned once it is no longer economical to continue operation, the plant is rendered redundant and/or no longer required for various reasons, or is unsafe to operate. Given the current stage of the Project components, detailed decommissioning plans have not yet been formulated. Impacts during decommissioning is expected to be assessed in detail in the Decommissioning Environmental Assessment (DEA) Report; therefore, this ESIA Study will not provide a detailed assessment of impacts for the decommissioning phase.

7. LNG RECEIVING TERMINAL IMPACT ASSESSMENT

7.1 Air Quality Impact Assessment

7.1.1 Introduction

The following section presents an assessment of potential impacts from the LNG Receiving Terminal to ambient air quality and identifies whether any additional mitigation or management procedures are needed to maintain residual impacts at environmentally or socially acceptable levels. Such measures are presented where appropriate and elaborated further within the Environmental Social Management Plan (ESMP).

The full Air Quality Impact Assessment (AQIA) containing the detailed methodology and results for each element of the assessment is presented in ***Appendix T*** and is referred to throughout this section where necessary to avoid repetition.

The AQIA has been undertaken in line with guidelines set out by the International Finance Corporation (IFC) and in line with international best practice as advocated by the IFC guidance.

7.1.2 Assumptions and Limitations

The automatic Haz-Scanner Environmental Perimeter Air Station (EPAS) was deployed at 10 locations in the Study Area for a continuous 72-hour period in both the wet and dry season. The Haz-Scanner monitors a number of air quality parameters including nitrogen dioxide (NO_2) using electrochemical sensors. Electrochemical NO_2 sensors can be susceptible to temperature, relative humidity and interfering gases that can affect the measurement. The NO_2 measurements from the EPAS were therefore analysed and outlying values removed to increase confidence in the results.

Passive diffusion tubes were deployed in triplicate at three locations between the 27 February 2018 and the 2 May 2018, and again from the 12 June 2018 to the 26 June 2018. Monitoring of NO_2 was conducted at 13 monitoring locations. It should be noted that due to unforeseen circumstances the first round of diffusion tubes were deployed beyond the recommended exposure period. The results may therefore be compromised however; they were still used to inform the assessment.

7.1.3 Assessment Methodology

The International Finance Corporation (IFC) Environmental, Health and Safety (EHS) guidelines are considered throughout this AQIA. The IFC guidelines provide the overarching guidance and principles for undertaking the assessment. The key documents considered are:

- IFC General EHS Guidelines for Air Emissions and Ambient Air Quality;
- IFC General EHS Guidelines for Construction and Decommissioning;
- IFC EHS Guidelines for Liquefied Natural Gas Facilities; and
- IFC EHS Guidelines for Ports, Harbours, and Terminals.

Where necessary, reference is made to other internationally recognised sources of information. These include, but are not necessarily limited to guidelines published by:

- the World Health Organisation (WHO);
- the European Union (EU);
- the United States Environmental Protection Agency (USEPA);
- the Australian National Pollution Inventory (NPi);
- the Department of Environment, Food and Rural Affairs (DEFRA); and

- reputable air quality institutes and working groups such as the Institute of Air Quality Management (IAQM).

The assessment of potential air quality impacts associated with the Project considers:

- sources, nature and quantity of emissions to air;
- a qualitative assessment of construction and decommissioning phase impacts;
- a detailed quantitative assessment of process emissions;
- an assessment of potential impacts on relevant sensitive receptors; and
- mitigation measures to reduce the impacts where necessary.

7.1.4 Baseline Summary

A project specific air quality monitoring survey was undertaken and the detailed methodology, results and interpretation is presented in ***Appendix T*** and summarised in ***Chapter 5***. The Study Area for the LNG Receiving Terminal for air quality include a 5 km radius from the facility. The baseline assessment indicates that the existing ambient concentrations of relevant substances in the study area are below the relevant air quality standards. On this basis, the air shed is considered 'non-degraded'.

7.1.5 Receptor Identification and Sensitivity

7.1.5.1 Construction Phase

The study area and receptors were specifically defined using the IAQM guidance on the assessment of dust from demolition and construction. The IAQM define the sensitivity of the area based on receptor type and the number of receptors within a certain distance from the source. Residential properties, schools, and hospitals are classified as high sensitivity to dust soiling and health effects. Locations where there are particularly important plant species (i.e. rice paddy) are classified as medium sensitivity. The criteria for estimating the sensitivity of the area as per the IAQM guidance is presented in ***Appendix T***. The guidance provides a screening criterion of 350 m and 50 m from the construction site and access road respectively beyond which impacts are not considered likely.

7.1.5.2 Operation Phase

The continuous emission to air generated from four-1160-kilowatt (kW) gas fired generators at the LNG terminal has the potential to affect ambient air quality at sensitive receptor locations. A number of representative air sensitive receptors were identified for the assessment and are presented in ***Appendix T***.

7.1.6 Summary of Project Activities with Potential Impacts

A preliminary screening assessment was undertaken to identify project activities that have the potential to affect ambient air quality and that subsequently require detailed assessment to inform the level of mitigation necessary to reduce impacts to an acceptable level throughout the lifetime of the Project. The assessment was completed using a combination of quantitative and semi quantitative techniques, project specific information, international guidelines and methodologies, and professional experience (refer to ***Appendix T***).

7.1.6.1 Construction Phase

The screening assessment found that ground preparation, ground excavation, material transfer, material stockpiling, construction of the main infrastructure and vehicles operating on unpaved road surfaces require detailed assessment and are considered further in this section.

7.1.6.2 Operation Phase

The screening assessment found that the continuous operation of four-1160 kW natural gas fired engines require detailed assessment and are therefore considered further in this chapter.

7.1.7 Assessment of Impacts to Air Quality

7.1.7.1 Construction Phase

Overview

During the construction phase of the LNG Receiving Terminal, a number of activities have been identified that will potentially result in adverse impacts to ambient air quality due to the generation of total suspended particulate (TSP) and particulate matter (PM_{10}). The key construction phase activities considered include:

- Demolition of existing infrastructure;
- Earthworks including ground excavation; material removal, transfer and stockpiling;
- Construction of the main infrastructure including the power plant and associated facilities; and
- Track out of dusty materials onto the public road network.

The associated impacts that may arise from construction activities include:

- Dust deposition resulting in the soiling of surfaces including homes and places of business;
- Elevated PM_{10} concentrations at air sensitive receptors.

Exhaust emissions from on-site plant (also known as non-road mobile machinery or NRMM) and site traffic are unlikely to impact ambient air quality significantly and have not been considered further.

Assessment of Impacts

Dust emissions during the construction phase can vary substantially and will largely depend on the activity being undertaken; the duration of the activity; the size of the site; the meteorological conditions; the proximity and sensitivity of the receptors; and the adequacy of the mitigation measures in place to reduce emissions.

The Institute of Air Quality Management (IAQM)[94] provide specific guidance for defining the dust impact risk from construction sites based on a) the scale and nature of the works; and b) the sensitivity of the receiving area (refer to ***Appendix T***). The premise of the IAQM guidance is that with the implementation of effective site-specific mitigation and management measures, the environmental effect will not be significant in most cases. The guidance also provides screening criteria of 350 m and 50 m from the construction site and access road respectively beyond which impacts are not considered likely.

A summary of the impact significance associated with the construction of the LNG Receiving Terminal (pre-mitigation) is presented in ***Table 7.1***, ***Table 7.2***, and ***Table 7.3***.

[94] Institute of Air Quality Management (IAQM) (2014) Guidance on the Assessment of Dust from Demolition and Construction [Online] Available at: http://iaqm.co.uk/guidance/ [Accessed 13 February 2019]

Table 7.1: Summary of Dust Risk from the LNG Receiving Terminal Construction (Pre-Mitigation)

Potential Impact	Risk [a]			
	Demolition [b]	Earthworks	Construction	Track out
Dust Soiling	*n/a*	Low	Low	Low
Human Health	*n/a*	Low	Low	Low
Ecological	*n/a*	Medium	Medium	*n/a*

[a] *As per IAQM approach*
[b] *No demolition required so assessment of risk is considered 'not applicable'.*

Table 7.2: Assessment of Impact on Human Health and Nuisance Relating to LNG Receiving Terminal Construction (Pre-Mitigation)

Significance of Impact					
Impact	Potential impacts on Ambient Air Quality				
Impact Nature	**Negative**	Positive	Neutral		
	Impacts to ambient air quality are considered adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to ambient air quality are considered direct.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Potential impacts to air quality will occur throughout the construction phase only. The duration is therefore short term.				
Impact Extent	**Local**	Regional	International		
	Construction activities at the site have the potential to result in emissions of dust up to 350m and 50m from the construction site boundary and unpaved access roads respectively. The extent is therefore local.				
Impact Scale	Potential impact will occur up to 350m and 50m from the construction site boundary and unpaved access roads respectively.				
Frequency	The impact will occur during daytime working hours (08:00-18:00) throughout the construction phase.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The expected dust emission magnitude during construction phase activities is predicted to be large from earthworks; and medium from construction and track out.				
Receptor Sensitivity	**Low**	Medium	High		
	There are 1-10 residential receptors <350m from the site boundary, and only one receptor <50m from the road up to 500m from the site entrance. The sensitivity of the area is therefore considered low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The significance of the impact is expected to be minor at worst.				

Table 7.3: Assessment of Impact on Ecology Relating to LNG Receiving Terminal Construction (Pre-Mitigation)

Significance of Impact					
Impact	Potential impacts on Ambient Air Quality				
Impact Nature	**Negative**	Positive	Neutral		
	Impacts to ambient air quality would be considered adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to ambient air quality are considered direct.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Potential impacts to air quality will occur throughout the construction phase only. The duration is therefore short term.				
Impact Extent	**Local**	Regional	International		
	Construction activities at the site have the potential to result in emissions of dust up to 50 m from the construction site boundary and any unpaved access roads respectively. The extent is therefore local.				
Impact Scale	Potential impact will occur up to 50 m from the construction site boundary and any unpaved access roads respectively.				
Frequency	The impact will occur during daytime working hours (08:00-18:00) throughout the construction phase.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	**Large**
	The expected dust emission magnitude during construction phase activities is predicted to be large from earthworks; and medium from construction and track out.				
Receptor Sensitivity	Low	**Medium**	High		
	Agriculture exists <20 m from the site boundary and <50 m from the access road up to 500 m from the site entrance. The sensitivity of the area is therefore considered medium.				
Impact Significance	Negligible	Minor	**Moderate**	**Major**	
	The significance of the impacts is expected to be moderate to major.				

Mitigation Measures

The mitigation measures required during the construction of the LNG Receiving Terminal based on the outcome of the dust risk assessment summarised in ***Table 7.1*** include:

- Develop and Implement a Dust Management Plan (DMP) detailing mitigation measures and a plan for implementation.
- Watering will be used to suppress wind and physical disturbance dust generation.
- Ensure an adequate water supply on site for effective dust suppression and mitigation.
- The site layout will be planned so that dust-causing activities are located away from receptors as far as is possible.
- Screens or barriers will be erected around dusty activities or the site boundary that are at least the height of any stockpile on site.
- All stockpiles will be covered or fenced off to prevent wind whipping.
- Only cutting, grinding, or sawing equipment fitted with suitable dust suppression techniques such as water sprays will be used.

- All chutes, conveyors and skips will be covered at all times.
- Drop heights from conveyors, loading shovels and hoppers will be minimised.
- No waste will be burned on site.
- Re-vegetate earthwork and exposed areas as soon as is practicable.
- Use hessian, mulches or trackifiers where it is not possible to revegetate, or cover with top soil as soon as is practicable.
- Sand and other aggregates will be stored in bunded areas and will not be allowed to dry out unless this is required for a particular process, in which case additional control measures such as those detailed in this section will be applied.
- Ensure that all vehicles entering and leaving the site are covered to avoid fugitive emissions during transport.
- Inspect on-site haul roads for integrity and instigate the necessary repairs to the surfaces as soon as reasonable practicable.
- Implement a wheel washing system.
- Regularly dampen and clean the site access and local roads to remove any materials tracked out of the site.
- All site access gates will be located at least 10m away from air sensitive receptors where possible.
- The site layout will be planned so that machinery is located away from receptors as far as is possible.
- All vehicles will switch off engines when stationary.
- A regular vehicle and machinery maintenance and repair programme will be implemented.
- Mains electricity or battery powered equipment will be used instead of diesel/petrol generators where practicable.

Residual Impact

The IAQM guidance suggest that when correctly applying and actively managing the prescribed mitigation and management measures the impacts to receptors located within 350m downwind of any construction activity are not likely to be significant for the large majority of the time. However, due to the nature of construction activities, the scale and duration of the construction phase, and the possibility of extreme weather conditions, it is possible that communities will experience occasional, short-term dust annoyance. The IAQM states, "*the likely scale of this would not normally be considered sufficient to change the conclusion that with mitigation the effects will be 'not significant'*. On this basis, it can be concluded that construction phase activities are likely to result in a **Negligible** impact at worst post mitigation.

Monitoring Plan

TPMC are required to implement the following monitoring procedures:

- Regular site inspections to monitor compliance with the DMP. All inspection results will be recorded and corrective actions taken where mitigation and management measures are not being implemented effectively (i.e. to reduce dust emissions).
- Daily onsite and offsite inspections to visually assess the dust emissions from earthwork and construction activities, and from vehicles exiting the construction sites. Results from the inspection will be recorded and mitigation measures intensified where necessary to reduce

emissions. The frequency of site inspections will be increased when activities with a high potential to produce dust are being carried out and during prolonged dry and windy conditions.

7.1.7.2 Operation Phase

Overview

During the operation of the LNG Receiving Terminal the continuous operation of four-1160 kW natural gas fired engines will potentially result in adverse impacts to ambient air quality and are considered further in this chapter.

Assessment of Impacts

Processes associated with the operation of the LNG Receiving Terminal including the combustion of natural gas will result in elevated ambient concentrations of nitrogen dioxide (NO_2) in the atmosphere. The resulting impact to ambient air quality at sensitive receptor locations during the operation phase was quantitatively assessed using the latest USEPA AERMOD dispersion model version 18081. AERMOD is a state of the art detailed dispersion model that can represent complex multiple emission sources and predict air quality at receptor locations taking into account meteorology. The model is widely recognised for use in this type of application, including by the IFC, United States Environmental Protection Agency (USEPA), UK Environment Agency and state based EPA's throughout Australia. Three years of hourly sequential meteorological data was used so that inter annual variability was incorporated into the model. The detailed modelling and assessment methodology including the approach for determining the magnitude and the significance of impacts, receptor grid spacing, meteorological data information, NO_x to NO_2 conversion and the treatment of buildings, land use and terrain is discussed in ***Appendix T***.

The LNG Gas Receiving Terminal modelling scenario considered the continuous operation of four-1160kW natural gas fired engines. The modelling scenario assumes continuous emissions for 365 days per year. The emissions from the generators are based on the Cummins C1160 N5C natural gas fired generator at 100% rated load.

The IFC's General EHS guideline for air emissions and ambient air quality states that:

- *Projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that:*

  - *emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines, or other internationally recognised source; and*

  - *emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed.*

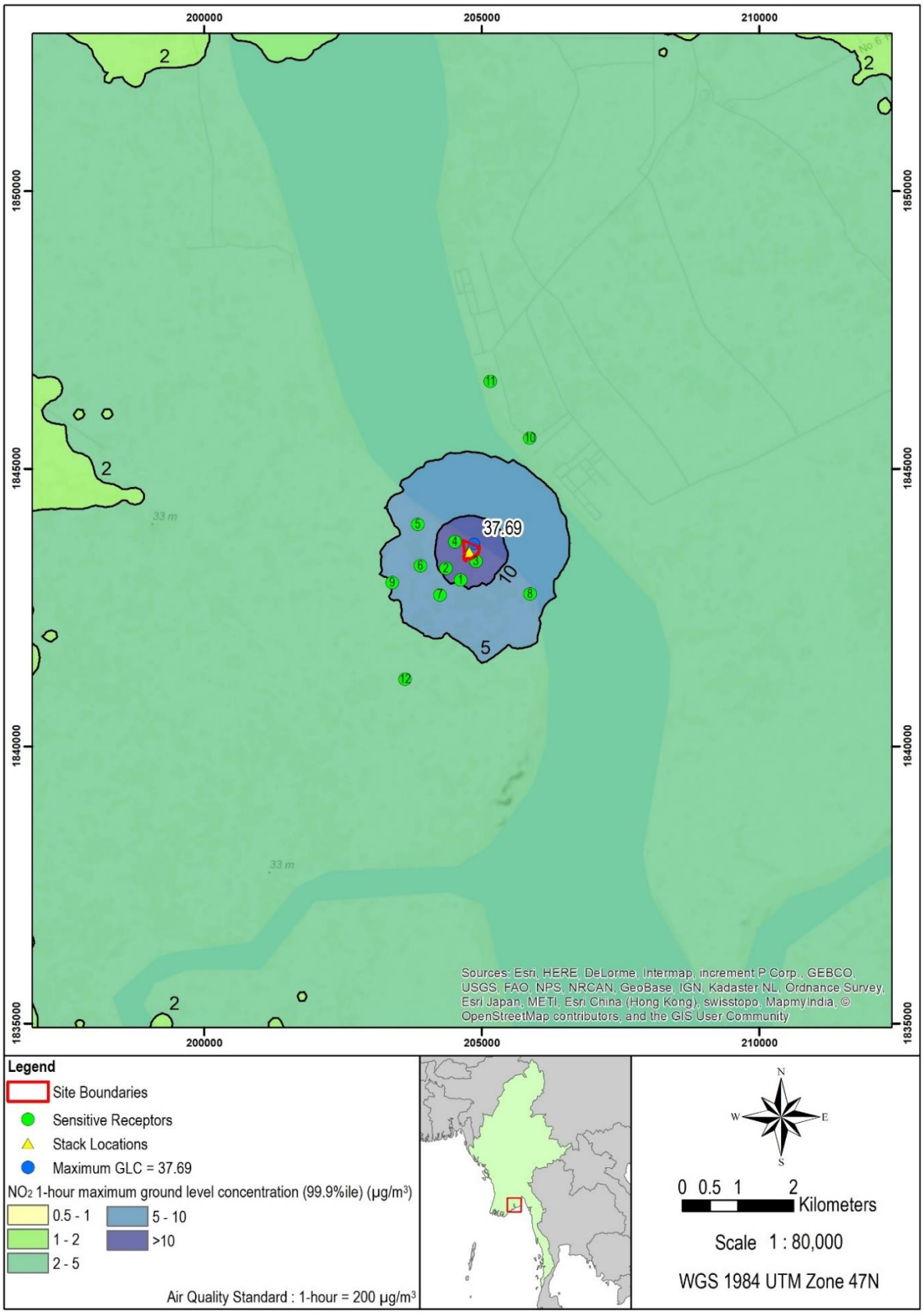
A summary of the maximum-modelled NO_2 concentrations found anywhere on the modelling grid and their impact significance is provided in ***Table 7.4***; the contour figures showing dispersion are provided in ***Figure 7.1*** and ***Figure 7.2***, and the summary of the impacts is presented in ***Table 7.5***. The assessment finds that the maximum PC and PEC is likely to be below 25% and 100% of the relevant air quality standard respectively throughout the study area. On this basis, the impact to ambient air quality from the LNG Receiving Terminal is expected to be negligible.

Table 7.4: Summary of LNG Receiving Terminal Modelling Results

Substance	Averaging Period	Baseline[a] (µg/m^3)	Max. PC[b] (µg/m^3)	Max. PEC[c] (µg/m^3)	AQS[d]	Significance of Impact
NO_2	1-hour	129	37.7	167	200	Negligible
	Annual	24.6	4.14	29.2	40	Negligible

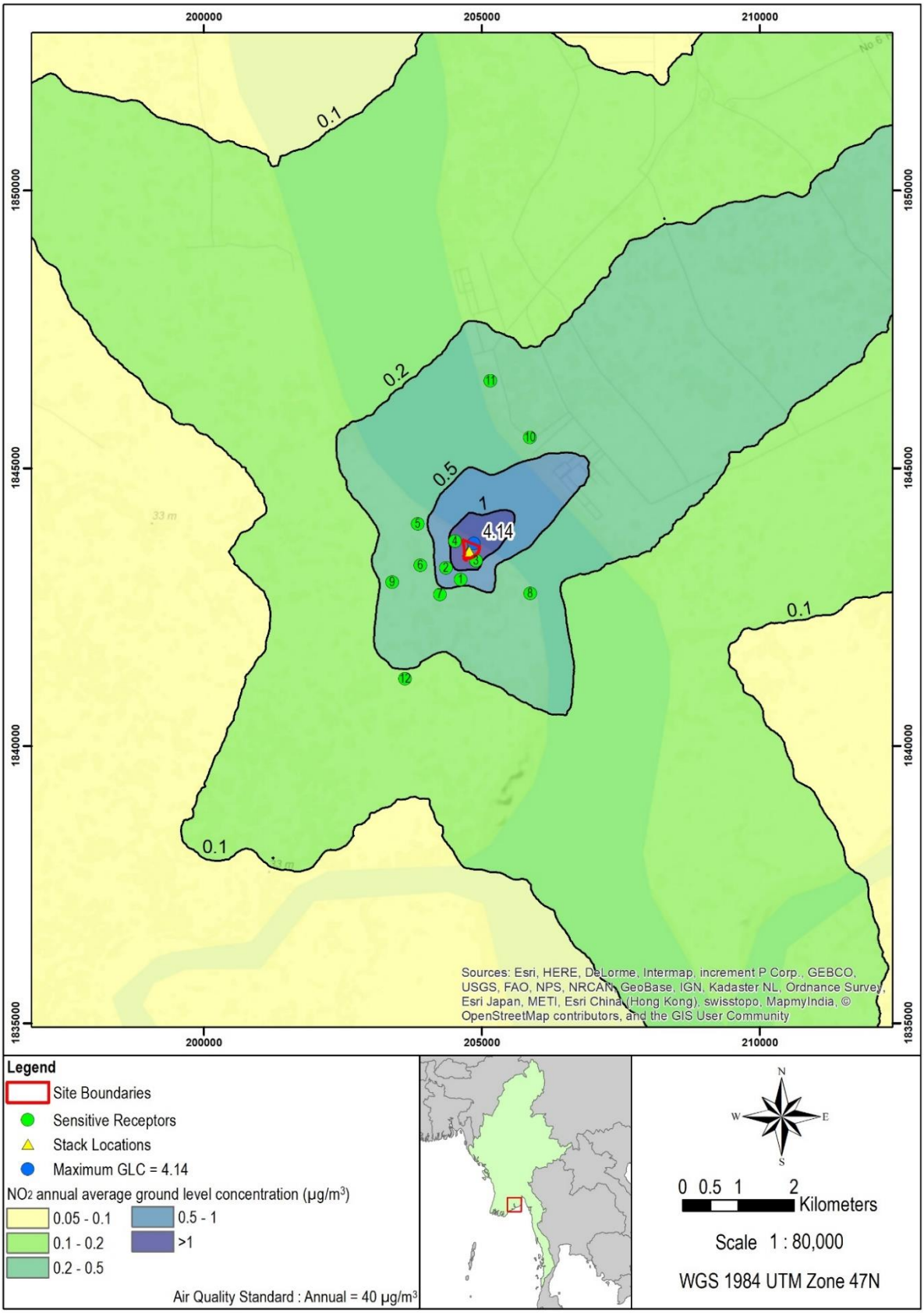
[a] *Refer to the baseline assessment in the air quality impact assessment presented in* ***Appendix T****.*
[b] *Process Contribution is the impact arising solely from project related emissions*
[c] *Predicted Environmental Concentration is the PC added to the existing baseline*
[d] *Air Quality Standard as prescribed in the National Environmental Quality (Emission) Guidelines (NEQEG) (2015)*

Figure 7.1: LNG Receiving Terminal Modelling Results (NO_2 1-hour Average)



Source: ERM, 2019.

Figure 7.2: LNG Receiving Terminal Modelling Results (NO_2 Annual Average)



Source: ERM, 2019.

Table 7.5: Assessment of Impact on Ambient Air Quality Relating to LNG Receiving Terminal Operation (Pre-Mitigation)

Significance of Impact					
Impact	Potential impacts on Ambient Air Quality				
Impact Nature	**Negative**	Positive	Neutral		
	Impacts to ambient air quality would be considered adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to ambient air quality are considered direct.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Potential impacts to air quality will occur throughout the operation phase only. The duration is therefore long-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts were considered up to 5km from the LNG Receiving terminal and are considered local in their extent.				
Impact Scale	The scale of the impacts is likely to be within 5 km from the point of release.				
Frequency	The impact will occurs 24/7 during the operation phase assuming continuous operation.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The expected impact magnitude is negligible.				
Receptor Sensitivity	Low	**Medium**	High		
	The approach assumes that sensitivity within the general study area is medium for human health.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The significance of the impact is expected to be negligible at worst.				

Mitigation and Management

The impact assessment defines the impacts on ambient air quality during operation as negligible. However, to minimise and control impacts to air quality during the operation of the Project the gas fired generators at the LNG receiving terminal will be serviced and maintained in accordance with the manufacturer's specification to maintain high performance throughout the lifetime of the Project.

Residual Impact

The predicted residual impact to ambient air quality during normal operation is **Negligible**.

Monitoring Plan

Based on the outcome of the impact assessment, monitoring of emissions from the generators or monitoring ambient air quality is not considered necessary.

7.2 Greenhouse Gas Impact Assessment

7.2.1 Introduction

During the construction and operation phases, there are activities that have the potential to increase greenhouse gas emissions. The main emission sources are released from fuel combustion (for example, diesel fuel combustion in mobile vehicles).

This chapter provides estimation of the greenhouse gas (GHG) emissions that are likely to be released from LNG Terminal of LNG Power Plant (Ahlone) Project (also referred to as 'Project'), as related to the issue of climate change. GHGs are assessed in order to provide an indication of the amount of GHG emission of the Project, and to provide mitigation measures early during the development process.

7.2.2 Assumption and Limitation

It is noted that all greenhouse data in this report cannot yet be used for official greenhouse gas inventory reporting[95] until the site is operational and actual operational data would be used for a more precise GHG inventory calculation.

All greenhouse gas calculation methodologies have been formulated using accurate calculation methodologies sourced from Intergovernmental Panel on Climate Change (IPCC). These methodologies can be replicated for GHG inventory use when the Project becomes operational.

In this chapter, some assumptions are made, as below:

- Equator Principles (June 2013) stated that Quantification of GHG emissions will be conducted by the client in accordance with internationally recognised methodologies and good practice, for example, the GHG Protocol. The client will quantify Scope 1 and Scope 2 emissions. Therefore, quantification of GHG emissions for the Project will consider Scope 1 (direct emissions from the facilities owned or controlled within physical Project boundary) and Scope 2 (indirect emissions associated with the off-site production of energy used by the Project), and excluding Scoping 3 emissions.
- The GHG assessment for the Project will focus on the construction and operation phases, excluding pre-work and land development phases, as the majority of the Project emissions will occur during these periods. A total area of the Project is approximately 8.97 acres or about 36,300 m2 with the current land use of scrubland with thickets of shrubs, young trees, degraded mangrove trees, and agricultural land for rice farming with some grazing areas for livestock, in which are not biomass-rich areas. The change in land use characteristics for development of the Project would alter the carbon stock due to removal of vegetation, but the effect is considered to be small.
- This document focuses on CO_2, CH_4, and N_2O emissions, because these are the most prevalent GHGs emitted from power industry operations.

7.2.3 Assessment Methodology

According to the Greenhouse Gas Protocol, greenhouse emissions fall under the following three scopes:

- **Scope 1** - **Direct GHG emissions**: Direct GHG emissions occur from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc.; emissions from chemical production in owned or controlled

[95] Official greenhouse gas inventory reporting includes Sustainability Reporting, CDP, DJSI or other nationally relevant greenhouse reporting schemes.

process equipment. Direct CO_2 emissions from the combustion of biomass shall not be included in scope 1 but reported separately.

- **Scope 2 - Electricity indirect GHG emissions**. Scope 2 accounts for GHG emissions from the power generation of purchased electricity consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated.
- **Scope 3 - Other indirect GHG emissions**. Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by the company. Some examples of scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services.

Scope 1 and 2 have been considered for this Project, which were quantified according to the following standards:

- GHG Protocol Corporate Accounting and Reporting Standard; and
- GHG Protocol Scope 2 Guidance
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories

The assessment of impact magnitude and significance related to GHG is based on the methodology described in ***Chapter 6***. The mitigation measures are based on international good practice (as recommended under the IFC EHS Guidelines), and good practice relevant to GHG emissions.

7.2.3.1 Global Warming Potentials

The global warming potentials (GWPs) used in this assessment are sourced from the 2007 IPCC Fourth Assessment Report (AR4). Although the 2013 Fifth Assessment Report (AR5) provides the latest GWPs, the GWPs from the AR4 are more commonly adapted.

The global warming potential is used to evaluate the potency of non-CO_2 greenhouse gases compared to CO_2 as a baseline. For example, methane (CH_4) is 25 times more potent than CO_2 in its global warming effect, meaning that 1 kg of CH_4 emitted is equivalent to 25 kg of CO_2 emitted. The 100 years' time horizon is used in line with greenhouse gas inventory best practices. Detail of GWP factors are in ***Table 7.6***.

Table 7.6: Global Warming Potentials

Industrial Designation or Common Name	Chemical Formula	Global Warming Potential for 100-years' Time Horizon from IPCC Fourth Assessment Report
Carbon Dioxide	CO_2	1
Methane	CH_4	25
Nitrous oxide	N_2O	298

Source: IPCC Fourth Assessment Report Working Group I
https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

7.2.3.2 Emission Factor

An emission factor represents an average emission rate for a given source, and is generally expressed as mass or volume of emissions per source type or measure of activity related to the source.

The 2006 IPCC Guidelines provide emission factors for stationary and mobile combustion, Default emission factors provided in ***Table 7.7*** and ***Table 7.8*** below, are related to the Project activities and used for the purposes of this report.

Table 7.7: Default IPCC Emission Factors for Stationary Combustion

Fuel	$kgCO_2/TJ$ (default)	$kgCH_4/TJ$ (default)	kgN_2O/TJ (default)
Motor Gasoline	69,300	3	0.6
Gas/ Diesel Oil	74,100	3	0.6
Natural Gas	56,100	1	0.1

Source: IPCC 2006 V.2 Ch.2 Table 2.2

Table 7.8: Default IPCC Emission Factors for Mobile Combustion

Fuel	$kgCO_2/TJ$ (default)	$kgCH_4/TJ$ (default)	kgN_2O/TJ (default)
Equipment/ Machineries			
Gas/ Diesel Oil	74,100[a]	4.15[a]	28.6[a]
Motor Gasoline (4-stroke)	69,300[a]	50[a]	2[a]
Road Transportation			
Gas/ Diesel Oil	74,100[b]	3.9[c]	3.9[c]

Source: [a] IPCC 2006 Vol. 2 Ch. 3 Table 3.3.1.
[b] IPCC 2006 Vol. 2 Ch. 3 Table 3.2.1.
[c] IPCC 2006 Vol. 2 Ch. 3 Table 3.2.2.

7.2.3.3 Net Calorific Values and Density

Energy data, consumption of solid, liquid and gaseous fuel are sometimes expressed in physical units, e.g. in litres, tonnes or cubic metres. For the purposes of greenhouse gas calculations, the apparent consumption should be converted to terajoules (TJ) on a Net Calorific Value (NCV) basis.

To convert these data to common energy units, this report uses conversion factors from the energy content of fuel provided in ***Table 7.9***.

Table 7.9: Default Net Calorific Values

Fuel Type	Net Calorific Value	Typical Density
Gas/ Diesel Oil	43.0 TJ/Gg[a]	874.31 kg/m^3 [b]
Gasoline	44.3 TJ/Gg[a]	742.39 kg/m^3 [b]
Natural Gas	48.0 TJ/Gg[a]	0.6728 kg/m^3 [b]

Source: [a] IPCC 2006 Vol. 2 Ch. 1 Table 1.2.
[b] API 2009 Compendium of Greenhouse Gas Emissions Methodologies for Oil and Natural Gas Industry Table 3-8.

7.2.4 Baseline Summary

Myanmar's total GHG emissions in 2013 were 201.5 million metric tons of carbon dioxide equivalent (MtCO2e), totalling 0.42 percent of global GHG emissions.[96]

According to the World Resources Institute Climate Analysis Indicators Tool (WRI CAIT), and Land Use Change and Forestry (LUCF) activities, were the leading sources of Myanmar's[97] GHG emissions in 2013, accounting for 51.0% of the country's total emissions.[98] Within the LUCF sector, changes in forest land contributed 73% of emissions.[99] Agriculture was the second most significant source (32.1%) with rice cultivation and enteric fermentation from livestock contributing 67% of agriculture emissions.[100] Energy was responsible for 10.9% of emissions, of which 50% were due to fugitive emissions and other fuel combustion. Waste and Industrial Processes (IP) contributed 5.8% and 0.2% of total emissions respectively.

7.2.5 Receptor Identification and Sensitivity

The direct receptor in the scope of this impact assessment is the global atmosphere. The indirect receptors from climate change due to an increase global greenhouse gas emissions include Myanmar's weather.

In accordance to National Oceanic and Atmospheric Administration (NOAA), *Global Climate Report – Annual 2018*, describes that 11 of 12 months of global land and ocean average temperature departures ranked among the five warmest for the respective years, becoming the fourth warmest year in NOAA's 139-year records, in which the top warmest years are all from the recent years (2015-2017) since the pre-industrial time. The year 2018 began with a La Niña episode present across the tropical Pacific Ocean, transitioning to ENSO-neutral by April 2018.[101] The frequency and intensity of extreme high temperature events are virtually certain to increase in the future as global temperature increases (high confidence). Extreme precipitation events will also very likely continue to increase in frequency and intensity throughout most of the world (high confidence).

Myanmar's Intended Nationally Determined Contribution (INDC) reported that Myanmar is extremely vulnerable to the negative effects of climate change. In 2015, for the third year, Myanmar was ranked globally by studies, as the second most vulnerable country in the world to extreme weather events over the last 20 years. In addition, climate models predict further sustained impacts from climate change in the future, which will further expose Myanmar to the negative impacts of climate change. Thus global GHG emission would highly influence the negative impact on Myanmar.

7.2.6 Summary of Project Activities with Potential Impacts

Based on the Scoping Study, and the Project Description and Alternatives (presented in ***Chapter 4***), the key potential impacts on greenhouse gas identified come from the following activities.

7.2.6.1 Construction Phase

The main equipment and machineries used in contributing to Scope 1 and Scope 2 of greenhouse gas emissions at the Project site are illustrated in ***Table 7.10***. By which, the majority of GHG emission sources come from mobile combustion devices, including transportation. GHG is estimated under the assumption that most of the fuel consumed by the construction machineries would be diesel, except

[96] https://www.climatelinks.org/resources/greenhouse-gas-emissions-factsheet-burma

[97] Burma ratified the UNFCCC as Myanmar. UNFCCC Status of Ratification, viewed on March 20, 2017.

[98] World Resources Institute Climate Analysis Indicators Tool (WRI CAIT 2.0, 2017). Global Warming Potentials (GWPs) are from the Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report (SAR).

[99] Food and Agriculture Organization of the United Nations Statistics Division (FAOSTAT). Myanmar, Emissions – Land use total, viewed on March 18, 2017.

[100] FAOSTAT. Myanmar, Emissions – Agriculture total, viewed on March 18, 2017.

[101] https://www.ncdc.noaa.gov/sotc/global/201813

for pump and vibrator which use gasoline Also, the calculation for GHG emission would be based on the fuel consumption of each machines. In which the machineries would operate 8 hrs/day for 26 weeks/year, and for transportation, it is assumed that transporting vehicles would be operating 8 hrs/day, 6 days/week, for 26 weeks/year.

Table 7.10: Project Scope and Activity by Emission Source during Construction

Project Component	Source Class	Scope 1 Emission Source (direct emission from project)	Scope 2 Emission Source (indirect emission, grid energy)
LNG Terminal	Stationary Combustion	■ Generator (Diesel) ■ Compressor (Diesel) ■ Pump (Gasoline)	Electricity purchased from the grid connected from substation, then connected to the Project.
	Mobile Combustion (equipment/ machineries)	■ Backhoe (Diesel) ■ Dozer (Diesel) ■ Grader (Diesel) ■ Truck (Diesel) ■ Concrete Pump Car (Diesel) ■ Concrete Truck (Diesel) ■ Crane (Diesel) - crane 200 ton - crane 100 ton - crane 50 ton ■ Pile Driver (Diesel) ■ Vibrator (Gasoline) ■ Fork Lift (Diesel)	
	Mobile Combustion (transportation)	■ 10-wheel truck(25ton) (Diesel) ■ 4-wheel truck(5 ton) (Diesel)	

Note: Mobile sources is a term used to describe a wide variety of vehicles, engines, and equipment that generate air pollution and that move, or can be moved, from place to place. It includes vehicles used on roads for transportation of passengers or freight as well as off-road vehicles, engines, and equipment used for construction, agriculture, transportation, recreation, and many other purposes. By definition, other combustion sources are considered to be stationary (Stationary Combustion Guidance, WRI/WBCSD (2005)).

7.2.6.2 Operation Phase

During the operation phase, scope 2 during the operation phase is omitted since electricity produced from the Project would also be utilized for facilitating within the project area with minimal purchased of electricity to be expected. The main source of GHG emissions will be from natural gas combustion for engine generator and fugitive emissions. The source of emission during operation illustrates in ***Table 7.11***.

Table 7.11: Project Scope and Activity by Emission Source during Operation

Project Component	Source Class	Scope 1 Emission Source	Scope 2 Emission Source
LNG Terminal	Stationary Combustion	Natural gas for Gas Engine Generator	N/A

7.2.7 Assessment of Impacts to Greenhouse Gas

7.2.7.1 Construction Phase

Summary of Scope 1 and 2 Emissions

The total release of GHG emissions during construction phase is estimated to be 3,850.17 tonnes CO_2eq per year as shown in ***Table 7.12***. The majority of emissions during construction phase are from stationary combustion followed by mobile combustion (the use of mobile equipment/ machineries onsite).

Table 7.12: Emissions Breakdown by Scope and Activity

Emission Scopes	Unit	Value
Scope 1 Direct Emissions		
Stationary Combustion	tCO_2eq/year	1,309.99
Mobile Combustion (equipment/ machineries)	tCO_2eq/year	1,147.55
Mobile Combustion (transportation)	tCO_2eq/year	788.29
Total Direct Emission	tCO_2eq/year	3,245.83
Scope 2 Electricity Indirect GHG Emissions		
Electricity Purchased (Myanmar's national grid)	tCO_2eq/year	604.34
Total Indirect Emission	tCO_2eq/year	604.34
Total Emission Scope 1 + Scope 2	tCO_2eq/year	3,850.17

Scope 1 Direct Emissions

Scope 1 Direct Emissions consists of 3 emission sources: stationary emission, mobile emission (equipment/ machinery), and mobile emission (transportation). Calculations detail are in the following sections.

Stationary Combustion

Stationary Combustion is defined as devices that combust solid, liquid, or gaseous fuel, generally for the purposes of producing electricity, generating steam, or providing useful heat or energy for industrial, commercial, or institutional use. Also includes auxiliary devices that assist in the electricity/ heat generation system i.e. generator, pump, and compressor.

Tier 1 method of IPCC was selected since information regarding site specific or country specific emission factors are not available. This approach is used to estimate the GHG emission in general by analyzing the emission based on fuel consumption.

Applying Tier 1 emission estimation would require the following data:

- Data on the amount of fuel combusted in the source category
- A default emission factor

In general, GHG emissions based on fuel use is the product of fuel consumption and emission factor of the fuel source as illustrated in the following ***Equation 1***:

Equation 1

Greenhouse Gas Emissions from Stationary Combustion

$$Equation_{GHG,fuel} = Fuel\ Consumption_{fuel} \times Emission\ Factor_{GHG,fuel}$$

Where:

$Emission_{GHG,fuel}$ = emission of a given GHG by type of fuel (kg GHG)

$Fuel\ Consumption_{fuel}$ = amount of fuel combusted (TJ)

$Emission\ Factor_{GHG,fuel}$ = default emission factor of a given GHG by type of fuel (kg gas/TJ).

For CO_2, including the carbon oxidation factor assumed to be 1.

Source: 2006 IPCC guideline for National Greenhouse gas inventories, Volume 2: Energy Chapter 2

In this Project, onsite machineries used for stationary combustion which include generator and compressor, are assumed to be utilizing 8 hours/day for 26 weeks/year and use diesel as the main fuel source. Based on the operational time during construction period mentioned, the estimation of fuel consumption is approximately equal to 469,548 litres/year as detailed in ***Table 7.13***.

Table 7.13: Expected Stationary Combustion

Project Component	Source	Mobile Fuels	Units	Estimated Annual Consumption
LNG Terminal	Generator	Diesel	Litre/year	449,280
	Compressor	Diesel	Litre/year	14,976
	Total Diesel used			**464,256**
	Pump	Gasoline	Litre/year	5,292
	Total gasoline used			**5,292**
	Total			**469,548**

Source: Fuel consumption estimated by TPMC and adjusted by ERM for the purpose of assessment in this report.

Fuel volume provided in ***Table 7.13*** will be converted to energy use (in terms of TJ of energy use) by multiplied with Net Calorific Value (NCV) and its density as provided in ***Table 7.9*** using the ***Equation 2*** and ***Equation 3***.

Equation 2: Fuel Energy Consumption

$$Fuel\ Consumption\ (TJ) = Diesel\ Use\ (I) \times NetCalorific\ Value\ (TJ/Gg) \times Diesel\ Density\ (kg/m^3) \times 10^{-6}(Gg/kg) \times 10^{-3}(m^3/I)$$

Equation 3: Fuel Energy Consumption

$$Fuel\ Consumption\ (TJ) = Gasoline\ Use\ (I) \times NetCalorific\ Value\ (TJ/Gg) \times Gasoline\ Density\ (kg/m^3) \times 10^{-6}(Gg/kg) \times 10^{-3}(m^3/I)$$

From ***Table 7.9***, default NCV for diesel and gasoline are 43.0 TJ/Gg and 44.3 TJ/Gg respectively with diesel density is 874.31 kg/m3 and gasoline density of 0.74 kg/l. The total energy consumption on the amount of fuel use 469,548 liters/year equal to 0.017 TJ.

Fuel Consumption (TJ) = Diesel Use (l) x 43.0 (TJ/Gg) x 874.31 (kg/m^3) x 10^{-6} (Gg/kg) x 10^{-3} (m^3/l)

= Diesel Use (l) x 3.76 x 10^{-5} (TJ/l)

= 464,256 (l) x 3.76 x 10^{-5} (TJ/l)

= 17.46 TJ

Fuel Consumption (TJ) Gasoline Use (l) x 44.3 (TJ/Gg) x 742.39 (kg/m^3) x 10^{-6} (Gg/kg) x 10^{-3} (m^3/l)

Gasoline Use (l) x 3.28 x 10^{-5} (TJ/l)

5,292 (l) x 3.28 x 10^{-5} (TJ/l)

0.17 TJ

After annual energy consumption, in term of fuel use, is identified, the multiplication of emission factor and GWP would be used to calculate the amount of total emission in the unit of kilogram of CO_2 equivalent per year. The estimated GHG emission for generators and compressor operated during construction is on average 1,309.99 tonnes CO_2e/year, as shown in ***Table 7.14***.

Table 7.14: Expected Stationary Emissions for LNG Terminal during Construction

Mobile Combustion	Annual Use (litre/year)	Annual Energy Use (TJ)	Annual Emissions (kg/year)			Total CO_2eq Emissions	
			CO_2	CH_4	N_2O	Kg CO_2eq/year	Tonnes CO_2eq/year
Diesel Emission Factors (kg of GHG/ TJ)[b]			74,100	3.0	0.6		
Gasoline Emission Factors (kg of GHG/ TJ)[b]			69,300	3.0	0.6		
Global Warming Potential for 100-year time horizon[a]			1	25	298		
Diesel	464,256	17.46	1,293,490	1,310	3,120	1,297,921.84	1,297.92
Gasoline	5,292	0.17	12,030	13	31	12,072.98	12.07
						Total	**1,309.99**

Source: [a] refers to ***Table 7.6***.

[b] 2006 IPCC guideline for National Greenhouse gas inventories, Volume 2: Energy Chapter 2.

Mobile Combustion

Mobile sources are used to describe types of vehicles, engines, and equipment that generate air pollution and that can be moved or travelled into distance.

According to IPCC guideline (2006) mobile combustion is referred to emission of fuel for all transportation activity (excluding military transport). It includes vehicles used on roads for transportation of passengers or freight as well as off-road vehicles, engines, and equipment used for construction, transportation and many other purposes.

Emissions can be estimated from either the fuel consumed as determined through direct measurements of fuel use (from purchase records, storage tank measurements, or company records) or the distance travelled by the vehicles. In general, the first approach (fuel consumed) is appropriate

for CO_2 and the second approach (distance travelled by vehicle type and road type) is appropriate for CH_4 and N_2O. Nevertheless, the Project is still in a planning process, actual data are not yet collected. Therefore, the assessment based on the information from other Project with similar activities, and from the experience of the project's owner, are considered as baseline.

Generally, when calculating GHG emissions for mobile combustion of mobile equipment/machineries, the information that needs to be determined first is the quantity of fuel use for combustion, in term of energy use. The emission equation for mobile combustion is as ***Equation 4***,

Equation 4: Calculation Method for GHG Emissions from Mobile Sources

$$Emissions = \sum (Fuel_j \cdot EF_j)$$

Where:

Emission = emissions (kg)

$Fuel_j$ = Fuel type j consumed (TJ)

EF_j = emission factor for fuel type j (kg/TJ)

Similar to stationary combustion, the emission based on NCV value for emission of each GHG of fuels (Diesel and Gasoline) would be used as a factor for calculation as well. The values of Fuels emission factors for mobile combustion are illustrated in ***Table 7.8***.

The calculation for estimating GHG emissions of mobile combustion equipment/machineries, such as backhoe, dozer, grader, etc., during the construction phase is 1,147.55 tonnes CO_2e/year, as shown in ***Table 7.15***.

Table 7.15: GHG Emissions by Machineries (except Transportation) during Construction of LNG Terminal Project

Source Description	Activity Data			Energy Content of Fuel Used (TJ)[a]	GHG Emission (kg CO_2e)		
	Fuel Type	Fuel Consumed (liter/day)	Rate of Fuel Consumed annually		CO_2	CH_4	N_2O
Emission Factors Diesel (kg of greenhouse gas per TJ)[b]					**74,100**	**4.15**	**28.6**
Emission Factors Motor Gasoline (kg of greenhouse gas per TJ)[b]					**69,300**	**50**	**2**
Global Warming Potential for 100-year time horizon (AR4) – See *Table 7.6*					**1**	**25**	**298**
Backhoe	Diesel	80	29,952	1.12620	83,451.06	116.84	9,598.34
Dozer	Diesel	96	5,990	0.22524	16,690.21	23.37	1,919.67
Grader	Diesel	96	5,990	0.22524	16,690.21	23.37	1,919.67
Truck	Diesel	24	17,971	0.67572	50,070.64	70.11	5,759.00
Concrete Pump Car	Diesel	80	2,880	0.10829	8,024.14	11.23	922.92
Concrete Truck	Diesel	80	52,920	1.98979	147,443.59	206.44	16,958.60
Crane 200 ton	Diesel	120	13,478	4.83325	358,144.15	501.45	41,192.86
Crane 100 ton	Diesel	80	29,952	1.50159	111,268.09	155.79	12,797.78
Crane 50 ton	Diesel	80	128,544	0.17358	12,028.93	8.6789	0.34716
Pile Driver	Diesel	80	39,936	1.12620	83,451.06	116.84	9,598.34
Vibrator	Gasoline	16	5,292	0.22524	16,690.21	23.37	1,919.67
Fork Lift	Diesel	80	37,440	0.22524	16,690.21	23.37	1,919.67
GHG emission during construction phase (except Transportation) (kg CO_2e)					1,029,128.89	1,432.76	116,984.69
GHG emission during construction phase (except Transportation) (kg CO_2e)							1,147,546.34
Total GHG emission during construction phase (except Transportation) (tonnes CO_2e)							**1,147.55**

Note: [a] *Use energy conversion unit to convert fuel consumption in physical unit to energy unit from DEDE (see **Equation 1** and **Equation 2**)*
[b] *Based on default emission factors (see **Table 7.8**).*

It is possible for mobile combustion transportation to use the same method as above. However, the mobile combustion for transportation, it is prioritized in CH_4 and NO_2 emission since on average the technological advancement on vehicles release more emission of CH_4 and NO_2 than other construction mobile machine, and therefore using different factor in calculation.

The amount of fuel combusted can be determined using vehicle activity data, fuel emission factors for vehicle type, and distance travelled. It is also good practice to estimate fuel use from the distance travelled data. Activity data could be in terms of vehicle kilometer traveled (VKT), freight tonnes-kilometer, passenger-kilometer, etc. This activity data would be multiplied by the appropriate fuel economy factors to generate an estimation of fuel consumed. In this case, tonnes-kilometer of VKT is used to estimate the total fuel consumption of mobile combustion transportation as per ***Equation 5*** below.

Equation 5: Validating Fuel Consumption

$$Estimated\ Fuel = \sum_{i,j} \left[Vehicles_{i,j} \cdot Distance_{i,j} \cdot Consumption_{i,j} \right]$$

Where:

Estimated Fuel (l)	=	total estimated fuel use estimated from distance travelled (VKT) data
Vehiclesi,j,t	=	number of vehicles of type i and using fuel j
Distancei,j,t	=	annual kilometres travelled per vehicle of type i and using fuel j (km)
Consumptioni,j,t	=	average fuel consumption (l/km) by vehicles of type i and using fuel j
i	=	vehicle type (e.g., car, bus)
j	=	fuel type (e.g. motor gasoline, diesel, natural gas, LPG)

The GHG emissions for material transportation by trucks transportation are calculated based on estimated number of trips and distance travelled for each type of trucks. In which, it is assumed that transporting vehicles would be operating 8 hrs/day, 6 days/week, for 26 weeks/year. The quantity of GHG emissions for road transport is estimated to be approximately 788.29 tonnes CO_2e/year, as illustrated in ***Table 7.16***.

Table 7.16: Expected GHG Emissions from Transportation Activities during Construction of LNG Terminal Project

Source Type	Source Description	Activity Data						Emission Factors (kg/TJ) (1)	GHG Emission (kg CO_2e)		
		Fuel Type	Distance Travelled (km)	Number of Vehicles	distance travel per liter of fuel	Total fuel used (liter/ day)	Rate of Fuel used annually (liter/year)		CO_2	CH_4	N_2O
Emission Factors Diesel (kg of greenhouse gas per TJ)									**74,100**	**3.9**	**3.9**
Global Warming Potential for 100-year time horizon (AR4) – See *Table 7.6*									**1**	**25**	**298**
Mobile Sources	10-wheel truck (25 tonnes)	Diesel	100	40	3km/liter	1,333	207,999.95	7.82	579,521.14	762.53	9,089.33
	4-wheel truck (5 tonnes)	Diesel	60	60	8km/liter	450	70,200.00	2.64	195,588	257.35	3,067.65
GHG Emissions from Transportation (kg CO_2e)									775,109.57	1,019.88	12,156.98
Total GHG Emissions from Transportation (kg CO_2e)											788,286.43
Total GHG Emissions from Transportation (tonnes CO_2e)											**788.29**

Note: (1) Emission factors for truck are based road transportation emission factors (see IPCC Guidelines Volume 2: Energy Chapter 3: Mobile Combustion Table 3.2.5)

Scope 2 Electricity indirect GHG emissions

During construction phase, TPMC will use electricity supply from local distribution. The following are the estimated annual consumption for TPMC. Total electricity consumption during construction phase (23 months) is estimated to be about 1,912,229 kWh annually. Since the Project's electricity use come from the purchase of Myanmar's electricity grid, GHG emission would be assumed to be proportional to the GHG emission from electricity production of Myanmar electricity grid (based on the amount of electricity used) as illustrated in ***Table 7.17***.

Table 7.17: Myanmar Electricity Grid Emission Factor

Emissions per kWh of electricity generated		
kgCO_2/kWh	**kgCH_4/kWh**	**kgN_2O/kWh**
0.315665174	0.00000622419	0.00000072998

Source: Electricity-specific emission factors for grid electricity, August 2011, https://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf.

In accordance to the national electricity grid, emission would be estimated by the multiplication of electricity use, emission factor of electricity generation, and the GWP. The result emissions from multiplying electrical consumption as shown in ***Table 7.18***. The total estimated Scope 2 indirect emissions during construction are estimated to be 604.34 tonnes CO_2e per year.

Table 7.18: Expected Indirect Emissions from Purchased Electricity

Electricity Purchased	Annual Consumption (kwh/year)	Annual Emissions (kg/year)			Total CO_2eq Emissions	
		CO_2	CH_4	N_2O	Kg CO_2e /year	tonnes CO_2e /year
Emissions per kWh of electricity generated		0.315665174	$6.22419x10^{-6}$	$7.2998 x10^{-7}$		
Global Warming Potential for 100-year time horizon		1	25	298		
Electricity	1,912,229	603,624.03	297.55	415.97	604,337.56	**604.34**

Source: 2006 IPCC guideline for National Greenhouse gas inventories, Volume 2: Energy Chapter 2

Impact Assessment Table of Scope 1 and 2 Emissions

After total amount of GHG emission during construction are estimated, the significance of potential impacts to greenhouse gas during construction phase could be assessed in accordance to the amount of impact during the construction period, as provided in ***Table 7.19***.

Table 7.19: Impact Assessment Table for Greenhouse Gas (Construction Phase)

Significance of Impact					
Impact	Potential impacts on climatic condition due to GHG emissions.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to climate would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts through the release of emissions from fuel combustion.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Many of the major greenhouse gases can remain in the atmosphere for tens to hundreds of years after being released.				
Impact Extent	Local	Regional	**International**		
	Greenhouse gasses are a global emission and may affect the global climate.				
Impact Scale	The emissions from construction phase are calculated to be 3,850.17 tonnes CO_2eq. Compared to Myanmar's GHG release of 201.5 million tonnes CO_2 equivalent, 2013, the total GHG releases from the Project are insignificant (approximately 0.0019%).				
Frequency	Emissions will be released intermittently, but repeatedly throughout the construction period.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Minor emissions of GHG will be emitted as a result of the Project construction, and considered insignificant emissions according to IFC (25,000 tonnes CO_2eq per year). Magnitude is considered Negligible.				
Receptor Sensitivity	**Low**	Medium	High		
	The direct receptor to greenhouse gas is the global atmosphere. The greenhouse effect is enhanced by greenhouse gas emissions of anthropogenic nature. Minor emissions of GHG will be emitted as a result of the Project, and not likely to significantly change atmospheric GHG concentrations. Receptor sensitivity is rated as Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low resource sensitivity and Negligible impact magnitude will result in an overall Negligible potential impact.				

Mitigation Measures

The following measures will be put in place for the Project during construction to reduce GHG emissions;

- Implement the same mitigation measures to minimize impacts to Air Quality (***Section 7.1***).
- Develop and implement preventive maintenance plan for machines, and engines to ensure combustion efficiency.
- Develop vehicle maintenance plan.

Residual Impacts

The significance of the residual impact on climatic condition as a result of GHG emissions is considered to be a **Negligible** Impact.

Monitoring Plan

In accordance to IFC requirements, "quantification of GHG emissions will be conducted by the client annually in accordance with internationally recognized methodologies and good practice" if the GHG emission from the project exceeds 25,000 tonnes CO_2e per year. However, as summarized in ***Table 7.12***, total amount of GHG emission of the project is summed to 3,850.17 tonnes CO_2e per year which is within the GHG emissions according to the applicable requirements (i.e. ADB SPS, EP III and IFC), therefore, it is not mandatory to do quantification of GHG emission every year.

7.2.7.2 Operation Phase

During the operation phase of the Project, the main activities contributing to Scope 1 direct greenhouse emission. Nevertheless, only direct emission would be considered under this Project, since electricity used on site would come mainly from in house electricity production only, and need electricity supplied from the national grid only for certain amount. Also, the GHG assessment during the operation period would not consider mobile combustion, since it is expected there would be no heavy machineries and equipment during operation. Therefore, emission during operation period would mainly come from engine generator, and natural gas would be use as fuel in the process of electricity generation.

Summary of Scope 1

The total release of GHG emissions during operation phase is estimated to be 11,028.14 tonnes CO_2eq per year as shown in ***Table 7.20***. The majority of emissions during operation phase are from natural gas combustion of engine generator, followed by in Fugitive emission.

Table 7.20: Emissions Breakdown by Scope and Activity

Emission Scopes	Unit	Value
Scope 1 Direct Emissions		
Natural Gas Combustion of Engine Generator	tCO_2eq/year	10,369.59
Fugitive emission (LNG process)	tCO_2eq/year	658.55
Total Emission	**tCO_2eq/year**	**11,028.14**

Scope 1 Direct Emissions

Natural Gas Combustion of Engine Generator

Gas will be supplied to the engine generator in LNG terminal about 0.496 mmscf per day or 181.04. mmscf annually Volume of natural gas supplied could be converted in term of energy content, as NCV of natural gas, by using conversion from DEDE Thailand as provided in ***Table 7.21***, then the annual consumption of natural gas in term of energy is calculated which will be approximately 184.66 TJ/year as illustrated in ***Table 7.21***.

Table 7.21: Fuels Net Calorific Values

Fuel	Units	Value
Natural Gas (Dry)	MJ/scf	1.02

Source: MOE, 2015.[102]

[102] MOE. (2015). Thailand Alternative Energy Situation. Ministry of Energy. Department of Alternative Energy Development and Efficiency. Pg 57. Retrieved from: http://www.dede.go.th/download/state_59/Thailand%20alternative%20energy%202015.pdf

Similar to the calculation on the emission during construction, once amount of gas used is determined (in term of energy content), amount of GHG emission could be determined using the emission factors illustrated in ***Table 7.7***.

From the value parameters, amount of GHG could be determined in kilogram of GHG emitted annually. To calculate the total amount of GHG emission in term of CO_2e per year, GWP would be multiplied by each GHG released from the operational activity. The total amount of GHG in term of kilogram CO_2e per year estimation is shown in ***Table 7.22***, which amounted to 10,369.59 tonnes CO_2e/year or 0.0104 million tonnes CO_2e/year.

Table 7.22: Expected Natural Gas Combustion of Engine Generator for LNG Terminal

Source	Annual natural gas supplies (scf/year)	Annual consumption (J/year)[1/]	Annual consumption TJ/year	Annual Emissions (kg/year)			Total CO_2eq Emissions	
				CO_2	CH_4	N_2O	kg CO_2eq/ year	tonnes CO_2eq/ year
Emissions per kWh of electricity generated				56,100	1	0.1		
Global Warming Potential for 100-year time horizon				1	25	298		
Natural Gas Engine Generator	$1.81x10^8$	$1.85x10^{14}$	184.66	$1.04x10^7$	$4.62x10^3$	$5.50x10^3$	$1.04x10^7$	**$1.04x10^4$**

Note: [1/] *1scf = 1.02 $x10^6$ J*

The estimated GHG emissions from the LNG Terminal during operation will exceed the threshold that defined significant emitters of GHGs by the ADB SPS and EP III (100,000 tonnes CO_2eq per year) and IFC PS3 (25,000 tonnes CO_2eq per year). Therefore, the Project is required to report annual GHG emissions as per the applicable reference framework.

Fugitive Combustion

The term fugitive emissions is broadly applied here to mean all greenhouse gas emissions from the gas systems except contributions from fuel combustion. In accordance of 2006 IPCC guidelines, there would be some amount of gas loss in the process of regasification process. The amount of gas loss which needs flaring/venting could be estimated by the percentage of natural gas throughput (0.05% of throughput). From ***Chapter 4***, the amount of LNG being regasification is approximately 63 MMscfd or 22,995 MMscf per annual. Using information in ***Table 7.7*** and ***Table 7.21*** amount of GHG emission from fugitive combustion could be estimated to 658.55 tonnes CO_2e/year as illustrated in ***Table 7.23***.

Table 7.23: Expected Fugitive Emissions for LNG Terminal

Source	Annual natural gas supplies (scf/year)	0.05% estimation for fugitive emission (scf/year)	Annual Energy conversion (TJ)[1/]	Annual Emissions (kg/year)			Total CO_2eq Emissions	
				CO_2	CH_4	N_2O	kg CO_2eq /year	tonnes CO_2eq /year
Natural Gas Emissions per kWh of electricity generated				56,100	1	0.1		
Global Warming Potential for 100-year time horizon[(1)]				1	25	298		
Regasification	2.30 x10^{10}	1.15x10^{7}	11.73	6.58x10^{5}	293	349	6.59x10^{5}	**658.55**

Note: [1/] 1scf = 1.02 x10^{-6} TJ

The estimated GHG emissions from the LNG Terminal during operation would not exceed the threshold that defined significant emitters of GHGs by the ADB SPS and EP III (100,000 tonnes CO_2eq per year) and IFC PS3 (25,000 tonnes CO_2eq per year). Therefore, the Project does not required to report annual GHG emissions as per the applicable reference framework.

Impact Assessment Table

Table 7.24: Impact Assessment Table for Greenhouse Gas (Operation Phase)

Significance of Impact				
Impact	Potential impacts on climatic condition due to GHG emissions.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts to climate would be considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Potential impacts would likely be direct impacts through the release of emissions from Project operation.			
Impact Duration	Temporary	Short-term	**Long-term**	Permanent
	Many of the major greenhouse gases can remain in the atmosphere for tens to hundreds of years after being released.			
Impact Extent	Local	Regional	**International**	
	Greenhouse gases can potentially affect the Earth's climate.			
Impact Scale	The emissions from LNG Terminal are calculated to be 11,028.14 tonnes of CO_2eq or 0.011			

Significance of Impact					
	million tonnes CO_2eq per year. Compared to Myanmar's GHG emissions of 201.5 million CO_2equivalent, 2013, the total GHG releases from the Project is approximately 0.0055%.				
Frequency	Emissions will be released continuously throughout the operation period.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The GHG emissions during operation phase are considered 'significant emissions' according to ADB SPS and EP III (100,000 tonnes CO_2eq per year) and of IFC PS3 (25,000 tonnes CO_2eq per year). Magnitude is therefore considered Small, since the emission is about half of the IFC standard.				
Receptor Sensitivity	**Low**	Medium	High		
	The direct receptor to greenhouse gas is the global atmosphere. The greenhouse effect is enhanced by greenhouse gas emissions of anthropogenic nature. The concentration of GHG in the atmosphere beyond the level of naturally occurring concentrations could result in more heat being held within the atmosphere. Receptor/resource sensitivity is rated as Medium.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	As per the impact assessment methodology defined in ***Chapter 6*** the combination of a Small resource sensitivity and Medium impact magnitude will result in an overall negligible potential impact.				

Mitigation Measures

It is proposed to undertake an annual GHG inventory to monitor the GHG emissions according to the applicable requirements (i.e. ADB SPS, EP III and IFC):

- Conduct annual pollutant release inventory to monitor the GHG emissions from the Project. The GHGs emission shall be reported as CO_2eq unit.
- Where feasible, arrange emissions offsets (including the Kyoto Protocol's flexible mechanisms and the voluntary carbon market), including reforestation, afforestation.

Residual Impact

The Project employs the most effective GHG reduction measure. The mitigation measures above have been put in place to monitor the GHG emission. There will be no reduction in the impact level, residual impact significance would be **Negligible** Impact.

Monitoring Plan

In accordance to IFC requirements, "*quantification of GHG emissions will be conducted by the client annually in accordance with internationally recognized methodologies and good practice*" if the GHG emission from the project exceeds 25,000 tonnes CO_2e per year. However, as summarized in ***Table 7.20***, total amount of GHG emission of the project during operation phase is summed to 11,028.14 tonnes CO_2e per year which is within the GHG emissions according to the applicable requirements (i.e. ADB SPS, EP III and IFC), therefore, it is not mandatory to do quantification of GHG emission every year.

7.3 Noise Impact Assessment

7.3.1 Introduction

This Chapter presents an assessment of the potential noise impacts arising from the construction and operational phases of the Project. Noise sensitive receivers (NSRs) and potential sources of noise generation were identified and an assessment of the potential impacts was carried out. Mitigation and management measures are recommended where necessary.

Impacts associated with noise (both during construction and operation phase) may affect NSRs such as human in the affected area. During the scoping activity, the following are impacts related to noise that will be assessed in this section (***Section 7.3***):

- Potential noise impacts from transportation of workers, equipment and machineries during construction phase;
- Potential noise impacts from operation of equipment and machineries during construction phase;
- Potential noise impacts from foundation work and civil construction during construction phase; and
- Potential noise impacts from operation of LNG Receiving Terminal.

7.3.2 Assumptions and Limitations

The assessment of potential impacts related to noise in this section is based on the environmental baseline data (***Chapter 5***) and the information available from the Project Proponent at the time of writing.

The noise impact assessment was carried out based on an assumed facility inventory for the construction and operational phases of the LNG Receiving Terminal. Noise modelling has been conducted to simulate the expected noise impacts from the equipment from each phase. These will be confirmed by the Engineering, Procurement and Construction (EPC) contractor prior to commencement of each phase. Should there be significant differences between the assumed plant inventory and that to be used on site, additional assessments may be needed and the proposed noise mitigation measures should be updated and implemented accordingly.

The modelling assumptions and limitations is further explained in ***Section 7.3.3.2*** and ***Section 7.3.3.3***.

7.3.3 Assessment Methodology

The methodology used for assessing impacts to noise is aligned with the general impact assessment methodology presented in ***Chapter 7***. The guidelines that will be used for the construction and operation noise impact assessment was conducted with reference to relevant international guidelines and local legislation, regulations, and standards, where available. Noise level guidelines given in Myanmar National Environmental Quality Guideline (NEQG) and that in IFC General EHS Guidelines: Environmental – Noise Management are the same, and are summarised in ***Table 3.11***.

Table 7.25: Myanmar NEQ and IFC General EHS Guidelines for Noise Levels at Receptors

Area	Maximum Allowable Noise Level (1 hour) [(a)] dB(A)	
	Daytime 0700 – 2200 hours	Night-time 2200 – 0700 hours
Residential, institutional, educational	55	45
Industrial/commercial areas	70	70

Note: [(a)] *Equivalent continuous sound level in decibels*
Noise impacts should not exceed the levels presented in this table, or result in a maximum increase in background levels of 3dBA at the nearest receptor location off-site.

7.3.3.1 Modelling Methodology

In this study, CadnaA-software was used for calculating and generating the noise contour of both LNG Receiving Terminal and Power Plant. The following definition are relevant to the understanding and description of the modelling results:

- PWL is defined as sound power level;
- L_{AT} is defined as equivalent continuous sound pressure level;
- L_{day} is defined as equivalent continuous sound pressure level in between 07:00 and 22:00;
- L_{night} is defined as equivalent continuous sound pressure level in between 22:00 and 07:00; and
- L_p is defined as noise pressure level.

7.3.3.2 Modelling Assumption

In this impact assessment study, CadnaA-software was used for calculating and generating the noise contour of both LNG Receiving Terminal and Power Plant. The methodology and results of this modelling will be presented further below. Key assumptions for the model are described here.

Noise sources from Power Plant can be defined as an omnidirectional point source placed on ground with the sound power level (PWL) and directivity as a function of the three orthogonal coordinates (x, y, z) are needed. The input data for sound propagation calculations according to ISO 9613-2 to be used for noise mapping are as follows:

- Emitting sound power level spectrum in octave bands;
- Location (coordinates x, y) and elevation (z) of the noise source;
- Dimensions and orientations;
- Directivity of the source;
- Working hours (day, evening, night, on a yearly averaged basis); and
- Operating conditions of the source.

The emitted sound power levels was set as a single band at the frequency of 500 Hz. The working hours are an essential input for the calculation of noise levels. The working hours shall be given for the day and night period.

7.3.3.3 Modelling Limitation

Leq at receiving point can be calculated with limitation of working hours and operating condition.

For working hours: day 07.00-22.00 night 22.00-07.00.

Operating condition: Continuous working 24 hrs/day.

Intermittent working 12 hrs/day.

In this study, the noise mapping is only presented as 2-dimensional.

7.3.3.4 Sound Power Level Calculation for Construction Equipment

The power level of equipment can be described as a point source placed on ground and calculated as shown by the following equation (***Equation 6***):

Equation 6: Sound Power Level Equation

$$PWL = L_p + 20log(r) + 8$$

Where: PWL – Power Level of Equipment

L_p – Noise Pressure Level dB(A)

R – Distance from the noise source

Source: AMacoustic, 2019

All noise level of equipment in construction phase of this study refer to FHWA Roadway Construction Noise Model User's Guide, Final Report, January 2006 as in the following table (***Table 7.26***).

Table 7.26: Noise Emission Reference Levels and Usage Factors[103]

Equipment Description	Is there a potential impact?	Acoustical Use Factor[a] (%)	Spec 721.560 L_{max} at 50ft (dBA, slow[b])	Actual Measured L_{max} at 50ft (dBA, slow)	No. of Actual Data Samples (count)
All Other Equipment > 5 HP	No	50	85	--N/A--	0
Auger Drill Rig	No	20	85	84	36
Backhoe	No	40	80	78	372
Bar Bender	No	20	80	--N/A--	0
Blasting	Yes	--N/A--	94	--N/A--	0
Boring Jack Power Unit	No	50	80	83	1
Chain Saw	No	20	85	84	46
Clam Shovel (dropping)	Yes	20	93	87	4
Compactor (ground)	No	20	80	83	57
Compressor (air)	No	40	80	78	18

[103] Noise emission reference levels and usage factors that were used as part of the Central Artery/Tunnel (CA/T) project in Boston. These noise emission levels will be used as a basis for the modelling of this noise impact assessment section.

Equipment Description	Is there a potential impact?	Acoustical Use Factor[a] (%)	Spec 721.560 L_{max} at 50ft (dBA, slow[b])	Actual Measured L_{max} at 50ft (dBA, slow)	No. of Actual Data Samples (count)
Concrete Batch Plant	No	15	83	--N/A--	0
Concrete Mixer Truck	No	40	85	79	40
Concrete Pump Truck	No	20	82	81	30
Concrete Saw	No	20	90	90	55
Crane	No	16	85	81	405
Dozer	No	40	85	82	55
Drill Rig Truck	No	20	84	79	22
Drum Mixer	No	50	80	80	1
Dump Truck	No	40	84	76	31
Excavator	No	40	85	81	170
Flat Bed Truck	No	40	84	74	4
Front End Loader	No	40	80	79	96
Generator	No	50	82	81	19
Generator (<25KVA VMS signs)	No	50	70	73	74
Gradall	No	40	85	83	70
Grader	No	40	85	--N/A--	0
Grapple (on backhoe)	No	40	85	87	1
Horizontal Boring Hydr .Jack	No	25	80	82	6
Hydra Break Ram	Yes	10	90	--N/A--	0
Impact Pile Driver	Yes	20	95	101	11
Jackhammer	Yes	20	85	89	133
Man Lift	No	20	85	75	23
Mounted Impact Hammer (Hoe Ram)	Yes	20	90	90	212
Pavement Scarafier	No	20	85	90	2
Paver	No	50	85	77	9
Pickup Truck	No	40	55	75	1
Pneumatic Tools	No	50	85	85	90
Pumps	No	50	77	81	17
Refrigerator Unit	No	100	82	73	3

Equipment Description	Is there a potential impact?	Acoustical Use Factor[a] (%)	Spec 721.560 L_{max} at 50ft (dBA, slow[b])	Actual Measured L_{max} at 50ft (dBA, slow)	No. of Actual Data Samples (count)
Rivit Buster/chipping gun	Yes	20	85	79	19
Rock Drill	No	20	85	81	3
Roller	No	20	85	80	16
Sand Blasting (Single Nozzle)	No	20	85	96	9
Scraper	No	40	85	84	12
Shears (on backhoe)	No	40	85	96	5
Slurry Plant	No	100	78	78	1
Slurry Trenching Machine	No	50	82	80	75
Soil Mix Drill Rig	No	50	80	--N/A--	0
Tractor	No	40	84	--N/A--	0
Vacuum Excavator (Vac Truck)	No	40	85	85	149
Vacuum Street Sweeper	No	10	80	82	19
Ventilation Fan	No	100	85	79	13
Vibrating Hopper	No	50	85	87	1
Vibratory Concrete Mixer	No	20	80	80	1
Vibratory Pile Driver	No	20	95	101	44
Warning Horn	No	5	85	83	12
Welder / Torch	No	40	73	74	5

Source: FHWA Roadway Construction Noise Model User's Guide, Final Report, January 2006.

Note: [a] *acoustical use factor refers to average percentage of equipment operating at full power*
[b] *slow refers to machineries working at lower gear or round*

7.3.3.5 Calculation of Sound Propagation according to ISO 9613-2

The A-weighted sound level at a receiver point L_{AT} (equivalent continuous sound pressure level) according to ISO 9613-2[104] is calculated by:

$$L_{AT} = L_W + D_1 + D_\Omega - A_{div} - A_{atm} - A_{gr} - A_{bar} - A_{misc}$$

Where: PWL – sound power level in dB relative to the reference sound power of 1pW

D_1 – directivity index – deviation from the direction of the continuous sound pressure level for the directionally radiating source in a specified direction from the level of an omnidirectional point source with the sound power level PWL

$D_\Omega(K_0)$ – correction for solid angle – term that accounts for sounds propagation into angles of less than 4π radians

A_{div} – attenuation due to geometrical divergence – the geometrical divergence calculates from the distance d between source and receiver:

$$A_{div} = \left[20 \lg\left(\frac{d}{d_0}\right) + 11\right] dB$$

with d distance source-receiver, $d_0 = 1$ m.

A_{atm} – atmosphere absorption :

$$A_{atm} = \propto_L * d/1000$$

Where:

αL atmospheric attenuation coefficientper kilometre

d distance source-receiver.

In CadnaA .For the default frequency of 500 Hz, the attenuation coefficient is 0.002 dB/m.

A_{gr} – attenuation due to ground effect.

A_{bar} – attenuation due to screening (due to berms, barriers, buildings, topography, cylinders, etc).

A_{misc} – attenuation due to miscellaneous effects:

- Foliage A_{fol}
- industrial sites A_{site}
- housing A_{hous}

7.3.3.6 Modelling Scenario

The following are the list of scenario cases which were modelled for this impact assessment:

- Case 1 – construction phase of LNG Receiving Terminal; and
  - Operation of machineries and equipment;
  - Foundation work and civil construction;
  - Transportation of workers and equipment;
- Case 2 – operation phase of LNG Receiving Terminal; and

[104] ISO 9613-2 refers to the standard for acoustic attenuation of sound during propagation outdoors – general method of calculation (2017).

- Operation of LNG Receiving Terminal components.

- Case 3 – operation phase (full phase) of LNG Receiving Terminal; and
  - Operation of LNG Receiving Terminal components.

L_{eq} at receiving point can be calculated with limitation of working hours and operating condition.

For working hours: day 07:00 – 22:00; night 22:00 – 07:00;

Operating condition: Continuous mean working 24 hours per day

Intermittent means working 12 hours per day

7.3.4 Summary of Baseline Conditions

Chapter 5 provides the details of the baseline conditions for noise in the Project study area.

Information on the ambient noise conditions for the Study Area is not publicly available. The background noise levels are expected to be typical of an urban and/or semi-urban environment in Myanmar. Sources of noise are likely to include local traffic (e.g. motorbikes, scooters and less so private cars), human activity (e.g. schools, barangay halls, local markets) and animals (e.g. dogs, cockerels).

As part of the ESIA Study, noise monitoring at selected locations (with consideration of NSRs) are conducted to form a primary baseline database. Further information on the baseline is presented in ***Section 5.1.4***.

Most noise stations have day time and night time A-weighted loudness equivalent levels that exceed the Myanmar Standard. Although there area couple of noise stations (N4, and N8) that are within the day time standard, only noise station N7 has day time and night time levels that are within the standard. Noise monitoring stations closest to the LNG Receiving Terminal (N9, and N10) both exceeded the Myanmar Standard.

7.3.5 Receptor Identification and Sensitivity

The nearest representative NSRs that may potentially experience noise impacts from the work sites of the Project during construction and operational phases are identified. There are two villages located nearby the LNG Receiving Terminal, which include, Thet Kei Kwin (1.2 km, northwest), and Shan Kaw (1.6 km, west) villages. As the identified NSRs are residential, the sensitivity of the receptor is considered as medium.

7.3.6 Summary of Project Activities with Potential Impacts

7.3.6.1 Construction Phase

Construction of the LNG Receiving Terminal will be carried out by the EPC contractor appointed by TPMC. Construction of the LNG Receiving Terminal is expected to take 23 months. Scheduled Commercial Operating Date (SCOD) is expected at the end of 2021. The maximum number of workers on-site during construction is anticipated to be 650 persons.

The Project Proponent will implement appropriate management and mitigation measures to reduce the significance of any impacts associated with noise, as will be discussed in the respective mitigation measures section for each impact type. The mitigation measures will also be summarised in the ESMP chapter (***Chapter 11***).

7.3.6.2 Operation Phase

The operation phase is expected to continue for approximately 25 years. The average number of permanent workers present during operation is expected to be approximately 30, with small numbers of additional staff for security, cleaning, technical assistance, and occasional maintenance. The

assessment of operational phase impacts includes those arising from routine operations and maintenance of the power plant. During the operation phase, potential impacts to NSRs may arise from various equipment within the LNG Receiving Terminal that will produce noise during the operation phase.

7.3.7 Assessment of Impacts from Noise

7.3.7.1 Impacts from Noise Level from Transportation of Workers, Equipment and Machineries during Construction Phase

Overview

During the construction phase, workers, equipment and materials will need to be transported by large trucks and/or other types of vehicles to the construction site. Truck and transportation vehicles will produce a certain level of noise impact towards the surrounding ambient noise and Noise Sensitive Receivers/Receptors (NSRs). The impact level will depend on the type of vehicles used, the number of trips within a specific time period, and the time of day for transportation.

During the LNG Receiving Terminal construction, workers and equipment will be transported to the construction site by road transportation. While other materials used for construction will be transported via barge.

Impact Assessment Table

The significance of potential impacts from generation of noise from transportation of workers, equipment and materials during construction phase is assessed in ***Table 7.27***, and mitigation measures are presented thereafter.

Table 7.27: Significance of Impacts Due to Generation of Noise from Transportation of Workers, Equipment and Materials during Construction Phase of LNG Receiving Terminal

Significance of Impact				
Impact	Potential impacts on NSRs due to noise emissions from the transportation of workers, equipment and material during construction phase.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts to NSRs would considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Potential impacts would likely be direct impacts.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	Construction is expected to start mid 2019 and be complete in 23 months, which would be considered short-term.			
Impact Extent	**Local**	Regional	International	
	Noise impact from the transportation of equipment will have localised impact on nearby NSRs therefore the impact extent is determined to be local.			
Impact Scale	Transportation vehicle for staff is measured to generate 86.7 dBA. Tug boat (assumed to be used for material transportation) has a reference sound level per unit of 87 dBA.			
Impact Frequency	Transportation of workers is expected to occur intermittently but frequently throughout the construction period. Transportation at night may sometimes occur. Transportation of equipment and materials is expected to occur one or two rounds during the			

Significance of Impact					
	construction phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the impact characteristics above, the impact magnitude is considered to be small.				
Receptor Sensitivity	Low		**Medium**	High	
	The identified NSRs are residential, the sensitivity of the receptor is considered as medium. Several communities/villages located along potential transportation route. Overall receptor sensitivity is medium.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a Medium Receptor Sensitivity and Small Impact Magnitude will result in an overall Minor impact.				

Mitigation Measures

The following measures will be put in place for the Project during the construction phase to mitigate impacts to NSRs:

- Schedule transportation of materials evenly throughout the day (to minimize accumulative noise impact from multiple noise sources);
- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components should be conducted; and
- Avoid transportation of materials on- and off-site through existing community areas.
- Workers operating near loud equipment/machines will wear appropriate PPE equipment.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **Negligible** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 11***), monitoring of noise should consist of the following:

- Monthly noise monitoring should be conducted at the representative NSRs, and within the construction site by the EPC contractor to check noise levels and compliance at the NSRs throughout the construction phase.

7.3.7.2 Impacts from Noise during Foundation Work and Civil Construction during Construction Phase

Overview

During the construction phase, the Project will require the use of construction equipment such as diesel generators, air compressor, and trucks and trailers. Each construction equipment will produce a certain level of noise impact towards NSRs. Knowing the location of each equipment is also important for understanding the spatial extent of noise impacts.

During the LNG Receiving Terminal construction phase, the list of equipment that will either be used or placed on standby, but will produce noise impacts are shown in ***Table 7.28***.

Table 7.28: Construction Equipment Noise Level

CODE	Equipment List	Lw, dBA	Operation/day
C_1	Diesel generator 1	113.66	08.00am-22.00pm
C_2	Diesel generator 2	113.66	08.00am-22.00pm
C_3	Diesel generator 3	113.66	08.00am-22.00pm
C_4	Diesel generator 4	113.66	08.00am-22.00pm
C_5	Diesel generator 5	113.66	08.00am-22.00pm
C_6	Diesel generator 6	113.66	08.00am-22.00pm
C_7	Diesel generator 7	113.66	08.00am-22.00pm
C_8	Diesel generator 8	113.66	08.00am-22.00pm
C_9	Diesel generator 9	113.66	08.00am-22.00pm
C_10	Diesel generator 10	113.66	08.00am-22.00pm
C_11	Air compressor1	111.66	08.00am-22.00pm
C_12	Trucks and trailers inside construction area	115.66	08.00am-22.00pm

Source: TPMC, 2019; adapted by AMacoustic, 2018.

The type and quantity of machinery that will be used for the construction of LNG Receiving Terminal earthwork is listed in ***Table 7.29***.

Figure 7.4, ***Figure 7.5*** and ***Figure 7.6*** shows noise contour developed by the model, demonstrating the noise level at different areas generated from the Power Plant construction phase.

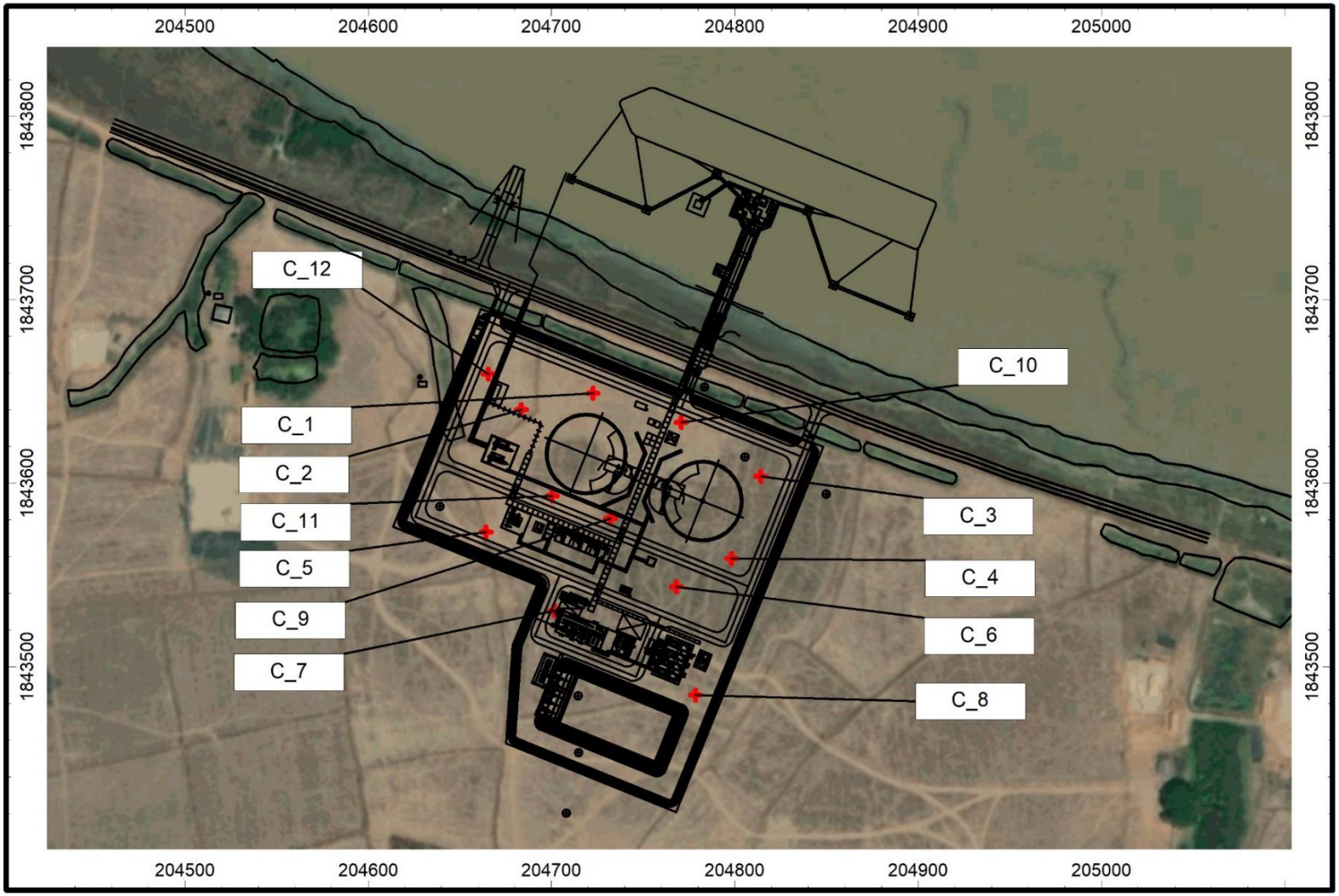
Table 7.29: Amount of Earthwork Machinery

Machinery Type	Amount
Piling Rig	3
Excavator	3
Bulldozer	2
Scraper	1
Light-duty vehicle	2
Water truck	2
Cranes	2
Transit mixer	500 Trip
Air Compressor	1
Diesel Generator	10
Compactor	2
Tipper trucks/trailer	3
Fuel and lube track	1
Pump	3

Source: TPMC, 2019.

The location of equipment that is expected to produce noise during the construction phase is shown in ***Figure 7.3***, with the red marking.

Figure 7.3: Location of Noise Emitting Equipment during Construction Phase



Source: TPMC, 2019. (Modified by AMacoustic)

Figure 7.4 and ***Figure 7.5*** shows the noise modelling results in the form of noise contours based upon the input data from ***Table 7.28***. Type A and type B figures show the same results; the difference involves using different graphical representations.

The results suggest that noise levels rapidly dissipate over distance; with the majority of noise emission levels that extend beyond the LNG Receiving Terminal boundary being >40.0 dB(A), which then dissipates down to >35 dB(A). With regards to ***Figure 7.3*** and ***Section 7.3.5***, there are no NSRs within the >45.0 dB(A) noise contour areas, this indicates that noise emissions during construction phase are well within the Myanmar Standard.

Based on methodology from the US Department of Transportation for estimation of construction and equipment noise, noise levels at various distances from a source can be calculated using ***Equation 7***:

Equation 7: Equipment Noise Level at Receptor Location

$$L_{eq}(equipment) = L_w - 20 \times \log_{10}\left(\frac{D}{D_0}\right)$$

Source: FHWA[105], Accessed in 2019.

Note: Leq (equipment) = the A-weighted, equivalent sound level at a receptor resulting from the operation of a single piece of equipment at distance D (dB(A))
Lw = Noise emission level of the particular piece of equipment at reference distance D_0 (dB(A))
D = Distance from the receptor to the piece of equipment (m)
D_0 = Reference distance where the source noise emission level was measured (m) (700.37 m) based on the location of noise station AQ3/N3, and the approximate distance from the Power Plant

For the Project, it is necessary to calculate the overall noise level produced by the simultaneous operation of several pieces of equipment. The overall noise level at a receptor is simply the sum (on an energy basis) of the individual contributions of each piece of equipment. Mathematically, the overall noise level at a receptor from several sources can be calculated using ***Equation 8***:

Equation 8: Combined Noise Level for Ambient and Construction Noise

$$L_{eq}(site) = 10 \times \log_{10}\left(\sum_{i=1}^{n} \frac{10^{Leq\ (equipment)_i}}{10}\right)$$

Note: L_{eq} (site) = the A-weighted, overall equivalent sound level obtained by summing the individual equipment noise levels on an energy basis.
n = Number of sources
*L_{eq} (equipment)$_i$ = the A-weighted, equivalent sound level at a receptor resulting from the operation of a single piece of equipment at distance D from its source, dB(A). Obtained from **Equation 7**.*

However, it should be noted that not all construction equipment will be operating at the same time. Different machinery will operate at different times and in different locations in a non-consistent manner. The overall construction noise level is governed primarily by the noisiest pieces of equipment. The quieter pieces do not affect the overall level, but they do reduce the magnitude of the fluctuations in the noise level (FHWA, 2011)[105]. The noise modelling produced by AMacoustic, as shown in ***Figure 7.4***, and ***Table 7.27***, will be used to substitute ***Equation 7***.

Table 7.30 shows the result of ***Equation 8*** for the combined noise levels at noise station N9 location, approximately 1.6 km northwest of the LNG Receiving Terminal. The results indicate that the combined noise levels from the contributing construction equipment to the baseline is insignificant; NSRs at this location or distance will not notice any increase in noise levels.

[105] http://www.fhwa.dot.gov/environment/noise/highway/hcn03.htm

Table 7.30: Combined Noise Level at Noise Station N9

Time of Day	Baseline (dBA)[a]	Contribution from Construction Equipment (dBA)	Total Noise Level (dBA)
Day Time	60	43.7	60.10063
Night time	54	43.7	54.38749

Source: SEM, 2018

Note: [a] Baseline data for noise station N1, survey period 11-12 May 2018.

Table 7.31 shows the result of ***Equation 8*** for the combined noise levels at noise station N10 location. The results indicate that the combined noise levels from the contributing construction equipment to the baseline is insignificant; NSRs at this location or distance will not notice any increase in noise levels.

Table 7.31: Combined Noise Level at Noise Station N10

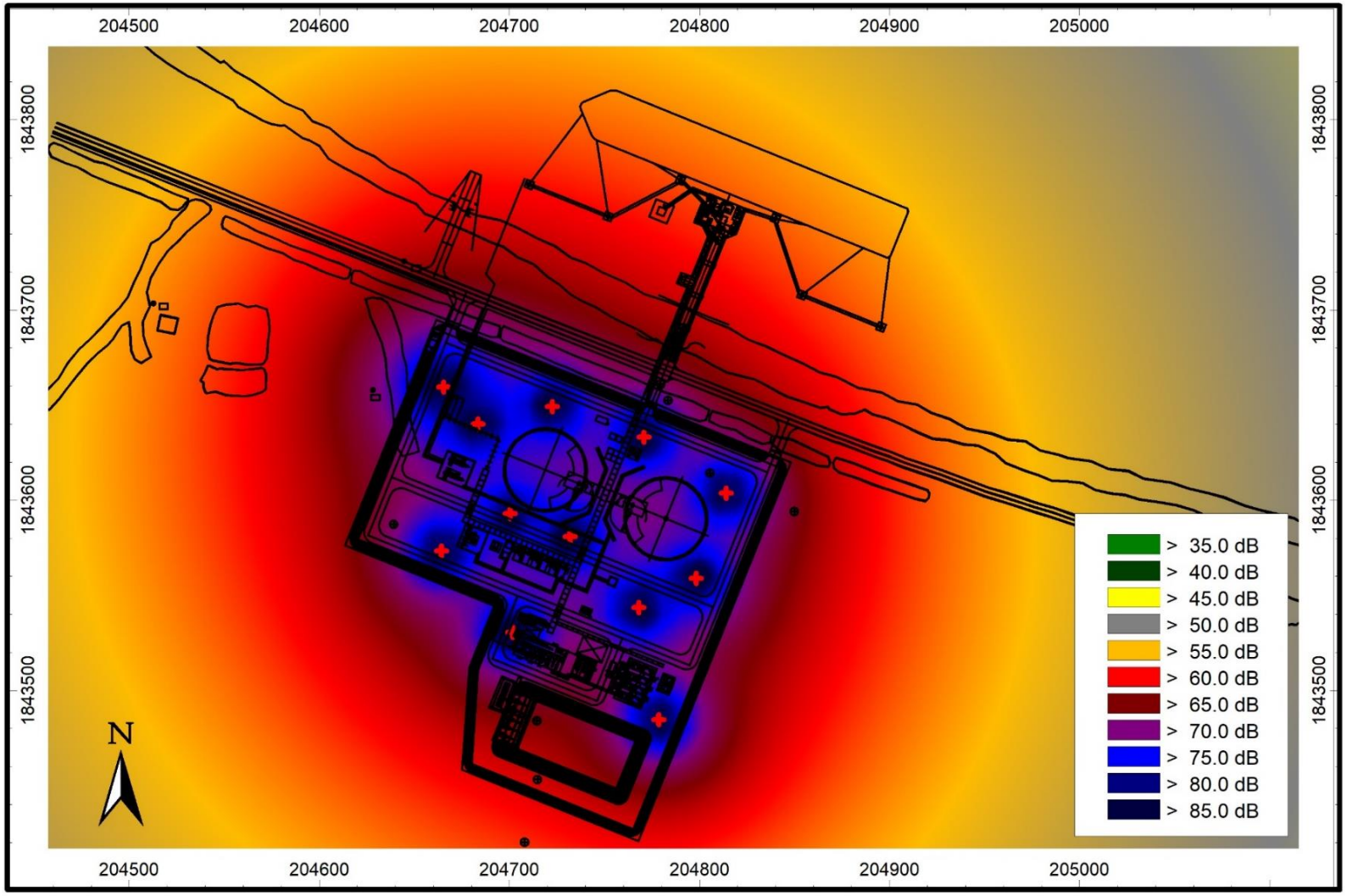
Time of Day	Baseline (dBA)[a]	Contribution from Construction Equipment (dBA)	Total Noise Level (dBA)
Day Time	63	39	63.01726
Night time	51	39	51.26572

Source: SEM, 2018

Note: [a] Baseline data for noise station N3, survey period 10-11 May 2018.

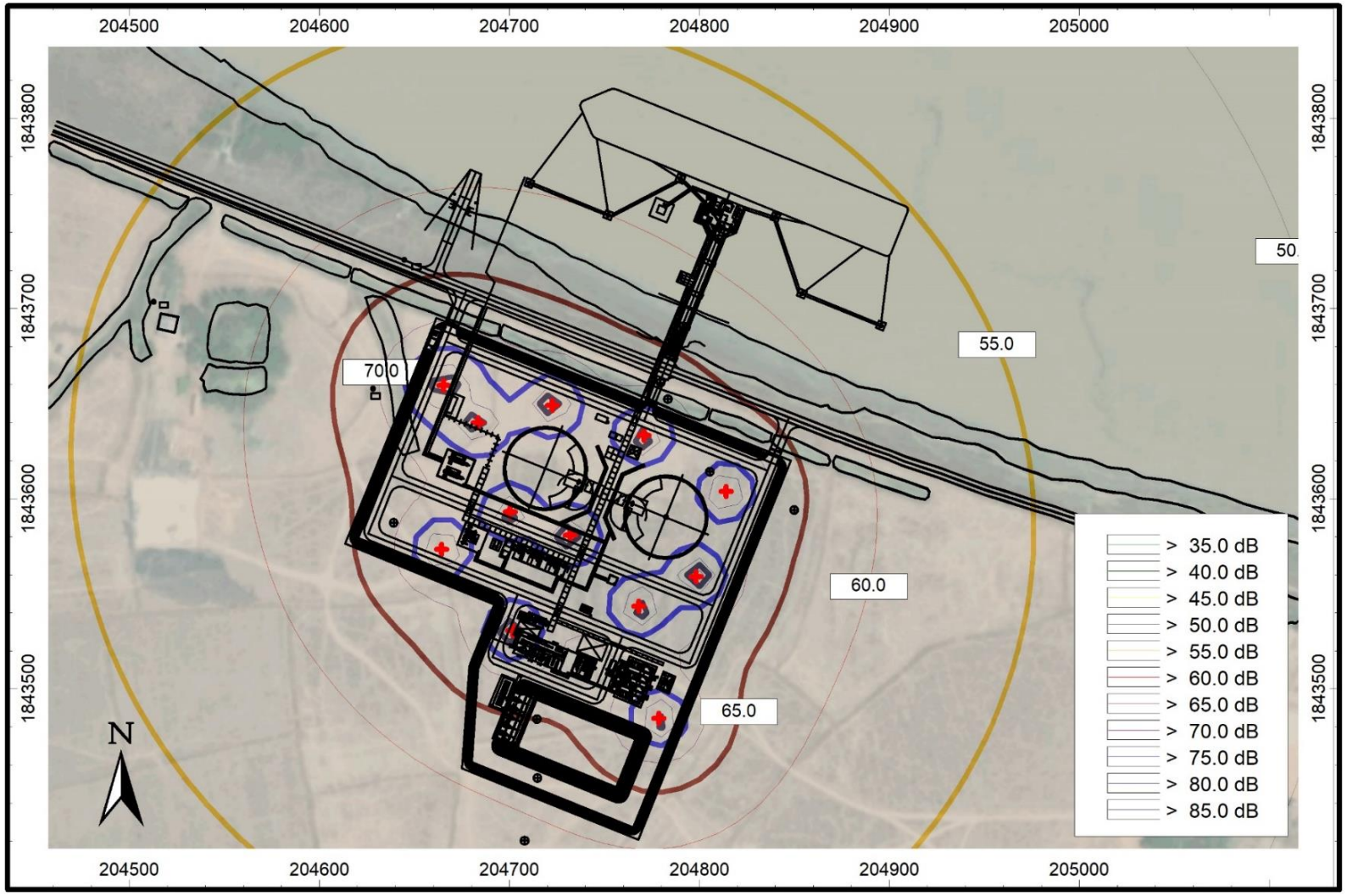
Type A map (noise gradient map which shows the dissipating of noise over distance) and type B (noise contour map which shows the noise level at certain distance) demonstrate is modelled based on the same noise level results; but with different graphical representation.

Figure 7.4: Noise Contour during Construction Phase (Type A)



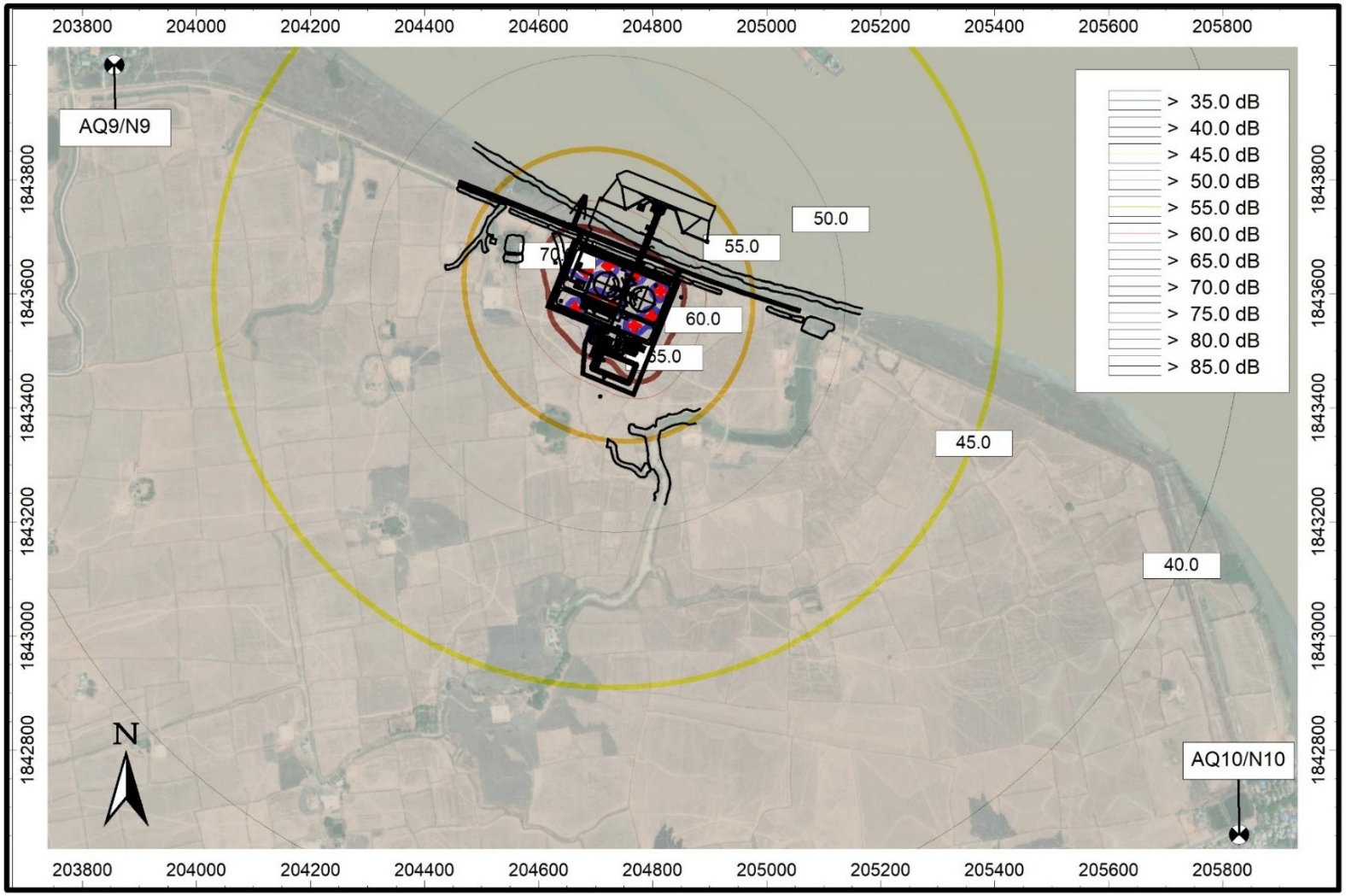
Source: AMacoustic, 2019.

Figure 7.5: Noise Contour during Construction Phase (Type B) – Zoomed in



Source: AMacoustic, 2019.

Figure 7.6: Noise Contour during Construction Phase (Type B) – Zoomed out



Source: AMacoustic, 2019.

According to the modelling results, the expected noise levels at each noise sampling station location is shown in ***Table 7.32***.

Table 7.32: Noise Level Results from Modelling at Noise Sampling Stations Location (Construction Phase)

Sampling Points	Coordination	UTP 47Q WGS84	Description of Sampling Point	Lday dB(A)	Lnight dB(A)	Leq dB(A)	NEQG Daytime (residential)	NEQG Daytime (industrial)
AQ9/N9	16°39'36.00"N	203856	In the compound of Aung Mingalar Monastery which located in That Kai Kwin Village, Dala Township, and Yangon Region	43.7	-	41.7	55	70
	96°13'25.32"E	1844001						
AQ10/N10	16°38'53.04"N	205829	In the Chaung Oo Village which located in Dala Township,	39.0	-	37.0	55	70
	96°14'32.48"E	1842652						

Impact Assessment Table

The significance of potential impacts to NSRs around the Project Area from noise generated through foundation work and civil construction during construction phase is assessed in ***Table 7.33***, and mitigation measures are presented thereafter.

Table 7.33: Significance of Impacts Due to Generation of Noise from Foundation Work and Civil Construction during Construction Phase of LNG Receiving Terminal

Significance of Impact					
Impact	Potential impacts to NSRs due to noise emissions from the operation of construction equipment during the construction phase.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts is considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction is expected to start mid 2019 and be complete in the region of 23 months, which would be considered short-term.				
Impact Extent	**Local**	Regional	International		
	Noise impact from construction equipment will have localised impact.				
Impact Scale	Considering there are no NSRs within the >45 dB noise contour areas of the model. Where the baseline noise levels at this location already exceeds the Myanmar Standard. ***Table 7.30*** and ***Table 7.31*** indicates that the increase in noise is not a noticeable difference (aggregate noise level is less than 3 dBA from the baseline).				
Impact Frequency	Throughout construction period; all construction equipment expected to only operate within 08.00am-22.00pm. Equipment is also expected to operate intermittently but repeatedly throughout the day.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Based on combination of above impact characteristics the impact magnitude is considered to be negligible.				
Receptor Sensitivity	**Low**	Medium	High		
	There are no NSRs located around the Project Area with significant noise level; the nearest NSR is approximately 1.2 km away. Therefore the receptor sensitivity level is considered as low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Receptor Sensitivity and Negligible Impact Magnitude will result in an overall Negligible impact.				

Mitigation Measures

The following measures will be put in place for the Project during the construction phase to mitigate impacts to NSRs:

- Noise barriers should be installed at the site boundary (facing the villages) and high enough which completely hides the noise sources from the NSR. It is anticipated that at least a 10 dB(A)

noise reduction can be provided[106]. The noise barrier material should have a superficial surface density of at least 7 kg/m^{-2} and have no openings or gaps;

- Well-maintained equipment to be operated on-site;
- Normal working hours of the contractor should be between 07:00 and 22:00 hours from Monday to Saturday (except holiday). If work needs to be undertaken outside these hours, it should be limited to activities that do not lead to exceedance of noise criteria at nearby NSRs and avoid early morning and night time construction;
- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components;
- Shut down or throttled down between work periods for machines and construction plant items (e.g. trucks) that may be in intermittent use ;
- Reduce the number of equipment operating simultaneously as far as practicable;
- Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable;
- Locate noisy plant (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable;
- Avoid transportation of materials on- and off-site through existing community areas; and
- Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site construction activities.

Residual Impacts

Since the pre-mitigation impacts were determined to be negligible, the significance level of residual impacts are also expected to be of **Negligible** Impact.

Monitoring Plan

Monthly noise monitoring should be conducted at the representative NSRs by the EPC contractor to check noise levels and compliance at the NSRs throughout the construction phase.

7.3.7.3 Operation of LNG Receiving Terminal (Operation Phase)

Overview

During the operation phase, the normal operation activities of LNG Receiving Terminal will include the operation of equipment, such as LNG pumps, gas engine generators, diesel fire pumps, etc. Some equipment will operate continuously, whereas other equipment will be placed on standby. During the LNG Receiving Terminal operation phase, equipment that will either be used or placed on standby but will produce noise impacts are shown in ***Table 7.34***. Equipment that is located “In Tank” and “Inside Enclosure” are not expected to produced noise beyond the equipment’s enclosure.

[106] https://www.fhwa.dot.gov/Environment/noise/noise_barriers/design_construction/keepdown.cfm

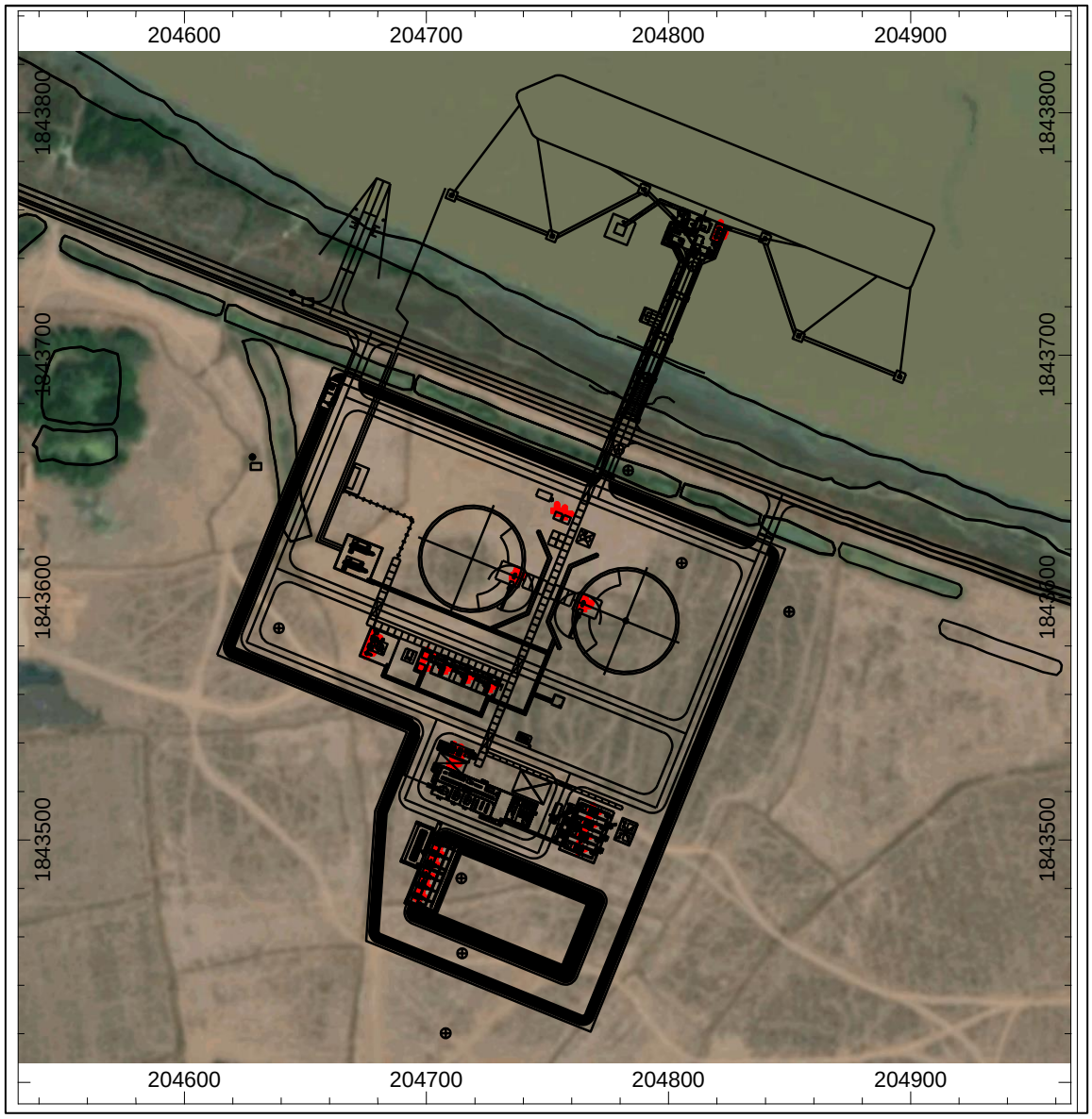
Table 7.34: Operation Equipment Noise Level

Code	Equipment List	Location Remark	Lw, dBA	Operation/ day
P_01	No. 1 LP LNG Pump A	In Tank	N/A	24 hr
P_02	No. 1 LP LNG Pump B	In Tank	N/A	stand by
P_03	No. 2 LP LNG Pump A	In Tank	N/A	stand by
P_04	No. 2 LP LNG Pump B	In Tank	N/A	stand by
P_05	Vapor Return Blower A	Outside building	85	12 hr (loading time only)
P_06	Vapor Return Blower B	Outside building	85	stand by
P_07	LP BOG Compressor A	Outside building	85	24 hr
P_08	LP BOG Compressor B	Outside building	85	stand by
P_09	LP BOG Compressor C	Outside building	85	stand by
P_10	HP Booster Pump A	Outside building	85	24 hr
P_11	HP Booster Pump B	Outside building	85	24 hr
P_12	HP Booster Pump C	Outside building	85	stand by
P_13	River Water Intake Pump A	Outside building	85	24 hr
P_14	River Water Intake Pump B	Outside building	85	24 hr
P_15	River Water Intake Pump C	Outside building	85	stand by
P_16	Gas Engine Generator 1	Inside Enclosure	N/A	24 hr
P_17	Gas Engine Generator 2	Inside Enclosure	N/A	24 hr
P_18	Gas Engine Generator 3	Inside Enclosure	N/A	24 hr
P_19	Gas Engine Generator 4	Inside Enclosure	N/A	stand by
P_20	HP BOG Compressor A	Outside building	85	24 hr
P_21	HP BOG Compressor B	Outside building	85	stand by
P_22	air compressor1	Outside building	85	24 hr
P_23	air compressor2	Outside building	85	stand by
P_24	Diesel Fire Pump 1	Outside building	85	stand by
P_25	Diesel Fire Pump 2	Outside building	85	stand by
P_26	Diesel Fire Pump 3	Outside building	85	stand by
P_27	Diesel Fire Pump 4	Outside building	85	stand by
P_28	Diesel Fire Pump 5	Outside building	85	stand by
P_29	Diesel Fire Pump 6	Outside building	85	stand by
P_30	EDG for LNG Terminal	Container type	85	by Process

Source: TPMC, 2019.

The location of equipment that is expected to produce noise during the operation phase, regardless of operation period, is shown in ***Figure 7.7***, with the red marking.

Figure 7.7: Location of Noise Emitting Equipment during Operation Phase



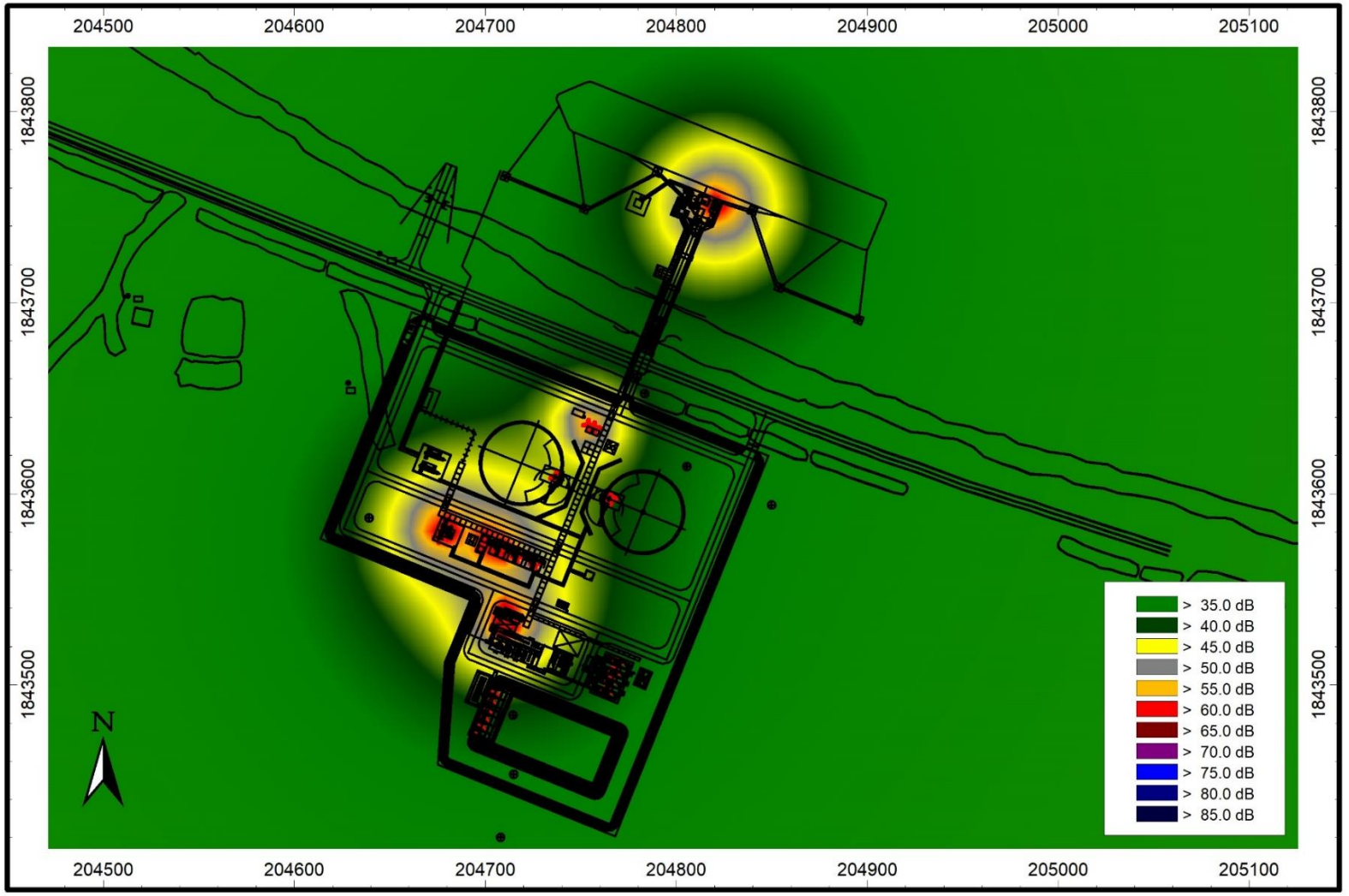
Source: TPMC, 2019. (Modified by AMacoustic)

Figure 7.8, ***Figure 7.9*** and ***Figure 7.10*** shows the noise modelling results in the form of noise contours based upon the input data from ***Table 7.34***. Type A (noise gradient map which shows the dissipating of noise over distance) and type B (noise contour map which shows the noise level at certain distance) figures show the same results; the difference involves using different graphical representations.

Although there are some equipment that is expected not to produce noise, given they are located “In tank” or “Inside Enclosure”, modelling has also been conducted for those equipment based on 85 dBA to simulate a worst-case scenario; therefore, ***Figure 7.11***, ***Figure 7.12*** and ***Figure 7.13*** shows the results of this scenario.

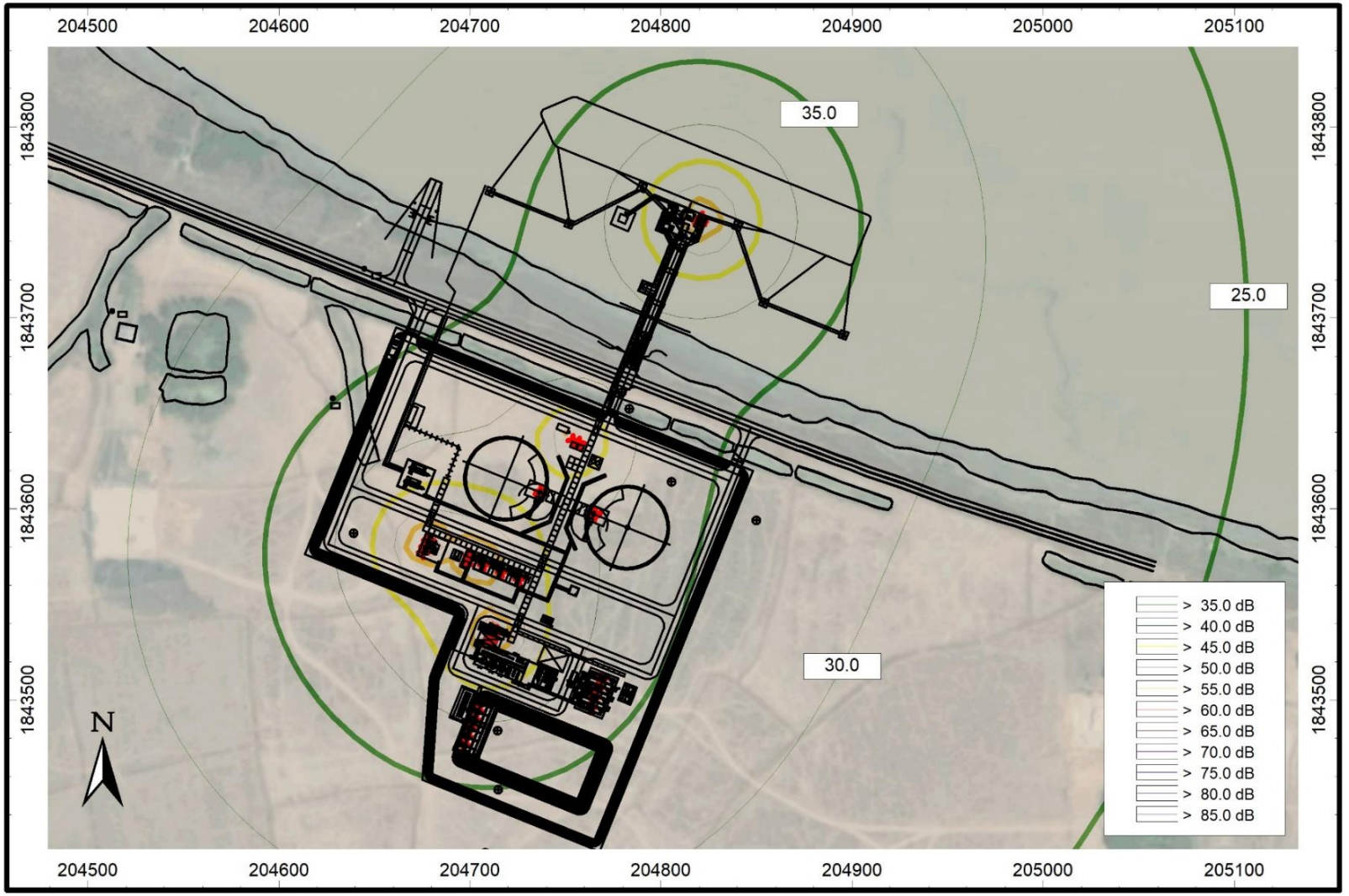
Based on the worst-case scenario (as shown in ***Figure 7.11***, ***Figure 7.12*** and ***Figure 7.13)***, the results suggest that noise levels rapidly dissipate over distance; with the majority of noise emission levels that extend beyond the LNG Receiving Terminal boundary being <40.0 dBA, which then dissipates down to <35 dBA. With regards to ***Figure 7.13*** and ***Section 7.3.5***, there are no NSRs within the >45.0 dBA noise contour areas, this indicates that noise emissions during operation are well within the Myanmar Standard.

Figure 7.8: Noise Contour during Operation Phase (Type A)



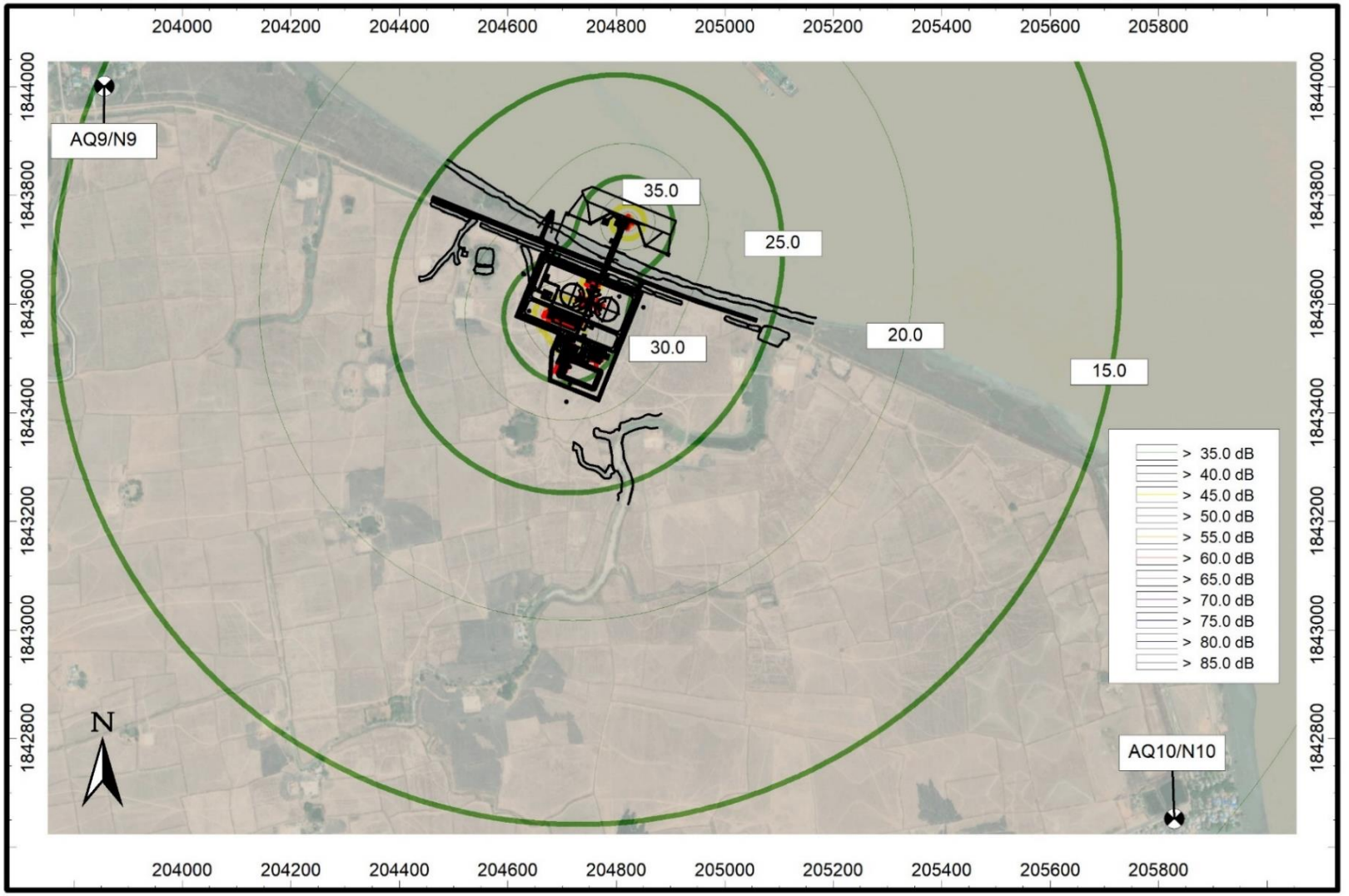
Source: AMacoustic, 2019.

Figure 7.9: Noise Contour during Operation Phase (Type B) – Zoomed In



Source: AMacoustic, 2019.

Figure 7.10: Noise Contour during Operation Phase (Type B) – Zoomed Out



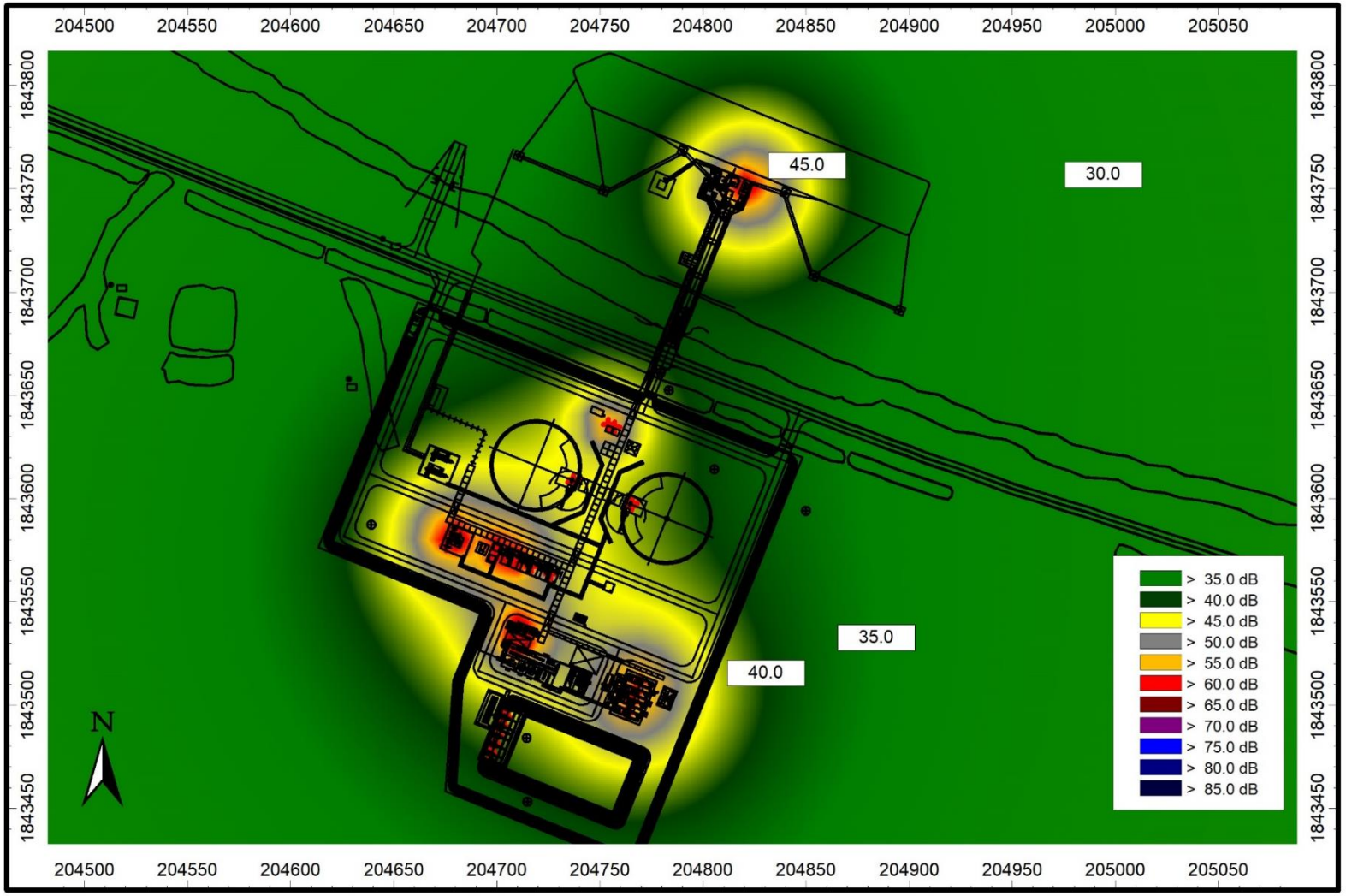
Source: AMacoustic, 2019.

Table 7.35: Operation Equipment Noise Level (Worst-case Scenario)

Code	Equipment List	Location Remark	Lw, dBA	Operation/ day
P_01	No. 1 LP LNG Pump A	In Tank	N/A	24 hr
P_02	No. 1 LP LNG Pump B	In Tank	N/A	stand by
P_03	No. 2 LP LNG Pump A	In Tank	N/A	stand by
P_04	No. 2 LP LNG Pump B	In Tank	N/A	stand by
P_05	Vapor Return Blower A	Outside building	85	12 hr (loading time only)
P_06	Vapor Return Blower B	Outside building	85	stand by
P_07	LP BOG Compressor A	Outside building	85	24 hr
P_08	LP BOG Compressor B	Outside building	85	stand by
P_09	LP BOG Compressor C	Outside building	85	stand by
P_10	HP Booster Pump A	Outside building	85	24 hr
P_11	HP Booster Pump B	Outside building	85	24 hr
P_12	HP Booster Pump C	Outside building	85	stand by
P_13	River Water Intake Pump A	Outside building	85	24 hr
P_14	River Water Intake Pump B	Outside building	85	24 hr
P_15	River Water Intake Pump C	Outside building	85	stand by
P_16	Gas Engine Generator 1	Inside Enclosure	N/A	24 hr
P_17	Gas Engine Generator 2	Inside Enclosure	N/A	24 hr
P_18	Gas Engine Generator 3	Inside Enclosure	N/A	24 hr
P_19	Gas Engine Generator 4	Inside Enclosure	N/A	stand by
P_20	HP BOG Compressor A	Outside building	85	24 hr
P_21	HP BOG Compressor B	Outside building	85	stand by
P_22	air compressor1	Outside building	85	24 hr
P_23	air compressor2	Outside building	85	stand by
P_24	Diesel Fire Pump 1	Outside building	85	stand by
P_25	Diesel Fire Pump 2	Outside building	85	stand by
P_26	Diesel Fire Pump 3	Outside building	85	stand by
P_27	Diesel Fire Pump 4	Outside building	85	stand by
P_28	Diesel Fire Pump 5	Outside building	85	stand by
P_29	Diesel Fire Pump 6	Outside building	85	stand by
P_30	EDG for LNG Terminal	Container type	85	by Process

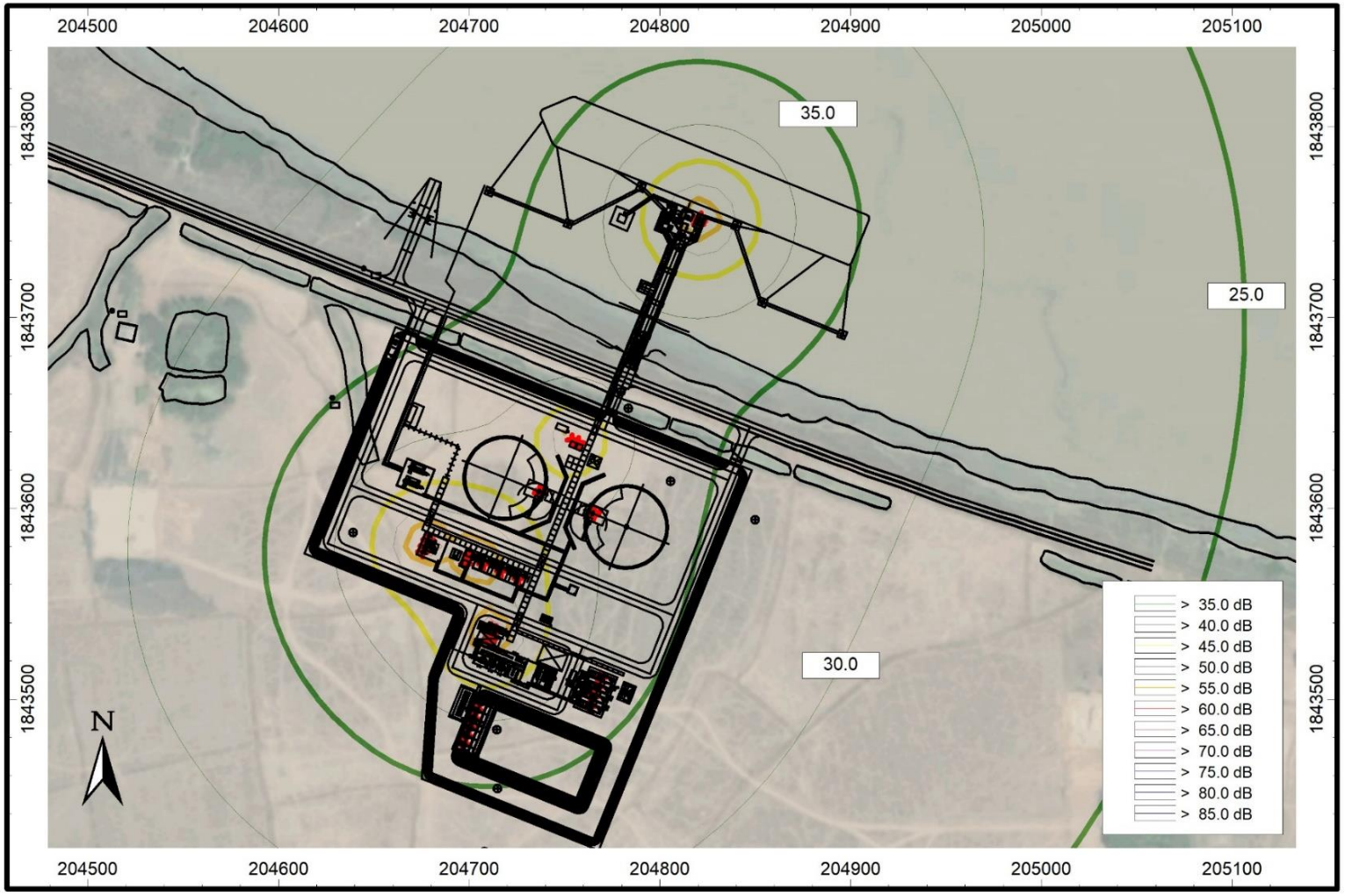
Source: TPMC, 2019.

Figure 7.11: Noise Contour during Operation Phase (Worst-case Scenario) (Type A)



Source: AMacoustic, 2019.

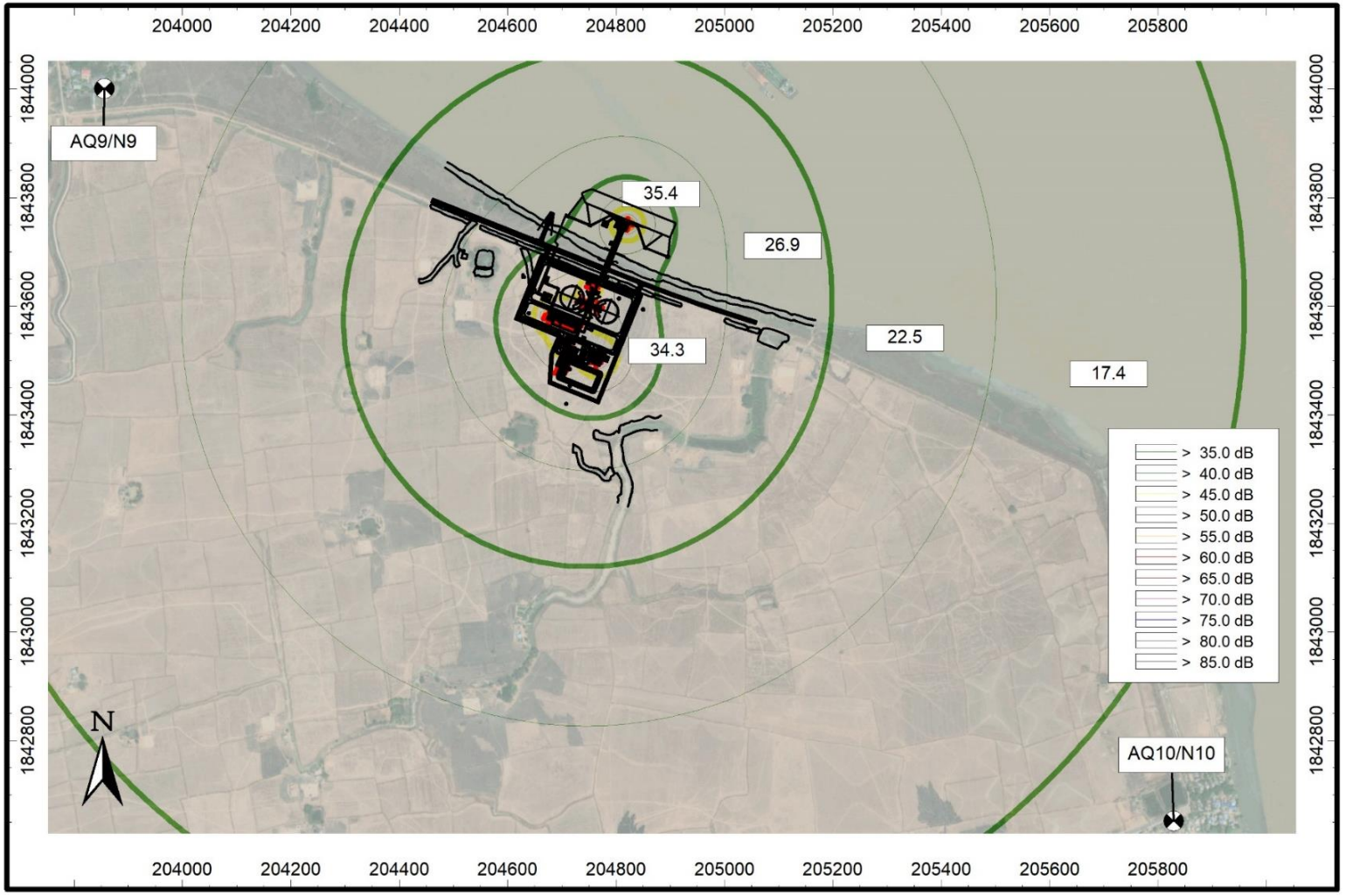
Figure 7.12: Noise Contour during Operation Phase (Worst-case Scenario) (Type B) – Zoomed In



Source: AMacoustic, 2019.

Note: Worst-Case Scenario refers to when all noise generating sources are operating at the same time.

Figure 7.13: Noise Contour during Operation Phase (Worst-case Scenario) (Type B) – Zoomed In



Source: AMacoustic, 2019.

Note: Worst-Case Scenario refers to when all noise generating sources are operating at the same time.

According to the modelling results, the expected noise levels at each noise sampling station location is shown in ***Table 7.36***.

Table 7.36: Noise Level Results from Modelling at Noise Sampling Stations Location (Operation Phase)

Sampling Points	Coordination	UTP 47Q WGS84	Description of Sampling Point	Lday dB(A)	Lnight dB(A)	Leq dB(A)	NEQG Daytime (residential)	NEQG Night-time (residential)	NEQG Daytime (industrial)	NEQG Night-time (industrial)
AQ9/N9	16°39'36.00"N	203856	In the compound of Aung Mingalar Monastery which located in That Kai Kwin Village, Dala Township, and Yangon Region	43.7	-	41.7	55	45	70	70
	96°13'25.32"E	1844001								
AQ10/N10	16°38'53.04"N	205829	In the Chaung Oo Village which located in Dala Township,	39.0	-	37.0	55	45	70	70
	96°14'32.48"E	1842652								

Note: This table is calculated based on a worst case scenario modelled data

Table 7.37 shows the result of ***Equation 8*** for the combined noise levels at noise station N9 location, approximately 1.6 km northwest of the LNG Receiving Terminal. The results indicate that the combined noise levels from the contributing operation equipment to the baseline is insignificant; NSRs at this location or distance will not notice any increase in noise levels.

Table 7.37: Combined Noise Level at Noise Station N9

Time of Day	Baseline (dBA)[a]	Noise Level Contribution from Construction Equipment (dBA)	Total Noise Level (dBA)	NEQG Daytime (residential)	NEQG Daytime (industrial)
Day Time	60	17.3	60.00023	55	70
Night time	54	17.0	54.00087	45	70

Source: SEM, 2018

Note: [a] Baseline data for noise station N1, survey period 11-12 May 2018.

Table 7.38 shows the result of ***Equation 8*** for the combined noise levels at noise station N10 location. The results indicate that the combined noise levels from the contributing operation equipment to the baseline is insignificant; NSRs at this location or distance will not notice any increase in noise levels.

Table 7.38: Combined Noise Level at Noise Station N10

Time of Day	Baseline (dBA)[a]	Noise Level Contribution from Construction Equipment (dBA)	Total Noise Level (dBA)	NEQG Daytime (residential)	NEQG Daytime (industrial)
Day Time	63	13.2	63.00005	55	70
Night time	51	12.9	51.00067	45	70

Source: SEM, 2018.

Note: [a] Baseline data for noise station N3, survey period 10-11 May 2018.

Impact Assessment Table

The significance of potential impacts to NSRs around the Project Area from noise generated through operation work during operation phase is assessed in ***Table 7.39***, and mitigation measures are presented thereafter.

Table 7.39: Significance of Impacts Due to Generation of Noise from Operation Activities of LNG Receiving Terminal during Operation Phase

Significance of Impact				
Impact	Potential impacts on NSRs due to noise emissions from operation of LNG Receiving Terminal equipment during the operation phase.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts is considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Potential impacts would likely be direct impacts.			
Impact Duration	Temporary	Short-term	**Long-term**	Permanent
	The operation phase is expected to continue for approximately 25 years, which would be			

Significance of Impact					
	considered long-term.				
Impact Extent	**Local**	Regional	International		
	Noise impact from operation equipment will have localised impact.				
Impact Scale	Considering there are no NSRs within the >45 dB noise contour areas, it is expected that NSRs near Project area may have negligible impact due to operation activities.				
Impact Frequency	Operation equipment is expected to run throughout operation period; however, some equipment will be placed on standby until certain situations arise, such as equipment failure (standby equipment to begin operation as back-up), and during unplanned events.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered to be negligible.				
Receptor Sensitivity	**Low**	Medium	High		
	There are no NSRs located around the Project Area with significant noise level; the nearest NSR is approximately 1.2 km away. Therefore the receptor sensitivity level is considered as low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a low resource sensitivity and negligible impact magnitude will result in an overall negligible significance level of impact.				

Mitigation Measures

The following measures will be put in place for the Project during the operation phase to mitigate impacts to NSRs:

- Well-maintained equipment to be operated on-site;
- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components;
- Shut down or throttled down between work periods for machines and non-essential operation plant items (e.g. trucks) that may be in intermittent use ;
- Reduce the number of equipment operating simultaneously as far as practicable;
- Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable;
- Locate noisy plant (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable; and
- Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site operation activities.

Residual Impacts

Since the pre-mitigation impacts were determined to be negligible, the significance level of residual impacts are also expected to be of **Negligible** Impact.

Monitoring Plan

No monitoring plan is required.

7.4 Surface Water Impact Assessment

7.4.1 Introduction

During the construction and operation phases, different activities have the potential to generate wastewater, accidental spills, sedimentation, and increased water consumption, which could lead to impacts on the hydrology and quality of surrounding freshwater bodies. In the LNG Receiving Terminal Study Area, the Yangon River is identified as the most prominent potential receiving water body. Therefore, it is important to understand the interaction between impacts generated from construction and operation activities of the LNG Receiving Terminal and the subsequent effects on surface water quality and hydrology. This section presents an evaluation of the potential impacts on surface water associated with the construction and operation of the proposed LNG Receiving Terminal based on the potential impacts identified during Scoping.

Potential impacts that have been identified and will be assessed under the Surface Water Impact Assessment includes the following:

- Water intake requirements for construction and operation activities;
- Cold Water Discharge (from regasification process);
- Sedimentation caused by soil erosion from storm water; and
- Sedimentation caused by piling activities.

This section also recommends management, mitigation and monitoring measures needed to ensure that any identified impacts can be reduced to as low as reasonably practical. Such measures are presented and will form part of the overall Environmental and Social Management Plan (ESMP, ***Chapter 12***) for the LNG Receiving Terminal.

7.4.2 Assumptions and Limitations

The assessment of potential impacts related to surface water in this section is based on the environmental baseline data (presented within ***Chapter 5***), socioeconomic baseline data (presented within ***Chapter 5***) and the information available from TPMC at the time of writing. Judgements and assessments have been made based on professional knowledge and previous experience of ERM. Should there be significant changes in factors such as assumed input data, engineering design of wastewater management and treatment components of the LNG Receiving Terminal, or agreed assessment criteria, then elements of this impact assessment and associated management, mitigation and monitoring measures may be needed to reflect these changes.

The environmental parameters that were sampled in the baseline survey (refer to ***Chapter 5***) are based upon commonly found contaminants, as well as local and international standards.

This section considers the nearby water bodies as the primary receptors. It is recognised that any changes to surface water may potentially impact other sensitive receptors that utilise these surface water resources. In this regard, this section assesses impacts and recommends management, mitigation and monitoring measures in relation to reducing direct impacts to surface water only. Assessing secondary impacts to receptors from changes to water quality or hydrology (identified as a result of this section) has been undertaken within other respective sections, taking into account the various management, mitigation and monitoring measures developed within this section.

Assessment of the impact towards other receptors will be carried out in the according receptor impact assessment section as follows:

- Loss of containment of hazardous waste (which includes diesel oil, hydraulic fluids, paint, battery, cement wash down, rinsing effluents, and sludge) generated from construction and operation activities (***Section 7.6: Waste***).

- Loss of containment of non-hazardous waste generated from construction and operation activities (which includes concrete, steel pipes, steel plates, structural steel, and wooden crates) generated from construction and operation activities (***Section 7.6: Waste***).
- Domestic solid waste generated from workers during construction phase, and permanent staff during operation phase (***Section 7.6: Waste***).
- Loss of containment of domestic liquid waste generated from workers during construction phase, and permanent staff during operation phase (***Section 7.6: Waste***).

7.4.3 Assessment Methodology

The methodology used for assessing impacts to surface water is aligned with the general impact assessment methodology presented in ***Chapter 6***.

7.4.4 Summary of Baseline Conditions

The main river located within the LNG Receiving Terminal area is the Yangon River. Modelling of the discharge of Yangon River indicates discharges ranging from < 500 m^3/s in April to approximately 7,000 m^3/s in August, with tidal water level variations of ~1 m to ~6 m based on water level measurements at Monkey Point downstream of LNG Receiving Terminal Site (De Koning & Janssen, 2015)[107].

The proposed Power Plant and LNG Receiving Terminal are located along the Yangon River, and the Natural Gas Pipeline that connects the LNG Receiving Terminal with the proposed Power Plant will cross the Twante canal from Dala Township to Sala Kanaungto Township, then cross the Yangon River again to Ahlone Township. The river is under tidal influence, and becomes brackish during the dry season. The estuary and creeks of the river are navigable by small craft with some areas covered by mangrove forest. There are a number of villages, as well as commercial ports located on its banks, therefore, the river is currently used for fisheries, navigation and marine logistic purposes.

Results from baseline sampling of surrounding water bodies, including the Yangon River, showed that, during the dry season, parameters that exceeded the compared local and/or international standards (Myanmar standards, IFC Standards, and EPA Standards) include TSS, TDS, Iron, and Manganese. Parameters that exceed the local and or international standards during the wet season include TSS, Iron, Mercury, and Manganese. All other parameters were found to be within the compared standards. Further details regarding Surface Water baseline conditions are shown in ***Chapter 5***.

7.4.5 Receptor Identification and Sensitivity

The primary receptor for impacts to surface water is the Yangon River, and downstream water users and aquatic ecosystems. Groundwater, ponds/lakes, and stored rainwater are the main water sources, along with stored water from streams. Water from the Yangon River is also used by villagers from townships within the Study Area; however, this is relatively limited. Water from the Yangon River is available year round.

Based on the baseline sampling conducted in the Yangon River, some parameters were found to be above relevant standards, and therefore the water bodies may be more sensitive to changes. However, the resources do not support very diverse or susceptible populations of flora and/or fauna, and their importance for local habitats and communities would be considered moderate. Overall, sensitivity of the receptor is considered Low.

[107] De Koning, R.J. & Janssen, M.P.J. (2015) Delft3D-FLOW Model of the Yangon Port Area. Delft University of Technology.

7.4.6 Summary of Project Activities with Potential Impacts

7.4.6.1 Construction Phase

Construction of the LNG Receiving Terminal will be carried out by the EPC contractor appointed by TPMC. Construction of the LNG Receiving Terminal is expected to take 23 months. Scheduled Commercial Operating Date (SCOD) is expected at the end of 2021. The maximum number of workers onsite during construction is anticipated to be 600 persons.

During the construction phase, potential impacts to surface water may arise from the following activities:

- Water Intake Requirements;
- Sedimentation caused by soil erosion during certain construction activities; and
- Sedimentation caused by piling activities.

7.4.6.2 Operation Phase

The operation phase is expected to continue for approximately 25 years. The average number of permanent workers present during operation is expected to be approximately 30, with small numbers of additional staff for security, cleaning, technical assistance, and occasional maintenance. The assessment of operational phase impacts includes those arising from routine operations and maintenance of the LNG Receiving Terminal.

During the operation phase, potential impacts to surface water may arise from the following activities:

- Water Intake Requirements; and
- Wastewater from LNGC (Ballast Water).
- Cold Water Discharge (from regasification process)

7.4.7 Assessment of Impacts to Surface Water

7.4.7.1 Overview

The assessment of impacts section will consider each type of the potential impact with respect to each phase (construction, operation), for those interactions/impacts that have been scoped in for the LNG Receiving Terminal. The section will be organized into sub-sections as follows:

- Overview – description of the LNG Receiving Terminal activities that have the potential to cause the impact during the respective phase;
- Impact Assessment Table – a summary table that assesses and evaluates impacts based on their characteristics, to determine the significance of the impact;
- Mitigation Measures – a list and description of corrective and preventive actions to be applied or implemented to LNG Receiving Terminal activities to reduce the significance of the assessed impact;
- Residual Impacts – reevaluation of impact significance after mitigation measures have been applied; and
- Monitoring Plan – summary of the monitoring plan, which has the objective to ensure that the mitigation measures have been implemented effectively and resulted in a reduction in the significance of residual impacts.

7.4.7.2 Water Intake Requirements (Construction Phase)

Overview

During the construction phase, various activities will require the use of water. Water requirements of the construction workforce is one factor that is to be considered, as personal water consumption, such as for hydration and washing is to be expected, as well as other construction activities that may also require water, which may place pressure on the local water supply.

Prefabricated concrete activities are estimated to consume 180 litres of water per day per litre of concrete, and another 50 litres of water for washing one (1) cubic meter of concrete work. An average of 18.42 m^3 of concrete work per day is estimated to consume 4,236 litres of water per day.

The maximum number of workers onsite during construction is anticipated to be 650 persons and each worker is estimated to consume approximately 33.3 litres of water per day[108], which is equivalent to 21,645 L/day for all construction workers. The average water consumption rate for all construction requirements, which includes human consumption and construction activities, is anticipated to be 900 m^3 per month (approximately 30 m^3 (30,000 L) per day). The raw water required during construction will be obtained from the local water distribution services, and will be treated and purified before use for construction.

The socioeconomic baseline study (***Chapter 5***) found that, in the LNG Receiving Terminal study area, groundwater, ponds/lakes, and stored rainwater are the main water sources, along with stored water from streams. Water from the Yangon River is also used by villagers from townships within the Study Area; however, this is relatively limited. Water from the Yangon River is available year round.

WHO Regional Office for South-East Asia[109] suggests that, including requirements for drinking, cooking, washing, cleaning, and waste disposal, up to 70 L per person per day of water are required for human use. The LNG Receiving Terminal's water requirement of 30,000 L per day during construction is equivalent to the water requirement for 429 people. Although the Yangon River will be the main source of water for construction activities, the water requirement for the LNG Receiving Terminal is not expected to impact the communities' existing water usage; communities mainly use lakes, ponds, or stored rain water as a source of water, with limited intake of the Yangon River.

In addition, considering the Yangon River is large with a constant flow of water, ranging from <500 m^3/s in April to 7,000 m^3/s in August, and with a relatively close distance (from LNG Receiving Terminal location) to the Gulf of Martaban, impacts to the Yangon River water supply is expected to have an insignificant difference.

Impact Assessment Table

Table 7.40: Impact Assessment Table for Water Intake Requirements (Construction Phase)

Significance of Impact			
Impact	Potential impacts on surface water due to water intake requirements during construction phase.		
Impact Nature	**Negative**	Positive	Neutral
	Potential impacts to surface water would be considered to be adverse (negative).		

[108] Metcalf& Eddy Inc. Wastewater Engineering: Treatment, Disposal, Reuse. 3rd Edition McGraw Hill, Network, 1979

[109] http://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/WHO/WHO5%20-%20Minimum%20water%20quantity%20needed%20for%20domestic%20use.pdf

Significance of Impact

Impact Type	**Direct**	Indirect	Induced	
	Impacts to surface water would be direct impacts through water intake from the Yangon River.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	Construction will take approximately 23 months, which would be considered short-term.			
Impact Extent	**Local**	Regional	International	
	Potential impacts would be limited to the LNG Receiving Terminal area, downstream of the Yangon River, and to any nearby water users, hence would be considered to be local.			
Impact Scale	The maximum number of workers onsite during construction is anticipated to be 650 persons. The LNG Receiving Terminal's water requirement of 30,000 L per day (30 m^3/day) during construction is equivalent to the water requirement for 429 people. Yangon River flow ranges from <500 m^3/s in April to 7,000 m^3/s in August. The raw water required during construction will be obtained from YCDC or other local water supplier, and will be transported by water trucks. The water requirement for the LNG Receiving Terminal is not expected to impact the communities' existing water usage; communities mainly use lakes, ponds, or stored rain water as a source of water, with limited intake of the Yangon River.			
Frequency	Impacts to surface water from water use could occur intermittently but repeatedly throughout the day for the duration of the construction phase.			
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Based on the characteristics above, the impact magnitude is likely to be Negligible.			
Receptor Sensitivity	**Low**	Medium	High	
	The primary receptor for impacts to surface water from water intake is the Yangon River, and downstream water users and aquatic ecosystems. Existing surface water quality is relatively poor. Groundwater, ponds/lakes, and stored rainwater are the main water sources, along with stored water from streams. Water from the Yangon River is also used by villagers from townships within the Study Area; however, this is relatively limited. Water from the Yangon River is available year round. The Yangon River does not support a diverse ecosystem and it would not be expected to be significantly impacted by changes in water quantity/flow rates. Given the background conditions of the Yangon River, sensitivity of the receptor is considered Low.			
Impact Significance	**Negligible**	Minor	Moderate	Major
	The combination of a Low Resource Sensitivity and Negligible Impact Magnitude will result in an overall Negligible impact.			

Mitigation / Management Measures

The significance of impacts is rated as Negligible, and no additional mitigation is considered necessary provided that existing/in-place controls are appropriately implemented.

Residual Impact (Post-mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts would be expected to be of **Negligible** significance.

Monitoring Plan

As detailed in the ESMP chapter, monitoring for surface water during the construction phase should consist of the following:

- Monthly monitoring of water intake quantities and flow rates in the Yangon River.

7.4.7.3 Water Intake Requirements (Operation Phase)

Overview

During the operation phase, various activities will require the use of water. These activities include water requirements for employees as personal water consumption (domestic water), and also water will be required specifically for the regasification unit, which will have the highest water intake requirements.

The main freshwater supply source will be taken from Yangon River. River water supply for the LNG Receiving Terminal will be used for heat transfer during regasification, and for domestic water use.

Table 7.41 presents the water requirements and their volumes during operation.

Table 7.41: Water Requirement during Operation

Water Requirement	Situation	Volume
Regasification heat transfer	Normal Operation	1,300 m^3/h
Domestic water (local authorized)	Normal Operation	4 m^3/h
Fire water	Normal Operation (Annual fire drill)	Fire water = 2,896 m^3/h (≤2 hours) Foam = 0.382 m^3
	Emergency (Largest fire scenario)	3,450 m^3/h (≤2 hours)

Source: TPMC, 2018.

During normal operations the main water consuming activity is from the regasification unit, with an expected volume requirement of 1,300 m^3/h (1,300,000 L/h), and from domestic water, with an expected volume requirement of estimated at 4 m^3/h (4,000 L/h), for a combined total of 1,304 m^3/h (1,304,000 L/h). In addition to normal operations, annual fire drills are expected consumer 2,896 m^3/h (2,896,000 L/h). Considering the Yangon River is large with a constant flow of water, ranging from <500 m^3/s in April to 7,000 m^3/s in August, and with a relatively close distance (from LNG Receiving Terminal location) to the Gulf of Martaban; therefore, impacts to the Yangon River water supply are expected to be relatively small.

The socioeconomic baseline study (***Chapter 5***) found that, in the LNG Receiving Terminal study area, groundwater, ponds/lakes, and stored rainwater are the main water sources, along with stored water from streams. Water from the Yangon River is also used by villagers from townships within the study are; however, this is relatively limited. Water from the Yangon River is available year round.

Impact Assessment Table

Table 7.42: Impact Assessment Table for Water Intake Requirements (Operation Phase)

Significance of Impact	
Impact	Potential impacts on surface water quantity due to pressure on local water supply due to LNG Receiving Terminal's water intake requirements during the operation phase.

Significance of Impact

Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts to surface water would be considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Impacts to surface water would be direct impacts through water intake from the Yangon River.			
Impact Duration	Temporary	Short-term	**Long-term**	Permanent
	The operation phase is expected to continue for approximately 25 years, which would be considered long-term.			
Impact Extent	**Local**	Regional	International	
	Potential impacts would be limited to the LNG Receiving Terminal area and downstream of the Yangon River, and hence would be considered to be local.			
Impact Scale	The maximum daily intake requirement for the LNG Receiving Terminal is expected to be 1,304 m^3/h (0.3622 m^3/s) (Regasification process and domestic water requirement). An annual fire drill will require a maximum intake of 2,896 m^3/h (0.8044 m^3/s), not more than two (2) hours consumption. During a worst-case scenario fire, the maximum water intake is approximately 3,450 m^3/h (0.9583 m^3/s), not more than two (2) hours consumption. Yangon River flow ranges from <500 m^3/s in April to 7,000 m^3/s in August. Although the Yangon River will be the main source of water for construction activities, the water requirement for the LNG Receiving Terminal is not expected to impact the communities' existing water usage; communities mainly use lakes, ponds, or stored rain water as a source of water, with limited intake of the Yangon River.			
Frequency	Most of the operational water intake for the LNG Receiving Terminal would be near-continuous for the LNG Receiving Terminal's operational duration. Annual fire drill water intake will only occur once every year, and for not longer than 2 hours continuously. Water intake for emergencies will only occur during an unplanned event involving fire/explosion, which is unlikely to occur (***Section 7.9***).			
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Based on the characteristics above, the impact magnitude is likely to be Negligible.			
Receptor Sensitivity	**Low**	Medium	High	
	The primary receptor for impacts to surface water from water intake is the Yangon River, and downstream water users and aquatic ecosystems. Existing surface water quality is relatively poor. Groundwater, ponds/lakes, and stored rainwater are the main water sources, along with stored water from streams. Water from the Yangon River is also used by villagers from townships within the Study Area; however, this is relatively limited. Water from the Yangon River is available year round. The Yangon River does not support a diverse ecosystem and it would not be expected to be significantly impacted by changes in water quantity/flow rates. Given the background conditions of the Yangon River, sensitivity of the receptor is considered Low.			
Impact Significance	**Negligible**	Minor	Moderate	Major
	The combination of a Low Resource Sensitivity and Negligible Impact Magnitude will result in an overall Negligible Impact.			

Mitigation / Management Measures

The significance of impacts is rated as Negligible; however, the following mitigation measure is recommended in order to minimize the impact:

- Ensure water intake does not exceed the flow rates of the Yangon River.

Residual Impact (Post-mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts are also expected to be of **Negligible** significance.

Monitoring Plan

As detailed in the ESMP chapter, monitoring for surface water during the operation phase should consist of the following:

- Biannual monitoring of water intake quantities and flow rates in the Yangon River.

7.4.7.4 Wastewater from LNGC (Operation Phase)

Overview

During the operation phase, LNG Carriers (LNGC) will be used to transport LNG to the LNG Receiving Terminal every 12 days. The unloading of LNG from the carrier takes approximately 12-16 hours. In addition, approximately 3 hours for mooring, cool down, connecting unloading arms, and cargo measurement, and approximately 3 hours for cargo measurement, arm purging, disconnecting arms, and unmooring; therefore, it is expected that the overall process will require 18-22 hours.

During the LNG unloading operation, ballast water will be taken on-board from the surrounding water into the double hull compartments to compensate for cargo discharge. No ballast water will be discharged in the Yangon River waters.

Contaminated water from the LNGC may contain oil, and other types of lubricants used for the LNGC operations; impact to surface water is caused when contaminated water is accidentally washed overboard from stormwater or deck cleaning.

Domestic wastewater from the LNGC crew is also expected to be another source of wastewater from the LNGC. Although discharge of domestic wastewater may occur while the LNGC is in the Yangon River, the amount is expected to be small.

Runoff of contaminated water, and domestic wastewater discharge directly into the Yangon River may cause some impact; however, they are expected to be insignificant, considering the sensitivity of the Yangon River is relatively low, and that the river flow of <500 m^3/s in April to 7,000 m^3/s in August will quickly dilute the contamination. Existing surface water quality is also relatively low considering parameters such as TSS and TDS exceed the related standards, and the ecological resources that it supports are not sensitive to a change in water quality.

Impact Assessment Table

Table 7.43: Impact Assessment Table for Wastewater from LNGC (from regasification process) (Operation Phase)

Significance of Impact					
Impact	Potential impacts on surface water quality due to wastewater from LNGC during the operation phase.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to surface water would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to surface water would be direct impacts through contaminated water runoff, and domestic wastewater discharge.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase is expected to continue for approximately 25 years, which would be considered long-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would be limited to the LNG Receiving Terminal area and downstream of the Yangon River, and hence would be considered to be local.				
Impact Scale	LNG Carriers (LNGC) will be used to transport LNG to the LNG Receiving Terminal every 12 days. Overall LNG unloading process will require 18-22 hours. No ballast water will be discharged in the Yangon River waters. Runoff of contaminated water, and domestic wastewater discharge directly into the Yangon River may cause some impact; however, they are expected to be insignificant, considering the sensitivity of the Yangon River is relatively low, and that the river flow of <500 m^3/s in April to 7,000 m^3/s in August will quickly dilute the contamination. Existing surface water quality is also relatively low considering parameters such as TSS and TDS exceed the related standards, and the ecological resources that it supports are not sensitive to a change in water quality.				
Frequency	Impacts to surface water quality from LNGC wastewater could occur intermittently but repeatedly throughout the LNG unloading process.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the characteristics above, the impact magnitude is likely to be small.				
Receptor Sensitivity	**Low**	Medium	High		
	The primary receptor for impacts to surface water from wastewater discharge and runoff is the Yangon River, and downstream water users and aquatic ecosystem. Existing surface water quality is relatively poor considering parameters such as TSS and TDS exceed the related standards, and the ecological resources that it supports are not sensitive to a change in water quality. Given the physical and biological background conditions, and downstream water users of the Yangon River, sensitivity of the receptor is considered Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Negligible Impact Magnitude will result in an overall Negligible Impact.				

Mitigation / Management Measures

The significance of impacts is rated as Negligible; however, the following mitigation measure is recommended in order to minimize the impact:

- Incorporate drainage systems or oil traps into the LNGC design to reduce the amount of potential contaminated water runoff; and
- Collect any contaminated water on the LNGC when possible, and send to certified contractor for disposal, to reduce potential contaminated water discharge into the Yangon River.

Residual Impact (Post-mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts are also expected to be of **Negligible** significance.

Monitoring Plan

As detailed in the ESMP chapter, monitoring for surface water during the operation phase should consist of the following:

- Quarterly surface water quality monitoring, using standard analytical methods; recommended monitoring locations include sampling station SW13 and SW14, which were used for baseline sampling, as shown in ***Section 5.1.5.2***.

7.4.7.5 Cold Water Discharge (from Regasification Process) (Operation Phase)

Overview

During the regasification process, the regasification unit will require a heat transfer medium (liquid) to increase the temperature LNG in order to change the state of matter from liquid to a gaseous form; as a result, the liquid medium will have lower temperatures, with an expected difference in temperature between inlet and outlet of river water is 10 °C. Improper storage, loss of containment, or discharge of wastewater that is not compliant with standards may cause impacts towards surface water. Different species of fauna or flora are adapted to a specific temperature range; exposure to temperatures beyond a species' temperature range may cause changes in behaviour, or may lead to possible die-off. Cold water discharge may also cause a shift in habitat, causing existing species to migrate to other locations, and/or allowing for species that are adapted to colder waters to thrive at the discharge point.

The cold water discharge is expected to be approximately 1,300 m^3/hr, and the difference in temperature between inlet and outlet of river water is 10 °C.

As wastewater will ultimately be discharged to the Yangon River to the South side of the LNG Receiving Terminal site; there may be potential impacts to downstream users of the water or aquatic ecosystems, due to altered water quality.

Summary of CORMIX Modelling

Environmental risk to surface water in the Yangon River from the development of the proposed LNG Receiving Terminal site was quantified using a steady-state discharge plume model for the planned heated discharge and cold water discharge, respectively. The United States Environmental Protection Agency (USEPA)-approved near-field model, CORMIX (Version 11.0), was used. CORMIX has been applied to many similar cases (http://www.cormix.info/) and is recognized by the USEPA and many other regulatory agencies as an appropriate model for computing trajectories, dilution rates, and mixing zone dimensions.

International Finance Corporation (IFC) water quality standards were applied as a basis for evaluating potential environmental impact to the Yangon River. The standard limits thermal discharges by the

temperature increase in the receiving waterbody; specifically, temperatures cannot exceed 3°C within a spatial region 100 meters from the discharge point. This standard was modified for analysing the cold water discharge not exceeding a 3°C reduction in background temperature 100 meters from the point of discharge.

An estimate of the LNG Receiving Terminal's maximum thermal loading to the Yangon River results in a 10°C decrease below ambient temperatures during both the warmer summer months (defined by Yangon River temperature of 31.3°C) and the cooler winter months (defined by a Yangon River temperature of 25.1°C). Mixing zone dimensions for the discharge from the LNG Receiving Terminal have been modelled with CORMIX for eight individually different scenarios, each varying with regards to ambient velocity, ambient temperature, effluent temperature, water depth, and tide / distance from shoreline. Design of the LNG Receiving Terminal effluent proved best to model the thermal plume as a single port discharge using CORMIX's single port discharge (CORMIX1) module.

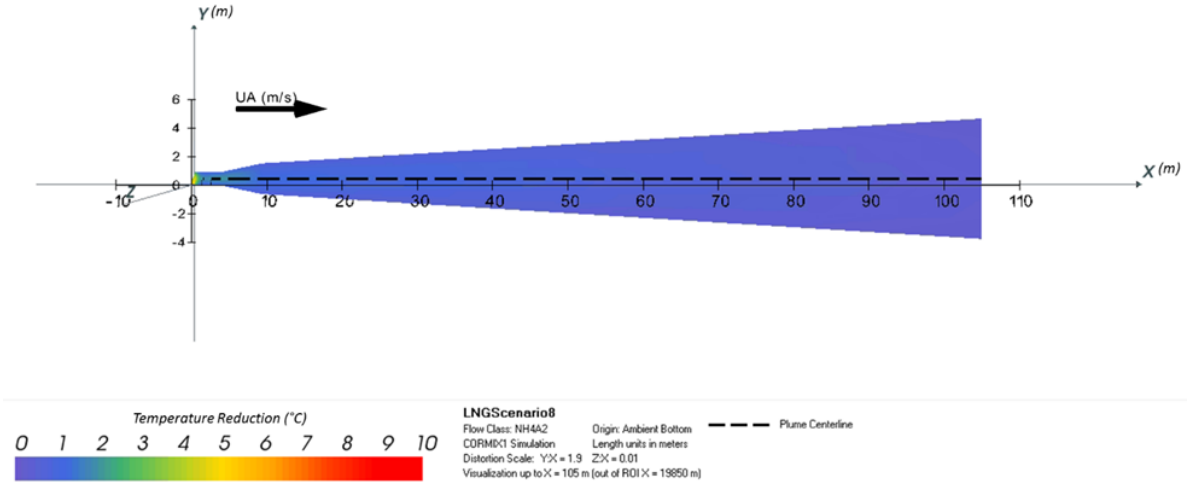
Various scenarios including critical conditions were modelled using CORMIX and evaluated for compliance with IFC standards. All modelling scenarios indicated the most critical scenario (worst case scenario) for the LNG Receiving Terminal involves high ambient velocity, high ambient temperature, and large depth. The < 3°C change in temperature requirement for the LNG is met approximately 9.1 m downstream (in the direction of ambient flow) and 2.6 m across the width of the Yangon River; therefore, the effluent does not exceed the NEQG 2.1.8 Natural Gas Liquefaction Standard, which states that the temperature difference between the river and the discharge effluent should not exceed 3°C beyond 100 meters from the point of discharge. The closed cycle cooling system is also used to reduce discharge temperatures.

ERM recommends using the results of the surface water plume modelling as a tool for comparison and not as a comprehensive compliance or impact analysis, as certain assumptions (e.g., the vertical configuration of the LNG discharge structure) may not necessarily be the most conservative of possible discharge options. Once certain site-specific details are confirmed, ERM recommends a more detailed modelling study aligned with the local regulatory permitting process be conducted.

The depictions of the two-dimensional plume are presented in ***Figure 7.14***, and ***Figure 7.15***.

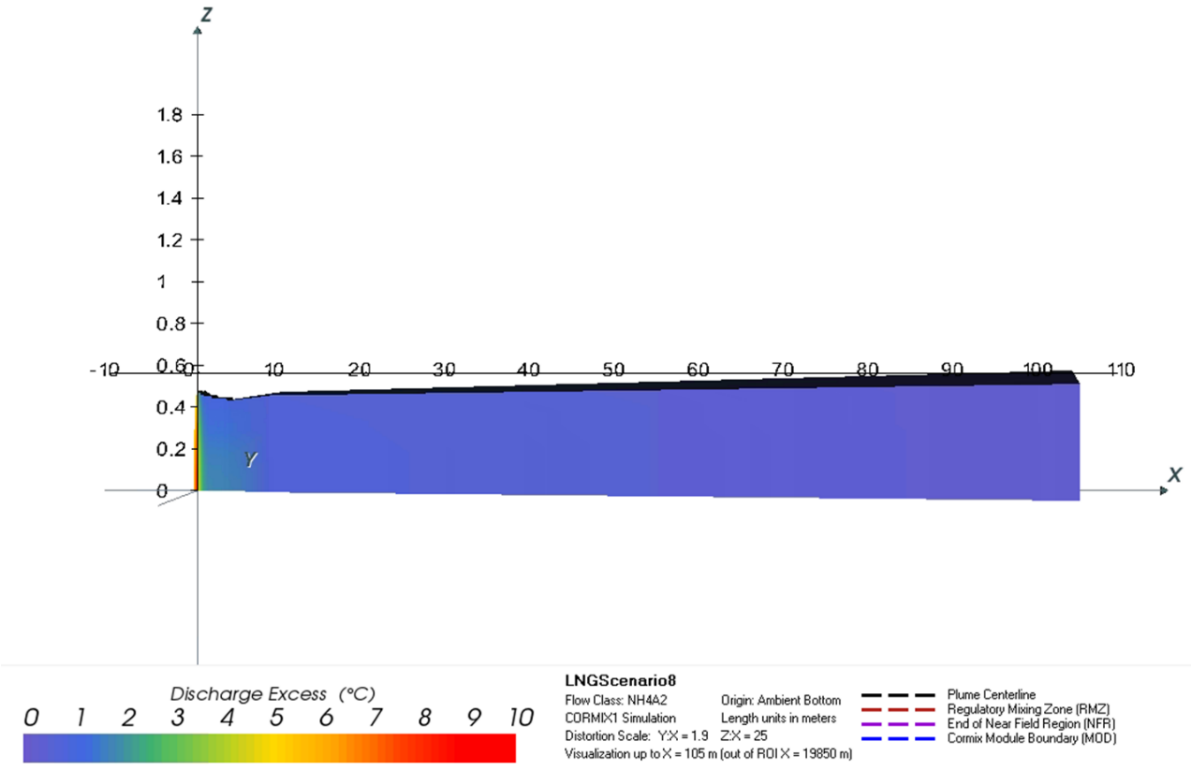
The full CORMIX modelling results are shown in ***Appendix U***.

Figure 7.14: Lateral (X-Y) View of the Thermal Plume Resulting from LNG Scenario 8 Critical Conditions



Source: ERM, 2019. (***Appendix U***)

Figure 7.15: Vertical (X-Y) View of the Thermal Plume Resulting from LNG Scenario 8 Critical Conditions



Source: ERM, 2019. (***Appendix U***)

Impact Assessment Table

Table 7.44: Impact Assessment Table for Cold Water Discharge (from regasification process) (Operation Phase)

Significance of Impact					
Impact	Potential impacts on surface water quality due to cold water discharge during the operation phase.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to surface water would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to surface water would be direct impacts through cold water discharge.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase is expected to continue for approximately 25 years, which would be considered long-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would be limited to the LNG Receiving Terminal area and downstream of the Yangon River, and hence would be considered to be local.				
Impact Scale	Approximate quantities which will be generated during operation are as follows: RU cold water discharge: 1,300 m^3/hr (Difference in temperature between inlet and outlet of river water is 10 °C) The most critical scenario for the LNG Receiving Terminal involves high ambient velocity, high ambient temperature, and large depth. The < 3°C change in temperature requirement for the LNG is met approximately 9.1 m downstream (in the direction of ambient flow) and 2.6 m across the width of the Yangon River; therefore, the IFC temperature standard for excess temperatures below 3°C within 100 m from the discharge point is met.				
Frequency	Impacts to surface water quality from cold water discharge is expected to occur continuously.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the characteristics above, the impact magnitude is likely to be small.				
Receptor Sensitivity	**Low**	Medium	High		
	The primary receptor for impacts to surface water from wastewater discharge and runoff is the Yangon River, and downstream water users and aquatic ecosystem. Existing surface water quality is relatively poor considering parameters such as TSS and TDS exceed the related standards, and the ecological resources that it supports are not sensitive to a change in water quality. Given the physical and biological background conditions, and downstream water users of the Yangon River, sensitivity of the receptor is considered Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Small Impact Magnitude will result in an overall Negligible Impact.				

Mitigation / Management Measures

The significance of impacts is rated as Negligible, and no additional mitigation is considered necessary provided that existing/in-place controls are appropriately implemented.

Residual Impact (Post-mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts are also expected to be of **Negligible** significance.

Monitoring Plan

As detailed in the ESMP chapter, monitoring for surface water during the operation phase should consist of the following:

- Continuous temperature monitoring at discharge point; by installing a continuous monitoring system at discharge point.

7.4.7.6 Sedimentation Caused by Soil Erosion during Certain Construction Activities (Construction Phase)

Overview

Earthworks activities that are expected from the LNG Receiving Terminal construction phase include primarily soil filling; no excavation activities are expected for this facility, therefore soil will be imported from a local supplier. Soil that is stored near water sources, such as canals or rivers, may erode and be carried by stormwater runoff into the water source.

The amount of soil that will be backfilled is approximately 100,000 m^3. The Plant construction site, being partially in an area subjected to flooding, may cause a similar impact caused by stormwater runoff. Flood water may cause suspension of exposed soil material, which may then be transported by the flow of water into the Yangon River or other nearby water sources; this will increase the total suspended solid levels. This will require careful study of potential placement of elevation and flood barriers.

The fill soil quality is also important to consider as contaminated soil may cause more impacts, in addition to increase in TSS. The impact potential will depend on the type of material/contamination found within the soil. Certain materials such as calcium, magnesium, sodium, etc. may only have a small effect on human health, and other organisms; however, materials such as chromium, cyanide, mercury, etc. will have a much greater impact. This will lead to the contamination of surface water, and the potential bioaccumulation in nearby water users, and aquatic organisms. The impacts from soil erosion can increase the sediment load (and therefore TSS) of the receiving water.

Increase in TSS levels will result in the decrease in light penetration in surface water, potentially reducing the photic zone area; therefore, inhibiting plant/organisms photosynthesis, which may reduce productivity, or lead to die-off. Visibility will also be decreased, which may limit the survivability of fish and other organisms that depend on visibility for navigation and survival.

The Yangon River's baseline conditions are considered relatively poor considering parameters such as TSS and TDS exceed the related standards, and the ecological resources that it supports are not sensitive to a change in water quality.

Impact Assessment Table

Table 7.45: Impact Assessment Table for Sedimentation Caused by Soil Erosion during Certain Construction Activities (Construction Phase)

Significance of Impact			
Impact	Potential impacts on surface water due to sedimentation from erosion during construction phase.		
Impact Nature	**Negative**	Positive	Neutral

Significance of Impact				
	Potential impacts to surface water would be considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Impacts to surface water would be direct impacts through sedimentation from soil erosion.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	Construction will take approximately 23 months, which would be considered short-term.			
Impact Extent	**Local**	Regional	International	
	Potential impacts would be limited to the LNG Receiving Terminal area and downstream of the Yangon River, and hence would be considered to be local.			
Impact Scale	The amount of soil that will be backfilled is approximately 100,000 m^3; during storage, exposure to stormwater runoff may lead to soil erosion. The impacts from soil erosion can increase the sediment load (and therefore TSS) of the receiving water. Increase in TSS levels will result in the decrease in light penetration in surface water, potentially reducing the photic zone area; therefore, inhibiting plant/organisms photosynthesis, which may reduce productivity, or lead to die-off. Visibility will also be decreased, which may limit the survivability of fish and other organisms that depend on visibility for navigation and survival.			
Frequency	Impacts to surface water from piling activities could occur intermittently but repeatedly throughout the day for the duration of the construction phase. Soil erosion from stormwater runoff may occur more frequently during the wet season, as compared to dry season.			
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the characteristics above, the impact magnitude is likely to be small.			
Receptor Sensitivity	**Low**	Medium	High	
	The primary receptor for impacts to surface water from sedimentation is the Yangon River, and downstream water users and aquatic ecosystems. Existing surface water quality is relatively poor considering parameters such as TSS and TDS exceed the related standards, and the ecological resources that it supports are not sensitive to a change in water quality. Given the background conditions of the Yangon River, sensitivity of the receptor is considered Low.			
Impact Significance	**Negligible**	Minor	Moderate	Major
	The combination of a Low Resource Sensitivity and Small Impact Magnitude will result in an overall Negligible impact.			

Mitigation / Management Measures

The significance of impacts is rated as Negligible; however, a number of additional mitigation measures are recommended in order to minimize the impact:

- Install silt trap to treat surface run-off from bunded areas prior to discharge to the stormwater system;
- Exposed soil surfaces should be protected by paving or fill material as soon as possible to reduce the potential of soil erosion and subsequent sedimentation;
- Use methods for minimising sediment runoff, as appropriate to the conditions on-site, including: wheel cleaning facilities, sand bag barriers, mulching, and re-vegetation, protect temporary trafficked areas on-site with coarse stone ballast or equivalent, open stockpiles of construction

materials or construction wastes on-site should be covered with tarpaulin or similar fabric during rainstorms;

- Regularly, and particularly following rainstorms, inspect and maintain drainage systems and erosion control and silt removal facilities to ensure proper and efficient operation at all times;
- Surface run-off from bunded areas should pass through oil/water separators prior to discharge to the storm water system;

Residual Impact (Post Mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts are also expected to be of **Negligible** significance.

Monitoring Plan

As detailed in the ESMP chapter, monitoring for surface water during the construction phase should consist of the following:

- Continuous monitoring of excavated soil, and any potential pathways for soil erosion into nearby water sources.
- Monthly surface water quality monitoring, using standard analytical methods.

7.4.7.7 Sedimentation Caused by Piling Activities (Construction Phase)

Overview

The Unloading Jetty will require piling activities to install approximately 70-80 piles that will support the Jetty topside structures. Piling activities is expected to cause high levels of disturbance to sediment from the strike caused by the hydraulic impact hammers, potentially causing sediment particles to become suspended. The impact from the disturbance of river sediments during jetty piling installation can both increase the sediment load (and therefore TSS) of the receiving water.

Increase in TSS levels will result in the decrease in light penetration in surface water, potentially reducing the photic zone area; therefore, inhibiting plant/organisms photosynthesis, which may reduce productivity, or lead to die-off. Visibility will also be decreased, which may limit the survivability of fish and other organisms that depend on visibility for navigation and survival.

The Yangon River's baseline conditions are considered relatively poor considering parameters such as TSS and TDS exceed the related standards, and the ecological resources that it supports are not sensitive to a change in water quality.

Impact Assessment Table

Table 7.46: Impact Assessment Table for Sedimentation Caused by Piling Activities during Certain Construction Activities (Construction Phase)

Significance of Impact			
Impact	Potential impacts on surface water due to sedimentation caused by piling activities during construction phase.		
Impact Nature	**Negative**	Positive	Neutral
	Potential impacts to surface water would be considered to be adverse (negative).		
Impact Type	**Direct**	Indirect	Induced
	Impacts to surface water would be direct impacts through sedimentation from soil erosion and piling activities.		

Significance of Impact					
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction will take approximately 23 months, which would be considered short-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would be limited to the LNG Receiving Terminal area and downstream of the Yangon River, and hence would be considered to be local.				
Impact Scale	The Unloading Jetty will require piling activities to install approximately 70-80 piles, which may disturb sediment. Piling activities is expected to cause high levels of disturbance to sediment from the strike caused by the hydraulic impact hammers, potentially causing sediment particles to become suspended. Increase in TSS levels will result in the decrease in light penetration in surface water, potentially reducing the photic zone area; therefore, inhibiting plant/organisms photosynthesis, which may reduce productivity, or lead to die-off. Visibility will also be decreased, which may limit the survivability of fish and other organisms that depend on visibility for navigation and survival.				
Frequency	Impacts to surface water from piling activities could occur intermittently but repeatedly throughout the day for the duration of the construction phase.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Based on the characteristics above, the impact magnitude is likely to be Negligible.				
Receptor Sensitivity	**Low**	Medium	High		
	The primary receptor for impacts to surface water from sedimentation is the Yangon River, and downstream water users and aquatic ecosystems. Existing surface water quality is relatively poor considering parameters such as TSS and TDS exceed the related standards, and the ecological resources that it supports are not sensitive to a change in water quality. Given the background conditions of the Yangon River, sensitivity of the receptor is considered Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Negligible Impact Magnitude will result in an overall Negligible impact.				

Mitigation / Management Measures

The significance of impacts is rated as Negligible; however, the following mitigation measure is recommended in order to minimize the impact:

- Evenly spread out the scheduling of piling activities to reduce the potential amount of sedimentation caused during one pilling session.

Residual Impact (Post Mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts are also expected to be of **Negligible** significance.

Monitoring Plan

As detailed in the ESMP chapter, monitoring for surface water during the construction phase should consist of the following:

- Monthly surface water quality monitoring once pilling activities commence, using standard analytical methods.

7.5 Soil and Groundwater Impact Assessment

7.5.1 Introduction

This section presents an evaluation of the potential impacts on soil and groundwater associated with the construction and operation of the proposed LNG Receiving Terminal based on the impacts identified during Scoping. During the construction and operation phases, various LNG Receiving Terminal activities have the potential to change soil structure, and generate wastewater or accidental leaks, which could potentially lead to impacts on the quality of soil, or to groundwater due to leaching.

Potential impacts that have been identified and will be assessed under the soil and groundwater Impact Assessment include the following:

- Accidental leaks of cold water from the regasification unit; and
- Loss of soil due to improper management during site clearance and excavation activities.

This section also presents management, mitigation and monitoring measures needed to ensure that any identified impacts can be reduced to as low as reasonably practical. Such measures will form part of the Environmental and Social Management Plan (ESMP, ***Chapter 12***) for the LNG Receiving Terminal.

7.5.2 Assumptions and Limitations

The assessment of potential impacts to soil and groundwater is based on the environmental baseline and the socioeconomic baseline data presented within ***Chapter 5***, and the information available from TPMC at the time of writing. Assessments have been made based on good industry practice, professional knowledge and previous experience of ERM. No quantitative modelling has been undertaken for the soil and groundwater impact assessment. Should there be significant changes in factors such as assumed input data, engineering design of the LNG Receiving Terminal components, or agreed assessment criteria, then elements of this impact assessment and associated management, mitigation and monitoring measures may be needed to be amended to reflect these changes. It is also recognised that there is considerable cross over with other sensitive receptors. In this regard, this section assesses impacts and recommends management, mitigation and monitoring measures in relation to reducing direct impacts to soil and groundwater only.

Assessment of the impact towards other receptors will be carried out in the according receptor impact assessment section as follows:

- Loss of containment of hazardous waste (which includes diesel oil, hydraulic fluids, paint, battery, cement wash down, rinsing effluents, and sludge) generated from construction and operation activities (***Section 7.6: Waste***).
- Loss of containment of non-hazardous waste generated from construction and operation activities (which includes concrete, steel pipes, steel plates, structural steel, and wooden crates) generated from construction and operation activities (***Section 7.6: Waste***).
- Domestic solid waste generated from workers during construction phase, and permanent staff during operation phase (***Section 7.6: Waste***).
- Loss of containment of domestic liquid waste generated from workers during construction phase, and permanent staff during operation phase (***Section 7.6: Waste***).

7.5.3 Assessment Methodology

The methodology used for assessing impacts to Soil/Groundwater is aligned with the general impact assessment methodology presented in ***Chapter 7***.

7.5.4 Summary of Baseline Conditions

Chapter 5 provides the details of the baseline conditions for soil and groundwater in the LNG Receiving Terminal study area. A summary of soil and ground baseline are as follows:

7.5.4.1 Soil

The Study Area is located on Meadow (Gleysol) and Meadow Alluvial soil (Fluvic Gleysols). The Meadow soil distributes near the river plains where occasional tidal floods occur and are typically non-carbonate, and they usually contain large amount of salts. Meadow Alluvial soil can be found in the flood plains. Sub-soil parameters that were found to exceed the Dutch Standard target values include copper and mercury; the locations with the exceeded values include S02 and S04, which are located along the pipeline alignment, therefore, the soil quality at the LNG Receiving Terminal is still within the Dutch Standard. All other parameters are also within the Dutch Standard.

7.5.4.2 Groundwater

The productivity of aquifers near the LNG Receiving Terminal area can be classified as “Strong Pore Water”, and groundwater quality is considered “Fresh Groundwater”. The groundwater type near the LNG Receiving Terminal area consists of "Continuous Aquifer in Plain and Intermountain Basin", with Natural Recharge Modulus ranging from 200,000-500,000 m^3/km^2-yr. Groundwater parameters that exceeded the Myanmar Standard and/or EPA Standard includes iron, total dissolved solids, and manganese. All three sampling sites (two (2) located along the pipeline alignment, and one (1) northeast of the Power Plant) contain parameters that exceed the standards. All other parameters are within the Myanmar standards, EPA, and WHO guidelines.

7.5.5 Receptor Identification and Sensitivity

Groundwater in the local communities surrounding the LNG Receiving Terminal area is used for domestic purposes. Groundwater quality ranges from good to slightly poor, and its sensitivity/importance can be rated as medium.

Soil quality can be considered degraded and of low sensitivity/importance. The resource does not support diverse habitat or populations, and has limited use in local communities (i.e. for topsoil of rubber plantations).

Given the background conditions, the sensitivity of soil and groundwater is considered low.

7.5.6 Summary of Project Activities with Potential Impacts

7.5.6.1 Construction Phase

Construction of the LNG Receiving Terminal will be carried out by the EPC contractor appointed by TPMC. Construction of the LNG Receiving Terminal is expected to take 23 months. Scheduled Commercial Operating Date (SCOD) is expected at the end of 2021.

During the construction phase, potential impacts to soil and groundwater may arise from loss of soil due to improper management during site clearance and excavation activities.

7.5.6.2 Operation Phase

The operation phase is expected to continue for approximately 25 years. The average number of permanent workers present during operation is expected to be approximately 30, with small numbers of additional staff for security, cleaning, technical assistance, and occasional maintenance. The assessment of operational phase impacts includes those arising from routine operations and maintenance of the LNG Receiving Terminal.

During the operation phase, potential impacts to soil and groundwater may arise from accidental leaks of cold water from the regasification unit.

7.5.7 Assessment of Impacts to Soil and Groundwater

7.5.7.1 Overview

The assessment of impacts section will consider each type of the potential impact with respect to each phase (construction, operation), for those interactions/impacts that have been scoped in for the LNG receiving terminal. The section will be organized into sub-sections as follows:

- Overview – description of the LNG Receiving Terminal activities that have the potential to cause the impact during the respective phase;
- Impact Assessment Table – a summary table that assesses and evaluates impacts based on their characteristics, to determine the significance of the impact;
- Mitigation Measures – a list and description of corrective and preventive actions to be applied or implemented to LNG Receiving Terminal activities to reduce the significance of the assessed impact;
- Residual Impacts – reevaluation of impact significance after mitigation measures have been applied; and
- Monitoring Plan – summary of the monitoring plan, which has the objective to ensure that the mitigation measures have been implemented effectively and resulted in a reduction in the significance of residual impacts.

7.5.7.2 Accidental Leaks of Cold Water from the Regasification Unit (Operation Phase)

Overview

During the regasification process, the regasification unit will require a heat transfer medium (liquid) to increase the temperature of LNG in order to change the state of matter from liquid to a gaseous form; as a result, the liquid medium will have a much lower temperature. The amount of cold water discharge is approximately 1,300 m^3/hr, and the difference in temperature between inlet and outlet of river water is 10 °C.

Accidental leaks of cold water occurring along the discharge pipeline (onshore section) may cause secondary impacts to biodiversity, which may reduce the health of certain organism or potential causing die-off within the area of direct contact with the cold water. No chemical dosing is involved; therefore, the cooling water discharge is considered non-hazardous. The impact from accidental leaks of cold water is expected to be relatively insignificant.

Impact Assessment Table

Table 7.47: Impact Assessment Table for Accidental Leaks of Cold Water from the Regasification Unit (Operation Phase)

Significance of Impact					
Impact	Potential impacts on soil due to accidental leaks of cold water from the regasification unit during the operation phase.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to soil would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to soil would be direct impacts through leakage of cold water discharge.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Cold water is expected to only have short-term impacts on soil and groundwater.				
Impact Extent	**Local**	Regional	International		
	Impacts would be limited to the LNG Receiving Terminal footprint; hence would be considered to be local.				
Impact Scale	The amount of cold water discharge is approximately 1,300 m^3/hr, and the difference in temperature between inlet and outlet of river water is 10 °C. Accidental leaks of cold water occurring along the discharge pipeline (onshore section) may cause secondary impacts to biodiversity, which may reduce the health of certain organism or potential causing die-off within the area of direct contact with the cold water. No chemical-dosing is involved with the regasification process; therefore, the cold water discharge is considered non-hazardous.				
Frequency	The impacts is not expected to occur.				
Likelihood	Very Unlikely	**Unlikely**	Likely to occur once or more in life of the Project	Likely to occur once or twice per year	Will likely occurs more than twice per year, or is continuous or certain to occur
	The likelihood of an accidental leak to occur is unlikely.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The impact magnitude is likely to be Negligible.				
Receptor Sensitivity	**Low**	Medium	High		
	Soil quality can be considered degraded and of low sensitivity/importance. The resource does not support diverse habitat or populations, and has limited use in local communities (i.e. for topsoil of rubber plantations). Given the background conditions, the sensitivity of soil and groundwater is considered low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Negligible Impact Magnitude will result in an overall Negligible impact.				

Mitigation / Management Measures

The significance of impacts is rated as Negligible; however, a number of additional mitigation measures are recommended in order to minimize the impact as follows:

- Project Proponent will prepare guidelines and procedures for immediate clean-up actions following any leaks;
- Use of spill or drip trays to contain leaks;
- Use of spill control kits to contain and clean small spills and leaks;
- Employee must be trained on emergency response procedure.

Residual Impact (Post-mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts are also expected to be of **Negligible** significance.

Monitoring Plan

No monitoring plan is required.

7.5.7.3 Loss of Soil due to Improper Management during Site Clearance and Excavation Activities (Construction Phase)

Overview

Earthworks activities that are expected from the LNG Receiving Terminal construction phase include primarily soil filling; no excavation activities are expected for this facility, therefore soil will be imported from a local supplier.

Earth works will include clearing of vegetation and grading of the LNG Receiving Terminal site. Soil excavation will not occur during the LNG Receiving Terminal construction phase; however, it is anticipated that soil will still be required for levelling/ backfilling, the amount of soil that will be backfilled is approximately 100,000 m^3.

Changes to soil structure may be caused by mechanical disturbance to the soil from these activities. Exposure of soil to rain and wind may in turn cause erosion and loss of top soil. It is anticipated that the subsoil, which will be stripped and removed from the LNG Receiving Terminal site, will be utilised for levelling/ backfilling, and therefore there will be no net loss from the main LNG Receiving Terminal site. This phase of the LNG Receiving Terminal is generally the most intensive in terms of potential for topsoil loss. Poor topsoil management can lead to a loss of topsoil through either the air (as dust) or as sediment entrained within surface water flows. Soil erosion can also result from poor management of stockpiled soils, excavated areas and general construction areas.

Additionally, soil will be compacted at the construction site and at access roads. Movement of heavy vehicles in the construction area will also result in soil compaction and damage to the soil structure. This compaction of the soil may potentially result in changed hydrological characteristics, such as reduced permeability and water infiltration to the soil, which could create additional surface run-off (and increase the flow velocity of this run-off), as well as reducing infiltration into subsurface aquifers.

Impact Assessment Table

Table 7.48: Impact Assessment Table for Loss of Soil due to Improper Management during Site Clearance and Excavation Activities (Construction Phase)

Significance of Impact					
Impact	Potential impacts on soil due to loss of soil due to improper management during site clearance and excavation activities during construction phase.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to soil and groundwater would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to soil and groundwater would be direct impacts through stormwater, excavation and movement of heavy equipment.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction is expected to start mid 2019 and be complete in 23 months, which would be considered short-term.				
Impact Extent	**Local**	Regional	International		
	Impacts would be limited to the LNG Receiving Terminal footprint; hence would be considered to be local.				
Impact Scale	The amount of soil that will be backfilled is approximately 100,000 m^3. Exposed soil may lead to soil erosion and potential impacts to groundwater. Impact expected to only occur near the Yangon River, in correlation to the location of the LNG Receiving Terminal. Possible changes to soil structure may be caused by mechanical disturbance and/or stormwater. Movement of heavy vehicles in the construction area will also result in soil compaction and damage to the soil structure.				
Frequency	Impacts to soil and groundwater from erosion of soil could occur intermittently but repeatedly throughout the day for the duration of the construction phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the characteristics above, the impact magnitude is likely to be small.				
Receptor Sensitivity	**Low**	Medium	High		
	Soil quality can be considered degraded and of low sensitivity/importance. The resource does not support diverse habitat or populations, and has limited use in local communities (i.e. for topsoil of rubber plantations). Given the background conditions, the sensitivity of soil and groundwater is considered low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Small Impact Magnitude will result in an overall Negligible impact.				

Mitigation / Management Measures

The significance of impacts is rated as Negligible; however, a number of additional mitigation measures are recommended in order to minimize the impact as follows:

- Delineation of clearance boundaries to limit the areas to be cleared;
- Scheduling clearance activities (if possible) to avoid extreme weather events such as heavy rainfall, extreme dry and high winds;
- Revegetation areas with temporary land use, conducting progressive rehabilitation;
- Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers;
- Reuse topsoil as much as possible within rehabilitation activities;
- Control erosion through diversion drains, sediment fences, and sediment retention basins; and
- Where topsoil is to be stored for later use in rehabilitation activities, the following basic principles are to be applied:
    - Stockpiles to be separated into topsoil and sub-soil and be located at least 50m from any surface water source or groundwater well;
    - To the extent possible, stockpiles are to be located in areas surrounded by natural wind barriers to minimise the potential for wind erosion;
    - Stockpile storage areas are to be prepared in advance of the removal of topsoil as much as possible; and
    - Topsoil heights are to be restricted in height to 2m above ground level to minimise wind erosion, and they are only to be partially compacted on the upper layer in order to promote aeration, maintain soil vertical structures, reduce runoff and encourage infiltration.

Residual Impact (Post-mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts are also expected to be of **Negligible** significance.

Monitoring Plan

As detailed in the ESMP chapter, monitoring for soil and groundwater during the construction phase should consist of the following:

- Conduct monthly site audit.

7.6 Waste Impact Assessment

7.6.1 Introduction

During the construction and operation phases, there are numerous Project activities that have the potential to generate hazardous and non-hazardous waste streams. This section identifies the various types of waste that will be generated, potential impacts associated with their generation and disposal, and appropriate mitigation, management and monitoring measures required to reduce residual impacts to an acceptable level.

Impacts associated with waste (both during planned and unplanned event) may affect various receptors, such as surface water, groundwater, soil and biodiversity. During the scoping activity, the following were identified as impacts related to waste and wastewater management:

- Storm water runoff from precipitation on-site;
- Impacts from waste generated activities that affect water sources and soil that are utilised by other receptors such as local communities, flora, fauna and marine species;
- Operational (non-hazardous) wastewater from LNG terminal – releasing of cold water into Yangon River may impact the ecosystem of the river and the people using the River; and
- Unplanned events causing loss of containment to the waste storage facilities on-site.

However, many of these are specific to certain receptors and are therefore assessed in other sections. Waste-related impacts that are assessed elsewhere include:

- Waste impacts whereby the receptor is air quality will be assessed in ***Section 7.1***;
- Waste impacts whereby the receptor is related to GHG emission will be assessed in ***Section 7.2***;
- Waste impacts whereby the receptor is surface water will be assessed in ***Section 7.4***;
- Waste impacts whereby the receptors are soil and groundwater will be assessed in ***Section 7.5***;
- Waste impacts whereby the receptor is biodiversity value will be assessed in ***Chapter 10***;
- Waste impacts whereby the receptor is social and health values will be assessed in ***Section 7.8***; and
- Waste impacts that are due to unplanned events (such as loss of containment) will be assessed in ***Section 7.9***.

There are some additional impacts associated with waste and wastewater management that have not been assessed elsewhere, and the purpose of this section (***Section 7.6***) is to assess those, which include the following:

- Biomass generated during construction activities (site clearance and preparation);
- Hazardous waste during construction and operation phase – such as diesel oil, hydraulic fluid, paint, battery, cement wash down, rinsing wastewater of contaminated equipment and sludge from operational system;
- Non-hazardous waste during construction and operation phase – concrete, steel pipes, steel plates and structures and wooden crates;
- Domestic solid waste during construction and operation phase – generated from workers on-site in the form of household waste and sewage; and
- Domestic liquid waste during construction and operation phase – majority of this will be sanitary waste.

7.6.2 Assumptions and Limitations

Project information and description and hence the potential impacts associated with the generation and management of waste and wastewater during construction and operation phase were reviewed in ***Chapter 4***. Based upon this review, potential sources of impacts associated with solid waste and wastewater that may arise during the construction and operation phases of the Project have been identified and are presented in the following sections. All the identified sources of potential impacts are then evaluated and their impact significance is determined based on the methodology described in ***Chapter 6*** (Impact Assessment Methodology). The temporal and spatial extent of activities will mean that the actual volumes and types of waste and wastewater generated will be dependent on the specific activities being undertaken at the time. Accordingly, to clearly identify impacts and development of management and mitigation measures specific to each activity, the potential impacts are described on a per-activity basis.

7.6.3 Assessment Methodology

The methodology used for assessing impacts to waste is aligned with the general impact assessment methodology presented in ***Chapter 6***.

7.6.4 Baseline Summary

Chapter 5 provides the details of the baseline conditions for current waste sources, including the typical waste management practices of the local community, current waste volume generated from the local community, major operating landfills and its capacity around the Project Study Area.

Generation of waste within the Study Area is a mixture of domestic, agricultural and industrial waste. Solid waste disposal is the responsibility of each household. Waste disposal areas exist in Hteinpin, Dawai Chang, Shwepyithar, Mingalardon, Dala, and Seikyi Khanaungato. Burning, landfilling and disposal into the nearest stream are common practice in the Project Study Area.

7.6.5 Receptor Identification and Sensitivity

The LNG Receiving Terminal is located in Dala Township, and adjacent to Yangon River. The closest community area is situated on the opposite bank of the river, in Kyauktan Township. The major structures within the 5 km Study Area of the Project are the jetty, warehouse and industrial buildings.

Currently, the total landfill capacity of the six waste disposal sites proposed as potential waste management facilities for the Project (as discussed in ***Section 5.1.10***) is estimated to be approximately 2,064 tonnes per day (cumulatively).

7.6.6 Summary of Project Activities with Potential Impacts

7.6.6.1 Construction Phase

Construction of the LNG Receiving Terminal will be carried out by the EPC contractor appointed by TPMC. Construction of the LNG Receiving Terminal is expected to take 23 months. Scheduled Commercial Operation Date (SCOD) is expected at the end of 2021. The maximum number of workers onsite during construction is anticipated to be 650 persons.

The Project Proponent will implement appropriate management and mitigation measures to reduce the significance of any impacts associated with waste or wastewater management, as will be discussed in the respective mitigation measures section for each impact type. The mitigation measures will also be summarised in the ESMP chapter (***Chapter 12***).

The following potential impacts associated with waste and wastewater management may occur from Project activities during the construction phase of the LNG Receiving Terminal:

- Potential impacts from improper management (storage and disposal) of biomass waste;

- Potential impacts from generation and management of hazardous waste (including diesel oil, hydraulic fluids, paint, battery, contaminated cement, wash down and rinsing effluent);
- Potential impacts from generation and management of non-hazardous waste (including uncontaminated concrete, steel pipes and plates, structural steel and wooden crates);
- Potential impact from generation and management of domestic solid waste; and
- Potential impact form generation and management of domestic liquid waste (including sanitary wastewater, greywater and kitchen water).

The details and potential receptors for the above impacts will be discussed further in the relevant sections below.

7.6.6.2 Operation Phase

The operation phase is expected to continue for approximately 25 years. The peak number of permanent workers present during operation is expected to be approximately 32 persons, with a small number of additional staff for security, cleaning, technical assistance, and occasional maintenance. The assessment of operational phase impacts includes those arising from routine operations and maintenance of the LNG Terminal. During the operation phase, the Receiving Terminal is expected to produce limited additional waste stream than those anticipated within the construction phase. These waste streams would consist of materials generated either due to the daily activities of the workforce (e.g. generation of putrescible waste) or a range of general construction waste such as paper from offices and scraps of steel/plastic during maintenance activities. Whilst most of these are likely to be non-hazardous, some of it may be hazardous, for example, used paint engine oils, hydraulic fluids, spent solvents, spent batteries etc. Whilst these volumes are anticipated to be much lower than those during the construction phase, the Project still needs to manage the waste appropriately, including consideration of the capacity of the existing waste management network and facilities in the region.

The Project Proponent will implement appropriate management and mitigation measures to reduce the significance of any impacts associated with waste or wastewater management, as will be discussed in the respective mitigation measures section for each impact type. The mitigation measures will also be summarised in the ESMP chapter (***Chapter 12***).

The following potential impacts associated with waste and wastewater management may occur from Project activities during the operation phase of the LNG Receiving Terminal:

- Potential impacts from generation and management of hazardous waste (including oil from operational machines and diesel oil from vehicles);
- Potential impacts from generation and management of non-hazardous waste (including uncontaminated concrete, steel pipes and plates, structural steel and wooden crates);
- Potential impact from generation and management of domestic solid waste; and
- Potential impact form generation and management of domestic liquid waste (including sanitary wastewater).

The details and potential receptors for the above impacts will be discussed further in the relevant sections below.

7.6.7 Assessment of Impacts from Waste

7.6.7.1 Impacts from Improper Management of Biomass Waste during Construction Phase

Overview

Whilst the site can be described as generally sparsely vegetated, there are small trees, shrubs and groundcover scattered throughout the site, which will need to be removed prior to earthwork commencing. The removed vegetation needs to be disposed of and therefore, will result in the generation of solid waste. Presently, it is estimated that up to 4,680 m^3 of biomass such as trees, shrubs and grass will be removed. Current common practice in the Study Area, where there is limited municipal waste options and facilities, is to gather the biomass waste into piles and dispose of it by burning. However, the EPC is expected to sell, where possible, biomass waste to locals for firewood. Remaining biomass waste will be buried. Potential impacts from improper management (storage and disposal) of biomass waste include:

- Decomposing biomass waste may release unpleasant odour and gases into the atmosphere, which can cause nuisance to locals, while also attracting certain wildlife or pests into the Study Area. However, the assessment of these impacts will be discussed in ***Chapter 10*** and ***Chapter 7.8*** (Biodiversity Impact Assessment and Social Impact Assessment); and
- As the EPC contractor is expected to bury the unsold portion of the Project construction biomass waste this can potentially impact the quality of surface water and soil and consequently groundwater. As a result, biodiversity receptors and human that uses these impacted receptors will also be influenced.

Impact Assessment Table

The significance of potential impacts due to improper management of biomass waste during the construction phase of LNG Receiving Terminal is assessed in ***Table 7.49***, and mitigation measures are presented thereafter.

Table 7.49: Significance of Impacts Due to Improper Management of Biomass Waste during Construction Phase of LNG Receiving Terminal

Significance of Impact					
Impact	Potential impacts due to improper management of removed biomass (biomass waste). Some of the impacts may be related to unpleasant spread of odor to the local community as the biomass waste is decomposing. In addition, environmentally harmful gases may be released into the atmosphere and threaten the condition of the air quality and the Study Area vicinity can potentially be released from the biomass waste. Moreover there are potential impacts related to contamination of soil quality, surface water and groundwater from direct burying of biomass waste.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts from improper waste management is considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts would be direct.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction will take approximately 23 months for the LNG Receiving Terminal. Duration is considered as short-term.				
Impact Extent	**Local**	Regional	International		
	The extent of potential impacts would likely be limited to the location where biomass is stored and buried, and therefore is local.				
Impact Scale	■ The anticipated volume of biomass to be removed and requiring management is approximately 4,680 m^3. ■ The impact would be limited to the footprint of where the biomass is stored and buried and therefore the scale is locally restricted.				
Impact Frequency	It is likely that this impact will occur intermittently during the site clearance and preparation stage.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered to be small.				
Receptor Sensitivity	Low	**Medium**	High		
	There are no sensitive receptors nearby. Most of the Study Area consist of open space, jetty and storage area with a small proportion of agricultural land. However, impact to soil quality (from burying biomass waste) may impact agricultural activity and therefore the receptor sensitivity is rated as medium.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a medium resource sensitivity and small impact magnitude will result in an overall minor significance level for the impact.				

Mitigation Measures

The following measures will be put in place for the Project during the construction phase to mitigate impacts to physical receptors (soil, groundwater and surface water):

- Any biomass not taken by the local community is to be appropriately stored (or immediately mulched) for later use within site stabilisation and rehabilitation activities;
- Site clearance and preparation is to be designed and conducted in a manner that requires minimum removal of vegetation;
- Introduce and implement, where practicable, a recycling plan for biomass waste to reduce the amount of biomass required to be burnt. This may include identifying potential market or appropriate industry to reintroduce the biomass as part of their resource consumption;
- Ensure no hazardous materials or chemicals are present within the biomass waste (for example due to an accidental spill) prior to burying; and
- Location of burying are to be far away from sensitive receptors and in a location where impact of burying can be appropriately controlled.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **Negligible** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during construction phase should consist of the following:

- Monitoring of waste segregation, transportation and disposal practices in the Project activity areas and disposal location, as to be defined in a Waste Management Plan to be prepared specifically for the Project; and
- Monitoring of appointed waste contractors using chain-of custody documentation, as to be defined in a Waste Management Plan to be prepared specifically for the Project.

7.6.7.2 Impacts from Generation and Management of Hazardous Materials during Construction Phase

Overview

During the construction phase, a range of hazardous waste (both solid and liquid form) will be generated due to the use of hazardous chemicals and construction materials that are contaminated by hazardous chemicals. A licensed waste contractor will be hired to dispose of waste appropriately. The total approximate quantities of hazardous waste during construction phase is shown in ***Table 7.50***. These waste will be stored on-site and transported off-site to a licensed waste disposal contractor.

Table 7.50: Hazardous Waste Quantities

Hazardous Material	Amount
Diesel oil	10 L per day
Hydraulic fluids	5 L per day
Paint	10 L per day (painting work period 90 days)
Battery	1 kg per day
Concrete	1 m^3 per day

Source: TPMC, 2019.

Additionally, hazardous wastewater may also be generated from chemical cleaning of the equipment during the pre-commissioning phase. The volume of anticipated rinsing effluent is unknown at this

time, but appropriate containment and management measures will be implemented by the Project, and the impact is therefore not expected to be significant. Hazardous wastewater from chemical cleaning will be transported off-site to a licensed Hazardous Waste Treatment Facility.

Additionally, the following impacts may occur to the existing waste management network from the Project construction activities:

- Project construction activities will generate waste which the EPC contractor plans to use a licensed waste contractor to appropriately dispose of the hazardous waste. This will therefore increase the pressure on these facilities due to increased quantity of incoming waste, and thereby reducing the local waste handling capacity; and
- Additional industrial waste (such as hydraulic fluids) will be introduced by the Project to the waste management network whereby the network may not be able to adapt their management strategy and methods to handle the new types of waste. And therefore impacting the waste management capacity.

Impact Assessment Table

The significance of potential impacts from generation and management of hazardous waste during the construction phase of the LNG Receiving Terminal are assessed in ***Table 7.51***, and mitigation measures are presented thereafter.

Table 7.51: Significance of Impacts from Generation and Management of Hazardous Waste during Construction Phase of LNG Receiving Terminal

Significance of Impact					
Impact	Impacts from generation and management of hazardous waste by increasing the stress put on the facilities and reducing the capacity and capability of the existing waste management network.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts is considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to the existing waste management network would be direct				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction of the LNG Receiving Terminal is expected to take 23 months. Duration would therefore be short-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would likely be restricted to the local area.				
Impact Scale	The scale of potential impacts due to release of waste is potentially large due to the quantities present during this stage, particularly when considered in light of the limited waste management network in the area.				
Impact Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the construction phase.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered to be medium.				
Receptor Sensitivity	Low	**Medium**	High		
	There are limited number of licensed waste contractors within the region henceforth the receptor sensitivity is rated as medium.				

Impact Significance	Negligible	Minor	**Moderate**	Major
	The combination of a medium resource sensitivity and medium impact magnitude will result in an overall moderate impact.			

Mitigation Measures

The following measures will be put in place for the Project during construction phase to mitigate impacts to the existing waste management facilities:

- Prior to construction commencing, TPMC is to engage with local authorities and other stakeholders to determine the capacity of the local waste management network to absorb the new waste streams generated from the Project during construction;
- A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project construction. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified. The WMP will be developed by the project proponent (or its EPC contractor) prior to commencing construction work;
- Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable;
- Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the construction site.;
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed. Bi-yearly unplanned audit will be performed by TPMC HSE team on all waste contractors in order to verify compliance with contract;
- Monitoring of appointed waste contractors using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and
- The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during construction activity is being managed responsibly.
- Effluent from chemical cleaning of the equipment during the pre-commissioning phase will be collected in an appropriate drainage system and transported off-site to a licensed Hazardous Waste Treatment Facility. The capacity of this facility will be assessed to ensure that it is capable of managing the Project's wastewater volumes.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **Minor** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during the construction phase should consist of the following:

- Monitoring of waste segregation, transportation and disposal practices in the project activity areas and disposal location, as to be defined in a Waste Management Plan to be prepared specifically for the Project; and
- Monitoring of appointed waste contractors using chain-of custody documentation, as to be defined in a Waste Management Plan to be prepared specifically for the Project.

7.6.7.3 Impacts from Generation and Management of Hazardous Materials and Waste during Operation Phase

Overview

During operation phase, diesel oil will be the only main hazardous waste produced. The hazardous materials to be stored on site during operation are presented in ***Table 7.52***. The chemicals will be stored, handled, and transported to the Project Site appropriately and according to their Material Safety Data Sheets (MSDS), and MSDS will be made available on-site.

Table 7.52: Hazardous Materials during LNG Receiving Terminal Operation Phase

Hazardous Material	Use of Hazardous Materials	Storage Location Onsite	Quantities to be Stored Onsite*
Diesel oil	Liquid fuel for emergency diesel engine generator, emergency diesel generator	Storage Tank	Estimate at 2 x 7200 litres x 3 days for fuel tank = 43,200 litres.

*Note: *Estimated figures only*

Moreover, during operation phase of the LNG Terminal, it is anticipated that there will be generation of sludge from operational processes. However, the volume of this sludge waste is unknown at this time. TPMC will assign a local waste contractor to dispose these waste responsibly.

Impact Assessment Table

The significance of potential impacts from generation and management of hazardous waste during operation phase of LNG Receiving Terminal are assessed in ***Table 7.53***, and mitigation measures are presented thereafter.

Table 7.53: Significance of Impacts from Generation and Management of Hazardous Waste during Operation Phase of LNG Receiving Terminal

Significance of Impact				
Impact	Impacts from generation and management of hazardous waste by increasing the stress put on the facilities and reducing the capacity and capability of the existing waste management network.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impact is considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Impacts to the existing waste management network would be direct.			
Impact Duration	Temporary	Short-term	**Long-term**	Permanent
	The operation phase is expected to continue for approximately 25 years, which would be considered as long-term.			
Impact Extent	**Local**	Regional	International	
	Potential impacts would likely be restricted to the local area.			
Impact Scale	Currently, there is a limited number of licensed waste contractor within the region that are capable of handling hazardous waste.			
Impact Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the operation phase which is anticipated to be 25 years.			

Significance of Impact					
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered to be small.				
Receptor Sensitivity	Low		**Medium**	High	
	There are limited number of licensed waste contractors within the region henceforth the receptor sensitivity is rated as medium.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a medium resource sensitivity and small impact magnitude will result in an overall minor impact.				

Mitigation Measures

The following measures will be put in place for the Project during operation phase of LNG Receiving Terminal to reduce the impact to existing waste management facilities:

- A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project operation. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the operation phase for all of the waste streams identified. The WMP will be developed by the project proponent (or its EPC contractor) prior to commencing construction work;
- Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable;
- Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations;
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed;
- Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and
- The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during operation activity is being managed responsibly.

Residual Impacts

If the recommended mitigation and management measures are implemented, residual impact significance would be reduced to **Negligible** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during both the construction and operation phases should consist of the following:

- Monitoring of waste segregation, transportation and disposal practices in the project activity areas and disposal location, as to be defined in a Waste Management Plan to be prepared specifically for the Project; and

- Monitoring of appointed waste contractors using chain-of custody documentation, as to be defined in a Waste Management Plan to be prepared specifically for the Project.

7.6.7.4 Impacts from Generation and Management of Non-Hazardous Waste during Construction Phase

Overview

During the construction phase, non-hazardous waste is likely to be produced from uncontaminated concrete, steel pipes, steel plates, structural steel and wooden crates. Opportunities will be explored for selling steels and wooden crates to locals. Remaining waste will be gathered and handover to a licensed waste contractor to be disposed responsibly. ***Table 4.15*** presents details of the total non-hazardous construction waste during construction phase.

Table 7.54: Construction Waste during LNG Receiving Terminal Construction Phase

Waste Type	Amount
Concrete	720 Tons
Steel Pipes	6 Tons
Steel Plates	6 Tons
Structural Steel	2 Tons
Wooden Crates	30 Tons

Source: TPMC, 2019.

Note: Construction waste amount is estimated for the entire construction phase.

Impact Assessment Table

The significance of potential impacts to the capacity of the existing waste management network to deal with non-hazardous waste from the Project construction activity is assessed in ***Table 7.58***, and mitigation measures are presented thereafter.

Table 7.55: Significance of Impacts from Generation and Management of Non-Hazardous Waste during Construction Phase of LNG Receiving Terminal

Significance of Impact				
Impact	Potential impacts from generation and management of non-hazardous waste by increasing the stress put on the facilities and reducing the capacity and capability of the existing waste management network.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts is considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Impacts would be direct.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	Construction will take approximately 23 months for the LNG Receiving Terminal. Duration is considered as short-term.			
Impact Extent	**Local**	Regional	International	
	Potential impacts would likely be restricted to the local area.			

Significance of Impact					
Impact Scale	The scale of potential impacts due to release of waste is potentially large due to the quantities present during this stage, particularly when considered in light of the limited waste management network in the area (YCDC estimate to have a landfill capacity of 2,064 tonnes per day).				
Impact Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the construction phase.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered to be medium.				
Receptor Sensitivity	Low	**Medium**	High		
	The existing waste network and facility within the Yangon City Development Committee (YCDC) is estimated to have a landfill capacity of 2,064 tonnes per day cumulative over six sites. This amount is considered to be relatively small comparative to the amount of waste generated by Yangon Region henceforth the receptor sensitivity is rated as medium.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a medium resource sensitivity and medium impact magnitude will result in an overall moderate significance level of impact.				

Mitigation Measures

The following measures will be put in place for the Project during construction phase of LNG Receiving Terminal to reduce the impact to existing waste management facilities:

- A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project construction. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified. The WMP will be developed by the project proponent (or its EPC contractor) prior to commencing construction work;
- Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable;
- Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations;
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed;
- Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of construction phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and
- The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during construction activity is being managed responsibly.

Residual Impacts

If the recommended mitigation and management measures are implemented, residual impact significance would be reduced to **Minor** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during both the construction and operation phases should consist of the following:

- Monitoring of waste segregation, transportation and disposal practices in the project activity areas and disposal location, as to be defined in a Waste Management Plan to be prepared specifically for the Project; and
- Monitoring of appointed waste contractors using chain-of custody documentation, as to be defined in a Waste Management Plan to be prepared specifically for the Project.

7.6.7.5 Impacts from Generation and Management of Non-Hazardous Waste during Operation Phase

Overview

Sources of non-hazardous operational waste will be from maintenance activities (which is categorised to be part of the operational phase). These waste is likely to be similar type to construction phase (i.e. uncontaminated concrete, steel pipes, steel plates, structural steel and wooden crates) but in lower quantity. Remaining waste will be gathered and handover to licensed waste contractor to be disposed responsibly. However, the volume of this waste is unable to be estimated as the quantity will depend on the size of the maintenance activity.

Impact Assessment Table

The significance of potential impacts to the capacity of the existing waste management network to deal with non-hazardous waste from the Project operation activity is assessed in ***Table 7.58***, and mitigation measures are presented thereafter.

Table 7.56: Significance of Impacts from Generation and Management of Non-Hazardous Waste during Operation Phase of LNG Receiving Terminal

Significance of Impact				
Impact	Impacts from generation and management of non-hazardous waste by increasing the stress put on the facilities and reducing the capacity and capability of the existing waste management network.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts is considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Impacts would be direct.			
Impact Duration	**Temporary**	Short-term	Long-term	Permanent
	Duration of maintenance activity will vary depending on the size and requirement of the maintenance. Therefore the impact duration is defined as temporary.			
Impact Extent	**Local**	Regional	International	
	Potential impacts would likely be restricted to the local area.			

Significance of Impact					
Impact Scale	The scale of potential impacts due to release of waste is potentially large due to the quantities present during this stage, particularly when considered in light of the limited waste management network in the area (YCDC estimate to have a landfill capacity of 2,064 tonnes per day).				
Impact Frequency	Impacts would occur intermittently but repeatedly throughout the operation and maintenance activity.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered to be small.				
Receptor Sensitivity	Low	**Medium**	High		
	The existing waste network and facility within the Yangon City Development Committee (YCDC) is estimated to have a landfill capacity of 2,064 tonnes per day cumulative over six sites. This amount is considered to be relatively small comparative to the amount of waste generated by Yangon Region henceforth the receptor sensitivity is rated as medium.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a medium resource sensitivity and small impact magnitude will result in minor level of impact significance.				

Mitigation Measures

The following measures will be put in place for the Project during operation phase of LNG Receiving Terminal to reduce the impact to existing waste management facilities:

- A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project operation. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the operation phase for all of the waste streams identified. The WMP will be developed by the project proponent (or its EPC contractor) prior to commencing construction work;
- Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable;
- Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations;
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed;
- Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and
- The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during operation and maintenance activity is being managed responsibly.

Residual Impacts

If the recommended mitigation and management measures are implemented, residual impact significance would be reduced to **Negligible** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during both the construction and operation phases should consist of the following:

- Monitoring of waste segregation, transportation and disposal practices in the project activity areas and disposal location, as to be defined in a Waste Management Plan to be prepared specifically for the Project; and
- Monitoring of appointed waste contractors using chain-of custody documentation, as to be defined in a Waste Management Plan to be prepared specifically for the Project.

7.6.7.6 Impacts from Generation and Management of Domestic Solid Waste during Construction and Operation Phase

Overview

During construction and operation phase of the LNG Receiving Terminal, domestic solid waste is anticipated to be generated from workers working on-site. The peak number of workers expected to be on-site during construction phase is 650 people and during operation phase is peaked at 62 (excluding maintenance staff). The expected amount of domestic solid waste from this source is presented in ***Table 7.57***.

Table 7.57: Anticipated Amount of Domestic Solid Waste during Construction and Operation Phase of LNG Receiving Terminal

Phase	Anticipated Quantity	Number of Workers	Total Solid Waste
Construction	1.65 kg per employee per week	650	1,072.5 kg per week
Operation		62	102.3 kg per week
Maintenance (every 3 years)		90 (for 30 days)	636.4 kg per 30 days

Currently, the EPC (during construction phase) and TPMC (during operation phase) is planned to rely on the existing landfill managed by YCDC to dispose of the domestic solid waste.

Impact Assessment Table

The significance of potential impacts from generation and management of domestic solid waste during construction and operation (and maintenance) phase of the LNG Receiving Terminal is assessed in ***Table 7.58***, and mitigation measures are presented thereafter.

Table 7.58: Significance of Impacts from Generation and Management of Domestic Solid Waste during Construction and Operation Phase of LNG Receiving Terminal

Significance of Impact				
Impact	Potential impacts due to generation and management of domestic solid waste by increasing the stress put on the facilities and reducing the capacity and capability of the existing waste management network.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts is considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Impacts would be direct.			
Impact	Temporary	**Short-term**	**Long-term**	Permanent

Significance of Impact					
Duration	Construction will take approximately 23 months for the LNG Receiving Terminal. Duration is considered as short-term. Operation will last approximately 25 years for the LNG Receiving Terminal. Duration is considered as long-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would likely be restricted to the local area.				
Impact Scale	During construction phase, the domestic solid waste is anticipated to be 1,072.5 kg per week. During operation phase, the domestic solid waste is anticipated to be 102.3 kg per week. During maintenance activity, the domestic solid waste is anticipated to be 636.4 kg per 30 days which is expected to occur once every 3 years.				
Impact Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the construction and operation phase (and during maintenance activity).				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered to be medium.				
Receptor Sensitivity	Low	**Medium**	High		
	The existing waste network and facility within the Yangon City Development Committee (YCDC) is estimated to have a landfill capacity of 2,064 tonnes per day cumulative over six sites. This amount is considered to be relatively small comparative to the amount of waste generated by Yangon Region henceforth the receptor sensitivity is rated as medium.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a medium resource sensitivity and medium impact magnitude will result in an overall moderate to moderate significance level of impact.				

Mitigation Measures

The following measures will be put in place for the Project during construction and operation phase of LNG Receiving Terminal to reduce the impact to existing waste management facilities:

- A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project construction. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the construction/operation phase for all of the waste streams identified. The WMP will be developed by the project proponent (or its EPC contractor) prior to commencing construction work;
- Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable;
- Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations;
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed;
- Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of construction/operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and

- The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during construction/operation activity is being managed responsibly.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **Minor** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during both the construction and operation phases should consist of the following:

- Conduct regular inspection of relevant domestic solid waste streams and sources of the domestic solid waste to ensure mitigation measures in place are being enforced and maintained throughout the phase.

7.6.7.7 Impacts from Generation and Management of Domestic Liquid Waste during Construction and Operation Phase

Overview

During construction and operation phase of the LNG Receiving Terminal, domestic liquid waste is anticipated to be generated from workers working on-site. Domestic liquid waste includes greywater, kitchen wastewater, and sanitary wastewater. The peak number of workers expected to be on-site during construction phase is 650 people and during operation phase is peaked at 62 (excluding maintenance staff). The expected amount of domestic liquid waste from this source is presented in ***Table 7.57***.

Table 7.59: Anticipated Amount of Domestic Liquid Waste during Construction and Operation Phase of LNG Receiving Terminal

Phase	Anticipated Volume	Number of Workers	Total Liquid Waste
Construction	33.3 litres per employee per day[110]	650	21,645 litres per day
Operation		62	2,064.6 litres per day
Maintenance (every 3 years)		90 (for 30 days)	89,910 litres per 30 days

Currently, during the construction phase the EPC plans to collect sanitary wastewater and sewage through underground pipes into a holding tank, from where the sewage will be routed to an on-site sewage treatment plant or alternatively transported periodically by vacuum trucks (as frequently as needed) to a septic tank or discharging to a designated local water body. During operation phase, since the number of workers anticipated will be significantly smaller and therefore the volume of waste produced during this phase is estimated to be dealt with a septic tank on-site without discharging. Henceforth, the Project Proponent plans to install a septic tank to handle domestic wastewater during operation phase.

Impact Assessment Table

The significance of potential impacts from generation and management of domestic liquid waste during the construction and operation phase of the LNG Receiving Terminal is assessed in ***Table 7.60***, and mitigation measures are presented.

[110] Metcalf& Eddy Inc. Wastewater Engineering: Treatment, Disposal, Reuse. 3rd Edition McGraw Hill, Network, 1979

Table 7.60: Significance of Impacts Due to Generation and Management of Liquid Waste during Construction and Operation Phase of LNG Receiving Terminal

Significance of Impact

Impact	Potential impacts due to generation and management of domestic liquid waste. Some of the impacts may be related to additional output of treated water into natural water bodies, unpleasant spread of odor to the local community due to improper storage of the domestic liquid waste.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts is considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts would be direct.				
Impact Duration	Temporary	**Short-term**	**Long-term**	Permanent	
	Construction will take approximately 23 months for the LNG Receiving Terminal. Duration is considered as short-term. Operation phase will continue for approximately 30 years for the LNG Receiving Terminal. Duration is considered as long-term.				
Impact Extent	**Local**	Regional	International		
	The extent of potential impacts would likely be limited to the location where sanitary wastewater is stored, treated and disposed of, and therefore is local.				
Impact Scale	During construction phase, the domestic liquid waste is anticipated to be 21,645 litres per day. During operation phase, the domestic liquid waste is anticipated to be 2,064.6 litres per day. During maintenance activity, the domestic liquid waste is anticipated to be 89,910 litres per 30 days which is expected to occur once every 3 years.				
Impact Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the construction and operation phase (and during maintenance activity).				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered to be medium.				
Receptor Sensitivity	**Low**	Medium	High		
	Additional treated sanitary wastewater stream to the existing wastewater management network and/or the water bodies that will receive the Project's effluent discharge can impact the condition of receptors (human, terrestrial and aquatic ecology) that are situated around the release of effluent if the transportation and discharging is conducted inappropriately. However, the current (pre-project) surface water condition of the designated discharge point is considered to be unhealthy. Therefore the sensitivity of the receptor in determined to be Low.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a low resource sensitivity and medium impact magnitude will result in an overall minor significance level of impact.				

Mitigation Measures

The following measures will be put in place for the Project during construction and operation phase of LNG Receiving Terminal to reduce the impact on physical receptors (soil, groundwater and surface water) and consequently human and biodiversity that uses these physical receptors:

- All waste collection and storage measures as detailed within ***Section 7.4*** and ***Section 7.5*** (Surface Water, Soil and Groundwater) will be implemented;
- Ensure the integrity of wastewater storage unit to avoid leaking of wastewater and odour to the surrounding receptors; and
- Enforce rules that prevent inappropriate materials going into the sanitary wastewater stream.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **Negligible** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during both the construction and operation phases should consist of the following:

- Conduct regular maintenance on sanitary wastewater treatment system to ensure that the system is functioning efficiently and effluent is achieving targeted quality; and
- Conduct regular testing of effluent water parameters to ensure effluent is within the relevant effluent standards prior releasing it at the discharge location.

7.7 Landscape and visual Impact Assessment

7.7.1 Introduction

The development of the Project will be introducing a number of new elements into the existing visual environment. This section presents a purely qualitative assessment of impacts to visual amenity (assessed as one of the interrelated effects on population and how various groups experience and perceive changes in the values attributed to the landscape). During the construction and operation there will be a range of activities which have the potential to change how various people will perceive/see the landscape. The key visually sensitive receptors within the vicinity of the proposed Project have been identified in the Baseline **Chapter 5** and this section undertakes an assessment of predicted impacts to these during construction and operation.

7.7.2 Assumption and Limitations

The assessment of potential impacts related to Visual Environment in this section is based on the environmental baseline data (presented within **Chapter 5**) and the information available from the Project Proponent at the time of writing. Judgements and assessments have been made based on professional knowledge and previous experience of ERM.

This assessment has been undertaken primarily as a desktop study drawing upon limited site analysis. No quantitative modelling, viewshed analysis, stakeholder engagement or photomontage development has been undertaken with regards to any elements of the visual impact assessment. It is based purely on information readily available as secondary sources (primarily online mapping databases) and information gathered during site visits for the purposes of gaining other qualitative environmental data. No direct onground identification of the visual baseline is therefore available. Additionally, no stakeholder engagement was undertaken to determine the various values that particular visual sensitive receptors place on various elements of the landscape.

7.7.3 Assessment Methodology

The methodology used for assessing impacts to surface water is aligned with the general impact assessment methodology presented in ***Chapter 6***.

7.7.4 Baseline Summary

The topography at the LNG Receiving Terminal suggests no elevation. The area surrounding the facility consists of mainly agricultural land and nearby villages. Across the Yangon River, directly opposite of the LNG Receiving Terminal is the Myanmar Integrated Port Limited Terminal.

7.7.5 Resources and Receptors

Potential sensitive visual receivers are located nearby the LNG Receiving Terminal, such as Thet Kei Kwin (North West), and Shan Kaw (West) villages. Given the nature of the proposed facilities, a 5 km radius from the main Project Site facilities has been taken as the study area for the Visual Baseline and impact assessment.

7.7.6 Summary of Project Activities with Potential Impacts

Visual impacts from the Project are considered likely to arise from the following activities:

7.7.6.1 Construction Phase

- Earthworks will include clearing of vegetation and grading of the Project site. It is expected that the subsoil, which will be stripped and removed from the Project site, shall be utilised for levelling/ backfilling.
- Construction of all elements of the LNG Receiving Terminal within the Project Site.

7.7.6.2 Operation Phase

The long-term operational presence of the following Project structures will change the nature of the existing landscape and visual amenity;

- LNG Storage Tanks (Total height of 39 m.);
- Cold vent stack (Total height of 33.8 m.)

7.7.7 Assessment of Impact

7.7.7.1 Construction Phase

Overview

Visual impacts during site formation and construction will be caused by earthworks, light emissions, disturbance and physical presence of facilities as they are erected.

Impact Assessment Table

Table 7.61: Impact Assessment Table for Landscape and Visual Impacts (Construction Phase)

Significance of Impact					
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	Site formation and construction works will be temporary.				
Impact Extent	**Local**	Regional	International		
	Earthworks, light emissions, disturbance and physical presence of new facilities will be local and largely confined of the Project Sites although some light emissions will be visible further away.				
Impact Scale	The impact will occur within the Project area covering 15 acres (60,702 m^2)				
Impact Frequency	It is assumed construction works will take place continuously until the Project is built.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Magnitude is considered to be medium.				
Receptor Sensitivity	**Low**	Medium	High		
	The key receptors of visual impact around LNG terminal are Shan Kan villages located 1.6 kilometres to the southwestern direction and there is no scenic-resource value located near the Project for instance Pagoda. Therefore, the sensitivity is considered to be Low.				
Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a low resource sensitivity and medium impact magnitude will result in an overall minor significance level of impact.				

Mitigation / Management Measures

The following mitigation measures should be implemented to mitigate the impacts:

- Provide soft landscaping (i.e. tree, low shrub and ground cover planting) within available space within the Project Site. Plant as soon as practical during construction phase;
- Minimize the extent of construction areas, including for dredging and including temporarily affected areas;
- Minimize clearing of vegetation as far as practical. Existing large trees (if any) should be retained as far as practical. Those that fall outside the earthworks area must be retained. Felled trees should be compensated for where possible;
- Reinstatement of temporarily affected areas which will no longer be required for the operational stage (e.g. contractor camp, laydown areas, etc.), to suitable pre-construction condition as soon as practical after use (e.g. using landscaping with suitable vegetation)

Residual Impact

Based on the implementation of the proposed mitigation measures, the significance of the impact is considered to be **Negligible** impact.

Monitoring plan

No monitoring plan is required.

7.7.7.2 Operation Phase

Overview

Visual impacts during operations will be caused by the physical presence of new facilities at the LNG receiving terminal, as well as light emissions and human disturbance.

Impact Assessment Table

Table 7.62: Impact Assessment Table for Landscape and Visual Impacts (Operation Phase)

Significance of Impact					
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The physical presence of LNG receiving terminal will cause visual impact for the duration of the proposed Project and after unless decommissioned.				
Impact Extent	**Local**	Regional	International		
	Facilities that rise higher than any fencing/ wall that will secure the main site will be visible a distance away, but will not extend beyond a local impact.				
Impact Scale	The highest facilities in the LNG receiving terminal is cold vent stack that will be visible to a further distance (approximately 2 kilometres). Therefore, the scenic impact will be limited to the 2 kilometres.				
Impact Frequency	The physical presence of the LNG Receiving Terminal is expected to last throughout the operation phase of 25 years.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Magnitude is considered to be Medium.				
Receptor Sensitivity	**Low**	Medium	High		
	The key receptors of visual impact around LNG terminal are Shan Kan villages located 1.6 kilometres to the southwestern direction and there is no scenic-resource value located near the Project for instance Pagoda. Therefore, the sensitivity is considered to be Low.				
Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a low resource sensitivity and medium impact magnitude will result in an overall minor significance level of impact.				

Mitigation / Management Measures

- Visual screening e.g. surround perimeter of site with native trees (can be compensatory trees for any felled during construction);
- Maintain soft landscaping (i.e. tree, low shrub and ground cover planting) within available space in the Project Site;
- Minimise overall lighting use and manage lighting on site to consider minimization of light pollution and horizon glow;
  - identify zones of high and low lighting requirements and contain light to areas that need illumination most;
  - prevent light spill/ glare with shielding i.e. All security and street/road lighting shall have “blinkers” or be specifically designed to ensure light is directed downwards while preventing side spill;
  - prevent light spill/ glare with directional lighting to focus on necessary area/object (eg reduce the height from which floodlights are fixed and with the focus of the lights being inward, rather than outward);
  - keep light intensity to as low as reasonably practicable;
  - all external light fittings shall not allow light to shine upwards;
  - area lighting on any tall buildings/ masts should be confined to the lower landform elevations.
- Maintain all structural facilities in good repair;

Residual Impact

Based on the implementation of the proposed mitigation measures, the significance of the impact is considered to be **Negligible** impact.

Monitoring plan

No monitoring plan is required.

7.8 Social Impact Assessment

7.8.1 Introduction

Settlements located closest to the Project infrastructure are likely to experience negative and positive impacts as a result of the Project activities, including economic opportunities, social and environmental changes, lifestyle changes, and changes to community health and safety. Other social receptors located further from the Project may also benefit or experience negative impacts from the Project.

The predicted impacts to the social environment as a result of the proposed LNG Receiving Terminal are described in this Chapter. The presence of economical, industrial, touristic and religious activities within the Study Area have all been considered as part of the assessment of impacts.

This Chapter also develops management, mitigation and monitoring measures needed to ensure that any identified impacts can be avoided, reduced, mitigated to as low as reasonably practical or compensated for. Such measures are presented and will form part of the overall Environmental and Social Management Plan (ESMP, ***Chapter 12***) for the Project.

7.8.2 Assumption and Limitations

The assessment of potential impacts related to the social environment in this section is based on the physical, biological, environmental and social baseline data (presented within ***Chapter 5*** of this report)

and the information available from the Project Proponent at the time of writing the report. Judgements and assessments have been made based on professional experience of similar projects in similar settings and previous general experience of ERM.

Limited secondary data focused on the Project area was available and the baseline draws from a range of secondary data at the national, regional and township level and primary data collected at local level during social baseline activities in November 2018. Secondary data information has been gathered from various sources including ministries, regional authorities, the Myanmar Information Management Unit, other relevant studies or previous studies conducted for the Project or in the area.

The primary data used in this section of the report was collected during the baseline survey through Focus Group Discussions (FGDs), Key Informant Interviews (KIIs) and detailed household survey in randomly selected households in the Project area (***Table 7.63***). Ad-hoc and informal discussion were also conducted with community members, fishermen, hotel owners as well as other project developer in the area.

Table 7.63: Numbers of Interviewees

Groups of interviewees	Total number of interviewees	Number of interviewees (per township)		
		Dala	Ahone	Seikgyikanaungto
Households	150	80	40	30
Village leaders	3	1	1	1
Women	3	1	1	1
Health specialists	3	1	1	1
Fisherman	1	1	-	-
Farmers	1	1	-	-

Source: ERM, 2018.

7.8.3 Assessment Methodology

The Social Area of Influence (SAoI) is defined as the area inhabited or used by stakeholders and likely to be positively or negatively affected by the Project. This includes short, long term or permanent changes, as well as direct, induced or indirect impacts. The SAoI includes:

- The Project site(s) and related facilities that TPMC develops or controls and the additional areas in which aspects of the environment could conceivably experience significant impacts.
- Associated facilities that are not developed and funded as part of the proposed Project, but are essential for the Project and without which the Project cannot proceed, and the associated areas in which the environment could conceivably experience significant impacts.
- Areas potentially affected by cumulative impacts resulting from other developments known at the time of the ESIA, further planned phases of the Project or any other existing circumstances.
- Areas potentially affected by impacts from predictable (but unplanned) developments as a result of the proposed Project (i.e., induced activities), occurring at a later stage or at a different location.

Box 7.1 provides a definition of the concept of area of interest from good practice guidance.

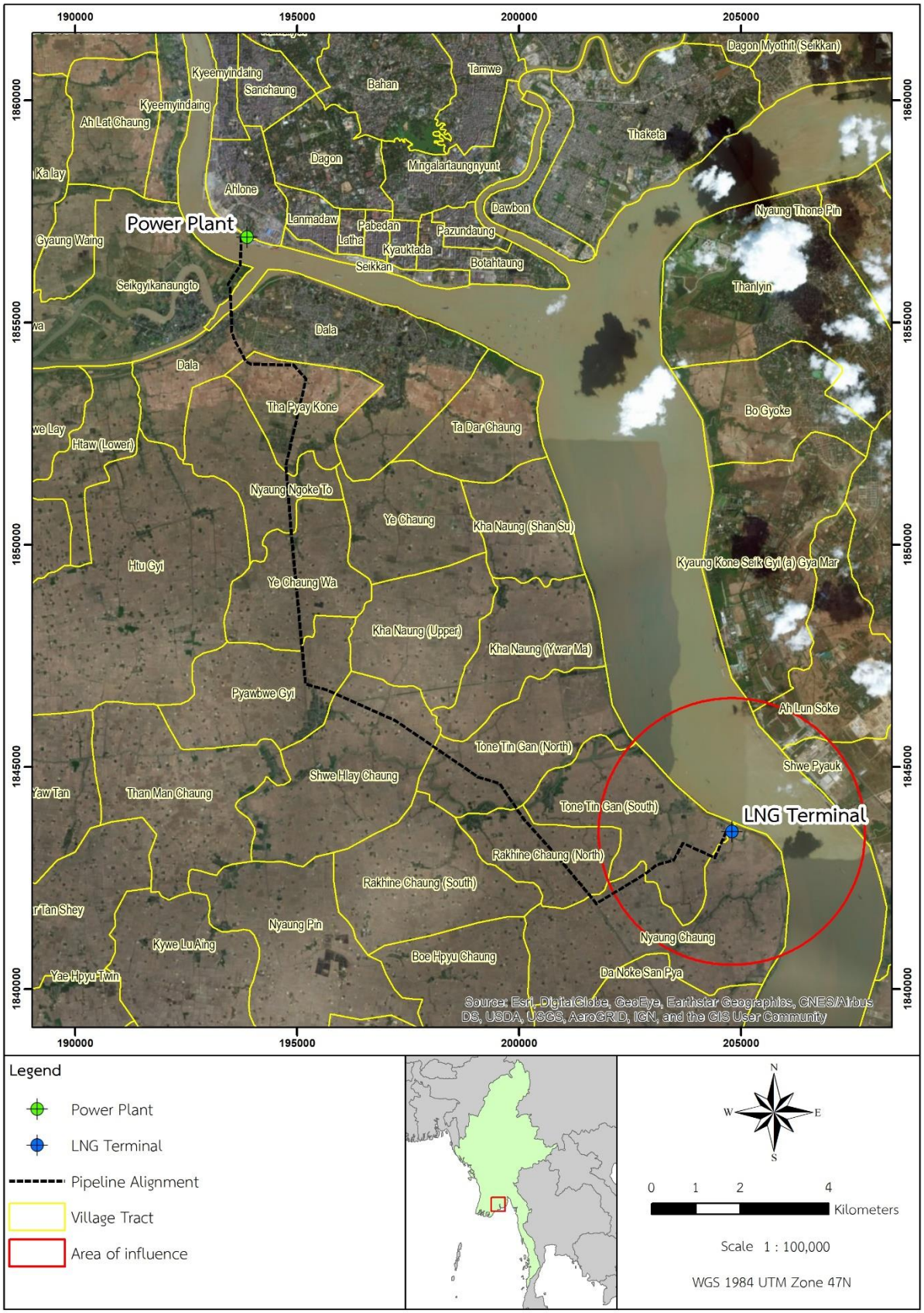
Box 7.1: IFC Definition of Area of Influence

The project's area of influence includes 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 the project; areas potentially impacted by cumulative impacts from further planned development of the 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 the project or independently of the project.

Source: IFC PS1, 2006.

For the LNG Receiving Terminal, based on this definition, experience with similar project, the social baseline in the area, and the human use identified, the area to be considered for social impact has been established at 3km around the LNG Terminal location. This area allow to include all socioeconomic activities that may be potentially impacted by the LNG Terminal activities during construction, operation and decommissioning phases. The SAoI of the LNG Terminal is shown in ***Figure 7.16***. The assessment for social impacts has focused on the stakeholders in Dala Township as the activities conducted on the other side of the Yangon River, opposite the LNG Receiving Terminal and within the 3 km radius, are industrial activities only.

Figure 7.16: LNG Receiving Terminal Social Area of Influence



Source: ERM, 2019.

7.8.4 Impact on Employment

7.8.4.1 Baseline Summary

Unemployment rate is low in the Yangon region with 4.1% of people in age of working without activity. In Dala Township, the percentage of unemployment provided by secondary data research is at 7.8%, but primary data collected during November 2018, show that 19.7% of Dala interviewees declare themselves without activity and 15.7% stated that they are daily labourers. Few of Dala interviewees also have experienced in working as manual labours, mechanic, general construction, security, and wielding. There is therefore a potential for local people to be employed on unskilled jobs during construction and operations.

Around 24% of Dala interviewees own a business in retail or trading sectors. Some of them also have computer certificate (17.4%), mechanic qualification (4.3%), wielding certificate (13%), driving license (4.3%) and teacher certificate (30.4%).

7.8.4.2 Receptor Identification and Sensitivity

The Project will offers both skilled and unskilled positions, with the number of unskilled positions reducing after the construction period. Due to most of the local population not being experienced in the industrial sector, the number of accessible opportunities, particularly during the operation phase, might be limited due to the skills required at some position. Therefore, construction unskilled jobs should nevertheless be accessible for the local population. Some of the skilled PAP (Project Affected People) could also have roles during the construction and operation phases.

In terms of indirect employment, the realization of opportunities will depend not only on the Project, but also on the initiative and business acumen of local entrepreneurs. Services for the employee (restaurant, shop) should benefit from the Project.

7.8.4.3 Impact during Construction

Overview

The construction phase of the LNG Receiving Terminal will last around 23 months. During the construction of onshore LNG receiving terminal, the Project will generate a range of employment opportunities and require an average of 400 workers per day with a peak at 600. Amongst these, more than half would be local Myanmar workers with up to 200 unskilled workers and 80 skilled ones. For the construction of the unloading jetty, 40 workers per day with peak at 50 will be required. Again, more than half of them would be local Myanmar workers with up to 20 unskilled workers, 10 semi-skilled workers and 3 skilled workers.

In addition, the Project will require goods and services throughout construction. There are opportunities for local businesses to provide these goods and services (e.g. construction equipment, food for the workers). As a result, existing local businesses may expand or new businesses may be established locally to meet these demands – providing employment opportunities. This is referred to as indirect employment.

The resulting impacts (e.g. increase in employment opportunities, increase in income for local people employed by the Project) were assessed as a **Positive** one.

Impact Assessment Table

Significance of Impact			
Impact	Potential impacts on Employment		
Impact Nature	Negative	**Positive**	Neutral
	Potential impacts on Employment will be positive.		
Impact Type	**Direct**	**Indirect**	Induced
	Potential impacts would likely be direct and indirect impacts.		

Mitigation Measures

In order to maximise the benefits from this impact for the local population, wherever possible, the workforce will be sourced from areas close to the Project after a training and selection process; and thereafter at a regional or national level. Given that levels of educational achievement and formal employment experience in relevant sectors is low within the SAoI, it is assumed that the majority of the available local labour may be unskilled or at most semi-skilled. The Project will develop a Sourcing, Procurement and Recruitment Management Plan which will be developed for this Project with the aim to promote benefits to locals from recruitment and procurement activities for the Project (including information, training and engagement).

Monitoring Plan

Monitoring of the local content should be done at the beginning of the construction phase to ensure maximum opportunities are given to local population.

7.8.4.4 Impact during Operation

Overview

During 25 years of operation, the Project will generate mainly skilled jobs and a limited number of unskilled jobs such as guard, gardener, cook or maid). O&M staffs with relevant experience of operating similar facilities along with adequate knowledge of comparable technology will be also deployed. It is expected that approximately 171 staff will work on the operational phase of the Project. These numbers are divided into 49 permanent staff (operation maintenance and back office), 12 external securities, 10 contract staff (cleaners, gardeners and helpers), 10 contract staff (technical hands), and 90 maintenance staff for 30 days (once every 3 years).

The resulting impacts (e.g. increase in employment opportunities, increase in income for local people employed by the Project) were assessed as a **Positive** one.

Impact Assessment Table

Significance of Impact			
Impact	Potential impacts on Employment		
Impact Nature	Negative	**Positive**	Neutral
	Potential impacts on Employment will be positive.		
Impact Type	**Direct**	**Indirect**	Induced
	Potential impacts would likely be direct and indirect impacts.		

Mitigation Measures

In order to maximise the benefits from this impact for the local population, all unskilled staffs must be recruited from the local population living directly around the Project area. When possible the skilled workforce should also be sourced from areas close to the Project after a training and selection process; and thereafter at a regional or national level. The Project will use the Sourcing, Procurement and Recruitment Management Plan developed for the construction stage and cooperate with local academic institutions to identify future local employees with the relevant skills.

Monitoring Plan

Monitoring of the local content should be done at the beginning of the operation phase to ensure maximum opportunities are given to local population. Thereafter during the operation, monitoring should continue on a yearly basis to ensure the level of local content stay, at the minimum, stable.

7.8.5 Impact to Fishing Activities

7.8.5.1 Baseline Summary

Small scale artisanal fishing takes place in the Yangon River. Local people catch fishes (i.e. hilsa, Indian salmon and croaker) daily or every few days by using drift netting or seine net.

The months with maximum fish catch are August, September, October and November while the months with the minimum fish catch are January, February, March and April. The restricted days for fishing are in April, May and June. Restricted species for being caught is the butter catfish.

Average fish caught per season is around 1,068 kg, and average annual income from fishing activities is around 150,000 Kyats.

7.8.5.2 Receptor Sensitivities

River area of the Yangon River will be limited for fishing activities because of the Project's activities for both construction and operation of the LNG terminal. The area impacted is limited and not specifically identified for fishing by local villagers who cast their nets a different places depending on the weather and the tide. Sensitivity of the receptors will be limited as the area impacted is small and plenty of alternatives exists in the area.

7.8.5.3 Impact during Construction

Overview

Construction phase of the LNG Receiving Terminal will last around 23 months. River works will include the installation of project infrastructure offshore and are located alongside the waterfront. During construction, no dredging of the Yangon River will be needed to allow operation of construction vessels and excavated sediment will only be discharged onshore.

An exclusion zone of 150 meters and a safe zone of 250 meters from construction will be established to ensure safety among the construction vessels, and other non-project related vessels that navigate the Yangon River. Signalling buoys will be installed around the alignment of the safe zone to indicate the restricted area to other vessels. Navigation will be forbidden within the exclusion zone and activities restricted within the safe zone. If a vessel enters the safe zone, the support tug vessels will assist to warn off the vessel.

TPMC will infrom local communities before commencement of the construction phase in order to avoid the impact on fishing net and fishing activites in the river.

The impact of the Project pre-mitigation on fishing activities during construction phase is considered a **Negligible** Impact.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts on Fishing Activities			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts on Fishing Activities would be considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Potential impacts would likely be direct impacts.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	Potential impacts on Fishing Activities will last only during construction phase.			
Impact Extent	**Local**	Regional	International	
	Potential impacts will be limited to the local area directly used for construction.			
Impact Scale	The scale of potential impact is small because impacts will be experienced only within the construction area and safe zone which extend to roughly 300 m from the shore (river is 1.6Km wide at that location).			
Frequency	The impact will occurs 24/7 during the construction phase.			
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be small because receptors will not be able to fish only in the restricted area.			
Receptor Sensitivity	**Low**	Medium	High	
	The receptor sensitivity is low as alternative exist directly around the impacted area and receptor do not rely on fishing only as livelihood or source of protein.			
Impact Significance	**Negligible**	Minor	Moderate	Major
	The significance is likely to be negligible.			

Mitigation Measures

Although the impact is expected to be Negligible, TPMC will need to develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on river ways/ areas. This will ensure stakeholders can anticipate and appropriately respond to the changes and limitations of uses on river ways/ areas. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose fishing activities are affected by the Project activities.

Monitoring Plan

TPMC will need to monitor the grievance log weekly during the construction phase to identify any specific grievance related to fishing activities.

7.8.5.4 Impact during Operation

Overview

During operation, the fuel supply for this Project will be based on imported LNG from overseas. The LNG Carrier will arrive at the LNG facilities (unloading jetty) every 12 days (approximately 2-4 LNG Carriers per month). The LNG carrier will be accompanied by two support tug vessels. While an LNG carrier is moored, a safety zone will be established with restriction of access for other vessels or boats.

An exclusion zone of 200 metres and a safe zone of 250 metres from the LNG unloading jetty will be established to ensure safety among the Project vessels, and other non-project related vessels that navigate the Yangon River. Signalling buoys will be installed around the alignment of the safe zone to indicate the restricted area to other vessels. Navigation will be forbidden within the exclusion zone and activities restricted within the safe zone. If any vessel enters the safe zone, the support tug vessels will assist to warn off the vessel.

TPMC will infrom local communities before commencement of the operation phase in order to avoid the impact on fishing net and fishinf activites in the river.

In addition, the discharge of LNG from the carrier takes approximately 12-16 hours. During the operational discharge, ballast water will be taken on-board. No ballast water will be discharged in the Yangon River waters. Also, after being treated, cold water from the RU will be discharged into the Yangon River.

Finally, the discharge in the Yangon River of cold water from the regasification process will likely push away fishes within the plume, but the worst case scenario from the modelling of the water discharge provide that the delta of temperature will be under 3°C within 9.1 metres from the discharge point, hence creating a very limited impact zone.

The impact of the Project pre-mitigation on fishing activities during operation phase is considered a **Negligible** Impact.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts on Fishing Activities				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts on Fishing Activities would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Potential impacts on Fishing Activities will last during the entire operation phase.				
Impact Extent	**Local**	Regional	International		
	This impact will be only experienced by Dala fishermen, who participate in fishing activities nearby the LNG terminal.				
Impact Scale	The scale of potential impact is small because impacts will be experienced around location of the LNG terminal, and established safe and marine exclusion zones only.				
Frequency	The impacts are likely to occur every 12 day or around 2 – 4 times per month				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be small because receptors will have a more restricted area for fishing during operation phase (25 years), but limitation of fishing activities will be only in the exclusion zone or in the safe zone every 12 day for approximately 24 hours.				
Receptor Sensitivity	**Low**	Medium	High		
	Receptors to this impact will not be able to catch fishes around location of the LNG terminal and safe zone, but other parts of the Yangon river are still available for catching fishes. Moreover, fishing activity is not the main livelihood of the receptors				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The significance is likely to be Negligible.				

Mitigation Measures

Although the impact is considered negligible, TPMC will continue to implement the Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on river ways/ areas. This will ensure that stakeholders can anticipate and appropriately respond to the change and limitation of uses on river ways/ areas. The Project should also continue to implement the Grievance Mechanism to collect grievances from local stakeholder whose fishing activities are affected by the Project activities.

Monitoring Plan

During operation, TPMC will need to monitor the grievance log weekly to identify any specific grievance related to fishing activities.

7.8.6 Impacts from Economical Displacement

7.8.6.1 Baseline Summary

Agricultural area represent approximately 87% of the total area of Dala and agriculture is the 4th largest income generating activity amongst interviewees. Twenty percent of survey respondents engage directly in farming or receive cash from farming activities, while 50% of those farming said it was their only livelihood activity and the others that it represented roughly 50% of their total incomes. The average size of land owned by farmers interviewed is around 16.25 acres.

7.8.6.2 Receptor Sensitivities

Dala farmers whose fields are in the proposed LNG Receiving Terminal location will not be able to cultivate rice during construction and operations. Those with land located on the path of an access road for construction or a laydown area will also be prevented from cultivating these lands during construction. At least 10% of the potential receptors will be very vulnerable to impacts on their farming activities given that it is their only livelihood activity. Also, no replacement land is available in the close area due to the high concentration of population.

7.8.6.3 Impact during Construction

Construction of the LNG Receiving Terminal will be located on the West bank of the Yangon River in the Dala Township. Project activities that will result in temporary and permanent loss of agricultural land will result from the direct Project footprint of the LNG Receiving Terminal, construction camps, lay down areas, borrow pits and access roads. In addition, loss of agricultural land will also result from safety and security exclusion zones around Project facilities. In total, it is an area of 15 acres. The land will be bought by TPMC after negotiation with land owners.

As a result of the Project, there will be:

- Temporary loss of livelihoods associated with the temporary loss of land used for annual crops e.g. due to construction access road or laydown areas.
- Permanent loss of livelihoods associated with the permanent loss of land used for annual crops e.g. for land take for the direct LNG Receiving Terminal footprint.

The impact of the Project pre-mitigation on economical displacement during construction phase is considered a **Minor** Impact.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts on Economical Displacement				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts on Economical Displacement would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	Temporary	**Short-term**	Long-term	**Permanent**	
	Potential impacts on Economical Displacement will last either only during construction phase or will be permanent.				
Impact Extent	**Local**	Regional	International		
	This impact will be experienced only at the location of the footprint of Project and construction facilities.				
Impact Scale	The total area to be impacted by the construction of the project is 15 acres				
Frequency	The impact will occurs 24/7 during the construction phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is small as the area to be impacted is relatively small, in particular compare to the total area available for agriculture in the township.				
Receptor Sensitivity	Low	**Medium**	High		
	Base on the survey sample, 20% practice farming, it represents their only livelihood activity (50%) or their main source of income (50%). The average size of land used by interviewee is larger than the area required for the Project. Therefore the sensitivity of the receptors is considered Medium.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The significance is likely to be minor.				

Mitigation Measures

In order to reduce negative impact for receptors, they will be informed and provided with prior notice about information of construction activities.

- Land take should be minimised to the extent possible both in terms of geographical size and duration; and as such, when no activities are being undertaken, exclusions will be lifted.
- TPMC will propose to recruit in priority stakeholders whose land is being impacted during construction phase. Recruitment should be considered to offers position to those who can extend past the construction phase, in particular for those whose land is permanently impacted.
- TPMC will compensate stakeholders whose land is temporarily or permanently impacted during construction and operation using market price with a premium (to compensate for the change).
- TPMC will compensate stakeholders whose crops is being impacted during construction using market price.
- TPMC will use an external specialist to identify market price for the type of land and crops being impacted by project activities.
- TPMC will develop and implement a Livelihood Restoration Plan as part of the Project. The Project will also implement a Grievance Mechanism to collect grievances from local stakeholder

whose agricultural activities are affected by the Project activities and regularly engage with the community.

■

Residual Impacts

Based on the implementation of the proposed mitigation measures, the significance of the impact is considered to be a **Negligible** Impact post mitigation.

Monitoring Plan

TPMC will need to monitor the grievance log weekly to identify any specific grievance related to agricultural activities.

During construction and operation, TPMC will monitor the employment of stakeholders whose land has been temporarily or permanently impacted by Project activities. If these people refused job offers from the Project, TPMC will engage yearly with them for the first 4 years after the start of construction to ensure their livelihood has not been significantly impacted negatively by the Project.

7.8.6.4 Impact during Operation

There is no specific Project activities during operation that will affect agricultural activities, except the presence of the facility and safe zone which will not extend from the one described in the construction phase.

Mitigation measures and monitoring plan described in the section on impacts during construction will remain valid for the operation phase.

7.8.7 Impacts to Navigation

7.8.7.1 Baseline Summary

Around the location of LNG terminal, there are few boats with passengers crossing the river or travelling to Yangon, but the majority of people travel by road to the north of Dala Township where Dala pier (Dala Ferry Terminal) is located. In addition, 42% of interviewees from Tone Tin Gan village tract daily engage in fishing activities at the Yangon River.

The Yangon River is also heavily used by commercial vessels travelling up and downstream of the proposed Project site. Majority of the vessel traffic cruises approximately 800 metres from the proposed Project site, i.e. more than 500 metres from the limit of the safe zone proposed for the LNG Receiving Terminal construction and operation activities. The Yangon Port is accessible to vessels of 167 m LOA, 9 m Draft and 15,000 DWT and the Thilawa Port, located near the proposed Project site is accessible up to vessels of 200 m LOA, 9 m Draft, 20,000 DWT.

7.8.7.2 Receptor Sensitivities

The use of the river for transport of passenger is limited in the area as most people traveling by car to the Dala pier. In addition, the exclusion zone will not impact a large part of the river, meaning that alternative routes exist. Similarly, commercial vessels traveling on the Yangon River use the middle of the river as a navigation channel. The exclusion zone and safe zone during construction will not impact that channel and more than 500 metres will remain between the end of safe zone and the navigation channel.

7.8.7.3 Impact during Construction

Overview

Construction phase of the LNG Receiving Terminal will last around 23 months. During construction, river works will include the installation of project infrastructure offshore located alongside the waterfront.

In addition, transportation of heavy, large volume and super-sized materials such as Regasification Units, generators, transformers, etc. will be made on river way. The required construction materials will be transported by vehicles from local suppliers or ports. Barges will transport heavy, and large volume materials to the Jetty. During construction, five vessels will be mobilised including, 1 crane barge, 2 transport barge, and 2 support tugs.

After pre-fabrication is complete, barge will transport the Unloading Jetty to designated location. The Unloading Jetty construction is expected to take approximately 12 months.

An exclusion zone of 150 metres and a safe zone of 250 metres from construction will be established to ensure safety among the construction vessels, and other non-project related vessels that navigate the Yangon River. Signalling buoys will be installed around the alignment of the safe zone to indicate the restricted area to other vessels. Navigation will be forbidden within the exclusion zone and activities restricted within the safe zone. If a vessel enters the safe zone, the support tug vessels will assist to warn off the vessel.

The impact of the Project pre-mitigation on navigation during construction phase is considered a **Minor** Impact.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts on Navigation			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts on Navigation would be considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Potential impacts would likely be direct impacts.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	Potential impacts on Navigation will last only during construction phase.			
Impact Extent	**Local**	Regional	International	
	This impact will be only experienced by Dala fishermen, service providers of local transportation and commercial vessel using the Yangon River.			
Impact Scale	The impact scale is limited to the construction and safe zone area, i.e 250 m from the shore.			
Frequency	The impact is likely to be experienced every day during the 23 month of construction.			
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is considered Medium as the safe zone will cover less than 1/5th of the river width at that location but the impact will be experience every day for 23 month.			
Receptor Sensitivity	**Low**	Medium	High	
	Receptors sensitivity to this impact is small as alternative navigation channel exist in the river for commercial vessels, who would normally avoid the construction area as it is close to the shore, and small local stakeholders do not navigate much in this area.			

Significance of Impact				
Impact Significance	Negligible	**Minor**	Moderate	Major
	The significance is Minor.			

Mitigation Measures

The following mitigation measures will need to be implemented during the construction phase of the LNG Receiving Terminal:

- At least 30 days prior to mobilization, TPMC will coordinate with local authorities , who will then issue “Notice to Mariner” regarding project activities to appropriate parties (i.e. Department of Fisheries, Ministry of Livestock, Fisheries and Rural Development, and Myanmar Navy).
- Establish a 150 m exclusion zone and 250 m safety zone around the construction zone and provide support vessels to observe fishing and commercial vessels approaching the safety zone to prevent collision.
- Provide appropriate lights and warning signals on construction vessels to prevent accidental collision.
- Ensure all captain and skippers on the construction vessels are trained and have the necessary permits and certificate to operate the construction vessels.
- TPMC will inform the exact location of the Project site with detail of safe zone, and alternative transportation routes to local stakeholders, as well as Department of Fisheries, Ministry of Livestock, Fisheries and Rural Development, and Myanmar Navy.
- TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on river ways/ areas. This will ensure that stakeholders can anticipate and appropriately respond to the change and limitation of uses on river ways/ areas. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular navigation is affected by the Project activities.

Residual Impacts

Based on the implementation of the proposed mitigation measures, residual impacts are considered **Negligible**.

Monitoring Plan

- TPMC will need to monitor the grievance log weekly during construction to identify any specific grievance related to fishing activities.
- TPMC will review the accident log of the support vessel daily to identify any recurring risks and decide of additional prevention measure as necessary.
- TPMC will conduct, at least 3 times per year unplanned verification of permit and safety equipment, in particular lighting, on contractor vessels.
- TPMC will review engagement and communication log with local authorities to ensure proper information are provided by its contractors.

7.8.7.4 Impact during Operation

Overview

During operation, the fuel supply for this Project will be based on imported LNG from overseas. The LNG Carrier will arrive at the LNG facilities (unloading jetty) every 12 days (approximately 2-3 LNG

Carriers per month). The LNG carrier will be accompanied by two support tug vessels, which will assist in LNG carriers' docking. While an LNG carrier is moored, a safety zone will be established with restriction of access for other vessels or boats.

An exclusion zone of 200 metres and a safe zone of 250 metres from the LNG unloading jetty will be established to ensure safety among the Project vessels, and other non-project related vessels that navigate the Yangon River. Signalling buoys will be installed around the alignment of the safe zone to indicate the restricted area to other vessels. Navigation will be forbidden within the exclusion zone and activities restricted within the safe zone. If any none project related vessel enters the safe zone, the support tug vessels will assist to warn off the vessel. In addition, the discharge of LNG from the carrier takes approximately 12-16 hours.

The impact of the Project pre-mitigation on navigation during operation phase is considered a **Negligible** Impact.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts on Navigation				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts on Navigation would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Impact are temporary as they last only during the presence of the LNGC in the river.				
Impact Extent	**Local**	Regional	International		
	This impact will be only experienced at and around the LNG Receiving Terminal.				
Impact Scale	The impact is limited to 250 m from the LNG unloading jetty, size of the safety zone.				
Frequency	Every 12 days or 2 – 4 times per month				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is small due to the limited area of the river being impacted and the low frequency of the impact (maximum 4 days per month)				
Receptor Sensitivity	**Low**	Medium	High		
	Receptors sensitivity is considered small as less than a third of the river width will be impacted and therefore alternative navigation channels are available.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The significance is Negligible.				

Mitigation Measures

Although the impact is considered Negligible, it is recommended that TPMC implement the following mitigation measures:

- Provide appropriate lights and warning signals on operation vessels to prevent accidental collision.
- Ensure all captain and skippers on the operation vessels are trained and have the necessary permits and certificate to operate the construction vessels.
- LNG / condensate carrier tankers will be piloted during berthing and loading operations

- TPMC will inform the exact location of the restricted area, and alternative transportation routes to local stakeholders, as well as Department of Fisheries, Ministry of Livestock, Fisheries and Rural Development, and Myanmar Navy.
- TPMC will continue to implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on river ways/ areas. This will ensure that stakeholders can anticipate and appropriately respond to the change and limitation of uses on river ways/ areas. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular navigation is affected by the Project activities

Monitoring Plan

TPMC will need to monitor the grievance log weekly during operations to identify any specific grievance related to fishing activities.

7.8.8 Impact to Traffic and Transport

7.8.8.1 Baseline Summary

Among various types of transportation (including bicycle, motorcycle/ moped, car/truck/van, bullock-cart, canoe/boat, 4-wheel tractor and motorboat), bicycles or motorcycles are mostly used and owned by local people.

7.8.8.2 Receptor Sensitivities

Local citizens will experience with increasing traffic congestion and reduced access to local road, but alternative roads exist and the use of small-sized vehicles will facilitate avoidance of obstacles on the road.

7.8.8.3 Impact during Construction

Project Activities during Construction

The construction phase for the LNG Receiving Terminal installation is expected to take 18 months. Trucks will be used to transport material/equipment from the Myanmar International Terminal Thilawa port to fabrication shop at South Dagon Township before being transported back to the barge loading area near the port and then to the laydown area. This activity also increases traffic congestion and reduce access of local people to local road.

The impact of the Project pre-mitigation on traffic and transport during construction phase is considered a **Negligible** Impact.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts on Traffic and Transport			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts on Traffic and Transport would be considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Potential impacts would likely be direct impacts.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	Potential impacts on Traffic and Transport will last only during construction phase.			

Significance of Impact					
Impact Extent	**Local**	Regional	International		
	This impact will be experienced only by a small number of citizens who travel along the road between MIIT and South Dagon Township.				
Impact Scale	The impact scale is 27 km in total but with only 7-8 km where it may have impact on traffic.				
Frequency	The impact will occur regularly during the day between 8am and 10pm.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is small as there will be a limited number of trucks on the road during construction phase and no heavy machinery.				
Receptor Sensitivity	**Low**	Medium	High		
	Receptor sensitivity is low because the main road impacted is not heavily used on most part of the impacted area and is fairly large, where small-sized vehicles can easily avoid traffic. Also, there are alternative roads that local citizens can use.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The significance is likely to be negligible.				

Mitigation Measures

The following mitigation measures will need to be implemented during the construction phase of the LNG Receiving Terminal:

- TPMC will not transport equipment and materials during the local traffic peak time.
- TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on or near local road. This will ensure that stakeholders can anticipate and can appropriately respond to the change and limitation of uses on local roads. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular transportation is affected by the Project activities.

Monitoring Plan

- TPMC will need to monitor the grievance log weekly during construction to identify any specific grievance related to traffic and transport activities.

7.8.8.4 Impact during Operation

There is no activity during operation phase that will generate impacts on traffic and transport.

7.8.9 Impacts to Existing Facilities and Utilities

7.8.9.1 Baseline Summary

Existing infrastructures and services in the Project SAoI are developed and considered in sufficient number for the local population. According to Dala interviewees, they visit Yangon hospital, Parrami clinic, SSC hospital and N/Oak hospital for medical treatment. In Dala Township, traditional and private clinics, rural/ sub-rural health centers, and township/ station hospitals can also be found. In addition, the concrete road network in the Township is well developed. All of interviewees agreed that overall quality and condition of transportation system is good. Dala has the highest percentage of inhabitant using electricity for lighting, but charcoal is used for cooking.

Some poor households use water from the lakes/ ponds within the Dala Township' area, which are filled in the rainy seasons. Dala citizens access to non-drinking water via pond and lake, but Dala

interviewees refer purified drinking water, rainwater, well and tap water as alternative sources for non-drinking water. These sources contain sufficient water with good quality. In addition, Dala citizens mostly access drinking water via pool, pond or lake, but majority of Dala interviewees (95%) use rainwater as drinking water. All of them believe that amount of water is sufficient with good quality, but it can becomes insufficient during March, April and May.

7.8.9.2 Receptor Sensitivities

Also the quality of the local infrastructures such as the road network is consider good by local population, the number of alternatives is limited. For villagers living closest to the LNG receiving Terminal proposed location, only one road connect to Dala urban center where they can find the hospitals, transport to Yangon and administrative center. The public services in the township also have a limited capacity to absorb additional users. Pool, pond and lake are also present in limited numbers and scarcity of water during March, April and May creates a vulnerability of the local population to changes of these resources.

7.8.9.3 Impact during Construction

Overview

Construction phase of the LNG Receiving Terminal will last around 23 months. During construction, the workforce will reach 400 workers daily and 600 workers at peak. These will comprise of more than half of the local workers which should come from the region and therefore limit the additional burden on local infrastructures and services. Any workers coming from other areas, including expatriate will be accommodated at the worker camp located at the LNG Receiving Terminal proposed location. The average water consumption rate during construction is anticipated to be 1,800 m^3 per month (approximately 60 m^3 (60,000 L) per day).

During construction, dredging of the Yangon River at the location of the Unloading Jetty will not be necessary and excavated sediment will be discharged onshore. In addition to mobilization of vessels for construction, some transportation of equipment, material and workers is expected to be done on existing local roads.

The electricity will be sourced from the existing 11 kV distribution line. The raw water required during construction will be obtained from the local water distribution services. The raw water will be treated and purified to supply for construction.

For solid wastes, wooden crates will be disposed of by an appropriate or a licensed waste contractor, while steel pipes, steel plates and structural steel will be sold. The hazardous wastewater from chemical cleaning will be transported off-site to the appropriate or licensed Hazardous Waste Treatment facilities available in Myanmar. Solid hazardous waste from the construction phase will be properly contained and transported off-site to an appropriate or licensed waste disposal contractor.

The impact of the Project pre-mitigation on existing facilities and utilities during construction phase is considered a **Moderate** Impact.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts on Existing Facilities and Utilities including roads, hospital, etc.		
Impact Nature	**Negative**	Positive	Neutral
	Potential impacts to Existing Facilities and Utilities would be considered to be adverse (negative).		

Significance of Impact				
Impact Type	**Direct**	Indirect	Induced	
	Potential impacts would likely be direct impacts.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	The impact may occur throughout the construction phase.			
Impact Extent	**Local**	Regional	International	
	This impact will be experienced by stakeholders living directly in the SAoI and along the transport route. Dala citizens will be the ones affected by this impact.			
Impact Scale	The number of Households that could be impacted is large due to the concentration of people living in the SAoI.			
Frequency	Impact could be experienced daily during the entire duration of the construction phase.			
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact will be small in nature as limited transport will be done on the existing road to Dala, water consumption is limited compare to the capacity of the area and wastes will be handled by experienced third party in dedicated facilities.			
Receptor Sensitivity	Low	Medium	**High**	
	The receptor sensitivity is high as stakeholder living near the LNG Receiving Terminal have little or no alternative to travel to public services and infrastructures or to access utilities.			
Impact Significance	Negligible	Minor	**Moderate**	Major
	The significance is likely to be moderate.			

Mitigation Measures

The following mitigation measures are suggested in order to mitigate impact on facilities and utilities:

- Provide appropriate amenities at the workforce accommodation camp – e.g. recreational opportunities. This will help reduce the need for workers to utilize local infrastructure and services;
- TPMC will ensure that company medical services have sufficient capacity and capability to treat a reasonable amount of workers at the same time.
- Develop and implement a Worker Code of Conduct for all employees, contractors and visitors directly related to the Project. This will be a contractual and enforced requirement for all staff and subcontractors.
- TPMC will communicate on its recruitment approach emphasising that priority for unskilled position will be given to inhabitant from Project SAoI.
- Develop and implement a traffic management plan to minimize the impact experienced by road users as a result of the Project. The traffic management plan should be developed in consultation with local stakeholders. Stakeholders should be notified in advance of the Project commencing of traffic routes that will be utilised and, where known, periods of increased traffic volumes. Where possible, traffic movements will be coordinated so as to limit disruptions to local activities;
- Develop and implement a community health management plan and an occupational health and safety plan in consultation with relevant stakeholders (e.g. local health practitioners). These plans will ensure that appropriate and adequate health care services are provided on site and at the accommodation camp to address/ manage worker illnesses and injuries.
- TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any

particularly activities on public infrastructures. This will ensure that stakeholders can anticipate and appropriately respond to the change and limitation of uses. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular use of public services and infrastructures is affected by the Project activities.

Residual Impacts

Based on the implementation of the proposed mitigation measures, the significance of the impact is considered to be a **Minor** impact post mitigation.

Monitoring Plan

Monitoring of impact on local infrastructures and services will be done through:

- Monthly engagement with local authorities and service providers;
- Weekly review of grievance log; and
- Monthly inspection of infrastructures and in particular the roads used for equipment and material transport.

7.8.9.4 Impact during Operation

Overview

During operation phase planned for 25 years, the Project will generate mainly skilled jobs and a limited number of unskilled jobs such as guard, gardener, cook or maid). O&M staff with relevant experience of operating similar facilities and with adequate knowledge of comparable technology will be also deployed. It is expected that approximately 171 staffs will work on the operational phase of the Project. These numbers are divided into 49 permanent staffs (operation maintenance and back office), 12 external securities, 10 contract staffs (cleaners, gardeners and helpers), 10 contract staffs (technical hands), and 90 maintenance staffs for 30 days (once every 3 years).

The raw water will be taken from Yangon River, using the Water Intake Pumping station at the flow rate of approximately 860 m^3/hour. The main freshwater supply source will be taken from Yangon River. In addition, the pre-water treatment plant will be installed to provide freshwater for operation phase. In addition, the LNG Receiving Terminal will be connected to a 33 kV transmission line that runs parallel along the access road and the pipeline.

The solid waste generated during the operation phase will be collected and segregated for recycle and non-recycle waste (i.e. paper, plastic). Project will use incineration on site and compost. There will also be minimal other wastes from maintenance activities, which will be provided to the local community as firewood. While some hazardous materials will be stored on site, the chemicals will be transported appropriately to the Project site and Material Safety Data Sheets (MSDS) will be prepared from chemical suppliers in Myanmar.

The impact of the Project pre-mitigation on existing facilities and utilities during operation phase is considered a **Negligible** Impact.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts on Existing Facilities and Utilities including roads, hospital, etc.		
Impact Nature	**Negative**	Positive	Neutral
	Potential impacts to Existing Facilities and Utilities would be considered to be adverse (negative).		

Significance of Impact				
Impact Type	**Direct**	Indirect	Induced	
	Potential impacts would likely be direct impacts.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	Impact has the potential to have a long lasting effect as the operation will last for 25 years.			
Impact Extent	**Local**	Regional	International	
	This impact will be experienced by stakeholders living directly in the SAoI and transport route. Dala citizens are the ones mainly affected by this impact.			
Impact Scale	The number of Households that could be impacted is small as only the people living directly next to the terminal will experience the impacts.			
Frequency	Impact will be experienced daily			
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The impact magnitude is negligible as the number of permanent staff will have no influence on the local demography, the water abstracted from the Yangon River represent a very small fraction of the river capacity and transport will be limited to light vehicle for the transport of workers.			
Receptor Sensitivity	Low	Medium	**High**	
	The receptor sensitivity is high as stakeholder living near the LNG Receiving Terminal have little or no alternative to travel to public services and infrastructures or to access utilities.			
Impact Significance	**Negligible**	Minor	Moderate	Major
	The significance is Negligible			

Mitigation Measures

Although the impact significance is Negligible, TPMC will implement the following mitigation measures:

- Develop and implement an employee Code of Conduct for all employees, contractors and visitors directly related to the Project. This will be a contractual and enforced requirement for all staff and subcontractors.
- TPMC will continue to implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The Project will also continue to implement the Grievance Mechanism to collect grievances from local stakeholder affected by the Project activities

Residual Impacts

No residual impacts are expected on the local infrastructures and utilities during operations.

Monitoring Plan

Monitoring of impact on local infrastructures and services will be done through:

- Bi-yearly engagement with local authorities and service providers (e.g. bus or ferry company);
- Monthly review of grievance log; and
- Yearly inspection of infrastructures and in particular the roads used for transport.

7.8.10 Impacts from Environmental Emissions (Noise, Dust, Vibration)

7.8.10.1 Baseline Summary

Currently the air shed in the Project SAoI is considered non-degraded, meaning that all parameters are below the limit fixed by the NEQ.

According to the noise baseline results all stations in the Project SAoI exceeded the Myanmar standard for at least one time period. Possible sources of high noise levels include traffic activities, human activities, rain/weather events, religious activities (i.e. bell sound), and agricultural activities (i.e. grain mill).

Vibrations are limited to the vehicle traffic on the local roads.

The predominant annual wind direction is north easterly, meaning that the wind blow from the Yangon River with speed at 8.8 - 11 metre per seconds. Another predominant wind direction comes from south of the LNG terminal at speed 7 – 11 metre per seconds.

7.8.10.2 Receptor Sensitivities

The Proposed Project site is located close to a settlement. Household's members in those settlements are potential receptors of this impact. The other sensitive receptors to be impacted by noise, dust or vibration will be Dala fishermen and Dala farmers as they daily conduct fishing or agricultural activities in the proximate area of the LNG terminal.

7.8.10.3 Impact during Construction

Overview

The construction of the Project will generate:

- Noise: which can result from a variety of onsite activities (e.g. construction of infrastructure, reversing sensors on large vehicles). Noise can lead to hearing loss and disrupt community activities (such as sleep). Ongoing disruptions have been linked to increases in depression and anxiety;
- Vibrations: which can result from construction activities (e.g. piling, drilling, operation of compressors and generators). Vibrations if strong enough can damage the foundation of nearby infrastructure (e.g. businesses, community centers, monastery); and
- Dust: which can be generated through vegetation clearing, site grading, driving on dry, dirt roads. This can impact the surrounding air quality, disrupting the amenity value of an area and potentially impacting community health (e.g. further aggravating existing respiratory illnesses).

It is anticipated that during the entire construction period the predicted noise levels do not comply with the assessment noise criteria. Dust will be generated during the first phase of construction only and impact a very limited number of receptors. Vibration will also be experienced mainly during the first phase of construction period.

Given the short-term nature of the impacts or the limited number of receptors, the impacts associated with environmental emissions are expected to be **Minor** Impact.

Impact Assessment Table

Significance of Impact					
Impact	Impact from Environmental Emissions				
Impact Nature	**Negative**	Positive	Neutral		
	Increase of environmental emissions has the potential to result in negative impacts in the local area.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is direct.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	Impact will be temporary, during site preparation for dust and vibration and during 23 month for noise.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited within the local area.				
Impact Scale	The impact scale is small.				
Impact Frequency	The impact will occurs 24/7 during the construction phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be small with the nearest settlement 800 metres away and not downwind compare to the proposed Project site.				
Receptor Sensitivity	Low	**Medium**	High		
	Receptor sensitivity is likely to be medium, mainly due to the material used in local houses nearby.				
Significance	Negligible	**Minor**	Moderate	Major	
	The significance is likely to be minor.				

Mitigation Measures

Mitigation measures have already been proposed in the Air Quality and Noise Impact Assessment sections but TPMC will also need to develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly noisy activities (e.g. pile driving). This will ensure that stakeholders can anticipate and appropriately respond to the disruption associated with noise. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder impacted by noise, dust and vibration.

Residual Impacts

Assuming that the management measures proposed in the Air Quality and Noise Impact Assessment sections are implemented and monitored over time, the residual impact was assessed as **Negligible** impact.

Monitoring Plan

Monitoring of air quality and noise have been described in the relevant chapters. In addition, TPMC will need to monitor the grievance log weekly during construction to identify any specific grievance related to environmental emissions.

7.8.10.4 Impact during Operation

Overview

No activity with risk of dust or vibration emissions are expected during operation. The risks associated with noise during operation and relevant mitigation measures are covered in the Noise Impact Assessment section of this report.

The Project should also continue to implement the Grievance Mechanism to collect grievances from local stakeholder impacted by noise, dust and vibration.

7.8.11 Impacts on Community Health and Safety

7.8.11.1 Baseline Summary

In Myanmar and Yangon region, common diseases and health problems are consisted of tuberculosis, underweight in children, malnutrition, Malaria, and AIDs. In Dala Township, most of interviewees (95.3%) are living with a good health conditions, although 38% have experienced fever in the past years. Average distance between resident in the Project SAoI houses and medical facilities is approximately 5.7 km. Yangon is the main business hub in Myanmar and also a tourism center. There are constant movement of population in the area including Myanmar local and offshore people. Therefore the inhabitant of the Project SAoI are constantly exposed to an above average pool of disease.

Dala citizens mostly transport by riding a bicycle and motorbike, but some of them also use boat/ canoe to transport to other areas. Around location of the LNG terminal, there are boats with passengers and fishing boats, but majority of boats and passengers can be observed at the northern of Dala Township, where Dala pier (Dala Ferry Terminal) is located. Based on interviewees from Tone Tin Gan village, majority of them use motorbike for transport, but some of them use bike or foot (walking).

7.8.11.2 Receptor Sensitivities

The entire population within the Project SAoI is a potential receptor of this impact. In particular this includes the population interacting directly with the Project staffs such as restaurant and shop owners, households of project staff, and medical staffs. People with disability, young children and old people are particularly at risk if exposed. The low density of population reduce the risk of epidemic but people living directly near the proposed Project site will be at risks in case of an epidemic within the workforce. Local communities are also not used to a volume of traffic meaning there are low to medium levels of awareness regarding road safety.

7.8.11.3 Impact during Construction

Overview

The presence of TPMC workforce may result in interactions between the workforce and local people. As it is unlikely that the entire workforce will come from the Project SAoI, workers from outside of the local area will also be present. These workers may be subject to communicable diseases and STDs.

In the event of an outbreak of an airborne (e.g., TB) or food-borne illness among the workers, the area where local workers live, and any settlement visited by Project workforce may also become susceptible to these infectious diseases.

An increase in the transmission of communicable diseases may occur as the result of the introduction of workers into the area and creation of vector habitat (worker camps).

In terms of communicable diseases, of particular note and concern are tuberculosis and HIV/ AIDS, given their current prevalence within the country and local area. The receptors located closest to the Project site are likely to be most affected by an increase in vector habitat.

If left untreated, communicable diseases can lead to long-term health issues and/ or in some instances death. In other words, the impact can be characterized as being long-term and in some instances permanent.

The handling, transport and treatment of the Project waste during construction may also result in risks to public health due to contamination of water resources and spread of disease carrying species such as rats.

The construction activities will create environmental emissions which may impact on community health and safety, in particular disruption of sleep, impact to building structure or aggravation of respiratory illness.

The risk of injuries from vessel accidents will increase during construction activities of the LNG terminal (including construction exclusion zone, transportation of vessels for Unloading Jetty, and transportation of heavy, large volume and super-sized materials, vessel operational discharge, and vessel anchoring) associated with river way.

In addition, the risk of injuries will also increase during construction activities of the LNG terminal (including mobilization of vessels for construction, transportation of equipment, material and workers, transportation of non-hazardous and hazardous wastes to designated location, and local suppliers of water) associated with the presence of mechanical equipment, excavation areas, and movement of equipment and people by road. Increased vehicle traffic, including vehicles operated by TPMC and their contractors increases the risk of accidents and injuries (up to and including deaths).

Unplanned event (including leak of non-hazardous and hazardous waste from vehicles or storage) will affect local people who are living proximate to the LNG terminal, and living along the road to designated location for disposal.

The security personnel active on site during construction will interact with local population. Due to their role and tasks it presents a risk of human right abuse.

The impact of the Project pre-mitigation on community health and safety during construction phase is considered a **Moderate** Impact.

Impact Assessment Table

Significance of Impact				
Impact	Impact on Community Health and Safety			
Impact Nature	**Negative**	Positive	Neutral	
	Increase of communicable diseases in the local area is negative.			
Impact Type	**Direct**	Indirect	Induced	
	The impact is direct.			
Impact Duration	Temporary	Short-term	**Long-term**	**Permanent**
	The impact could be long lasting, even permanent, if left untreated or resulting in death.			
Impact Extent	**Local**	Regional	Global	
	The effect of the impact will be mainly experienced by local population living directly next to the proposed Project site.			
Impact Scale	The impact scale is small due to the limited number of people potentially impacted.			
Impact Frequency	The impact likely occurs during the construction phase with the rare frequency.			

Significance of Impact					
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is likely to be Medium as the potential changes for the local population can have long term adverse consequences but with a rare frequency and at a small scale.				
Receptor Sensitivity	Low	**Medium**	High		
	Receptor sensitivity is medium due to the lack of awareness of the population and potential high level of interaction with workers.				
Significance	Negligible	Minor	**Moderate**	Major	
	The significance of the impact is Moderate.				

Mitigation Measures

The following mitigation measures should be implemented to reduce the significance of the impact:

- Training for all workers on the transmission routes and common symptoms of communicable diseases. This can help reduce the potential for workers to unknowingly transmit communicable diseases. This may also help to increase knowledge within Project SAoI – e.g. through the training of workers that have been sourced from the local area;
- Establish amenities at the worker camp to help minimize the interaction between the workforces (particularly temporary construction workers) and local villagers. This includes recreation facilities and health care infrastructure;
- Establish a workforce code of conduct, which include the specific measures that target anti-social behaviour, such as becoming involved with commercial sex workers;
- Undertake pre-employment screening to ensure fitness for work. It is important that the pre-screening process does not result in discrimination, but instead is used as a tool to minimize the transmission of communicable diseases;
- Vector management procedures, including measures to reduce the presence of vector habitat and consideration of whether pesticides will be utilized to reduce the presence of vectors onsite;
- Provision of onsite health care and medical facilities, to ensure that basic medical attention and first aid treatment can be sought during the hours that the work is being undertaken at the Project site. This will also help reduce the potential pressure on local health care facilities;
- Pre-placement medical examination of all workers, supported by periodic medical examinations. A regular voluntary Worker Medical Screening Program onsite and a Monitoring and Evaluation (M&E) system. In addition a workplace policy and training and awareness programme on risks described above and prevention and mitigation of HIV impacts will be implemented with Project staff.
- In collaboration with the local and regional Government, local emergency providers and local health care facilities, TPMC will develop and implement Emergency Prevention, Preparedness and Response Plans (EPPRPs) to cover all incidents presenting risks to public safety and the affected communities in proximity to the Project Sites and the environment.
- Develop and implement a Workforce Code of Conduct which will be adhered to by all Contractors and TPMC employees. Any employee or Contractor found in violation of the Code shall face disciplinary hearing which may result in dismissal.
- Ensure there is access to free condoms (including female condoms) at the worker camp to promote safe sexual practices.
- Conduct information, education and communication campaigns amongst Project personnel on hygiene and sanitation.

- The EPC contractor should develop an effective Waste Management Plan that ensures adequate and legally acceptable control and management of transport and disposal of all wastes on and off site.
- Security personnel will be contracted and trained in line with the Voluntary Principles on Security and Human Rights.
- Accommodation should be provided to external workers in accordance with international good practice on workers' accommodation, including IFC / EBRD standards to prevent transmission of diseases associated with poor living conditions.
- The Project should implement measures to reduce the presence of standing water onsite through environmental controls and source reduction to avoid the creation of new breeding grounds.
- All the mitigation presented in the air quality and noise impact assessment chapter will be implemented.
- The Project should develop a Traffic Management Plan covering vehicle safety, speed limits on roads, driver and passenger behaviour, use of drugs and alcohol, hours of operation, rest periods and location of rest stops and accident reporting and investigations.
- Require Project drivers to be trained in defensive driving within the previous 3 years.
- All vehicles used for the project should be regularly serviced and maintained.
- Local speed limits should be adhered to when travelling through communities by all Project related traffic. Such speed limits will have the added advantage of reducing dust emissions.
- Undertake consultation with communities along key transport routes to inform them about the potential for increased traffic movements prior to any changes.
- TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The Project will also include a Grievance Mechanism to collect grievances from local stakeholder affected by the Project activities
- The Project will ensure that signs are put up around construction sites advising people of the risks associated with trespass. All signs should be in diagram form to ensure those with low levels of literacy understand the signs.
- The Project will ensure that there is adequate fencing around construction site to minimise the risk of trespass. Fencing will be checked daily to ensure that it is in good condition and to look for any signs of entry.

Where appropriate the community health management plan should be implemented in close coordination with government authorities and local health care providers.

In addition to the community health plan it is recommended that a complementary occupational health and safety plan be developed – to focus on managing potential issues that may affect the Project workforce. The plan should include measures to minimize the potential for the workforce to contract a communicable disease. This will help reduce the potential for the workforce to contract a communicable disease and subsequently introduce the disease in their home village/ community.

Residual Impacts

Once management measures have been implemented, it is predicted that the impact will become minor and negative during construction due to the potential for long term or permanent impact in case of accident. Therefore, on-going monitoring and evaluation of the management measures and community health situation will be needed. If monitoring indicates an increase in the transmission of communicable diseases, the management measures will need to be revised. This includes monitoring the Project's direct activities as well as Project contractors.

Monitoring Plan

Monitoring of impact on Community Health and Safety will be done through:

- Bi-monthly review of training log to confirm all employee are trained on the company H&S standard;
- Monitoring and review of accidents/ incidents due to construction activities; workers' health by daily monitoring and monthly review of near-misses, incidents, occupational diseases, dangerous occurrences, accidents at project activity areas and construction workers camp, as per construction phase Health and Safety Plan, which will be prepared by the EPC contractor.
- Development of a Community health and safety monitoring and surveillance programme.
- Daily monitoring of construction area, worker camp and surrounding (standing water, fence, warning sign).
- Regular unplanned audit related to the worker code of conduct (alcohol and drug use, speed limit, activities linked with local population).
- Bi-yearly unplanned audit of waste management contractors and facilities.
- Monthly visual inspection of first aid facilities and records, review of employment records and health insurance subscription records
- Weekly review of grievance log.

7.8.11.4 Impact during Operation

Overview

During operational phase of the Project, approximately 171 staff will be working. These numbers are divided into 49 permanent staffs (operation maintenance and back office), 12 external securities, 10 contract staffs (cleaners, gardeners and helpers), 10 contract staffs (technical hands), and 90 maintenance staffs for 30 days (once every 3 years). They will be accommodated outside of TPMC camps, in house or apartment in the area. The expatriate workforce will be educated skilled employees who are expected to have good understanding of health and safety risks, in particular in relation to communicable diseases.

Amongst the local staff, approximately 10 security guards will be employed. The site will be fenced and access restricted.

Vehicle traffic will be reduced to light vehicle for the transport of Project staffs but also to the movement of LNG carriers at a frequency of maximum 4 vessels per month.

The risk of injuries from vessel accidents will increase during operation activities of the LNG terminal (including safe zone, LNG carriers, vessel operational discharge, vessel anchoring, operation of LNGC, and FLNG discharges to river) associated with river way.

Unplanned event (including explosion, fire, oil spill from LNG carriers, and leak of non-hazardous and hazardous waste from vehicles or storage) will affect local people who are living near the LNG terminal, and along the road of designated location for disposal.

The impact of the Project pre-mitigation on community health and safety during operation phase is considered a **Negligible** Impact.

Impact Assessment Table

Significance of Impact					
Impact	Impact on Community Health and Safety				
Impact Nature	**Negative**	Positive	Neutral		
	Increase of communicable diseases in the local area is negative.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is direct.				
Impact Duration	Temporary	Short-term	**Long-term**	**Permanent**	
	The impact could be long lasting, even permanent, if left untreated or resulting in death.				
Impact Extent	**Local**	Regional	Global		
	The effect of the impact will be mainly experienced by local population living directly next to the proposed Project site.				
Impact Scale	The impact scale is small due to the limited number of people potentially impacted.				
Impact Frequency	The impact likely occurs during the operation phase with a rare frequency.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be small as the potential changes for the local population can have long term adverse consequences but will be rare and at a small scale.				
Receptor Sensitivity	**Low**	Medium	High		
	Receptor sensitivity is considered low as a result of awareness campaign during the construction phase, the limited number of expected interaction with project staff and the mitigation measures in place to ensure navigation safety.				
Significance	**Negligible**	Minor	Moderate	Major	
	The significance of the impact is Negligible.				

Mitigation Measures

Although the expected impacts are negligible, it is recommended that the following mitigation measures should be implemented to reduce any risks:

- Training for all workers on the transmission routes and common symptoms of communicable diseases. This can help reduce the potential for workers to unknowingly transmit communicable diseases. This may also help to increase knowledge within Project SAoI – e.g. through the training of workers that have been sourced from the local area;
- Undertake pre-employment screening to ensure fitness for work. It is important that the pre-screening process does not result in discrimination, but instead is used as a tool to minimize the transmission of communicable diseases;
- Pre-placement medical examination of all workers, supported by periodic medical examinations. A regular voluntary Worker Medical Screening Program onsite and a Monitoring and Evaluation (M&E) system. In addition a workplace policy and training and awareness programme on risks described above and prevention and mitigation of HIV impacts will be implemented with Project staff.
- Develop and implement a Workforce Code of Conduct which will be adhered to by all Contractors and TPMC employees. The specific measures that target anti-social behaviour, such as becoming involved with commercial sex workers are also include. Any employee or Contractor found in violation of the Code shall face disciplinary hearing which may result in dismissal.

- Security personnel will be contracted and trained in line with the Voluntary Principles on Security and Human Rights.
- All the mitigation presented in the air quality, noise, waste and surface water impact assessment chapter will be implemented.
- TPMC will continue to implement the Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. It will include the Grievance Mechanism to collect grievances from local stakeholder affected by the Project activities
- The Project will ensure that signs are put up around the site advising people of the risks associated with trespass. All signs should be in diagram form to ensure those with low levels of literacy understand the signs.
- The Project will ensure that there is adequate fencing around the site to minimise the risk of trespass. Fencing will be checked daily to ensure that it is in good condition and to look for any signs of entry.

Monitoring Plan

Monitoring of impact on Community Health and Safety will be done through:

- Bi-yearly review of training log to confirm all employee are trained on the company H&S standard;
- Development of a Community health and safety monitoring and surveillance programme.
- Regular unplanned audit related to the worker code of conduct (alcohol and drug use, speed limit, activities linked with local population).
- Bi-yearly unplanned audit of waste management contractors and facilities.
- Monthly visual inspection of first aid facilities and records, review of employment records and health insurance subscription records.
- Weekly review of grievance log.

7.8.12 Impacts on Occupational Health and Safety

7.8.12.1 Baseline Summary

National occupational safety and health legislation is limited with the main laws to consider for the Project being the Prevention and Control of Communicable Diseases Law (Law No. 1/95), Law Amending the Factories Act 1951 (Pyidaungsu Hluttaw Law No. 12/2016) and Prevention From Danger of Chemical and Associated Materials Law, 2013 (28/2013). Myanmar has ratified 23 out of 189 ILO conventions. Experience of industrial health and safety standards is limited in the Project SAoI except for those who have experience working at the industrial ports.

7.8.12.2 Receptor Sensitivities

International employees are likely to have a better understanding of national and international health and safety standards, and therefore understand the relevance of any training and mitigation measures and appropriate working conditions. Similarly, employee during the operation period will be skilled workers mainly and will receive extensive training improving their knowledge of risks and how to handle these. Employees sourced from the SAoI may have a higher sensitivity to the impact due to a poorer understanding of OHS standards and working conditions, and lower education levels.

7.8.12.3 Impact during Construction

Overview

For onshore LNG receiving terminal construction, the workforce will be 400 workers on average and 600 workers at the peak of construction activities. For construction of unloading jetty, 40 workers per day with peak at 50 will be required. As much as possible the company will try to source workforce from Project SAoI although some expatriate workers are expected on certain jobs. The nature of the activities mean that there is the potential for accidents and injuries to occur if occupational health and safety systems are not developed and strictly enforced for all Project personnel.

The potential impacts on the workers (unskilled, semi-skilled and skilled) of the Project are likely to result from the civil construction activities, truck movement, heat stress and hot surface, electrocution, chemical exposure, falling objects, working at height or in confined spaces and any unplanned event that may occur during the construction phase of the Project. These impacts are likely to increase in proportion to the increase in activity.

The risk of injuries from vessel accidents will increase during construction activities of the LNG terminal (including construction exclusion zone, transportation of vessels for Unloading Jetty, and transportation of heavy, large volume and super-sized materials, vessel operational discharge, vessel anchoring, and berth construction) associated with river way.

In addition, the risk of injuries will also increase during construction activities of the LNG terminal (including transportation of equipment, material and workers, local contractor for waste and local suppliers of water) associated with the movement of equipment and people by road. Increased vehicle traffic, including vehicles operated by TPMC and their contractors increases the risk of accidents and injuries (up to and including deaths).

Unplanned event (including leak of non-hazardous and hazardous waste from vehicles or storage) will affect the Project workers who are proximate to the LNG terminal.

The impact of the Project pre-mitigation on occupational health and safety during construction phase is considered a **Moderate** Impact.

Impact Assessment Table

Significance of Impact				
Impact	Impact on Occupational Health and Safety			
Impact Nature	**Negative**	Positive	Neutral	
	The potential increase in Health and safety of workforce and Labour and working conditions are negative.			
Impact Type	**Direct**	Indirect	Induced	
	The impact is direct.			
Impact Duration	Temporary	Short-term	**Long-term**	**Permanent**
	Impact has the potential to have a long lasting effect with injured workers being unable to work for a long time or even permanent in case of accident crippling or killing workers.			
Impact Extent	**Local**	Regional	Global	
	The impact is limited to the workers at the site and external waste and water contractors/suppliers.			
Impact Scale	The impact scale is small.			
Impact Frequency	The impact likely occurs during the construction with a rare frequency.			

Significance of Impact					
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is potentially medium with long term impact but with a rare frequency and small scale.				
Receptor Sensitivity	Low	**Medium**	High		
	Receptor sensitivity is likely to be medium with unskilled staff not aware of H&S risks and best practice.				
Significance	Negligible	Minor	**Moderate**	Major	
	The significance is likely to be Moderate due to the potential duration and gravity of the impact but the rare frequency of the impact.				

Mitigation Measures

The Project will develop and implement a Construction Occupational Health and Safety Management Plan (OHSMP) in line with good industry practice and corporate policies.

- The 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 potential hazards. This shall include (but not limited to) the following hazards:
  - falling from height;
  - falling into water;
  - entanglement with machinery;
  - tripping over permanent obstacles or temporary obstructions;
  - slipping on greasy walkways;
  - falling objects;
  - asphyxiation;
  - explosion;
  - contact with dangerous substances;
  - electric shock;
  - variable weather conditions;
  - lifting excessive weights; and
  - traffic operations.
- A Permit to Enter system will be established to ensure that only authorised persons gain entry to the construction site.
- Competent and adequately resourced sub-contractors will be used where construction activities are to be sub-contracted.
- All persons working on the construction site will be provided information about risks on Site and arrangements will be made for workers to discuss health and safety with the Contractor.
- All workers will be properly informed, consulted and trained on health and safety issues.

- Personal Protective Equipment (PPE) shall be worn at all times on the construction Site. This shall include appropriate safety shoes, safety eyewear, and hard hats. Non-slip or studded boots will be worn to minimize the risk of slips.
- Before starting work all the appropriate safety equipment and the first-aid kits will be assembled and checked as being in working order. Breathing apparatus if necessary will be tested at regular intervals in the manner specified by the manufacturer.
- All lifting equipment and cranes will be tested and inspected regularly. All hoist ways will be guarded.
- All scaffolding will be erected and inspected in conformity with the Factories Act (1951) and the appropriate records maintained by the Contractor.
- Safety hoops or cages will be provided for ladders with a height in excess of two meters.
- When there is a risk of drowning lifebelts shall be provided and it shall be ensured that personnel wear adequate buoyancy equipment or harness and safety lines, and that rescue personnel are present when work is proceeding (near the water extraction point).
- All breathing apparatus, safety harnesses, life-lines, reviving apparatus and any other equipment provided for use in, or in connection with, entry into Confined Spaces, and for use in emergencies, will be properly maintained and thoroughly examined at least once a month, and after every occasion on which it has been used.
- Where sound levels cannot be reduced at the source, suitable hearing protection will be provided when noise levels indicate a Leq of more than 85 dB(A). When hearing protection is used, arrangements will be made to ensure the wearers can be warned of other hazards.
- The Contractor shall provide appropriate safety barriers with hazard warning signs attached around all exposed openings and excavations.
- The EPC contractor will comply with the IFC Performance Standard 2, local regulation and ILO conventions signed by Myanmar.
- TPMC will develop and monitor an internal standard to guide labour practices and apply this to supply chain to ensure that no child and/or forced labour will be employed by the EPC contractor and its sub-contractors.

In addition an OHS monitoring programme should be put in place to verify the effectiveness of prevention and control strategies and a worker grievance mechanism developed and implemented.

Residual Impacts

Based on the implementation of the proposed mitigation measures, the significance of the impact is considered to be a Minor and Negative Impact post mitigation due to the impossibility to reduce the accident risk to zero and the potential negative effects on workers.

Monitoring Plan

Monitoring of impact on Occupational Health and Safety will be done through:

- Six monthly review of training log to confirm all employee are trained on the company H&S standard;
- Monitoring and review of accidents/ incidents due to construction activities; workers' health by daily monitoring and monthly review of near-misses, incidents, occupational diseases, dangerous occurrences, accidents at project activity areas and construction workers camp, as per construction phase Health and Safety Plan, which will be prepared by the EPC contractor.
- Development of an Occupational health and safety monitoring and surveillance programme.

- Weekly review of worker grievance log.

7.8.12.4 Impact during Operation

Overview

During operational phase of the Project, approximately 171 staffs will be working. These numbers are divided into 49 permanent staffs (operation maintenance and back office), 12 external securities, 10 contract staffs (cleaners, gardeners and helpers), 10 contract staffs (technical hands), and 90 maintenance staffs for 30 days (once every 3 years). These staffs are expected to have a better understanding of health and Safety risks associated with the operation due to training and experienced gained during construction.

Project activities likely to present a risk during operation are linked with light vehicle travel at site and maintenance operations, in particular at height or in confined space. Heat stress and hot surface, electrocution and chemical exposure also present a risks for workers during the operation phase of the Project. Unplanned event like fire and explosion also present a risk for workers during operation but are covered under the unplanned event section of this report.

The risk of injuries from vessel accidents will remain during operation activities of the LNG terminal (including LNG carriers, vessel operational discharge, vessel anchoring, and operation of LNGC) associated with river way.

The impact of the Project pre-mitigation on occupational health and safety during operation phase is considered a **Minor** Impact.

Impact Assessment Table

Significance of Impact					
Impact	Impact on Occupational Health and Safety				
Impact Nature	**Negative**	Positive	Neutral		
	The potential impact on Labour and working conditions are negative.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is direct.				
Impact Duration	Temporary	Short-term	**Long-term**	**Permanent**	
	Impact has the potential to have a long lasting effect with injured workers being unable to work for a long time or even permanent in case of accident crippling or killing workers.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited to the workers at the site.				
Impact Scale	The impact scale is small.				
Impact Frequency	The impact likely occurs during the operation with a rare frequency.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is potentially medium.				
Receptor Sensitivity	**Low**	Medium	High		
	Receptor sensitivity is likely to be low due to training, experience and skills.				
Significance	Negligible	**Minor**	Moderate	Major	
	The significance is likely to be Minor due to the potential duration and gravity of the impact but the rare frequency and the low vulnerability of the receptor.				

Mitigation Measures

The mitigation measures developed for the construction phase apply to the operation phase. The Occupational Health and Safety Management Plan (OHSMP) will be updated to integrate the new potential risks of the operation and be linked to the Emergency Response Plan for unplanned event. The grievance mechanism for workers should also be maintained.

Residual Impacts

Based on the implementation of the proposed mitigation measures, the significance of the impact is considered to be a Minor and Negative Impact post mitigation due to the impossibility to reduce the accident risk to zero and the potential negative effects on workers.

Monitoring Plan

Monitoring of impact on Occupational Health and Safety during operation will be done through:

- Six monthly review of training log to confirm all employee are trained on the company H&S standard;
- Monitoring and review of accidents/ incidents due to operations activities; workers' health by daily monitoring and monthly review of near-misses, incidents, occupational diseases, dangerous occurrences, accidents at project activity areas, as per operation phase Health and Safety Plan, which will be prepared by the TPMC.
- Development of an Occupational health and safety monitoring and surveillance programme.
- Weekly review of worker grievance log.

7.8.13 Impacts to Cultural Heritage

7.8.13.1 Baseline Summary

There are no known cultural heritage site within the footprint of the Project site. The history of the site also support the absence of such site or any cultural or religious use. The main cultural heritage sites located nearest to the proposed Project site is Danot Pagoda, Ah Nar Gan Sayar Thetgyi (meditation station) located roughly 900m from the proposed Project site.

7.8.13.2 Receptor Sensitivities

The vast majority of the population in the Project SAoI is Buddhist and regularly attend the monastery or Pagoda for ritual or weekly praying.

7.8.13.3 Impact during Construction

Overview

The Project activities that may have impact on cultural heritage sites during construction are the same as the ones described in the impacts from environmental emissions sections. This include all activities that may create noise, dust or vibration impacts.

The impact of the Project pre-mitigation on cultural heritage during construction phase is considered a **Negligible** Impact.

Impact Assessment Table

Significance of Impact					
Impact	Impact on Cultural Heritage				
Impact Nature	**Negative**	Positive	Neutral		
	The potential impact on Labour and working conditions are negative.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is direct.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Impact will be experienced during construction phase only.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited to the area directly.				
Impact Scale	The impact scale is small.				
Impact Frequency	The impact likely occurs daily for 23 month during construction.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is considered small with the nearest settlement 800 metres away and not downwind compare to the proposed Project site.				
Receptor Sensitivity	**Low**	Medium	High		
	Receptor sensitivity is likely to be low due to distance from the proposed Project site and the quality of the construction of the Pagoda.				
Significance	**Negligible**	Minor	Moderate	Major	
	The significance is considered to be Negligible.				

Mitigation Measures

All the measures described in the Impacts from Environmental Emissions section will be implemented for impact by environmental emissions. In addition:

- The EPC contractor during construction will monitor the state of any cultural heritage closest to the project site. If damage is done to the buildings by vehicle of the Project, compensation (in kind or in cash) should be organised to restore the building to its state before the damage occur.
- The EPC contractor will develop the construction planning in discussion with the nearest temple/monastery in order to make sure that any Project activity near the monastery (e.g transport of large equipment) do not take place during special religious activities.
- TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The Project will also include a Grievance Mechanism to collect grievances from local stakeholder affected by the Project activities

Monitoring Plan

Monitoring of impact on cultural heritage will be done through:

- Monitoring and review of accidents/ incidents due to construction activities;
- Weekly review of grievance log.

7.8.13.4 Impact during Operation

Overview

No activity presenting a risk for cultural heritage are expected during operation apart from large industrial accidents covered in the unplanned event section of this report.

The Project should nevertheless continue to implement the Grievance Mechanism to collect grievances from local stakeholder.

7.9 Unplanned Event Impact Assessment

7.9.1 Introduction

An unplanned event is defined as oil spill, vessel collision, fire, explosion and accidental chemical release that have the potential to occur during construction and operation phases. The unplanned events associated to the activities above can be listed as follows;

- Vessel collision;
- Chemical spill or leak;
- Fire and explosion;
- Seismic and earthquake; and
- Typhoon and extreme weather condition; and
- Loss of containment of chemical storage facilities.

7.9.2 Assumption and Limitation

As described in the Project Description in ***Chapter 4***, the Project is being designed, and will be constructed and operated, according to the best practice for preventing the risk and impact on health, safety, and environment. However, there is a potential for accidents, malfunctions or unplanned events to occur during any Project phase that cause impacts to the health and safety of community and employee of the Project. This is required to consider in this ESIA report.

The assessment of significant impacts of unplanned events considers the probability of events occurring and an estimate of the severity of the consequences of the events. In assessing the severity of impact, “A worst case scenario” is taken into consideration. This chapter presents the probable impacts of unplanned events associated with construction and operation of the Project. The unplanned events are considered separately from routine and non-routine activities as they arise as a result of a technical failure, human error, or as a result of natural phenomena.

7.9.3 Assessment Methods

As discussed in ***Chapter 3***, the IFC Environmental, Health and Safety (EHS) standards and guidelines are considered throughout the assessment and provide the overarching guidance and principles for undertaking the assessment. The key documents considered are as follows:

- **IFC Performance Standard 1 Assessment and Management of Environmental and Social Risks and Impacts:** The ESMS will establish and maintain an emergency preparedness and response system so that the client, in collaboration with appropriate and relevant third parties, will be prepared to respond to accidental and emergency situations associated to prevent and mitigate any harm to people and/or the environment;
- **IFC Performance Standard 2 Labor and Working Conditions:** It is required the Project to prevent risk and impacts on the staffs working in the Project area. Taking into account inherent risks in its particular sector/ classes of hazards in the client work area including physical, chemical, biological, radiological hazards, threats to women;

- **IFC Performance Standard 4 Community Health and Safety and Security:** The project must avoid and minimize risk and impact caused by the Project on health and safety of the community;
- **Environmental, Health, and Safety (EHS) General Guidelines**; and
- **EHS Guidelines:** Liquefied Natural Gas Facilities (2017).

Assessment of significant impact associated to unplanned event considers the likelihood (or frequency) of incident occurrence and the consequence of the incident should it occur. The assessment of likelihood takes a qualitative approach based on professional judgement, experience from similar projects. The assessment of consequence is based on specialists' input and professional experience. The details are provided in the next sections. Since the Project activities during the construction and operation period are varied. The unplanned events will be assessed based on the Project phase listed in the following sections.

7.9.4 Baseline Summary

7.9.4.1 Vessel Collision

The river navigation was a major mode of transport for Myanmar. The proposed Project is located on the bank of the Yangon River and the river will be the transportation route for LNGC and supporting vessels. There are a few major ports and terminals located along the Yangon River including Yangon main port and Thilawa area port. All vessels calling to Yangon port use the Yangon river estuary's navigation channel and large vessels (over 200 GRT) is required to make a pilot on board at the pilot station adjacent to the estuary of Yangon River before entering.

The field surveys regarding to the congestion of vessels along the passage route have not been conducted according to JICA (2016). Hence, there are no available quantitative data regarding the traffic of vessels.[111] Currently, the lack of aids to navigations and the absence of navigation control system cause the high risk for safety navigation in the Yangon River.

7.9.4.2 Seismic and Earthquake

Myanmar rests on one of the world's two main earthquake belts. One of its many fault lines run 1,000 kilometres (600 miles) north to south through the country's agriculturally rich central plain, placing major Myanmar cities, including Mandalay, Bago and Yangon, at risk.[112] Due to this situation the country is exposed to the hazards of large earthquakes and tsunamis (M. Thein et al.)

7.9.4.3 Tropical Strom and Extreme Weather Condition

According to the statistic during 1992–2017, there were 18 tropical storms that affected Myanmar listed in ***Table 7.64*** below.

[111] JICA. (2014). The Preparatory Survey for the Project for Expansion of Yangon Port in Thilawa Area. Japan International Cooperation Agency. Retrieved from: http://open_jicareport.jica.go.jp/pdf/12244893.pdf

[112] Irin. (2011). Myanmar's urban areas at risk from earthquakes. Myanmar Times. Retrieved from: https://www.mmtimes.com/national-news/2691-myanmar-s-urban-areas-at-risk-from-earthquakes.html

Table 7.64: Tropical Storms in Myanmar

Name	SSHS Category	Year
1. BOB 01	Category 1	1992
2. Forrest	Category 4	1992
3. BOB 01	Category 4	1994
4. 02B	Tropical Storm	2002
5. 01B	Category 1	2003
6. BOB 01	Category 1	2004
7. Mala	Category 4	2006
8. Akash	Tropical storm	2007
9. Nargis	Category 4	2008
10. Giri	Category 4	2010
11. Viyaru	Tropical storm	2013
12. Phailin	Category 4	2013
13. Komen	Tropical storm	2015
14. Roanu	Tropical storm	2016
15. Dianmu	Tropical storm	2016
16. Kyant	Tropical storm	2016
17. Maarutha	Tropical storm	2017
18. Mora	Severe Cyclonic Storm	2017

Remark: Saffir–Simpson hurricane scale (SSHS): Tropical cyclone must have one-minute maximum sustained winds of at least 74 mph (33 m/s; 64 kn; 119 km/h) (Category 1). The highest classification in the scale, Category 5, consists of storms with sustained winds over 156 mph (70 m/s; 136 kn; 251 km/h). The classifications can provide some indication of the potential damage and flooding a hurricane will cause upon landfall.

It could be seen that in the Year 1992, 2013, 2016 and 2017, there were two (2) tropical storms that made it in-land.

7.9.5 Resources and Receptors

The resources and receptors of unplanned events depend on the type of extent of the incident. For vessel collisions, the main receptors are: cargo vessels; fishing boats; and Project employees. Emergency unplanned events that cause fire, explosions and toxic chemical discharges can cause damage to life and property of the local community. Project employees may also be affected by emergency events, for example, earthquake, tropical storm, and extreme weather condition.

Table 7.65: Identified Receptors for Unplanned Events

Unplanned Events	Potential Receptors
Vessel Collision	The receptors of vessel collision are the vessels passing by the proposed Project and nearby including fishing boat, tanker, cargo vessel, and passenger boat.
Chemical spill and leak	When community or workers exposed to the spills or contaminated environment, it may cause short/ long term health depending on the time of exposure, type of contaminants, and amount released. The severity of the impact can be ranged from irritation to fatality.
Fire and Explosion	Fire and explosion can affect personnel operating at the facilities and cause damage on machines, equipment and any related facilities. In addition, the impact could cause the damage to the communities at the surrounding area.
Seismic earthquake	Earthquake-induced ground motion can cause damage to the LNG tank, equipment, and any another related facilities. In addition, this would expose the public to substantial risk of injury.
Tropical Storm and Extreme Weather Condition	The tropical storm occurs at the Project Area, it could affect the personnel working inside the facilities, on LNGC or the supporting vessels.
Impacts from Loss of Containment of Chemical Storage Facilities On-site	Loss of contaminant would affect the surrounding environment e.g. soil, waterbody, flora, and fauna. Also, it could cause potential health and safety risk to receptors using surface water, soil and groundwater.

In which, the Dala village tract and part of Yangon River are located within 1 kilometre from the LNG receiving terminal.

7.9.6 Project Activities

The list of Project activities of LNG Receiving Terminal that will be involved to the unplanned events in are listed as follows;

Table 7.66: Project Activities Potentially Involved with Unplanned Events

Phase	Project Activities Related to Unplanned Events
Construction Phase	■ River work activities such as piling, installation of foundation; ■ Installation of jetty; ■ Installation of LNG terminal.
Operation Phase	■ LNGC berthing and departure; ■ LNG handling and storage ■ Re-gasification Process

Project activities during construction and operation of LNG terminal requires marine transportation. There will be increasing numbers of vessels navigating in-out the port that will increase the risk of collision or maritime incident. The estimated number of vessels during both construction and operation are provided as follows;

- The jetty construction for LNG receiving terminal requires the support vessels including two (2) transportation barges, two (2) support tugs, one (1) crane barge working alongside with the waterfront for 12 months. In addition, jetty construction for instance piling, installation of structure etc. may also obstruct the navigation of ships including the construction of trestle and berth and dredging activities. These activities will increase the risk of vessel collisions;
- LNG will be transported from oversea by the LNGC. The frequency of LNGC approached to the Project is every 2-4 times per month, along with one (1) navigation boat, and two (2) support tugs.

7.9.7 Assessment of Impact

7.9.7.1 Impact of Vessel Collision during Construction and Operation Phase

Overview

A collision is defined as an accidental event, which may occur as a result of a vessel losing its station-keeping/positioning and navigational abilities due to structural, mechanical, or electrical failure, human error, environmental conditions, or some combination thereof (Lloyd register). The consequence of collision depend on characteristics of vessel, the speed. It could lead to the ship structural damage, injury or fatality of staff/ public, and release of hazardous materials into the environment.

Potential impacts of vessel collision include injuries, fatalities, and damage to property. Severity of potential impacts depends on type of vessel, severity of the collision, and number of crew or operators on board. However, the Project shall provide lifesaving equipment for every personnel on support vessels and drilling rig. Lifesaving equipment shall be maintained to be in good condition and ready for use. An emergency response plan for vessel collisions shall be prepared. ***Severity of potential impact is considered medium***.

A review of historical data of LNG accidents since 1965 until 2006, there are four (4) accidents occur as follows;

- 1978 – 123,890 m^3 Khannur vessel collided with the carge ship Hong Hwa in the Strait of Sin;
- 1985 – 126,000 m^3 Ramdane Abane collision while loaded;
- 1997 – 125,000 m^3 Northwest Swift collided with a fishery vessel;
- 2002 – LNG Ship Norman Lady collision within U.S. Navy Nuclear.

In all case, there were no cargo spillage from collision, grounding, fire, explosion, or hull failure. The record of vessel collision occurred in the Yangon River, there were 5 collisions in the Yangon River during 2009 to 2011 according to JICA report listed in ***Table 7.67***.

Table 7.67: Recorded Vessel Collisions in the Yangon River (2009-2011)

Date	Incident	Latitude	Longitude
15th Feb 2009	MV Bago and MPA1 collision	16-35.2'N	96-15.3'E
13th Mar 2009	MV Clipper Stamford and Tug Sintha Dastun 9 Collision	16-13.127'N	96-19.4'E
24th Aug 2009	MV Young Brother 2 and MV Iner Prime Collision	16-35.6'N	96-14.9'E
20th May 2011	MV Intan T2801 Chief Officer Manoverboard	16-14.67'N	96-35.8'E
16th Dec 2011	MVKota Rukun and RORO IV Collision	16-45.9'N	96-09.4'E

Source: JICA.

Considered from the statistic of accident above, the chance of vessel collision is considered "**Likely to occur once or more in life of the Project**" if vessel navigation is managed improperly. The details of the assessment are provided below:

Impact Assessment Table

Significance of Impact			
Impact	Potential impacts on public health and safety, and occupational health and safety from accidental vessel collision.		
Impact Nature	**Negative**	Positive	Neutral
	Any damage or loss from vessel collision would considered to be adverse (negative).		

Significance of Impact					
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts from vessel collision would likely be direct impacts from Project activities.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Potential impacts to public health and occupational health and safety from vessel collision could result in damage to vessels and/or injuries or fatalities to those on the vessels, depending on magnitude of vessel collision. However, there are safeguards in place and significant collisions are not expected to occur. Therefore, the duration is considered Short term.				
Impact Extent	**Local**	Regional	International		
	Extent of potential impact would be at the incident location. Thus it is considered Local potential impact.				
Impact Scale	The Project will use a number of vessels of different types for various purposes. However, any potential incident is likely to only involve a small number of vessels, if any were to occur at all.				
Impact Frequency	As indicated in Section 6, there will be maximum number of 5 vessels during construction phase and 4 vessels during operation phase, which could be operating in the same duration in both construction and operation phases. Thus, the calculated frequency of collision risk of infield vessels to passing vessels and installation during construction and operation is 10 times per day and 8 times per day, respectively.				
Impact Consequence	Incidental	Minor	**Moderate**	Major	Severe
	Based on the above impact characteristics, the magnitude of impact from vessel collision is anticipated to be moderate.				
Impact Likelihood	Very Unlikely	Unlikely	**Likely to occur once or more in life of the Project**	Likely to occur once or twice per year	Will likely occurs more than twice per year, or is continuous or certain to occur
	The likelihood of vessel collisions is anticipated to be likely to occur once or more in life of the Project.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	Considering the level of magnitude and likelihood, the significance of the impact from vessel collision is expected to be Moderate.				

Mitigation / Management Measures

Construction Phase

- A dedicated safe area should be provided to relevant authorities and local fisherman during construction of the marine component;
- The contractor shall coordinate with relevant authorities such as Myanma Port Authority (MPA) under the management of the ministry of Transport and Myanmar Fishery Federation (MFF) to disseminate information regarding the construction schedule, construction area, and activities to the fishermen and other river users;
- The Contractor shall install buoy, navigation light, or warning sign as appropriate at the construction area; and
- Safety boats shall patrol the construction area to warn and provide navigational safety information to other local vessels;

- Navigation aids should be installed at the separated channel leading into the port to ensure the safety of vessel manoeuvring;
- The navigation schedule shall be communicated to relevant stakeholders by using various communication channels such as posters, local radio, and fishery group meetings; and
- Establish a maritime safety management plan.

Operation Phase

- A dedicated safe area should be provided to relevant authorities and local fisherman during operation phase especially during LNGC docking and LNG transferring;
- The Project Proponent shall coordinate with relevant authorities such as Myanma Port Authority (MPA) under the management of the ministry of Transport and Myanmar Fishery Federation (MFF) to disseminate information regarding the LNGC schedule and activities to the fishermen and other river users;
- The Project Proponent shall install buoy, navigation light, or warning sign as appropriate at the Jetty area; and
- Navigation aids should be installed at the separated channel leading into the port to ensure the safety of vessel manoeuvring;
- The navigation schedule shall be communicated to relevant stakeholders by using various communication channels such as posters, local radio, and fishery group meetings; and
- Establish a maritime safety management plan.

Residual Impact (Post Mitigation)

With the implementation of the above mitigation measures, the residual impacts would be expected to be of **Minor** significance.

7.9.7.2 Impact of Chemical Spill or Leak

Overview

There are a number of chemicals used, stored, and handled in the various construction and operation phase. If handle and store inappropriately, these chemicals may spill or release into environment and cause the contamination to the environmental receptors for instance soil, surface water, or groundwater. The examples of the control measures are listed as follows:

- Store chemicals in the appropriate container with clear label;
- Install bund in the chemical area, and the floor is impermeable with respect to the liquids stored;
- Prepare chemical spill response kit adequately and appropriately;
- Provide fire-fighting equipment at readily accessible locations at the storage area; and
- Prepare the emergency response plan to cover the event of chemical spill/ leakage.

For operation phase, when considering the properties of these chemicals, some e.g. hydrochloric acid, and sodium hydroxide etc. is severely corrosive agent which could cause severe burning to skin, respiratory system, or gastronomy. The remaining items can cause the irritating effects to respiratory, skin, or eyes. To minimize the risk of incident to be lowest as possible, the hazardous material management plan will be implemented similar to the construction period. For the sensitivity of receptor, ground water is the major source of drinking water with stored water from stream in the study area. Given the reliance on existing water sources, it is unlikely that the local villages would have the ability to adapt to any sort of contamination – i.e. be able to find an alternative drinking water source.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts from accidental releases of hazardous substances could be contamination to environments and cause the health effect to human.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts from accidental releases of hazardous substances would be considered adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts from accidental releases of hazardous substances would likely be direct impacts from Project activities.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The duration of potential impacts is long-term as it can have long lasting impacts on health or the environment.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would be limited to the Project footprint and vicinity area in the worst case hence would be considered to be Local.				
Impact Scale	The impact is limited within the local villages. The impact scale is medium.				
Impact Frequency	N/A, the impact is not expected to occur.				
Impact Consequence	Incidental	Minor	**Moderate**	Major	Severe
	Based on the above impact characteristics, the magnitude of impact from accidental releases in the Project Area is anticipated to be moderate.				
Impact Likelihood	Very Unlikely	**Unlikely**	Likely to occur once or more in life of the Project	Likely to occur once or twice per year	Will likely occurs more than twice per year, or is continuous or certain to occur
	The likelihood of chemical spill or leaks is anticipated to be unlikely.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	Considering the level of magnitude and likelihood, the significance of the impact from vessel collision is expected to be Minor.				

Mitigation / Management Measures

- Contractor will prepare unloading and loading protocols and train staff to prevent spills and leaks;
- Contractor will prepare guidelines and procedures for immediate clean-up actions following any spillages of oils, fuels or chemicals;
- 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 for fuel oil and chemicals will be surrounded by bunds or other containment devices to prevent spilled oil, fuel and chemicals from percolating into the ground or reaching the receiving waters;

- Implement a construction materials inventory management system to minimise over-supply of the materials;
- Provide dedicated storage areas for construction materials to minimize the potential for damage or contamination of the materials;
- Ensure storage areas have impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest storage container;
- Provision of grounding and lightning protection for equipment that handles flammable materials;
- Establish a first-aid centre with first-aid trained staff on site. The first-aid centre shall be equipped with sufficient first-aid equipment, first-aid kit and medicines;
- Emergency response plan should include informing the public and relevant parties
- Employee and contractor must be trained on emergency response procedure.

Residual Impact (Post Mitigation)

With the implementation of the above mitigation measures, the residual impacts are expected to be of **Negligible** significance.

Monitoring Plan

No Monitoring plan is required

7.9.7.3 Impact of Fire and Explosion

Overview

Fire and explosion from during project operation could will cause the serious accident or, even catastrophic accidents. The potential sources of major fire and explosion are likely considered from LNG tank.

The hazard identification process is to evaluate the sources and probability of release of hazardous substances that can cause serious danger to persons according to *Appendix B, World Bank Guideline for Identifying, Analyzing and Controlling Major Hazard Installation in Developing Countries, Office of Environmental and Scientific Affairs Projects Policy Department (1988)*. The criteria to be considered in the identification process include chemical property, storage quantity, and operating condition of equipment that has potential to pose major accidents including units that operate in temperature and pressure higher than the ambient condition.

Assumption for Assessment

The operation of the LNG terminal involve the storage of LNG and regasification. The equipment with maximum volume of LNG is LNG storage tank with the storage volume of 25,000 m^3 capacity each. Both storage tanks will store LNG at a temperature of -160 °C at atmospheric pressure. Each storage tank consists of the following layers:

- Layer 1: Stainless steel primary barrier constructed of chromium nickel stainless steel; the primary barrier would be corrugated to allow for expansion and contraction associated with heat changes;
- Layer 2: A secondary barrier comprised of laminated glass cloth and aluminium foil; as well as a=chromium nickel stainless steel barrier filled with perlite insulation, designed to contain LNG in case of leakage through the primary barrier

Natural Gas Characteristics

Natural gas consists of methane, propane, butane, carbon, and nitrogen as shown in the ***Table 7.68***. The molecular weight is depended on the proportion of each components. Boiling Point is -163 Celsius. Flammable limit is ranged from 50,000 to 150,000. Vapour pressure is 2,900 mmHg at 140 degree Celsius. Flash fire is less than -50 °C as shown in the ***Table 7.69***.

Table 7.68: LNG Components

Components	Unit	Proportion
Methane (not less than)	84 mol%	84
Ethane (not more than)	12 mol%	12
Propane (not more than)	4 mol%	4
Butane, Pentane and others	Min: 2 mol %, Max: 2.5%	2 – 2.5

Source: TPMC, 2019.

Table 7.69: LNG Characteristics

Characteristic	Detail
Molecular weight	Depending on the LNG components
Water solubility	0.006 g/ml (20° C)
Vapor pressure	2,900 mm Hg (140 °C) ; 16,600 mm Hg (-100 °C)
Boiling point	-163 °C
Flash point	< -50 °C
Ignition limit	50,000 to 150,000 %
Melting point	-182 to –150 °C
Temperature during combustion	482 to 632 °C

Source: Environment Canada, Manual for spill of Hazardous Materials, 19, pg. 352

Mathematical Model

BREEZE Incident Analyst Version 1.2 and input Data for BREEZE Incident Analyst Version 1.2.

The Results of Risk Assessment

Table 7.70: Estimated Impact Area from Fire and Explosion of Natural Gas: Jet Fire, Fireball, Flash Fire, and VCE at LNG storage tank

Scenarios	Heat Radiation Radius (m)	Affected Area
NG Storage Tank		
1. Leakage (Hole size o.25")		
1.1 Jet Fire		
Thermal Intensity 37.5 kW/m^2	-	-
Thermal Intensity 25.0 kW/m^2	-	-
Thermal Intensity 12.5 kW/m^2	-	-
Thermal Intensity 4.0 kW/m^2	1.34	Project area and Cropland
.2 Rupture) Hole size16 "(		

2.1 Fireball		
Thermal Intensity 37.5 kW/m^2	699.48	Project area, cropland, and river
Thermal Intensity 25.0 kW/m^2	856.69	Project area, cropland, and river
Thermal Intensity 12.5 kW/m^2	1,211.54	Project area, cropland, and river
Thermal Intensity 4.0 kW/m^2	2,141.72	Project area, cropland, river, and small portion of industrial area
2.2 Flash Fire		
Lower flammable limit)LFL (50,000)ppm(	1,046.20	Project area, cropland, and river
2.3 VCE		
Pressure Level14.5 psi	282.20	Project area, cropland, and river
Pressure Level8 psi	383.33	Project area, cropland, and river
Pressure Level 3.5 psi	657.80	Project area, cropland, and river
Pressure Level 1 psi	1,491.11	Project area, cropland, and river

Heat radiation radius assessment of fireball in rupture scenario has the radius of severe impacts from 699 m to 856 m, where the energy level are 37.5 kW/m^2 and 25.0 kW/m^2 respectively (illustrated in ***Figure 7.17***). The impact area covers project area, cropland, and river, no residence in the area. The affected people are Project workers, including permanent staffs, security team, contract staffs, maintenance team, and marine vessels operators. The damage is considered severe within the affected area, as suggested in ***Table 7.70***.

Heat radiation radius assessment of flashfire in rupture scenario (LFL 50,000 ppm) has the impact radius of 1,046 meter (illustrated in ***Figure 7.18***). The impact area covers project area, cropland, and river, no residence in the area. The affected people are project workers, including permanent staffs, security team, contract staffs, maintenance team, and marine vessels operators. The damage is considered severe within the affected area, as suggested in ***Table 7.71***.

Heat radiation radius assessment of VCE in rupture scenario has the radius of severe impacts from 282 m to 383 m, where the pressure level are 14.5 psi and 8 psi respectively (illustrated in ***Figure 7.19***). The impact area covers project area, cropland, and river, no residence in the area. The estimated number of affected project workers would be about 150 people, which includes permanent staffs, security team, contract staffs, maintenance team, and marine vessels operators. The damage is considered severe within the affected area, as suggested in

Table 7.72.

Table 7.71: Concern Levels of Thermal Radiation

Incident Flux (kW/m^2)	Effect	
	Structural Damage	**Health Effect**
4.0	-	Causes pain if duration is longer than 20s but blistering is unlikely.
12.5	Minimum energy to ignite wood with a flame; melts plastic tubing	1% lethality in 1 min. 1st degree burns in 10s.
25.0	Wood structure is burnt without flame	100% lethality in 1 min. Severe Injury in 10s, when being directly in contact.
37.5	Damage to process equipment	100% lethality in 1 min. 1% lethality in 10s when being directly in contact.

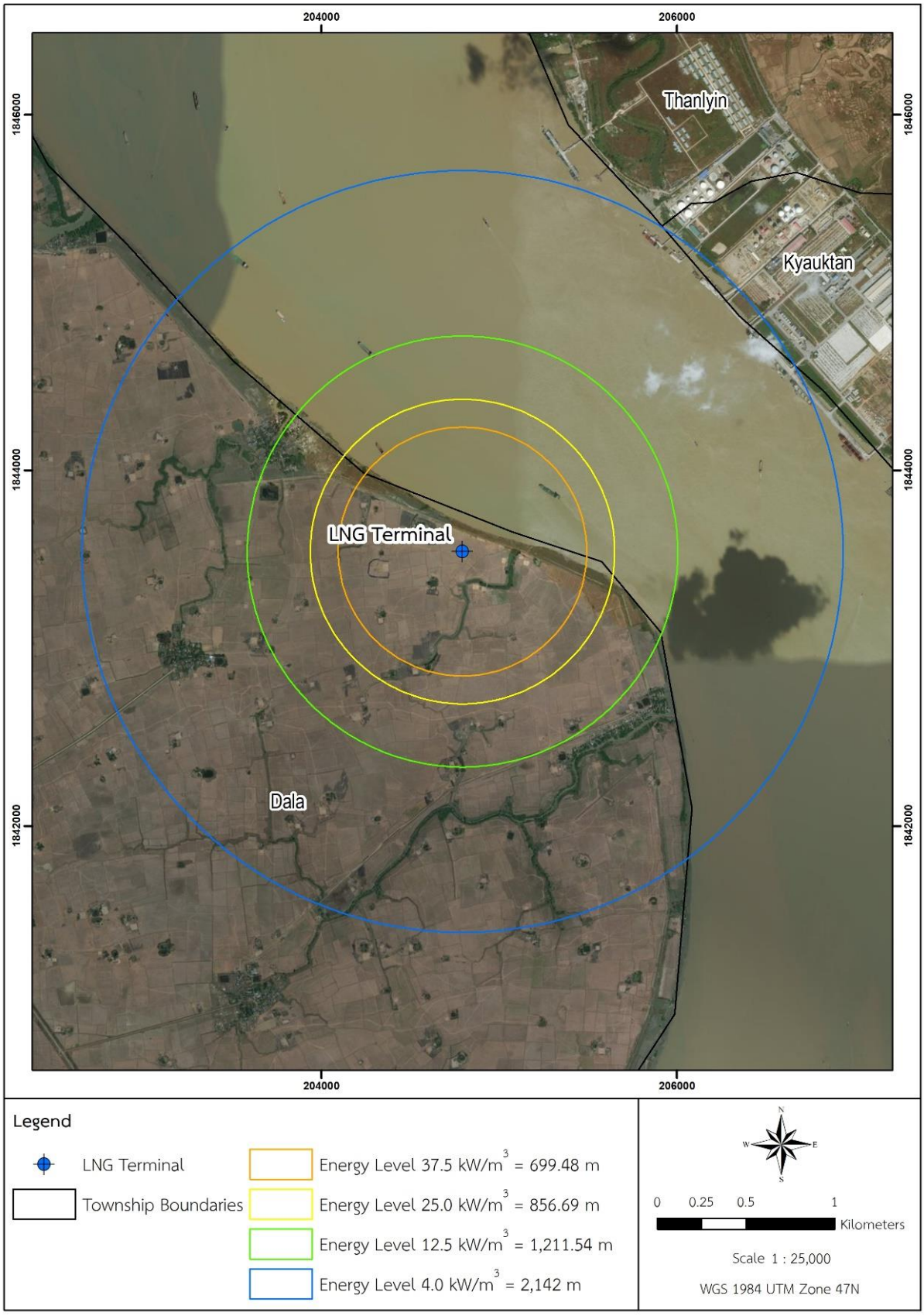
Source: World Bank technical paper number 55, Techniques for Assessing Industrial Hazards a Manual (1998)

Table 7.72: Effects of Over pressure

Blast Pressure (PSI)	Effects
1 PSIG	■ Shatters glass.[a]
3.5 PSIG	■ Serious injury likely.[a] ■ Steel frame building distorted and pulled away from foundation.[b] ■ Severe damage to houses.[c]
8 PSIG	■ Destruction of buildings.[a] ■ Severe damage to reinforced concrete building.[c] ■ Moderate damage to massive concrete building.[c]
14 PSIG	■ Causes those directly exposed to the pressure 1-99% fatality.[a]

Source: [a] Breeze Incident Analyst User Guide Version 1.4, Trinity Consultants (2018)
[b] Lees, Frank P., Loss Prevention in the Process Industries, Vol.1, London and Boston (1980)
[c] Planning Guidance for Response to a Nuclear Detonation, Federal Emergency Management Agency (FEMA) (2010)

Figure 7.17: Heat radiation radius in of fire ball scenario

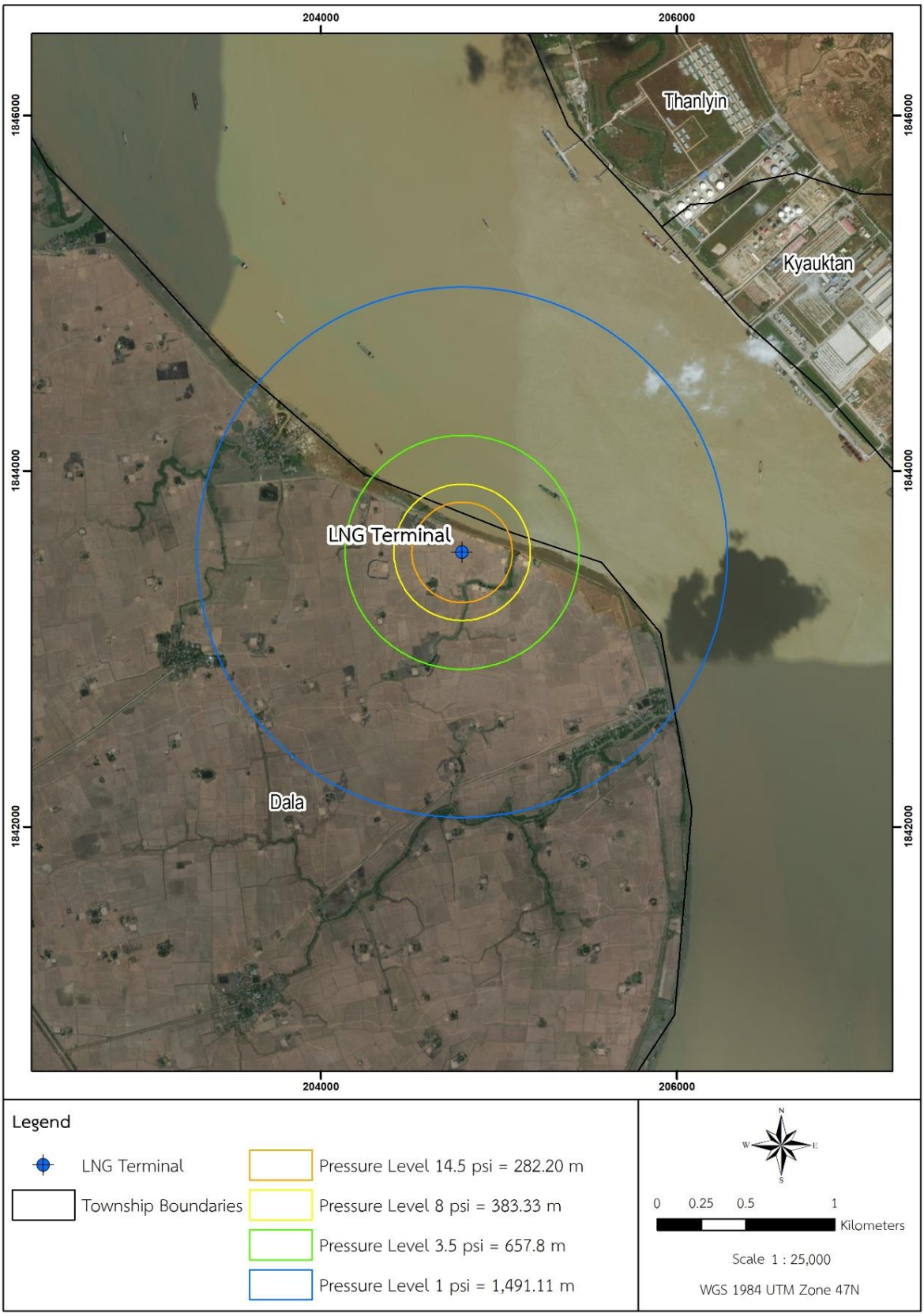


Source: BREEZE Incident Analyst. (Modified by ERM)

Figure 7.18: Heat radiation radius in of Flashfire scenario

Source: BREEZE Incident Analyst. (Modified by ERM)

Figure 7.19: Heat radiation radius in of VCE scenario



Source: BREEZE Incident Analyst. (Modified by ERM)

Impact Assessment Table

Significance of Impact

Impact	Potential impacts from fire and explosion may cause injury, loss of life or damage to property.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts from fire and explosion would be considered adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Potential impacts from fire and explosion would likely be direct impacts from Project activities.			
Impact Duration	Temporary	**Short-term**	**Long-term**	Permanent
	The impact duration is short-term or long-term depending on the volume of LNG released.			
Impact Extent	**Local**	Regional	International	
	Extent of potential impact would be at the incident location and surrounding, up to 2,142 m radius. Thus, it is considered Local potential impact.			
Impact Scale	Impact can be varied from property damage, person injury and fatality			
Impact Frequency	The frequency over the course of the Project is most likely to be zero occurrences. Fire and explosion would be a non-repeating, unplanned, event-related impact.			
Impact Consequence	Incidental	Minor	Moderate	Major	**Severe**
	The impact consequence is Severe because there is a possibility for fatality.			
Impact Likelihood	Very Unlikely	**Unlikely**	Likely to occur once or more in life of the Project	Likely to occur once or twice per year	Will likely occurs more than twice per year, or is continuous or certain to occur
	The likelihood of fire and explosion is anticipated to be unlikely.			
Impact Significance	Negligible	Minor	Moderate	**Major**
	Considering the level of magnitude and likelihood, the significance of the impact from fire and explosion is expected to be Major.			

Mitigation / Management Measures

- The Project will implement measures to minimize risk during construction and operation to lowest as possible. The list of mitigation measures include:
- Develop a preventive maintenance program for process equipment and pipeline connection in order to avoid failures and implement program regularly;
- Ensure the staff working to standard and strictly follow working procedures in order to prevent any incident;
- Install leak detecting and alarming system in operating areas and tank farm;
- Establish an Emergency Centre with 24 hours standby staff and firemen. This centre will be equipped with a communication system such as hot (emergency) line telephone, trunk radios, paging, inter-com, different alarm tones correspondence with each kind of situation, CCTV monitors those can view different areas of the Complex, etc.;
- Install fire protection and firefighting system including but limited following items:

- Gas detection system: gas detector and fire alarm devices will be installed in potential leakage area of toxic chemicals and flammable substances like large size valves, flanges, major rotating equipment and high temperature fluctuation area;
- Fire water system: fire water pond and pumps will distribute fire water to all plants in the Complex via fire water pipeline;
- Water firefighting system in all plants: water hydrants, water monitors, fixed water spray system;
- Foam firefighting system in Tank Farm area: foam monitors, foam chamber equipped at heavy hydrocarbon storage tanks;
- Fire extinguishing system: portable fire extinguishers (foam, powder and CO_2) in plants and buildings at appropriate locations;
- Inert gas fire suppression system: Inert gas total flooding fire extinguishing system will be provided in some areas such as control rooms and substations; and
- Fire alarm system (automatic fire detectors and manual fire call points) will be provided in required areas.

- All fire prevention and firefighting systems shall be routinely inspected and maintained the by responsible persons;
- Establish a First-aid centre with 24 hours standby First-aid trained staff. The First-aid centre must be equipped with sufficient first-aid equipment, first-aid kit and medicines;
- To establish emergency plan and evacuation plan with a clear emergency procedure set up. The procedure will include explanation of steps and guidelines that everybody has to follow such as below items;
  - Witness should first control the emergency situation or extinguish fire based on emergency activity plan and report to Boardman or shift supervisor or foreman of that unit immediately to request the support team from the Emergency Centre of the Complex;
  - The event shall be reported to the higher management level and emergency team shall be immediately formed according to the procedure set forth for providing support;
  - When the emergency signal rings, all workers have to stop all activities to a safe condition and move to assembly point immediately;
  - Assembly point shall be assigned for head counting and stand by for providing support;
  - The workers who first witness the accident have to put on the necessary personal protective equipment and enter the incident area from upwind only;
  - Limit the fire areas by utilizing the appropriate firefighting equipment;
  - All firefighting technique has to be exercised routinely during normal situation; and
  - Coordination with outside organizations such as nearby plants, hospitals, outside fire brigade team and so on.
- Proper communication equipment of either station or mobile type will be provided in the plant such as hot (emergency) line telephones, trunk radios, paging, inter-com and different alarm tones correspondence with each kind of situation.

Residual Impact (Post Mitigation)

With the implementation of the above mitigation measures, the residual impacts are expected to be of **Minor** significance.

7.9.7.4 Impact of Seismic and Earthquake

Overview

Earthquake events have been identified as potential initiating events for catastrophic releases. The largest ever instrumentally recorded earthquake in Myanmar was a magnitude 8.0 event that occurred at Taunggyi in 23 May 1912, approximately 453 kilometre to northern direction of the Project area. In Yangon where the Project locate, there were a recorded number of earthquake occurring with more frequently since 2010.

The Project design LNG tank and associate facilities to meet the seismic design standard for instance NFPA 59A, API standard 650, etc. In the LNG industry, a two-tier design approach is stipulated, within the same framework of the risk category seismic design philosophy used for nuclear facilities. The Operating Basis Earthquake (OBE) is the maximum earthquake for which the structure sustains no permanent damage and restart and safe operation can resume after the earthquake.

Therefore, the likelihood major earthquake occurring in the project area during the operating life of LNG terminal is likely to occur once or more in life of the Project but the project will design the facilities in according to the seismic design standard. Therefore, the magnitude of the impact will be small.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts from seismic and earthquake may cause injury, loss of life or damage to property.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts from seismic and earthquake would be considered adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts from seismic and earthquake would likely be direct impacts from Project activities.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Potential impacts from seismic and earthquake activities could result in damage to the structure of terminal and/or injuries depending on magnitude of earthquake. However, there are safeguards in place. Also, the site would be reconstructed afterward if incident occurs, therefore, the impact duration is considered short-term.				
Impact Extent	**Local**	Regional	International		
	Extent of potential impact would be at the incident location and surrounding. Thus, it is considered Local potential impact.				
Impact Scale	The affected area is expected to be the structures inside the project boundary and community in adjacent area.				
Impact Frequency	The frequency of the seismic and earthquake to occur in Yangon is rare.				
Impact Consequence	Incidental	Minor	Moderate	Major	**Severe**
	The impact consequence is Severe because there is a possibility for fatality.				
Impact Likelihood	Very Unlikely	Unlikely	**Likely to occur once or more in life of the Project**	Likely to occur once or twice per year	Will likely occurs more than twice per year, or is continuous or certain to occur
	The likelihood of the seismic and earthquake is anticipated to be likely to occur once or				

Significance of Impact				
	more in life of the Project.			
Impact Significance	Negligible	Minor	Moderate	**Major**
	Considering the level of magnitude and likelihood, the significance of the impact from seismic and earthquake is expected to be Major.			

Mitigation / Management Measures

- The Project facilities should be designed to meet the seismic design standard for instance NFPA 59A, API 650, etc.;
- Construct the LNG storage tank and other critical structures on driven pile foundations if possible;
- Geotechnical studies during design phase and slope stability measures to consider impact of earthquakes of 1 in 10,000 year return period;
- Conduct evacuation drill and response to earthquake evacuation plan on a regular basis, at least once a year;
- The Project shall provide emergency response plan and procedures for seismic and earthquake response.

Residual Impact (Post Mitigation)

With the implementation of the above mitigation measures, the residual impacts are expected to be of **Major** significance.

7.9.7.5 Tropical Storm and Extreme Weather Condition

Overview

Tropical storms are a natural phenomenon that could result in severe damage. The storm is named according to its origin: a storm that develops in the Pacific Ocean and South China Sea is called a typhoon. Tropical storms generally occur during monsoon seasons and can be categorized by wind speed as follows:

- **Depression**: maximum sustained winds up to 33 knots (61 km/h);
- **Tropical storms**: maximum sustained winds between 34 and 63 knots (62 - 117 km/h); and
- **Cyclone or Typhoon**: maximum sustained winds of 64 knots and over (118 km/h and above).

Wind and flooding caused damage to critical fuel facilities such as terminals, pipelines, storage facilities and truck racks, as well as to the electric power infrastructure that energizes those facilities. Docks, control systems, vapour recovery units, and electric switching gear within facilities were some of the supporting infrastructure that sustained serious damage. In addition, the storm could be harmful to personnel working at the LNG terminal, or support vessels. It could result in injuries, mortality.

Impact Assessment Table

Significance of Impact			
Impact	Potential impacts from tropical storms (typhoon) and extreme weather conditions may cause injury, loss of life or damage to property.		
Impact Nature	**Negative**	Positive	Neutral
	Potential impacts from tropical storms (typhoon) and extreme weather conditions would be considered adverse (negative).		

Significance of Impact

Impact Type	**Direct**	Indirect	Induced		
	Potential impacts from tropical storms (typhoon) and extreme weather conditions would likely be direct impacts from Project activities.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	Potential impacts from tropical cyclone could result in damage to the structure of terminal and/or injuries depending on magnitude of tropical storm. However, there are safeguards in place, therefore, the impact duration is considered temporary.				
Impact Extent	**Local**	Regional	International		
	Extent of potential impact would be at the incident location and surrounding. Thus, it is considered Local potential impact.				
Impact Scale	The affected area is expected to be the structures inside the project boundary and community in adjacent area.				
Impact Frequency	The frequency of the tropical storm or extreme weather condition to occur is every few years. However, the Project will design the facilities and equipment to be persistent to the storm and severe weather condition. Therefore, the frequency is expected to be rare.				
Impact Consequence	Incidental	Minor	**Moderate**	Major	Severe
	The magnitude of impact from tropical storm and severe weather condition is anticipated to be moderate				
Impact Likelihood	Very Unlikely	Unlikely	**Likely to occur once or more in life of the Project**	Likely to occur once or twice per year	Will likely occurs more than twice per year, or is continuous or certain to occur
	The likelihood of the seismic and earthquake is anticipated to be likely to occur once or more in life of the Project.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	Considering the level of magnitude and likelihood, the significance of the impact from severe weather condition is expected to be Moderate				

Mitigation / Management Measures

The project will implement measures to minimize risk during construction and operation to lowest as possible. The list of mitigation measures include:

- Review weather forecast and monitor weather condition on a daily basis;
- Prepare typhoon response plan and typhoon evacuation plan;
- Conduct evacuation drill and response to typhoon evacuation plan on a regular basis, at least once a year.
- Emergency response procedures for the tropical storm and severe weather condition will be formulated to contain and limit an emergency situation should one arise.
- Construct appropriate flood barriers capable of holding the worst-case scenario flooding scenarios.
- Construct diversion canals appropriately to redirect any excess water during flooding conditions.

Residual Impact (Post Mitigation)

With the implementation of the above mitigation measures, the residual impacts are expected to be of **Minor** significance.

Monitoring Plan

Assign Project employees to monitor the weather condition regularly.

7.9.7.6 Impact from Loss of Containment of Chemical Storage Facilities On-site during Construction and Operation Phase

Overview

During construction and operation phase, loss of containment can occur from improper storage of chemical and the degree of impact will be dependent on the available mitigation measures to handle such unplanned event. EPC and the Project Proponent will have different storage facilities on-site. However, it is anticipated that during construction the volume of waste will be greater than during operation phase due to the nature of activities during its respective phases and the amount of waste it will produced and stored on-site. Therefore, this section will assess the variety of impact characteristics towards all potential receptors during and after loss of containment. The potential impacts and receptors foreseen from loss of containment of waste storage facilities are:

- Soil and groundwater contamination;
- Surface water contamination;
- Impact to habitat of fauna and flora;
- Disturbance to livelihood of human; and
- Potential health and safety risk to receptors using surface water, soil and groundwater.

Even though these impacts are related to other receptors, the source of impact is directly connected to waste generation, management and storage, henceforth, it will be assessed in this Chapter (***Chapter 7.6***).

Impact Assessment Table

Significance of Impact

Impact	Potential impacts from loss of containment of waste storage facilities on-site may cause contamination to environments and cause the health effect to human.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts from loss of containment of waste storage facilities on-site would be considered adverse (negative).			
Impact Type	**Direct**	**Indirect**	Induced	
	Impacts would be direct for soil, surface water and groundwater. Impacts would be indirect for human, flora and fauna or other receptors that uses the impacted soil, surface water and groundwater.			
Impact Duration	Temporary	Short-term	**Long-term**	**Permanent**
	Loss of containment impact can be seen as long-term impact due to the lasting effect of the impact towards soil, surface water and groundwater. Moreover, if the impact scale is large enough, this could result in a permanent impact to the habitat (habitat loss). Additionally, impact towards human health whereby the impact resulted in death, this is also considered as permanent duration.			

Significance of Impact

Impact Extent	**Local**	Regional	International		
	The extent of potential impacts would likely be limited to the location where waste storage unit is located (within Project footprint) and therefore is considered limited (thus local extent).				
Impact Scale	The scale of the impact will be dependent on the volume of waste in the storage unit at the time of the loss of containment. The scale of potential incident during construction may be substantial but during operation phase, the scale is anticipated to be minimal due to the significant lower storage volume.				
Impact Frequency	If construction and operation activities are carried out appropriately, the frequency is anticipated to be in-frequent				
Impact Consequence	Incidental	**Minor**	**Moderate**	Major	Severe
	Based on the combination of the above impact characteristics, the impact magnitude is considered to be Minor to Moderate.				
Impact Likelihood	Very Unlikely	Unlikely	**Likely to occur once or more in life of the Project**	**Likely to occur once or twice per year**	Will likely occurs more than twice per year, or is continuous or certain to occur
	The likelihood of the loss of containment is anticipated to be likely to occur once or more in life of the Project during construction phase. The likelihood of the loss of containment is anticipated to be likely to occur once or twice per year during operation phase.				
Impact Significance	Negligible	**Minor**	**Moderate**	Major	
	The combination of minor to moderate consequence level and “likely to occur once or more in life of the Project” to “likely to occur once or twice per year” will result in an overall minor to moderate significance level of impact.				

Mitigation Measures

- Ensure the integrity of wastewater storage unit to avoid leaking of wastewater and odour to the surrounding receptors;
- Use appropriate waste containers and build secondary containment around chemical or waste storage on-site to avoid spillage of waste and leakage of leachate during waste storage on-site;
- Siting of chemical and waste storage should consider nearby receptors, i.e. site away from watercourses or portable water sources;
- Hazardous waste should be stored so as to prevent or control accidental releases to air, soil and water resources. Where practicable:
  - The storage area should be clearly labelled and demarcated;
  - Readily available information on chemical compatibility should be provided to employees, including labelling each container to identify its contents;
  - Hazardous waste should be stored in a manner that prevents the commingling or contact between incompatible wastes and allows for inspection between containers to monitor leaks or spills;
  - Hazardous waste should be stored in closed containers away from direct sunlight, wind and rain;
  - Hazardous waste storage area should be have an impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest waste container; and

- Hazardous waste storage areas have adequate ventilation, fire prevention system (if needed).

- Spill response and emergency plans should be prepared and implemented to address the potential accidental release of hazardous waste;
- On-site and off-site transportation of waste should be conducted so as to prevent or minimise spills, release and exposures to employees and public;
- Maintenance facilities should be located on hard standing surfaces within a bounded area. Sumps and oil interceptors should be provided. Maintenance of vehicles and equipment involving activities with potential for leakage and spillage should only be undertaken within areas appropriately equipped to control these discharges; and
- Design discharge point to be furthest away from sensitive receptors.

Residual Impacts (Post Mitigation)

If the recommended mitigation measures are implemented, residual impact significance would be **Negligible** to **Minor** Impact.

Monitoring Plan

No monitoring plan is needed.

7.10 Summary of Impact Significance

This section will provide a summary of the significance of impacts for all physical and social receptors within ***Chapter 7***. The following receptors that will be summarised are listed below:

- ***Section 7.1***: Air Quality;
- ***Section 7.2***: Greenhouse Gas;
- ***Section 7.3***: Noise;
- ***Section 7.4***: Surface Water;
- ***Section 7.5***: Soil and Groundwater;
- ***Section 7.6***: Waste;
- ***Section 7.7***: Visual;
- ***Section 7.8***: Social; and
- ***Section 7.9***: Unplanned Event.

The significance of impact for all physical and social receptors are summarised in ***Table 7.73***.

Table 7.73: Summary of the Significance of Impact for Physical and Social Receptors

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
Air	Dust soiling	Construction	Minor	Negligible
	Human health	Construction	Minor	Negligible
	Ecology	Construction	Moderate to Major	Negligible
	Dust soiling	Operation	Minor	Negligible

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
	Human health	Operation	Minor	Negligible
	Ecology	Operation	Moderate	Negligible
GHG	GHG Emissions	Construction	Negligible	Negligible
	GHG Emissions	Operation	Minor	Minor
Noise	Transportation	Construction	Minor	Negligible
	Foundation and construction	Construction	Negligible	Negligible
	Operation	Operation	Negligible	Negligible
Surface Water	Water intake requirement	Construction	Negligible	Negligible
	Water intake requirement	Operation	Negligible	Negligible
	Wastewater	Operation	Negligible	Negligible
	Cold water discharge	Operation	Negligible	Negligible
	Sedimentation caused by erosion	Construction	Negligible	Negligible
	Sedimentation caused by piling	Construction	Negligible	Negligible
Soil and Groundwater	Accidental leaks of cold water	Operation	Negligible	Negligible
	Loss of soil due to improper management during site clearance and excavation	Construction	Negligible	Negligible
Waste	Improper biomass management	Construction	Minor	Negligible
	Generation and Management of Hazardous Waste	Construction	Moderate	Minor
	Generation and Management of Hazardous Waste	Operation	Minor	Negligible
	Generation and Management of Non-Hazardous Waste	Construction	Moderate	Minor
	Generation and Management of Non-Hazardous Waste	Operation	Minor	Negligible
	Generation and Management of Domestic Solid Waste	Operation	Moderate	Minor
	Generation and Management of Domestic Liquid Waste	Operation	Minor	Negligible
Visual	Construction	Construction	Minor	Negligible
	Operation	Operation	Minor	Negligible
Biodiversity	Permanent and Temporary Habitat Loss	N/A	Minor	Negligible
	Temporary disturbance or displace of fauna	N/A	Negligible	Negligible

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
	Degradation of Habitat	N/A	Negligible to Minor	Negligible
	Mortality of resident species	N/A	Negligible to Minor	Negligible
Social	Employment	Construction	Positive	-
	Employment	Operation	Positive	-
	Fishing	Construction	Negligible	Negligible
	Fishing	Operation	Negligible	Negligible
	Economical displacement	Construction	Minor	Negligible
	Existing facilities and utilities	Construction	Moderate	Minor
	Existing facilities and utilities	Operation	Moderate	Negligible
	Environmental emission	Construction	Minor	Negligible
	Community health and safety	Construction	Moderate	Minor
	Community health and safety	Operation	Negligible	Negligible
	Occupational health and safety	Construction	Moderate	Minor
	Occupational health and safety	Operation	Minor	Minor
	Navigation	Construction	Minor	Negligible
	Navigation	Operation	Negligible	Negligible
	Traffic and Transport	Construction	Negligible	Negligible
	Cultural Heritage	Construction	Negligible	Negligible
Unplanned Event	Vessel Collision	All	Moderate	Minor
	Chemical Spill or Leak	All	Minor	Negligible
	Fire and Explosion	All	Major	Minor
	Seismic and Earthquake	All	Major	Major
	Tropical Storm and Extreme Weather Conditions	All	Moderate	Minor
	Loss of Containment of Chemical Storage Facilities On-site	All	Minor to Moderate	Negligible to Minor

8. PIPELINE IMPACT ASSESSMENT

8.1 Air Quality Impact Assessment

8.1.1 Introduction

The following section presents an assessment of potential impacts from the Natural gas pipeline to ambient air quality and identifies whether any additional mitigation or management procedures are needed to maintain residual impacts at environmentally or socially acceptable levels. Such measures are presented where appropriate and elaborated further within the Environmental Social Management Plan (ESMP).

The full Air Quality Impact Assessment (AQIA) containing the detailed methodology and results for each element of the assessment is presented in ***Appendix T*** and is referred to throughout this chapter where necessary to avoid repetition.

The AQIA has been undertaken in line with guidelines set out by the International Finance Corporation (IFC) and in line with international best practice as advocated by the IFC guidance.

8.1.2 Assumption and Limitations

The automatic Haz-Scanner Environmental Perimeter Air Station (EPAS) was deployed at 10 locations in the Study Area for a continuous 72-hour period in both the wet and dry season. The Haz-Scanner monitors a number of air quality parameters including nitrogen dioxide (NO_2) using electrochemical sensors. Electrochemical NO_2 sensors can be susceptible to temperature, relative humidity and interfering gases that can affect the measurement. The NO_2 measurements from the EPAS were therefore analysed and outlying values removed to increase confidence in the results.

Passive diffusion tubes were deployed in triplicate at three locations between the 27 February 2018 and the 2 May 2018, and again from the 12 June 2018 to the 26 June 2018. Monitoring of NO_2 was conducted at 13 monitoring locations. It should be noted that due to unforeseen circumstances the first round of diffusion tubes were deployed beyond the recommended exposure period. The results may therefore be compromised however; they were still used to inform the assessment.

8.1.3 Assessment Methodology

The International Finance Corporation (IFC) Environmental, Health and Safety (EHS) guidelines are considered throughout this AQIA. The IFC guidelines provide the overarching guidance and principles for undertaking the assessment. The key documents considered are:

- IFC General EHS Guidelines for Air Emissions and Ambient Air Quality;
- IFC General EHS Guidelines for Construction and Decommissioning.

Where necessary, reference is made to other internationally recognised sources of information. These include, but are not necessarily limited to guidelines published by:

- the World Health Organisation (WHO);
- the European Union (EU);
- the United States Environmental Protection Agency (USEPA);
- the Australian National Pollution Inventory (NPi);
- the Department of Environment, Food and Rural Affairs (DEFRA); and
- reputable air quality institutes and working groups such as the Institute of Air Quality Management (IAQM).

The assessment of potential air quality impacts associated with the Project considers:

- sources, nature and quantity of emissions to air;
- a qualitative assessment of construction and decommissioning phase impacts;
- a detailed quantitative assessment of process emissions;
- an assessment of potential impacts on relevant sensitive receptors; and
- mitigation measures to reduce the impacts where necessary.

8.1.4 Baseline Summary

A project specific air quality monitoring survey was undertaken and the detailed methodology, results and interpretation is presented in ***Appendix T*** and summarised in ***Chapter 5***. The Study Area for the pipeline for air quality include 350 m from each side of the Natural Gas Pipeline. The baseline assessment indicates that the existing ambient concentrations of relevant substances in the study area are below the relevant air quality standards. On this basis, the air shed is considered 'Non-degraded'.

8.1.5 Receptor Identification and Sensitivity

8.1.5.1 Construction Phase

The study area and receptors were specifically defined using the IAQM guidance on the assessment of dust from demolition and construction. The IAQM define the sensitivity of the area based on receptor type and the number of receptors within a certain distance from the source. Residential properties, schools, and hospitals are classified as high sensitivity to dust soiling and health effects. Locations where there are particularly important plant species (i.e. rice paddy) are classified as medium sensitivity. The criteria for estimating the sensitivity of the area as per the IAQM guidance is presented in ***Appendix T***. The guidance provides a screening criterion of 350 m and 50 m from the construction site and access road respectively beyond which impacts are not considered likely.

8.1.5.2 Operation

Considering the Project activities that are expected to occur during the operation phase, the screening assessment found no sensitive receptors associated with the operation of the Pipeline that require detailed consideration.

8.1.6 Summary of Project Activities with Potential Impacts

A preliminary screening assessment was undertaken to identify project activities that have the potential to affect ambient air quality and that subsequently require detailed assessment to inform the level of mitigation necessary to reduce impacts to an acceptable level throughout the lifetime of the Project. The assessment was completed using a combination of quantitative and semi quantitative techniques, project specific information, international guidelines and methodologies, and professional experience (refer to ***Appendix T***).

8.1.6.1 Construction Phase

The screening assessment found that the activities associated with the construction of the Pipeline that require detailed consideration include ground preparation, ground excavation, material transfer, material stockpiling, construction of the main infrastructure and vehicles operating on unpaved road surfaces.

8.1.6.2 Operation Phase

A preliminary screening assessment was undertaken to identify the activities that have the potential to affect ambient air quality and that subsequently require detailed assessment to inform the level of mitigation necessary to reduce impacts to an acceptable level throughout the lifetime of the Project.

The screening assessment found no activities associated with the operation of the Pipeline that require detailed consideration. There is no expected residual adverse impact to ambient air quality due to the operation of the pipeline.

8.1.7 Assessment of Impacts to Air Quality

8.1.7.1 Construction Phase

Overview

During the construction of the Pipeline, a number of activities have been identified that will potentially result in adverse impacts to ambient air quality due to the generation of total suspended particulate (TSP) and particulate matter (PM_{10}). The key construction phase activities considered include:

- Demolition of existing infrastructure;
- Earthworks including ground excavation; material removal, transfer and stockpiling;
- Construction of the main infrastructure including the power plant and associated facilities; and
- Track out of dusty materials onto the public road network.

The associated impacts that may arise from construction activities include:

- Dust deposition resulting in the soiling of surfaces including homes and places of business;
- Elevated PM_{10} concentrations at air sensitive receptors.

Exhaust emissions from on-site plant (also known as non-road mobile machinery or NRMM) and site traffic are unlikely to impact ambient air quality significantly and have not been considered further.

Assessment of Impacts

Dust emissions during the construction phase can vary substantially and will largely depend on the activity being undertaken; the duration of the activity; the size of the site; the meteorological conditions; the proximity and sensitivity of the receptors; and the adequacy of the mitigation measures in place to reduce emissions.

The Institute of Air Quality Management (IAQM)[113] provide specific guidance for defining the dust impact risk from construction sites based on a) the scale and nature of the works; and b) the sensitivity of the receiving area (refer to ***Appendix T***). The premise of the IAQM guidance is that with the implementation of effective site-specific mitigation and management measures, the environmental effect will not be significant in most cases. The guidance also provides screening criteria of 350 m and 50 m from the construction site and access road respectively beyond which impacts are not considered likely.

A summary of the impact significance associated with the construction of the LNG terminal (pre-mitigation) is presented in ***Table 8.1***, ***Table 8.4***, and ***Table 8.5***.

[113] Institute of Air Quality Management (IAQM) (2014) Guidance on the Assessment of Dust from Demolition and Construction [Online] Available at: http://iaqm.co.uk/guidance/ [Accessed 13 February 2019]

Table 8.1: Summary of Dust Risk from Pipeline Construction (Pre-Mitigation)

Potential Impact	Risk			
	Demolition	Earthworks	Construction	Track out
Dust Soiling	*n/a*	Large	*n/a*	Large
Human Health	*n/a*	Large	*n/a*	Large
Ecological	*n/a*	Medium	*n/a*	Medium

[a] *As per IAQM approach*
[b] *No demolition or construction activities identified so assessment of risk is not applicable*

Table 8.2: Assessment of Impact on Human Health and Nuisance Relating to Pipeline Construction (Pre-Mitigation)

Significance of Impact					
Impact	Potential impacts on Ambient Air Quality				
Impact Nature	**Negative**	Positive	Neutral		
	Impacts to ambient air quality are considered adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to ambient air quality are considered direct.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Potential impacts to air quality will occur throughout the construction phase only. The duration is therefore short term.				
Impact Extent	**Local**	Regional	International		
	Construction activities at the site have the potential to result in emissions of dust up to 350m and 50m from the construction site boundary and unpaved access roads respectively. The extent is therefore local.				
Impact Scale	Potential impact will occur up to 350 m and 50 m from the construction site boundary and unpaved access roads respectively.				
Frequency	The impact will occur during daytime working hours (08:00-18:00) throughout the construction phase.				
Impact Magnitude	Positive	Negligible	Small	Medium	**Large**
	The expected dust emission magnitude during construction phase activities is expected to be large from earthworks and track out.				
Receptor Sensitivity	Low	Medium	**High**		
	A review of aerial imagery indicates that in the proximity of the pipeline installation area there are potentially 10-100 human receptors <20 m from the site boundary in some cases. The sensitivity of the area is therefore considered high.				
Impact Significance	Negligible	Minor	Moderate	**Major**	
	The significance of the impact is likely to be major.				

Table 8.3: Assessment of Impact on Ecology Relating to Pipeline Construction (Pre-Mitigation)

Significance of Impact					
Impact	Potential impacts on Ambient Air Quality				
Impact Nature	**Negative**	Positive	Neutral		
	Impacts to ambient air quality would be considered adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to ambient air quality are considered direct.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Potential impacts to air quality will occur throughout the construction phase only. The duration is therefore short term.				
Impact Extent	**Local**	Regional	International		
	Construction activities at the site have the potential to result in emissions of dust up to 50m from the construction site boundary and any unpaved access roads respectively. The extent is therefore local.				
Impact Scale	Potential impact will occur up to 50m from the construction site boundary and any unpaved access roads respectively.				
Frequency	The impact will occur during daytime working hours (08:00-18:00) throughout the construction phase.				
Impact Magnitude	Positive	Negligible	Small	Medium	**Large**
	The expected dust emission magnitude during construction phase activities is expected to be large from earthworks and track out.				
Receptor Sensitivity	Low	**Medium**	High		
	Agriculture exists <20m from the pipeline route. The sensitivity of the agriculture to dust soiling from construction activities will be medium.				
Impact Significance	Negligible	Minor	Moderate	**Major**	
	The significance of the impact is likely to be Major.				

Mitigation Measures

A series of site-specific mitigation measures are presented for earthworks, construction and trackout. These are based on the outcome of the dust risk assessment summarised in ***Table 8.1*** and are as follows:

- Develop and Implement a Dust Management Plan (DMP) detailing mitigation measures and a plan for implementation.
- Watering will be used to suppress wind and physical disturbance dust generation.
- Ensure an adequate water supply on site for effective dust suppression and mitigation.
- The site layout will be planned so that dust-causing activities are located away from receptors as far as is possible.
- Screens or barriers will be erected around dusty activities or the site boundary that are at least the height of any stockpile on site.
- All stockpiles will be covered or fenced off to prevent wind whipping.

- Only cutting, grinding, or sawing equipment fitted with suitable dust suppression techniques such as water sprays will be used.
- No waste will be burned on site.
- Re-vegetate earthwork and exposed areas as soon as is practicable.
- Use hessian, mulches or trackifiers where it is not possible to revegetate, or cover with top soil as soon as is practicable.
- Sand and other aggregates will be stored in bunded areas and will not be allowed to dry out unless this is required for a particular process, in which case additional control measures such as those detailed in this section will be applied.
- Ensure that all vehicles entering and leaving the site are covered to avoid fugitive emissions during transport.
- Inspect on-site haul roads for integrity and instigate the necessary repairs to the surfaces as soon as reasonable practicable.
- Implement a wheel washing system.
- Regularly dampen and clean the site access and local roads to remove any materials tracked out of the site.
- All site access gates will be located at least 10m away from air sensitive receptors where possible.
- The site layout will be planned so that machinery is located away from receptors as far as is possible.
- All vehicles will switch off engines when stationary.
- A regular vehicle and machinery maintenance and repair programme will be implemented.
- Mains electricity or battery powered equipment will be used instead of diesel/petrol generators where practicable.

Residual Impact

The IAQM guidance suggest that when correctly applying and actively managing the prescribed mitigation and management measures the impacts to receptors located within 350m downwind of any construction activity are not likely to be significant for the large majority of the time. However, due to the nature of construction activities, the scale and duration of the construction phase, and the possibility of extreme weather conditions, it is possible that communities will experience occasional, short-term dust annoyance. The IAQM states, "*the likely scale of this would not normally be considered sufficient to change the conclusion that with mitigation the effects will be 'not significant'*. On this basis, it can be concluded that construction phase activities are likely to result in a **Negligible** impact at worst post mitigation.

Monitoring Plan

TPMC are required to implement the following monitoring procedures:

- Regular site inspections to monitor compliance with the DMP. All inspection results will be recorded and corrective actions taken where mitigation and management measures are not being implemented effectively (i.e. to reduce dust emissions).
- Daily onsite and offsite inspections to visually assess the dust emissions from earthwork and construction activities, and from vehicles exiting the construction sites. Results from the inspection will be recorded and mitigation measures intensified where necessary to reduce

emissions. The frequency of site inspections will be increased when activities with a high potential to produce dust are being carried out and during prolonged dry and windy conditions.

- Conduct monthly air quality monitoring at sensitive receptors.

8.2 Greenhouse Gas Impact Assessment

8.2.1 Introduction

During the construction and operation phases, different activities have the potential to increase greenhouse gas emissions. The main emission sources are released from fuel combustion (for example, diesel fuel combustion in construction equipment and mobile vehicles).

This chapter provides an estimate of the greenhouse gas (GHG) emissions that are likely to be emitted from the construction of LNG Pipeline of LNG Power Plant (Ahlone) Project (also referred to as 'Project') , as related to the issue of climate change. GHGs are assessed in order to provide an indication of what a Project's GHG emissions will be, and to find ways to mitigate them early in the development process.

8.2.2 Assumption and Limitation

It is noted that all greenhouse data in this report cannot yet be used for official greenhouse gas inventory reporting[114] until the site is operational and actual operational data would be used for a more precise GHG inventory calculation.

All greenhouse gas calculation methodologies have been formulated using accurate calculation methodologies sourced from Intergovernmental Panel on Climate Change (IPCC). These methodologies can be replicated for greenhouse gas inventory use when the Project becomes operational.

In this chapter, some assumptions are made, as below:

Equator Principles (June 2013) stated that "Quantification of GHG emissions will be conducted by the client in accordance with internationally recognised methodologies and good practice, for example, the GHG Protocol. The client will quantify only Scope 1 emission". Therefore, quantification of GHG emissions for the Project will consider Scope 1 (direct emissions from the facilities owned or controlled within physical Project boundary), and excluding Scoping 2 and 3 emissions.

The GHG assessment for the Project will focus on the construction and operation phases, excluding pre-work and land development phases, as the majority of the Project emissions will occur during these periods. A total area of the Project is approximately 8.97 acres or about 36,300 m^2 with the current land use of scrubland with thickets of shrubs, young trees, degraded mangrove trees, and agricultural land for rice farming with some grazing areas for livestock, in which are not biomass-rich areas. The change in land use characteristics for development of the Project would alter the carbon stock due to removal of vegetation, but the effect is considered to be small.

This document focuses on CO_2, CH_4, and N_2O emissions, because these are the most prevalent GHGs emitted from power industry operations.

8.2.3 Assessment Methodology

According to the Greenhouse Gas Protocol, greenhouse emissions fall under the following three scopes:

- **Scope 1 - Direct GHG emissions**: Direct GHG emissions occur from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled

[114] Official greenhouse gas inventory reporting includes Sustainability Reporting, CDP, DJSI or other nationally relevant greenhouse reporting schemes.

boilers, furnaces, vehicles, etc.; emissions from chemical production in owned or controlled process equipment. Direct CO2 emissions from the combustion of biomass shall not be included in scope 1 but reported separately.

- **Scope 2 - Electricity indirect GHG emissions**. Scope 2 accounts for GHG emissions from the generation of purchased electricity consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated.
- **Scope 3 - Other indirect GHG emissions**. Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by the company. Some examples of scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services.

Only scope 1 has been considered for this Project, since it is sufficient to only rely on mobile generators for construction. In which it was quantified according to the following standards:

- GHG Protocol Corporate Accounting and Reporting Standard; and
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories

The assessment of impact magnitude and significance related to GHG is based on the methodology described in ***Chapter 6***. The mitigation measures are based on international good practice (as recommended under the IFC EHS Guidelines), and good practice relevant to GHG emissions.

8.2.3.1 Global Warming Potentials

The global warming potentials (GWPs) used in this assessment are sourced from the 2007 IPCC Fourth Assessment Report (AR4). Although the 2013 Fifth Assessment Report (AR5) provides the latest GWPs, the GWPs from the AR4 are more commonly adapted.

The global warming potential is used to evaluate the potency of non-CO_2 greenhouse gases compared to CO_2 as a baseline. For example, methane (CH_4) is 25 times more potent than CO_2 in its global warming effect, meaning that 1 kg of CH_4 emitted is equivalent to 25 kg of CO_2 emitted. The 100 years' time horizon is used in line with greenhouse gas inventory best practices. Detail of GWP factors are in ***Table 8.4***.

Table 8.4: Global Warming Potentials

Industrial Designation or Common Name	Chemical Formula	Global Warming Potential for 100-years' Time Horizon from IPCC Fourth Assessment Report
Carbon Dioxide	CO_2	1
Methane	CH_4	25
Nitrous oxide	N_2O	298

Source: IPCC Fourth Assessment Report Working Group I
https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

8.2.3.2 Emission Factor

An emission factor represents an average emission rate for a given source, and is generally expressed as mass or volume of emissions per source type or measure of activity related to the source.

The 2006 IPCC Guidelines provide emission factors for stationary and mobile combustion, Default emission factors provided in ***Table 8.5*** and ***Table 8.6*** below, are related to the Project activities and used for the purposes of this report.

Table 8.5: Default IPCC Emission Factors for Stationary Combustion

Fuel	$kgCO_2/TJ$ (default)	$kgCH_4/TJ$ (default)	kgN_2O/TJ (default)
Motor Gasoline	69,300	3	0.6
Gas/ Diesel Oil	74,100	3	0.6

Source: IPCC 2006 V.2 Ch.2 Table 2.2

Table 8.6: Default IPCC Emission Factors for Mobile Combustion

Fuel	$kgCO_2/TJ$ (default)	$kgCH_4/TJ$ (default)	kgN_2O/TJ (default)
Equipment/Machineries	74,100[a]	74,100[a]	74,100[a]
Road Transport	74,100[b]	74,100[c]	3.9[c]

Source: [a] IPCC 2006 Vol. 2 Ch. 3 Table 3.3.1
[b] IPCC 2006 Vol. 2 Ch. 3 Table 3.2.1
[c] IPCC 2006 Vol. 2 Ch. 3 Table 3.2.2

8.2.3.3 Net Calorific and Density

Often energy data, consumption of solid, liquid and gaseous fuel are expressed in physical units, e.g. in litres, tonnes or cubic metres. For the purposes of greenhouse gas calculations, the apparent consumption should be converted to terajoules (TJ) on a net calorific value basis.

To convert these data to common energy units, this report uses conversion factors for the energy content of fuel provided in ***Table 8.7***.

Table 8.7: Default Net Calorific Values

Fuel Type	Net Calorific Value	Typical Density
Gas/ Diesel Oil	43.0 TJ/Gg[a]	874.31 kg/m^3 [b]
Gasoline	44.3 TJ/Gg[a]	742.39 kg/m^3 [b]

Source: [a] IPCC 2006 Vol. 2 Ch. 1 Table 1.2

[b] API 2009 Compendium of Greenhouse Gas Emissions Methodologies for Oil and Natural Gas Industry Table 3-8

8.2.4 Baseline Summary

Myanmar's total GHG emissions in 2013 were 201.5 million metric tons of carbon dioxide equivalent ($MtCO_2e$), totalling 0.42 percent of global GHG emissions.[115]

According to the World Resources Institute Climate Analysis Indicators Tool (WRI CAIT), and Land Use Change and Forestry (LUCF) activities, were the leading sources of Myanmar's [116] GHG emissions in 2013, accounting for 51.0% of the country's total emissions.[117] Within the LUCF sector, changes in forest land contributed 73% of emissions.[118] Agriculture was the second most significant source (32.1%) with rice cultivation and enteric fermentation from livestock contributing 67% of

[115] https://www.climatelinks.org/resources/greenhouse-gas-emissions-factsheet-burma

[116] Burma ratified the UNFCCC as Myanmar. UNFCCC Status of Ratification, viewed on March 20, 2017.

[117] World Resources Institute Climate Analysis Indicators Tool (WRI CAIT 2.0, 2017). Global Warming Potentials (GWPs) are from the Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report (SAR).

[118] Food and Agriculture Organization of the United Nations Statistics Division (FAOSTAT). Myanmar, Emissions – Land use total, viewed on March 18, 2017.

agriculture emissions.[119] Energy was responsible for 10.9% of emissions, of which 50% were due to fugitive emissions and other fuel combustion. Waste and Industrial Processes (IP) contributed 5.8% and 0.2% of total emissions respectively.

8.2.5 Receptor Identification and Sensitivity

The direct receptor in the scope of this impact assessment is the global atmosphere. The indirect receptors from climate change due to an increase global greenhouse gas emissions include Myanmar's weather.

In accordance to National Oceanic and Atmospheric Administration (NOAA), *Global Climate Report – Annual 2018*, describes that 11 of 12 months of global land and ocean average temperature departures ranked among the five warmest for the respective years, becoming the fourth warmest year in NOAA's 139-year records, in which the top warmest years are all from the recent years (2015-2017) since the pre-industrial time. The year 2018 began with a La Niña episode present across the tropical Pacific Ocean, transitioning to ENSO-neutral by April 2018.[120] The frequency and intensity of extreme high temperature events are virtually certain to increase in the future as global temperature increases (high confidence). Extreme precipitation events will also very likely continue to increase in frequency and intensity throughout most of the world (high confidence).

Myanmar's Intended Nationally Determined Contribution (INDC) reported that Myanmar is extremely vulnerable to the negative effects of climate change. In 2015, for the third year, Myanmar was ranked globally by studies, as the second most vulnerable country in the world to extreme weather events over the last 20 years. In addition, climate models predict further sustained impacts from climate change in the future, which will further expose Myanmar to the negative impacts of climate change. Thus global GHG emission would highly influence the negative impact on Myanmar.

8.2.6 Summary of Project Activities with Potential Impacts

Based on the Scoping Study, and the Project Description and Alternatives (presented in ***Chapter 4***), the key potential impacts on greenhouse gas identified come from the following activities.

The main equipment and machineries used in contributing to Scope 1 of greenhouse gas emissions at the Project site are illustrated in ***Table 8.8***. By which, the majority of GHG emission sources come from mobile combustion devices, including transportation. GHG is estimated under the assumption that most of the fuel consumed by the construction machineries would be diesel, except for pump which uses gasoline. Also, the calculation for GHG emission would be based on the fuel consumption of each machines. In which the machineries would operate 8 hrs/day for 26 weeks/year, and for transportation, it is assumed that transporting vehicles would be operating 8 hrs/day, 6 days/week, for 26 weeks/year.

[119] FAOSTAT. Myanmar, Emissions – Agriculture total, viewed on March 18, 2017.

[120] https://www.ncdc.noaa.gov/sotc/global/201813

Table 8.8: Project Scope and Activity by Emission Source during Construction

Project Component	Source Class	Scope 1 Emission Source (direct emission from project)
Pipeline	Stationary Combustion	■ Generator (200, 100, and 50 kW) (Diesel) ■ Pump (Gasoline)
	Mobile Combustion (equipment/ machineries)	■ Excavator (Diesel) ■ Backhoe (Diesel) ■ Scraper (Diesel) ■ Crane 25 tonne (Diesel) ■ Fork Lift (Diesel) ■ Compactor (Diesel)
	Mobile Combustion (transportation)	■ 10-wheel truck (25 tonne) (Diesel) ■ 4-wheel truck (5 tonne) (Diesel)

Note: Mobile sources is a term used to describe a wide variety of vehicles, engines, and equipment that generate air pollution and that move, or can be moved, from place to place. It includes vehicles used on roads for transportation of passengers or freight as well as off-road vehicles, engines, and equipment used for construction, agriculture, transportation, recreation, and many other purposes. By definition, other combustion sources are considered to be stationary (Stationary Combustion Guidance, WRI/WBCSD (2005)).

8.2.6.1 Operation Phase

During the operation phase, there would be no GHG emission since the sole purpose of a pipeline is to transport fuel (natural gas) from one point to another. Therefore, there would be no emission associates within natural gas pipeline, and GHG impact assessment is not necessary for this project during the operation phase.

8.2.7 Assessment of Impacts to Greenhouse Gas

8.2.7.1 Construction Phase

Summary of Scope 1 Emissions

The total release of GHG emissions during construction phase is estimated to be 2,087.51 tonnes CO_2eq per year as shown in ***Table 8.9***. The majority of emissions during construction phase are from use of mobile transportation, followed by mobile combustion for construction activity and stationary.

Table 8.9: Emissions Breakdown by Scope and Activity

Emission Scopes	Unit	Value
Scope 1 Direct Emissions		
Stationary Combustion	tCO_2eq/year	637.02
Mobile Combustion (equipment/ machineries)	tCO_2eq/year	662.20
Mobile Combustion (transportation)	tCO_2eq/year	788.29
Total Direct Emission	tCO_2eq/year	2,087.51

Scope 1 Direct Emissions

Scope 1 Direct Emissions would consists of 3 emission sources: stationary emission, mobile emission (equipment/ machinery), and mobile emission (transportation). Calculations detail are in the following sections.

Stationary Combustion

Stationary Combustion is defined as devices that combust solid, liquid, or gaseous fuel, generally for the purposes of producing electricity, generating steam, or providing useful heat or energy for industrial, commercial, or institutional use. Also includes auxiliary devices that assist in the electricity/ heat generation system i.e. pump.

Tier 1 method of IPCC was selected since information regarding site specific or country specific emission factors are not available. This approach is used to estimate the GHG emission in general by analyzing the emission based on fuel consumption.

Applying a Tier 1 emission estimation requires the following for each source category and fuel:

- Data on the amount of fuel combusted in the source category
- A default emission factor

In general, GHG emissions based on fuel used is the product of fuel consumption and emission factor of the fuel source as illustrated in ***Equation 9***:

Equation 9: Greenhouse Gas Emissions from Stationary Combustion

$$Equation_{GHG,fuel} = Fuel\ Consumption_{fuel} \times Emission\ Factor_{GHG,fuel}$$

Where:

$Emission_{GHG,fuel}$ = emission of a given GHG by type of fuel (kg GHG)

$Fuel\ Consumption_{fuel}$ = amount of fuel combusted (TJ)

$Emission\ Factor_{GHG,fuel}$ = default emission factor of a given GHG by type of fuel (kg gas/TJ).

For CO2, including the carbon oxidation factor assumed to be 1

Source: 2006 IPCC guideline for National Greenhouse gas inventories, Volume 2: Energy Chapter 2

In this Project, onsite machineries used for stationary combustion which include generator and compressor, are assumed to be utilizing 8 hrs/day for 26 weeks/year and use diesel as the main fuel source. Based on the operational time during construction period mentioned, the estimation of fuel consumption is approximately equal to 228,326 liters/year as detailed in ***Table 8.10***.

Table 8.10: Expected Stationary Combustion

Project Component	Source	Mobile Fuels	Units	Estimated Annual Consumption
Pipeline	Generator 200 kW	Diesel	Litre/year	125,568
	Generator 100 kW	Diesel	Litre/year	64,512
	Generator 50 kW	Diesel	Litre/year	34,560
	Total Diesel used			**224,640**
	Pump	Gasoline	Litre/year	3,686
	Total gasoline used			**3,686**
	Total			**228,326**

Source: Fuel consumption estimated by TPMC and adjusted by ERM for the purpose of assessment in this report.

Fuel volume provided in ***Table 8.10*** will be converted to energy use (in terms of TJ of energy use) by multiplied with Net Calorific Value (NCV) and its density as provided in ***Table 8.7*** using the ***Equation 10*** and ***Equation 11***.

Equation 10: Fuel Energy Consumption (Diesel)

$$Fuel\ Consumption\ (TJ) = Diesel\ Use\ (I) \times NetCalorific\ Value\ (TJ/Gg) \times Diesel\ Density\ (kg/m^3) \times 10^{-6}(Gg/kg) \times 10^{-3}(m^3/I)$$

Equation 11: Fuel Energy Consumption (Gasoline)

$$Fuel\ Consumption\ (TJ) = Gasoline\ Use\ (I) \times NetCalorific\ Value\ (TJ/Gg) \times Gasoline\ Density\ (kg/m^3) \times 10^{-6}(Gg/kg) \times 10^{-3}(m^3/I)$$

From ***Table 8.7***, default NCV value for diesel is 43.0 TJ/Gg and diesel density is 874.31 kg/m^3. The total energy consumption on the amount of fuel use 47,840 litres/year equal to 0.0018 TJ.

Fuel Consumption (TJ) = Diesel Use (l) x 43.0 (TJ/Gg) x 874.31 (kg/m^3) x 10^{-6} (Gg/kg) x 10^{-3} (m^3/l)

= Diesel Use (l) x 3.76 x 10^{-5} (TJ/l)

= 224,640 (l) x 3.76 x 10^{-5} (TJ/l)

= 8.45 TJ

Fuel Consumption (TJ) Gasoline Use (l) x 44.3 (TJ/Gg) x 742.39 (kg/m^3) x 10^{-6} (Gg/kg) x 10^{-3} (m^3/l)

Gasoline Use (l) x 3.28 x 10^{-5} (TJ/l)

3,686 (l) x 3.28 x 10^{-5} (TJ/l)

0.12 TJ

After annual energy consumption, in term of fuel use, is identified, the multiplication of emission factor and GWP would be used to calculate the amount of total emission in the unit of kilogram of CO_2 equivalent per year. The estimated GHG emission for generators and compressor operated during construction is on average 637.02 tonnes CO_2e/year, as shown in ***Table 8.11***.

Table 8.11: Expected Stationary Emissions for LNG Pipeline during Construction

Mobile Combustion	Annual Use (litre/year)	Annual Energy Use (TJ)	Annual Emissions (kg/year)			Total CO_2eq Emissions	
			CO_2	CH_4	N_2O	Kg CO_2eq/year	Tonnes CO_2eq/year
Diesel Emission Factors (kg of GHG/ TJ)[b]			74,100	3.0	0.6		
Global Warming Potential for 100-year time horizon[a]			1	25	298		
Diesel	47,840.00	8.45	625.88	0.63	1.51	637,017.10	**637.02**
Gasoline	3,686	0.12	8.96	0.01	0.02		

Source: [a] refers to ***Table 8.4***.

[b] 2006 IPCC guideline for National Greenhouse gas inventories, Volume 2: Energy Chapter 2.

Mobile Combustion

Mobile sources are used to describe a term of wide variety of vehicles, engines, and equipment that generate air pollution and that can be moved or travelled into distances.

According to IPCC guideline (2006) mobile combustion is referred to emission of fuel for all transportation activity (excluding military transport). It includes vehicles used on roads for transportation of passengers or freight as well as off-road vehicles, engines, and equipment used for construction, transportation and many other purposes.

Emissions can be estimated from either the fuel consumed as determined through direct measurements of fuel use (from purchase records, storage tank measurements, or company records) or the distance travelled by the vehicles. In general, the first approach (fuel consumed) is appropriate for CO_2 and the second approach (distance travelled by vehicle type and road type) is appropriate for CH_4 and N_2O.[121] Nevertheless, the Project is still in the planning process, actual data are not yet collected. Therefore, the assessment based on the information from other Project with similar activities, and from the experience of the project's owner, are considered a baseline.

Generally, when calculating GHG emissions for mobile combustion of mobile equipment/machineries, the information that needs to be determined first is the quantity of fuel use for combustion, in term of energy use. The emission equation for mobile combustion is as ***Equation 12***,

Equation 12: Calculation Method for GHG Emissions from Mobile Sources

$$Emissions = \sum (Fuel_j \cdot EF_j)$$

Where:

Emission = emissions (kg)

$Fuel_j$ = Fuel type j consumed (TJ)

EF_j = emission factor for fuel type j (kg/TJ)

Similar to stationary combustion, the emission based on NCV value for emission of each GHG of fuels (Diesel and Gasoline) would be used as a factor for calculation as well. The values of Fuels emission factors for mobile combustion are illustrated in ***Table 8.6***.

The calculation for estimating GHG emissions of mobile combustion equipment/machineries, such as backhoe, bulldozer, excavator, etc., during the construction phase is 622.20 tonnes CO_2e/year, as shown in ***Table 8.12***.

[121] Intergovernmental Panel on Climate Change (IPCC). 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2,Chapter 3 :Mobile Combustion, Page 3.10

Table 8.12: GHG Emissions by Machine (except Transportation) during Construction of LNG Pipeline Project

Source Description	Activity Data			Energy Content of Fuel Used (TJ)[a]	GHG Emission (kg CO_2e)		
	Fuel Type	Fuel Consumed (liter/day)	Rate of Fuel Consumed annually		CO_2	CH_4	N_2O
Emission Factors Diesel (kg of greenhouse gas per TJ)[b]					**74,100**	**4.15**	**28.6**
Global Warming Potential for 100-year time horizon (AR4) – See *Table 8.4*					**1**	**25**	**298**
Excavator	Diesel	7	103,219	3.88	287,585.21	402.66	33,077.34
Backhoe	Diesel	10	18,432	0.69	51,354.50	71.90	5,906.67
Bulldozer	Diesel	12	22,118	0.83	61,625.40	86.28	7,088.00
Scraper	Diesel	15	27,648	1.04	77,031.75	107.85	8,860.00
Cranes 25 tonne	Diesel	6	11,059	0.42	30,812.70	43.14	3,544.00
Forklift	Diesel	10	23,040	0.87	64,193.13	89.88	7,383.34
Compactor	Diesel	4	7,373	0.28	20,541.80	28.76	2,362.67
GHG emission during construction phase (except Transportation) (kg CO_2e)					593,144.49	830.48	68,222.02
GHG emission during construction phase (except Transportation) (kg CO_2e)							662,196.99
Total GHG emission during construction phase (except Transportation) (tonnes CO_2e)							**662.20**

Note: [a] *Use energy conversion unit to convert fuel consumption in physical unit to energy unit from DEDE (see **Equation 9** and **Equation 10**)*
[b] *Based on default emission factors (see **Table 8.6**).*

It is possible for mobile combustion transportation to use the same method as above. However, the mobile combustion for transportation, it is prioritized in CH_4 and NO_2 emission since on average the technological advancement on vehicles release more emission of CH_4 and NO_2 than other construction mobile machine, and therefore using different factor in calculation.

The amount of fuel combusted can be determined using vehicle activity data, fuel emission factors for vehicle type, and distance travelled. It is also good practice to estimate fuel use from the distance travelled data. Activity data could be in terms of vehicle kilometre travelled (VKT), freight tonnes-kilometre, passenger-kilometre, etc. This activity data would be multiplied by the appropriate fuel economy factors to generate an estimation of fuel consumed. In this case, tonnes-kilometre of VKT is used to estimate the total fuel consumption of mobile combustion transportation as per ***Equation 13*** below.

Equation 13: Validating Fuel Consumption

$$Estimated\ Fuel = \sum_{i,j} \left[Vehicles_{i,j} \cdot Distance_{i,j} \cdot Consumption_{i,j} \right]$$

Where:

Estimated Fuel (l)	=	total estimated fuel use estimated from distance travelled (VKT) data
Vehiclesi,j,t	=	number of vehicles of type i and using fuel j
Distancei,j,t	=	annual kilometres travelled per vehicle of type i and using fuel j (km)
Consumptioni,j,t	=	average fuel consumption (l/km) by vehicles of type i and using fuel j
i	=	vehicle type (e.g., car, bus)
j	=	fuel type (e.g. motor gasoline, diesel, natural gas, LPG)

The GHG emissions for material transportation by trucks transportation are calculated based on estimated number of trips and distance travelled for each type of trucks. The quantity of GHG emissions for road transport is estimated to be approximately 788.29 tonnes CO_2e/year, as illustrated in ***Table 8.13***.

Table 8.13: Expected GHG Emissions from Transportation Activities during Construction of LNG Pipeline Project

Source Type	Source Description	Activity Data						Emission Factors (kg/TJ) (1)	GHG Emission (kg CO_2e)		
		Fuel Type	Distance Travelled (km)	Number of Vehicles	distance travel per litre of fuel	Total fuel used (litre/ day)	Rate of Fuel used annually (litre/year)		CO_2	CH_4	N_2O
Emission Factors Diesel (kg of greenhouse gas per TJ)									**74,100**	**3.9**	**3.9**
Global Warming Potential for 100-year time horizon (AR4) – See *Table 8.4*									**1**	**25**	**298**
Mobile Sources	10-wheel truck (25 tonnes)	Diesel	100	40	3km/litre	1,333	207,999.95	7.82	579,521.14	762.53	9,089.33
	4-wheel truck (5 tonnes)	Diesel	60	60	8km/litre	450	70,200.00	2.64	195,588	257.35	3,067.65
GHG Emissions from Transportation (kg CO_2e)									775,109.57	1,019.88	12,156.98
Total GHG Emissions from Transportation (kg CO_2e)											788,286.43
Total GHG Emissions from Transportation (tonnes CO_2e)											**788.29**

Note: (1) Emission factors for truck are based road transportation emission factors (see IPCC Guidelines Volume 2: Energy Chapter 3: Mobile Combustion Table 3.2.5)

Impact Assessment Table of Scope 1 Emission

When total amount of GHG emission during construction are estimated, the significance of potential impacts to GHG during construction phase is assessed in accordance to the amount of impact during the construction period, as provided in ***Table 8.14***.

Table 8.14: Impact Assessment Table for Greenhouse Gas (Construction Phase)

Significance of Impact					
Impact	Potential impacts on climatic condition due to GHG emissions.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to climate would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts through the release of emissions from fuel combustion.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Many of the major greenhouse gases can remain in the atmosphere for tens to hundreds of years after being released.				
Impact Extent	Local	Regional	**International**		
	Greenhouse gasses are a global emission and may affect the global climate.				
Impact Scale	The emissions from construction phase are calculated to be 2,087.51 tonnes CO_2eq. Compared to Myanmar's GHG release of 201.5 million tonnes CO_2 equivalent, 2013, the total GHG releases from the Project are insignificant (approximately 0.0010%).				
Frequency	Emissions will be released intermittently, but repeatedly throughout the construction period.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Minor emissions of GHG will be emitted as a result of the Project construction, and considered insignificant emissions according to IFC (25,000 tonnes CO_2eq per year). Magnitude is considered Negligible.				
Receptor Sensitivity	**Low**	Medium	High		
	The direct receptor to greenhouse gas is the global atmosphere. The greenhouse effect is enhanced by greenhouse gas emissions of anthropogenic nature. Minor emissions of GHG will be emitted as a result of the Project, and not likely to significantly change atmospheric GHG concentrations. Receptor sensitivity is rated as Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low resource sensitivity and Negligible impact magnitude will result in an overall Negligible potential impact.				

Mitigation Measures

The following measures will be put in place for the Project during construction to reduce GHG emissions;

- Implement the same mitigation measures to minimize impacts to Air Quality (***Section 8.1***).
- Develop and implement preventive maintenance plan for machines, and engines to ensure combustion efficiency.
- Develop vehicle maintenance plan.

Residual Impacts

The significance of the residual impact on climatic condition as a result of GHG emissions is considered to be a **Negligible** Impact.

Monitoring Plan

In accordance to IFC requirements, "*quantification of GHG emissions will be conducted by the client annually in accordance with internationally recognized methodologies and good practice*" if the GHG emission from the project exceeds 25,000 tonnes CO_2e per year. However, as summarized in ***Table 8.9***, total amount of GHG emission of the project is summed to 2,087.51 tonnes CO_2e per year which is within the GHG emissions according to the applicable requirements (i.e. ADB SPS, EP III and IFC), therefore, it is not mandatory to do quantification of GHG emission every year.

8.2.7.2 Operation Phase

During the operation phase of the Project, the GHG emission is considered negligible since there is no major activity that would cause GHG emission under normal operation. Though, there might be GHG emission involved when having a maintenance due to the travelling along the pipeline, the GHG generated is as small as a vehicles passing through the project area; therefore, could be considered negligible. And in case that an incident occur, the mitigation measure and emergency plan would be implemented as suggested in the mitigation measures of Air Quality (***Section 8.1***)

8.3 Noise Impact Assessment

8.3.1 Introduction

This Chapter presents an assessment of the potential noise impacts arising from the construction and operational phases of the Project. Noise sensitive receivers (NSRs) and potential sources of noise generation were identified and an assessment of the potential impacts was carried out. Mitigation and management measures are recommended where necessary.

Impacts associated with noise (both during construction and operation phase) may affect NSRs such as human in the affected area. During the scoping activity, the following are impacts related to noise that will be assessed in this Chapter (***Chapter 8.3***):

- Potential noise impacts from transportation of workers, equipment and machineries during construction phase; and
- Potential noise impacts from excavation work and civil construction during construction phase.

8.3.2 Assumptions and Limitations

The assessment of potential impacts related to noise in this section is based on the environmental baseline data (***Chapter 5***) and the information available from the Project Proponent at the time of writing.

The noise impact assessment was carried out based on an assumed facility inventory for the construction and operational phases of the pipeline. No noise modelling has been conducted to simulate the expected noise impacts. These will be confirmed by the Engineering, Procurement and Construction (EPC) contractor prior to commencement of each phase. Should there be significant differences between the assumed plant inventory and that to be used on site, additional assessments may be needed and the proposed noise mitigation measures should be updated and implemented accordingly.

8.3.3 Assessment Methodology

The methodology used for assessing impacts to noise is aligned with the general impact assessment methodology presented in ***Chapter 7***. The guidelines that will be used for the construction and

operation noise impact assessment was conducted with reference to relevant international guidelines and local legislation, regulations, standards where available. Noise level guidelines given in Myanmar National Environmental Quality Guideline (NEQ) and that in IFC General EHS Guidelines: Environmental – Noise Management are the same and are summarised in ***Table 3.11***.

Table 8.15: Myanmar NEQ and IFC General EHS Guidelines for Noise Levels at Receptors

Area	Maximum Allowable Noise Level (1 hour) [(a)] dB(A)	
	Daytime 0700 – 2200 hours	Night-time 2200 – 0700 hours
Residential, institutional, educational	55	45
Industrial/commercial areas	70	70

Note: *[(a)] Equivalent continuous sound level in decibels*
Noise impacts should not exceed the levels presented in this table, or result in a maximum increase in background levels of 3dBA at the nearest receptor location off-site.

8.3.4 Summary of Baseline Conditions

Chapter 5 provides the details of the baseline conditions for noise in the Project study area.

Information on the ambient noise conditions for the Study Area is not publicly available. The background noise levels are expected to be typical of an urban and/or semi-urban environment in Myanmar. Sources of noise are likely to include local traffic (e.g. motorbikes, scooters and less so private cars), human activity (e.g. schools, barangay halls, local markets) and animals (e.g. dogs, cockerels).

As part of the ESIA Study, noise monitoring at selected locations (with consideration of NSRs) are conducted to form a primary baseline database. Further information on the baseline is presented in ***Section 5.1.4***.

Most noise stations have day time and night time A-weighted loudness equivalent levels that exceed the Myanmar Standard. Although there area couple of noise stations (N4, and N8) that are within the day time standard, only noise station N7 has day time and night time levels that are within the standard. Stations that are closest along the pipeline alignment includes N1, N5, N6, N7, N8, and N9.

8.3.5 Receptor Identification and Sensitivity

There are multiple NSRs along the pipeline alignment which range from individual households and villages, to dense residential areas. All identified NSRs are located within Dala Township. As the identified NSRs are residential, the sensitivity of the receptor would be considered as medium; however, considering the number of NSRs, and the density of NSRs within northern Dala, the sensitivity of the receptor is considered as medium.

8.3.6 Project Activities

8.3.6.1 Construction Phase

Construction of the Pipeline will be carried out by the EPC contractor appointed by TPMC. The construction phase for the Natural Gas Pipeline installation is expected to take 18 months. Scheduled Commercial Operating Date (SCOD) is expected at the end of 2021. The maximum number of workers onsite during construction is anticipated to be 117 persons.

The Project Proponent will implement appropriate management and mitigation measures to reduce the significance of any impacts associated with noise, as will be discussed in the respective mitigation

measures section for each impact type. The mitigation measures will also be summarised in the ESMP chapter (***Chapter 12***).

8.3.6.2 Operation Phase

During the pipeline operation phase, related activities include the transfer of natural gas from the LNG Receiving Terminal to the Power Plant via pipeline, and pipeline maintenance. Both activities are not expected to have any significant noise impacts towards NSRs; therefore, the noise impact assessment for pipeline during operation phase will not be assessed.

8.3.7 Assessment of Impacts from Noise

8.3.7.1 Impacts from Noise Level from Transportation of Workers, Equipment and Machineries during Construction Phase

Overview

During the construction phase, workers, equipment and materials will need to be transported by large trucks and/or other types of vehicles to the construction site. Truck and transportation vehicles will produce a certain level of noise impact towards the surrounding ambient noise and Noise Sensitive Receivers/Receptors (NSRs). The impact level will depend on the type of vehicles used, the number of trips within a specific time period, and the time of day for transportation.

During the Pipeline construction, workers and equipment will be transported to the construction site by road transportation. While other materials used for construction will be transported via barge.

Impact Assessment Table

The significance of potential impacts from generation of noise from transportation and operation of workers, equipment and materials during construction phase is assessed in ***Table 8.16***, and mitigation measures are presented thereafter.

Table 8.16: Significance of Impacts Due to Generation of Noise from Transportation of Workers, Equipment and Materials of Pipeline during Construction Phase

Significance of Impact				
Impact	Potential impacts on NSRs due to noise emissions from the transportation of pipeline construction equipment, materials and workers during the construction phase.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts is considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Potential impacts would likely be direct impacts.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	Construction will take approximately 18 months, which would be considered short-term.			
Impact Extent	**Local**	Regional	International	
	Noise impact from operation equipment will have localised impact.			
Impact Scale	Transportation vehicle for staff and construction material is measured to generate 86.7 dBA. Considering that there are NSRs along the transportation route, the NSRs are expected to receive approximately 86.7 dBA from the vehicles. Car ferry to be used for transporting trucks containing construction material has a reference			

Significance of Impact					
	sound level per unit of 87 dBA.[122] Assuming that the closest distance between a car ferry and a NSR is 300 metres, the approximate noise level from the car ferry at 300 meters is 61.12 dBA.				
Impact Frequency	Transportation is expected to occur intermittently but frequently throughout the construction period. Transportation of equipment and materials is expected to occur one or two rounds during the construction phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the impact characteristics above, the impact magnitude is considered to be small.				
Receptor Sensitivity	Low		**Medium**	High	
	The identified NSRs are residential, the sensitivity of the receptor is considered as medium.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a Medium Receptor Sensitivity and Small Impact Magnitude will result in an overall Minor impact.				

Mitigation Measures

The following measures will be put in place for the Project during the construction phase to mitigate impacts to NSRs:

- Schedule transportation of materials evenly throughout the day (to minimize accumulative noise impact from multiple noise sources);
- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components should be conducted; and
- Avoid transportation of materials on- and off-site through existing community areas.

Residual Impact

If the recommended mitigation measures are implemented, residual impact significance would be **Negligible** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of noise should consist of the following:

- Monthly noise monitoring should be conducted at the representative NSRs by the EPC contractor to check noise levels and compliance at the NSRs throughout the construction phase.

8.3.7.2 Impact from Noise during Excavation Work and Civil Construction during Construction Phase

Overview

During the construction phase, the Project will require the use of construction equipment such as horizontal directional drilling rig, excavators, diesel generators, etc. Each construction equipment will produce a certain level of noise impact towards NSRs. Given that the pipeline will be constructed in

[122] Referred noise level is taken from the reference for a Tug Boat, assuming both type of vessels have a power output of 900-1,000 hp. Source: Epsilon. (2006). Hudson River PCBs Superfund Site – Phase 1 Final Design Report. Attachment J – Noise Impact Assessment. Epsilon Associates Incorporated. Table 4-1. Retrieved from: https://www3.epa.gov/hudson/pdf/2006_03_21%20Phase%20I%20FDR%20ATTACHMENT%20J.pdf

sections at a time, there is no fixed location for any specific equipment, with the exception of the horizontal directional drilling rig.

During the pipeline construction phase, the list of equipment that will be used and will produce noise impacts are shown in ***Table 8.17***.

Table 8.17: Construction Equipment List

Machinery Type	Number of Machineries On-Site
Horizontal Directional Drilling Rig	1
Excavator	4
Auger Drill	2
Bulldozer	1
Light-duty vehicle	8
Water truck	2
Cranes	2
Diesel Generator 200KW	1
Diesel Generator 100KW	1
Diesel Generator 50KW	2
Tipper trucks/trailer	14
Fuel and lube truck	1
Pump	6

Source: TPMC, 2019.

Impact Assessment Table

The significance of potential impacts to NSRs around the Project Area from noise generated through excavation work and civil construction during construction phase is assessed in ***Table 8.18***, and mitigation measures are presented thereafter.

Table 8.18: Significance of Impacts Due to Generation of Noise from Excavation Work and Civil Construction during Construction Phase of Pipeline

Significance of Impact				
Impact	Potential impacts on NSRs due to Excavation Work and Civil Construction activities during construction phase.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts is considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Potential impacts would likely be direct impacts.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	Construction will take approximately 18 months, which would be considered long-term.			
Impact Extent	**Local**	Regional	International	
	Noise impact from construction equipment will have localised impact.			
Impact Scale	The excavation work and civil construction activities will generate noise impacts during its operation and standby phase. ***Table 8.17*** shows that there will be a large number of			

Significance of Impact

	machineries operating on-site which will contribute to the baseline noise level. Therefore, noise impacts from this source is expected to be at a moderate scale. The loudest equipment expected is from earthmovers, such as excavators and bulldozers, which are expected to emit at most 94 dBA from 3 meters. Considering there are NSRs located along the pipeline alignment, assuming the closest NSR is 10 metres from the construction activities, the expected noise level is approximately 83.54 dBA.				
Impact Frequency	Equipment is also expected to operate intermittently but repeatedly throughout the day.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the impact characteristics above, the impact magnitude is considered to be small.				
Receptor Sensitivity	Low		**Medium**	High	
	The identified NSRs are residential, the sensitivity of the receptor is considered as medium.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a Medium Receptor Sensitivity and Small Impact Magnitude will result in an overall Minor impact.				

Mitigation Measures

The following measures will be put in place for the Project during the construction phase to mitigate impacts to NSRs:

- Noise barriers should be installed at the site boundary (facing the villages) and high enough which completely hides the noise sources from the NSR[123]. It is anticipated that at least a 10 dB(A) noise reduction can be provided. The noise barrier material should have a superficial surface density of at least 7 kg/m^{-2} and have no openings or gaps;
- Well-maintained equipment to be operated on-site;
- Normal working hours of the contractor should be between 07:00 and 22:00 hours from Monday to Saturday (except holiday). If work needs to be undertaken outside these hours, it should be limited to activities that do not lead to exceedance of noise criteria at nearby NSRs and avoid early morning and night time construction;
- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components;
- Shut down or throttled down between work periods for machines and construction plant items (eg trucks) that may be in intermittent use ;
- Reduce the number of equipment operating simultaneously as far as practicable;
- Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable;
- Locate noisy equipment and machineries (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable; and
- Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site construction activities.

[123] https://www.fhwa.dot.gov/Environment/noise/noise_barriers/design_construction/keepdown.cfm

Residual Impact

If the recommended mitigation measures are implemented, residual impact significance would be **Negligible** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of noise should consist of the following:

- Monthly noise monitoring should be conducted at the representative NSRs by the EPC contractor to check noise levels and compliance at the NSRs throughout the construction phase.

8.4 Surface Water Impact Assessment

8.4.1 Introduction

During the construction and operation phases, different activities have the potential to generate wastewater, accidental spills, sedimentation, and increased water consumption, which could lead to impacts on the hydrology and quality of surrounding freshwater bodies. In the pipeline study area, the Yangon River is identified as the most prominent potential receiving body. Therefore, it is important to understand the interaction between impacts generated from construction and operation activities of the pipeline and the subsequent effects on surface water quality and hydrology. This section presents an evaluation of the potential impacts on surface water associated with the construction and operation of the proposed pipeline based on the impacts identified during Scoping.

Potential impacts that have been identified and will be assessed under the Surface Water Impact Assessment includes the following:

- Water intake requirements for construction[124];
- Water discharge from hydrostatic testing; and
- Sedimentation caused by soil erosion from storm water.

This section also develops management, mitigation and monitoring measures needed to ensure that any identified impacts can be reduced to as low as reasonably practical. Such measures are presented and will form part of the overall Environmental and Social Management Plan (ESMP, ***Chapter 12***) for the pipeline.

8.4.2 Assumptions and Limitations

The assessment of potential impacts related to surface water in this section is based on the environmental baseline data (presented within ***Chapter 5***), socioeconomic baseline data (presented within ***Chapter 5***) and the information available from TPMC at the time of writing. Judgements and assessments have been made based on professional knowledge and previous experience of ERM. It is noted that no quantitative modelling has been undertaken with regards to any elements of the surface water impact assessment. Should there be significant changes in factors such as assumed input data, engineering design of wastewater management and treatment components of the pipeline, or agreed assessment criteria, then elements of this impact assessment and associated management, mitigation and monitoring measures may be needed to reflect these changes.

The environmental parameters sampled in the baseline survey (refer to ***Chapter 5***) are based upon commonly found contaminants.

This section considers the nearby water bodies as the primary receptors. It is recognised that any changes to surface water may potentially impact other sensitive receptors that utilise these surface water resources. In this regard, this section assesses impacts and recommends management, mitigation and monitoring measures in relation to reducing direct impacts to surface water only.

[124] Pipeline operation and maintenance activities will be coordinated by the Power Plant operational staff.

Assessing secondary impacts to receptors from changes to water quality or hydrology (identified as a result of this section) has been undertaken within other respective sections, taking into account the various management, mitigation and monitoring measures developed within this section.

Assessment of the impact towards other receptors will be carried out in the according receptor impact assessment section as follows:

- Loss of containment of hazardous waste (which includes diesel oil, hydraulic fluids, paint, battery, cement wash down, rinsing effluents, and sludge) generated from construction and operation activities (***Section 8.6: Waste***).
- Loss of containment of non-hazardous waste generated from construction and operation activities (which includes concrete, steel pipes, steel plates, structural steel, and wooden crates) generated from construction and operation activities (***Section 8.6: Waste***).
- Domestic solid waste generated from workers during construction phase, and permanent staff during operation phase (***Section 8.6: Waste***).
- Loss of containment of domestic liquid waste generated from workers during construction phase, and permanent staff during operation phase (***Section 8.6: Waste***).

8.4.3 Assessment Methodology

The methodology used for assessing impacts to surface water is aligned with the general impact assessment methodology presented in ***Chapter 6***.

8.4.4 Summary of Baseline Conditions

The main river within the pipeline area is Yangon River. The proposed Power Plant, and LNG Receiving Terminal are located along the Yangon River, the Natural Gas Pipeline that connects the LNG Receiving Terminal with the proposed Power Plant will cross the Twante canal from Dala Township to Sala Kanaungto Township, then cross the Yangon River again to Ahlone Township. The river is under tidal influence, and becomes brackish during the dry season. The estuary and creeks of the river are navigable by small craft with some areas covered by mangrove forest. There are number of villages, as well as commercial ports located on its banks, therefore, the river is currently used for fisheries, navigation and marine logistic purposes.

Results from baseline sampling of surrounding water bodies, including the Yangon River, showed that, during the dry season, parameters that exceeded the compared local and/or international standards (Myanmar standards, IFC Standards, and EPA Standards) include TSS, TDS, Iron, and Manganese. Parameters that exceed the local and or international standards during the wet season include TSS, Iron, Mercury, and Manganese. All other parameters were found to be within the compared standards. Further details regarding Surface Water baseline conditions are shown in ***Chapter 5***.

8.4.5 Receptor Identification and Sensitivity

The primary receptor for impacts to surface water is the Yangon River, adjoining streams and tributaries, and downstream water users and aquatic ecosystems. Groundwater, ponds/lakes, and stored rainwater are the main water sources, along with stored water from streams. Water from the Yangon River is also used by villagers from townships within the Study Area; however, this is relatively limited. Water from the Yangon River is available year round.

Based on the baseline sampling conducted in the Yangon River, some parameters were found to be above relevant standards, and therefore the water bodies may be more sensitive to changes. However, the resources do not support very diverse or susceptible populations of flora and/or fauna, and their importance for local habitats and communities would be considered moderate. Overall, sensitivity of the receptor is considered Low.

8.4.6 Summary of Project Activities with Potential Impacts

8.4.6.1 Construction Phase

Proposed Project Activities with Potential Impacts

Construction of the Pipeline will be carried out by the EPC contractor appointed by TPMC. The construction phase for the Natural Gas Pipeline installation is expected to take 18 months. Scheduled Commercial Operating Date (SCOD) is expected at the end of 2021. The maximum number of workers onsite during construction is anticipated to be 117 persons.

During the construction phase, potential impacts to surface water may arise from the following activities:

- Water intake requirements;
- Water discharge from hydrostatic testing; and
- Sedimentation caused by soil erosion during certain construction activities.

8.4.6.2 Operation Phase

During the pipeline operation phase, related activities include the transfer of natural gas from the LNG Receiving Terminal to the Power Plant via pipeline, and pipeline maintenance. Neither activity is expected to have any impacts towards Surface Water; therefore, the pipeline operation phase will not be assessed.

8.4.7 Assessment of Impacts to Surface Water

8.4.7.1 Overview

The assessment of impacts section will consider each type of the potential impact with respect to each phase (construction, operation), for those interactions/impacts that have been scoped in for the pipeline. The section will be organized into sub-sections as follows:

- Overview – description of the pipeline activities that have the potential to cause the impact during the respective phase;
- Impact Assessment Table – a summary table that assesses and evaluates impacts based on their characteristics, to determine the significance of the impact;
- Mitigation Measures – a list and description of corrective and preventive actions to be applied or implemented to pipeline activities to reduce the significance of the assessed impact;
- Residual Impacts – re-evaluation of impact significance after mitigation measures have been applied; and
- Monitoring Plan – summary of the monitoring plan, which has the objective to ensure that the mitigation measures have been implemented effectively and resulted in a reduction in the significance of residual impacts.

8.4.7.2 Water Intake Requirements (Construction Phase)

Overview

During the construction phase, various activities will require the use of water in order to function. Water requirements of the construction workforce is one factor that is to be considered, as personal water consumption, such as for hydration and washing, is to be expected. Prefabrication of concrete slabs will require water for the process, similar to any other process for making/mixing concrete.

During construction, water is required for construction worker activities and prefabricated concrete activities, which may place pressure on the local water supply. The maximum number of workers onsite during construction is anticipated to be 117 persons and each worker is estimated to consume approximately 33.3 litres of water per day[125]. Prefabrication of Cover Slab concrete activities are estimated to consume 230 litres of water per day per m^3 of concrete, and estimated 2,500 m^3 of water for hydrostatic testing / total water volume of 2,643.75 m^3. All construction activities are estimated to consume 3 m^3 of water per day.

The average water consumption rate during construction is anticipated to be 78 m^3 per month (approximately 3 m^3 (3,000 L) per day). The raw water required during construction will be obtained from the Yangon River. The raw water will be treated and purified to supply for construction.

The socioeconomic baseline study (***Chapter 5***) found that, in the study area, public water supply utilities, and groundwater is the main source of drinking water along with stored water from streams. Water from the Yangon River is also used by villagers from township within the study area to some extent for domestic use but not as drinking water. Water is available all year round.

WHO Regional Office for South-East Asia[126] suggests that, including requirements for drinking, cooking, washing, cleaning, and waste disposal, up to 70 L per person per day of water are required for human use. The pipeline's water requirement of 3,000 L per day during construction is equivalent to the water requirement for 43 people. Although the Yangon River will be the main source of water for construction activities, the water requirement for the pipeline is not expected to impact the communities' existing water usage; communities mainly use lakes, ponds, or stored rain water as a source of water, with limited intake of the Yangon River. In addition, considering the Yangon River is large with a constant flow of water, ranging from <500 m^3/s in April to 7,000 m^3/s in August, and with a relatively close distance (from LNG Receiving Terminal location) to the Gulf of Martaban, impacts to the Yangon River water supply is expected to have an insignificant difference.

Impact Assessment Table

Table 8.19: Impact Assessment Table for Water Intake Requirements (Construction Phase)

Significance of Impact				
Impact	Potential impacts on surface water due to water intake requirements during construction phase.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts to surface water would be considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Impacts to surface water would be direct impacts through water intake from the Yangon River and adjoining streams and tributaries.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	Construction is expected to be completed in 18 months, which would be considered short-term.			
Impact Extent	**Local**	Regional	International	
	Potential impacts would be limited to the pipeline area, downstream of the Yangon River, adjoining streams and tributaries, and to any nearby water users, hence would be considered			

[125] Metcalf& Eddy Inc. Wastewater Engineering: Treatment, Disposal, Reuse. 3rd Edition McGraw Hill, Network, 1979

[126] http://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/WHO/WHO5%20-%20Minimum%20water%20quantity%20needed%20for%20domestic%20use.pdf

Significance of Impact					
	to be local.				
Impact Scale	The maximum number of workers onsite during construction of the pipeline is anticipated to be 117 persons. The pipeline's water requirement of 3,000 L per day during construction is equivalent to the water requirement for 43 people. The raw water required during construction will be obtained from YCDC or other local water supplier, and will be transported by water trucks. The water requirement for the pipeline is not expected to impact the communities' existing water usage; communities mainly use lakes, ponds, or stored rain water as a source of water, with limited intake of the Yangon River.				
Frequency	Impacts to surface water from water use could occur intermittently but repeatedly throughout the day for the duration of the construction phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be small.				
Receptor Sensitivity	**Low**	Medium	High		
	The primary receptor for impacts to surface water from water intake is the Yangon River, adjoining streams and tributaries, and downstream water users and aquatic ecosystems. Existing surface water quality is relatively poor. Groundwater, ponds/lakes, and stored rainwater are the main water sources, along with stored water from streams. Water from the Yangon River is also used by villagers from townships within the Study Area; however, this is relatively limited. Water from the Yangon River is available year round. The Yangon River does not support a diverse ecosystem and it would not be expected to be significantly impacted by changes in water quantity/flow rates. Given the background conditions of the Yangon River, sensitivity of the receptor is considered Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Small Impact Magnitude will result in an overall Negligible impact.				

Mitigation / Management Measures

The significance of impacts is rated as Negligible, and no additional mitigation is considered necessary provided that existing/in-place controls are appropriately implemented.

Residual Impact (Post-mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts would be expected to be of **Negligible** significance.

Monitoring Plan

As detailed in the ESMP chapter, monitoring for surface water during the construction phase should consist of the following:

- Monthly monitoring of water intake quantities and flow rates in the Yangon River.

8.4.7.3 Water Discharge from Hydrostatic Testing (Construction Phase)

Overview

Hydrostatic testing involves pumping fluid into pressure system (such as a pipeline) to perform strength test and identify leak points. Once the Pipeline has been constructed, the Pipeline system will need to undergo Hydrostatic testing before proceeding with operation.

The hydrostatic testing fluid will utilize water provided from the river or canal near the construction site location, no chemicals will be added to the water before or after testing; therefore, the fluid is considered non-hazardous. The amount of hydrostatic testing fluid required for testing is approximately 2,500 m^3.

Considering that the fluid is non-hazardous, the fluid will be discharged directly into the Yangon River. The discharge method will involve opening the pipeline at a point closest to the Yangon River.

Considering that the water from the Yangon River will be used, and chemical-dosing will not be conducted, contaminants such as plankton and other living organisms are likely to be found. Hydrostatic testing is expected to last more than 24 hours to properly test the pipeline, within this time period, die-off of living organisms within the hydrostatic testing liquid may occur, and consequently lead to degradation. It is expected that the water quality of the hydrostatic testing fluid will be different from when intake occurred.

Given that the discharge is expected to be the same amount as the intake (provided that leaks to not occur), and considering the flow of the Yangon River ranges from <500 m^3/s in April to 7,000 m^3/s in August, the receiving water is likely to quickly dilute the discharged water; therefore, the impact from the discharge of degraded hydrostatic testing fluid is expected to be insignificant.

Impact Assessment Table

Table 8.20: Impact Assessment Table for Water Discharge from Hydrostatic Testing (Construction Phase)

Significance of Impact				
Impact	Potential impacts on surface water due to water discharge from hydrostatic testing during construction phase.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts to surface water would be considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Impacts to surface water would be direct impacts through discharge of hydrostatic testing fluid to the Yangon River and adjoining streams and tributaries.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	Construction is expected to be complete in 18 months, which would be considered short-term.			
Impact Extent	**Local**	Regional	International	
	Potential impacts would be limited to the pipeline area, downstream of the Yangon River, adjoining streams and tributaries, and to any nearby water users, hence would be considered to be local.			
Impact Scale	The hydrostatic testing fluid will utilize water provided from the river or canal near the construction site location, no chemicals will be added to the water before or after testing; therefore, the fluid is considered non-hazardous. Fluid required for testing is approximately 2,500 m^3.			

Significance of Impact					
	Die-off of living organisms within the hydrostatic testing liquid may occur, and consequently lead to degradation. Considering the flow of the Yangon River ranges from <500 m^3/s in April to 7,000 m^3/s in August, the receiving water is likely to quickly dilute the discharged water.				
Frequency	Impacts to surface water from the discharge of degraded hydrostatic testing fluid is only expected to occur once per hydrostatic test.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The impact magnitude is likely to be Negligible.				
Receptor Sensitivity	**Low**	Medium	High		
	The primary receptor for impacts to surface water from water intake is the Yangon River, adjoining streams and tributaries, and downstream water users and aquatic ecosystems. Existing surface water quality is relatively poor. Groundwater, ponds/lakes, and stored rainwater are the main water sources, along with stored water from streams. Water from the Yangon River is also used by villagers from townships within the Study Area; however, this is relatively limited. Water from the Yangon River is available year round. The Yangon River does not support a diverse ecosystem and it would not be expected to be significantly impacted by changes in water quantity/flow rates. Given the background conditions of the Yangon River, sensitivity of the receptor is considered Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Negligible Impact Magnitude will result in an overall Negligible impact.				

Mitigation / Management Measures

The significance of impacts is rated as Negligible; however, a number of additional mitigation measures are recommended in order to minimize the impact:

- Implement a hydrostatic test monitoring plan;
- After the hydrostatic testing is complete, analyse the test water for contamination and appropriately treat before it is returned to the environment. Alternatively, the water can be treated/ disposed of by a licensed wastewater disposal/treatment company;
- Ensure minimum erosion during discharge of hydrostatic test water;
- Carry out monitoring and reporting of water consumption;
- Reduce water need by optimizing the hydrostatic testing operation.

Residual Impact (Post-mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts would be expected to be of **Negligible** significance.

Monitoring Plan

As detailed in the ESMP chapter, monitoring for surface water during the construction phase should consist of the following:

- Monitor water quality of hydrostatic testing fluid intake (before test), and before discharge (after test completion).

8.4.7.4 Sedimentation Caused by Soil Erosion during Certain Construction Activities (Construction Phase)

Overview

An open cut construction method for the pipeline will involve primarily earthworks, which consists of excavating soil from the planned pipeline alignment. Once the soil has been excavated to the designed depth, the proper native soil or padding sand (if necessary) will be filled at the bottom. Backhoes, or other appropriate machinery will then lower the pipeline on top of the bottom layer; once aligned, proper native soil or sand (if necessary) will be used to cover the entire pipeline. Soil that is stored near water sources, such as canals or rivers, may erode and be carried by stormwater runoff into the water source.

The construction phase of the pipeline will require excavation of soil to conduct open-cut method. The amount of soil that will be removed and then backfilled is approximately 75,000 m^3. The pipeline will also cross over canals at four (4) different locations. Given that the pipeline is located nearby water bodies, especially at canal crossings, excavated soil may potentially be dropped into the canal or by soil erosion via rainfall. Although this impact is expected to originate from pipeline activities, it may also be dependent on external factors, such as rainfall, to cause impacts on Surface Water.

The fill soil quality is also important to consider as contaminated soil may cause more impacts, in addition to increase in TSS. The impact potential will depend on the type of material/contamination found within the soil; certain types of heavy metals or other chemical substances may varying levels of impact on human health, and other organisms. This will lead to the contamination of surface water, and the potential bioaccumulation in nearby water users, and aquatic organisms.

Increase in TSS levels will result in the decrease in light penetration in surface water, potentially reducing the photic zone area; therefore, inhibiting plant/organisms photosynthesis, which may reduce productivity, or lead to die-off. Visibility will also be decreased, which may limit the survivability of fish and other organisms that depend on visibility for navigation and survival.

The Yangon River, and four (4) canal crossings' baseline conditions are considered relatively poor considering parameters such as TSS and TDS exceed the related standards, and the ecological resources that it supports are not sensitive to a change in water quality.

The prevalence of sedimentation will also depend on the amount of rainfall received; the wet season will result in greater stormwater, subsequently leading to increased soil erosion. In contrast, the dry season will see less rainfall, and therefore, the impact from soil erosion will be considerably smaller.

Impact Assessment Table

Table 8.21: Impact Assessment Table for Sedimentation Caused by Soil Erosion during Certain Construction Activities (Construction Phase)

Significance of Impact				
Impact	Potential impacts on surface water due to erosion of all construction activities during construction phase.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts to surface water would be considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Impacts to surface water would be direct impacts through sedimentation from soil erosion.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	Construction is expected to be completed in 18 months, which would be considered short-			

Significance of Impact					
	term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would be limited to the pipeline area, downstream of the Yangon River, adjoining streams and tributaries, and to any nearby water users, hence would be considered to be local.				
Impact Scale	The amount of soil that will be removed due to excavation activities for the pipeline and then backfilled is approximately 75,000 m^3. Impact expected to only occur near the proposed pipeline canal crossings at approximately four (4) locations. The impacts from soil erosion can increase the sediment load (and therefore TSS) of the receiving water. Increase in TSS levels will result in the decrease in light penetration in surface water, potentially reducing the photic zone area; therefore, inhibiting plant/organisms photosynthesis, which may reduce productivity, or lead to die-off. Visibility will also be decreased, which may limit the survivability of fish and other organisms that depend on visibility for navigation and survival.				
Frequency	Soil erosion from stormwater runoff may occur more frequently during the wet season, as compared to dry season. This is expected to occur intermittently.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the characteristics above, the impact magnitude is likely to be small.				
Receptor Sensitivity	**Low**	Medium	High		
	The primary receptor for impacts to surface water from soil erosion is the Yangon River, and adjoining streams and tributaries. Existing surface water quality is relatively poor considering parameters such as TSS and TDS exceed the related standards, and the ecological resources that it supports are not sensitive to a change in water quality. Given the background conditions of the Yangon River, sensitivity of the receptor is considered Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Small Impact Magnitude will result in an overall Negligible impact.				

Mitigation / Management Measures

The significance of impacts is rated as Negligible; however, a number of additional mitigation measures are recommended in order to minimize the impact:

- Install silt trap to treat surface run-off from bunded areas prior to discharge to the stormwater system;
- Exposed soil surfaces should be protected by paving or fill material as soon as possible to reduce the potential of soil erosion and subsequent sedimentation;
- Use methods for minimising sediment runoff, as appropriate to the conditions on-site, including: wheel cleaning facilities, sand bag barriers, mulching, and re-vegetation, protect temporary trafficked areas on-site with coarse stone ballast or equivalent, open stockpiles of construction materials or construction wastes on-site should be covered with tarpaulin or similar fabric during rainstorms;

- Regularly, and particularly following rainstorms, inspect and maintain drainage systems and erosion control and silt removal facilities to ensure proper and efficient operation at all times;
- Surface run-off from bunded areas should pass through oil/water separators prior to discharge to the storm water system;

Residual Impact (Post-mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts would be expected to be of **Negligible** significance.

Monitoring Plan

As detailed in the ESMP chapter, monitoring for surface water during the construction phase should consist of the following:

- Continuous monitoring of excavated soil, and any potential pathways for soil erosion into nearby water sources.
- Monthly surface water quality monitoring, using standard analytical methods.

8.5 Soil and Groundwater Impact Assessment

8.5.1 Introduction

This section presents an evaluation of the potential impacts on soil and groundwater associated with the construction and operation of the proposed pipeline based on the impacts identified during Scoping. During the construction and operation phases, various pipeline activities have the potential to change soil structure, and generate wastewater or accidental leaks, which could potentially lead to impacts on the quality of soil, or to groundwater due to leaching.

Potential impacts that have been identified and will be assessed under the soil and groundwater Impact Assessment include the following:

- Water leakage from hydrostatic testing; and
- Loss of containment of the sending and receiving station for HDD;
- Loss of containment of waste bentonite storage; and
- Loss of soil due to improper management during site clearance and excavation activities.

This section also presents management, mitigation and monitoring measures needed to ensure that any identified impacts can be reduced to as low as reasonably practical. Such measures will form part of the Environmental and Social Management Plan (ESMP, ***Chapter 12***) for the pipeline.

8.5.2 Assumptions and Limitations

The assessment of potential impacts to soil and groundwater is based on the environmental baseline and the socioeconomic baseline data presented within ***Chapter 5***, and the information available from TPMC at the time of writing. Assessments have been made based on good industry practice, professional knowledge and previous experience of ERM. No quantitative modelling has been undertaken for the soil and groundwater impact assessment. Should there be significant changes in factors such as assumed input data, engineering design of the pipeline components, or agreed assessment criteria, then elements of this impact assessment and associated management, mitigation and monitoring measures may be needed to be amended to reflect these changes. It is also recognised that there is considerable cross over with other sensitive receptors. In this regard, this section assesses impacts and recommends management, mitigation and monitoring measures in relation to reducing direct impacts to soil and groundwater only.

Assessment of the impact towards other receptors will be carried out in the according receptor impact assessment section as follows:

- Loss of containment of hazardous waste (which includes diesel oil, hydraulic fluids, paint, battery, cement wash down, rinsing effluents, and sludge) generated from construction and operation activities (***Section 8.6: Waste***).
- Loss of containment of non-hazardous waste generated from construction and operation activities (which includes concrete, steel pipes, steel plates, structural steel, and wooden crates) generated from construction and operation activities (***Section 8.6: Waste***).
- Domestic solid waste generated from workers during construction phase, and permanent staff during operation phase (***Section 8.6: Waste***).
- Loss of containment of domestic liquid waste generated from workers during construction phase, and permanent staff during operation phase (***Section 8.6: Waste***).
- Unplanned event from chemical / waste leak / loss of containment during construction and operation phase (***Section 8.9: Unplanned Event***)

8.5.3 Assessment Methodology

The methodology used for assessing impacts to Soil/Groundwater is aligned with the general impact assessment methodology presented in ***Chapter 6***.

8.5.4 Summary of Baseline Conditions

Chapter 5 provides the details of the baseline conditions for soil and groundwater in the pipeline study area.

8.5.4.1 Soil

The Study Area is located on Meadow (Gleysol) and Meadow Alluvial soil (Fluvic Gleysols). The Meadow soil distributes near the river plains where occasional tidal floods occur and are typically non-carbonate, and they usually contain large amount of salts. Meadow Alluvial soil can be found in the flood plains. Sub-soil parameters that were found to exceed the Dutch Standard target values include copper and mercury; the locations with the exceeded values include S02 and S04, which are located along the pipeline alignment. All other parameters are within the Dutch Standard.

8.5.4.2 Groundwater

The productivity of aquifers near the pipeline area can be classified as “Strong Pore Water”, and groundwater quality is considered “Fresh Groundwater”. The groundwater type near the pipeline area consists of "Continuous Aquifer in Plain and Intermountain Basin", with Natural Recharge Modulus ranging from 200,000-500,000 m^3/km^2-yr. Groundwater parameters that exceeded the Myanmar Standard and/or EPA Standard includes iron, total dissolved solids, and manganese. All three sampling sites (two (2) located along the pipeline alignment, and one (1) northeast of the Power Plant) contain parameters that exceed the standards. All other parameters are within the Myanmar standards, EPA, and WHO guidelines.

8.5.5 Receptor Identification and Sensitivity

Groundwater in the local communities surrounding the pipeline area is used for domestic purposes and/or drinking. Groundwater quality ranges from good to slightly poor, and its sensitivity/importance can be rated as medium.

Soil quality can be considered degraded and of low sensitivity/importance. The resource does not support diverse habitat or populations, and has limited use in local communities (i.e. for topsoil of rubber plantations).

Given the background conditions, the sensitivity of soil and groundwater is considered low.

8.5.6 Summary of Project Activities with Potential Impacts

8.5.6.1 Construction Phase

Proposed Project Activities with Potential Impact

Construction of the pipeline will be carried out by the EPC contractor appointed by TPMC. The construction phase for the Natural Gas Pipeline installation is expected to take 18 months. Scheduled Commercial Operating Date (SCOD) is expected at the end of 2021. The maximum number of workers onsite during construction is anticipated to be 117 persons.

During the construction phase, potential impacts to soil and groundwater may arise from the following activities:

- Water Leakage from hydrostatic testing;
- Loss of containment of the sending and receiving station for HDD;
- Loss of containment of waste bentonite storage; and
- Loss of soil due to improper management during site clearance and excavation activities.

8.5.6.2 Operation Phase

During the pipeline operation phase, related activities include the transfer of natural gas from the LNG Receiving Terminal to the Power Plant via pipeline, and pipeline maintenance. Both activities are not expected to have any impacts towards soil and groundwater; therefore, the pipeline operation phase will not be assessed.

8.5.7 Assessment of Impacts to Soil and Groundwater

8.5.7.1 Overview

The assessment of impacts section will consider each type of the potential impact with respect to each phase (construction, operation), for those interactions/impacts that have been scoped in for the pipeline. The section will be organized into sub-sections as follows:

- Overview – description of the pipeline activities that have the potential to cause the impact during the respective phase;
- Impact Assessment Table – a summary table that assesses and evaluates impacts based on their characteristics, to determine the significance of the impact;
- Mitigation Measures – a list and description of corrective and preventive actions to be applied or implemented to pipeline activities to reduce the significance of the assessed impact;
- Residual Impacts – re-evaluation of impact significance after mitigation measures have been applied; and
- Monitoring Plan – summary of the monitoring plan, which has the objective to ensure that the mitigation measures have been implemented effectively and resulted in a reduction in the significance of residual impacts.

8.5.7.2 Water Leakage from Hydrostatic Testing (Construction Phase)

Overview

Hydrostatic testing involves pumping fluid into pressure system (such as a pipeline) to perform strength test and identify leak points. Once the Pipeline has been constructed, the Pipeline system will need to undergo Hydrostatic testing before proceeding with operation.

The hydrostatic testing fluid will utilize water provided from the river or canal near the construction site location, no chemicals will be added to the water before or after testing; therefore, the fluid is considered non-hazardous. The amount of hydrostatic testing fluid required for testing is approximately 2,500 m^3.

Considering that the fluid is non-hazardous, the fluid will be discharged directly into the Yangon River. The discharge method will involve opening the pipeline at a point closest to the Yangon River.

Leaks that occur during hydrostatic testing may lead to soil erosion. The scale of the impact will depend on the duration of the leak, and the amount of leaked hydrostatic testing fluid. This impact is not expected to cause any impacts to groundwater.

Impact Assessment Table

Table 8.22: Impact Assessment Table for Water Leakage from Hydrostatic Testing (Construction Phase)

Significance of Impact					
Impact	Potential impacts on soil and due to water leakage from hydrostatic testing during construction phase.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to soil would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to soil and groundwater would be direct impacts through stormwater, excavation and movement of heavy equipment.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction is expected to be completed in 18 months, which would be considered short-term.				
Impact Extent	**Local**	Regional	International		
	Impacts would be limited to the pipeline footprint; hence would be considered to be local.				
Impact Scale	The hydrostatic testing fluid will utilize water provided from the river or canal near the construction site location; no chemicals will be added to the water before or after testing; therefore, the fluid is considered non-hazardous. Amount of fluid required for testing is approximately 2,500 m^3. The scale of the impact will depend on the duration of the leak, and the amount of leaked hydrostatic testing fluid. This impact is not expected to cause any impacts to groundwater.				
Frequency	Impacts to soil from leaked hydrostatic testing fluid could occur during the hydrostatic testing process, and may occur continuously until testing stops and/or the leak is sealed.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the characteristics above, the impact magnitude is likely to be small.				
Receptor Sensitivity	**Low**	Medium	High		
	Soil quality can be considered degraded and of low sensitivity/importance. The resource				

	does not support diverse habitat or populations, and has limited use in local communities (i.e. for topsoil of rubber plantations). Overall, the sensitivity of soil and groundwater is considered low.			
Impact Significance	**Negligible**	Minor	Moderate	Major
	The combination of a Low Resource Sensitivity and Small Impact Magnitude will result in an overall Negligible impact.			

Mitigation / Management Measures

The following measures will be put in place for the Project during the construction phase to mitigate impacts to soil:

- Control erosion through diversion drains, sediment fences, and sediment retention basins;
- Drain all hydrostatic testing fluid at the designated discharge point as soon as possible, once all leaks have been identified, to minimize soil erosion.

Residual Impact (Post-Mitigation)

If the recommended mitigation measures are implemented, residual impact significance would be of **Negligible** Significance.

Monitoring Plan

No monitoring plan is required.

8.5.7.3 Loss of Containment of the Sending and Receiving Station for HDD

Overview

The sending pit is an excavated area to make room for HDD equipment, whereas the receiving pit, which is also an excavated area, is to provide a clear open area for exit of the drill bit. During normal operations, both the sending and receiving pits are expected to contain used bentonite from the HDD process. While both pits are intended to hold used bentonite, this is only temporary, and will be transferred by pumps, or excavators to the appropriate storage containers to be disposed by a licenced waste contractor.

During the HDD process, there is a possibility that bentonite containment in the sending and/or receiving station may be lost, or a potential blow out may occur that releases bentonite outside of either pits. This will potentially lead to contamination of soil beyond the sending and receiving pits.

Although this impact may occur, according to the Material Safety Data Sheet (MSDS) for bentonite[127], bentonite consists of naturally occurring materials, and does not pose any long-term adverse effects on the environment; therefore, bentonite effects on soil is considered insignificant.

Impact Assessment Table

Table 8.23: Impact Assessment Table for Loss of Containment of the Sending and Receiving Station for HDD (Construction Phase)

Significance of Impact				
Impact	Potential impacts on soil due to loss of containment of sending and receiving station for HDD during construction phase.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts to soil would be considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Impacts to soil would be direct impacts through leakage of bentonite.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	Bentonite is expected to only have short-term impacts on soil and groundwater.			

[127] ECCA. (2019). Material Safety Data Sheet: Bentonite. ECCA Holdings (PTY) Limited. Retrieved from http://www.capebentonite.co.za/downloads/BENTONITE%20MATERIAL%20SAFETY%20DATA%20SHEET.pdf

Significance of Impact

Impact Extent	**Local**	Regional	International		
	Impacts would be limited to the pipeline footprint; hence would be considered to be local.				
Impact Scale	It is expected that the amount of bentonite produced from HDD activities is approximately 1,000 m^3. Possibility that bentonite containment in the sending and/or receiving station may be lost, or a potential blow out may occur that releases bentonite outside of either pits. This will potentially lead to contamination of soil beyond the sending and receiving pits. Bentonite consists of naturally occurring materials, and does not pose any long-term adverse effects on the environment.				
Frequency	The frequency over the course of the Project is most likely to be zero occurrences.				
Likelihood	Very Unlikely	Unlikely	**Likely to occur once or more in life of the Project**	Likely to occur once or twice per year	Will likely occurs more than twice per year, or is continuous or certain to occur
	The likelihood of an accidental leak is anticipated to be likely to occur once or more in life of the Project.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be Small.				
Receptor Sensitivity	**Low**	Medium	High		
	Soil quality can be considered degraded and of low sensitivity/importance. The resource does not support diverse habitat or populations, and has limited use in local communities (i.e. for topsoil of rubber plantations). Given the background conditions, the sensitivity of soil and groundwater is considered low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Small Impact Magnitude will result in an overall Negligible impact.				

Mitigation / Management Measures

The significance of impacts is rated as Negligible; however, a number of additional mitigation measures are recommended in order to minimize the impact as follows:

- Place/install a buffer zone (such as sandbags, trenches, or other appropriate barriers) around the sending and receiving pits to reduce the potential of soil contamination in adjacent area;
- Place the sending and receiving station at least 7.5 metres from any water source, to reduce the
- Use mobile pumps, vacuum trucks, and other appropriate equipment to clean any bentonite spills;
- Stop HDD activities, and other associated activities until the spill has been cleaned;
- Re-evaluate appropriate drilling pressure for the specific area conditions before continuing HDD activities;
- Conduct preventive maintenance for HDD and spill clean-up equipment;
- Use sandbags to quarantine any bentonite spills beyond the planned buffer zone; and
- Spill response plans should be prepared and implemented to address the potential accidental release of bentonite.

Residual Impact (Post-Mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts are also expected to be of **Negligible** significance.

Monitoring Plan

As detailed in the ESMP chapter (***Chapter 12***), monitoring for soil and groundwater during the construction phase should consist of the following:

- Conduct regular inspection of HDD equipment to reduce risk of bentonite spills; and
- Conduct weekly inspection of spill clean-up equipment to reduce risk of equipment failure during an incident.

8.5.7.4 Loss of Containment of Waste Bentonite Storage (Construction Phase)

Overview

Horizontal directional drilling (HDD) is a method of installing pipeline without having to cut and fill soil. This method is particularly advantageous in areas where excavation is not practical

Bentonite is used as drilling fluid to assist the drilling of boreholes. During HDD method, bentonite will be used as drilling fluid for the HDD rig. It is expected that the amount of bentonite produced from HDD activities is approximately 1,000 m^3. The waste will stored in appropriate containers prior to disposal by a licensed waste contractor.

During storage, loss of containment may occur, which may cause impacts to the immediate surrounding area. According to the Material Safety Data Sheet (MSDS) for bentonite[128], bentonite consists of naturally occurring materials, and does not pose any long-term adverse effects on the environment. Considering the mobility of bentonite is classified as solid, non-volatile, and insoluble in water, impacts to soil is expected to be insignificant.

Impact Assessment Table

Table 8.24: Impact Assessment Table for Loss of Containment of Waste Bentonite Storage (Construction Phase)

Significance of Impact				
Impact	Potential impacts on soil due to loss of containment of waste bentonite storage during construction phase.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts to soil would be considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Impacts to soil would be direct impacts through leakage of bentonite.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	Bentonite is expected to only have short-term impacts on soil and groundwater.			
Impact Extent	**Local**	Regional	International	
	Impacts would be limited to the pipeline footprint; hence would be considered to be local.			
Impact Scale	It is expected that the amount of bentonite produced from HDD activities is approximately			

[128] ECCA. (2019). Material Safety Data Sheet: Bentonite. ECCA Holdings (PTY) Limited. Retrieved from http://www.capebentonite.co.za/downloads/BENTONITE%20MATERIAL%20SAFETY%20DATA%20SHEET.pdf

Significance of Impact					
	1,000 m^3. The waste will stored in appropriate containers prior to disposal by a licensed waste contractor. Bentonite, is considered persistent, non-biodegradable; however, long-term adverse effects on the environment is expected to be unlikely.				
Frequency	The impacts is not expected to occur.				
Likelihood	Very Unlikely	**Unlikely**	Likely to occur once or more in life of the Project	Likely to occur once or twice per year	Will likely occurs more than twice per year, or is continuous or certain to occur
	The likelihood of an accidental leak to occur is unlikely.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be Small.				
Receptor Sensitivity	**Low**	Medium	High		
	Soil quality can be considered degraded and of low sensitivity/importance. The resource does not support diverse habitat or populations, and has limited use in local communities (i.e. for topsoil of rubber plantations). Given the background conditions, the sensitivity of soil and groundwater is considered low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Small Impact Magnitude will result in an overall Negligible impact.				

Mitigation / Management Measures

The significance of impacts is rated as Negligible; however, a number of additional mitigation measures are recommended in order to minimize the impact as follows:

- Use appropriate waste containers and build secondary containment around chemical or waste storage on-site to avoid spillage or leakage of bentonite;
- Obtain permission from the land owner to use selected land for bentonite waste storage;
- Provide waste sub-contractor or land owner with the bentonite MSDS, and the bentonite's properties, such as Electrical Conductivity (ECe), Exchangeable Sodium, and Exchangeable Sodium Percentage;
- Ensure bentonite waste storage is not located on agricultural, and aquaculture land;
- Ensure bentonite waste storage is at least 30 metres away from any groundwater sources;
- Spill response plans should be prepared and implemented to address the potential accidental release of bentonite;
- Prepare only the require amount of bentonite needed for HDD activities, to prevent excess amounts of bentonite to be disposed.

Residual Impact (Post-Mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts are also expected to be of **Negligible** significance.

Monitoring Plan

No monitoring plan is required.

8.5.7.5 Loss of Soil due to Improper Management during Site Clearance and Excavation Activities (Construction Phase)

Overview

An open cut construction method for the pipeline will involve primarily earthworks, which consists of excavating soil from the planned pipeline alignment. Once the soil has been excavated to the designed depth, the proper native soil or padding sand (if necessary) will be filled at the bottom. Backhoes, or other appropriate machinery will then lower the pipeline on top of the bottom layer; once aligned, proper native soil or sand (if necessary) will be used to cover the entire pipeline.

During earthwork activities, the construction phase of the pipeline will require excavation of soil to conduct open-cut method. The amount of soil that will be removed due to excavation activities for the pipeline and then backfilled is approximately 75,000 m^3; this amount also accounts for the excavated soil during HDD activities. Excavation activities that occur during HDD include the excavation of the sending and receiving pits; however, each pit is only expected to cover a small area, and the excavated soil will also be backfilled once HDD activities are completed. Some amounts of soil will be lost during HDD activities, in the form of drill cuttings; as this is combined with used drilling mud (bentonite), a licenced waste contractor will dispose the cuttings.

Changes to soil structure may be caused by mechanical disturbance to the soil from these activities. Exposure of soil to rain and wind may in turn cause erosion and loss of top soil. It is anticipated that the subsoil, which will be stripped and removed from the pipeline site, will be utilised for levelling/ backfilling, and therefore there will be no net loss from the main pipeline site. This phase of the pipeline is generally the most intensive in terms of potential for topsoil loss. Poor topsoil management can lead to a loss of topsoil through either the air (as dust) or as sediment entrained within surface water flows. Soil erosion can also result from poor management of stockpiled soils, excavated areas and general construction areas.

Additionally, soil may be compacted along the pipeline alignment and access roads. Movement of heavy vehicles in the construction area will also result in soil compaction and damage to the soil structure. This compaction of the soil may potentially result in changed hydrological characteristics, such as reduced permeability and water infiltration to the soil, which could create additional surface run-off (and increase the flow velocity of this run-off), as well as reducing infiltration into subsurface aquifers.

Impact Assessment Table

Table 8.25: Impact Assessment Table for Loss of Soil due to Improper Management during Site Clearance and Excavation Activities (Construction Phase)

Significance of Impact			
Impact	Potential impacts on soil and due to loss of soil due to improper management during site clearance and excavation activities during construction phase.		
Impact Nature	**Negative**	Positive	Neutral
	Potential impacts to soil and groundwater would be considered to be adverse (negative).		
Impact Type	**Direct**	Indirect	Induced
	Impacts to soil and groundwater would be direct impacts through stormwater, excavation and movement of heavy equipment.		

Significance of Impact					
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction is expected to be completed in 18 months, which would be considered short-term.				
Impact Extent	**Local**	Regional	International		
	Impacts would be limited to the pipeline footprint; hence would be considered to be local.				
Impact Scale	The amount of soil that will be removed due to excavation activities for the pipeline and then backfilled is approximately 75,000 m^3. HDD include the excavation of the sending and receiving pits. Possible changes to soil structure may be caused by mechanical disturbance and/or stormwater. Movement of heavy vehicles in the construction area will also result in soil compaction and damage to the soil structure				
Frequency	Impacts to soil and groundwater from erosion of soil could occur intermittently but repeatedly throughout the day for the duration of the construction phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the characteristics above, the impact magnitude is likely to be small.				
Receptor Sensitivity	**Low**	Medium	High		
	Soil quality can be considered degraded and of low sensitivity/importance. The resource does not support diverse habitat or populations, and has limited use in local communities (i.e. for topsoil of rubber plantations). Overall, the sensitivity of soil and groundwater is considered low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Small Impact Magnitude will result in an overall Negligible impact.				

Mitigation / Management Measures

The significance of impacts is rated as Negligible; however, a number of additional mitigation measures are recommended in order to minimize the impact as follows:

- Delineation of clearance boundaries to limit the areas to be cleared;
- Scheduling clearance activities (if possible) to avoid extreme weather events such as heavy rainfall, extreme dry and high winds;
- Revegetation areas with temporary land use, conducting progressive rehabilitation;
- Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers;
- Reuse topsoil as much as possible within rehabilitation activities;
- Control erosion through diversion drains, sediment fences, and sediment retention basins; and
- Where topsoil is to be stored for later use in rehabilitation activities, the following basic principles are to be applied:
    - Stockpiles to be separated into topsoil and sub-soil and be located at least 50 m from any surface water source or groundwater well;
    - To the extent possible, stockpiles are to be located in areas surrounded by natural wind barriers to minimise the potential for wind erosion;

- Stockpile storage areas are to be prepared in advance of the removal of topsoil as much as possible; and
- Topsoil heights are to be restricted in height to 2 m above ground level to minimise wind erosion, and they are only to be partially compacted on the upper layer in order to promote aeration, maintain soil vertical structures, reduce runoff and encourage infiltration.

Residual Impact (Post-Mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts are also expected to be of **Negligible** significance.

Monitoring Plan

As detailed in the ESMP chapter (***Chapter 12***), monitoring for soil and groundwater during the construction phase should consist of the following:

- Conduct monthly site audit.

8.6 Waste Impact Assessment

8.6.1 Introduction

During the construction phase, there are numerous Project activities that have the potential to generate hazardous and non-hazardous waste streams. This section identifies the various types of waste that will be generated, potential impacts associated with their generation and disposal and appropriate mitigation, management and monitoring measures required to reduce residual impacts to an acceptable level.

Impact associated with waste (both during planned and unplanned event) may affect various receptors such as surface water, groundwater, soil and biodiversity. During the scoping activity, the following were identified as impacts related to waste and wastewater management:

- Water discharge from hydrotesting activities;
- Storm water runoff from precipitation on-site;
- Excavation and backfilling of soil during construction phase;
- Soil cuttings during HDD activity (soil cuttings are expected to be mixed together with used bentonite; therefore, soil cutting are to be classified under bentonite waste);
- Impacts from waste generated activities that affect water sources and soil that are utilised by other receptors such as local communities, flora, fauna and marine species;
- Unplanned events causing loss of containment to the waste storage facility on-site; and
- Unplanned events causing degrading of structural integrity leading to fractures or disruption in transferring of LNG processes.

However, many of these are specific to certain receptors and are therefore assessed in other sections. Waste related impacts that are assessed elsewhere includes:

- Waste impacts whereby the receptor is air quality will be assessed in ***Section 8.1***;
- Waste impacts whereby the receptor is related to GHG emission will be assessed in ***Section 8.2***;
- Waste impacts whereby the receptor is surface water will be assessed in ***Section 8.4***;
- Waste impacts whereby the receptors are soil and groundwater will be assessed in ***Section 8.5***;
- Waste impacts whereby the receptor is biodiversity value will be assessed in ***Chapter 10***;

- Waste impacts whereby the receptor is social and health values will be assessed in ***Section 8.8***; and
- Waste impacts that are caused by unplanned events will be assessed in ***Section 8.9***.

There are some additional impacts associated with waste and wastewater management that have not been assessed elsewhere, and the purpose of this section (***Section 8.6***) is to assess those, which include the following:

- Biomass generated during construction activities (site clearance and preparation);
- Hazardous waste during construction phase – such as diesel oil, hydraulic fluid, paint, battery, cement wash down and rinsing wastewater of contaminated equipment;
- Non-hazardous waste during construction phase – concrete, steel pipes, and bentonite;
- Domestic solid waste during construction phase – generated from workers on-site in the form of household waste and sewage; and
- Domestic liquid waste during construction phase – majority of this will be sanitary wastewater.

8.6.2 Assumptions and Limitations

Project information and description and hence the potential impacts associated with the generation and management of waste and wastewater during construction and operation phase were reviewed in ***Chapter 4***. Based upon this review, potential sources of impacts associated with solid waste and wastewater that may arise during the construction and operation phases of the Project have been identified and are presented in the following sections. All the identified sources of potential impacts are then evaluated and their impact significance is determined based on the methodology described in ***Chapter 6*** (Impact Assessment Methodology). The temporal and spatial extent of activities will mean that the actual volumes types of waste and wastewater generated will be dependent on the specific activities being undertaken at the time. Accordingly, to clearly identify impacts and development of management and mitigation measures specific to each activity, the potential impact are described on an activity basis.

8.6.3 Assessment Methodology

The methodology used for assessing impacts to waste is aligned with the general impact assessment methodology presented in ***Chapter 6***.

8.6.4 Baseline Summary

Chapter 5 provides the details of the baseline conditions for current waste sources, including the typical waste management practices of the local community, current waste volume generated from the local community, major operating landfills and its capacity around the Project Study Area.

Generation of waste within the Study Area is a mixture of domestic, agricultural and industrial waste. Solid waste disposal is the responsibility of each household. Waste disposal areas exist in Hteinpin, Dawai Chang, Shwepyithar, Mingalardon, Dala, and Seikyi Khanaungato. Burning, landfilling and disposal into the nearest stream are common practice in the Project Study Area.

8.6.5 Receptor Identification and Sensitivity

Majority of the Project is located in Dala Township with a small cross over in Seikyikhanaungato and Ahlone Townships. The Pipeline will also be installed below the river bed in order to overcome Yangon River by using HDD installation technique. Therefore majority of the receptors will be settlements and agricultural area within Study Area in Dala Township.

In terms of the current total landfill capacity of the six waste disposal sites proposed as potential waste management facilities for the Project (as discussed in ***Chapter 5.1.10***) is estimated to be approximately 2,064 tonnes per day (cumulatively).

8.6.6 Summary of Project Activities with Potential Impacts

8.6.6.1 Construction Phase

Construction of the Pipeline will be carried out by the EPC contractor appointed by TPMC, this will include site preparation for construction, erection/burying and installation of the Project facilities. It is anticipated that the construction of pipeline will take 18 months. Commercial Operating Date (COD) is expected at the end of 2021. The management of solid and liquid wastes during the design, construction and commissioning phases will be conducted in accordance with the Myanmar National Emission Quality (NEQ) Guidelines and WB/IFC EHS Guidelines. The maximum number of workers onsite during construction is anticipated to be 117 persons. EPC contractor is planning to use open-cut construction method which consists of excavating soil from the planned pipeline alignment. Additionally, Horizontal Directional Drilling (HDD) is the supplementary method for pipeline installation where this method is expected to negate the need for cut and fill of soil. HDD will be performed in areas where excavation method is not practical, such as river crossings.

The Project Proponent will implement appropriate management and mitigation measures to reduce the significance of any impacts associated with waste or wastewater management, as will be discussed in the respective mitigation measures section for each impact type. The mitigation measures will also be summarised in the ESMP chapter (***Chapter 12***).

The following potential impacts associated with waste and wastewater management may occur form Project activities during the construction phase of the Pipeline:

- Potential impacts from improper management (storage and disposal) of biomass waste;
- Potential impacts from generation and management of hazardous waste (including diesel oil, hydraulic fluids, paint, battery, contaminated cement, wash down and rinsing effluent);
- Potential impacts from generation and management of non-hazardous waste (including uncontaminated concrete, steel pipes and plates, structural steel and wooden creates);
- Potential impacts from generation and management of domestic solid waste; and
- Potential impacts from generation and management of domestic liquid waste (including sanitary wastewater, greywater and kitchen water).

The details and potential receptors for the above impacts will be discussed further in the relevant sections below.

8.6.6.2 Operation Phase

The operation phase is expected to continue for approximately 25 years. The assessment of operational phase impacts includes those arising from routine operations and maintenance of the Pipeline. During this phase, the operation staff and maintenance will be shared with the LNG Terminal and Power Plant workers. These activities are not expected to have any significant impacts towards the existing waste management facility and waste generation.

The Project Proponent will implement appropriate management and mitigation measures to reduce the significance of any impacts associated with waste or wastewater management, as will be discussed in the respective mitigation measures section for each impact type. The mitigation measures will also be summarised in the ESMP chapter (***Chapter 12***).

However, during operation phase it is anticipated that no significant impacts will be generated with respect to waste.

8.6.7 Assessment of Impact

8.6.7.1 Impacts from Improper Management of Biomass Waste during Construction Phase

Overview

The general site coverage consist of sparsely vegetated areas, with small trees, shrubs and groundcover scattered throughout the proposed site. Therefore prior the construction of the Pipeline, it land preparation will be required, which will include vegetation clearance. The removed vegetation (which is categorised as biomass waste) will need to be disposed responsibly. Presently, it is anticipated that up to 2,500 m^3 of biomass waste will be generated during this phase for the pipeline's construction.

Current common practice in the Study Area, where there is limited municipal waste options and facilities, is to gather the biomass waste into piles and dispose of it by burning. However, the EPC is expected to sell, where possible, biomass waste to locals for firewood. Remaining biomass waste will be buried. Potential impacts from improper management (storage and disposal) of biomass waste include:

- Decomposing of biomass waste will releasing unpleasant odor and gases into the atmosphere whereby this can cause nuisance to locals while attracting certain wildlife or pests into the Study Area, however, this assessment will be discussed in ***Chapter 10*** and ***Chapter 8.8*** (Biodiversity Impact Assessment and Social Impact Assessment); and
- As the EPC contractor is expected to bury the unsold portion of the Project construction biomass waste this can potentially impact the quality of surface water and soil and consequently groundwater. As a result, biodiversity receptors and human that uses these impacted receptors will also be influenced.

Impact Assessment Table

The significance of potential impacts due to improper management of biomass waste during the construction phase of pipeline is assessed in ***Table 8.26*** and mitigation measures are presented thereafter.

Table 8.26: Significance of Impacts Due to Improper Management of Biomass Waste during Construction Phase of Pipeline

Significance of Impact				
Impact	Potential impacts due to improper management of removed biomass (biomass waste). Some of the impacts may be related to unpleasant spread of odour to the local community as the biomass waste is decomposing. In addition, environmentally harmful gases may be released into the atmosphere and threaten the condition of the air quality and the Study Area vicinity can potentially be released from the biomass waste. Moreover there are potential impacts related to contamination of soil quality, surface water and groundwater from direct burying of biomass waste.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts from improper waste management is considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Impacts would be direct.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	Construction will take approximately 18 months for the Pipeline. Duration is considered as			

Significance of Impact	
	short-term.

Significance of Impact					
Impact Extent	**Local**	Regional	International		
	The extent of potential impacts would likely be limited to the location where biomass is stored and buried, and therefore is local.				
Impact Scale	■ The anticipated volume of biomass to be removed and requiring management is approximately 2,500 m^3. ■ The impact would be limited to the footprint of where the biomass is stored and buried and therefore the scale is locally restricted.				
Impact Frequency	It is likely that this impact will occur intermittently during the site clearance and preparation stage.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered to be small.				
Receptor Sensitivity	Low	**Medium**	High		
	There are no sensitive receptors nearby. Most of the Study Area consist of open space, jetty and agricultural area. However, impact to soil quality (from burying of biomass waste) can potentially result in a positive manner (if biomass waste is uncontaminated and buried appropriately) and enhance agricultural activity. The receptor sensitivity is rated as medium.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a medium receptor sensitivity and small impact magnitude will result in an overall minor significance level of impact.				

Mitigation Measures

The following measures will be put in place for the Project during the construction phase to mitigate impacts to physical receptors (soil, groundwater and surface water):

- Any biomass not taken by the local community is to be appropriately stored (or immediately mulched) for later use within site stabilisation and rehabilitation activities;
- Site clearance and preparation is to be designed and conducted in a manner that requires minimum removal of vegetation;
- Introduce and implement, where practicable, a recycling plan for biomass waste to reduce the amount of biomass required to be burnt. This may include identifying potential market or appropriate industry to reintroduce the biomass as part of their resource consumption;
- Ensure no hazardous materials or chemicals are present within the biomass waste (for example due to an accidental spill) prior to burying; and
- Location of burying are to be far away from sensitive receptors and in a location where impact of burying can be appropriately controlled.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **Negligible** Impacts.

Monitoring Plan

As specified in the ESMP, monitoring of waste during both the construction and operation phases should consist of the following:

- Monitoring of waste segregation, transportation and disposal practices in the Project activity areas and disposal location, as to be defined in a Waste Management Plan to be prepared specifically for the Project; and
- Monitoring of appointed waste contractors using chain-of custody documentation, as to be defined in a Waste Management Plan to be prepared specifically for the Project.

8.6.7.2 Impacts of Generation and Management of Hazardous Materials and Waste during Construction Phase

Overview

During the construction phase, a range of hazardous waste (both solid and liquid form) will be generated due to the use of hazardous chemicals and construction materials that are contaminated by hazardous chemicals. A licensed waste contractor will be hired to dispose of waste appropriately. The total approximate quantities of hazardous waste during construction phase is shown in ***Table 8.27***. These waste will be stored on-site and transported off-site to a licensed waste disposal contractor, either DOWA, or YCDC.

Table 8.27: Hazardous Waste Quantities

Hazardous Material	Amount
Diesel oil	2 L per day
Hydraulic fluids	2 L per day
Paint	0.2 L per day
Battery	0.05 kg per day

Source: TPMC, 2019.

Based on data gathered and presented within the environmental and social baseline chapters, the local waste management network and facilities within the area is limited. Therefore, any additional waste streams generated by the Project are likely to place additional stress on this already struggling waste management network. Additionally, waste produced by the construction activity may be types that are new to the waste management network and could potentially raise concerns on the appropriateness of management method. Therefore, this may require the existing technology of the facility to be upgraded before they are able to handle the new waste.

Additionally, the following impacts may occur to the existing waste management network from the Project construction activities:

- Project construction activities will generate waste which the EPC contractor plans to use a licensed waste contractor to appropriately dispose of the hazardous waste. This will therefore increase the pressure on these existing facilities due to increased quantity of incoming waste, and thereby reducing the local waste handling capacity; and
- Additional industrial waste (such as hydraulic fluid) will be introduced by the Project to the waste management network whereby the network may not be able to adapt their management strategy and methods to handle the new type of waste. And therefore impact the waste management handling capacity.

Impact Assessment Table

The significance of potential impacts to the capacity of the existing waste management network to deal with hazardous waste streams from the Project construction phase of Pipeline are assessed in ***Table 8.28***, and mitigation measures are presented thereafter.

Table 8.28: Significance of Impacts from Generation and Management of Hazardous Waste during Construction Phase of Pipeline

Significance of Impact					
Impact	Impacts of generation and management of hazardous waste by increasing the stress put on the facilities and reducing the capacity and capability of the existing waste management network.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts is considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to the existing waste management network would be direct				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction of the Pipeline is expected to take 18 months. Duration would therefore be considered as short-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would likely be restricted to the local area.				
Impact Scale	The scale of potential impacts due to release of waste is potentially medium due to the quantities present during this stage, particularly when considered in light of the limited waste management network in the area.				
Impact Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the construction phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered to be medium.				
Receptor Sensitivity	Low	Medium	**High**		
	The existing waste network and facility within the Yangon City Development Committee (YCDC) is estimated to have a landfill capacity of 2,064 tonnes per day cumulative over six sites. This amount is considered to be relatively small comparative to the amount of waste generated by Yangon Region. Additionally there are limited number of licensed waste contractors within the region henceforth the receptor sensitivity is rated as high.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a high resource sensitivity and small impact magnitude will result in an overall moderate impact.				

Mitigation Measures

The following measures will be put in place for the Project during construction phase to mitigate impacts to the existing waste management facilities:

- Prior to construction commencing, TPMC is to engage with local authorities and other stakeholders to determine the capacity of the local waste management network to absorb the new waste streams generated from the Project during construction;
- A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project construction. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified;

- Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable;
- Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the construction site;
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed. Bi-yearly unplanned audit will be performed by TPMC HSE team on all waste contractors in order to verify compliance with contract;
- Monitoring of appointed waste contractors using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations;
- The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during construction activity is being managed responsibly; and
- All hazardous materials required during the construction phase will be appropriately transported, stored and handled according to MSDS.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **Minor** Impacts.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during the construction phase should consist of the following:

- Monitoring of waste segregation, transportation and disposal practices in the project activity areas and disposal location, as to be defined in a Waste Management Plan to be prepared specifically for the Project; and
- Monitoring of appointed waste contractors using chain-of custody documentation, as to be defined in a Waste Management Plan to be prepared specifically for the Project.

8.6.7.3 Impacts from Generation and Management of Non-Hazardous Waste during Construction Phase

Overview

During construction phase, non-hazardous waste is likely to be produced from uncontaminated concrete, steel pipes, and bentonite. Opportunities will be explored for selling steels and wooden crates to locals. Remaining waste will be gathered and handover to a licensed waste contractor to be disposed responsibly. ***Table 4.34*** presents details of the total non-hazardous construction waste during construction phase.

Table 8.29: Construction Waste during Pipeline Construction

Waste Type	Amount
Concrete	75,000 kg
Steel Pipes	17,000 kg
Bentonite	1,000 m^3 total

Source: TPMC, 2019.

Impact Assessment Table

The significance of potential impacts to the capacity of the existing waste management network to deal with hazardous waste from the Project construction activities is assessed in ***Table 8.30***, and mitigation measures are presented thereafter.

Table 8.30: Significance of Impacts Due to Generation and Management of Non-Hazardous Waste during Construction Phase of Pipeline

Significance of Impact					
Impact	Potential impacts due to generation and management of non-hazardous waste by increasing the stress put on the facilities and reducing the capacity and capability of the existing waste management network.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts is considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts would be direct.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction will take approximately 18 months for the Pipeline. Duration is considered as short-term.				
Impact Extent	**Local**	Regional	International		
	The extent of potential impacts would likely be limited to the Project footprint and is therefore considered as local extent.				
Impact Scale	The scale of potential impacts due to release of waste is potentially large due to the quantities present during this stage, particularly when considered in light of the limited waste management network in the area (YCDC estimate to have a landfill capacity of 2,064 tonnes per day).				
Impact Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the construction phase which is anticipated to be 18 months.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered to be small.				
Receptor Sensitivity	Low	Medium	**High**		
	The existing waste network and facility within the Yangon City Development Committee (YCDC) is estimated to have a landfill capacity of 2,064 tonnes per day cumulative over six sites. This amount is considered to be relatively small comparative to the amount of waste generated by Yangon Region henceforth the receptor sensitivity is rated as high.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a high resource sensitivity and small impact magnitude will result in an overall moderate significance level of impact.				

Mitigation Measures

The following measures will be put in place for the Project during construction phase of the Pipeline to reduce the impact to existing waste management facilities:

- A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project construction. The WMP will include specific requirements to

manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified;

- Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable;
- Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations;
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed;
- Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and
- The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during construction activity is being managed responsibly.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **Negligible** to **Minor** Impacts.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during the construction phase should consist of the following:

- Monitoring of waste segregation, transportation and disposal practices in the project activity areas and disposal location, as to be defined in a Waste Management Plan to be prepared specifically for the Project; and
- Monitoring of appointed waste contractors using chain-of custody documentation, as to be defined in a Waste Management Plan to be prepared specifically for the Project.

8.6.7.4 Impacts from Generation and Management of Domestic Solid Waste during Construction Phase

Overview

During the construction phase of the Pipeline, domestic solid waste is anticipated to be generated from workers on-site. The peak number of workers expected to be on-site during construction phase is 117 while during operation phase. The expected amount of domestic solid waste from this source is presented in ***Table 8.31***.

Table 8.31: Anticipated Amount of Domestic Solid Waste during Construction Phase of Pipeline

Phase	Anticipated Quantity	Number of Workers	Total Solid Waste
Construction	1.65 kg per employee per week	117	193.05 kg per week

Source: TPMC/ERM, 2019.

Currently, the EPC (during construction phase) and TPMC (during operation phase) is planned to rely on the existing landfill managed YCDC to dispose of the domestic solid waste.

Impact Assessment Table

The significance of potential impacts from generation and management of domestic solid waste during construction phase of the Pipeline is assessed in ***Table 8.32***, and mitigation measures are presented thereafter.

Table 8.32: Significance of Impacts Due to Generation and Management of Domestic Solid Waste during Construction Phase of Pipeline

Significance of Impact					
Impact	Potential impacts due to generation and management of domestic solid waste by increasing the stress put on the existing waste management facilities and reducing the capacity of the existing waste management network.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts is considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts would be direct.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction will take approximately 18 months for the Pipeline. Duration is considered as short-term.				
Impact Extent	**Local**	Regional	International		
	The extent of potential impacts would likely be limited to the Project footprint and is therefore considered as local extent.				
Impact Scale	The scale of potential impacts due to release of waste is potentially small due to the quantities present during this stage, particularly when considered in light of the limited waste management network in the area (YCDC estimate to have a landfill capacity of 2,064 tonnes per day).				
Impact Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the construction phase which is anticipated to be 18 months.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered to be small.				
Receptor Sensitivity	Low	Medium	**High**		
	The existing waste network and facility within the Yangon City Development Committee (YCDC) is estimated to have a landfill capacity of 2,064 tonnes per day cumulative over six sites. This amount is considered to be relatively small comparative to the amount of waste generated by Yangon Region henceforth the receptor sensitivity is rated as high.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a high resource sensitivity and small impact magnitude will result in an overall moderate significance level of impact.				

Mitigation Measures

The following measures will be put in place for the Project during construction phase of the Pipeline to reduce the impact to existing waste management facilities:

- A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project construction. The WMP will include specific requirements to

manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified;

- Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable;
- Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations;
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed;
- Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations;
- The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during construction activity is being managed responsibly; and
- All hazardous materials required during the construction phase will be appropriately transported, stored and handled according to MSDS.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **Negligible** to **Minor** Impacts.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during the construction phase should consist of the following:

- Conduct regular inspection of relevant domestic solid waste streams and sources of the domestic solid waste to ensure mitigation measures in place are being enforced and maintained throughout the phase.

8.6.7.5 Impacts from Generation and Management of Domestic Liquid Waste during Construction Phase

Overview

During construction phase of the Pipeline, domestic liquid waste is anticipated to be generated from workers working on-site. Domestic liquid waste includes greywater, kitchen wastewater, and sanitary wastewater. The peak number of workers expected to be on-site during construction phase is 117 people while during operation phase, the maintenance and supporting/operating staff will be shared with the Power Plant and LNG Receiving Terminal facilities (therefore no waste impact assessment during operation phase will be conducted). The expected amount of domestic liquid waste from this source is presented in ***Table 8.33***.

Table 8.33: Anticipated Amount of Domestic Liquid Waste during Construction Phase of Pipeline

Phase	Anticipated Volume	Number of Workers	Total Liquid Waste
Construction	33.3 litres per employee per day[129]	117	3,896 litres per day

Source: TPMC/ERM, 2019.

Currently, during the construction phase the EPC plans to collect sanitary wastewater and sewage through underground pipes into a holding tank, from where the sewage will be routed to an on-site sewage treatment plant or alternatively transported periodically by vacuum trucks (as frequently as needed) to a septic tank or discharging to a designated local water body.

Impact Assessment Table

The significance of potential impacts from generation and management of domestic liquid waste during construction phase of the Pipeline is assessed in ***Table 8.34***, and mitigation measures are presented thereafter.

Table 8.34: Significance of Impacts Due to Generation and Management of Domestic Liquid Waste during Construction Phase of Pipeline

Significance of Impact					
Impact	Potential impacts due to generation and management of domestic liquid waste by increasing the stress put on the existing waste management facilities and reducing the capacity of the existing waste management network.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts is considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts would be direct.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction will take approximately 18 months for the Pipeline. Duration is considered as short-term.				
Impact Extent	**Local**	Regional	International		
	The extent of potential impacts may travel outside of the Project footprint but will still remain within local extent.				
Impact Scale	During construction phase, the domestic liquid waste is anticipated to be 3,896 litres per day. The scale of potential impacts due to release of waste is potentially small due to the quantities present during this stage, particularly when considered in light of the limited waste management network in the area (YCDC estimate to have a landfill capacity of 2,064 tonnes per day).				
Impact Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the construction phase which is anticipated to be 18 months.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered to be medium.				
Receptor	**Low**	Medium	High		

[129] Metcalf& Eddy Inc. Wastewater Engineering: Treatment, Disposal, Reuse. 3rd Edition McGraw Hill, Network, 1979

Significance of Impact				
Sensitivity	Additional treated sanitary wastewater stream to the existing wastewater management network and/or the water bodies that will receive the Project's effluent discharge can impact the condition of receptors (human, terrestrial and aquatic ecology) that are situated around the release of effluent if the transportation and discharging is conducted inappropriately. However, the current (pre-project) surface water condition of the designated discharge point is considered to be unhealthy. Therefore the sensitivity of the receptor in determined to be Low.			
Impact Significance	Negligible	**Minor**	Moderate	Major
	The combination of a low resource sensitivity and medium impact magnitude will result in an overall minor significance level of impact.			

Mitigation Measures

The following measures will be put in place for the Project during construction phase of the Pipeline to reduce the impact on physical receptors (soil, groundwater and surface water) and consequently human and biodiversity that uses these receptors:

- All waste collection and storage measures as detailed within ***Chapter 8.4*** and ***Chapter 8.5*** (Surface Water, Soil and Groundwater) will be implemented;
- Ensure the integrity of wastewater storage unit to avoid leaking of wastewater and odour to the surrounding receptors; and
- Enforce rules that prevent inappropriate materials going into the sanitary wastewater stream.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **Negligible** Impacts.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during the construction phase should consist of the following:

- Conduct regular maintenance on sanitary wastewater treatment system to ensure that the system is functioning efficiently and effluent is achieving targeted quality; and
- Conduct regular testing of effluent water parameters to ensure effluent is within the relevant effluent standards prior releasing it at the discharge location.

8.7 Landscape and Visual Impact Assessment

8.7.1 Introduction

The development of the Project will be introducing a number of new elements into the existing visual environment. This section presents a purely qualitative assessment of impacts to visual amenity (assessed as one of the interrelated effects on population and how various groups experience and perceive changes in the values attributed to the landscape). During the construction and operation there will be a range of activities which have the potential to change how various people will perceive/see the landscape. The key visually sensitive receptors within the vicinity of the proposed Project have been identified in the Baseline **Chapter 5** and this section undertakes an assessment of predicted impacts to these during construction and operation.

8.7.2 Assumption and Limitations

The assessment of potential impacts related to Visual Environment in this section is based on the environmental baseline data (presented within **Chapter 5**) and the information available from the Project Proponent at the time of writing. Judgements and assessments have been made based on professional knowledge and previous experience of ERM.

This assessment has been undertaken primarily as a desktop study drawing upon limited site analysis. No quantitative modelling, viewshed analysis, stakeholder engagement or photomontage development has been undertaken with regards to any elements of the visual impact assessment. It is based purely on information readily available as secondary sources (primarily online mapping databases) and information gathered during site visits for the purposes of gaining other qualitative environmental data. No direct onground identification of the visual baseline is therefore available. Additionally, no stakeholder engagement was undertaken to determine the various values that particular visual sensitive receptors place on various elements of the landscape.

8.7.3 Assessment Methodology

The methodology used for assessing impacts to surface water is aligned with the general impact assessment methodology presented in ***Chapter 6***.

8.7.4 Baseline Summary

The topography along the Natural Gas Pipeline alignment suggests no elevation. The area along the pipeline alignment will mainly consist of agricultural land and other small villages; however, the northern section of the pipeline will be located near the dense residential area of Dala, Seikgyikanaungto, and Ahlone Townships.

8.7.5 Resources and Receptors

There are multiple receptors located along various sections of the pipeline. The section of pipeline with the most receptors is located along the pipeline in the northern section of Dala Township. Given the nature of the proposed facilities, a 500 m Study Area along each side of the pipeline has been taken for the Baseline and impact assessment.

8.7.6 Summary of Project Activities with Potential Impacts

8.7.6.1 Construction Phase

Earthworks will include clearing of vegetation and grading of the Project site. It is expected that the subsoil, which will be stripped and removed from the Project site, shall be utilised for levelling/ backfilling. The pipeline is planned to be constructed in sections; therefore, construction of each section is expected to be completed before the total completion time of 18 months. Excavated soil piles are not expected to exceed 2 m in height. Considering the characteristics of the construction activities, the pipeline construction phase will not be assessed.

8.7.6.2 Operation Phase

Once the pipeline is complete, most of the pipeline will be buried underground; the only section of pipeline that will be above ground will be located at canal crossings, in parallel with road bridges. Considering the characteristics of the construction activities, the pipeline construction phase will not be assessed.

8.8 Social Impact Assessment

8.8.1 Introduction

Settlements located closest to the Project infrastructure are likely to experience negative and positive impacts as a result of the Project activities, including economic opportunities, social and environmental changes, lifestyle changes, and changes to community health and safety. Other social receptors located further from the Project may also benefit or experience negative impacts from the Project.

The predicted impacts to the social environment as a result of the proposed Natural Gas Pipeline are described in this Chapter. The presence of economical, industrial, touristic and religious activities within the Study Area have all been considered as part of the assessment of impacts.

This Chapter also develops management, mitigation and monitoring measures needed to ensure that any identified impacts can be avoided, reduced, mitigated to as low as reasonably practical or compensated for. Such measures are presented and will form part of the overall Environmental and Social Management Plan (ESMP, ***Chapter 12***) for the Project.

8.8.2 Assumption and Limitations

The assessment of potential impacts related to the social environment in this section is based on the physical, biological, environmental and social baseline data (presented within ***Chapter 5*** of this report) and the information available from the Project Proponent at the time of writing the report. Judgements and assessments have been made based on professional experience of similar projects in similar settings and previous general experience of ERM.

Limited secondary data focused on the Project area was available and the baseline draws from a range of secondary data at the national, regional and township level and primary data collected at local level during social baseline activities in November 2018. Secondary data information has been gathered from various sources including ministries, regional authorities, the Myanmar Information Management Unit, other relevant studies or previous studies conducted for the Project or in the area.

The primary data used in this section of the report was collected during the baseline survey through Focus Group Discussions (FGDs), Key Informant Interviews (KIIs) and detailed household survey in randomly selected households in the Project area (***Table 8.35***). Ad-hoc and informal discussion were also conducted with community members, fishermen, hotel owners as well as other project developer in the area.

Table 8.35: Numbers of Interviewees

Groups of interviewees	Total number of interviewees	Number of interviewees(per township)		
		Dala	Ahone	Seikgyikanaungto
Households	150	80	40	30
Village leaders	3	1	1	1
Women	3	1	1	1
Health specialists	3	1	1	1
Fisherman	1	1	-	-
Farmers	1	1	-	-

Source: ERM 2018.

8.8.3 Assessment Methodology

The Social Area of Influence (SAoI) is defined as the area inhabited or used by stakeholders and likely to be positively or negatively affected by the Project. This includes short, long term or permanent changes, as well as direct, induced or indirect impacts. The SAoI includes:

- The Project site(s) and related facilities that TPMC develops or controls and the additional areas in which aspects of the environment could conceivably experience significant impacts.
- Associated facilities that are not developed and funded as part of the proposed Project, but are essential for the Project and without which the Project cannot proceed, and the associated areas in which the environment could conceivably experience significant impacts.
- Areas potentially affected by cumulative impacts resulting from other developments known at the time of the ESIA, further planned phases of the Project or any other existing circumstances.
- Areas potentially affected by impacts from predictable (but unplanned) developments as a result of the proposed Project (i.e., induced activities), occurring at a later stage or at a different location.

Box 8.1 provides a definition of the concept of area of interest from good practice guidance.

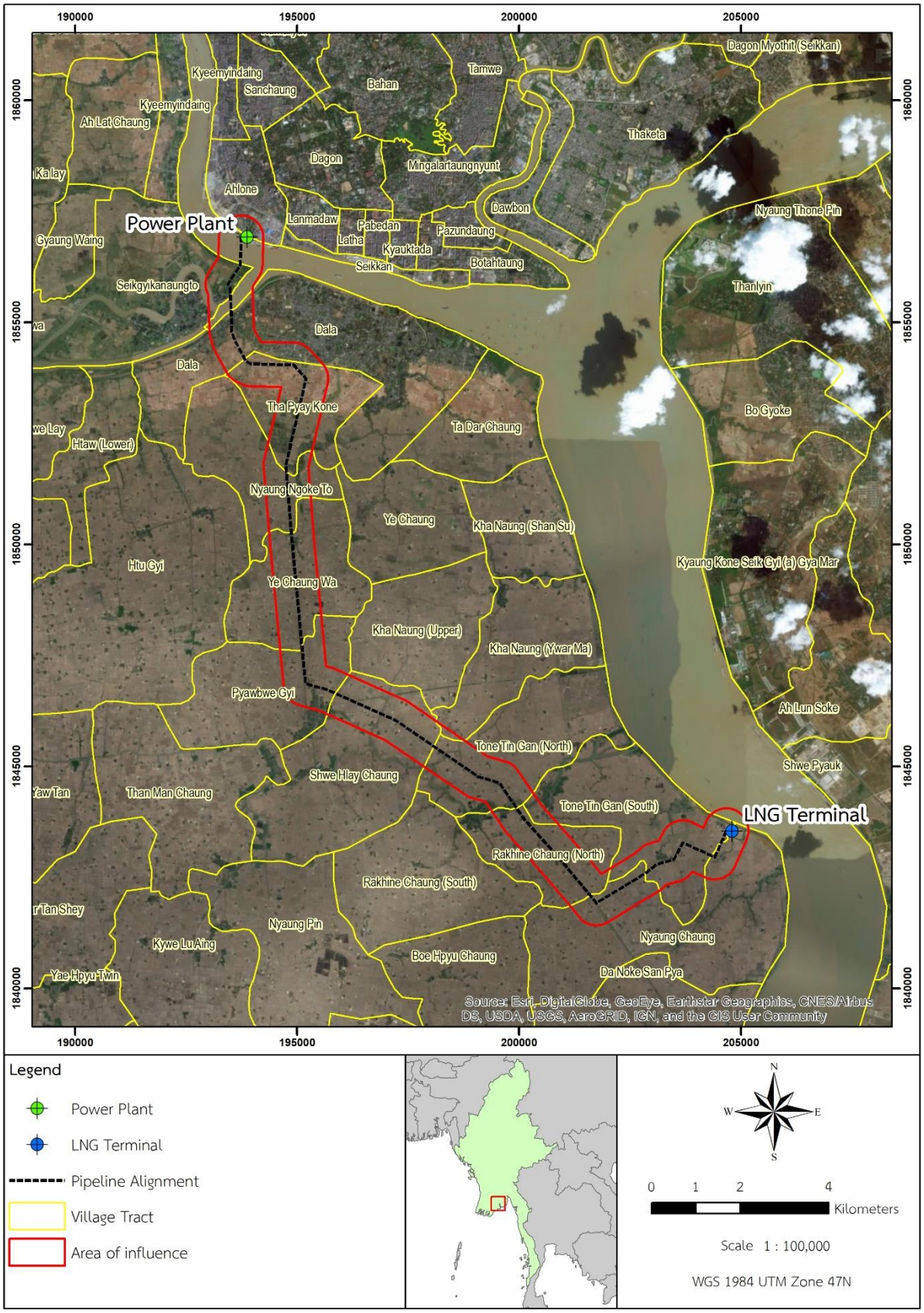
Box 8.1: IFC Definition of Area of Influence

The project's area of influence includes 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 the project; areas potentially impacted by cumulative impacts from further planned development of the 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 the project or independently of the project.

Source: IFC PS1, 2006.

For the Natural Gas Pipeline, based on this definition, experience with similar project, the social baseline in the area, and the human use identified, the area to be considered for social impact has been established at 500 metres each sides of the Natural Gas Pipeline alignment. This area allow to include all socioeconomic activities that may be potentially impacted by the Natural Gas Pipeline activities during construction, operation and decommissioning phases. The SAoI of the Natural Gas Pipeline is shown in ***Figure 8.1***. The assessment for social impact has focused on the stakeholders in Dala Township where most of the pipeline alignment is located, but data for the other potentially impacted Townships such as Seikgyikanaungto and Ahlone are also included in this section.

Figure 8.1: Pipeline Social Area of Influence



Source: ERM, 2019.

8.8.4 Impact on Employment

8.8.4.1 Baseline Summary

Unemployment rate is low in the Yangon region with 4.1% of people in age of working without activity. In Dala Township, the percentage of unemployment provided by secondary data research is 7.8%, but primary data collected during November 2018, show that 19.7% of Dala interviewees declare themselves without activities and 15.7% stated that they are daily laborers. Few of Dala interviewees also have experienced in working as manual labours, mechanic, general construction, security, and wielding. Around 24% of Dala interviewees own a business in retail or trading sectors.

In Seikgyikanaungto Township, the percentage of unemployment provided by secondary data research is 4.6%, but primary data collected during November 2018, show that 13.9% of Seikgyikanaungto interviewees declare themselves unemployed and 16.8% stated that they are daily laborers. Small number of Seikgyikanaungto interviewees also have experienced in working as manual labours, mechanic, cleaning, welding, general construction, and vehicle/ machinery maintenance. Around 21% of Seikgyikanaungto interviewees own a business in retail or trading sectors.

In Ahlone Township, the percentage of unemployment provided by secondary data research is at 4.8%, but primary data collected during November 2018, show that 18.1% of Ahlone interviewees declare themselves unemployed and 7.7% stated that they are daily laborers. Few number of Ahlone interviewees also have experienced in working as manual labours, driver, cleaning, and vehicle/ machinery maintenance. Around 23% of Ahlone interviewees own their own business in retail or trading sectors.

8.8.4.2 Receptor Identification and Sensitivity

Receptors are mainly the local population without long term employment, either without any specific qualification for unskilled job opportunities or with professional certificate for semi-skilled opportunities. The potential for these receptor to secure a job during 18 months and gain new skills or experience is important and can have sensible positive impacts on their livelihood, both during the Project construction and thereafter.

In terms of indirect employment, the realization of opportunities will depend not only on the Project, but also on the initiative and business acumen of local entrepreneurs. Providers of services for the employee (restaurant, shop) should benefit from the Project.

8.8.4.3 Impact during Construction

Overview

The construction phase for the Natural Gas Pipeline installation is expected to take 18 months. The Project will generate a range of employment opportunities and require an average of 81 workers per day with a peak at 117. Amongst these, more than half would be local Myanmar workers with up to 32 unskilled and 35 semi-skilled or skilled workers.

In addition, the Project will require goods and services throughout construction. There are opportunities for local businesses to provide these goods and services (e.g. construction equipment, food for the workers). As a result, existing local businesses may expand or new businesses may be established locally to meet these demands – providing employment opportunities and increase in livelihood. This is referred to as indirect employment.

The resulting impact (e.g. increase in employment opportunities, and income for all local people employed by the Project) were assessed as a **Positive** one.

Impact Assessment Table

Significance of Impact			
Impact	Potential impacts on Employment and Economic		
Impact Nature	Negative	**Positive**	Neutral
	Potential impacts to employment will be positive		
Impact Type	**Direct**	**Indirect**	Induced
	Potential impacts would likely be direct and indirect impacts.		

Mitigation Measures

In order to maximise the benefits from this impact for the local population, wherever possible, the workforce will be sourced from areas close to the Project after a training and selection process; and thereafter at a regional or national level. Given that levels of educational achievement and formal employment experience in relevant sectors is low within the SAoI, it is assumed that the majority of the available local labour may be unskilled or at most semi-skilled. The Project will develop a Sourcing, Procurement and Recruitment Management Plan which will be developed for this Project with the aim to promote benefits to locals from recruitment and procurement activities for the Project (including information, training and engagement).

Monitoring Plan

Monitoring of the local content should be done at the beginning of the construction phase to ensure maximum opportunities are given to local population.

8.8.4.4 Impact during Operation

Overview

There is no Project operation activity that will have impact on local employment as the number of personnel involved at that stage is limited and will be considered as part of the Power Plant workforce.

8.8.5 Impacts to Fishing and Navigation Activities

8.8.5.1 Baseline Summary

Small scale artisanal fishing only takes place in the Yangon River. They catch fishes (i.e. hilsa, Indian salmon and croaker) daily or every few days by using drift netting or seine net. The months with maximum fish catch are August, September, October and November. Average fish catch per season is around 1,068 kg, and average annual income from fishing activities is around 150,000 Kyats. Fishermen can only be found in Dala Township with a total numbers of 518 people.

Within Dala Township, there is Dala pier (Dala Ferry Terminal), in which ferries from Pansodan Pier of Yangon will dock along with approximately 30,000 passenger embarking daily. Some of Dala citizens transport to other places by using boat/ canoe.

Finally, ferry boats and fishermen are also active on the river during the day.

8.8.5.2 Receptor Sensitivities

Fishing activity is not the primary source of Dala citizens's livelihood. Given the difficulty to use car compared with the relatively cheap cost and ease of use of boat transport, local community mostly depends on boat transport to reach Yangon City. Similarly, commercial vessels traveling on the Yangon River use the middle of the river as a navigation channel.

8.8.5.3 Impact during Construction

Overview

Construction activities will take place onshore. HDD in particular will be conducted near to the Yangon River, but as it will occur on ground area without restriction on river area, therefore generates no impact on fishing and navigation activities.

The required construction materials will be transported to the construction site by vehicles from the LNG Receiving Terminal lay-down area.

Difficulty for fishing activities and navigation on river way will therefor only result from the transport of equipment and construction material to the LNG Terminal Receiving facility by barge from the nearby port.

The impact of the Project pre-mitigation on fishing and navigation activities during construction phase is considered a **Negligible** Impact.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts on Fishing and Navigation Activities				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts on Fishing and Navigation Activities would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Potential impacts on Fishing and Navigation Activities will last only during construction phase.				
Impact Extent	**Local**	Regional	International		
	This impact will be only experienced by fishermen, service providers of local transportation and commercial vessel using the Yangon River.				
Impact Scale	The scale of potential impact is small because the transportation of required material will be only moored until the completion of transferring material to construction site. And, the transportation will interrupt fishing area at small scale.				
Frequency	The impact will be experienced only during transfer from local port to LNG Receiving Terminal area, which will occur with a low frequency during construction phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be small as the impact will be experienced at a low frequency and only in a limited area.				
Receptor Sensitivity	**Low**	Medium	High		
	The receptor sensitivity is low as fishing activity is not primary source of livelihood, and alternative river areas are available for transportation and fishing activity.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The significance is likely to be negligible.				

Mitigation Measures

Although the impact is expected to be Negligible, TPMC will need to develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include

measures to notify local stakeholders in advance of any particularly activities on river ways/ areas. This will ensure that stakeholders can anticipate and can appropriately respond to the changes and limitations of uses on river ways/ areas. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose fishing activities are affected by the Project activities.

Monitoring Plan

TPMC will need to monitor the grievance log weekly during the construction to identify any specific grievance related to fishing activities.

8.8.5.4 Impact during Operation

Overview

There is no activity during operation phase that will generate impact on fishing and navigation activities.

8.8.6 Impacts from Economical and Physical Displacement

8.8.6.1 Baseline Summary

Approximately 85% of the total area of Dala is used for agriculture and 20% of the people interviewed said they engage in farming or that they receive cash from farming activities. The average size of land owned by farmers interviewed is 16.25 acres. About 38% of the people interviewed said they engage in business activities or that they receive cash from such activities.

In Seikgyikanaungto, around 47% of total area is agriculture fields, with a small number of households engage in cultivation of monsoon paddy outside the village. In addition, 71% of the people interviewed said they engage in business activities or that they receive cash from such activities.

Nonetheless, the area in Seikgyikanaungto Township that will be impacted by the Natural Gas Pipeline construction is currently not used for any specific human activities.

8.8.6.2 Receptor Identification and Sensitivities

In Dala, 50% of those farming said it was their only livelihood activity and the others said that it represented roughly 50% of their total incomes. Agriculture is therefore an important part of local population livelihood, even though it ranks 4th in term of income generating activity. Population may therefore have a medium to high sensitivity to loss of agricultural land, depending on the duration and size of land lost by each household. Moreover, no replacement land is available in the close area due to the high concentration of population.

In Dala, business is the 3rd largest income generating activity amongst interviewees. 46.4% of those people said business was their only livelihood activity. 41.5% of private businesses are shop/ market, and 5% are restaurant/ tea house.

In Seikgyikanaungto, business is the 1st largest income generating activity amongst interviewees. 60% of those people said business was their only livelihood activity. 57.1% of private businesses are shop/ market.

8.8.6.3 Impact during Construction

Overview

The construction phase for the Natural Gas Pipeline installation is expected to take 18 months.

The pipeline alignment in Dala Township will cross agriculture areas (rice paddies) over approximately 1.8 km between the LNG Receiving Terminal and the road. It will then be set along the main road to Dala ferry terminal and along a secondary road in the dense area of Dala Township.

An open cut construction method for the pipeline will involve primarily earthworks, which consists of excavating soil from the planned pipeline alignment, storing it next to the project site and then refilling it when the pipeline is installed.

In addition to the trench for the pipeline, the construction will require a RoW of 20 m (only on one side of the pipeline alignment, away from the road), where no other activities will be possible during the construction phase. The RoW during construction will be required during 1 month for each sections of ~1.4 km of pipeline.

The RoW will be reduced in the populated area of Dala to reduce the risks of physical displacement but it is likely that some construction and houses will have to be resettled. This will be permanently impacted.

The impact of the Project pre-mitigation on economical and physical displacement during construction phase is considered a **Major** Impact.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts on Economical Displacement				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts on Economical Displacement would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	Temporary	**Short-term**	Long-term	**Permanent**	
	Potential impacts on Economical Displacement will last only during construction phase of each segment as well as until the land is rehabilitated for agricultural activities. Impact from physical displacement will be permanent.				
Impact Extent	**Local**	Regional	International		
	This impact will be experienced only by owners of local shops, located along the side of pipeline, and farmers whose agricultural lands will be displaced by pipeline.				
Impact Scale	The total area to be impacted by the construction of the project is approximately 22 km*85 m. This includes nearby local shops and agricultural areas.				
Frequency	The impact will occurs 24/7 during the construction phase.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	**Large**
	The impact magnitude of economical resettlement is medium as construction phase will impact to a maximum of two (2) cultivation cycle only. The impact magnitude is also Medium for shop owners because trench will be opened only for 1 month. The impact magnitude for physical displacement is large at it will be permanent for those impacted and bring a very important change.				

Significance of Impact

Receptor Sensitivity	Low	**Medium**	**High**	
	Also only 20% of the interviewees practice farming, it represent their only livelihood activity (50%) or their main income (50%) but the average size of land used by interviewee is larger than the area required for the Project. Therefore the sensitivity of the receptors is considered Medium. In Dala, around 38% of the interviewees operated businesses. 46.4% of interviewees have businesses as only source of income. Therefore the sensitivity of the receptors is considered High. Similarly, people living in the houses or business operating in the building that will have to be resettled will be permanently impacted by the project and have a high sensitivity.			
Impact Significance	Negligible	Minor	Moderate	**Major**
	The significance is likely to be major.			

Mitigation Measures

In order to reduce negative impact for receptors, they will be informed and provided with prior notice about information of construction activities.

- TPMC will provide passages for local people to access local shops when trench is opened.
- TPMC will engage a third party to develop a Resettlement Action Plan for the pipeline in order to ensure all receptors impacted by the Project are considered and compensated in accordance with international best practices.
- TPMC will compensate stakeholders whose land is temporarily or permanently impacted during construction and operation using market price with a premium (to compensate for the change) and include the time during which the land is not fully rehabilitated.
- TPMC will compensate stakeholders whose crops is being impacted during construction using the up-to-date market price for all cycle of production impacted.
- TPMC will compensate stakeholders whose houses or building is impacted during construction using up to date market price (with preference for in-kind compensation) and relocation allowance.
- In case of loss of economic opportunities due to resettlement of structures, TPMC will compensate business owner based on the agreed loss of opportunities.
- TPMC will use an external specialist to identify market price for the type of land, crops and structures being impacted by project activities.
- Land take should be minimised to the extent possible both in terms of size and duration; and as such, when no activities are being undertaken, exclusions will be lifted.
- TPMC will propose to recruit in priority stakeholders whose land, business or structure are being impacted during construction phase. Recruitment should offer position to those who can extend past the construction phase, in particular for those whose land is permanently impacted.
- TPMC will need to develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities that will be conducted along areas, where pipeline will be installed. This will ensure that stakeholders can anticipate and can appropriately respond to the change and limitation of uses of areas. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose agricultural activities or shops are affected by the Project activities.

Residual Impacts

Based on the implementation of the proposed mitigation measures, the significance of the impact is considered to be a **Moderate** Impact post mitigation.

Monitoring Plan

TPMC will need to monitor the grievance log weekly to identify any specific grievance related to agricultural and business activities.

During construction and operation, TPMC will monitor the employment of stakeholders whose land has been temporarily or permanently impacted by Project activities. If these people refused job offers from the Project, TPMC will engage yearly with them for the first 4 years after the start of construction to ensure their livelihood has not been significantly impacted negatively by the Project.

8.8.6.4 Impact during Operation

Overview

During operation, the pipeline will maintain a RoW of 20 m (only on one side of the pipeline alignment, away from the road)and will be reduced where necessary to accommodate for high population density near the Twantay canal. In that RoW, some activities will be excluded such as construction or cultivation of most crops but cultivation of rice, the main crop grown in the area, will be possible. No additional physical resettlement are expected during operation as the RoW of the pipeline will be reduced compare to construction.

The impact of the Project pre-mitigation on economical displacement during operation phase is considered a **Negligible** Impact.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts on Economical Displacement				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts on Economical Displacement would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts are direct impacts.				
Impact Duration	Temporary	Short-term	Long-term	**Permanent**	
	Potential impacts on Economical Displacement will last during the entire operation which can be considered as permanent.				
Impact Extent	**Local**	Regional	International		
	This impact will be experienced only by owners of land located along the side of pipeline.				
Impact Scale	The total area to be impacted by the operation of the pipeline is approximately 22km * 50m of the RoW.				
Frequency	The impact will occurs continuously during the operation phase.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The impact magnitude is small as only construction and some limited agricultural activities will be limited during operation. The main crops grown in the area will be authorised in the RoW.				

Significance of Impact				
Receptor Sensitivity	Low	**Medium**	**High**	
	Also only 20% of the interviewees practice farming, it represent their only livelihood activity (50%) or their main income (50%) but the average size of land used by interviewee is larger than the area required for the Project. Therefore the sensitivity of the receptors is considered Medium.			
Impact Significance	**Negligible**	Minor	Moderate	Major
	The significance is likely to be negligible.			

Mitigation Measures

As the impact during operation is considered to be negligible only the following mitigation measures will need to be implemented:

- TPMC will implement the Resettlement Action Plan developed for the construction phase if any agricultural activity cannot be performed during the operation phase.
- TPMC will use an external specialist to identify market price for the type of land and crops being impacted by project activities.
- Land take should be minimised to the extent possible both in terms of size and duration; and as such, when no activities are being undertaken, exclusions will be lifted.
- TPMC will need to continue implementing the Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan will include measures to notify local stakeholders in advance of any particularly activities. This will ensure stakeholders anticipate (and can appropriately respond to) the change and limitation of uses of areas. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose agricultural activities are affected by the Project activities.

Residual Impacts

Based on the implementation of the proposed mitigation measures, the significance of the impact is considered to be a **Negligible** Impact post mitigation.

Monitoring Plan

TPMC will need to monitor weekly the grievance log to identify any specific grievance related to agricultural activities.

During operation, TPMC will monitor the employment of stakeholders whose land has been temporarily or permanently impacted by Project activities. If these people refused job offers from the Project, TPMC will engage yearly with them for the first 4 years after start of construction to ensure their livelihood has not been significantly impacted negatively by the Project.

8.8.7 Impacts to Traffic and Transportation

8.8.7.1 Baseline Summary

Among various types of transportation (including bicycle, motorcycle/ moped, car/truck/van, bullock-cart, canoe/boat, 4-wheel tractor and motorboat), bicycles or motorcycles are mostly used and owned by Dala citizens for travelling to other locations.

8.8.7.2 Receptor Identification and Sensitivities

Local citizens will experience with increasing traffic congestion and reduced access to local road, but alternative roads exist and the use of small-sized vehicles will facilitate avoidance of obstacles on the road.

8.8.7.3 Impact during Construction

Overview

The construction phase for the Natural Gas Pipeline installation is expected to take 18 months. There will be a presence of 45 machineries for earthworks, which will use local roads to reach construction area.

Trucks will be used to transport material/equipment from the laydown area to the pipeline construction area. This activity also increases traffic congestion and reduce access of local people to local road. Traffic will be experienced on the main road between the LNG Receiving Terminal and Dala ferry and on the secondary road in the dense area of Dala along the pipeline alignment.

The impact of the Project pre-mitigation on traffic and transport during construction phase is considered a **Negligible** Impact.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts on Traffic and Transport				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts on Traffic and Transport would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Potential impacts on Traffic and Transport will last only during construction phase.				
Impact Extent	**Local**	Regional	International		
	This impact will be experienced only by Dala citizens who travel along construction areas of the Natural Gas pipeline.				
Impact Scale	The impact scale is small because the impact will be felt only between the laydown area and the construction area.				
Frequency	The impact will occur regularly during the day between 8 am and 10 pm.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is small as there will be a maximum of 17 trucks on the road during construction phase and the heavy machinery will travel in the RoW of the pipeline.				
Receptor Sensitivity	**Low**	Medium	High		
	Receptor sensitivity is low because the main road impacted is fairly large, where small-sized vehicles can easily avoid traffic. Also, there are alternative roads that local citizens can use.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The significance is likely to be negligible.				

Mitigation Measures

The following mitigation measures will need to be implemented during the construction phase of the Natural Gas pipeline:

- TPMC will not transport workers, equipment and materials during the local traffic peak time.
- TPMC will limit time for construction activities that will take place on or near local roads.
- TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on or proximate to local road. This will ensure that stakeholders can anticipate and can appropriately respond to the change and limitation of uses on local roads. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular transportation is affected by the Project activities.

Monitoring Plan

- TPMC will need to monitor the grievance log weekly during construction to identify any specific grievance related to traffic and transport activities.

8.8.7.4 Impact during Operation

There is no activity during operation phase that will generate impacts on traffic and transport.

8.8.8 Impacts to Existing Facilities and Utilities

8.8.8.1 Baseline Summary

Existing infrastructures and services in the Project SAoI are developed and considered in sufficient number for the local population.

In Dala, people visit Yangon hospital, Parrami clinic, SSC hospital, N/Oak hospital, traditional and private clinics, rural/ sub-rural health centers, and township/ station hospitals for medical treatment.

About 85.8% of Dala citizens use pond or lake as source of non-drinking water, but interviewees have purified drinking water, rainwater, well, and tap water as alternative sources for non-drinking water. These sources contain sufficient water with good quality. In addition, 85.4% of Dala citizens access drinking water via pool, pond or lake, but 95% also use rainwater as drinking water. All of them believe that amount of water is sufficient with good quality, but it is insufficient during March, April and May.

8.8.8.2 Receptor Identification and Sensitivities

Pool, pond and lake are present in limited numbers and the scarcity of water is experienced during March, April and May which creates a vulnerability of the local population to changes from these resources. Poor households that access to such water sources may have limited alternatives, and face with difficulties in changing to others water source.

8.8.8.3 Impact during Construction

Overview

The construction phase for the Natural Gas Pipeline installation is expected to take 18 months. During construction phase, activities and use of machineries (including 45 machineries for the ROW, excavation, open cut, transportation of material/equipment/workers and earthworks) generates wastes, which may affect nearby lake and pond in case of leak.

The maximum number of workers onsite during construction is anticipated to be 117 persons and each worker is estimated to consume approximately 33.3 litres of water per day. Cover Slab concrete

are estimated to consume 230 litres of water per day per m^3 of concrete/ total water volume 143.75 m^3. All construction activities are estimated to consume 3 m^3 of water per day. The average water consumption rate during construction is anticipated to be 78 m^3 per month (approximately 3 m^3 (3,000 L) per day).

The number of workers is not expected to be large enough to have a noticeable effect on local infrastructures such as hospitals, roads etc. The water quantity needed for construction is also too small to have noticeable effects.

The impact of the Project pre-mitigation on existing facilities and utilities during construction phase is considered a **Negligible** Impact.

Impact Assessment Table

Significance of Impact					
Impact	Potential impacts on local infrastructures including roads, hospital, and utilities.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to local infrastructures would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	The impact may occur throughout the construction phase.				
Impact Extent	**Local**	Regional	International		
	The impact will be experience only locally.				
Impact Scale	This impact will be experienced only by stakeholders using public sources of water (pool, pond, and lake), which are located nearby to construction areas.				
Frequency	Rarely				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The average water consumption rate during construction phase will be approximately 3 m^3 (3,000 L) per day and the number of workers not sufficient to have noticeable effect on public infrastructure and utilities. Only the risk of pollution of lake, pond and pools which may occur with a rare frequency and in limited quantity.				
Receptor Sensitivity	Low	Medium	**High**		
	The receptor sensitivity is high as more than 85% of stakeholders in Dala access water from pool, pond, or lake.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The significance is likely to be negligible.				

Mitigation Measures

The following mitigation measures are suggested in order to mitigate impact on facilities and utilities:

- TPMC will avoid parking vehicles and machinery next to sources of water for local population.
- TPMC will ensure regular maintenance of all the equipment and vehicles used for construction.
- TPMC will have specific and secured storage for used oil and other construction wastes.
- TPMC will use certified contractor for waste management.
- TPMC will used a certified contractor for the procurement of water during construction.

- TPMC will engage monthly with local authorities and population to ensure access to water resources and other utilities are not impacted.
- TPMC will provide appropriate amenities at the workforce accommodation camp – e.g. recreational opportunities. This will help reduce the need for workers to utilize local infrastructure and services;
- TPMC will ensure that company medical services have sufficient capacity and capability to treat a reasonable amount of workers at the same time.
- TPMC will develop and implement a Worker Code of Conduct for all employees, contractors and visitors directly related to the Project. This will include specified amount of water that the Project activities and workers can use per day. This will also be a contractual and enforced requirement for all staff and subcontractors.
- TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on public infrastructures. This will ensure that stakeholders can anticipate and can appropriately respond to the change and limitation of uses. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular use of public services and infrastructures is affected by the Project activities.

Monitoring Plan

Monitoring of impact on local infrastructures and services will be done through:

- Weekly review of grievance log;
- Monthly inspection of infrastructures and in particular nearby sources of water; and
- Monitoring plan for surface water will also support monitoring of impact on utilities.

8.8.8.4 Impact during Operation

Overview

There is no specific Project activities during operation of the pipeline that will affect existing facilities and utilities.

8.8.9 Impacts from Environmental Emissions (Noise, Dust, Vibration)

8.8.9.1 Baseline Summary

Popular construction materials in Dala are bamboo for wall, wood for floor, and corrugated sheet for roof.

Along the pipeline location, noise stations that exceeded the Myanmar standard for at least one time period, include station N1, N5, N6, N8, and N9. However, station N7 indicates noise level below the Myanmar standard. Existing sources of noise consist of the gas turbine power plant generator for N1, the traffic activity of vehicles (including cars, motorbike, boats and ships), activities of human, grain mill, wind blowing sound and tiny bell sound on the pagoda.

The air quality baseline show that the air shed is non-degraded in the pipeline area.

Vibrations are limited to the vehicle traffic on the local roads

8.8.9.2 Receptor Identification and Sensitivity

The Proposed Project site for pipeline is located along the road, which passes through several settlements. Household's members in those settlements are the potential receptors of this impact. The

other sensitive receptors which could be impacted by dust will be Dala farmers whose land is located near the pipeline alignment.

8.8.9.3 Impact during Construction

Overview

The construction phase for the Natural Gas Pipeline installation is expected to take 18 months. Earthworks with uses 45 machineries for clearing of vegetation and grading for the ROW of the pipeline.

An open cut construction method for the pipeline will involve primarily earthworks, which consists of excavating soil from the planned pipeline alignment.

The construction of the Project will generate:

- Noise: which can result from a variety of onsite activities (e.g. construction of infrastructure, reversing sensors on large vehicles). Noise can lead to hearing loss and disrupt community activities (such as sleep). Ongoing disruptions have been linked to increases in depression and anxiety;
- Vibrations: which can result from construction activities (e.g. piling, drilling, operation of compressors and generators). If the vibrations are strong enough, it can damage the foundation of nearby infrastructure (e.g. businesses, community centres, monastery); and
- Dust: which can be generated through vegetation clearing, site grading, driving on dry, dirt roads. This can impact the surrounding air quality, disrupting the amenity value of an area and potentially impacting community health (e.g. further aggravating existing respiratory illnesses).

Dust, noise and vibration will only generated during the construction and will impact a very limited number of receptors (only those who are living nearby pipeline alignment under construction).

The impact of the Project pre-mitigation from environmental emission during construction phase is considered a **Minor** Impact.

Impact Assessment Table

Significance of Impact					
Impact	Impact from Environmental Emissions				
Impact Nature	**Negative**	Positive	Neutral		
	Increase of environmental emissions has the potential to result in negative impacts in the local area.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is direct.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	Impact will be temporary, limited to the area where construction of pipeline is taking place.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited within the local area.				
Impact Scale	The impact scale is small.				
Impact Frequency	The impact will occur daily between 8am and 10pm during the construction period.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be small with no activities generating heavy vibrations and				

	noise and dust impact limited to the 8am-10pm period in small areas where the trench is being excavated.			
Receptor Sensitivity	Low	**Medium**	High	
	Receptor sensitivity is likely to be medium, mainly due to the material used in local houses nearby.			
Significance	Negligible	**Minor**	Moderate	Major
	The significance is likely to be minor.			

Mitigation Measures

Mitigation measures have already been proposed in the Air Quality and Noise Impact Assessment sections but TPMC will also need to develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly noisy activities (e.g. pile driving). This will ensure that stakeholders can anticipate and can appropriately respond to the disruption associated with noise. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder impacted by noise, dust and vibration.

Residual Impacts

Assuming that the management measures proposed in the Air Quality and Noise Impact Assessment sections are implemented and monitored over time, the residual impact was assessed as **Negligible** impact.

Monitoring Plan

Monitoring of air quality and noise have been described in the relevant chapters. In addition, TPMC will need to monitor the grievance log weekly during construction to identify any specific grievance related to environmental emissions.

8.8.9.4 Impact during Operation

There is no specific Project activities during operation of the pipeline that will generate environmental emissions.

8.8.10 Impacts on Community Health and Safety

8.8.10.1 Baseline Summary

In Myanmar and Yangon region, common diseases and health problems consist of tuberculosis, underweight in children, malnutrition, Malaria, and AIDs. In Dala Township, most of interviewees (95.3%) said they are in good health conditions, although 38% have experienced fever in the past years. Average distance between resident houses in the Project SAoI and medical facilities is approximately 5.7 km. Yangon is the main business hub in Myanmar and also a tourism center. There are constant movement of population in the area including Myanmar local and offshore people. Therefore the inhabitant of the Project SAoI are constantly exposed to an above average pool of disease.

In addition, Dala citizens mostly transport by riding a bicycle, but some of them also use boat/ canoe to transport to other areas.

In Seikgyikanaungto Township, most of interviewees (84.5%) are living with a good health conditions, although 16.7% have experienced fever in the past years. Average distance between resident in the Project SAoI houses and medical facilities is approximately 0.8 km. In addition, Seikgyikanaungto citizens mostly transport by riding a bicycle and motorbike.

8.8.10.2 Receptor Identification and Sensitivities

The entire population within the Project SAoI is a potential receptor of this impact. In particular this includes the population interacting directly with the Project staffs such as restaurant and shop owners, households of project staff, and medical staffs. People with disability, young children and old people are particularly at risk if exposed. The low density of population reduce the risk of epidemic but people living directly near the proposed Project site will be at risks in case of an epidemic within the workforce. Local communities are also not used to a large volume of traffic meaning there are low to medium levels of awareness regarding road safety.

8.8.10.3 Impact during Construction

Overview

The Project sites will be fenced and the construction camp will be located inside the Project boundary. However, the presence of TPMC workforce may result in interactions between the workforce and local people. As it is unlikely that the entire workforce will come from the Project SAoI, workers from outside of the local area will also be present. These workers may be subject to communicable diseases and STDs.

In the event of an outbreak of an airborne (e.g., TB) or food-borne illness among the workers, the area where local workers live, and any settlement visited by Project workforce may also become susceptible to these infectious diseases.

An increase in the transmission of communicable diseases may occur as the result of the introduction of workers into the area and creation of vector habitat (worker camps).

In terms of communicable diseases, of particular note and concern are tuberculosis and HIV/ AIDS, given their current prevalence within the country and local area. The receptors located closest to the Project site are likely to be most affected by an increase in vector habitat.

If left untreated, communicable diseases can lead to long-term health issues and/ or in some instances death. In other words, the impact can be characterized as being long-term and in some instances permanent.

The handling, transport and treatment of the Project waste during construction may also result in risks to public health due to contamination of water resources and spread of disease carrying species such as rats.

The construction activities will create environmental emissions which may impact on community health and safety, in particular disruption of sleep, impact to building structure or aggravation of respiratory illness.

In addition, the risk of injuries will also increase during construction activities of the pipeline associated with the presence of mechanical equipment, excavation areas, and movement of equipment and people by road. Increased vehicle traffic, including vehicles operated by TPMC and their contractors also increases the risk of accidents and injuries (up to and including deaths).

Unplanned event are also considered in this study by included in the section of a specific unplanned event section for the pipeline.

The impact of the Project pre-mitigation on community health and safety during construction phase is considered a **Moderate** Impact.

Impact Assessment Table

Significance of Impact			
Impact	Impact on Community Health and Safety		
Impact Nature	**Negative**	Positive	Neutral

Significance of Impact

	Increase of communicable diseases in the local area is negative.			
Impact Type	**Direct**	Indirect	Induced	
	The impact is direct.			
Impact Duration	Temporary	Short-term	**Long-term**	**Permanent**
	The impact could be long lasting, even permanent, if left untreated or resulting in death.			

Significance of Impact					
Impact Extent	**Local**	Regional	Global		
	The effect of the impact will be mainly experienced by local population living directly next to the proposed Project site or interacting with Project staff.				
Impact Scale	The impact scale is small due to the limited number of people potentially impacted.				
Impact Frequency	The impact likely occurs during the construction phase with the rare frequency.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is likely to be Medium as the potential changes for the local population can have long term adverse consequences but will be rare.				
Receptor Sensitivity	Low	**Medium**	High		
	Receptor sensitivity is medium due to the lack of awareness of the population and potential for interaction with workers.				
Significance	Negligible	Minor	**Moderate**	Major	
	The significance of the impact is moderate.				

Mitigation Measures

The following mitigation measures should be implemented so as to reduce the significance of the impact:

- Training for all workers on the transmission routes and common symptoms of communicable diseases. This can help reduce the potential for workers to unknowingly transmit communicable diseases. This may also help to increase knowledge within Project SAoI – e.g. through the training of workers that have been sourced from the local area;
- Establish amenities at the worker camp to help minimize the interaction between the workforces (particularly temporary construction workers) and local villagers. This includes recreation facilities and health care infrastructure;
- Establish a workforce code of conduct. This include the specific measures that target anti-social behaviour, such as becoming involved with commercial sex workers;
- Undertake pre-employment screening to ensure fitness for work. It is important that the pre-screening process does not result in discrimination, but instead is used as a tool to minimize the transmission of communicable diseases;
- Vector management procedures, including measures to reduce the presence of vector habitat and consideration of whether pesticides will be utilized to reduce the presence of vectors onsite;
- Provision of onsite health care and medical facilities, to ensure that basic medical attention and first aid treatment can be sought during the hours that the work is being undertaken at the Project site. This will also help reduce the potential pressure on local health care facilities;
- Pre-placement medical examination of all workers, supported by periodic medical examinations. A regular voluntary Worker Medical Screening Program onsite and a Monitoring and Evaluation (M&E) system. In addition a workplace policy and training and awareness programme on risks described above and prevention and mitigation of HIV impacts will be implemented with Project staff.
- In collaboration with the local and regional Government, local emergency providers and local health care facilities, TPMC will develop and implement Emergency Prevention, Preparedness and Response Plans (EPPRPs) to cover all incidents presenting risks to public safety and the affected communities in proximity to the Project Sites and the environment.

- Develop and implement a Workforce Code of Conduct. The Workforce Code of Conduct will be adhered to by all Contractors and TPMC employees. Any employee or Contractor found in violation of the Code shall face disciplinary hearing which may result in dismissal.
- Ensure the access to free condoms (including female condoms) at the worker camp to promote safe sexual practices.
- Conduct information, education and communication campaigns amongst Project personnel on hygiene and sanitation.
- The EPC contractor should develop an effective Waste Management Plan that ensures adequate and legally acceptable control and management of transport and disposal of all wastes on and off site, including the exclusive use of licensed waste management contractors.
- Security personnel will be contracted and trained in line with the Voluntary Principles on Security and Human Rights.
- Accommodation should be provided to external workers in accordance with international good practice on workers' accommodation, including IFC / EBRD standards to prevent transmission of diseases associated with poor living conditions.
- The Project should implement measures to reduce the presence of standing water onsite through environmental controls and source reduction to avoid the creation of new breeding grounds.
- All the mitigation presented in the air quality and noise impact assessment chapter will be implemented.
- The Project should develop a Traffic Management Plan covering vehicle safety, speed limits on roads, driver and passenger behaviour, use of drugs and alcohol, hours of operation, rest periods and location of rest stops and accident reporting and investigations.
- Require Project drivers to be trained in defensive driving within the previous 3 years.
- All vehicles used for the project should be regularly serviced and maintained.
- Local speed limits should be adhered to when travelling through communities by all Project related traffic. Such speed limits will have the added advantage of reducing dust emissions.
- Undertake consultation with communities along key transport routes to inform them about the potential for increased traffic movements prior to any changes.
- Bentonite will be disposed of using a licensed contractor.
- TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. As part of this Plan, awareness campaign on community health and safety, in particular regarding traffic accident and communicable diseases, should be develop and implemented. The Project will also include a Grievance Mechanism to collect grievances from local stakeholder affected by the Project activities
- The Project will ensure that signs are put up around construction sites advising people of the risks associated with trespass. All signs will be in diagram format to ensure key message is well received and understood by all parties;
- Implement pipeline safety training plan in the villages proximity to pipeline; and
- The Project will ensure that there is adequate fencing around construction site to minimise the risk of trespass. Fencing will be checked daily to ensure that it is in good condition and to look for any signs of entry.

In addition: it is recommended that a complementary occupational health and safety plan be developed – to focus on managing potential issues that may affect the Project workforce. The plan should include measures to minimize the potential for the workforce to contract a communicable

disease. This will help reduce the potential for the workforce to contract a communicable disease and subsequently introduce the disease in their home village/ community.

Residual Impacts

Once management measures have been implemented, it is predicted that the impact will be minor and negative during construction due to the potential for long term or permanent impact in case of accident. Therefore, on-going monitoring and evaluation of the management measures and community health situation will be needed. If monitoring indicates an increase in the transmission of communicable diseases, the management measures will need to be revised. This includes monitoring the Project's direct activities as well as Project contractors.

Monitoring Plan

Monitoring of impact on Community Health and Safety will be done through:

- Bi-monthly review of training log to confirm all employee are trained on the company H&S standard;
- Monitoring and review of accidents/ incidents due to construction activities; workers' health by daily monitoring and monthly review of near-misses, incidents, occupational diseases, dangerous occurrences, accidents at project activity areas and construction workers camp, as per construction phase Health and Safety Plan, which will be prepared by the EPC contractor.
- Daily monitoring of construction area, worker camp and surrounding (standing water, fence, warning sign).
- Regular unplanned audit related to the worker code of conduct (alcohol and drug use, speed limit, activities linked with local population).
- Bi-yearly unplanned audit of waste management contractors and facilities.
- Monthly visual inspection of first aid facilities and records, review of employment records and health insurance subscription records
- Weekly review of grievance log.

8.8.10.4 Impact during Operation

Overview

All personnel involved with pipeline operations will be considered in the Power Plant workforce section. However, Project activities likely to present a risk during operation are linked with unplanned event, covered in the unplanned event specific section for the Pipeline.

8.8.11 Impacts on Occupational Health and Safety

8.8.11.1 Baseline Summary

Health and safety standards in the construction sector are relatively low in Myanmar. National occupational safety and health legislation is very limited with the main laws to consider for the Project being the Prevention and Control of Communicable Diseases Law (Law No. 1/95), Law Amending the Factories Act 1951 (Pyidaungsu Hluttaw Law No. 12/2016) and Prevention From Danger of Chemical and Associated Materials Law, 2013 (28/2013). Myanmar has ratified 23 out of 189 ILO conventions. Experience of industrial health and safety standards is limited in the Project SAoI except for those who have experience working mainly at the industrial ports.

8.8.11.2 Receptor Identification and Sensitivities

International employees are likely to have a better understanding of national and international health and safety standards, and therefore understand the relevance of any training and mitigation measures and appropriate working conditions. Employees sourced from the SAoI may have a higher sensitivity to the impact due to a poorer understanding of OHS standards and working conditions, and lower education levels.

8.8.11.3 Impact during Construction

Overview

The Project sites will be fenced and a construction camp will be located inside the Project boundary.

During construction, the workforce will reach 117 workers at peak. As much as possible the company will try to source workforce from Project SAoI although some expatriate workers are expected on certain jobs. The nature of the activities mean that there is the potential for accidents and injuries to occur if occupational health and safety systems are not developed and strictly enforced for all Project personnel.

The potential impacts on the workers (unskilled, semi-skilled and skilled) of the Project are likely to result from right of way clearance, excavation, foundation work, HDD, boring, open cut, and hydrostatic testing. These impacts are likely to increase in proportion to the increase in activity.

In addition, the risk of injuries will also increase during construction activities of the pipeline (including transportation of equipment, material and workers, and transportation of non-hazardous and hazardous wastes to designated location) associated with the movement of equipment and people by road.

The impact of the Project pre-mitigation on occupational health and safety during construction phase is considered a **Moderate** Impact.

Impact Assessment Table

Significance of Impact					
Impact	Impact on Occupational Health and Safety				
Impact Nature	**Negative**	Positive	Neutral		
	The potential increase in Health and safety of workforce and Labour and working conditions are negative.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is direct.				
Impact Duration	Temporary	Short-term	**Long-term**	**Permanent**	
	Impact has the potential to have a long lasting effect with injured workers being unable to work for a long time or even permanent in case of accident crippling or killing workers.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited to the workers at the site and external waste and water contractors/suppliers.				
Impact Scale	The impact scale is small.				
Impact Frequency	The impact likely occurs during the construction with a rare frequency.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is potentially medium with long term impact but with a rare frequency				

	and small scale.			
Receptor Sensitivity	Low	**Medium**	High	
	Receptor sensitivity is likely to be medium with unskilled staff not aware of H&S risks and best practice.			
Significance	Negligible	Minor	**Moderate**	Major
	The significance is likely to be Moderate due to the potential duration and gravity of the impact but the rare frequency of the impact.			

Mitigation Measures

The Project will develop and implement a Construction Occupational Health and Safety Management Plan (OHSMP) in line with good industry practice and corporate policies.

- The Contractor will prepare and implement a Health and Safety Plan prior to commencing work. This plan will include method statements for work activities, construction sequence and safety arrangements.
- Measures will be implemented to reduce the likelihood and consequence of the potential hazards. This shall include (but not limited to) the following hazards:
  - falling from height (in the trench);
  - falling into water;
  - entanglement with machinery;
  - tripping over permanent obstacles or temporary obstructions;
  - slipping on greasy walkways;
  - falling objects;
  - asphyxiation;
  - explosion;
  - contact with dangerous substances;
  - electric shock;
  - variable weather conditions;
  - lifting excessive weights; and
  - traffic operations.
- A Permit to Enter system will be established to ensure that only authorised persons gain entry to the construction site.
- Competent and adequately resourced sub-contractors will be used where construction activities are to be sub-contracted.
- All persons working on the construction site will be provided information about risks on Site and arrangements will be made for workers to discuss health and safety with the Contractor.
- The Contractor will prepare and implement a Health and Safety Plan prior to commencing work. This plan will include method statements for work activities, construction sequence and safety arrangements.
- All workers will be properly informed, consulted and trained on health and safety issues.

- Personal Protective Equipment (PPE) shall be worn at all times on the construction site. This shall include appropriate safety shoes, safety eyewear, and hard hats. Non-slip or studded boots will be worn to minimize the risk of slips.
- Before starting work all the appropriate safety equipment and the first-aid kits will be assembled and checked as being in working order. Breathing apparatus if necessary will be tested at regular intervals in the manner specified by the manufacturer.
- All lifting equipment and cranes will be tested and inspected regularly. All hoist ways will be guarded.
- When there is a risk of drowning, lifebelts shall be provided and it shall be ensured that personnel wear adequate buoyancy equipment or harness and safety lines, and that rescue personnel are present when work is proceeding (near the water extraction point, the Yangon river or water channels).
- Where sound levels cannot be reduced at the source, suitable hearing protection will be provided when noise levels indicate a Leq of more than 85 dB(A). When hearing protection is used, arrangements will be made to ensure the wearers can be warned of other hazards.
- The Contractor shall provide appropriate safety barriers with hazard warning signs attached around all exposed openings and excavations.
- The EPC contractor will comply with the IFC Performance Standard 2, local regulation and ILO conventions signed by Myanmar.
- TPMC will develop and monitor an internal standard to guide labour practices and apply this to supply chain to ensure that no child and/or forced labour will be employed by the EPC contractor and its sub-contractors.

In addition an OHS monitoring programme should be put in place to verify the effectiveness of prevention and control strategies and a worker grievance mechanism developed and implemented.

Residual Impacts

Based on the implementation of the proposed mitigation measures, the significance of the impact is considered to be a **Minor** Impact post mitigation.

Monitoring Plan

Monitoring of impact on Occupational Health and Safety will be done through:

- Six monthly review of training log to confirm all employee are trained on the company H&S standard;
- Monitoring and review of accidents/ incidents due to construction activities; workers' health by daily monitoring and monthly review of near-misses, incidents, occupational diseases, dangerous occurrences, accidents at project activity areas and construction workers camp, as per construction phase Health and Safety Plan, which will be prepared by the EPC contractor.
- Development of an Occupational health and safety monitoring and surveillance programme.
- Weekly review of worker grievance log.

8.8.11.4 Impact during Operation

Overview

Project activities likely to present a risk during operation are linked with the unplanned event which covered in the unplanned event section of the impact assessment for the pipeline.

8.8.12 Impacts to Cultural Heritage

8.8.12.1 Baseline Summary

There are no known cultural heritage site within the footprint of the Project site. The history of the site also support the absence of such site or any cultural or religious use and archaeological resources. The main cultural heritage sites located nearest to the proposed Project site is Danot Pagoda, Ah Nar Gan Sayar Thetgyi (meditation station).

8.8.12.2 Receptor Identification and Sensitivities

The vast majority of the population in the Project SAoI is Buddhist and regularly attend the monastery for ritual or weekly praying. There are limited alternative in the Project SAoI but no site have been identified directly next to the pipeline alignment apart from a monastery mid-way between the LNG Receiving Terminal and Dala pier.

8.8.12.3 Impact during Construction

Overview

The construction phase for the Natural Gas Pipeline installation is expected to take 18 months. An open cut construction method for the pipeline will involve primarily earthworks, which consists of excavating soil from the planned pipeline alignment. This will result in a temporary loss of access to the monastery or other cultural heritage sites.

The impact of the Project pre-mitigation on cultural heritage during construction phase is considered a **Negligible** Impact.

Impact Assessment Table

Significance of Impact					
Impact	Impact on Cultural Heritage				
Impact Nature	**Negative**	Positive	Neutral		
	The potential impact on Cultural Heritage are negative.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is direct.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	Impact would be temporary, only during the time the trench is open and access reduced.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited to the area excavated and nearby cultural heritage site.				
Impact Scale	The impact scale is small.				
Impact Frequency	The impact likely occurs during the construction with a rare frequency (only one site clearly identified).				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The impact magnitude is Negligible as the access to the monastery or other potential cultural heritage site will be limited in time.				
Receptor Sensitivity	Low	**Medium**	High		
	Receptor sensitivity is likely to be medium as the closest alternative to the monastery of other cultural heritage site is likely to be far enough to require the use of a car.				
Significance	**Negligible**	Minor	Moderate	Major	

	The significance is likely to be Negligible due to the limited duration of the impact.

Mitigation Measures

Although the impact is negligible, the following mitigation measures should be implemented:

- If any cultural heritage is identify during the construction period, TPMC will contact the keys governmental department accordingly.
- The EPC contractor will provide an alternative access to the monastery during the duration of the excavation on the main access path. The alternative access should be secured and able to sustain normal traffic to the monastery (reinforced structure if car often access the monastery for example).
- The EPC contractor will develop the construction planning in discussion with the nearest temple/monastery in order to make sure that any Project activity near the monastery (e.g transport of large equipment) do not take place during special religious activities.
- TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The Project will also include a Grievance Mechanism to collect grievances from local stakeholder affected by the Project activities

Monitoring Plan

Monitoring of impact on cultural heritage will be done through:

- Monitoring and review of accidents/ incidents due to construction activities;
- Weekly review of grievance log.

8.8.12.4 Impact during Operation

Overview

No activity presenting a risk for cultural heritage are expected during operation.

The Project should nevertheless continue to implement the Grievance Mechanism to collect grievances from local stakeholder.

8.9 Unplanned Event Impact Assessment

8.9.1 Introduction

The unplanned events associated to the activities above can be listed as follows;

- Fire and explosion;
- Seismic and Earthquake; and
- Loss of Containment of Chemical.

8.9.2 Assumption and Limitation

As described in the Project Description in ***Chapter 4***, the Project is being designed, and will be constructed and operated, according to the best practice for preventing the risk and impact on health, safety, and environment. However, there is a potential for accidents, malfunctions or unplanned events to occur during any Project phase that cause impacts to the health and safety of community and employee of the Project. This is required to consider in this ESIA report.

The assessment of significant impacts of unplanned events considers the probability of events occurring and an estimate of the severity of the consequences of the events. In assessing the severity of impact, “A worst case scenario” is taken into consideration. This chapter presents the probable

impacts of unplanned events associated with construction and operation of the Project. The unplanned events are considered separately from routine and non-routine activities as they arise as a result of a technical failure, human error, or as a result of natural phenomena.

8.9.3 Assessment Methods

As discussed in ***Chapter 3***, the IFC Environmental, Health and Safety (EHS) standards and guidelines are considered throughout the assessment and provide the overarching guidance and principles for undertaking the assessment. The key documents considered are as follows:

- **IFC Performance Standard 1 Assessment and Management of Environmental and Social Risks and Impacts:** The ESMS will establish and maintain an emergency preparedness and response system so that the client, in collaboration with appropriate and relevant third parties, will be prepared to respond to accidental and emergency situations associated to prevent and mitigate any harm to people and/or the environment;
- **IFC Performance Standard 2 Labour and Working Conditions:** It is required the Project to prevent risk and impacts on the staffs working in the Project area. Taking into account inherent risks in its particular sector/ classes of hazards in the client work area including physical, chemical, biological, radiological hazards, threats to women;
- **IFC Performance Standard 4 Community Health and Safety and Security:** The project must avoid and minimize risk and impact caused by the Project on health and safety of the community;
- **Environmental, Health, and Safety (EHS) General Guidelines**; and
- **EHS Guidelines:** Gas Distribution Systems (2007).

Assessment of significant impact associated to unplanned event considers the likelihood (or frequency) of incident occurrence and the consequence of the incident should it occur. The assessment of likelihood takes a qualitative approach based on professional judgement, experience from similar projects. The assessment of consequence is based on specialists' input and professional experience. The details are provided in the next sections. Since the Project activities during the construction and operation period are varied. The unplanned events will be assessed based on the Project phase listed in the following sections.

8.9.4 Baseline Summary

8.9.4.1 Seismic and Earthquake

Myanmar rests on one of the world's two main earthquake belts. One of its many fault lines run 1000 kilometres (600 miles) north to south through the country's agriculturally rich central plain, placing major Myanmar cities, including Mandalay, Bago and Yangon, at risk.[130] Due to this situation the country is exposed to the hazards of large earthquakes and tsunamis (M. Thein et al.)

8.9.5 Resources and Receptors

The resources and receptors of unplanned events depend on the type of extent of the incident. Emergency unplanned events that cause fire and explosions can cause damage to life and property of the local community. Project employees may also be affected by emergency events, such as earthquake.

Table 8.36: Identified Receptors for Unplanned Events

Unplanned Events	Potential Receptors

[130] Irin. (2011). Myanmar's urban areas at risk from earthquakes. Myanmar Times. Retrieved from: https://www.mmtimes.com/national-news/2691-myanmar-s-urban-areas-at-risk-from-earthquakes.html

Fire and Explosion	Fire and explosion can affect personnel operating at the facilities and cause damage on machines, equipment and any related facilities. In addition, the impact could cause the damage to the communities at the surrounding area.
Seismic earthquake	Earthquake-induced ground motion can cause damage to the pipeline and any another related facilities. In addition, this would expose the public to substantial risk of injury.
Impacts from Loss of Containment of Chemical Storage Facilities On-site	Loss of contaminant would affect the surrounding environment e.g. soil, waterbody, flora, and fauna. Also, it could cause potential health and safety risk to receptors using surface water, soil and groundwater

The communities (village track) located within 100 meter along the pipeline are listed as follows;

- Dala village tract;
- Tha Pyay Kone village tract;
- Nyaung Ngoke To village tract;
- Ye Chaung Wa village tract;
- Pyawbwe Gyi village tract;
- Shwe Hlay Chaung village tract;
- Tone Tin Gan (North) village tract;
- Tone Tin Gan (South) village tract;
- Rakhin Chaung (North) village tract;
- Nyaung Chaung village tract; and
- Seikgyikanaaungto village tract.

8.9.6 Project Activities

The list of Project activities of pipeline that will be involved to the unplanned events in are listed as follows;

Table 8.37: Project Activities Potentially Involved with Unplanned Events

Phase	Project Activities Related to Unplanned Events
Construction Phase	■ Earthwork ■ Installation of Pipeline
Operation Phase	■ NG Transfer

8.9.7 Assessment of Impact

8.9.7.1 Impact of Fire and Explosion

Overview

Fire and explosion from during Project operation will cause the serious accident or, even catastrophic accidents. The potential sources of major fire and explosion are likely from the natural gas being transported via pipeline.

The hazard identification process is to evaluate the sources and probability of release of hazardous substances that can cause serious danger to persons according to *Appendix B, World Bank Guideline for Identifying, Analyzing and Controlling Major Hazard Installation in Developing Countries, Office of Environmental and Scientific Affairs Projects Policy Department (1988)*. The criteria to be considered

in the identification process include chemical property, storage quantity, and operating condition of equipment that has potential to pose major accidents including units that operate in temperature and pressure higher than the ambient condition.

Pipeline Key Components

The operation of the pipeline involves transferring natural gas from the LNG Receiving Terminal to the Power Plant. The key components of natural gas pipeline are as follows:

Table 8.38: Pipeline Components and Specifications

Pipeline Components	Specifications
Length	24.9 km
Diameter	20 inches
Thickness	≥ 9.53 mm.
Design Pressure	Appx. 64 barG
Min. Yield Strength	4,481.6 barG

Source: TPMC, 2019.

Natural Gas Characteristics

Natural gas consists of methane, propane, butane, carbon, and nitrogen as shown in the ***Table 8.39***. The molecular weight is depended on the proportion of each components. Boiling Point is -163 Celsius. Flammable limit is ranged from 50,000 to 150,000. Vapor pressure is 2,900 mmHg at 140 degree Celsius. Flash fire is less than -50 degree Celsius as shown in the ***Table 8.40*** and the result of the assessment are illustrated in ***Table 8.41***.

Table 8.39: Natural Gas Components

Components	Unit	Proportion
Methane (not less than)	84 mol%	84
Ethane (not more than)	12 mol%	12
Propane (not more than)	4 mol%	4
Butane, Pentane and others	Min: 2 mol %, Max: 2.5%	2 – 2.5

Source: TPMC, 2019.

Table 8.40: Natural Gas Characteristics

Characteristic	Detail
Molecular weight	Depending on the LNG components
Water solubility	0.006 g/ml (20° C)
Vapor pressure	2,900 mm Hg (140 °C) ; 16,600 mm Hg (-100 °C)
Boiling point	-163 °C
Flash point	< -50 °C
Ignition limit	50,000 to 150,000 %
Melting point	-182 to -150 °C
Temperature during combustion	482 to 632 °C

Source: Environment Canada, Manual for spill of Hazardous Materials, 19, pg. 352.

Mathematical Model

BREEZE Incident Analyst Version 1.2 and input Data for BREEZE Incident Analyst Version 1.2.

The Result of Risk Assessment

Table 8.41: Estimated impact area from fire and explosion of natural gas: Jet Fire, Fireball, Flash Fire, and VCE at LNG storage tank and NG pipeline

Scenarios	Heat Radiation Radius (m)	Affected Area
1. Hole size 1”		
1.1 Jet Fire		
Thermal Intensity 37.5 kW/m^2	16.24	Project area, power plant, and receiving terminal, cropland, woodland, and river
Thermal Intensity 25.0 kW/m^2	17.18	Project area, power plant, and receiving terminal, cropland, woodland, and river
Thermal Intensity 12.5 kW/m^2	19.17	Project area, power plant, and receiving terminal, cropland, woodland, and river
Thermal Intensity 4.0 kW/m^2	24.27	Project area, power plant, and receiving terminal, cropland, woodland, and river
2. Rupture (Hole size 16”)		
2.1 Fireball		
Thermal Intensity 37.5 kW/m^2	691.93	Project area, power plant, and receiving terminal, cropland, woodland, river, and villages
Thermal Intensity 25.0 kW/m^2	847.44	Project area, power plant, and receiving terminal, cropland, woodland, river, and villages
Thermal Intensity 12.5 kW/m^2	1,198.46	Project area, power plant, and receiving terminal, cropland, woodland, river, and villages
Thermal Intensity 4.0 kW/m^2	2,118.61	Project area, power plant, and receiving terminal, cropland, woodland, river, and villages
2.2 Flash fire		
Lower flammable limit (LFL) (50,000 ppm)	1,027.08	Project area, power plant, and receiving terminal, cropland, woodland, river, and villages
2.3 VCE		
Pressure Level 14.5 psi	279.16	Project area, power plant, and receiving terminal, cropland, woodland, river, and villages
Pressure Level 8 psi	379.21	Project area, power plant, and receiving terminal, cropland, woodland, river, and villages
Pressure Level 3.5 psi	650.72	Project area, power plant, and receiving terminal, cropland, woodland, river, and villages

Scenarios	Heat Radiation Radius (m)	Affected Area
Pressure Level 1 psi	1,475.06	Project area, power plant, and receiving terminal, cropland, woodland, river, and villages

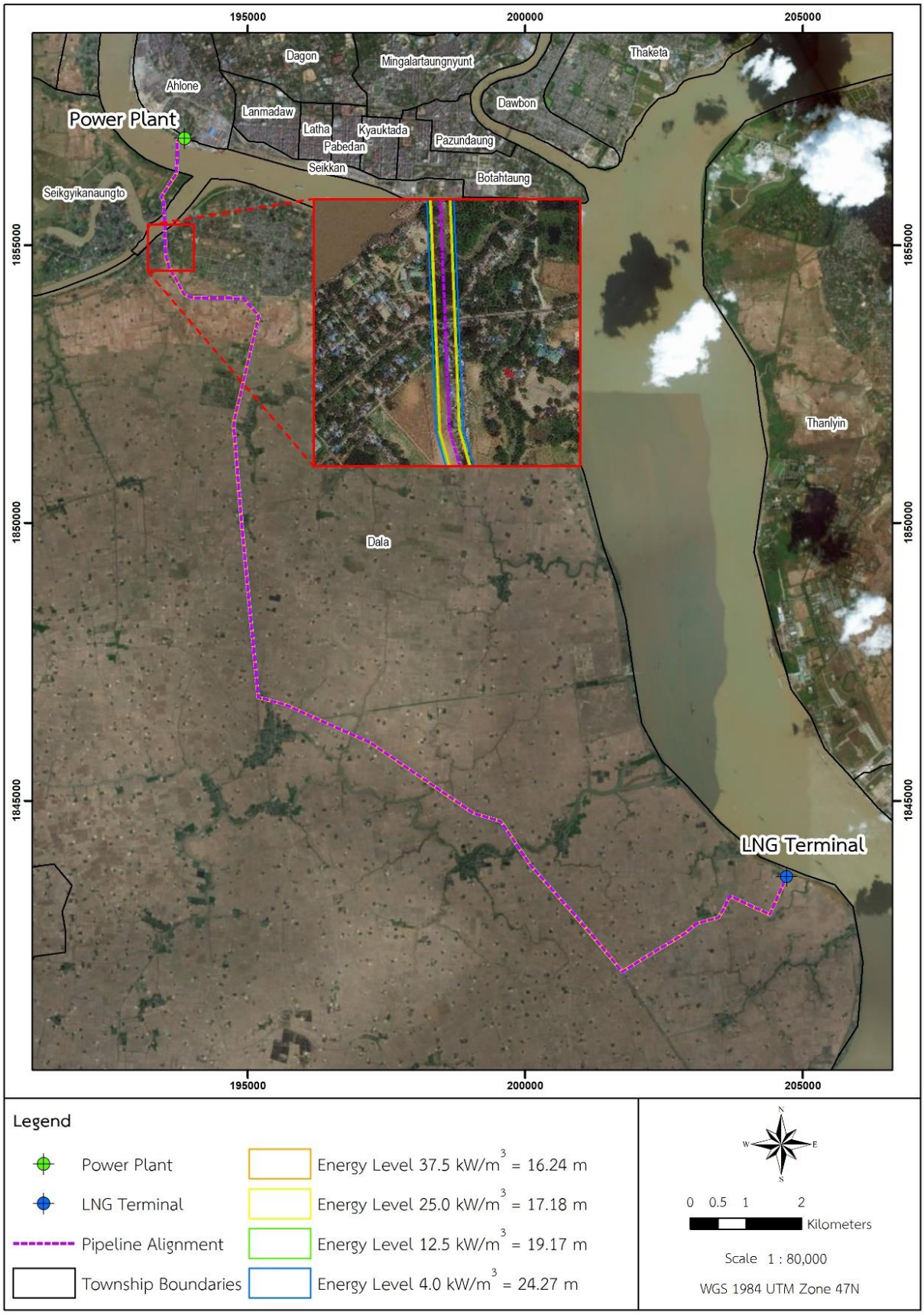
Heat radiation radius assessment of jet fire hole size of 1" scenario has the radius of severe impacts from 16.24 m to 17.18 m around the pipeline, where the energy level are 37.5 kW/m^2 and 25.0 kW/m^2 respectively as shown in ***Figure 8.2***. The impact area covers project area, power plant, and receiving terminal, cropland, woodland, and river. The affected people are project workers who are doing inspection/ maintenance along the pipeline and local community surrounding the pipeline. The damage is considered severe within the affected area, as suggested in ***Table 8.42***.

Heat radiation radius assessment of fireball in rupture scenario has the radius of severe impacts from 692 m to 847 m, where the energy level are 37.5 kW/m^2 and 25.0 kW/m^2 respectively as shown in ***Figure 8.3***. The impact area covers local residence, project area, power plant, and receiving terminal, cropland, woodland, and river. The affected people are project workers who are doing inspection/ maintenance along the pipeline and local community surrounding the pipeline. The damage is considered severe within the affected area, as suggested in ***Table 8.42***.

Heat radiation radius assessment of flashfire in rupture scenario (LFL 50,000 ppm) has the impact radius of 1,027 meter as shown in ***Figure 8.4***. The impact area covers local residence, Project area, power plant, and receiving terminal, cropland, woodland, and river. The affected people are Project workers who are doing inspection/ maintenance along the pipeline and local community surrounding the pipeline. The damage is considered severe within the affected area, as suggested in ***Table 8.42***.

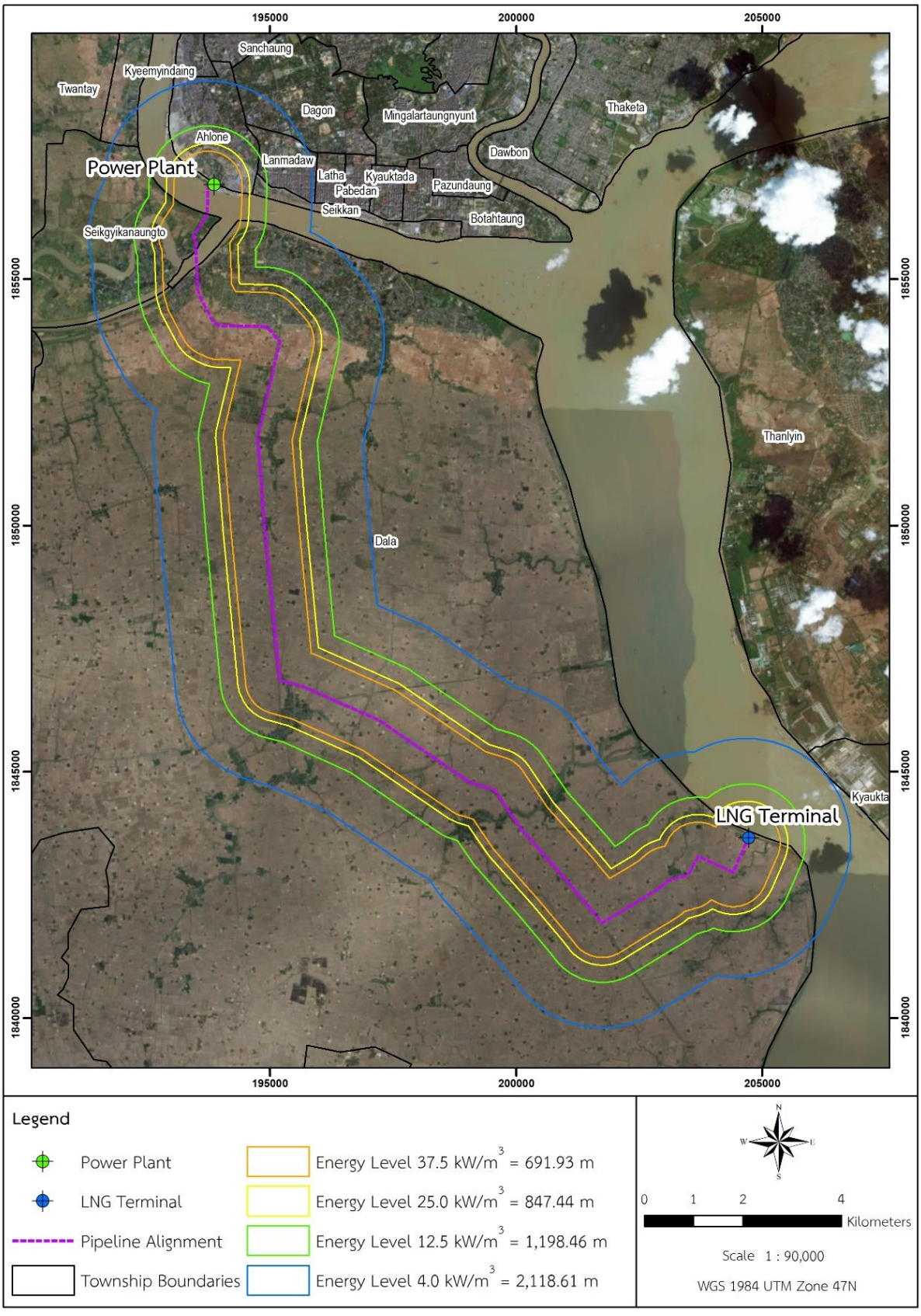
Heat radiation radius assessment of VCE in rupture scenario has the radius of severe impacts from 279 m to 379 m, where the pressure level are 14.5 psi and 8 psi respectively as shown in ***Figure 8.5***. The impact area covers local residence, project area, power plant, and receiving terminal, cropland, woodland, and river. The affected people are Project workers who are doing inspection/ maintenance along the pipeline and local community surrounding the pipeline. The damage is considered severe within the affected area, as suggested in ***Table 8.43***.

Figure 8.2: Heat Radiation Radius in of Jet Fire Scenario



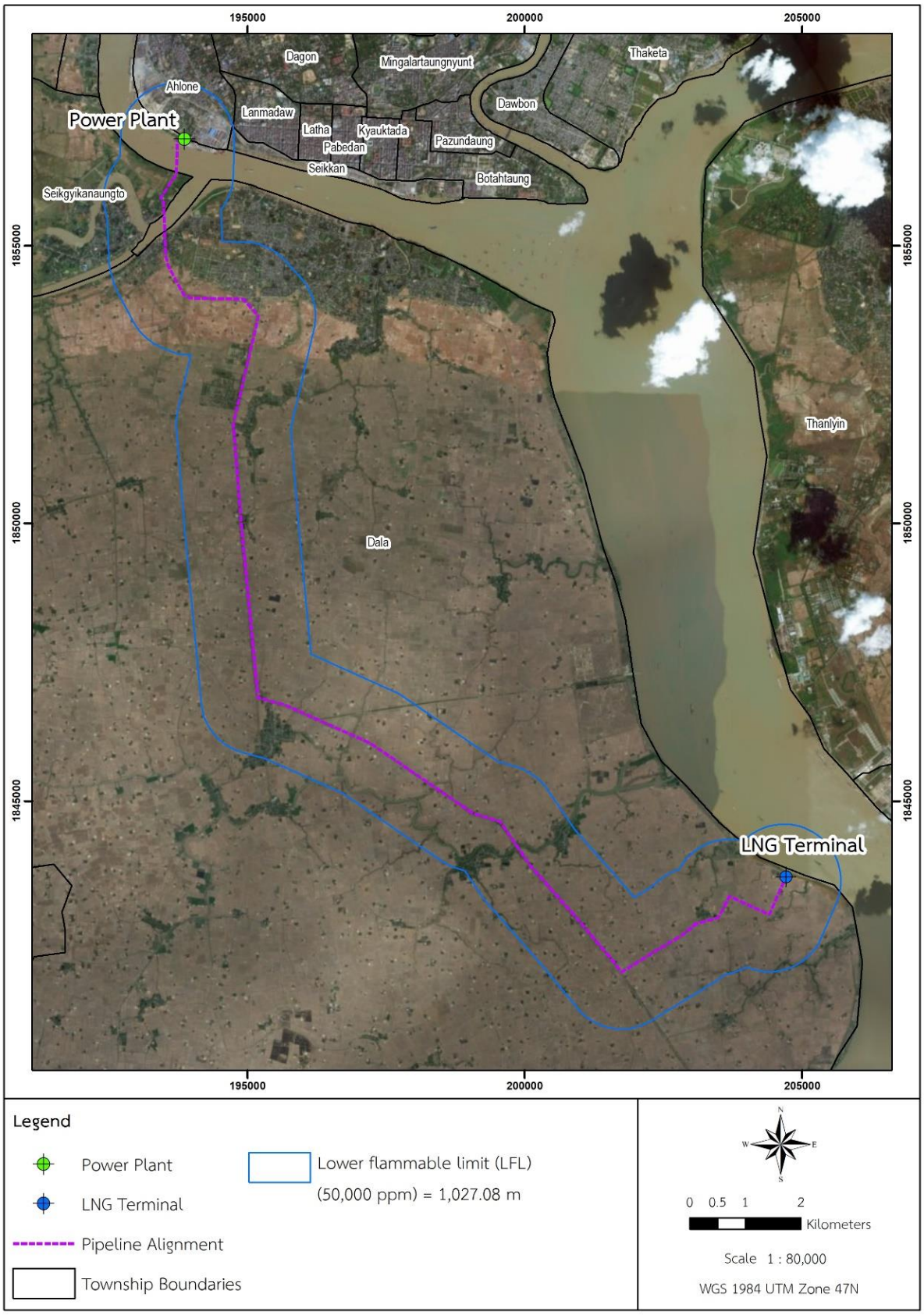
Source: BREEZE Incident Analyst. (Modified by ERM)

Figure 8.3: Heat Radiation Radius in of Fire Ball Scenario



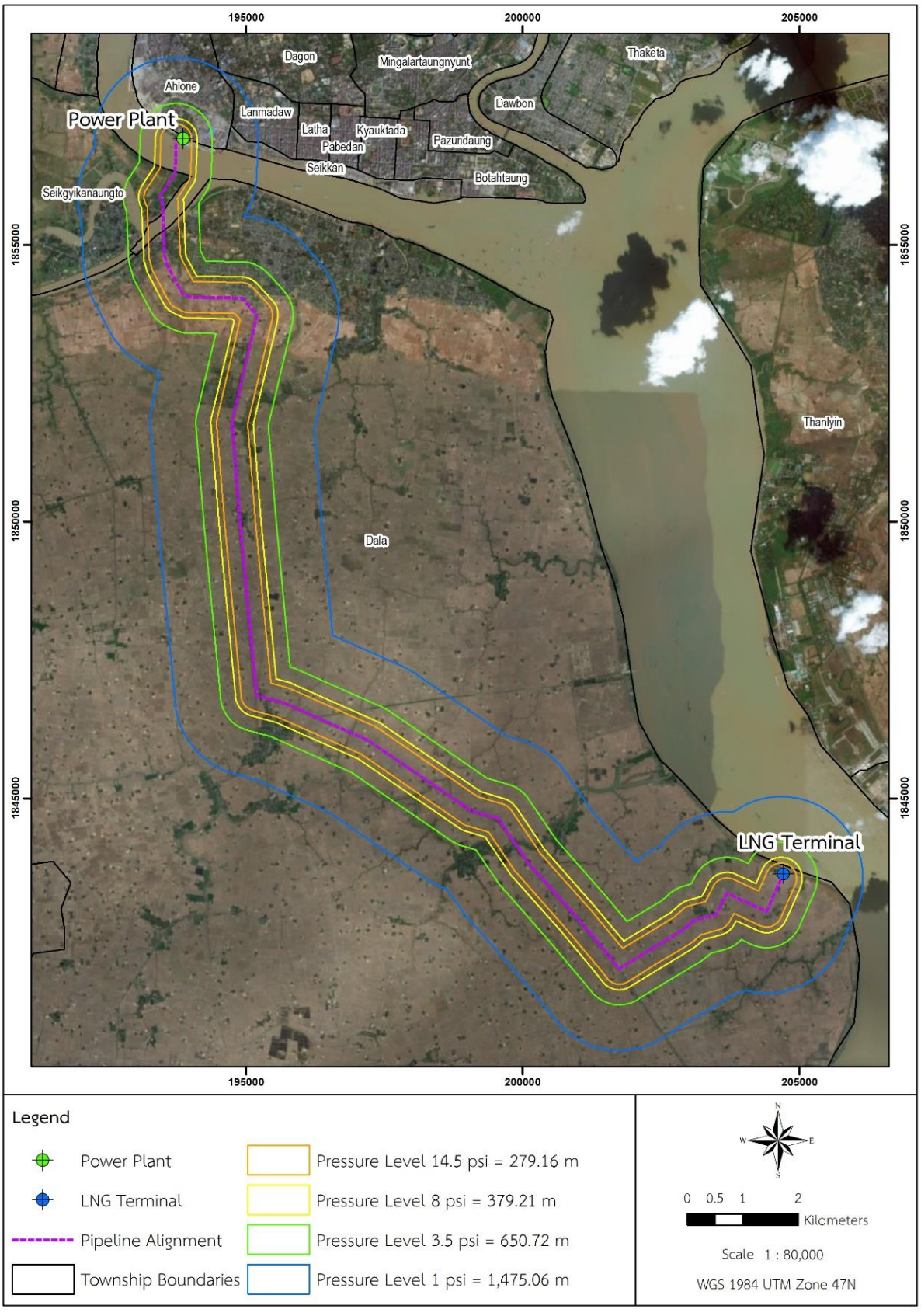
Source: BREEZE Incident Analyst. (Modified by ERM)

Figure 8.4: Heat Radiation Radius in of Flash Fire Scenario



Source: BREEZE Incident Analyst. (Modified by ERM)

Figure 8.5: Heat Radiation Radius in of VCE Scenario



Source: BREEZE Incident Analyst. (Modified by ERM)

Table 8.42: Concern Levels of Thermal Radiation

Incident Flux (kW/m^2)	Effect	
	Structural Damage	Health Effect
4.0	-	Causes pain if duration is longer than 20s but blistering is unlikely.
12.5	Minimum energy to ignite wood with a flame; melts plastic tubing	1% lethality in 1 min. 1st degree burns in 10s.
25.0	Wood structure is burnt without flame	100% lethality in 1 min. Severe Injury in 10s, when being directly in contact.
37.5	Damage to process equipment	100% lethality in 1 min. 1% lethality in 10s when being directly in contact.

Source: World Bank technical paper number 55, Techniques for Assessing Industrial Hazards a Manual (1998)

Table 8.43: Effects of Overpressure

Blast Pressure (PSI)	Effects
1 PSIG	■ Shatters glass.[a]
3.5 PSIG	■ Serious injury likely.[a] ■ Steel frame building distorted and pulled away from foundation.[b] ■ Severe damage to houses.[c]
8 PSIG	■ Destruction of buildings.[a] ■ Severe damage to reinforced concrete building.[c] ■ Moderate damage to massive concrete building.[c]
14 PSIG	■ Causes those directly exposed to the pressure 1-99% fatality.[a]

Source: [a] Breeze Incident Analyst User Guide Version 1.4, Trinity Consultants (2018)
[b] Lees, Frank P., Loss Prevention in the Process Industries, Vol.1, London and Boston (1980)
[c] Planning Guidance for Response to a Nuclear Detonation, Federal Emergency Management Agency (FEMA) (2010)

Impact Assessment Table

Significance of Impact

Impact	Potential impacts from fire and explosion may cause injury, loss of life or damage to property.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts from fire and explosion would be considered adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Potential impacts from fire and explosion would likely be direct impacts from Project activities.			
Impact Duration	Temporary	**Short-term**	**Long-term**	Permanent
	The impact duration is short-term or long-term depending on the volume of LNG released.			
Impact Extent	**Local**	Regional	International	
	Extent of potential impact would be at the incident location and surrounding. Thus, it is considered Local potential impact.			
Impact Scale	Impact can be varied from property damage, person injury and fatality			
Impact	The frequency over the course of the Project is most likely to be zero occurrences. Fire and			

Significance of Impact					
Frequency	explosion would be a non-repeating, unplanned, event-related impact.				
Impact Consequence	Incidental	Minor	Moderate	Major	**Severe**
	The impact consequence is Severe because there is a possibility for fatality.				
Impact Likelihood	Very Unlikely	Unlikely	**Likely to occur once or more in life of the Project**	Likely to occur once or twice per year	Will likely occurs more than twice per year, or is continuous or certain to occur
	The likelihood of the fire and explosion is anticipated to be Likely to occur once or more in life of the Project.				
Impact Significance	Negligible	Minor	Moderate	**Major**	
	Considering the level of magnitude and likelihood, the significance of the impact from fire and explosion is expected to be Major.				

Mitigation Measures

The Project will implement measures to minimize risk during construction and operation to lowest as possible. The list of mitigation measures include:

- Develop a preventive maintenance program for pipelines in order to avoid failures and implement program regularly;
- Ensure the staff working to standard and strictly follow working procedures in order to prevent any incident;
- Install leak detecting and alarming system in operating areas and along the pipeline;
- Limiting the amount of other flammable materials taken below ground;
- Establish a First-aid centre with 24 hours standby First-aid trained staff. The First-aid centre must be equipped with sufficient first-aid equipment, first-aid kit and medicines
- Gas detection system: gas detector and fire alarm devices will be installed in potential leakage area of toxic chemicals and flammable substances like large size valves, flanges, major rotating equipment and high temperature fluctuation area
- To establish emergency plan emergency procedure set up. The procedure will include explanation of steps and guidelines that everybody has to follow such as below items;
    - Witness should first control the emergency situation or extinguish fire based on emergency activity plan and report to Boardman or shift supervisor or foreman of that unit immediately;
    - The event shall be reported to the higher management level and emergency team shall be immediately formed according to the procedure set forth for providing support;
    - When the emergency signal rings, workers have to stop all activities to a safe condition and move to assembly point immediately;
    - The workers who first witness the accident have to put on the necessary personal protective equipment and enter the incident area from upwind only;
    - Limit the fire areas by utilizing the appropriate firefighting equipment;
    - All firefighting technique has to be exercised routinely during normal situation; and
    - Coordination with outside organizations such as nearby plants, hospitals, outside fire brigade team and so on.
    - Minimising the spread of fire, smoke, fumes or toxic gases;

Residual Impact (Post Mitigation)

With the implementation of the above mitigation measures, the residual impacts are expected to be of **Major** significance.

Monitoring Plan

Regular inspection maintenance of pipeline.

8.9.7.2 Impact of Seismic and Earthquake

Overview

Earthquake events have been identified as potential initiating events for catastrophic releases. The largest ever instrumentally recorded earthquake in Myanmar was a magnitude 8.0 event that occurred at Taunggyi in 23 May 1912, approximately 453 kilometre to northern direction of the Project area. In Yangon where the Project locate, there were a recorded number of earthquake occurring with more frequently since 2010.

The natural gas supply pipeline will be designed as per ASME B31.8: Gas Transmission and Distribution Systems. In compliance ASME B31.8 standard, the thickness and pipeline yield strength are designed to withstand impact of seismic and earthquake activity up to the stress level of 4,481.6 barG. The design would also meet seismic design standard, for example, FEMA, ICC, NEHRP. Though it is possible for major earthquake occurring in the project area once or more in life of the project, the design of facilities is in compliance with design standard. Therefore, the magnitude of the impact will be small.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts from seismic and earthquake may cause injury, loss of life or damage to property.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts from seismic and earthquake would be considered adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts from seismic and earthquake would likely be direct impacts from Project activities.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Potential impacts from seismic and earthquake activities could result in damage to the structure of pipeline and/or injuries of workers around the area at the time of incident depending on magnitude of earthquake. However, there are safeguards in place. Also, the site would be reconstructed afterward if incident occurs, therefore, the impact duration is considered Short-term.				
Impact Extent	**Local**	Regional	International		
	Extent of potential impact would be at the incident location and surrounding. Thus, it is considered Local potential impact.				
Impact Scale	The affected area is expected to be the structures inside the project boundary and community in adjacent area.				
Impact Frequency	The frequency of the seismic and earthquake to occur in Yangon is rare.				
Impact	Incidental	Minor	Moderate	**Major**	Severe

Significance of Impact					
Consequence	The impact consequence from seismic and earthquake is anticipated to be major				
Impact Likelihood	Very Unlikely	Unlikely	**Likely to occur once or more in life of the Project**	Likely to occur once or twice per year	Will likely occurs more than twice per year, or is continuous or certain to occur
	The likelihood of the seismic and earthquake is anticipated to be likely to occur once or more in life of the Project.				
Impact Significance	Negligible	Minor	Moderate	**Major**	
	Considering the level of consequence and likelihood, the significance of the impact from seismic and earthquake is expected to be Major.				

Mitigation / Management Measures

- The Project facilities should be designed to meet the seismic design standard for instance FEMA, ICC, NEHRP etc.;
- Geotechnical studies during design phase and slope stability measures to consider impact of earthquakes of 1 in 10,000 year return period;
- The Project shall provide emergency response plan and procedures for the seism activity for employees working along the project area

Residual Impact (Post Mitigation)

With the implementation of the above mitigation measures, the residual impacts are expected to be of **Moderate** significance.

Monitoring Plan

No monitoring plan is required

8.9.7.3 Impact from Loss of Containment of Chemical during Construction Phase

Overview

During construction phase, loss of containment can occur along the pipeline (loss of natural gas) the degree of impact will be dependent on the available mitigation measures to handle such unplanned event. EPC and the Project Proponent will have different storage facilities on-site. This section will assess the variety of impact characteristics towards all potential receptors during and after loss of containment. The potential impacts and receptors foreseen are as followed:

- Soil and groundwater contamination;
- Surface water contamination;
- Impact to habitat of fauna and flora;
- Disturbance to livelihood of human; and
- Potential health and safety risk to receptors using surface water, soil and groundwater.

Impact Assessment Table

Significance of Impact	
Impact	Potential impacts from loss of containment of waste storage facilities on-site may cause injury, loss of life or damage to property.

Significance of Impact

Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts from loss of containment of waste storage facilities on-site would be considered adverse (negative).				
Impact Type	**Direct**	**Indirect**	Induced		
	Impacts would be direct for soil, surface water and groundwater. Impacts would be indirect for human, flora and fauna or other receptors that uses the impacted soil, surface water and groundwater.				
Impact Duration	Temporary	Short-term	**Long-term**	**Permanent**	
	Loss of containment impact can be seen as long-term impact due to the lasting effect of the impact towards soil, surface water and groundwater. Moreover, if the impact scale is large enough, this could result in a permanent impact to the habitat (habitat loss). Additionally, impact towards human health whereby the impact resulted in death, this is also considered as permanent duration.				
Impact Extent	**Local**	Regional	International		
	The extent of potential impacts would likely be limited to the location where waste storage unit is located (within Project footprint) and therefore is considered local.				
Impact Scale	The scale of the impact will be dependent on the volume of waste in the storage unit at the time of the loss of containment. The scale of potential incident during construction may be substantial but during operation phase, the scale is anticipated to be minimal due to the significant lower storage volume.				
Impact Frequency	If construction and operation activities are carried out appropriately, the frequency is anticipated to be zero (0).				
Impact Consequence	Incidental	**Minor**	**Moderate**	Major	Severe
	Based on the combination of the above impact characteristics, the impact magnitude is considered to be minor to moderate.				
Impact Likelihood	Very Unlikely	Unlikely	**Likely to occur once or more in life of the Project**	**Likely to occur once or twice per year**	Will likely occurs more than twice per year, or is continuous or certain to occur
	The likelihood of the loss of containment is anticipated to be likely to occur once or more in life of the Project during construction phase. The likelihood of the loss of containment is anticipated to be likely to occur once or twice per year during operation phase.				
Impact Significance	Negligible	**Minor**	**Moderate**	Major	
	The combination of minor to moderate consequence level and “likely to occur once or more in life of the Project” to “likely to occur once or twice per year” will result in an overall minor to moderate significance level of impact.				

Mitigation Measures

The following measures will be put in place for the Project during construction phase of the pipeline to reduce the impact on the aforementioned receptors:

- Ensure the integrity of wastewater storage unit to avoid leaking of wastewater and odour to the surrounding receptors;
- Use appropriate waste containers and build secondary containment around chemical or waste storage on-site to avoid spillage of waste and leakage of leachate during waste storage on-site;

- Siting of chemical and waste storage should consider nearby receptors, i.e. site away from watercourses or portable water sources;
- Hazardous waste should be stored so as to prevent or control accidental releases to air, soil and water resources. Where practicable:
  - The storage area should be clearly labelled and demarcated;
  - Readily available information on chemical compatibility should be provided to employees, including labelling each container to identify its contents;
  - Hazardous waste should be stored in a manner that prevents the commingling or contact between incompatible wastes and allows for inspection between containers to monitor leaks or spills;
  - Hazardous waste should be stored in closed containers away from direct sunlight, wind and rain;
  - Hazardous waste storage area should be have an impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest waste container; and
  - Hazardous waste storage areas have adequate ventilation, fire prevention system (if needed).
- Spill response and emergency plans should be prepared and implemented to address the potential accidental release of hazardous waste;
- On-site and off-site transportation of waste should be conducted so as to prevent or minimise spills, release and exposures to employees and public;
- Maintenance facilities should be located on hard standing surfaces within a bounded area. Sumps and oil interceptors should be provided. Maintenance of vehicles and equipment involving activities with potential for leakage and spillage should only be undertaken within areas appropriately equipped to control these discharges; and
- Design discharge point to be furthest away from sensitive receptors.

Residual Impacts (Post Mitigation)

If the recommended mitigation measures are implemented, residual impact significance would be **Negligible** to **Minor** impact.

8.10 Summary of Impact Significance

This section will provide a summary of the significance of impacts for all physical and social receptors within ***Chapter 8***. The following receptors that will be summarized are listed below:

- ***Section 8.1***: Air Quality;
- ***Section 8.2***: Green House Gas;
- ***Section 8.3***: Noise;
- ***Section 8.4***: Surface Water;
- ***Section 8.5***: Soil and Groundwater;
- ***Section 8.6***: Waste;
- ***Section 8.7***: Visual;
- ***Section 8.8***: Social; and
- ***Section 8.9***: Unplanned Event.

The significance of impact for all physical and social receptors are summarized in ***Table 8.44***.

Table 8.44: Summary of the Significance of Impact for Physical and Social Receptors

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
Air	Dust soiling	Construction	Major	Negligible
	Human health	Construction	Major	Negligible
	Ecology	Construction	Major	Negligible
	Dust soiling	Operation	N/A	N/A
	Human health	Operation	N/A	N/A
	Ecology	Operation	N/A	N/A
GHG	GHG Emissions	Construction	Negligible	Negligible
Noise	Transportation	Construction	Minor	Negligible
	Excavation work	Construction	Minor	Negligible
Surface Water	Water intake requirement	Construction	Negligible	Negligible
	Hydrostatic Testing Discharge	Construction	Negligible	Negligible
	Sedimentation	Construction	Negligible	Negligible
Soil and Groundwater	Hydrostatic Testing Water Leakage	Construction	Negligible	Negligible
	Loss of containment of the sending and receiving station for HDD	Construction	Negligible	Negligible
Soil and Groundwater	Loss of containment of waste bentonite storage	Construction	Negligible	Negligible
	Loss of soil due to improper management during site clearance	Construction	Negligible	Negligible

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
	and excavation			
Waste	Improper biomass management	Construction	Minor	Negligible
	Generation and Management of Hazardous Waste	Construction	Minor	Negligible
	Generation and Management of Non-Hazardous Waste	Construction	Minor	Negligible
	Generation and Management of Domestic Solid Waste	Construction	Minor	Negligible
	Generation and Management of Domestic Liquid Waste	Construction	Minor	Negligible
Biodiversity	Permanent and Temporary Habitat Loss	N/A	Minor	Negligible
	Temporary disturbance or displace of fauna	N/A	Negligible	Negligible
	Degradation of Habitat	N/A	Negligible to Minor	Negligible
	Mortality of resident species	N/A	Negligible to Minor	Negligible
Social	Employment	Construction	Positive	
	Fishing and navigation	Construction	Negligible	Negligible
	Economical displacement	Construction	Major	Minor
	Economical displacement	Operation	Negligible	Negligible
	Traffic and transportation	Construction	Negligible	Negligible
	Existing facilities and utilities	Construction	Negligible	Negligible
	Environmental emission	Construction	Minor	Negligible
	Community health and safety	Construction	Moderate	Minor
	Occupational health and safety	Construction	Moderate	Minor
	Cultural Heritage	Construction	Negligible	Negligible
Unplanned Event	Fire and Explosion	All	Major	Major
	Seismic and Earthquake	All	Major	Moderate
	Loss of Containment of Waste Storage	All	Minor to Moderate	Negligible to Minor

9. POWER PLANT IMPACT ASSESSMENT

9.1 Air Quality Impact Assessment

9.1.1 Introduction

The following section presents an assessment of potential impacts from the Power Plant to ambient air quality and identifies whether any additional mitigation or management procedures are needed to maintain residual impacts at environmentally or socially acceptable levels. Such measures are presented where appropriate and elaborated further within the Environmental Social Management Plan (ESMP).

The full Air Quality Impact Assessment (AQIA) containing the detailed methodology and results for each element of the assessment is presented in ***Appendix T*** and is referred to throughout this chapter where necessary to avoid repetition.

The AQIA has been undertaken in line with guidelines set out by the International Finance Corporation (IFC) and in line with international best practice as advocated by the IFC guidance.

9.1.2 Assumption and Limitations

The automatic Haz-Scanner Environmental Perimeter Air Station (EPAS) was deployed at 10 locations in the Study Area for a continuous 72-hour period in both the wet and dry season. The Haz-Scanner monitors a number of air quality parameters including nitrogen dioxide (NO_2) using electrochemical sensors. Electrochemical NO_2 sensors can be susceptible to temperature, relative humidity and interfering gases that can affect the measurement. The NO_2 measurements from the EPAS were therefore analysed and outlying values removed to increase confidence in the results.

Passive diffusion tubes were deployed in triplicate at three locations between the 27 February 2018 and the 2 May 2018, and again from the 12 June 2018 to the 26 June 2018. Monitoring of NO_2 was conducted at 13 monitoring locations. It should be noted that due to unforeseen circumstances the first round of diffusion tubes were deployed beyond the recommended exposure period. The results may therefore be compromised however; they were still used to inform the assessment.

9.1.3 Assessment Methodology

The International Finance Corporation (IFC) Environmental, Health and Safety (EHS) guidelines are considered throughout this AQIA. The IFC guidelines provide the overarching guidance and principles for undertaking the assessment. The key documents considered are:

- IFC General EHS Guidelines for Air Emissions and Ambient Air Quality;
- IFC General EHS Guidelines for Construction and Decommissioning; and
- IFC EHS Guidelines for Thermal Power Plants.

Where necessary, reference is made to other internationally recognised sources of information. These include, but are not necessarily limited to guidelines published by:

- the World Health Organisation (WHO);
- the European Union (EU);
- the United States Environmental Protection Agency (USEPA);
- the Australian National Pollution Inventory (NPi);
- the Department of Environment, Food and Rural Affairs (DEFRA); and
- reputable air quality institutes and working groups such as the Institute of Air Quality Management (IAQM).

The assessment of potential air quality impacts associated with the Project considers:

- sources, nature and quantity of emissions to air;
- a qualitative assessment of construction and decommissioning phase impacts;
- a detailed quantitative assessment of process emissions;
- an assessment of potential impacts on relevant sensitive receptors; and
- mitigation measures to reduce the impacts where necessary.

9.1.4 Baseline Summary

A Project specific air quality monitoring survey was undertaken and the detailed methodology, the result and interpretation is presented in ***Appendix T***, and summarised in ***Chapter 5***. The Study Area for the Power Plant for air quality include a 10 km radius from the facility. The baseline assessment indicates that the existing ambient concentrations of relevant substances in the study area are below the relevant air quality standards. On this basis, the air shed is considered 'non-degraded'.

9.1.5 Impacts during Construction

9.1.5.1 Overview

During the construction phase of the Power Plant, a number of activities have been identified that will potentially result in adverse impacts to ambient air quality due to the generation of total suspended particulate (TSP) and particulate matter (PM_{10}). The key construction phase activities considered include:

- Earthworks including ground excavation; material removal, transfer and stockpiling;
- Construction of the main infrastructure including the power plant and associated facilities; and
- Track out of dusty materials onto the public road network.

The associated impacts that may arise from construction activities include:

- Dust deposition resulting in the soiling of surfaces including homes and places of business;
- Elevated PM_{10} concentrations at air sensitive receptors.

Exhaust emissions from on-site plant (also known as non-road mobile machinery or NRMM) and site traffic are unlikely to impact ambient air quality significantly and have not been considered further.

9.1.5.2 Assessment of Impacts

Dust emissions during the construction phase can vary substantially and will largely depend on the activity being undertaken; the duration of the activity; the size of the site; the meteorological conditions; the proximity and sensitivity of the receptors; and the adequacy of the mitigation measures in place to reduce emissions.

The Institute of Air Quality Management (IAQM)[131] provide specific guidance for defining the dust impact risk from construction sites based on a) the scale and nature of the works; and b) the sensitivity of the receiving area (refer to ***Appendix T***). The premise of the IAQM guidance is that with the implementation of effective site-specific mitigation and management measures, the environmental effect will not be significant in most cases. The guidance also provides screening criteria of 350 m and 50m from the construction site and access road respectively beyond which impacts are not considered likely. A summary of the impact significance associated with the construction of the Power Plant (pre-mitigation) is presented in ***Table 9.1***, ***Table 9.2***, and ***Table 9.3***.

[131] Institute of Air Quality Management (IAQM) (2014) Guidance on the Assessment of Dust from Demolition and Construction [Online] Available at: http://iaqm.co.uk/guidance/ [Accessed 13 February 2019]

Table 9.1: Summary of Dust Risk from the Power Plant Construction (Pre-Mitigation)

Potential Impact	Risk [a]			
	Demolition	Earthworks	Construction	Track out [b]
Dust Soiling	Negligible	Low	Low	*n/a*
Human Health	Negligible	Low	Low	*n/a*
Ecological	Low	Medium	Medium	*n/a*

[a] *As per IAQM approach*
[b] *A review of the aerial imagery indicates that there are no sensitive receptors adjacent to the access road so the assessment of risk associated with track out is considered 'not applicable'.*

Table 9.2: Assessment of Impact on Human Health and Nuisance Relating to Power Plant Construction (Pre-Mitigation)

Significance of Impact					
Impact	Potential impacts on Ambient Air Quality				
Impact Nature	**Negative**	Positive	Neutral		
	Impacts to ambient air quality are considered adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to ambient air quality are considered direct.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Potential impacts to air quality will occur throughout the construction phase, which will take approximately 23 months. The duration is therefore short term.				
Impact Extent	**Local**	Regional	International		
	Construction activities at the site have the potential to result in emissions of dust up to 350 m from the construction site boundary. The extent is therefore local.				
Impact Scale	Potential impact will occur up to 350 m from the construction site boundary.				
Frequency	The impact will occur during daytime working hours (08:00-22:00) throughout the construction phase.				
Impact Magnitude	Positive	Negligible	Small	Medium	**Large**
	The expected dust emission magnitude during construction phase activities is predicted to be large from earthworks; medium from construction and track out; and small from demolition.				
Receptor Sensitivity	**Low**	Medium	High		
	There are approximately 10-100 human receptors <100 m from the site boundary and between 1-10 human receptors <50 m from the site boundary The sensitivity of the area is therefore considered low.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The significance of the impact is expected to be minor at worst.				

Table 9.3: Assessment of Impact on Ecology Relating to Power Plant Construction (Pre-Mitigation)

Significance of Impact					
Impact	Potential impacts on Ambient Air Quality				
Impact Nature	**Negative**	Positive	Neutral		
	Impacts to ambient air quality would be considered adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to ambient air quality are considered direct.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Potential impacts to air quality will occur throughout the construction phase only, which will take approximately 23 months. The duration is therefore short term.				
Impact Extent	**Local**	Regional	International		
	Construction activities at the site have the potential to result in emissions of dust up to 50m from the construction site boundary. The extent is therefore local.				
Impact Scale	Potential impact will occur up to 50 m from the construction site boundary.				
Frequency	The impact will occur during daytime working hours (08:00-22:00) throughout the construction phase.				
Impact Magnitude	Positive	Negligible	Small	Medium	**Large**
	The expected dust emission magnitude during construction phase activities is predicted to be large from earthworks; and medium from construction and track out.				
Receptor Sensitivity	Low	**Medium**	High		
	Mangroves exist within 20 m from the site boundary The sensitivity of the area is therefore considered medium.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The significance of the impact is expected to be moderate at worst.				

9.1.5.3 Mitigation Measures

The mitigation measures required during the construction of the Power Plant based on the outcome of the dust risk assessment summarised in ***Table 9.1*** include:

- Develop and Implement a Dust Management Plan (DMP) detailing mitigation measures and a plan for implementation.
- Watering will be used to suppress wind and physical disturbance dust generation.
- Ensure an adequate water supply on site for effective dust suppression and mitigation.
- The site layout will be planned so that dust-causing activities are located away from receptors as far as is possible.
- Screens or barriers will be erected around dusty activities or the site boundary that are at least the height of any stockpile on site.
- All stockpiles will be covered or fenced off to prevent wind whipping.
- Only cutting, grinding, or sawing equipment fitted with suitable dust suppression techniques such as water sprays will be used.
- No waste will be burned on site.

- Re-vegetate earthwork and exposed areas as soon as is practicable.
- Use hessian, mulches or trackifiers where it is not possible to revegetate, or cover with top soil as soon as is practicable.
- Sand and other aggregates will be stored in bunded areas and will not be allowed to dry out unless this is required for a particular process, in which case additional control measures such as those detailed in this section will be applied.
- Ensure that all vehicles entering and leaving the site are covered to avoid fugitive emissions during transport.
- Inspect on-site haul roads for integrity and instigate the necessary repairs to the surfaces as soon as reasonable practicable.
- Implement a wheel washing system.
- Regularly dampen and clean the site access and local roads to remove any materials tracked out of the site.
- All site access gates will be located at least 10 m away from air sensitive receptors where possible.
- The site layout will be planned so that machinery is located away from receptors as far as is possible.
- All vehicles will switch off engines when stationary.
- A regular vehicle and machinery maintenance and repair programme will be implemented.
- Mains electricity or battery powered equipment will be used instead of diesel/petrol generators where practicable.

9.1.5.4 Residual Impact

The IAQM guidance suggest that when correctly applying and actively managing the prescribed mitigation and management measures the impacts to receptors located within 350 m downwind of any construction activity are not likely to be significant for the large majority of the time. However, due to the nature of construction activities, the scale and duration of the construction phase, and the possibility of extreme weather conditions, it is possible that communities will experience occasional, short-term dust annoyance. The IAQM states, "*the likely scale of this would not normally be considered sufficient to change the conclusion that with mitigation the effects will be 'not significant'*. On this basis, it can be concluded that construction phase activities are likely to result in a negligible impact at worst post mitigation.

9.1.5.5 Monitoring Plan

TPMC are required to implement the following monitoring procedures:

- Regular site inspections to monitor compliance with the DMP. All inspection results will be recorded and corrective actions taken where mitigation and management measures are not being implemented effectively (i.e. to reduce dust emissions).
- Daily onsite and offsite inspections to visually assess the dust emissions from earthwork and construction activities, and from vehicles exiting the construction sites. Results from the inspection will be recorded and mitigation measures intensified where necessary to reduce emissions. The frequency of site inspections will be increased when activities with a high potential to produce dust are being carried out and during prolonged dry and windy conditions.

9.1.6 Impacts during Operation

9.1.6.1 Overview

During the operation of the Power Plant the continuous operation of two-117 MW[132] natural gas fired turbines will potentially result in adverse impacts to ambient air quality and are considered further in this chapter.

9.1.6.2 Assessment of Impacts

Processes associated with the operation of the Power Plant including the combustion of natural gas will result in elevated ambient concentrations of nitrogen dioxide (NO_2) in the atmosphere. The resulting impact to ambient air quality at sensitive receptor locations during the operation phase was quantitatively assessed using the latest USEPA AERMOD dispersion model version 18081. AERMOD is a state of the art detailed dispersion model that can represent complex multiple emission sources and predict air quality at receptor locations taking into account meteorology. The model is widely recognised for use in this type of application, including by the IFC, United States Environmental Protection Agency (USEPA), UK Environment Agency and state based EPA's throughout Australia. Three years of hourly sequential meteorological data was used so that inter annual variability was incorporated into the model. The detailed modelling and assessment methodology including the approach for determining the magnitude and the significance of impacts, receptor grid spacing, meteorological data information, NO_x to NO_2 conversion and the treatment of buildings, land use and terrain is discussed in ***Appendix T***.

The Power Plant modelling scenario considers the continuous operation of two-117 MW natural gas fired turbines. The emissions from the turbines are derived from the manufactures guaranteed NO_x emission concentration of 51 mg/Nm^3. The modelling scenario assumes continuous emissions throughout one entire year comprising of 365 days. In practice, the power plant will operate below the guaranteed emission level, thus the modelling scenario is an absolute worst-case representation of the potential impact on ambient air quality.

The IFC's General EHS guideline for air emissions and ambient air quality states that:

- *Projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that:*

  - *emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines, or other internationally recognised source; and*

  - *emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed.*

A summary of the maximum-modelled NO_2 concentrations found anywhere on the modelling grid and their impact significance is provided in ***Table 9.4***; and the contour figures showing dispersion are provided in ***Figure 9.1*** and ***Figure 9.2***, and the summary of the impacts is presented in ***Table 9.5***. The assessment finds that the maximum PC and PEC is likely to be below 25% and 100% of the relevant air quality standard respectively throughout the study area. On this basis, the impact to ambient air quality from Power Plant operation is expected to be negligible.

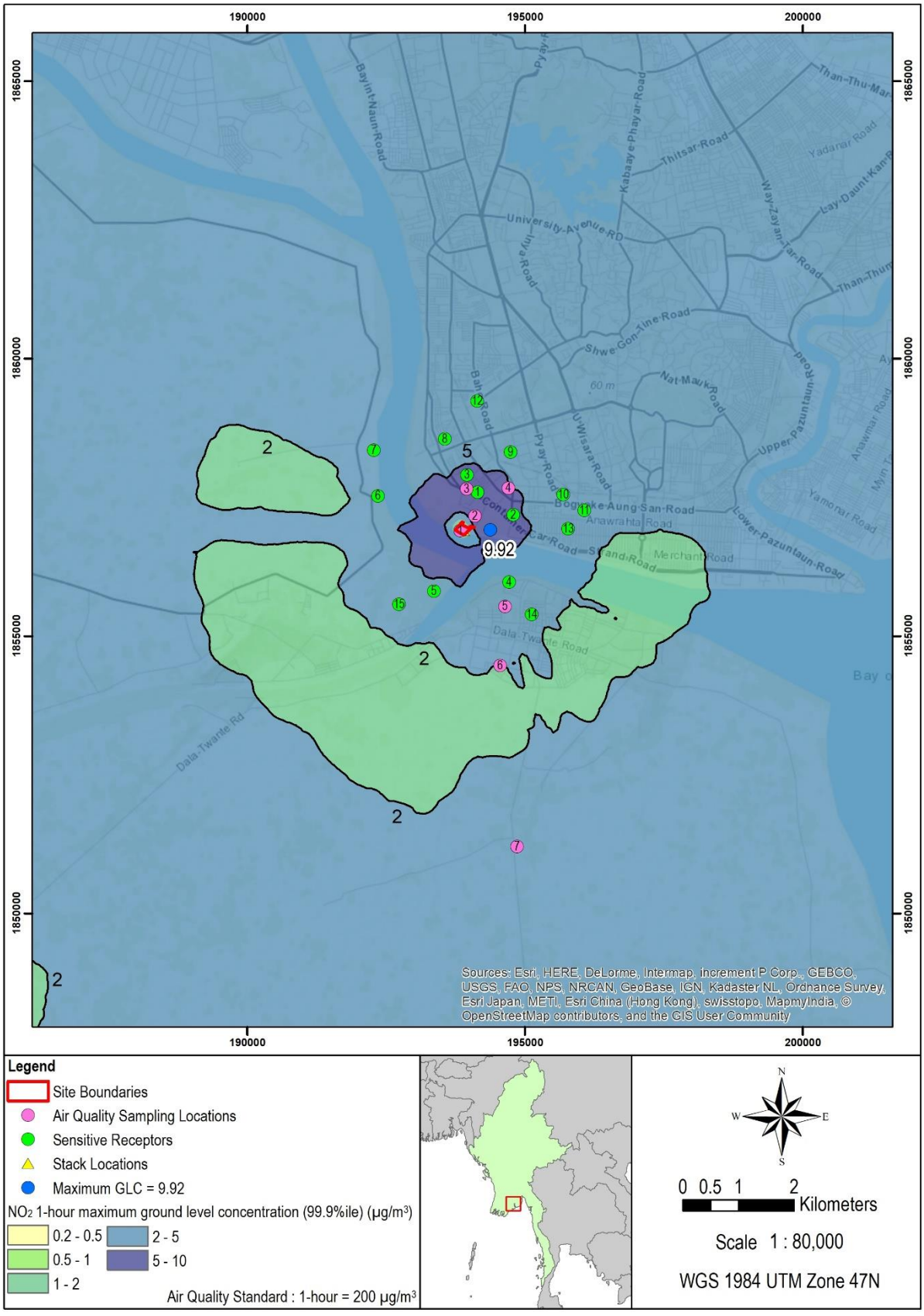
[132] Expected output during operation and is not representative of the maximum steam turbine's capacity.

Table 9.4: Summary of Power Plant Modelling Results

Substance	Averaging Period	Baseline[a] (µg/m^3)	Max. PC[b] (µg/m^3)	Max. PEC[c] (µg/m^3)	AQS[d]	Significance of Impact
NO_2	1-hour	170	9.92	180	200	Negligible
	Annual	24.6	0.0446	25.0	40	Negligible

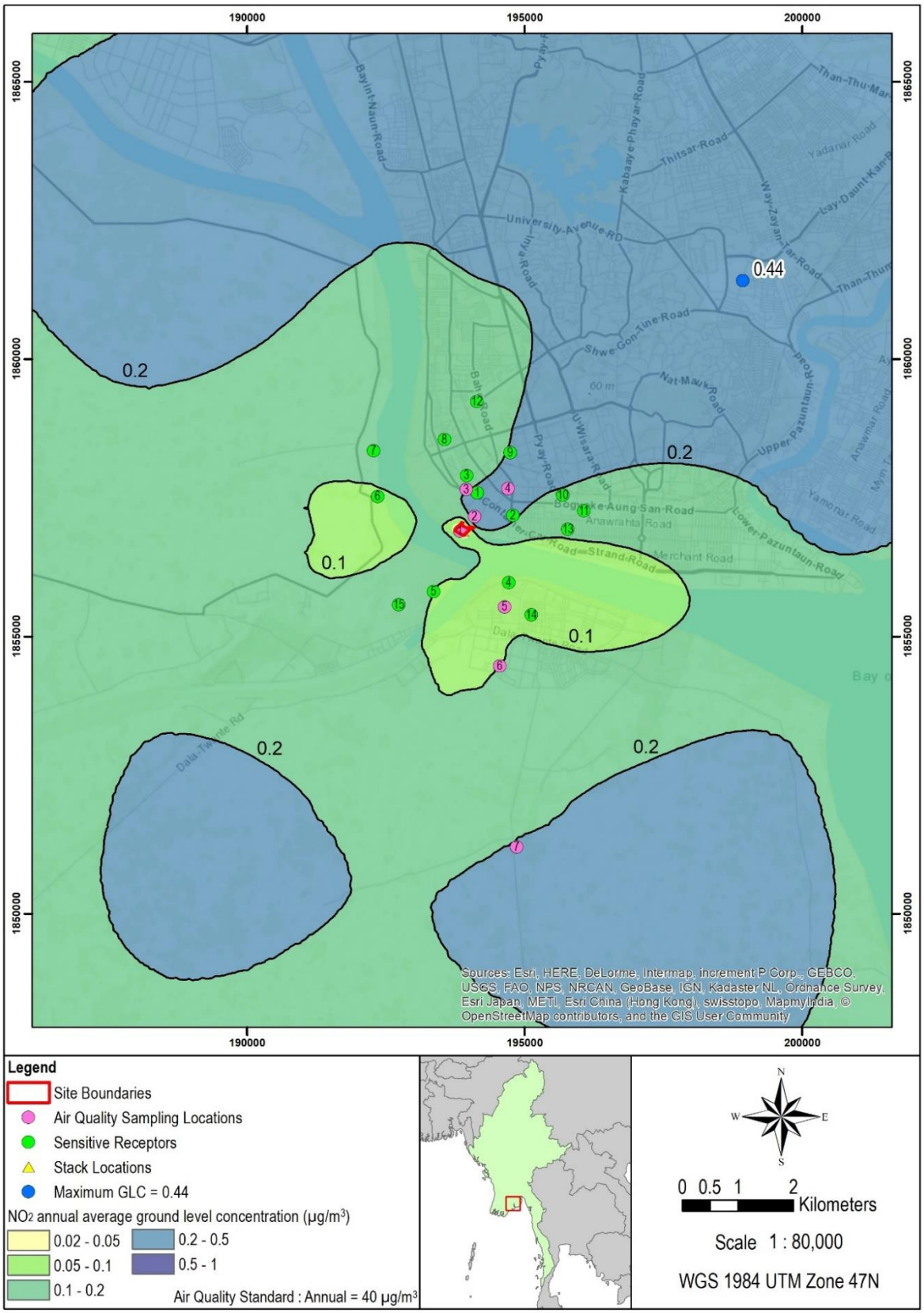
[a] *Refer to the baseline assessment in the air quality impact assessment presented in* ***Appendix T****.*
[b] *Process Contribution is the impact arising solely from project related emissions*
[c] *Predicted Environmental Concentration is the PC added to the existing baseline*
[d] *Air Quality Standard as prescribed in the National Environmental Quality (Emission) Guidelines (NEQEG) (2015)*

Figure 9.1: Power Plant Modelling Results (NO_2 1-hour Average)



Source: ERM, 2019.

Figure 9.2: Power Plant Modelling Results (NO_2 Annual Average)



Source: ERM, 2019.

Table 9.5: Assessment of Impact Relating to Air Quality during Normal Operation of the Power Plant (Pre-Mitigation)

Significance of Impact					
Impact	Potential impacts on Ambient Air Quality				
Impact Nature	**Negative**	Positive	Neutral		
	Impacts to ambient air quality would be considered adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to ambient air quality are considered direct.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Potential impacts to air quality will occur throughout the operation phase only. The duration is therefore long-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts were considered up to 10 km from the Power Plant stack location and are considered local in their extent.				
Impact Scale	The scale of the impacts is likely to be within 10km from the point of release.				
Frequency	The impact will occurs 24/7 during the operation phase assuming continuous operation.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The expected impact magnitude is negligible.				
Receptor Sensitivity	Low	**Medium**	High		
	The approach assumes that sensitivity within the general study area is medium for human health.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The significance of the impact is expected to be negligible at worst.				

9.1.6.3 Mitigation and Management

The impact assessment defines the impacts on ambient air quality during operation as negligible therefore no additional mitigation measures are considered necessary.

9.1.6.4 Residual Impact

The predicted residual impact to ambient air quality during normal operation is negligible.

9.1.6.5 Monitoring Plan

To minimise and control impacts to air quality during Power Plant operation, international good practice monitoring measures will be implemented including:

- Continuous stack emission monitoring (CEM) throughout the operational lifetime of the power plant to confirm that the NO_x emission concentration does not exceed the turbine manufacturer guarantee of 51 mg/Nm^3; and

Annual stack emission testing at the power plant will be undertaken to counter check the performance of the continuous emission monitoring system.

9.2 Greenhouse Gas Impact Assessment

9.2.1 Introduction

During the construction and operation phases, different activities have the potential to increase greenhouse gas emissions. The main emission sources are released from fuel combustion (for example, natural gas combustion in electricity generation process, diesel fuel combustion in mobile vehicles).

This chapter provides an estimate of the greenhouse gas (GHG) emissions that are likely to be emitted by the LNG Power Plant (Ahlone) Project (also referred to as 'Project'), as related to the issue of climate change. GHGs are assessed in order to provide an indication of what a Project's GHG emissions will be, and to find ways to mitigate them early in the development process.

9.2.2 Assumption and Limitation

It is noted that all greenhouse data in this report cannot yet be used for official greenhouse gas inventory reporting[133] until the site is operational and actual operational data would be used for a more precise GHG inventory calculation.

All greenhouse gas calculation methodologies have been formulated using accurate calculation methodologies sourced from Intergovernmental Panel on Climate Change (IPCC). These methodologies can be replicated for greenhouse gas inventory use when the Project becomes operational.

In this chapter, some assumptions are made, as below:

- Equator Principles (June 2013) stated that Quantification of GHG emissions will be conducted by the client in accordance with internationally recognised methodologies and good practice, for example, the GHG Protocol. The client will quantify Scope 1 and Scope 2 emissions. Therefore, quantification of GHG emissions for the Project will consider Scope 1 (direct emissions from the facilities owned or controlled within physical Project boundary) and Scope 2 (indirect emissions associated with the off-site production of energy used by the Project), and excluding Scoping 3` emissions.
- The GHG assessment for the Project will focus on the construction and operation phases, excluding pre-work and land development phases, as the majority of the Project emissions will occur during these periods. A total area of the Project is approximately 8.97 acres or about 36,300 m^2 with the current land use of scrubland with thickets of shrubs, young trees, degraded mangrove trees, and agricultural land for rice farming with some grazing areas for livestock, in which are not biomass-rich areas. The change in land use characteristics for development of the Project would alter the carbon stock due to removal of vegetation, but the effect is considered to be small.
- This document focuses on CO_2, CH_4, and N_2O emissions, because these are the most prevalent GHGs emitted from power industry operations.

9.2.3 Assessment Methodology

According to the Greenhouse Gas Protocol, greenhouse emissions fall under the following three scopes:

- **Scope 1 - Direct GHG emissions**: Direct GHG emissions occur from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc.; emissions from chemical production in owned or controlled

[133] Official greenhouse gas inventory reporting includes Sustainability Reporting, CDP, DJSI or other nationally relevant greenhouse reporting schemes.

process equipment. Direct CO_2 emissions from the combustion of biomass shall not be included in scope 1 but reported separately.

- **Scope 2 - Electricity indirect GHG emissions**. Scope 2 accounts for GHG emissions from the generation of purchased electricity consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated.
- **Scope 3 - Other indirect GHG emissions**. Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by the company. Some examples of scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services.

Scope 1, 2 have been considered for this Project, which were quantified according to the following standards:

- GHG Protocol Corporate Accounting and Reporting Standard; and
- GHG Protocol Scope 2 Guidance
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories

The assessment of impact magnitude and significance related to GHG is based on the methodology described in ***Chapter 6***. The mitigation measures are based on international good practice (as recommended under the IFC EHS Guidelines), and good practice relevant to GHG emissions.

9.2.3.1 Global Warming Potentials

The global warming potentials (GWPs) used in this assessment are sourced from the 2007 IPCC Fourth Assessment Report (AR4). Although the 2013 Fifth Assessment Report (AR5) provides the latest GWPs, the GWPs from the AR4 are more commonly adapted.

The global warming potential is used to evaluate the potency of non-CO_2 greenhouse gases compared to CO_2 as a baseline. For example, methane (CH_4) is 25 times more potent than CO_2 in its global warming effect, meaning that 1 kg of CH_4 emitted is equivalent to 25 kg of CO_2 emitted. The 100 years' time horizon is used in line with greenhouse gas inventory best practices. Detail of GWP factors are in ***Table 9.6***.

Table 9.6: Global Warming Potentials

Industrial Designation or Common Name	Chemical Formula	Global Warming Potential for 100-years' Time Horizon from IPCC Fourth Assessment Report
Carbon Dioxide	CO_2	1
Methane	CH_4	25
Nitrous Oxide	N_2O	298

Source: IPCC Fourth Assessment Report Working Group I
https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

9.2.3.2 Emission Factor

An emission factor represents an average emission rate for a given source, and is generally expressed as mass or volume of emissions per source type or measure of activity related to the source.

The 2006 IPCC Guidelines provide emission factors for stationary and mobile combustion, Default emission factors provided in ***Table 9.7*** and ***Table 9.8*** below, are related to the Project activities and used for the purposes of this report.

Table 9.7: Default IPCC Emission Factors for Stationary Combustion

Fuel	$kgCO_2/TJ$ (default)	$kgCH_4/TJ$ (default)	kgN_2O/TJ (default)
Motor Gasoline	69,300	3	0.6
Gas/ Diesel Oil	74,100	3	0.6
Natural Gas	56,100	1	0.1

Source: IPCC 2006 V.2 Ch.2 Table 2.2

Table 9.8: Default IPCC Emission Factors for Mobile Combustion

Fuel	$kgCO_2/TJ$ (default)	$kgCH_4/TJ$ (default)	kgN_2O/TJ (default)
Mobile Combustion (equipment/ machineries)			
Gas/ Diesel Oil	74,100[a]	4.15[a]	28.6[a]
Motor Gasoline (4-stroke)	69,300[a]	50[a]	2[a]
Mobile Combustion (Road Transport)			
Gas/ Diesel Oil	74,100[b]	3.9[c]	3.9[c]

Source: [a] IPCC 2006 Vol. 2 Ch. 3 Table 3.3.1
[b] IPCC 2006 Vol. 2 Ch. 3 Table 3.2.1
[c] IPCC 2006 Vol. 2 Ch. 3 Table 3.2.2

9.2.3.3 Net Calorific Values and Density

Often energy data, consumption of solid, liquid and gaseous fuel are expressed in physical units, eg in litres, tonnes or cubic metres. For the purposes of greenhouse gas calculations, the apparent consumption should be converted to terajoules (TJ) on a net calorific value basis.

To convert these data to common energy units, this report uses conversion factors for the energy content of fuel provided in ***Table 9.9***.

Table 9.9: Default Net Calorific Values

Fuel Type	Net Calorific Value	Typical Density
Gas/ Diesel Oil	43.0 TJ/Gg[a]	874.31 kg/m^3 [b]
Gasoline	44.3 TJ/Gg[a]	742.39 kg/m^3 [b]
Natural Gas	48.0 TJ/Gg[a]	0.6728 kg/m^3 [b]

Source: [a] IPCC 2006 Vol. 2 Ch. 1 Table 1.2
[b] API 2009 Compendium of Greenhouse Gas Emissions Methodologies for Oil and Natural Gas Industry Table 3-8

9.2.4 Baseline Summary

Myanmar's total GHG emissions in 2013 were 201.5 million metric tons of carbon dioxide equivalent ($MtCO_2e$), totalling 0.42 percent of global GHG emissions.[134]

According to the World Resources Institute Climate Analysis Indicators Tool (WRI CAIT), and Land Use Change and Forestry (LUCF) activities, were the leading sources of Myanmar's [135] GHG emissions in 2013, accounting for 51.0% of the country's total emissions.[136] Within the LUCF sector, changes in forest land contributed 73% of emissions.[137] Agriculture was the second most significant source (32.1%) with rice cultivation and enteric fermentation from livestock contributing 67% of agriculture emissions.[138] Energy was responsible for 10.9% of emissions, of which 50% were due to fugitive emissions and other fuel combustion. Waste and Industrial Processes (IP) contributed 5.8% and 0.2% of total emissions respectively.

9.2.5 Receptor Identification and Sensitivity

The direct receptor in the scope of this impact assessment is the global atmosphere. The indirect receptors from climate change due to an increase global greenhouse gas emissions include Myanmar's weather.

In accordance to National Oceanic and Atmospheric Administration (NOAA), *Global Climate Report – Annual 2018*, describes that 11 of 12 months of global land and ocean average temperature departures ranked among the five warmest for the respective years, becoming the fourth warmest year in NOAA's 139-year records, in which the top warmest years are all from the recent years (2015-2017) since the pre-industrial time. The year 2018 began with a La Niña episode present across the tropical Pacific Ocean, transitioning to ENSO-neutral by April 2018.[139] The frequency and intensity of extreme high temperature events are virtually certain to increase in the future as global temperature increases (high confidence). Extreme precipitation events will also very likely continue to increase in frequency and intensity throughout most of the world (high confidence).

Myanmar's Intended Nationally Determined Contribution (INDC) reported that Myanmar is extremely vulnerable to the negative effects of climate change. In 2015, for the third year, Myanmar was ranked globally by studies, as the second most vulnerable country in the world to extreme weather events over the last 20 years. In addition, climate models predict further sustained impacts from climate change in the future, which will further expose Myanmar to the negative impacts of climate change. Thus global GHG emission would highly influence the negative impact on Myanmar.

9.2.6 Project Activities

Based on the Scoping Study, and the Project Description and Alternatives (presented in ***Chapter 4***), the key potential impacts on greenhouse gas identified arise from the following activities.

9.2.6.1 Construction Phase

The main equipment and machineries used in contributing to Scope 1 and 2 of greenhouse gas emissions at the Project site are illustrated in ***Table 9.10***. By which, the majority of GHG emission sources come from mobile combustion devices, including transportation. GHG is estimated under the assumption that most of the fuel consumed by the construction machineries would be diesel, except

[134] https://www.climatelinks.org/resources/greenhouse-gas-emissions-factsheet-burma

[135] Burma ratified the UNFCCC as Myanmar. UNFCCC Status of Ratification, viewed on March 20, 2017.

[136] World Resources Institute Climate Analysis Indicators Tool (WRI CAIT 2.0, 2017). Global Warming Potentials (GWPs) are from the Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report (SAR).

[137] Food and Agriculture Organization of the United Nations Statistics Division (FAOSTAT). Myanmar, Emissions – Land use total, viewed on March 18, 2017.

[138] FAOSTAT. Myanmar, Emissions – Agriculture total, viewed on March 18, 2017.

[139] https://www.ncdc.noaa.gov/sotc/global/201813

for pump and vibrator which use gasoline. Also, the calculation for GHG emission would be based on the fuel consumption of each machines. In which the machineries would operate 8 hrs/day for 26 weeks/year, and for transportation, it is assumed that transporting vehicles would be operating 8 hrs/day, 6 days/week, for 26 weeks/year.

Table 9.10: Project Scope and Activity by Emission Source during Construction

Project Component	Source Class	Scope 1 Emission Source (direct emission from project)	Scope 2 Emission Source (indirect emission, grid energy)
Power Plant	Stationary Combustion	■ Generator (Diesel) ■ Compressor (Diesel) ■ Pump (Gasoline)	Electricity purchased from the grid connected from substation, then connected to the Project.
	Mobile Combustion (equipment/ machineries)	■ Backhoe (Diesel) ■ Dozer (Diesel) ■ Grader (Diesel) ■ Truck (Diesel) ■ Concrete Pump Car (Diesel) ■ Concrete Truck (Diesel) ■ Crane (Diesel) - crane 200 ton - crane 100 ton - crane 50 ton ■ Pile Driver (Diesel) ■ Vibrator (Gasoline) ■ Fork Lift (Diesel)	
	Mobile Combustion (transportation)	■ 10-wheel truck(25ton) (Diesel) ■ 4-wheel truck(5 ton) (Diesel)	

Note: Mobile sources is a term used to describe a wide variety of vehicles, engines, and equipment that generate air pollution and that move, or can be moved, from place to place. It includes vehicles used on roads for transportation of passengers or freight as well as off-road vehicles, engines, and equipment used for construction, agriculture, transportation, recreation, and many other purposes. By definition, other combustion sources are considered to be stationary (Stationary Combustion Guidance, WRI/WBCSD (2005).

9.2.6.2 Operation Phase

During the operation phase, main source of GHG emissions will be from natural gas combustion for electricity generation. The source of emission during operation illustrates in ***Table 9.11***.

Table 9.11: Project Scope and Activity by Emission Source during Operation

Project Component	Source Class	Scope 1 Emission Source	Scope 2 Emission Source
Power Plant	Stationary Combustion	Natural gas for Gas Turbine Generator	N/A

Note: Scope 2 during the operation phase is omitted since electricity produced from the Project would also be utilized for facilitating within the project area before distribution.

9.2.7 Assessment of Impacts

9.2.7.1 Impact to Greenhouse Gas Emission during Construction Phase

9.2.7.2 Summary of Scope 1 and 2 Emissions

The total release of GHG emissions during construction phase is estimated to be 2,891.06 tonnes CO_2eq per year as shown in ***Table 9.12***. The majority of emissions during construction phase are from use of mobile equipment/ machineries onsite, followed by indirect emission from electricity purchased from national grid.

Table 9.12: Emissions Breakdown by Scope and Activity

Emission Scopes	Unit	Value
Scope 1 Direct Emissions		
Stationary Combustion	tCO_2eq/year	160.50
Mobile Combustion (equipment/ machineries)	tCO_2eq/year	1,552.19
Mobile Combustion (transportation)	tCO_2eq/year	788.29
Total Direct Emission	**tCO_2eq/year**	**2,500.98**
Scope 2 Electricity Indirect GHG Emissions		
Electricity Purchased (Myanmar's national grid)	tCO_2eq/year	390.08
Total Indirect Emission	tCO_2eq/year	**390.08**
Total Emission Scope 1 + Scope 2	tCO_2eq/year	**2,891.06**

Scope 1 Direct Emissions

Scope 1 Direct Emissions would consists of 3 emission sources: stationary emission, mobile emission (equipment/ machinery), and mobile emission (transportation). Calculations detail are in the following sections.

Stationary Combustion

Stationary Combustion is defined as devices that combust solid, liquid, or gaseous fuel, generally for the purposes of producing electricity, generating steam, or providing useful heat or energy for industrial, commercial, or institutional use. Also includes auxiliary devices that assist in the electricity/ heat generation system i.e. pump, and compressor.

Tier 1 method of IPCC was selected since information regarding site specific or country specific emission factors are not available. This approach is used to estimate the GHG emission in general by analyzing the emission based on fuel consumption.

Applying Tier 1 emission estimation would require the following data:

- Data on the amount of fuel combusted in the source category
- A default emission factor

In general, GHG emissions based on fuel use is the product of fuel consumption and emission factor of the fuel source as illustrated in the following ***Equation 14***:

Equation 14: Greenhouse Gas Emissions from Stationary Combustion

$$Equation_{GHG,fuel} = Fuel\ Consumption_{fuel} \times Emission\ Factor_{GHG,fuel}$$

Where:

$Emission_{GHG,fuel}$ = emission of a given GHG by type of fuel (kg GHG)

$Fuel\ Consumption_{fuel}$ = amount of fuel combusted (TJ)

$Emission\ Factor_{GHG,fuel}$ = default emission factor of a given GHG by type of fuel (kg gas/TJ).

For CO_2, including the carbon oxidation factor assumed to be 1.

Source: 2006 IPCC guideline for National Greenhouse gas inventories, Volume 2: Energy Chapter 2

In this Project, onsite machineries used for stationary combustion which include generator and compressor, are assumed to be utilizing 8 hours/day for 26 weeks/year and use diesel as the main fuel source. Based on the operational time during construction period mentioned, the estimation of fuel consumption is approximately equal to 57,408 litres/year as detailed in ***Table 9.13***.

Table 9.13: Expected Stationary Combustion

Project Component	Source	Mobile Fuels	Units	Estimated Annual Consumption
Power Plant	Generator	Diesel	litre/year	44,928.00
	Compressor	Diesel	litre/year	12,480.00
			Total	**57,408.00**

Source: Fuel consumption estimated by TPMC and adjusted by ERM for the purpose of assessment in this report.

Fuel volume provided in ***Table 9.13*** will be converted to energy use (in terms of TJ of energy use) by multiplied with Net Calorific Value (NCV) and its density as provided in ***Table 9.9*** using the ***Equation 15*** and ***Equation 16*** below.

Equation 15: Fuel Energy Consumption (Diesel)

$$Fuel\ Consumption\ (TJ) = Diesel\ Use\ (I) \times NetCalorific\ Value\ (TJ/Gg) \times Diesel\ Density\ (kg/m^3) \times 10^{-6}(Gg/kg) \times 10^{-3}(m^3/I)$$

Equation 16: Fuel Energy Consumption (Gasoline)

$$Fuel\ Consumption\ (TJ) = Gasoline\ Use\ (I) \times NetCalorific\ Value\ (TJ/Gg) \times Gasoline\ Density\ (kg/m^3) \times 10^{-6}(Gg/kg) \times 10^{-3}(m^3/I)$$

From ***Table 9.9***, default NCV value for diesel is 43.0 TJ/Gg and diesel density is 874.31 kg/m^3. The total energy consumption on the amount of fuel use 57,408 litres/year equal to 2.16 TJ.

Fuel Consumption (TJ) = Diesel Use (l) x 43.0 (TJ/Gg) x 874.31 (kg/m^3) x 10^{-6} (Gg/kg) x 10^{-3} (m^3/l)

= Diesel Use (l) x 3.76 x 10^{-5} (TJ/l)

= 57,408 (l) x 3.76 x 10^{-5} (TJ/l)

= 2.16 TJ

After annual energy consumption, in term of fuel use, is identified, the multiplication of emission factor and GWP would be used to calculate the amount of total emission in the unit of kilogram of CO_2 equivalent per year. The estimated GHG emission for generators and compressor operated during construction is on average 160.50 tonnes CO_2e/year, as shown in Table 9.2 9.

Table 9.14: Expected Stationary Emissions for Power Plant during Construction

Mobile Combustion	Annual Use (litre/year)	Annual Energy Use (TJ)	Annual Emissions (kg/year)			Total CO_2eq Emissions	
			CO_2	CH_4	N_2O	Kg CO_2eq/year	Tonnes CO_2eq/year
Diesel Emission Factors (kg of GHG/ TJ)[b]			74,100	3.0	0.6		
Global Warming Potential for 100-year time horizon[a]			1	25	298		
Diesel	57,408.00	2.16	159,947.87	161.89	385.95	160,495.71	**160.50**

Source: [a] refers to ***Table 9.6***.

[b] 2006 IPCC guideline for National Greenhouse gas inventories, Volume 2: Energy Chapter 2.

Mobile Combustion

Mobile sources are used to describe types of vehicles, engines, and equipment that generate air pollution and that can be moved or travelled into distance.

According to IPCC guideline (2006) mobile combustion is referred to emission of fuel for all transportation activity (excluding military transport). It includes vehicles used on roads for transportation of passengers or freight as well as off-road vehicles, engines, and equipment used for construction, transportation and many other purposes.

Emissions can be estimated from either the fuel consumed as determined through direct measurements of fuel use (from purchase records, storage tank measurements, or company records) or the distance travelled by the vehicles. In general, the first approach (fuel consumed) is appropriate for CO2 and the second approach (distance travelled by vehicle type and road type) is appropriate for CH4 and N2O. Nevertheless, the Project is still in a planning process, actual data are not yet collected. Therefore, the assessment based on the information from other Project with similar activities, and from the experience of the project's owner, are considered as baseline.

Generally, when calculating GHG emissions for mobile combustion of mobile equipment/machineries, the information that needs to be determined first is the quantity of fuel use for combustion, in term of energy use. The emission equation for mobile combustion is shown in ***Equation 17***.

Equation 17: Calculation Method for GHG Emissions from Mobile Sources

$$Emissions = \sum (Fuel_j \cdot EF_j)$$

Where:

Emission = emissions (kg)

$Fuel_j$ = Fuel type j consumed (TJ)

EF_j = emission factor for fuel type j (kg/TJ)

Similar to stationary combustion, the emission based on NCV value for emission of each GHG of fuels (Diesel and Gasoline) would be used as a factor for calculation as well. By using the ***Equation 15*** and ***Equation 16*** to calculate for the energy conversion of fuel used and the values of fuels emission factors for mobile combustion are illustrated in ***Table 9.8*** the GHG emission of each emission source could be calculated. The calculation for estimating GHG emissions of mobile combustion equipment/machineries, such as backhoe, dozer, grader, etc., during the construction phase is 1,552.19 tonnes CO_2e/year, as shown in ***Table 9.15***.

Table 9.15: GHG Emissions by Machine (except Transportation) during Construction of Power Plant Project

Source Description	Activity Data			Energy Content of Fuel Used (TJ)[a]	GHG Emission (kg CO_2e)		
	Fuel Type	Fuel Consumed (liter/day)	Rate of Fuel Consumed annually		CO_2	CH_4	N_2O
Emission Factors Diesel (kg of greenhouse gas per TJ)[b]					**74,100**	**4.15**	**28.6**
Emission Factors Motor Gasoline (kg of greenhouse gas per TJ)[b]					**69,300**	**50**	**2**
Global Warming Potential for 100-year time horizon (AR4) – See *Table 9.6*					**1**	**25**	**298**
Backhoe	Diesel	80	44,928	1.68908	125,161.05	175.24	14,395.72
Dozer	Diesel	96	5,990	0.22521	16,688.14	23.37	1,919.43
Grader	Diesel	96	5,990	.22521	16,688.14	23.37	1,919.43
Truck	Diesel	24	26,957	1.01345	75,096.63	105.15	8,637.43
Concrete Pump Car	Diesel	80	5,760	0.21655	16,046.29	22.47	1,845.60
Concrete Truck	Diesel	80	97,615	3.66986	271,936.45	380.75	31,277.46
Crane 650 tonnes	Diesel	160	29,952	1.12606	83,440.70	116.83	9,597.14
Crane 200 tonnes	Diesel	144	44,928	1.68908	125,161.05	175.24	14,395.72
Crane 100 tonnes	Diesel	120	18,720	0.70378	52,150.44	73.02	5,998.22
Crane 50 tonnes	Diesel	80	169,728	6.38098	472,830.63	662.03	54,383.82
Pile Driver	Diesel	80	19,968	0.75070	55,627.13	77.89	6,398.10
Fork Lift	Diesel	16	9,761	0.36699	27,193.64	38.07	3,127.75
Vibrator	Gasoline	80	24,960	0.82088	56,887.08	1,026.10	489.25
GHG emission during construction phase (except Transportation) (kg CO_2e)					1,394,907.37	2,899.51074	154,385.05
GHG emission during construction phase (except Transportation) (kg CO_2e)							1,552,191.94
Total GHG emission during construction phase (except Transportation) (tonnes CO_2e)							**1,552.19**

*Note: (1) Use energy conversion unit to convert fuel consumption in physical unit to energy unit from DEDE (see **Equation 15** and **Equation 16**)*
*(2) Based on default emission factors (see **Table 9.8**)*

It is possible for mobile combustion transportation to use the same method as above. However, the mobile combustion for transportation, it is prioritized in CH_4 and NO_2 emission since on average the technological advancement on vehicles release more emission of CH_4 and NO_2 than other construction mobile machine, and therefore using different factor in calculation.

The amount of fuel combusted can be determined using vehicle activity data, fuel emission factors for vehicle type, and distance travelled. It is also good practice to estimate fuel use from the distance travelled data. Activity data could be in terms of vehicle kilometre travelled (VKT), freight tonnes-kilometre, passenger-kilometre, etc. This activity data would be multiplied by the appropriate fuel economy factors to generate an estimation of fuel consumed. In this case, tonnes-kilometre of VKT is used to estimate the total fuel consumption of mobile combustion transportation as per ***Equation 18*** below.

Equation 18: Validating Fuel Consumption

$$Estimated\ Fuel = \sum_{i,j} \left[Vehicles_{i,j} \cdot Distance_{i,j} \cdot Consumption_{i,j} \right]$$

Where:

Estimated Fuel (l)	=	total estimated fuel use estimated from distance travelled (VKT) data
Vehiclesi,j,t	=	number of vehicles of type i and using fuel j
Distancei,j,t	=	annual kilometres travelled per vehicle of type i and using fuel j (km)
Consumptioni,j,t	=	average fuel consumption (l/km) by vehicles of type i and using fuel j
i	=	vehicle type (e.g., car, bus)
j	=	fuel type (e.g. motor gasoline, diesel, natural gas, LPG)

The GHG emissions for material transportation by trucks transportation are calculated based on estimated number of trips and distance travelled for each type of trucks. In which, it is assumed that transporting vehicles would be operating 8 hrs/day, 6 days/week, for 26 weeks/year. The quantity of GHG emissions for road transport is estimated to be approximately 788.29 tonnes CO_2e/year, as illustrated in ***Table 9.16***.

Table 9.16: Expected GHG Emissions from Transportation Activities during Construction of Power Plant Project

Source Type	Source Description	Activity Data						Emission Factors (kg/TJ) (1)	GHG Emission (kg CO_2e)		
		Fuel Type	Distance Travelled (km)	Number of Vehicles	distance travel per litre of fuel	Total fuel used (litre/ day)	Rate of Fuel used annually (litre/year)		CO_2	CH_4	N_2O
Emission Factors Diesel (kg of greenhouse gas per TJ)									**74,100**	**3.9**	**3.9**
Global Warming Potential for 100-year time horizon (AR4) – See *Table 9.6*									**1**	**25**	**298**
Mobile Sources	10-wheel truck (25 tonnes)	Diesel	100	40	3km/litre	1,333	207,999.95	7.82	579,521.14	762.53	9,089.33
	4-wheel truck (5 tonnes)	Diesel	60	60	8km/litre	450	70,200.00	2.64	195,588	257.35	3,067.65
GHG Emissions from Transportation (kg CO_2e)									775,109.57	1,019.88	12,156.98
Total GHG Emissions from Transportation (kg CO_2e)											788,286.43
Total GHG Emissions from Transportation (tonnes CO_2e)											**788.29**

Note: (1) Emission factors for truck are based road transportation emission factors (see IPCC Guidelines Volume 2: Energy Chapter 3: Mobile Combustion Table 3.2.5)

Scope 2 Electricity Indirect GHG Emissions

During construction phase, TPMC will use electricity supply from local distribution. The following are the estimated annual consumption for TPMC. Total electricity consumption during construction phase (23 months) is estimated to be about 1,234,285.71 kWh annually. Since the Project's electricity use come from the purchase of Myanmar's electricity grid, GHG emission would be assumed to be proportional to the GHG emission from electricity production of Myanmar electricity grid (based on the amount of electricity used) as illustrated in ***Table 9.17***.

Table 9.17: Myanmar Electricity Grid Emission Factor

Emissions per kWh of electricity generated		
kgCO_2/kWh	**kgCH_4/kWh**	**kgN_2O/kWh**
0.315665174	0.00000622419	0.00000072998

Source: Electricity-specific emission factors for grid electricity, August 2011, https://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf.

In accordance to the national electricity grid, emission would be estimated by the multiplication of electricity use, emission factor of electricity generation, and the GWP. The result emissions from multiplying electrical consumption as shown in the ***Table 9.18***. The total estimated Scope 2 indirect emissions during construction are estimated to be 390.08 tonnes CO_2eq per year.

Table 9.18: Expected Indirect Emissions from Purchased Electricity

Electricity Purchased	Annual Consumption (kwh/year)	Annual Emissions (kg/year)			Total CO_2eq Emissions	
		CO_2	CH_4	N_2O	Kg CO_2e /year	tonnes CO_2e /year
Emissions per kWh of electricity generated		0.315665174	6.22419×10^{-6}	7.2998×10^{-7}		
Global Warming Potential for 100-year time horizon		1	25	298		
Electricity	1,234,285.71	389,621.01	192.06	268.50	390,081.57	**390.08**

Source: 2006 IPCC guideline for National Greenhouse gas inventories, Volume 2: Energy Chapter 2

Impact Assessment Table of Scope 1 and 2 Emissions

When total amount of GHG emission during construction are estimated, the significance of potential impacts to greenhouse gas during construction phase is assessed in accordance to the amount of impact during the construction period, as provided in ***Table 9.19***.

Table 9.19: Impact Assessment Table for Greenhouse Gas (Construction Phase)

Significance of Impact					
Impact	Potential impacts on climatic condition due to GHG emissions.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to climate would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts through the release of emissions from fuel combustion.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Many of the major greenhouse gases can remain in the atmosphere for tens to hundreds of years after being released.				
Impact Extent	Local	Regional	**International**		
	Greenhouse gasses are a global emission and may affect the global climate.				
Impact Scale	The emissions from construction phase are calculated to be 2,891.06 tonnes CO_2eq. Compared to Myanmar's GHG release of 201.5 million tonnes CO_2 equivalent, 2013, the total GHG releases from the Project are insignificant (approximately 0.0014%).				
Frequency	Emissions will be released intermittently, but repeatedly throughout the construction period.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Minor emissions of GHG will be emitted as a result of the Project construction, and considered insignificant emissions according to IFC (25,000 tonnes CO_2eq per year). Magnitude is considered Negligible.				
Receptor Sensitivity	**Low**	Medium	High		
	The direct receptor to greenhouse gas is the global atmosphere. The greenhouse effect is enhanced by greenhouse gas emissions of anthropogenic nature. Minor emissions of GHG will be emitted as a result of the Project, and not likely to significantly change atmospheric GHG concentrations. Receptor sensitivity is rated as Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low resource sensitivity and Negligible impact magnitude will result in an overall Negligible potential impact.				

Mitigation Measures

The following measures will be put in place for the Project during construction to reduce GHG emissions;

- Implement the same mitigation measures to minimize impacts to Air Quality (***Section 9.1***).
- Develop and implement preventive maintenance plan for machines, and engines to ensure combustion efficiency.
- Develop vehicle maintenance plan.

Residual Impacts

The significance of the residual impact on climatic condition as a result of GHG emissions is considered to be a **Negligible** Impact.

Monitoring Plan

In accordance to IFC PS3 requirements, "*quantification of GHG emissions will be conducted by the client annually in accordance with internationally recognized methodologies and good practice*" if the GHG emission from the project exceeds 25,000 tonnes CO_2e per year. However, as summarized in ***Table 9.12***, total amount of GHG emission of the project is summed to 1,685 tonnes CO_2e per year which is within the GHG emissions according to the applicable requirements (i.e. ADB SPS, EP III and IFC), therefore, it is not mandatory to do quantification of GHG emission every year.

9.2.7.3 Impact to Greenhouse Gas Emission during Operation Phase

During the operation phase of the Project, the main activities contributing to Scope 1 direct greenhouse emission. Nevertheless, only direct emission would be considered under this Project, since electricity used on site would come mainly from in house electricity production only, and need electricity supplied from the national grid only for certain amount. Also, the GHG assessment during the operation period would not consider mobile combustion, since it is expected there would be no heavy machineries and equipment during operation. Therefore, emission during operation period would mainly come from electricity generation from the gas turbine generators in the Combined Cycle Power Plant (CCPP), and natural gas would be use as fuel in the process of electricity generation.

Scope 1 Direct Emissions

Stationary Combustion

Gas will be supplied to the power plant about 59.78 mmscfd per day. Volume of natural gas supplied could be converted in term of energy content based on NCV of natural gas by using conversion from DEDE Thailand as provided in ***Table 9.20***, then the annual consumption of natural gas in term of energy is calculated which will be approximately 22,256.09 TJ/year as illustrated in ***Table 9.21***.

Table 9.20: Fuels Net Calorific Values

Fuel	Units	Value
Natural Gas (Dry)	MJ/scf	1.02

Source: MOE, 2015.[140]

Similar to the calculation on the emission during operation, once amount of gas used is determined (in term of energy content), amount of GHG emission could be determined using the emission factors illustrated in ***Table 9.20***.

From the value parameters from and ***Table 9.21*** the amount of GHG could be determined in kilogram of GHG emitted annually. To calculate the total amount of GHG emission in term of CO_2e per year, GWP would be multiplied by each GHG emitted from the operational activity. The total amount of GHG in term of kilogram CO_2e per year estimation is shown in ***Table 9.21***, which amounted to 1.25x106 tonnes CO_2e/year or 1.25 million tonnes CO_2e/year.

[140] MOE. (2015). Thailand Alternative Energy Situation. Ministry of Energy. Department of Alternative Energy Development and Efficiency. Pg 57. Retrieved from: http://www.dede.go.th/download/state_59/Thailand%20alternative%20energy%202015.pdf

Table 9.21: Expected Stationary Emissions for Power Plant

Source	Annual natural gas supplies (scf/year)	Annual consumption (J/year)[a]	Annual consumption TJ/year	Annual Emissions (kg/year)			Total CO_2eq Emissions	
				CO_2	CH_4	N_2O	kg CO_2eq/ year	tonnes CO_2eq/ year
Emissions per kWh of electricity generated				56,100	1	0.1		
Global Warming Potential for 100-year time horizon				1	25	298		
Natural Gas Engine Generator	2.18x1010	2.23x1016	22,256.09	$1.25x10^9$	$5.56x10^5$	$6.63x10^5$	$1.25x10^9$	$1.25x10^6$

Note: [a] *1scf = 1.02 x106 J*

The estimated GHG emissions from the power plant during operation will exceed the threshold that defined significant emitters of GHGs by the ADB SPS and EP III (100,000 tonnes CO_2eq per year) and IFC PS3 (25,000 tonnes CO_2eq per year). Therefore, the Project is required to report annual GHG emissions as per the applicable reference framework.

Nonetheless, the technology used during operation phase of the Project is an efficient form of combined cycle mode. In a combined cycle operation, the heat of exhaust gas will be admitted to the Heat Recovery Steam Generator (HRSG) where superheated steam will be produced which will drive the steam turbine to generate electrical power. This combination increases the thermal efficiency to approximately 50-60%. In addition, the Project uses natural gas as its fuel to generate electricity that provides more efficiency than coal because of higher operating temperatures, and when used together with the more efficient combined-cycle results in even higher efficiencies (IEA, 2006).[141] In comparison, the GHG emissions of the best available technology for coal is anticipated to be 900 gCO_2/kWhe, while for gas the GHG emission is anticipated to be 400 gCO_2/kWhe.[142]

The proposed Project is likely to have a long-term positive effect on emissions reduction in power generation industry. In 2010/2011 a total of 7,543.06 million kWh[143] was generated by the Myanmar Electric Power Enterprise (MEPE). Of the total production, 8.9% was thermal power generation, 0.4% was diesel-generated electricity, 67.7% was hydropower, and the remaining 23% was production from gas power plants. Since Myanmar has considerable natural gas reserves, an option for emission reductions would be fossil fuel switching from coal use to the less carbon intensive natural gas.

A study showed switching the current thermal production from coal in Myanmar to natural gas would result in emission reductions of about 251,053 tons of CO_2[144], if fully replacing coal with natural gas for the production of the same amount of MWh. Replacing the 600 MW of power production currently planned as coal power with natural gas, would give another 1,455,300 tonnes of CO_2 emission reductions. The significance of potential impacts to greenhouse gas during operation phase is assessed in ***Table 9.22***

[141] IEA, 2006a: Energy Technology Perspectives 2006: Scenarios and strategies to 2050. International Energy Agency, Paris, 484 pp.

[142] European Commission Joint Research Centre (EUR 19754 EN), Greenhouse Gas Emissions from Fossil Fuel Fired Power Generation Systems.

[143] http://www.csostat.gov.mm/S09MA02.asp cited in UNEP RISØ CENTRE, June 2013, Emission Reduction Profile Myanmar

[144] Calculated using IPCC guidelines regarding emission factors and plant efficiency, for plants built after 2000. cited in UNEP RISØ CENTRE, June 2013, Emission Reduction Profile Myanmar

Impact Assessment Table

Table 9.22: Impact Assessment Table for Greenhouse Gas (Operation Phase)

Significance of Impact					
Impact	Potential impacts on climatic condition due to GHG emissions.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to climate would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts through the release of emissions from Project operation.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Many of the major greenhouse gases can remain in the atmosphere for tens to hundreds of years after being released.				
Impact Extent	Local	Regional	**International**		
	Greenhouse gases can potentially affect the Earth's climate.				
Impact Scale	The emissions from Power Plant are calculated to be $1.25x10^6$ tonnes of CO_2eq or 1.25 million tonnes CO_2eq per year. Compared to Myanmar's GHG emissions of 201.5 millions CO_2equivalent, 2013, the total GHG releases from the Project is approximately 0.62%.				
Frequency	Emissions will be released continuously throughout the operation period.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The GHG emissions during operation phase are considered 'significant emissions' according to ADB SPS and EP III (100,000 tonnes CO_2eq per year) and of IFC PS3 (25,000 tonnes CO_2eq per year). Magnitude is therefore considered Medium.				
Receptor Sensitivity	Low	**Medium**	High		
	The direct receptor to greenhouse gas is the global atmosphere. The greenhouse effect is enhanced by greenhouse gas emissions of anthropogenic nature. The concentration of GHG in the atmosphere beyond the level of naturally occurring concentrations could result in more heat being held within the atmosphere. Receptor/resource sensitivity is rated as Medium.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	As per the impact assessment methodology defined in ***Chapter 6*** the combination of a Medium resource sensitivity and Medium impact magnitude will result in an overall Moderate potential impact.				

Mitigation Measures

The Project has employed a CCGT technology which was designed for high reliability and efficiency operation with lower environmental impact. CCGT plant offer half as much CO_2 per kWh compared to other power generation technology. At this stage it is considered that further design measures and control measures are not considered necessary due to the higher efficiencies of combined-cycle technology.

It is therefore proposed to undertake an annual GHG inventory to monitor the GHG emissions according to the applicable requirements (i.e. ADB SPS, EP III and IFC):

- Conduct annual pollutant release inventory to monitor the GHG emissions from the Project. The GHGs emission shall be reported as CO_2eq unit.
- Where feasible, arrange emissions offsets (including the Kyoto Protocol's flexible mechanisms and the voluntary carbon market), including reforestation, afforestation.

Residual Impact

The Project employs the most effective GHG reduction measure. The mitigation measures above have been put in place to monitor the GHG emission. There will be no reduction in the impact level, residual impact significance would be **Moderate** Impact.

Monitoring Plan

In accordance to IFC requirements, "*quantification of GHG emissions will be conducted by the client annually in accordance with internationally recognized methodologies and good practice*" if the GHG emission from the project exceeds 25,000 tonnes CO_2e per year. As shown in ***Table 9.22***

total amount of GHG emission of the project will be exceeding the GHG emissions according to the applicable requirements (i.e. ADB SPS, EP III and IFC) significantly, summed to 1.25x106 tonnes CO_2e per year or 1.25 million tonnes per year. Therefore, it is mandatory to do quantification of GHG emission during the operation phase every year.

9.3 Noise Impact Assessment

9.3.1 Introduction

This Chapter presents an assessment of the potential noise impacts arising from the construction and operational phases of the Project. Noise sensitive receivers (NSRs) and potential sources of noise generation were identified, and an assessment of the potential impacts was carried out. Mitigation and management measures are recommended where necessary.

Impacts associated with noise (both during construction and operation phase) may affect NSRs such as humans in the affected area. During the scoping activity, the following were identified as potential impacts related to noise that will be assessed in this Chapter (***Chapter 9.3***):

- Potential noise impacts from transportation of workers, equipment and machineries during construction phase;
- Potential noise impacts from operation of equipment and machineries during construction phase;
- Potential noise impacts from foundation work and civil construction during construction phase;
- Potential noise impacts from pre-commissioning and testing; and
- Potential noise impacts from operation of Power Plant.

9.3.2 Assumptions and Limitations

The assessment of potential impacts related to noise in this section is based on the environmental baseline data (***Chapter 5***) and the information available from the Project Proponent at the time of writing.

The noise impact assessment was carried out based on an assumed facility inventory for the construction and operational phases of the Power Plant. Noise modelling has been conducted to simulate the expected noise impacts from the equipment from each phase. These will be confirmed by the Engineering, Procurement and Construction (EPC) contractor prior to commencement of each phase. Should there be significant differences between the assumed plant inventory and that to be used on site, additional assessments may be needed and the proposed noise mitigation measures should be updated and implemented accordingly.

The modelling assumptions and limitations is further explained in ***Section 9.3.3.2*** and ***Section 9.3.3.3***.

9.3.3 Assessment Methodology

The methodology used for assessing impacts to noise is aligned with the general impact assessment methodology presented in ***Chapter 7***. The guidelines that will be used for the construction and operation noise impact assessment was conducted with reference to relevant international guidelines and local legislation, regulations, and standards, where available. Noise level guidelines given in Myanmar National Environmental Quality Guideline (NEQG) and that in IFC General EHS Guidelines: Environmental – Noise Management are the same, and are summarised in ***Table 3.11***.

Table 9.23: Myanmar NEQ and IFC General EHS Guidelines for Noise Levels at Receptors

Area	Maximum Allowable Noise Level (1 hour) [(a)] dB(A)	
	Daytime 0700 – 2200 hours	Night-time 2200 – 0700 hours
Residential, institutional, educational	55	45
Industrial/commercial areas	70	70

Note: [(a)] *Equivalent continuous sound level in decibels*
Noise impacts should not exceed the levels presented in this table, or result in a maximum increase in background levels of 3dBA at the nearest receptor location off-site.

9.3.3.1 Modelling Methodology

In this study, CadnaA-software was used for calculating and generating the noise contour of both LNG Receiving Terminal and Power Plant. The following definition are relevant to the understanding and description of the modelling results:

- PWL is defined as sound power level;
- L_{AT} is defined as equivalent continuous sound pressure level;
- L_{day} is defined as equivalent continuous sound pressure level in between 07:00 and 22:00;
- L_{night} is defined as equivalent continuous sound pressure level in between 22:00 and 07:00; and
- L_p is defined as noise pressure level.

9.3.3.2 Modelling Assumption

In this impact assessment study, CadnaA-software was used for calculating and generating the noise contour of both LNG Receiving Terminal and Power Plant. The methodology and results of this modelling will be presented further below. Key assumptions for the model are described here.

Noise sources from Power Plant can be defined as an omnidirectional point source placed on ground with the sound power level (PWL) and directivity as a function of the three orthogonal coordinates (x, y, z) are needed. The input data for sound propagation calculations according to ISO 9613-2 to be used for noise mapping are as follows:

- Emitting sound power level spectrum in octave bands;
- Location (coordinates x, y) and elevation (z) of the noise source;
- Dimensions and orientations;
- Directivity of the source;
- Working hours (day, evening, night, on a yearly averaged basis); and
- Operating conditions of the source.

The emitted sound power levels was set as a single band at the frequency of 500Hz. The working hours are an essential input for the calculation of noise levels. The working hours shall be given for the day and night period.

9.3.3.3 Modelling Limitation

Leq at receiving point was calculated with limitations of working hours and operational conditions.

For working hours, assumptions: day 07.00-22.00 night 22.00-07.00.

Operating conditions: Continuous working 24 hrs/day.

Intermittent working 12 hrs/day.

Furthermore, the noise mapping is only presented as 2-dimensional.

9.3.3.4 Sound Power Level Calculation for Construction Equipment

The power level of equipment can be described as a point source placed on ground and calculated as shown by the following equation (***Equation 19***):

Equation 19: Sound Power Level Equation

$$PWL = L_p + 20log(r) + 8$$

Where: PWL – Power Level of Equipment

L_p – Noise Pressure Level dB (A)

R – Distance from the noise source

Source: AMacoustic, 2019

All noise level of equipment in construction phase of this study refer to FHWA Roadway Construction Noise Model User's Guide, Final Report, January 2006 as in the following table (***Table 9.24***).

Table 9.24: Noise Emission Reference Levels and Usage Factors[145]

Equipment Description	Is there a potential impact?	Acoustical Use Factor[a] (%)	Spec 721.560 L_{max} at 50ft (dBA, slow[b])	Actual Measured L_{max} at 50ft (dBA, slow)	No. of Actual Data Samples (count)
All Other Equipment > 5 HP	No	50	85	--N/A--	0
Auger Drill Rig	No	20	85	84	36
Backhoe	No	40	80	78	372
Bar Bender	No	20	80	--N/A--	0
Blasting	Yes	--N/A--	94	--N/A--	0
Boring Jack Power Unit	No	50	80	83	1
Chain Saw	No	20	85	84	46
Clam Shovel (dropping)	Yes	20	93	87	4
Compactor (ground)	No	20	80	83	57
Compressor (air)	No	40	80	78	18

[145] Noise emission reference levels and usage factors that were used as part of the Central Artery/Tunnel (CA/T) project in Boston. These noise emission levels will be used as a basis for the modelling of this noise impact assessment section.

Equipment Description	Is there a potential impact?	Acoustical Use Factor[a] (%)	Spec 721.560 L_{max} at 50ft (dBA, slow[b])	Actual Measured L_{max} at 50ft (dBA, slow)	No. of Actual Data Samples (count)
Concrete Batch Plant	No	15	83	--N/A--	0
Concrete Mixer Truck	No	40	85	79	40
Concrete Pump Truck	No	20	82	81	30
Concrete Saw	No	20	90	90	55
Crane	No	16	85	81	405
Dozer	No	40	85	82	55
Drill Rig Truck	No	20	84	79	22
Drum Mixer	No	50	80	80	1
Dump Truck	No	40	84	76	31
Excavator	No	40	85	81	170
Flat Bed Truck	No	40	84	74	4
Front End Loader	No	40	80	79	96
Generator	No	50	82	81	19
Generator (<25KVA VMS signs)	No	50	70	73	74
Gradall	No	40	85	83	70
Grader	No	40	85	--N/A--	0
Grapple (on backhoe)	No	40	85	87	1
Horizontal Boring Hydr .Jack	No	25	80	82	6
Hydra Break Ram	Yes	10	90	--N/A--	0
Impact Pile Driver	Yes	20	95	101	11
Jackhammer	Yes	20	85	89	133
Man Lift	No	20	85	75	23
Mounted Impact Hammer (Hoe Ram)	Yes	20	90	90	212
Pavement Scarafier	No	20	85	90	2
Paver	No	50	85	77	9
Pickup Truck	No	40	55	75	1
Pneumatic Tools	No	50	85	85	90
Pumps	No	50	77	81	17
Refrigerator Unit	No	100	82	73	3

Equipment Description	Is there a potential impact?	Acoustical Use Factor[a] (%)	Spec 721.560 L_{max} at 50ft (dBA, slow[b])	Actual Measured L_{max} at 50ft (dBA, slow)	No. of Actual Data Samples (count)
Rivit Buster/chipping gun	Yes	20	85	79	19
Rock Drill	No	20	85	81	3
Roller	No	20	85	80	16
Sand Blasting (Single Nozzle)	No	20	85	96	9
Scraper	No	40	85	84	12
Shears (on backhoe)	No	40	85	96	5
Slurry Plant	No	100	78	78	1
Slurry Trenching Machine	No	50	82	80	75
Soil Mix Drill Rig	No	50	80	--N/A--	0
Tractor	No	40	84	--N/A--	0
Vacuum Excavator (Vac Truck)	No	40	85	85	149
Vacuum Street Sweeper	No	10	80	82	19
Ventilation Fan	No	100	85	79	13
Vibrating Hopper	No	50	85	87	1
Vibratory Concrete Mixer	No	20	80	80	1
Vibratory Pile Driver	No	20	95	101	44
Warning Horn	No	5	85	83	12
Welder / Torch	No	40	73	74	5

Source: FHWA Roadway Construction Noise Model User's Guide, Final Report, January 2006

Note: [a] *acoustical use factor refers to average percentage of equipment operating at full power*
[b] *slow refers to machineries working at lower gear or round*

9.3.3.5 Calculation of Sound Propagation according to ISO 9613-2

The A-weighted sound level at a receiver point L_{AT} (equivalent continuous sound pressure level) according to ISO 9613-2[146] is calculated by:

$$L_{AT} = L_W + D_1 + D_\Omega - A_{div} - A_{atm} - A_{gr} - A_{bar} - A_{misc}$$

Where: PWL – sound power level in dB relative to the reference sound power of 1pW

D_1 – directivity index – deviation from the direction of the continuous sound pressure level for the directionally radiating source in a specified direction

[146] ISO 9613-2 refers to the standard for acoustic attenuation of sound during propagation outdoors – general method of calculation (2017).

from the level of an omnidirectional point source with the sound power level PWL

$D_\Omega(K_0)$ – correction for solid angle – term that accounts for sounds propagation into angles of less than 4π radians

A_{div} – attenuation due to geometrical divergence – the geometrical divergence calculates from the distance d between source and receiver:

$$A_{div} = \left[20 \lg\left(\frac{d}{d_0}\right) + 11\right] dB$$

with d distance source-receiver, $d_0 = 1$ m.

A_{atm} – atmosphere absorption :

$$A_{atm} = \propto_L * d/1000$$

Where:

αL atmospheric attenuation coefficientper kilometer

d distance source-receiver.

In CadnaA .For the default frequency of 500 Hz, the attenuation coefficient is 0.002 dB/m.

A_{gr} – attenuation due to ground effect.

A_{bar} – attenuation due to screening)due to berms, barriers, buildings, topography,cylinders, etc(.

A_{misc} – attenuation due to miscellaneous effects:

- Foliage A_{fol}
- industrial sites A_{site}
- housing A_{hous}

9.3.3.6 Modelling Scenario

The following are the list of scenario cases which were modelled for this impact assessment:

- Case 1 – construction phase of Power Plant;
  - Operation of machineries and equipment;
  - Foundation work and civil construction;
  - Transportation of workers and equipment;
- Case 2 – operation phase of Power Plant;
  - Operation of Power Plant components;

L_{eq} at receiving point can be calculated with limitation of working hours and operating condition.

For working hours: day 07:00 – 22:00; night 22:00 – 07:00;

Operating condition: Continuous mean working 24 hours per day

Intermittent means working 12 hours per day

9.3.4 Summary of Baseline Conditions

Chapter 5 provides the details of the baseline conditions for noise in the Project study area.

Existing information on the ambient noise conditions for the Study Area is not publicly available. The background noise levels are expected to be typical of an urban and/or semi-urban environment in Myanmar. Sources of noise are likely to include local traffic (e.g. motorbikes, scooters and less so private cars), human activity (e.g. schools, barangay halls, local markets) and animals (e.g. dogs, cockerels).

As part of the ESIA Study, noise monitoring at selected locations (with consideration of NSRs) are conducted to form a primary baseline database. Further information on the baseline is presented in ***Section 5.1.4***.

Most noise stations have daytime and night time A-weighted loudness equivalent levels that exceed the Myanmar Standard. Although there are a couple of noise stations (N4, and N8) that are within the day time standard, only noise station N7 has day time and night time levels that are within the standard. Noise monitoring stations closest to the Power Plant (N1, and N2) exceeded the Myanmar Standard.

9.3.5 Receptor Identification and Sensitivity

The nearest representative NSRs that may potentially experience noise impacts from the work sites of the Project during construction and operational phases are identified. Since the Power Plant is located within the Ahlone Township, the NSRs within this area are small and medium-density residential areas, which are not categorized as villages. The closest receptor to the Power Plant is a small household area approximately 80 metres north of the Power Plant; and the medium density residential area approximately 670 metres northeast of the Power Plant, within Ahlone Township.

9.3.6 Project Activities

9.3.6.1 Construction Phase

Construction of the Power Plant will be carried out by the EPC contractor appointed by TPMC. The construction phase for the Power Plant will take approximately 28 months. Scheduled Commercial Operating Date (SCOD) is expected at the end of 2021. The maximum number of workers onsite during construction is anticipated to be 600 persons.

The Project Proponent will implement appropriate management and mitigation measures to reduce the significance of any impacts associated with noise, as will be discussed in the respective mitigation measures section for each impact type. The mitigation measures will also be summarised in the ESMP chapter (***Chapter 12***).

9.3.6.2 Operation Phase

The operation phase is expected to continue for approximately 25 years. The average number of permanent workers present during operation is expected to be approximately 50, with small numbers of additional staff for security, cleaning, technical assistance, and occasional maintenance. The assessment of operational phase impacts includes those arising from routine operations and maintenance of the power plant. During the operation phase, potential impacts to NSRs may arise from various equipment within the Power Plant that will produce noise during the operation phase.

9.3.7 Assessment of Impacts from Noise

9.3.7.1 Impacts from Noise Level from Transportation of Workers, Equipment and Machineries during Construction Phase

Overview

During the construction phase, workers, equipment and materials will need to be transported by large trucks and/or other types of vehicles to the construction site. Truck and transportation vehicles will produce a certain level of noise impact towards the surrounding ambient noise and Noise Sensitive Receivers/Receptors (NSRs). The impact level will depend on the type of vehicles used, the number of trips within a specific time period, and the time of day for transportation.

During the Power Plant construction, workers and equipment will be transported to the construction site by road transportation. While other materials used for construction will be transported via barge.

Impact Assessment Table

The significance of potential impacts from generation of noise from transportation of workers, equipment and machineries during construction phase is assessed in ***Table 9.25***, and mitigation measures are presented thereafter.

Table 9.25: Significance of Impacts Due to Generation of Noise from Transportation of Workers, Equipment and Materials during Construction Phase of Power Plant

Significance of Impact					
Impact	Potential impacts on NSRs due to noise emissions from the transportation of Power Plant construction equipment and workers during the construction phase.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to NSRs would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would be direct impacts.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction is expected to start mid 2019 and be complete in 28 months, which would be considered short-term.				
Impact Extent	**Local**	Regional	International		
	Noise impact from the transportation of equipment will have localised impact on nearby NSRs therefore the impact extent is determined to be local.				
Impact Scale	Transportation vehicle for staff is measured to generate 86.7 dBA. Tug boat (assumed to be used for material transportation) has a reference sound level per unit of 87 dBA.				
Frequency	Transportation is expected to occur intermittently but frequently throughout the construction period. Transportation of equipment and materials is expected to occur one or two rounds during the construction phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the impact characteristics above, the impact magnitude is considered to be small.				
Receptor	Low	**Medium**	High		

Significance of Impact				
Sensitivity	The identified NSRs are residential, the sensitivity of the receptor is considered as medium.			
Impact Significance	Negligible	**Minor**	Moderate	Major
	The combination of a Medium Receptor Sensitivity and Small Impact Magnitude will result in an overall Minor impact.			

Mitigation Measures

The following measures will be put in place for the Project during the construction phase to mitigate impacts to NSRs:

- Schedule transportation of materials evenly throughout the day (to minimize accumulative noise impact from multiple noise sources);
- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components should be conducted; and
- Avoid transportation of materials on- and off-site through existing community areas.

Residual Impact

If the recommended mitigation measures are implemented, residual impact significance would be **Negligible** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of noise should consist of the following:

- Monthly noise monitoring should be conducted at the representative NSRs by the EPC contractor to check noise levels and compliance at the NSRs throughout the construction phase.

9.3.7.2 Impact from Noise during Foundation Work and Civil Construction during Construction Phase

Overview

During the construction phase, the Project will require the use of construction equipment such as diesel generators, air compressor, and trucks and trailers. Each construction equipment will produce a certain level of noise impact towards NSRs. Knowing the location of each equipment is also important for understanding the spatial extent of noise impacts.

During the Power Plant construction phase, the list of equipment that will either be used or placed on standby, but will produce noise impacts are shown in ***Table 9.26***.

Table 9.26: Construction Equipment Noise Level

Code	Equipment List	Lw, dBA	Operation/day
C_1	Bulldozer	116.7	08.00am-22.00pm
C_2	Excavator	116.7	08.00am-22.00pm
C_3	Dump Truck	115.7	08.00am-22.00pm
C_4	Water Bowser	115.7	08.00am-22.00pm
C_5	Vibratory Sheet Foot Roller/Plane Roller	116.7	08.00am-22.00pm
C_6	Vehicle for Staff	86.7	08.00am-22.00pm
C_7	Generator	113.7	08.00am-22.00pm
C_8	Piling Machine	126.7	08.00am-22.00pm
C_9	50 T crane for Steel Structure (1)	116.7	08.00am-22.00pm
C_10	50 T crane for Steel Structure (2)	116.7	08.00am-22.00pm
C_11	600 Ton Crane for Heavy lift	116.7	08.00am-22.00pm
C_12	300 Ton Crane for Heavy lift	116.7	08.00am-22.00pm
C_13	80 T crane for Mech Installation	116.7	08.00am-22.00pm
C_14	50 T crane for Mech Installation	116.7	08.00am-22.00pm
C_15	50 T crane for piping Installation	116.7	08.00am-22.00pm
C_16	50 T crane for E & I	116.7	08.00am-22.00pm
C_17	50 T crane for Pre-Comm	116.7	08.00am-22.00pm
C_18	Crane Truck 10 T for Warehouse	116.7	08.00am-22.00pm
C_19	Flog Lift 3 T for warehouse	86.7	08.00am-22.00pm
C_20	25 T crane for warehouse.	116.7	08.00am-22.00pm

Source: TPMC, 2018; adapted by AMacoustic, 2018.

The type and quantity of machinery that will be used for the construction of Power Plant earthworks is listed in ***Table 9.27***.

Table 9.27: Type and Quantity of Earthwork Machinery

Machinery Type	Quantity
Bulldozer	1
Excavator	1
Dump Truck	1

Machinery Type	Quantity
Water Bowser/Tanker	1
Vibratory Sheet Foot Roller/Plane Roller	1
Vehicle for Staff	1
Generator	1
Piling Machine	1
50 T Crane for Steel Structure	2
600 Ton Crane for Heavy Lift	1
300 Ton Crane for Heavy Lift	1
80 T Crane for Mech Installation	1
50 T Crane for Mech Installation	1
50 T Crane for Pipe Installation	1
50 T Crane for E & I	1
50 T crane for Pre-Comm	1
10 T Crane Truck for Warehouse	1
3 T Flog Lift for warehouse	1
25 T crane for warehouse.	1

Source: TPMC, 2019.

The location of equipment that is expected to produce noise during the construction phase, regardless of operation period, is shown in ***Figure 9.3***.

Figure 9.4, ***Figure 9.5***, ***Figure 9.6***, and ***Figure 9.7*** shows noise contour developed by the model, demonstrating the noise level at different areas generated from the Power Plant construction phase.

As shown in ***Figure 9.6***, noise station AQ3/N3 is located at the medium-density residential area north of the Power Plant.

Based on methodology from the US Department of Transportation for estimation of construction and equipment noise, noise levels at various distances from a source can be calculated using ***Equation 20***:

Equation 20: Equipment Noise Level at Receptor Location

$$L_{eq}(equipment) = L_w - 20 \times \log_{10}\left(\frac{D}{D_0}\right)$$

Source: FHWA[147], Accessed in 2019.

Note: *Leq (equipment) = the A-weighted, equivalent sound level at a receptor resulting from the operation of a single piece of equipment at distance D (dB(A))*
Lw = Noise emission level of the particular piece of equipment at reference distance D_0 (dB(A))
D = Distance from the receptor to the piece of equipment (m)
D_0 = Reference distance where the source noise emission level was measured (m) (700.37 m) based on the location of noise station AQ3/N3, and the approximate distance from the Power Plant

For the Project, it is necessary to calculate the overall noise level produced by the simultaneous operation of several pieces of equipment. The overall noise level at a receptor is simply the sum (on

[147] FHWA. (2017). Special Report - Measurement, Prediction, and Mitigation. U.S. Department of Transportation. Federal Highway Administration. Retrieved from http://www.fhwa.dot.gov/environment/noise/highway/hcn03.htm

an energy basis) of the individual contributions of each piece of equipment. Mathematically, the overall noise level at a receptor from several sources can be calculated using ***Equation 21***:

Equation 21: Combined Noise Level for Ambient and Construction Noise

$$L_{eq}(site) = 10 \times \log_{10}\left(\sum_{i=1}^{n} \frac{10^{Leq\ (equipment)_i}}{10}\right)$$

Note: L_{eq} *(site) = the A-weighted, overall equivalent sound level obtained by summing the individual equipment noise levels on an energy basis.*
n = Number of sources
L_{eq} *(equipment)$_i$ = the A-weighted, equivalent sound level at a receptor resulting from the operation of a single piece of equipment at distance D from its source, dB(A). Obtained from* ***Equation 20****.*

However, it should be noted that not all construction equipment will be operating at the same time. Different machinery will operate at different times and in different locations in a non-consistent manner. The overall construction noise level is governed primarily by the noisiest pieces of equipment. The quieter pieces do not affect the overall level, but they do reduce the magnitude of the fluctuations in the noise level (FHWA, 2011). The noise modelling produced by AMacoustic, as shown in ***Figure 9.4***, ***Figure 9.5***, ***Figure 9.6***, and ***Figure 9.7*** will be used to substitute ***Equation 20***.

Table 9.28 shows the result of ***Equation 21*** for the combined noise levels at the closest NSR, approximately 80 metres north of the Power Plant. Although there are no noise sampling stations located at the closest NSR, noise station N1 (approximately 160 metres) is located closest to the NSR. Baseline data from noise station N1 will be used, assuming that the noise level at the closest NSR is similar. The results indicate that the combined noise levels from the contributing construction equipment to the baseline is significant (since the total noise level is above the NEQG).

The operational time period for construction equipment is approximately 08.00 am to 22.00 pm, this time period does not apply to the Myanmar Standards for night time (22.00 pm to 07.00 am); therefore, modelling for night time has been excluded for the construction phase.

Table 9.28: Combined Noise Level at Closest NSR

Time of Day	Baseline (dBA)[a]	Noise Level Contribution from Construction Equipment (dBA)	Total Noise Level (dBA)	NEQG Daytime (residential)	NEQG Daytime (industrial)
Day Time	59	85.3	85.31	55	70
Night time	59	0	59	45	70

Source: SEM, 2018.

Note: [a] *Baseline data for noise station N1, survey period 2-4 May 2018.*

Table 9.29 shows the results of ***Equation 21*** for the combined noise levels at noise station N3. The results indicate that the combined noise levels from the contributing construction equipment to the baseline is insignificant.

Table 9.29: Combined Noise Level at Noise Station N3 (2-4, May 2018)

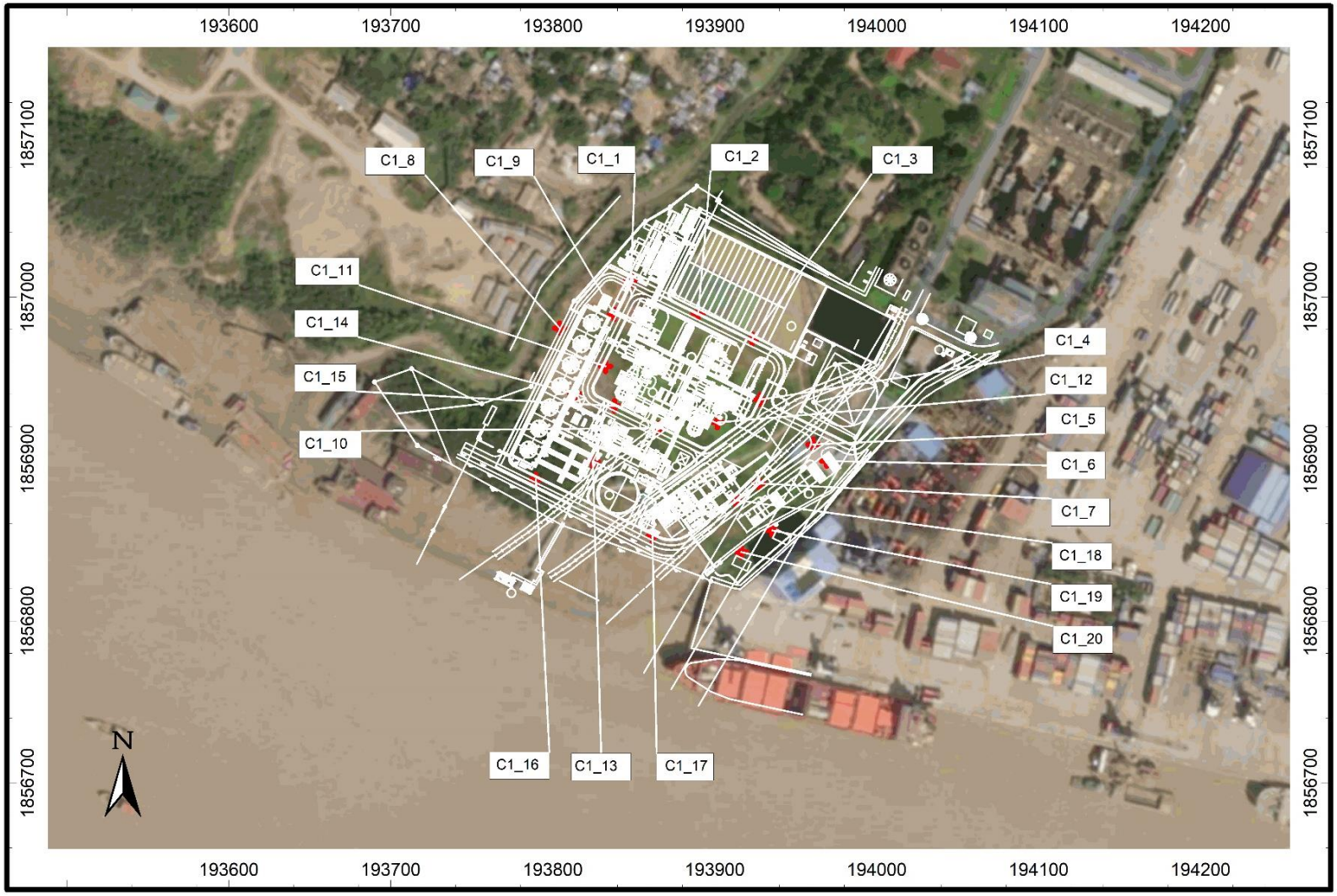
Time of Day	Baseline (dBA)[a]	Noise Level Contribution from Construction Equipment (dBA)	Total Noise Level (dBA)	NEQG Daytime (residential)	NEQG Daytime (industrial)
Day Time	71	54.0	71.08580	55	70
Night time	66	0	66	45	70

Source: SEM, 2018.

Note: [a] *Baseline data for noise station N3, survey period 2-4 May 2018.*

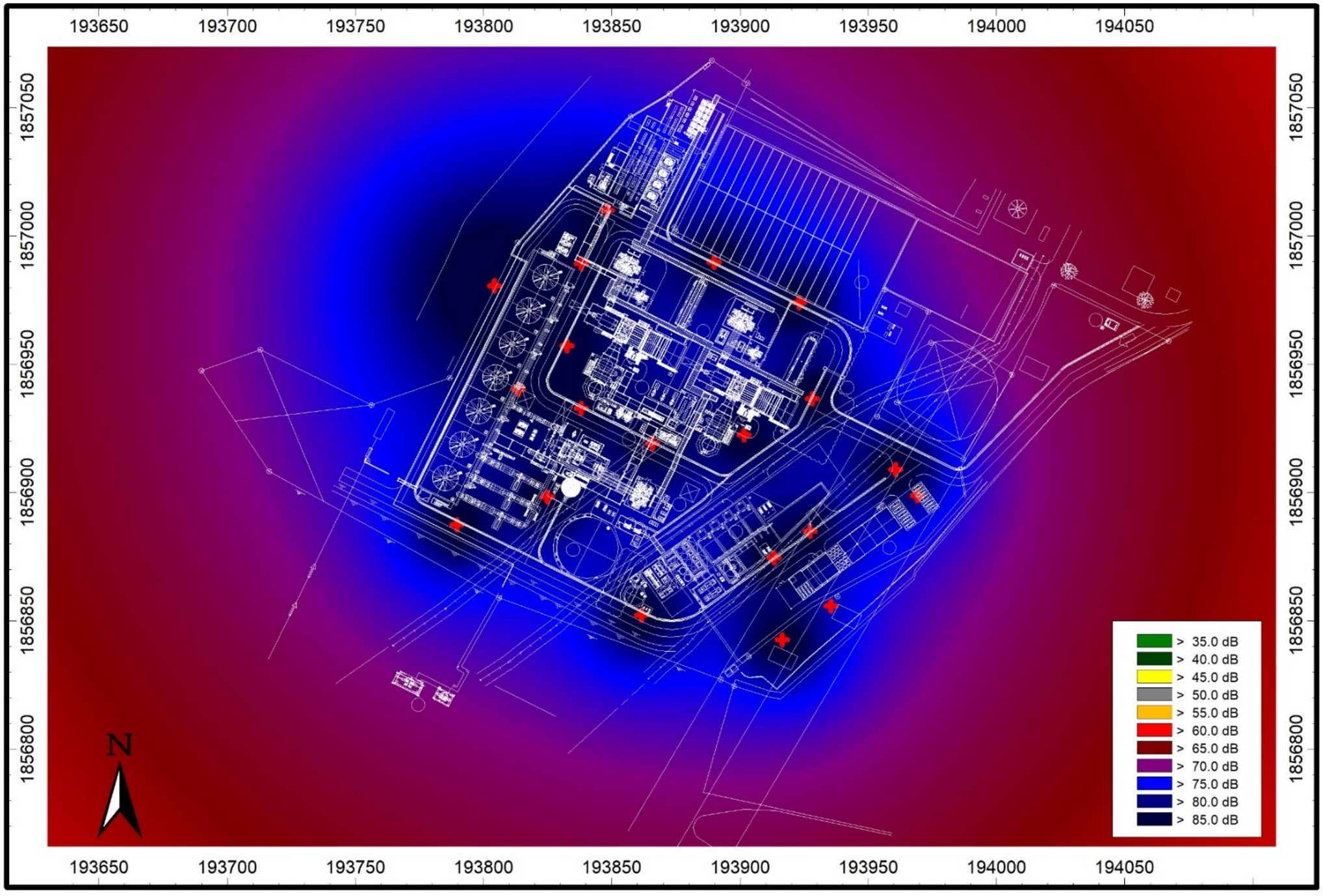
Type A map (noise gradient map which shows the dissipating of noise over distance) and type B (noise contour map which shows the noise level at certain distance) demonstrate is modelled based on the same noise level results; but with different graphical representation.

Figure 9.3: Construction Equipment Location



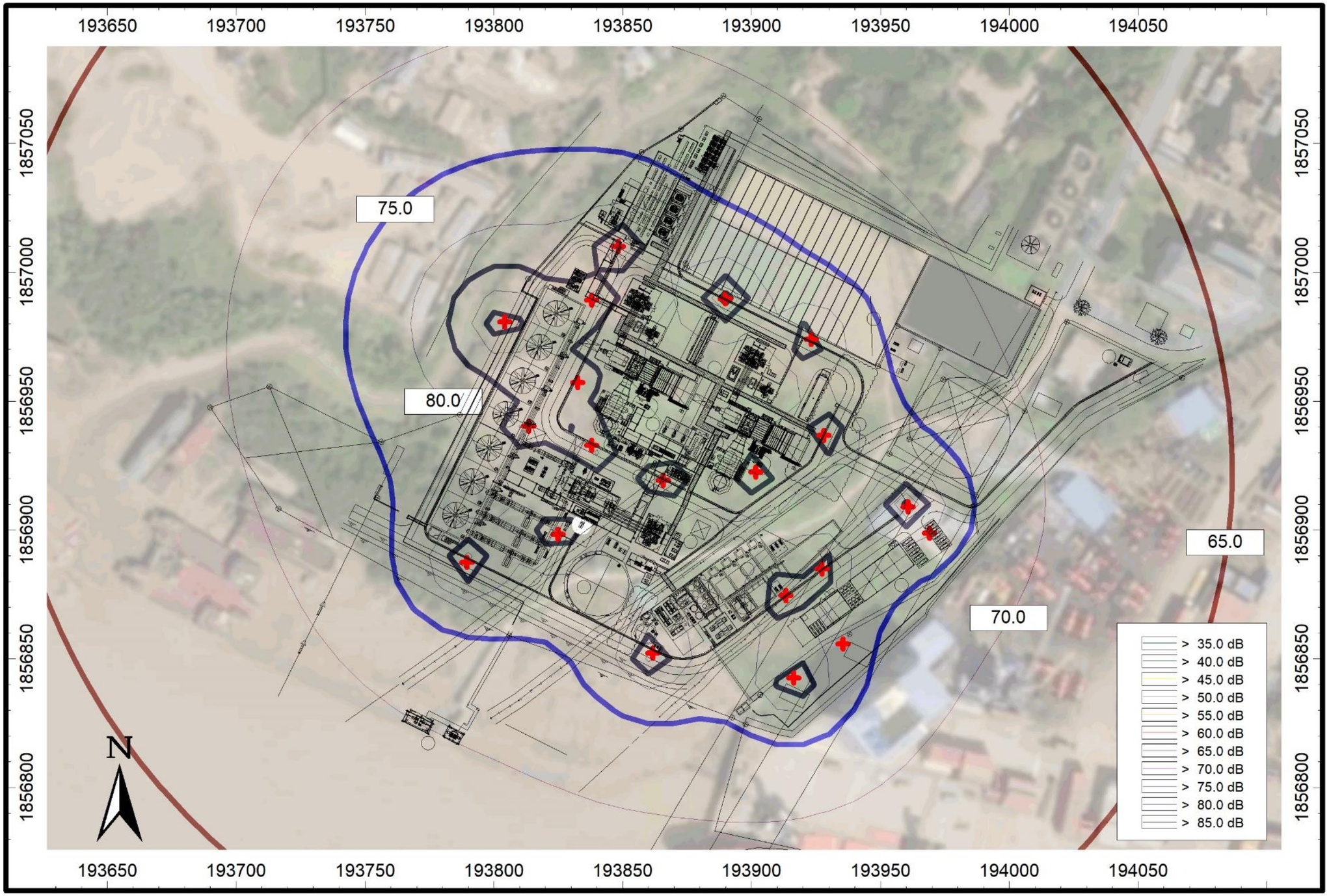
Source: TPMC, 2019. (Modified by AMacoustic)

Figure 9.4: Noise Contour during Construction Phase (Type A)



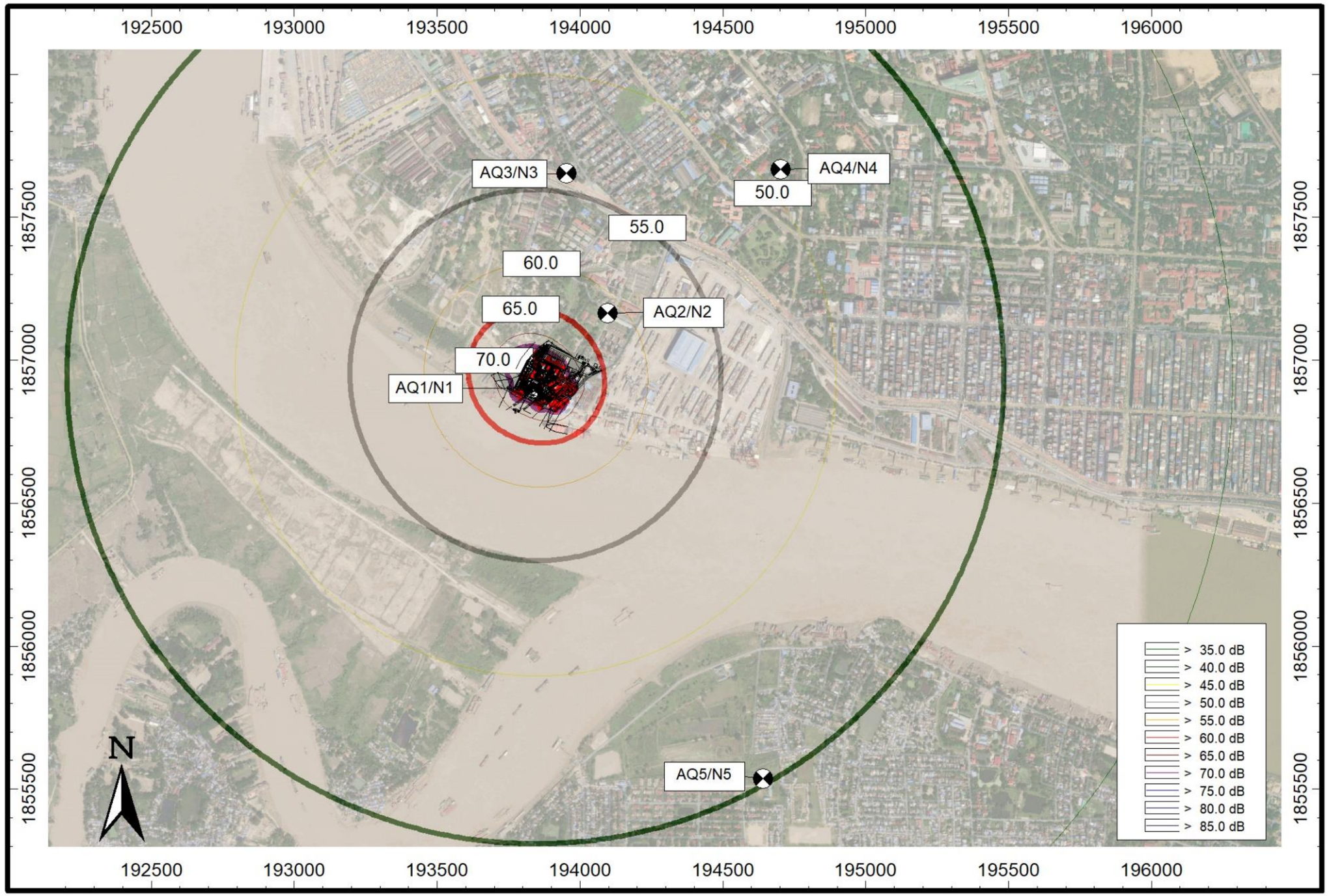
Source: AMacoustic, 2019.

Figure 9.5: Noise Contour during Construction Phase (Type B) – Zoomed In



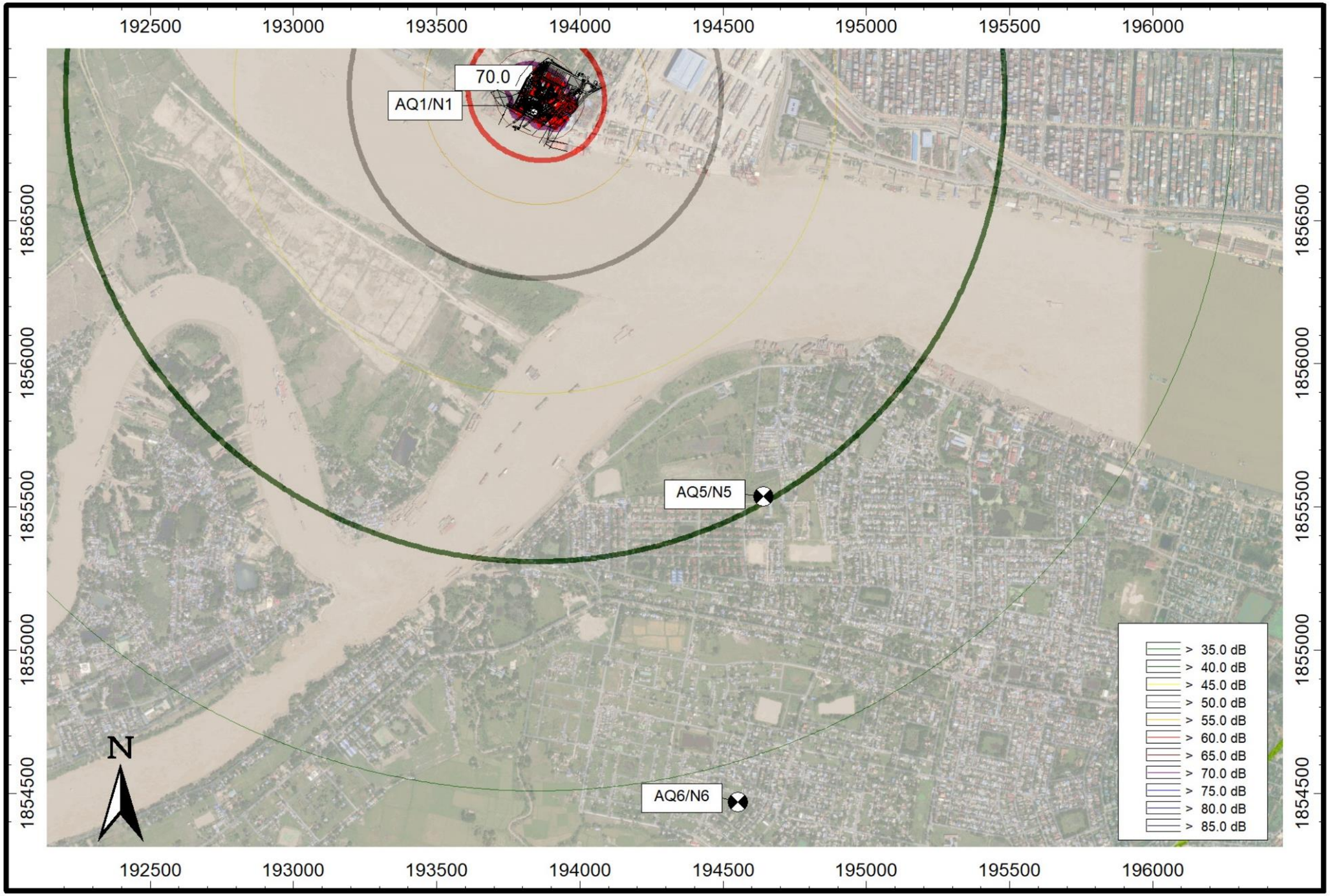
Source: AMacoustic, 2019.

Figure 9.6: Noise Contour during Construction Phase (Type B) – Zoomed Out 1



Source: AMacoustic, 2019.

Figure 9.7: Noise Contour during Construction Phase (Type B) – Zoomed Out 2



Source: AMacoustic, 2019.

According to the modelling results, the expected noise levels at each noise sampling station location is shown in ***Table 9.30***.

Table 9.30: Noise Level Results from Modelling at Noise Sampling Stations Location (Construction Phase)

Sampling Points	Coordination	UTP 47Q WGS84	Description of Sampling Point	Lday dB(A)	Lnight dB(A)	Leq dB(A)	NEQG Daytime (residential)	NEQG Daytime (industrial)
AQ1/N1	16°46'30.69"N	193834	In the compound of Combined Cycle Power Plant (at project area) located in Ahlone Township, Yangon Region	85.3	-	83.3	55	70
	96° 7'41.11"E	1856902						
AQ2/N2	16°46'39.33"N	194096	Same as the AQ1/N1	63.5	-	61.4	55	70
	96° 7'49.79"E	1857164						
AQ3/N3	16°46'55.17"N	193952	In the compound of Aung Mingalar Monastery (near the Kannar Road) located in Ahlone Township, Yangon Region	56.1	-	54.0	55	70
	96° 7'44.70"E	1857653						
AQ4/N4	16°46'56.00"N	194702	In the compound of Church (near the Thakhinmya Park) Ahlone Township, Yangon Region	51.3	-	49.3	55	70
	96° 8'10.00"E	1857668						
AQ5/N5	16°45'46.67"N	194641	In the compound of No. (22) Basic Education Primary School in Dala Township, Yangon Region	47.2	-	45.1	55	70
	96° 8'8.97"E	1855536						
AQ6/N6	16°45'11.99"N	194551	In the compound of Yadanarayeyeikthar Monastery located in Kyansitthar Ward, Dala Township, Yangon Region	41.3	-	39.3	55	70
	96° 8'6.46"E	1854470						

Impact Assessment Table

The significance of potential impacts to NSRs around the Project Area from noise generated through foundation work and civil construction during construction phase is assessed in ***Table 9.31***, and mitigation measures are presented thereafter.

Table 9.31: Significance of Impacts Due to Generation of Noise from Foundation Work and Civil Construction during Construction Phase of Power Plant

Significance of Impact					
Impact	Potential impacts to NSRs due to noise emissions Foundation Work and Civil Construction during the construction phase.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to NSRs would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction is expected to start mid 2019 and be complete in 28 months, which would be considered short-term.				
Impact Extent	**Local**	Regional	International		
	Noise impact from construction equipment will have localised impact.				
Impact Scale	The baseline noise (before combining the construction equipment noise) already exceeds the noise standard, the secondary threshold value (maximum 3 dBA greater than the baseline noise level) will be used; the increased in noise at N1 is greater than 3 dBA which exceeds the Myanmar Standard.				
Impact Frequency	Equipment is also expected to operate intermittently but repeatedly throughout the day.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Based on the impact characteristics above, the impact magnitude is considered to be medium.				
Receptor Sensitivity	Low	**Medium**	High		
	The identified NSRs are residential, the sensitivity of the receptor is considered as medium.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a Medium Receptor Sensitivity and Medium Impact Magnitude will result in an overall Moderate impact.				

Mitigation Measures

The following measures will be put in place for the Project during the construction phase to mitigate impacts to NSRs:

- Noise barriers should be installed at the site boundary (facing the closest NSRs) and high enough which completely hides the noise sources from the NSR. It is anticipated that at least a 10 dB(A)

noise reduction can be provided[148]. The noise barrier material should have a superficial surface density of at least 7 kg/m^2 and have no openings or gaps;

- Well-maintained equipment to be operated on-site;
- Normal working hours of the contractor should be between 07:00 and 22:00 hours from Monday to Saturday (except holiday). If work needs to be undertaken outside these hours, it should be limited to activities that do not lead to exceedance of noise criteria at nearby NSRs and avoid early morning and night time construction;
- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components;
- Shut down or throttled down between work periods for machines and construction plant items (e.g. trucks) that may be in intermittent use;
- Reduce the number of equipment operating simultaneously as far as practicable;
- Orientate equipment known to emit noise strongly so that the noise is directed away from receptors far as practicable;
- Locate noisy equipment (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable;
- Avoid transportation of materials on- and off-site through existing community areas; and
- Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site construction activities.

Residual Impact

If the recommended mitigation measures are implemented, residual impact significance would be **Negligible** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of noise should consist of the following:

- Monthly noise monitoring should be conducted at the representative NSRs by the EPC contractor to check noise levels and compliance at the NSRs throughout the construction phase.

9.3.7.3 Impact from Noise during Pre-commissioning, Commissioning and Testing during Construction Phase

Overview

Once the main construction activities have been completed, the Power Plant will have to undergo pre-commissioning and testing to ensure all equipment is functioning as intended, before the Power Plant proceeds to normal operation phase. The pre-commissioning and testing stage is expected to produce the same level of noise as during the Power Plant operation phase but for significantly shorter duration.

Pre-commissioning and testing is conducted just before the Power Plant is allowed to proceed into the operation phase. This activity ensures that all equipment are functioning as designed, and also ensuring the maximum design capabilities are achievable to guarantee the required level of safety. This activity is expected to be similar to the operation of the Power Plant, as normal operation equipment will be tested; therefore, producing the same level of sound as during the operation phase.

[148] FHWA. (2017). Highway Traffic Noise Barriers at a Glance. U.S. Department of Transportation. Federal Highway Administration. Retrieved from: https://www.fhwa.dot.gov/Environment/noise/noise_barriers/design_construction/keepdown.cfm

During the Power Plant pre-commissioning, commissioning and testing phase, equipment that will be operating are shown in ***Table 9.32***.

Table 9.32: Pre-Commissioning, Commissioning and Testing Equipment Noise Level

Code	Equipment List	Lw, dBA	Hours	Operation	Working	Standby
P1_3	No.1 Gas Turbine Package	N/A	N/A	N/A	1	0
P1_4	No.2 Gas Turbine Package	85	24 hr.	Constant	2	0
P1_6	No.1 HRSG	N/A	24 hr.	N/A	2	0
P1_7	No.2 HRSG	N/A	N/A	N/A	1	0
P1_30	Steam Turbine Package	85	24 hr.	Constant	1	0

Source: TPMC, 2019

Impact Assessment Table

The significance of potential impacts to NSRs around the Project Area from noise generated through pre-commissioning and testing work during construction phase is assessed in ***Table 9.33***, and mitigation measures are presented thereafter.

Table 9.33: Significance of Impacts Due to Generation of Noise from Pre-commissioning, Commissioning and Testing during Construction Phase of Power Plant

Significance of Impact					
Impact	Potential impacts on NSRs due to noise emissions from Pre-commissioning and Testing during the construction phase.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	Construction is expected to start mid 2019 and be completed in 28 months, which would be considered short-term; however, this impact will only occur during the last stages of the construction phase (approximately 5 months depending testing duration of each unit), which would be considered temporary duration.				
Impact Extent	**Local**	Regional	International		
	Noise impact from operation equipment will have localised impact.				
Impact Scale	The pre-commissioning, commissioning and testing of the Power Plant will have similar impacts as during operation which was will be assessed in ***Section 9.3.7.4***, which resulted in a significance increase of noise level.				
Frequency	Equipment is expected to operate intermittently but repeatedly throughout the day.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the impact characteristics above, the impact magnitude is considered to be small.				
Receptor Sensitivity	Low	**Medium**	High		
	The identified NSRs are residential, the sensitivity of the receptor is considered as medium.				

Significance of Impact				
Impact Significance	Negligible	**Minor**	Moderate	Major
	The combination of a Medium Receptor Sensitivity and Small Impact Magnitude will result in an overall Minor impact.			

Mitigation Measures

The following measures will be put in place for the Project during the construction phase to mitigate impacts to NSRs:

- Noise barriers should be installed at the site boundary (facing the closest NSRs) and high enough which completely hides the noise sources from the NSR. It is anticipated that at least a 10 dB(A) noise reduction can be provided[149]. The noise barrier material should have a superficial surface density of at least 7 kg/m^2 and have no openings or gaps;
- Well-maintained equipment to be operated on-site;
- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components;
- Reduce the number of equipment operating simultaneously as far as practicable;
- Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable;
- Locate noisy plant (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable;

Residual Impact

If the recommended mitigation measures are implemented, residual impact significance would be **Negligible** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of noise should consist of the following:

- Noise pre-commissioning test should be conducted for the Power Plant items by the Project Proponent prior to the operation of the Project to ensure compliance with the relevant noise criteria at the representative NSRs.

9.3.7.4 Impact from Noise during Operation of Power Plant

Overview

During the operation phase, the normal operation activities of the Power Plant will include the operation of equipment, such as gas turbines, HRSGs (Heat Recovery Steam Generators), steam turbines, etc. Some equipment will operate continuously, whereas other equipment will be placed on standby.

During the Power Plant operation phase, equipment that will either be used or placed on standby are shown in ***Table 9.34***.

Table 9.34: Operation Equipment Noise Level

Code	Equipment List	Lw, dBA	Hours	Operation	Working	Standby

[149] https://www.fhwa.dot.gov/Environment/noise/noise_barriers/design_construction/keepdown.cfm

Code	Equipment List	Lw, dBA	Hours	Operation	Working	Standby
p1_2	Fuel Gas Heater	85	24 hr.	Constant	1	0
P1_3	No.1 Gas Turbine Package	N/A	N/A	N/A	1	0
P1_4	No.2 Gas Turbine Package	85	24 hr.	Constant	2	0
P1_5	Compressor Wash Water Pit	N/A	24 hr.	N/A	1	0
P1_6	No.1 HRSG	N/A	24 hr.	N/A	2	0
P1_7	No.2 HRSG	N/A	N/A	N/A	1	0
P1_8	Deaerator And Storage Tank	N/A	24 hr.	N/A	1	0
P1_9	No.1 & No.2 & No.3 HP/LP Boiler Feed Water Pump	85	24 hr.	Constant	2	1
P1_10	HP Warm-Up Silencer	85	12 hr.	Intermittent	1	0
P1_11	LP Warm-Up Silencer	85	12 hr.	Intermittent	1	0
P1_12	External Heat Exchanger	85	24 hr.	Constant	1	0
P1_13	No.1 Blowdown Tank	N/A	N/A	N/A	1	0
P1_14	No.1 Blowdown Pit	N/A	N/A	N/A	1	0
P1_15	No.2 Blowdown Tank	N/A	24 hr.	N/A	2	0
P1_16	No.2 Blowdown Pit	N/A	24 hr.	N/A	2	0
P1_17	No.1 & No.2blowdown Pit Pump	N/A	N/A	N/A	1	0
P1_18	No.3 & No.4 Blowdown Pit Pump	85	12 hr.	Intermittent	2	2
P1_19	Continuous Emission Monitoring System (CEMs) For No.1 & No.2 HRSG	85	24 hr.	Constant	1	0
P1_20	Oxygen Scavenger Dosing Tank	N/A	24 hr.	N/A	1	0
P1_21	Oxygen Scavenger Mixer	85	24 hr.	Constant	1	0
P1_22	Oxygen Scavenger Dosing Pump	85	24 hr.	Constant	1	1
P1_23	Ammonia Dosing Tank	N/A	24 hr.	N/A	1	0
P1_24	Ammonia Mixer	85	24 hr.	Constant	1	0
P1_25	Ammonia Dosing Pump	85	24 hr.	Constant	1	1
P1_26	Phosphate Dosing Tank	N/A	24 hr.	N/A	1	0
P1_27	Phosphate Mixer	85	24 hr.	Constant	1	0
P1_28	HP Phosphate Dosing Pump	85	24 hr.	Constant	2	1
P1_29	LP Phosphate Dosing Pump	85	24 hr.	Constant	2	1
P1_30	Steam Turbine Package	85	24 hr.	Constant	1	0
P1_31	No.1 & No.2 HP Turbine By-Pass Valve	85	N/A	N/A	2	0
P1_32	No.1 & No.2 LP Turbine By-Pass Valve	85	N/A	N/A	2	0
P1_33	Main Condenser	N/A	24 hr.	N/A	1	0
P1_34	No.1 & No.2 & No.3 Condensate Extraction Pump	85	24 hr.	Constant	2	1

Code	Equipment List	Lw, dBA	Hours	Operation	Working	Standby
P1_35	Sampling Skid	85	24 hr.	Constant	1	0
P1_36	No.1 & No.2 River Water Intake Pump With Priming Tank And Pontoon	85	24 hr.	Constant	1	1
P1_37	No.1 & No.2 Existing Settling Pond	N/A	24 hr.	N/A	1	1
P1_38	No.1 & No.2 Raw Water Pump	85	24 hr.	Constant	1	1

Source: TPMC, 2019.

The location of equipment that is expected to produce noise during the operation phase, regardless of operation period, is shown in ***Figure 9.8***. ***Figure 9.9*** also shows the location of the operation equipment with red markings.

Figure 9.8: Location of Noise Emitting Equipment during Operation Phase

Source: TPMC, 2019.

Figure 9.10 and ***Figure 9.11*** shows the noise modelling results in the form of noise contours based upon the input data from ***Table 9.34***. Type A (noise gradient map which shows the dissipating of noise over distance) and type B (noise contour map which shows the noise level at certain distance) figures show the same results; the difference involves using different graphical representations.

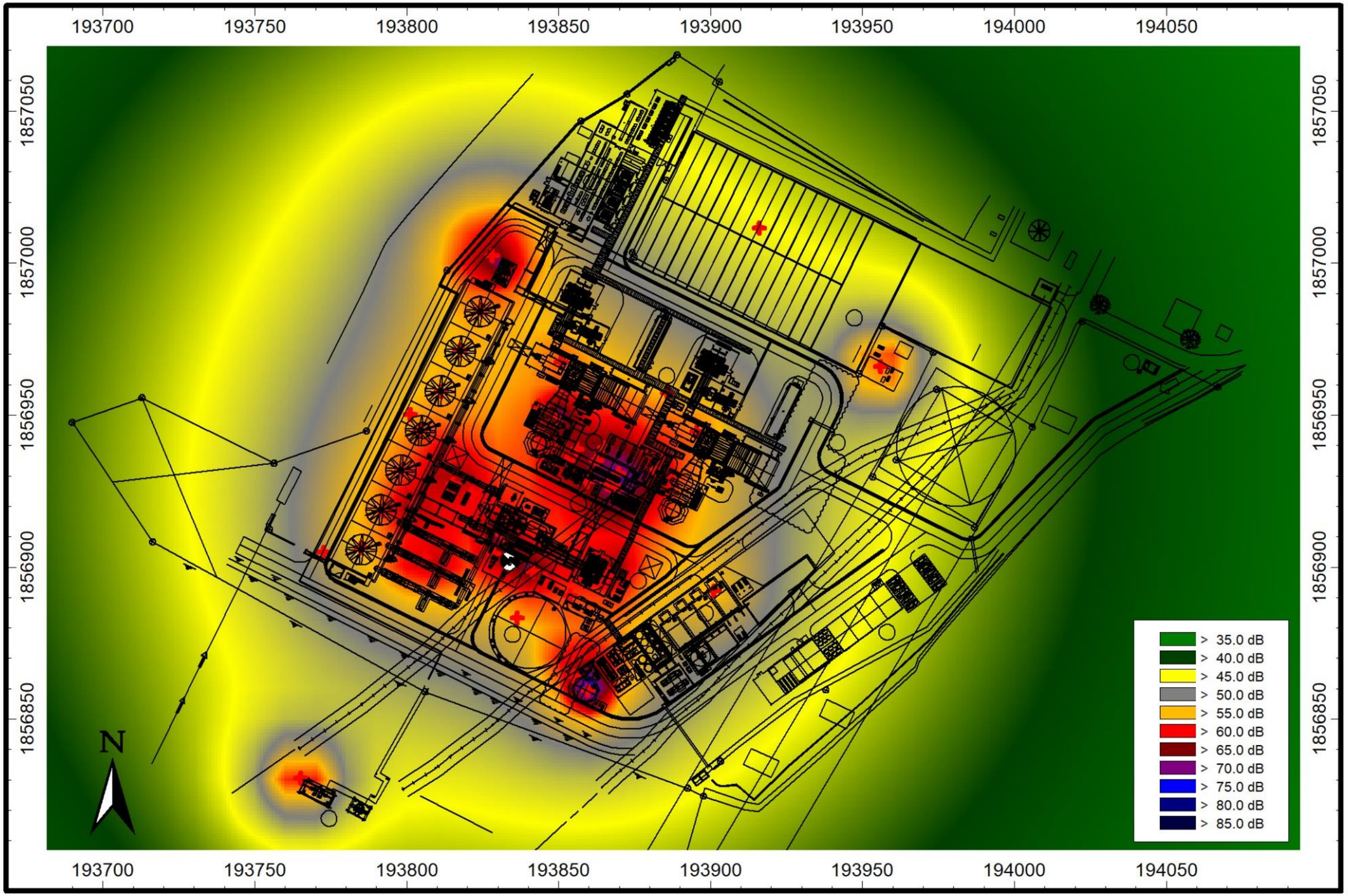
The results suggest that noise levels rapidly dissipate over distance; with the majority of noise emission levels that extend beyond the Power Plant boundary being <45 dBA, which then dissipates down to <40 dBA.

The >40 dBA noise contour is shown to extend beyond the Power Plant boundaries, specifically within the northwest area of the Power Plant; however, this location is situated within an industrial zone, which has a higher threshold noise level. The results indicate that there are no NSRs within the range for noise from operation equipment to cause impacts.

Figure 9.9: Operation Equipment Location for Modelling Input

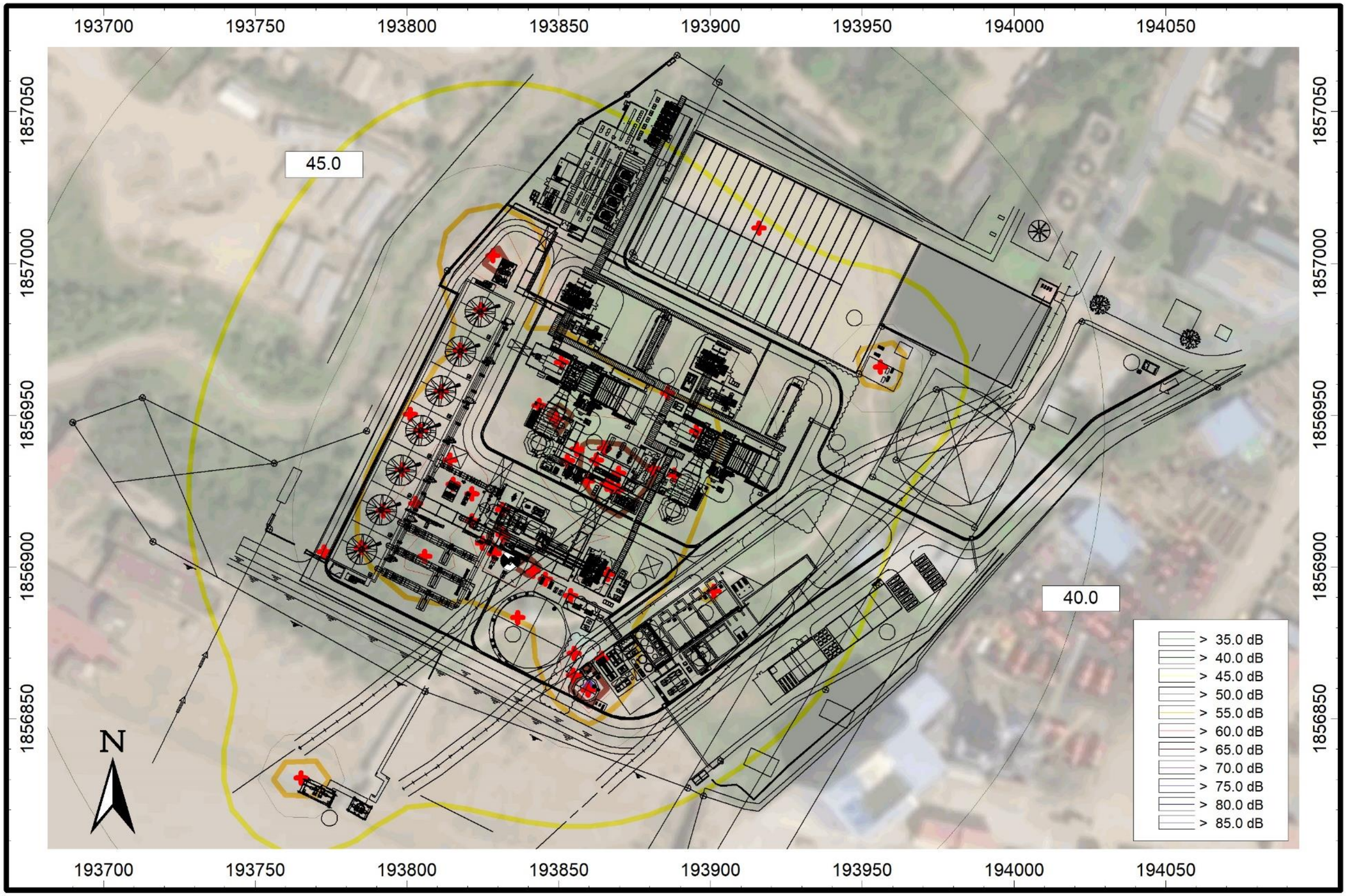
Source: TPMC, 2019. (Modified by AMacoustic)

Figure 9.10: Noise Contour during Operation Phase (Type A)



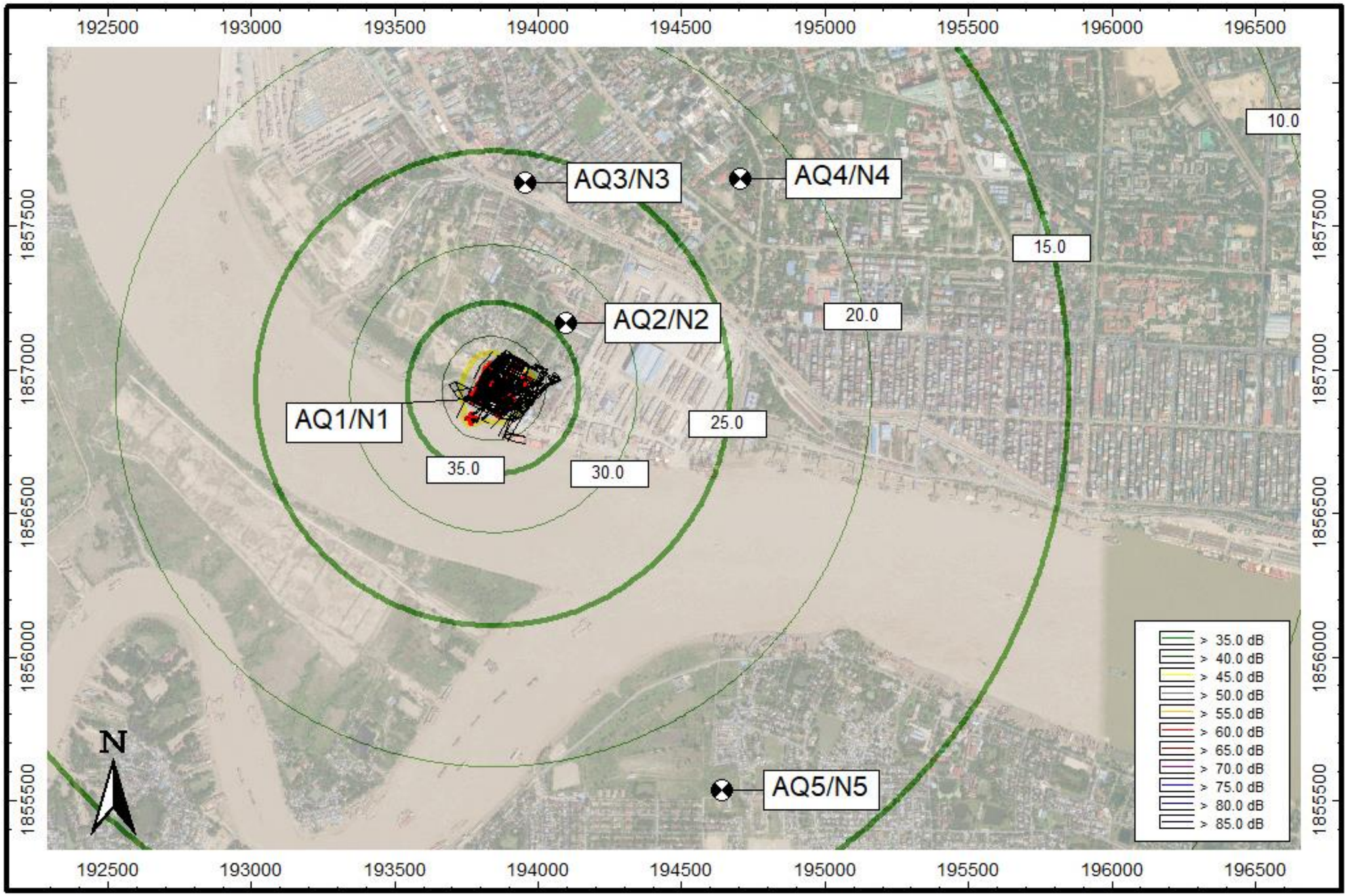
Source: AMacoustic, 2019.

Figure 9.11: Noise Contour during Operation Phase (Type B1)



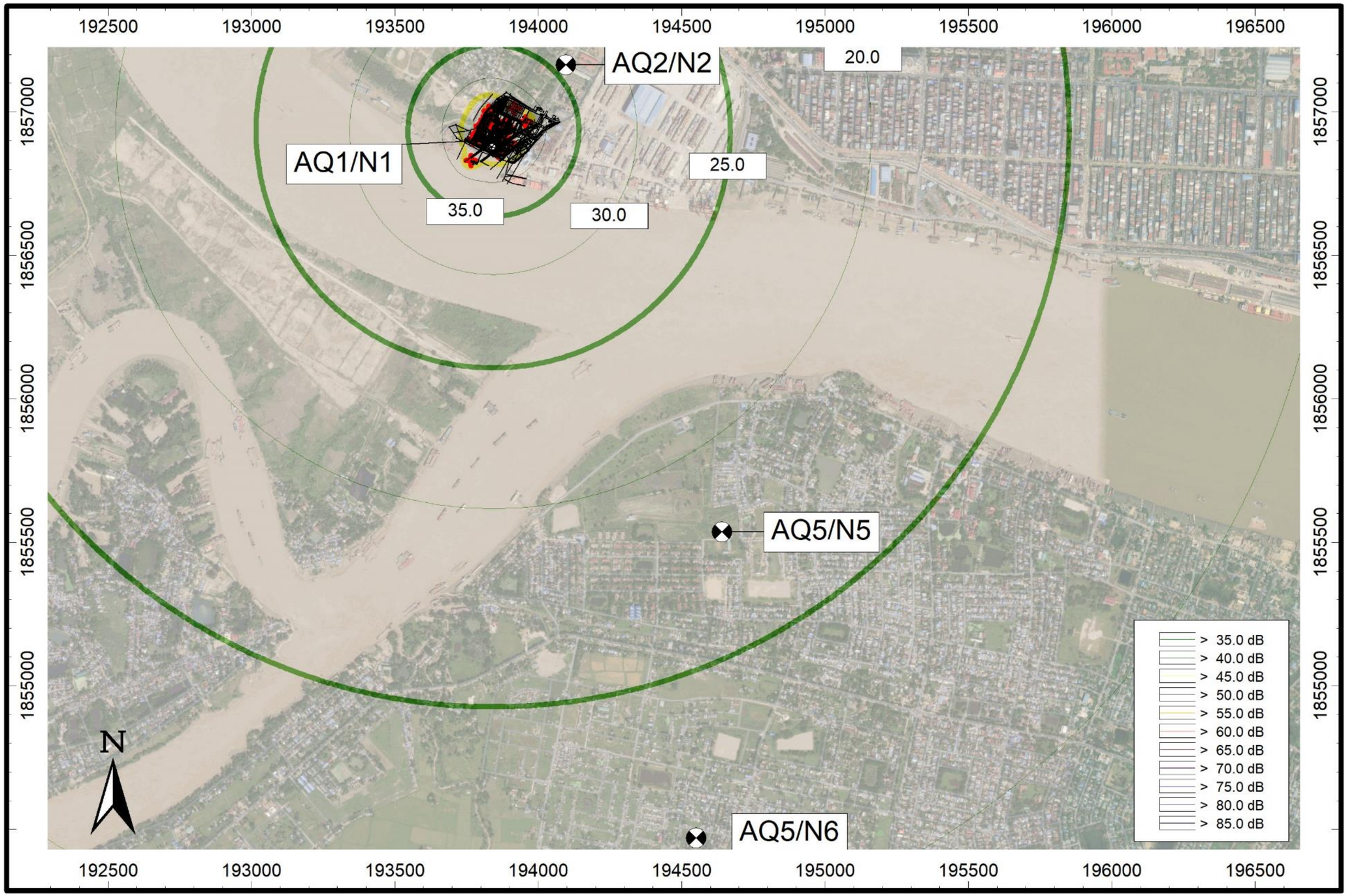
Source: AMacoustic, 2019.

Figure 9.12: Noise Contour during Operation Phase (Type B2)



Source: AMacoustic, 2019.

Figure 9.13: Noise Contour during Operation Phase (Type B3)



Source: AMacoustic, 2019.

According to the modelling results, the expected noise levels at each noise sampling station location is shown in ***Table 9.35***.

Table 9.35: Noise Level Results from Modelling at Noise Sampling Stations Location (Operation Phase)

Sampling Points	Coordination	UTP 47Q / WGS84	Description of Sampling Point	Lday dB(A)	Lnight dB(A)	Leq dB(A)	NEQG Daytime (residential)	NEQG Night-time (residential)	NEQG Daytime (industrial)	NEQG Night-time (industrial)
AQ1/N1	16°46'30.69"N	193834	In the compound of Combined Cycle Power Plant (at project area) located in Ahlone Township, Yangon Region	61.7	61.6	61.7	55	45	70	70
	96° 7'41.11"E	1856902								
AQ2/N2	16°46'39.33"N	194096	Same as AQ1/N1	33.8	33.5	33.7	55	45	70	70
	96° 7'49.79"E	1857164								
AQ3/N3	16°46'55.17"N	193952	In the compound of Aung Mingalar Monastery (near the Kannar Road) located in Ahlone Township, Yangon Region	26.4	26.1	26.3	55	45	70	70
	96° 7'44.70"E	1857653								
AQ4/N4	16°46'56.00"N	194702	In the compound of Church (near the Thakhinmya Park) Ahlone Township, Yangon Region	21.8	21.5	21.7	55	45	70	70
	96° 8'10.00"E	1857668								
AQ5/N5	16°45'46.67"N	194641	In the compound of No. (22) Basic Education Primary School in Dala Township, Yangon Region	17.8	17.5	17.7	55	45	70	70
	96° 8'8.97"E	1855536								
AQ6/N6	16°45'11.99"N	194551	In the compound of Yadanarayeyeikthar Monastery located in Kyansitthar Ward, Dala Township, Yangon Region	11.9	11.6	11.8	55	45	70	70
	96° 8'6.46"E	1854470								

Table 9.36 shows the result of ***Equation 21*** for the combined noise levels at the closest NSR, approximately 80 metres north of the Power Plant. Although there are no noise sampling stations located at the closest NSR, noise station N1 (approximately 160 metres) is located closest to the NSR. Baseline data from noise station N1 will be used, assuming that the noise level at the closest NSR is similar. The results indicate that the combined noise levels from the contributing operation equipment to the baseline shows a significant increase in total noise level (greater than 3 dBA increase from the baseline).

Table 9.36: Combined Noise Level at Closest NSR

Time of Day	Baseline (dBA)[a]	Noise Level Contribution from Construction Equipment (dBA)	Total Noise Level (dBA)	NEQG Daytime (residential)	NEQG Daytime (industrial)
Day Time	59	61.7	63.56683	55	70
Night time	57	61.6	62.89283	45	70

Source: SEM, 2018.

Note: [a] Baseline data for noise station N1, survey period 2-3 May 2018.

Table 9.37 and ***Table 9.38***, shows the result of ***Equation 21*** for the combined noise levels at noise station N3 location (N3 is chosen to represent the noise level at the closest community). The results indicate that the combined noise levels from the contributing operation equipment to the baseline is insignificant (differences between baseline and total noise level is less than 3 dBA); NSRs at this location or distance will not notice any increase in noise levels.

Table 9.37: Combined Noise Level at Noise Station N3 (2-3, May 2018)

Time of Day	Baseline (dBA)	Noise Level Contribution From Construction Equipment (dBA)	Total Noise Level (dBA)	NEQG Daytime (residential)	NEQG Daytime (industrial)
Day Time	71	26.3	71.00015	55	70
Night time	66	26.3	66.00047	45	70

Source: SEM, 2018.

Table 9.38: Combined Noise Level at Noise Station N3 (3-4, May 2018)

Time of Day	Baseline (dBA)	Noise Level Contribution From Construction Equipment (dBA)	Total Noise Level (dBA)	NEQG Daytime (residential)	NEQG Daytime (industrial)
Day Time	70	26.3	70.00019	55	70
Night time	67	26.3	67.00037	45	70

Source: SEM, 2018.

Impact Assessment Table

The significance of potential impacts to NSRs around the Project Area from noise generated through operation activities during operation phase is assessed in ***Table 9.39***, and mitigation measures are presented thereafter.

Table 9.39: Significance of Impacts Due to Generation of Noise from Operation Activities of Power Plant during Operation Phase

Significance of Impact					
Impact	Potential impacts on NSRs due to noise emissions from the operation of Power Plant equipment during the operation phase.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts is considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase is expected to continue for approximately 25 years, which would be considered long-term.				
Impact Extent	**Local**	Regional	International		
	Noise impact from operation equipment will have localised impact.				
Impact Scale	***Table 9.36*** (representing the closest NSRs to the Power Plant) indicates a significant increase in background noise levels while ***Table 9.37*** and ***Table 9.38*** (representing noise level at a community nearby the Power Plant). Considering that baseline noise (before combining the operation equipment noise) already exceeds the noise standard, the secondary threshold value (maximum 3 dBA greater than the baseline noise level) will be used; the increased noise is greater than 3 dBA at the closest NSR and therefore exceeding the Myanmar Standard.				
Impact Frequency	Operation equipment is expected to run throughout operation period; however, some equipment will be placed on standby until certain situations arise, such as equipment failure (standby equipment to begin operation as back-up), and during unplanned events. There will be operation equipment that will operate during certain hours (not 24 hours a day) as per requirement of operating procedures				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Based on the characteristics above, the impact magnitude is likely to be medium during day time.				
Receptor Sensitivity	Low	**Medium**	High		
	The identified NSRs are residential, the sensitivity of the receptor is considered as medium.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a Medium Resource Sensitivity and Medium Impact Magnitude will result in an overall Moderate impact.				

Mitigation Measures

The following measures will be put in place for the Project during the operation phase to mitigate impacts to NSRs:

- Noise barriers should be installed at the site boundary (facing the closest NSRs) and high enough which completely hides the noise sources from the NSR. It is anticipated that at least a 10 dB(A) noise reduction can be provided[150]. The noise barrier material should have a superficial surface density of at least 7 kg/m^2 and have no openings or gaps;

[150] https://www.fhwa.dot.gov/Environment/noise/noise_barriers/design_construction/keepdown.cfm

- Well-maintained equipment to be operated on-site;
- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components;
- Reduce the number of equipment operating simultaneously as far as practicable;
- Orientate equipment known to emit noise strongly so that the noise is directed away from receptors far as practicable; and
- Locate noisy plant (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable.

Residual Impact

If the recommended mitigation measures are implemented, residual impact significance would be **Negligible** to **Minor** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of noise should consist of the following:

- Annual noise monitoring should be conducted at the representative NSRs by the Project Proponent to check noise levels and compliance at the NSRs throughout the operation phase.

9.4 Surface Water Impact Assessment

9.4.1 Introduction

During the construction and operation phases, different activities have the potential to generate wastewater, accidental spills, sedimentation, and increased water consumption, which could lead to impacts on the hydrology and quality of surrounding freshwater bodies. In the Power Plant study area, the Yangon River is identified as the most prominent potential receiving body. Therefore, it is important to understand the interaction between impacts generated from construction and operation activities of the Power Plant and the subsequent effects on surface water quality and hydrology. This section presents an evaluation of the potential impacts on surface water associated with the construction and operation of the proposed Power Plant based on the impacts identified during Scoping.

Potential impacts that have been identified and will be assessed under the Surface Water Impact Assessment includes the following:

- Water intake requirements for construction and operation activities;
- Demineralized plant neutralized water discharge; and
- Cooling Water Discharge;
- Sedimentation caused by soil erosion from storm water.

This section also develops management, mitigation and monitoring measures needed to ensure that any identified impacts can be reduced to as low as reasonably practical. Such measures are presented and will form part of the overall Environmental and Social Management Plan (ESMP, ***Chapter 12***) for the Power Plant.

9.4.2 Assumptions and Limitations

The assessment of potential impacts related to surface water in this section is based on the environmental baseline data (presented within ***Chapter 5***), socioeconomic baseline data (presented within ***Chapter 5***) and the information available from TPMC at the time of writing. Judgements and assessments have been made based on professional knowledge and previous experience of ERM.

Should there be significant changes in factors such as assumed input data, engineering design of wastewater management and treatment components of the Power Plant, or agreed assessment criteria, then elements of this impact assessment and associated management, mitigation and monitoring measures may be needed to reflect these changes.

The environmental parameters sampled in the baseline survey (refer to ***Chapter 5***) are based upon commonly found contaminants.

This section considers the nearby water bodies as the primary receptors. It is recognised that any changes to surface water may potentially impact other sensitive receptors that utilise these surface water resources. In this regard, this section assesses impacts and recommends management, mitigation and monitoring measures in relation to reducing direct impacts to surface water only. Assessing secondary impacts to receptors from changes to water quality or hydrology (identified as a result of this section) has been undertaken within other respective sections, taking into account the various management, mitigation and monitoring measures developed within this section.

Assessment of the impact towards other receptors will be carried out in the according receptor impact assessment section as follows:

- Loss of containment of hazardous waste (which includes diesel oil, hydraulic fluids, paint, battery, cement wash down, rinsing effluents, and sludge) generated from construction and operation activities (***Section 9.6: Waste***).
- Loss of containment of non-hazardous waste generated from construction and operation activities (which includes concrete, steel pipes, steel plates, structural steel, and wooden crates) generated from construction and operation activities (***Section 9.6: Waste***).
- Domestic solid waste generated from workers during construction phase, and permanent staff during operation phase (***Section 9.6: Waste***).
- Loss of containment of domestic liquid waste generated from workers during construction phase, and permanent staff during operation phase (***Section 9.6: Waste***).

9.4.3 Assessment Methodology

The methodology used for assessing impacts to surface water is aligned with the general impact assessment methodology presented in ***Chapter 6***.

9.4.4 Summary of Baseline Conditions

The main river within the Power Plant area is the Yangon River. The proposed Power Plant, and LNG Receiving Terminal are located along the Yangon River, the Natural Gas Pipeline that connects the LNG Receiving Terminal with the proposed Power Plant will cross the Twante canal from Dala Township to Sala Kanaungto Township, then cross the Yangon River again to Ahlone Township. The river is under tidal influence, and becomes brackish during the dry season. The estuary and creeks of the river are navigable by small craft with some areas covered by mangrove forest. There are number of villages, as well as commercial ports located on its banks, therefore, the river is currently used for fisheries, navigation and marine logistic purposes.

Results from baseline sampling of surrounding water bodies, including the Yangon River, showed that, during the dry season, parameters that exceeded the compared local and/or international standards (Myanmar standards, IFC Standards, and EPA Standards) include TSS, TDS, Iron, and Manganese. Parameters that exceed the local and or international standards during the wet season include TSS, Iron, Mercury, and Manganese. All other parameters were found to be within the compared standards. Further details regarding Surface Water baseline conditions are shown in ***Chapter 5***.

9.4.5 Receptor Identification and Sensitivity

The primary receptor for impacts to surface water is the Yangon River, and downstream water users and aquatic ecosystems. Groundwater, ponds/lakes, and stored rainwater are the main water sources, along with stored water from streams. Water from the Yangon River is also used by villagers from townships within the Study Area; however, this is relatively limited. Water from the Yangon River is available year round.

Based on the baseline sampling conducted in the Yangon River, some parameters were found to be above relevant standards, and therefore the water bodies may be more sensitive to changes. However, the resources do not support very diverse or susceptible populations of flora and/or fauna, and their importance for local habitats and communities would be considered moderate. Overall, sensitivity of the receptor is considered Low.

9.4.6 Summary of Project Activities with Potential Impacts

9.4.6.1 Construction Phase

Proposed Project Activities with Potential Impact

Construction of the Power Plant will be carried out by the EPC contractor appointed by TPMC. The construction phase for the Power Plant will take approximately 28 months. Scheduled Commercial Operating Date (SCOD) is expected at the end of 2021. The maximum number of workers onsite during construction is anticipated to be 600 persons.

During the construction phase, potential impacts to surface water may arise from the following activities:

- Water Intake Requirements; and
- Sedimentation caused by soil erosion during certain construction activities.

9.4.6.2 Operation Phase

Proposed Project Activities with Potential Impact

The operation phase is expected to continue for approximately 25 years. The average number of permanent workers present during operation is expected to be approximately 49, with small numbers of additional staff for security, cleaning, technical assistance, and occasional maintenance. The assessment of operational phase impacts includes those arising from routine operations and maintenance of the Power Plant. During the operation phase, potential surface water impacts may arise from domestic wastewater discharge, inappropriate waste storage and disposal, contaminated surface water runoff, cooling water withdrawal, erosion, and sedimentation.

During the operation phase, potential impacts to surface water may arise from the following activities:

- Water Intake Requirements;
- Demineralized plant neutralized water discharge; and
- Thermal Discharge (from Cooling Water System).

9.4.7 Assessment of Impacts to Surface Water

9.4.7.1 Overview

The assessment of impacts section will consider each type of the potential impact with respect to each phase (construction, operation), for those interactions/impacts that have been scoped in for the power plant. The section will be organized into sub-sections as follows:

- Overview – description of the Power Plant activities that have the potential to cause the impact during the respective phase;
- Impact Assessment Table – a summary table that assesses and evaluates impacts based on their characteristics, to determine the significance of the impact;
- Mitigation Measures – a list and description of corrective and preventive actions to be applied or implemented to Power Plant activities to reduce the significance of the assessed impact;
- Residual Impacts – reevaluation of impact significance after mitigation measures have been applied; and
- Monitoring Plan – summary of the monitoring plan, which has the objective to ensure that the mitigation measures have been implemented effectively and resulted in a reduction in the significance of residual impacts.

9.4.7.2 Water Intake Requirements (Construction Phase)

Overview

During the construction phase, various activities will require the use of water. Water requirements of the construction workforce is one factor that is to be considered, as personal water consumption, such as for hydration and washing is to be expected, as well as other construction activities that may also require water, which may place pressure on the local water supply.

Prefabricated concrete activities are estimated to consume 40 m^3 of water per day. All construction activities are estimated to consume 65 m^3 of water per day.

The maximum number of workers onsite during construction is anticipated to be 600 persons and each worker is estimated to consume approximately 33.3 litres of water per day[151]. The average water consumption rate during construction is anticipated to be 624 m^3 per month (approximately 30 m^3 (30,000 L) per day). The raw water required during construction will be obtained from the local water distribution services, and will be treated and purified before use for construction.

The socioeconomic baseline study (***Chapter 5***) found that, in the Power Plant study area, groundwater, ponds/lakes, and stored rainwater are the main water sources, along with stored water from streams. Water from the Yangon River is also used by villagers from townships within the study are; however, this is relatively limited. Water from the Yangon River is available year round.

WHO Regional Office for South-East Asia[152] suggests that, including requirements for drinking, cooking, washing, cleaning, and waste disposal, up to 70 L per person per day of water are required for human use. The Power Plant's water requirement of 30,000 L per day during construction is equivalent to the water requirement for 429 people. Although the Yangon River will be the main source of water for construction activities, the water requirement for the Power Plant is not expected to impact the communities' existing water usage; communities mainly use lakes, ponds, or stored rain water as a source of water, with limited intake of the Yangon River. In addition, considering the Yangon River is large with a constant flow of water, ranging from <500 m^3/s in April to 7,000 m^3/s in August, and with a relatively close distance (from Power Plant location) to the Gulf of Martaban, impacts to the Yangon River water supply is expected to have an insignificant difference.

[151] Metcalf& Eddy Inc. Wastewater Engineering: Treatment, Disposal, Reuse. 3rd Edition McGraw Hill, Network, 1979

[152] http://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/WHO/WHO5%20-%20Minimum%20water%20quantity%20needed%20for%20domestic%20use.pdf

Impact Assessment Table

Table 9.40: Impact Assessment Table for Water Intake Requirements (Construction Phase)

Significance of Impact					
Impact	Potential impacts on surface water due to water intake requirements during construction phase.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to surface water would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to surface water would be direct impacts through water intake from the Yangon River.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction will take approximately 28 months, which would be considered short-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would be limited to the Power Plant area, downstream of the Yangon River, and to any nearby water users, hence would be considered to be local.				
Impact Scale	The maximum number of workers onsite during construction is anticipated to be 600 persons. The Power Plant's water requirement of 30,000 L/day (30 m^3/day) during construction is equivalent to the water requirement for 429 people. Yangon River flow ranges from <500 m^3/s in April to 7,000 m^3/s in August. The raw water required during construction will be obtained from YCDC or other local water supplier, and will be transported by water trucks. The water requirement for the Power Plant is not expected to impact the communities' existing water usage; communities mainly use lakes, ponds, or stored rain water as a source of water, with limited intake of the Yangon River.				
Frequency	Impacts to surface water from water use could occur intermittently but repeatedly throughout the day for the duration of the construction phase.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Based on the characteristics above, the impact magnitude is likely to be Negligible.				
Receptor Sensitivity	**Low**	Medium	High		
	The primary receptor for impacts to surface water from water intake is the Yangon River, and downstream water users and aquatic ecosystems. Existing surface water quality is relatively poor. Groundwater, ponds/lakes, and stored rainwater are the main water sources, along with stored water from streams. Water from the Yangon River is also used by villagers from townships within the Study Area; however, this is relatively limited. Water from the Yangon River is available year round. The Yangon River does not support a diverse ecosystem and it would not be expected to be significantly impacted by changes in water quantity/flow rates. Given the background conditions of the Yangon River, sensitivity of the receptor is considered Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Negligible Impact Magnitude will result in an overall Negligible impact.				

Mitigation / Management Measures

The significance of impacts is rated as Negligible, and no additional mitigation is considered necessary provided that existing/in-place controls are appropriately implemented.

Residual Impact (Post-mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts would be expected to be of **Negligible** significance.

Monitoring Plan

As detailed in the ESMP chapter (***Chapter 12***), monitoring for surface water during the construction phase should consist of the following:

- Monthly monitoring of water intake quantities and flow rates in the Yangon River.

9.4.7.3 Water Intake Requirements (Operation Phase)

Overview

During the operation phase, various activities will require the use of water in order to function. Water requirements of the employees is one factor that is to be considered, as personal water consumption, also categorized as domestic water, is to be expected. During Power Plant operations, cooling water will be required for various activities and equipment, such as the HSRG and steam turbines.

The main freshwater supply source will be taken from Yangon River. In addition, the pre-water treatment plant will be used ensure intake water is adjusted to the required standards for operation phase purposes.

The raw water will be passed through a coagulation mixer, flocculation tank and clarifier prior to collection in Service water and Firefighting storage tank as service water. Service water is majority of the water will be supplied to meet the plant water users and demineralized water requirement.

Table 4.49 presents the water requirements and their volumes during operation.

Table 9.41: Water Requirement during Operation

Water Requirement	Volume
Cooling water system	601 m^3/h
Domestic water (local authorized)	4 m^3/h

Source: TPMC, 2018.

During normal operations the main water consuming activity is from the regasification unit, with an expected volume requirement of 601 m^3/h (601,000 L/h), and from domestic water, with an expected volume requirement of estimated at 4 m^3/h (4,000 L/h), for a combined total of 605 m^3/h (605,000 L/h).

Considering the Yangon River is large with a constant flow of water, ranging from <500 m^3/s in April to 7,000 m^3/s in August, and with a relatively close distance (from Power Plant's location) to the Gulf of Martaban, impacts to the Yangon River water supply is expected to have an unnoticeable difference.

The socioeconomic baseline study (***Chapter 5***) found that, in the Power Plant study area, groundwater, ponds/lakes, and stored rainwater are the main water sources, along with stored water from streams. Water from the Yangon River is also used by villagers from townships within the study are; however, this is relatively limited. Water from the Yangon River is available year round.

Impact Assessment Table

Table 9.42: Impact Assessment Table for Water Intake Requirements (Operation Phase)

Significance of Impact					
Impact	Potential impacts on surface water due to water intake requirements during operation phase.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to surface water would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase is expected to continue for approximately 25 years, which would be considered long-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would be limited to the Power Plant area and downstream of the Yangon River, and hence would be considered to be local.				
Impact Scale	The maximum intake requirement for the Power Plant is expected to be 605 m^3/h (605,000 L/h). Yangon River flow ranges from <500 m^3/s in April to 7,000 m^3/s in August. Although the Yangon River will be the main source of water for construction activities, the water requirement for the Power Plant is not expected to impact the communities' existing water usage; communities mainly use lakes, ponds, or stored rain water as a source of water, with limited intake of the Yangon River.				
Frequency	Water intake for the Power Plant would be near-continuous for the Power Plant's operational duration.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Based on the characteristics above, the impact magnitude is likely to be Negligible.				
Receptor Sensitivity	**Low**	Medium	High		
	The primary receptor for impacts to surface water from water intake is the Yangon River, and downstream water users and aquatic ecosystems. Existing surface water quality is relatively poor. Groundwater, ponds/lakes, and stored rainwater are the main water sources, along with stored water from streams. Water from the Yangon River is also used by villagers from townships within the Study Area; however, this is relatively limited. Water from the Yangon River is available year round. The Yangon River does not support a diverse ecosystem and it would not be expected to be significantly impacted by changes in water quantity/flow rates. Given the background conditions of the Yangon River, sensitivity of the receptor is considered Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Negligible Impact Magnitude will result in an overall Negligible Impact.				

Mitigation / Management Measures

The impact significance is Negligible; however, the following mitigation measure is recommended in order to minimize the impact:

- Ensure wate intake does not exceed the flow rates of the Yangon River.

Residual Impact (Post-mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts are also expected to be of **Negligible** significance.

Monitoring Plan

As detailed in the ESMP chapter (***Chapter 12***), monitoring for surface water during the operation phase should consist of the following:

- Biannual monitoring of water intake quantities and flow rates in the Yangon River.

9.4.7.4 Demineralized Plant Neutralized Water Discharge (Operation Phase)

Overview

Demineralized (DM) plant neutralized water is wastewater from the demineralization process which has undergone treatment through neutralization; therefore, classified as neutralized water. Discharge of neutralized water may elevate the amount of nutrients in the water, which may cause contamination, or secondary impacts such as increased algae growth.

The scale of impact from this source is expected to be relatively low considering that the purpose of the neutralization process is to dilute and neutralize the wastewater in accordance to relevant standards before being discharged. The approximate quantity of neutralized water is 20 m^3/hr; this amount is considered relatively low, compared to the flow the Yangon River, which is approximately <500 m^3/s in April to 7,000 m^3/s in August. The flow of the Yangon River is expected to immediately dilute the neutralized water discharge.

Existing/ In-place Controls

Discharge waste water quality will meet IFC EHS guideline for Thermal Power Plant, pH, Temperature and Conductitiy. Discharge will follow the NEQG 1.2 Wastewater Standard. Online measurement will be used to measure waste water quality before discharge to the Yangon River.

Impact Assessment Table

Table 9.43: Impact Assessment Table for Demineralized Plant Neutralized Water Discharge (Operation Phase)

Significance of Impact				
Impact	Potential impacts on surface water quality due to demineralized plant neutralized water discharge during the operation phase.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts to surface water would be considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Impacts to surface water would be direct impacts through neutralization water discharge.			
Impact Duration	Temporary	Short-term	**Long-term**	Permanent
	The operation phase is expected to continue for approximately 25 years, which would be			

Significance of Impact					
	considered long-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would be limited to the Power Plant area and downstream of the Yangon River, and hence would be considered to be local.				
Impact Scale	Discharge of neutralized water may elevate the amount of nutrients in the water, which may cause contamination, or secondary impacts such as increased algae growth. The approximate quantity of neutralized water is 20 m^3/hr; this amount is considered relatively low, compared to the flow the Yangon River, which is approximately <500 m^3/s in April to 7,000 m^3/s in August.				
Frequency	Impacts to surface water quality from wastewater management could occur intermittently and/or continuously, depending on wastewater source.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Impacts to surface water quality from improper wastewater management could occur intermittently or from improper storage/disposal during operation phase.				
Receptor Sensitivity	**Low**	Medium	High		
	The primary receptor for impacts to surface water from wastewater discharge and runoff is the Yangon River, and downstream water users and aquatic ecosystem. Existing surface water quality is relatively poor considering parameters such as TSS and TDS exceed the related standards, and the ecological resources that it supports are not sensitive to a change in water quality. Given the physical and biological background conditions, and downstream water users of the Yangon River, sensitivity of the receptor is considered Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Negligible Impact Magnitude will result in an overall Negligible Impact.				

Mitigation / Management Measures

The impact significance is Negligible; however, the following mitigation measure is recommended in order to minimize the impact:

- Discharge waste water quality will meet IFC EHS guideline for Thermal Power Plant, pH, Temperature and Conductitiy, as well as NEQG 1.2 Wastewater Standard, before discharge.

Residual Impact (Post Mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts are also expected to be of **Negligible** significance.

Monitoring Plan

No monitoring plan is required.

9.4.7.5 Thermal Discharge (Operation Phase)

Overview

Cooling water discharge is derived from the gas turbine cooling system, heat exchangers, steam turbine generator cooler, and other related equipment. Improper storage, loss of containment, or

discharge of cooling water that is not compliant with standards may cause impacts towards surface water. The amount of cooling water discharge is approximately 210 m^3/hr.

Water from service water and fire water storage tanks are fed to the cooling tower basin by the cooling water make up pump. Cooling water from the cooling tower basin which is supplied to the main condenser of STG, Closed Cycle Heat Exchager and Blowdown tank. Cooling water blowdown will be dischrage to final pit.

The quality control of cooling water is adjusted by blowdown flow. Online measurements of pH, temperature and conductivity to be proived for measure water quality before discharge to river.

Different species of fauna or flora are adapted to a specific temperature range; exposure to temperatures beyond a species' temperature range may cause changes in behaviour, or may lead to possible die-off. Cooling water discharge may also cause a shift in habitat, causing existing species to migrate to other locations, and/or allowing for species that are adapted to colder waters to thrive at the discharge point.

It shall be noted that the Project will utilize a closed cycle cooling system, as described in ***Section 4.8.1.8***; this is considered as an existing measure to limit temperature differences between the Yangon River and the thermal discharge, and will significantly reduce thermal discharge temperatures as compared to a once-through cooling system. The expected water quality of the blowdown water is shown in ***Table 9.44***.

Table 9.44: Water Quality of Blowdown Water

Parameter	Unit	Maximum (3 Cycle)	Average (3 Cycle)
Turbidity	NTU	30	30
TSS	mg/L	45	30
pH	-	6.0-9.0	6.0-9.0
Silica	mg/L as SiO_2	148	32
Total hardness	mg/L as $CaCO_3$	7,633	1,822
Chloride	mg/L as Cl^-	19,790	4,659
Sulfate	mg/L as SO_4^{2-}	2,323	705
Total Iron	mg/L as Fe^-	0.3	0.3
Conductivity	µs/cm	53,498	13,643
M-Alkalinity	mg/L as $CaCO_3$	408	240
Ca-Alkalinity	mg/L as $CaCO_3$	4,238	993
Free Chlorine	mg/L as Cl_2	0.2	0.2

Source: TPMC, 2020.

Summary of CORMIX Modelling

Environmental risk to surface water in the Yangon River from the development of the proposed Power Plant and LNG TPMC sites was quantified using a steady-state discharge plume model for the planned heated discharge and cold water discharge, respectively. The United States Environmental Protection Agency (USEPA)-approved near-field model, CORMIX (Version 11.0), was used. CORMIX has been applied to many similar cases (http://www.cormix.info/) and is recognized by the USEPA and many other regulatory agencies as an appropriate model for computing trajectories, dilution rates, and mixing zone dimensions.

International Finance Corporation (IFC) water quality standards were applied as a basis for evaluating potential environmental impact to the Yangon River. The standard limits thermal discharges by the

temperature increase in the receiving waterbody; specifically, temperatures cannot exceed 3°C within a spatial region 100 meters from the discharge point. This standard was modified for analysing the cold water discharge not exceeding a 3°C reduction in background temperature 100 meters from the point of discharge. An estimate of the TPMC Power Plant's maximum thermal loading to the Yangon River results in a 10.7 °C increase above ambient temperatures during the warmer summer months (based on Yangon River temperature of 31.3°C) and a 16.9°C increase above ambient temperatures during the cooler winter months (based on a Yangon River temperature of 25.1°C). Mixing zone dimensions for the discharge from TPMC's Power Plant have been modelled with CORMIX for eight individually different scenarios, each varying with regards to ambient velocity, ambient temperature, effluent temperature, water depth, and tide / distance from shoreline. Design of the Power Plant effluent proved best to model the thermal plume as a single port discharge using CORMIX's single port discharge (CORMIX1) module.

Various scenarios including critical conditions were modelled using CORMIX and evaluated for compliance with IFC standards. All modelling scenarios indicated the most critical scenario (worst case scenario) for the Power Plant involves high ambient velocity, high ambient temperature, and large depth. The < 3°C excess temperature requirement for the Power Plant is met approximately 4.2 m downstream (in the direction of ambient flow) and 0.6 m across the width of the Yangon River; therefore, the effluent is does not exceed the NEQG 2.1.1 Thermal Power of not more 3°C temperature change, which is achieved 4.2 meters beyond the discharge point. A 4.2 meter mixing zone for the temperature to reduce below 3°C difference is considered insignificant. The Power Plant will also utilize a closed cycle cooling system, to reduce discharge temperatures as best as practicable.

ERM recommends using the results of the surface water plume modelling as a tool for comparison and not as a comprehensive compliance or impact analysis, as certain assumptions may not necessarily be the most conservative of possible discharge options. Once certain site-specific details are confirmed, ERM recommends a more detailed modelling study aligned with the local regulatory permitting process be conducted.

The CORMIX modelling results are shown in ***Appendix U***.

Impact Assessment Table

Table 9.45: Impact Assessment Table for Wastewater Management (Operation Phase)

Significance of Impact					
Impact	Potential impacts on surface water quality due to wastewater management during the operation phase.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to surface water would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to surface water would be direct impacts through stormwater, neutralization water, and cooling water discharge.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase is expected to continue for approximately 25 years, which would be considered long-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would be limited to the Power Plant area and downstream of the Yangon River, and hence would be considered to be local.				
Impact Scale	The amount of cooling water discharge is approximately 210 m^3/hr. The most critical scenario for the Power Plant involves high ambient velocity, high ambient temperature, and large depth. The < 3°C excess temperature requirement for the Power Plant is met approximately 4.2 m downstream (in the direction of ambient flow) and 0.6 m across the width of the Yangon River; therefore, the IFC temperature standard for excess temperatures below 3°C within 100 m from the discharge point is met.				
Frequency	Impacts to surface water quality from wastewater management could occur intermittently and/or continuously, depending on wastewater source.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Impacts to surface water quality from improper wastewater management could occur intermittently or from improper storage/disposal during operation phase.				
Receptor Sensitivity	**Low**	Medium	High		
	The primary receptor for impacts to surface water from wastewater discharge and runoff is the Yangon River, and downstream water users and aquatic ecosystem. Existing surface water quality is relatively poor considering parameters such as TSS and TDS exceed the related standards, and the ecological resources that it supports are not sensitive to a change in water quality. Given the physical and biological background conditions, and downstream water users of the Yangon River, sensitivity of the receptor is considered Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Small Impact Magnitude will result in an overall Negligible Impact.				

Mitigation / Management Measures

The significance of impacts is rated as Negligible, and no additional mitigation is considered necessary provided that existing/in-place controls are appropriately implemented.

Residual Impact (Post Mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts are also expected to be of **Negligible** significance.

Monitoring Plan

As detailed in the ESMP chapter (***Chapter 12***), monitoring for surface water during the operation phase should consist of the following:

- Temperature monitoring at discharge point, bi-weekly, using standard analytical methods.

9.4.7.6 Sedimentation Caused by Soil Erosion during Certain Construction Activities (Construction Phase)

Overview

Earthworks activities that are expected from the Power Plant construction phase is the excavation of soil. Excavated soil located near water sources, such as canals, may erode into the water sources, which can be caused by rainfall.

It is anticipated that the subsoil, which will be stripped and removed from the Power Plant site, shall be utilised for levelling/ backfilling, it is also anticipated that the amount of soil that will be removed due to excavation activities and then backfilled is approximately 29,600 m^3. The Plant construction site, being partially in an area subjected to flooding, may cause a similar impact caused by stormwater runoff. Flood water may cause suspension of exposed soil material, which may then be transported by the flow of water into the Yangon River or other nearby water sources; this will increase the total suspended solid levels. This will require careful study of potential placement of elevation and flood barriers.

The fill soil quality is also important to consider as contaminated soil may cause more impacts, in addition to increase in TSS. The impact potential will depend on the type of material/contamination found within the soil. Certain materials such as calcium, magnesium, sodium, etc. may only have a small effect on human health, and other organisms; however, materials such as chromium, cyanide, mercury, etc. will have a much greater impact. This will lead to the contamination of surface water, and the potential bioaccumulation in nearby water users, and aquatic organisms.

Increase in TSS levels will result in the decrease in light penetration in surface water, potentially reducing the photic zone area; therefore, inhibiting plant/organisms photosynthesis, which may reduce productivity, or lead to die-off. Visibility will also be decreased, which may limit the survivability of fish and other organisms that depend on visibility for navigation and survival.

The Yangon River's baseline conditions are considered relatively poor considering parameters such as TSS and TDS exceed the related standards, and the ecological resources that it supports are not sensitive to a change in water quality.

Impact Assessment Table

Table 9.46: Impact Assessment Table for Sedimentation Caused by Soil Erosion during Certain Construction Activities (Construction Phase)

Significance of Impact

Impact	Potential impacts on surface water due to sedimentation from erosion during construction phase.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to surface water would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to surface water would be direct impacts through sedimentation from soil erosion.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction will take approximately 28 months, which would be considered short-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would be limited to the Power Plant area and downstream of the Yangon River, and hence would be considered to be local.				
Impact Scale	The amount of soil that will be removed due to excavation activities for the Power Plant and then backfilled is approximately 29,600 m^3. The impacts from soil erosion can increase the sediment load (and therefore TSS) of the receiving water. Increase in TSS levels will result in the decrease in light penetration in surface water, potentially reducing the photic zone area; therefore, inhibiting plant/organisms photosynthesis, which may reduce productivity, or lead to die-off. Visibility will also be decreased, which may limit the survivability of fish and other organisms that depend on visibility for navigation and survival.				
Frequency	Soil erosion from stormwater runoff may occur more frequently during the wet season, as compared to dry season.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the characteristics above, the impact magnitude is likely to be small.				
Receptor Sensitivity	**Low**	Medium	High		
	The primary receptor for impacts to surface water from sedimentation is the Yangon River, and downstream water users and aquatic ecosystems. Existing surface water quality is relatively poor considering parameters such as TSS and TDS exceed the related standards, and the ecological resources that it supports are not sensitive to a change in water quality. Given the background conditions of the Yangon River, sensitivity of the receptor is considered Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Small Impact Magnitude will result in an overall Negligible impact.				

Mitigation / Management Measures

The significance of impacts is rated as Negligible; however, a number of additional mitigation measures are recommended in order to minimize the impact:

- Install silt trap to treat surface run-off from bunded areas prior to discharge to the stormwater system;
- Exposed soil surfaces should be protected by paving or fill material as soon as possible to reduce the potential of soil erosion and subsequent sedimentation;
- Use methods for minimising sediment runoff, as appropriate to the conditions on-site, including: wheel cleaning facilities, sand bag barriers, mulching, and re-vegetation, protect temporary trafficked areas on-site with coarse stone ballast or equivalent, open stockpiles of construction materials or construction wastes on-site should be covered with tarpaulin or similar fabric during rainstorms;
- Regularly, and particularly following rainstorms, inspect and maintain drainage systems and erosion control and silt removal facilities to ensure proper and efficient operation at all times;
- Surface run-off from bunded areas should pass through oil/water separators prior to discharge to the storm water system;

Residual Impact (Post Mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts are also expected to be of **Negligible** significance.

Monitoring Plan

As detailed in the ESMP chapter (***Chapter 12***), monitoring for surface water during the construction phase should consist of the following:

- Continuous monitoring of excavated soil, and any potential pathways for soil erosion into nearby water sources.
- Monthly surface water quality monitoring, using standard analytical methods.

9.4.7.7 Sedimentation caused by Piling Activities (Construction Phase)

Overview

The pontoon will require piling activities to install 4 piles that will support the topside structures. Piling activities is expected to cause high levels of disturbance to sediment from the strike caused by the hydraulic impact hammers, potentially causing sediment particles to become suspended. The impact from the disturbance of river sediments during jetty piling installation can both increase the sediment load (and therefore TSS) of the receiving water.

Increase in TSS levels will result in the decrease in light penetration in surface water, potentially reducing the photic zone area; therefore, inhibiting plant/organisms photosynthesis, which may reduce productivity, or lead to die-off. Visibility will also be decreased, which may limit the survivability of fish and other organisms that depend on visibility for navigation and survival.

The Yangon River's baseline conditions are considered relatively poor considering parameters such as TSS and TDS exceed the related standards, and the ecological resources that it supports are not sensitive to a change in water quality.

Impact Assessment Table

Table 9.47: Impact Assessment Table for Sedimentation caused by Piling Activities (Construction Phase)

Significance of Impact					
Impact	Potential impacts on surface water due to piling activities during construction phase.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to surface water would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to surface water would be direct impacts through sedimentation from piling activities.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction will take approximately 28 months, which would be considered short-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would be limited to the Power Plant area and downstream of the Yangon River, and hence would be considered to be local.				
Impact Scale	The Unloading Jetty will require piling activities to install approximately 4 piles, which may disturb sediment. Piling activities is expected to cause high levels of disturbance to sediment from the strike caused by the hydraulic impact hammers, potentially causing sediment particles to become suspended. Increase in TSS levels will result in the decrease in light penetration in surface water, potentially reducing the photic zone area; therefore, inhibiting plant/organisms photosynthesis, which may reduce productivity, or lead to die-off. Visibility will also be decreased, which may limit the survivability of fish and other organisms that depend on visibility for navigation and survival.				
Frequency	Impacts to surface water from piling activities could occur intermittently but repeatedly throughout the day for the duration of the construction phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the characteristics above, the impact magnitude is likely to be small.				
Receptor Sensitivity	**Low**	Medium	High		
	The primary receptor for impacts to surface water from sedimentation is the Yangon River, and downstream water users and aquatic ecosystems. Existing surface water quality is relatively poor considering parameters such as TSS and TDS exceed the related standards, and the ecological resources that it supports are not sensitive to a change in water quality. Given the background conditions of the Yangon River, sensitivity of the receptor is considered Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Small Impact Magnitude will result in an overall Negligible impact.				

Mitigation / Management Measures

The significance of impacts is rated as Negligible; however, the following mitigation measure is recommended in order to minimize the impact:

- Evenly spread out the scheduling of piling activities to reduce the potential amount of sedimentation caused during one pilling session.

Residual Impact (Post Mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts are also expected to be of **Negligible** significance.

Monitoring Plan

As detailed in the ESMP chapter (***Chapter 12***), monitoring for surface water during the construction phase should consist of the following:

- Monthly surface water quality monitoring once pilling activities commence, using standard analytical methods.

9.5 Soil and Groundwater Impact Assessment

9.5.1 Introduction

This section presents an evaluation of the potential impacts on soil and groundwater associated with the construction and operation of the proposed Power Plant based on the impacts identified during Scoping. During the construction and operation phases, various Power Plant activities have the potential to change soil structure, and generate wastewater or accidental leaks, which could potentially lead to impacts on the quality of soil, or to groundwater due to leaching.

Potential impacts that have been identified and will be assessed under the soil and groundwater Impact Assessment include the following:

- Accidental leaks of demineralized plant neutralized water;
- Accidental leaks of cooling water; and
- Loss of soil due to improper management during site clearance and excavation activities.

This section also presents management, mitigation and monitoring measures needed to ensure that any identified impacts can be reduced to as low as reasonably practical. Such measures will form part of the Environmental and Social Management Plan (ESMP, ***Chapter 12***) for the Power Plant.

9.5.2 Assumptions and Limitations

The assessment of potential impacts to soil and groundwater is based on the environmental baseline and the socioeconomic baseline data presented within ***Chapter 5***, and the information available from TPMC at the time of writing. Assessments have been made based on good industry practice, professional knowledge and previous experience of ERM. No quantitative modelling has been undertaken for the soil and groundwater impact assessment. Should there be significant changes in factors such as assumed input data, engineering design of wastewater management and treatment components of the Power Plant, or agreed assessment criteria, then elements of this impact assessment and associated management, mitigation and monitoring measures may be needed to be amended to reflect these changes. It is also recognised that there is considerable cross over with other sensitive receptors. In this regard, this section assesses impacts and recommends management, mitigation and monitoring measures in relation to reducing direct impacts to soil and groundwater only.

Assessment of the impact towards other receptors will be carried out in the according receptor impact assessment section as follows:

- Loss of containment of hazardous waste (which includes diesel oil, hydraulic fluids, paint, battery, cement wash down, rinsing effluents, and sludge) generated from construction and operation activities (***Section 7.6: Waste***).

- Loss of containment of non-hazardous waste generated from construction and operation activities (which includes concrete, steel pipes, steel plates, structural steel, and wooden crates) generated from construction and operation activities (***Section 7.6: Waste***).
- Domestic solid waste generated from workers during construction phase, and permanent staff during operation phase (***Section 7.6: Waste***).
- Loss of containment of domestic liquid waste generated from workers during construction phase, and permanent staff during operation phase (***Section 7.6: Waste***).

9.5.3 Assessment Methodology

The methodology used for assessing impacts to Soil/Groundwater is aligned with the general impact assessment methodology presented in ***Chapter 7***.

9.5.4 Summary of Baseline Conditions

Chapter 5 provides the details of the baseline conditions for soil and groundwater in the Power Plant study area.

9.5.4.1 Soil

The Study Area is located on Meadow (Gleysol) and Meadow Alluvial soil (Fluvic Gleysols). The Meadow soil distributes near the river plains where occasional tidal floods occur and are typically non-carbonate, and they usually contain large amount of salts. Meadow Alluvial soil can be found in the flood plains. Sub-soil parameters that were found to exceed the Dutch Standard target values include copper and mercury; the locations with the exceeded values include S02 and S04, which are located along the pipeline alignment, therefore, the soil quality at the Power Plant is still within the Dutch Standard. All other parameters are also within the Dutch Standard.

9.5.4.2 Groundwater

The productivity of aquifers near the Power Plant area can be classified as “Strong Pore Water”, and groundwater quality is considered “Fresh Groundwater”. The groundwater type near the Power Plant area consists of "Continuous Aquifer in Plain and Intermountain Basin", with Natural Recharge Modulus ranging from 200,000-500,000 m^3/km^2-yr. Groundwater parameters that exceeded the Myanmar Standard and/or EPA Standard includes iron, total dissolved solids, and manganese. All three sampling sites (two (2) located along the pipeline alignment, and one (1) northeast of the Power Plant) contain parameters that exceed the standards. All other parameters are within the Myanmar standards, EPA, and WHO guidelines.

9.5.5 Receptor Identification and Sensitivity

Groundwater in the local communities surrounding the Power Plant area is used for domestic purposes and/or drinking. Groundwater quality ranges from good to slightly poor, and its sensitivity/importance can be rated as medium.

Soil quality can be considered degraded and of low sensitivity/importance. The resource does not support diverse habitat or populations, and has limited use in local communities (i.e. for topsoil of rubber plantations).

Given the background conditions, the sensitivity of soil and groundwater is considered low.

9.5.6 Summary of Project Activities with Potential Impacts

9.5.6.1 Construction Phase

Proposed Project Activities with Potential Impact

Construction of the Power Plant will be carried out by the EPC contractor appointed by TPMC. The construction phase for the Power Plant will take approximately 28 months. Scheduled Commercial Operating Date (SCOD) is expected at the end of 2021. The maximum number of workers onsite during construction is anticipated to be 600 persons.

During the construction phase, potential impacts to soil and groundwater may arise from loss of soil due to improper management during site clearance and excavation activities.

9.5.6.2 Operation Phase

The operation phase is expected to continue for approximately 25 years. The average number of permanent workers present during operation is expected to be approximately 49, with small numbers of additional staff for security, cleaning, technical assistance, and occasional maintenance. The assessment of operational phase impacts includes those arising from routine operations and maintenance of the Power Plant.

During the operation phase, potential impacts to soil and groundwater may arise from the following activities:

- Accidental leaks of demineralized plant neutralized water; and
- Accidental leaks of cooling water.

9.5.7 Assessment of Impacts to Soil and Groundwater

9.5.7.1 Overview

The assessment of impacts section will consider each type of the potential impact with respect to each phase (construction, operation), for those interactions/impacts that have been scoped in for the power plant. The section will be organized into sub-sections as follows:

- Overview – description of the Power Plant activities that have the potential to cause the impact during the respective phase;
- Impact Assessment Table – a summary table that assesses and evaluates impacts based on their characteristics, to determine the significance of the impact;
- Mitigation Measures – a list and description of corrective and preventive actions to be applied or implemented to Power Plant activities to reduce the significance of the assessed impact;
- Residual Impacts – reevaluation of impact significance after mitigation measures have been applied; and
- Monitoring Plan – summary of the monitoring plan, which has the objective to ensure that the mitigation measures have been implemented effectively and resulted in a reduction in the significance of residual impacts.

9.5.7.2 Accidental Leaks of Demineralized Plant Neutralized Water (Operation Phase)

Overview

Demineralized (DM) plant neutralized water is essentially wastewater from the demineralization process, which has gone through the neutralization process. The approximate quantity of neutralized

water discharged is 20 m^3/hr. The purpose of the neutralization process is to dilute and neutralize the wastewater in accordance to relevant standards before being intentionally discharged into the Yangon River.

Although planned discharge will not cause any impacts to soil and groundwater, accidental leaks in neutralized water before the neutralization process is complete, as well as leaks occurring along the discharge pipeline (onshore section) may cause contamination to soil and groundwater. This impact may cause disturbances to flora and subsurface organisms, and the leaching of contaminated soil into groundwater. The scale of the impact from this source is expected to be relatively low

Existing/ In-place Controls

Wastewater from the demineralization plant will be treated with pH control within a pH range 6 to 9 in the neutralization treatment system and oil-water separator system. The treated wastewater will be discharge into final checking pond before discharge to the Yangon River.

Impact Assessment Table

Table 9.48: Impact Assessment Table for Accidental Leaks of Demineralized Plant Neutralized Water (Operation Phase)

Significance of Impact					
Impact	Potential impacts on soil and groundwater quality due to demineralized plant neutralized water leakage during the operation phase.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to soil and groundwater would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to soil and groundwater would be direct impacts through accidental leaks of demineralized plant neutralized water.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Neutralized water is expected to only have short-term impacts on soil and groundwater.				
Impact Extent	**Local**	Regional	International		
	Impacts would be limited to the Power Plant footprint; although potential groundwater movement can cause impacts beyond Power Plant footprint, the impact would still be considered local.				
Impact Scale	Accidental leaks in neutralized water before the neutralization process is complete, as well as leaks occurring along the discharge pipeline (onshore section) may cause contamination to soil and groundwater. This impact may cause disturbances to flora and subsurface organisms, and the leaching of contaminated soil into groundwater.				
Frequency	The impacts is not expected to occur.				
Likelihood	Very Unlikely	**Unlikely**	Likely to occur once or more in life of the Project	Likely to occur once or twice per year	Will likely occurs more than twice per year, or is continuous or certain to occur
	The likelihood of an accidental leak to occur is unlikely.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Potential impact due to accidental leaks in the Project area is expected to be Negligible.				

Significance of Impact				
Receptor Sensitivity	**Low**	Medium	High	
	Groundwater in the local communities surrounding the Power Plant area is used for domestic purposes. Groundwater quality ranges from good to slightly poor, and its sensitivity/importance can be rated as medium. Soil quality can be considered degraded and of low sensitivity/importance. The resource does not support diverse habitat or populations, and has limited use in local communities (i.e. for topsoil of rubber plantations). Overall, the sensitivity of soil and groundwater is considered low.			
Impact Significance	**Negligible**	Minor	Moderate	Major
	The combination of a Low Resource Sensitivity and Negligible Impact Magnitude will result in an overall Negligible impact.			

Mitigation / Management Measures

The significance of impacts is rated as Negligible; however, a number of additional mitigation measures are recommended in order to minimize the impact as follows:

- Project Proponent will prepare guidelines and procedures for immediate clean-up actions following any leaks;
- Use of spill or drip trays to contain leaks;
- Use of spill control kits to contain and clean small spills and leaks;
- Employee must be trained on emergency response procedure.

Residual Impact (Post-Mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts are also expected to be of **Negligible** significance.

Monitoring

As detailed in the ESMP chapter, monitoring for soil and groundwater during the construction phase should consist of the following:

- Monthly inspection of the discharge pipeline to identify any potential/occurring leak points.

9.5.7.3 Accidental Leaks of Cooling Water (Operation Phase)

Overview

Cooling water discharge originates from the gas turbine cooling system, heat exchangers, steam turbine generator cooler, and other related equipment. The amount of cooling water discharge is approximately 210 m^3/hr, and the effluent temperature at point of discharge is expected to be 42 °C.

Accidental leaks of cooling water occurring along the discharge pipeline (onshore section) may cause secondary impacts to biodiversity, which may reduce the health of certain organism or potential causing die-off within the area of direct contact with the cooling water. No chemical dosing is involved; therefore, the cooling water discharge is considered non-hazardous. The impact from accidental leaks of cooling water is expected to be relatively insignificant.

Impact Assessment Table

Table 9.49: Impact Assessment Table for Accidental Leaks of Cooling Water (Operation Phase)

Significance of Impact					
Impact	Potential impacts on soil due to accidental leaks of cooling water the operation phase.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to soil would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to soil would be direct impacts through accidental leaks of cooling water.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Cooling water is expected to only have short-term impacts on soil and groundwater.				
Impact Extent	**Local**	Regional	International		
	Impacts would be limited to the Power Plant footprint; hence would be considered to be local.				
Impact Scale	The amount of cooling water discharge is approximately 210 m^3/hr, and the effluent temperature at point of discharge is expected to be 42 °C. Accidental leaks of cooling water occurring along the discharge pipeline (onshore section) may cause secondary impacts to biodiversity, which may reduce the health of certain organism or potential causing die-off within the area of direct contact with the cooling water. No chemical dosing is involved; therefore, the cooling water discharge is considered non-hazardous.				
Frequency	The impacts is not expected to occur.				
Likelihood	Very Unlikely	**Unlikely**	Likely to occur once or more in life of the Project	Likely to occur once or twice per year	Will likely occurs more than twice per year, or is continuous or certain to occur
	The likelihood of an accidental leak to occur is unlikely.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The impact magnitude is likely to be Negligible.				
Receptor Sensitivity	**Low**	Medium	High		
	Soil quality can be considered degraded and of low sensitivity/importance. The resource does not support diverse habitat or populations, and has limited use in local communities (i.e. for topsoil of rubber plantations). Overall, the sensitivity of soil and groundwater is considered low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Negligible Impact Magnitude will result in an overall Negligible impact.				

Mitigation / Management Measures

The significance of impacts is rated as Negligible; however, a number of additional mitigation measures are recommended in order to minimize the impact as follows:

- Project Proponent will prepare guidelines and procedures for immediate clean-up actions following any leaks;

- Use of spill or drip trays to contain leaks;
- Employee must be trained on emergency response procedure.

Residual Impact (Post-Mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts are also expected to be of **Negligible** significance.

Monitoring

As detailed in the ESMP chapter, monitoring for soil and groundwater during the construction phase should consist of the following:

- Monthly inspection of the discharge pipeline to identify any potential/occurring leak points.

9.5.7.4 Loss of Soil due to Improper Management during Site Clearance and Excavation Activities (Construction Phase)

Overview

Earth works will include clearing of vegetation and grading of the Power Plant site. It is anticipated that the subsoil, which will be stripped and removed from the Power Plant site, will be utilised for levelling/ backfilling, it is anticipated that the amount of soil that will be removed due to excavation activities and then backfilled is approximately 29,600 m^3. The Plant construction site, being partially in an area subjected to flooding, will require careful study of potential placement of elevation and flood barriers.

Changes to soil structure may be caused by mechanical disturbance to the soil from these activities. Exposure of soil to rain and wind may in turn cause erosion and loss of top soil. It is anticipated that the subsoil, which will be stripped and removed from the Power Plant site, will be utilised for levelling/ backfilling, and therefore there will be no net loss from the main Power Plant site. This phase of the Power Plant is generally the most intensive in terms of potential for topsoil loss. Poor topsoil management can lead to a loss of topsoil through either the air (as dust) or as sediment entrained within surface water flows. Soil erosion can also result from poor management of stockpiled soils, excavated areas and general construction areas.

Additionally, soil will be compacted at the Power Plant site and access roads. Movement of heavy vehicles in the construction area will also result in soil compaction and damage to the soil structure. This compaction of the soil may potentially result in changed hydrological characteristics, such as reduced permeability and water infiltration to the soil, which could create additional surface run-off (and increase the flow velocity of this run-off), as well as reducing infiltration into subsurface aquifers.

Impact Assessment Table

Table 9.50: Impact Assessment Table for Loss of Soil due to Improper Management during Site Clearance and Excavation Activities (Construction Phase)

Significance of Impact					
Impact	Potential impacts on soil due to loss of soil due to improper management during site clearance and excavation activities during construction phase.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to soil would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to soil would be direct impacts through stormwater, excavation and movement of heavy equipment.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction is expected to start mid 2019 and be complete in 28 months, which would be considered short-term.				
Impact Extent	**Local**	Regional	International		
	Impacts would be limited to the Power Plant footprint; hence would be considered to be local.				
Impact Scale	The amount of soil that will be removed due to excavation activities for the Power Plant and then backfilled is approximately 29,600 m^3. Impact expected to only occur near the Yangon River, in correlation to the location of the Power Plant. Possible changes to soil structure may be caused by mechanical disturbance and/or stormwater. Movement of heavy vehicles in the construction area will also result in soil compaction and damage to the soil structure.				
Frequency	Impacts to soil and groundwater from erosion of soil could occur intermittently but repeatedly throughout the day for the duration of the construction phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the characteristics above, the impact magnitude is likely to be small.				
Receptor Sensitivity	**Low**	Medium	High		
	Soil quality can be considered degraded and of low sensitivity/importance. The resource does not support diverse habitat or populations, and has limited use in local communities (i.e. for topsoil of rubber plantations). Given the background conditions, the sensitivity of soil and groundwater is considered low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Small Impact Magnitude will result in an overall Negligible impact.				

Mitigation / Management Measures

The significance of impacts is rated as Negligible; however, a number of additional mitigation measures are recommended in order to minimize the impact as follows:

- Delineation of clearance boundaries to limit the areas to be cleared;
- Scheduling clearance activities (if possible) to avoid extreme weather events such as heavy rainfall, extreme dry and high winds;
- Revegetation areas with temporary land use, conducting progressive rehabilitation;
- Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers;
- Reuse topsoil as much as possible within rehabilitation activities;
- Control erosion through diversion drains, sediment fences, and sediment retention basins; and
- Where topsoil is to be stored for later use in rehabilitation activities, the following basic principles are to be applied:
    - Stockpiles to be separated into topsoil and sub-soil and be located at least 50m from any surface water source or groundwater well;
    - To the extent possible, stockpiles are to be located in areas surrounded by natural wind barriers to minimise the potential for wind erosion;
    - Stockpile storage areas are to be prepared in advance of the removal of topsoil as much as possible; and
    - Topsoil heights are to be restricted in height to 2 m above ground level to minimise wind erosion, and they are only to be partially compacted on the upper layer in order to promote aeration, maintain soil vertical structures, reduce runoff and encourage infiltration.

Residual Impact (Post-Mitigation)

Since the pre-mitigation impacts were determined to be **Negligible**, residual impacts are also expected to be of **Negligible** significance.

Monitoring Plan

No monitoring plan is required.

9.6 Waste Impact Assessment

9.6.1 Introduction

During the construction and operation phases, there are numerous Project activities that have potential to generate hazardous and non-hazardous waste streams. This section identified the various types of waste that will be generated, potential impacts associated with their generation and disposal, and appropriate mitigation, management and monitoring measures required to reduce residual impacts to an acceptable level.

Impacts associated with waste (both during planned and unplanned event) may affect various receptors, such as surface water, groundwater, soil and biodiversity. During the scoping activity, the following are impacts related to waste and wastewater management:

- Storm water runoff from precipitation on-site;
- Neutralised waste from water demineralisation plant;
- Wastewater from cooling tower blowdown;
- Impacts from waste generated activities that affect water sources and soil that are utilised by other receptors such as local communities, flora, fauna and marine species; and
- Unplanned events causing loss of containment to the waste storage facilities on-site.

However, a lot of these are specific to certain receptors and are therefore assessed in other sections. Waste related impacts that are assessed elsewhere includes:

- Waste impacts whereby the receptor is air quality will be assessed in ***Section 9.1***;
- Waste impacts whereby the receptor is related to GHG emission will be assessed in ***Section 9.2***;
- Waste impacts whereby the receptor is surface water will be assessed in ***Section 9.4***;
- Waste impacts whereby the receptors are soil and groundwater will be assessed in ***Section 9.5***;
- Waste impacts whereby the receptor is biodiversity value will be assessed in ***Chapter 10***;
- Waste impacts whereby the receptor is social and health values will be assessed in ***Section 9.8***; and
- Waste impacts that is generated from unplanned events ***Section 9.9***.

There are some additional impacts associated with waste and wastewater management that have not been assessed elsewhere, and the purpose of this section (***Section 9.6***) is to assess those, these are:

- Biomass generated during construction activities (site clearance and preparation);
- Hazardous waste during construction and operation phase – such as diesel oil, hydraulic fluid, paint, battery, cement wash down, rinsing wastewater of contaminated equipment and sludge from operational system;
- Non-hazardous waste during construction and operation phase – concrete, steel pipes, steel plates and structures and wooden crates;
- Domestic solid waste during construction and operation phase – generated from workers on-site in the form of household waste and sewage; and
- Domestic liquid waste during construction and operation phase – majority of this will be sanitary wastewater.

9.6.2 Assumptions and Limitations

Project information and description and hence the potential impacts associated with the generation and management of waste and wastewater during construction and operation phase were reviewed in ***Chapter 4***. Based upon this review, potential sources of impacts associated with solid waste and wastewater that may arise during the construction and operation phases of the Project have been identified and are presented in the following sections. All the identified sources of potential impacts are then evaluated and their impact significance is determined based on the methodology described in ***Chapter 6*** (Impact Assessment Methodology). The temporal and spatial extent of activities will mean that the actual volumes types of waste and wastewater generated will be dependent on the specific activities being undertaken at the time. Accordingly, to clearly identify impacts and development of management and mitigation measures specific to each activity, the potential impact are described on an activity basis.

9.6.3 Assessment Methodology

The methodology used for assessing impacts to waste is aligned with the general impact assessment methodology presented in ***Chapter 6***.

9.6.4 Baseline Summary

Chapter 5 provides the details of the baseline conditions for current waste sources, including the typical waste management practices of the local community, current waste volume generated from the local community, major operating landfills and its capacity around the Project Study Area.

Generation of waste within the Study Area is a mixture of domestic, agricultural and industrial waste. Solid waste disposal is the responsibility of each household. Waste disposal areas exist in Hteinpin, Dawai Chang, Shwepyithar, Mingalardon, Dala, and Seikyi Khanaungato. Burning, landfilling and disposal into the nearest stream are common practice in the Project Study Area.

9.6.5 Receptor Identification and Sensitivity

The Power Plant is located in Ahlone Township, and adjacent to Yangon River. The Project Area is surrounded by communities, Jetty, warehouse and industrial buildings. The closest significant receptors for humans are nearby hospitals; 9 hospitals were identified within the 5 km radius of the Study Area.

Currently, the total landfill capacity of the six waste disposal sites proposed as potential waste management facilities for the Project (as discussed in ***Section 5.1.10***) is estimated to be approximately 2,064 tonnes per day.

9.6.6 Project Activities

9.6.6.1 Construction Phase

Construction of the Power Plant will be carried out by the EPC contractor appointed by TPMC. The construction phase for the Power Plant will take approximately 28 months. Schedule Commercial Operation Date (SCOD) is expected at the end of 2021. The maximum number of workers onsite during construction is anticipated to be 600 persons.

The Project Proponent will implement appropriate management and mitigation measures to reduce the significance of any impacts associated with waste or wastewater management, as will be discussed in the respective mitigation measures section for each impact type. The mitigation measures will also be summarised in the ESMP chapter (***Chapter 12***).

The following potential impacts associated with waste and wastewater management may occur from Project activities during the construction phase of the Power Plant:

- Potential impacts from improper management (storage and disposal) of biomass waste;

- Potential impacts from generation and management of hazardous waste (including diesel oil, hydraulic fluids, paint, battery, contaminated cement, wash down and rinsing effluent);
- Potential impacts from generation and management of non-hazardous waste (including uncontaminated concrete, steel pipes and plates, structural steel and wooden crates);
- Potential impact from generation and management of domestic solid waste; and
- Potential impact form generation and management of domestic liquid waste (including sanitary wastewater, greywater and kitchen water).

The details and potential receptors for the above impacts will be discussed further in the relevant sections below.

9.6.6.2 Operation Phase

The operation phase is expected to continue for approximately 25 years. The peak number of permanent workers present during operation is expected to be approximately 52 persons, with a small number of additional staff for security, cleaning, technical assistance, and occasional maintenance. The assessment of operational phase impacts includes those arising from routine operations and maintenance of the Power Plant. During the operation phase, the Power Plant is expected to produce limited additional waste stream than those anticipated within the construction phase. These waste streams would consist of materials generated either due to the daily activities of the workforce (e.g. generation of putrescible waste) or a range of general construction waste such as paper from offices and scraps of steel/plastic during maintenance activities. Whilst most of these are likely to be non-hazardous, some of it may be hazardous, for example, used paint engine oils, hydraulic fluids, spent solvents, spent batteries etc. Whilst these volumes are anticipated to be significantly lower than those during the construction phase, the Project still needs to manage the waste appropriately, including consideration of the capacity of the existing waste management network and facilities in the region.

The Project Proponent will implement appropriate management and mitigation measures to reduce the significance of any impacts associated with waste or wastewater management, as will be discussed in the respective mitigation measures section for each impact type. The mitigation measures will also be summarised in the ESMP chapter (***Chapter 12***).

The following potential impacts associated with waste and wastewater management may occur from Project activities during the operation phase of the Power plant:

- Potential impacts from generation and management of hazardous waste (including oil from operational machines and diesel oil from vehicles);
- Potential impacts from generation and management of non-hazardous waste (including uncontaminated concrete, steel pipes and plates, structural steel and wooden crates);
- Potential impact from generation and management of domestic solid waste; and
- Potential impact form generation and management of domestic liquid waste (including sanitary wastewater).

The details and potential receptors for the above impacts will be discussed further in the relevant sections below.

9.6.7 Assessment of Impacts

9.6.7.1 Impacts from Improper Management of Biomass Waste during Construction Phase

Overview

During construction of the Power Plant, majority of the Project Area is covered with small trees, bushes and shrubs and therefore appropriate clearance will be needed. The removed vegetation will needs to be disposed of and therefore, is a new solid waste stream that both the EPC contractor and Project Proponent decide on its management strategy. Presently, it is estimated that up to 10,560 m^3 of biomass waste such as trees, shrubs and grass will be removed the construction phase. Current common practice in the Study Area, where there is limited municipal waste options and facilities, is to gather the biomass waste into piles and dispose of it by burning. However, the EPC is expected to sell, where possible, biomass waste to locals for firewood. Remaining biomass waste will be buried. Potential impacts from improper management (storage and disposal) of biomass waste includes:

- Decomposing biomass waste may release unpleasant odour and gases into the atmosphere, which this can cause nuisance to locals, while also attracting certain wildlife or pests into the Study Area. However, the assessment of these impacts will be discussed in ***Chapter 10*** and ***Chapter 9.8*** (Biodiversity Impact Assessment and Social Impact Assessment); and
- As the EPC contractor is expected to bury the unsold portion of the Project construction biomass waste this can potentially impact the quality of surface water and soil and consequently groundwater. As a result, biodiversity receptors and human that uses these impacted receptors will also be influenced.

Impact Assessment Table

The significance of potential impacts to improper management of biomass waste during the construction phase of the Power Plant is assessed in ***Table 9.51*** and mitigation measures are presented thereafter.

Table 9.51: Significance of Impacts Due to Improper Management of Biomass Waste during Construction Phase of the Power Plant

Significance of Impact				
Impact	Potential impacts due to improper management of removed biomass (biomass waste). Some of the impacts may be related to contamination of soil quality, surface water and groundwater from direct burying of biomass waste.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts from improper waste management is considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Impacts would be direct.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	Construction will take approximately 28 months for the Power Plant. Duration is considered as short-term.			
Impact Extent	**Local**	Regional	International	
	The extent of potential impacts would likely be limited to the location where biomass is stored and buried, and therefore is local.			

Significance of Impact					
Impact Scale	■ The anticipated volume of biomass to be removed and requiring management is approximately 10,560 m^3. ■ The impact would be limited to the footprint of where the biomass is stored, with any emission from burning is likely be very locally restricted.				
Impact Frequency	It is likely that this impact will occur intermittently during the site clearance and preparation stage.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered as medium.				
Receptor Sensitivity	Low	**Medium**	High		
	The receptors in the event that the vegetation is buried will be the local communities situated within 1 km of the site. Additionally, within a 5 km radius from the Project Location (Power Plant) there are a few hospital whereby hospital is a receptor that is considered as moderate (medium) sensitive to changes of environmental condition (such as odor creating nuisance to patients in the hospital).				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a medium resource sensitivity and medium impact magnitude will result in an overall moderate significance level of impact.				

Mitigation Measures

The following measures will be put in place for the Project during the construction phase of Power Plant to mitigate impacts to physical receptors (soil, groundwater and surface water):

- Any biomass not taken by the local community is to be appropriately stored (or immediately mulched) for later use within site stabilisation and rehabilitation activities;
- Site clearance and preparation is to be designed and conducted in a manner that requires minimum removal of vegetation;
- Introduce and implement, where practicable, a recycling plan for biomass waste to reduce the amount of biomass required to be burnt. This may include identifying potential market or appropriate industry to reintroduce the biomass as part of their resource consumption;
- Ensure no hazardous materials or chemicals are present within the biomass waste (for example due to an accidental spill) prior to burying; and
- Location of burying are to be far away from sensitive receptors and in a location where impact of burying can be appropriately controlled.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **Minor** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during construction phase of Power Plant should consist of the following:

- Monitoring of waste segregation, transportation and disposal practices in the Project activity areas and disposal location, as to be defined in a Waste Management Plan to be prepared specifically for the Project; and

- Monitoring of appointed waste contractors using chain-of custody documentation, as to be defined in a Waste Management Plan to be prepared specifically for the Project.

9.6.7.2 Impacts from Generation and Management of Hazardous Waste during Construction Phase

Overview

During the construction phase, a range of hazardous waste (both solid and liquid form) will be generated due to the use of hazardous chemicals and construction materials that are contaminated by hazardous chemicals. A licensed waste contractor will be hired to dispose of waste appropriately. The total approximate quantities of hazardous waste during construction phase is shown in ***Table 4.48***. These waste will be stored on-site and transported off-site to a licensed waste disposal contractor.

Table 9.52: Hazardous Waste Quantities

Hazardous Material	Amount
Diesel oil	10 L per day
Hydraulic fluids	5 L per day
Paint	10 L per day
Battery	0.2 kg per day

Source: TPMC, 2019.

Additionally, hazardous wastewater may also be generated from chemical cleaning of the equipment during the pre-commissioning phase. The volume of anticipated rinsing effluent is unknown at this time, but appropriate containment and management measures will be implemented by the Project, and the impact is therefore not expected to be significant. Hazardous wastewater from chemical cleaning will be transported off-site to a licensed Hazardous Waste Treatment Facility.

Additionally, the following impacts may occur to the existing waste management network from the Project construction activities:

- Project construction activities will generate waste which the EPC contractor plans to use a licensed waste contractor to appropriately dispose of the hazardous waste. This will therefore increase the pressure on these facilities due to increased quantity of incoming waste, and thereby reducing the local waste handling capacity; and
- Additional industrial materials and waste (such as diesel oil and hydraulic fluids) will be introduced by the Project to the waste management network whereby the network may not be able to adapt their management strategy and methods to handle the new types of waste. And therefore impacting the waste management capacity.

Impact Assessment Table

The significance of potential impacts from generation and management of hazardous waste during the construction phase of the Power Plant are assessed in ***Table 9.53***, and mitigation measures are presented thereafter.

Table 9.53: Significance of Impacts from Generation and Management of Hazardous Waste during Construction Phase of Power Plant

Significance of Impact					
Impact	Impacts from generation and management of hazardous waste by increasing the stress put on the facilities and reducing the capacity and capability of the existing waste management network.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts is considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to the existing waste management network would be direct				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction of the Power Plant is expected to take 28 months. Duration would therefore be short-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would likely be restricted to the local area.				
Impact Scale	The scale of potential impacts due to release of waste is potentially large due to the quantities present during this stage, particularly when considered in light of the limited waste management network in the area.				
Impact Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the construction phase.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered to be medium.				
Receptor Sensitivity	Low	**Medium**	High		
	There are limited number of licensed waste contractors within the region henceforth the receptor sensitivity is rated as medium.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a medium resource sensitivity and medium impact magnitude will result in an overall moderate impact.				

Mitigation Measures

The following measures will be put in place for the Project during construction phase of Power Plant to mitigate impacts to the existing waste management facilities:

- Prior to construction commencing, TPMC is to engage with local authorities and other stakeholders to determine the capacity of the local waste management network to absorb the new waste streams generated from the Project during construction;
- A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project construction. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste

streams identified. The WMP will be developed by the project proponent (or its EPC contractor) prior to commencing construction work;

- Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable;
- Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the construction site;
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed. Bi-yearly unplanned audit will be performed by TPMC HSE team on all waste contractors in order to verify compliance with contract;
- Monitoring of appointed waste contractors using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations;
- The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during construction activity is being managed responsibly; and
- Effluent from chemical cleaning of the equipment during the pre-commissioning phase will be collected in an appropriate drainage system and transported off-site to a licensed Hazardous Waste Treatment Facility. The capacity of this facility will be assessed to ensure that it is capable of managing the Project's wastewater volumes.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **Minor** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during construction phase of Power Plant should consist of the following:

- Monitoring of waste segregation, transportation and disposal practices in the project activity areas and disposal location, as to be defined in a Waste Management Plan to be prepared specifically for the Project; and
- Monitoring of appointed waste contractors using chain-of custody documentation, as to be defined in a Waste Management Plan to be prepared specifically for the Project.

9.6.7.3 Impacts from Generation and Management of Hazardous Waste during Operation Phase

Overview

During operation phase, diesel oil will be the only main hazardous waste produced. The hazardous materials to be stored on site during operation are presented in ***Table 9.54***. The chemicals will be stored, handled, and transported to the Project Site appropriately and according to their Material Safety Data Sheets (MSDS), and MSDS will be made available on-site (if one exists).

Table 9.54: Hazardous Materials during Power Plant Operation

Hazardous Material	Use of Hazardous Materials	Storage Location Onsite	Quantities to be Stored Onsite*
Oxygen Scavenger	Chemical Dosing System	Chemical Storage House	Estimate 1 m^3
Phosphates	Chemical Dosing System	Chemical Storage House	Estimate 1 m^3
Condensate Treatment	Chemical Dosing System	Chemical Storage House	Estimate 1 m^3
Corrosion Inhibitor	Chemical Dosing System	Chemical Storage House	Estimate 4 m^3
Biocides	Chemical Dosing System	Chemical Storage House	Estimate 34 m^3
Sulfuric Acid	Chemical Dosing System	Chemical Storage House	Estimate 103 m^3
Scale Inhibitor	Chemical Dosing System	Chemical Storage House	Estimate 4 m^3
Sodium Hydroxide	Water Treatment System and Demineralised Water System	Chemical Storage House	Estimate 58 m^3
Sulfuric Acid	Water Treatment System and Demineralised Water System	Chemical Storage House	Estimate 2 m^3
Sodium Hypochlorite	Water Treatment System	Chemical Storage House	Estimate 115 m^3
Poly Aluminium Chloride	Water Treatment System	Chemical Storage House	Estimate 39 ton
Anion Polymer	Water Treatment System	Chemical Storage House	Estimate 2 ton
RO Antiscalant	Water Treatment System and Demineralised Water System	Chemical Storage House	Estimate 1 m^3
Sodium metabisulfite	Water Treatment System and Demineralised Water System	Chemical Storage House	Estimate 1 ton
Citric Acid	Water Treatment System and Demineralised Water System	Chemical Storage House	Estimate 1 ton
Diesel oil	Liquid fuel for emergency diesel engine generator, emergency diesel generator	Storage Tank	Estimate at 2 x 7200 litres x 3 days for fuel tank = 43,200 litres.

*Note: *Estimated figures only for 2 months in chemical storage house*

Moreover, during operation phase of the Power Plant, it is anticipated that there will be generation of sludge from operational processes, approximately 3,000 m^3/day (intermittent). TPMC will assign a local waste contractor to dispose these waste responsibly.

Impact Assessment Table

The significance of potential impacts to the capacity of the existing waste management network to deal with hazardous waste from the Project operation and maintenance phase are assessed in ***Table 9.55***, and mitigation measures are presented thereafter.

Table 9.55: Significance of Impacts from Generation and Management Hazardous Waste during Operation Phase of Power Plant

Significance of Impact					
Impact	Impacts from generation and management of hazardous waste by increasing the stress put on the facilities and reducing the capacity and capability of the existing waste management network.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impact is considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to the existing waste management network would be direct.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase is expected to continue for approximately 25 years, which would be considered as long-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would likely be restricted to the local area.				
Impact Scale	The scale of potential impacts due to release of waste is potentially large due to the quantities present during this stage, particularly when considered in light of the limited waste management network in the area (YCDC estimate to have a landfill capacity of 2,064 tonnes per day). Currently, there is a limited number of licensed waste contractor within the region that are capable of handling hazardous waste.				
Impact Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the operation phase which is anticipated to be 25 years.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered to be medium.				
Receptor Sensitivity	Low	**Medium**	High		
	There are limited number of licensed waste contractors within the region henceforth the receptor sensitivity is rated as medium.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a medium resource sensitivity and medium impact magnitude will result in an overall moderate impact.				

Mitigation Measures

The following measures will be put in place for the Project during operation phase to mitigate impacts to the existing waste management facilities:

- A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project operation. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the operation phase for all of the waste streams identified. The WMP will be developed by the project proponent (or its EPC contractor) prior to commencing construction work;

- Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable;
- Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations;
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed;
- Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and
- The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during operation activity is being managed responsibly.

Residual Impacts

If the recommended mitigation and management measures are implemented, residual impact significance would be reduced to **Minor** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during operation phase of Power plant should consist of the following:

- Monitoring of waste segregation, transportation and disposal practices in the project activity areas and disposal location, as to be defined in a Waste Management Plan to be prepared specifically for the Project; and
- Monitoring of appointed waste contractors using chain-of custody documentation, as to be defined in a Waste Management Plan to be prepared specifically for the Project.

9.6.7.4 Impacts of Generation and Management of Non-Hazardous Waste during Construction Phase

Overview

During the construction phase, non-hazardous waste is likely to be produced from uncontaminated concrete, steel pipes, steel plates, structural steel and wooden crates. Opportunities will be explored for selling steels and wooden crates to locals. Remaining waste will be gathered and handover to a licensed waste contractor to be disposed responsibly. ***Table 4.15*** presents details of the total non-hazardous construction waste during construction phase.

Table 9.56: Construction Waste during Power Plant Construction

Waste Type	Amount
Concrete	4,331 Tons
Steel Pipes	11.6 Tons
Structural Steel	3.9 Tons
Wooden Crates	90 Tons

Source: TPMC, 2019.

Note: Construction waste amount is estimated for the entire construction phase.

Impact Assessment Table

The significance of potential impacts to the capacity of the existing waste management network to deal with non-hazardous waste from the Project construction activity is assessed in ***Table 9.57***, and mitigation measures are presented thereafter.

Table 9.57: Significance of Impacts from Generation and Management of Non-Hazardous Waste during Construction Phase of Power Plant

Significance of Impact					
Impact	Potential impacts from generation and management of non-hazardous waste by increasing the stress put on the facilities and reducing the capacity and capability of the existing waste management network.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts is considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts would be direct.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Construction will take approximately 28 months for the Power Plant. Duration is considered as short-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would likely be restricted to the local area.				
Impact Scale	The scale of potential impacts due to release of waste is potentially large due to the quantities present during this stage, particularly when considered in light of the limited waste management network in the area (YCDC estimate to have a landfill capacity of 2,064 tonnes per day).				
Impact Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the construction phase.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered to be medium.				
Receptor Sensitivity	Low	**Medium**	High		
	The existing waste network and facility within the Yangon City Development Committee (YCDC) is estimated to have a landfill capacity of 2,064 tonnes per day cumulative over six sites. This amount is considered to be relatively small comparative to the amount of waste generated by Yangon Region henceforth the receptor sensitivity is rated as medium.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a medium resource sensitivity and medium impact magnitude will result in an overall moderate significance level of impact.				

Mitigation Measures

The following measures will be put in place for the Project during construction phase of Power Plant to reduce the impact to existing waste management facilities:

- A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project construction. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste

streams identified. The WMP will be developed by the project proponent (or its EPC contractor) prior to commencing construction work;

- Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable;
- Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations;
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed;
- Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and
- The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during construction activity is being managed responsibly.

Residual Impacts

If the recommended mitigation and management measures are implemented, residual impact significance would be reduced to **Minor** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during construction phase should consist of the following:

- Monitoring of waste segregation, transportation and disposal practices in the project activity areas and disposal location, as to be defined in a Waste Management Plan to be prepared specifically for the Project; and
- Monitoring of appointed waste contractors using chain-of custody documentation, as to be defined in a Waste Management Plan to be prepared specifically for the Project.

9.6.7.5 Impacts of Generation and Management of Non-Hazardous Waste during Operation Phase

Overview

During the operation phase, a range of non-hazardous waste will be generated due to the operation process of the Power Plant. Most of the non-hazardous waste during operation phase will be from maintenance activities (which is categorised to be part of the operational phase). These waste is likely to be similar type to construction phase (i.e. uncontaminated concrete, steel pipes, steel plates, structural steel and wooden crates) but in lower quantity. Remaining waste will be gathered (with operational wastewater from Power Plant) and handover to licensed waste contractor to be disposed responsibly. However, the volume of this waste is unable to be estimated as the quantity will depend on the size of the maintenance activity.

Impact Assessment Table

The significance of potential impacts to the capacity of the existing waste management network to deal with non-hazardous waste from the Project operation (and maintenance) phase are assessed in ***Table 9.58***, and mitigation measures are presented thereafter.

Table 9.58: Significance of Impacts from Generation and Management of Non-Hazardous Waste during Operation Phase of Power Plant

Significance of Impact					
Impact	Impacts from generation and management of non-hazardous waste by increasing the stress put on the facilities and reducing the capacity and capability of the existing waste management network.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts is considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to the existing waste management network would be direct.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase is expected to continue for approximately 25 years, which would be considered as long-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would likely be restricted to the local area.				
Impact Scale	The scale of potential impacts due to release of waste is potentially small due to the quantities anticipated during this stage, particularly when considered in light of the limited waste management network in the area.				
Impact Frequency	Impacts would occur intermittently but repeatedly throughout the operation and maintenance activity.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered to be small.				
Receptor Sensitivity	Low	**Medium**	High		
	The existing waste network and facility within the Yangon City Development Committee (YCDC) is estimated to have a landfill capacity of 2,064 tonnes per day over six sites. This amount is considered to be relatively small comparative to the amount of waste generated by Yangon Region henceforth the receptor sensitivity is rated as medium.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a medium resource sensitivity and small impact magnitude will result in an overall minor impact.				

Mitigation Measures

The following measures will be put in place for the Project during operation phase of the Power Plant to reduce the impact to existing waste management facilities:

- A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project operation. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the operation phase for all of the waste streams identified. The WMP will be developed by the project proponent (or its EPC contractor) prior to commencing construction work;

- Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable;
- Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations;
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed;
- Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and
- The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during operation activity is being managed responsibly.

Residual Impacts

If the recommended mitigation and management measures are implemented, residual impact significance would be reduced to **Negligible** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during both the construction and operation phases should consist of the following:

- Monitoring of waste segregation, transportation and disposal practices in the project activity areas and disposal location, as to be defined in a Waste Management Plan to be prepared specifically for the Project; and
- Monitoring of appointed waste contractors using chain-of custody documentation, as to be defined in a Waste Management Plan to be prepared specifically for the Project.

9.6.7.6 Impacts from Generation and Management of Domestic Solid Waste during Construction and Operation Phase

Overview

During construction and operation phase of the Power Plant, domestic solid waste is anticipated to be generated from workers working on-site. The peak number of workers expected to be on-site during construction phase is 600 people and during operation phase is peaked at 82 (excluding maintenance staff). The expected amount of domestic solid waste from this source is presented in ***Table 9.59***.

Table 9.59: Anticipated Amount of Domestic Solid Waste during Construction and Operation Phase of Power Plant

Phase	Anticipated Quantity	Number of Workers	Total Solid Waste
Construction	1.65 kg per employee per week	600	990.0 kg per week
Operation		82	135.3 kg per week
Maintenance (every 3 years)		90 (for 30 days)	636.4 kg per 30 days

Currently, the EPC (during construction phase) and TPMC (during operation phase) is planned to rely on the existing landfill managed by YCDC to dispose of the domestic waste.

Impact Assessment Table

The significance of potential impacts from generation and management of domestic solid waste during construction and operation (and maintenance) phase of the Power Plant is assessed in ***Table 9.60***, and mitigation measures are presented thereafter.

Table 9.60: Significance of Impacts from Generation and Management of Domestic Solid Waste during Construction and Operation Phase of Power Plant

Significance of Impact					
Impact	Potential impacts due to generation and management of domestic solid waste by increasing the stress put on the facilities and reducing the capacity and capability of the existing waste management network.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts is considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Impacts would be direct.				
Impact Duration	Temporary	**Short-term**	**Long-term**	Permanent	
	Construction will take approximately 28 months for the Power Plant. Duration is considered as short-term. Operation will last approximately 25 years for the Power Plant. Duration is considered as long-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would likely be restricted to the local area.				
Impact Scale	During construction phase, the domestic solid waste is anticipated to be 990.0 kg per week. During operation phase, the domestic solid waste is anticipated to be 135.3 kg per week. During maintenance activity, the domestic solid waste is anticipated to be 636.4 kg per 30 days which is expected to occur once every 3 years.				
Impact Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the construction and operation phase (and during maintenance activity).				
Impact Magnitude	Positive	Negligible	**Small**	**Medium**	Large
	Based on the combination of the above impact characteristics the impact magnitude is considered to be small (operation phase) to medium (construction phase).				
Receptor Sensitivity	Low	**Medium**	High		
	The existing waste network and facility within the Yangon City Development Committee (YCDC) is estimated to have a landfill capacity of 2,064 tonnes per day cumulative over six sites. This amount is considered to be relatively small comparative to the amount of waste generated by Yangon Region henceforth the receptor sensitivity is rated as medium.				
Impact Significance	Negligible	**Minor**	**Moderate**	Major	
	The combination of a medium resource sensitivity and small to medium impact magnitude will result in an overall moderate to minor significance level of impact.				

Mitigation Measures

The following measures will be put in place for the Project during construction and operation phase of Power Plant to reduce the impact to existing waste management facilities:

- A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project construction. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified. The WMP will be developed by the project proponent (or its EPC contractor) prior to commencing construction work;
- Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable;
- Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations;
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed;
- Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and
- The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during construction activity is being managed responsibly.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **Negligible** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during both the construction and operation phases should consist of the following:

- Conduct regular inspection of relevant domestic solid waste streams and sources of the domestic solid waste to ensure mitigation measures in place are being enforced and maintained throughout the phase.

9.6.7.7 Impacts from Generation and Management of Domestic Liquid Waste during Construction and Operation Phase

Overview

During construction and operation phase of the Power Plant, domestic liquid waste is anticipated to be generated from workers working on-site. Domestic liquid waste includes greywater, kitchen wastewater, and sanitary wastewater. The peak number of workers expected to be on-site during construction phase is 600 people and during operation phase is peaked at 82 (excluding maintenance staff). The expected amount of domestic liquid waste from this source is presented in ***Table 9.61***.

Table 9.61: Anticipated Amount of Domestic Liquid Waste during Construction and Operation Phase of Power Plant

Phase	Anticipated Volume	Number of Workers	Total Liquid Waste
Construction	33.3 litres per employee per day[153]	600	30,000 litres per day
Operation		82	4,100 litres per day
Maintenance (every 3 years)		90 (for 30 days)	135,000 litres per 30 days

Currently, during the construction phase the EPC plans to collect sanitary wastewater and sewage through underground pipes into a holding tank, from where the sewage will be routed to an on-site sewage treatment plant or alternatively transported periodically by vacuum trucks (as frequently as needed) to a septic tank or discharging to a designated local water body. During operation phase, since the number of workers anticipated on-site will be significantly smaller and therefore the volume of waste produced during this phase is estimated to be dealt with a septic tank on-site without the need to discharge. Henceforth, the Project Proponent plans to install a septic tank to handle domestic wastewater during operation phase.

Impact Assessment Table

The significance of potential impacts from generation and management of domestic liquid waste during the construction and operation phase of the Power Plant is assessed in ***Table 9.62***, and mitigation measures are presented.

Table 9.62: Significance of Impacts Due to Generation and Management of Domestic Liquid Waste during Construction and Operation Phase of Power Plant

Significance of Impact				
Impact	Potential impacts due to generation of sanitary wastewater. Some of the impacts may be related to additional output of treated water into natural water bodies, unpleasant spread of odor to the local community due to improper storage of the domestic liquid waste.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts is considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Impacts would be direct.			
Impact Duration	Temporary	**Short-term**	**Long-term**	Permanent
	Construction will take approximately 28 months for the Power Plant. Duration is considered as short-term. Operation will continue for approximately 25 years for the Power Plant. Duration is considered as long-term.			
Impact Extent	**Local**	Regional	International	
	The extent of potential impacts would likely be limited to the location where sanitary wastewater is stored, treated and disposed of, and therefore is local.			
Impact Scale	During construction phase, the domestic liquid waste is anticipated to be 30,000 litres per day. During operation phase, the domestic liquid waste is anticipated to be 4,100 litres per day. During maintenance activity, the domestic liquid waste is anticipated to be 135,000 litres per			

[153] Metcalf& Eddy Inc. Wastewater Engineering: Treatment, Disposal, Reuse. 3rd Edition McGraw Hill, Network, 1979

Significance of Impact					
	30 days which is expected to occur once every 3 years.				
Impact Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the construction and operation phase (and during maintenance activity).				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Magnitude is considered to be medium due to the large volume of sanitary wastewater expected to be discharged.				
Receptor Sensitivity	**Low**	Medium	High		
	Additional treated sanitary wastewater stream introduced to the existing wastewater management network and/or the water bodies that will receive the Project's effluent discharge can impact the condition of receptors (human, terrestrial and aquatic ecology) that are situated around the release of effluent. However, the current (pre-project) surface water condition of the designated discharge point is considered to be unhealthy. Therefore the sensitivity of the receptor in determined to be Low.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a low resource sensitivity and medium impact magnitude will result in an overall minor significance level of impact.				

Mitigation Measures

The following measures will be put in place for the Project during construction and operation phase of Power Plant to reduce the impact on physical receptors (soil, groundwater and surface water) and consequently human and biodiversity that uses these physical receptors:

- All waste collection and storage measures as detailed within ***Chapter 9.4*** and ***Chapter 9.5*** (Surface Water, Soil and Groundwater) will be implemented;
- Ensure the integrity of wastewater storage unit to avoid leaking of wastewater and odor to the surrounding receptors;
- Enforce rules that prevent inappropriate materials going into the sanitary wastewater stream; and
- Design discharge point to be furthest away from sensitive receptors.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **Negligible** Impacts.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during both the construction and operation phases should consist of the following:

- Conduct regular maintenance on sanitary wastewater treatment system to ensure that the system is functioning efficiently and effluent is achieving targeted quality; and
- Conduct regular testing of effluent water parameters to ensure effluent is within the relevant effluent standards prior releasing it at the discharge location.

9.7 Landscape and Visual Impact Assessment

9.7.1 Introduction

The development of the Project will be introducing a number of new elements into the existing visual environment. This section presents a purely qualitative assessment of impacts to visual amenity (assessed as one of the interrelated effects on population and how various groups experience and perceive changes in the values attributed to the landscape). During the construction and operation there will be a range of activities which have the potential to change how various people will perceive/see the landscape. The key visually sensitive receptors within the vicinity of the proposed Project have been identified in the Baseline **Chapter 5** and this Chapter undertakes an assessment of predicted impacts to these during construction and operation.

9.7.2 Assumption and Limitations

The assessment of potential impacts related to Visual Environment in this section is based on the environmental baseline data (presented within **Chapter 5**) and the information available from the Project Proponent at the time of writing. Judgements and assessments have been made based on professional knowledge and previous experience of ERM.

This assessment has been undertaken primarily as a desktop study drawing upon limited site analysis. No quantitative modelling, viewshed analysis, stakeholder engagement or photomontage development has been undertaken with regards to any elements of the visual impact assessment. It is based purely on information readily available as secondary sources (primarily online mapping databases) and information gathered during site visits for the purposes of gaining other qualitative environmental data. No direct onground identification of the visual baseline is therefore available. Additionally, no stakeholder engagement was undertaken to determine the various values that particular visual sensitive receptors place on various elements of the landscape.

9.7.3 Assessment Methodology

The methodology used for assessing impacts to surface water is aligned with the general impact assessment methodology presented in ***Chapter 6***.

9.7.4 Baseline Summary

The topography at the Power Plant are primarily flat land with no noticeable elevations; however, towards the northeast of the Power Plant, there is high elevations that lead up the highest point exactly where the Shwedagon Pagoda is located (approximately 57 – 62 metre elevation). Beside the Power Plant, to the east, is a cargo port called Ahlone Shipyard.

9.7.5 Resources and Receptors

The closest receptor to the Power Plant is a small household area approximately 80 metres north of the Power Plant; and the medium density residential area approximately 670 metres northeast of the Power Plant, within Ahlone Township. Given the nature of the proposed facilities, a 3 km radius from the main Project Site facilities has been taken as the study area for the Visual Baseline and impact assessment.

9.7.6 Summary of Project Activities with Potential Impacts

Visual impacts from the Project are considered likely to arise from the following activities:

9.7.6.1 Construction Phase

- Earthworks will include clearing of vegetation and grading of the Project site. It is expected that the subsoil, which will be stripped and removed from the Project site, shall be utilised for levelling/ backfilling.
- Construction of all elements of the Power Plant within the Project Site.

9.7.6.2 Operation Phase

The long-term operational presence of the following Project structures will change the nature of the existing landscape and visual amenity;

- Power Plant Stack (Total height of 40 m.).

9.7.7 Assessment of Impact

9.7.7.1 Construction Phase

Overview

Visual impacts during site formation and construction will be caused by earthworks, light emissions, disturbance and physical presence of facilities as they are erected.

Impact Assessment Table

Table 9.63: Impact Assessment Table for Landscape and Visual Impacts (Construction Phase)

Significance of Impact					
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	Site formation and construction works will be temporary.				
Impact Extent	**Local**	Regional	International		
	Earthworks, light emissions, disturbance and physical presence of new facilities will be local and largely confined of the Project Sites although some light emissions will be visible further away.				
Impact Scale	The impact will occur within the Project area covering 8.97 acres (36,300 m^2)				
Impact Frequency	It is assumed construction works will take place continuously until the Project is built.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Magnitude is considered to be medium.				
Receptor Sensitivity	**Low**	Medium	High		
	The closest receptor to the Power Plant is a small household area approximately 80 metres north of the Power Plant; and the medium density residential area approximately 670 metres northeast of the Power Plant, within Ahlone Township. There is an existing Power Plant located next to this proposed Power Plant. There is no scenic-resource value located near the Project for instance Pagoda. Therefore,				

Significance of Impact				
	the sensitivity is considered to be Low.			
Significance	Negligible	**Minor**	Moderate	Major
	The combination of a low resource sensitivity and medium impact magnitude will result in an overall minor significance level of impact.			

Mitigation / Management Measures

The following mitigation measures should be implemented to mitigate the impacts:

- Provide soft landscaping (i.e. tree, low shrub and ground cover planting) within available space within the Project Site. Plant as soon as practical during construction phase;
- Minimize the extent of construction areas, including for dredging and including temporarily affected areas;
- Minimize clearing of vegetation as far as practical. Existing large trees (if any) should be retained as far as practical. Those that fall outside the earthworks area must be retained. Felled trees should be compensated for where possible;
- Reinstatement of temporarily affected areas which will no longer be required for the operational stage (e.g. contractor camp, laydown areas, etc.), to suitable pre-construction condition as soon as practical after use (e.g. using landscaping with suitable vegetation)

Residual Impact

Based on the implementation of the proposed mitigation measures, the significance of the impact is considered to be **Negligible** impact.

Monitoring plan

No monitoring plan is required.

9.7.7.2 Operation Phase

Overview

Visual impacts during operations will be caused by the physical presence of new facilities at the Power Plant, as well as light emissions and human disturbance.

Impact Assessment Table

Table 9.64: Impact Assessment Table for Landscape and Visual Impacts (Operation Phase)

Significance of Impact				
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts would be considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Potential impacts would likely be direct impacts.			
Impact Duration	Temporary	Short-term	**Long-term**	Permanent
	The physical presence of Power Plant will cause visual impact for the duration of the proposed Project and after unless decommissioned.			

Significance of Impact					
Impact Extent	**Local**	Regional	International		
	Facilities that rise higher than any fencing/ wall that will secure the main site will be visible a distance away, but will not extend beyond a local impact.				
Impact Scale	The highest facilities in the Power Plan is emission stack that will be visible to a further distance (approximately 2 kilometres). Therefore, the scenic impact will be limited to the 2 kilometres.				
Impact Frequency	The physical presence of the Power Plant is expected to last throughout the operation phase of 25 years.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Magnitude is considered to be medium.				
Receptor Sensitivity	**Low**	Medium	High		
	The closest receptor to the Power Plant is a small household area approximately 80 metres north of the Power Plant; and the medium density residential area approximately 670 metres northeast of the Power Plant, within Ahlone Township. There is an existing Power Plant located next to this proposed Power Plant. There is no scenic-resource value located near the Project for instance Pagoda. Therefore, the sensitivity is considered to be Low.				
Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a low resource sensitivity and medium impact magnitude will result in an overall minor significance level of impact.				

Mitigation / Management Measures

- Visual screening e.g. surround perimeter of site with native trees (can be compensatory trees for any felled during construction);
- Maintain soft landscaping (i.e. tree, low shrub and ground cover planting) within available space in the Project Site;
- Minimise overall lighting use and manage lighting on site to consider minimization of light pollution and horizon glow;
  - identify zones of high and low lighting requirements and contain light to areas that need illumination most;
  - prevent light spill/ glare with shielding i.e. All security and street/road lighting shall have “blinkers” or be specifically designed to ensure light is directed downwards while preventing side spill;
  - prevent light spill/ glare with directional lighting to focus on necessary area/object (eg reduce the height from which floodlights are fixed and with the focus of the lights being inward, rather than outward);
  - keep light intensity to as low as reasonably practicable;
  - all external light fittings shall not allow light to shine upwards;
  - area lighting on any tall buildings/ masts should be confined to the lower landform elevations.
- Maintain all structural facilities in good repair;

Residual Impact

Based on the implementation of the proposed mitigation measures, the significance of the impact is considered to be **Negligible** impact.

Monitoring plan

No monitoring plan is required.

9.8 Social Impact Assessment

9.8.1 Introduction

Settlements located closest to the Project infrastructure are likely to experience negative and positive impacts as a result of the Project activities, including economic opportunities, social and environmental changes, lifestyle changes, and changes to community health and safety. Other social receptors located further from the Project may also benefit or experience negative impacts from the Project.

The predicted impacts to the social environment as a result of the proposed Power Plant are described in this Chapter. The presence of economical, industrial, touristic and religious activities within the Study Area have all been considered as part of the assessment of impacts.

This Chapter also develops management, mitigation and monitoring measures needed to ensure that any identified impacts can be avoided, reduced, mitigated to as low as reasonably practical or compensated for. Such measures are presented and will form part of the overall Environmental and Social Management Plan (ESMP, ***Chapter 12***) for the Project.

9.8.2 Assumption and Limitation

The assessment of potential impacts related to the social environment in this section is based on the physical, biological, environmental and social baseline data (presented within ***Chapter 5*** of this report) and the information available from the Project Proponent at the time of writing the report. Judgements and assessments have been made based on professional experience of similar projects in similar settings and previous general experience of ERM.

Limited secondary data focused on the Project area was available and the baseline draws from a range of secondary data at the national, regional and township level and primary data collected during social baseline activities in November 2018. Secondary data information has been gathered from various sources including ministries, regional authorities, the Myanmar Information Management Unit, other relevant studies or previous studies conducted for the Project or in the area.

The primary data used in this section of the report was collected during the baseline survey through Focus Group Discussions (FGDs), Key Informant Interviews (KIIs) and detailed household survey in randomly selected households in the Project area (***Table 9.65***). Ad-hoc and informal discussion were also conducted with community members, fishermen, hotel owners as well as other project developer in the area.

Table 9.65: Numbers of interviewees

Groups of interviewees	Total number of interviewees	Number of interviewees (per township)		
		Dala	Ahone	Seikgyikanaungto
Households	150	80	40	30
Village leaders	3	1	1	1
Women	3	1	1	1
Health specialists	3	1	1	1
Fisherman	1	1	-	-
Farmers	1	1	-	-

Source: ERM 2018.

9.8.3 Assessment Methodology

The Social Area of Influence (SAoI) is defined as the area inhabited or used by stakeholders and likely to be positively or negatively affected by the Project. This includes short, long term or permanent changes, as well as direct, induced or indirect impacts. The SAoI includes:

- The Project site(s) and related facilities that TPMC develops or controls and the additional areas in which aspects of the environment could conceivably experience significant impacts.
- Associated facilities that are not developed and funded as part of the proposed Project, but are essential for the Project and without which the Project cannot proceed, and the associated areas in which the environment could conceivably experience significant impacts.
- Areas potentially affected by cumulative impacts resulting from other developments known at the time of the ESIA, further planned phases of the Project or any other existing circumstances.
- Areas potentially affected by impacts from predictable (but unplanned) developments as a result of the proposed Project (i.e., induced activities), occurring at a later stage or at a different location.

Box 9.1 provides a definition of the concept of area of interest from good practice guidance.

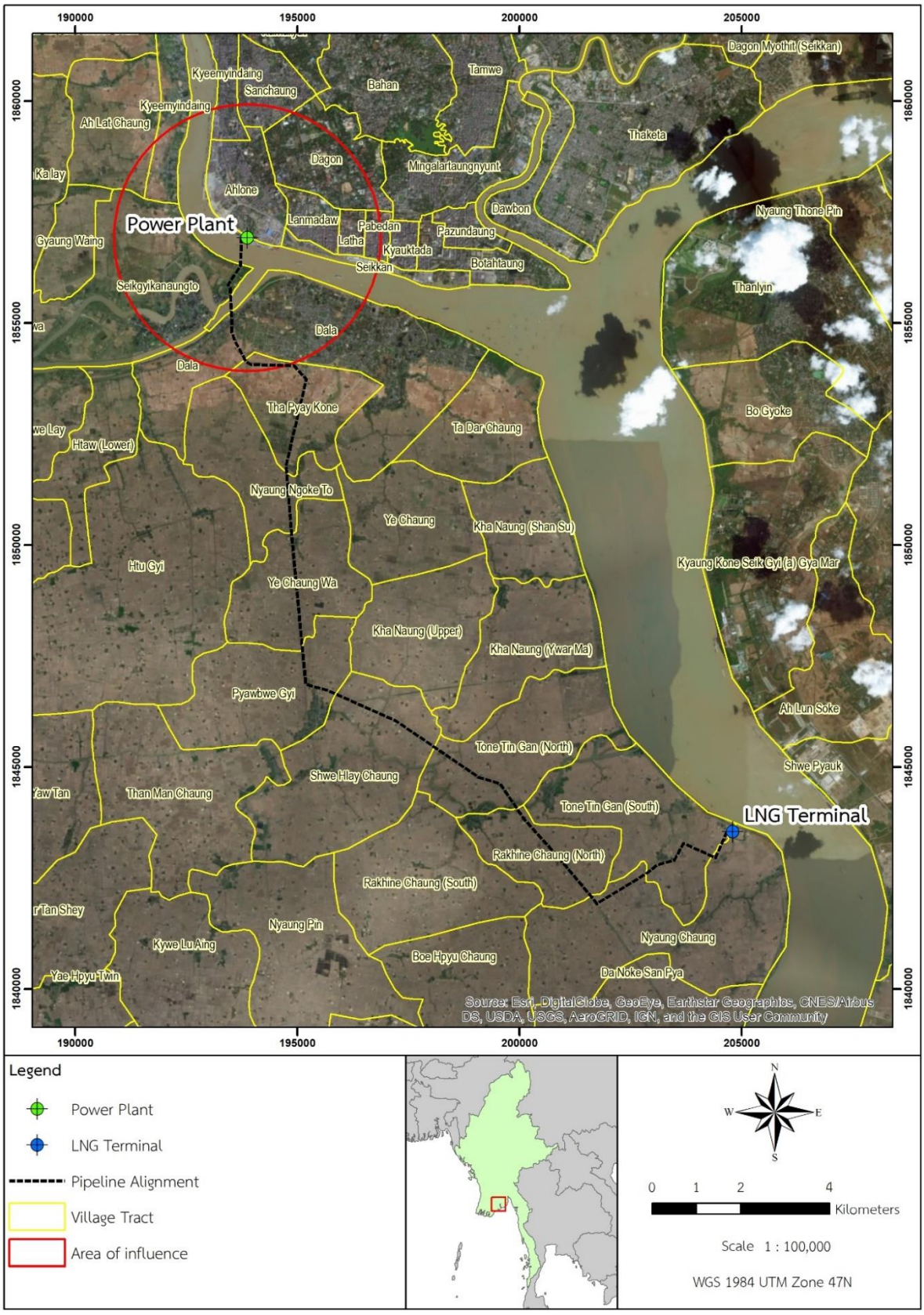
Box 9.1: IFC Definition of Area of Influence

The project's area of influence includes 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 the project; areas potentially impacted by cumulative impacts from further planned development of the 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 the project or independently of the project.

Source: IFC PS1, 2006

For the Power Plant, based on this definition, experience with similar project, the social baseline in the area, and the human use identified, the area to be considered for social impact has been established at 3 km around the Power Plant. This area allow to include all socioeconomic activities that may be potentially impacted by the power plant activities during construction, operation and decommissioning phases. The SAoI of the power plant is shown in ***Figure 9.14***.

Figure 9.14: TPMC Power Plant Social Area of Influence



Source: ERM, 2019.

9.8.4 Impact on Employment

9.8.4.1 Baseline Summary

Unemployment rate is low in the Yangon region at 4.1% of people in age of working. In Ahlone Township the percentage is only marginally higher at 4.8%. But amongst the people directly affected by the Project (PAP) interviewed during November 2018, 18.7% in Ahlone declare themselves unemployed and 7.7% said they were daily labourer in the agriculture sector. Hence a higher vulnerability of PAP (Project Affected People) to change, but also a source of local unskilled labour. Few of the PAP have been exposed to working in an industrial environment on machinery maintenance, welding, mechanic or general construction.

Around 23% of PAP own a business in the retail or trading sector. Some also have a computer (18.8%) or accountant (12.5%) certificate, a driving license (31.3%) or a teacher certification (6.2%).

9.8.4.2 Receptor Identification and Sensitivity

The Project will offers both skilled and unskilled positions, with the number of unskilled positions reducing after the construction period. Due to most of the local population not being experienced in the industrial sector, the number of accessible opportunities, particularly during the operation phase, might be limited due to the skills required at some position. Therefore, construction unskilled jobs should nevertheless be accessible for the local population. Some of the skilled PAP could also have roles during the construction and operation phases. Few unskilled jobs will also be available during operation.

In terms of indirect employment, the realization of opportunities will depend not only on the Project, but also on the initiative and business acumen of local entrepreneurs. Services for the employee (restaurant, shop) should benefit from the Project.

9.8.4.3 Impact during Construction

Overview

During approximately 23 months of construction, the Project will generate a range of employment opportunities and require an average of 400 workers per day with a peak at 600. Amongst these, more than half would be local Myanmar workers with up to 200 unskilled workers and 80 skilled ones.

In addition, the Project will require goods and services throughout construction. There are opportunities for local businesses to provide these goods and services (e.g. construction equipment, food for the workers). As a result, existing local businesses may expand or new businesses may be established locally to meet these demands – providing employment opportunities. This is referred to as indirect employment.

The resulting impacts (e.g. increase in employment opportunities, increase in income for local people employed by the Project) were assessed as a **Positive** one.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts on Employment		
Impact Nature	Negative	**Positive**	Neutral
	Potential impacts to Employment will be positive		
Impact Type	**Direct**	**Indirect**	Induced
	Potential impacts would likely be direct and indirect impacts.		

Mitigation Measures

In order to maximise the benefits from this impact for the local population, wherever possible, the workforce will be sourced from areas close to the Project after a training and selection process; and thereafter at a regional or national level. Given that levels of educational achievement and formal employment experience in relevant sectors is low within the SAoI, it is assumed that the majority of the available local labour may be unskilled or at most semi-skilled. The Project will develop a Sourcing, Procurement and Recruitment Management Plan which will be developed for this Project with the aim to promote benefits to locals from recruitment and procurement activities for the Project (including information, training and engagement).

Monitoring Plan

Monitoring of the local content should be done at the beginning of the construction phase to ensure maximum opportunities are given to local population.

9.8.4.4 Impact during Operation

Overview

During 25 years of operation plan, the Project will generate mainly skilled jobs and a limited number of unskilled jobs such as guard, gardener, cook or maid. It is expected that 49 permanent staffs will be required at skilled positions, as well as 12 security guards, 10 cleaners, gardener and 10 unskilled technical hands. In addition during maintenance, 90 skilled staffs will be required for 30 days.

The resulting impacts (e.g. increase in employment opportunities, increase in income for local people employed by the Project) were assessed as a **Positive** one.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts on Employment		
Impact Nature	Negative	**Positive**	Neutral
	Potential impacts to employment will be positive		
Impact Type	**Direct**	**Indirect**	Induced
	Potential impacts would likely be direct and indirect impacts.		

Mitigation Measures

In order to maximise the benefits from this impact for the local population and thereafter at a regional or national level. The Project will use the Sourcing, Procurement and Recruitment Management Plan developed for the construction stage and cooperate with local academic institutions to identify future local employees with the relevant skills.

Monitoring Plan

Monitoring of the local content should be monitored at the beginning of the operation phase to ensure maximum opportunities are given to local population. Thereafter during operation, monitoring should continue on a yearly basis to ensure the level of local content stay, at the minimum, stable.

9.8.5 Impacts to Navigation

9.8.5.1 Baseline Summary

Around 100 boats travel across the river to Yangon daily between 5:30 am to 8:00 pm and about 500 boats were observed within Seikgyikanaungto Township alone. The journey takes around 15 minutes from Seikgyikanaungto to Yangon.

In addition, heavy cargo traffic was observed in the Yangon River. Asia World Port Terminal, Myanmar Industrial Port (MIP) and Ahlone International Port Terminal (A.I.P.T) are located close to the Project site and bulk vessel travel up and downstream of the site during the day and night time.

Sand dredgers have also been observed on the Yangon River. There are sand dredging activities in Dala Township as well as dredging being conducted by Myanmar Industrial Port which is next the Project Site. The Myanmar Industrial Port is accessible to vessels of 167 m LOA, 9 m Draft and 15000 DWT.

Finally, ferry boats and fishermen are also active on the river during the day. Small scale artisanal fishing usually takes place in the Yangon River, including around the Project Site.

9.8.5.2 Receptor Identification and Sensitivity

The Yangon River is approximately 550 m wide at the Project location. Travelling to Yangon by car can take around 2 hours (depending on traffic). Given the difficulty to use car compared with the relatively cheap cost and ease of use of boat transport, local community depends mostly on boat transport to reach Yangon City.

The largest commercial vessels docking at the Myanmar Industrial Port have limited maneuver capacities but are normally supported by tug boats and the turn basin for the port is located downstream of the proposed Project site.

9.8.5.3 Impact during Construction

Overview

Construction phase of the Power Plant will last around 23 months. During construction, river works will include the installation of project infrastructure and unloading of construction equipment and material. The transportation of heavy, large volume and super-sized materials such as turbines, generators, transformers, etc. will be made on river way. Barges will transport heavy, and large volume materials to the site.

An exclusion zone of 100 meters and a safe zone of 150 meters from construction will be established to ensure safety among the construction vessels, and other non-project related vessels that navigate the Yangon River. Signalling buoys will be installed around the alignment of the safe zone to indicate the restricted area to other vessels. Navigation will be forbidden within the exclusion zone and activities restricted within the safe zone. If a vessel enters the safe zone, the support tug vessels will assist to warn off the vessel.

The impact of the Project pre-mitigation on navigation activities during construction phase is considered a **Negligible** Impact.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts on Navigation		
Impact Nature	**Negative**	Positive	Neutral
	Potential impacts on Navigation would be considered to be adverse (negative).		

Significance of Impact

Impact Type	**Direct**	Indirect	Induced	
	Potential impacts would likely be direct impacts.			
Impact Duration	**Temporary**	Short-term	Long-term	Permanent
	The impact may occur throughout the construction phase.			
Impact Extent	**Local**	Regional	International	
	This impact will be experienced only by stakeholders using the Yangon river downstream or directly in front of the proposed Project site.			
Impact Scale	The impacts will be experience within the safe zone, i.e 0.035km^2.			
Frequency	Impact will occur regularly during the 23 month of construction.			
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be small as the area impacted is limited and the impact will not be experienced every day during the construction phase.			
Receptor Sensitivity	**Low**	Medium	High	
	As the area impacted is limited, stakeholders will have alternative navigation route that will not increase significantly their travel time.			
Impact Significance	**Negligible**	Minor	Moderate	Major
	The significance is likely to be Negligible.			

Mitigation Measures

Although the impact significance is Negligible, due to the location of the impact on the water and relative risks, the following mitigation measures will need to be implemented during the construction phase of the Power Plant:

- At least 30 days prior to mobilization, TPMC will coordinate with local authorities , who will then issue “Notice to Mariner” regarding project activities to appropriate parties (i.e. Department of Fisheries, Ministry of Livestock, Fisheries and Rural Development, and Myanmar Navy).
- Establish a 100 m exclusion zone and 150 m safety zone around the construction zone and provide support vessels to observe fishing and commercial vessels approaching the safety zone to prevent collision.
- Provide appropriate lights and warning signals on construction vessels to prevent accidental collision.
- Ensure all captain and skippers on the construction vessels are trained and have the necessary permits and certificate to operate the construction vessels.
- TPMC will inform the exact location of the Project site with detail of safe zone, and alternative transportation routes to local stakeholders, as well as Department of Fisheries, Ministry of Livestock, Fisheries and Rural Development, and Myanmar Navy.
- TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on river ways/ areas. This will ensure that stakeholders can anticipate and appropriately respond to the change and limitation of uses on river ways/ areas. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular navigation is affected by the Project activities.

Residual Impact

No residual impacts are expected after the implementation of the above mitigation measures.

Monitoring Plan

- TPMC will need to monitor the grievance log weekly during construction to identify any specific grievance related to fishing activities.
- TPMC will review the accident log of the support vessel daily to identify any recurring risks and decide of additional prevention measure as necessary.
- TPMC will conduct, at least 3 times per year unplanned verification of permit and safety equipment, in particular lighting, on contractor vessels.
- TPMC will review engagement and communication log with local authorities to ensure proper information are provided by its contractors.

9.8.5.4 Impact during Operation

Overview

No activities on the Yangon River linked with the Power Plant are planned during operation.

9.8.6 Impacts to Traffic and Transportation

9.8.6.1 Baseline Summary

The concrete road network in the Ahlone Township is well developed but can be congested with traffic during peak hours. Public transport exist with several bus lines and taxi. All of interviewees agreed that overall quality and condition of transportation system is good.

The main road outside the proposed Project site is used both by local communities and truck transporting containers and loose material received at the Myanmar Industrial Port located next to the Project area. The road is not heavily used due to the toll users have to pay. Parallel to this toll road is a more used and congested during peak hours 6 lanes public road, used to access the rest of the Township and connecting to downtown Yangon or to the North.

9.8.6.2 Receptor Identification and Sensitivity

The toll road is the only road that can be used to access to the industrial areas of the Township. The public road is one of the main road of the Township with most of the public buses lane passing into the Township. It is the main road in the Township which has no other similar road but a few secondary roads going in the same direction. Public transport have no alternative route as they cannot use the secondary roads.

9.8.6.3 Impact during Construction

Overview

Equipment and material for the construction of the Power Plant will be delivered to the AWP and transported to the laydown area by truck. This will result in negative impact to the traffic between the AWP port and the laydown area but will impact only the toll road on a short distance. In addition, the workers during construction will be accommodated outside of the construction site. They will be travelling in buses to the Project site before and after their shift. This could represent 3 buses every 12 hours. In addition, local workers will come to the construction site but it is likely that they will be using public transport to travel from their home to the site. It is also possible that the Project will procure some equipment or material locally and will be trucking them to the project site. During levelling of the site for example, it is expected that fill material will be sourced from outside the project

area and will be trucked to the site. Although the exact number of potential heavy trucks and bus used during construction is not known, it is expected that this will result, at least during the levelling of the site, in some negative impacts on the traffic around the proposed Project site.

The impact of the Project pre-mitigation on traffic and transport activities during construction phase is considered a **Negligible** Impact.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts on Traffic and Transport			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts on Traffic and Transport would be considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Potential impacts would likely be direct impacts.			
Impact Duration	**Temporary**	Short-term	Long-term	Permanent
	The impact may occur at specific moment the construction phase.			
Impact Extent	**Local**	Regional	International	
	This impact will be experienced mainly by stakeholders using the toll road in front of the Project site.			
Impact Scale	The impacts will be experience on less than 2km for the equipment and material and a few kilometre for workers transport.			
Frequency	Impact will occur regularly during the 23 month of construction.			
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be small as the distance impacted is limited and the most intense impact will not be experienced every day during the construction phase.			
Receptor Sensitivity	**Low**	Medium	High	
	As the distance of impact is short and limited to the toll road which is not heavily used, the stakeholder sensitivity is considered Low.			
Impact Significance	**Negligible**	Minor	Moderate	Major
	The significance is likely to be Negligible.			

Mitigation Measures

The following mitigation measures will need to be implemented during the construction phase of the Power Plant:

- TPMC will not transport equipment and materials during the local traffic peak time between 8:00-9:00 and 14:00-16:00.
- Prior to transportation of Construction phase material & equipmenet to site, TPMC will inform proposed tranportation route and scheudle to Yangon Regional Governement and will tranport within permitted date and duration.
- TPMC will implement a Stakeholder Engagement Plan as part of the Project. The plan will include measures to notify local stakeholders in advance of any particularly activities on or near local roads to ensure that stakeholders can anticipate and appropriately respond to the change and limitation of uses on local roads. The Project will also develop a Grievance Mechanism to collect grievances from local stakeholders affected by the Project activities. Detail of the Grievance Mechanism can be found in ***Chapter 13.6*** and ***Appendix V***.

Monitoring Plan

- TPMC will need to monitor the grievance log weekly during construction to identify any specific grievance related to traffic and transport activities.
- TPMC will monitor and record the traffic congestion near the project site and along the transportation route, daily during construction phase.

9.8.6.4 Impact during Operation

There is no activity during operation phase that will generate impacts on traffic and transport.

9.8.7 Impacts to Existing Facilities and Utilities

Baseline Summary

Existing infrastructures and services in the Project SAoI are developed and consider insufficient for the local population. There are three hospitals, consisting of Academy Hospital, West Yangon General Hospital and Yangon Children Hospital in Ahlone Township and local people walk approximately 900 meters to reach hospital. The concrete road network in the Township is well developed but can be congested with traffic during peak hours. Public transport exist with several bus lines, ferry to cross the Yangon River and taxi or taxi boat easy to find or located in the Project SAoI. All of interviewees agreed that overall quality and condition of transportation system is good. Ahlone has the highest percentage of inhabitant using electricity for lighting and cooking.

Receptor Sensitivities

Social receptors in the SAoI have many alternatives in term of transport or public infrastructures. Existing facilities and infrastructures are developed to service a large number of users with capacity to absorb additional ones.

9.8.7.2 Impact during Construction

Overview

During construction, the workforce will reach 600 workers during peak activity and 400 on average. These will comprise of more than half local workers which should come from the region and therefore limit the additional burden on local infrastructures and services. The workers coming from other area, including expatriate will be accommodated nearby the Project site. The material and transport routes during construction are limited to the toll road between AWP port and the construction site.

The impact of the Project pre-mitigation on existing facilities and utilities during construction phase is considered a **Moderate** Impact.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts on Existing Facilities and Utilities including roads, hospital, etc.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts on Existing Facilities and Utilities would be considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Potential impacts would likely be direct impacts.			
Impact	**Temporary**	Short-term	Long-term	Permanent

Significance of Impact					
Duration	The impact may occur throughout the construction phase.				
Impact Extent	**Local**	Regional	International		
	This impact will be experienced by stakeholders living directly in the SAoI and transport route.				
Impact Scale	The number of Households that could be impacted is large due to the concentration of people leaving in the SAoI.				
Frequency	Daily impact				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is likely to be medium due to the number of workers and transport activities expected during the construction phase.				
Receptor Sensitivity	**Low**	Medium	High		
	Local infrastructures are fairly developed and considered to provide good services for a large number of people. Alternative options exists in case of disruption to one public service or the other.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The significance is likely to be moderate.				

Mitigation Measures

The following mitigation measures are suggested in order to mitigate impact on facilities and utilities:

- Provide appropriate amenities at the workforce accommodation camp – e.g. recreational opportunities. This will help reduce the need for workers to utilize local infrastructure and services;
- TPMC will ensure that company medical services have sufficient capacity and capability to treat a reasonable amount of workers at the same time.
- Develop and implement a Worker Code of Conduct for all employees, contractors and visitors directly related to the Project which will be a contractual and enforced requirement for all staff and subcontractors.
- Develop and implement a traffic management plan to minimize the impact experienced by road users as a result of the Project. The traffic management plan should be developed in consultation with local stakeholders. Stakeholders should be notified in advance of the Project commencing of traffic routes that will be utilised and, where known, periods of increased traffic volumes. Where possible, traffic movements will be coordinated so as to limit disruptions to local activities;
- Develop and implement a community health management plan and an occupational health and safety plan in consultation with relevant stakeholders (e.g. local health practitioners). These plans will ensure that appropriate and adequate health care services are provided on site and at the accommodation camp to address/ manage worker illnesses and injuries.

Residual Impacts

Based on the implementation of the proposed mitigation measures, the significance of the impact is considered to be a **Negligible** Impact post mitigation.

Monitoring Plan

Monitoring of impact on local infrastructures and services will be done through:

- Monthly engagement with local authorities and service providers (e.g. bus or ferry company);

- Weekly review of grievance log; and
- Monthly inspection of infrastructures and in particular the roads used for equipment and material transport.

9.8.7.3 Impact during Operation

Overview

The anticipated workforce during operation comprise 49 permanent staffs for Operation and Maintenance (with some expats), 32 staffs for security, cleaning etc. (all local people) and 90 persons for 30 days every 3 years for maintenance.

Impact Assessment

No impact to existing facilities and utilities are expected from the Power Plant during operation as the Project SAoI can easily absorb the limited number of additional person with no degradation of the access or capacity of local facilities and utilities.

9.8.8 Impacts from Environmental Emissions (Noise, Dust, Vibration)

9.8.8.1 Baseline Summary

Currently the air shed in the Project SAoI is considered non-degraded, meaning that all parameters are below the limit fixed by the NEQ.

According to the noise baseline results, all stations in the Project SAoI exceeded the Myanmar standard for at least one time period. Possible sources of high noise levels include the existing Power Plant, traffic activities, human activities, and rain/weather events.

Vibrations are limited to the vehicle traffic on the local roads as well as the vibration from the existing industrial activities.

The predominant annual wind direction is south westerly, meaning that the wind blow from the Yangon River toward the existing government power plant and the industrial port.

9.8.8.2 Receptor Identification and Sensitivity

The Proposed Project site is located close to a settlement. The North West corner of the site is 40 meters away from the nearest houses and 200 metres from the last house in the settlement. These house are old houses and it is expected that they have shallow foundation at best and limited insulation capacities. The other sensitive receptors in the area will be the employee from the industrial port and the existing power plants for noise and dust. The next houses are located too far from the Project site to be impacted by noise, dust or vibration.

9.8.8.3 Impact during Construction

Overview

The construction of the Project will generate:

- Noise: which can result from a variety of onsite activities (e.g. construction of infrastructure, reversing sensors on large vehicles). Noise can lead to hearing loss and disrupt community activities (such as sleep). Ongoing disruptions have been linked to increases in depression and anxiety;
- Vibrations: which can result from construction activities (e.g. piling, drilling, operation of compressors and generators). Vibrations if strong enough can damage the foundation of nearby infrastructure (e.g. businesses, community centers, monastery); and

- Dust: which can be generated through vegetation clearing, site grading, driving on dry, dirt roads. This can impact the surrounding air quality, disrupting the amenity value of an area and potentially impacting community health (e.g. further aggravating existing respiratory illnesses).

It is not anticipated that during the entire construction period the predicted noise levels do not comply with the assessment noise criteria. Dust will be generated during the first phase of construction only and impact a very limited number of receptors. Vibration will also be experienced mainly during the first phase of construction period.

Given the short-term nature of the impacts or the limited number of receptors, the impacts associated with environmental emissions are expected to be a **Minor** Impact.

Impact Assessment Table

Significance of Impact					
Impact	Impact from Environmental Emissions				
Impact Nature	**Negative**	Positive	Neutral		
	Increase of environmental emissions has the potential to result in negative impacts in the local area.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is direct.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	Impact will be temporary, during site preparation for dust and vibration and during 23 month for noise.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited within the local area.				
Impact Scale	The impact scale is small.				
Impact Frequency	The impact will occurs 24/7 during the construction phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be small.				
Receptor Sensitivity	Low	**Medium**	High		
	The vulnerability of receptor is likely to be medium, mainly due to the local houses nearby.				
Significance	Negligible	**Minor**	Moderate	Major	
	The significance is likely to be minor.				

Mitigation Measures

Mitigation measures have already been proposed in the Air Quality and Noise Impact Assessment sections but TPMC will also need to develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly noisy activities (e.g. pile driving). This will ensure stakeholders anticipate (and can appropriately respond to) the disruption associated with noise. The Project should also continue to use the Grievance Mechanism to collect grievances from local stakeholder impacted by noise, dust and vibration.

Residual Impacts

Assuming that the management measures proposed in the Air Quality and Noise Impact Assessment sections are implemented and monitored over time, the residual impact was assessed as **Negligible** impact.

Monitoring Plan

Monitoring of air quality and noise have been described in the relevant chapters. In addition, TPMC will need to monitor the grievance log weekly during construction to identify any specific grievance related to environmental emissions.

9.8.8.4 Impact During Operation

Overview

No activity with risk of dust or vibration emissions are expected during operation. The risks associated with noise during operation and relevant mitigation measures are covered in the Noise Impact Assessment section of this report.

The Project should also continue to implement the Grievance Mechanism to collect grievances from local stakeholder impacted by noise, dust and vibration.

9.8.9 Impacts on Community Health and Safety

9.8.9.1 Baseline Summary

In Myanmar and Yangon region, common diseases and health problems are consisted of tuberculosis, underweight in children, malnutrition, Malaria, and AIDs. In Ahlone Township, most of interviewees (94.1%) are living with a good health conditions, although 30% have experienced diabetes in the past years. Average distance between resident in the Project SAoI houses and medical facilities is approximately 0.9 km. Yangon is the main business hub in Myanmar and also a tourism center. There are constant movement of population in the area including Myanmar local and offshore people. Therefore, the inhabitant of the Project SAoI are constantly exposed to an above average pool of disease.

9.8.9.2 Receptor Identification and Sensitivity

The entire population within the Project SAoI is a potential receptor of this impact. In particular this includes the population interacting directly with the Project staffs such as restaurant and shop owners, households of project staff, and medical staffs. People with disability, young children and old people are particularly at risk if exposed. The high density of population increase the risk of epidemic but the constant exposure of the population within the Project SAoI to a wide pool of disease (increasing the potential for immunity due to exposure), and the improved access to medical facilities can also balance the sensitivity and vulnerability of the population. The situation of the area as a business and touristic hub explain the high HIV prevalence (24.6%), making this region one of locations with the highest percentage of HIV prevalence in the Southeast Asia Pacific region. Local communities are used to high traffic volumes meaning there are high levels of awareness regarding road safety.

9.8.9.3 Impact during Construction

Overview

The presence of TPMC workforce may result in interactions between the workforce and local people. As it is unlikely that the entire workforce will come from the Project SAoI, workers from outside of the local area will also be present. These workers may be subject to communicable diseases and STDs.

In the event of an outbreak of an airborne (e.g., TB) or food-borne illness among the workers, the area where local workers live, and any settlement visited by Project workforce may also become susceptible to these infectious diseases.

An increase in the transmission of communicable diseases may occur as the result of the introduction of workers into the area and creation of vector habitat (worker camps).

In terms of communicable diseases, of particular note and concern are tuberculosis and HIV/ AIDS, given their current prevalence within the country and local area. The receptors located closest to the Project site are likely to be most affected by an increase in vector habitat.

If left untreated communicable diseases can lead to long-term health issues and/ or in some instances death. In other words, the impact can be characterized as being long-term and in some instances permanent.

The handling, transport and treatment of the Project waste during construction may also result in risks to public health due to contamination of water resources and spread of disease carrying species such as rats.

The construction activities will create environmental emissions which may impact on community health and safety, in particular disruption of sleep, impact to building structure or aggravation of respiratory illness.

The risk of injuries from road traffic accidents associated with the movement of equipment and people by road will increase during civil construction work (including site mobilisation and demobilisation). Increased vehicle traffic, including vehicles operated by TPMC and their contractors increases the risk of accidents and injuries (up to and including deaths); this will particularly be the case if informal traders increase their presence around key junctions and along the road side.

Similarly the risk of collision between local transport boats or fishermen and Project vessels will increase during the construction period.

The security personnel active on site during construction will interact with local population. Due to their role and tasks it can presents a risk of human right abuse.

The impact of the Project pre-mitigation on community health and safety during construction phase is considered a **Moderate** Impact.

Impact Assessment Table

Significance of Impact				
Impact	Impact on Community Health and Safety			
Impact Nature	**Negative**	Positive	Neutral	
	Increase of communicable diseases in the local area is negative.			
Impact Type	**Direct**	Indirect	Induced	
	The impact is direct.			
Impact Duration	Temporary	Short-term	**Long-term**	**Permanent**
	The impact could be long lasting, even permanent, if left untreated or resulting in death.			
Impact Extent	**Local**	**Regional**	Global	
	Due to the area being a hub for business and tourism, heath issues could have regional effect.			
Impact Scale	The impact scale is large due to the potential number of people impacted.			
Impact Frequency	The impact likely occurs during the construction phase with the rare frequency.			

Significance of Impact					
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is likely to be Medium as the potential changes for the local population can have long term adverse consequences.				
Receptor Sensitivity	Low	**Medium**	High		
	The vulnerability of receptor is Medium due to the concentration of population and potential new vector habitat in a context of facilitated access to medical facilities and expected existing immunity.				
Significance	Negligible	Minor	**Moderate**	Major	
	The significance is likely to be Moderate.				

Mitigation Measures

The following mitigation measures should be implemented so as to reduce the significance of the impact:

- Training for all workers on the transmission routes and common symptoms of communicable diseases. This can help reduce the potential for workers to unknowingly transmit communicable diseases. This may also help to increase knowledge within Project SAoI – e.g. through the training of workers that have been sourced from the local area;
- Establish amenities at the worker camp to help minimize the interaction between the workforces (particularly temporary construction workers) and local villagers. This includes recreation facilities and health care infrastructure;
- Undertake pre-employment screening to ensure fitness for work. It is important that the pre-screening process does not result in discrimination, but instead is used as a tool to minimize the transmission of communicable diseases;
- Vector management procedures, including measures to reduce the presence of vector habitat and consideration of whether pesticides will be utilized to reduce the presence of vectors onsite;
- Provision of onsite health care and medical facilities, to ensure that basic medical attention and first aid treatment can be sought during the hours that the work is being undertaken at the Project site. This will also help reduce the potential pressure on local health care facilities;
- Pre-placement medical examination of all workers, supported by periodic medical examinations. A regular voluntary Worker Medical Screening Program onsite and a Monitoring and Evaluation (M&E) system. In addition a workplace policy and training and awareness programme on risks described above and prevention and mitigation of HIV impacts will be implemented with Project staff.
- In collaboration with the local and regional Government, local emergency providers and local health care facilities, TPMC will develop and implement Emergency Prevention, Preparedness and Response Plans (EPPRPs) to cover all incidents presenting risks to public safety and the affected communities in proximity to the Project Sites and the environment.
- Develop and implement a Workforce Code of Conduct which will be adhered to by all Contractors and TPMC employees. The specific measures that target anti-social behaviour, such as becoming involved with commercial sex workers are also include. Any employee or Contractor found in violation of the Code shall face disciplinary hearing which may result in dismissal.
- Ensure there is access to free condoms (including female condoms) at the worker camp to promote safe sexual practices.
- Conduct information, education and communication campaigns amongst Project personnel on hygiene and sanitation.

- The EPC contractor should develop an effective Waste Management Plan that ensures adequate and legally acceptable control and management of transport and disposal of all wastes on and off site.
- Security personnel will be contracted and trained in line with the Voluntary Principles on Security and Human Rights.
- Accommodation should be provided to external workers in accordance with international good practice on workers' accommodation, including IFC / EBRD standards to prevent transmission of diseases associated with poor living conditions.
- The Project should implement measures to reduce the presence of standing water onsite through environmental controls and source reduction to avoid the creation of new breeding grounds.
- All the mitigation presented in the air quality and noise impact assessment chapter will be implemented.
- The Project should develop a Traffic Management Plan covering vehicle safety, speed limits on roads, driver and passenger behaviour, use of drugs and alcohol, hours of operation, rest periods and location of rest stops and accident reporting and investigations.
- Require Project drivers to be trained in defensive driving within the previous 3 years.
- All vehicles used for the project should be regularly serviced and maintained.
- Local speed limits should be adhered to when travelling through communities by all Project related traffic. Such speed limits will have the added advantage of reducing dust emissions.
- Undertake consultation with communities along key transport routes to inform them about the potential for increased traffic movements prior to any changes.
- At least 30 days prior to mobilization, TPMC will coordinate with local authorities , who will then issue "Notice to Mariner" regarding project activities to appropriate parties (i.e. Department of Fisheries, Ministry of Livestock, Fisheries and Rural Development, and Myanmar Navy).
- Establish a 100 m exclusion zone and 150 m safety zone around the construction zone and provide support vessels to observe fishing and commercial vessels approaching the safety zone to prevent collision.
- Provide appropriate lights and warning signals on construction vessels to prevent accidental collision.
- Ensure all captain and skippers on the construction vessels are trained and have the necessary permits and certificate to operate the construction vessels.
- TPMC will inform the exact location of the Project site with detail of safe zone, and alternative transportation routes to local stakeholders, as well as Department of Fisheries, Ministry of Livestock, Fisheries and Rural Development, and Myanmar Navy.
- TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on river ways/ areas. This will ensure stakeholders anticipate (and can appropriately respond to) the change and limitation of uses on river ways/ areas. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular navigation is affected by the Project activities.
- The Project will ensure that signs are put up around construction sites advising people of the risks associated with trespass. All signs should be in diagram form to ensure those with low levels of literacy understand the signs.

- The Project will ensure that there is adequate fencing around construction site to minimise the risk of trespass. Fencing will be checked daily to ensure that it is in good condition and to look for any signs of entry.

Where appropriate the community health management plan should be implemented in close coordination with government authorities and local health care providers.

In addition to the community health plan, it is recommended that a complementary occupational health and safety plan be developed – to focus on managing potential issues that may affect the Project workforce. The plan should include measures to minimize the potential for the workforce to contract a communicable disease. This will help reduce the potential for the workforce to contract a communicable disease and subsequently introduce the disease in their home village/ community.

Residual Impacts

Once management measures have been implemented, it is predicted that the impact will be reduced to minor and negative during construction. However, on-going monitoring and evaluation of the management measures and community health situation will be needed. If monitoring indicates an increase in the transmission of communicable diseases, the management measures will need to be revised. This includes monitoring the Project's direct activities as well as Project contractors.

Monitoring Plan

Monitoring of impact on Community Health and Safety will be done through:

- Bi-monthly review of training log to confirm all employee are trained on the company H&S standard;
- Monitoring and review of accidents/ incidents due to construction activities; workers' health by daily monitoring and monthly review of near-misses, incidents, occupational diseases, dangerous occurrences, accidents at project activity areas and construction workers camp, as per construction phase Health and Safety Plan, which will be prepared by the EPC contractor.
- Development of a Community health and safety monitoring and surveillance programme.
- Daily monitoring of construction area, worker camp and surrounding (standing water, fence, warning sign).
- Regular unplanned audit related to the worker code of conduct (alcohol and drug use, speed limit, activities linked with local population).
- Bi-yearly unplanned audit of waste management contractors and facilities.
- Monthly visual inspection of first aid facilities and records, review of employment records and health insurance subscription records
- Weekly review of grievance log.

9.8.9.4 Impact during Operation

Overview

During operation, only a very limited number of workers will be mobilized, including 49 Operation and Maintenance staffs. It is likely to count some expatriates and around 35 unskilled staffs including only Myanmar national from the Project SAoI. They will be accommodated outside of TPMC camps, in house or apartment in Yangon. The expatriate workforce will be educated skilled employees who are expected to have good understanding of health and safety risks, in particular in relation to communicable diseases.

Amongst the local staff, approximately 10 security guards will be employed.

Vehicle traffic will be reduced to light vehicle for the transport of Project staffs, including the use of public transport.

The site will be fenced and access restricted.

Project will also result in gaseous emissions from the electricity production process.

Impact Assessment Table

The impact to community Health and Safety during operation are considered negligible due to the limited number of staffs employed and the limited interactions between project activities and local population. The impact due to unplanned event or emission from the power plant operation are covered in the air quality and unplanned event impact assessment chapters. Impact from solid wastes are covered in the waste impact assessment chapter and wastewater in the Surface Water impact assessment chapter.

Mitigation Measures

Although the expected impacts are negligible, it is recommended that the following mitigation measures should be implemented to reduce any risks:

- Training for all workers on the transmission routes and common symptoms of communicable diseases. This can help reduce the potential for workers to unknowingly transmit communicable diseases. This may also help to increase knowledge within Project SAoI – e.g. through the training of workers that have been sourced from the local area;
- Undertake pre-employment screening to ensure fitness for work. It is important that the pre-screening process does not result in discrimination, but instead is used as a tool to minimize the transmission of communicable diseases;
- Pre-placement medical examination of all workers, supported by periodic medical examinations. A regular voluntary Worker Medical Screening Program onsite and a Monitoring and Evaluation (M&E) system. In addition a workplace policy and training and awareness programme on risks described above and prevention and mitigation of HIV impacts will be implemented with Project staff.
- Develop and implement a Workforce Code of Conduct which will be adhered to by all Contractors and TPMC employees. The specific measures that target anti-social behaviour, such as becoming involved with commercial sex workers are also include. Any employee or Contractor found in violation of the Code shall face disciplinary hearing which may result in dismissal.
- Security personnel will be contracted and trained in line with the Voluntary Principles on Security and Human Rights.
- All the mitigation presented in the air quality, noise, waste and surface water impact assessment chapter will be implemented.
- A grievance procedure should be established whereby any complaints by neighbours or affected parties can be submitted, recorded and responded to.
- The Project will ensure that signs are put up around the site advising people of the risks associated with trespass. All signs should be in diagram form to ensure those with low levels of literacy understand the signs.
- The Project will ensure that there is adequate fencing around the site to minimise the risk of trespass. Fencing will be checked daily to ensure that it is in good condition and to look for any signs of entry.

Monitoring Plan

Monitoring of impact on Community Health and Safety will be done through:

- Bi-monthly review of training log to confirm all employee are trained on the company H&S standard;
- Development of a Community health and safety monitoring and surveillance programme.
- Regular unplanned audit related to the worker code of conduct (alcohol and drug use, speed limit, activities linked with local population).
- Bi-yearly unplanned audit of waste management contractors and facilities.
- Monthly visual inspection of first aid facilities and records, review of employment records and health insurance subscription records.
- Weekly review of grievance log.

9.8.10 Impacts on Occupational Health and Safety

9.8.10.1 Baseline Summary

Health and safety standards in the construction sector are relatively low in Myanmar. National occupational safety and health legislation is very limited with the main laws to consider for the Project being the Prevention and Control of Communicable Diseases Law (Law No. 1/95), Law Amending the Factories Act 1951 (Pyidaungsu Hluttaw Law No. 12/2016) and Prevention From Danger of Chemical and Associated Materials Law, 2013 (28/2013). Myanmar has ratified 23 out of 189 ILO conventions. Experience of industrial health and safety standards is limited in the Project SAoI except for those who have experience working at the industrial ports.

9.8.10.2 Receptor Identification and Sensitivity

International employees are likely to have a better understanding of national and international health and safety standards, and therefore understand the relevance of any training and mitigation measures and appropriate working conditions. Similarly, employee during the operation period will be mainly skilled workers who will receive extensive training improving their knowledge of risks and how to handle these. Employees sourced from the SAoI may have a higher sensitivity to the impact due to a poorer understanding of OHS standards and working conditions and lower literacy levels.

9.8.10.3 Impacts during Construction

Overview

During construction, the workforce will reach 600 workers. As much as possible, the company will try to source workforce from Project SAoI although some expatriate workers are expected on certain jobs. The nature of the activities mean that there is the potential for accidents and injuries to occur if occupational health and safety systems are not developed and strictly enforced for all Project personnel.

The potential impacts on the workers (unskilled, semi-skilled and skilled) of the Project are likely to result from the civil construction activities, truck movement, heat stress and hot surface, electrocution, chemical exposure, falling objects, working at height or in confined spaces and any unplanned event that may occur during the construction phase of the Project. These impacts are likely to increase in proportion to the increase in activity.

The risk of injuries from road traffic accidents associated with the movement of equipment and people by road will increase during the civil construction work (including site mobilisation and demobilisation).

Similarly, the risk of impact resulting from collision between commercial vessels, local transport boats or fishermen and Project vessels will also increase during the construction period.

The impact of the Project pre-mitigation on occupational health and safety during construction phase is considered a **Moderate** Impact.

Impact Assessment Table

Significance of Impact					
Impact	Impact on Occupational Health and Safety				
Impact Nature	**Negative**	Positive	Neutral		
	The potential increase in Health and safety of workforce and Labour and working conditions are negative.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is direct.				
Impact Duration	Temporary	Short-term	**Long-term**	**Permanent**	
	Impact has the potential to have a long lasting effect with injured workers being unable to work for a long time or even permanent in case of accident crippling or killing workers.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited to the workers at the site.				
Impact Scale	The impact scale is small.				
Impact Frequency	The impact likely occurs during the construction with a rare frequency.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is potentially medium.				
Receptor Sensitivity	Low	**Medium**	High		
	The vulnerability of receptor is likely to be medium.				
Significance	Negligible	Minor	**Moderate**	Major	
	The significance is likely to be Moderate due to the potential duration and gravity of the impact but the rare frequency of the impact.				

Mitigation Measures

The Project will develop and implement a Construction Occupational Health and Safety Management Plan (OHSMP) in line with good industry practice and corporate policies.

- The 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 potential hazards. This shall include (but not limited to) the following hazards:
  - falling from height;
  - falling into water;
  - entanglement with machinery;
  - tripping over permanent obstacles or temporary obstructions;
  - slipping on greasy walkways;
  - falling objects;
  - asphyxiation;
  - explosion;
  - contact with dangerous substances;

- electric shock;
- variable weather conditions;
- lifting excessive weights; and
- traffic operations.

- A Permit to Enter system will be established to ensure that only authorised persons gain entry to the construction site.
- Competent and adequately resourced sub-contractors will be used where construction activities are to be sub-contracted.
- All persons working on the construction site will be provided information about risks on Site and arrangements will be made for workers to discuss health and safety with the Contractor.
- The 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.
- All workers will be properly informed, consulted and trained on health and safety issues.
- Personal Protective Equipment (PPE) shall be worn at all times on the construction Site. This shall include appropriate safety shoes, safety eyewear, and hard hats. Non-slip or studded boots will be worn to minimize the risk of slips.
- Before starting work all the appropriate safety equipment and the first-aid kits will be assembled and checked as being in working order. Breathing apparatus if necessary will be tested at regular intervals in the manner specified by the manufacturer.
- All lifting equipment and cranes will be tested and inspected regularly. All hoist ways will be guarded.
- All scaffolding will be erected and inspected in conformity with the Factories Act (1951) and the appropriate records maintained by the Contractor.
- Safety hoops or cages will be provided for ladders with a height in excess of two meters.
- When there is a risk of drowning lifebelts shall be provided and it shall be ensured that personnel wear adequate buoyancy equipment or harness and safety lines, and that rescue personnel are present when work is proceeding (near the water extraction point).
- All breathing apparatus, safety harnesses, life-lines, reviving apparatus and any other equipment provided for use in, or in connection with, entry into Confined Spaces, and for use in emergencies, will be properly maintained and thoroughly examined at least once a month, and after every occasion on which it has been used.
- Where sound levels cannot be reduced at the source, suitable hearing protection will be provided when noise levels indicate a Leq of more than 85 dB(A). When hearing protection is used, arrangements will be made to ensure the wearers can be warned of other hazards.
- The Contractor shall provide appropriate safety barriers with hazard warning signs attached around all exposed openings and excavations.
- The EPC contractor will comply with the IFC Performance Standard 2, local regulation and ILO conventions signed by Myanmar.
- TPMC will develop and monitor an internal standard to guide labour practices and apply this to supply chain to ensure that no child and/or forced labour will be employed by the EPC contractor and its sub-contractors.

In addition an OHS monitoring programme should be put in place to verify the effectiveness of prevention and control strategies and a worker grievance mechanism developed and implemented.

Residual Impacts

Based on the implementation of the proposed mitigation measures, the significance of the impact is considered to be a Minor and Negative Impact post mitigation.

Monitoring Plan

Monitoring of impact on Occupational Health and Safety will be done through:

- Six monthly review of training log to confirm all employee are trained on the company H&S standard;
- Monitoring and review of accidents/ incidents due to construction activities; workers' health by daily monitoring and monthly review of near-misses, incidents, occupational diseases, dangerous occurrences, accidents at project activity areas and construction workers camp, as per construction phase Health and Safety Plan, which will be prepared by the EPC contractor.
- Development of an Occupational health and safety monitoring and surveillance programme.
- Weekly review of worker grievance log.

9.8.10.4 Impact during Operation

Overview

Project activities likely to present a risk during operation are linked with light vehicle travel at site and maintenance operations, in particular at height or in confined space. Heat stress and hot surface, electrocution and chemical exposure also present a risks for workers during the operation phase of the Project. Unplanned event like fire and explosion also present a risk for workers during operation but are covered under the unplanned event section of this report.

The impact of the Project pre-mitigation on cultural heritage during operation phase is considered a **Minor** Impact.

Impact Assessment Table

Significance of Impact					
Impact	Impact on Occupational Health and Safety				
Impact Nature	**Negative**	Positive	Neutral		
	The potential impact on Labour and working conditions are negative.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is direct.				
Impact Duration	Temporary	Short-term	**Long-term**	**Permanent**	
	Impact has the potential to have a long lasting effect with injured workers being unable to work for a long time or even permanent in case of accident crippling or killing workers.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited to the workers at the site.				
Impact Scale	The impact scale is small.				
Impact Frequency	The impact likely occurs during the construction with a rare frequency.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is potentially medium.				
Receptor	**Low**	Medium	High		

Significance of Impact				
Sensitivity	The vulnerability of receptor is likely to be low due to training, experience and skills.			
Significance	Negligible	**Minor**	Moderate	Major
	The significance is likely to be Minor due to the potential duration and gravity of the impact but the rare frequency and the low vulnerability of the receptor.			

Mitigation Measures

The mitigation measures developed for the construction phase apply to the operation phase. The Occupational Health and Safety Management Plan (OHSMP) will be updated to integrate the new potential risks of the operation and be linked to the Emergency Response Plan for unplanned event. The grievance mechanism for workers should also continue.

Residual Impacts

Based on the implementation of the proposed mitigation measures, the significance of the impact is considered to be a **Minor** Impact post mitigation due to the impossibility to reduce the accident risk to zero and the potential negative effects on workers.

Monitoring Plan

Monitoring of impact on Occupational Health and Safety during operation will be done through:

- Six monthly review of training log to confirm all employee are trained on the company H&S standard;
- Monitoring and review of accidents/ incidents due to construction activities; workers' health by daily monitoring and monthly review of near-misses, incidents, occupational diseases, dangerous occurrences, accidents at project activity areas, as per operation phase Health and Safety Plan, which will be prepared by the TPMC.
- Development of an Occupational health and safety monitoring and surveillance programme.
- Weekly review of worker grievance log.

9.8.11 Impacts to Cultural Heritage

9.8.11.1 Baseline Summary

There are no known cultural heritage site within the footprint of the Project site. The history of the site also support the absence of such site or any cultural or religious use. The nearest cultural heritage site is the Monastery and Pagoda located on the other side of the main road out of the area, approximately 600 metres from the site boundary and 60 meters from the main transport route. The main cultural heritage site located nearest to the proposed Project site is the Sule Pagoda, more than 3 km away from the site boundary.

9.8.11.2 Receptor Identification and Sensitivity

The vast majority of the population in the Project SAoI is Buddhist and regularly attend the monastery for ritual or weekly praying. Apart from the nearest monastery, there are other monastery or Pagoda accessible in a short time for the population living in the Project SAoI.

9.8.11.3 Impact during Construction

Overview

The main activity with a potential to impact cultural heritage during construction is the transport of equipment and material to the Project site with potential to increase traffic, reduce access and emit dust, noise and vibration.

The impact of the Project pre-mitigation on cultural heritage during construction phase is considered a **Negligible** Impact.

Impact Assessment Table

Significance of Impact

Impact	Impact on Cultural Heritage				
Impact Nature	**Negative**	Positive	Neutral		
	The potential impact on Cultural Heritage are negative.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is direct.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	Impact would be temporary, only during the time material and equipment are transported to the Project site from the AWP port.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited to the sites near the transport route.				
Impact Scale	The impact scale is small.				
Impact Frequency	The impact likely occurs during the construction with a medium frequency.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is Small as the road to be used is only 60 metres away from the monastery closest to the project site but will occur during a short period of time on a road designed for heavy cargo traffic.				
Receptor Sensitivity	**Low**	Medium	High		
	The vulnerability of receptor is likely to be low as the closest alternative to the monastery or other cultural heritage site is close and the monastery is located on another parallel road.				
Significance	**Negligible**	Minor	Moderate	Major	
	The significance is likely to be Negligible due to the limited duration of the impact.				

Mitigation Measures

All the measures described in the Impacts from Environmental Emissions section will be implemented for impact by environmental emissions to the monastery nearby. In addition:

- The EPC contractor during construction will monitor the state of the monastery closest to the project site. If damage is done to the buildings by vehicle of the Project, compensation (in kind or in cash) should be organised to restore the building to its state before the damage occur.
- The EPC contractor will develop the construction planning in discussion with the temple in order to make sure that any Project activity near the monastery (e.g. transport of large equipment) do not take place during special religious activities.
- The EPC contractor will monitor the grievance log weekly during construction.

Residual Impacts

Based on the implementation of the proposed mitigation measures, the significance of the impact is considered to be **Negligible** post mitigation.

Monitoring Plan

Monitoring of impact on cultural heritage will be done through:

- Monitoring and review of accidents/ incidents due to construction activities;
- Weekly review of grievance log.

9.8.11.4 Impact during Operation

Overview

No activity presenting a risk for cultural heritage are expected during operation.

The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder impacted by noise, dust and vibration.

9.9 Unplanned Event Impact Assessment

9.9.1 Introduction

The unplanned events associated to the activities above can be listed as follows;

- Chemical Spill or Leak;
- Fire and Explosion;
- Tropical Storm and Extreme Weather Condition; and
- Impacts from Loss of Containment of Chemical Storage Facilities On-site

9.9.2 Assumption and Limitation

As described in the Project Description in ***Chapter 4***, the Project is being designed, and will be constructed and operated, according to the best practice for preventing the risk and impact on health, safety, and environment. However, there is a potential for accidents, malfunctions or unplanned events to occur during any Project phase that cause impacts to the health and safety of community and employee of the Project. This is required to consider in this ESIA report.

The assessment of significant impacts of unplanned events considers the probability of events occurring and an estimate of the severity of the consequences of the events. In assessing the severity of impact, “A worst case scenario” is taken into consideration. This chapter presents the probable impacts of unplanned events associated with construction and operation of the Project. The unplanned events are considered separately from routine and non-routine activities as they arise as a result of a technical failure, human error, or as a result of natural phenomena.

9.9.3 Assessment Methods

As discussed in Chapter 3, the IFC Environmental, Health and Safety (EHS) standards and guidelines are considered throughout the assessment and provide the overarching guidance and principles for undertaking the assessment. The key documents considered are as follows:

- **IFC Performance Standard 1 Assessment and Management of Environmental and Social Risks and Impacts:** The ESMS will establish and maintain an emergency preparedness and response system so that the client, in collaboration with appropriate and relevant third parties, will

be prepared to respond to accidental and emergency situations associated to prevent and mitigate any harm to people and/or the environment;

- **IFC Performance Standard 2 Labor and Working Conditions:** It is required the Project to prevent risk and impacts on the staffs working in the Project area. Taking into account inherent risks in its particular sector/ classes of hazards in the client work area including physical, chemical, biological, radiological hazards, threats to women;
- **IFC Performance Standard 4 Community Health and Safety and Security:** The project must avoid and minimize risk and impact caused by the Project on health and safety of the community;
- **Environmental, Health, and Safety (EHS) General Guidelines**; and
- **EHS Guidelines:** Thermal Power Plants.

Assessment of significant impact associated to unplanned event considers the likelihood (or frequency) of incident occurrence and the consequence of the incident should it occur. The assessment of likelihood takes a qualitative approach based on professional judgement, experience from similar projects. The assessment of consequence is based on specialists' input and professional experience. The details are provided in the next sections. Since the Project activities during the construction and operation period are varied. The unplanned events will be assessed based on the Project phase listed in the following sections.

9.9.4 Baseline Summary

9.9.4.1 Seismic and Earthquake

Myanmar rests on one of the world's two main earthquake belts. One of its many fault lines run 1000 kilometres (600 miles) north to south through the country's agriculturally rich central plain, placing major Myanmar cities, including Mandalay, Bago and Yangon, at risk.[154] Due to this situation the country is exposed to the hazards of large earthquakes and tsunamis (M. Thein et al.)

9.9.4.2 Tropical Strom and Extreme Weather Condition

According to the statistic during 1992–2017, there were 18 tropical storms that affected Myanmar listed in ***Table 9.66*** below.

Table 9.66: Tropical Storms in Myanmar

Name	SSHS Category	Year
1. BOB 01	Category 1	1992
2. Forrest	Category 4	1992
3. BOB 01	Category 4	1994
4. 02B	Tropical Storm	2002
5. 01B	Category 1	2003
6. BOB 01	Category 1	2004
7. Mala	Category 4	2006
8. Akash	Tropical storm	2007
9. Nargis	Category 4	2008
10. Giri	Category 4	2010

[154] Irin. (2011). Myanmar's urban areas at risk from earthquakes. Myanmar Times. Retrieved from: https://www.mmtimes.com/national-news/2691-myanmar-s-urban-areas-at-risk-from-earthquakes.html

Name	SSHS Category	Year
11. Viyaru	Tropical storm	2013
12. Phailin	Category 4	2013
13. Komen	Tropical storm	2015
14. Roanu	Tropical storm	2016
15. Dianmu	Tropical storm	2016
16. Kyant	Tropical storm	2016
17. Maarutha	Tropical storm	2017
18. Mora	Severe Cyclonic Storm	2017

Remark: Saffir–Simpson hurricane scale (SSHS): Tropical cyclone must have one-minute maximum sustained winds of at least 74 mph (33 m/s; 64 kn; 119 km/h) (Category 1). The highest classification in the scale, Category 5, consists of storms with sustained winds over 156 mph (70 m/s; 136 kn; 251 km/h). The classifications can provide some indication of the potential damage and flooding a hurricane will cause upon landfall.

It could be seen that in the Year 1992, 2013, 2016 and 2017, there were two (2) tropical storms that made it in-land.

9.9.5 Resources and Receptors

The resources and receptors of unplanned events depend on the type of extent of the incident. For chemical spill and leak, the main receptors are: local residents and Project employees. Emergency unplanned events that cause fire, explosions and toxic discharges can cause damage to life and property of the local community. Project employees may also be affected by emergency events for example, earthquake, tropical storm, and extreme weather condition.

Table 9.67: Identified Receptors for Unplanned Events

Unplanned Events	Potential Receptors
Chemical spill and leak	When community or workers exposed to the spills or contaminated environment, it may cause short/ long term health depending on the time of exposure, type of contaminants, and amount released. The severity of the impact can be ranged from irritation to fatality.
Fire and explosion	Workers in the power plant and communities near the Project area.
Tropical Storm and Extreme Weather Condition	The tropical storm occurs at the Project Area, it could affect the personnel working inside the facilities.
Impacts from Loss of Containment of Chemical Storage Facilities On-site	Loss of contaminant would affect the surrounding environment e.g. soil, waterbody, flora, and fauna. Also, it could cause potential health and safety risk to receptors using surface water, soil and groundwater

The village tract which are located within 5 kilometres from the power plant consist of the following;

- Ah Lat Chaung village tract;
- Ah lone village tract;
- Kyeemyindaing village tract;
- Sanchaung village tract;
- Dagon village tract;
- Latha village tract;
- Lanmadaw village tract;
- Seikkan village tract;

- Pabedan village tract;
- Dala village tract;
- Tha Pyay Kone village tract; and
- Seikgyikanaungto village tract

9.9.6 Project Activities

The list of project activities of power plant that will be involved to the unplanned events in are listed as follows:

Table 9.68: Project Activities Potentially Involved with Unplanned Events

Phase	Project Activities Related to Unplanned Events
Construction Phase	■ Mobilization ■ Earthwork ■ River work ■ Installation of power plant.
Operation Phase	■ Power generation ■ Maintenance.

9.9.7 Assessment of Impact

9.9.7.1 Impact of Chemical Spill or Leak

Overview

There are a number of chemicals used, stored, and handled in the various construction and operation phase. If handle and store inappropriately, these chemicals may spill or release into environment and cause the contamination to the environmental receptors for instance soil, surface water, or groundwater. The examples of the control measures are listed as follows:

- Store chemicals in the appropriate container with clear label;
- Install bund in the chemical area, and the floor is impermeable with respect to the liquids stored;
- Prepare chemical spill response kit adequately and appropriately;
- Provide fire-fighting equipment at readily accessible locations at the storage area; and
- Prepare the emergency response plan to cover the event of chemical spill/ leakage.

For operation phase, when considering the properties of these chemicals, some e.g. hydrochloric acid, and sodium hydroxide etc. is severely corrosive agent which could cause severe burning to skin, respiratory system, or gastronomy. The remaining items can cause the irritating effects to respiratory, skin, or eyes. To minimize the risk of incident to be lowest as possible, the hazardous material management plan will be implemented similar to the construction period. For the sensitivity of receptor, ground water is the major source of drinking water with stored water from stream in the study area. Given the reliance on existing water sources, it is unlikely that the local villages would have the ability to adapt to any sort of contamination – i.e. be able to find an alternative drinking water source.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts from accidental releases of hazardous substances could be contamination to environments and cause the health effect to human.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts from accidental releases of hazardous substances would be considered adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts from accidental releases of hazardous substances would likely be direct impacts from Project activities.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The duration of potential impacts is long-term as it can have long lasting impacts on health or the environment.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would be limited to the Project footprint and vicinity area in the worst case hence would be considered to be Local.				
Impact Scale	The impact is limited within the local villages. The impact scale is medium.				
Impact Frequency	N/A, the impact is not expected to occur.				
Impact Consequence	Incidental	Minor	**Moderate**	Major	Severe
	Based on the above impact characteristics, the magnitude of impact from accidental releases in the Project Area is anticipated to be moderate.				
Impact Likelihood	Very Unlikely	**Unlikely**	Likely to occur once or more in life of the Project	Likely to occur once or twice per year	Will likely occurs more than twice per year, or is continuous or certain to occur
	The likelihood of chemical spill or leaks is anticipated to be unlikely.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	Considering the level of magnitude and likelihood, the significance of the impact from chemical spill or leak is expected to be minor.				

Mitigation Measures

- Contractor will prepare unloading and loading protocols and train staff to prevent spills and leaks;
- Contractor will prepare guidelines and procedures for immediate clean-up actions following any spillages of oils, fuels or chemicals;
- 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 for fuel oil and chemicals will be surrounded by bunds or other containment devices to prevent spilled oil, fuel and chemicals from percolating into the ground or reaching the receiving waters;

- Implement a construction materials inventory management system to minimise over-supply of the materials;
- Provide dedicated storage areas for construction materials to minimize the potential for damage or contamination of the materials;
- Ensure storage areas have impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest storage container;
- Provision of grounding and lightning protection for equipment that handles flammable materials;
- Establish a first-aid centre with first-aid trained staff on site. The first-aid centre shall be equipped with sufficient first-aid equipment, first-aid kit and medicines;
- Emergency response plan should include informing the public and relevant parties;
- Employee and contractor must be trained on emergency response procedure.

Residual Impact (Post Mitigation)

With the implementation of the above mitigation measures, the residual impacts are expected to be of **Negligible** significance.

Monitoring Plan

No Monitoring plan is required

9.9.7.2 Impact of Fire and Explosion

Overview

The operation of the Project involves certain flammable or explosive substances that have potential to cause serious danger to person or damage to properties due to the fire, explosion, and toxic release. The Project identify the sources of major hazards referred to World Bank Technical Paper Number 55 (World Bank, 1998) by considering 3 major activities which are (1) process activities (2) chemical storage and (3) transportation of hazardous materials. The criteria for identifying potential sources of fire and explosion are listed as follows:

- Properties of hazardous substances- toxic substances, flammable substances, highly reactive substances and explosive substances;
- Threshold quantities of hazardous substances – chemical inventory from World Bank Guidelines (World Bank, 1988) are used for screening the potential hazard unit/ equipment; and
- Operating condition (temperature, pressure higher than atmospheric conditions).

When natural gas released to the atmosphere, the consequence of the release depends on (1) volume of released gas, (2) nearby ignition source, and (3) surrounded environment. In worst case, released hydrocarbon may be ignited as a jet fire or fireball. The heat intensity will cause the health effects to human within the radiation. The damages are based upon correlations with radiation flux and damage levels.

However, the Project will prepare the control measures to minimize the risk associated to the fire or explosion in the case of gas leak. Therefore, it is anticipated that the likelihood of the pipe leak will be small. When considering the surrounding receptor, the land use along the pipeline consists of the agricultural land and light residential area.

Impact Assessment Table

Significance of Impact

Significance of Impact					
Impact	Potential impacts from fire and explosion may cause injury, loss of life or damage to property.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts from fire and explosion would be considered adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts from fire and explosion would likely be direct impacts from Project activities.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The impact duration is long-term due to the damage after the accident.				
Impact Extent	**Local**	Regional	International		
	Extent of potential impact would be at the incident location and surrounding. Thus, it is considered Local potential impact.				
Impact Scale	Impact can be varied from property damage, person injury and fatality				
Impact Frequency	NA. This incident is not expected to occur.				
Impact Consequence	Incidental	Minor	Moderate	Major	**Severe**
	The impact consequence is Severe because there is a possibility for fatality.				
Impact Likelihood	Very Unlikely	**Unlikely**	Likely to occur once or more in life of the Project	Likely to occur once or twice per year	Will likely occurs more than twice per year, or is continuous or certain to occur
	The likelihood of fire and explosion is anticipated to be unlikely.				
Impact Significance	Negligible	Minor	Moderate	**Major**	
	Considering the level of magnitude and likelihood, the significance of the impact from fire and explosion is expected to be Major.				

Mitigation / Management Measures

The Project will implement measures to minimize risk during construction and operation to lowest as possible. The list of mitigation measures include:

- Develop a preventive maintenance program for process equipment and pipeline connection in order to avoid failures and implement program regularly;
- Ensure the staff working to standard and strictly follow working procedures in order to prevent any incident;
- Install dike/bund around tank storage areas to contain the chemicals in case of leaked or spilled. The capacity of dike/ bund should be sufficient to contain the chemical from the largest tank;
- Establish an Emergency Centre with 24 hours standby staff and firemen. This centre will be equipped with a communication system such as hot (emergency) line telephone, trunk radios, paging, inter-com, different alarm tones correspondence with each kind of situation, CCTV monitors those can view different areas of the Power plant,;
- Install fire protection and firefighting system including but limited following items:

- Gas detection system: gas detector and fire alarm devices will be installed in potential leakage area of toxic chemicals and flammable substances like large size valves, flanges, major rotating equipment and high temperature fluctuation area;
- Fire water system: fire water pond and pumps will distribute fire water to all plants in the Complex via fire water pipeline;
- Water firefighting system in all plants: water hydrants, water monitors, fixed water spray system;
- Foam firefighting system in Tank Farm area: foam monitors, foam chamber equipped at heavy hydrocarbon storage tanks;
- Fire extinguishing system: portable fire extinguishers (foam, powder and CO_2) in plants and buildings at appropriate locations;
- Inert gas fire suppression system: Inert gas total flooding fire extinguishing system will be provided in some areas such as control rooms and substations; and
- Fire alarm system (automatic fire detectors and manual fire call points) will be provided in required areas.

- Establish a First-aid centre with 24 hours standby First-aid trained staff. The First-aid centre must be equipped with sufficient first-aid equipment, first-aid kit and medicines;
- To establish emergency plan and evacuation plan with a clear emergency procedure set up. The procedure will include explanation of steps and guidelines that everybody has to follow such as below items;
  - Witness should first control the emergency situation or extinguish fire based on emergency activity plan and report to boardman or shift supervisor or foreman of that unit immediately to request the support team from the Emergency Centre of the Complex;
  - The event shall be reported to the higher management level and emergency team shall be immediately formed according to the procedure set forth for providing support;
  - When the emergency signal rings, all workers have to stop all activities to a safe condition and move to assembly point immediately;
  - Assembly point shall be assigned for head counting and stand by for providing support;
  - The workers who first witness the accident have to put on the necessary personal protective equipment and enter the incident area from upwind only;
  - Limit the fire areas by utilizing the appropriate firefighting equipment;
  - All firefighting technique has to be exercised routinely during normal situation; and
  - Coordination with outside organizations such as nearby plants, hospitals, outside fire brigade team and so on.
- Proper communication equipment of either station or mobile type will be provided in the plant such as hot (emergency) line telephones, trunk radios, paging, inter-com and different alarm tones correspondence with each kind of situation.
- Power plant will be built and maintained according to American Petroleum Institute (API) or the American Society of Mechanical Engineering (ASME) standards; Residual Impact (Post Mitigation)
- Conduct routine inspections and preventive maintenance for equipment within power plant facility and associated equipment at least once per year.

Residual Impact (Post Mitigation)

With the implementation of the above mitigation measures, the residual impacts are expected to be of **Negligible** significance.

Monitoring Plan

No Monitoring plan is required

9.9.7.3 Tropical Storm and Extreme Weather Condition

Overview

Tropical storms are a natural phenomenon that could result in severe damage. The storm is named according to its origin: a storm that develops in the Pacific Ocean and South China Sea is called a typhoon. Tropical storms generally occur during monsoon seasons and can be categorized by wind speed as follows:

- Depression: maximum sustained winds up to 33 knots (61 km/h);
- Tropical storms: maximum sustained winds between 34 and 63 knots (62 - 117 km/h); and
- Cyclone or Typhoon: maximum sustained winds of 64 knots and over (118 km/h and above).

Wind and flooding caused damage to critical fuel facilities such as terminals, pipelines, storage facilities and truck racks, as well as to the electric power infrastructure that energizes those facilities. Docks, control systems, vapour recovery units, and electric switching gear within facilities were some of the supporting infrastructure that sustained serious damage. In addition, the storm could be harmful to personnel working at the power plant. It could result in injuries, mortality.

Impact Assessment Table

Significance of Impact

Impact	Potential impacts from tropical storms (typhoon) and extreme weather conditions may cause injury, loss of life or damage to property.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts from tropical storms (typhoon) and extreme weather conditions would be considered adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Potential impacts from tropical storms (typhoon) and extreme weather conditions would likely be direct impacts from Project activities.			
Impact Duration	**Temporary**	Short-term	Long-term	Permanent
	Potential impacts from tropical cyclone could result in damage to the structure of power plant and/or injuries depending on magnitude of tropical storm. However, there are safeguards in place, therefore, the impact duration is considered temporary.			
Impact Extent	**Local**	Regional	International	
	Extent of potential impact would be at the incident location and surrounding. Thus, it is considered local potential impact.			
Impact Scale	The affected area is expected to be the structures inside the project boundary and community in adjacent area.			
Impact Frequency	The frequency of the tropical storm or extreme weather condition to occur is every few years. However, the Project will design the facilities and equipment to be persistent to the storm and severe weather condition. Therefore, the frequency is expected to be rare.			

Significance of Impact					
Impact Consequence	Incidental	Minor	**Moderate**	Major	Severe
	The magnitude of impact from tropical storm and severe weather condition is anticipated to be moderate				
Impact Likelihood	Very Unlikely	Unlikely	**Likely to occur once or more in life of the Project**	Likely to occur once or twice per year	Will likely occurs more than twice per year, or is continuous or certain to occur
	The likelihood of the seismic and earthquake is anticipated to be likely to occur once or more in life of the Project.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	Considering the level of magnitude and likelihood, the significance of the impact from severe weather condition is expected to be moderate				

Mitigation / Management Measures

The project will implement measures to minimize risk during construction and operation to lowest as possible. The list of mitigation measures include:

- Review weather forecast and monitor weather condition on a daily basis;
- Prepare typhoon response plan and typhoon evacuation plan;
- Conduct evacuation drill and response to typhoon evacuation plan on a regular basis, at least once a year.
- Emergency response procedures for the tropical storm and severe weather condition will be formulated to contain and limit an emergency situation should one arise.
- Construct appropriate flood barriers capable of holding the worst-case scenario flooding scenarios.
- Construct diversion canals appropriately to redirect any excess water during flooding conditions.

Residual Impact (Post Mitigation)

With the implementation of the above mitigation measures, the residual impacts are expected to be of **Minor** significance.

Monitoring Plan

Assign project employees to monitor the weather condition regularly.

9.9.7.4 Impacts from Loss of Containment of Chemical Storage Facilities On-site during Construction and Operation Phase

Overview

During construction and operation phase, loss of containment of waste can occur from improper storage of chemical and the degree of impact will be dependent on the available mitigation measures to handle such unplanned event. EPC and the Project Proponent will have different storage facilities on-site. However, it is anticipated that during construction the volume of waste will be greater than during operation phase due to the nature of activities during its respective phase and the amount of waste it will produced and stored on-site. Therefore, this section will assess the variety of impact characteristics towards all potential receptors during and after loss of containment. The potential impacts and receptors foreseen from loss of containment of waste storage facilities are:

- Soil and groundwater contamination;
- Surface water contamination;
- Impact to habitat of fauna and flora;
- Disturbance to livelihood of human; and
- Potential health and safety risk to receptors using surface water, soil and groundwater.

Even though these impacts are related to other receptors, the source of impact is directly connected to waste generation, management and storage, henceforth, it will be accessed in this chapter (***Chapter 9.6***).

Impact Assessment Table

Significance of Impact

Impact	Potential impacts from loss of containment of waste storage facilities on-site may cause contamination to environments and cause the health effect to human.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts from loss of containment of waste storage facilities on-site would be considered adverse (negative).				
Impact Type	**Direct**	**Indirect**	Induced		
	Impacts would be direct for soil, surface water and groundwater. Impacts would be indirect for human, flora and fauna or other receptors that uses the impacted soil, surface water and groundwater.				
Impact Duration	Temporary	Short-term	**Long-term**	**Permanent**	
	Loss of containment impact can be seen as long-term impact due to the lasting effect of the impact towards soil, surface water and groundwater. Moreover, if the impact scale is large enough, this could result in a permanent impact to the habitat (habitat loss). Additionally, impact towards human health whereby the impact resulted in death, this is also considered as permanent duration.				
Impact Extent	**Local**	Regional	International		
	The extent of potential impacts would likely be limited to the location where waste storage unit is located (within Project footprint) and therefore is considered limited (thus local extent).				
Impact Scale	The scale of the impact will be dependent on the volume of waste in the storage unit at the time of the loss of containment. The scale of potential incident during construction may be substantial but during operation phase, the scale is anticipated to be minimal due to the significant lower storage volume.				
Impact Frequency	If construction and operation activities are carried out appropriately, the frequency is anticipated to be in-frequent				
Impact Consequence	Incidental	**Minor**	**Moderate**	Major	Severe
	Based on the combination of the above impact characteristics, the impact magnitude is considered to be Minor to Moderate.				
Impact Likelihood	Very Unlikely	Unlikely	**Likely to occur once or more in life of the Project**	**Likely to occur once or twice per year**	Will likely occurs more than twice per year, or is continuous or certain to occur
	The likelihood of the loss of containment is anticipated to be likely to occur once or more in life of the Project during construction phase.				

Significance of Impact				
	The likelihood of the loss of containment is anticipated to be likely to occur once or twice per year during operation phase.			
Impact Significance	Negligible	**Minor**	**Moderate**	Major
	The combination of minor to moderate consequence level and “likely to occur once or more in life of the Project” to “likely to occur once or twice per year” will result in an overall minor to moderate significance level of impact.			

Mitigation Measures

The following measures will be put in place for the Project during construction and operation phase of the power plant to reduce the impact on the aforementioned receptors:

- Ensure the integrity of wastewater storage unit to avoid leaking of wastewater and odour to the surrounding receptors;
- Use appropriate waste containers and build secondary containment around chemical or waste storage on-site to avoid spillage of waste and leakage of leachate during waste storage on-site;
- Siting of chemical and waste storage should consider nearby receptors, i.e. site away from watercourses or portable water sources;
- Hazardous waste should be stored so as to prevent or control accidental releases to air, soil and water resources. Where practicable:
  - The storage area should be clearly labelled and demarcated;
  - Readily available information on chemical compatibility should be provided to employees, including labelling each container to identify its contents;
  - Hazardous waste should be stored in a manner that prevents the commingling or contact between incompatible wastes and allows for inspection between containers to monitor leaks or spills;
  - Hazardous waste should be stored in closed containers away from direct sunlight, wind and rain;
  - Hazardous waste storage area should be have an impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest waste container; and
  - Hazardous waste storage areas have adequate ventilation, fire prevention system (if needed).
- Spill response and emergency plans should be prepared and implemented to address the potential accidental release of hazardous waste;
- On-site and off-site transportation of waste should be conducted so as to prevent or minimise spills, release and exposures to employees and public;
- Maintenance facilities should be located on hard standing surfaces within a bunded area. Sumps and oil interceptors should be provided. Maintenance of vehicles and equipment involving activities with potential for leakage and spillage should only be undertaken within areas appropriately equipped to control these discharges; and
- Design discharge point to be furthest away from sensitive receptors.

Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **Negligible** to **Minor** Impact.

Monitoring Plan

As specified in the ESMP (***Chapter 12***), monitoring of waste during both the construction and operation phases should consist of the following:

- Conduct regular maintenance on domestic liquid waste treatment system to ensure that the system is functioning efficiently and effluent is achieving targeted quality; and
- Conduct regular testing of effluent water parameters to ensure effluent is within the relevant effluent standards prior releasing it at the discharge location.

9.10 Summary of Impact Significance

This section will provide a summary of the significance of impacts for all physical and social receptors within ***Chapter 9***. The following receptors that will be summarised are listed below:

- ***Section 9.1***: Air Quality;
- ***Section 9.2***: Green House Gas;
- ***Section 9.3***: Noise;
- ***Section 9.4:*** Surface Water;
- ***Section 9.5***: Soil and Groundwater;
- ***Section 9.6***: Waste;
- ***Section 9.7***: Visual;
- ***Section 9.8***: Social; and
- ***Section 9.9***: Unplanned Event.

The significance of impact for all physical and social receptors are summarised in ***Table 9.69***.

Table 9.69: Summary of the Significance of Impact for Physical and Social Receptors

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
Air	Dust soiling	Construction	Minor	Negligible
	Human health	Construction	Minor	Negligible
	Ecology	Construction	Moderate	Negligible
	Dust soiling	Operation	Minor	Negligible
	Human health	Operation	Minor	Negligible
	Ecology	Operation	Moderate	Negligible
GHG	GHG Emissions	Construction	Negligible	Negligible
	GHG Emissions	Operation	Moderate	Moderate
Noise	Transportation	Construction	Minor	Negligible
	Foundation and construction	Construction	Moderate	Negligible
	Pre-commissioning, commissioning and testing	Construction	Minor	Negligible

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
	Operation	Operation	Moderate	Negligible to Minor
Surface Water	Water intake requirement	Construction	Negligible	Negligible
	Water intake requirement	Operation	Negligible	Negligible
	Demineralized plant neutralized water discharge	Operation	Negligible	Negligible
	Cooling water discharge	Operation	Negligible	Negligible
	Sedimentation caused by erosion	Construction	Negligible	Negligible
	Sedimentation caused by piling	Construction	Negligible	Negligible
Soil and Groundwater	Accidental leaks of demineralized plant neutralized water	Operation	Negligible	Negligible
	Accidental leaks of cooling water	Operation	Negligible	Negligible
	Loss of soil due to improper management during site clearance and excavation	Construction	Negligible	Negligible
Waste	Improper biomass management	Construction	Moderate	Minor
	Generation and Management of Hazardous Waste	Construction	Moderate	Minor
	Generation and Management of Hazardous Waste	Operation	Moderate	Minor
	Generation and Management of Non-Hazardous Waste	Construction	Moderate	Minor
	Generation and Management of Non-Hazardous Waste	Operation	Minor	Negligible
	Generation and Management of Domestic Solid Waste	Operation	Minor to Moderate	Negligible
	Generation and Management of Domestic Liquid Waste	Operation	Minor	Negligible
Visual	Construction	Construction	Minor	Negligible

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
	Operation	Operation	Minor	Negligible
Biodiversity	Permanent and Temporary Habitat Loss	N/A	Minor	Negligible
	Temporary disturbance or displace of fauna	N/A	Negligible	Negligible
	Degradation of Habitat	N/A	Negligible to Minor	Negligible
	Mortality of resident species	N/A	Negligible to Minor	Negligible
Social	Employment	Construction	Positive	
	Employment	Operation	Positive	
	Navigation	Construction	Negligible	Negligible
	Traffic and transport	Construction	Negligible	Negligible
	Existing facilities and utilities	Construction	Moderate	Negligible
	Environmental emission	Construction	Minor	Negligible
	Community health and safety	Construction	Moderate	Minor
	Community health and safety	Operation	Negligible	Negligible
	Occupational health and safety	Construction	Moderate	Minor
	Occupational health and safety	Operation	Minor	Minor
	Navigation	Construction	Negligible	Negligible
	Cultural Heritage	Construction	Negligible	Negligible
Unplanned Event	Chemical Spill or Leak	All	Minor	Negligible
	Fire and Explosion	All	Major	Negligible
	Tropical Storm and Extreme Water Conditions	All	Moderate	Minor
	Loss of Containment of Chemical Storage	All	Minor to Moderate	Negligible to Minor

10. BIODIVERSITY IMPACT ASSESSMENT

This Chapter outlines the results of the assessment of impacts to terrestrial and aquatic biodiversity and ecosystem services. Mitigation and management measures have been recommended to align with the requirements for compliance with IFC PS6 (Dated November 2018).

This Chapter also develops management, mitigation and monitoring measures needed to ensure that any identified impacts can be reduced to as low as reasonably practical. Such measures are presented and will form part of the overall Environmental and Social Management Plan (ESMP, ***Chapter 12***) for the Project.

10.1 Assumptions and Limitations

The assessment of potential impacts related to biodiversity and ecosystem services in this section is based on the environmental baseline data (presented within ***Chapter 5***), socioeconomic baseline data (presented within ***Chapter 5***) and the information available from the Project Proponent at the time of writing. Judgements and assessments have been made based on professional knowledge and previous experience of ERM.

10.2 Assessment Methodology

The significance of the impacts has been evaluated using a standardised approach based on ERM's Impact Assessment Standard. This Standard has been determined based on the requirements of IFC PS6. It is based on the relationship between the magnitude of impact and nature of receptor (sensitivity).

The significance of the impacts has been assessed using the approach and methodology as described in ***Chapter 6***. The criteria for sensitivity to and magnitude of the impact to Terrestrial Biodiversity (Habitat & Species) are defined in ***Table 10.1*** to ***Table 10.4***.

Table 10.1: Sensitivity Criteria for Biodiversity - Habitat

Sensitivity	Definition
Low	Habitats with no, or only a local designation/ recognition, habitats of significance for species listed as 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.
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.
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.

Source: ERM, 2012a.

Table 10.2: Magnitude Criteria for Impacts to Biodiversity - Habitat

Magnitude	Definition
Negligible	No existing habitat is affected
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.

Source: ERM, 2012a.

Table 10.3: Sensitivity Criteria for Biodiversity - Species

Sensitivity	Definition
Low	Species and sub-species of LC on the IUCN Red List, or not meeting criteria for medium or high value.
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.
High	Species on IUCN Red List as CR, or EN. Species having a globally restricted range (i.e. 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) of less than 50,000 km^2), internationally important numbers of migratory, congregatory species, key evolutionary species, and species vital to the survival of a high value species.

Source: ERM, 2012a.

Table 10.4: Magnitude Criteria for Impacts to Biodiversity – Species

Magnitude	Definition
Negligible	No species is affected
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).

Source: ERM, 2012a.

10.2.1 Scoping of Likely Impacts to Biodiversity Values

Table 10.5 broadly defines the types of threats to biodiversity values that have potential to occur as a result of this Project. These threats to biodiversity are derived from IFC PS6 and relate to the activities that are likely to occur during construction and post construction phases.

Table 10.5: Types of Threats to Biodiversity Values

Term	Description
Loss of habitat	Permanent loss of habitat or species due to permanent or temporary site activities.
Disturbance or displacement of individuals ■ Light ■ Noise ■ Vibration Impacts	Temporary disturbance to, or displacement/exclusion of a species from foraging habitat due to construction activities, and operational and maintenance activities. Permanent impacts from light, noise and vibration sources on surrounding habitats during operation causing disturbance and displacement and changes in behaviour
Barrier creation, fragmentation and edge effects	Permanent and temporary creation of barriers to the movements of animals, especially fish, but also mammals, reptiles and amphibians and invertebrates and plants with limited powers of dispersal. Fragmentation of habitat, or permanent /temporary severance of wildlife corridors between isolated habitats of importance for biodiversity. Impacts that occur when a habitat is exposed to a different adjacent habitat type or structure. These impacts can include increased risk of parasitism or disease, increased risk of predation, adverse microclimate conditions (including drying out and subsequent fire risk), and competition from invasive species
Degradation of habitat ■ Dust ■ Water Pollution ■ Invasive Species	Disturbance or damage to adjacent habitat and species caused by changes in microclimate, vulnerability to predation and invasion and overall changes in conditions that can lead to a change in the community and its values for flora and fauna. This can include increased exposure to noise, light and dust. Introduction or spreading of alien species during the construction works.
Mortality – vehicle strike, hunting and poaching	Mortality of individual fauna species as a result of vehicle or machinery strike or falling debris during clearing activities. Mortality to individual fauna species as a result of worker influx and hunting/poaching of extant fauna

10.2.2 Biodiversity Impact Typology

The scoping and screening of potential Project impacts identified a number of Project aspects and activities that have potential to biodiversity values. Whilst the potential impacts relate to a combination of Project aspects/activities and biodiversity threats, they can be summarised into a number of key potential impacts according to the biodiversity threat type. These impacts can relate to habitat areas, specific species or both.

These impact assessment types are further explored in relation to the biodiversity values identified within the Project Area and outlined in the physical and biological baseline (***Chapter 5***) and the specific Project activities/aspects.

This section discusses on the nature of impacts to biodiversity values at it relates to the characteristics of the Project Area as determined by assessing the impacts of the Project Description (***Chapter 4***). The information has been used to inform the evaluation of the significance of the impact in the impact assessment summary tables following each impact assessment type. Impact assessments have been undertaken for both the Construction Phase and Operation Phase.

ERM has utilised the mitigation hierarchy to outline avoidance, mitigation and compensation (offset) requirements as required by the IFC PS6. ***Table 10.6*** scopes the impacts likely during the construction, operational and decommissioning phases of the Project. The impact assessment for these impact types are further assessed below.

Table 10.6: Scoping of Potential Impacts during Construction and Operation Phases

Type of Impact	Direct/ Indirect	Operational Phase
Permanent and temporary loss of habitat	Direct	No
Temporary disturbance or displacement of fauna	Direct	Continuing from construction phase
Temporary and permanent barrier creation, fragmentation and edge effects	Indirect	Continuing from construction phase
Temporary degradation of habitat	Indirect	Continuing from construction phase
Mortality – vehicle strike, hunting and poaching	Direct	Reassessed for operational phase

Notes: ***Yes****: considered to be likely impacts during the phase*
No*: considered that there will be no impacts or negligible impacts during the phase*
Continuing from construction/operation phase*: the impact is likely to continue from the operation phase and the mitigations outlined are appropriate to manage impacts during construction and/or operational phase.*
Reassessed for operational phase*: the impact is likely to be different during the phase and hence is reassessed based on the likely impacts. Additional mitigations may be outlined to apply to this phase.*

10.3 Assessment Criteria

10.3.1 Impacts Screened into this assessment

The following impact types have been screened into this impact assessment:

- Permanent and temporary loss of habitat
- Temporary disturbance or displacement of fauna
- Temporary and permanent barrier creation, fragmentation and edge effects
- Temporary degradation of habitat
- Mortality – vehicle strike, hunting and poaching

10.3.2 Permanent and Temporary Habitat Loss

The impacts from the loss of habitat within the Project Area during the construction and operation phase are predominately related to the construction and operation of infrastructure necessary for the Project.

10.3.2.1 Summary of Baseline Conditions

The distribution of habitat within the AoI consists of both Natural Habitat and Modified Habitat. Critical Habitat has been identified for mangrove areas in the intertidal zone. The Project Area consists of Modified Habitats being agriculture and village land classes. The area of Natural Habitat and Modified Habitat within the AoI and Project Area are shown in ***Table 10.7*** below.

Table 10.7: Natural Habitat and Modified Habitat within the AoI and Project Area (LNG Terminal, Pipeline, and Power Plant)

Habitat Type	Project Area (ha)	Habitat Type
Natural Habitat	3.05	1028.16
Modified Habitat	55.73	7457.86

10.3.2.2 Proposed Project activity

Clearing of land for the construction and operation of the power plant and associated facilities will remove vegetation cover available for species within the Project Area.

10.3.2.3 Receptor Identification and Sensitivity

The receptor for habitat loss is Modified Habitats that have a Low sensitivity. No species of conservation significance were identified within Modified Habitats within the Project Area.

Table 10.8: Rating of Impacts on Habitat Loss

Significance of Impact				
Impact	Potential impacts on habitat loss.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts to habitat loss would be considered to be adverse (negative).			
Impact Type	**Direct**	**Indirect**	Induced	
	Potential impacts would likely be indirect and direct impacts.			
Impact	**Temporary**	Short-term	Long-term	**Permanent**

Significance of Impact					
Duration	The clearing of habitats will be both temporary and permanent.				
Impact Extent	**Local**	Regional	International		
	The clearing of habitats will be restricted to the Project Area only (LNG Terminal, Pipeline, and Power Plant).				
Impact Scale	It is anticipated that the impact will be limited to the Project Area during construction and operation. A total of 3.02ha will be cleared during construction and operation. The habitat will be agricultural land classes that are considered to be Modified Habitat. A maximum area of 200 square metres will be impacted that is considered to be natural habitat; however, no mangroves will be cleared.				
Frequency	The event will occur once prior to construction and operation.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be negligible to small.				
Receptor Sensitivity	**Low**	Medium	High		
	The Project Area is considered to be mostly Modified Habitat and hence the sensitivity of the receptor is Low.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The significance is likely to be negligible to minor.				

10.3.2.4 Mitigation / Management Measures

The following mitigation measures should be implemented so as to reduce the significance of the impact:

- Strict rules against clearing vegetation will be imposed on all Project staff, workers, and all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws;
- The Project Proponent shall be directly responsible for dissemination to its staff and workers of all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation, as well as the punishment that can expected if any staff or worker or other person associated with the Project violate rules and regulations;
- The planned clearance area for the construction and operation works shall be clearly identified and marked to avoid accidental clearing;
- Use of the access road should be restricted to construction and operation vehicles only. Checkpoints should be used to manage access.

10.3.2.5 Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance of the impact on Project infrastructure is considered to be a **Negligible** Impact post mitigation

10.3.2.6 Comparison with applicable regulations, standards and guidelines

The applicable standard is the IFC Performance Standard 6. Paragraph 15 of the PS requires clients to apply the mitigation hierarchy to projects (avoid, mitigate and offset impacts to biodiversity values). The Project area is located mostly within Modified Habitat and hence satisfies the requirement to avoid Natural Habitat and Critical Habitat as required by the Mitigation Hierarchy.

10.3.2.7 Monitoring plan

The Construction and operation Contractor, will schedule and implement a routine inspection program throughout construction and operation period to monitor vegetation clearing extent.

10.3.3 Temporary disturbance or displacement of fauna

Disturbance and displacement of species during construction and operation will be primarily caused by light, noise and vibration impacts during construction and operation activities. The use of machinery during day and night time operation will result in increases of light, noise and vibration impacts.

10.3.3.1 Summary of Baseline Conditions

Species detected at the project location include species with a wide distribution and are classified as Least Concern or Not Evaluated according to the IUCN Red List.

10.3.3.2 Proposed Project activity

The use of machinery, human presence and subsequent light, noise and vibration impacts during construction and operation.

10.3.3.3 Receptor Identification and Sensitivity

The Project Area is considered to be Modified Habitat. The sensitivity of the receptor is therefore considered to be High.

Table 10.9: Rating of Impacts on Disturbance and Displacement of Fauna and Flora

Significance of Impact					
Impact	Potential impacts on disturbance and displacement of fauna and flora.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to habitat loss would be considered to be adverse (negative).				
Impact Type	Direct	**Indirect**	Induced		
	Potential impacts would likely be indirect impacts.				
Impact Duration	Temporary	Short-term	Long-term	**Permanent**	
	Only occurs during the construction and operation period.				
Impact Extent	**Local**	Regional	International		
	Impact extent will be within the Project Area and adjacent habitats within the AoI.				
Impact Scale	Disturbance and displacement will be small in scale and limited to areas within the Project Area and adjacent habitats within the AoI				
Frequency	Occurs only once.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The impact magnitude is likely to be Negligible.				
Receptor Sensitivity	**Low**	Medium	High		
	The receptors are Least Concern species so the sensitivity is considered to be Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The significance is likely to be Negligible.				

10.3.3.4 Mitigation / Management Measures

The following mitigation measures should be implemented so as to reduce the significance of the impact:

- Operational vehicles will be maintained in accordance with industry standard to minimise unnecessary noise generation;
- Traffic signs will be maintained on all roads depicting speed limits;
- Access to facilities, including the access road should be restricted to operational vehicles only;
- For operational areas requiring night-time lighting, lights will be used only where necessary and will be directed toward the subject area and away from habitat areas where possible; and
- Commitment will be made to raise awareness of the operator work force regarding flora and fauna values and make arrangements for restriction of hunting and poaching.

10.3.3.5 Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance of the impact on Project infrastructure is considered to be a **Negligible** impact post mitigation

10.3.3.6 Comparison with applicable regulations, standards and guidelines

The applicable standard is the IFC Performance Standard 6. Paragraph 15 of the PS requires clients to apply the mitigation hierarchy to projects (avoid, mitigate and offset impacts to biodiversity values). The Project area is located within Modified Habitat and hence satisfies the requirement to avoid Natural Habitat and Critical Habitat as required by the Mitigation Hierarchy.

10.3.3.7 Monitoring plan

Regular inspections of the application of require mitigation and management measures. No specific monitoring of species or habitats is required.

10.3.4 Degradation of Habitat

A range of Project activities have the potential to lead to degradation of native flora and fauna habitats during operation. These include: blasting, drilling, refuelling, hazardous materials storage and maintenance and transport of construction materials. In general the impacts will cause: dust; runoff; release of potential contaminants; and invasive species. These impacts will occur throughout all Project components; however the majority of impacts will occur within the vicinity of construction site.

During construction and operation, activities have the potential to generate dust which may settle on vegetation adjacent to the operation areas. Excessive dust deposition on flora may act to suppress growth through limiting photosynthesis and the dusted foliage may also become unpalatable to foraging fauna. The construction and operation activities will be temporary and dust generation is likely to be localised to active work areas. Rainfall will generally remove dust from foliage.

Runoff and maintenance of access roads will expose earth areas to be vulnerable to erosion (wind and/or runoff). Runoff erosivity is likely to be higher during the wet season. The maintenance of the access road is located adjacent to a natural watercourse. Erosive processes transport sediment downstream depositing mobilized sediment downstream/downslope of habitats (both aquatic and terrestrial). This indirect impact has potential to degrade downstream habitat areas or change habitat characteristics, and as such influencing suitability for native flora and fauna communities.

Accidental release or spill of these materials can be toxic to flora and fauna locally and downstream if substances are released into the aquatic environment. Flows from quarries and vehicle parking/maintenance areas have the potential to carry contaminants substantial distance downstream. Construction and operation activities such as refuelling, storage and other activities that

require oil and hazardous substances to be used, are undertaken at risk of accidental release. This will be most distinct adjacent to vehicle storage and maintenance areas.

Invasive species (flora and fauna) have the potential to be introduced or spread throughout the Project area through increased movement of people, vehicles, machinery, vegetation and soil. The impacts from the introduction and proliferation of invasive species will be the same as described during construction and operation. Impacts within Natural Habitat areas adjacent to the Project area will be susceptible.

10.3.4.1 Summary of Baseline Conditions

The AoI contains Natural Habitat and Modified Habitat. Invasive species have been identified within the Project Area. These species are shown in ***Table 10.10*** below.

Table 10.10: Invasive species within the Project Area and Area of Influence

S/N	Scientific Name	Common Name	Origin
1	*Ficus religiosa* L.	Bo tree, Lagat, Pipal, Bawdi-nyaung	India/ Native
2	*Mimosa invisa* Martius ex Colla M.pigra M.pudica L.	Senstitive plant, Tigayon	South America. Mexico, Amazon. Tropical America
3	*Alternanthera philoxeroides*	Alligator weed	Temperate South America
4	*Leucaena leucocephala*	white leadtree, jumbay, river tamarind, subabul,white popinac, Bawza-gaing, Awai-yar	Mexico and northern Central America
5	*Eichhornia crassipes*	common water hyacinth	Amazon Basin
6	*Acacia auriculiformis*	Ear-leaf acacia	Papua New Guinea, Indonesia and Australia
7	*Albizia saman*	Rain tree	Central America, northern South America

10.3.4.2 Proposed Project activity

Construction and operation activities causing degradation of habitats from dust, runoff, release of contaminants and invasive species.

10.3.4.3 Receptor Identification and Sensitivity

The Project Area is considered to be Modified Habitat. The sensitivity of the receptor is therefore considered to be Low.

Table 10.11: Rating of Impacts Degradation of Habitats

Significance of Impact			
Impact	Potential impacts on disturbance and displacement of fauna and flora.		
Impact Nature	**Negative**	Positive	Neutral
	Potential impacts to habitat loss would be considered to be adverse (negative).		
Impact Type	Direct	**Indirect**	Induced
	Potential impacts would likely be indirect impacts.		

Significance of Impact					
Impact Duration	Temporary	Short-term	Long-term	**Permanent**	
	Only occurs during the construction and operation period.				
Impact Extent	**Local**	Regional	International		
	Impact extent will be within the Project Area and adjacent habitats within the AoI.				
Impact Scale	Disturbance and displacement will be small in scale and limited to areas within the Project Area and adjacent habitats within the AoI				
Frequency	Occurs only once.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The impact magnitude is likely to be Negligible.				
Receptor Sensitivity	**Low**	Medium	High		
	The receptors are Least Concern species so the sensitivity is considered to be Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The significance is likely to be Negligible.				

10.3.4.4 Mitigation / Management Measures

The following mitigation measures should be implemented so as to reduce the significance of the impact:

- Construction and operation and domestic waste will be appropriately stored and disposed of to avoid attracting native and alien species to the construction and worker camp areas;
- For areas in direct runoff path to a watercourse, sediment and erosion control devices will be installed and maintained until vegetation replanting can occur to stabilise disturbed soil surfaces;
- Oil, chemical and solid waste will be stored, and handled and disposed of by appropriately licenced waste management contractors;
- Invasive species management measures should be implemented in accordance to avoid introduction of weeds to natural and modified habitat areas;
- Speed limits to maximum of 40 km/hr for construction and operation vehicles will be enforced to limit noise and dust generation; and
- Construction and operation materials and chemicals will be appropriately secured to avoid accidental release to the natural environment (wind and water erosion).

10.3.4.5 Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance of the impact on Project infrastructure as a result of flash flood events is considered to be a **Negligible** Impact post mitigation

10.3.4.6 Comparison with applicable regulations, standards and guidelines

The applicable standard is the IFC Performance Standard 6. Paragraph 12 requires the application of appropriate mitigation measures to reduce impacts on biodiversity values. Paragraphs 21 to 23 require the management of invasive alien species within Natural Habitats.

10.3.4.7 Monitoring plan

Regular inspections of the application of require mitigation and management measures. No specific monitoring of species or habitats is required.

10.3.5 Mortality of Resident Species

Mortality of resident species can occur through vehicle and machinery strike as well as hunting and poaching.

Fauna mortality can occur during operation activities (e.g. excavation, vehicle movement) in the event individuals are struck by vehicles and machinery.

It is likely that most individuals will disperse from operation activity locations into adjacent habitats as a result of noise and other disturbance however some less mobile species may experience a localised reduction in abundance during this period, such as amphibians, reptiles and small mammals.

With greater human activity in the Project Area and increased access points to the Natural Habitats there is a risk of increased hunting and poaching activities leading to fauna mortality from workers and also local people who may have access to habitats that were previously restricted. Through increased ease of access, hunting and poaching may increase.

10.3.5.1 Summary of Baseline Conditions

No significant species were detected during baseline surveys.

10.3.5.2 Proposed Project activity

Impacts on resident species during construction and operation, including vehicle machinery strike and hunting and poaching by workers and local people.

10.3.5.3 Receptor Identification and Sensitivity

Threatened species have been identified within the Project Area and AoI.

Table 10.12: Rating of Mortality of Resident Species

Significance of Impact					
Impact	Potential impacts on mortality of resident species				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to fauna and flora would be considered to be adverse (negative).				
Impact Type	Direct	**Indirect**	Induced		
	Potential impacts would likely be indirect impacts.				
Impact Duration	Temporary	Short-term	Long-term	**Permanent**	
	Only occurs during the construction and operation period.				
Impact Extent	**Local**	Regional	International		
	Impact extent will be to resident species within the Project Area and adjacent habitats within the AoI.				
Impact Scale	Fauna mortality will be small in scale and limited to areas within the Project Area and adjacent habitats within the AoI.				
Frequency	Occurs only once.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be negligible to small.				

Significance of Impact				
Receptor Sensitivity	**Low**	Medium	High	
	The presence of modified habitat indicates a Low sensitivity.			
Impact Significance	**Negligible**	**Minor**	Moderate	Major
	The significance is likely to be negligible to minor.			

10.3.5.4 Mitigation / Management Measures

The following mitigation measures should be implemented so as to reduce the significance of the impact:

- Speed limits to maximum of 40 km/hr for construction and operation vehicles will be enforced to minimise potential for fauna strike;
- Commitment will be made to raise awareness of values of important species and habitat areas to construction and operation work force and arrangements will be made for restriction of poaching and forest product collection by staff;
- Access restriction should be applied to Project facilities for non-construction and operation vehicles;
- Hunting wild animals will be strictly prohibited for all staff; and
- Fishing and using of illegal fishing gear anywhere along the stream will be prohibited.

10.3.5.5 Residual Impact (Post-mitigation)

Based on the implementation of the proposed mitigation measures, the significance of the impact on Project infrastructure as a result of flash flood events is considered to be a **Negligible** Impact post mitigation

10.3.5.6 Comparison with applicable regulations, standards and guidelines

The applicable standard is the IFC Performance Standard 6. Paragraph 15 of the PS requires clients to apply the mitigation hierarchy to projects (avoid, mitigate and offset impacts to biodiversity values). The Project area is located within Modified Habitat and hence satisfies the requirement to avoid Natural Habitat and Critical Habitat as required by the Mitigation Hierarchy.

10.3.5.7 Monitoring plan

Regular inspections of the application of require mitigation and management measures. No specific monitoring of species or habitats is required.

10.4 Summary of Impact Significance

This section will provide a summary of the significance of impacts for biodiversity (***Chapter 10***). The following impacts that are summarized are listed below (***Table 10.13***):

Table 10.13: Summary of the Significance of Impact for Biodiversity

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
Biodiversity	Permanent and Temporary Habitat Loss	N/A	Minor	Negligible
	Temporary disturbance or displace of fauna	N/A	Negligible	Negligible
	Degradation of Habitat	N/A	Negligible to Minor	Negligible
	Mortality of resident species	N/A	Negligible to Minor	Negligible

11. CUMULATIVE IMPACT ASSESSMENT

11.1 Introduction

"Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones" (IFC, 2013). The multiple and successive environmental and social impacts caused by existing activities or conditions, combined with the possible incremental impacts that could result from future proposed and/or planned projects, can potentially generate greater cumulative impacts than would be expected in the case of a single project (IFC, 2013). According to the IFC, the assessment and management of cumulative impacts is appropriate when there is concern that a project or activity under consideration could contribute to generating cumulative impacts on one or more valued environmental and social component (VEC) (IFC, 2013).

This chapter presents the cumulative impact assessment (CIA) for the Project conducted to evaluate the potential contribution of the Project towards the cumulative impacts on the resources identified as VECs. Following good international industry practice, this CIA follows the IFC's Good Practice Handbook—Cumulative Impact Assessment and Management: Guidance for Private Sector in Emerging Markets (the "Handbook") (IFC, 2013). The Handbook provides a methodology for identifying the most significant cumulative impacts; the methodology includes a desktop review of publicly available information and consultation with key stakeholders. This methodology focuses on environmental and social components, referred to in the handbook as VECs, which are: (1) rated as "critical" by potential project-affected communities and/or the scientific community; and (2) cumulatively impacted by the project under evaluation, by other projects, and/or by natural environmental and social external drivers (IFC, 2013). The methodology is considered consistent with the IFC Performance Standards (PS), especially PS 1—Assessment and Management of Environmental and Social Risks and Impacts, and PS 6—Biodiversity Conservation and Sustainable Management of Living Natural Resources (IFC, 2012).

11.2 Objective and Scope

The overall objective of this CIA is to identify and assess the contribution by the Project to cumulative impacts in the Project AOI. It is based on information presented throughout prior chapters of this ESIA, information provided by the Project Sponsor, and information available in the public domain. The specific objectives are to:

- Identify VECs that could be impacted cumulatively in areas potentially affected by the Project, considering input from stakeholders through the consultation process and the scientific community;
- Identify other existing and planned projects and external environmental and social drivers that could cumulatively impact VECs;
- Undertake a high-level assessment of potential cumulative impacts on VECs, considering the Project and the other identified existing and planned projects and external drivers in the area; and
- Recommend a management framework for the integrated management of potential cumulative impacts.

11.3 Methodology

11.3.1 Definitions of Key Terminology for the CIA

The following are definitions for key terminology used in the CIA (IFC, 2013).

Cumulative Impact: Impacts that result from the successive, incremental, and/or combined effects of an action, project, or activity added to other existing, planned, and/or reasonably anticipated actions, projects, or activities. For practical reasons, the identification, assessment, and management of cumulative impacts are limited to those effects generally recognized as important on the basis of scientific concern and/or concerns of affected communities.

CIA: Process to identify and evaluate cumulative impacts.

Other Projects: Existing, planned, or reasonably expected future developments, projects and/or activities potentially affecting VECs.

External Drivers: Sources or conditions that could affect or cause physical, biological, or social stress on VECs, such as natural environmental and social drivers, human activities, and external stressors. These can include climate change, population influx, natural disasters, or deforestation, among others. These are typically less defined and planned than Other Projects.

VEC: Environmental and social components considered as important by the scientific community and/or project-affected communities. VECs may include:

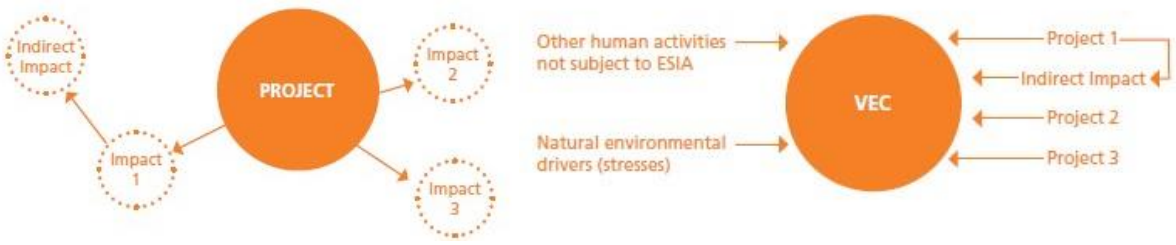
- Physical features, habitats, wildlife populations (e.g., biodiversity, water supply);
- Ecosystem services (e.g., protection from natural hazards, provision of food);
- Natural processes (e.g., water and nutrient cycles, microclimate);
- Social conditions (e.g., community health, economic conditions); and
- Cultural heritage or cultural resources aspects (e.g., archaeological, historic, or traditional sites).

VECs reflect the public and scientific community's "concern" or special interest about environmental, social, cultural, economic, or aesthetic values. VECs are considered the ultimate recipients of cumulative impacts because they tend to be at the ends of ecological pathways.

11.3.2 Overall CIA Approach

Unlike an ESIA, which focuses on a project as a generator of impacts on various environmental and social receptors, a CIA focuses on VECs as the receptors of impacts from different projects and activities (see ***Figure 11.1***). In a CIA, the overall resulting condition of the VEC and its related viability are assessed.

Figure 11.1: Comparing ESIA and CIA



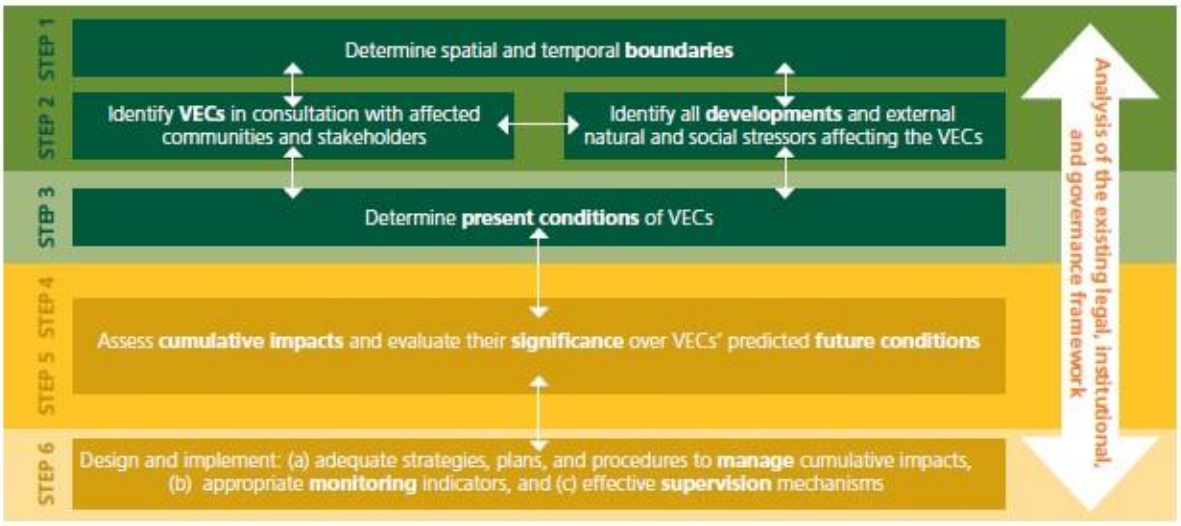
ESIA: Project-Centered Perspective **CIA: VEC-Centered Perspective**

Source: IFC, 2013.

CIA = cumulative impact assessment; ESIA = Environmental and Social Impact Assessment; VEC = valued environmental and social component

This CIA follows the Handbook's six step methodology (see ***Figure 11.2***). The process is iterative and flexible, with some steps having to be revisited in response to the results of others. For example, the VEC selection step usually needs to be adjusted after the potential impacts of the project are identified. The steps are described in detail below.

Figure 11.2: Summary of IFC's Cumulative Impact Assessment Methodology



Source: EFC, 2013.

VEC = valued environmental and social component

11.3.3 Limitations

The Handbook takes into consideration the limitations that a private developer may face carrying out a CIA as part of an ESIA, or difficulties encountered in compiling such information. The limitations applicable to this CIA include: (1) incomplete information about other projects and activities (e.g., the information is not available in the public domain); (2) uncertainty with respect to the implementation of future projects; and (3) difficulty in establishing thresholds or limits of acceptable change for VECs, and therefore the significance of cumulative impacts.

11.3.4 Determination of Spatial and Temporal Boundaries

The spatial boundary of the CIA encompasses the project areas of influence (AOI) which have been delineated in other sections of this ESIA, as shown in ***Table 11.1***.

Table 11.1: Project Areas of Influence

Area of Influence (AOI)	Power Plant	LNG Terminal	Natural Gas Pipeline
Air Quality AOI	10 km radius from the Power Plant facility	5 km radius from the LNG Terminal facility	350 m from each side of the pipeline alignment
Socioeconomic AOI	3 km radius from the Power Plant facility	3 km radius from the LNG Terminal	500 m from each sides of the pipeline alignment

Source: ERM, 2018.

Temporal delimitation for a CIA is frequently a challenge due to the uncertainty inherent to potential future projects and activities. For this reason, good international industry practice suggests consideration of a 3-year temporal boundary when conducting a CIA (IFC, 2013). The CIA used this suggested time horizon for other projects and external drivers due to their uncertainty. As the Project has a greater level of certainty, a 30-year temporal boundary is used with respect to the Project,

considering the construction (28 months) and operations (25 years) stages of the Project. Construction of the Power Plant and LNG Terminal is expected to commence in mid-late 2021.

11.3.5 Identification of VECs, Other Projects, and External Drivers

11.3.5.1 VECs

To be included in a CIA, a VEC must first be confirmed to be valued by some identifiable stakeholder group and/or the scientific community. Second, the VEC must be reasonably expected to be affected by both the project components under evaluation (i.e., the LNG terminal, pipeline and power plant) and some combination of other projects and/or external drivers.

Input from stakeholders has been collected as part of the ESIA stakeholder engagement and consultation process. Engagement activities included interaction with governmental authorities, communities, population groups, and social organizations present in the AOI. The engagement and consultation strategy, a joint knowledge building process, allowed for the progressive identification of risks and impacts, information sharing, and participation during the preparation of the ESIA.

11.3.5.2 Other Projects

Through a thorough review of publicly available information, existing and future planned projects and activities located within the spatial and temporal boundaries of the CIA, having the potential to result in cumulative impacts on identified VECs were identified. ***Section 11.4.1***, Other Projects, describes the identified other projects.

11.3.5.3 External Drivers

Regionally present external drivers and stressors were identified through the ESIA-generated information and publicly available information. ***Section 11.4.2***, External Drivers, describes the identified external drivers.

11.3.6 Description of VEC Conditions

The baseline conditions of the selected VECs were characterized based on the data presented in the environmental and social baseline sections of the current ESIA (see ***Section 11.5.2***, VEC Description). The VEC baselines provide information on the VECs' current conditions and anticipated resilience against external stressors and potential impacts (cumulative impacts and sources of stress) and thus provide an indication of their viability and sustainability.

11.3.7 Assessment of Cumulative Impacts on VECs

CIAs are future-oriented and project contributions are assessed as the difference between the expected future condition of the VEC in the context of all possible known stressors plus the project under evaluation. This step of the CIA assesses the future conditions of the VECs, considering the Project, other projects, and external drivers.

The results of the CIA are presented in tabular format in ***Section 11.6***, Assessment of Cumulative Impacts on VECs. The significance of cumulative impacts is not evaluated in terms of the magnitude of change, but instead in terms of VEC response and the resulting condition and sustainability. If cumulative impacts do not exceed the VEC threshold, the development of the project under assessment is considered acceptable. Given the intrinsic limitations of CIAs carried out by a private developer, (see ***Section 11.3.3***, Limitations), the present study was not intended to obtain sufficient baseline information to establish thresholds of the selected VECs and therefore establish the significance of the cumulative impacts. Instead, based on the current ESIA-generated information and publicly available information, cumulative impacts were categorized by priority using the following definitions:

- **High Priority**: The VEC is expected to be or is currently being adversely impacted by other projects and/or external drivers and the future addition of the Project could incrementally contribute to the potential adverse impact. Actions should be implemented in the short term to mitigate potential adverse cumulative impacts on the VEC.
- **Medium Priority**: The VEC could potentially be impacted by other projects and/or external drivers, and the Project could potentially incrementally contribute to the adverse impact. Actions should be implemented in the medium term to mitigate potential adverse cumulative impacts on the VEC.
- **Low Priority**: The VEC is not expected to be potentially impacted by other projects and/or external drivers, and therefore the Project impacts would not be expected to contribute to an adverse cumulative impact. No actions are required to mitigate potential adverse cumulative impacts on the VEC beyond Project mitigation measures.

11.3.8 Cumulative Impact Management Framework

Internationally recognized good practices for managing cumulative impacts include:

- "Effective application of the mitigation hierarchy (avoid, reduce, and remedy) in the environmental and social management of the specific contributions of a project to expected cumulative impacts; and
- Undertaking best efforts to engage, leverage, and/or contribute in multi-stakeholder collaborative initiatives or discussion groups to implement management measures that are beyond the capacity and responsibility of any individual project developer" (IFC, 2013).

Project design features and management measures included in the current ESIA provide a means to mitigate the specific contributions of the Project to effects on VECs, following the mitigation hierarchy (refer to mitigation measures in ***Chapter 7***, 8, and 9, Impact Assessment; and ***Chapter 12***, Environmental and Social Management Plans). Supplementing these controls and management measures, the CIA provides recommendations for the Project Sponsor to apply in the context of the Project to further manage potential cumulative impacts on the VECs.

11.4 Other Projects and External Drivers

11.4.1 Other Projects

11.4.1.1 Existing Power Plant

There is an existing 120 MW natural gas power plant located within the Project site boundary currently operated and owned by the Project Proponent. The existing CCPP started its operation in April 2013 and is comprised of 2 Combined Cycle Gas Turbine (CCGT) units (121 MW total) The existing CCPP was given a 30-year concession period for Build-Operate-Transfer (BOT) with the Myanmar Electric Power Enterprise; the generated power is supplied to the Hlaingthayar sub-station via a 230 kV overhead transmission line.

11.4.1.2 New Yangon City

Driven by the New Yangon Development Company Ltd (NYDC), the New Yangon City is expected to ultimately occupy a land mass of approximately 680 km^2 to the west and south of Yangon (as shown in ***Figure 11.3***). NYDC aspires to build world-class urban infrastructure (e.g., integrated community hubs, improved public transport, 100% reliable utility services with a focus on renewables, and smart city technology). There are two development phases planned for New Yangon City:

Phase 1: located in a semi-urban to rural area in Seikgyi-Kanaungto, Twante and Kyee-Myin-Daing Townships to the west of Yangon. Covering an area of approximately 90 km2, the master plan for Phase 1 includes the following:

- Infrastructure projects: two bridges 26 km of artery roads, power (a 1x230 kV transformer substation and transformer and distribution lines), water and wastewater systems, and a 13 km^2 industrial zone.
- Social projects and aspects: urban village (resettlement) areas, existing village and settlement areas
- Supporting aspects: green spaces and waterways

Phase 1 development is projected to support the creation of 600-900 thousand jobs in total.

Phase 2: will cover a land area of approximately 600 km^2. Infrastructure improvements to enhance trading connectivity and boost economic opportunities for the Ayeyawady Region. Phase 2 of the New Yangon City project expects to generate 1-1.2 million jobs.

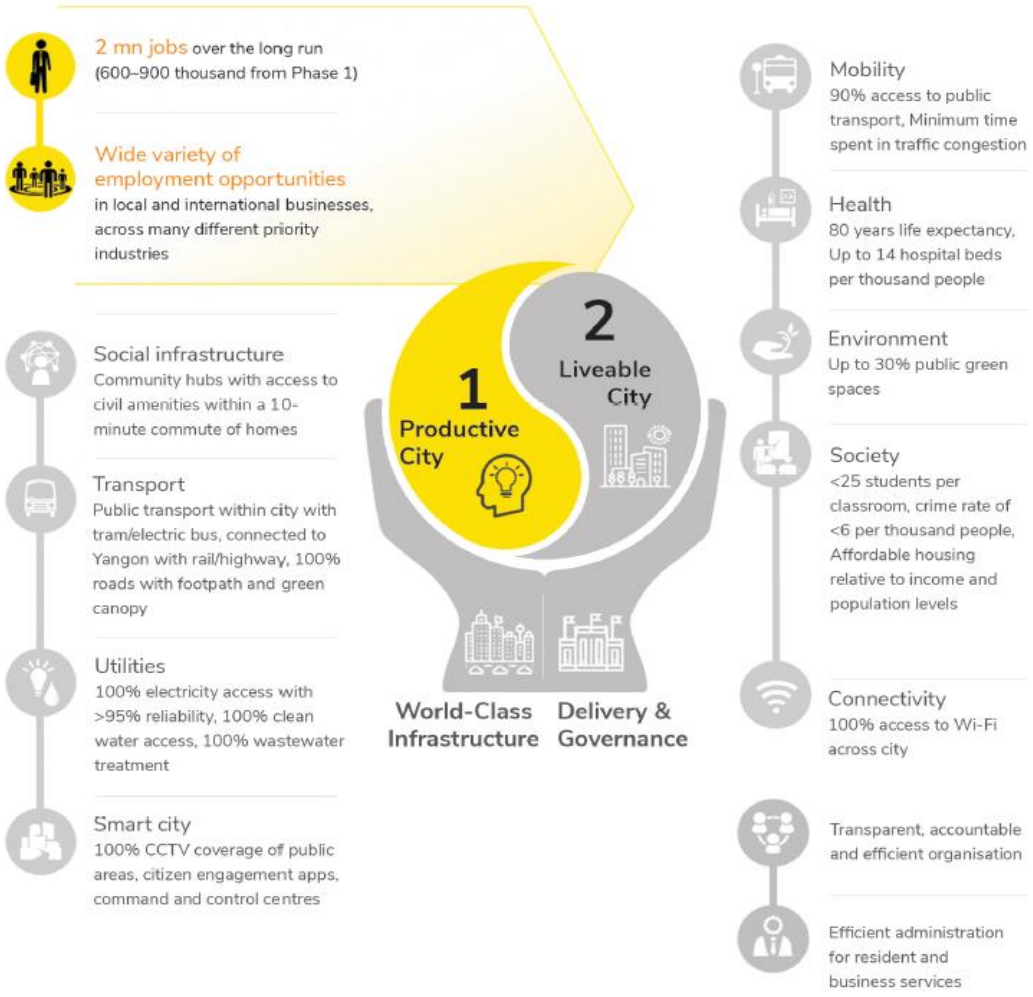
Figure 11.3: New Yangon City Layout

Source: NYDC, 2018.

11.4.1.3 Thilawa Special Economic Zone (SEZ)

The Thilawa SEZ is the first developed according to international standards, located in Kyauktan Township Myanmar. The Thilawa SEZ is developed by a Myanmar-Japan joint venture company with the name of Myanmar Japan Thilawa Development Limited; construction started in November 2013, and became commercially operational in 2015. The Thilawa Multipurpose International Terminal was also constructed to provide logistics for the Thilawa SEZ.

Figure 11.4: New Yangon End State Aspirations



Source: NYDC, 2018.

11.4.2 External Drivers

11.4.2.1 Climate Change

Myanmar ranked second out of 183 countries most affected by extreme weather events between 1995 and 2014 in the Global Climate Risk Index (Kreft, 2016). Recent extreme weather events such as Cyclone Nargis in 2008, riverine flooding in 2015 and extreme heat waves in 2010 have had disastrous impacts on the society, ecology and economy of the country. Climate change threatens to compound the frequency and intensity of these events and, more importantly, to alter the conditions to which human and natural systems have adapted over millennia.

Myanmar's climate is projected to shift dramatically in the coming decades, having a lasting and significant impact on Myanmar's ecosystems and, in turn, on human health, agriculture, food security, infrastructure, local livelihoods and the larger economy. During extreme events in urban areas, failures in one infrastructure system—such as energy, transportation, or water infrastructure—can quickly cause failures in other systems, leading to broad and rapidly emerging crises. (Horton, et al. 2016)

11.4.2.2 Cyclones

An average of 10 tropical cyclones form each year in the Bay of Bengal, of which only 6.4% reach land in Myanmar. Since 1990, the total number of tropical cyclones reaching Myanmar has increased, and there has been a rise in tropical cyclone events occurring just before the monsoon season, while those occurring after the monsoon season have decreased. (Horton, et al. 2016).

Nargis hit Myanmar's Ayeyarwady Delta region on May 2, 2008, and ranks among the world's deadliest cyclones ever to make landfall. An estimated 140,000 people were killed. The storm surge was estimated to be 3 to 4 meters high and reached 50 km upstream from the mouth of the Yangon. Much of the damage to buildings resulted from the very high wind speeds and intense wave action, as well as inland flooding via irrigation channels connected to the main waterways. (Horton, et al. 2016).

11.5 VEC Selection and Description

11.5.1 Selection of VECs

Potentially eligible VECs were analyzed against the following criteria: (1) confirmed to be valued by an identifiable stakeholder group (in the case of local communities, identified by a representative number of communities in the AOI) and/or the scientific community; (2) reasonably expected to be potentially impacted by the Project; and (3) reasonably expected to be potentially impacted by some combination of other projects and/or external drivers. ***Table 11.2*** summarizes the VECs selected for this CIA.

Table 11.2: Selected VECs for Inclusion in CIA

VEC	Valued by Stakeholders or Scientific Community	Potentially Affected by the Project*	Potentially Affected by One or More Other Projects	Potentially Affected by One or More External Drivers
Air quality	Yes	Yes	Yes	Yes
Socioeconomic conditions	Yes	Yes	Yes	Yes
Community health	Yes	Yes	Yes	Yes

CIA = cumulative impact assessment; VEC = valued environmental and social component

Several environmental and social receptors or components were not selected as potentially eligible for the CIA because they were not identified as components of value or concern by stakeholders; not reasonably expected to be significantly impacted by the Project; or not reasonably expected to be potentially impacted by some combination of other projects and/or external drivers. Receptors and components that were not selected due to a residual impact significance rating of **Minor** and below include: surface water, soil and groundwater, visual and biodiversity.

11.5.2 VEC Descriptions

11.5.2.1 Air Quality

A project specific air quality monitoring survey was undertaken and the detailed methodology, results and interpretation is presented in ***Appendix T*** and summarised in ***Chapter 5***. The baseline assessment indicates that the existing ambient concentrations of relevant substances in the study area are below the relevant air quality standards. On this basis, the air shed is considered 'non-degraded'.

The predominant annual wind direction is north easterly, meaning that the wind blows from the Yangon River with speed at 8.8 - 11 meter per seconds. Another predominant wind direction comes from south of the LNG terminal at speed 7 – 11 meter per seconds.

11.5.2.2 Surface Water Quality

A surface water sampling was undertaken and the detailed methodology, results, and interpretation is presented in ***Chapter 5***. Results from baseline sampling of surrounding water bodies, including the Yangon River, showed that, during the dry season, parameters that exceeded the compared local and/or international standards (Myanmar standards, IFC Standards, and EPA Standards) include TSS, TDS, Iron, and Manganese. Parameters that exceeded the local and or international standards during the wet season include TSS, Iron, Mercury, and Manganese. All other parameters were within the compared standards. Temperature readings near the Power Plant during both dry and wet seasons indicate no significant differences between temperature readings located further away. The lowest and highest flow rate range from <500 m^3/s to 7,000 m^3/s.

11.5.2.3 Community Health and Wellbeing

Existing infrastructures and services in the Project SAoI are developed and considered in sufficient number for the local population. In addition, the concrete road network in the Township is well developed. All of interviewees agreed that overall quality and condition of transportation system is good. Dala has the highest percentage of inhabitant using electricity for lighting, but charcoal is used for cooking.

The existing waste network and facility within the Yangon City Development Committee (YCDC) is estimated to have a landfill capacity of 2,064 tonnes per day cumulative over six sites. This amount is considered to be relatively small comparative to the amount of waste generated by Yangon Region. Additionally there are limited number of licensed waste contractors within the region. Further information on landfills and waste generation is presented in ***Section 5.1.10***.

Some poor households use water from the lakes/ ponds within the Dala Township' area, which are filled in the rainy seasons. Dala citizens access to non-drinking water via pond and lake, but Dala interviewees refer purified drinking water, rainwater, well and tap water as alternative sources for non-drinking water. These sources contain sufficient water with good quality. In addition, Dala citizens mostly access drinking water via pool, pond or lake, but majority of Dala interviewees (95%) use rainwater as drinking water. All of them believe that amount of water is sufficient with good quality, but it can becomes insufficient during March, April and May.

According to the noise baseline results all stations in the Project SAoI exceeded the Myanmar standard for at least one time period. Possible sources of high noise levels include traffic activities,

human activities, rain/weather events, religious activities (i.e. bell sound), and agricultural activities (i.e. grain mill). Vibrations are limited to the vehicle traffic on the local roads. Further information on the baseline is presented in ***Section 5.1.4***.

11.5.2.4 Socioeconomic Conditions

Unemployment rate is low in the Yangon region at 4.1% of people in age of working. In Ahlone Township the percentage is only marginally higher at 4.8%. But amongst the people directly affected by the Project (PAP) interviewed during November 2018, 18.7% in Ahlone declare themselves unemployed and 7.7% said they were daily labourer in the agriculture sector. Hence the vulnerability of PAP (Project Affected People) is expected to increase, but also a source of local unskilled labour. Few of the PAP have been exposed to working in an industrial environment on machinery maintenance, welding, mechanic or general construction.

Around 23% of PAP own a business in the retail or trading sector. Some also have a computer (18.8%) or accountant (12.5%) certificate, a driving license (31.3%) or a teacher certification (6.2%).

11.6 Assessment of Cumulative Impacts on VECs

Table 11.3 summarizes the assessment of cumulative impacts for the VECs identified for the CIA. The cumulative impacts discussed consider potential impacts assessed for the Project (for further details see ***Chapters 4***, Project Description, and ***Chapter 7***, 8, and 9, Impact Assessment), other projects (see ***Section 11.4.1***, Other Projects), and external drivers (see ***Section 11.4.2***, External Drivers). Priority ranking is established for each VEC and the estimated cumulative impacts, based on the definition established in Section 1.3.7, Assessment of Cumulative Impacts on VECs.

In summary, **Medium** priority cumulative impacts, where VECs are expected to be adversely impacted by other projects and/or external drivers, and the Project could incrementally contribute to the potential adverse impact, and therefore actions should be implemented in the medium-term, were identified for the following VECs: air quality, community health and wellbeing impacts from waste, noise, and vibration. The other VEC (socioeconomic conditions) is deemed as **Low** priority cumulative impact, where the VEC is not expect to be potentially negatively impacted by other projects and/or external drivers, and therefore the Project impacts would not be expected to contribute to adverse cumulative impacts.

As CIAs are not static and given the level of uncertainty of the potential other projects, it is recommended that future CIA efforts identify and confirm specific and reasonably expected other projects and update the assessment of cumulative impacts accordingly.

Table 11.3: Cumulative Impact Assessment

VEC	Potential Impacts from the Project	Potential Impacts from Other Projects	Potential Impacts from External Drivers	Cumulative Impact	Significance
Air quality	**Construction Phase**: generation of total suspended particulate (TSP) and particulate matter (PM10). Dust can be generated through vegetation clearing, site grading, driving on dry, dirt roads, resulting in a negligible impact to local houses. **Operation Phase**: Project related NO_2 emissions are expected to be below relevant air quality standards throughout the study area.	**New Yangon City Project** *Construction Phase:* generation of dust; *Operation Phase*: emissions from vehicles, heavy machinery and generators. **Existing 120 MW Power Plant** *Operation Phase:* generation of NO_2 emissions from natural gas combustion. **Thilawa SEZ** *Operation Phase:* generation of emissions from manufacturing and cargo vessels.	Increased urbanization, vehicle use and industrial expansion are likely to have negative impacts to air quality in the study area. Climate change can also increase ground-level ozone and/or particulate matter air pollution.	Diminished air quality from an increase in NO_2, TSP, and PM_{10}. Over time, these cumulative impacts could affect: community health (e.g. further aggravating existing respiratory illnesses), the amenity value of an area, and sensitive ecological receptors.	**Medium**
Surface Water Quality	**Construction Phase**: During construction, exposure of soil will cause soil erosion which results in sedimentation of nearby water sources. This causes increase in total suspended solids (TSS). **Operation Phase**: During operation, thermal discharge will cause temperatures at the discharge point to be higher that normal conditions temporarily.	**Existing 120 MW Power Plant** *Operation Phase:* thermal discharge will cause temperatures at the discharge point to be higher that normal conditions temporarily. **Thilawa SEZ** *Operation Phase:* discharge of wastewater from manufacturing and cargo vessels.	Increased urbanization, industrial expansion, and dredging are likely to have negative impacts to surface water quality in the study area. Climate change can also cause water temperature variations.	Reduced surface water quality from sedimentation. Cumulatively, thermal discharge from the existing Power Plant and the proposed Power Plant will increase temperatures temporarily.	**Medium**
Socioeconomic conditions	**Construction Phase**: During construction, the workforce will	**New Yangon City Project** *Construction Phase:* relocation	Any risks that climate change poses to critical infrastructure	Increased employment and increased demand for goods	**Low**

VEC	Potential Impacts from the Project	Potential Impacts from Other Projects	Potential Impacts from External Drivers	Cumulative Impact	Significance
	reach 400 workers on average and 600 at peak. These will comprise of more than half of local workers which should limit the additional burden on local infrastructures and services. **Operation Phase**: During 25 years of operation, the Project will generate mainly skilled jobs and a limited number of unskilled jobs. It is expected that approximately 171 staff will work on the operational phase of the Project.	of Urban Village and loss of farmland. Employment generation and increased economic activities. *Operation Phase*: increase in access and connectivity, job creation for the local people.	systems in Myanmar, such as energy, transportation, buildings, water supply and wastewater, and telecommunications also pose a direct risk to livelihoods that depend on them.	and services. Local infrastructure and services are not expected to be significantly impacted upon by the Project. The New Yangon City Project is expected to improve upon	
Community health and wellbeing: waste	**Construction and Operation Phases**: Potential impacts due to improper management of removed biomass (biomass waste). Some of the impacts may be related to contamination of soil quality, surface water and groundwater from direct burying of biomass waste Impacts from generation and management of hazardous waste by increasing the stress put the existing waste network.	**New Yangon City Project** Construction and Operation phases: generation of non-hazardous and hazardous wastes.	Climate change risks can impact solid waste facilities both directly and indirectly. Higher temperatures may directly alter decomposition rates. Flooding also poses significant threats to solid waste infrastructure.	Cumulatively, these projects and external stressors would put additional stress on the existing waste network and facility within the Yangon City Development Committee, thereby reducing the capacity and capability of the existing network. Large quantities of removed biomass could affect soil and water quality, as well as generate odour that could impact local communities' wellbeing.	**Medium**
Community	**Construction and Operation**	New Yangon City Project	Increased urbanization, vehicle	Noise can lead to hearing	**Medium**

VEC	Potential Impacts from the Project	Potential Impacts from Other Projects	Potential Impacts from External Drivers	Cumulative Impact	Significance
health and wellbeing: noise and vibration	**Phases**: Noise can result from a variety of onsite activities (e.g. construction of infrastructure, reversing sensors on large vehicles). Vibrations can result from construction activities (e.g. piling, drilling, operation of compressors and generators).	*Construction Phase*: noise from mechanical equipment (excavators, bulldozers, generators, trucks, etc). *Operation Phase*: increased noise from use of the bridges and roads	use and industrial expansion are likely to result in increased noise pollution in the study area.	loss and disrupt community activities (such as sleep). If the vibrations are strong enough, it can damage the foundation of nearby infrastructure (e.g. businesses, community centers, and monasteries).	

11.7 Cumulative Impacts Management

Effective application of the mitigation hierarchy (avoid, reduce, and remedy) to manage individual contributions of cumulative impacts is recommended as best practice. The project Sponsor has incorporated Project design features that include physical or procedural controls to avoid and reduce possible impacts that are planned as part of the Project (see ***Chapters 4***, Project Description, for their description). These are considered from the very start of the impact assessment process as part of the Project, and are factored into the pre-mitigation impact significance ratings. In addition, a number of mitigation measures have been proposed to address potential impacts from the Project. These are presented in the Environmental and Social Management Plan (see ***Chapter 12***, Environmental and Social Management Plans) and considered in the residual significance impact ratings.

At the Project level, the above measures are considered sufficient to address the contributions of the Project to cumulative impacts.

Ultimately, the management of cumulative impacts is the responsibility of government and regional planners. However, it is considered best international practice that private-sector developers make best efforts to engage relevant stakeholders and promote management of cumulative impacts in their project areas (IFC, 2013; Franks et al., 2010).

The Project Sponsor could foster such collaboration by participating, to the extent feasible and practicable, in working groups and/or government initiatives aimed at addressing management of potential impacts on regional resources to which the Project could incrementally contribute with respect to cumulative impacts.

12. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Through a systematic assessment, the ESIA has identified a number of significant environmental and social impacts that may potentially result from the construction and operation of the Project. In order to manage and mitigate these impacts, a range of measures have been developed to reduce the overall residual impacts to acceptable levels and as low as reasonably practicable. Implementing and tracking the effect of these management and mitigation measures is an essential element to ensuring that the assessed residual impact levels are confirmed.

12.1 Objectives

The key objectives of this Environmental and Social Management Plan (ESMP) are to:

- Collate the various mitigation and management measures developed throughout the ESIA into a single point;
- Identify all of the detailed management plans which will need to be developed for implementation throughout the various phases of the Project;
- Define monitoring requirements to determine the efficacy of all mitigation and management measures; and
- Provide clarity to all stakeholders as to what impacts have been identified, how they will be mitigated and managed, and through what means.

12.2 Scope of this ESMP

The scope of this ESMP covers both construction and operation phases of the Project, which have the potential to affect, positively or negatively, the environment and communities in which the Project Proponent and/or its contractors/sub-contractors will operate.

For decommissioning, the detailed mitigation measures will be determined at later stage when the future of the infrastructures is known. In addition, a Decommissioning Management Plan framework will be developed.

As required by this ESMP, a range of detailed management plans will be developed and implemented for each specific phase of the Project. The responsibility for the implementation of these plans will lay variously with the Project Proponent, contractors and sub-contractors. It is noted that this is only a framework ESMP into which the full range of management and monitoring activities will eventually fit into.

In addition, it is to be noted that environmental, social and governance (ESG) considerations are embedded in the Project Proponent's business decisions and processes. The ESMP for the Project will also align with TTCL Code of Conduct and HSE Goal and Objectives of the Project Proponent, which are presented in ***Box 12.1*** and ***Box 12.2***, respectively. The Project will also follow these policies and specific actions will be planned to align with them.

Box 12.1: Sustainability Policy of the Project Proponent

1. Comply with laws and regulations of the countries of business operation and with internal corporate rules, with the highest standards of honesty, integrity and fairness.
   - We realize and comply with applicable laws, regulations and the highest ethical standards in performing our global business to achieve our customer's satisfaction and our own continued growth.
   - We observe internal corporate rules and maintain good communication with supervisors and co-workers to achieve corporate success.
   - We uphold the highest ethical standards to enhance the social trust which is essential to achieve our business goals.
2. Respect humanity of the people in the world, free from discrimination and harassment.
   - We realize and respect the history, culture and customs of each country in which we operate.
   - We respect human rights and refrain from discrimination by race, religion, creed, gender, social status, nationality, age, disability, etc.
   - We maintain a work environment that is free from discrimination and harassment. Great care is taken not to cause recourse to legal proceeding as a consequence of discrimination, harassment, abuse of power, etc.
3. Comply with international arrangements governing global business operations.
   - We realize and comply with international agreements pertinent to our global operations including, inter alia, export and import regulations and tax laws.
   - We recognize the differences in business practices and legal structures in each country in which we operate and conduct our business with the highest standards of integrity and ethics.
4. Comply with international treaties and laws and regulations for environmental conservation and protection, and place the highest priority on health, safety, security and environment.
   - We recognize that environmental conservation is given high priority in the 21st Century. We endeavor to minimize the environmental impact from our global engineering business and aim to harmonize industrial and economic development with environmental conservation.
   - We shall endeavor to develop technologies and products that contribute to environmental conservation.
   - We are committed to the standards of quality, health, safety and security that are essential for TTCL to be recognized as a socially reliable company.
5. Respect intellectual properties, patented or otherwise, of customers, partners and others and protect those of TTCL.
   - We recognize the value of confidential and proprietary information of TTCL. We protect such information in accordance with our Information Security Policy.
   - We shall not divulge confidential information of TTCL to any third parties. We shall not use confidential and proprietary information for personal interests or any purposes against the interests of TTCL.
   - We treat the intellectual property as well as confidential and proprietary information of our customers, partners and other with the greatest care in accordance with applicable laws and regulations.
6. Do not commit unfair business transactions such as insider trading of stocks, in compliance with laws and regulations of the countries of business operation.
   - In the event we obtain confidential information relating to TTCL, our customers or partners, both domestic and abroad, we shall not trade stocks/shares/securities of the entity to which the confidential information relates, (insider trading) until such information becomes the public domain.
7. Keep accurate, complete and timely financial and accounting records, in compliance with laws and regulations of the countries of business operation.
   - We keep accurate, complete and timely financial accounting records. Fraudulent or

misleading records are strictly prohibited.
- We disclose our corporate information on a timely basis in accordance with applicable laws and regulations to protect investors.

8. Do not stand against the overall interests of TTCL, and with the highest standards of ethics draw a line between public and private.
   - We do not act against the interest of TTCL for the purpose of pursuing personal or and third party's interests.
   - We place the highest priority to the continued growth of TTCL and to our contribute to the societies. We shall not put private interests ahead of the interests of TTCL.
9. Comply with laws and regulations of countries of business operation in dealing with customers, partners and stakeholders, and observe the highest standards of ethics in conducting business anywhere in the world.
   - We observe the highest ethical standards and the applicable laws and regulations that prohibit offering benefits, including, inter alia, money, gifts, meals and entertainment to any government officials or any other persons who have similar capacities.
   - We observe the highest ethical standards and shall not offer excessive benefits including, inter alia, money, gifts, meals and entertainment to our customers, partners and stakeholders that are beyond ethical business practice
   - We shall not accept any benefits from our customers, partners and stakeholders that are beyond ethical business practice or may impair the interests of TTCL.
10. Oppose resolutely any antisocial influences and do not submit to their demands.
    - We resolutely oppose any unlawful or unethical practices, for example corporate racketeering, and shall not make unlawful or unethical settlements, financial or otherwise, as a consequence of such practices.
11. Report immediately and in good faith to the upper management level of any known or suspected violation of this Code of Conduct.
    - All the Personnel have a duty to report, immediately and in good faith, any known or suspected violation of this Code of Conduct to the upper management level.
    - We are responsible for cooperating in the fact-finding investigation related to the reported violation.
    - In the event that a serious violation is proven, the offender and his or her supervisor may be subject to disciplinary action.
    - It is the responsibility of the management of TTCL to ensure that no retaliation of any kind shall be taken against those Personnel who reported a violation or cooperated, in good faith, with the fact-finding investigation.

Source: TTCL, 2019.

Box 12.2: Health, Safety and Environment Goal and Objectives

LNG Power Plant (Ahlone) Project HSE Goal is to maintain an injury free workplace with minimal adverse impact of the environment. Prevent community and promote resource conservation associate with project execution.

The project HSE objectives are established followings;

1. TTCL shall carry out project management and construction management activities in compliance with the applicable legal and other HSE requirements as specified in the contract.
2. TTCL shall perform and manage construction work in safe manner to achieve the safety target of “No Lost time Accident”
3. Project incidence rates should not exceed the following value;
   a. IFR (Incidence frequency rates), 3.7
   b. ISR Incidence severity rates), 37
4. TTCL shall perform construction work by taking into account for the Environmental impact protection and complaint from the community shall be “Zero”.

Source: TPMC, 2018.

12.3 Summary of Impacts and Mitigation / Management Measures

Key environmental and social impacts have been identified and reported in the following sections of ***Chapter 7***, 8, and 9:

- Air Quality;
- Noise;
- Surface Water Quality;
- Soil and Groundwater;
- Landscape and Visual;
- Greenhouse Gas;
- Biodiversity;
- Social and Health;
- Waste; and
- Unplanned Events;

Chapter 11 on Cumulative Impacts also identify key environmental and social impacts.

A summary of mitigation measures identified for the construction and operation phases of the Project are presented in ***Table 12.2*** for the LNG Terminal ***Table 12.3*** for the Natural Gas Pipeline and ***Table 12.4*** for the LNG Power Plant. 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. 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.

The construction phase of the Project is anticipated to be completed in the region within 30 months, whereas the operation phase of the Project is 25 years, as per the Power Purchase Agreement.

The Project Proponent will be responsible for ensuring that the mitigation measures in the ESMP are implemented throughout the life span of the Project.

12.4 Detailed Management Plan

Based upon the outcomes of the ESIA, detailed management plans are required to guide the Project Proponent and its contractors in the implementation of all mitigation and management measures. This is essential to ensure that the key outcomes of the impact assessment process are put in place throughout the life of the Project, and their overall efficacy tracked. These detailed management plans will include all the mitigation measures included in this ESMP chapter and will be leveraged by EPC contractors in developing their own management plans. The management plans to be prepared are the Project Proponent and its Contactors commitment to the mitigation and management measures.

As identified with the summary of impacts and mitigation and management measures, the detailed management plans listed in ***Table 12.1*** are considered necessary to effectively implement the outcomes of the ESIA throughout the life of the Project:

Table 12.1: Management Plan Index

No.	Document Title	Merge Document	Doc. No.
1	Air Quality Management Plan	Environmental Control and Management Plan	F050-MNL-024
	Dust Management Plan		
	Marine Safety Managmement Plan		
	Noise and Vibration Management Plan		
	Surface water Management Plan		
	Soil and Groundwater Management Plan		
	Biodiversity Action Plan		
2	Waste Management Plan (Hazardous Waste)	Waste Management Plan	F050-MNL-026
	Waste Management Plan (Non Hazardous Waste)		
	Recycling Plan		
3	Worker Occupational Health and Safety Management Plan	HSE Plan Procedure	F050-MNL-028
	Worker Training Plan (including Induction Training Program)		
4	Oil and Chemical Spill Contingency Management Plan	Project Incident and Emergency Response Plan	F050-MNL-030
	Emergency Response Plan (including Community Emergency Response Plan)		
	Evacuation Plan		
5	Site Safety Rules and Regulation Procedure		F050-MNL-059
6	Security Plan and Decommissioning Management Plan Framework		F050-MNL-083
7	Traffic Management Plan		F050-MNL-084
8	Community Health Management Plan		F050-MNL-085
9	Fire Prevention Plan		F050-MNL-086
10	Typhoon Response Plan and Typhoon Evacuation Plan		F050-MNL-092

11	Worker's Accommodation Management plan	F050-MNL-093
12	Cultural Heritage Chance Find Procedure	F050-MNL-094
13	Community Development Plan	-

Source: TPMC, 2020.

It is intended that these documents will be prepared by EPC Contractor prior commencing the construction work, to cover the site clearance and construction phase of the Project. Prior to operation commencing documents will be developed to cover the operation phase and when details are known for decommissioning, Decommissioning Management Plan Framework will be developed.

Specific plans will be disclosed to stakeholders at the appropriate time.

It is to be noted that commitments and framework for the implementation of Emergency Response Plan (ERP) and Stakeholder Engagement Plan (SEP) (***Appendix V***), including Grievance Management Plan, have been disclosed to the relevant stakeholders during the public consultation during May 2019.

12.5 Environmental and Social Monitoring Program

Monitoring is a means of verifying overall effectiveness of the management and mitigation measures contained within the management plans listed above. Key objectives of the monitoring process are to:

- Confirm effectiveness of management and mitigation measures;
- Ensure compliance with Applicable Standards (Myanmar NEQ, IFC Performance Standards and IFC EHS Guidelines) and the Project Proponent's objectives;
- Monitoring the status of, and impacts on, identified sensitive receptors;
- Provide an early warning that any of the control measures or practices are failing to achieve their desired performance and ensure changes can be implemented to remedy these practices;
- Determine whether environmental and social changes are attributable to Project activities, or as a result of other activities or natural variation; and
- Provide a basis for continual review and improvements to Project design and execution.

12.5.1 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 12.5*** for the LNG Terminal, ***Table 12.6*** for the Natural Gas Pipeline and ***Table 12.7*** for the LNG Power Plant.

This includes the tentative parameters to be measured, methods to be utilised, sampling locations, frequency of measurements, detection limits, cost and responsibilities for implementation and supervision.

However, it is to be noted that the detailed and specific monitoring measures will be developed and included within the relevant management plans. The monitoring components of the various management plans will be refined and finalised during plan development.

Impact monitoring will be undertaken during the life of the Project to verify the predicted levels of residual impacts from the Project and the effectiveness of the various management plans.

12.5.2 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.

Prior to the commencement of the construction activities, the Project Proponent will finalise the format and frequency for reporting on the status and progress of environmental and social monitoring.

During construction and operation phases, it is recommended that the report shall be submitted to the relevant authorities and funding agencies on a regular basis. Frequency will be agreed with relevant authorities and funding agencies.

However, it is recommended that the Project Proponent shall submit the report to the relevant authorities and funding agencies on six-monthly basis during construction and on annually basis during operation.

The format will be designed to meet all the compliance conditions associated with the local and international requirements. The contractor will be required to submit the duly filled up reporting form on the agreed frequency to the Project Proponent.

12.5.2.1 Mitigation Measures for the LNG Terminal

Table 12.2: Environmental and Social Management Plans for the LNG Terminal

S. No.	Affected Resource/ Receptor	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
A	**Site Preparation and Construction Phase**							
1.1	Air Quality	Construction activities	Dust emissions from Project activities have the potential to impact to air quality, human health, and ecology.	■ Develop and Implement a Dust Management Plan (DMP) detailing mitigation measures and a plan for implementation. ■ Watering will be used to suppress wind and physical disturbance dust generation. ■ Ensure an adequate water supply on site for effective dust suppression and mitigation. ■ The site layout will be planned so that dust-causing activities are located away from receptors as far as is possible. ■ Screens or barriers will be erected around dusty activities or the site boundary that are at least the height of any stockpile on site. ■ All stockpiles will be covered or fenced off to prevent wind whipping. ■ Only cutting, grinding, or sawing equipment fitted with suitable dust suppression techniques such as water sprays will be used. ■ All chutes, conveyors and skips will be covered at all times. ■ Drop heights from conveyors, loading shovels and hoppers will be minimised. ■ No waste will be burned on site. ■ Re-vegetate earthwork and exposed areas as soon as is practicable. ■ Use hessian, mulches or trackifiers where it is not possible to revegetate, or cover with top soil as soon as is practicable. ■ Sand and other aggregates will be stored in bunded areas and will not be allowed to dry out unless this is required for a particular process, in which case additional control measures such as those detailed in this section will be applied. ■ Ensure that all vehicles entering and leaving the site are covered to avoid fugitive emissions during transport. ■ Inspect on-site haul roads for integrity and instigate the necessary repairs to the surfaces as soon as reasonable practicable. ■ Implement a wheel washing system. ■ Regularly dampen and clean the site access and local roads to remove any materials tracked out of the site. ■ All site access gates will be located at least 10m away from air sensitive receptors where possible. ■ The site layout will be planned so that machinery is located away from receptors as far as is possible. ■ All vehicles will switch off engines when stationary. ■ A regular vehicle and machinery maintenance and repair programme will be implemented. ■ Mains electricity or battery powered equipment will be used instead of diesel/petrol generators where practicable.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Regular site inspections to monitor compliance with DMP. Daily onsite and offsite inspection.	EPC Contractor Cost
1.2	Greenhouse gas	Use of onsite vehicles and heavy machineries for construction have the potential to increase greenhouse gas emissions	Impact on climatic condition due to GHG emissions.	■ Implement the same mitigation measures to minimize impacts to Air Quality (***No 1.1***). ■ Develop and implement preventive maintenance plan for machines, and engines to ensure combustion efficiency. ■ Develop vehicle and machine maintenance plan.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly report to the Project Proponent	EPC Contractor Cost
1.3	Noise level	Transportation and operation of workers, equipment and materials.	Impacts to noise sensitive receivers (NSRs) due to noise emission	■ Schedule transportation of materials evenly throughout the day (to minimize accumulative noise impact from multiple noise sources); ■ Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components should be conducted; ■ Avoid transportation of materials on- and off-site through existing community areas. ■ Workers operating near loud equipment/machines will wear appropriate PPE equipment.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly monitoring conducted at the representative NSRs by EPC contractor throughout the construction	EPC Contractor Cost
	Noise level	Foundation work and	Impacts to noise	■ Noise barriers should be installed at the site boundary (facing the villages) and high enough which	Appointed EPC	On site Project	Monthly monitoring	EPC

S. No.	Affected Resource/ Receptor	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
		civil constructions	sensitive receivers (NSRs) due to noise emission	completely hides the noise sources from the NSR. It is anticipated that at least a 10 dB(A) noise reduction can be provided[155]. The noise barrier material should have a superficial surface density of at least 7 kg/m^{-2} and have no openings or gaps; ■ Well-maintained equipment to be operated on-site; ■ Normal working hours of the contractor should be between 07:00 and 22:00 hours from Monday to Saturday (except holiday). If work needs to be undertaken outside these hours, it should be limited to activities that do not lead to exceedance of noise criteria at nearby NSRs and avoid early morning and night time construction; ■ Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components; ■ Shut down or throttled down between work periods for machines and construction plant items (e.g. trucks) that may be in intermittent use ; ■ Reduce the number of equipment operating simultaneously as far as practicable; ■ Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable; ■ Locate noisy plant (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable; ■ Avoid transportation of materials on- and off-site through existing community areas; and ■ Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site construction activities.	Contractor	Management team and designated EHS team	conducted at the representative NSRs by EPC contractor throughout the construction	Contractor Cost
1.4	Surface Water	Water Intake Requirements during construction phase	Impact to surface water	■ Ensure wate intake does not exceed the flow rates of the Yangon River.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly monitoring of Water intake and flow rates in the Yangon River	EPC Contractor Cost
	Surface Water	Sedimentation caused by soil erosion during construction activities	Impact to surface water through sedimentation from soil erosion and pilling activities	■ Install silt trap to treat surface run-off from bunded areas prior to discharge to the stormwater system; ■ Exposed soil surfaces should be protected by paving or fill material as soon as possible to reduce the potential of soil erosion and subsequent sedimentation; ■ Use methods for minimising sediment runoff, as appropriate to the conditions on-site, including: wheel cleaning facilities, sand bag barriers, mulching, and re-vegetation, protect temporary trafficked areas on-site with coarse stone ballast or equivalent, open stockpiles of construction materials or construction wastes on-site should be covered with tarpaulin or similar fabric during rainstorms; ■ Regularly, and particularly following rainstorms, inspect and maintain drainage systems and erosion control and silt removal facilities to ensure proper and efficient operation at all times; and ■ Surface run-off from bunded areas should pass through oil/water separators prior to discharge to the storm water system.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Continuous monitoring of excavated soil for potential pathways of soil erosion. Monthly monitoring surface water quality	EPC Contractor Cost
	Surface Water	Sedimentation caused by piling activities	Impact to surface water through sedimentation from soil erosion and pilling activities	■ Evenly spread out the scheduling of piling activities to reduce the potential amount of sedimentation caused during one pilling session.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly monitoring surface water quality after piling activities	EPC Contractor Cost
1.5	Soil and Groundwater	Improper management during site clearance and excavation activities can lead to loss of soil.	Impact to soil and groundwater due to improper management of soil	■ Delineation of clearance boundaries to limit the areas to be cleared; ■ Scheduling clearance activities (if possible) to avoid extreme weather events such as heavy rainfall, extreme dry and high winds; ■ Revegetation areas with temporary land use, conducting progressive rehabilitation; ■ Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers; ■ Reuse topsoil as much as possible within rehabilitation activities; ■ Control erosion through diversion drains, sediment fences, and sediment retention basins; and ■ Where topsoil is to be stored for later use in rehabilitation activities, the following basic principles are to be applied: – Stockpiles to be separated into topsoil and sub-soil and be located at least 50m from any surface water	Appointed EPC Contractor	On site Project Management team and designated EHS team	Conduct monthly site audit	EPC Contractor Cost

[155] https://www.fhwa.dot.gov/Environment/noise/noise_barriers/design_construction/keepdown.cfm

S. No.	Affected Resource/ Receptor	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				source or groundwater well; – To the extent possible, stockpiles are to be located in areas surrounded by natural wind barriers to minimise the potential for wind erosion; – Stockpile storage areas are to be prepared in advance of the removal of topsoil as much as possible; and – Topsoil heights are to be restricted in height to 2m above ground level to minimise wind erosion, and they are only to be partially compacted on the upper layer in order to promote aeration, maintain soil vertical structures, reduce runoff and encourage infiltration.				
1.6	Waste	Improper management of biomass waste during construction phase	Impact to soil, groundwater, surface water, biodiversity and human receptors	■ Any biomass not taken by the local community is to be appropriately stored (or immediately mulched) for later use within site stabilisation and rehabilitation activities; ■ Site clearance and preparation is to be designed and conducted in a manner that requires minimum removal of vegetation; ■ Introduce and implement, where practicable, a recycling plan for biomass waste to reduce the amount of biomass required to be burnt. This may include identifying potential market or appropriate industry to reintroduce the biomass as part of their resource consumption; ■ Ensure no hazardous materials or chemicals are present within the biomass waste (for example due to an accidental spill) prior to burying; and ■ Location of burying are to be far away from sensitive receptors and in a location where impact of burying can be appropriately controlled.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monitoring of waste segregation, transportation and disposal practices. Monitoring of appointed waste contractors using COC documentation.	EPC Contractor Cost
	Waste	Generation and management of hazardous waste during construction	Impact to soil, groundwater, surface water, biodiversity and human receptors	■ Prior to construction commencing, TPMC is to engage with local authorities and other stakeholders to determine the capacity of the local waste management network to absorb the new waste streams generated from the Project during construction; ■ A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project construction. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified; ■ Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable; ■ Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the construction site; ■ Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed. All end points for collected waste are to be inspected and audited and noted to be developed such that all waste is able to be disposed of in an environmental responsible manner and in accordance with all prevailing IFC requirements; ■ Monitoring of appointed waste contractors using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; ■ The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during construction activity is being managed responsibly; and ■ Effluent from chemical cleaning of the equipment during the pre-commissioning phase will be collected in an appropriate drainage system and transported off-site to a licensed Hazardous Waste Treatment Facility. The capacity of this facility will be assessed to ensure that it is capable of managing the Project's wastewater volumes.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monitoring of waste segregation, transportation and disposal practices. Monitoring of appointed waste contractors using COC documentation.	EPC Contractor Cost
	Waste	Generation and management of non-hazardous waste during construction	Impact to soil, groundwater, surface water, biodiversity and human receptors	■ A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project construction. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified; ■ Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable; ■ Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations; ■ Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed; ■ Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and ■ The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monitoring pf waste segregation, transportation and disposal practices. Monitoring of appointed waste contractors using COC documentation.	EPC Contractor Cost

S. No.	Affected Resource/ Receptor	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				boundary transport of waste. This is to ensure that waste management during construction activity is being managed responsibly.				
1.7	Visual Impact	Earthworks, light emissions, disturbance and physical presence of new facilities	Impact to local communities around LNG terminal	■ Provide soft landscaping (i.e. tree, low shrub and ground cover planting) within available space within the Project Site. Plant as soon as practical during construction phase; ■ Minimize the extent of construction areas, including for dredging and including temporarily affected areas; ■ Minimize clearing of vegetation as far as practical. Existing large trees (if any) should be retained as far as practical. Those that fall outside the earthworks area must be retained. Felled trees should be compensated for where possible; ■ Reinstatement of temporarily affected areas which will no longer be required for the operational stage (e.g. contractor camp, laydown areas, etc.), to suitable pre-construction condition as soon as practical after use (e.g. using landscaping with suitable vegetation).	Appointed EPC Contractor	On site Project Management team and designated EHS team	Not Required	EPC Contractor Cost
1.8	Biodiversity	Construction Activities	Impacts to biodiversity values (habitats and species) due to permanent and temporary habitat loss	■ Strict rules against clearing vegetation will be imposed on all Project staff, workers, and all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws; ■ The Project Proponent shall be directly responsible for dissemination to its staff and workers of all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation, as well as the punishment that can expected if any staff or worker or other person associated with the Project violate rules and regulations; ■ The planned clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing; ■ Use of the access road should be restricted to construction vehicles only. Checkpoints should be used to manage access and inspect vehicles for timber and forest products taken from the Project Area.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Schedule and Implement a routine inspection program, and monitor vegetation clearing	EPC Contractor Cost
	Biodiversity	Construction Activities	Temporary disturbance or displacement of fauna	■ Construction vehicles will be maintained in accordance with industry standard to minimise unnecessary noise generation; ■ Traffic signs will be maintained on all roads depicting speed limits; ■ Access to facilities, including the access road should be restricted to construction vehicles only; and ■ Commitment will be made to raise awareness of the operator work force regarding flora and fauna values and make arrangements for restriction of hunting and poaching.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Regular inspection of the application of require mitigation measures.	EPC Contractor Cost
	Biodiversity	Construction Activities	Degradation of Habitat	■ Construction and domestic waste will be appropriately stored and disposed of to avoid attracting native and alien species to the construction and worker camp areas; ■ For areas in direct runoff path to a watercourse, sediment and erosion control devices will be installed and maintained until vegetation replanting can occur to stabilise disturbed soil surfaces; ■ Oil, chemical and solid waste will be stored, and handled and disposed of by appropriately licenced waste management contractors; ■ Invasive species management measures should be implemented in accordance to avoid introduction of weeds to natural and modified habitat areas; ■ Speed limits to maximum of 40 km/hr for construction vehicles will be enforced to limit noise and dust generation; and ■ Construction materials and chemicals will be appropriately secured to avoid accidental release to the natural environment (wind and water erosion).	Appointed EPC Contractor	On site Project Management team and designated EHS team	Regular inspection of the application of require mitigation measures.	EPC Contractor Cost
	Biodiversity	Construction Activities	Mortality of Resident Species	■ Speed limits to maximum of 40 km/hr for construction vehicles will be enforced to minimise potential for fauna strike; ■ Commitment will be made to raise awareness of values of important species and habitat areas to construction work force and arrangements will be made for restriction of poaching and forest product collection by staff; ■ Access restriction should be applied to Project facilities for non-construction vehicles; ■ Hunting wild animals will be strictly prohibited for all staff; and ■ Fishing and using of illegal fishing gear anywhere along the stream will be prohibited.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Regular inspection of the application of require mitigation measures.	EPC Contractor Cost
1.9	Social	Employment	Project needs can lead to increased employment rates	■ The workforce will be sourced from areas close to the Project after a training and selection process; and thereafter at a regional or national level; and ■ Develop a Sourcing, Procurement and Recruitment Management Plan to promote benefits to locals from recruitment and procurement activities for the Project (including information, training and engagement).	Appointed EPC Contractor	On site Project Management team and designated HSE team	Monitor the local content at the beginning of the construction phase	EPC Contractor Cost
	Social	Construction of LNG	Impacts to fishing	■ Develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan	Appointed EPC	On site Project	Weekly monitoring	EPC

S. No.	Affected Resource/ Receptor	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
		Receiving Terminal	activities	should include measures to notify local stakeholders in advance of any particularly activities on river ways/ areas. ■ Develop a Grievance Mechanism to collect grievances from local stakeholder whose fishing activities are affected by the Project activities.	Contractor	Management team and designated HSE team	of the grievance log during construction period	Contractor Cost
	Social	Impact from economical displacement	Impact to the economic	■ Land take should be minimised to the extent possible both in terms of geographical size and duration; and as such, when no activities are being undertaken, exclusions will be lifted. ■ TPMC will propose to recruit in priority stakeholders whose land is being impacted during construction phase. Recruitment should be considered to offers position to those who can extend past the construction phase, in particular for those whose land is permanently impacted. ■ TPMC will compensate stakeholders whose land is temporarily or permanently impacted during construction and operation using market price with a premium (to compensate for the change). ■ TPMC will compensate stakeholders whose crops is being impacted during construction using market price. ■ TPMC will use an external specialist to identify market price for the type of land and crops being impacted by project activities. ■ TPMC will need to develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on agricultural areas. This will ensure that stakeholders can anticipate and appropriately respond to the change and limitation of uses of agricultural areas. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose agricultural activities are affected by the Project activities.	Appointed EPC Contractor	On site Project Management team and designated HSE team	Monitor the grievance log weekly during construction.	EPC Contractor Cost
	Social	Impact from transportation used during construction	Impact to the navigation	■ At least 30 days prior to mobilization, TPMC will coordinate with local authorities , who will then issue “Notice to Mariner” regarding project activities to appropriate parties (i.e. Department of Fisheries, Ministry of Livestock, Fisheries and Rural Development, and Myanmar Navy). ■ Establish a 150 m exclusion zone and 250 m safety zone around the construction zone and provide support vessels to observe fishing and commercial vessels approaching the safety zone to prevent collision. ■ Provide appropriate lights and warning signals on construction vessels to prevent accidental collision. ■ Ensure all captain and skippers on the construction vessels are trained and have the necessary permits and certificate to operate the construction vessels. ■ TPMC will inform the exact location of the Project site with detail of safe zone, and alternative transportation routes to local stakeholders, as well as Department of Fisheries, Ministry of Livestock, Fisheries and Rural Development, and Myanmar Navy. ■ TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on river ways/ areas. This will ensure that stakeholders can anticipate and appropriately respond to the change and limitation of uses on river ways/ areas. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular navigation is affected by the Project activities.	Appointed EPC Contractor	On site Project Management team and designated HSE team	TPMC will; monitor the grievance log weekly; Review accident log daily; Conduct at least 3 times per year unplanned verification of permit and safety equipment; and Review engagement and communication log.	EPC Contractor Cost
	Social	Transportation during construction activities	Impact to traffic and transportation	■ TPMC will not transport equipment and materials during the local traffic peak time. ■ TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on or near local road. This will ensure that stakeholders can anticipate and can appropriately respond to the change and limitation of uses on local roads. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular transportation is affected by the Project activities.	Appointed EPC Contractor	On site Project Management team and designated HSE team	Monitor the grievance log weekly.	EPC Contractor Cost
	Social	The use of existing facilities and utilities by the project	Reducing the capacity of the existing facilities and utilities	■ Provide appropriate amenities at the workforce accommodation camp – e.g. recreational opportunities. This will help reduce the need for workers to utilize local infrastructure and services; ■ TPMC will ensure that company medical services have sufficient capacity and capability to treat a reasonable amount of workers at the same time. ■ Develop and implement a Worker Code of Conduct for all employees, contractors and visitors directly related to the Project. This will be a contractual and enforced requirement for all staff and subcontractors. ■ TPMC will communicate on its recruitment approach emphasising that priority for unskilled position will be given to inhabitant from Project SAoI. ■ Develop and implement a traffic management plan to minimize the impact experienced by road users as a result of the Project. The traffic management plan should be developed in consultation with local stakeholders. Stakeholders should be notified in advance of the Project commencing of traffic routes that	Appointed EPC Contractor	On site Project Management team and designated HSE team	Monthly engagement with local authorities and service providers. Weekly review of grievance log. Monthly inspection of infrastructures (e.g. road).	EPC Contractor Cost

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				will be utilised and, where known, periods of increased traffic volumes. Where possible, traffic movements will be coordinated so as to limit disruptions to local activities; ■ Develop and implement a community health management plan and an occupational health and safety plan in consultation with relevant stakeholders (e.g. local health practitioners). These plans will ensure that appropriate and adequate health care services are provided on site and at the accommodation camp to address/ manage worker illnesses and injuries. ■ TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on public infrastructures. This will ensure that stakeholders can anticipate and appropriately respond to the change and limitation of uses. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular use of public services and infrastructures is affected by the Project activities.				
	Social	Construction activities (noise, vibrations and dust)	Causing nuisance to human receptors	■ Mitigation measures have already been proposed in the Air Quality and Noise Impact Assessment sections but TPMC will also need to develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly noisy activities (e.g. pile driving); and ■ The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder impacted by noise, dust and vibration.	Appointed EPC Contractor	On site Project Management team and designated HSE team	Monitor the grievance log weekly during construction period.	EPC Contractor Cost
	Social	Construction activities	Impacts to health and safety of the community	■ Training for all workers on the transmission routes and common symptoms of communicable diseases. This can help reduce the potential for workers to unknowingly transmit communicable diseases. This may also help to increase knowledge within Project SAoI – e.g. through the training of workers that have been sourced from the local area; ■ Establish amenities at the worker camp to help minimize the interaction between the workforces (particularly temporary construction workers) and local villagers. This includes recreation facilities and health care infrastructure; ■ Establish a workforce code of conduct, which include the specific measures that target anti-social behaviour, such as becoming involved with commercial sex workers; ■ Undertake pre-employment screening to ensure fitness for work. It is important that the pre-screening process does not result in discrimination, but instead is used as a tool to minimize the transmission of communicable diseases; ■ Vector management procedures, including measures to reduce the presence of vector habitat and consideration of whether pesticides will be utilized to reduce the presence of vectors onsite; ■ Provision of onsite health care and medical facilities, to ensure that basic medical attention and first aid treatment can be sought during the hours that the work is being undertaken at the Project site. This will also help reduce the potential pressure on local health care facilities; ■ Pre-placement medical examination of all workers, supported by periodic medical examinations. A regular voluntary Worker Medical Screening Program onsite and a Monitoring and Evaluation (M&E) system. In addition a workplace policy and training and awareness programme on risks described above and prevention and mitigation of HIV impacts will be implemented with Project staff; ■ In collaboration with the local and regional Government, local emergency providers and local health care facilities, TPMC will develop and implement Emergency Prevention, Preparedness and Response Plans (EPPRPs) to cover all incidents presenting risks to public safety and the affected communities in proximity to the Project Sites and the environment; ■ Develop and implement a Workforce Code of Conduct which will be adhered to by all Contractors and TPMC employees. Any employee or Contractor found in violation of the Code shall face disciplinary hearing which may result in dismissal; ■ Ensure the access to free condoms (including female condoms) at the worker camp to promote safe sexual practices; ■ Conduct information, education and communication campaigns amongst Project personnel on hygiene and sanitation; ■ The EPC contractor should develop an effective Waste Management Plan that ensures adequate and legally acceptable control and management of transport and disposal of all wastes on and off site; ■ Security personnel will be contracted and trained in line with the Voluntary Principles on Security and Human Rights; ■ Accommodation should be provided to external workers in accordance with international good practice on workers' accommodation, including IFC / EBRD standards to prevent transmission of diseases associated with poor living conditions; ■ The Project should implement measures to reduce the presence of standing water onsite through	Appointed EPC Contractor	On site Project Management team and designated HSE team	Bi monthly review of training log; Monitoring and review of accidents due to construction (daily monitoring and monthly review). Community health and safety monitoring and surveillance program. Daily monitoring of construction area, worker camp and surrounding; Regular unplanned audit on worker code conduct; Bi-yearly unplanned audit of waste management contractors. Monthly visual inspection of first aid facilities and records. Weekly review of grievance log.	EPC Contractor Cost

S. No.	Affected Resource/ Receptor	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				environmental controls and source reduction to avoid the creation of new breeding grounds; ■ All the mitigation presented in the air quality and noise impact assessment chapter will be implemented; ■ The Project should develop a Traffic Management Plan covering vehicle safety, speed limits on roads, driver and passenger behaviour, use of drugs and alcohol, hours of operation, rest periods and location of rest stops and accident reporting and investigations; ■ Require Project drivers to be trained in defensive driving within the previous 3 years; ■ All vehicles used for the project should be regularly serviced and maintained; ■ Local speed limits should be adhered to when travelling through communities by all Project related traffic. Such speed limits will have the added advantage of reducing dust emissions; ■ Undertake consultation with communities along key transport routes to inform them about the potential for increased traffic movements prior to any changes; ■ TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The Project will also include a Grievance Mechanism to collect grievances from local stakeholder affected by the Project activities; ■ The Project will ensure that signs are put up around construction sites advising people of the risks associated with trespass. All signs should be in diagram form to ensure those with low levels of literacy understand the signs; ■ The Project will ensure that there is adequate fencing around construction site to minimise the risk of trespass. Fencing will be checked daily to ensure that it is in good condition and to look for any signs of entry.				
	Social	Construction activities	Impacts to health and safety of the workers	■ The 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 potential hazards. This shall include (but not limited to) the following hazards: – falling from height; – falling into water; – entanglement with machinery; – tripping over permanent obstacles or temporary obstructions; – slipping on greasy walkways; – falling objects; – asphyxiation; – explosion; – contact with dangerous substances; – electric shock; – variable weather conditions; – lifting excessive weights; – traffic operations; ■ A Permit to Enter system will be established to ensure that only authorised persons gain entry to the construction site; ■ Competent and adequately resourced sub-contractors will be used where construction activities are to be sub-contracted; ■ All persons working on the construction site will be provided information about risks on Site and arrangements will be made for workers to discuss health and safety with the Contractor; ■ The 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; ■ All workers will be properly informed, consulted and trained on health and safety issues; ■ Personal Protective Equipment (PPE) shall be worn at all times on the construction Site. This shall include appropriate safety shoes, safety eyewear, and hard hats. Non-slip or studded boots will be worn to minimize the risk of slips; ■ Before starting work all the appropriate safety equipment and the first-aid kits will be assembled and checked as being in working order. Breathing apparatus if necessary will be tested at regular intervals in the manner specified by the manufacturer; ■ All lifting equipment and cranes will be tested and inspected regularly. All hoist ways will be guarded; ■ All scaffolding will be erected and inspected in conformity with the Factories Act (1951) and the appropriate records maintained by the Contractor; ■ Safety hoops or cages will be provided for ladders with a height in excess of two meters; ■ When there is a risk of drowning lifebelts shall be provided and it shall be ensured that personnel wear	Appointed EPC Contractor	On site Project Management team and designated HSE team	Six monthly review of training log. Monitor and review of accidents (daily monitoring and monthly review). Development of occupational health and safety monitoring program. Weekly review of worker grievance log.	EPC Contractor Cost

S. No.	Affected Resource/ Receptor	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				adequate buoyancy equipment or harness and safety lines, and that rescue personnel are present when work is proceeding (near the water extraction point); ■ All breathing apparatus, safety harnesses, life-lines, reviving apparatus and any other equipment provided for use in, or in connection with, entry into Confined Spaces, and for use in emergencies, will be properly maintained and thoroughly examined at least once a month, and after every occasion on which it has been used; ■ Where sound levels cannot be reduced at the source, suitable hearing protection will be provided when noise levels indicate a Leq of more than 85 dB(A). When hearing protection is used, arrangements will be made to ensure the wearers can be warned of other hazards; ■ The Contractor shall provide appropriate safety barriers with hazard warning signs attached around all exposed openings and excavations; ■ The EPC contractor will comply with the IFC Performance Standard 2, local regulation and ILO conventions signed by Myanmar; and ■ TPMC will develop and monitor an internal standard to guide labour practices and apply this to supply chain to ensure that no child and/or forced labour will be employed by the EPC contractor and its sub-contractors.				
	Social	Construction activities and transportation	Potential impacts to cultural sites	■ The EPC contractor during construction will monitor the state of any cultural heritage closest to the project site. If damage is done to the buildings by vehicle of the Project, compensation (in kind or in cash) should be organised to restore the building to its state before the damage occur; ■ The EPC contractor will develop the construction planning in discussion with the nearest temple/monastery in order to make sure that any Project activity near the monastery (e.g. transport of large equipment) do not take place during special religious activities; and ■ TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The Project will also include a Grievance Mechanism to collect grievances from local stakeholder affected by the Project activities.	Appointed EPC Contractor	On site Project Management team and designated HSE team	Monitor and review of accidents and incidents; and Weekly review of grievance log.	EPC Contractor Cost
1.10	Unplanned Event	Vessel collision	Potential impacts include injuries, fatalities, and ship structural damage	■ A dedicated safe area should be provided to relevant authorities and local fisherman during construction of the marine component; ■ The contractor shall coordinate with relevant authorities such as the Southern Vietnam Maritime Safety Corporation and fishermen to disseminate information regarding the construction schedule, construction area, and activities; ■ The Contractor shall install buoy, navigation light, or warning sign as appropriate at the construction area; ■ Safety boats shall patrol the construction area to warn and provide navigational safety information to other local vessels; ■ Navigation aids should be installed at the separated channel leading into the port to ensure the safety of vessel manoeuvring; ■ The navigation schedule shall be communicated to relevant stakeholders by using various communication channels such as posters, local radio, and fishery group meetings; and ■ Establish a maritime safety management plan.	Appointed EPC Contractor	On site Project Management team and designated HSE team	Not required	EPC Contractor Cost
	Unplanned Event	Fire and Explosion	Potential impacts include injuries, fatalities, and damage to property	■ Develop a preventive maintenance program for process equipment and pipelines in order to avoid failures and implement program regularly; ■ Ensure the staff working to standard and strictly follow working procedures in order to prevent any incident; ■ Install leak detecting and alarming system in operating areas and tank farm; ■ Establish an Emergency Centre with 24 hours standby staff and firemen. This centre will be equipped with a communication system such as hot (emergency) line telephone, trunk radios, paging, inter-com, different alarm tones correspondence with each kind of situation, CCTV monitors those can view different areas of the Complex, etc. ■ Install fire protection and firefighting system including but limited following items: – Gas detection system: gas detector and fire alarm devices will be installed in potential leakage area of toxic chemicals and flammable substances like large size valves, flanges, major rotating equipment and high temperature fluctuation area; – Fire water system: fire water pond and pumps will distribute fire water to all plants in the Complex via fire water pipeline; – Water firefighting system in all plants: water hydrants, water monitors, fixed water spray system; – Foam firefighting system in Tank Farm area: foam monitors, foam chamber equipped at heavy hydrocarbon storage tanks; – Fire extinguishing system: portable fire extinguishers (foam, powder and CO2) in plants and buildings at appropriate locations;	Appointed EPC Contractor	On site Project Management team and designated HSE team	Not required	EPC Contractor Cost

S. No.	Affected Resource/ Receptor	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				– Inert gas fire suppression system: Inert gas total flooding fire extinguishing system will be provided in some areas such as control rooms and substations; and – Fire alarm system (automatic fire detectors and manual fire call points) will be provided in required areas ■ All fire prevention and firefighting systems shall be routinely inspected and maintained the by responsible persons ■ Establish a First-aid centre with 24 hours standby nurse. The First-aid centre must be equipped with sufficient first-aid equipment, first-aid kit and medicines ■ To establish emergency plan and evacuation plan with a clear emergency procedure set up. The procedure will include explanation of steps and guidelines that everybody has to follow such as below items; – Witness should first control the emergency situation or extinguish fire based on emergency activity plan and report to boardman or shift supervisor or foreman of that unit immediately to request the support team from the Emergency Centre of the Complex – The event shall be reported to the higher management level and emergency team shall be immediately formed according to the procedure set forth for providing support – When the emergency signal rings, all workers have to stop all activities to a safe condition and move to assembly point immediately – Assembly point shall be assigned for head counting and stand by for providing support – The workers who first witness the accident have to put on the necessary personal protective equipment and enter the incident area from upwind only – Limit the fire areas by utilizing the appropriate firefighting equipment – All firefighting technique has to be exercised routinely during normal situation – Coordination with outside organizations such as nearby plants, hospitals, outside fire brigade team and so on ■ Proper communication equipment of either station or mobile type will be provided in the plant such as hot (emergency) line telephones, trunk radios, paging, inter-com and different alarm tones correspondence with each kind of situation				
	Unplanned Event	Seismic and earthquake	Potential impacts include injuries, fatalities, and damage to property	■ The Project facilities should be designed to meet the seismic design standard for instance NFPA 59A, ASME etc. ■ Construct the LNG storage tank and other critical structures on driven pile foundations if possible; ■ Geotechnical studies during design phase and slope stability measures to consider impact of earthquakes of 1 in 10,000 year return period ■ Emergency response procedures for the seismand severe weather condition will be formulated to contain and limit an emergency situation should one arise.	Appointed EPC Contractor	On site Project Management team and designated HSE team	Not required	EPC Contractor Cost
	Unplanned Event	Tropical storm and extreme weather condition	Potential impacts include injuries, fatalities, and damage to property	■ Review weather forecast and monitor weather condition on a daily basis; ■ Prepare typhoon response plan and typhoon evacuation plan; ■ Conduct evacuation drill and response to typhoon evacuation plan on a regular basis, at least once a year; ■ Emergency response procedures for the tropical storm and severe weather condition will be formulated to contain and limit an emergency situation should one arise.	Appointed EPC Contractor	On site Project Management team and designated HSE team	Not required	EPC Contractor Cost
	Unplanned Event	Loss of containment of waste storage facilities on-site	Impact to soil, groundwater, surface water, biodiversity and human receptors	■ Ensure the integrity of wastewater storage unit to avoid leaking of wastewater and odor to the surrounding receptors; ■ Use appropriate waste containers and build secondary containment around chemical or waste storage on-site to avoid spillage of waste and leakage of leachate during waste storage on-site; ■ Siting of chemical and waste storage should consider nearby receptors, i.e. site away from watercourses or portable water sources; ■ Hazardous waste should be stored so as to prevent or control accidental releases to air, soil and water resources. Where practicable: – The storage area should be clearly labelled and demarcated; – Readily available information on chemical compatibility should be provided to employees, including labelling each container to identify its contents; – Hazardous waste should be stored in a manner that prevents the commingling or contact between incompatible wastes and allows for inspection between containers to monitor leaks or spills; – Hazardous waste should be stored in closed containers away from direct sunlight, wind and rain; – Hazardous waste storage area should be have an impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest waste container; and – Hazardous waste storage areas have adequate ventilation, fire prevention system (if needed).	Appointed EPC Contractor	On site Project Management team and designated HSE team	Not required	EPC Contractor Cost

S. No.	Affected Resource/ Receptor	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				■ Spill response and emergency plans should be prepared and implemented to address the potential accidental release of hazardous waste; ■ On-site and off-site transportation of waste should be conducted so as to prevent or minimise spills, release and exposures to employees and public; ■ Maintenance facilities should be located on hard standing surfaces within a bunded area. Sumps and oil interceptors should be provided. Maintenance of vehicles and equipment involving activities with potential for leakage and spillage should only be undertaken within areas appropriately equipped to control these discharges; and ■ Design discharge point to be furthest away from sensitive receptors.				
B	**Operation Phase**							
1.1	Air Quality	Operation activities	Impact to air quality due to dust emissions	■ To minimise and control impacts to air quality during the operation of the Project the natural gas fired generators at the LNG receiving terminal will be serviced and maintained in accordance with the manufacturer's specification to maintain high performance throughout the lifetime of the Project.	Designated HSE team	HSE Department Manager	Not required	TPMC Operation Cost
1.2	Greenhouse Gas	Electricity generation from the gas turbine generators in the Combined Cycle Power Plant (CCPP)	Impact on climatic condition due to GHG emissions.	■ Conduct annual pollutant release inventory to monitor the GHG emissions from the Project. The GHGs emission shall be reported as CO2eq unit. ■ Where feasible, arrange emissions offsets (including the Kyoto Protocol's flexible mechanisms and the voluntary carbon market), including reforestation, afforestation.	Designated HSE team	HSE Department Manager	Not required	TPMC Operation Cost
1.3	Noise level	Operation of LNG Receiving Terminal	Impacts to noise sensitive receivers (NSRs) due to noise emission	■ Well-maintained equipment to be operated on-site; ■ Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components; ■ Shut down or throttled down between work periods for machines and non-essential operation plant items (e.g. trucks) that may be in intermittent use ; ■ Reduce the number of equipment operating simultaneously as far as practicable; ■ Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable; ■ Locate noisy plant (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable; and ■ Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site operation activities.	Designated HSE team	HSE Department Manager	Not required	TPMC Operation Cost
1.4	Surface Water	Water Intake Requirement	Impact to surface water	■ Not require	Designated HSE team	HSE Department Manager	Biannual monitoring of water intake quantities and flow rates in the Yangon River.	TPMC Operation Cost
	Surface Water	Waste water from LNCG (regasification process)	Impact to surface water through contaminated water runoff and domestic wastewater discharge	■ Incorporate drainage systems or oil traps into the LNGC design to reduce the amount of potential contaminated water runoff; and ■ Collect any contaminated water on the LNGC when possible, and send to certified contractor for disposal, to reduce potential contaminated water discharge into the Yangon River.	Designated HSE team	HSE Department Manager	Quarterly surface water quality monitoring, using standard analytical methods; recommended monitoring locations include sampling station SW13 and SW14, which were used for baseline sampling, as shown in ***Section 5.1.5.2***	TPMC Operation Cost
	Surface	Cold water discharge	Impact to surface	■ Not require	Designated HSE	HSE Department	Continuous	TPMC

S. No.	Affected Resource/ Receptor	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
	Water	(regasification process)	water		team	Manager	temperature monitoring at discharge point; by installing a continuous monitoring system at discharge point.	Operation Cost
1.5	Soil and Ground water	Accidental Leaks of Cold Water from the regasification unit	Impact to soil and ground water	■ Project Proponent will prepare guidelines and procedures for immediate clean-up actions following any leaks; ■ Use of spill or drip trays to contain leaks; ■ Use of spill control kits to contain and clean small spills and leaks; and ■ Employee must be trained on emergency response procedure.	Designated HSE team	HSE Department Manager	Not required	TPMC Operation Cost
1.6	Waste	Generation and management of hazardous waste during operation	Impact to soil, groundwater, surface water, biodiversity and human receptors	■ A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project operation. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the operation phase for all of the waste streams identified; ■ Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable; ■ Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations; ■ Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed; ■ Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and ■ The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during operation activity is being managed responsibly.	Designated HSE team	HSE Department Manager	Monitoring of waste segregation, transportation and disposal practices. Monitoring of appointed waste contractors using COC documentation.	TPMC Operation Cost
	Waste	Generation and management of non-hazardous waste during operation	Impact to soil, groundwater, surface water, biodiversity and human receptors	■ A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project operation. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the operation phase for all of the waste streams identified; ■ Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable; ■ Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations; ■ Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed; ■ Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and ■ The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during operation activity is being managed responsibly.	Designated HSE team	HSE Department Manager	Monitoring pf waste segregation, transportation and disposal practices. Monitoring of appointed waste contractors using COC documentation.	TPMC Operation Cost
	Waste	Generation and management of domestic solid waste during operation phase	Impact to soil, groundwater, surface water, biodiversity and human receptors	■ A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project operation. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the operation phase for all of the waste streams identified; ■ Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable; ■ Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations; ■ Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed;	Designated HSE team	HSE Department Manager	Conduct regular inspection of relevant domestic solid waste streams and sources.	TPMC Operation Cost

S. No.	Affected Resource/ Receptor	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				■ Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and ■ The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during operation activity is being managed responsibly.				
	Waste	Generation and management of domestic liquid waste during operation phase	Impact to soil, groundwater, surface water, biodiversity and human receptors	■ All waste collection and storage measures as detailed within ***Chapter 7.4*** and ***Chapter 7.5*** (Surface Water, Soil and Groundwater) will be implemented; ■ Ensure the integrity of wastewater storage unit to avoid leaking of wastewater and odour to the surrounding receptors; and ■ Enforce rules that prevent inappropriate materials going into the sanitary wastewater stream.	Designated HSE team	HSE Department Manager	Conduct regular maintenance on sanitary wastewater treatment system. Conduct regular testing of effluent water parameters at the discharge location.	TPMC Operation Cost
1.7	Visual Impact	The physical presence of LNG receiving terminal	Change of landscape and visual aspect	■ Visual screening e.g. surround perimeter of site with native trees (can be compensatory trees for any felled during construction); ■ Maintain soft landscaping (i.e. tree, low shrub and ground cover planting) within available space in the Project Site; ■ Minimise overall lighting use and manage lighting on site to consider minimization of light pollution and horizon glow; – identify zones of high and low lighting requirements and contain light to areas that need illumination most; – prevent light spill/ glare with shielding i.e. All security and street/road lighting shall have “blinkers” or be specifically designed to ensure light is directed downwards while preventing side spill; – prevent light spill/ glare with directional lighting to focus on necessary area/object (eg reduce the height from which floodlights are fixed and with the focus of the lights being inward, rather than outward); – keep light intensity to as low as reasonably practicable; – all external light fittings shall not allow light to shine upwards; – area lighting on any tall buildings/ masts should be confined to the lower landform elevations; and ■ Maintain all structural facilities in good repair.	Designated HSE team	HSE Department Manager	Not required	TPMC Operation Cost
1.8	Biodiversity	Operation Activities	Impacts to biodiversity values (habitats and species) due to permanent and temporary habitat loss	■ Strict rules against clearing vegetation will be imposed on all Project staff, workers, and all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws; ■ The Project Proponent shall be directly responsible for dissemination to its staff and workers of all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation, as well as the punishment that can expected if any staff or worker or other person associated with the Project violate rules and regulations; ■ Use of the access road should be restricted to operation vehicles only. Checkpoints should be used to manage access and inspect vehicles for timber and forest products taken from the Project Area.	Designated HSE team	On site Project Management team and designated EHS team	Schedule and Implement a routine inspection program, and monitor vegetation clearing	TPMC Operation Cost
	Biodiversity	Operation Activities	Temporary disturbance or displacement of fauna	■ Operational vehicles will be maintained in accordance with industry standard to minimise unnecessary noise generation; ■ Traffic signs will be maintained on all roads depicting speed limits; ■ Access to facilities, including the access road should be restricted to operational vehicles only; ■ For operational areas requiring night-time lighting, lights will be used only where necessary and will be directed towards the subject area and away from habitat areas where possible; and ■ Commitment will be made to raise awareness of the operator work force regarding flora and fauna values and make arrangements for restriction of hunting and poaching.	Designated HSE team	On site Project Management team and designated EHS team	Regular inspection of the application of require mitigation measures.	TPMC Operation Cost
	Biodiversity	Operation Activities	Degradation of Habitat	■ Operation and domestic waste will be appropriately stored and disposed of to avoid attracting native and alien species; ■ Oil, chemical and solid waste will be stored, and handled and disposed of by appropriately licenced waste management contractors; ■ Invasive species management measures should be implemented in accordance to avoid introduction of weeds to natural and modified habitat areas;	Designated HSE team	On site Project Management team and designated EHS team	Regular inspection of the application of require mitigation measures.	TPMC Operation Cost

S. No.	Affected Resource/ Receptor	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				■ Speed limits to maximum of 40 km/hr for operation vehicles will be enforced to limit noise and dust generation; and ■ Operation materials and chemicals will be appropriately secured to avoid accidental release to the natural environment (wind and water erosion).				
	Biodiversity	Operation Activities	Mortality of Resident Species	■ Speed limits to maximum of 40 km/hr for operation vehicles will be enforced to minimise potential for fauna strike; ■ Commitment will be made to raise awareness of values of important species and habitat areas to operation work force and arrangements will be made for restriction of poaching and forest product collection by staff; ■ Access restriction should be applied to Project facilities for non-operation vehicles; ■ Hunting wild animals will be strictly prohibited for all staff; and ■ Fishing and using of illegal fishing gear anywhere along the stream will be prohibited.	Designated HSE team	On site Project Management team and designated EHS team	Regular inspection of the application of require mitigation measures.	TPMC Operation Cost
1.9	Social	Employment	Impacts to employment rates (increased)	■ All unskilled staffs must be recruited from the local population living directly around the Project area. If possible, the skilled workforce should also be sourced from areas close to the Project after a training and selection process; and thereafter at a regional or national level. ■ The Project will use the Sourcing, Procurement and Recruitment Management Plan developed for the construction stage and cooperate with local academic institutions to identify future local employees with the relevant skills.	Designated HSE team	HSE Department Manager	Monitored at the beginning of the operation phase and continued on a yearly basis	TPMC Operation Cost
	Social	Release of cold water from the LNG Terminal	Impact to fishing activities	■ TPMC will continue to implement the Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on river ways/ areas; and ■ The Project should also continue to implement the Grievance Mechanism to collect grievances from local stakeholder whose fishing activities are affected by the Project activities.	Designated HSE team	HSE Department Manager	Monitor the grievance log weekly.	TPMC Operation Cost
	Social	Impact from economical displacement	Impact to the economic	■ Land take should be minimised to the extent possible both in terms of geographical size and duration; and as such, when no activities are being undertaken, exclusions will be lifted; ■ TPMC will propose to recruit in priority stakeholders whose land is being impacted during construction phase. Recruitment should consider job offers position to those who can extend past the construction phase, in particular for those whose land is permanently impacted; ■ TPMC will compensate stakeholders whose land is temporarily or permanently impacted during construction and operation using market price with a premium (to compensate for the change); ■ TPMC will compensate stakeholders whose crops is being impacted during construction using market price; ■ TPMC will use an external specialist to identify market price for the type of land and crops being impacted by project activities; ■ Develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on agricultural areas; and ■ Develop a Grievance Mechanism to collect grievances from local stakeholder whose agricultural activities are affected by the Project activities.	Designated HSE team	HSE Department Manager	Monitor the grievance log weekly.	TPMC Operation Cost
	Social	Impact from transportation used during operation	Impact to the navigation	■ Provide appropriate lights and warning signals on operation vessels to prevent accidental collision; ■ Ensure all captain and skippers on the construction vessels are trained and have the necessary permits and certificate to operate the construction vessels; ■ LNG / condensate carrier tankers will be piloted during berthing and loading operations; ■ TPMC will inform the exact location of the restricted area, and alternative transportation routes to local stakeholders, as well as Department of Fisheries, Ministry of Livestock, Fisheries and Rural Development, and Myanmar Navy; ■ TPMC will continue to implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on river ways/ areas; and ■ The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular navigation is affected by the Project activities.	Designated HSE team	HSE Department Manager	Monitor the grievance log weekly	TPMC Operation Cost
	Social	Project using the existing facilities and utilities	Reducing the capacity of the existing facilities and utilities	■ Develop and implement an employee Code of Conduct for all employees, contractors and visitors directly related to the Project. This will be a contractual and enforced requirement for all staff and subcontractors; and ■ TPMC will continue to implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The Project will also continue to implement the Grievance Mechanism to collect grievances from local	Designated HSE team	HSE Department Manager	Bi-yearly engagement with local authorities and service provider.	TPMC Operation Cost

S. No.	Affected Resource/ Receptor	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				stakeholder affected by the Project activities.			Monthly review of grievance log. Yearly inspection of infrastructures.	
	Social	Operation activities (noise, dust, vibration)	Impact to community health	■ Continue implement the Grievance Mechanism to collect grievances from local stakeholder impacted by noise, dust and vibration.	Designated HSE team	HSE Department Manager	Monitor the grievance log weekly	TPMC Operation Cost
	Social	Operation activities	Impacts to health and safety of the community	■ Training for all workers on the transmission routes and common symptoms of communicable diseases. This can help reduce the potential for workers to unknowingly transmit communicable diseases. This may also help to increase knowledge within Project SAoI – e.g. through the training of workers that have been sourced from the local area; ■ Undertake pre-employment screening to ensure fitness for work. It is important that the pre-screening process does not result in discrimination, but instead is used as a tool to minimize the transmission of communicable diseases; ■ Pre-placement medical examination of all workers, supported by periodic medical examinations. A regular voluntary Worker Medical Screening Program onsite and a Monitoring and Evaluation (M&E) system. In addition a workplace policy and training and awareness programme on risks described above and prevention and mitigation of HIV impacts will be implemented with Project staff; ■ Develop and implement a Workforce Code of Conduct which will be adhered to by all Contractors and TPMC employees. The specific measures that target anti-social behaviour, such as becoming involved with commercial sex workers are also include. Any employee or Contractor found in violation of the Code shall face disciplinary hearing which may result in dismissal; ■ Security personnel will be contracted and trained in line with the Voluntary Principles on Security and Human Rights; ■ All the mitigation presented in the air quality, noise, waste and surface water impact assessment chapter will be implemented; ■ TPMC will continue to implement the Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. It will include the Grievance Mechanism to collect grievances from local stakeholder affected by the Project activities; ■ The Project will ensure that signs are put up around the site advising people of the risks associated with trespass. All signs should be in diagram form to ensure those with low levels of literacy understand the signs; and ■ The Project will ensure that there is adequate fencing around the site to minimise the risk of trespass. Fencing will be checked daily to ensure that it is in good condition and to look for any signs of entry.	Designated HSE team	HSE Department Manager	Bi-yearly review of training log. Develop a community health and safety monitoring and surveillance programme. Conduct regular unplanned audit of the worker code of conduct. Bi-yearly unplanned audit of waste management activities. Monthly visual inspection pf first aid facilities and record, review of employment records and health insurance subscription records. Monitor the grievance log weekly	TPMC Operation Cost
	Social	Operation activities	Impact to occupational health and safety	■ The Occupational Health and Safety Management Plan (OHSMP) will be update to integrate new potential risks of the operation and be linked to the Emergency Response Plan for unplanned event. This plan will include method statements for work activities, plant utilisation, and safety arrangements; ■ Measures will be implemented to reduce the likelihood and consequence of the potential hazards. This shall include (but not limited to) the following hazards: – falling from height; – falling into water; – entanglement with machinery; – tripping over permanent obstacles or temporary obstructions; – slipping on greasy walkways; – falling objects; – asphyxiation; – explosion; – contact with dangerous substances; – electric shock;	Designated HSE team	HSE Department Manager	Six monthly review of training log. Daily and monthly monitoring and review of accidents and incidents. Developed an occupational health and safety monitoring and surveillance programme.	TPMC Operation Cost

S. No.	Affected Resource/ Receptor	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				– variable weather conditions; – lifting excessive weights; and – traffic operations. ■ A Permit to Enter system will be established to ensure that only authorised persons gain entry to the site; ■ Competent and adequately resourced sub-contractors will be used where activities are to be sub-contracted; ■ All persons working on the site will be provided information about risks on Site and arrangements will be made for workers to discuss health and safety with the Contractor; ■ All workers will be properly informed, consulted and trained on health and safety issues; ■ Personal Protective Equipment (PPE) shall be worn at all times on the Site. This shall include appropriate safety shoes, safety eyewear, and hard hats. Non-slip or studded boots will be worn to minimize the risk of slips; ■ Before starting work all the appropriate safety equipment and the first-aid kits will be assembled and checked as being in working order. Breathing apparatus if necessary will be tested at regular intervals in the manner specified by the manufacturer; ■ All lifting equipment and cranes will be tested and inspected regularly. All hoist ways will be guarded; ■ All scaffolding will be erected and inspected in conformity with the Factories Act (1951) and the appropriate records maintained by the Contractor; ■ Safety hoops or cages will be provided for ladders with a height in excess of two meters; ■ When there is a risk of drowning lifebelts shall be provided and it shall be ensured that personnel wear adequate buoyancy equipment or harness and safety lines, and that rescue personnel are present when work is proceeding (near the water extraction point); ■ All breathing apparatus, safety harnesses, life-lines, reviving apparatus and any other equipment provided for use in, or in connection with, entry into Confined Spaces, and for use in emergencies, will be properly maintained and thoroughly examined at least once a month, and after every occasion on which it has been used; ■ Where sound levels cannot be reduced at the source, suitable hearing protection will be provided when noise levels indicate a Leq of more than 85 dB(A). When hearing protection is used, arrangements will be made to ensure the wearers can be warned of other hazards; ■ The Contractor shall provide appropriate safety barriers with hazard warning signs attached around all exposed openings and excavations; ■ The EPC contractor will comply with the IFC Performance Standard 2, local regulation and ILO conventions signed by Myanmar; ■ TPMC will develop and monitor an internal standard to guide labour practices and apply this to supply chain to ensure that no child and/or forced labour will be employed by the EPC contractor and its sub-contractors; and ■ Maintain the grievance mechanism for workers.			Weekly review of worker grievance log.	
	Social	Operation activities	Impact to cultural heritage	■ Continue implementing the Grievance Mechanism to collect grievances from local stakeholder.	Designated HSE team	HSE Department Manager	Not required	TPMC Operation Cost
1.10	Unplanned Event	Vessel collision	Potential impacts include injuries, fatalities, and ship structural damage.	■ Navigation aids should be installed at the separated channel leading into the port to ensure the safety of vessel manoeuvring ■ The navigation schedule shall be communicated to relevant stakeholders by using various communication channels such as posters, local radio, and fishery group meetings ■ Establish a maritime safety management plan.	Designated HSE team	HSE Department Manager	Not required	TPMC Operation Cost
	Unplanned Event	Fire and explosion	Potential impacts include injuries, fatalities, and damage to property	■ Develop a preventive maintenance program for process equipment and pipelines in order to avoid failures and implement program regularly ■ Ensure the staff working to standard and strictly follow working procedures in order to prevent any incident ■ Install leak detecting and alarming system in operating areas and tank farm ■ Install dike/bund around tank storage areas to contain the chemicals in case of leaked or spilled. The capacity of dike/ bund should be sufficient to contain the chemical from the largest tank ■ Establish an Emergency Centre with 24 hours standby staff and firemen. This centre will be equipped with a communication system such as hot (emergency) line telephone, trunk radios, paging, inter-com, different alarm tones correspondence with each kind of situation, CCTV monitors those can view different areas of the Complex, etc. ■ Install fire protection and firefighting system including but limited following items:	Designated HSE team	HSE Department Manager	Not required	TPMC Operation Cost

S. No.	Affected Resource/ Receptor	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				– Gas detection system: gas detector and fire alarm devices will be installed in potential leakage area of toxic chemicals and flammable substances like large size valves, flanges, major rotating equipment and high temperature fluctuation area; – Fire water system: fire water pond and pumps will distribute fire water to all plants in the Complex via fire water pipeline; – Water firefighting system in all plants: water hydrants, water monitors, fixed water spray system; – Foam firefighting system in Tank Farm area: foam monitors, foam chamber equipped at heavy hydrocarbon storage tanks; – Fire extinguishing system: portable fire extinguishers (foam, powder and CO_2) in plants and buildings at appropriate locations; – Inert gas fire suppression system: Inert gas total flooding fire extinguishing system will be provided in some areas such as control rooms and substations; and – Fire alarm system (automatic fire detectors and manual fire call points) will be provided in required areas ■ All fire prevention and firefighting systems shall be routinely inspected and maintained the by responsible persons ■ Establish a First-aid centre with 24 hours standby nurse. The First-aid centre must be equipped with sufficient first-aid equipment, first-aid kit and medicines ■ To establish emergency plan and evacuation plan with a clear emergency procedure set up. The procedure will include explanation of steps and guidelines that everybody has to follow such as below items ■ Witness should first control the emergency situation or extinguish fire based on emergency activity plan and report to boardman or shift supervisor or foreman of that unit immediately to request the support team from the Emergency Centre of the Complex ■ The event shall be reported to the higher management level and emergency team shall be immediately formed according to the procedure set forth for providing support ■ When the emergency signal rings, all workers have to stop all activities to a safe condition and move to assembly point immediately ■ Assembly point shall be assigned for head counting and stand by for providing support ■ The workers who first witness the accident have to put on the necessary personal protective equipment and enter the incident area from upwind only ■ Limit the fire areas by utilizing the appropriate firefighting equipment ■ All firefighting technique has to be exercised routinely during normal situation ■ Coordination with outside organizations such as nearby plants, hospitals, outside fire brigade team and so on ■ Proper communication equipment of either station or mobile type will be provided in the plant such as hot (emergency) line telephones, trunk radios, paging, inter-com and different alarm tones correspondence with each kind of situation.				
	Unplanned Event	Seismic and earthquake	Potential impacts include injuries, fatalities, and damage to property	■ The Project facilities should be designed to meet the seismic design standard for instance NFPA 59A, ASME etc. ■ Construct the LNG storage tank and other critical structures on driven pile foundations if possible ■ Geotechnical studies during design phase and slope stability measures to consider impact of earthquakes of 1 in 10,000 year return period ■ Emergency response procedures for the seismand severe weather condition will be formulated to contain and limit an emergency situation should one arise.	Designated HSE team	HSE Department Manager	Not required	TPMC Operation Cost
	Unplanned Event	Tropical storm and extreme weather condition	Potential impacts include injuries, fatalities, and damage to property	■ Review weather forecast and monitor weather condition on a daily basis ■ Prepare typhoon response plan and typhoon evacuation plan ■ Conduct evacuation drill and response to typhoon evacuation plan on a regular basis, at least once a year. ■ Emergency response procedures for the tropical storm and severe weather condition will be formulated to contain and limit an emergency situation should one arise. ■ Construct appropriate flood barriers capable of holding the worst-case scenario flooding scenarios. ■ Construct diversion canals appropriately to redirect any excess water during flooding conditions.	Designated HSE team	HSE Department Manager	Not required	TPMC Operation Cost
	Unplanned Event	Loss of containment of waste storage facilities on-site	Impact to soil, groundwater, surface water, biodiversity and	■ Ensure the integrity of wastewater storage unit to avoid leaking of wastewater and odor to the surrounding receptors; ■ Use appropriate waste containers and build secondary containment around chemical or waste storage on-site to avoid spillage of waste and leakage of leachate during waste storage on-site;	Designated HSE team	HSE Department Manager	Not required	TPMC Operation Cost

S. No.	Affected Resource/ Receptor	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
			human receptors	■ Siting of chemical and waste storage should consider nearby receptors, i.e. site away from watercourses or portable water sources; ■ Hazardous waste should be stored so as to prevent or control accidental releases to air, soil and water resources. Where practicable: – The storage area should be clearly labelled and demarcated; – Readily available information on chemical compatibility should be provided to employees, including labelling each container to identify its contents; – Hazardous waste should be stored in a manner that prevents the commingling or contact between incompatible wastes and allows for inspection between containers to monitor leaks or spills; – Hazardous waste should be stored in closed containers away from direct sunlight, wind and rain; – Hazardous waste storage area should be have an impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest waste container; and – Hazardous waste storage areas have adequate ventilation, fire prevention system (if needed). ■ Spill response and emergency plans should be prepared and implemented to address the potential accidental release of hazardous waste; ■ On-site and off-site transportation of waste should be conducted so as to prevent or minimise spills, release and exposures to employees and public; ■ Maintenance facilities should be located on hard standing surfaces within a bunded area. Sumps and oil interceptors should be provided. Maintenance of vehicles and equipment involving activities with potential for leakage and spillage should only be undertaken within areas appropriately equipped to control these discharges; and ■ Design discharge point to be furthest away from sensitive receptors.				

12.5.2.2 Mitigation Measures for the Pipeline

Table 12.3 Environmental and Social Management Plans for the Pipeline

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
A	**Site Preparation and Construction Phase**							
1.1	Air Quality	Construction activities	Impact to air quality due to dust emissions	■ Develop and Implement a Dust Management Plan (DMP) detailing mitigation measures and a plan for implementation. ■ Watering will be used to suppress wind and physical disturbance dust generation. ■ Ensure an adequate water supply on site for effective dust suppression and mitigation. ■ The site layout will be planned so that dust-causing activities are located away from receptors as far as is possible. ■ Screens or barriers will be erected around dusty activities or the site boundary that are at least the height of any stockpile on site. ■ All stockpiles will be covered or fenced off to prevent wind whipping. ■ Only cutting, grinding, or sawing equipment fitted with suitable dust suppression techniques such as water sprays will be used. ■ All chutes, conveyors and skips will be covered at all times. ■ Drop heights from conveyors, loading shovels and hoppers will be minimised. ■ No waste will be burned on site. ■ Re-vegetate earthwork and exposed areas as soon as is practicable. ■ Use hessian, mulches or trackifiers where it is not possible to revegetate, or cover with top soil as soon as is practicable. ■ Sand and other aggregates will be stored in bunded areas and will not be allowed to dry out unless this is required for a particular process, in which case additional control measures such as those detailed in this section will be applied. ■ Ensure that all vehicles entering and leaving the site are covered to avoid fugitive emissions during transport. ■ Inspect on-site haul roads for integrity and instigate the necessary repairs to the surfaces as soon as reasonable practicable. ■ Implement a wheel washing system. ■ Regularly dampen and clean the site access and local roads to remove any materials tracked out of the site. ■ All site access gates will be located at least 10m away from air sensitive receptors where possible. ■ The site layout will be planned so that machinery is located away from receptors as far as is possible. ■ All vehicles will switch off engines when stationary. ■ A regular vehicle and machinery maintenance and repair programme will be implemented. ■ Mains electricity or battery powered equipment will be used instead of diesel/petrol generators where practicable.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Regular Site Inspection to monitor compliance with the DMP. Daily onsite and offsite inspections to visually assess the dust emissions. Conduct monthly air quality monitoring at sensitive receptors.	EPC Contractor Cost
1.2	Greenhouse gas	Use of on site vehicles and heavy machineries for construction have the potential to increase greenhouse gas emissions	Impact on climatic condition due to GHG emissions.	■ Implement the same mitigation measures to minimize impacts to Air Quality (***No 1.1***). ■ Develop and implement preventive maintenance plan for machines, and engines to ensure combustion efficiency. ■ Develop vehicle and machine maintenance plan.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly report to the Project Proponent	EPC Contractor Cost
1.3	Noise Level	Transportation and operation of workers, equipment and materials	Impacts to noise sensitive receivers (NSRs) due to noise emission	■ Schedule transportation of materials evenly throughout the day (to minimize accumulative noise impact from multiple noise sources); ■ Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components should be conducted; and ■ Avoid transportation of materials on- and off-site through existing community areas.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly noise monitoring conducted at the representative NSRs by the EPC contractor.	EPC Contractor Cost
	Noise Level	Excavation work and civil construction	Impacts to noise sensitive receivers	■ Noise barriers should be installed at the site boundary (facing the villages) and high enough which completely hides the noise sources from the NSR. It is anticipated that at least a 10 dB (A) noise	Appointed EPC Contractor	On site Project Management	Monthly noise monitoring	EPC Contractor

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
			(NSRs) due to noise emission	reduction can be provided. The noise barrier material should have a superficial surface density of at least 7 kg/m^{-2} and have no openings or gaps; ■ Well-maintained equipment to be operated on-site; ■ Normal working hours of the contractor should be between 07:00 and 22:00 hours from Monday to Saturday (except holiday). If work needs to be undertaken outside these hours, it should be limited to activities that do not lead to exceedance of noise criteria at nearby NSRs and avoid early morning and night time construction; ■ Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components; ■ Shut down or throttled down between work periods for machines and construction plant items (eg trucks) that may be in intermittent use ; ■ Reduce the number of equipment operating simultaneously as far as practicable; ■ Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable; ■ Locate noisy equipment and machineries (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable; and ■ Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site construction activities.		team and designated EHS team	conducted at the representative NSRs by the EPC contractor.	Cost
1.4	Surface Water	Water Intake from the Yangon river and adjoining streams and tributaries	Impact to surface water	■ Not required	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly monitoring of water intake quantities and flow rates in the Yangon River.	EPC Contractor Cost
	Surface Water	Water Discharge from Hydrostatic Testing	Impact to surface water	■ Implement a hydrostatic test monitoring plan; ■ After the hydrostatic testing is complete, analyse the test water for contamination and appropriately treat before it is returned to the environment. Alternatively, the water can be treated/ disposed of by a licensed wastewater disposal/treatment company; ■ Ensure minimum erosion during discharge of hydrostatic test water; ■ Carry out monitoring and reporting of water consumption; ■ Reduce water need by optimizing the hydrostatic testing operation.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monitor water quality of hydrostatic testing fluid intake (before test), and before discharge (after test completion).	EPC Contractor Cost
	Surface Water	Sedimentation caused by soil erosion	Sedimentation in to Yangon River	■ Install silt trap to treat surface run-off from bunded areas prior to discharge to the stormwater system; ■ Exposed soil surfaces should be protected by paving or fill material as soon as possible to reduce the potential of soil erosion and subsequent sedimentation; ■ Use methods for minimising sediment runoff, as appropriate to the conditions on-site, including: wheel cleaning facilities, sand bag barriers, mulching, and re-vegetation, protect temporary trafficked areas on-site with coarse stone ballast or equivalent, open stockpiles of construction materials or construction wastes on-site should be covered with tarpaulin or similar fabric during rainstorms; ■ Regularly, and particularly following rainstorms, inspect and maintain drainage systems and erosion control and silt removal facilities to ensure proper and efficient operation at all times; ■ Surface run-off from bunded areas should pass through oil/water separators prior to discharge to the storm water system.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Continuous monitoring of excavated soil. Monthly surface water quality monitoring.	EPC Contractor Cost
1.5	Soil and Groundwater	Water Leakage from Hydrostatic Testing	Loss of soil	■ Control erosion through diversion drains, sediment fences, and sediment retention basins; ■ Drain all hydrostatic testing fluid at the designated discharge point as soon as possible, once all leaks have been identified, to minimize soil erosion.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Not required	EPC Contractor Cost
	Soil and Groundwater	Loss of containment of the sending and receiving station for HDD	Soil contamination	■ Place/install a buffer zone (such as sandbags, trenches, or other appropriate barriers) around the sending and receiving pits to reduce the potential of soil contamination in adjacent area; ■ Place the sending and receiving station at least 7.5 metres from any water source, to reduce the ■ Use mobile pumps, vacuum trucks, and other appropriate equipment to clean any bentonite spills; ■ Stop HDD activities, and other associated activities until the spill has been cleaned; ■ Re-evaluate appropriate drilling pressure for the specific area conditions before continuing HDD activities;	Appointed EPC Contractor	On site Project Management team and designated EHS team	Not required	EPC Contractor Cost

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				■ Conduct preventive maintenance for HDD and spill clean-up equipment; ■ Use sandbags to quarantine any bentonite spills beyond the planned buffer zone; and ■ Spill response plans should be prepared and implemented to address the potential accidental release of bentonite.				
	Soil and Groundwater	Loss of containment of waste bentonite storage	Soil contamination	■ Use appropriate waste containers and build secondary containment around chemical or waste storage on-site to avoid spillage or leakage of bentonite; ■ Obtain permission from the land owner to use selected land for bentonite waste storage; ■ Provide waste sub-contractor or land owner with the bentonite MSDS, and the bentonite's properties, such as Electrical Conductivity (ECe), Exchangeable Sodium, and Exchangeable Sodium Percentage; ■ Ensure bentonite waste storage is not located on agricultural, and aquaculture land; ■ Ensure bentonite waste storage is at least 30 metres away from any groundwater sources; ■ Spill response plans should be prepared and implemented to address the potential accidental release of bentonite; ■ Prepare only the require amount of bentonite needed for HDD activities, to prevent excess amounts of bentonite to be disposed.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Not required	EPC Contractor Cost
1.5	Soil and Groundwater	Improper management during site clearance and excavation activities	Loss of soil	■ Delineation of clearance boundaries to limit the areas to be cleared; ■ Scheduling clearance activities (if possible) to avoid extreme weather events such as heavy rainfall, extreme dry and high winds; ■ Revegetation areas with temporary land use, conducting progressive rehabilitation; ■ Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers; ■ Reuse topsoil as much as possible within rehabilitation activities; ■ Control erosion through diversion drains, sediment fences, and sediment retention basins; ■ Where topsoil is to be stored for later use in rehabilitation activities, the following basic principles are to be applied: – Stockpiles to be separated into topsoil and sub-soil and be located at least 50m from any surface water source or groundwater well; – To the extent possible, stockpiles are to be located in areas surrounded by natural wind barriers to minimise the potential for wind erosion; – Stockpile storage areas are to be prepared in advance of the removal of topsoil as much as possible; and – Topsoil heights are to be restricted in height to 2m above ground level to minimise wind erosion, and they are only to be partially compacted on the upper layer in order to promote aeration, maintain soil vertical structures, reduce runoff and encourage infiltration.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Not required	EPC Contractor Cost
1.6	Waste	Improper management of biomass waste	Impact to soil, groundwater, surface water, human and biodiversity	■ Any biomass not taken by the local community is to be appropriately stored (or immediately mulched) for later use within site stabilisation and rehabilitation activities; ■ Site clearance and preparation is to be designed and conducted in a manner that requires minimum removal of vegetation; ■ Introduce and implement, where practicable, a recycling plan for biomass waste to reduce the amount of biomass required to be burnt. This may include identifying potential market or appropriate industry to reintroduce the biomass as part of their resource consumption; ■ Ensure no hazardous materials or chemicals are present within the biomass waste (for example due to an accidental spill) prior to burying; and ■ Location of burying are to be far away from sensitive receptors and in a location where impact of burying can be appropriately controlled.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monitoring pf waste segregation, transportation and disposal practices. Monitoring of appointed waste contractors using COC documentation.	EPC Contractor Cost
	Waste	Generation and management of hazardous waste	Impact to soil, groundwater, surface water, human and biodiversity	■ Prior to construction commencing, TPMC is to engage with local authorities and other stakeholders to determine the capacity of the local waste management network to absorb the new waste streams generated from the Project during construction; ■ A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project construction. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified. ■ Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable; ■ Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the construction site; ■ Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed. Bi-yearly unplanned audit will be performed by TPMC HSE team	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monitoring pf waste segregation, transportation and disposal practices. Monitoring of appointed waste contractors using COC documentation.	EPC Contractor Cost

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				on all waste contractors in order to verify compliance with contract; ■ Monitoring of appointed waste contractors using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; ■ The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during construction activity is being managed responsibly; and ■ All hazardous materials required during the construction phase will be appropriately transported, stored and handled according to MSDS.				
	Waste	Generation and management of non-hazardous waste	Impact to soil, groundwater, surface water, human and biodiversity	■ A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project construction. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified; ■ Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable; ■ Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations; ■ Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed; ■ Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and ■ The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during construction activity is being managed responsibly.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monitoring of waste segregation, transportation and disposal practices in the project activity areas and disposal location. Monitoring of appointed waste contractors using chain-of custody documentation	EPC Contractor Cost
	Waste	Generation and management of domestic solid waste	Impact to soil, groundwater, surface water, human and biodiversity	■ A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project construction. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified. ■ Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable; ■ Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations; ■ Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed; ■ Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; ■ The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during construction activity is being managed responsibly; and ■ All hazardous materials required during the construction phase will be appropriately transported, stored and handled according to MSDS.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Regular Inspection of relevant domestic solid waste stream and sources of the domestic solid waste.	EPC Contractor Cost
	Waste	Generation and management of domestic liquid waste	Impact to soil, groundwater, surface water, human and biodiversity	■ All waste collection and storage measures as detailed within ***Chapter 8.4*** and ***Chapter 8.5*** (Surface Water, Soil and Groundwater) will be implemented; ■ Ensure the integrity of wastewater storage unit to avoid leaking of wastewater and odor to the surrounding receptors; and ■ Enforce rules that prevent inappropriate materials going into the sanitary wastewater stream.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Conduct regular maintenance on sanitary wastewater treatment system. Conduct regular testing of effluent water parameters at discharge location.	EPC Contractor Cost
1.8	Biodiversity	Construction Activities	Impacts to biodiversity values (habitats and	■ Strict rules against clearing vegetation will be imposed on all Project staff, workers, and all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws;	Appointed EPC Contractor	On site Project Management	Schedule and Implement a routine	EPC Contractor

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			species) due to permanent and temporary habitat loss	■ The Project Proponent shall be directly responsible for dissemination to its staff and workers of all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation, as well as the punishment that can expected if any staff or worker or other person associated with the Project violate rules and regulations; ■ The planned clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing; ■ Use of the access road should be restricted to construction vehicles only. Checkpoints should be used to manage access and inspect vehicles for timber and forest products taken from the Project Area.		team and designated EHS team	inspection program, and monitor vegetation clearing.	Cost
	Biodiversity	Construction Activities	Temporary disturbance or displacement of fauna	■ Construction vehicles will be maintained in accordance with industry standard to minimise unnecessary noise generation; ■ Traffic signs will be maintained on all roads depicting speed limits; ■ Access to facilities, including the access road should be restricted to construction vehicles only; and ■ Commitment will be made to raise awareness of the operator work force regarding flora and fauna values and make arrangements for restriction of hunting and poaching.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Regular inspection of the application of require mitigation measures.	EPC Contractor Cost
	Biodiversity	Construction Activities	Degradation of Habitat	■ Construction and domestic waste will be appropriately stored and disposed of to avoid attracting native and alien species to the construction and worker camp areas; ■ For areas in direct runoff path to a watercourse, sediment and erosion control devices will be installed and maintained until vegetation replanting can occur to stabilise disturbed soil surfaces; ■ Oil, chemical and solid waste will be stored, and handled and disposed of by appropriately licenced waste management contractors; ■ Invasive species management measures should be implemented in accordance to avoid introduction of weeds to natural and modified habitat areas; ■ Speed limits to maximum of 40 km/hr for construction vehicles will be enforced to limit noise and dust generation; and ■ Construction materials and chemicals will be appropriately secured to avoid accidental release to the natural environment (wind and water erosion).	Appointed EPC Contractor	On site Project Management team and designated EHS team	Regular inspection of the application of require mitigation measures.	EPC Contractor Cost
	Biodiversity	Construction Activities	Mortality of Resident Species	■ Speed limits to maximum of 40 km/hr for construction vehicles will be enforced to minimise potential for fauna strike; ■ Commitment will be made to raise awareness of values of important species and habitat areas to construction work force and arrangements will be made for restriction of poaching and forest product collection by staff; ■ Access restriction should be applied to Project facilities for non-construction vehicles; ■ Hunting wild animals will be strictly prohibited for all staff; and ■ Fishing and using of illegal fishing gear anywhere along the stream will be prohibited.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Regular inspection of the application of require mitigation measures.	EPC Contractor Cost
1.9	Social	Employment	Impacts to employment rates (increased)	■ The workforce will be sourced from areas close to the Project after a training and selection process; and thereafter at a regional or national level; and ■ The Project will develop a Sourcing, Procurement and Recruitment Management Plan which will be developed to promote benefits to locals from recruitment and procurement activities for the Project (including information, training and engagement).	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monitoring of local content conducted at the beginning of the construction phase.	EPC Contractor Cost
	Social	Transportation of equipment and construction material	Impact to fishing and Navigation	■ Develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on river ways/ areas. ■ The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose fishing activities are affected by the Project activities.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monitor the grievance log weekly	EPC Contractor Cost
	Social	Construction activity	Impact from economical displacement	■ TPMC will provide passages for local people to access local shops when trench is opened. ■ TPMC will engage a third party to develop a Resettlement Action Plan for the pipeline in order to ensure all receptors impacted by the Project are considered and compensated in accordance with international best practices. ■ TPMC will compensate stakeholders whose land is temporarily or permanently impacted during construction and operation using market price with a premium (to compensate for the change) and include the time during which the land is not fully rehabilitated. ■ TPMC will compensate stakeholders whose crops is being impacted during construction using the up-to-date market price for all cycle of production impacted. ■ TPMC will compensate stakeholders whose houses or building is impacted during construction using up	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monitor the grievance log weekly. Monitor the employment of stakeholders whose land are impacted.	EPC Contractor Cost

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				to date market price (with preference for in-kind compensation) and relocation allowance. ■ In case of loss of economic opportunities due to resettlement of structures, TPMC will compensate business owner based on the agreed loss of opportunities. ■ TPMC will use an external specialist to identify market price for the type of land, crops and structures being impacted by project activities. ■ Land take should be minimised to the extent possible both in terms of size and duration; and as such, when no activities are being undertaken, exclusions will be lifted. ■ TPMC will propose to recruit in priority stakeholders whose land, business or structure are being impacted during construction phase. Recruitment should offer position to those who can extend past the construction phase, in particular for those whose land is permanently impacted. ■ TPMC will need to develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities that will be conducted along areas, where pipeline will be installed. This will ensure that stakeholders can anticipate and can appropriately respond to the change and limitation of uses of areas. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose agricultural activities or shops are affected by the Project activities.				
	Social	Impact from transportation used during construction	Impact to the traffic and transport	■ TPMC will not transport workers, equipment and materials during the local traffic peak time; ■ TPMC will limit time for construction activities that will take place on or near local roads; and ■ TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on or proximate to local road. This will ensure that stakeholders can anticipate (and can appropriately respond to) the change and limitation of uses on local roads. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular transportation is affected by the Project activities.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monitor the grievance log on a weekly basis during operation phase	EPC Contractor Cost
	Social	Project using the existing facilities and utilities	Reducing the capacity of the existing facilities and utilities	■ TPMC will avoid parking vehicles and machinery next to sources of water for local population. ■ TPMC will ensure regular maintenance of all the equipment and vehicles used for construction. ■ TPMC will have specific and secured storage for used oil and other construction wastes. ■ TPMC will use certified contractor for waste management. ■ TPMC will used a certified contractor for the procurement of water during construction. ■ TPMC will engage monthly with local authorities and population to ensure access to water resources and other utilities are not impacted. ■ TPMC will provide appropriate amenities at the workforce accommodation camp – e.g. recreational opportunities. This will help reduce the need for workers to utilize local infrastructure and services; ■ TPMC will ensure that company medical services have sufficient capacity and capability to treat a reasonable amount of workers at the same time. ■ TPMC will develop and implement a Worker Code of Conduct for all employees, contractors and visitors directly related to the Project. This will include specified amount of water that the Project activities and workers can use per day. This will also be a contractual and enforced requirement for all staff and subcontractors. ■ TPMC will develop and implement a Stakeholder Engagement Plan ***Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on public infrastructures. This will ensure that stakeholders can anticipate and can appropriately respond to the change and limitation of uses. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular use of public services and infrastructures is affected by the Project activities.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Weekly review of grievance. Monthly inspection of infrastructure especially those near water sources. Monitoring for surface water.	EPC Contractor Cost
	Social	Construction activities (Noise, Vibrations, Dust)	Impacts to health and safety of the locals	■ TPMC will also need to develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly noisy activities (e.g. pile driving). ■ The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder impacted by noise, dust and vibration.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Weekly review of grievance log.	EPC Contractor Cost
	Social	Construction activities	Impacts to health and safety of the locals	■ Training for all workers on the transmission routes and common symptoms of communicable diseases. This can help reduce the potential for workers to unknowingly transmit communicable diseases. This may also help to increase knowledge within Project SAoI – e.g. through the training of workers that have been sourced from the local area; ■ Establish amenities at the worker camp to help minimize the interaction between the workforces (particularly temporary construction workers) and local villagers. This includes recreation facilities and	Appointed EPC Contractor	On site Project Management team and designated EHS team	Bi monthly review of training log. Monitoring and review of accidents due to construction	EPC Contractor Cost

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				health care infrastructure; ■ Establish a workforce code of conduct. This includeInclude in the code specific measures that target anti-social behaviour, such as becoming involved with commercial sex workers; ■ Undertake pre-employment screening to ensure fitness for work. It is important that the pre-screening process does not result in discrimination, but instead is used as a tool to minimize the transmission of communicable diseases; ■ Vector management procedures, including measures to reduce the presence of vector habitat and consideration of whether pesticides will be utilized to reduce the presence of vectors onsite; ■ Provision of onsite health care and medical facilities, to ensure that basic medical attention and first aid treatment can be sought during the hours that the work is being undertaken at the Project site. This will also help reduce the potential pressure on local health care facilities; ■ Pre-placement medical examination of all workers, supported by periodic medical examinations. A regular voluntary Worker Medical Screening Program onsite and a Monitoring and Evaluation (M&E) system. In addition a workplace policy and training and awareness programme on risks described above and prevention and mitigation of HIV impacts will be implemented with Project staff; ■ In collaboration with the local and regional Government, local emergency providers and local health care facilities, TPMC will develop and implement Emergency Prevention, Preparedness and Response Plans (EPPRPs) to cover all incidents presenting risks to public safety and the affected communities in proximity to the Project Sites and the environment; ■ Develop and implement a Workforce Code of Conduct. The Workforce Code of Conduct will be adhered to by all Contractors and TPMC employees. Any employee or Contractor found in violation of the Code shall face disciplinary hearing which may result in dismissal; ■ Ensure there is the access to free condoms (including female condoms) at the worker camp to promote safe sexual practices; ■ Conduct information, education and communication campaigns amongst Project personnel on hygiene and sanitation; ■ The EPC contractor should develop an effective Waste Management Plan that ensures adequate and legally acceptable control and management of transport and disposal of all wastes on and off site, including the exclusive use of licensed waste management contractors; ■ Security personnel will be contracted and trained in line with the Voluntary Principles on Security and Human Rights; ■ Accommodation should be provided to external workers in accordance with international good practice on workers' accommodation, including IFC / EBRD standards to prevent transmission of diseases associated with poor living conditions; ■ The Project should implement measures to reduce the presence of standing water onsite through environmental controls and source reduction to avoid the creation of new breeding grounds; ■ All the mitigation presented in the air quality and noise impact assessment chapter will be implemented; ■ The Project should develop a Traffic Management Plan covering vehicle safety, speed limits on roads, driver and passenger behaviour, use of drugs and alcohol, hours of operation, rest periods and location of rest stops and accident reporting and investigations; ■ Require Project drivers to be trained in defensive driving within the previous 3 years; ■ All vehicles used for the project should be regularly serviced and maintained; ■ Local speed limits should be adhered to when travelling through communities by all Project related traffic. Such speed limits will have the added advantage of reducing dust emissions; ■ Undertake consultation with communities along key transport routes to inform them about the potential for increased traffic movements prior to any changes; ■ Bentonite will be disposed of using a licensed contractor; ■ TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. As part of this Plan, awareness campaign on community health and safety, in particular regarding traffic accident and communicable diseases, should be develop and implemented. The Project will also include a Grievance Mechanism to collect grievances from local stakeholder affected by the Project activities; ■ The Project will ensure that signs are put up around construction sites advising people of the risks associated with trespass. All signs will be in diagram format to ensure key message is well received and understood by all parties; ■ Implement pipeline safety training plan in the villages proximity to pipeline; and ■ The Project will ensure that there is adequate fencing around construction site to minimise the risk of trespass. Fencing will be checked daily to ensure that it is in good condition and to look for any signs of entry.			(daily monitoring and monthly review). Community health and safety monitoring and surveillance program. Daily monitoring of construction area, worker camp and surrounding. Regular unplanned audit on worker code conduct. Bi-yearly unplanned audit of waste management contractors. Monthly visual inspection of first aid facilities and records. Weekly review of grievance log.	

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	Social	Construction activities	Impacts to health and safety of the workers	■ The Contractor will prepare and implement a Health and Safety Plan prior to commencing work. This plan will include method statements for work activities, construction sequence and safety arrangements; ■ Measures will be implemented to reduce the likelihood and consequence of the potential hazards. This shall include (but not limited to) the following hazards: – falling from height (in the trench); – falling into water; – entanglement with machinery; – tripping over permanent obstacles or temporary obstructions; – slipping on greasy walkways; – falling objects; – asphyxiation; – explosion; – contact with dangerous substances; – electric shock; – variable weather conditions; – lifting excessive weights; and – traffic operations. ■ A Permit to Enter system will be established to ensure that only authorised persons gain entry to the construction site; ■ Competent and adequately resourced sub-contractors will be used where construction activities are to be sub-contracted; ■ All persons working on the construction site will be provided information about risks on Site and arrangements will be made for workers to discuss health and safety with the Contractor; ■ The Contractor will prepare and implement a Health and Safety Plan prior to commencing work. This plan will include method statements for work activities, construction sequence and safety arrangements; ■ All workers will be properly informed, consulted and trained on health and safety issues; ■ Personal Protective Equipment (PPE) shall be worn at all times on the construction site. This shall include appropriate safety shoes, safety eyewear, and hard hats. Non-slip or studded boots will be worn to minimize the risk of slips; ■ Before starting work all the appropriate safety equipment and the first-aid kits will be assembled and checked as being in working order. Breathing apparatus if necessary will be tested at regular intervals in the manner specified by the manufacturer; ■ All lifting equipment and cranes will be tested and inspected regularly. All hoist ways will be guarded; ■ When there is a risk of drowning, lifebelts shall be provided and it shall be ensured that personnel wear adequate buoyancy equipment or harness and safety lines, and that rescue personnel are present when work is proceeding (near the water extraction point, the Yangon river or water channels); ■ Where sound levels cannot be reduced at the source, suitable hearing protection will be provided when noise levels indicate a Leq of more than 85 dB(A). When hearing protection is used, arrangements will be made to ensure the wearers can be warned of other hazards; ■ The Contractor shall provide appropriate safety barriers with hazard warning signs attached around all exposed openings and excavations; ■ The EPC contractor will comply with the IFC Performance Standard 2, local regulation and ILO conventions signed by Myanmar; and ■ TPMC will develop and monitor an internal standard to guide labour practices and apply this to supply chain to ensure that no child and/or forced labour will be employed by the EPC contractor and its sub-contractors.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Six monthly review of training log. Monitoring and review of accident and incidents (daily monitoring and monthly review). Development of occupational health and safety monitoring program. Weekly review of worker grievance log.	EPC Contractor Cost
	Social	Transportation and operation of machineries	Impact to cultural heritage sites	■ The EPC contractor will provide an alternative access to the monastery during the duration of the excavation on the main access path. The alternative access should be secured and able to sustain normal traffic to the monastery (reinforced structure if car often access the monastery for example); ■ The EPC contractor will develop the construction planning in discussion with the nearest temple/monastery in order to make sure that any Project activity near the monastery (e.g transport of large equipment) do not take place during special religious activities; and ■ TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The Project will also include a Grievance Mechanism to collect grievances from local stakeholder affected by the Project activities.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monitoring and review of accidents and incidents. Weekly review of grievance log.	EPC Contractor Cost
1.10	Unplanned Event	Fire and explosion	Potential impacts include injuries, fatalities, and damage	■ Develop a preventive maintenance program for process equipment and pipelines in order to avoid failures and implement program regularly ■ Ensure the staff working to standard and strictly follow working procedures in order to prevent any	Appointed EPC Contractor	On site Project Management team and	Not required	EPC Contractor Cost

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			to property	incident ■ Install leak detecting and alarming system in operating areas and tank farm ■ Establish an Emergency Centre with 24 hours standby staff and firemen. This centre will be equipped with a communication system such as hot (emergency) line telephone, trunk radios, paging, inter-com, different alarm tones correspondence with each kind of situation, CCTV monitors those can view different areas of the Complex, etc. ■ Install fire protection and firefighting system ■ All fire prevention and firefighting systems shall be routinely inspected and maintained the by responsible persons ■ Establish a First-aid centre with 24 hours standby nurse. The First-aid centre must be equipped with sufficient first-aid equipment, first-aid kit and medicines ■ To establish emergency plan and evacuation plan with a clear emergency procedure set up. The procedure will include explanation of steps and guidelines that everybody has to follow such as below items – Witness should first control the emergency situation or extinguish fire based on emergency activity plan and report to boardman or shift supervisor or foreman of that unit immediately – The event shall be reported to the higher management level and emergency team shall be immediately formed according to the procedure set forth for providing support; – When the emergency signal rings, all workers have to stop all activities to a safe condition and move to assembly point immediately; – Assembly point shall be assigned for head counting and stand by for providing support; – The workers who first witness the accident have to put on the necessary personal protective equipment and enter the incident area from upwind only; – Limit the fire areas by utilizing the appropriate firefighting equipment; – All firefighting technique has to be exercised routinely during normal situation; and – Coordination with outside organizations such as nearby plants, hospitals, outside fire brigade team and so on. ■ Proper communication equipment of either station or mobile type will be provided in the plant such as hot (emergency) line telephones, trunk radios, paging, intercom and different alarm tones correspondence with each kind of situation.		designated EHS team		
	Unplanned Event	Seismic and earthquake	Potential impacts include injuries, fatalities, and damage to property	■ The Project facilities should be designed to meet the seismic design standard for instance NFPA 59A, ASME etc.; ■ Geotechnical studies during design phase and slope stability measures to consider impact of earthquakes of 1 in 10,000 year return period; ■ Emergency response procedures for the seismand severe weather condition will be formulated to contain and limit an emergency should one arise.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Not required	EPC Contractor Cost
	Unplanned Event	Loss of containment of waste storage unit	Potential impacts include contamination to environments and cause health effect to humans	■ Ensure the integrity of wastewater storage unit to avoid leaking of wastewater and odor to the surrounding receptors; ■ Use appropriate waste containers and build secondary containment around chemical or waste storage on-site to avoid spillage of waste and leakage of leachate during waste storage on-site; ■ Siting of chemical and waste storage should consider nearby receptors, i.e. site away from watercourses or portable water sources; ■ Hazardous waste should be stored so as to prevent or control accidental releases to air, soil and water resources. Where practicable: – The storage area should be clearly labelled and demarcated; – Readily available information on chemical compatibility should be provided to employees, including labelling each container to identify its contents; – Hazardous waste should be stored in a manner that prevents the commingling or contact between incompatible wastes and allows for inspection between containers to monitor leaks or spills; – Hazardous waste should be stored in closed containers away from direct sunlight, wind and rain; – Hazardous waste storage area should be have an impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest waste container; and – Hazardous waste storage areas have adequate ventilation, fire prevention system (if needed). ■ Spill response and emergency plans should be prepared and implemented to address the potential accidental release of hazardous waste; ■ On-site and off-site transportation of waste should be conducted so as to prevent or minimise spills, release and exposures to employees and public; ■ Maintenance facilities should be located on hard standing surfaces within a bunded area. Sumps and oil interceptors should be provided. Maintenance of vehicles and equipment involving activities with	Appointed EPC Contractor	On site Project Management team and designated EHS team	Not required	EPC Contractor Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				potential for leakage and spillage should only be undertaken within areas appropriately equipped to control these discharges; and ■ Design discharge point to be furthest away from sensitive receptors.				
B	**Operation Phase**							
1.1	Biodiversity	Operation Activities	Impacts to biodiversity values (habitats and species) due to permanent and temporary habitat loss	■ Strict rules against clearing vegetation will be imposed on all Project staff, workers, and all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws; ■ The Project Proponent shall be directly responsible for dissemination to its staff and workers of all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation, as well as the punishment that can expected if any staff or worker or other person associated with the Project violate rules and regulations; ■ Use of the access road should be restricted to operation vehicles only. Checkpoints should be used to manage access and inspect vehicles for timber and forest products taken from the Project Area.	Designated HSE team	On site Project Management team and designated EHS team	Schedule and Implement a routine inspection program, and monitor vegetation clearing	TPMC Operation Cost
	Biodiversity	Operation Activities	Temporary disturbance or displacement of fauna	■ Operational vehicles will be maintained in accordance with industry standard to minimise unnecessary noise generation; ■ Traffic signs will be maintained on all roads depicting speed limits; ■ Access to facilities, including the access road should be restricted to operational vehicles only; ■ For operational areas requiring night-time lighting, lights will be used only where necessary and will be directed towards the subject area and away from habitat areas where possible; and ■ Commitment will be made to raise awareness of the operator work force regarding flora and fauna values and make arrangements for restriction of hunting and poaching.	Designated HSE team	On site Project Management team and designated EHS team	Regular inspection of the application of require mitigation measures.	TPMC Operation Cost
	Biodiversity	Operation Activities	Degradation of Habitat	■ Operation and domestic waste will be appropriately stored and disposed of to avoid attracting native and alien species; ■ Oil, chemical and solid waste will be stored, and handled and disposed of by appropriately licenced waste management contractors; ■ Invasive species management measures should be implemented in accordance to avoid introduction of weeds to natural and modified habitat areas; ■ Speed limits to maximum of 40 km/hr for operation vehicles will be enforced to limit noise and dust generation; and ■ Operation materials and chemicals will be appropriately secured to avoid accidental release to the natural environment (wind and water erosion).	Designated HSE team	On site Project Management team and designated EHS team	Regular inspection of the application of require mitigation measures.	TPMC Operation Cost
	Biodiversity	Operation Activities	Mortality of Resident Species	■ Speed limits to maximum of 40 km/hr for operation vehicles will be enforced to minimise potential for fauna strike; ■ Commitment will be made to raise awareness of values of important species and habitat areas to operation work force and arrangements will be made for restriction of poaching and forest product collection by staff; ■ Access restriction should be applied to Project facilities for non-operation vehicles; ■ Hunting wild animals will be strictly prohibited for all staff; and ■ Fishing and using of illegal fishing gear anywhere along the stream will be prohibited.	Designated HSE team	On site Project Management team and designated EHS team	Regular inspection of the application of require mitigation measures.	TPMC Operation Cost
1.2	Social	Operation activities	Impact from Economic displacement	■ TPMC will implement the Resettlement Action Plan developed for the construction phase if any agricultural activity cannot be performed during the operation phase. ■ TPMC will use an external specialist to identify market price for the type of land and crops being impacted by project activities. ■ Land take should be minimised to the extent possible both in terms of size and duration; and as such, when no activities are being undertaken, exclusions will be lifted. ■ TPMC will need to continue implementing the Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan will include measures to notify local stakeholders in advance of any particularly activities. This will ensure stakeholders anticipate (and can appropriately respond to) the change and limitation of uses of areas. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose agricultural activities are affected by the Project activities.	Designated HSE team	HSE Department Manager	Monitor the grievance log weekly	TPMC Operation Cost
1.3	Unplanned Event	Fire and explosion	Potential impacts include injuries, fatalities, and damage to property	■ Develop a preventive maintenance program for process equipment and pipelines in order to avoid failures and implement program regularly ■ Ensure the staff working to standard and strictly follow working procedures in order to prevent any incident ■ Install leak detecting and alarming system in operating areas and tank farm	Designated HSE team	HSE Department Manager	Not required	TPMC Operation Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				■ Establish an Emergency Centre with 24 hours standby staff and firemen. This centre will be equipped with a communication system such as hot (emergency) line telephone, trunk radios, paging, inter-com, different alarm tones correspondence with each kind of situation, CCTV monitors those can view different areas of the Complex, etc. ■ Install fire protection and firefighting system ■ All fire prevention and firefighting systems shall be routinely inspected and maintained the by responsible persons ■ Establish a First-aid centre with 24 hours standby nurse. The First-aid centre must be equipped with sufficient first-aid equipment, first-aid kit and medicines ■ To establish emergency plan and evacuation plan with a clear emergency procedure set up. The procedure will include explanation of steps and guidelines that everybody has to follow such as below items ■ Witness should first control the emergency situation or extinguish fire based on emergency activity plan and report to boardman or shift supervisor or foreman of that unit immediately ■ The event shall be reported to the higher management level and emergency team shall be immediately formed according to the procedure set forth for providing support; ■ When the emergency signal rings, all workers have to stop all activities to a safe condition and move to assembly point immediately; ■ Assembly point shall be assigned for head counting and stand by for providing support; ■ The workers who first witness the accident have to put on the necessary personal protective equipment and enter the incident area from upwind only; ■ Limit the fire areas by utilizing the appropriate firefighting equipment; ■ All firefighting technique has to be exercised routinely during normal situation; and ■ Coordination with outside organizations such as nearby plants, hospitals, outside fire brigade team and so on. ■ Proper communication equipment of either station or mobile type will be provided in the plant such as hot (emergency) line telephones, trunk radios, paging, intercom and different alarm tones correspondence with each kind of situation.				
	Unplanned Event	Seismic and earthquake	Potential impacts include injuries, fatalities, and damage to property	■ The Project facilities should be designed to meet the seismic design standard for instance NFPA 59A, ASME etc.; ■ Geotechnical studies during design phase and slope stability measures to consider impact of earthquakes of 1 in 10,000 year return period; ■ Emergency response procedures for seismic and severe weather condition will be formulated to contain and limit an emergency should one arise.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Not required	EPC Contractor Cost

12.5.2.3 Mitigation Measures for the Power Plant

Table 12.4 Environmental and Social Management Plans for the Power Plant

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
A	**Site Preparation and Construction Phase**							
1.1	Air Quality	Construction activities	Impact to air quality due to dust emissions	■ Develop and Implement a Dust Management Plan (DMP) detailing mitigation measures and a plan for implementation. ■ Watering will be used to suppress wind and physical disturbance dust generation. ■ Ensure an adequate water supply on site for effective dust suppression and mitigation. ■ The site layout will be planned so that dust-causing activities are located away from receptors as far as is possible. ■ Screens or barriers will be erected around dusty activities or the site boundary that are at least the height of any stockpile on site. ■ All stockpiles will be covered or fenced off to prevent wind whipping. ■ Only cutting, grinding, or sawing equipment fitted with suitable dust suppression techniques such as water sprays will be used. ■ All chutes, conveyors and skips will be covered at all times. ■ Drop heights from conveyors, loading shovels and hoppers will be minimised. ■ No waste will be burned on site. ■ Re-vegetate earthwork and exposed areas as soon as is practicable. ■ Use hessian, mulches or trackifiers where it is not possible to revegetate, or cover with top soil as soon as is practicable. ■ Sand and other aggregates will be stored in bunded areas and will not be allowed to dry out unless this is required for a particular process, in which case additional control measures such as those detailed in this section will be applied. ■ Ensure that all vehicles entering and leaving the site are covered to avoid fugitive emissions during transport. ■ Inspect on-site haul roads for integrity and instigate the necessary repairs to the surfaces as soon as reasonable practicable. ■ Implement a wheel washing system. ■ Regularly dampen and clean the site access and local roads to remove any materials tracked out of the site. ■ All site access gates will be located at least 10m away from air sensitive receptors where possible. ■ The site layout will be planned so that machinery is located away from receptors as far as is possible. ■ All vehicles will switch off engines when stationary. ■ A regular vehicle and machinery maintenance and repair programme will be implemented. ■ Mains electricity or battery powered equipment will be used instead of diesel/petrol generators where practicable.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Regular site inspection to monitor compliance with the DMP. Daily onsite and offsite inspections to visually assess the dust emissions.	EPC Contractor Cost
1.2	Greenhouse gas	Use of on-site vehicles and heavy machineries for construction has the potential to increase greenhouse gas emissions	Impact on climatic condition due to GHG emissions.	■ Implement the same mitigation measures to minimize impacts to Air Quality (***No 1.1***). ■ Develop and implement preventive maintenance plan for machines, and engines to ensure combustion efficiency. ■ Develop vehicle and machineries maintenance plan.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly report to the Project Proponent	EPC Contractor Cost
1.3	Noise	Transportation and operation of workers, equipment and machineries	Impact to the ambient noise level	■ Schedule transportation of materials evenly throughout the day (to minimize accumulative noise impact from multiple noise sources); ■ Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components should be conducted; and ■ Avoid transportation of materials on- and off-site through existing community areas.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly noise monitoring conducted at the representative NSRs	EPC Contractor Cost
	Noise	Foundation work and	Impact to the	■ Noise barriers should be installed at the site boundary (facing the closest NSRs) and high enough	Appointed EPC	On site Project	Monthly noise	EPC Contractor

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
		civil construction	ambient noise level	which completely hides the noise sources from the NSR. It is anticipated that at least a 10 dB(A) noise reduction can be provided[156]. The noise barrier material should have a superficial surface density of at least 7 kg/m^2 and have no openings or gaps; ■ Well-maintained equipment to be operated on-site; ■ Normal working hours of the contractor should be between 07:00 and 22:00 hours from Monday to Saturday (except holiday). If work needs to be undertaken outside these hours, it should be limited to activities that do not lead to exceedance of noise criteria at nearby NSRs and avoid early morning and night time construction; ■ Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components; ■ Shut down or throttled down between work periods for machines and construction plant items (e.g. trucks) that may be in intermittent use; ■ Reduce the number of equipment operating simultaneously as far as practicable; ■ Orientate equipment known to emit noise strongly so that the noise is directed away from receptors far as practicable; ■ Locate noisy equipment (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable; ■ Avoid transportation of materials on- and off-site through existing community areas; and ■ Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site construction activities.	Contractor	Management team and designated EHS team	monitoring conducted at the representative NSRs	Cost
	Noise	Pre-commissioning, commissioning and testing	Impact to the ambient noise level	■ Noise barriers should be installed at the site boundary (facing the closest NSRs) and high enough which completely hides the noise sources from the NSR. It is anticipated that at least a 10 dB(A) noise reduction can be provided. The noise barrier material should have a superficial surface density of at least 7 kg/m^2 and have no openings or gaps; ■ Well-maintained equipment to be operated on-site; ■ Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components; ■ Reduce the number of equipment operating simultaneously as far as practicable; ■ Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable; ■ Locate noisy plant (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable;	Appointed EPC Contractor	On site Project Management team and designated EHS team	Noise pre-commissioning test should be conducted and kept as baseline at the representative NSRs.	EPC Contractor Cost
1.4	Surface Water	Sedimentation caused by soil erosion during construction	Impact to surface water quality	■ Install silt trap to treat surface run-off from bunded areas prior to discharge to the stormwater system; ■ Exposed soil surfaces should be protected by paving or fill material as soon as possible to reduce the potential of soil erosion and subsequent sedimentation; ■ Use methods for minimising sediment runoff, as appropriate to the conditions on-site, including: wheel cleaning facilities, sand bag barriers, mulching, and re-vegetation, protect temporary trafficked areas on-site with coarse stone ballast or equivalent, open stockpiles of construction materials or construction wastes on-site should be covered with tarpaulin or similar fabric during rainstorms; ■ Regularly, and particularly following rainstorms, inspect and maintain drainage systems and erosion control and silt removal facilities to ensure proper and efficient operation at all times; and ■ Surface run-off from bunded areas should pass through oil/water separators prior to discharge to the storm water system.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Continuous monitoring of excavated soil. Monthly surface water quality monitoring.	EPC Contractor Cost
	Surface Water	Sedimentation caused by piling activities	Impact to surface water quality	■ Evenly spread out the scheduling of piling activities to reduce the potential amount of sedimentation caused during one pilling session.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly surface water quality monitoring once pilling activities commence	EPC Contractor Cost
	Surface Water	Water intake during construction activities	Impact to surface water	■ Ensure water intake does not exceed the flow rates of the Yangon River.	Appointed EPC Contractor	On site Project Management team and	Monthly monitoring of water intake quantities and flow rates in the	EPC Contractor Cost

[156] FHWA. (2017). Highway Traffic Noise Barriers at a Glance. U.S. Department of Transportation. Federal Highway Administration. Retrieved from: https://www.fhwa.dot.gov/Environment/noise/noise_barriers/design_construction/keepdown.cfm

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
						designated EHS team	Yangon river	
1.5	Soil and Groundwater	Improper management during site clearance and excavation activities	Loss of soil	■ Delineation of clearance boundaries to limit the areas to be cleared; ■ Scheduling clearance activities (if possible) to avoid extreme weather events such as heavy rainfall, extreme dry and high winds; ■ Revegetation areas with temporary land use, conducting progressive rehabilitation; ■ Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers; ■ Reuse topsoil as much as possible within rehabilitation activities; ■ Control erosion through diversion drains, sediment fences, and sediment retention basins; and ■ Where topsoil is to be stored for later use in rehabilitation activities, the following basic principles are to be applied: – Stockpiles to be separated into topsoil and sub-soil and be located at least 50m from any surface water source or groundwater well; – To the extent possible, stockpiles are to be located in areas surrounded by natural wind barriers to minimise the potential for wind erosion; – Stockpile storage areas are to be prepared in advance of the removal of topsoil as much as possible; and – Topsoil heights are to be restricted in height to 2m above ground level to minimise wind erosion, and they are only to be partially compacted on the upper layer in order to promote aeration, maintain soil vertical structures, reduce runoff and encourage infiltration.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Not required	EPC Contractor Cost
1.6	Waste	Improper management of biomass waste during site clearance	Impact to soil, groundwater, surface water, biodiversity and human receptors	■ Any biomass not taken by the local community is to be appropriately stored (or immediately mulched) for later use within site stabilisation and rehabilitation activities; ■ Site clearance and preparation is to be designed and conducted in a manner that requires minimum removal of vegetation; ■ Introduce and implement, where practicable, a recycling plan for biomass waste to reduce the amount of biomass required to be burnt. This may include identifying potential market or appropriate industry to reintroduce the biomass as part of their resource consumption; ■ Ensure no hazardous materials or chemicals are present within the biomass waste (for example due to an accidental spill) prior to burying; and ■ Location of burying are to be far away from sensitive receptors and in a location where impact of burying can be appropriately controlled.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monitoring pf waste segregation, transportation and disposal practices. Monitoring of appointed waste contractors using COC documentation.	EPC Contractor Cost
	Waste	Generation and management of hazardous waste during construction	Impact to soil, groundwater, surface water, biodiversity and human receptors	■ Prior to construction commencing, TPMC is to engage with local authorities and other stakeholders to determine the capacity of the local waste management network to absorb the new waste streams generated from the Project during construction; ■ A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project construction. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified; ■ Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable; ■ Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the construction site; ■ Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed. Bi-yearly unplanned audit will be performed by TPMC HSE team on all waste contractors in order to verify compliance with contract; ■ Monitoring of appointed waste contractors using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; ■ The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during construction activity is being managed responsibly; and ■ Effluent from chemical cleaning of the equipment during the pre-commissioning phase will be collected in an appropriate drainage system and transported off-site to a licensed Hazardous Waste Treatment Facility. The capacity of this facility will be assessed to ensure that it is capable of managing the Project's wastewater volumes.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monitoring pf waste segregation, transportation and disposal practices. Monitoring of appointed waste contractors using COC documentation.	EPC Contractor Cost
	Waste	Generation and	Impact to soil,	■ A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior	Appointed EPC	On site Project	Monitoring pf waste	EPC Contractor

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
		management of non-hazardous waste during construction	groundwater, surface water, biodiversity and human receptors	commencement of the Project construction. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified; ■ Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable; ■ Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations; ■ Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed; ■ Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and ■ The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during construction activity is being managed responsibly.	Contractor	Management team and designated EHS team	segregation, transportation and disposal practices. Monitoring of appointed waste contractors using COC documentation.	Cost
	Waste	Generation and management of domestic solid waste during construction and operation phase	Impact to soil, groundwater, surface water, biodiversity and human receptors	■ A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project construction. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the construction phase for all of the waste streams identified; ■ Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable; ■ Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations; ■ Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed; ■ Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of construction phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and ■ The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during construction activity is being managed responsibly.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Conduct regular inspection of relevant domestic solid waste streams and sources of the domestic solid waste	EPC Contractor Cost
	Waste	Generation and management of domestic liquid waste during construction and operation phase	Impact to soil, groundwater, surface water, biodiversity and human receptors	■ All waste collection and storage measures as detailed within ***Chapter 9.4*** and ***Chapter 9.5*** (Surface Water, Soil and Groundwater) will be implemented; ■ Ensure the integrity of wastewater storage unit to avoid leaking of wastewater and odor to the surrounding receptors; ■ Enforce rules that prevent inappropriate materials going into the sanitary wastewater stream; and ■ Design discharge point to be furthest away from sensitive receptors.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Conduct regular maintenance on sanitary wastewater treatment system. Conduct regular testing of effluent water parameters at discharge location.	EPC Contractor Cost
1.7	Visual and Landscape	Physical presence during construction	Impact to the scenic	■ Provide soft landscaping (i.e. tree, low shrub and ground cover planting) within available space within the Project Site. Plant as soon as practical during construction phase; ■ Minimize the extent of construction areas, including for dredging and including temporarily affected areas; ■ Minimize clearing of vegetation as far as practical. Existing large trees (if any) should be retained as far as practical. Those that fall outside the earthworks area must be retained. Felled trees should be compensated for where possible; and ■ Reinstatement of temporarily affected areas which will no longer be required for the construction stage (e.g. contractor camp, laydown areas, etc.), to suitable pre-construction condition as soon as practical after use (e.g. using landscaping with suitable vegetation).	Appointed EPC Contractor	On site Project Management team and designated EHS team	Not required	EPC Contractor Cost
1.8	Biodiversity	Construction Activities	Impacts to biodiversity values	■ Strict rules against clearing vegetation will be imposed on all Project staff, workers, and all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws;	Appointed EPC Contractor	On site Project Management	Schedule and Implement a routine	EPC Contractor Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
			(habitats and species) due to permanent and temporary habitat loss	■ The Project Proponent shall be directly responsible for dissemination to its staff and workers of all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation, as well as the punishment that can expected if any staff or worker or other person associated with the Project violate rules and regulations; ■ The planned clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing; ■ Use of the access road should be restricted to construction vehicles only. Checkpoints should be used to manage access and inspect vehicles for timber and forest products taken from the Project Area.		team and designated EHS team	inspection program, and monitor vegetation clearing.	
	Biodiversity	Construction Activities	Temporary disturbance or displacement of fauna	■ Construction vehicles will be maintained in accordance with industry standard to minimise unnecessary noise generation; ■ Traffic signs will be maintained on all roads depicting speed limits; ■ Access to facilities, including the access road should be restricted to construction vehicles only; and ■ Commitment will be made to raise awareness of the operator work force regarding flora and fauna values and make arrangements for restriction of hunting and poaching.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Regular inspection of the application of require mitigation measures.	EPC Contractor Cost
	Biodiversity	Construction Activities	Degradation of Habitat	■ Construction and domestic waste will be appropriately stored and disposed of to avoid attracting native and alien species to the construction and worker camp areas; ■ For areas in direct runoff path to a watercourse, sediment and erosion control devices will be installed and maintained until vegetation replanting can occur to stabilise disturbed soil surfaces; ■ Oil, chemical and solid waste will be stored, and handled and disposed of by appropriately licenced waste management contractors; ■ Invasive species management measures should be implemented in accordance to avoid introduction of weeds to natural and modified habitat areas; ■ Speed limits to maximum of 40 km/hr for construction vehicles will be enforced to limit noise and dust generation; and ■ Construction materials and chemicals will be appropriately secured to avoid accidental release to the natural environment (wind and water erosion).	Appointed EPC Contractor	On site Project Management team and designated EHS team	Regular inspection of the application of require mitigation measures.	EPC Contractor Cost
	Biodiversity	Construction Activities	Mortality of Resident Species	■ Speed limits to maximum of 40 km/hr for construction vehicles will be enforced to minimise potential for fauna strike; ■ Commitment will be made to raise awareness of values of important species and habitat areas to construction work force and arrangements will be made for restriction of poaching and forest product collection by staff; ■ Access restriction should be applied to Project facilities for non-construction vehicles; ■ Hunting wild animals will be strictly prohibited for all staff; and ■ Fishing and using of illegal fishing gear anywhere along the stream will be prohibited.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Regular inspection of the application of require mitigation measures.	EPC Contractor Cost
1.9	Social	Construction activities increasing employment opportunity	Increase employment rate	■ The workforce will be sourced from areas close to the Project after a training and selection process; and thereafter at a regional or national level; and ■ The Project will develop a Sourcing, Procurement and Recruitment Management Plan which will be developed to promote benefits to locals from recruitment and procurement activities for the Project (including information, training and engagement).	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monitor at the beginning of the construction phase	EPC Contractor Cost
	Social	Transportation of materials	Increase navigation traffic	■ At least 30 days prior to mobilization, TPMC will coordinate with local authorities , who will then issue “Notice to Mariner” regarding project activities to appropriate parties (i.e. Department of Fisheries, Ministry of Livestock, Fisheries and Rural Development, and Myanmar Navy). ■ Establish a 100 m exclusion zone and 150 m safety zone around the construction zone and provide support vessels to observe fishing and commercial vessels approaching the safety zone to prevent collision. ■ Provide appropriate lights and warning signals on construction vessels to prevent accidental collision. ■ Ensure all captain and skippers on the construction vessels are trained and have the necessary permits and certificate to operate the construction vessels. ■ TPMC will inform the exact location of the Project site with detail of safe zone, and alternative transportation routes to local stakeholders, as well as Department of Fisheries, Ministry of Livestock, Fisheries and Rural Development, and Myanmar Navy. ■ TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monitor grievance log weekly. Review accident log of support as necessary. Conduct at least 3 times per year unplanned verification of permit and safety equipment. Review engagement and communication log with local	EPC Contractor Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on river ways/ areas. This will ensure that stakeholders can anticipate and appropriately respond to the change and limitation of uses on river ways/ areas. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular navigation is affected by the Project activities.			authorities.	
	Social	Transportation during construction	Impact to traffic and transport	■ TPMC will not transport equipment and materials during the local traffic peak time. ■ Prior to transportation of Construction phase material & equipmenet to site, TPMC will inform proposed tranportation route and scheudle to Yangon Regional Governement and will tranport within permitted date and duration. ■ TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on or near local road. This will ensure that stakeholders can anticipate and can appropriately respond to the change and limitation of uses on local roads. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular transportation is affected by the Project activities.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monitor the grievance log weekly during construction	EPC Contractor Cost
	Social	Construction activities	Increase consumption of existing facilities and utilities	■ Provide appropriate amenities at the workforce accommodation camp – e.g. recreational opportunities. This will help reduce the need for workers to utilize local infrastructure and services; ■ TPMC will ensure that company medical services have sufficient capacity and capability to treat a reasonable amount of workers at the same time. ■ Develop and implement a Worker Code of Conduct for all employees, contractors and visitors directly related to the Project which will be a contractual and enforced requirement for all staff and subcontractors. ■ Develop and implement a traffic management plan to minimize the impact experienced by road users as a result of the Project. The traffic management plan should be developed in consultation with local stakeholders. Stakeholders should be notified in advance of the Project commencing of traffic routes that will be utilised and, where known, periods of increased traffic volumes. Where possible, traffic movements will be coordinated so as to limit disruptions to local activities; ■ Develop and implement a community health management plan and an occupational health and safety plan in consultation with relevant stakeholders (e.g. local health practitioners). These plans will ensure that appropriate and adequate health care services are provided on site and at the accommodation camp to address/ manage worker illnesses and injuries.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monthly engagement with local authorities and service providers. Weekly review of grievance log. Monthly inspection of infrastructure.	EPC Contractor Cost
	Social	Construction activities	Emission causing nuisance human receptors	■ Develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly noisy activities (e.g. pile driving); and. ■ The Project should also continue to use the Grievance Mechanism to collect grievances from local stakeholder impacted by noise, dust and vibration.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Monitor the grievance log on a weekly basis	EPC Contractor Cost
	Social	Construction activities	Impact to the community health and safety	■ Training for all workers on the transmission routes and common symptoms of communicable diseases. This can help reduce the potential for workers to unknowingly transmit communicable diseases. This may also help to increase knowledge within Project SAoI – e.g. through the training of workers that have been sourced from the local area; ■ Establish amenities at the worker camp to help minimize the interaction between the workforces (particularly temporary construction workers) and local villagers. This includes recreation facilities and health care infrastructure; ■ Undertake pre-employment screening to ensure fitness for work. It is important that the pre-screening process does not result in discrimination, but instead is used as a tool to minimize the transmission of communicable diseases; ■ Vector management procedures, including measures to reduce the presence of vector habitat and consideration of whether pesticides will be utilized to reduce the presence of vectors onsite; ■ Provision of onsite health care and medical facilities, to ensure that basic medical attention and first aid treatment can be sought during the hours that the work is being undertaken at the Project site. This will also help reduce the potential pressure on local health care facilities; ■ Pre-placement medical examination of all workers, supported by periodic medical examinations. A regular voluntary Worker Medical Screening Program onsite and a Monitoring and Evaluation (M&E) system. In addition a workplace policy and training and awareness programme on risks described above and prevention and mitigation of HIV impacts will be implemented with Project staff; ■ In collaboration with the local and regional Government, local emergency providers and local	Appointed EPC Contractor	On site Project Management team and designated EHS team	Bi-monthly review of training log. Monitor and review accidents and incidents due to construction activities (daily monitoring and monthly review). Development community health and safety monitoring program. Daily monitoring of construction area, worker camp and surrounding. Regular unplanned	EPC Contractor Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				health care facilities, TPMC will develop and implement Emergency Prevention, Preparedness and Response Plans (EPPRPs) to cover all incidents presenting risks to public safety and the affected communities in proximity to the Project Sites and the environment; ■ Develop and implement a Workforce Code of Conduct which will be adhered to all Contractors and TPMC employees. The specific measures that target anti-social behaviour, such as becoming involved with commercial sex workers are also include. Any employee or Contractor found in violation of the Code shall face disciplinary hearing which may result in dismissal; ■ Ensure the access to free condoms (including female condoms) at the worker camp to promote safe sexual practices; ■ Conduct information, education and communication campaigns amongst Project personnel on hygiene and sanitation; ■ The EPC contractor should develop an effective Waste Management Plan that ensures adequate and legally acceptable control and management of transport and disposal of all wastes on and off site; ■ Security personnel will be contracted and trained in line with the Voluntary Principles on Security and Human Rights; ■ Accommodation should be provided to external workers in accordance with international good practice on workers' accommodation, including IFC / EBRD standards to prevent transmission of diseases associated with poor living conditions; ■ The Project should implement measures to reduce the presence of standing water onsite through environmental controls and source reduction to avoid the creation of new breeding grounds; ■ All the mitigation presented in the air quality and noise impact assessment chapter will be implemented; ■ The Project should develop a Traffic Management Plan covering vehicle safety, speed limits on roads, driver and passenger behaviour, use of drugs and alcohol, hours of operation, rest periods and location of rest stops and accident reporting and investigations; ■ Require Project drivers to be trained in defensive driving within the previous 3 years; ■ All vehicles used for the project should be regularly serviced and maintained; ■ Local speed limits should be adhered to when travelling through communities by all Project related traffic. Such speed limits will have the added advantage of reducing dust emissions; ■ Undertake consultation with communities along key transport routes to inform them about the potential for increased traffic movements prior to any changes; ■ At least 30 days prior to mobilization, TPMC will coordinate with local authorities , who will then issue "Notice to Mariner" regarding project activities to appropriate parties (i.e. Department of Fisheries, Ministry of Livestock, Fisheries and Rural Development, and Myanmar Navy); ■ Establish a 100 m exclusion zone and 150 m safety zone around the construction zone and provide support vessels to observe fishing and commercial vessels approaching the safety zone to prevent collision; ■ Provide appropriate lights and warning signals on construction vessels to prevent accidental collision; ■ Ensure all captain and skippers on the construction vessels are trained and have the necessary permits and certificate to operate the construction vessels; ■ TPMC will inform the exact location of the Project site with detail of safe zone, and alternative transportation routes to local stakeholders, as well as Department of Fisheries, Ministry of Livestock, Fisheries and Rural Development, and Myanmar Navy; ■ TPMC will develop and implement a Stakeholder Engagement Plan ***(Appendix V)*** as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on river ways/ areas. This will ensure stakeholders anticipate (and can appropriately respond to) the change and limitation of uses on river ways/ areas. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular navigation is affected by the Project activities; ■ The Project will ensure that signs are put up around construction sites advising people of the risks associated with trespass. All signs should be in diagram form to ensure those with low levels of literacy understand the signs; and ■ The Project will ensure that there is adequate fencing around construction site to minimise the risk of trespass. Fencing will be checked daily to ensure that it is in good condition and to look for any signs of entry.			audit related to worker code of conduct. Bi-yearly unplanned audit of waste management contractors and facilities. Monthly visual inspection of first aid facilities and records. Weekly review of grievance log.	
	Social	Construction activities	Impact to the	■ The 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	Appointed EPC	On site Project	Six monthly review of	EPC Contractor

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
			occupational health and safety	and safety arrangements; ■ Measures will be implemented to reduce the likelihood and consequence of the potential hazards. This shall include (but not limited to) the following hazards: – falling from height; – falling into water; – entanglement with machinery; – tripping over permanent obstacles or temporary obstructions; – slipping on greasy walkways; – falling objects; – asphyxiation; – explosion; – contact with dangerous substances; – electric shock; – variable weather conditions; – lifting excessive weights; and – traffic operations. ■ A Permit to Enter system will be established to ensure that only authorised persons gain entry to the construction site; ■ Competent and adequately resourced sub-contractors will be used where construction activities are to be sub-contracted; ■ All persons working on the construction site will be provided information about risks on Site and arrangements will be made for workers to discuss health and safety with the Contractor; ■ The 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; ■ All workers will be properly informed, consulted and trained on health and safety issues; ■ Personal Protective Equipment (PPE) shall be worn at all times on the construction Site. This shall include appropriate safety shoes, safety eyewear, and hard hats. Non-slip or studded boots will be worn to minimize the risk of slips; ■ Before starting work all the appropriate safety equipment and the first-aid kits will be assembled and checked as being in working order. Breathing apparatus if necessary will be tested at regular intervals in the manner specified by the manufacturer; ■ All lifting equipment and cranes will be tested and inspected regularly. All hoist ways will be guarded; ■ All scaffolding will be erected and inspected in conformity with the Factories Act (1951) and the appropriate records maintained by the Contractor; ■ Safety hoops or cages will be provided for ladders with a height in excess of two meters; ■ When there is a risk of drowning lifebelts shall be provided and it shall be ensured that personnel wear adequate buoyancy equipment or harness and safety lines, and that rescue personnel are present when work is proceeding (near the water extraction point); ■ All breathing apparatus, safety harnesses, life-lines, reviving apparatus and any other equipment provided for use in, or in connection with, entry into Confined Spaces, and for use in emergencies, will be properly maintained and thoroughly examined at least once a month, and after every occasion on which it has been used; ■ Where sound levels cannot be reduced at the source, suitable hearing protection will be provided when noise levels indicate a Leq of more than 85 dB(A). When hearing protection is used, arrangements will be made to ensure the wearers can be warned of other hazards; ■ The Contractor shall provide appropriate safety barriers with hazard warning signs attached around all exposed openings and excavations; ■ The EPC contractor will comply with the IFC Performance Standard 2, local regulation and ILO conventions signed by Myanmar; and ■ TPMC will develop and monitor an internal standard to guide labour practices and apply this to supply chain to ensure that no child and/or forced labour will be employed by the EPC contractor and its sub-contractors.	Contractor	Management team and designated EHS team	training log. Monitoring and review of accidents and incidents due to construction activities (daily monitoring and monthly review). Development of an occupational health and safety monitoring program. Weekly review of worker grievance log.	Cost
	Social	Construction activities and transportation of equipment	Impact to cultural heritage sites	■ The EPC contractor during construction will monitor the state of the monastery closest to the project site. If damage is done to the buildings by vehicle of the Project, compensation (in kind or in cash) should be organised to restore the building to its state before the damage occur; ■ The EPC contractor will develop the construction planning in discussion with the temple in order to make sure that any Project activity near the monastery (e.g transport of large equipment) do not	Appointed EPC Contractor	On site Project Management team and designated HSE	Monitoring and review of accidents and incidents. Weekly review of	EPC Contractor Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				take place during special religious activities; and ■ The EPC contractor will monitor the grievance log weekly.		team	grievance log.	
1.11	Unplanned Event	Chemical spill or leak	Potential impacts include contamination to environments and cause health effect to humans	■ Contractor will prepare unloading and loading protocols and train staff to prevent spills and leaks; ■ Contractor will prepare guidelines and procedures for immediate clean-up actions following any spillages of oils, fuels or chemicals; ■ 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 for fuel oil and chemicals will be surrounded by bunds or other containment devices to prevent spilled oil, fuel and chemicals from percolating into the ground or reaching the receiving waters; ■ Implement a construction materials inventory management system to minimise over-supply of the materials; ■ Provide dedicated storage areas for construction materials to minimize the potential for damage or contamination of the materials; ■ Ensure storage areas have impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest storage container; ■ Provision of grounding and lightning protection for equipment that handles flammable materials; ■ Establish a first-aid centre with first-aid trained staff on site. The first-aid centre shall be equipped with sufficient first-aid equipment, first-aid kit and medicines; ■ Emergency response plan should include informing the public and relevant parties ■ Employee and contractor must be trained on emergency response procedure.	Appointed EPC Contractor	On site Project Management team and designated HSE team	Not required	EPC Contractor Cost
	Unplanned Event	Fire and explosion	Potential impacts include injuries, fatalities, and damage to property	■ Pipelines will be built and maintained according to American Petroleum Institute (API) or the American Society of Mechanical Engineering (ASME) standards; ■ Install a system pressure monitor to detect leaks; ■ Conduct routine inspections and preventive maintenance for all pipelines and associated equipment at least once per year; ■ Set up the communication procedure between project staff and external parties; ■ Train operators to strictly follow the working procedures both for normal operation and emergency; and ■ Emergency response plan should include informing the public and relevant parties	Appointed EPC Contractor	On site Project Management team and designated HSE team	Not required	EPC Contractor Cost
	Unplanned Event	Loss of containment of waste storage facilities on-site during construction phase	Potential impacts include contamination to environments and cause health effect to humans	■ Ensure the integrity of wastewater storage unit to avoid leaking of wastewater and odour to the surrounding receptors; ■ Use appropriate waste containers and build secondary containment around chemical or waste storage on-site to avoid spillage of waste and leakage of leachate during waste storage on-site; ■ Siting of chemical and waste storage should consider nearby receptors, i.e. site away from watercourses or portable water sources; ■ Hazardous waste should be stored so as to prevent or control accidental releases to air, soil and water resources. Where practicable: – The storage area should be clearly labelled and demarcated; – Readily available information on chemical compatibility should be provided to employees, including labelling each container to identify its contents; – Hazardous waste should be stored in a manner that prevents the commingling or contact between incompatible wastes and allows for inspection between containers to monitor leaks or spills; – Hazardous waste should be stored in closed containers away from direct sunlight, wind and rain; – Hazardous waste storage area should be have an impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest waste container; and – Hazardous waste storage areas have adequate ventilation, fire prevention system (if needed). ■ Spill response and emergency plans should be prepared and implemented to address the potential accidental release of hazardous waste; ■ On-site and off-site transportation of waste should be conducted so as to prevent or minimise spills, release and exposures to employees and public; ■ Maintenance facilities should be located on hard standing surfaces within a bunded area. Sumps and oil interceptors should be provided. Maintenance of vehicles and equipment involving activities with potential for leakage and spillage should only be undertaken within areas appropriately	Appointed EPC Contractor	On site Project Management team and designated HSE team	Regular maintenance on domestic liquid waste treatment system. Regular testing of effluent water parameters at the discharge location.	EPC Contractor Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				equipped to control these discharges; and ■ Design discharge point to be furthest away from sensitive receptors.				
B	**Operation Phase**							
1.1	Air quality	Operation activities	Impact to air quality due to continuous Power Plant operations	■ Not required	Designated HSE team	HSE Department Manager	Continuous stack emission monitoring (CEM) throughout the operation. Annual stack emission testing.	TPMC Operation Cost
1.2	Greenhouse gas	Use of natural gas in turbine generator for electricity generator has the potential to increase greenhouse gas emissions	Impact on climatic condition due to GHG emissions.	■ Conduct annual pollutant release inventory to monitor the GHG emissions from the Project. The GHGs emission shall be reported as CO_2eq unit. ■ Where feasible, arrange emissions offsets (including the Kyoto Protocol's flexible mechanisms and the voluntary carbon market), including reforestation, afforestation.	Designated HSE team	HSE Department Manager	Collect data monthly and report annually	TPMC Operation Cost
1.3	Noise level	Operation activities	Impact to ambient noise level	■ Noise barriers should be installed at the site boundary (facing the closest NSRs) and high enough which completely hides the noise sources from the NSR. It is anticipated that at least a 10 dB(A) noise reduction can be provided. The noise barrier material should have a superficial surface density of at least 7 kg/m^2 and have no openings or gaps; ■ Well-maintained equipment to be operated on-site; ■ Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components; ■ Reduce the number of equipment operating simultaneously as far as practicable; ■ Orientate equipment known to emit noise strongly so that the noise is directed away from receptors far as practicable; and ■ Locate noisy plant (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable.	Designated HSE team	HSE Department Manager	Annual noise monitoring conducted at representative NSRs	TPMC Operation Cost
1.4	Surface Water	Operation activities	Impact to water intake	■ Not required	Designated HSE team	HSE Department Manager	Biannual monitoring water intake in the Yangon river	TPMC Operation Cost
	Surface Water	Operation of demineralized plant neutralized water	Impact to surface water	■ Discharge waste water quality will meet with IFC EHS guildline for Thermal Power Plant, pH, Temperature and Conductitiy, as well as NEQG 1.2 Wastewater Standard, before discharge.	Designated HSE team	HSE Department Manager	Bi-weekly monitoring the temperature at discharge point.	TPMC Operation Cost
	Surface Water	Operational Thermal Discharge	Impact to surface water	■ Not required	Designated HSE team	HSE Department Manager	Temperature monitoring at discharge point, bi-weekly, using standard analytical methods.	
1.5	Soil and Groundwater	Accidental leaks of demineralized plant neutralized water	Impact to soil and groundwater quality	■ Project Proponent will prepare guidelines and procedures for immediate clean-up actions following any leaks; ■ Use of spill or drip trays to contain leaks; ■ Use of spill control kits to contain and clean small spills and leaks; and ■ Employee must be trained on emergency response procedure.	Designated HSE team	HSE Department Manager	Monthly inspection of the discharge pipeline for leaks.	TPMC Operation Cost
	Soil and Groundwater	Accidental leaks of cooling water	Impact to soil and groundwater quality	■ Project Proponent will prepare guidelines and procedures for immediate clean-up actions following any leaks; ■ Use of spill or drip trays to contain leaks; ■ Employee must be trained on emergency response procedure.	Designated HSE team	HSE Department Manager	Monthly inspection of the discharge pipeline for leaks.	TPMC Operation Cost
1.6	Waste	Generation and management of hazardous waste	Impact to soil, groundwater, surface water,	■ A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project operation. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the operation phase for all of the waste streams identified;	Designated HSE team	HSE Department Manager	Monitoring of waste segregation, transportation and	TPMC Operation Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
		during operation	biodiversity and human receptors	■ Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable; ■ Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations; ■ Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed; ■ Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and ■ The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during operation activity is being managed responsibly.			disposal practices. Monitoring of appointed waste contractors using COC documentation.	
	Waste	Generation and management of non-hazardous waste during operation	Impact to soil, groundwater, surface water, biodiversity and human receptors	■ A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project operation. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the operation phase for all of the waste streams identified; ■ Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable; ■ Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations; ■ Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed; ■ Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and ■ The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during operation activity is being managed responsibly.	Designated HSE team	HSE Department Manager	Monitoring pf waste segregation, transportation and disposal practices. Monitoring of appointed waste contractors using COC documentation.	TPMC Operation Cost
	Waste	Generation and management of domestic solid waste during operation phase	Impact to soil, groundwater, surface water, biodiversity and human receptors	■ A Waste Management Plan (WMP) is to be developed by TPMC and EPC and confirmed prior commencement of the Project operation. The WMP will include specific requirements to manage, avoid, reduce and reuse waste during the operation phase for all of the waste streams identified; ■ Regular training and monitoring of all workers action on site shall be conducted strictly to avoid, reduce and reuse wastes generated where practicable; ■ Waste clean-up measures are to be undertaken on at least a fortnightly basis to collect any waste or unused materials from the Project site. All waste collected should be managed and disposed of in accordance with the required regulations; ■ Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be transported and managed; ■ Monitoring of approved waste contractors (which will be chosen by the EPC prior commencement of operation phase) using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations; and ■ The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during operation activity is being managed responsibly.	Designated HSE team	HSE Department Manager	Conduct regular maintenance on sanitary wastewater treatment system. Conduct regular testing of effluent water parameters at discharge location.	TPMC Operation Cost
	Waste	Generation and management of domestic liquid waste during operation phase	Impact to soil, groundwater, surface water, biodiversity and human receptors	■ All waste collection and storage measures as detailed within ***Chapter 9.4*** and ***Chapter 9.5*** (Surface Water, Soil and Groundwater) will be implemented; ■ Ensure the integrity of wastewater storage unit to avoid leaking of wastewater and odor to the surrounding receptors; ■ Enforce rules that prevent inappropriate materials going into the sanitary wastewater stream; and ■ Design discharge point to be furthest away from sensitive receptors.	Designated HSE team	HSE Department Manager	Conduct regular maintenance on sanitary wastewater treatment system. Conduct regular testing of effluent water parameters at discharge location.	TPMC Operation Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
1.7	Visual	Physical presence during operation phase	Impact to the scenic	■ Visual screening e.g. surround perimeter of site with native trees (can be compensatory trees for any felled during construction); ■ Maintain soft landscaping (i.e. tree, low shrub and ground cover planting) within available space in the Project Site; ■ Minimise overall lighting use and manage lighting on site to consider minimization of light pollution and horizon glow; - identify zones of high and low lighting requirements and contain light to areas that need illumination most; - prevent light spill/ glare with shielding i.e. All security and street/road lighting shall have “blinkers” or be specifically designed to ensure light is directed downwards while preventing side spill; - prevent light spill/ glare with directional lighting to focus on necessary area/object (eg reduce the height from which floodlights are fixed and with the focus of the lights being inward, rather than outward); - keep light intensity to as low as reasonably practicable; - all external light fittings shall not allow light to shine upwards; - area lighting on any tall buildings/ masts should be confined to the lower landform elevations; and ■ Maintain all structural facilities in good repair.	Designated HSE team	HSE Department Manager	Not required	TPMC Operation Cost
1.1	Biodiversity	Operation Activities	Impacts to biodiversity values (habitats and species) due to permanent and temporary habitat loss	■ Strict rules against clearing vegetation will be imposed on all Project staff, workers, and all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws; ■ The Project Proponent shall be directly responsible for dissemination to its staff and workers of all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation, as well as the punishment that can expected if any staff or worker or other person associated with the Project violate rules and regulations; ■ Use of the access road should be restricted to operation vehicles only. Checkpoints should be used to manage access and inspect vehicles for timber and forest products taken from the Project Area.	Designated HSE team	On site Project Management team and designated EHS team	Schedule and Implement a routine inspection program, and monitor vegetation clearing	TPMC Operation Cost
	Biodiversity	Operation Activities	Temporary disturbance or displacement of fauna	■ Operational vehicles will be maintained in accordance with industry standard to minimise unnecessary noise generation; ■ Traffic signs will be maintained on all roads depicting speed limits; ■ Access to facilities, including the access road should be restricted to operational vehicles only; ■ For operational areas requiring night-time lighting, lights will be used only where necessary and will be directed towards the subject area and away from habitat areas where possible; and ■ Commitment will be made to raise awareness of the operator work force regarding flora and fauna values and make arrangements for restriction of hunting and poaching.	Designated HSE team	On site Project Management team and designated EHS team	Regular inspection of the application of require mitigation measures.	TPMC Operation Cost
	Biodiversity	Operation Activities	Degradation of Habitat	■ Operation and domestic waste will be appropriately stored and disposed of to avoid attracting native and alien species; ■ Oil, chemical and solid waste will be stored, and handled and disposed of by appropriately licenced waste management contractors; ■ Invasive species management measures should be implemented in accordance to avoid introduction of weeds to natural and modified habitat areas; ■ Speed limits to maximum of 40 km/hr for operation vehicles will be enforced to limit noise and dust generation; and ■ Operation materials and chemicals will be appropriately secured to avoid accidental release to the natural environment (wind and water erosion).	Designated HSE team	On site Project Management team and designated EHS team	Regular inspection of the application of require mitigation measures.	TPMC Operation Cost
	Biodiversity	Operation Activities	Mortality of Resident Species	■ Speed limits to maximum of 40 km/hr for operation vehicles will be enforced to minimise potential for fauna strike; ■ Commitment will be made to raise awareness of values of important species and habitat areas to operation work force and arrangements will be made for restriction of poaching and forest product collection by staff; ■ Access restriction should be applied to Project facilities for non-operation vehicles; ■ Hunting wild animals will be strictly prohibited for all staff; and ■ Fishing and using of illegal fishing gear anywhere along the stream will be prohibited.	Designated HSE team	On site Project Management team and designated EHS team	Regular inspection of the application of require mitigation measures.	TPMC Operation Cost
1.9	Social	Operation activities	Increase employment	■ All unskilled staffs must be recruited from the local population living directly around the Project area. If possible, the skilled workforce should also be sourced from areas close to the Project after a training and selection process; and thereafter at a regional or national level; and	Designated HSE team	HSE Department	Monitored at the beginning of the	TPMC Operation Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
			potential	■ The Project will use the Sourcing, Procurement and Recruitment Management Plan developed for the construction stage and cooperate with local academic institutions to identify future local employees with the relevant skills.		Manager	operation phase. Yearly monitoring during operation.	
	Social	Operation activities	Impact to environment	■ Continue to implement the Grievance Mechanism to collect grievances from local stakeholder impacted by noise, dust and vibration.	Designated HSE team	HSE Department Manager	Not required	TPMC Operation Cost
	Social	Operation activities	Impact to community health and safety	■ Training for all workers on the transmission routes and common symptoms of communicable diseases. This can help reduce the potential for workers to unknowingly transmit communicable diseases. This may also help to increase knowledge within Project SAoI – e.g. through the training of workers that have been sourced from the local area; ■ Undertake pre-employment screening to ensure fitness for work. It is important that the pre-screening process does not result in discrimination, but instead is used as a tool to minimize the transmission of communicable diseases; ■ Pre-placement medical examination of all workers, supported by periodic medical examinations. A regular voluntary Worker Medical Screening Program onsite and a Monitoring and Evaluation (M&E) system. In addition a workplace policy and training and awareness programme on risks described above and prevention and mitigation of HIV impacts will be implemented with Project staff; ■ Develop and implement a Workforce Code of Conduct which will be adhered to by all Contractors and TPMC employees. The specific measures that target anti-social behaviour, such as becoming involved with commercial sex workers are also include. Any employee or Contractor found in violation of the Code shall face disciplinary hearing which may result in dismissal; ■ Security personnel will be contracted and trained in line with the Voluntary Principles on Security and Human Rights; ■ All the mitigation presented in the air quality, noise, waste and surface water impact assessment chapter will be implemented; ■ A grievance procedure should be established whereby any complaints by neighbours or affected parties can be submitted, recorded and responded to; ■ The Project will ensure that signs are put up around the site advising people of the risks associated with trespass. All signs should be in diagram form to ensure those with low levels of literacy understand the signs; and ■ The Project will ensure that there is adequate fencing around the site to minimise the risk of trespass. Fencing will be checked daily to ensure that it is in good condition and to look for any signs of entry.	Designated HSE team	HSE Department Manager	Bi-monthly review of training log. Development of a community health and safety monitoring program. Regular unplanned audit related to the worker code of conduct. Bi-yearly unplanned audit of waste management contractors. Monthly visual inspection of first aid facilities and records. Weekly review of grievance log.	TPMC Operation Cost
	Social	Operation activities	Impact to occupational health and safety	■ The 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, operation sequence and safety arrangements; ■ Measures will be implemented to reduce the likelihood and consequence of the potential hazards. This shall include (but not limited to) the following hazards: – falling from height; – falling into water; – entanglement with machinery; – tripping over permanent obstacles or temporary obstructions; – slipping on greasy walkways; – falling objects; – asphyxiation; – explosion; – contact with dangerous substances; – electric shock; – variable weather conditions; – lifting excessive weights; and – traffic operations. ■ A Permit to Enter system will be established to ensure that only authorised persons gain entry to the operation site; ■ Competent and adequately resourced sub-contractors will be used where operation activities are to be sub-contracted; ■ All persons working on site will be provided information about risks on site, and arrangements will	Designated HSE team	HSE Department Manager	Six monthly review of training log. Monitoring and review of accidents and incidents (daily monitoring and monthly review). Development of an occupational health and safety monitoring program. Weekly review of worker grievance log.	TPMC Operation Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				be made for workers to discuss health and safety with any contractors; ■ All workers will be properly informed, consulted and trained on health and safety issues; ■ Personal Protective Equipment (PPE) shall be worn at all times on site. This shall include appropriate safety shoes, safety eyewear, and hard hats. Non-slip or studded boots will be worn to minimize the risk of slips; ■ Before starting work all the appropriate safety equipment and the first-aid kits will be assembled and checked as being in working order. Breathing apparatus if necessary will be tested at regular intervals in the manner specified by the manufacturer; ■ All lifting equipment and cranes will be tested and inspected regularly. All hoist ways will be guarded; ■ Safety hoops or cages will be provided for ladders with a height in excess of two meters; ■ When there is a risk of drowning, lifebelts shall be provided and it shall be ensured that personnel wear adequate buoyancy equipment or harness and safety lines, and that rescue personnel are present when work is proceeding (near the water extraction point); ■ All breathing apparatus, safety harnesses, life-lines, reviving apparatus and any other equipment provided for use in, or in connection with, entry into Confined Spaces, and for use in emergencies, will be properly maintained and thoroughly examined at least once a month, and after every occasion on which it has been used; ■ Where sound levels cannot be reduced at the source, suitable hearing protection will be provided when noise levels indicate a Leq of more than 85 dB(A). When hearing protection is used, arrangements will be made to ensure the wearers can be warned of other hazards; ■ The EPC contractor will comply with the IFC Performance Standard 2, local regulation and ILO conventions signed by Myanmar; and ■ TPMC will develop and monitor an internal standard to guide labour practices and apply this to supply chain to ensure that no child and/or forced labour will be employed by the EPC contractor and its sub-contractors.				
	Social	Operation activities	Impact to cultural heritage	■ The EPC contractor during construction will monitor the state of the monastery closest to the project site. If damage is done to the buildings by vehicle of the Project, compensation (in kind or in cash) should be organised to restore the building to its state before the damage occur; ■ The EPC contractor will develop the construction planning in discussion with the temple in order to make sure that any Project activity near the monastery (e.g transport of large equipment) do not take place during special religious activities; and ■ The EPC contractor will monitor the grievance log weekly.	Designated HSE team	HSE Department Manager	Not required	TPMC Operation Cost
1.11	Unplanned Event	Chemical spill and leakage	Potential impacts include contamination to environments and cause health effect to humans	■ Contractor will prepare unloading and loading protocols and train staff to prevent spills and leaks; ■ Contractor will prepare guidelines and procedures for immediate clean-up actions following any spillages of oils, fuels or chemicals; ■ 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 for fuel oil and chemicals will be surrounded by bunds or other containment devices to prevent spilled oil, fuel and chemicals from percolating into the ground or reaching the receiving waters; ■ Ensure storage areas have impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest storage container; ■ Provision of grounding and lightning protection for equipment that handles flammable materials; ■ Establish a first-aid centre with first-aid trained staff on site. The first-aid centre shall be equipped with sufficient first-aid equipment, first-aid kit and medicines; ■ Emergency response plan should include informing the public and relevant parties ■ Employee and contractor must be trained on emergency response procedure.	Designated HSE team	HSE Department Manager	Not required.	TPMC Operation Cost
	Unplanned Event	Fire and explosion	Potential impacts include injuries, fatalities, and damage to property	■ Pipelines will be built and maintained according to American Petroleum Institute (API) or the American Society of Mechanical Engineering (ASME) standards; ■ Install a system pressure monitor to detect leaks; ■ Conduct routine inspections and preventive maintenance for all pipelines and associated equipment at least once per year; ■ Set up the communication procedure between project staff and external parties; ■ Train operators to strictly follow the working procedures both for normal operation and emergency;	Designated HSE team	HSE Department Manager	Not required.	TPMC Operation Cost

S. No.	Project Stage/ Affected Aspect	Project Activity and affected area	Potential Impacts	Proposed Mitigation Measures (if applicable)	Responsibility for Mitigation implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Mitigation Cost Source
				and ■ Emergency response plan should include informing the public and relevant parties.				
	Unplanned Event	Loss of containment of waste storage facilities on-site during operation phase	Potential impacts include contamination to environments and cause health effect to humans	■ Ensure the integrity of wastewater storage unit to avoid leaking of wastewater and odor to the surrounding receptors; ■ Use appropriate waste containers and build secondary containment around chemical or waste storage on-site to avoid spillage of waste and leakage of leachate during waste storage on-site; ■ Siting of chemical and waste storage should consider nearby receptors, i.e. site away from watercourses or portable water sources; ■ Hazardous waste should be stored so as to prevent or control accidental releases to air, soil and water resources. Where practicable: – The storage area should be clearly labelled and demarcated; – Readily available information on chemical compatibility should be provided to employees, including labelling each container to identify its contents; – Hazardous waste should be stored in a manner that prevents the commingling or contact between incompatible wastes and allows for inspection between containers to monitor leaks or spills; – Hazardous waste should be stored in closed containers away from direct sunlight, wind and rain; – Hazardous waste storage area should be have an impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest waste container; and – Hazardous waste storage areas have adequate ventilation, fire prevention system (if needed). ■ Spill response and emergency plans should be prepared and implemented to address the potential accidental release of hazardous waste; ■ On-site and off-site transportation of waste should be conducted so as to prevent or minimise spills, release and exposures to employees and public; ■ Maintenance facilities should be located on hard standing surfaces within a bunded area. Sumps and oil interceptors should be provided. Maintenance of vehicles and equipment involving activities with potential for leakage and spillage should only be undertaken within areas appropriately equipped to control these discharges; and ■ Design discharge point to be furthest away from sensitive receptors.	Designated HSE team	HSE Department Manager	Regular maintenance on domestic liquid waste treatment system. Regular testing of effluent water parameters at the discharge location.	TPMC Operation Cost

12.5.2.4 Monitoring Programme for the LNG Terminal

Table 12.5: Environmental and Social Monitoring Programme for the LNG Terminal (Construction and Operation Phase)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for implementation	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 and construction workers camp	Visual inspection of all active work areas	Daily	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
Air quality	Impact to air quality due to dust emissions	Implementation of Dust Management Plan (DMP)	Project activity areas and construction workers camp (***Figure 12.1***).	As per DMP requirements (PM2.5 and PM10)	As per DMP requirements (Minimum every 2 month)	EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Impact to air quality due to vehicle emissions	Implementation of the Machinery Maintenance and Repair Programme (MMRP)	Project activity areas and construction workers camp (***Figure 12.1***).	As per MMRP requirements	As per MMRP requirements (Minimum every 6 month)	EPC Contractor	EPC Contractor Cost (included in Capex cost)
Noise	Increase in ambient noise levels	Noise levels in Leq, Leq day, Leq night and hourly Leq	Identified NSRs within 500 m from the Project boundary (***Figure 12.1***).	24-hour	Quarterly	3rd Party Environmental Consultant	EPC Contractor Cost (Approx ~3,000 USD / time)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for implementation	Cost
	Workers Health	Noise levels in Leq	Identified location within the construction area (***Figure 12.1***).	24-hour	Monthly	EPC Contractor	EPC Contractor Cost (included in Capex cost)
Soil	Contamination of soil	pH, salinity, NH_4^+, total P, heavy metals	Construction site or laydown area or spill area	Standard analytical methods	In the event of any leakage or spillage of hazardous substances, oil, or toxic chemicals	3rd Party Environmental Consultant	EPC Contractor Cost (Approx ~2500 USD / time)
	Soil quality	Monitoring of soil quality in the event of any leakage or spillage of hazardous substances, with the parameters to be sampled based upon the likely chemical compositions of the material.	Locations, to be defined on a case by case basis.	Standard analytical methods	Frequency to be defined on a case by case basis.	3rd Party Environmental Consultant	EPC Contractor Cost (Approx ~2500 USD / time)
Surface Water	Contamination of surface water	Parameters as per NEQG 1.2 Wastewater, Effluent, Sanitary Discharges and Storm Water Runoff	Yangon River (upstream and downstream of the LNG Receiving Terminal) (***Figure 12.1***)	Standard analytical methods	Every 6 month	3rd Party Environmental Consultant	EPC Contractor Cost (Approx ~2500 USD / time)
Ground Water	Contamination of ground water	pH, Electrical Conductivity,	At nearest ground water extraction	Standard analytical methods	Every 6 month or upon complaint	3rd Party Environmental	EPC Contractor

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for implementation	Cost
		Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Nitrogen, Total Phosphorus, Oil & Grease, Total Suspended Solids(TSS), Total Coliform Bacteria (TCB), Total Chromium (Cr), Copper (Cu), Iron (Fe), Zinc (Zn), Lead (Pb), Cadmium (Cd), Mercury (Hg); Arsenic (As).	pump		from local stakeholders	Consultant	Cost (Approx ~2500 USD / time)
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	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
Waste	Impact from non-hazardous wastes storage, transport and disposal	Implementation of Waste Management Plan (WMP)	Project activity areas and construction workers camp,	Compliance to the WMP	Unplanned audit twice a year	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for implementation	Cost
			transport assets and disposal areas				
	Impact from hazardous wastes storage, transport and disposal	Implementation of Waste Management Plan (WMP)	Project activity areas and construction workers camp, transport assets and disposal areas	Compliance to the WMP	Unplanned audit twice a year	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
Biodiversity	Impacts to biodiversity values (habitats and species) due to vegetation clearing (Habitat loss) and mortality (vehicle strike, hunting and poaching) at the work site	Records of training, Fauna Shepherding protocol and accidents	NA	Compliance against protocols.	3 monthly basis	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
Biodiversity	Introduction/ proliferation of invasive species in natural habitat	Implementation of mitigation measures	Project activity areas and construction workers camp	Compliance against invasive management measures	Monthly	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
Social	Local content employment	Percentage of local (directly from the Project SAoI) employed during construction	NA	Compliance against the Sourcing, Procurement and Recruitment Management Plan	Start of construction and bi-monthly after.	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Stakeholder Engagement	Number or frequency of	NA	Compliance against the Stakeholder	Monthly	EHS Team of EPC Contractor	EPC Contractor

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for implementation	Cost
		engagement		Engagement Plan			Cost (included in Capex cost)
	Grievance Mechanism (all impact)	Number and resolution of grievances	NA	Compliance of resolution duration of grievance with Grievance Mechanism	Weekly	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Impact to navigation	Permit and safety equipment	Construction vessels	Unplanned Compliance audit against international regulation for operating vessels	Every 4 month	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Impact to existing facilities	State of Public infrastructures	Roads used for construction	Capacity to use the infrastructure safely	Monthly	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Impacts to health and safety of the community	Worker training, grievances, accident log, implementation of Community H&S monitoring and surveillance programme, implementation of worker code of conduct	NA	Compliance against plan	Bi monthly review of training log; Monitoring and review of accidents due to construction (daily monitoring and monthly review). Community health and safety monitoring and surveillance	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)

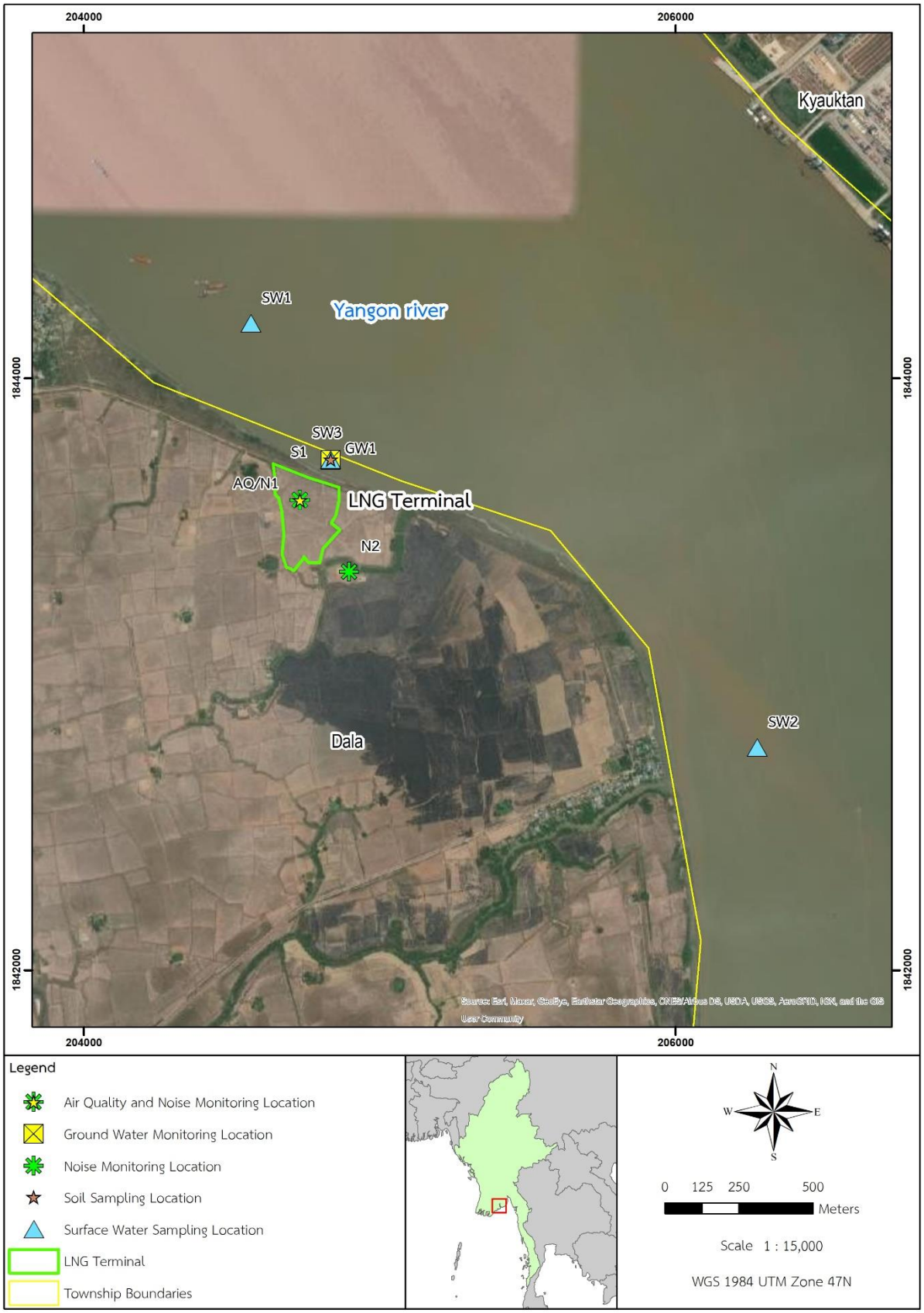
Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for implementation	Cost
					program. Daily monitoring of construction area, worker camp and surrounding; Regular unplanned audit on worker code conduct; Monthly visual inspection of first aid facilities and records. Weekly review of grievance log.		
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 and yearly	EHS and/or Community Liaison Officer of EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Public concerns	Complaints from community	Neighbouring communities around the Project activity areas	As per the grievance redress mechanism	Continuous	Project Company	EPC Contractor Cost (included in Capex cost)
Operation Phase							
Surface water	Impact to surface water through contaminated water runoff and domestic wastewater	pH, Electrical Conductivity, Biochemical Oxygen Demand	Discharge point (upstream and downstream of the LNG Receiving Terminal) (***Figure***	Standard analytical methods	Quarterly	3rd Party Environmental Consultant	TPMC Opex cost (Approx ~2500 USD / time)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for implementation	Cost
	discharge	(BOD), Chemical Oxygen Demand (COD), Total Nitrogen, Total Phosphorus, Oil & Grease, Total Suspended Solids(TSS), Total Coliform Bacteria (TCB), Total Chromium (Cr), Copper (Cu), Iron (Fe), Zinc (Zn), Lead (Pb), Cadmium (Cd), Mercury (Hg); Arsenic (As).	***12.1***)				
Surface Water	Cold Water Discharge	Temperature	Discharge pipeline	Temperature	Bi-weekly	TPMC EHS team	TPMC Opex cost
Soil and ground water	Accidental Leaks of Cold Water from the regasification unit	Discharge pipeline integrity	Discharge pipeline	Integrity of pipeline	Monthly	TPMC EHS team	TPMC Opex cost
Waste	Impact to soil, groundwater, surface water, biodiversity and human receptors	Implementation of Waste Management Plan (WMP)	Project activity areas and construction workers camp, transport assets	Compliance to the WMP	Unplanned audit yearly	TPMC EHS team	TPMC Opex cost

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for implementation	Cost
			and disposal areas				
Social	Local content employment	Percentage of local (directly from the Project SAoI) employed during operation	NA	Compliance against the Sourcing, Procurement and Recruitment Management Plan	Start of operation and yearly after.	TPMC EHS team	TPMC Opex cost
	Stakeholder Engagement	Number or frequency of engagement	NA	Compliance against the Stakeholder Engagement Plan	Quarterly	TPMC EHS team	TPMC Opex cost
	Grievance Mechanism (all impact)	Number and resolution of grievances	NA	Compliance of resolution duration of grievance with Grievance Mechanism	Weekly	TPMC EHS team	TPMC Opex cost
	Impact from economical displacement	Resettled stakeholder livelihood	NA	Estimate of stakeholder incomes and expenditures	Every 2 years	3rd party social consultant	TPMC Opex cost (Approx ~5000 USD / time)
	Reducing the capacity of the existing facilities and utilities	Capacity of public infrastructures	Project activity areas and public infrastructure in the SAoI	Capacity to use the infrastructure safely	Yearly	TPMC EHS team	TPMC Opex cost
	Impacts to health and safety of the community	Compliance with operation plans	Project activity areas	Percentage of non-compliance against plans	Bi-yearly review of training log. Bi-yearly review of compliance against community health and safety	TPMC EHS team	TPMC Opex cost

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for implementation	Cost
					monitoring and surveillance programme. Conduct regular unplanned audit of the worker code of conduct. Bi-yearly unplanned audit of waste management activities. Monthly visual inspection of first aid facilities and record, review of employment records and health insurance subscription records.		
	Impact to occupational health and safety	Accidents or incidents due to operation activities, workers' health	Near-misses, incidents, occupational diseases, dangerous occurrences	Project activity areas	As defined in operation phase Health & Safety Plan to be prepared by EPC contractor	TPMC EHS team	TPMC Opex cost

Figure 12.1: Indicative Monitoring Locations for the LNG Terminal



Source: ERM, 2021.

12.5.2.5 Monitoring Programme for the Natural Gas Pipeline

Table 12.6 Environmental and Social Monitoring Programme for the Natural Gas Pipeline (Construction and Operation Phase)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for Implementation	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 and construction workers camp	Visual inspection of all active work areas	Daily	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
Air quality	Impact to air quality due to dust emissions	Implementation of Dust Management Plan (DMP)	Project activity areas and construction workers camp (***Figure 12.2***).	As per DMP requirements (PM2.5 and PM10)	As per DMP requirements (Minimum every 2 month)	EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Impact to air quality due to vehicle emissions	Implementation of the Machinery Maintenance and Repair Programme (MMRP)	Project activity areas and construction workers camp (***Figure 12.2***).	As per MMRP requirements	As per MMRP requirements (Minimum every 6 month)	EPC Contractor	EPC Contractor Cost (included in Capex cost)
Noise	Increase in ambient noise levels	Noise levels in Leq, Leq day, Leq night and hourly Leq	Identified NSRs within 500 m from the Project boundary (***Figure 12.2***).	24-hour	Quarterly	3rd Party Environmental Consultant	EPC Contractor Cost (Approx ~3,000 USD / time)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for Implementation	Cost
	Workers Health	Noise levels in Leq	Identified location within the construction area (***Figure 12.2***).	24-hour	Monthly	EPC Contractor	EPC Contractor Cost (included in Capex cost)
Soil	Contamination of soil	pH, salinity, NH_4^+, total P, heavy metals	Construction site or laydown area or spill area	Standard analytical methods	In the event of any leakage or spillage of hazardous substances, oil, or toxic chemicals	3rd Party Environmental Consultant	EPC Contractor Cost (Approx ~2500 USD / time)
	Soil quality	Monitoring of soil quality in the event of any leakage or spillage of hazardous substances, with the parameters to be sampled based upon the likely chemical compositions of the material.	Locations, to be defined on a case by case basis.	Standard analytical methods	Frequency to be defined on a case by case basis.	3rd Party Environmental Consultant	EPC Contractor Cost (Approx ~2500 USD / time)
Surface Water	Contamination of surface water	Parameters as per NEQG 1.2 Wastewater, Effluent, Sanitary Discharges and Storm Water Runoff	Yangon River and water bodies (upstream and downstream of the pipeline alignment) (***Figure 12.2***).	Standard analytical methods	Every 6 month	3rd Party Environmental Consultant	EPC Contractor Cost (Approx ~2500 USD / time)
Ground Water	Contamination of	pH, Electrical	At nearest ground	Standard analytical	Every 6 month or	3rd Party	EPC Contractor

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for Implementation	Cost
	ground water	Conductivity, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Nitrogen, Total Phosphorus, Oil & Grease, Total Suspended Solids(TSS), Total Coliform Bacteria (TCB), Total Chromium (Cr), Copper (Cu), Iron (Fe), Zinc (Zn), Lead (Pb), Cadmium (Cd), Mercury (Hg); Arsenic (As).	water extraction pump from pipeline construction area	methods	upon complaint from local stakeholders	Environmental Consultant	Cost (Approx ~2500 USD / time)
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	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
Waste	Impact from non-hazardous wastes storage, transport	Implementation of Waste Management Plan	Project activity areas and construction	Compliance to the WMP	Unplanned audit twice a year	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)

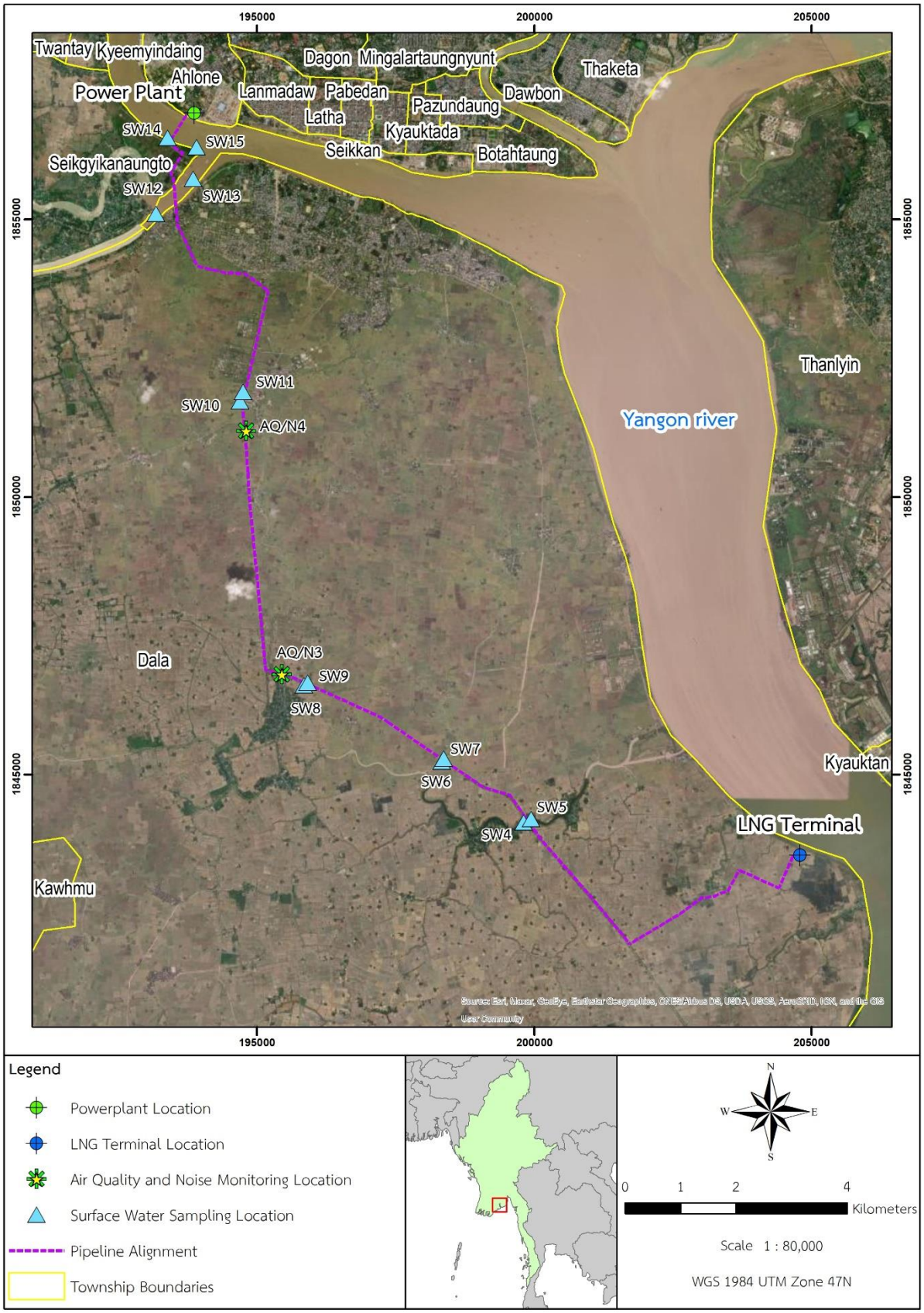
Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for Implementation	Cost
	and disposal	(WMP)	workers camp, transport assets and disposal areas				
	Impact from hazardous wastes storage, transport and disposal	Implementation of Waste Management Plan (WMP)	Project activity areas and construction workers camp, transport assets and disposal areas	Compliance to the WMP	Unplanned audit twice a year	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
Biodiversity	Impacts to biodiversity values (habitats and species) due to vegetation clearing (Habitat loss) and mortality (vehicle strike, hunting and poaching) at the work site	Records of training, Fauna Shepherding protocol and accidents	NA	Compliance against protocols.	3 monthly basis	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
Biodiversity	Introduction/ proliferation of invasive species in natural habitat	Implementation of mitigation measures	Project activity areas and construction workers camp	Compliance against invasive management measures	Monthly	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
Social	Local content employment	Percentage of local (directly from the Project SAoI) employed during construction	NA	Compliance against the Sourcing, Procurement and Recruitment Management Plan	Start of construction and bi-monthly after.	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for Implementation	Cost
	Stakeholder Engagement	Number or frequency of engagement	NA	Compliance against the Stakeholder Engagement Plan	Monthly	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Grievance Mechanism	Number and resolution of grievances	NA	Compliance of resolution duration of grievance with Grievance Mechanism	Weekly	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Impact to traffic	Permit and code of conduct	Construction area	Unplanned Compliance audit against worker Code of Conduct	Every 4 month	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Impact to existing facilities	State of Public infrastructures	Roads used for construction	Capacity to use the infrastructure safely	Monthly	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Impacts to health and safety of the community	Worker training, grievances, accident log, implementation of Community H&S monitoring and surveillance programme, implementation of worker code of conduct	NA	Compliance against plan	Bi monthly review of training log; Monitoring and review of accidents due to construction (daily monitoring and monthly review). Community health and safety monitoring and surveillance program.	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for Implementation	Cost
					Daily monitoring of construction area, worker camp and surrounding; Regular unplanned audit on worker code conduct; Monthly visual inspection of first aid facilities and records. Weekly review of grievance log.		
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 and yearly	EHS and/or Community Liaison Officer of EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Public concerns	Complaints from community	Neighbouring communities around the Project activity areas	As per the grievance redress mechanism	Continuous	Project Company	EPC Contractor Cost (included in Capex cost)
Operation Phase							
Social	Stakeholder Engagement	Number or frequency of engagement	NA	Compliance against the Stakeholder Engagement Plan	Quarterly	TPMC EHS team	TPMC Opex cost
	Grievance Mechanism (all	Number and resolution of	NA	Compliance of resolution duration	Weekly	TPMC EHS team	TPMC Opex cost

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for Implementation	Cost
	impact)	grievances		of grievance with Grievance Mechanism			
	Impact from economical displacement	Resettled stakeholder livelihood	NA	Estimate of stakeholder incomes and expenditures	Every 2 years	3rd party social consultant	TPMC Opex cost (Approx ~5000 USD / time)
	Impact to occupational health and safety	Accidents or incidents due to operation activities, workers' health	Near-misses, incidents, occupational diseases, dangerous occurrences	Project activity areas	As defined in operation phase Health & Safety Plan to be prepared by EPC contractor	TPMC EHS team	TPMC Opex cost

Figure 12.2: Indicative Monitoring Locations for the Pipeline



Source: ERM, 2021.

12.5.2.6 Monitoring Programme for the Power Plant

Table 12.7 Environmental and Social Monitoring Programme for the LNG Power Plant (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 and construction workers camp	Visual inspection of all active work areas	Daily	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
Air quality	Impact to air quality due to dust emissions	Implementation of Dust Management Plan (DMP)	Project activity areas and construction workers camp (***Figure 12.3***).	As per DMP requirements (PM2.5 and PM10)	As per DMP requirements (Minimum every 2 month)	EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Impact to air quality due to vehicle emissions	Implementation of the Machinery Maintenance and Repair Programme (MMRP)	Project activity areas and construction workers camp (***Figure 12.3***).	As per MMRP requirements	As per MMRP requirements (Minimum every 6 month)	EPC Contractor	EPC Contractor Cost (included in Capex cost)
Noise	Increase in ambient noise levels	Noise levels in Leq, Leq day, Leq night and hourly Leq	Identified NSRs within 500 m from the Project boundary (***Figure 12.3***).	24-hour	Quarterly	3rd Party Environmental Consultant	EPC Contractor Cost (Approx ~3,000 USD / time)
	Workers Health	Noise levels in Leq	Identified location	24-hour	Monthly	EPC Contractor	EPC Contractor

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
			within the construction area (***Figure 12.3***).				Cost (included in Capex cost)
Soil	Contamination of soil	pH, salinity, NH_4^+, total P, heavy metals	Construction site or laydown area or spill area	Standard analytical methods	In the event of any leakage or spillage of hazardous substances, oil, or toxic chemicals	3rd Party Environmental Consultant	EPC Contractor Cost (Approx ~2500 USD / time)
	Soil quality	Monitoring of soil quality in the event of any leakage or spillage of hazardous substances, with the parameters to be sampled based upon the likely chemical compositions of the material.	Locations, to be defined on a case by case basis.	Standard analytical methods	Frequency to be defined on a case by case basis.	3rd Party Environmental Consultant	EPC Contractor Cost (Approx ~2500 USD / time)
Surface Water	Contamination of surface water	Parameters as per NEQG 1.2 Wastewater, Effluent, Sanitary Discharges and Storm Water Runoff	Yangon River (upstream and downstream of the Power plant location) (***Figure 12.3***).	Standard analytical methods	Every 6 month	3rd Party Environmental Consultant	EPC Contractor Cost (Approx ~2500 USD / time)
Ground Water	Contamination of ground water	pH, Electrical Conductivity,	At nearest ground water extraction	Standard analytical methods	Every 6 month or upon complaint	3rd Party Environmental	EPC Contractor Cost (Approx

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
		Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Nitrogen, Total Phosphorus, Oil & Grease, Total Suspended Solids(TSS), Total Coliform Bacteria (TCB), Total Chromium (Cr), Copper (Cu), Iron (Fe), Zinc (Zn), Lead (Pb), Cadmium (Cd), Mercury (Hg); Arsenic (As).	pump in Ahlone Towsnship		from local stakeholders	Consultant	~2500 USD / time)
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	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
Waste	Impact from non-hazardous wastes storage, transport and disposal	Implementation of Waste Management Plan (WMP)	Project activity areas and construction workers camp,	Compliance to the WMP	Unplanned audit twice a year	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
			transport assets and disposal areas				
	Impact from hazardous wastes storage, transport and disposal	Implementation of Waste Management Plan (WMP)	Project activity areas and construction workers camp, transport assets and disposal areas	Compliance to the WMP	Unplanned audit twice a year	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
Biodiversity	Impacts to biodiversity values (habitats and species) due to vegetation clearing (Habitat loss) and mortality (vehicle strike, hunting and poaching) at the work site	Records of training, Fauna Shepherding protocol and accidents	NA	Compliance against protocols.	3 monthly basis	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
Biodiversity	Introduction/ proliferation of invasive species in natural habitat	Implementation of mitigation measures	Project activity areas and construction workers camp	Compliance against invasive management measures	Monthly	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
Social	Local content employment	Percentage of local (directly from the Project SAoI) employed during construction	NA	Compliance against the Sourcing, Procurement and Recruitment Management Plan	Start of construction and bi-monthly after.	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Stakeholder	Number or	NA	Compliance	Monthly	EHS Team of EPC	EPC Contractor

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
	Engagement	frequency of engagement		against the Stakeholder Engagement Plan		Contractor	Cost (included in Capex cost)
	Grievance Mechanism	Number and resolution of grievances	NA	Compliance of resolution duration of grievance with Grievance Mechanism	Weekly	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Impact to navigation	Permit and safety equipment	Construction vessels	Unplanned Compliance audit against international regulation for operating vessels	Every 4 month	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Impact to traffic	Permit and code of conduct	Construction area and roads used for transport of workers and construction material	Unplanned Compliance audit against worker Code of Conduct	Every 4 month	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Impact to existing facilities	State of Public infrastructures	Roads used for construction	Capacity to use the infrastructure safely	Monthly	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Impacts to health and safety of the community	Worker training, grievances, accident log, implementation of Community H&S monitoring and	NA	Compliance against plan	Bi monthly review of training log; Monitoring and review of accidents due to construction (daily monitoring	EHS Team of EPC Contractor	EPC Contractor Cost (included in Capex cost)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
		surveillance programme, implementation of worker code of conduct			and monthly review). Community health and safety monitoring and surveillance program. Daily monitoring of construction area, worker camp and surrounding; Regular unplanned audit on worker code conduct; Monthly visual inspection of first aid facilities and records. Weekly review of grievance log.		
Community Health and Safety	Community disturbance and potential safety hazard due to road traffic	Accidents, incidents and complaints	Roads used for transport of workers and construction material	Incidents, accidents and community complaints	Based on occurrence and yearly	EHS and/or Community Liaison Officer of EPC Contractor	EPC Contractor Cost (included in Capex cost)
	Public concerns	Complaints from community	Neighbouring communities around the Project activity areas	As per the grievance redress mechanism	Continuous	Project Company	EPC Contractor Cost (included in Capex cost)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
Operation Phase							
Air Quality	Impact to air quality due to operation emissions	Stack emissions (CEMS)	Stack	NOx	Online Monitoring	Project Company	
	Impact to air quality due to operation emissions	Parameters as per NEQG Ambient Air Quality Guidelines (***Table 3.7***)	One point within Project boundary and one point at identified NSRs within 500 m from the Project boundary (***Figure 12.3***)	As per parameters	Every 6 months	3rd Party Environmental Consultant	TPMC Opex cost (Approx ~5000 USD / time)
Noise	Impact to ambient noise level	Noise from operation activities	One point within Project boundary and one point at identified NSRs within 500 m from the Project boundary (***Figure 12.3***).	Decibels	Quarterly	3rd Party Environmental Consultant	TPMC Opex cost (Approx ~2000 USD / time)
Surface water	Impact to surface water through release of thermal discharge	Parameters as per NEQG 2.1.1 Thermal Power Standards	Discharge point (upstream and downstream of the Power plant location) (***Figure 12.3***).	As per parameters	Quarterly	TPMC EHS team	TPMC Opex cost
	Thermal Discharge	Temperature	Discharge pipeline	Temperature	Bi-weekly	TPMC EHS team	TPMC Opex cost
Soil and	Accidental Leaks of	Monitoring of soil	Locations, to be	Standard analytical	Frequency to be	3rd Party	Approx ~2500 USD

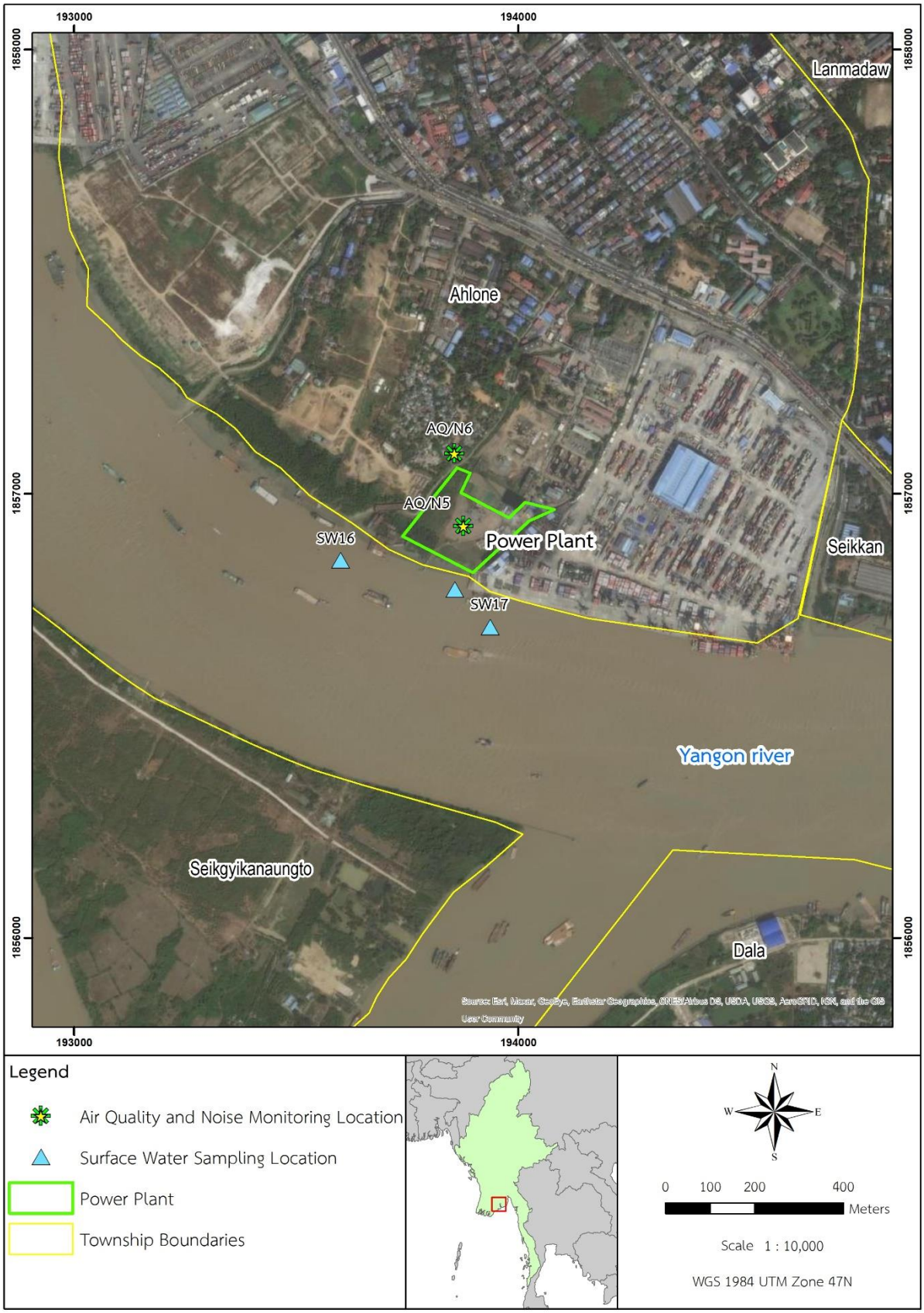
Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
ground water	demineralized plant neutralized water	quality in the event of any leakage or spillage of hazardous substances, with the parameters to be sampled based upon the likely chemical compositions of the material.	defined on a case by case basis.	methods	defined on a case by case basis.	Environmental Consultant	/ time
	Accidental leak of cooling water	Discharge pipeline integrity	Discharge pipeline	Visual inspection	Monthly	TPMC EHS team	TPMC Opex cost
Waste	Impact to soil, groundwater, surface water, biodiversity and human receptors	Implementation of Waste Management Plan (WMP)	Project activity areas and construction workers camp, transport assets and disposal areas	Compliance to the WMP	Unplanned audit yearly	TPMC EHS team	TPMC Opex cost
	Impact to soil, groundwater, surface water, biodiversity and human receptors	Effluent water quality.	Discharge location	Standard analytical methods	Bi-monthly	TPMC EHS team	TPMC Opex cost
Social	Local content employment	Percentage of local (directly from the Project SAoI) employed during operation	NA	Compliance against the Sourcing, Procurement and Recruitment	Start of operation and yearly after.	TPMC EHS team	TPMC Opex cost

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
				Management Plan			
	Stakeholder Engagement	Number or frequency of engagement	NA	Compliance against the Stakeholder Engagement Plan	Quarterly	TPMC EHS team	TPMC Opex cost
	Grievance Mechanism (all impact)	Number and resolution of grievances	NA	Compliance of resolution duration of grievance with Grievance Mechanism	Weekly	TPMC EHS team	TPMC Opex cost
	Impacts to health and safety of the community	Compliance with operation plans	Project activity areas	Percentage of non-compliance against plans	Bi-yearly review of training log. Bi-yearly review of compliance against community health and safety monitoring and surveillance programme. Conduct regular unplanned audit of the worker code of conduct. Bi-yearly unplanned audit of waste management activities. Monthly visual	TPMC EHS team	TPMC Opex cost

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
					inspection of first aid facilities and record, review of employment records and health insurance subscription records.		
	Impact to occupational health and safety	Accidents or incidents due to operation activities, workers' health	Near-misses, incidents, occupational diseases, dangerous occurrences	Project activity areas	As defined in operation phase Health & Safety Plan to be prepared by EPC contractor	TPMC EHS team	TPMC Opex cost

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
Greenhouse Gas	Potential impacts on climatic condition due to GHG emissions	Fossil fuel consumption report	LNG Power Plant	Record of fuel use for project operation and calculate GHG emission annually according to recognized international guideline or standard (e.g. IPCC, GHG Protocol)	Record or monitor the fossil fuel consumption report on a monthly basis and quantify GHG emissions annually	TPMC EHS team	TPMC Opex cost

Figure 12.3: Indicative Monitoring Locations for the Power Plant



Source: ERM, 2021.

12.6 Institutional Setting and Implementation Arrangements

12.6.1 Construction Phase

The ESMP 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 Proponent's staff, specifically the EHS Officer and Site Engineer, will monitor the implementation of these mitigation measures by the contractors at the site. These officers will be responsible for the field level monitoring of the Project.

The roles and responsibilities of the Project Proponent and EPC Contractor for implementation and monitoring have been outlined in ***Table 12.8***.

Table 12.8: Roles and Responsibilities of Sponsor and EPC Contractor

Sponsor	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 Contractor and supported by the third party environmental consultants	Joint verification with the Project Proponent and Third Party Environmental Consultant for review of ESMP implementation
Interaction and reporting to the respective department of Government of Myanmar	Interaction with the Project Proponent and appointed supervision consultant, if any
Interaction and reporting to lenders	Filling of reporting formats as per the reporting schedule and submission to the Project Proponent
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 by the Sponsor
Keeping records of all permits obtained by EPC Contractor	Management of labour camp and to provide drinking water, sanitation facility
Overall supervision of ESMP implementation	
Approval of plans prepared by EPC Contractor	
Addressing grievances of local community and information dissemination	
Environmental monitoring through laboratory	

While the EPC 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 EHS 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. The Sponsor will document the process for creating, allocating and approving unique identifiers and will communicate this to relevant staff.

12.6.2 Operation Phase

During Operation Phase, the Project Proponent, especially the EHS team and operation team will be fully responsible for implementation of the ESMP. The Project Proponent's staff, specifically the EHS Officer and Plant Engineer, will monitor the implementation of these mitigation measures.

12.7 Training

12.7.1 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 the Sponsor to develop and deliver a training program on implementation of the ESMP, monitoring and reporting will be conducted 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;
- EHS 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 and social monitoring and reporting, which will include:

- Applicable environmental and social 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 ESMP during the construction phase of the Project. It will also help in ensuring internal and external monitoring and verification of the environmental and social performance of the Project. The timeframe for reporting and verification during the construction phase will be agreed between the Project Proponent, the relevant authorities and the Lenders.

12.7.2 Operation Phase

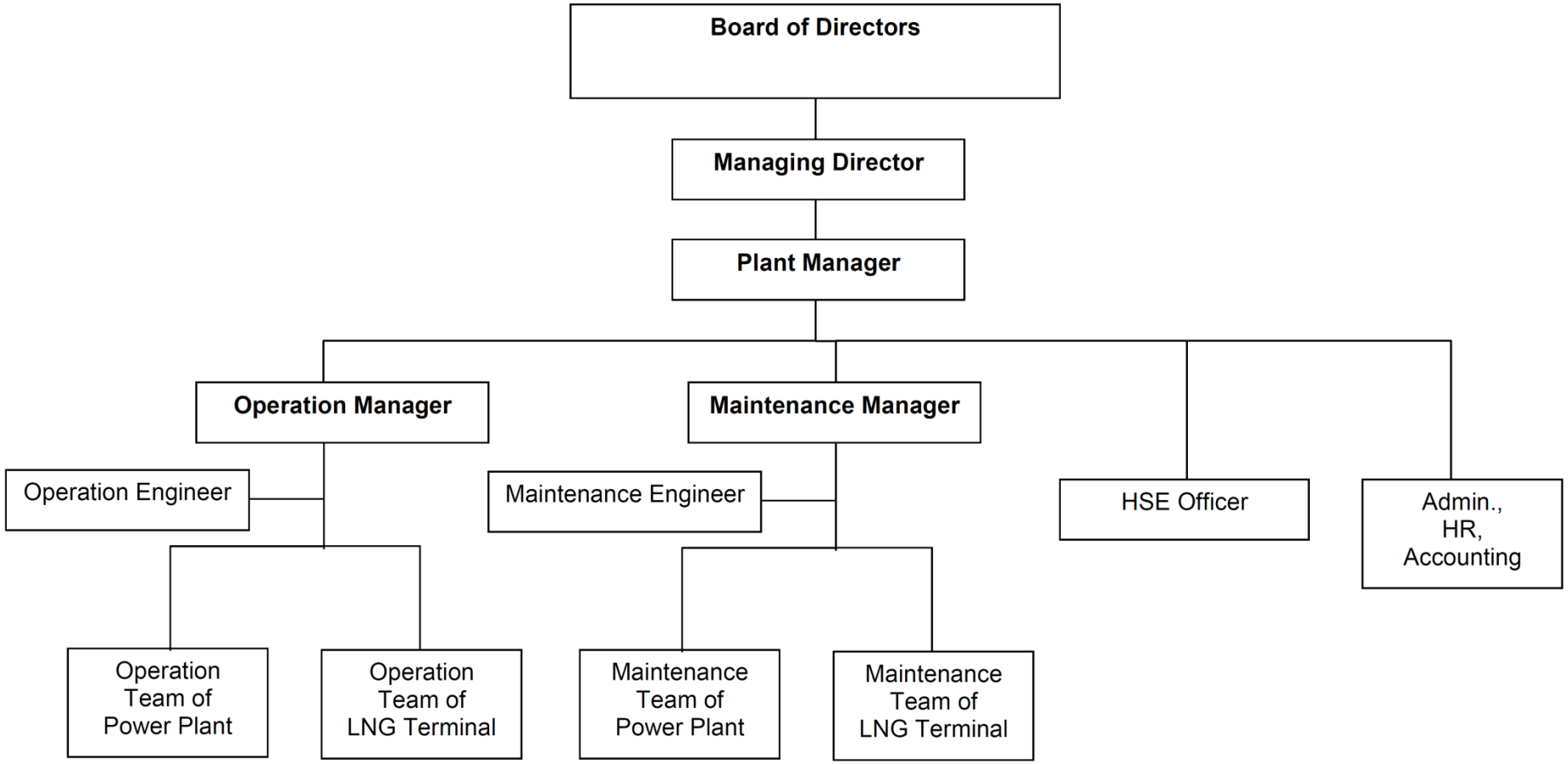
Prior to the commencement of the Plant operation, a suitably qualified in-house/ external environmental expert will be engaged by the Sponsor to develop and deliver a training program on operation phase environmental and social monitoring and reporting. The topics will be mostly same as that during the construction phase. However, it will also include following modules, which are specific to the operation phase:

- Continuous emission monitoring;
- Hazardous chemicals and waste management;
- Occupational health and safety programs, including Emergency Response Plan for both employee and nearby communities;

The training will help in capacity building and implementation of the ESMP during the operation phase of the Project. It will also help in ensuring internal and external monitoring and verification of the environmental and social performance of the Project. The timeframe for reporting and verification during the construction phase will be agreed between the Sponsor, the relevant authorities and the Lenders.

The Project Proponent's overall Project organisation chart, the Project Proponent's organisation chart during construction, including EPC contractor and other contractors, are shown in ***Figure 12.4***.

Figure 12.4: TPMC's Overall Project Organisation Chart



Source: TPMC, 2018.

12.8 Plans for Construction and Operation Phase of the Project

12.8.1 Management Plans

12.8.1.1 Environmental Control and Management Plan

This plan describes the environmental control and management compliance activities for contractors and subcontractors, during construction, and commissioning until COD of the Project. This plan addresses field implementation and controls for environmental management as well as the processes for monitoring and mitigation of construction activities that could potentially impact the environment.

The purpose of this plan is to achieve the HSE objectives of Project and to comply with environmental legal and applicable requirements. The Environmental Control & Management Plan has been prepared in conformance with ISO 14001:2015 requirements.

The Environmental Control and Management Plan is shown in ***Appendix W***.

12.8.1.2 Waste Management Plan

The Project proponent will prepare procedure in accordance with best practice of engineering and other environmental impact consideration for contril waste generation, temporary storage, collection, separation, transportation,and disposal. Also the plan will prevent impact to the environment and public during construction and commissioning period in manner that waste management plan is integrated to manage all aspect of plant construction and commissioning waste. The waste management plan is shown in ***Appendix H***. The plan includes;

Resonsibilities for;

- Contractor Project Manager
- Contractor Construction Manager
- Contractor Environmental Engineer
- Contractor HSE Manager
- Subcontractors; Management Representatives, Safety Officer, Supervisor, Employee, Waste Coordinator, Authorized Waste Transport

Procedure includes;

- Contractor shall determine local waste management capacity to absorb the new waste stream from the Project together with local authorities and other stakeholders.
- Training for all workers to avoid, reduce and reuse waste generated.
- Each subcontractors shall assign a waste coordinator to work together with the Contractor′s environmental engineering to established team consolidate on site level.
- Waste disposal by burning in within the Project Area is prohibited.
- Proper waste management by gathering, temporary storage, separate, reduced, transport and disposal which are carried out applying appropriate methods.
- Location of burying to be far away from sensitive receptors and where impacts can be properly controlled.
- Ensure that no hazardous material or chemicals are present within the domestic waste, and that hazardous waste is handling appropriately.
- Apply Waste Collection Sheet for waste transportation from generated source to TWSA, and waste collection and transport shall be approved by environmental engineer.

- Subcontractors employed shall clearly identify waste management in their bidding documents.
- Establish monitoring and reporting system to ensure compliance; contractor's environmental engineer must ensure that waste management data is reported on weekly basis.
- Avoid leaking of wastewater and odor to surrounding receptors.
- Enforce rules that prevent inappropriate materials going into sanitary waste stream.
- Effluent from chemical cleaning of the equipment during the pre-commissioning phase will be collected in an appropriate drainage system and transported off-site to a licensed hazardous waste treatment facility

12.8.1.3 HSE Plan Procedure

The purpose of this plan is to establish the HSE management system, HSE requirements, HSE rules and regulations, HSE organization and responsibilities, and provide guidelines for accident and incident prevention, including environmental impact protection.

The HSE Management System is summarized in this plan which defines the HSE principle requirements associated with the TTCL / subcontractor and concerned parties to be practiced at construction sites of the project at all time, to ensure safely working environment for occupational health preservation, accident / incident prevention and environmental impact protection would be achieved.

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.

The HSE Plan Procedure is shown in ***Appendix X***.

12.8.1.4 Project Incident and Emergency Response Plan

TPMC has in place a Project Incident and Emergency Response Plan to provide the necessary course of action during an unplanned event.

The potential emergency scenarios that apply to this plan are as follows:

- Person(s) fall from height – on land;
- Material fall from height;
- Vehicle collision with plant/equipment/pedestrian(s);
- Vehicle incident offsite;

- Collapse of scaffold – no person(s) present/person(s) present;
- Collapse of structure – no person(s) present/person(s) present;
- Collapse of deep excavations – person(s) present;
- Fire/Explosion – electrics, substances;
- Oil and chemical spillage – on land;
- Medical emergency – mass food poisoning/bird flu;
- Medical emergency – contagious disease;
- Uncontrolled flammable/toxic release;
- Adverse weather conditions (flooding, lighting strike);
- Loss of services (water, sewerage, electricity);
- Radiation (Radiation Source Exposition); and
- Other (Earthquake, terrorist act, bomb threat, trespassers).

The full Project Incident and Emergency Response Plan is shown in ***Appendix I***.

12.8.1.5 Site Safety Rules and Regulation Procedure

The pupose of this procedure is to establish site safety rules and regulations to preserve Occupational Health and Safety of contractor employees, subcontractors and other concerned parties including environment impact protection.

The procedure provides rules for the following aspects:

- General Safety Rules;
- Guest and Visitor;
- Barricade and Notice of Work Activity;
- Confined Space;
- Portable Equipment and Hand Tool;
- Excavation;
- Fire Prevention;
- Hazardous Substance;
- Hot Work;
- Housekeeping;
- Ladders;
- Scaffolds;
- Lock out / Tag out (LOTO); and
- PPE.

The Site Safety Rules and Regulation Procedure is shown in ***Appendix Y***.

12.8.1.6 Security Plan and Decommissioning Management Plan Framework

TPMC's policy stipulates that each location shall establish a security program designed to provide a secure working environment. Every employee has the responsibility to conduct themselves in such a way as to protect the company's assets. This document describes the various elements of the security plan and the details within each element.

This document is to define the control access into and out of secured areas and all access into restricted zones inside secured areas. So, it shall provide the protection of property from theft and fire.

The Security Plan and Decommissioning Management Plan Framework is shown in ***Appendix Z***.

12.8.1.7 Traffic Management Plan

This plan addresses field implementation and controls for traffic and transportation management during construction and commissioning. It shall be updated if conditions or traffic and transportation requirements change. These traffic and transportation arrangements are depend on the provision of agreed site access control.

This will be required towards prevention of local traffic disruptions, avoid peak hours rush and prevent accidents. Movement of all heavy equipment and vehicles from Jetty to Project site needs to be coordinated with the logistics team of the Project Proponent and in discussion with relevant local authorities.

The Traffic Management Plan is shown in ***Appendix AA***.

12.8.1.8 Community Health Management Plan

The purpose of this plan is to avoid or limit risks to, and impacts on, the health and safety of the community from the project activities during the construction phase. This is achieved through implementing targeted prevention program to reduce risks, along with the implementation of an effective monitoring and evaluation program and to improve the existing health of the local community.

The Community Health Management Plan is shown in ***Appendix BB***.

Communicable Disease Management Plan for COVID-19

Coronaviruses (CoV) are a family of RNA (ribonucleic acid) viruses. They are called coronaviruses because the virus particle exhibits a characteristic 'corona' (crown) of spike proteins around its lipid envelope. CoV infections are common in animals and humans. Some strains of CoV are zoonotic, meaning they can be transmitted between animals and humans, but many strains are not zoonotic. The CoV which causes COVID-19 has been designated as SARS-CoV-2 by the International Committee on Taxonomy of Viruses (ICTV); this is the scientific name. The virus may also be referred to as "the COVID-19 virus" or "the virus responsible for COVID-19". COVID-19 refers to the disease caused by the virus. COVID-19 was declared a pandemic on 11 March 2020, and is currently ongoing.

This plan provides for the prevention and control of infection disease, including outbreaks management for COVID-19, the purpose of this plan is to:

- Provide basic guidance on controls needed to prevent disease outbreaks,
- Recommend surveillance practices to quickly identify potential outbreaks,
- Recommend steps to take to limit or interrupt infectious disease transmission amongthe workers when an outbreak occurs, or is suspected to have occurred.

The scope of this management plan includes

- Disease prevention, facility preparation for an outbreak, and control measures to take when an outbreak occurs,
- Investigation of an outbreak,
- Management of suspected personnel,
- Sharing of lesson learned.

The Communicable Disease Management Plan for COVID-19 is shown in ***Appendix CC***.

12.8.1.9 Fire Prevention Plan

The purpose of this plan is to assist contractor and their subcontractors in complying with all applicable fire prevention requirements during construction and commissioning until Commercial Operating Date (COD).

This plan addresses field implementation and controls for fire prevention management as well as the processes for monitoring and mitigation of construction activities that could potentially impact the environment. This plan will be updated if conditions on fire prevention requirements change.

The plan's instructions cover the following aspects:

- Matrial Storage;
- Flammable and Combustible Liquids;

- Compressed Gas Cylinders;
- Training;
- Inspection;
- Storage;
- Protective Apparel / PPE;
- Use of cylinders and Regulators;
- Oxy-Fuel Torches and Hoses;
- Welding / Cutting;
- Fire Protection Equipment; and
- Fire Fighting Training.

The Fire Prevention Plan is shown in ***Appendix DD***.

12.8.1.10 Typhoon Response Plan and Typhoon Evacuation Plan

The purpose of this management plan is to prevent accidents and minimize the effects of Typhoon. To establish a crisis preparedness program and delineate the roles and responsibility. To create an incident management structure that should provide comprehensive organizational framework designed for foreseeable types of emergencies.

The management plan consists of five main procedural steps, which include:

1. Pre-typhoon Preparation
2. Emergency Alerting and Communication System
3. During the Storm/Typhoon
4. During Evacuation
5. After the Storm/Typhoon

The full management plan is shown in ***Appendix EE***.

12.8.1.11 Worker's Accommodation Management Plan

This procedure includes specifications for the design and management of camp infrastructure and sleeping accommodation to which contractor and subcontractors will comply with when housing their workforce;

The purpose of the plan is to ensure that the construction workers of the project have accommodation that is healthy, clean and safe through the entire construction period of the project; and ensure that workers are housed in a way that minimizes potentially harmful impacts on host communities and the surrounding environment and optimizes local residents' opportunities to participate in benefits.

The Worker's Accommodation Management Plan is shown in ***Appendix FF***.

12.8.1.12 Cultural Heritage Chance Find Procedure

The purpose of this procedure is to provide an overarching chance find procedure to be applied for the project when cultural resources, or unmarked graves are discovered, these further include the following:

- Items of cultural and archaeological heritage significance;
- Artifact scatters comprising stone and terracotta objects;

- Remains of structural foundation reinforced by layers of soil mixed with seashells and terracotta debris (i.e. pottery shards); and
- Remains of UXOs explosive weapons.

The Cultural Heritage Chance Find Procedure is shown in ***Appendix GG***.

12.8.1.13 Community Development Plan

The community development plant (CDP) aims (i) to establish appropriate sustainable development activities that will benefit the local communities within the Project's Area of Influence (AoI) during Project's construction and operations phases, (ii) to improve the income-earning capacity, production levels and standards of living of vulnerable groups affected by project's land acquisition and (iii) to address the Project's challenges and opportunities to the impacted local communities within AoI. Main beneficiaries of the CDP are impacted local communities within AoI, with a focus on the vulnerable groups and their households throughout the Project life-cycle. The CDP also serves to fulfil the local requirement of having a Corporate Social Responsibility Programme via the proposed Community Development method.

The Community Development Plan is shown in ***Appendix HH***.

12.8.2 Budget

The EPC Contractor and the Project Proponent 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 Corporate Social Responsibility (CSR) activities, which will be conducted by the Sponsor for community development. Total budget for environmental monitoring activities during construction phase is estimated to be 18,2250 USD. Indicative annual budget for environmental monitoring activities during operation phase is estimated to be 20,000 USD.

12.8.3 Corporate Social Responsibility (CSR) Activities

Proposed CSR Activities are described in the Community Development Plan (***Section 12.8.1.13***).

12.9 Updating of ESMP

This ESMP will be updated, revised and reviewed internally on regular basis to ensure particularly that ESMP continuing suitability, adequacy and effectiveness regarding the Project commitment to continual improvement. The ESMP of the Project will be monitored and reviewed on half-yearly basis.

Furthermore, in the event of an unanticipated impact and design change with respect to the Project Standards (including Myanmar Government and IFC requirements); the ESMP would be updated as necessary.

13. PUBLIC CONSULTATION AND DISCLOSURE

This Chapter describes the stakeholder engagement activities undertaken during development of the ESIA. This includes key issues raised by stakeholders and where each of these issues have been addressed in the ESIA.

The engagement process has been designed to meet both Myanmar legal requirements according to the Environmental Impact Assessment Procedure No. 616/2015 for public participation, and international requirements for engagement as outlined by the IFC Performance Standards.

13.1 Methodology and Approach

13.1.1 Purpose of the Consultation

The first step in establishing a dialogue is identifying the Project stakeholders. Stakeholders are persons or groups who are directly or indirectly affected by a project, and those who may have interests in and/ or the ability to influence a project's outcomes (either positively or negatively).

The Project team is committed to undertaking a process that delivers inclusive and continuous dialogue with the Project stakeholders during the ESIA. The objectives of this engagement are to:

- Identify all those affected or interested in the Project to ensure they are included in the engagement process
- Ensure Understanding through open, culturally inclusive, appropriate and transparent engagement process. Information has been disclosed as early and comprehensively as possible.
- Involve Stakeholders in the scoping of issues, the assessment of impacts, the generation of mitigation and management measures and the finalisation of the ESIA report. Stakeholders also played an important role in providing local knowledge and information for the baseline that informs the impact assessment.
- Build Relationships and trust through open dialogue and engagement. Establish transparency of TTCL activities to build and maintain trust with stakeholders.
- Engage Vulnerable Peoples by having an inclusive approach to consultation. Some stakeholders need special attention in such a process due to their vulnerability.
- Manage Expectations with respect to proposed Project benefits. The engagement process served as a mechanism for understanding and managing stakeholder and community expectations, where the latter will be achieved by disseminating accurate information in an accessible way.
- Ensuring Compliance. The process is designed to ensure compliance with both Myanmar regulatory requirements and international best practices.

13.1.2 Identification of Relevant Stakeholders and Potential Issues

A stakeholder mapping exercise was undertaken to identify the Project stakeholders as well as potential issues of concern to the stakeholders. A key part of this process was to identify individuals and groups who may find it difficult to participate, as well as those who may be differentially or disproportionately affected by the Project because of their marginalised or vulnerable status.

The mapping exercise was developed based on desktop review of maps detailing the Project site and surrounding land uses/ activities, data collected during early site visits, discussions with some of the stakeholders, and the scoping report prepared for the Project.

Stakeholders were prioritized based on their level of interest in the Project and their power or ability to influence the Project. Level of interest for each stakeholder was confirmed during the subsequent visits to the site through formal engagement or ad-hoc discussions.

By identifying the Project stakeholders early, the ESIA team was able to tailor the engagement approach to meet their needs and expectations – e.g. address the issues of most concern to stakeholders during meetings.

Table 13.1 provides the list of Project stakeholders identified during the mapping exercise. It includes villages located in close proximity to the Project site and/ or its associated facilities.

Table 13.1: List of Project Stakeholders

Stakeholder Group	Stakeholder
Union Government	■ Ministry of Natural Resources and Environmental Conservation (MONREC) ■ Ministry of Electricity and Energy (MOEE) ■ Electric Power Generation Enterprise (EPGE) ■ Myanmar Investment Commission (MIC) ■ Myanma Oil and Gas Enterprise (MOGE) ■ Myanmar Port Authority (MPA) ■ Ministry of Agriculture, Livestock and Irrigation (MALI) ■ Ministry of Labour, Immigration and Population (MLIP) ■ Ministry of Social Welfare, Relief and Resettlements (MSWRR) ■ Ministry of Sports and Physical Education
Regional Authorities	■ Department of Electrical Power Planning (DEPP) ■ Chief Minister Office ■ Myanmar Port Authorities
Township Authorities (Ahlone, Dagon, Lanmadaw, Latha, Pabedan, Kyauktada, Seikkan, Botataung, Pazundaung, Mingala Taungnyunt, Kyimyindaing, Sanchaung, Bahan, Seikgyikanaungto, Dala, Thanlyin, Thuwana, Thingangyung, Pardagyi, Sin Kan, Kyauktan, Oak Pho Su, Bauk Htaw Twin, Bago Su, Myoma, Nyaung Thone Pin, Myo Haung, Bago Su, Shwe Pyout, Shwe Pyi Thar Yar, Shwe Kone, Thidar Myine, Phayar Kone, Oak Pho, Amhuhtan, Thout Taw Twin, A Lwan Swut, Htan Pin Kone, Myo Thit, Kyaung Oak Sake, Pu Zun Daung).	■ General Administration Department (GAD) ■ Department of Livestock, Fisheries and Rural Development ■ Department of Irrigation and Agriculture ■ Department of Electric Power ■ Department of Industry and Trade ■ Department of Social Welfare, Relief and Resettlements ■ Department of Labour ■ Forestry Department ■ Fire Department ■ Health Care Department ■ Finance Department ■ Water Utilization Department ■ Municipal Department ■ Tax and Revenue Department ■ Development Committee
Communities Stakeholders	■ Village Tract Leaders ■ Local villagers – Shan Kan, Nyaung Chaung, Tha Pyay Kone, Gwa, Nyaung Ngoke To, Nga Tan Ta Yar, Pyawbwe, Yakaing gyaung, Pyaw Bwal Gyi, Tone Tin Gan, Pyaw Bwal Gyi, Htun O, Pann Pin Chaung, Thet Kal Kwin, Rakhine Chaung, Kyan Sitt Tharr, Shan Kan, Mhaw Sett, Sein Pan, Ka Mar Ka Sit, Da Note, Pazundaung, Shwe Lay Chaung, Ta Pin Shwe Htee, Nyaung Chaung, Shwe Lay Chaung, Tar Gyi, Tha Yaw Tan, Kyar Hpyu Kan, Ye Chaung, Tha Ke Ta, Tha Khin Ba Thaung, Nyaung Ngoke To, Tha Pyay Kone, Shwe Hlay Chaung, Pyaw Bwe Gyi, Shan Kan, Htaw, Shan Kan, Da Noke, Kha Naung Ywar Ma, Paya Kone, Htan Pin Kone, Nyanung Thone Pin, Shwe Pyauk, Bogyoke, Ah Lwan Sut, ■ Farmers within local villages

	■ Fishermen within local villagers ■ Women's group representatives within local villages ■ Youth representatives within local villages ■ Healthcare workers within local villages and regional health care facilities ■ Community based organisations ■ Boat owners ■ Vulnerable groups (e.g. landless, poor) within the local villages
NGO, Media, Academic	■ Myanmar Environment Rehabilitation-Conservation Network (MERN) ■ Biodiversity and Nature Conservation Association (BANCA) ■ Ecosystem Conservation and Community Development Initiative (ECCDI), Yangon Or ■ Environmental Conservation and Livelihood Outreach Foundation (ECLOF), Yangon ■ Yangon University
Business	■ Yangon Industrial Ports ■ Yangon Ferry Operators ■ New Yangon Development City ■ Samsung ■ Yangon Electricity Supply Corporation (YESC) ■ Engineering Procurement Construction (EPC)

Source: ERM, 2019.

13.1.3 Overall Approach and Scope of Engagement for the Impact Assessment

Under Section 7 of the Environmental Conservation Law and Articles 52 and 53 of the Environmental Conservation Rules of the Republic of the Union of Myanmar, the Project Proponent is required to undertake an Environmental Impact Assessment (EIA) to obtain the Environmental Compliance Certificate (ECC) for the proposed LNG Receiving Terminal development and operations. The EIA Procedure (dated 29 December 2015) sets out the requirements for development, assessment and subsequent monitoring of an EIA, which are illustrated in ***Figure 13.1***, including the consultation requirements, which are discussed below.

According to Article 50 of the EIA Procedure (2015), as part of the Scoping exercise, the Project Proponent shall ensure the following public consultation and participation processes are carried out:

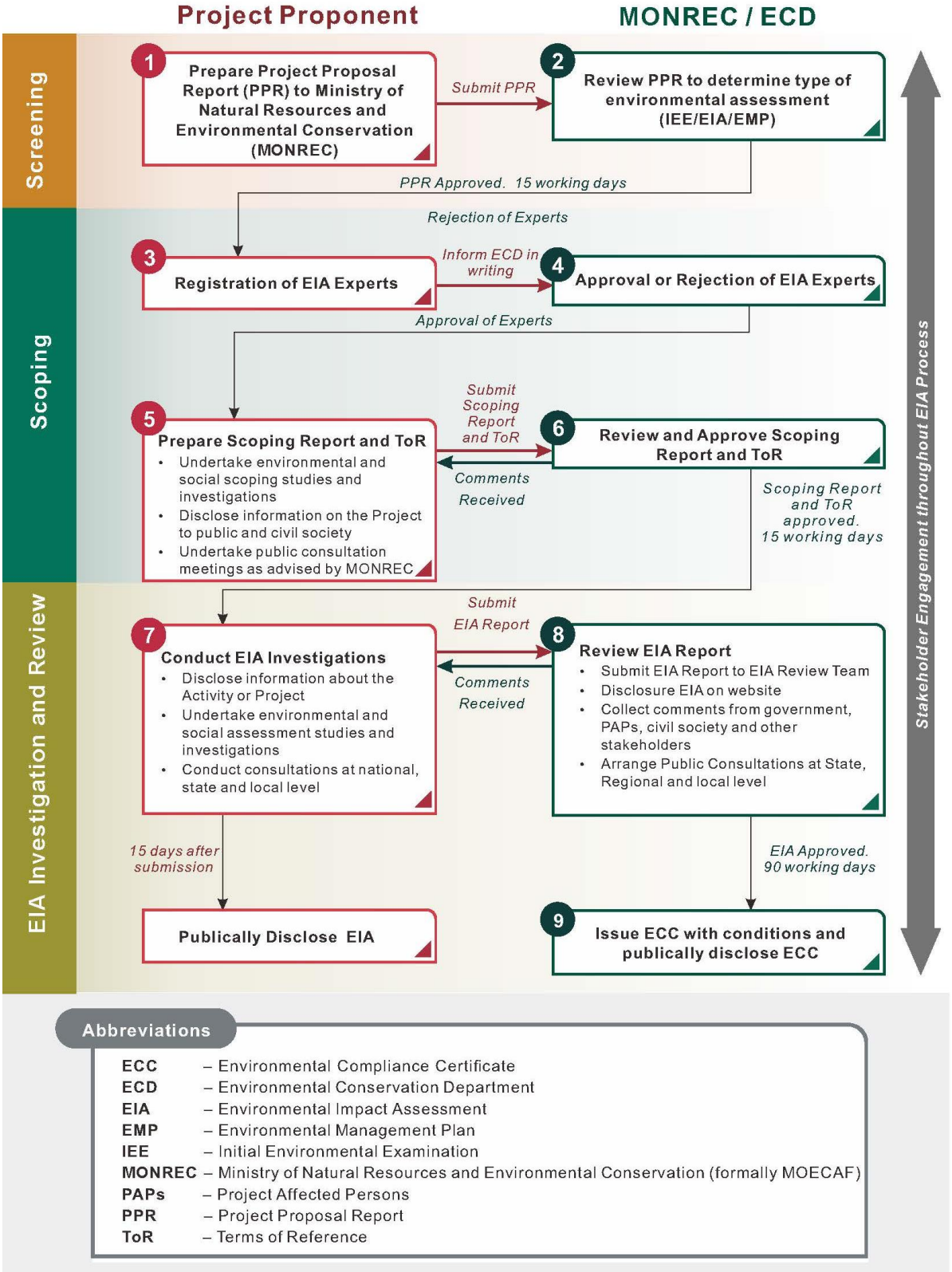
- Disclose information about the proposed Project to the public and civil society through posting on the Project or Project Proponent's website(s) and local media, including by means of the prominent posting of legible sign boards and advertising boards at the Project site which are visible to the public;
- Arrange the required consultation meetings, as advised by the Ministry, with local communities, potentially PAPs, local authorities, community based organizations, and civil society, and provide appropriate and timely explanations in press conferences and media interviews;

According to Article 61, as part of the EIA investigations the Project Proponent shall undertake the following consultation process:

- Timely disclosure of all relevant information about the proposed Project and its likely Adverse Impacts to the public and civil society through local and national media, the website(s) of the Project or Project Proponent, at public places such as libraries and community halls, and on sign boards at the Project site visible to the public, and provide appropriate and timely explanations in press conferences and media interviews;
- Arrange consultation meetings at national, regional, state, Nay Pyi Taw Union Territory and local levels, with PAPs, authorities, community based organizations and civil society;

- Consultations with concerned government organizations including the Ministry, the concerned sector ministry, regional government authorities and others; and
- Field visits for the Ministry and concerned government organizations.

Figure 13.1: Role of the Project Proponent on Stakeholder Engagement in the EIA process as defined by the EIA Procedure (2015)

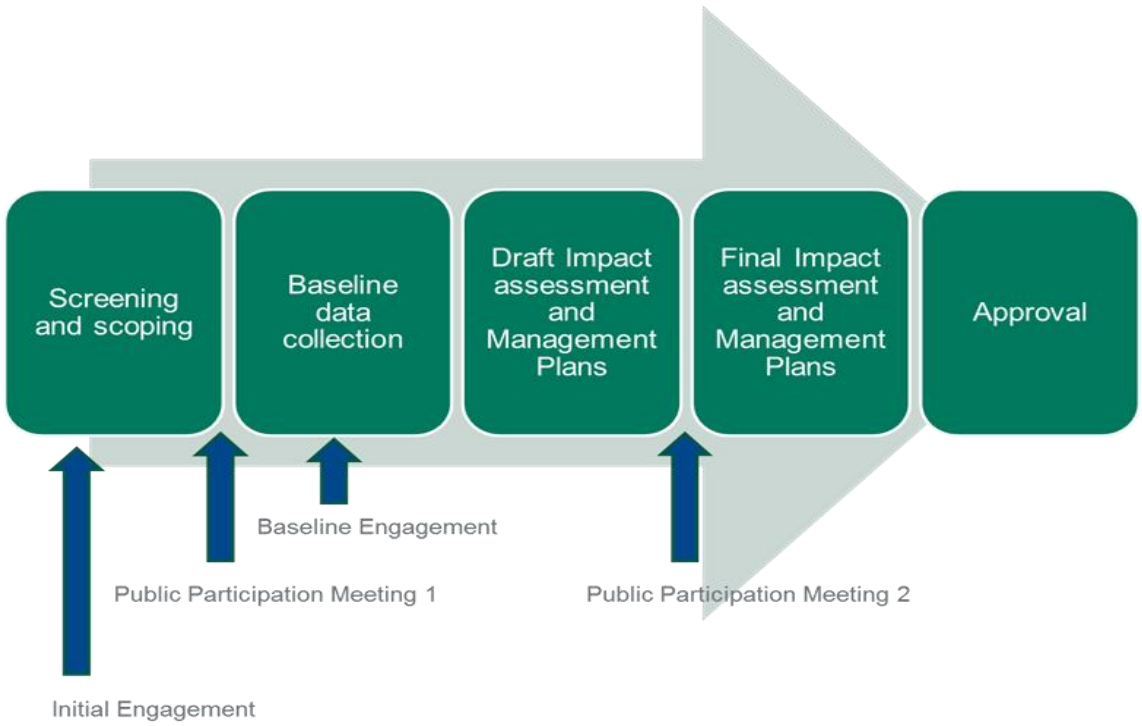


Source: ERM, 2018.

Project stakeholders have been engaged at various moments during the development of the ESIA, as shown in Figure 13.2. The engagement activities focused on:

- Introducing the Project and providing ongoing updates as the design of the Project is further refined;
- Providing an overview of the likely impacts and proposed management measures and related monitoring activities;
- Gathering stakeholder insights and input, including feedback on previously identified impacts, proposed management measures and monitoring activities; and
- Responding to key issues raised by stakeholders.

Figure 13.2: Steps of Stakeholder Engagement Process for the ESIA



Source: ERM, 2019.

13.2 Consultation for the Scoping Process

13.2.1 Format and Content of Consultation Meetings

The stakeholder consultation meetings were structured as follows:

- Introductions and information disclosure: introduce the Project Proponent, the ESIA and the proposed stakeholder engagement process, the potential environmental and social impacts and mitigation to help the stakeholders understand the Project and the Project Proponent's intentions for engagement.
- Question and answer (Q&A) session for all stakeholders in the township meeting to raise concerns, comments or ask questions that the ESIA consultant and Project Proponent could directly respond.
- Data collection: collection of additional in-depth information through interviews with key stakeholder groups in the village tracts.

In order to inform stakeholders about the Project and share information on the activities, a four page Information Document containing Project information and details on how to feedback into the Project was produced. All information was communicated by the use of visual media (including posters and power point presentations) and provided in local Myanmar language. Copies of the presentations can be found in ***Appendix II***. Copy of the Business Information Document in ***Appendix JJ***. Minutes of the engagement meetings can be found in ***Appendix KK***.

Stakeholders were also given time to share their concerns and views and any further clarifications they required at the end of the meetings. A feedback form was also provided to stakeholders for raising any additional questions or comments they may not have been able to raise during the Question and Answer session.

To gather more environmental and social baseline data and to identify potentially affected communities, Focus Group Discussions (FDGs) were undertaken at village level and were guided by questionnaires covering information relating to:

- Generic village profile: Collected information on demographic patterns, communities, occupations, and communication and grievance systems from Village leader.
- FGD questionnaires: Collected information on fishing, farming, women and ecosystem services.
- Health: Collected information on main health issues and services from Health Practitioner.

Any queries raised by the stakeholders were responded to, and noted as additional information for the impact assessment process for the ESIA.

Household Interviews that were carried out in each village are listed on ***Table 13.2***.

Table 13.2: Household Interviews in each Village

Township	Village	No. of Households (HH)
Ahlone	Thit Taw	23
	Saw Yan Paing	17
Dala	Ta Pin Shwe Hti	11
	Kyansisthar	8
	Tha Pyae Kone	15
	Ye Chaung Wa	15
	Tone Tin Gan	10

Township	Village	No. of Households (HH)
	Thet Kal Kwin	7
	Tone Tin Gun	2
Seikgyikanaungtoe	Nyaung Ngok To	12
	Seikgyi (East)	19

Source: ERM, 2019.

13.2.2 Summary of Consultation Activities Undertaken for the Scoping Process

Representatives from 17 Townships and villages were invited to attend public consultation meeting – Thanlyin, Kyauk Tan, Shwe Pyi Thar, Ahlone, Lanmadaw, Seik Kan, Dagon, Mingalardon, Pazundaung, Kamaryut, Tarmwe, Dala, Seikgyikanaungto, Shwe Pyi Thar, Pu Zun Daung, Tha Ke Ta, and Tha Khin Ba Thaung.

The meetings held were conducted between 30October and 11 December 2018. Various stakeholders were invited including Chief Minister and State Government, concerned Regional level ECD and GAD, Members of Parliament, Township GAD, village administrators, and local communities. The date, time, location, stakeholder and number of participants of each meeting is provided in ***Table 13.3***. The consultations were also communicated in two (2) Myanmar Newspapers both in English and Myanmar language (see ***Figure 13.3***).

The consultation helped the Project gather information on potentially affected people, and on potential data gaps and how these can be closed out in the ESIA Report. It also enabled various stakeholders to learn about the project and voice out their concerns and suggestions.

Table 13.3: Consultation Activities Undertaken for the Scoping Process

Date	Location	Stakeholder	Number of Participants
29/10/2018	Ahlone Township hall	GAD (Forestry and Fire Department), Parliament Member (Regional Gov't), Regional ECD, Village Leader, Elder people, Villagers, Journalist, Reporter, Yangon Electricity Supply Corporation (YESC), Corporations, and Engineering Procurement Construction (EPC)	182
10/12/2018	Dala Township hall	Parliament Member, GAD, Concerned Departments, Ward Administrator, Village Leader, Villagers, Ministry of Sports and Physical Education, YESC, Journalists, Reporters, and Yangon City Development Committee (YCDC)	211
11/12/2018	Thanlyin Township hall	GAD, Concerned Departments, Village Leader, Elder people, Villagers, Journalist, EPC, and Corporation	208

13.2.3 Results of Consultation after the Scoping Process

The following section summarises the key issues raised during the scoping public consultation meetings and ***Table 13.4*** presents the responses concerned with these issues. Photos taken during the first public consultation are shown in ***Figure 13.3***.

Table 13.4: Key Concerns and Question Raised during Public Consultation 1

Questions	Stakeholder	Response	Reference/Response in ESIA
How much is the electric cost per unit?	Name: Daw Khin Thwe Thwe Tun Position: Ward administrator Address: Dagon Township	TPMC: Currently, we cannot provide exact details regarding the electricity rates since we are still discussing with MOEE regarding the power purchase agreement. However, the discussion with MOEE is only in regards to the rates between producers and buyers for long-term contract. The MOEE is responsible for the distribution of electricity and electricity rates.	N/A
How will you prevent accidents?	Name: Daw Khin Thwe Thwe Tun Position: Ward administrator Address: Dagon Township	ERM: Within the ESIA, accidents are referred to as unplanned events. ESIA will study what types of unplanned events are likely to occur, and how the Project can manage them properly. In addition, emergency response training sessions are included in the management plan. The mitigation measures for unplanned events are included as a part of the ESIA report. TTCL has a separate EHS organization for safety management. The organization has the function in developing risk assessment and identifying risk factors. The safety management plan will always be developed in cooperation with international safety organization and specialist. TTCL Company holds ISO-9001 and ISO-14001 certificates	Project Description Chapter Unplanned Event Chapter Environmental and Social Management Plans (ESMP) Chapter.
How will you manage compensation to affected community?	Name: Daw Khin Thwe Thwe Tun Position: Ward administrator Address: Dagon Township	TPMC: We will need to conduct the compensation process, if there are any impacts, especially impacts generated from the natural gas pipeline construction. Nevertheless, our compensation for stakeholders will be provided in accordance with Myanmar Laws and guidelines from relevant authorities.	Social Impact Assessment (SIA) chapter
Please explain details of gas pipeline design and pipeline routing. One concern is that if gas pipeline crosses Ahlone Township, which is a crowded area, there might	Name: U San Tun Position: Ward administrator Address: Dagon Township	TPMC: Both terminal and gas pipeline of this project are designed in accordance with international standards and guidelines for LNG facilities, and with comments and suggestions from LNG business specialists. The construction of gas pipeline will be operated under the guidelines and supervision of MOGE. Gas pipeline will not cross through Ahlone Township as it will be connected with the existing power plant, which is located at Yangon river bank. As the construction	Project Description Chapter

Questions	Stakeholder	Response	Reference/Response in ESIA
be impacts on residential areas. Will there be disturbance in water traffic and navigation, if there is gas pipeline across Yangon River?		of gas pipeline beneath the Yangon river will be taken place by using HDD machine, there will therefore be no impact on the navigational traffic.	
Are there CSR activities carried out by TTCL in previous project activities, ERM or other third-party organizations?	Name: U Sit Maung Position: Ward Elder Address: Ahlone Township	TPMC: In our previous projects, we have organized “CSR committee”, which includes people from local communities. We have two types of CSR activities: internal CSR activity and external CSR activity. Internal CSR activities focus on our staff. For external CSR activities, we had supported local people’s needs in the project areas such as, educational, religious and health support. We also donated in the areas, affected by floods.	N/A
One concern is the shortage of LNG. So, is there long-term contract with LNG supplier?	Name: U Sit Maung Position: Ward Elder Address: Ahlone Township	TPMC: We have to contract with LNG supplier for long-term purchase. We may have to sign contract with more than one supplier in order to assure the long-term availability of LNG. It is also important for us to have substantial LNG along the operational period. If we do not have sufficient LNG power, we have to provide compensation to the government for incapability in supplying power as per contract agreement.	Project Description Chapter
According to presentation, I assumed that the LNG terminal is located on the bank of Yangon River, which is near Twan Tay canal. The current river flow in that area is about 7 miles per hour. There is high navigational traffic every day. Another concern is your proposed	Name: U Than Aye Position: Resident Address: Ahlone Township	TPMC: Our LNG terminal will be located on the riverbank of southern Dala township, which is the opposite side of Thilwa Industrial Zone. Therefore, it is far from Dala downtown area. The LNG vessel will dock once per week. As the jetty will only be located in where the Myanmar Port Authority allows us, it will not disturb the river waterway.	Project Description Chapter

Questions	Stakeholder	Response	Reference/Response in ESIA
terminal location is very close to the area of Dala Township. So, will it be possible to relocate the LNG terminal to another safer area?			
What are the gas pipeline construction codes and standards, API standard or MOGE guideline? And, what are the codes and practices of MOGE?	Name: U Thet Aung Soe Position: Engineer/ observer	TPMC: Currently, we are considering API for gas pipeline construction. However, gas pipeline ROW is not finalized by MOGE. In addition, the code and standard for gas pipeline construction will follow MOGE guidelines.	Administrative Framework Chapter
What are the vertical and horizontal clearance of existing and new 230 KV transmission line? Are they in line with the right of way (ROW) guideline from Department of Power Transmission and System Control (DPTSC)?	Name: U Thet Aung Soe Position: Engineer/ observer	TPMC: For right of way of transmission line, the allowed clearance is published on MOEE's website. The right of way of our new transmission line will be ready by DPTSC and its guidance.	Project Description Chapter
How long is the project construction period?	Name: N/A Position: Resident Address: Kyauktan	TPMC: The project is estimated to start construction work in the middle of 2019. Project construction will take about 28 months. The operation period is 25 to 30 years.	Project Description Chapter
How will you control for the noise, air & water pollution? We are experiencing constantly the noise from one of the power plant from Thilawa	Name: U Nay Win Position: Resident Address: Kyauktan Township	ERM: To determine impacts from project, we have to collect the existing soil, air quality and noise data from study area as well as need to study the potential impact from project. Depends on the existing air, soil , water quality and potential impact study, mitigation measures and monitoring plan will proposed if necessary. ESIA report including monitoring plan have to submit to MONREC for approval. Project	Impact Assessment Chapters

Questions	Stakeholder	Response	Reference/Response in ESIA
Zone.		proponent company have to comply with our proposed impact management plan. Environmental monitoring report is required to submit to MONREC department minimum every six month. If after the Project is running and mitigation are implemented, you still experience impact; you have access to the grievance mechanism to report issues to TPMC.	
Is there any punishment procedure from ECD if the project company does not follow the limitation of ESIA law?	Name: U Si Thu Position: Resident Position: Kyauktan Township	ERM: Local residents are allowed to report to ECD department in the case they experience impact from project. ECD department will monitor and make sure the project is running within the given environmental guidelines. We will also have unplanned check procedure to monitor the emission from project. If we found out the project company not follow their mitigation measures, we may severely punished the project company, from WARNING stage to terminating the plant/factory entirely.	ESMP Chapter
Due to third party is hired by project company, how can we ensure the transparency of information?	Name: U Si Thu Position: Resident Position: Kyauktan Township	ERM: EIA third party company is hired by project proponent company. However, EIA organization has to work on their own principles and regulatory guidelines. Environmental impact studies and mitigation measure proposed to project company will indicated in Impact assessment report. Final ESIA report will be reviewed by EIA review committee which is formed with experts from each relevant ministries.	N/A
Are there emergency response plan?	Name: U Si Thu Position: Resident Position: Kyauktan Township	ERM: Yes, mitigation measures for unplanned events and emergency responses will be included as a part of ESIA report.	Unplanned Event Chapter ESMP Chapter
Have you considered the natural disaster like Earthquake in your terminal design?	Name: N/A Position: Ward Elder Address: Dala	TPMC: When we design the foundation of Terminal, we have to implement the earthquake zone information (seismic factor) in design. Also, there is Myanmar National Building Code (MNBC 2016) to implement in associated building design.	Project Description Chapter
Will the jetty from your terminal make impact to riverbank and river waterway?	Name: N/A Position: Ward Elder Address: Dala	TPMC: Unlike ordinary jetty, the width of LNG receiving jetty is just about 60 feet, only the jetty mooring area is about 200m. Also, our selected terminal area has 10m water depth. So, dredging work is not required and it will not make impact to water way.	Project Description Chapter

Questions	Stakeholder	Response	Reference/Response in ESIA
Are there any impact from vessel anchored to the jetty?	Name: N/A Position: Ward Elder Address: Dala	TPMC: LNG vessel will come to anchor at the jetty approximately 3 times/ month. Maximum anchoring time is about 1.5 days for LNG unloading process. So, it will not make impact to traffic in river and water way.	Project Description Chapter
Since you proposed the gas pipeline to pass through residential area and agriculture lands, how will you compensate impacted people?	Name: U Hla Maung Position: Red Cross member Address: Seikkyikhanaungto	TPMC: Considering minimum impact to residential area & agriculture land, our current gas pipeline has been designed to route in parallel with Dala - Danote main road. We will seek approval of our pipeline route from YESC, MOGE and other relevant ministries. In the case of impact with private own land, we will directly and properly engage with owner in accordance with the guideline from Land Compensation committee. Additionally, as we have mentioned earlier, HDD method will deploy to avoid the damage to road & public properties.	Project Description Chapter SIA Chapter
Are there impact to soil due to gas pipe construction?	Name: U Thaung Position: Resident Address: Kyine Kyii village	ERM: To determine impacts from project, we have to collect the existing soil, air quality data from study area; we need to study the potential impact from project. Depends on the existing air, soil , water quality and potential impact study, mitigation measures and monitoring plan will proposed if necessary. ESIA report including monitoring plan have to submit to MONREC for approval.	Impact Assessment Chapters
How would you take Responsibility for project stakeholder?	Name: U Thaung Position: Resident Address: Kyine Kyii village	TPMC: As the project will develop in collaboration with MOEE, we fully aware for taking responsibilities and transparency of the project. The purpose of this public participation meeting is to inform the stakeholders about our project to consult any concerns. That is indicate the transparency of our project. We will arrange the second time public participation meeting and further detail information will present.	Public Consultation Chapter
Are there Job opportunities for local?	Name: U Thaung Position: Resident Address: Kyine Kyii village	TPMC: This project will create job opportunities for local business and people throughout the construction to operation phases. As we will hire the local contractors during construction phase of project. Local people will also have the chance to be employed in our project along the operation period. For example, in our Ahlone 1 project, during first three years of operation phase, foreign technician are worked together with locals. Job training were provided at that time. After 3 years, now our	Project Description Chapter

Questions	Stakeholder	Response	Reference/Response in ESIA
		plant is running with 95% local employees	
Since Seikkyikhanaungto township is surrounded by water, we are experiencing riverbank collapsing from every aspect. So, how it will impact to your gas pipe construction?	Name: U Tin Nyunt Position: Resident Address: Seikkyikhanaungto	ERM: As we have mentioned, we are in progress of ESIA assessment. We will consider your suggestion for our study and will present the results of these studies along with the analysis of potential impacts and proposed management strategies at the second round of public participation.	Impact Assessments Chapter
In my experience, local farmers were not able to carry on their plantation due to construction material deposit in farmland during gas pipe construction. Moreover, leakage from old gas pipeline are noticed during wet season.	Name : U Chit Naing Win Position :Ward leader Address : Seikkyikhanaungto	TPMC: We are working on selection of proper gas pipeline right of way. Once we have concluded the gas pipe right of way with relevant ministries, we will directly engage with impacted landowner. In addition, using quality material for gas pipe is also mandatory for our company. If there is fuel shortage occur, we will also have to suffer for not meeting promised power capacity. Therefore, we are fully aware of this matter.	Project Description Chapter Unplanned Event Chapter

Figure 13.3: Photos during 1st Public Consultation Meetings

Staffs conducting presentation in Ahlone Township

Participator in Ahlone Township presented questions and concerns

Staffs conducting presentation in Dala Township

Staffs conducting presentation in Thanlyin Township

Source: TPMC, 2018.

13.3 Consultation during the Draft ESIA Presentation

13.3.1 Format and Content of Consultation Meetings

The stakeholder consultation meetings during ESIA phase were structured as follows:

- Introductions and information disclosure: Introduce the Project Proponent, the ESIA and the results of the Environmental and Social Impact Assessment and proposed mitigation measures to avoid, reduce or compensate for these impacts.
- Propose plan for future engagement and grievance mechanism.
- Question and answer session for all stakeholders in the township meeting to raise concerns, comments or ask questions to which the ESIA consultant and Project Proponent could directly respond.
- Collect feedback from stakeholders on the proposed mitigation measures.

All information was communicated by the use of visual media (including posters and power point presentations) and provided in local Myanmar language. Copies of the presentations can be found in ***Appendix LL***. Minutes of the engagement meetings can be found in ***Appendix MM***. Feedbacks received from the stakeholders were integrated into the final impact assessment report and feedback and comment forms were distributed for stakeholders to raise additional questions or concerns after the meeting.

13.3.2 Summary of Consultation Activities Undertaken for draft ESIA Presentation

Representatives from 32 Townships and Villages were invited to attend public consultation meeting – Dala, Thingangyung, Thanlyin, Pardagyi, Sin Kan, Kyauktan, Oak Pho Su, Bauk Htaw Twin, Myoma (South & North), Bago Su, Nyaung Thone Pin, Myo Haung (West, East, and Middle), Shwe Pyout, Nyaung Wine, Shwe Pyi Thar Yar, Shwe Kone, Thidar Myine, Phayar Kone, Oak Pho, Amhuhtan, Thout Taw Twin, A Lwan Swut, Yaynan, Htan Pin Kone, Myo Thit (west), Kyaung Oak Sake, A Lwan Swut, Thar Kya Ta, Aungmingalar, Ahlone, Latha, Thuwana, and Dagon.

The meetings were held from 12 to 14June 2019. Various stakeholders were invited including Chief Minister and State Government, concerned Regional level ECD and GAD, Members of Parliament, Township GAD, village administrators, and local communities. The date, time, location, stakeholder and purpose of each meeting is provided in ***Table 13.5***. The consultations were also communicated in two (2) Myanmar Newspapers both in English and Myanmar language (see ***Figure 13.6***).

The consultation helped the Project gather information on potentially affected people, and on potential data gaps and how these can be closed out in the ESIA Report. It also enabled various stakeholders to learn about the project and voice out their concerns and suggestions.

Table 13.5: Consultation Activities Undertaken during draft ESIA presentation

Date	Location	Stakeholder	Number of Participants
12/06/2019	Ahlone Township hall, Ahlone Township	GAD (Project), ECD, Village Leader, CSOs, Elder people, Villagers, MOGE, Ministry of Education, Ministry of Agriculture, Livestock and Irrigation , Ministry of Electricity & Energy , Reporter, Myanmar Industrial Port, YCDC, NGO, Corporations, and EPC	187
13/06/2019	Thardana Beikmann Hall, Thanlyin Township	GAD (Health Care, Finance, MONREC, Fire service Department), Ministry of Agriculture, Livestock and Irrigation, EPC, YCDC, Parliament Member, ECD, Ward Administrator, Village Leader, and Villagers	180
14/06/2019	Thin Zaya Naw Ya Htar Hall, Dala Township	GAD (Construction, Project, Health Care, Piping, Agriculture, Administration, Fire service, Water and Sanitation, MONREC, and Ward Administration Department), MOE, Parliament Member (Regional Gov't), Regional ECD, Red Cross Society, Village Leader, Elder people, and Villagers	143

13.3.3 Results of Consultation during Draft ESIA Presentation

This section summarises the key issues raised during the public consultation meetings ***Table 13.6*** shows the responses concerning these issues, and photos taken during the second public consultation are shown in ***Figure 13.4.***

Table 13.6: Key Concerns and Questions Raised during Draft ESIA presentation

Questions	Stakeholder	Response	Reference/Response in ESIA
Has any construction started in Dala? Why is the power plant not constructed in Hlaingtharya?	Name: U Tin Lin Position: Lut Latt Yay Ward Administrator Address: Ahlone	There is an existing 121MW Power Plant near MOEE's electricity supply and distribution office (Ahlone) by which constructed and operated by TTCL since 2012. It is MOEE's guidance and instruction to construct this new combine cycle power plant on the vacant land next to existing power plant. That is why the power plant is located in Ahlone. Additionally, the reason of building the terminal and jetty in Dala townships is that the selected location's water depth is deep enough to construct the jetty for LNG carrier vessel.	Project Description Chapter
How will the electricity be transferred from Ahlone to Hlaingtharyar?	Name: U Hla Win, Position: Ward Administrator Address: Ahlone	The underground gas pipeline will start from LNG receiving Terminal in Dala, follow the existing Dala-Danote main road to the Seikkyikhanaungto township and directly to the power plant located on Ahlone river bank by crossing the Yangon river from below. Therefore, gas pipe will not pass through downtown townships.	Project Description Chapter
Which Township will benefit from the project?	Name: U Hla Win, Position: Ward Administrator Address: Ahlone	As TTCL is an independent power producer, our scope of work is to build and operate the plant. All the produced power will be sold out to MOEE with power purchase agreement. Distribution to households is in the scope of MOEE.	Project Description Chapter
What are the possible impact of the project on electricity cost?	Name: U Hla Win, Position: Ward Administrator Address: Ahlone	It is under the management of MOEE whether there will be impact on electricity cost or not.	N/A
How will the maintenance of the pipeline be done for the section under the Yangon River?	Name: N/A, Position: MOEE, Address: Ahlone	For the process of unloading and storage of LNG, We will required advised from experienced safety Consultant Company (experience in Japan, china, Korea, etc.). We will utilize their technical know-how and experiences in our terminal design for safety operations.	Project Description Chapter
Suggested TTCL to recruit and seek advice by local engineer	Name: N/A, Position: MOEE, Address: Ahlone	Our gas Pipeline standard followed minimum compliance of MOGE's practices. However, international code and standards such as ASME are also complied by monitor and maintain the gas Pipeline every year to ensure the good condition	Project Description Chapter SIA Chapter

Questions	Stakeholder	Response	Reference/Response in ESIA
Suggested operating the power plant safely and sustainably.	Name: N/A, Position: MOEE, Address: Ahlone	Company has to put a huge amount of investment on the Project. Therefore, the sustainable operation of project is a very crucial point for the Company. Regarding to safety concerns of the Projects, we have hired experts from safety Consultant Company. With their support, we have already presented about our project safety precautions to Yangon Regional Government & MOEE.	Project Description Chapter ESMP Chapter
What sort of impacts are expected from LNG operation?	Name: N/A, Position: Parliament member	LNG unloading and storage process will be complied with the International fire prevention and safety guideline such as NFPA. Equipment such as fire prevention and leakage detection sensors will be equipped in terminal to prepare for the immediate actions of any event. In the case of unplanned event, LNG storage layout is properly designed to handle the impact within the terminal area only.	Impact Assessment Chapters
In term of impact, where does the LNG rank compared with other type of fuel?	Name: N/A, Position: Parliament member	There are various source of energy such as coal, hydro, natural gas. LNG is a liquid form of natural gas, which is one of the energy sources with minimum impact to the environmental. In terms of safety, this project will applied IFC and other international standard/guidelines.	N/A
How will the impacts be mitigated?	Name: N/A, Position: Parliament member	Our unplanned event mitigation measures are prepared according to applicable international guideline and analysing what is likely to occur in LNG fuel power plant. These measures included how to prevent the accidents, how to properly respond in the case of accidents, and train project personnel for the emergency response plan. As our measures are prepared for the worst-case scenario, such unplanned accidents will be properly handle.	Impact Assessment Chapters
Project information should be displayed to Township parliament office.	Name: Dr. Sein Mya Aye Position: Parliament member Address: Dala	During the first round of public consultation we have distributed project information documents to all attended stakeholders. In which, we have described all the project progress and way forward. We have also informed about the grievance mechanism Local communities were invited to report if there is any issues or comments on ESIA process. Comments and suggestions from first meeting are recorded and implemented in the ESIA report.	Public Consultation Chapter
What kind of CSR	Name: Dr. Sein Mya Aye	Our project will be developed only after MIC permit is granted. In order to	N/A

Questions	Stakeholder	Response	Reference/Response in ESIA
activities will contribute to local?	Position: Parliament member Address: Dala	obtain MIC permit from, Project Company is required to develop and comply with the CSR program. We are going to implement our CSR program with the collaboration from local level.	
Suggested TTCL to inform people more about their rights toward the Project.	Name: Dr. Sein Mya Aye Position: Parliament member Address: Dala	N/A	N/A
How will the company activities will be verified or monitor? What would be the punishment and penalties if Project Company does not follow the ESIA law?	Name: Dr. Sein Mya Aye Position: Parliament member Address: Dala	There are Myanmar Environmental conversation law, Environmental Conversation Rule & Environment Impact Assessment procedure 2015. ECD department will determined the necessary level of environmental assessment for the proposed project. Project proposed company is responsible to comply with the applicable environmental law. If company fail to follow environmental management, the company is punishable to pay fine or other severe punishment according to law.	ESMP Chapter
Suggested the impact to public road should be repair by the company	Name: N/A Position: Resident	Our gas pipeline route is currently designed to be along the Dala-Danote main road. However, it is subjected to change depending to detail survey that we are about to do with the cooperation from relevant government departments. In the case of road damage occurred by Machinery/Vehicles used in pipeline construction, company will be responsible to repair.	SIA Chapter ESMP Chapter
Why the construction of power plant is not in Dala?	Name: N/A Position: Resident	We have to develop project components only on permitted land/ area by government. We have decided to build up the terminal and jetty in Dala townships following the instruction from Yangon regional government and Myanmar Port Authority. The selected location's water depth is deep enough to construct the jetty for LNG carrier vessel.	Project Description Chapter
What is the project schedule?	Name: N/A Position: Resident	Commercial operation of project will commence 28 months after PPA effective date.	Project Description Chapter
TTCL should include the risk management plan	Name: N/A, Position: Police Department, Address: Dala	Company will be responsible for every impact occurred by project activities during construction and operation phase. Company will compensate fair amount of compensation.	ESMP Chapter
If project affect the paddy field people should			

Questions	Stakeholder	Response	Reference/Response in ESIA
receive fair compensation.			
What are the measures to prevent gas leakage?	Name: N/A, Position: Village Administrator Address: Pyaw Bwe Gyee Village	ERM has proposed specific mitigation measures for an un-planned event of spill or leakage of oil, fuel and gas. The measures including how to prevent and prepare for the leakage, and providing training for staffs to properly respond in the case of gas leakage	Project Description Chapter
What are the measures in the case of gas leakage?	Name: N/A, Position: Village Administrator Address: Pyaw Bwe Gyee Village	Detection system is implemented in gas pipeline design to detect the gas leakage. Block valve stations located between terminal and power plant will also implemented for emergency response. When the gas leakage is detected, company will be able to take immediate action to prevent the people and environment	ESMP Chapter
Which part of the Seikkyikhanaungto Township will be impacted by the project?	Name: N/A Position: Medical personnel	Underground gas pipe from Dala township will be connected to Seikkyikhaunaungto Township crossing the Twantay Canal by deploying HDD machine. The gas pipe will then directly connected to Power plant from the below of Yangon River. Therefore, a small portion of Seikkyikhanaungto townships is concerned in project components.	Project Description Chapter

Figure 13.4: Photos during 2nd Public Consultation Meetings

Staffs conducting presentation in Ahlone Township

Participator in Ahlone Township presented questions and concerns

Staffs conducting presentation in Thanlyin Township

Staffs conducting presentation in Dala Township

Source: TPMC, 2019

13.4 Ongoing Consultations

During the Project, there will be additional engagement as per the recommendations in the impact assessment chapters of this report. It is expected that meetings will be held on ad-hoc basis with the relevant stakeholder. The format of these meetings will vary based on the type of information that needs to be shared with the stakeholders.

13.5 Disclosure

Information disclosure is one of the most important aspects of any engagement process. The process of disclosure involves the provisioning of information in an accessible manner (allowing for easy understanding, such as in the local language or using visual tools) to the various stakeholders in the Project. This disclosure not only allows for trust building amongst the stakeholders through the sharing of information, but also allows for more constructive participation in the other processes of consultation and resolution of grievances due to availability of accurate and timely information.

As per the requirements of the EIA Procedure, the Project Proponent has disclosed information about the Project on their website at the following address: http://www.ttcl.com/news/activities. Project information will continue to be available on this website and signboards will be posted at the Project site. There will also be adverts in one English and one Myanmar newspaper within 15 days from submission of the report to ECD and hard copies of the report (Executive Summary chapter in Myanmar language) will be made available at the Project office in Ahlone Township and at Parliament of GAD offices within the Project Study Area.

In addition, since September 19, 2019, the full ESIA report has been available for public access on the Project Proponent website as follows: https://www.ttcl.com/news/activities/view/113. The report is published in English with executive summary in Myanmar language.

The advertisements announcing the draft ESIA engagement where done in The Global New Light of Myanmar (English) and The Mirror (Burmese) on October for the Scoping process (see ***Figure 13.5***) and June for the draft ESIA process (see ***Figure 13.6***).

Figure 13.5: Newspaper Advertisements during Scoping Process

TTCL Power Myanmar Company Limited

16B, 16th Floor, Centre Point Tower, No. 65, Corner of Sule Pagoda Road and Merchant Street, Kyauktada Township, Yagon, Myanmar

News Release

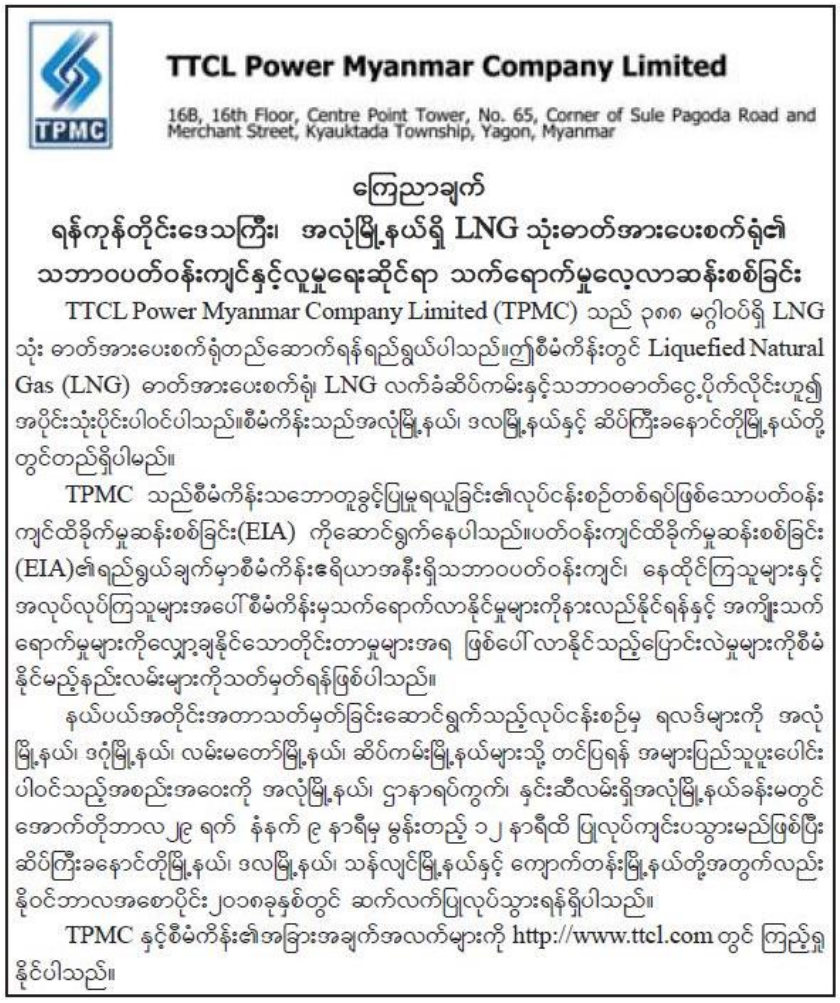
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENTS of a 388 MW Combined Cycle Power Plant in Ahlone Township, Yangon Region.

TTCL Power Myanmar Company Limited (TPMC)is planning to build a 388 MW Combined Cycle Power Plant supplied in Natural Gas. The project consists of three main components, which includes the Liquefied Natural Gas (LNG) power plant, the LNG receiving facility, andnatural gas (NG) pipeline. The Project will be located in Ahlone, Dala, and Seikgyikanaungto Townships.

As part of the approval process, TPMC is undertaking an Environmental Impact Assessment (EIA) study. The purpose of the EIA is to understand how the Project may impact the environment and the people living and working close to the Project area and identify ways to manage any changes that may occur through the development of mitigation measures.

Public Participation meeting to present the result of the scoping phase will be held in Ahlone, Dagon, Lanmadaw, Seikkan Township on 29th October as well as in Seikgyikanaungto and Dala Townships, Thanlyin and Kyauktan in October 2018.

More info about TPMC and the Project can be found at http://www.ttcl.com



TTCL Power Myanmar Company Limited

16B, 16th Floor, Centre Point Tower, No. 65, Corner of Sule Pagoda Road and Merchant Street, Kyauktada Township, Yagon, Myanmar

ကြေညာချက်

ရန်ကုန်တိုင်းဒေသကြီး၊ အလုံမြို့နယ်ရှိ LNG သုံးဓာတ်အားပေးစက်ရုံ၏ သဘာဝပတ်ဝန်းကျင်နှင့်လူမှုရေးဆိုင်ရာ သက်ရောက်မှုလေ့လာဆန်းစစ်ခြင်း

TTCL Power Myanmar Company Limited (TPMC) သည် ၃၈၈ မဂ္ဂါဝပ်ရှိ LNG သုံး ဓာတ်အားပေးစက်ရုံတည်ဆောက်ရန်ရည်ရွယ်ပါသည်။ဤစီမံကိန်းတွင် Liquefied Natural Gas (LNG) ဓာတ်အားပေးစက်ရုံ၊ LNG လက်ခံဆိပ်ကမ်းနှင့်သဘာဝဓာတ်ငွေ့ပိုက်လိုင်းဟူ၍ အဓိကသုံးပိုင်းပါဝင်ပါသည်။စီမံကိန်းသည်အလုံမြို့နယ်၊ ဒဂုံမြို့နယ်နှင့် ဆိပ်ကြီးခနောင်တိုမြို့နယ်တို့တွင်တည်ရှိပါမည်။

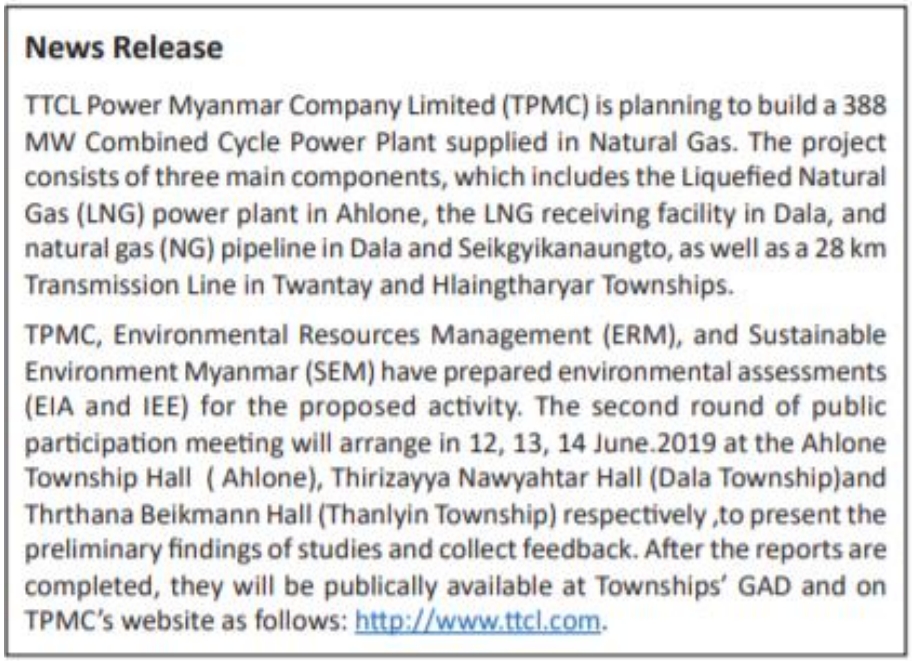
TPMC သည်စီမံကိန်းသဘောတူခွင့်ပြုမှုရယူခြင်း၏လုပ်ငန်းစဉ်တစ်ရပ်ဖြစ်သောပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း(EIA) ကိုဆောင်ရွက်နေပါသည်။ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း(EIA)၏ရည်ရွယ်ချက်မှာစီမံကိန်း၏ရေယာအနီးရှိသဘာဝပတ်ဝန်းကျင်၊ နေထိုင်ကြသူများနှင့် အလုပ်လုပ်ကြသူများအပေါ် စီမံကိန်းမှသက်ရောက်လာနိုင်မှုများကိုနားလည်နိုင်ရန်နှင့် အကျိုးသက်ရောက်မှုများကိုလျှော့ချနိုင်သောတိုင်းတာမှုများအရ ဖြစ်ပေါ်လာနိုင်သည့်ပြောင်းလဲမှုများကိုစီမံနိုင်မည့်နည်းလမ်းများကိုသတ်မှတ်ရန်ဖြစ်ပါသည်။

နယ်ပယ်အတိုင်းအတာသတ်မှတ်ခြင်းဆောင်ရွက်သည့်လုပ်ငန်းစဉ်မှ ရလဒ်များကို အလုံမြို့နယ်၊ ဒဂုံမြို့နယ်၊ လမ်းမတော်မြို့နယ်၊ ဆိပ်ကမ်းမြို့နယ်များသို့ တင်ပြရန် အများပြည်သူပူးပေါင်းပါဝင်သည့်အစည်းအဝေးကို အလုံမြို့နယ်၊ ဌာနာရပ်ကွက်၊ နှင်းဆီလမ်းရှိအလုံမြို့နယ်ခန်းမတွင် အောက်တိုဘာလ ၂၉ ရက် နံနက် ၉ နာရီမှ မွန်းတည့် ၁၂ နာရီထိ ပြုလုပ်ကျင်းပသွားမည်ဖြစ်ပြီး ဆိပ်ကြီးခနောင်တိုမြို့နယ်၊ ဒဂုံမြို့နယ်၊ သန်လျင်မြို့နယ်နှင့် ကျောက်တန်းမြို့နယ်တို့အတွက်လည်း နိုဝင်ဘာလအစောပိုင်း ၂၀၁၈ခုနှစ်တွင် ဆက်လက်ပြုလုပ်သွားရန်ရှိပါသည်။

TPMC နှင့်စီမံကိန်း၏အခြားအချက်အလက်များကို http://www.ttcl.com တွင် ကြည့်ရှုနိုင်ပါသည်။

Source: TPMC, 2018.

Figure 13.6: Newspaper Advertisements during Draft ESIA Process



News Release

TTCL Power Myanmar Company Limited (TPMC) is planning to build a 388 MW Combined Cycle Power Plant supplied in Natural Gas. The project consists of three main components, which includes the Liquefied Natural Gas (LNG) power plant in Ahlone, the LNG receiving facility in Dala, and natural gas (NG) pipeline in Dala and Seikgyikanaungto, as well as a 28 km Transmission Line in Twantay and Hlaingtharyar Townships.

TPMC, Environmental Resources Management (ERM), and Sustainable Environment Myanmar (SEM) have prepared environmental assessments (EIA and IEE) for the proposed activity. The second round of public participation meeting will arrange in 12, 13, 14 June.2019 at the Ahlone Township Hall (Ahlone), Thirizayya Nawyahtar Hall (Dala Township)and Thrthana Beikmann Hall (Thanlyin Township) respectively ,to present the preliminary findings of studies and collect feedback. After the reports are completed, they will be publically available at Townships' GAD and on TPMC's website as follows: http://www.ttcl.com.

အများသိစေရန်ကြေညာခြင်း

TTCL Power Myanmar Company Limited (TPMC)

သည် ၃၈၈ မဂ္ဂါဝပ်ရှိ LNG သုံးဓာတ်အားပေးစက်ရုံ တည်ဆောက်ရန် ဆောင်ရွက်လျက်ရှိပါသည်။ ဤစီမံကိန်းတွင် အလုံမြို့နယ်အတွင်း တည်ရှိမည့် Liquefied Natural Gas (LNG) ဓာတ်အားပေးစက်ရုံ၊ ဒလမြို့နယ်အတွင်းတည်ရှိမည့် LNG လက်ခံဆိပ်ကမ်းနှင့် ဒလမြို့နယ်နှင့် ဆိပ်ကြီးခနောင်တိုမြို့နယ်တို့အတွင်းတွင် တည်ရှိမည့် သဘာဝဓာတ်ငွေ့ပိုက်လိုင်းသွယ်တန်းခြင်းဟူ၍ အဓိကအပိုင်း သုံးပိုင်း ပါဝင်ပါသည်။ ထို့အပြင် (၂၈) ကီလိုမီတာခန့် အရှည်ရှိမည့် ဓာတ်အားလိုင်းသွယ်တန်းခြင်းလုပ်ငန်းလည်း တွဲတေးနှင့် လိုင်သာယာမြို့နယ်အတွင်း ဆောင်ရွက်မည်ဖြစ်ပါသည်။

TPMC , Environmental Resources Management (ERM), and Sustainable Environment Myanmar (SEM) ကုမ္ပဏီတို့မှ အဆိုပါစီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှု လေ့လာဆန်းစစ်ခြင်းစာတမ်း (EIA နှင့် IEE)တို့ကို လေ့လာပြုစုလျက်ရှိပါသည်။ အဆိုပါလေ့လာမှု၏ ပဏာမတွေ့ရှိချက်များကို စီမံကိန်းနှင့် သက်ဆိုင်သူများသို့တင်ပြ၍ ဆွေးနွေးအကြံပြုချက်များကို လက်ခံလိုသောကြောင့် ဒုတိယအကြိမ် လူထုပါဝင်ဆွေးနွေးပွဲကို ၂၀၁၉ ခုနှစ် ဇွန်လ ၁၂၊ ၁၃၊ ၁၄ ရက်များတွင် အလုံမြို့နယ်ခန်းမ၊ ဒလမြို့ သီရိဇေယျနောရထာခန်းမနှင့် သန်လျင်မြို့ သာသနာ့ဒိမာန်ခန်းမတို့တွင် အသီးသီး ပြုလုပ်သွားမည်ဖြစ်ပါသည်။

ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း စာတမ်းများ ပြည့်စုံစွာပြုစုပြီးသောအခါ အများပြည်သူအတွက် သက်ဆိုင်ရာမြို့နယ်အုပ်ချုပ်ရေးမှူးရုံးများနှင့် TPMC ဝက်ဆိုဒ် http://www.ttcl.com တို့တွင် ကြည့်ရှုနိုင်မည်ဖြစ်ပါသည်။

Source: TPMC, 2019.

13.6 Grievance Mechanism

The Grievance Redress Mechanism (GRM) is another critical component of effective stakeholder engagement. The GRM will be accessible and understandable for all stakeholders, for the entire project life. The GRM will be communicated to all relevant stakeholders and will also be applicable to any contractor that will occupy and/or use land during the construction and operation phases.

Grievances can be report through the following address:

16B, 16th Floor, Centre Point Tower, No.65,

Corner of Sule Pagoda Road and Merchant Street,

Kyauktada Township, Yangon, Myanmar 11182

The 24 hour contactable number is as follows: **+95 1 371962**

The guiding principles of the ESIA feedback mechanism, including the five key steps through which it operates and the communication and feedback channels available to stakeholders**.** These elements of the feedback mechanism will be clearly explained to all stakeholders during engagement activities at all Project phases.

All feedback that is gathered will be recorded in a stakeholder database in which relevant responses or resolutions will also be recorded. The feedback evaluation form will be used to identify and analyse issues, including any unforeseen issues. A detailed stakeholder database has the advantage of strengthening the continuity of the Project, building on the experience and lessons learned from the stakeholder engagement process, and understanding stakeholder needs and expectations.

More details on grievances and categories, GRM principles, and the process of receiving, documenting, addressing and closing grievances are presented in Stakeholder Engagement Plan (SEP) ***Appendix V.***

14. CONCLUSION AND RECOMMENDATION

This Environmental Impact Assessment (EIA) report has been prepared based on the technical information provided by the Project Proponent, existing studies and reports relevant to the Project, site visits, baseline environmental and social data collection and the stakeholder engagement.

Through this process, the assessment has been conducted of the potential environmental and social impacts attributable to the construction and operation phases of the Project. Qualitative and quantitative (where relevant) assessments of impacts have been presented, significance of each potential impact has been identified, and mitigation measures to minimise and reduce the impacts have been recommended. Cumulative environmental impacts particularly on air quality, noise, waste and community health and safety have also been assessed taking into consideration the existing industrial facilities and civil activities and known future projects present in the Study Area.

Although a number of potential environmental, social and health impacts were identified, the assessments found that impacts are typically short term in duration have minor residual significance after implementation of mitigation measures. The potential for impacts is well understood with little or no evidence of adverse consequences on the majority of environmental, social or health receptors provided that adequate in-place controls and/or mitigation measures are implemented. The suggested mitigation measures in the ESMP are well established amongst international practice, and proven to be effective in managing any impacts that might occur to acceptable levels, including for similar projects in similar settings.

Many of the impacts are localised and short-term or temporary in nature (linked to the construction phase) 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 (ESMP).

In terms of social aspect, the results from initial stakeholder engagement indicate that the Project has received favourable support from local people and other stakeholders. 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, potential employment (direct and indirect) and that the negative impacts can be mitigated, provided the Project proponent implement all the proposed mitigation measures.

For all the impacts identified in the study, mitigation measures have been proposed and included in the ESMP chapters, including the schedule for monitoring. If any impacts result in more severe significance that assess in this report, actions to be taken by the Project proponent or its contractors are also described.

The effective implementation of the ESMP and adherence with the Myanmar NEQ, and IFC guidelines will assist in minimising the environmental impacts to acceptable levels. With continued engagement with local stakeholders and monitoring as proposed in the ESMP of impact significance, the environmental and social assessment of the Project ascertains that the Project is unlikely to cause any significant environmental and social impacts and will bring benefits to local stakeholders and a more reliable supply of electricity to the region.

15. STATEMENT OF COMMITMENT

TPMC will at all times comply fully with the commitments, mitigation measures and monitoring plans that have been presented in this ESIA Report.

TPMC shall fully implement the ESMP, all Project commitments, and conditions, and is liable to ensure that all contractors and subcontractors of the project comply fully with all applicable Laws, including the Environmental Conservation Law (2012), Environmental Conservation Rules and Environmental Impact Assessment Procedure (2015), as well as the ESMP, Project commitments and conditions.

TPMC and ERM hereby confirm that:

1. The ESIA Report is accurate, consolidated and complete to the best of our knowledge, at the time of preparing this Report;
2. The ESIA has been conducted in accordance with relevant laws, including the EIA Procedure (2015); and
3. The Project Proponent will fully follow the commitments, mitigation measure and management plans set out in this ESIA Report.

The signed commitment letter is shown in ***Appendix PP***.

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APPENDIX A PPR SUBMISSION LETTER

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To
U Hla Maung Thein
Director General
Environmental Conservation Department
Ministry of Natural Resources and Environmental Conservation
Office 53, Naypyidaw
The Republic of Union of Myanmar

Letter: TTCL 063/17 H/O
Date: December 11th, 2017

Subject: Appointment of Third Party Consultant for Environment Impact Assessment (EIA) Study for the development of an expansion phases for 354 MW Combined Cycle Power Plant for Ahlone Power Plant in Yangon, Myanmar

TTCL is pleased to inform that Environmental Resources Management (ERM) has been appointed as the organisation to carry out the Environmental Impact Assessment (EIA) Study for the project.

ERM have formally applied as an Organisation to undertake IEEs and EIAs in Myanmar on the Transitional Consultant Registration Scheme.

ERM will undertake an Environmental Impact Assessment (EIA) Study (also referred to as Environmental and Social Impact Assessment: ESIA) for the Project. The outcomes of the EIA Study will be submitted to relevant Myanmar authorities for assessment in order to inform the decision for the Project Proponent to obtain an Environmental Compliance Certificate (ECC).

For this Project, ERM will work with the qualified sub-consultant, Sustainable Environment Myanmar Co., Ltd (SEM), who has experience in carrying out the baseline survey and public consultation meetings in the local context. Note that all the works provided by SEM are under ERM supervision.

Should you require further information on TICL's intended EIA approach, please do not hesitate to contact me.

We do attach: (A) ERM's Company Profile & Experience
(B) SEM's Company Profile & Experience

Best Regards,

Mr. Hironobu Iriya
President & CEO
TTCL Public Company Limited

Copy to:

1. Union Minister, Ministry of Electricity and Energy
2. Deputy Minister, Ministry of Electricity and Energy
3. Permanent Secretary, Ministry of Electricity and Energy
4. Managing Director, Electric Power Generation Enterprise, MOEE
5. Director General, Department of Electric Power Planning, MOEE

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED
COMPANY REGISTRATION NO. 0107551000185
27th-30th FLOOR, SERMMIT TOWER, 159/41-44 SUKHUMVIT 21, ASOKE ROAD,
NORTH KLONGTOEY, WATTANA, BANGKOK 10110 THAILAND
TEL. +66 (0) 2260-8505 FAX. +66 (0) 2260-8525-6

To
U Hla Maung Thein
Director General
Environmental Conservation Department
Ministry of Natural Resources and Environmental Conservation
Office 53, Naypyidaw
The Republic of Union of Myanmar

Letter: TTCL 064/17 H/O
Date: December 14th, 2017

Subject: Submission of Project Proposal Report for Environment Impact Assessment (EIA) Study for the Development of an expansion phases for 354 MW Combined Cycle Power Plant for Ahlone Power Plant in Yangon, Myanmar

TTCL Public Company Limited (TTCL) is pleased to attach herewith the Project Proposal Report for the proposed development of expansion phases for 354 MW Combined Cycle Power Plant for Ahlone Power Plant in Yangon, Myanmar

This Project Proposal Report has been prepared by the Project Proponent and Environmental Resources Management (ERM), as per Section 7 of the Environmental Conservation Law, Articles 52 and 53 of the Environmental Conservation Rules of the Republic of the Union of Myanmar, and Annex 1 of the EIA Procedure, dated 29th December 2015, that MONREC requires the Project Proponent to proceed with an Environmental Impact Assessment (EIA) Study of the Project and prepare an Environmental Management Plan (EMP) to put forward its commitments for environmental and social mitigation and management measures.

Please do not hesitate to contact me directly should you have any queries on the enclosed.

We do attach: (A) Project Proposal Report (PPR)
Booklet Report and CD are enclosed herewith

Best Regards,

Mr. Hironobu Iriya
President & CEO
TTCL Public Company Limited

Copy to:

1. Union Minister, Ministry of Electricity and Energy
2. Deputy Minister, Ministry of Electricity and Energy
3. Permanent Secretary, Ministry of Electricity and Energy
4. Managing Director, Electric Power Generation Enterprise, MOEE
5. Director General, Department of Electric Power Planning, MOEE

APPENDIX B SCOPING REPORT SUBMISSION LETTER

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

COMPANY REGISTRATION NO. 0107551000185
27th-30th FLOOR, SERMMIT TOWER, 159/41-44 SUKHUMVIT 21, ASOKE ROAD,
NORTH KLONGTOEY, WATTANA, BANGKOK 10110 THAILAND
TEL. +66 (0) 2260-8505 FAX. +66 (0) 2260-8525-6

To,
Director General
Department of Electric Power Planning
Ministry of Electricity and Energy
Office 27 Naypyidaw,
The Republic of the Union of Myanmar

Letter No: TTCL 004/19 H/O
Date: January 9th, 2019

Project: LNG Power Plant (Ahlone) Project

Subject: Submission of Scoping Report for Environmental Impact Assessment (EIA) study of LNG Power Plant (Ahlone) Project, Yangon, Myanmar.

TTCL Public Company Limited (TTCL) is pleased to attach the Project Scoping Report which is the next step for EIA process for LNG Power Plant (Ahlone) Project, Yangon, Myanmar. Please refer to **Attachment (A).**

In accordance with Myanmar's EIA procedure, TTCL have been acquired the approval form Ministry of Natural Resources and Environmental Conversation (MONREC) on the Third Party Appointment and Project Proposal Report for the EIA study of LNG Power Plant (Ahlone) Project. Refer to per **Attachment (B)** and **(C)** respectively.

Moreover, TTCL have been accomplished the first round of Public Participation Meeting with the participants from project concerned townships, according to Myanmar EIA law and regulation.

This Project Scoping Report has been prepared by the Project Proponent and Environmental Resources Management (ERM), as per section 7 of the Environmental Conversation Law, Article 52 and 53 of the Environmental Conversational Rules of the Republic of the Union of Myanmar, and Annex 1 of the EIA procedure, dated 29th December 2015.

TTCL confirms that the Scoping Report including the Terms of Reference will be implemented and form part of the FULL ESIA study.

Should you require further information, please do not hesitate to contact Mr. Htet Aung Mon via htetaung.m@ttcl.com or phone on +95 9974953914 or +95-1-371963.

Attached with
(A) Scoping Report for the LNG Power Plant (Ahlone) Project
(B) ECD respond letter for Third Party Confirmation_Letter_EIA-2/ Petroleum [1018/2018]
(C) ECD Respond Letter for PPR_Letter_EIA- 2/2 [1005 (E)/2018]

Best Regards,

Ms. Suratana Trinratana
Senior Vice President
TTCL Public Company Limited

10.1.19
ဝင်စာအမှတ်
067-431490-
01c 1011

JOY OF ENGINEERING AND ACHIEVEMENT

APPENDIX C ECD COMMENTS ON SCOPING REPORT

No.	Comment from ECD	Response from ERM
1.	Sufficient ESIA shall carry out to cover the total project capacity of 388MW as ECD found out the project capacity indicated in Scoping Reported have been increased to 388MW, although the approved PPR report had indicated as 356MW.	The Project Description and Alternative chapter (***Chapter 4*** of this report) include the 388MW capacity and the ESIA has been carried-out considering this capacity and not the initial 356MW described in the PPR report.
2.	To indicate current Myanmar Legislation Relevant to the Project. To describe the project commitment to follow those Myanmar legislation, regulation, procedure and applicable International standard relevant to the project.	The relevant Myanmar legislation are presented in the Policy, Legal and Institutional Framework Chapter (***Chapter 3*** of this report). The Project Commitment relative to the legislation, regulation, procedure and applicable standards are included in the Conclusion and Statement of Commitment Chapter (***Chapter 14*** of this report).
3.	To indicate the updated project timeline of each components.	The Project Description and Alternative chapter (***Chapter 4*** of this report) include the tentative timeline for each of the Project's components.
4.	To indicate the Fire Prevention Plans, Emergency Response plans for the project main components of Power Plant, LNG receiving Terminal & LNG storage tank.	The Project Description and Alternative chapter (***Chapter 4*** of this report) and the Environmental and Social Management Plan chapter (***Chapter 12*** of this report) include a description of these management plans. The plans are also appendixes to this report.
5.	To indicate the flooding risk & prevention plans for the project main components of Power Plant, LNG receiving Terminal & LNG storage tank.	The Environmental and Social Management Plan chapter (***Chapter 12*** of this report) include mitigation measures to be implemented in relation to flooding risks. In addition, the flooding risk study has been carried out for the Power Plant, this is attached as ***Appendix NN***.
6.	To indicate the impact assessment on climate based on the climate change projection data available from union level and international research organization, including impacts on environmental & societies, action plan and emergency response plan.	The Impact Assessment Chapters (***Chapters 7***, ***8***, and ***9*** of this report) include the assessment of impact from Greenhouse Gas and the Environmental and Social Management Plan chapter (***Chapter 12*** of this report) include mitigation measures to be implemented in relation to these impacts.
7.	To identify the primary impacts(Environment, Communities)from the project development	The Impact Assessment Chapters (***Chapters 7***, ***8***, and ***9*** of this report) include the assessment of all the potential impacts from the development of this Project.
8.	To indicate the complete environmental and social baseline data collected from project main components area.	The Description of the Environment Chapter (chapters 5 of this report) include the complete environmental and social baseline data collected in the Project Area of Influence.
9.	To indicate the project impacts and mitigation measures as well as action plan, in charge organization.	The Impact Assessment Chapters (***chapters 7***, ***8***, and ***9*** of this report) include the assessment of all Project impacts and the Environmental and Social Management Plan chapter (***Chapter 12*** of this report) include mitigation measures to be implemented in relation to these impacts as well

No.	Comment from ECD	Response from ERM
		as the company organisation during construction and operation.
10.	To indicate the mitigation measure for road traffic & river traffic.	The Impact Assessment Chapters (***Chapters 7***, ***8***, and ***9*** of this report) include the assessment of the Project impacts in relation to road and river traffic and the Environmental and Social Management Plan chapter (***Chapter 12*** of this report) include mitigation measures to be implemented in relation to these impacts.
11.	To study out the **Cumulative Impact** assessment related to project impacts (air quality, noise, waste disposal, road traffic) and to propose mitigation measure.	All cumulative impacts and mitigation measures are presented in the Cumulative Impact Assessment chapter (***Chapter 11*** of this report) and reported in the Environmental and Social Management Plan chapter (***Chapter 12*** of this report).
12.	To indicate detail of project waste classification base on type/volume, waste management plan, hazardous waste storage plan, transportation and final disposal location.	The Project Description and Alternative chapter (***Chapter 4*** of this report) include the details of Project waste. The Environmental and Social Management Plan chapter (***Chapter 12*** of this report) include the framework of the waste management plan.
13.	To indicate the number of worker during construction phase and worker accommodation plan. To indicate the environmental & social impact due to worker workers influx and mitigation measure.	The Project Description and Alternative chapter (***Chapter 4*** of this report) include the details of required workers for each component and each phase of the Project. The Impact Assessment Chapters (***Chapters 7***, ***8***, and ***9*** of this report) include the assessment of the Project impacts in relation to the presence of these workers and worker accommodations.
14.	To indicate the Stake Holder Communication plan during Operation Phase.	The Public Consultation and Disclosure chapter (***Chapter 13*** of this report) include the framework for stakeholder engagement during operation. The Impact Assessment Chapters (***Chapters 7***, ***8***, and ***9*** of this report) also include some details on the stakeholder engagement during operation phase.
15.	To indicate detail the job employment rate (%) for local people into project and job training program.	The Project Description and Alternative chapter (***Chapter 4*** of this report) include the details of required workers for each component and each phase of the Project, including the expected level of local workers. The Impact Assessment Chapters (***Chapters 7***, ***8***, and ***9*** of this report) and the Environmental and Social Management Plan chapter (***Chapter 12*** of this report) include details of mitigation measures relative to training programme.
16.	To carry out the ground survey and study the erosion and sedimentation impacts from proposed project.	The Description of the Environment Chapter (***Chapters 5*** of this report) details the survey realised for this Project. The Impact Assessment

No.	Comment from ECD	Response from ERM
		Chapters (***Chapters 7***, ***8***, and ***9*** of this report) and the Environmental and Social Management Plan chapter (***Chapter 12*** of this report) include details of mitigation measures relative to these aspects.
17.	To indicate the water consumption for Power Station and water resource competition assessment for project nearby.	The Project Description and Alternative chapter (***Chapter 4*** of this report) include the details of water consumption need for the Project. The Impact Assessment Chapters (***Chapters 7***, ***8***, and ***9*** of this report) and the Environmental and Social Management Plan chapter (***Chapter 12*** of this report) include details of mitigation measures relative to these aspects. The Cumulative Impact Assessment chapter (***Chapter 11*** of this report) consider the other planned development and projects in the Project Area of Influence.
18.	According to ***Section 8.4*** of Scoping report, to carry out the Future Stakeholder Engagement activities on village, township level focusing on project nearby communities. To implement their suggestions & concerns.	The Public Consultation and Disclosure chapter (***Chapter 13*** of this report) include details of all the engagement conducted during the development of the ESIA for this Project as well as the results of these engagement. The minutes of all the meetings are appendixes to this report.
19.	To indicate the complete Terms of Reference for the ESIA study as per ***Chapter 10*** of Scoping report.	The Terms or Reference of the ESIA study will be included in ***Appendix OO***.
20.	According EIA procedure paragraph 50, to disclose the project information on Project (or) project proponent website. To establish notice board/sign board purpose to disclosure of project to public in project location. To disclose on newspaper & media.	The Public Consultation and Disclosure chapter (***Chapter 13*** of this report) include details of all the disclosure realised by the Project, including print screen of disclosures in newspaper, and link to the Project disclosure on the website.

APPENDIX D THIRD-PARTY CONFIRMATION LETTER

The Republic of the Union of Myanmar

Ministry of Natural Resources and Environmental Conservation

Environmental Conservation Department

Office Number (53), Naypyitaw.

Letter No: EIA- 2/ Petroleum (1018/2018)

Date: 24 August, 2018

To

Union Ministry Office

Ministry of Natural Resources and Environmental Conservation, Office (28)

Subject: **To respond confirmation of Third Party to Environmental Resources Management (ERM) & Sustainable Environment Myanmar (SEM) who will comply EIA for 356 MW LNG Power Plant Project**

Reference: (1) Letter No. TTCL 073/18 H/O, of TTCL Public Co., Ltd on 3.7.2018

1. Refer as per subject, TTCL Public Company Limited requested to allow to conduct EIA report by Third Party who are Environmental Resources Management (ERM) & Sustainable Environment Myanmar Co., Ltd (SEM) for 356 MW LNG Power Plant Project at inside of Ahlone Power Plant Area in Ahlone Township, Yangon Division according reference letter.

2. We, ECD found out that Third Party who ERM (Hong Kong) & SEM will conduct EIA for propose project had registered certificate, and also has many experiences in Oil and Gas project fields. Many specialist members will participate to conduct the following EIA activities and subjects;

1. Technical review for Power Plant, LNG Facilities, Oil and Gas Transport and input to EIA Engineering,
2. Social Baseline Impact Assessment,
3. Environmental Baseline Impact Assessment,
4. Ecology and Biodiversity Baseline Impact Assessment
5. Air Quality Impact Assessment, GHG Assessment
6. Noise Impact Assessment
7. Health Impact Assessment
8. Surface Water Impact Assessment
9. Unplanned Event Impact Assessment
10. Regulatory requirement

11. Social Specialist
12. Local Ecology Expert

3. **Therefore, there has no objection for Third Party who are Environmental Resources Management (ERM) & Sustainable Environment Myanmar Co., Ltd (SEM) for conducting EIA Report of TTCL Public Company Limited perform 356 MW LNG Combine Cycle Power Plant Project in Ahlone Township, Yangon.**

Hla Maung Thein

Director General

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Office received, Letter series, Case File

APPENDIX E TPMC'S HSE PLAN PROCEDURE

AHLONE 2

ISSUED
8 OCT 2018
TTCL PUBLIC COMPANY LIMITED

HSE PLAN PROCEDURE

PROJECT DOC. NO. F050-MNL-028

FOR INFORMATION

LNG POWER PLANT (AHLONE) PROJECT

TTCL JOB NO. F-050

Total (Including this Page): 24 sheets

0	24-Sep-18	For Information				
REV.	DATE	DESCRIPTION	MADE	CHECKED	APPROVED	AUTH'D

For Project Use only

Originator	Distribution	PW	PR	MA	ME	PP	EE	IN	CV	QC	PC	Proj	Site	Owner	Total
Project	No. of Copy	-	-	-	-	-	-	-	-	1	-	ORG.	1	1	4

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TTCL PUBLIC COMPANY LIMITED

Revision History Sheet

Rev.	Date	Description
0	September 24, 2018	For Information

CONTENTS

CONTENTS Page

1. GENERAL

1.1 PURPOSE

The purpose of this plan is to establish HSE management System, HSE requirements, HSE rules and regulations, HSE organization and responsibilities, and provide the HSE guidelines for accident incident prevention and environmental impact protection.

This plan establishes the minimum requirements for HSE execution of **LNG POWER PLANT (AHLONE) PROJECT** and establishes safe working practices and standards which shall be implemented on the site.

Depending upon the location of the site, it is likely that some conflict will arise between the requirements of the procedure and the Laws governing HSE at work in the country. In such even, the subcontractors shall apply the more stringent of the regulations at all times.

1.2 SCOPE

The scope of this document is to establish the minimum requirements for HSE execution, define the HSE standard, HSE organization, plan, rules and regulation, responsibilities and implementation guideline for construction phase of **LNG POWER PLANT (AHLONE) PROJECT**

1.3 DEFINITION

In this HSE plan, the following words and expressions are used, and they have the respective meaning hereby assigned to them, except where the context otherwise requires.

"CONTRACTOR" means **TTCL PUBLIC COMPANY LIMITED.** is onshore construction consortium member who perform the "Engineering Procurement and Construction (EPC) of the project.

"OWNER" means **TTCL POWER MYANMAR COMPANY LIMITED .(TPMC)** employing construction in connection with the "Engineering Procurement and Construction (EPC) of the project.

"SITE" means the place or places so designated by owner for construction of the project including places adjacent thereto which are for storage and assembly of equipment and materials.

"SUBCONTRACTOR(S)" means the subcontractor(s) employed by contractor or the owner in connection with the construction of the project.

"HSE" means Occupational Health, Safety and Environment.

"HSE MS" means Occupational Health, Safety and Environmental Management System
"Standard" means HSE standard which requires condition, or the adoption or use of one or more practices, operations or process, reasonably necessary or appropriated to safe employee healthful and environmental impact protection, such as TIS etc.

"Construction Phase" means Construction activities comprising direct (prefabrication assembly, pre-commissioning up to mechanical completion, and other activity specified in Contract) and indirect (scaffolding, transport at site, maintenance of equipment etc.).

"OHSAS" means Occupational Health Safety Assessment Standard.

"TIS" means Thailand Industrial Standard.

"ISO" means International Organization for Standardization

"EIA" means Environmental Impact Assessment. The EIA report is identify the environmental sensitivities and impacts relevant to the project and environmental impact protection requirement.

"Hazard" means intrinsic property or ability of something (e.g. work materials, equipment, work methods and practices) with potential to cause harm.

"Risk" means compiling result of hazard severity and its likelihood that has potential to cause harm.

"3R Principle" means Waste Management Principle: Reduce, Reuse and Recycle.

"PTA" means Pre Task Analysis.

"PPE" mean Personnel Protective Equipment.

"ERT" means Emergency Response Team.

2. HSE MANAGEMENT SYSTEM

The HSE Management System is summarized in this plan which defines the HSE principle requirements associated with the TTCL / Sub-Contractor and any others to be practiced at construction worksites of the project at all time, to ensure safely working environment for occupational health preservation, accident / incident prevention and environmental impact protection would be achieved.

2.1 HSE GOAL AND OBJECTIVE

LNG POWER PLANT (AHLONE) PROJECT HSE Goal is to maintain an injury free workplace with minimum adverse impact of the environment. Prevent community and promote resource conservation associate with project execution.

The project HSE objectives are established followings;

1) TTCL shall carry out project management and construction management activities in compliance with the applicable legal and other HSE requirements as specified in the contract.

2) TTCL shall perform and manage construction work in safe manner to achieve the safety target of "No Lost time Accident"

3) Project incidence rates should not exceed the following value;
IFR (incidence frequency rates), 3.7
ISR (incidence severity rates), 37

4) TTCL shall perform construction work by taking into account for the Environmental impact protection and complaint from the community shall be "Zero".

The Project HSE Objectives are shown in Appendix 1 and 2.

2.2 HSE POLICY, MANAGEMENT SYSTEM STANDARD AND REFERENCE DOCUMENTS

2.2.1 TTCL HSE POLICY

TTCL Top Management considers Occupational Health, Safety and Work Place Environment issues concerned with all employees, subcontractors, customers and the community to be the utmost importance. TTCL Top Management has developed, implemented and maintained the Occupational Health, Safety and Environmental Management system and committed to provide direction and necessary resource to ensure the desirable HSE goal and objectives, including the full compliance with Thailand HSE regulation, relevant standards and requirements would be achieved.

To clearly and concisely communicated; the TTCL HSE policy and objectives are communicated to all project's personnel, subcontractor and vender through TTCL Management messages, newsletters, Pre-Mobilization Meeting, HSE awareness or HSE training program and HSE campaigns.

The TTCL HSE policy shows as the following:

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TEL. +66 (0) 2260-8505 FAX. +66 (0) 2260-8525-6

As of June 18, 2015

HSE POLICY

TTCL Public Company Limited is a leading engineering contractor that specializes in design, engineering, procurement, construction and commissioning of turnkey projects for both industrial and process plants including related facilities. The company is most active in the fields of chemicals, petrochemicals, oil and gas, fertilizers and power generation plants.

The safety of our employees, partners, concerned parties and environmental protection are our highest priorities. TTCL is committed to maintain an injury free workplace with minimum adverse impact of the environment. With recognition to the importance of Occupational Health, Safety and Environmental Management, the company has introduced the Occupational Health, Safety and Environmental Management System as part of this commitment.

In order to achieve our desired goals, the President & CEO has established a HSE Policy Statement. This policy states:

1. *All company activities shall comply with all HSE legal and other applicable requirements.*
2. *HSE Policy and related HSE information shall be communicated to employees, partners and concerned parties to make them understand their duties and responsibilities regarding the Occupational Health, Safety and Environmental Management System and perform their tasks correctly.*
3. *HSE Objectives for the company and projects shall be established. A monitoring, measurement and control system shall be established to monitor HSE performance.*
4. *HSE Procedures and documentation for each project and functional organizations shall be established and implemented so that all activities are performed safely with concern for the environment.*
5. *The necessary resources shall be provided to support the implementation of the Occupational Health, Safety and Environmental Management Systems.*
6. *Top management shall review the HSE Policy and objectives annually for its effectiveness and suitability and seek out the opportunity for improvement of the Occupational Health, Safety and Environmental Management Systems.*

Hironobu Iriya
President& CEO
TTCL Public Company Limited

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ณ วันที่ 18 มิถุนายน 2558

นโยบาย ด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อม

บริษัท ทีทีซีแอล จำกัด (มหาชน) เป็นหนึ่งในผู้นำด้านธุรกิจวิศวกรรมบริการและรับเหมาก่อสร้างแบบครบวงจร มีความเชี่ยวชาญในการให้บริการออกแบบ, วิศวกรรมบริการ, จัดซื้อ จัดหาวัสดุอุปกรณ์และรับเหมาก่อสร้างแบบเบ็ดเสร็จ สำหรับภาคอุตสาหกรรมและโรงงาน รวมถึงสิ่งสนับสนุนอำนวยความสะดวกต่างๆ ในการผลิต โดยลูกค้าส่วนใหญ่เป็นกลุ่มโรงงานเคมี ปิโตรเคมี โรงกลั่นน้ำมันและก๊าซ โรงปุ๋ยและโรงไฟฟ้า เป็นต้น

บริษัทฯ ให้ความสำคัญอย่างสูงสุดต่อความปลอดภัยและอาชีวอนามัยของพนักงาน, คู่ค้า, ผู้ที่มีส่วนเกี่ยวข้องต่างๆ รวมถึงการป้องกันผลกระทบต่อสิ่งแวดล้อม บริษัทฯ จึงแสดงเจตนารมณ์ที่จะสร้างและรักษาไว้ซึ่งสภาพการทำงานที่ปลอดภัย ไม่มีการบาดเจ็บหรือการเจ็บป่วยจากการทำงาน และป้องกันการเกิดผลกระทบต่อสิ่งแวดล้อม

ด้วยความตระหนักถึงความสำคัญของระบบการบริหารจัดการด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อม บริษัทฯ จึงได้นำเอาระบบการบริหารจัดการด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อมเข้ามาเป็นส่วนหนึ่งในการดำเนินงานของบริษัทฯ และเพื่อให้บรรลุตามเป้าหมายที่ตั้งไว้ ประธานเจ้าหน้าที่บริหารและกรรมการผู้จัดการใหญ่ของบริษัทฯ จึงได้กำหนดนโยบายอาชีวอนามัย ความปลอดภัย และสิ่งแวดล้อมไว้ดังนี้

1. การดำเนินงานของบริษัทฯจะต้องสอดคล้องกับกฎหมาย และข้อกำหนดอื่นๆที่เกี่ยวข้องในด้านอาชีวอนามัย ความปลอดภัยและสภาพแวดล้อมในการทำงานและการป้องกันผลกระทบต่อสิ่งแวดล้อม
2. นโยบาย ข้อมูล ข่าวสาร ด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อมจะต้องถูกสื่อสารไปยังพนักงาน คู่ค้าและผู้มีส่วนเกี่ยวข้องเพื่อให้เข้าใจ บทบาทหน้าที่ความรับผิดชอบและปฏิบัติได้อย่างถูกต้อง
3. วัตถุประสงค์ด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อมของบริษัทฯและโครงการทุกแห่งรวมถึงระบบการติดตาม, วัดผลและควบคุมจะต้องถูกกำหนดขึ้น เพื่อติดตามประสิทธิผลของการดำเนินงาน ด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อม
4. ระเบียบปฏิบัติและเอกสารที่เกี่ยวข้องในด้านอาชีวอนามัย ความปลอดภัย และสิ่งแวดล้อมของบริษัทฯ และโครงการจะต้องถูกจัดทำขึ้นและนำไปปฏิบัติตาม เพื่อให้การดำเนินกิจกรรมต่างๆ ของบริษัทฯ เป็นไปด้วยความปลอดภัยและคำนึงถึงสิ่งแวดล้อม
5. ทรัพยากรต่างๆที่จำเป็น จะได้รับการสนับสนุนให้เพียงพอต่อการดำเนินงานตลอดจนการดูแลรักษาและปรับปรุงพัฒนาระบบการบริหารจัดการด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อม
6. นโยบาย และวัตถุประสงค์ด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อมของบริษัทฯ จะต้องถูกทบทวนโดยผู้บริหารระดับสูงเป็นประจำทุกปี เพื่อทบทวนประสิทธิผลของการดำเนินงาน และความเหมาะสมกับสภาวการณ์ของนโยบาย และวัตถุประสงค์ ดังกล่าว รวมถึง มองหาโอกาสในการปรับปรุงและพัฒนา ระบบการบริหารจัดการด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อมของบริษัทฯ

นายฮิโร โนบุ อิริยา
ประธานเจ้าหน้าที่บริหารและกรรมการผู้จัดการใหญ่
บริษัท ทีทีซีแอล จำกัด (มหาชน)

2.2.2 HSE MANAGEMENT SYSTEM STANDARD

The Occupational Health, Safety and Environmental Management system apply to LNG POWER PLANT (AHLONE) PROJECT. All personnel who involved with "the Project" worksites and activities are required to comply with the requirements of these HSE Management systems.

2.2.3 REFERENCE DOCUMENTS

The followings documents shall be used as applicable or for reference together with this HSE Plan.

(a) TTCL HSE Manual and Company Procedure (QM-130 and QPs)
(b) Contract Documents / Project Specifications
(c) TTCL applicable Supportive Procedure and Supportive Reference (SP and SR)
(d) Occupational Health and Safety Management system standards TIS18001 /OHSAS 18001 and Environmental Management System Standards ISO 14001currently revision.
(e) Others specific requirements and standards applicable to the project.

3. HSE ORGANIZATION AND RESPONSIBILITIES

3.1 HSE ORGANIZATION

TTCL Project Management shall establish Project HSE Organization sufficiently resourced and assigned competent person, to manage the HSE aspects of the Project within TTCL responsibility. For implementation and measure the effectiveness of the HSE system. Typical Project Organization is shown in Appendix 3.

3.2 HSE RESPONSIBILITY

TTCL PROJECT MANAGER (PM)

PM is responsible for assuring the implementation of HSE Policy, HSE Plan, HSE procedure and instruction to ensure that safe operation are performed by TTCL, Subcontractors including the compliance with Thailand HSE regulation, relevant standards and requirements.

PM shall coordinate with HSEM for provide the preventive plan for hazardous material handling and the demarcation and lay-out of areas for storage of various materials, in the particular where dangerous materials or substances are concerned.

PM is responsible for Environmental Management System during project site construction prior are minimize environmental impact and increase efficiently preventive measurement and ensuring all persons in project have environmental awareness

TTCL CONSTRUCTION MANAGER (CM)

CM is responsible for the execution of HSE procedure and instruction that safe operationsare performed by TTCL, Subcontractors including visitors and concerned persons.

CM in cooperative with HSEM, is responsible to appoint the competent persons to carry out routine or periodic inspection to construction equipments and activities inclusive of following; (but not limited to)

- Electrical equipments and appliance including hand tools.
- Scaffolding, temporary platforms ladders (Access and Egress).
- Cranes, Lifting appliance and Lifting gear / shackle.
- Heavy vehicle and Fork lift.
- Excavation including support and access
- Confined Space working
- Radiography Work
- Fire Fighting
- Spill kit

TTCL Commissioning Manager

Commissioning Manager shall supersede CM function on handed over and equipment. For grey area concern which its scope is not clear separated then it shall be co responsible by Commissioning Manager and CM. Following are Commissioning Manager responsible (but not limit to);

a) Ensure that hazards of working in commissioning are or equipment are identified and adequate preventive / protective measures are in place prior to work.
b) Approve JSA and risk assessment and Permit to Work for commissioning work and work which will be performed in commissioning area.
c) Provide adequate protection for person working on commissioning equipment from hazardous stored energy e.g. Training , LOTO, warning sign, hard barricade, appropriate PPE,etc.

TTCL Commissioning Engineer

Commissioning Engineer shall be responsible (but not limit to);

a) Review JSA and risk assessment and Permit to Work for commissioning work any work performed in commissioning area or equipment.
b) Administrative control of LOTO.
c) Check and confirm that the equipment is complete isolated and de-energized them release the Permit to Work.

TTCL HSE MANAGER/ LEADER (HSEM)

HSEM is responsible to develop an effective HSE management program;

- To establish project HSE procedures and instruction covering project activities, to ensure effective compliance with the company HSE policy, Project HSE requirements.
- Develop and implement the HSE program, organize HSE meetings, collect and report and analyze HSE performance against objective and identify initiative for implement where necessary with training.

- To establish and implement HSE promotion program.
- To implement risk assessment and environmental impacts determination and control.

HSEM shall responsible to following;

1. Ensure risk identified and risk assessment, environmental aspects identification and impacts determination are communicated to TTCL PM and Subcontractor Representatives and all concern parties including Owner.
2. Monitor and maintain the HSE performance of the Project.
3. Close contact with TTCL PM, Subcontractor Representative on the Project to enforces HSE standard practice and responsible to provide HSE feedback to TTCL PM.
4. Ensure all TTCL's Subcontractors are complying with the Project HSE requirements.
5. Ensure that Subcontractor's appointed Safety Officers who are qualified and capable of performing the duties assigned.
6. Appoint HSE competent persons or inspectors to carry out routine or periodic HSE inspection to identify unsafe action, unsafe condition, environmental aspects and take corrective action, to assure reporting of all incident and accident.
7. Ensure TTCL, Subcontractors are carry out periodic inspections of all tools and equipments and relevant records are maintained.
8. Ensure all HSE meetings; PTA toolbox talks and any required meetings are conducted and reported to all concerned.

TTCL SAFETY OFFICER (SFO)

Safety Officer Professional level (SFO) shall responsible to

1. Provide HSE training to project personnel and ensure that all project personnel have attended the HSE induction and others specific HSE training required.
2. Ensure that TTCL, Subcontractors are in full compliance with the HSE requirements under scope of works being conducted on the project, in relation to Project specific HSE rule and regulation, HSE Plans and Procedures.
3. Ensure all first aid equipments, safety equipments, spill kit, security facilities are maintained in good condition and in sufficient quantities and necessary training provided.
4. Report to HSEM for HSE matter within the project.
5. Analysis HSE statistic and provide the report to HSEM.

TTCL ENVIRONMENTAL ENGINEER (ENV)

Environmental Engineer (ENV) shall responsible to

1. Provide HSE training to project personnel and ensure that all project personnel have attended the HSE induction and others specific HSE training required.
2. Ensure that TTCL, Subcontractors are in full compliance with the HSE requirements under scope of works being conducted on the project, in relation to Project specific HSE rule and regulation, HSE Plans and Procedures.
3. Overall implementation of Waste Management, monitoring and report to HSEM and PM of any issue concerns.
4. Assist Subcontractor plans and coordinates the works for effectively implement the requirements of the procedure.
5. Ensure the required HSE records are generated and available for review by TTCL HSEM.
6. Ensure that waste management data shall be reported in weekly basis.

7. Prepare supportive document and coordinate with Project Owner for waste generator licensed requisition from DIW.

TTCL Supervisor and Engineer

SV or EN (Regardless of main contractor or subcontractor) shall responsible to;

a) Implementation of safety measure indicated in risk control plan and risk reduction plan are in place prior to work
b) Prepare and/ or review work method statement, Job Safety Analysis & Risk Assessment (JSA/RA)
c) Work preparation; right tool and equipments, adequate number and skilled of workers
d) Check and confirm condition of construction equipments, clearance of hazard in working area, skill and readiness of workers and lead tool box talk to commence daily work
e) On the training to workers of safe work and instruction to correct use of PPE
f) Direct responsible to his subordinate (and / or lower tier subcontractor) workers safety for any arising incident e.g. emergency situation therefore he shall keep record of manpower and report to HSE center accordingly.

TTCL SAFETY SUPERVISOR (SSV)

Safety technician level (SSV) shall responsible to

1. Ensure that the project HSE policy, requirements, procedure and HSE working practice are fully understood and being effectively applied.
2. Create healthy and safely working condition and environmental impact prevention throughout the project.
3. Conduct HSE inspection and reporting to Safety Officer.

SUBCONTRACTOR MANAGEMENT REPRESENTATIVE

Subcontractor Management Representatives shall responsible to

1. Ensure that Subcontractor's project HSE plan and procedure has been established and that it is adequate for Project HSE requirement,
2. Ensure that Subcontractor's project HSE plan and procedure are fully implemented and maintained,
3. Monitor their HSE performance and take appropriate corrective / preventive action if need.

SUBCONTRACTOR SAFETY OFFICER/ENVIRONMENTAL ENGINEER

Subcontractor Safety Officer/Environmental engineer shall responsible to

1. Ensure that their HSE Plan and Procedures are fully implemented and comply with the project HSE requirements,
2. Ensure that all risk assessment and significant environmental aspect are identified on the project and communicate to their employees,
3. Implement and maintain Daily Tool Box Talk and HSE Meeting,
4. Practice in the HSE inspection program and HSE promotion programs,
5. Report all HSE matter to Subcontractor Representatives.

EMPLOYEES / WORKER

All employees / workers at all levels are involved in accident prevention and environmental impact protection. Individual employee actions are the key to achievement

of HSE Goal and objectives. They have a duty to themselves and their follow employees to exercise care and good judgment in preventing accidents, avoiding hazards to health and environmental protection.

Each employee / worker is responsible for their health protection, safety and environmental impact protection and that of their co-worker whilst on the project, the responsibilities of individual worker / employee is following;

- To attend project HSE training.
- To attend a daily / weekly toolbox talk to be aware and understand the HSE requirement in the area.
- To ensure they have the correct PPE for executing work, and used it correctly.
- To ensure all tools and equipments work properly and have been inspected before used.
- To execute work in accordance with the HSE procedure and instruction.
- To report any unsafe action or unsafe condition or environmental aspect& impact to their immediate supervisor and / or HSE personnel immediately.
- Participate in and support the HSE Policy, and their site HSE promotion program.

4. HSE REQUIREMENTS

4.1 HEALTH REQUIREMENTS

TTCL develop the health requirement for occupational health preservation and protection to ensuring good occupational health for project's personnel.

General Provision

Project's personal hygiene is importance, so the temporary office and all facilities, working area, equipments / tools and storage area shall be kept in hygienic conditions.

EIA Requirements

Owner and TTCL must comply with EIA Requirements

Health Medical Facilities and First Aid

- TTCL shall provide First Aid Center, First Aid Staff and First Aid Equipments in accordance with Thailand Regulation or applicable local legislation.
- TTCL shall provided personnel First Aid instruction and training such as basic CPR/First Aid from Professional Nurse according to specific work risk.
- TTCL shall manage to acquire medical service from nearest hospital as need.
- TTCL shall arrange initial first aid with 1 emergency vehicle at the construction area for hospitalizing purpose in accordance with Thai Regulation

Welfare Facilities

- TTCL shall construct toilet for construction workers not less than those required by the Ministerial Regulation No. 2 issue under the factory Act A.D. 1992 together with the proper waste water treatment using septic tanks and cesspools.

Sanitation

- TTCL shall provide sufficient covered garbage container at the proper location to ensure adequate storage capacity and prevent litter accumulating.

- TTCL shall provide sufficient signage and containers for materials to be reused or recycled to ensure proper segregation and storage capacity, enabling the maximum reuse and recycling of material.
- TTCL shall provide sufficient signage and containers for hazardous waste and hazardous materials to avoid spillage to the environment, By safe storage, collection and disposal in accordance with Thailand regulation.
- TTCL shall collect and dispose of all wastes and recycle them in accordance with Thailand regulation.
- TTCL shall treatment of each area as necessary to prevent the breeding of insects and vermin.
- TTCL shall contact the local government authorized agencies to collect all garbage for disposal

Substances Hazardous to Health

- TTCL establish the minimum requirements for controlling substances that may be hazardous to health, which will address the instruction for handling of
- chemical, potentially toxic and hazardous materials required at each worksite.

4.2 HSE REQUIREMENTS

4.2.1 SAFETY REQUIREMENTS

- TTCL shall develop and implement HSE Management System.
- TTCL Project Manager responsible for maintain ratio of Safety Supervisor per project workforce at 1:50. (To be adjusted as per project requirement)
- The qualified safety supervisor shall as a minimum, be qualified by having attend a course approved by Ministry of Labor for Safety Practitioner.
- TTCL shall develop the project HSE procedure and instruction for identification and elimination of construction hazards, HSE incentives which focus on recognizing and awarding positive HSE activities which eliminate potential hazard incidents, the enhancement of workforce HSE behavior and awareness, and elimination of all personnel injury.

The project's HSE procedures, HSE instructions would be covered owner' HSE requirements and communicated to subcontractors by various methods such as class room training, Tool box talk, documents, CD Rom etc., to ensure that all subcontractors are acknowledged and comply with HSE procedures shall be at least as followings (But not limited to);

- Risk Assessment & JSA
- PPE provided and using guidelines.
- Incident and Emergency Response Plan
- Fire Prevention
- Excavation
- Scaffolding
- Fall Protection
- Lifting Rigging and Crane Operation

- Equipment Inspection
- Electrical Inspection and Grounding
- Compressed Gas Cylinder Handling
- Permit to Work
- Energy Isolation
- Hazard Communication
- Pressure Test
- Etc.
- TTCL will develop and implement necessary HSE Training Program for project personnel.
- TTCL will implement Work Permit system associate with Risk Assessment and Job Safety Analysis.
- TTCL will develop and implement HSE inspection and audit program to ensure project worksite achieves a safe working condition for accident and incident prevention.
- TTCL will maintain HSE statistics and generate weekly, monthly report to all concerned.
- TTCL and Subcontractors shall provide the PPE as defined standard by legal for their employee as followings;

Uniform: Trousers and Long Sleeves shirt

Mandatory basic PPE;

- Safety Helmet with chin strap (Bearing the name or logo of company and color to be agreed with TTCL).
- Safety Shoes
- Safety Glasses
- Specific PPE as required by circumstance (SDS or JSA);
- Hearing Protection
- Specific Hand protection as required
- Goggle
- Rubber boots with toe protection
- Safety harness and lifeline, include fall arrester
- Filtered eye protection for welding
- Respirator equipment as required by circumstance
- Chemical suit
- Etc. as work related.

4.2.2 ENVIRONMENTAL PROTECTION REQUIREMENTS

EIA (Project Environmental Impact Assessment)

Project Environmental Impact Assessment (EIA) mitigation measure shall be implement by all project's personnel.

Environmental Impact Control

TTCL shall provide the "Environmental Control and Management Plan" for environmental impact control system of the project, this plan will meet the following

principle:

- Prevent adverse impacts on human health and the environment.
- Reduce wastes and emissions to achieve reduction goals and manage a product's life cycle from inception to final disposal.
- Prevent Soil and Groundwater contamination.
- Control noise levels which are nuisance to project personnel and communities.
- The Facility should be low impact on the community. (e.g. Noise, Light, Odors, Smoke, Dust, etc.).
- Meet applicable regulatory requirement.

And this plan shall address the EIA mitigation measure issue; this plan will be included environmental monitoring and testing program (if required in project EIA monitoring measure) such as water sampling, noise monitoring, and emission monitoring and ambient monitoring.

Waste Management (Solid waste and Liquid waste)

- TTCL shall develop the Waste Management Plan for the project. This plan provides guideline and minimum requirements for handle, collection and separation of waste, offsite disposal method and management. Waste Management Plan established in accordance with project EIA mitigation measure, Industrial Estate requirements (if any) and 3R principle for reduce waste.
- All solid waste would be registered and the disposition would be done through an approved waste disposal company.
- For the draining of sanitary and chemical waste water, water used for the spraying or rinsing of equipment during project construction phase shall be authorized by owner and Industrial Estate.
- Prohibit littering or discarding construction material into the water drainage system.
- Site runoff shall pass though an over/under weir and be monitoring for contaminants.

Air Management

- The operation of the combustion installation or combustion engines (e.g. aggregates, welding machine, engine-driving pump, etc.) shall be in compliance with the Thailand regulation requirement.
- No waste oils may be used as fuel. Only standard fuels that can be obtained commercially may be used (e.g. light fuel oil, butane, propane, natural gas and petrol).
- The combustion installation shall be safely operated and not result in an increase of the fire risk.
- When certain activities may result in the emission of dangerous substances, the work method shall be determined beforehand.
- Open fires (with the exception of flame torch and acetylene welding/cutting and roofing burners) are forbidden.
- TTCL, Subcontractors shall keep construction machine and vehicle in good condition to reduce the pollutant emission.
- TTCL, Subcontractors shall provide canvas to cover the trucks carrying during construction material transportation to the project for material falling protection or prevent dust dispersion.
- TTCL, Subcontractors shall clean up the access roads or public roads if construction materials drop or spill during transportation.

Noise Control

Noise control measure will be applied to all project equipment by using low noise equipment where practicable. Where high noise cannot be reduced following method can be applied.

- Hydraulic piling hammers will be used wherever practicable in preference to diesel driven hammer.
- Acoustic shielding will be employed to contain the high noise levels in defined project boundaries.
- Silencers will be fitted during blow down and drying of lines and vessels during pre-commissioning.

Prior to the commencement of noisy or vibration operation TTCL Construction Manager (CM) shall inform intended working hours to owner. Noise and vibration monitoring program will be developed by TTCL.

Wastewater Management

The following mitigation measures are presented for minimizing impact from wastewater handling and disposal;

- Construction equipment and vehicle washing to be carried out at designed areas provided with wash water collection systems. Alternatively, equipment and vehicle washing may be carried out at off-site locations (such as central workshops of contracting companies), where adequate facilities are available. The wash water collection system will typically include settling tanks for separation of suspended solids and oil& grease. The floating oil& grease is to be removed using skimmers or soaking pads and collected in drums. The water after settling is to be routed to Sewage treatment plant (STP) for treatment.
- Sewage generated on-site to be collected through underground pipes into holding tanks, from where the sewage will be routed to onsite sewage treatment plant or alternatively transport periodically by vacuum trucks and transferred to an approved sewage treatment plant to the site for treatment and disposal;
- The hydro test water need to be collected in the lined pond and the water to be tested for any contaminants. If the collected hydrotest water is found not to be contaminated, and further if the water quality conforms to land discharge standards, then the water can be discharged on to the land in small quantities. The discharge will be done in a way as to avoid drainage from large areas. However, if the water is found contaminated then it is to be evaporated in the pond, else it is to be treated in the wastewater treatment plant after the plant is operational.
- Accidental spillages of hazardous substances to be immediately remediated to prevent contaminated runoffs and potential contamination of soil and groundwater;
- Waste consignment notes to be prepared and documented for transportation of wastewater (sanitary and other wastewater), if any, to offsite treatment facilities.

Soil, spill containment and clean-up

- Spillage of any harmful substance shall be immediately reported to TTCL and owner representative in charge. Where the potential for spill is evident, the appropriate spill kit shall be provide and readily for use. The necessary training should be provided to ERT.

- All chemical substance that can leach out, as well as all liquid, shall be stored in such a way that any leaks shall not cause a risk of soil contamination (e.g. placement in a vat, double tanks, etc.).
- The used of any fueling device which may be locked open for hands free operation is prohibited. All fueling devices shall be carrying out with 100% hand control.
- If leak causes soil contamination, it shall be cleaned up immediately. The clean up costs (namely, carry out of analysis, soil drillings and the clean up operation itself) shall be paid for by the polluter. (PPP; Polluter Pay Principle).
- The moving of soil or modifying the level of the grounds is only permitted after written confirmation from owner representative in charge.
- The storage of chemical is not allowed on the site. The sole exception on this rule is made when the products are needed for executing activities. At the working point, a storage of max 24 hours is permitted given they are stored on a safe
  (e.g. fire, explosion, pollution etc.) and environmentally aware way (see soil). When the storage of big quantities imposes itself, this shall be discussed with and put down in writing by owner representative and TTCL person in charge and Environment Consultant Service Company.

Traffic Management Plan

The main aim of traffic management plan is to assist TTCL and subcontractor employees in complying with all applicable traffic and transportation requirements during construction state. Furthermore the propose of this plan is to provide the framework for movement of equipment, workers and local community to/from the project site.

- The employees including the drivers are to be trained on the driving requirement to be followed for the project;
- The movements of heavy vehicles and equipment are to be planned in such a way such as to avoid peak hours on main roads in order to minimize traffic congestion;
- Training on defensive driving are to be provided for drivers. The drivers are also to be trained on emergency response measures and requirements;
- Approved transporters are to be used for transportation of hazardous materials and heavy equipment/goods.
- TTCL shall provide security officer for 24 hours, who responsibly to monitor, check and control traffic of construction area.

4.3 PROJECT SITE SECURITY

TTCL shall arrange appropriate security system and develop site security plan for the project and lay down area.

5. HAZARD IDENTIFICATION, RISK ASSESSMENT AND ENVIRONMENTAL ASPECTS IDENTIFICATION& IMPACTS DETERMINATION

The identification of hazards, risk assessment/ environmental aspect identification& impact determination and management of the risk/ impact in order to achieve the HSE a goal is incorporated into the general management principles and working procedure. The system is

designed to identify hazards/ environmental aspects during associated with construction activities and execution of the work. In addition, the system is also designed to cover identification of hazard/ environmental aspect in the facilities.

The planning, identification and communication of risk assessment/ environmental aspect & impact determination and risk/ impact management takes place in a number of forums, e.g.

- Routine and non-routine activities.
- Department meeting.
- Supervision of work activities.
- Job Safety Analysis (JSA) and Hazard Identification system.
- Internal, second party and third party audits.
- Management review meetings.
- Planned inspection and patrol.
- Project and contract meetings

All project employees and line supervisors are responsible for identification and elimination of hazards/ environmental aspects.

Communications of hazards/ environmental aspects and controls: individuals identifying a hazard/ environmental aspect are responsible for taking immediate action and eliminate the hazard/environmental aspect it selves whenever possible. If unable to eliminate the hazard/ environmental aspect, the individual will ensure that the situation is highlighted as a warning to others and will notify concerned supervisor, HSE personnel or management to initiate the corrective action.
The recording of hazards/ environmental aspects identification and corrective actions taken or planned will be maintained in a number of ways, e.g. JSA records, Accident reports, HSE Audit Reports, Inspection reports, Minutes of meetings, Tool box Talk records, etc. The HSE Department will maintain these records and, in addition, will maintain a Corrective Action Log, which will summarize all corrections, which have been identified and indicate the current status of corrective actions.

All outstanding corrective actions with regard to HSE record in the various records will be assigned to a responsible person for close-out and will be followed up by the HSE Department to ensure that they are closed out in a timely manner.
All hazards and risks/ environmental aspects and impacts identified will be reviewed and objectives and priorities set for their resolution. Personal will be identified as responsible for successful resolution in a timely manner.

The determination of controls uses the results of risk assessment/ environmental impact determination for consideration which is given to reduce the risks/ environmental impacts according to the following hierarchy as Elimination, Substitution, operational controls, Signage or warnings, PPE etc.

6. HAZARD AND ENVIRONMENTAL ASPECT COMMUNICATION

TTCL shall communicate to all project personnel whom using or handle of chemical and hazardous substances.

7. HSE TRAINING

TTCL is responsible for conducting preliminary and continuous HSE training for all personnel in order to develop and maintain personal interest in the HSE program and to train personnel in the safe practices and work procedures.

TTCL shall identified the training need for Project persons, including subcontractors and other concerned, and initiate a training program to demonstrate that the person involved are suitably qualified and competent.

8. HSE INSPECTION AND AUDIT PROGRAM

8.1 PROJECT HSE INSPECTION AND MANAGEMENT PATROL

TTCL shall develop the HSE inspection and management patrol program which Site HSE inspection shall be conducted daily by TTCL and subcontractor Safety officer/Environmental Engineer.

In addition periodical management patrol, which performed by TTCL Site Managements, Superintendents, Supervisors, HSE personals and Subcontractor's representative should be conducted weekly, to observe and verify the effectiveness of
HSE control measure employed on site.

All discrepancies noticed during HSE inspection and Management Patrol shall be promptly report to TTCL Project Manager, Subcontractor Representatives and concerned HSE personnel who will take immediately correction and provide corrective / preventive action to prevent recurrence. The records shall be properly filed.

TTCL as well as owner representative has the right to stop any work or acts which are considered to be dangerous without any obligation. All TTCL and Subcontractors personnel shall promptly comply with the instructions of TTCL and/or owner representative at all times.

8.2 TTCL INTERNAL AUDIT

The "Internal Audit" shall be performed to verify the effective implementation of Occupational Health and Safety Management System (OHSAS 18001 / TIS 18001), Environmental Management System (EMS, ISO 14001) to ensure that the control measures applied to associate risk/ environmental impact and HSE activities are properly executed.

"Internal Audit" shall be performed in accordance with the predetermined schedule on the certain scope, taking the project activities into consideration.

The audit findings shall be recorded and the audit result shall be sent to the TTCL PM, and project organization concerned. In case Nonconformity has been found in the audit, the "Corrective Action Request" (CAR) shall be issued to concerned person for correction or rectification and prevention of recurrence.

8.3 CONSTRUCTION EQUIPMENT INSPECTION

Construction Equipment such as cranes, lifting equipment, electrical appliances and vehicles shall be inspected when brought into the site.

Related certification or third party / authority inspection documents (if any) shall be submitted and proven identification shall be displayed on the equipment. And also this construction equipment on the site shall be inspected by designated personnel at specified intervals (minimum 3 month / time). Inspection records on check lists shall be kept as evidences.

9. HSE MEETING

considers HSE meetings a highly important part of the HSE Management System in that they permit HSE communication to take place between management and employees, and vice versa.

AIMS AND PURPOSE OF HSE MEETINGS

- A team orientated and transparent communication tool.
- An economical use of time in disseminating HSE information.
- An opportunity to contribute ideas, suggestions for HSE improvements.
- A tool for continuing education and motivation of the workforce.
- A tool to maximize proactive HSE performance at work.
- To openly discuss sound HSE practice and emphasize areas that needs improvement.
- Better understanding of SITE related HSE issues for line Management/ supervision.

AGENDA

HSE meetings provide a communications flow on HSE matters. Topics to be discussed shall include, but are not limited to:-

- Review/ Discuss Management HSE concerns.
- Review/ Discuss Employee HSE concerns.
- Review/ Discuss Accident/incident investigation.
- Reporting and follow-up status of unsafe acts, conditions and practices with discuss action and corrective action (s) to expedite closure.
- Review/ Discuss all fire and emergency situations and potential hazards/ significant environmental aspects since the last HSE meeting.
- Review/ Discuss Work procedures.
- To remind the important objective of personal protective equipment.
- Additional Requisition HSE awareness training program.
- Propose the HSE Incentive program, and related campaign(s).
- Review/Discuss Site Security program.

ATTENDANCE

1) HSE Weekly Meeting

The meetings shall be attended by owner representative, TTCL and all subcontractors HSE representatives and consider to invite concerned Subcontractors Supervisors.

2) HSE Committee Monthly Meeting

The Committee meeting shall be attended by owner representative, TTCL PM /CM, HSEM, Safety officers/Environmental Engineer and all Subcontractor Representatives and HSE personnel.

The committee agenda shall focus on the following:

- Review of past months meeting minutes.
- Actions taken.
- High-risk work or activity/ high significant environmental aspects
- Current activities and problem areas.
- Accident review and corrective actions.
- Future activities.

HSE committee meeting attendance is mandatory for each Subcontractor.

MINUTES OF MEETING

Minutes of Meeting shall be recorded by TTCL Safety officer/Environmental Engineer, reviews by TTCL HSEM and approved by TTCL PM then distributed to all members. It shall be responsibility of all committee members to ensure that the topics discussed at these meeting's are, where required, disseminated appropriately and effectively. Subcontractors shall take the necessary action to promptly implement HSE committee directives and recommendations.

10. ACCIDENT/INCIDENT REPORT

All accident / incident, which occur at or in association with the Project, will be reported and investigated as following.

- Near miss and first aid reported by incident initial report
- Injury, illness, property damage, environmental accident and all fire incident case reported by incident initial report and followed with detail investigation report

TTCL shall develop the accident/incident investigation and report procedure for identify the primary causes to prevention the re-occurrence by root cause analysis method.

11. EMERGENCY PREPAREDNESS AND RESPONSE

TTCL shall develop the project emergency response plan and procedure which suitable for project requirements and situation.

Project's Emergency Response Team (ERT) would be appointed and trained and resourced with required rescues equipment.

Emergency drill including all fires case, spills, other environmental& safety related issues would be conducted once a year.

12. SUPPORTIVE PROCEDURES

Specific details of HSE implementation would be described in the following supportive procedures;

1. F050-MNL-047 : Risk Assessment, JSA &EIA Tool Box Talk Procedure

2. F050-MNL-049 : Confined Space Entry Procedure
3. F050-MNL-061 : Pressure Test Procedure
4. F050-MNL-048: Permit to Work Procedure
5. F050-MNL-051 : Control of Hazardous (Lockout/ Tagout) Procedure
6. F050-MNL-024 : Environmental Control and Management Plan
7. F050-MNL-026: Waste Management Plan
8. F050-MNL-029 : Site Security Procedure
9. F050-MNL-050 : Personal Protective Equipment Procedure

13. APPENDIX

APPENDIX 1: Project HSE Objective (English Version)

APPENDIX 2: Project HSE Objective (Thai Version)

APPENDIX 3: Typical Project Organization

APPENDIX 4: TTCL HSE Management and Control Organization

APPENDIX 1

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

PROJECT TITLE

HSE OBJECTIVE

FOR PROJECT "LNG POWER PLANT (AHLONE) PROJECT''

JOB NO. "F-050"

The HSE Objectives, for Project "LNG POWER PLANT (AHLONE) PROJECT" are defined as follow;

1) *TTCL shall carry out project management and construction management activities in compliance with the applicable legal, and other HSE requirements as specified in the contract.*

2) *TTCL shall perform and manage construction work in safe manner to achieve the safety target of "No Lost time Accident"*

3) *Project incidence rates should not exceed the following value;*

   ***IFR** (incidence frequency rates), 3.7*

   ***ISR** (incidence severity rates), 37*

4) *TTCL shall perform construction work by taking into account for the environmental impact protection and complaint from the community shall be "**Zero**",*

.....

(.....)

Project Manager

TTCL Public Company Limited

APPENDIX 2

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

PROJECT TITLE

วัตถุประสงค์ด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อม

โครงการ "LNG POWER PLANT (AHLONE) PROJECT"

โครงการเลขที่ "F-050"

โครงการฯ ได้กำหนดวัตถุประสงค์ด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อมของโครงการ "LNG POWER PLANT (AHLONE)PROJECT" ไว้ดังต่อไปนี้

1) บริษัท ทีทีซีแอล จำกัด (มหาชน) จะบริหารและดำเนินการก่อสร้างโครงการฯภายใต้การดำเนินการที่สอดคล้องกับกฎหมายและข้อกำหนดด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อมอื่นๆที่บังคับใช้กับโครงการหรือตามที่ได้ตกลงกันไว้ในสัญญาจ้าง

2) บริษัท ทีทีซีแอล จำกัด (มหาชน) จะดำเนินการ ก่อสร้างโครงการฯ ให้เป็นไปด้วยความปลอดภัย โดยปราศจากอุบัติเหตุถึงขั้นหยุดงาน (No Los Time Accident)

3) บริษัท ทีทีซีแอล จำกัด (มหาชน) จะควบคุมค่าดัชนีด้านความถี่ และความรุนแรงของอุบัติเหตุในโครงการฯ ตามที่ได้ตั้งเป้าหมายไว้ ดังต่อไปนี้

IFR (ดัชนีความถี่ของอุบัติเหตุ), 3.7

ISR (ดัชนีความรุนแรงของอุบัติเหตุ), 37

4) บริษัท ทีทีซีแอล จำกัด (มหาชน) จะดำเนินการก่อสร้างโดยความตระหนักถึงความสำคัญในการบริหารจัดการ ด้านการป้องกันผลกระทบต่อสิ่งแวดล้อม ทั้งนี้จะต้องไม่มีข้อร้องเรียนจากชุมชน

.....

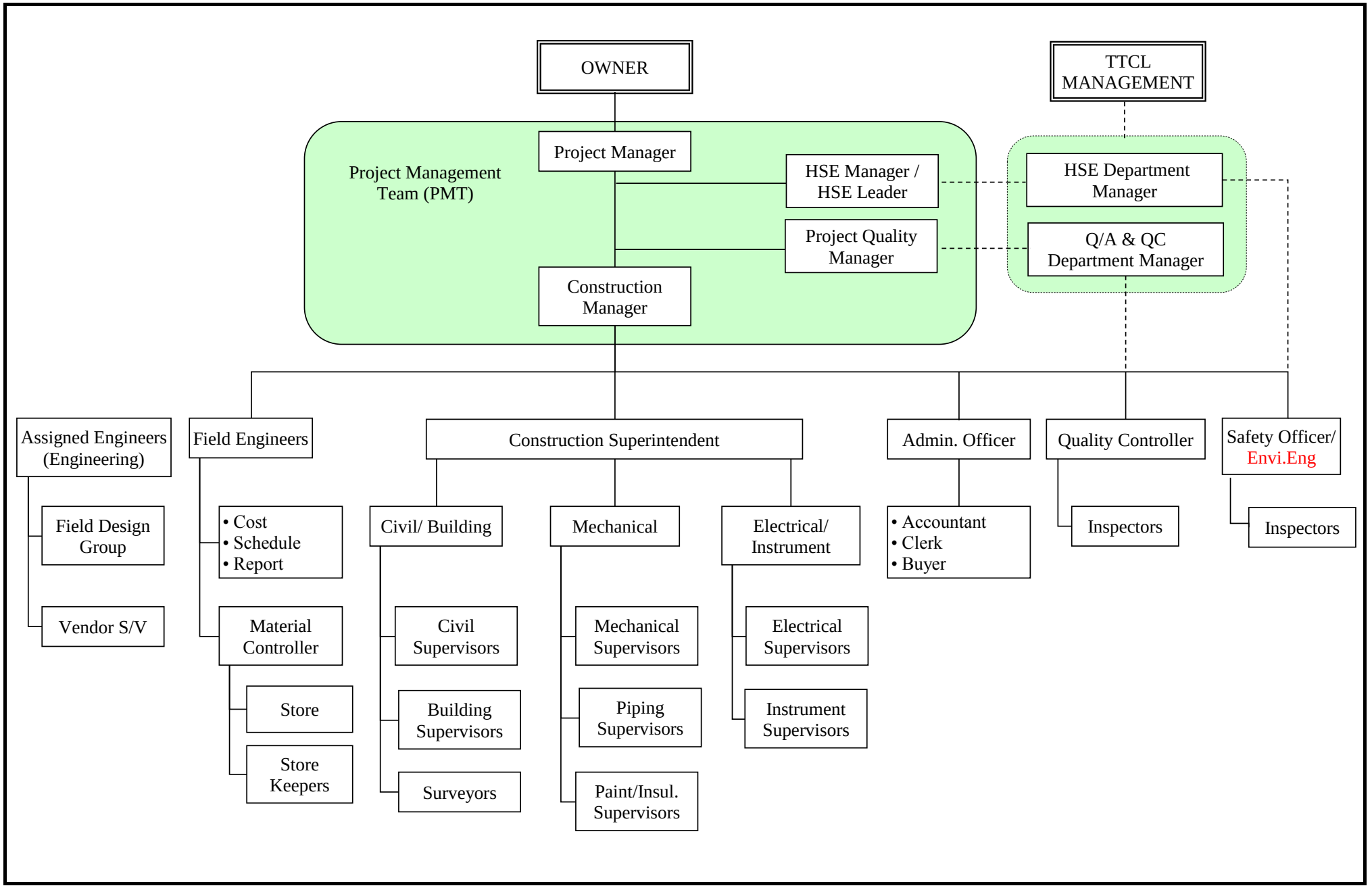
(.....)

ผู้จัดการโครงการ

บริษัท ทีทีซีแอล จำกัด (มหาชน)

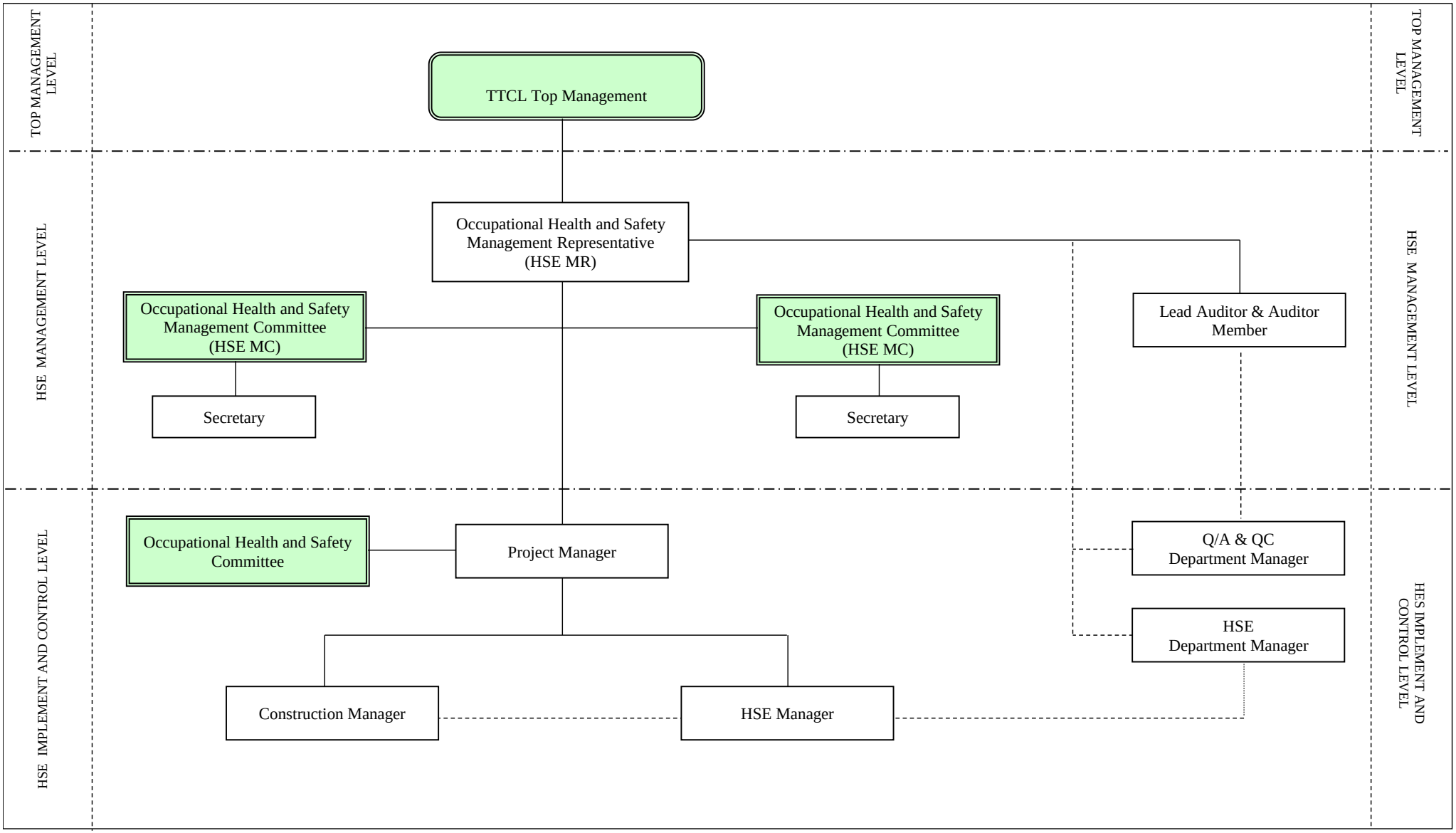
APPENDIX-3

Typical Project Organization



APPENDIX-4

TTCL Occupational Health and Safety Management and Control Organization



APPENDIX F PRELIMINARY PROJECT MASTER SCHEDULE

AHLONE

SITE PREPARATION WORK METHOD STATEMENT

LNG POWER PLANT (AHLONE) PROJECT

TTCL JOB NO. F-050(1)

Total (Including this Page): 9 sheets

0	28-May-19	For Information				
REV.	DATE	DESCRIPTION	MADE	CHECKED	APPROVED	AUTH'D

For Project Use only

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

Revision History Sheet

Rev.	Date	Description
0	May 28, 2019	For Information

CONTENTS

Appendix List;

1. Purpose

This method statement is outline construction activity of site preparation to clearing debris, soil stripping work, and land filling work to expect level to protect Plant area from flooding.

2. Work outline

Site Location : LNG receiving Terminal at Dala Town ship, Yangon Myanmar.

Work Title : Site Preparation, Land fill

Area : 35,543 Square Meter (8.78 Acre) for Plant Area.
: 13,025 Square Meter (3.14 Acre) for Construction Facility Area.

Existing Ground Level : Average + 5.6 m.CD of Bow Aung Kyaw Street wharf Tidal Station.

Finished Ground Level : + 7.5 m.CD for Plant Area.
: + 6.5 m.CD for Construction facility Area.

Soil filling Volume : Plant Area 58,187 m^3
: Construction Facility Area 13,304 m^3
: Total 71,491 m^3

Temporary jetty Volume : 4,000 m^3
(Landing Ramp)

3. Reference

3.1 Document and Drawing

- Engineering Specification for Site Preparation Work : F050-CV-006
- Site Preparation Overall Plan : F050(1)-AD-00-110-AA
- Site Preparation Existing Elevation Section & Detail : F050(1)-AD-00-110-AB/AC
- Plot Plan LNG Receiving Terminal for LNG Power Plant (Ahlone) Project
- Topographic Map

3.2 Code and Standard

- American Association of State Highway and Transportation Officials (AASHTO)
- American Society for Testing Materials (ASTM)
- Myanmar National Building Code 2016 (MNBC 2016)

4. Responsibility

TTCL will proceed and coordinate with concerned parties to supply construction materials and control all site activities by personnel as follows;

Civil Superintendent

He has overall responsibility for the site preparation management in accordance with the contract requirements.

He shall coordinate and control the execution of the Site Preparation, and ensure completion within scheduled time and the observance of HSE and quality procedures and practices in accordance with the relevant regulation of authorities.

Site HSE Officer

He has overall responsibility for the implementation of HSE plan according to the Project HSE Plan. He shall investigate and report all major accident, recommend protection measures, and ensure the availability of safety equipment and first aid kits.

Civil Supervisor

He has overall responsibility for the implementation of Site Preparation Works in this specification. He shall arrange the manpower, equipment and materials required for the implementation of the works, coordinate with HSE officer involved in the tasks in accord to the method statement and reporting

5. Schedule

Total schedule of Site preparation work will take time around 9 weeks from mobilization till demobilization as show in Table-1.

Table-1 Detail Schedule of Site Preparation Work

Items	Activities	BOQ	Duration (Days)	Week No.	Week No.1	Week No.2	Week No.3	Week No.4	Week No.5	Week No.6	Week No.7	Week No.8	Week No.9
				Day	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
A	Site Preparation Work												
1	Man-Power Mobilization	-	7										
2	Equipment Mobilization	-	11										
3	Stripping	35,545 m2	14										
4	Sand Filling for Site Preparation	84,795 m3	42										
5	Base Course (Crash stone)	1,110 m3	11										
6	Compoction Tests Reports	-	3										

6. Material, Tools, Machines and Equipment

6.1 Material

6.1.1 Material Specification

- Soil filling material shall not contain any root, organic material, debris or other deleterious material
- The fill material shall be granular or suitable clay with liquid limit less than 35% and plastic index less than 6%.
- Filling soil material laboratory result will submit before deliver to construction area.

6.1.2 Material Sourcing

Sand souring will be sucked from Yangon River where designed location and far from construction area around 5 to 10 km. Then sand will be delivered to construction area by boat.

Assorted crush stone and rock will be delivered from Mandalay and transport to construction area by boat

Sand supply boat will contain with 90 m^3 per boat and deliver 2 trips per day. The total boat usage is around 15 to 20 set.

Photo of mark sand sourcing location

6.2 Equipment, Machine and Tool

6.2.1 Equipment

- Sand Pump Station 6 Set
- Discharge pipes (4 to 8 inch) 1,200 m

6.2.2 Machine and Tools

- Sand Supply Boat (90 m^3/boat) 20 Set
- Survey Equipment 1 Set
- Bulldozer 1 Set
- Roller, 10 Ton 1 Set
- Water Pump and Water Bowser (1600 Gal.) 1 Set
- Excavator 2 Set
- Dump truck 60 Set
- Barge 1 Set
- Re-bar cutting and bending tool 1 Set
- Portable Concrete Mixer 1 Set
- Concrete Vibrator and Small Compactor 1 Set
- Diesel Generator 1 Set
- Water Tank 1 Set

7. Equipment and Manpower Mobilization Method

Due to limitation of access road and to prevent disturb to community around the plant. Equipment and manpower shall be mobilized by river transportation.

8. Manpower Plan

Total manpower of Site preparation work included Site manager, Engineer, Surveyor, Machine and equipment operator, worker and helper will separate two (2) major works as contain as following;

- Site preparation work : Total 110 persons

9. Work Method and Procedure

9.1 Site Preparation Work

9.1.1 Cutting, removing and disposal of trees bushes, rubbish and debris. And then grade existing soil with bulldozer.

9.1.2 Survey level, and pack level point (layer by layer marking)

9.1.3 Prepare protection for prevent sand flow during sand filling period

9.1.4 Fill sand will be discharged from boat by pumping with water by layer and compact by Roller.

9.1.5 Make proper temporary drainage to flow water in sand

9.1.6 Field compaction test will be done after finished sand filling up to require level.

Photo of typical sand filling work (1)

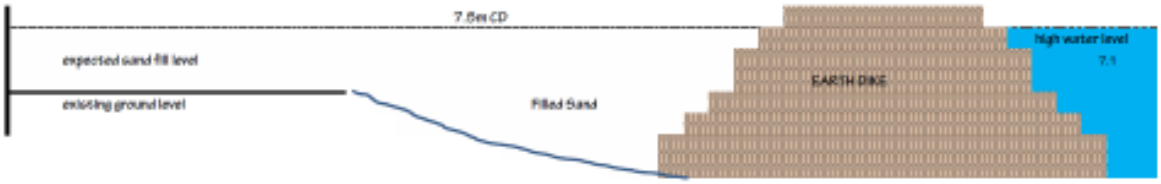
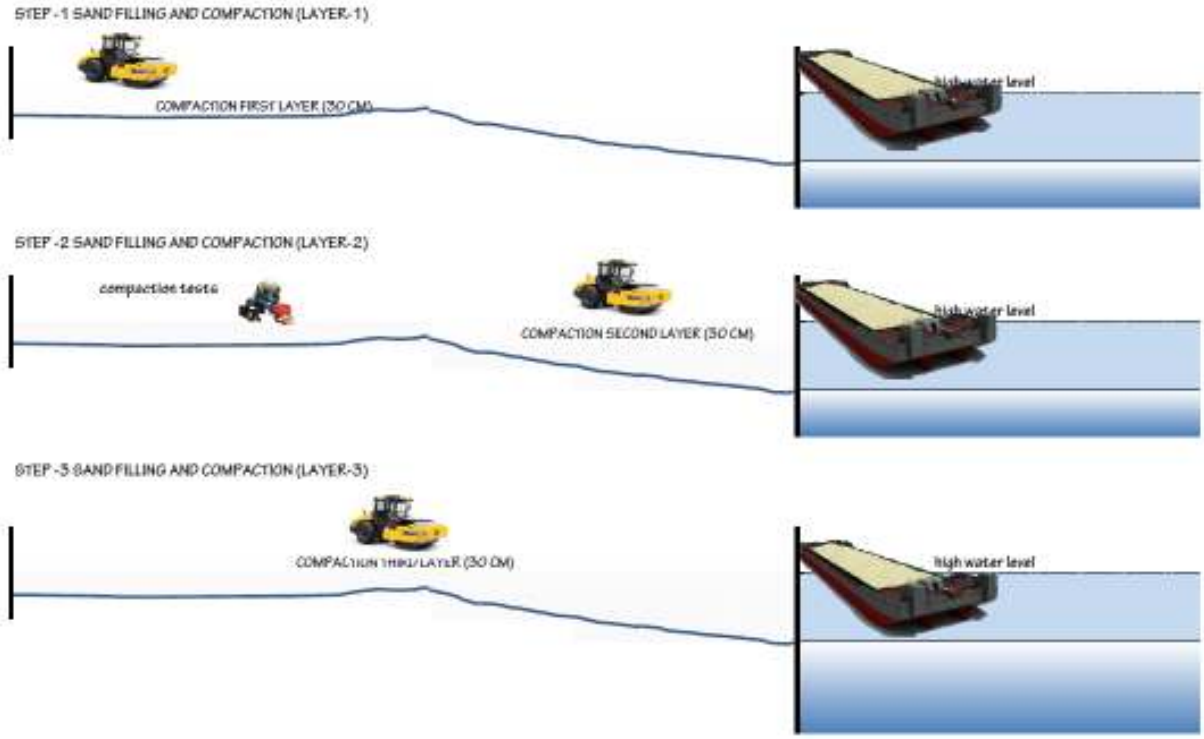


Photo of typical sand filling work (2)



APPENDIX G SITE PREPARATION WORK METHOD STATEMENT

AHLONE 2

WASTE MANAGEMENT PLAN

PROJECT DOC. NO. F050-MNL-026

LNG POWER PLANT (AHLONE) PROJECT

TTCL JOB NO. F-050

Total (Including this Page): 14 sheets

0	30-Sep-19	For Information	Phakin P.	Nimit A.	Anuchit P.	Peerapat T.
REV.	DATE	DESCRIPTION	MADE	CHECKED	APPROVED	AUTH'D

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Originator	Distribution	PW	PR	MA	ME	PP	EE	IN	CV	QC	PC	Proj	Site	Owner	Total
Project	No. of Copy	-	-	-	-	-	-	-	-	-	-	ORG.	1	1	2

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

Revision History Sheet

Rev.	Date	Description
0	September 30, 2019	For Information

CONTENTS

1. **PURPOSE**

This procedure is provided in accordance with best practice of engineering and other environmental impact considerations for control waste generation, temporary storage, collection, separation, transportation, disposal and also prevent impact to the environment and public during construction and commissioning period for LNG POWER PLANT (AHLONE) PROJECT, in manner that is waste management plan are integrated to manage all aspect of plant construction and commissioning waste.

2. **SCOPE**

This plan addresses field implementation and controls for waste management plan during construction, commissioning period until Commercial Operation Date (COD) as well as the processes for environmental monitoring and mitigation of construction activities that could potentially impact the environment and public.

3. **DEFINITION**

CONTRACTOR" means **TTCL PUBLIC COMPANY LIMITED (TTCL)** and **TTCL MYANMAR ENGINEERING AND CONSTRUCTION COMPANY LIMITED (TTMEC)** who perform the "Engineering Procurement and Construction (EPC) of the project.

"OWNER" means **TTCL POWER MYANMAR COMPANY LIMITED (TPMC)** who employ CONTRACTOR in connection with the "Engineering Procurement and Construction (EPC) of the project.

"SUBCONTRACTOR(S)" means the subcontractor(s) employed by CONTRACTOR or OWNER in connection with the construction of the project.

"LANDFILL" means physical and engineering facility use for the disposal of waste in the surface soil of the earth. (Landfills for domestic waste are called sanitary landfill , for hazardous waste are called secure landfill)

"HSE" means Occupational Health, Safety and Environment.

"TWSA" means Temporary Waste storage Area that CONTRACTOR & OWNER assigned for waste storage in construction area.

"AUTHORIZED TRANSPORTER" means waste transportation to disposal service provider who has registered by local authorities.

4. RESPONSIBILITY

When an activity is defined for a certain position in this procedure, the responsibility remains with that person although a designee may perform the implementation of that activity. The appointed designee must report directly to the assigned individual.

4.1 CONTRACTOR Project Manager (PM)

The PM has the overall responsibility for this procedure and is responsible for supporting it and for ensuring that all entities at the jobsite actively participate, responsible for providing the personnel, facilities, and other resources necessary to effectively implement this procedure.

4.2 CONTRACTOR Construction Manager (CM)

CONTRACTOR CM is responsible to conduct the construction execution in the safe practices. In conjunction with CONTRACTOR HSE Manager/Leader to ensure the safety and health of employees include environmental impact control in every aspect related to works.

CM is responsible for assuring the overall implementation of and compliance with environmental impact protection policy and procedures. They shall be familiar with the environmental impact protection policy and utilize the expertise at their disposal to ensure employees are protected from hazardous area.

4.3 CONTRACTOR HSE Manager/ Leader (HSEM)

CONTRACTOR HSE Manager/Leader, in collaboration with the CM & PM, is responsible for implementing and administering this procedure.

HSEM will perform function as:

(1) An adjudicator on any issues from the implementation of this procedure
(2) Audit SUBCONTRACTORS to ensure the requirements of this procedure are implemented and will provide feedback on performance to PM and SUBCONTRACTOR management representative.
(3) To assist SUBCONTRACTOR plans and coordinates the works for effectively implement the requirements of the procedure.
(4) To ensure the required HSE records are generated and available for review by PM and authorities as appropriate.

4.4 CONTRACTOR environmental engineer

(1) Overall implementation of waste management, monitoring and report to HSEM and PM of any issue concerns.
(2) Receive Environmental Protection Laws and approved environmental procedure from project management team then review and propose to implement at project site..

(3) Audit SUBCONTRACTORS to ensure the requirements of this procedure are implemented and will provide feedback on performance to HSEM.
(4) To assist SUBCONTRACTOR plans and coordinates the works for effectively implement the requirements of the procedure.
(5) To ensure the required HSE records are generated and available for review by HSEM.
(6) Responsible for assist waste transportation.
(7) environmental engineer must ensure that waste management data shall be reported in weekly basis.

4.5 SUBCONTRACTOR management representative

The SUBCONTRACTOR management representative has the responsibility for compliance with this procedure and shall provide the personnel, facilities, and other resources necessary to effectively implement, administer and enforce this procedure.

The SUBCONTRACTOR management representative is responsible for the effective dissemination and education of the requirements throughout its organizations and all lower tier SUBCONTRACTORS.

The SUBCONTRACTOR management representative shall ensure that all SUBCONTRACTOR employees and all lower tier SUBCONTRACTORS comply and actively participate with its requirements.

4.6 SUBCONTRACTOR safety officer

SUBCONTRACTOR safety officer shall be responsible for the continuous monitoring of the implementation in this procedure.

SUBCONTRACTOR safety officer will provide feedback on performance and assist SUBCONTRACTOR supervision plan and coordinate the work to effectively implement the requirements of the procedure.

4.7 SUBCONTRACTOR supervisor

SUBCONTRACTOR supervisor shall be thoroughly familiar with this procedure and with their individual responsibilities regarding its implementation and enforcement.

SUBCONTRACTOR supervisor shall ensure that only competent persons are assigned work tasks.

This includes ensuring the workers have the skills, physique and knowledge to safely execute the work task.

4.8 Employees

Employees have to know, understand and comply with this procedure.
Employees have to report their supervisor for any potential environmental impact incident.
Employees have to immediately apprise their supervisor whenever unsure of the instructions for a task or where concerned about the environmental impact status of any tasks.

4.9 SUBCONTRACTOR waste coordinator

SUBCONTRACTOR waste coordinator shall thoroughly familiar with this procedure and with their individual responsibilities regarding its implementation and enforcement.

SUBCONTRACTOR waste coordinator shall ensure that all SUBCONTRACTOR employees implementation are effective comply with this procedure.

4.10 Authorized transporter for waste disposal

All hazardous waste transportations to waste disposal service provider shall be executed by authorized transporter who is registered by local authorities.

Non hazardous waste transportations shall be executed by transporter which approved by CONTRACTOR.

5. PROCEDURE

5.1 CONTRACTOR shall engage with local authorities and other stakeholders to determine the capacity of the local waste management network to absorb the new waste streams generated from the Project during construction.

5.2 All workers shall be trained to avoid, reduce and reuse wastes generated.

5.3 Each SUBCONTRACTOR shall assign a representative employees who is waste coordinator for working with CONTRACTOR environmental engineer and supply manpower balancing with waste quantity to established team consolidate on site level as necessary.

5.4 Waste disposal by burning in LNG POWER PLANT (AHLONE) PROJECT is prohibited.

5.5 All wastes which were generated inside LNG POWER PLANT (AHLONE) PROJECT shall be properly managed by gathering, temporally storage, separate, reduced, transport and eliminated by appropriate disposal method. SUBCONTRACTOR waste coordinator who is responsible for waste calculations generated rate that base on seven (7) working days per week.

5.6 Locations of burying are to be far away from sensitive receptors and in a location where

impact of burying can be appropriately controlled.

5.7 Ensure no hazardous material or chemicals are present within the domestic waste, all waste materials shall be classified and segregated into the following categories:

5.7.1 Hazardous waste

- Oil, chemical, solvents, paint, insulations, any toxic substances etc.
  All hazardous must be collected in plastic bag with tag to indentify the hazardous waste.

5.7.2 Non Hazardous waste

- Type A: non value materials such stone, bricks, grit etc. These will be disposal by legal government.
- Type B: valuable materials such metals, electrical and instrument cabling, wood, plastic, rubber etc. These will be collected and transported by authority company that shall be approved by local government.
- Type C: Domestic waste, food, rubbish etc. These will be collected in plastic bag.

5.8 Waste transportation from generated source to TWSA shall be applying Waste Collection Sheet (F050-MNL-026 ATTACHMENT 2) for internal project control purpose. It shall be applying prior waste transport from source to TWSA. Section A: It is necessary for waste contamination control and declares necessary information. (Such waste type, quantity, generator company name, container code, etc.) Waste handling shall be carry out by appropriated container to TWSA. Waste separation is a critical step in waste management system because effective ways become for waste reduction by reused or recycle their materials. CONTRACTOR environmental engineer shall responsible for assist this activity.

5.9 SUBCONTRACTORS employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed. All end points for collected waste are to be inspected and audited and noted to be developed such that all waste is able to be disposed of in an environmental responsible manner and in accordance with all prevailing IFC requirements.

5.10 Monitoring of appointed waste SUBCONTRACTORS using chain-of custody documentation for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with all prevailing regulations.

5.11 The appointed waste SUBCONTRACTOR shall report on an annual basis to the Project proponent on any cross-boundary transport of waste. This is to ensure that waste management during construction activity is being managed responsibly.

5.12 Effluent from chemical cleaning of the equipment during the pre-commissioning phase

will be collected in an appropriate drainage system and transported off-site to a licensed hazardous waste treatment facility. The capacity of this facility will be assessed to ensure that it is capable of managing the Project's wastewater volumes.

5.13 CONTRACTOR'S environmental engineer must ensure that waste management data shall be reported in weekly basis. Risk assessment part in waste management form (SECTION A) shall be carried out for identified risk level and control mitigation measure during transportation from source to TWSA. The waste generator (means CONTRACTOR discipline supervisor, SUBCONTRACTOR waste coordinator) shall prepared this part and submit for approve by environmental engineer.

5.14 Ensure the integrity of wastewater storage unit to avoid leaking of wastewater and odor to the surrounding receptors.

5.15 Enforce rules that prevent inappropriate materials going into the sanitary wastewater stream.

5.16 Risk assessment matrix was shown in waste management form. Safety Data Sheet (SDS) will be used for risk assessment step (when available), as there is containing the necessary information for properly waste evaluation. Each risk assessment shall be allocated a unique number that used for labeling their waste.

5.17 SECTION B: Waste collection and transportation step shall be approved by environment engineer prior waste transportation from source to TWSA commencement.

6. RECORD KEEPING

Completed records of all waste management system will be retaining in CONTRACTOR HSE department.

7. APPENDIX

APPENDIX A WASTE MANAGEMENT FLOW DIAGRAM

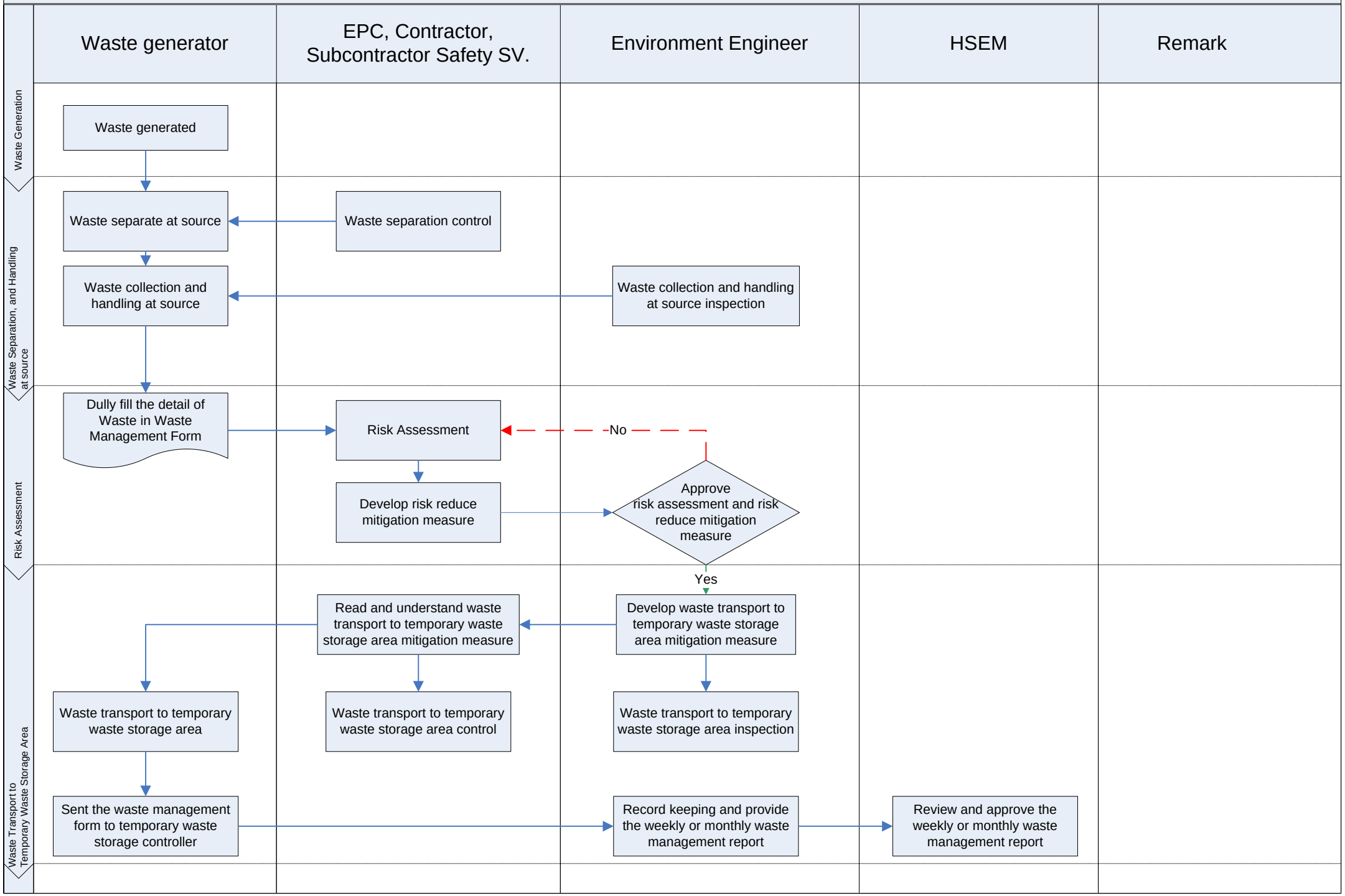
8. ATTACHMENT

ATTACHMENT 1 WASTE DISPOSAL PLAN

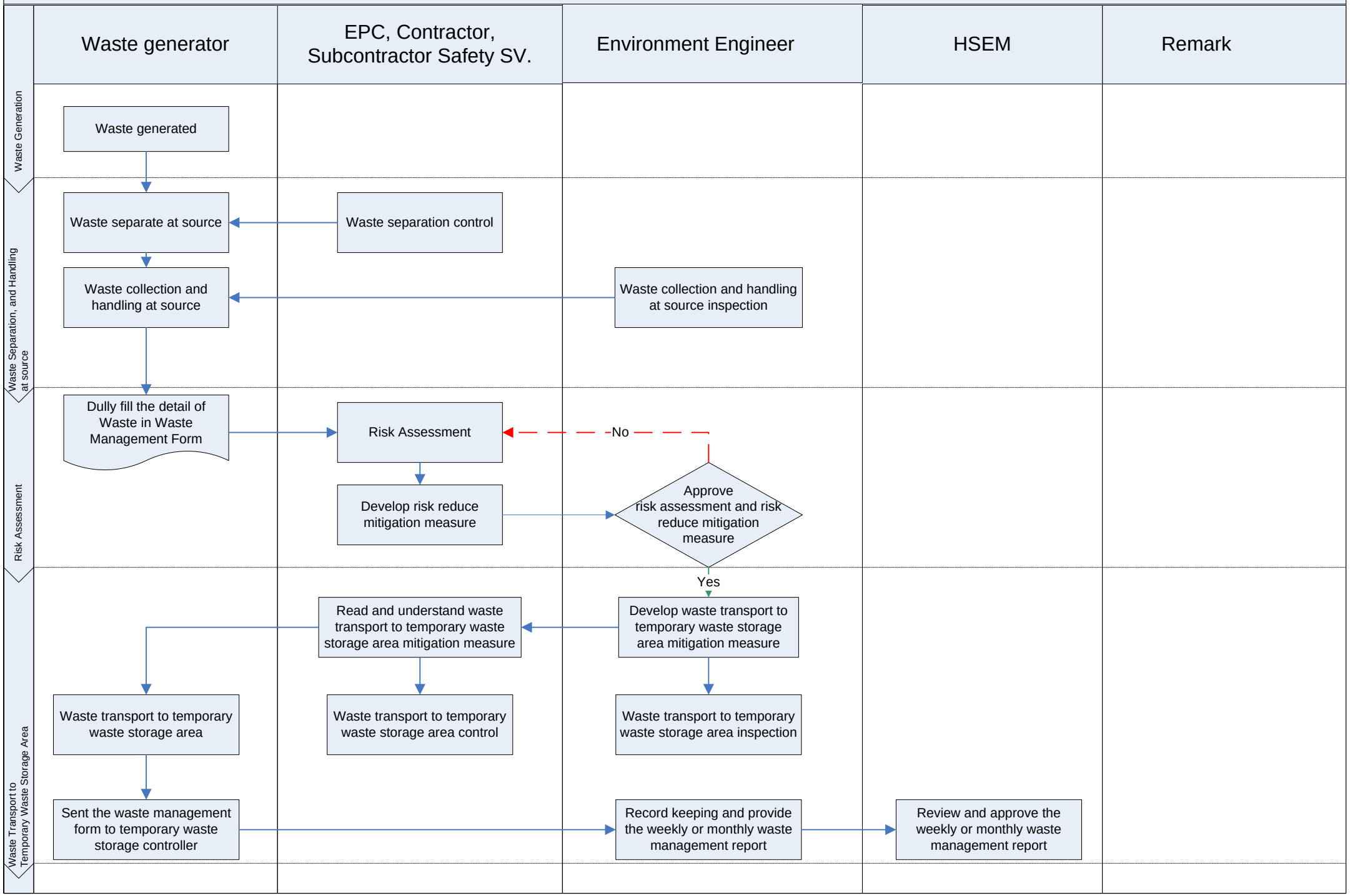
ATTACHMENT 2 WASTE COLLECTION SHEET

APPENDIX A

Waste Management Follow Diagram



Waste Management Follow Diagram



ATTACHMENT 1

TTCL PUBLIC COMPANY LIMITED
LNG POWER PLANT (AHLONE) PROJECT
WASTE DISPOSAL PLAN

WORKSITE WASTE AND SCRAP LISTS (1/2)

ITEM	DESCRIPTION	Waste Generate Source	OFFSITE DISPOSAL FREQUENCY	DISPOSAL COMPANY	CONTAINER	DISPOSAL METHOD	REMARK
1	**HAZARDOUS WASTE**						
1.1	Used oil and Oil packaging material.						
1.2	Solvents,paint,bitumen, include package and equipment contaminate etc.						
1.3	Insulation.						
1.4	Soil contaminate oil/chemical solution						
1.5	Used absorbent material (Spill Kit)						
1.6	Infection medical waste						
2	**NON-HAZARDOUS WASTE**						
	(General Waste; From Construction Activities)						
2.1	Soil, Sand, Gravel etc.						
2.2	Concrete pile tips						
2.3	Reinforce Concrete scarp, Concrete scarp etc.						
2.4	Rebar, Metal, Steel, Aluminium, etc.						
2.5	Wood, wood sheet etc.						
2.6	Plastic (such as PVC, LDPE, HDPE etc.)						
2.7	Electrical & Instrument cabling etc.						
3	**DOMESTIC WASTE**						
3.1	Food waste, Rubbish, Bottles, Tins etc.						
3.2	Sanitary waste						

TTCL PUBLIC COMPANY LIMITED
PROJECT NAME
ACCUMULATE WASTE DISPOSAL RECORD

WASTE DISPOSAL COMPANY MOBILIZATION (2/2)

ITEM	DESCRIPTION	Year												Year												Year											
		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
1	**HAZARDOUS WASTE**																																				
1.1	Used oil and Oil packaging material.																																				
1.2	Solvents,paint,bitumen, include package and equipment contaminate etc.																																				
1.3	Insulation.																																				
1.4	Soil contaminate oil/chemical solution																																				
1.5	Used absorbent material (Spill Kit)																																				
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2.1	Soil, Sand, Gravel etc.																																				
2.2	Concrete pile tips																																				
2.3	Reinforce Concrete scarp, Concrete scarp etc.																																				
2.4	Rebar, Metal, Steel, Aluminium, etc.																																				
2.5	Wood, wood sheet etc.																																				
2.6	Plastic (such as PVC, LDPE, HDPE etc.)																																				
2.7	Electrical & Instrument cabling etc.																																				
3	**DOMESTIC WASTE**																																				
3.1	Food waste, Rubbish, Bottles, Tins etc.																																				
3.2	Sanitary waste																																				

ATTACHMENT 2

TTCL PUBLIC COMPANY LIMITED

LNG POWER PLANT (AHLONE) PROJECT

Date .....

WASTE COLLECTION SHEET

Registration No (For Contractor Staff Only)

SECTION A
WASTE GENERATION, WASTE SEPARATION

❶ **Waste Generator Company:** .....

❷ **Discipline:** .....

❸ **Source of Waste Generation:** .....

❹ **Type of Waste:**

- ☐ **Rubbish Waste**.....**Kg.**
- ☐ **General Waste**..... **Kg.**
  - ☐ **Concrete Scrap**..... **Kg.**
  - ☐ **Wood Scrap**..... **Kg.**
  - ☐ **Plastic Scrap**..... **Kg.**
  - ☐ **Metal Scrap**.....**Kg.**
  - ☐ **Packaging Scrap**..... **Kg.**
  - ☐ **Other**..... **Kg.**
- ☐ **Hazardous Waste**..... **Kg.**
  - ☐ **Insulation**..... **Kg.**
  - ☐ **Solvent and Paint Packaging**..... **Kg.**
  - ☐ **Used Oil**..... **Kg.**
  - ☐ **Chemical Solution**.....**Kg.**
  - ☐ **Other**..... ..... **Kg.**

❺ **Quantity:** .....

Container Code or Number: .....

❻ **Risk Assessment**

Risk Assessment Matrix (Environment)

TTCL	HAZARD SEVERITY S		
	Slight / S	**Moderate/ M**	**High/ H**
	No impact or impact to construction area only	Impact to public less than 1 Km radius of construction area	Impact to public more than 1 Km redius of construction area
LIKELIHOOD OF OCCURRENCE L — **Unlikely/U** Historical experience show low likelihood of occurrence	LOW	LOW	MEDIUM
Possible/P Historical experience shows some likelihood or sometime to occur when there is activity	LOW	MEDIUM	HIGH
Likely/L It may be occurred frequently or all time when there is activity	MEDIUM	HIGH	HIGH

Assessment Method
(Likelihood of Occurrence) x (Hazard Severity)

Risk Assessment Result: .....

❼ **Risk Control Mitigation Measure:**
.....
.....
.....
.....
.....

❽ **Sign**..... **Safety Supervisor**

❾ **Sign**..... **Contractor Environmental Engineer**

SECTION B
WASTE COLLECTION AND TRANSPORTATION

Waste Transportation to Secured Temporary Waste Storage Area (TWSA) Mitigation

.....
.....
.....
.....
.....

I read with understand and will follow requirement and regulations of this document with special care to perform the work.

❿ **Sign**..... **Waste Coordinator**

I checked the detail of this document and environmental impact control mitigation measure; this waste could be transport to TWSA for transfer to offsite waste disposal.

⓫ **Sign**..... **Contractor Environmental Engineer**

APPENDIX H WASTE MANAGEMENT PLAN

AHLONE 2

ISSUED
29 MAY 2019
TTCL PUBLIC COMPANY LIMITED

PROJECT INCIDENT AND EMERGENCY RESPONSE PLAN

PROJECT DOC. NO. F050-MNL-030

FOR INFORMATION

LNG POWER PLANT (AHLONE) PROJECT

TTCL JOB NO. F-050

Total (Including this Page): 27 sheets

1	27-May-19	For Information	Wasutida J.		Khwankaew.C	
0	24-Sep-18	For Information	Original signed			
REV.	DATE	DESCRIPTION	MADE	CHECKED	APPROVED	AUTH'D

For Project Use only

Originator	Distribution	PW	PR	MA	ME	PP	EE	IN	CV	QC	PC	Proj	Site	Owner	Total
Project	No. of Copy	1	1	1	1	1	1	1	1	1	1	ORG.	1	1	12

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

Revision History Sheet

Rev.	Date	Description
0	September 24, 2018	For Information
1	May 27, 2019	For Information (Revise as per mark 1)
		- LNG Power Plant (Ahlone) Project Included Power plant,
		LNG Terminal, Gas Pipeline and Transmission Line

CONTENTS

ATTACHMENT LIST

1. PURPOSE

1.1 To provide a clear understanding to all TTCL and TTCL/Subcontractors, with regard to Emergency situations requiring a response (either assembly point or full evacuation).

1.2 To give site personnel a clear understanding of the roles and responsibilities of both line management/supervision and the Emergency Response Team members role on the project in the unlikely event of a real Emergency Response Operation being put into effect.

1.3 To assign the duties and responsibilities of Emergency Response Team (ERT) in Site.

1.4 To enable Emergency Response Team members as well as the designated incident ground commander a clear identifiable communications method of reporting.

2. SCOPE AND RESPONSIBILITIES

2.1 This procedure is applicable to all LNG Power Plant (Ahlone) Project areas during Emergency situations.

2.2 This procedure addresses many of potential emergency scenarios, however it shall be understood by all power plant personnel that those scenarios listed are not exhaustive, and are indicative only.

2.3 As well as incidents that may occur within the Project site, there may be other incidents external to TTCL, which may require a response by TTCL. For example, external fire incidents could occur or there could be a security alert in the local area, whereupon TTCL could be asked for assistance.

2.4 The following items are addressed within this Emergency Preparedness Procedure:

- Contact list of local authority
- Site information
- Potential emergency Scenarios
- Duties and responsibilities
- Emergency Plan
- Evacuation Plan
- Training requirements
- Communications
- Emergency Response drills
- Emergency Evacuation Organization
- Alarm/ Signals

2.5 The Environment, Health and Safety Officer is responsible for the oversight and coordination of the plant's Emergency Response program.

3. SITE INFORMATION

3.1 Power Plant Location

Name: LNG Power Plant (Ahlone) Project

Location: No.39, Ahlone Power Station Compound, Kan Nar Road, Ayayarwaddy Quarter, Ahlone Township, Yangon.

Tel: +95(0) 9732 19873

3.2 LNG Receiving Terminal

Location: Dala township, Yanggon Region , Myanmar.

Tel: TBC

1

3.3 Emergency Contacts

In the event of an emergency in LNG Power Plant (Ahlone) Project, or in the event involving plant personnel off site, the following listed key contact numbers for Power Plant as *Attachment-1* are used for communication purposes and listed key contact number for LNG Receiving Terminal as *Attachment-4* .

1

TTCL provide Trunk walkie-talkie to key personnel of Power Plant including Managers, HSE Officer and Engineers for site communication and one channel shall be reserved for emergency communication.

During the day-time working hours (08.00 - 17.00), above TTCL project personnel should be contacted. Outside normal Project working hours, the Safety Officer will be contacted in the first instance. The attached communications chart will be the call-out procedure followed in all emergency situations.

These communication numbers shall be posted conspicuously in all site offices and worker areas.

4. POTENTIAL EMERGENCY SCENARIOS

4.1 Incident Type

There are a variety of potential emergency scenarios and incident types that exist. The following scenarios listed below are not exhaustive, and are indicative only:

(1) Person(s) fall from height – on land

(2) Material fall from height

(3) Vehicle collision with plant/equipment/ pedestrian(s)

(4) Vehicle incident offsite

(5) Collapse of scaffold – no person(s) present/ person(s) present

(6) Collapse of structure – no person(s) present/ person(s) present

(7) Collapse of stacked/stored material

(8) Collapse of deep excavations – person(s) present

(9) Fire/Explosion – electrics, substances

(10) Chemical spillage – on land

(11) Medical emergency – Mass Food poisoning/ Bird flu

(12) Medical emergency – contagious disease

(13) Uncontrolled flammable/toxic release

(14) Adverse weather conditions (flooding, lightning strike)

(15) Loss of services (water, sewerage, electricity)

(16) Radiation (Radiation Source Exposition)

(17) Other (Earthquake, terrorist act, bomb threat, trespassers)

4.2 Levels of Response

The level of response to an emergency must be appropriate to the level/type of incident occurring. By ‘scaling’ or ‘tiring’ the required level of response to an incident type, this should utilize the resources for an emergency response from both within and external to the Project, without unnecessary waste of such resources.

Example:

Level	Action Response
1	TTCL Project Emergency Response Team (Project-ERT)
2	Project-ERT and supported team by Owner.

3 Government Authority (i.e. Industrial Estate, Municipal)

4.3 Personnel Affected

The type and location of an incident will have a bearing upon who potentially may be affected. As well as TTCL Project personnel, the sub-contractor workforce, visitors, Owners' personnel could all potentially be involved with or be affected by an incident/accident that may occur within the Project site and surrounding construction areas.

Should an incident occur that involves project vehicles offsite, there is the potential for members of the local community/public to be affected.

4.4 Work Areas Covered

Project site construction areas include access roads to and from these areas back to the main security gates. Well-defined Assembly Points will be established in all of these areas.

4.5 Emergency Response Team (ERT)

Project-ERT shall consist of members of the TTCL HSE department and Construction Team, and a selection of personnel from the Subcontractor companies, such as scaffolding and mechanical operatives where applicable.

In the first instance, the Project-ERT shall respond to assist the Site Medic at the scene of any accident/incident. Once the site medic has made an assessment, assistance from other ERT members may be requested, with a minimum of 4 people required – site medic, incident controller, 2 persons to assist with Para-guard stretcher (if required).

The Project-ERT members ideally are trained and prepared to fulfill the roles required by the specific situation, wearing red safety helmet and red vest coat

To identify ERT team for Project site, a group of people who prepare for and respond to any emergency incident, such as fire or explosion. Emergency response teams are common in corporations as well. This team is generally composed of specific members designated before an incident occurs, although under certain circumstances the team may be an unplanned group of willing volunteers.

5. DUTIES AND RESPONSIBILITIES

5.1 Project Manager (PM)

Project Manager shall give all details of the TTCL Program to HSE Department for drafting TTCL Standard Safety Procedure "Emergency Preparedness".

Project Manager shall support TTCL Emergency Preparedness Procedure and support necessary documents and emergency evacuation tools and equipment to HSE Department for preparation and execution in case of emergency evacuation.

Project Manager shall be acted as Emergency Director for command and control of emergency situation in case of TTCL Emergency Evacuation Case.

5.2 HSE Manager / HSE Officer

HSE Manager / HSE Officer shall be responsible to draft the TTCL Emergency Preparedness Procedure and Plan to Project Manager for approval.

HSE Manager / HSE Officer shall be directly taken order from Project Manager in case of emergency situation by cooperation the evacuation order from Project manager to On-Scene Commander.

HSE Manager / HSE Officer shall prepare emergency evacuation tools and equipment, i.e. the designated Assembly Points, Emergency Route & Signs.

HSE Manager / HSE Officer shall step up the Emergency Response Team (ERT) for supporting in case of Emergency Evacuation Situation.

HSE Manager / HSE Officer shall set up Emergency Evacuation Training & Drills to be ready for the potential real case.

HSE Manager / HSE Officer shall be coordinated with the On-Scene Commander in case of Emergency Evacuation Situations.

5.3 Construction Manager (CM)

Construction Manager shall manage and control the Emergency Response Team (ERT) by this Emergency Response Procedure.

Construction Manager shall support HSE Department in case of Emergency evacuation in LNG Power Plant (Ahlone) Project who support for the emergency training and drills in their area responsibilities.

5.4 Emergency Response Team (ERT)

ERT will be consisted of followings:

- Fire Fighting Team
- Rescuing Team
- First Aid Team
- Head Counting Team
- Route Leader / Traffic Controller

ERT will be strictly followed by On-Scene Commander order in case of Emergency evacuation situation.

ERT will be received the emergency training & drills as HSE requirement regarding the sequence of the evacuation steps including the emergency Route and the Assembly point locations.

6. EMERGENCY PLAN

6.1 Pre-Emergency Plan consists of 3 main items as followings:

(1) Inspection and monitoring Plan

To conduct the area inspection and monitoring by assigning the responsible person as in charge of inspection to their areas:

(2) Emergency Evacuation Training & Drills Plan

To conduct the emergency training and drills by HSE Department and assign ERT for response in case of the Emergency Situations.

To manage and conduct the Fire or Emergency Training & Drills to TTCL. They shall be trained the basic fire prevention and basic fire suppression course at least 40 % of all the employees.

6.2 Fire & Emergency Campaign;

(1) To manage and conduct the Fire & Emergency campaign to TTCL area. The Campaign Posters shall be displayed in TTCL areas.

(2) The Non-smoking zones shall be strictly established, fire extinguishers shall be located to all pre-defined locations.

6.3 Fire Fighting & Rescue Plan consists of 2 plans as followings;

(1) Fire Fighting Plan

To assign the Fire Fighter Team with the trained persons

(2) Rescue Plan

To assign the Rescue Team with the trained persons to rescue the victims in case of emergency

7. EVACUATION PLAN

7.1 The Evacuation Plan shall be established and covered to all Site areas.

7.2 Project Manager shall confirm the emergency situation from area inspector and then information will be conducted to On-Scene Commander at Central Control Room (CCR) by Two way Radio Walkie/Talkie Emergency Channel

7.3 TTCL Central Control Room (CCR) will be immediately signaling to Alarm Siren that is installed on central pipe rack and inform ERT by Radio Walkie/Talkie Emergency Channel.

7.4 All TTCL personnel shall be conducted to designated Assembly Points and then Head counting will be carried out.

8. EMERGENCY EVACUATION ORGANIZATION

8.1 Emergency Director (Project Manager)
Duties and Responsibilities
(1) Immediately attended to the location of Emergency
(2) Assess the situation and order call for Assistance as necessary (Outsource Fire Fighting, Police, and Ambulance etc.)
(3) Order for shutting off main power switches as necessary
(4) Direct control and supervise emergency actions to the emergency response team members.
(5) Order to barricade the affected area (if necessary)
(6) Issue command for evacuation to assembly point

8.2 On-Scene Commander (Construction Manager)
Duties and Responsibilities
(1) Immediately attended to the location of emergency
(2) Assess the situation together with Emergency Director or HSE Manager/ Officer
(3) Follow as Emergency Director's command for controlling emergency situation
(4) Control and supervise ERT on scene
(5) Report the status of emergency situation to Emergency Director

8.3 First Aid Coordinator (HSE Manager/ Officer)
Duties and Responsibilities
(1) Proceed to the scene immediately
(2) Assess the situation together with Emergency Director or On-Scene Commander.
(3) Advise any firefighting technique on scene to Fire Fighting Team
(4) Advise any patient movement technique in scene to rescue team
(5) Stand-by for any medical assistance required
(6) Prepare emergency medical kits

8.4 Emergency Response Team (ERT)
Duties and Responsibilities

(1) Route Leader / Traffic Controller
- Control the traffic condition on power plant
- Navigate all personnel to designated Assembly point

(2) Fire Fighting Team
- Follow as an On-Scene Commander order for controlling emergency situation
- Proceed to control fire appropriately as training course
- Communicate to On-Scene Commander periodically

(3) Rescue Team
- Proceed to search and rescue the injured person who cannot go out of emergency area by himself/herself to safe location
- Provide basic first aid to injured person (if necessary)
- Communicate to On-Scene Commander periodically

(4) Head Counting Team
- Proceed to head counting at Assembly Point
- Inform the present head count number to On-Scene Commander / Emergency Director
- Control all evacuated personnel at Assembly Point until emergency situation is completed.

9. RETURN TO WORK

Return to work can only occur once a situation has been made safe, and a return deemed acceptable by the Emergency Director (ED) for serious incident or the TTCL Emergency Control Manager (EM) for minor incident. No other person such as a Line Manager or Supervisor can communicate a 'return to work' status.

If the incident is such that the level of response requires the interaction of outside agencies, they may require certain areas to be cordoned off for investigation purposes. Should this occur, no work will be allowed in those areas, until such time as the "*ALL CLEAR*" has been given by the relevant agency.

Upon the return to work being notified, all permits are to be revalidated by the TTCL permit controller.

10. INVESTIGATION PROCESS

All accidents and incidents resulting in an Emergency Response shall require full investigation. The level of investigation should be appropriate with the level of response to the accident/incident. For most level 1 or 2 responses, members of the TTCL HSE teams will collate information as an attachment to the main accident/incident report. This shall de submitted to the Owner in a timely manner immediately following the Incident/Accident Emergency.

Where the seriousness of the event raises the level of response to level 2 or 3, then a formal investigation and report will be required. This may involve post event investigation meetings and lesson learned briefings with all Site Project Management team members.

All emergencies investigated shall be documented in accordance with F050-MNL-039: Incident Investigation Procedure.

11. LESSONS LEARNED

11.1 Overview

Whether there have been 'Near Miss' reports or a major incident with multiple casualties, there are always lessons that can be learned, and steps taken to reduce future potential.

All incidents, including 'near miss' reports, are to be logged and tracked, to identify any trends forming. If trends are identified, then appropriate steps are taken to reduce the likelihood of such re-occurring. These shall be recorded on the TTCL action tracking register.

11.2 Findings from the Investigation

After high potential accidents/incidents that may or have affected strategic Project work, meetings shall be held with all the relevant parties to run through all items that have occurred during that particular operation, including any accidents and incidents. This should enable improvements to be made, where applicable, to create safer working practices for future tasks.

11.3 Continual Improvement

Any items identified from investigations or lessons learned meetings should result in the requirement for Procedures to be amended or for method statements and risk assessments to be reviewed and updated. This is part of the 'continual improvement' cycle, where any item no matter how small could potentially have a negative impact upon the process, and therefore should be considered and included in the revision of relevant Project documents.

12. TRAINING AND AWARENESS

12.1 Training

All members of the Project-ERT will attend relevant training in the appointed team person role, use of emergency equipment and basic first aid course.

Additional training identified through the course of the Project will also be provided if considered integral to the efficiency and effectiveness of the Project-ERT.

12.2 Communication to Project Personnel

Information relating to general Emergency Response, safe working and accidents/incidents on site will be communicated to Project personnel via the initial Project Induction process, toolbox talks, safety alerts, posters etc.

12.3 Emergency Drills

Individual Emergency scenarios will be worked out through the life of the Project/s; however TTCL intend to carry out 2 Emergency drills each calendar year in co-operation with Owner.

A schedule shall be prepared indicating the proposed times for general practice runs as wells as planned full-scale emergency drills, where applicable involving the Owner and TTCL Project-ERT.

A report shall be prepared hi-lighting the findings from such drills, with amendments/additions being made to required documentation as part of the lessons learned/continual improvement process.

13. ALARM / SIGNAL

In case of Fire Emergency Evacuation, the emergency siren sound will be continuous for 30 seconds (Only 1 Times)

For Finishing Emergency Situation, the Siren sound will be activated for 3 times (15 Seconds/time)

ATTACHMENT-1

EMERGENCY CONTACT FOR POWER PLANT 1

TTCL PUBLIC CO., LTD.
"LNG POWER PLANT (AHLONE) PROJECT"
หมายเลขโทรศัพท์แจ้งเหตุฉุกเฉิน EMERGENCY CALLS

OWNER	
TTCL Power Myanmar Company Limited (TPMC)	
Name	Tel. No.

CONTRACTOR		
TTCL Public Company Limited (TTCL)		
Name	Position	Tel. No.
Mr. Manasphong Pattarakorn	Project Maneger	TBC
Mr. Jakkrit Tipmak	Construction Maneger	TBC
Ms. Khwankaew Choochuen	Project Engineering Maneger	TBC

SUBCONTRACTOR	
Name	Tel. No.

สถานีตำรวจ POLICE STATIONS, EMERGENCY CALL 191	
	Tel. No.
Police Station	191

โรงพยาบาล HOSPITALS	
	Tel. No.
Asia Royal Hospital	951538055

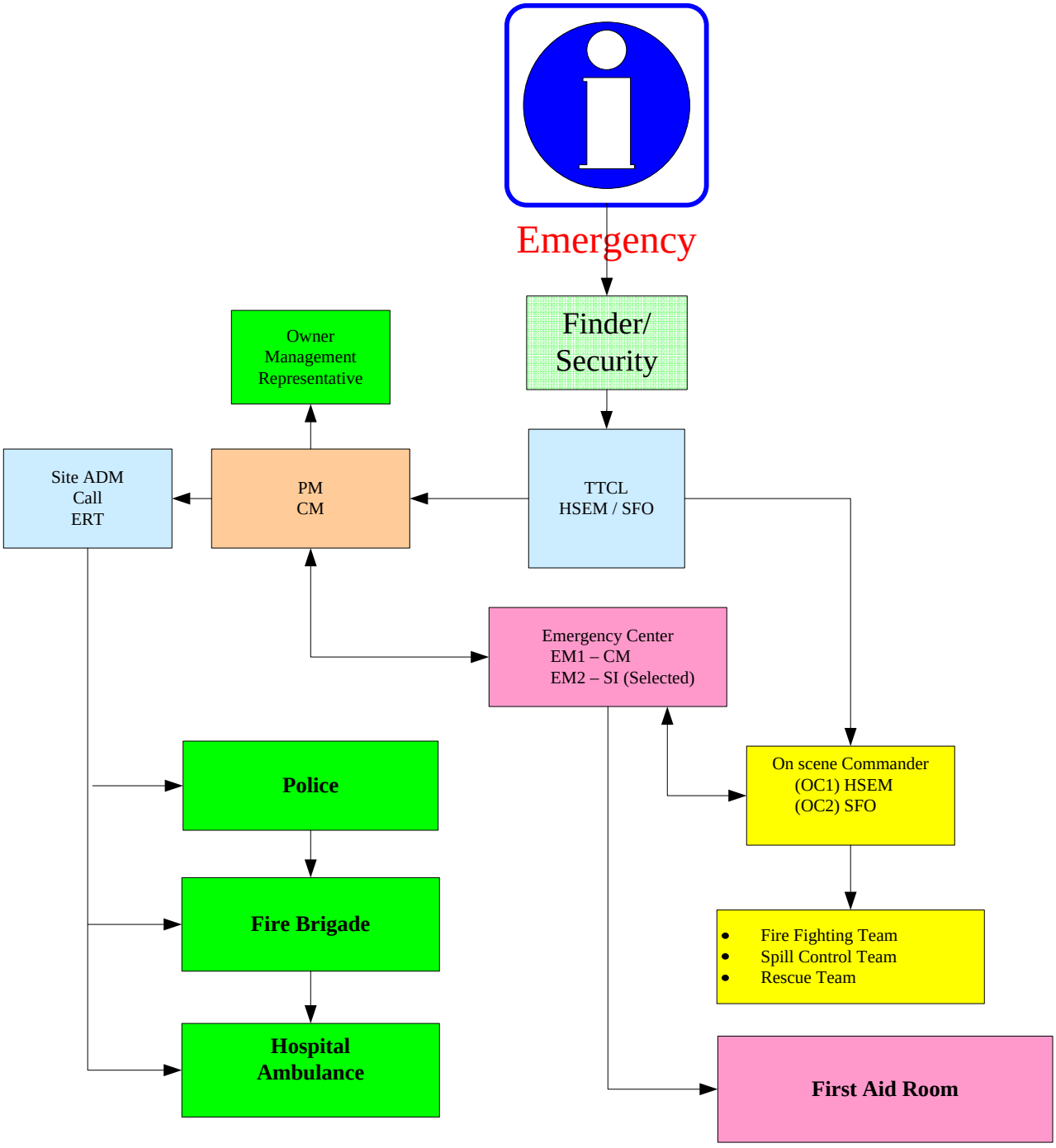
สถานีดับเพลิง A Fire Station	
	Tel. No.
Fire Station	252011, 252022

สถานีไฟฟ้าย่อย Substation	
	Tel. No.
Ahlone Sucstaion	2300469

ATTACHMENT-2

EMERGENCY COMMUNICATION FLOW CHART

Site Emergency Communication Flow Chart



ATTACHMENT-3

EMERGENCY EVACUATION ROUTES FOR POWER PLANT 1

DWG NO. F050-AD-00-010-02

TN
PN 0°
270° 90°
180°

AREA NO.	DESCRIPTION	GRID NO.	REMARKS
01	STG AREA	F-5	
02	GTG AREA FOR UNIT 1 & 2	G-6	
03	HRSG AREA FOR UNIT 1 & 2	F-5, G-5	
04	BOILER FEED WATER PUMP AND DEAERATOR	F-5	
05	RIVER PONTOON AREA	E-1	
06	WATER TREATMENT AREA AND DEMIN AREA	H-4, F-3	
07	COOLING TOWER AREA	E-5	
08	AIR COMPRESSOR AREA	G-4	
09	COMMON AND FACILITY AREA	H-6, J-8	
10	EXISTING SETTLING POND AREA	H-8	
20	PIPE RACK AREA	F-5	
21	COMMON ROAD AND PAVING	I-6	
22	GAS METERING AREA	D-4	

LEGEND

- POWER PLANT BOUNDARY
- U/G FUEL GAS EXISTING LINE
- PIPE RACK
- U/G CABLE TRENCH

NOTE :

1) ALL DIMENSIONS AND ELEVATIONS ARE IN MILLIMETER UNLESS INDICATED OTHERWISE.
2) ALL COORDINATES ARE IN MILLIMETER UNLESS INDICATED OTHERWISE.
3) GL EL.0 mm = EL.0 mm of TTPMC PLANT = +4,420 mm MSL = +7,250 mm CDL
4) EXISTING FUEL GAS LINE MAY BE MODIFIED.
5) EXISITNG RIVER WATER LINE FOR 121 MW COMBINED CYCLE POWER PLANT PROJECT SHALL BE MODIFIED.
6) REFER TO THAI REGULATION, AREA UNDER 20 M FROM 230 kV TRANSMISSION LINE IS PROHIBITED TO CONSTRUCT BUILDING, RESIDENCE, ETC.
7) RESERVED AREA FOR PIPE AND CABLE INTERCONNECTING ROUTE FOR 121 MW COMBINED CYCLE POWER PLANT PROJECT.

ASSEMBLY POINT

SMOKING AREA

FIRE EXTINGUISHER

TOTAL REQUIRED AREA
36,300 m2 or 8.97 Acres

REV.	DESCRIPTION	DWN.	CHK'D	CHIEF	MGR	APVD	AUTH	ISSUE	DATE MM/DD/YY
								C L F V	/ /
								C L F V	/ /
								C L F V	/ /
1 B	APPROVED FOR PLANNING-1	PISUT						C L F V	04/24/18
0 A	APPROVED FOR PLANNING	PISUT	(ORIGINAL SIGNED)					C L F V	03/05/18

356 MW COMBINED CYCLE POWER PLANT PROJECT

TTCL Power Myanmar Company Limited

ABBR. FOR ISSUE
C = CUSTOMER
L = LICENSOR
F = FIELD
V = VENDOR

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

TTCL JOB NO. F-050 | ACCOUNT | CUSTOMER'S ORDER NO.

ISSUE MARK: B
04/24/18 MM/DD/YY

GENERAL PLOT PLAN

SCALE : 1/400 | DWG. NO. F050-AD-00-010-02

ATTACHMENT-4

EMERGENCY CONTACT FOR LNG RECEIVING TERMINAL 1

TTCL PUBLIC CO., LTD.

"LNG POWER PLANT (AHLONE) PROJECT"

หมายเลขโทรศัพท์แจ้งเหตุฉุกเฉิน EMERGENCY CALLS

OWNER	
TTCL Power Myanmar Company Limited (TPMC)	
Name	Tel. No.

CONTRACTOR		
TTCL Public Company Limited (TTCL)		
Name	Position	Tel. No.
Mr. Manasphong Pattarakorn	Project Maneger	TBC
Mr. Jakkrit Tipmak	Construction Maneger	TBC
Mrs. Wilailak Kraisut	Project Engineering Maneger	TBC

SUBCONTRACTOR	
Name	Tel. No.

สถานีตำรวจ POLICE STATIONS, EMERGENCY CALL 191	
	Tel. No.
Pyaw Bwe Police Station	956449006

โรงพยาบาล HOSPITALS	
	Tel. No.
Pyaw Bwe Gyi Hospital	TBC

สถานีดับเพลิง A Fire Station	
	Tel. No.
Pyaw Bwe Fire Station	956449022

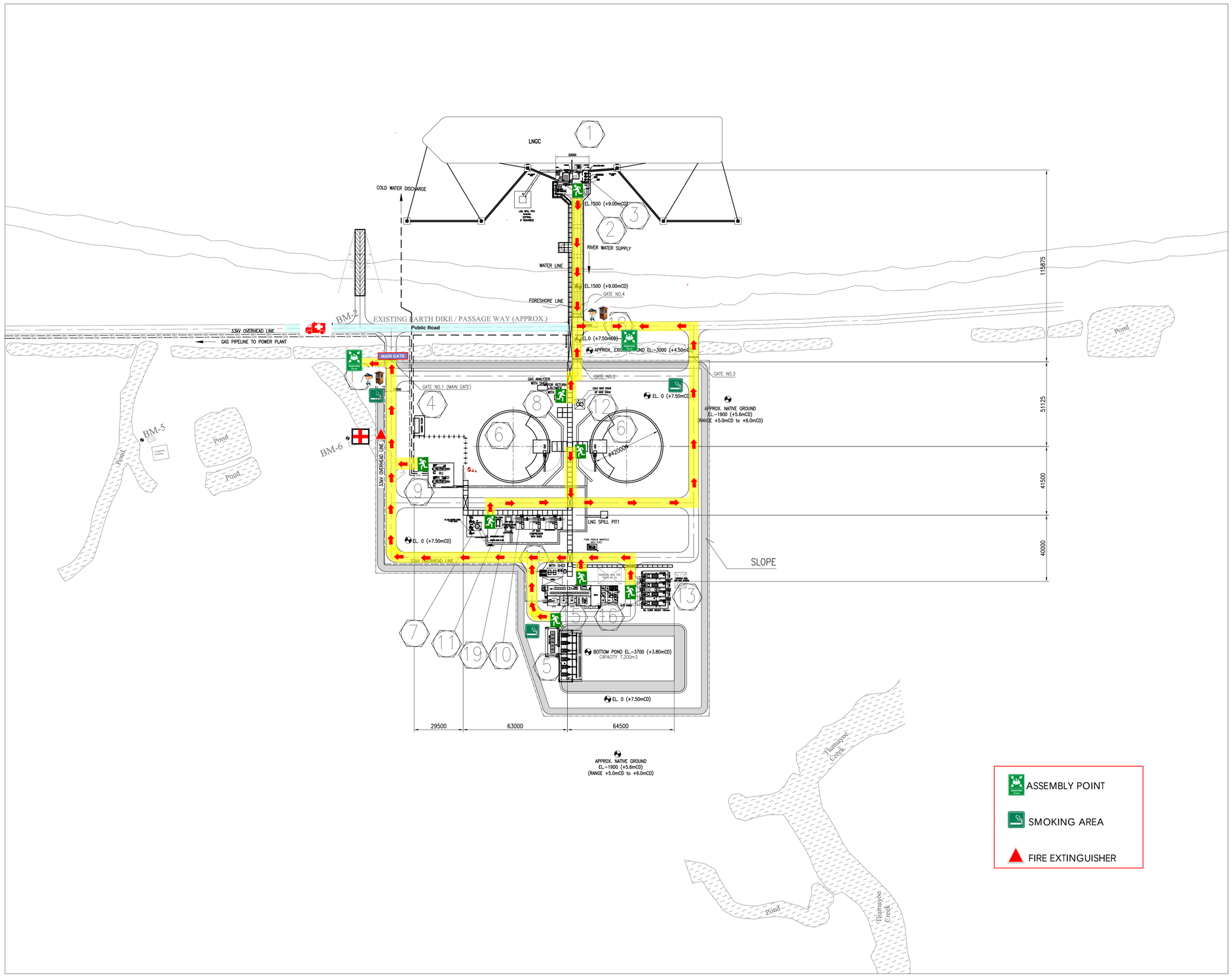
สถานีไฟฟ้าย่อย Substation	
	Tel. No.
Pyaw Bwe Substaion	TBC

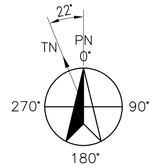
ATTACHMENT-5

EMERGENCY EVACUATION ROUTES
FOR LNG RECEIVING TERMINAL

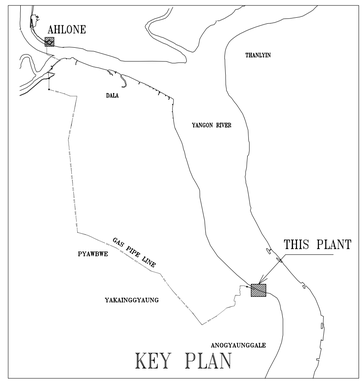
1

DWG NO. –





EQUIPMENT LIST	
ITEM NO.	EQUIPMENT NAME
1	LNG CARRIER
2	JETTY AREA
3	RIVER WATER PUMP
4	DEBRIS FILTER
5	FIRE WATER PUMPS AND FIRE WATER POND
6	LNG STORAGE TANK 1 & 2 WITH LNG TRANSFER PUMPS
7	HP LNG BOOSTER PUMPS, LNG SUCTION DRUM, &RECONDENSER
8	VAPOR RETURN BLOWERS
9	REGASIFICATION UNIT
10	LP BOG COMPRESSOR
11	NG PRE-HEATER
12	HIGH PRESSURE STACK AND COLD VENT STACK
13	GAS ENGINE GENERATOR
14	AIR COMPRESSOR,AIR RECIVER, AND NITROGEN SYSTEM
15	ELECTRICAL ROOM, EDG, AND CONTROL ROOM BUILDING
16	ADMIN, FIRST AID AND CANTEEN BUILDING
17	MAIN GATE GUARD HOUSE
18	JETTY GUARD HOUSE
19	HP BOG COMPRESSOR



ASSEMBLY POINT

SMOKING AREA

FIRE EXTINGUISHER

REV.	DESCRIPTION	DWN.	CHKD	A/E	CHIEF	MGR.	APPR.	ISSUE	DATE MM/DD/YY
								C L F V	/ /
								C L F V	/ /
								C L F V	/ /
								C L F V	/ /
								C L F V	/ /
								C L F V	/ /
								C L F V	/ /
	FOR INFORMATION							C L F V	12/28/18

LNG POWER PLANT(AHLONE) PROJECT

TTCL Power Myanmar Company Limited

ABBR. FOR ISSUE
C = CUSTOMER
L = LICENSOR
F = FIELD
V = VENDOR

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

TTCL JOB NO. F-050 | ACCOUNT | CUSTOMER'S ORDER NO.

ISSUE MARK –

12/28/'18

PLOT PLAN LNG RECEIVING TERMINAL FOR LNG POWER PLANT(AHLONE) PROJECT 1/1

SCALE – | DWG. NO. –

ATTACHMENT-6

EMERGENCY EVACUATION ROUTES
FOR GAS PIPELINE

1

DWG NO. –

N 0° 90° 180° 270°

PROPOSED AREA
FOR LNG RECEIVING TERMINAL

THANLYIN

GWA-YWA

YANGON RIVER

ANOGYAUNGGALE

DALA-DANODE Road

DALA-DANODE Road

YAKAINGGYAUNG

DALA-DANODE Road

KYAUKTADA

GAS PIPE LINE APPROXIMATE 25km

DALA

PYAWBWE

LNG POWER PLANT
(AHLONE) PROJECT

MIP Port

DALA-DANODE Road

Assembly Point

- ASSEMBLY POINT
- SMOKING AREA
- FIRE EXTINGUISHER

REV.	DESCRIPTION	DWN.	CHKD	A/E	CHIEF	MGR.	APPR.	ISSUE	DATE MM/DD/YY
								C L F V	/ /
								C L F V	/ /
								C L F V	/ /
								C L F V	/ /
								C L F V	/ /
								C L F V	/ /
								C L F V	/ /
0 A	FOR INFORMATION							C L F V	05/22/'19

LNG POWER PLANT(AHLONE) PROJECT

TTCL Power Myanmar Company Limited

ABBR. FOR ISSUE
C = CUSTOMER
L = LICENSOR
F = FIELD
V = VENDOR

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

TTCL JOB NO. F-050 | ACCOUNT | CUSTOMER'S ORDER NO.

ISSUE MARK A 05/22/'19

OVERALL PLOT PLAN FOR LNG POWER PLANT(AHLONE) PROJECT

1/1

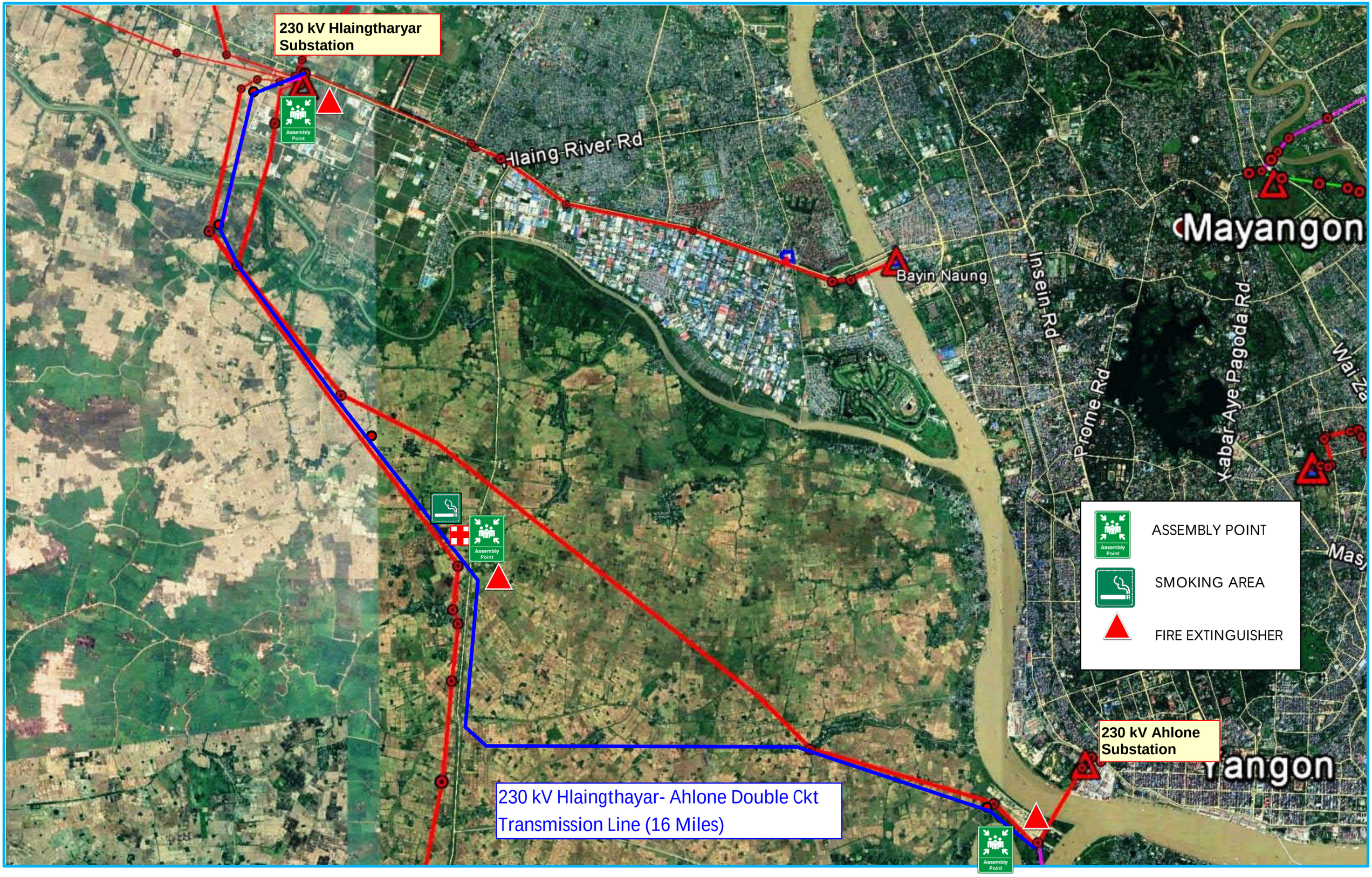
SCALE – | DWG. NO. –

ATTACHMENT-7

EMERGENCY EVACUATION ROUTES
FOR TRANSMISSION LINE

1

230 kV Hlaingtharyar-Ahlone Transmission Line (16 Miles)



APPENDIX I PROJECT INCIDENT AND EMERGENCY RESPONSE PLAN

AHLONE 2

ISSUED
04 FEB 2019
TTCL PUBLIC COMPANY LIMITED

SITE SECURITY PROCEDURE

PROJECT DOC. NO. F050-MNL-029

FOR INFORMATION

LNG POWER PLANT (AHLONE) PROJECT

TTCL JOB NO. F-050

Total (Including this Page): 50 sheets

0	21-Jan-19	For Information				for
REV.	DATE	DESCRIPTION	MADE	CHECKED	APPROVED	AUTH'D

For Project Use only

Originator	Distribution	PW	PR	MA	ME	PP	EE	IN	CV	QC	PC	Proj	Site	Owner	Total
Project	No. of Copy	1	1	1	1	1	1	1	1	1	1	ORG.	1	1	12

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

Revision History Sheet

Rev.	Date	Description
0	January 21, 2019	For Information

CONTENTS

APPENDIX LIST

ATTACHMENTS LIST

1. PURPOSE

It is the policy of the company that each location shall establish a Security Program designed to provide a secure working environment. Every employee has the responsibility to conduct themselves in such a way as to protect the company's assets. This document describes the various elements of the security plan and the details within each element.

This document is to define the control access into and out of secured areas and all access into restricted zones inside secured areas. So, it shall provide the protection of property from theft and fire.

2. SCOPE

This document is designed to cover the Project Site Security Plan for the Project site. Every employee shall be training and understand the Project Safety Rules.

3. DEFINITIONS

Security Area	Project site is concerning in working area, Power Plant, LNG Receiving Terminal, Gas Pipeline, Transmission Line and warehouse that shall be entry restricted and/or secured for unauthorized person entry and project asset lost prevention purpose.
Restricted Zone	Construction area which is being hazard exists during working such as an areas of scaffolding erection, crane operation, machine, electrical operation and process operation which accidental protection and/or property stolen prevention purpose.
Security Officer (SCO)	The employee who is responsible for security matters which is protect unauthorized person entry and loss of project asset in working area, gate pass control for entrance & exit of personal, material or equipment in project site.
Chief Security Guard	The Subcontractor employees who were employ by security service provider (subcontractor) for Security Supervisor duty. He shall works in shift operation and responsibility for routine security matters during on duty.

4. RESPONSIBILITY

4.1 TTCL PROJECT MANAGER (PM)

(a) PM is responsible for assuring implementation of Site Security Procedure to ensure that security operation are performed by TTCL, Subcontractors and other concerned parties in the project.

(b) Lead by an example, modeling the behavior expected from all personnel performing work at the jobsite.

4.2 TTCL CONSTRUCTION MANAGER (CM)

(a) CM is responsible for construction execution of Site Security Procedure that make collaboration by TTCL employees, Subcontractors employees including visitors and concerned persons.

(b) Lead by an example, modeling the behavior expected from all personnel performing work at the jobsite.

4.3 TTCL HSE MANAGER (HSEM)

HSEM is responsible to execute an effective Site Security covering construction area, warehouse, parking, lay down, except TTCL Site office (which will be control by TTCL Admin) as following;

(a) Establish Site Security Procedure covering project activities risk.

(b) Ensuring effective compliance with this Site Security Procedure.

(c) Ensuring that this procedure is administered properly and develop Site Security Procedure where necessary.

(d) Ensure that all site personal (TTCL and Subcontractor employees) are received "Site Safety Rules and Regulation procedure" training and adhere to its entire requirement.

(e) Lead by an example, modeling the behavior expected from all personnel performing work at the jobsite.

4.4 TTCL SECURITY OFFICER (SCO)

TTCL Security Officer is responsible for;

(a) Provide direction and oversight to the site security contractor / subcontractor and to facilitate interface with local security and police officials for all activities associated with the Project.

(b) Manage, control and co-ordinate with security guards for security provisional activities and being the universal guard / site security center for his entire site area.

(c) Overall security and the implementation of the Secure Assets work processes and appropriate supporting work processes.

(d) Ensuring that all employees process ID badges and report to the site with picture ID badge displayed visibly on their body.

(e) Ensuring only construction material delivery employees equipped with Basic PPE; steel toe cap safety shoes, long sleeve shirt, full length trousers, approved safety glasses, and hard hat can be allowed to enter the site.

(f) Perform random searches on employees (lunch boxes and carry-on items) to prevent employee from bringing alcohol, firearms or illegal drugs onto the jobsite or to prevent theft of project materials as employees leave the site.

(g) Ensuring that all vehicles and equipment have a valid inspection and access pass to gain access to the project site.

(h) Ensuring that vendors delivery vehicle is in safe operating condition in order to be allowed on the project.

4.5 TTCL Site Admin

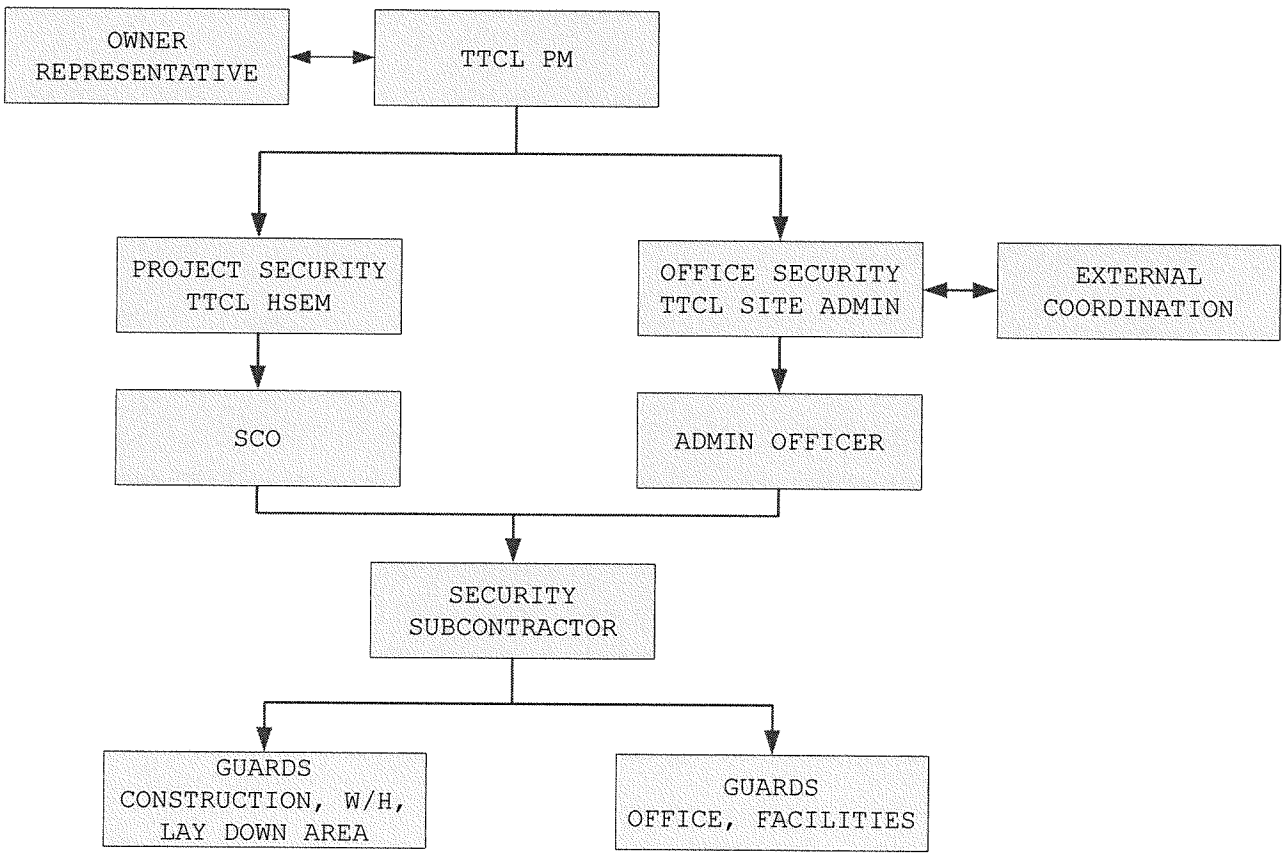
TTCL Site Admin is responsible for external coordination project security matters and TTCL Site office security such office building, office facilities and being the spare key keeper for regularly or emergency entire site office.

4.6 TTCL / SUBCONTRACTOR EMPLOYEES

Conduct themselves in such a way as to protect the Company's assets. Each Subcontractor is responsible for the security of his own tools, equipment and material.

Understand Security processes and their individual role in protecting the assets of the Company; for example, confidential information, travel to high risk areas and reporting (crime and theft).

5. SECURITY ORGANIZATION



6. SYSTEM REQUIREMENTS

The main components of this system are:

A. Physical barriers (Fence, Gates).

B. Badge (Personal access control)

C. Mobilization and demobilization of employees

D. Asset control

E. Guards

F. Vehicle policy

G. Security supervision

H. Photography control

A. PHYSICAL BARRIERS

(1) Fences

Outer (perimeter) & Inner temporary fences shall be installed for Project boundary and to separate construction area and site office area for security & safety purpose.

(2) Gates

(a) TTCL PM in conjunction with TTCL HSEM shall determine project access requirements for construction activities and locate suitable temporary gates to support the construction effort.

(b) These gates shall be controlled by the Security guards. (TTCL Security Officer and Subcontractor guards)

(c) Security guards shall ensure at the gate that employees authorized personnel, visitor, vehicle, material and equipment shall be effective entry and exit control;

i. Authorized employees – Personal badge

ii. Visitor – ID card swap to Temporary personal gate pass

iii. Authorized vehicle – Vehicle gate pass sticker

iv. Vehicle – Generally driving license card swap to Temporary personal and vehicle gate pass when required inspection (if applicable) is satisfied as following;

- Mobile Crane: load test certificate and project inspection are required
- Delivery truck: check general condition by Guard. Any doubt be found then call Project Inspector for advise
- Pickup Truck: check general condition by Guard. Reversing alarm is required to access construction area. Unroofed pickup truck is not allowed personnel transportation (person can be only in the cabin) in the site.

(d) Security guards shall perform random checks at the gate on personnel and vehicles requesting entry to ensure contraband (drugs, alcohol, firearms, photographic equipment etc.) are not brought into project site.

B. BADGE (PERSONAL ACCESS CONTROL)

(1) All employees who work for the project shall have own personal badge after passed safety indoctrination training. This course shall be carried out by TTCL trainer. The personal badge shall allow access to project site permission zone.

(2) Personal badge shall be issued in English and shall contain minimum information as following:

Name – surname	Issue date	Sex / Age
Company	Expire date	Entry permission zone
Badge register no.	Blood group	Photo, etc.

(3) Project groups classification shall be identified by different colors badge such;

i. Owner / Consultant (with photo)
ii. Main contractor (with photo)
iii. Subcontractor (with photo)
iv. Temporary worker (without photo)
v. Visitor (without photo)

Remark: Identify badge colors shall be designed on kick off meeting.

(4) Personal badge shall be prominent displayed at all times while within the project area.

(5) For Visitors, they shall inform entry purpose to security guard.

(6) In case of personal contact, Guard needs to be confirmed by destination person prior entry permission.

(7) In case of 1st time visit, Visitor shall entry with destination personal escort.

After entry request is granted,

i. Visitor shall fill up his information in Visitor Log Book.
ii. Read and understand through the "Proper entry and instruction for Visitor"
iii. Change his personal ID card to "Visitor" badge
iv. Prominent post "Visitor" badge prior entry to project site.

C. MOBILIZATION AND DEMOBILIZATION OF EMPLOYEES

(1) Prior TTCL and Subcontractor employee mobilization to project site. Safety & Security system shall be ready prepared to implementation.

(2) Safety training (approx. 1:30 hrs.) & Personal badge making shall be conducted to all employees.

(3) TTCL Discipline and Subcontractor Management Representative shall three (3) days in advance submit employees name list which is approved by TTCL discipline to training center. After that, Safety trainer shall arrange training day and time for them.

(4) TTCL Discipline and Subcontractor Management Representative are responsible for enforcement they nominated employees to attend booked up course.

(5) Employee without personal badge shall not be allowed entry to project site.

(6) Employee whom is not yet done Safety training shall not be allowed to work on project site.

(7) Incase short term period working or temporary working in an office, Safety brief training course shall be conduct by TTCL Safety Officer. (15 minutes brief)

(8) Employee, who has completed of work, transferred to other project or terminated and demobilization from project site shall return his personal badge to TTCL HSEM.

(9) Subcontractors Management Representative is responsible to return individual employee personal badge and vehicle gate pass sticker (if any) to TTCL HSEM in case of individual employee is demobilization from project site.

D. ASSET CONTROL

(a) Procedures are required to control and document material entering and leaving the Project site. Typical activities include purchasing, shipping, receiving, storage, salvage, donations, employee sales, scrap and waste.

(b) Separation of authority shall be in place for the following functions: authorizing, approving, shipping and receiving. Exceptions shall be documented and approved.

(c) Compliance audits are required to assure policies are followed and controlled.

(d) All packages for delivery to personnel on site shall be inspected by the security guards at the access gates. The addressee shall be informed about the arrival of the package prior to inspection. After inspection, the package may be collected by the addressee or stored in the Security office, depending on the addressee's advice or the contents of the package.

(e) All vehicles leaving the work site with materials of any description (except for waste) shall be required to submit an authorized Material Gate Pass to the Gate House. The authorized list for Material Gate Pass signatories shall be provided to all concerned parties. For the procedure how to transport waste see the F050-MNL-026 Waste Management Plan.

(f) All incoming deliveries of supplies, materials and equipment for the project shall be accompanied by a material entry pass or a delivery note, if from a vendor. Security shall examine the material and/or equipment and compare with the delivery note or material entry pass and notify TTCL Project management which concerns of the delivery. Security shall retain a copy of the material entry pass or delivery note if necessary.

(g) The Material Gate Pass (see *Attachment 4*) shall:

i. State the date on which the materials are to be removed.
ii. State the full description of the materials, including quantities.
iii. Be signed by the authorized person concerned.

(h) Be endorsed by an approved authorized signatory. The LIST OF AUTHORIZED SIGNATURES shall be provided and retain at egress Gate House.

(i) The Gate Guards shall check that the quantity and nature of the materials detailed on the material gate pass matches those contained within the vehicle and where any discrepancies are found, the vehicle shall not be allowed to leave/enter the work site.

(j) Material gate passes shall be prepared by the Remover authorized personal. The original material gate pass form shall be submitted to the gatehouse and a copy shall be retained by the Remover authorized personal.

(k) The original of each material gate pass shall be give daily to the TTCL SCO by the Security Guard.

(l) Employees, vendor, visitor, etc., who bringing their own personal equipment (or non project owned) into the jobsite shall be inform and / or register with the Gate Guards.

E. SECURITY GUARDS

(a) Security guards shall be sufficient provided by TTCL for overall security matters execution and the implementation of the secure assets work process lay down area and appropriate supporting work processes for LNG POWER PLANT (AHLONE) PROJECT on 24 hours per day, 7 days/week.

(b) Ensuring that all employees process ID badges and report to the site with picture ID badge displayed visibly on their body.

(c) Ensuring employees equipped with Basic PPE, wear long sleeve shirt and full length trousers; can enter the construction site.

(d) Perform random searches on employees (lunch boxes and carry-on items) to prevent employee from bringing alcohol, firearms or illegal drugs onto the jobsite or to prevent theft of project materials as employees leave the site.

(e) Ensuring that all vehicles and equipment have a valid inspection and access pass to gain access to the project site.

(f) Ensuring that vendors make deliveries to the project with vehicles that are in safe operating condition in order to be allowed on the project.

(g) Fire alarm trigger and first attack fire fighting volunteer.

(h) Guard is responsibility in *Appendix B*, INSTRUCTIONS FOR SECURITY GUARDS.

F. TRAFFIC CONTROL POLICY

Traffic Regulations - The following traffic rules are in place on the Project site.

(a) Driver's license

Motor vehicle drivers and equipment operators shall be qualified and licensed in accordance with the regulations. Vehicle drivers shall be in possession of a valid Myanmar driver's license and equipment operators shall be in possession of a valid Myanmar equipment operator license specific to the type of equipment operated and a competency certificate issued by management.

(b) Warning flags and lights

Red flags shall be used during hours of daylight and red lights during the hours of darkness on any load that extends beyond the front, side or rear of any vehicle.

(c) Traffic signs

All traffic signs and signals, whether fixed or portable, shall be obeyed and drivers shall cooperate with representatives appointed to direct traffic.

(d) Speed limit

All vehicles shall be operated within the 20-kilometer per hour posted speed limits on the project. Within the Construction area speed limit is 10 km/hr (walking speed)

(e) Walks and Roadways

All personnel and / or subcontractors will use only designated walk path. The use of short cuts or undesignated pathways is prohibited.

(f) Driving and parking

- Motorcycles are not allowed to enter the site.
- All vehicles need to switch on headlights whilst driving in the project site.
- Parking will be permitted in designated area only and not be parked so as to block or interfere with the use of fire hydrants or emergency equipment.

- Reversed parking rule shall be respected for all Vehicles.
- Vehicles shall not be left unattended with the motor running.
- All vehicles parking in the project with his/her own risk.
- Overtaking is prohibited on the project site.

(g) Right-of-way

All motor vehicles shall give right-of-way to pedestrians, ambulances and fire fighting equipment and other emergency vehicles. All drivers of motor vehicles shall practice extra ordinary driving courtesy.

(h) Passengers

- Passengers shall be limited to the number according to the design of the vehicle and manufacturer specification and the vehicle shall not be overcrowded.
- Drivers of motor vehicles shall not permit passengers to ride on fenders, running boards, tops or bumpers of motor vehicles.
- Passengers shall keep all parts of their bodies inside the cab or body of vehicles and must be seated while vehicle is in motion.
- Tailgates must be kept closed. Passengers shall not get on or off a vehicle while it is in motion.

(i) Windshield or window obstruction

Vehicles having nontransparent window materials, which interfere with clear visibility through any side window or windshields with cracks in the windshield shall not be operated on the project. All vehicles shall be equipped with adequate rear-view mirrors.

(j) Back-up alarm

All construction vehicles and motorized equipment shall be equipped with a back-up alarm that is audible at a distance of 10 meters. And a flag man is required to assist in construction area and/or in narrow pass.

(k) Obstructing streets, roads and fire equipment or fire fighting facilities. Roads/streets shall not be blocked without permission from TTCL CM. When work obstructs a road or street, approved lights, barriers, warning devices, and/or signalmen shall be provided. Parked vehicles shall not block fire equipment, fire fighting facilities and fire hydrants.

(l) Regularly Vehicles Gate Pass

- In the interests of safety and security, the number of vehicles permitted entry onto the work site shall be minimized. Normal means to move to the worksite will be walking.
- In case vehicle movements are required, all subcontractors shall be required to submit transport plans which will be reviewed by TTCL CM to ensure that the maximum usage is made of pool car such as buses and van.
- TTCL / Subcontractor employee driving vehicles onto the project shall be required to submit an application (see *Attachment-9*) for a project vehicle pass to the TTCL SCO for 3 days in advance prior to requesting admittance to the site. TTCL SCO shall screening reasonable permission gate pass prior submit for approve by TTCL CM. these included subcontractors pick up or trucks to transport materials as well. Defensive Driving training requirements for people driving on site shall be arrange as necessary.
- Vehicle gate pass applications (see *Attachment-9*) shall be inspection required by TTCL HSE dept. prior submitted completed correctly with valid copies of driver license and/or equipment operator's competency certification and equipment, third party inspection certificate where required, license plate number and description of vehicle and current insurance documents.
- All vehicles and equipment entering the project site and lay-down facilities shall be in safe operating condition and will therefore be subjected to a safety inspection by TTCL project HSE department. The inspection shall at a minimum include the proper safe working of (1) brakes; (2) lights; two headlights; taillights, brake light; (3) horn; (4) muffler; (5) safety glass; (6) windshield wiper and rear view mirror.

- The vehicle passes shall be displayed on the inside of the windshield on the left side. Equipment passes shall be displayed on the outside to the right side of the equipment. Vehicles and equipment without a valid pass shall not be allowed access to the site or lay-down facilities.
- Vehicle passes and equipment passes shall not be issued if documentation is incomplete or if all requirements are not met.

(m) Temporary Vehicle Gate Pass

- Temporary gate passes can be obtained at the security main gates.
- Vehicle driver shall inform entering purpose to the Guard.
- After check and approved, Driver shall issue and swap driving license with temporary personal and vehicle gate passes.
- This vehicle gate passes shall be displayed clearly visible inside the windshield on the vehicle right side.
- The validation period is 1 day max.
- When Driver is return to the Main gate for exit, Temporary personal and gate passes shall be swap back with previous driving license.

(n) The guards will collect the badge and temporary vehicle gate pass for checking in case of an emergency occurred.

(o) Depending on the Security level, searches shall be performed by the Security Guards (use of mirrors and inspection of hood and rear trunk will be performed) on incoming and outgoing vehicles to check all waste, material and goods being transported are in line with the appropriate process and documentation. Metal detectors shall be used for that.

G. SECURITY SUPERVISION

TTCL shall security supervision by install lighting at the Project site construction and Lay down area in order to enhance surveillance and deter theft. Security guards shall make scheduled and unscheduled patrol security survey. The patrol timing, frequency and routing shall be report to TTCL HSEM.

H. PHOTOGRAPHY CONTROL

(a) Photographic equipment which to be use in the LNG Power Plant (Ahlone) Project (included process/lay down areas) shall get permission by TTCL CM. (except HSE team)

(b) Photography permission shall be prepared by photographer according with camera permit form (see *Attachment-5*).

(c) All cameras or camcorders shall be inspection by TTCL HSE Department and get approved sticker on camera or camcorder prior brings to use.

(d) Cellular phones which build-in camera are not allowed to take photography at site, if not following above (a) and (b) items. It is hard security control for ignite explosive atmosphere or easily interfere electronic control system.

(e) Approved photographic equipment shall be used only by authorized photographer.

(f) A list of the regularly authorized photographer shall be approved by TTCL CM.

(g) The Regularly authorized photographer shall be maintained and provided camera permitted card (see *Attachment-5*) by the TTCL SCO.

(h) For Temporary photographer such visitors, vendors, etc., shall be get approved by TTCL CM prior taking photographic equipment in to site construction. Photographic equipment shall be pass inspection according with item (b).

(i) Temporary photographer such visitors, vendors, etc., shall be passed safety precaution training or briefing by TTCL HSE Department prior photography commencement.

7. GENERAL GUIDELINE FOR SECURITY

7.1 GROUP MEETING

(a) Daily meeting shall be carrying out for each shift security. Updated information shall be communicated to coming fresh shift. Otherwise, guards number and health examine shall be observe.

(b) Weekly meeting shall be conduct between TTCL SCO and Security Subcontractor Representative. Meeting purpose is for security problem discussion, problem solving and review the shift security performance. In case of decision making required, TTCL HSEM shall be decision maker.

7.2 SECUIRTY REPORT

(a) Daily security report log book shall be conduct by individual guard. It is guard responsibility to first contact with visitor, personal-vehicles entry-exit registration and control, security check, inspection, observe, verification or investigation any abnormal event (which called security incident) and shall be immediate verbal report to Chief Security Guard (Subcontractor employee shift supervisor) and record those incident detail in his written daily report log book.

(b) In case of abnormal event which called security incident occurred, Incident Initial Report shall be apply according with Project Incident and Emergency Response Plan (F050-MNL-030)

(c) Chief Security Guard shall review and completed information with quality on written daily report log book and Incident Initial Report prior submits to TTCL SCO for next step execution.

7.3 SECURITY COMMUNICATION

(a) Hand-held radio transmitter (CB radio), including a charger, shall be provided by security subcontractor and located at each gate, check points and equipped for patrol guard to establish effective project security system and facilitate project radio communication network.

(b) Guards shall immediately report any incident found by radio to Chief Security Guard (Subcontractor employee shift supervisor). A Message shall be short (with radio code), meaningful and polite.

(c) Chief Security Guard shall review and completed information with quality on brief description and report to TTCL SCO by radio for problem solving or decision making. A Message shall be short (with radio code), meaningful and polite.

(d) There is no secret on radio transmission; therefore company or project confidential message shall not be transmitted via CB radio. Cellular phone shall be use if necessary.

(e) Security transceivers shall standby in specified channel only.

(f) For explosion prove zone and/or secure transmission; Trunk radio (Intrinsically safe type) shall be considered, not CB radio.

(g) During Emergency; Incident Controller may give instruction/command via radio. Security guards shall give full support accordingly.

(h) All Transceivers shall comply with standard Radio Amateur Ethics requirements.

(i) Before Push-to-Talk (PTT); Transmitter shall be waiting 5 seconds to ensure there is nobody sending message then start calling.

(j) Maximum 3 calls per a transmission, if no reply then wait for a few minutes to let other use.

(k) Everyone shall respect other more priority message especially emergency message shall be transmitted as first priority.

(l) Guards shall not talkative or chatty behavior without work concerns. A Message shall be short (with radio code), meaningful and polite. Violator guard shall be rejecting from project site.

APPENDIX A

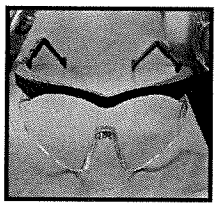
GENERAL BASIC RULES FOR VISITOR

TTCL PUBLIC COMPANY LIMITED
LNG POWER PLANT (AHLONE) PROJECT (F-050)

General Basic Rules for Visitors

All site visitors will be escorted by project personnel at all time when outside the OWNER/ TTCL Office Zone.

1. Visitor is prohibited to visit the site alone unless accompanied by the assigned project personnel and shall wear safety shoe/ Safety helmet/Safety glasses and long sleeve shirt with long trousers.


2. The vehicle speed in site is limited at 20 km/hr. Within the Construction area speed limit is 10 km/hr (walking speed).
3. During the visit, photographing is forbidden.
4. Smoking and toilet shall be limited to the specified place.
5. Keep away from working mobile equipment and vehicles.
6. Never cross over or enter a barricaded or red flag area.
7. Immediately report any type of accident, injury or hazard.
8. If any accident happen go to designated "Muster Point" obey instruction from TTCL management, supervisors and security personnel.
9. Ensure that you report to security before entering and leaving.
10. After the visit, please change back visitor ID card with entrance permit.

APPENDIX B

INSTRUCTION FOR SECURITY

INSTRUCTIONS FOR SECURITY GUARD

1. GENERAL INSTRUCTIONS

1.1 Company Image Conservation

Security guard is a front line for public impression and good company image. They are company representative employees who contributing public and essential display the spirit, friendliness, courtesy, cooperation and businesslike appearance. Nevertheless, they shall behave in a manner to command respect. Security guards shall be firm, calm and courteous in enforcing the project rules adopted by the management in this procedure or set force.

Security guard was expected to use his judgment in uncertain situations e.g. assisting another guard or injured person or dealing with a dangerous condition requiring their immediate attention.

1.2 Property Loss Prevention

Security guards shall be thoroughly familiar with the property that they are protecting, including name or number designation of lay down areas, buildings, doors and fire exits. They shall be aware of the locations of materials, offices, warehouses and other physical project site assets.

1.3 Fire Prevention and Protection

Security guards shall patrol they responsible area for finding potential fire situation. They shall familiar with portable fire extinguisher location and usage, fire hoses, hydrant, sprinkler and other parts of project own fire protection system included basic fire fighting method.

2. EMERGENCY RESPONSE

2.1 Emergency Procedure

(a) Security guards shall familiar with the project emergency procedure and Emergency Response Team (ERT). Security guards shall support ERT and automatic perform function according with emergency plan when emergency situation announcement.

(b) Security guards shall not leave their assigned duties except in an emergency situation. In such cases, they shall either notify their superior or other guards as soon as possible and send a prearranged signal to a constantly attended location.

2.2 Trigger on Fire Alarms

Security guards shall know the exact fire alarm push button to report fire incident or other emergencies. Where appropriate, they shall report exact fire locations, fire extension and direct responding parties / appropriated equipment for scene, etc.

2.3 First Attach Fire Fighting

Security guard shall given an alarm prior first attach fire fighting and shall take appropriate action as only one person present when fire is discovered. He shall fire fighting with proper fire extinguisher when his experience tells him that it can be effectively.

2.4 Incident Reporting

Security guard shall prepare an emergency call phone number of project management key personnel for day and night reporting purpose. In such case, Security guard shall report the serious incident or uncertain situations to TTCL HSEM first.

3. RESPONSIBILITIES

3.1 Main gate security guard (Subcontractor employee shift supervisors)

Security guard who is assigned at project main entrance gate shall;

(1) Essential display a spirit, friendliness, courtesy, cooperation and businesslike appearance with visitors, employees. Nevertheless, Security guards shall behave in the manner to command respect.

(2) Firm, calm and courteous in enforcing the project rules adopted by the management in this procedure or set force and courteously challenge suspicious persons.

(3) Make thorough personnel check for all coming to the site and keep a list of disable badges for screening their unauthorized use.

(4) Service and coordination for visitor personal or business contact.

(5) Security check vehicle entering to site for ensure contraband (drugs, alcohol, firearms, etc.) are not brought into project site.

(6) Security inspection for all vehicles which are leaving from site, including driver cab and trunk or pickup truck. If anything unauthorized is found, they shall be confiscated, immediately inform Chief Security Guard and record.

(7) Recognized company or project management personnel.

(8) Recognized project management personal who has authorized admit during an emergency situation.

(9) Follow emergency response plan about pre-arranged information in the functions of direct outsiders contact such press release, government officer or social public personal to prevent mistake or company image.

(10) Know how to direct traffic during emergency.

3.2 Patrol security guard

Security patrol guard is a nominated Security guard in a shift. Security guard shall;

(1) Prepare and checking his necessary accessories prior commence his round trip. It shall include available flashlight, vest-light reflector, communication tools (walkie-talkie and mobile phone), patrol check list, logbook etc.

(2) Perform security operations on each round are as:

(a) Visit and confirm each security check point is an available and effective.

(b) Office building windows and doors were closed checking during off-hour working periods.

(c) Observe adequate lighting to prevent material stolen and improvement report if any.

(d) Observe building escape doors obstruction and report or remove it if necessary.

(e) Observe building fire fighting equipment was obstruction or damaged and report.

3.3 Chief Security Guard (Subcontractor employee shift supervisor)

Security Guard who is assigned for Chief of security shift operation shall;

(1) Assure security operations shall comply with items 3.1 & 3.2.

(2) If any abnormal situation found, Chief Security Guard shall immediately inform HSEM and written security incident reports.

(3) Know how to direct outside fire department responding to a fire.

(4) Familiar with the general fire plans, especially which entrance is to be opened to admit fire truck and fire fighting team.

3.4 TTCL Security Officer (SCO)

TTCL HSE employee, who was assign for security matters. TTCL SCO shall;

- Assure security operation shall comply with items 3.1, 3.2 & 3.3.
- Provide direction and oversight to the site security subcontractor and to facilitate interface with local security for all activities associated with the Project.
- Manage, control and co-ordinate with project employees, visitor, owner and security guards for security provisional activities and being the universal guard / site security center for his entire site area.

4. ROUTINE DUTY

4.1 Reporting

Security guards shall report for duty at times specified by their superior. When a guard is unable to report for duty due to illness, injury or other causes, Guard shall notify his superior as soon as possible. Unnecessary delay in such notification is justification for disciplinary action.

4.2 Shift transmission

Guards shall remain on duty until shift relief. Guards shall transmit any special orders or pertinent information to their relief.

Guards shall not accept relief by another guard who is not in a condition to work for any reasons. Guard shall assume responsibility for reasonable diligence in judging that relief guard is fit for duty.

4.3 Notice board

Any fresh orders or updated instructions shall be posted on a notice board at Guard Houses. Guards shall frequently check a notice board for any fresh orders or updated instructions. Written orders or instructions are to be removed, replaced, erased or torn by Security chief. Disciplinary action shall take against Guards who disregard this rule. If any Guards fail to carry out orders or instructions posted on the notice board, Guard shall be penalized. After three times warnings, that Guard shall be dismissed.

5. GOOD PRACTICES AND IMAGE APPEARANCE

5.1 Good Practices

(1) Information giving

In information giving matter, Guards shall certain accurate. Guards shall not discuss details of their assignments except with authorized persons.

(2) Conversations

Conversation with fellow guards or other persons shall be only in the line of duty except during rest periods.

(3) Alertness

Guards shall be fit for duty and alert at all times. Sleeping during taking duty is prohibited.

(4) Smoking and Eating

Guards shall smoke, eat and drink in designated areas only. In some very dangerous for fire and explosion hazard locations, even carrying matches or cigarettes lighters shall be restricted for accident prevention.

5.2 Image Appearance

(1) Security guards good looking

(a) Guards shall wear uniform clothing specified for their particular assignment. Uniform shall be clean and in good condition. Such requirements which apply to wearing coats buttoned, ties not loosened, shoe polished and other features to make the guard's appearance professional.

(b) Guards shall wear basic PPE such Safety helmet, Safety glass and Safety shoes at all times while on site, carry a whistle on a lanyard while on duty and carry a flash light on night shift.

(c) Guards shall have the following at all times;

i. Safety helmet

ii. Safety Shoes

iii. Eye Protection

iv. Whistle

v. Flash light

(d) Guards shall not throw any paper or cigarette butts in any place except in the paper bin or ash tray.

(e) Guard House shall be maintaining tidy and good housekeeping at all time.

ATTACHMENT 1

VISITORS LOG

TTCL PUBLIC COMPANY LIMITED

LNG POWER PLANT (AHLONE) PROJECT (F-050)

VISITORS LOG

PRINT LEGIBLY	PLEASE USE MILITARY TIME
PROJECT NUMBER : F-050	PROJECT NAME : LNG POWER PLANT (AHLONE) PROJECT

I have read and agree to abide by the Project SAFETY & SECURITY RULES and any others which may be communicated to me while visiting or working at the project site.

NAME	COMPANY	DISTINATION OR PERSON TO SEE	TIME IN	TIME OUT	PPE ISSUED?	VEHICLE/VISITOR PASS NUMBER

ATTACHMENT 2

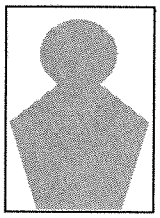
ACCESS BADGES

LNG POWER PLANT (AHLONE) PROJECT (F-050)

ACCESS BADGE (1/3)

TTCL PUBLIC CO., LTD.

LNG POWER PLANT (AHLONE) PROJECT (F-050) → BLUE



NAME:

CHOKEDEE MEECHAI

BADGE No. TTCL-XXX

POSITION: SAFETY OFFICER

COMPANY: TTCL PUBLIC CO., LTD.

DATE OF ISSUE	DATE OF EXPIRE
XX-XXX-XX	XX-XXX-XX

Approved by _____

SUGGESTION

1. Display badge at all time while being in Project site.
2. Follow HSE regulations of Project site.
3. Return this badge to TTCL Admin when employee finished.

For "TTCL Public Company Limited."

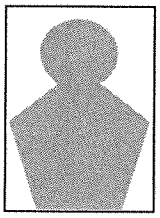
LNG POWER PLANT (AHLONE) PROJECT (F-050)

ACCESS BADGE (2/3)

TTCL PUBLIC CO., LTD.

LNG POWER PLANT (AHLONE) PROJECT (F-050)

→ GREEN



NAME:

CHOKEDEE MEECHAI

BADGE No. TTCL-XXX

POSITION:

COMPANY: (Owner Company)

DATE OF ISSUE	DATE OF EXPIRE
XX-XXX-XX	XX-XXX-XX

Approved by _____

SUGGESTION

1. Display badge at all time while being in Project site.
2. Follow HSE regulations of Project site.
3. Return this badge to TTCL Admin when employee finished.

For "Owner"

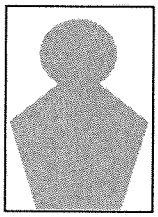
LNG POWER PLANT (AHLONE) PROJECT (F-050)

ACCESS BADGE (3/3)

TTCL PUBLIC CO., LTD.

LNG POWER PLANT (AHLONE) PROJECT (F-050)

→ **RED**



NAME:

CHOKEDEE MEECHAI

BADGE No. **TTCL-XXX**

POSITION:

COMPANY: **(Subcontractor Company)**

DATE OF ISSUE	DATE OF EXPIRE
XX-XXX-XX	**XX-XXX-XX**

Approved by _____

SUGGESTION

1. Display badge at all time while being in Project site.
2. Follow HSE regulations of Project site.
3. Return this badge to TTCL Admin when employee finished.

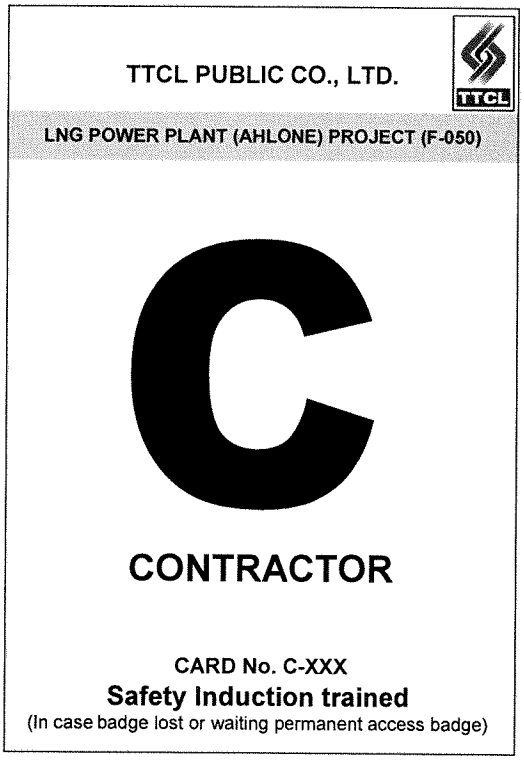
For "Subcontractor"

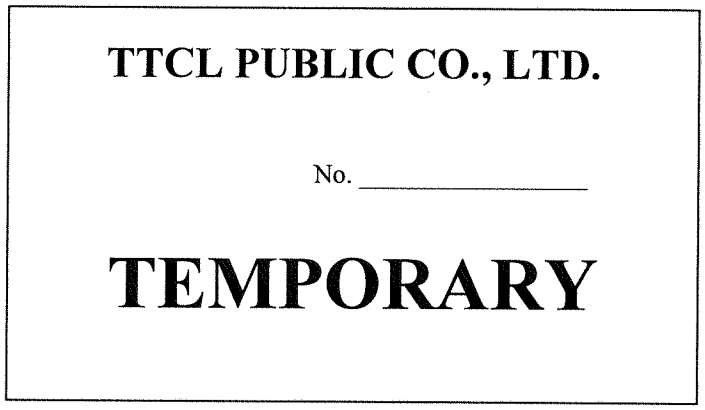
ATTACHMENT 3

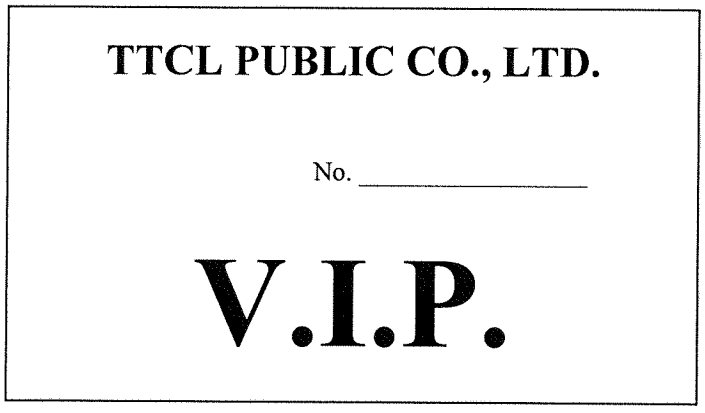
VISITOR BADGES

LNG POWER PLANT (AHLONE) PROJECT (F-050)

Visitor/ Temporary Worker and Government Authority badge







ATTACHMENT 4

MATERIAL EQUIPMENT GATE PASS

TTCL PUBLIC COMPANY LIMITED
LNG POWER PLANT (AHLONE) PROJECT (F-050)

DATE:_____/_____/_____.

MATERIAL / EQUIPMENT REMOVAL GATE PASS

MATERIAL / EQUIPMENT	QUANTITY	REASON FOR REMOVAL FROM SITE

METHOD OF REMOVAL FROM SITE : TRUCK TRAILER OTHER_____(SPECIFY)

DRIVER NAME :	**DRIVER I.D. CARD NO. :**
NAME OF COMPANY :	**VEHICLE REG. NO. :**

REQUESTER : **TTCL / SUBCONTRACTOR**	**APPROVED :** **(TTCL'S DEPARTMENT IN CHARGE)**	**APPROVED :** **(TTCL'S SITE REPRESENTATIVE)**
DISTRIBUTION: **ORIGINAL - SECURITY OFFICER** **PINK - DEPARTMENT IN CHARGE BLUE - REQUESTER / DRIVER**		**CHECK & SIGN.:** **(TTCL'S SECURITY OFFICER)**

ATTACHMENT 5

CAMERA PERMIT

TTCL PUBLIC COMPANY LIMITED

LNG POWER PLANT (AHLONE) PROJECT (F-050)

CAMERA PERMIT

SERIAL No:	**DATE:**
PROJECT NAME:	
USERNAME:	**BADGE NUMBER:**
☐ **TTCL EMPLOYEE** ☐ **SUBCONTRACTOR** ☐ **VENDOR RESPESENTATIVE** ☐ **VISITOR**	
THIS PASS VALID FROM:	**TO:**
PLANNED USAGE:	
RESTRICTIONS:	
REQUESTED BY:	**DATE:**
APPROVED BY:	**DATE:**

TTCL PUBLIC COMPANY LIMITED
LNG POWER PLANT (AHLONE) PROJECT (F-050)

CAMERA PERMIT

Serial No. _____

Badge No. _____

Username. _____

Expiry Date _____

ATTACHMENT 6

VEHICLE GATE PASS

LNG POWER PLANT (AHLONE) PROJECT (F-050)

VEHICLE GATE PASS

TTCL PUBLIC COPANY LIMITED

LNG POWER PLANT (AHLONE) PROJECT

Job No. : F-050_____

TEMPORARY VEHICLE PASS

TTCL PUBLIC COMPANY LIMITED

LNG POWER PLANT (AHLONE) PROJECT

VEHICLE GATE PASS

ISSUED TO : _____

COMPANY : _____

VEHICLE REG. : _____

VEHICLE TYPE: _____

VALIDITY : _____ TO _____

APPROVED BY: _____

ATTACHMENT 7

SAFETY INDUCTION REQUEST

TTCL PUBLIC COMPANY LIMITED
LNG POWER PLANT (AHLONE) PROJECT (F-050)

SAFETY TRAINING / ID CARD REQUEST

DATE: / /

APPLICANT'S NAME (BLOCK CAPITALS)	: _____
POSITION	: _____
APPLICANT'S SEX	MALE FEMALE BLOOD TYPE : _____
DATE OF BIRTH	: _____ / _____ / _____ / RELIGION : _____ DAY MONTH YEAR
NATIONALITY	: _____
HOME ADDRESS	: _____ _____
PRESENT ADDRESS	: _____ _____
EMERGENCY CONTACT	: _____ _____
I.D. or PASSPORT NO.	: _____
COMPANY'S NAME	: _____
TELEPHONE No.	: _____
HEALTH CHECK UP STATUS	: _____
CONGETAL DISEASE	☐ High Blood Pressure ☐ Diabetes ☐ Heart disease ☐ Other _____
SIGN (COMPANY'S REPRESENTATIVE)	SIGN (APPLICANT)

NOTE: TWO (2) PHOTOGRAPHS (2cm X 3cm) AND ONE COPY OF I.D. CARD TO BE ATTACHED.
IF APPLICANT IS FOREIGN NATIONAL, ONE COPY OF WORK PERMIT TO BE ATTACHED.

FOR TTCL CERTIFICATION OF SAFETY INDUCTION
DATE OF SAFETY INDUCTION :

_____/_____/_____

CERTIFIED BY

TTCL USE ONLY.

I.D.CARD No.: _____

CHECKED	APPROVED

ATTACHMENT 8

VISITOR GATE PASS FORM

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

DATE :_____/_____/_____

VISITOR GATE PASS

VISITOR'S NAME :		COMPANY :
PERSON / COMPANY TO BE VISITED :		
PURPOSE OF VISIT :		
VISITOR I.D. NO. /		TEMPORARY VEHICLE PASS NO.
TIME (IN) : _____:_____AM/PM	TIME (OUT) : _____:_____AM/PM	ISSUED BY :
SIGN (VISITOR)		SIGN (PERSON VISITED)

❋ TO BE SIGNED UPON COMPLETION OF THE VISIT, AND SUBMITTED BY THE VISITOR TO THE GATE HOUSE UPON LEAVING.

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

DATE:_____/_____/_____

REGULAR VEHICLE GATE PASS REQUEST

COMPANY NAME		VEHICLE TYPE
Requested Category of Gate Pass : A : Office Area only (Private Vehicle of Office Staff) ☐ ☐ B : A + Const. Area (Const. Vehicle and Vehicle for access to Site)		
MODEL COLOR		VEHICLE REG. NO.
ENGINE TYPE DIESEL / PETROL		REQUESTED BY

For TTCL use only.

PASS NO.:_____

Checked	Approved

THE FOLLOWING DOCUMENT TO BE ATTACHED:

1. DRIVING LICENSE'S PHOTO COPIED
2. ROAD TAX REGISTRATION'S PHOTO COPIED
3. INSURANCE'S PHOTO COPIED

NOTE : THE REGULAR VEHICLES GATE PASS SHALL BE DISPLAYED INSIDE THE WIND SHIELD AT ALL TIMES

APPENDIX J SITE SECURITY PROCEDURE

AHLONE 2

PERSONALE PROTECTIVE EQUIPMENT PROCEDURE

PROJECT DOC. NO. F050-MNL-050

FOR INFORMATION

LNG POWER PLANT (AHLONE) PROJECT

TTCL JOB NO. F-050

Total (Including this Page): 15 sheets

0	04-Oct-18	For Information				
REV.	DATE	DESCRIPTION	MADE	CHECKED	APPROVED	AUTH'D

For Project Use only

Originator	Distribution	PW	PR	MA	ME	PP	EE	IN	CV	QC	PC	Proj	Site	Owner	Total
Project	No. of Copy	-	-	-	-	-	-	-	-	๑	-	ORG.	1	1	4

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

Revision History Sheet

Rev.	Date	Description
0	October 04, 2018	For Information

CONTENT

1. PURPOSE

The purpose of this procedure is to establish specification, decision criteria and guidance complied with Notice by Department of Labour Protection and Welfare B.E. 2554 for selection and use of Personal Protective Equipments (PPE) in an effective and safety manner under their limitations. The PPE do not eliminate the working hazards or substitutes for effective engineering, other hazard control measures and safe working conditions, but they are essential for protecting of the individual worker from injury and occupational health illness.

2. SCOPE

This Personal Protective Equipment (PPE) procedure is applied to all personnel entering to the **LNG POWER PLANT (AHLONE) PROJECT** construction site and facilities e.g. warehouse, workshop, or where PPE zone is classified. This procedure shall be used in conjunction with the TTCL HSE, regulations and other HSE procedures that require wearing PPE when performing particular job.

The requirements of this procedure adhere to Local Regulation as the minimum requirement.

3. DEFINITION

Personal Protective Equipment (PPE) Any clothing or equipment that used to shield or isolate individuals from chemical, physical and biological hazards that may be encountered in the work place. This includes, but is not limited to, the following types of equipment:

(a) Hard Hat Safety Helmet

(b) Safety glasses, goggles and shields

(c) Prescription Safety Glasses for personnel who need corrected lenses

(d) Safety Shoe

(e) Safety Gloves

(f) Hearing protection device

(g) Fall arrest harness

(h) Respiratory protection device

(i) Chemical resistance clothing and aprons

PPE Zone — Any area where the wearing PPE are specified and the mandatory PPE wearing signs existed, except the specific area or walkway in the work shop or warehouse and normal office work which does not require PPE.

Chemical Hazard — This arises from excessive airborne concentration of mist, vapors gases, or solids that are in the form of dusts or fumes. In addition to the hazard of inhalation, many of these materials may act as skin irritants or toxic by absorption through the skin or swallow.

Physical Hazard — This kind of hazard includes noise, thermal stress, vibration, darkness, light, radiation and electrical that can adversely affect employee health safety and productivity.

Biological Hazard — This includes insects, molds, fungi, bacterial and virus contamination, Bird-Flu, mosquitoes, rodents, ant, cockroach, fly and infectious microorganisms.

4. RESPONSIBILITY

Proper selection, use and maintenance of PPE are essential for employee safety. All TTCL employees and subcontractors shall be aware of their individual responsibilities.

4.1 TTCL PROJECT MANAGER (PM)

(a) Responsible for assuring implementation of Site Safety Rules and Regulations concerning with PPE is properly implement by TTCL, Subcontractors and other concerned parties in the project.

(b) To ensure that TTCL staffs and subcontractors are provided and equipped with a proper PPE use at all times while performing jobs in Project construction area.

(c) To ensure that visitors have their proper PPE and comply with this procedure.

(d) Lead by an example, modeling the behavior expected from all personnel performing work at the jobsite.

4.2 TTCL CONSTRUCTION MANAGER (CM)

(a) CM is responsible for construction execution of Site Safety Rules and Regulations that make safe operation by TTCL employees, Subcontractors employees including visitors and concerned persons.

(b) To ensure that TTCL staffs and subcontractors are provided and equipped with a proper PPE use at all times while performing jobs in Project construction area.

(c) To ensure that the PPE in Project construction area is maintained in sanitary and reliable condition.

(d) Lead by an example, modeling the behavior expected from all personnel performing work at the jobsite.

4.3 TTCL HSE MANAGER (HSEM)

HSEM is responsible to develop an effective this procedure as following;

(a) To ensure that TTCL staffs and subcontractors are provided and equipped with a proper PPE use at all times while performing jobs in Project construction area.

(b) Provide the PPE training program for TTCL staffs and/or Subcontractors follow with project requirements.

(c) To ensure that the PPE in Project construction area is maintained in sanitary and reliable condition.

(d) To establish and implement the use of PPE to employees under supervision before doing work-training program to know when PPE are necessary; what types are necessary; how they are to be worn; and what their limitations are.

(e) Determine hazardous zones that required the use of PPE to be presented or likely.

(f) Ensure that this procedure is administered properly and develops this procedure where necessary.

(g) Develop and revise standards, work instructions that related to PPE program.

(h) Define and maintain an update TTCL PPE General requirement and specification.

(i) Recommend an appropriate PPE used base on government mandatory notice by Department of Labour Protection and Welfare B.E.2554 concerning with PPE standard.

(j) Lead by an example, modeling the behavior expected from all personnel performing work at the jobsite.

4.4 TTCL PROJECT SITE ADMIN

TTCL Project Site Admin is responsible to provide and maintain sufficient inventory PPE and safety sign complying with specifications and standards.

4.5 SUBCONTRACTOR MANAGEMENT REPRESENTATIVE

Subcontractor Management Representatives is responsible to;

(a) Provide their own PPE and that PPE meet the local regulations and accepted standards specifications.

(b) Ensure that Subcontractor employees absolutely follow Site Safety Rules and Regulations.

(c) Ensure that all supports as need with PPE requirements are appropriate response and collaborations.

(d) Ensure that subcontractor employees are provided and equipped with a proper PPE use at all times while performing jobs in project construction area.

(e) Monitoring their employee safety performance concerning with PPE and take appropriate corrective / preventive action as need.

(f) Ensure that subcontractor employees are provided with and receive training in the selection and use of PPE.

(g) Ensure that PPE for employees is maintained in sanitary and reliable condition.

(h) Lead by an example, modeling the behavior expected from all personnel performing work at the jobsite.

4.6 EMPLOYEES / WORKERS

(a) All employees/ workers at all levels are involved in Site Safety Rules and Regulations procedure. The objectives are preventing accidents, avoiding hazards to health and environmental impact protection.

(b) Know, understand and carry out duty in accordance with Site Safety Rules and Regulations, work instructions and permit to work system that related to PPE.

(c) To make a full and proper use of all PPE provided by company.

(d) To ensure that PPE are maintained properly.

(e) To inspect PPE prior to use and routinely afterwards. Notify supervisor and find the replacement when any equipment is found to be unsatisfactory condition and need to be removed from Project construction area.

4.7 VISITOR

(a) Visitor is responsible to comply with PPE Policy and Instructions with this procedure.

(b) Project Site Admin shall temporally provide their PPE for Visitor and Visitor shall return their PPE to Project Site Admin after used.

(c) Project Site Admin is responsible to be sanitary cleanness their PPE for next usage purpose.

5. INSTRUCTION

The employer is responsible for requiring the wearing of appropriate Personal Protective Equipment in all operations where there is an exposure to hazardous conditions or where this procedure is indicates the need for using such equipment to reduce the hazards to the employee.

Types of PPE cover Head, Hearing, Eyes, Face, Respiratory, Hand/Arm, Body and Foot / Leg Protection. Uses of PPE depend on the potential hazards to be encountered.

5.1 BASIC PPE

Basic PPE is a minimum requirement which complies with Project Safety Rules in the Project Construction, warehouse and workshop areas are follows;

(a) Safety hat safety Helmet

(b) Safety glasses.

(c) Safety Shoes

(d) Long sleeve shirt and pants.

5.2 SPECIFIC PPE

Specific PPE is an additional requirement on basic PPE usage. Specific PPE is depending on tape of work or specific hazard in construction area or rise by JSA or Risk Assessments identification or other activities to meet the desirable degree of protection. The particular jobs which are required specific or additional PPE refer to the risk assessments such as but not limit to;

- Hearing loss Protection (ear plugs or ear muffs)
- Respiratory protection (dust, mist, fume, gases)
- Work at Height protection (Please see the SP-650-017 " Fall Protection Procedure")

- Working in Confined Space. (Please see SP-650-001 "Confined Space Entry Procedure")
- Hot work (Safety shoes, welder's Goggles, welding helmets or welding goggles ,Rubber Gloves or cotton Gloves, Fireproof Blue collar)
- Etc.

In addition, PPE shall be used according to PPE zone where wearing specific PPE are specified.

5.3 PPE SELECTION

All PPE specification (basic and specific) that to be used in TTCL premises shall be complied with Notice of Department of Labour and Welfare B.E.2554 as defined in Attachment 1 – TTCL PPE Standard Reference. The desirable degree of protection is considered as specified in Job Safety Analysis, Risk Assessment and encounter hazards appearance. If there is any constrain selection of the PPE occurred, foreseeable emergency situations have also to be evaluated. PPE have to be correctly fit and adjust for effective and maximum comfort. PPE fit test shall be conducted in regularly period. There is a lot of type and number available, thus providing individual choice and thereby encouraging use purpose.

5.4 PROCUREMENT & STORAGE

(a) All PPE that to be purchasing shall be defined specification in accordance with Attachment 1 - TTCL PPE Standard Reference and Attachment 2 - TTCL PPE General Requirements and Specifications.

(b) Basic PPE (included full body safety harness) have to be kept by Project Site Admin department with a minimum stock to be ready for service request.

(c) Special PPE (included SCBA but excluded full body safety harness) that need where there is an exposure to hazardous condition or for particular jobs such as working in confine space, loud noise working environment, respiratory hazardous atmosphere, etc. have to be kept and usage controlled by Project HSE department.

5.5 CARE AND MAINTENANCE

(a) The expected degree of protection shall not be achieved in practice unless PPE was cleaned and well maintained.

(b) Each employee is responsible for the proper cleaning and sanitizing of own protective clothing and personal protective equipment.

(c) All PPE which worn on face, eyes, respiratory system or in contact with the skin have to be thoroughly cleaned and sanitized after being used .

(d) The common borrowing PPE for visitor, Project Site Admin shall temporally provide their PPE for them and return their PPE after used. Site Admin shall maintain in sanitary and reliable condition their PPE prior another use. Typical items include:

- Safety hat,
- Ear Plugs / Ear Muffs,
- Spectacles or goggles,
- Safety shoes,
- Lather gloves,
- Rubber Boots,
- Half mask for respiratory protection,
- Protective clothing.

(e) Safety helmet shall never be painted, as the paint or solvent shall damage the helmet.

(f) Safety helmet shall never be drilled a hole, as a hole on the hat shall possible decrease protective strength resistant of helmet.

(g) Direct exposed sunlight or excessive heat for storage or placement the Safety helmet shall be avoided because it shall be distorted and damaged to helmet shell. It may split and crack or decrease hardness which is lead to loss of impact resistant characteristic.

(h) Lather gloves, rubber gloves, cotton gloves shall be keep at ambient temperature away from the light, moisture, solvents and chemicals.

(i) Chemical Protective Clothing or Suit shall be keep at ambient temperature, good ventilation and away from direct sunlight, excessive heat or moisture. Any contamination on the suit shall be washed or wiped off immediately where practicable or on completion of the jobs or on the end of working day. Water and mild detergent is usually adequate usage but contaminated solution shall properly containment and disposal.

(j) Safety harness, lanyard and all restraining lines shall be cleaned and regularly examined comply with manufacturer advice.

(k) Respirators shall be always thoroughly cleaned after use. It shall be stored in a clean, dry condition and close receptacle away from direct sunlight. A clean plastic bag is suitable for this purpose. Repairing of PPE shall be followed by manufacturer guideline. Employees shall immediately discontinue using of any malfunction or defected PPE.

5.6 INSPECTION and REPLACEMENT

Each employee is responsible for routing inspection of PPE prior use and after used. Inspection guidelines are as following but not limit to.

(a) All PPE components and accessories, if any, shall be visually inspected daily for sign of dents, cracks, penetration and damage/defect due to impact, rough provided.

(b) The manufacturer instructions are recommended to use as a guideline for inspection and replacement. Replacement of PPE should take place when the PPE are found expired or damaged / defected and not fit for use.

(c) The manufacturer instructions are recommended to use as a guideline to define PPE expiration.

(d) For safety helmet, practical experience suggests that the replacements for polyethylene and polycarbonate helmet are 2-3 years and 5-6 years respectively. Additionally, safety helmet should be smooth and shiny to reflect solar heat. However, if the safety helmet has been subjected to a heavy impact as well as its visible damage occurred, the helmet should be replaced.

(e) For Respiratory Protection, according to the recommendation from manufacturer is the replacement period of respiratory protection PPE should be considered as follows;

1) Face piece (Rubber made)

- Physical damaged of face piece accepts for head straps due to it can replace with spare part
- Does not fit to face. (fit test result)
- Inhalation valve is not work or damaged

2) Face Piece (silicone made), normally 1 or 1.5 years if on shelf but the following finding observed shall be replaced;

- Physical damaged of face piece (Accepts head straps. It can be replaced with spare part
- Does not fit to face. (fit test result)
- inhalation valve is not work or damaged

3) Air Purify element or filter, the following finding observed shall be replaced;

- Physical damage filter cartridge.
- 6 months expired after packing was open.
- Saturated filter with get smell inside respirator. (breakthrough filter)

5.7 DISPOSAL

Contaminated, expired, damaged, defected and unfit for use of PPE shall be suitably disposed as define in (SP-650-021 _Waste Management Plan) by Authorized Waste Disposal Service Company. Therefore, each employee shall individual dispose own non used PPE as above. It shall not be disposed in general garbage bin.

6. APPENDIX

APPENDIX A PPE SPECIFICATION AND STANDARD REFERENCE

APPENDIX A

TTCL PUBLIC COMPANY LIMITED
LNG POWER PLANT (AHLONE) PROJECT

PPE SPECIFICATION AND STANDARD REFERENCE

No	Personal Protective Equipment	Standard
1.	**Head Protection**	
	- Helmet	TIS 368-1995 /ANSI/ISEA Z89.1-2009, EN 397:1995
	- Face shield	ANSI/ISEA Z87.1-2003, EN 166
2.	**Hand Protection**	
	- Gloves	EN 420
3.	**Eye Protection**	
	- Safety Glasses	ANSI Z87.1-2003, EN 166 FT CE
	- Goggle	
4.	**Hearing Protection**	
	- Ear plug	ANSI S12.6-1984
	- Ear muff	
5.	**Fall Protection**	ANSI A10.32
	- Safety Belt	
	- Safety Harness	ANSI A10.32/CE 120 EN 361
	- Land yard	ANSI A10.32/CE 120 EN 354
6.	**Respiratory Protection**	
	- Disposable Respirator	ANSI Z88.6 Respirator Use
	- Air purify Respirator	ANSI Z88.7-2001
	- SCBA & Supplied Air Respirator	ANSI Z88.2-1992
7.	**Chemical Protective Clothing**	ASTM F2061/EN943.1-1997
8.	**Safety Shoe**	
	- Safety Shoe	TIS 523-1985 / ANSI Z41-1991, EN345

Remark: These PPE standards shall be comply with Notice by Department of Labour Protection and Welfare B.E. 2554 for the specific PPE standards requirements.

APPENDIX K PERSONALE PROTECTIVE EQUIPMENT PROCEDURE

SECTION 14 FIRE PREVENTION PLAN

1. General

The aim of the fire protection and fire safety philosophy is to minimize loss of life or serious injury, contain and prevent the spread of a fire, extinguish it in the early stages if possible and thus to minimize the damage and financial loss caused by such an incident. This philosophy is to enhance the reduction of risk to As Low As Reasonably Practical (ALARP).

2. Applicable code and standard

- The Fire protection system should be designed in accordance with the national fire protection association (NFPA) code and standard where practical.
- All Fire Fighting Equipment and devices should prefer to be UL/FM listed, unless approval from TTCL Project / Plant operation team, due to it may concern to insurance policy.

Fire Fighting System & Fire Protection Design Basis

- NFPA 10 : Standard for Portable Fire Extinguishers
- NFPA 11 : Standard for Low-, Medium-, and High-Expansion Foam
- NFPA 15 : Standard for Water Spray Fixed Systems for Fire Protection
- NFPA 20 : Standard for the Installation of Stationary Pumps for Fire Protection
- NFPA 24 : Standard for the Installation of Private Fire Service Mains and Their Appurtenances
- NFPA 59A : Standard for the Production, Storage and Handling of Liquefied Natural Gas (LNG)

3. Fire Fighting Components

Fire water Hydrant, Water Monitor

Fire water hydrant and Fire water hydrant with monitor (with or without foam) or equivalent system are strategically provided to cover Process area, Central Control Building, Common Facilities area and Jetty area which contain combustible material. The spacing between hydrants coverage will not more than 90m for process area and utilities area.

Fire Water Main Ring Pipe

The fire water main ring pipe will be of closed loop designed and will be laid along the main road. The fire water main ring pipe will be laid underground looped for onshore area and aboveground pipe for jetty area. Pipe used in the fire water main ring pipe will be made of carbon steel for aboveground and will be made of HDPE pipe where install underground. Fire water main ring pipe will have sufficient post indicator valves so that it will be possible to take any leg of the reticulation out of service for maintenance or repair.

Fire Fighting Water Supply

The fire fighting system design will be based on the assumption that there will be only one major fire occur at a time.The estimated minimum capacity of fire water pump is based on highest fire water demand for one major fire area plus 230 m3/h (1,000 GPM) for hose stream demand according to NFPA 59A. The estimated minimum capacity of fire water required is totally 6,900 m3 (TBC) for biggest fire case at LNG storage area. The pressure of the fire water in the mains will be maintained at 10 BarG.

Water for fire fighting purposes is obtained from Fire Water Pond (TBC), capacity not less than 6,900 (TBC) m3 for firefighting demand 2 hours and fire pumps shall be as follows below;

5 Ea (TBC) Diesel Engine Fire pumps (duty) (690 m3/hr, discharge @10barg, TBC)

1 Ea Diesel Engine Fire pumps (standby) (690 m3/hr, discharge @10barg, TBC)

1 Ea Electrical Jockey pump (11.5 m3/hr, maintain 10 barg,TBC)

4. Scope of Design

The fire fighting facilities shall be designed generally covering the items below however the detail design will be verified during detail engineering period;

- Fire Water Main and their apparatus
- Fire Water Hydrant (Outdoor hydrant)
- Fire Water Hydrant with Monitor (with or without foam)
- Hose Cabinet and Accessory
- Fixed Water Spray System (Deluge System)
- Fixed Foam System
- Fire Extinguisher (Portable, Wheel Type)

5. Preliminary Summary Table of active Fire Protection System for Building and Equipment (Subject to be revised during design stage)

Fire Hazardous source	Fire Water Hydrant	Fire Water Hydrant with Monitor	Fixed Water Spray System	Fixed Foam System	Fire Alarm Detector	Fire Extinguisher	Remark
Jetty							
1. Jetty Platform		●		●		●	
2. Walkway & Mooring Dolphin							
3. Loading Arm(s)			●			●	
4. River Intake Pump						●	
4. Other (if any)							
Process Area							
1. LNG Storage Tank(s), transfer pump(s), LNG spill pit*		●	●**	●*		●	** Water spray system applies for roof and shell of LNG storage tanks. *Fixed foam system applies only on LNG spill pit for any LNG spillage
2. BOG Compressor(s)	●					●	
3.Regasification Unit(s)	●		●			●	
4.HP LNG Booster pump suction drum	●		●			●	
5.NG pre-heater	●					●	
6.Vent Stack	●					●	
7.Gas Engine Generator	●					●	
8. Air Compressor and Nitrogen System	●					●	

Fire Hazardous source	Fire Water Hydrant	Fire Water Hydrant with Monitor	Fixed Water Spray System	Fixed Foam System	Fire Alarm Detector	Fire Extinguisher	Remark
9.Fire Water Pumps	●					●	
Central Control Building							
- Electrical Room					●	●	
- Control Room					●	●	
- Transformer			●			●	
Common Facility Area							
1.Administration , First Aid and Canteen Building	●				●	●	
2. Main Gate Guardhouse	●				●	●	
2.Jetty Guardhouse	●				●	●	

Note :

1. Detail information can be changed during Engineering Stage.

2. Fire alarm detector shall be confirming in detail Design Stage.

APPENDIX L FIRE PREVENTION PLAN FOR THE LNG RECEIVING TERMINAL

Physical Baseline Studies Report (Dry Season)

For

The Extension of Power Generation Activities (TTCL)

In Ahlone and Dala Townships

TABLE OF CONTACTS

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PHYSICAL ENVIRONMENT BASELINE
For Dry Season

1.1 Outline

The actual physical baseline survey for environmental impact assessment was surveyed at/near gas turbine power plant, Ahlone and Dala Township, Yangon Region. Ten air quality and noise monitoring locations, three locations of groundwater, fourteen locations of surface water quality, nine locations of soil quality and six locations of sediment survey were measured and collected. The summary of physical environmental survey is shown in Table 1.1-1, and sampling points for environmental survey are shown in Figure 1.1-1.

Table 1.1-1 Summary of Physical Environmental Survey for Dry Season

Air Quality & Meteorology	Parameter	1) Nitrogen Dioxide, 2) Nitric Oxide, 3) Sulphur Dioxide, 4) Particulate Matter PM10, 5) Particulate Matter PM 2.5, 6) Carbon Monoxide, 7) Relative Humidity, 8) Temperature, 9) Wind Speed, and 10) Wind Direction
	Period	10 points for one time within three continuous days
	Location	Residential and rural areas
Noise Level	Parameter	LAeq (A-weighted loudness equivalent)
	Period	One time at 10 locations within two continuous days
	Location	Residential and rural areas
Surface Water Quality	Parameter	1)Water Depth, 2) Flow rate, 3) Water temperature, 4) pH, 5) Salinity, 6) Electrical Conductivity, 7) Dissolved Oxygen, 8) Total Dissolved Solid, 9) Turbidity, and 10) Color
	Period	One time at 14 locations
	Location	River and Stream
Ground Water Quality	Parameter	1)Tube well Depth, 2) Water temperature, 3) pH, 4) Salinity,5) Electrical Conductivity, 6) Dissolved Oxygen, 7) Total Dissolved Solid, and 8) Color
	Period	One time at 3 locations
	Location	Wells
Soil Quality	Parameter	In-situ
	Period	One time at 9 locations
	Location	Residential and rural areas
Sediment	Parameter	In-situ
	Period	One time at 6 locations
	Location	River

Source: Field Survey, May 2018

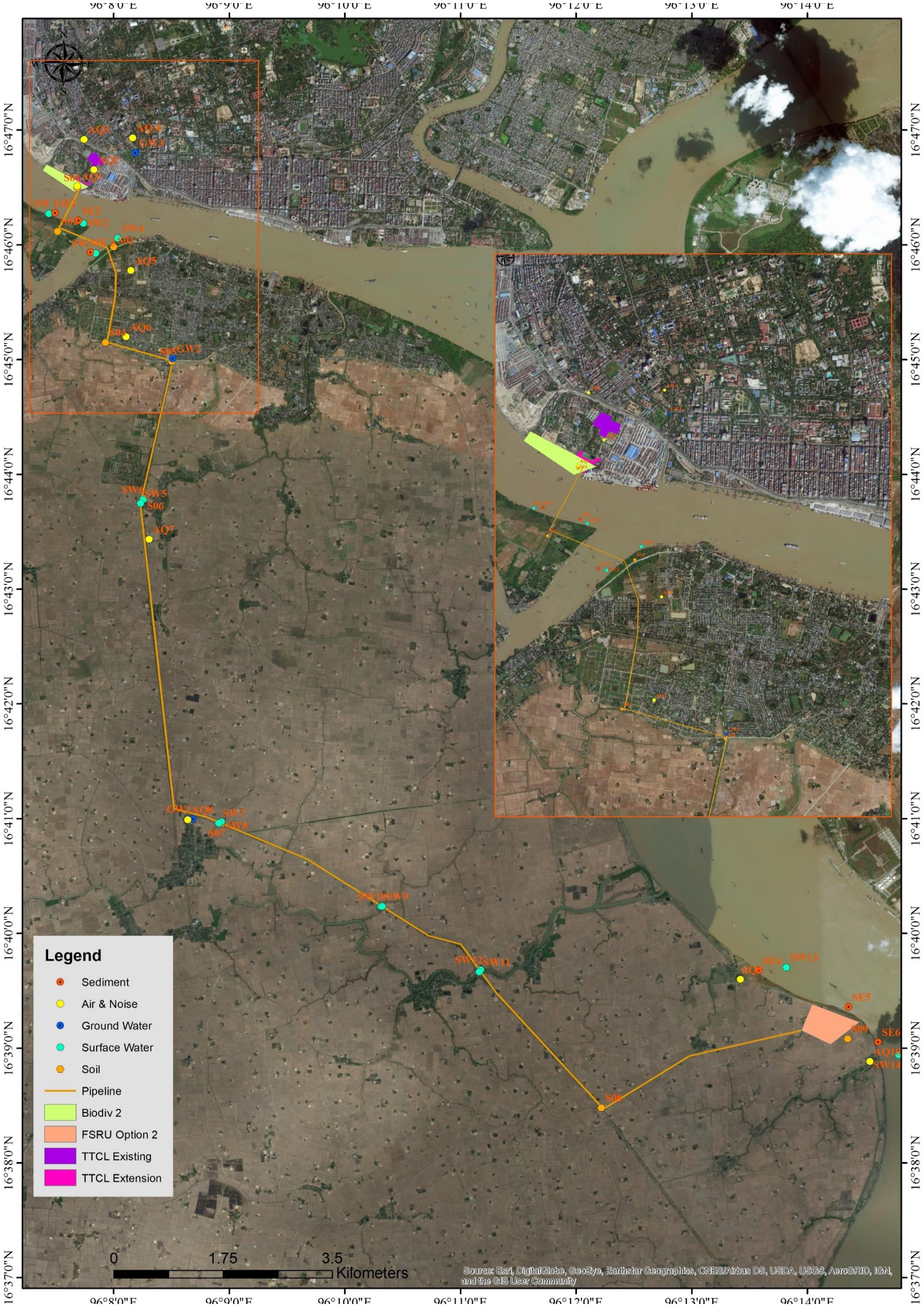

Figure 1.1-1 Location map of water, air, noise and soil quality survey

1.2 Air Quality

1.2.1 Survey Item

Myanmar National Environmental Quality (Emission) Guidelines were announced on 29th December, 2015 and guideline values for air pollution level are shown in Table 1.2-1.

Table 1.2-1 Myanmar National Environmental Quality Guideline values for survey parameters of air quality

No	Parameter	Averaging Period	Guideline Value	Units
1.	Nitric oxide	-	-	µg/m3
2.	Nitrogen dioxide	1-hour	200	µg/m3
3.	Sulphur dioxide	24-hour	20	µg/m3
4.	Particulate matter PM_{10} [a]	24-hours	50	µg/m3
5.	Particulate matter $PM_{2.5}$ [b]	24-hours	25	µg/m3
6.	Carbon Monoxide	-	-	-
7.	Relative Humidity	-	-	%
8.	Temperature	-	-	℃
9.	Wind Speed	-	-	-
10.	Wind Direction	-	-	-

Remark: PM_{10} [a] = Particulate matter 10 micrometers or less in diameter

$PM_{2.5}$ [b] = Particulate matter 2.5 micrometers or less in diameter

1.2.2 Survey Location

The coordinate location of air quality monitoring survey in detail are shown in Table 1.2-2.

Table 1.2-2 Sampling location for air quality survey

Sampling Points	Coordination	Description of Sampling Point
AQ1/N1	16°46'30.69"N 96° 7'41.11"E	In the compound of Combined Cycle Power Plant (at project area) located in Ahlone Township, Yangon Region
AQ2/N2	16°46'39.33"N 96° 7'49.79"E	Same as the AQ1/N1
AQ3/N3	16°46'55.17"N 96° 7'44.70"E	In the compound of Aung Mingalar Monastery (near the Kannar Road) located in Ahlone Township, Yangon Region
AQ4/N4	16°46'56.00"N 96° 8'10.00"E	In the compound of Church (near the Thakhinmya Park) which located in Ahlone Township, Yangon Region
AQ5/N5	16°45'46.67"N 96° 8'8.97"E	In the compound of No. (22) Basic Education Primary School which located in Dala Township, Yangon Region
AQ6/N6	16°45'11.99"N 96° 8'6.46"E	In the compound of Yadanarayeyeikthar Monastery located in Kyansitthar Ward, Dala Township, Yangon Region
AQ7/N7	16°43'26.10"N 96° 8'18.40"E	In the Nuaung Ngok To Village, in Dala Township, Yangon Region
AQ8/N8	16°40'59.48"N 96° 8'38.41"E	In the compound of Pyasu Monastery which located in Pyaw Bwe Gyi Village, Dala Township, and Yangon Region
AQ9/N9	16°39'36.00"N 96°13'25.32"E	In the compound of Aung Mingalar Monastery which located in That Kai Kwin Village, Dala Township, and Yangon Region
AQ10/N10	16°38'53.04"N 96°14'32.48"E	In the Chaung Oo Village which located in Dala Township, Yangon Region

AQ1/N1

AQ1/N1 was measured in the compound of Combined Cycle Power Plant Project (Ahlone) which located in Ahlone Township, Yangon, and the project area. It is also situated in the left bank of Hlaing River and behind the Ahlone gas turbine power plant. The shrub land and Mangrove Forest encircled are occurred at the location. The possible pollution source might be emitted from gas turbine power plant funnel. The unusual noises may be come out of the gas turbine power plant generator and the traffic activity of boats and ships in 24 hours. The activities of AQ1/N1 is shown in Figure 1.2-1.


Figure 1.2-1 Air quality monitoring survey at AQ1/N1

AQ2/N2

AQ2/N2 was observed in the compound of Combined Cycle Power Plant Project (Ahlone) which located in Ahlone Township, Yangon, and the project area. The area is flat terrain with bushes and near power plant generator. The possible air pollution source may be come from gas turbine power plant funnel. As the power plant generator is running the whole day, the noise source may also be come from it. The activities of AQ2/N2 is shown in Figure 1.2-2.

Figure 1.2-2 Air quality monitoring survey at AQ2/N2

AQ3/N3

AQ3/N3 was surveyed in the compound of Aung Mingalar Monastery (near the Kannar Street) and about monitoring point is set up at upstairs of monastery with 6 feet in height. There is a generator room behind the monastery and it generally works two times per day. The location is encircled by residential houses. It is possible that pollution source emitted from the human activities. The unusual noises may be come out generator and traffic activity by cars and lorry in 24 hours. The activities of AQ3/N3 is shown in Figure 1.2-3.

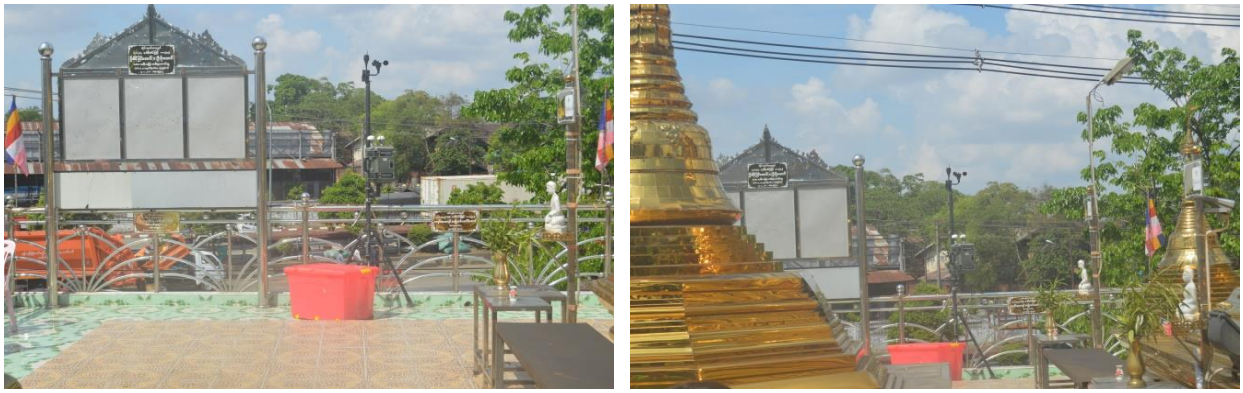

Figure 1.2-3 Air quality monitoring survey at AQ3/N3

AQ4/N4

AQ4/N4 was surveyed in the compound of Church (near the Thakhinmya Park) which located in Ahlone Township, Yangon Region and lies about 1.03 kilometers at northeast of power plant. It is possible that pollution source emitted from the human activities. The unusual noises may be come out traffic activity by motorbike in the day time. The activities of AQ4 is shown in Figure 1.2-4.

Figure 1.2-4 Air quality monitoring survey at AQ4/N4

AQ5/N5

AQ5/N5 was measured in the compound of No. (22) Basic Education Primary School which located in Dala Township, Yangon Region. It situated 0.22 kilometers away from proposed gas pipeline. The location is encircled by many residential houses. It is possible that pollution source emitted from the human activities. The unusual noises may be come out traffic activity by motorbike in the day time. The activities of AQ5/N5 is shown in Figure 1.2-5.

Figure 1.2-5 Air quality monitoring survey at AQ5/N5

AQ6/N6

AQ6/N6 was monitored in the compound of Yadanarayeyeikthar Monastery which located in Kyansitthar Ward, Dala Township, and Yangon Region and fared about 0.17 kilometers at north of gas pipeline. The location is surrounded by residential houses. The possible pollution source may be emitted from residences activities. The unusual noises may be come out the activities of human. The activities of AQ6/N6 is shown in Figure 1.2-6.

Figure 1.2-6 Air quality monitoring survey at AQ6/N6

AQ7/N7

AQ7/N7 was observed in the Nuaung Ngok To Village, Dala Township, Yangon Region and situated about 0.07 kilometers away from proposed gas pipeline. The location is at flat terrain and encircled with residential houses. It is possible that pollution source emitted from the human activities. The unusual noises may be come out traffic activities of motorbike in the day time. The activities of AQ7/N7 is shown in Figure 1.2-7.

Figure 1.2-7 Air quality monitoring survey at AQ7/N7

AQ8/N8

AQ8/N8 was surveyed in the compound of Pyasu Monastery in Pyaw Bwe Gyi Village, Dala Township. It lies about 0.11 kilometers away from proposed gas pipeline. There is a grain mill in front of monastery and it works in the day time. The location is surrounded by many residential houses. It is possible that pollution source emitted from crematorium and the human activities. The unusual noises may be come out grain mill and traffic activity by cars and motorbike in the day time. The activities of AQ8/N8 is shown in Figure 1.2-8.

Figure 1.2-8 Air quality monitoring survey at AQ8/N8

AQ9/N9

AQ9/N9 was measured in the compound of Aung Mingalar Monastery, That Kai Kwin Village, Dala Township, Yangon Region. It lies about 1.02 kilometers away from proposed gas pipeline. The measured point is situated near bushes, trees, and paddy field. The location is surrounded by residential houses. It is possible that pollution source emitted from the residents' activities. The unusual noises may be come out wind blowing sound and tiny bell sound on the pagoda. The activities of AQ9/N9 is shown in Figure 1.2-9.

Figure 1.2-9 Air quality monitoring survey at AQ9/N9

AQ10/N10

AQ10/N10 was monitored in the Chaung Oo Village, Dala Township, Yangon Region and sited about 0.59 kilometers at southeast of proposed FSRU Option 2. It situated near paddy field and by the right band of Yangon River. The location is encircled by many residential houses. It is possible that pollution source emitted from the human activities. The unusual noises may be come out traffic activity by motorbike, boats and ships in 24 hours. The field activities of AQ10/N10 is shown in Figure 1.2-10.

Figure 1.2-10 Air quality monitoring survey at AQ10/N10

1.2.3 Survey Period

Air quality survey was conducted from 2nd - 15th of May 2018 for baseline studies. Each sampling duration is described in Table 1.2-3.

Table 1.2-3 Sampling Duration for Air Quality Survey

Point	Period
AQ1 **AQ2** **AQ3**	May 2nd – 5th, 2018 (72 hours)
AQ5 **AQ6** **AQ7**	May 6th – 9th, 2018 (72 hours)
AQ8 **AQ9** **AQ10**	May 9th – 12nd, 2018 (72 hours)
AQ4	May 12nd – 15th, 2018 (72 hours)

1.2.4 Survey Method

Methodology

Sampling and analysis of ambient air pollutants were conducted by referring to the recommendation of United States Environmental Protection Agency (U.S. EPA). The Haz-Scanner EPAS Wireless Environmental Perimeter Air Station was used to collect Ambient Air Monitoring data.

Table 1.2-4 Sampling and Analysis Method for Air Quality

No.	Parameter	Analysis Method
1	Nitric oxide (NO_x)	On site reading
2	Nitrogen dioxide (NO2)	On site reading
3	Sulphur dioxide (SO2)	On site reading
4	Particulate matter 10 (PM10)	On site reading
5	Particulate matter 2.5 (PM2.5)	On site reading
6	Carbon Monoxide	On site reading
7	Relative Humidity	On site reading
8	Temperature	On site reading
9	Wind Speed	On site reading
10	Wind Direction	On site reading

1.2.5 Survey Result

AQ1

Average values of ambient gaseous levels at AQ1 are shown in Table 1.2-5. NO_2, PM10 and SO_2 concentrations are within the standard while PM2.5 concentrations occur higher than the standard for two days in 72 hours continuous monitoring. So, it generally means the area had few particulates sources at the area. Hourly results of AQ1 described in appendix.

Table 1.2-5 Daily Ambient air quality results at AQ1

Date	**Time**	**CO**	**NO2**	**NO**	**PM2.5**	**PM10**	**RH**	**SO2**	**TmpC**
D.M.Y	**hours**	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	**%**	µg/m3	**Deg. C**
2-3 May, 2018	24	61.16	20.94	0.01	11.78	17.91	79.28	12.18	28.60
3-4 May, 2018	24	60.26	28.58	0.01	30.04	41.39	83.57	4.52	29.56
4-5 May, 2018	24	110.66	25.79	0.01	47.44	49.14	82.41	9.52	29.30
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

AQ2

Average values of ambient gaseous levels at AQ2 are shown in Table 1.2-6. NO_2, PM2.5, PM10 and SO_2 concentrations are within the standard expect PM2.5 for last day of survey period. Generally, it can say the area is lower than the standard except one day period for PM2.5 at the area. Hourly results of AQ2 described in appendix.

Table 1.2-6 Daily Ambient air quality results at AQ2

Date	**Time**	**CO**	**NO2**	**NO**	**PM2.5**	**PM10**	**RH**	**SO2**	**TmpC**
D.M.Y	**hours**	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	**%**	µg/m3	**Deg. C**
2-3 May, 2018	24	60.15	20.93	15.32	8.38	9.16	68.07	5.96	28.99
3-4 May, 2018	24	59.36	28.34	13.93	25.79	30.15	74.12	4.49	29.26
4-5 May, 2018	24	80.28	25.64	18.71	35.76	42.63	73.62	8.66	28.60
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

AQ3

Average values of ambient gaseous levels at AQ3 are shown in Table 1.2-7. NO_2, PM2.5, PM10 and SO_2 concentrations are within the standard. Hourly results of AQ3 described in appendix.

Table 1.2-7 Daily Ambient air quality results at AQ3

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	**hours**	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	**%**	µg/m3	**Deg. C**
2-3 May, 2018	24	230.34	71.42	0.00	24.36	29.24	74.19	12.54	28.62
3-4 May, 2018	24	291.27	62.96	0.05	2.25	7.28	80.48	19.88	27.51
4-5 May, 2018	24	313.26	43.47	0.06	2.20	7.69	73.45	28.03	28.47
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

AQ4

Average values of ambient gaseous levels at AQ4 are shown in Table 1.2-8. CO and NO_x values are not specified in Myanmar emission guideline. NO_2, PM2.5, PM10 and SO_2 concentrations are within the standard according to the baseline monitoring survey. Hourly results of AQ4 described in appendix.

Table 1.2-8 Daily Ambient air quality results at AQ4

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	**hours**	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	**%**	µg/m3	**Deg. C**
12-13 May, 2018	24	344.42	47.60	0.00	2.24	7.21	84.04	27.68	25.77
13-14 May, 2018	24	183.65	56.95	0.0004	2.45	8.57	74.62	10.36	28.08
14-15 May, 2018	24	224.91	60.19	0.036	2.12	7.57	82.28	14.89	26.76
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	

AQ5

Average values of ambient gaseous levels at AQ5 are shown in Table 1.2-9. CO and NO_x values are not specified in Myanmar emission guideline. NO_2, PM2.5, PM10 and SO_2 concentrations are within the standard according baseline monitoring survey. Hourly results of AQ5 described in appendix.

Table 1.2-9 Daily Ambient air quality results at AQ5

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	**hours**	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	**%**	µg/m3	**Deg. C**

06-07 May, 2018	24	121.72	50.59	0.018	2.15	7.10	73.13	8.77	29.55
07-08 May, 2018	24	143.51	58.58	0.025	2.38	9.45	71.73	5.94	30.11
08-09 May, 2018	24	147.02	59.53	0.026	2.44	7.65	71.52	6.50	30.25
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	

AQ6

Average values of ambient gaseous levels at AQ6 are shown in Table 1.2-10. CO and NO_x values are not specified in Myanmar emission guideline. NO_2, PM2.5, PM10 and SO_2 concentrations are within the standard. Hourly results of AQ6 described in appendix.

Table 1.2-10 Daily Ambient air quality results at AQ6

Date	**Time**	**CO**	**NO2**	**NO**	**PM2.5**	**PM10**	**RH**	**SO2**	**TmpC**
D.M.Y	**hours**	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	**%**	µg/m3	**Deg. C**
06-07 May, 2018	24	58.92	19.94	22.13	20.59	22.06	70.36	12.82	30.72
07-08 May, 2018	24	80.74	26.89	21.70	21.05	22.62	66.67	11.36	30.16
08-09 May, 2018	24	77.61	26.67	19.98	25.08	26.74	68.06	8.78	31.95
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	

AQ7

Average values of ambient gaseous levels at AQ7 are shown in Table 1.2-11. NO_2, PM2.5, PM10 and SO_2 concentrations are within the standard. Hourly results of AQ7 described in appendix.

Table 1.2-11 Daily Ambient air quality results at AQ7

Date	**Time**	**CO**	**NO2**	**NO**	**PM2.5**	**PM10**	**RH**	**SO2**	**TmpC**
D.M.Y	**hours**	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	**%**	µg/m3	**Deg. C**
06-07 May, 2018	24	114.96	58.86	0.010	24.36	29.24	75.99	2.77	32.23
07-08 May, 2018	24	129.54	59.82	0.569	24.18	24.89	74.43	5.15	33.17
08-09 May, 2018	24	144.84	74.29	0.012	21.73	29.09	74.01	7.48	33.68
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	

AQ8

Average values of ambient gaseous levels at AQ8/N8 are shown in Table 1.2-12. NO_2, PM2.5, PM10 and SO_2 concentrations are within the standard. Hourly results of AQ8 described in appendix.

Table 1.2-12 Daily Ambient air quality results at AQ8/N8

Date	**Time**	**CO**	**NO2**	**NO**	**PM2.5**	**PM10**	**RH**	**SO2**	**TmpC**
D.M.Y	**hours**	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	**%**	µg/m3	**Deg. C**
09-10 May, 2018	24	109.20	63.04	0.02	2.12	8.63	79.19	6.63	28.28
10-11 May, 2018	24	128.88	59.94	0.01	2.35	7.33	85.17	5.51	26.07
11-12 May, 2018	24	152.42	76.32	0.01	2.94	8.51	89.38	6.43	25.00
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	

AQ9

Average values of ambient gaseous levels at AQ9 are shown in Table 1.2-13. NO_2, PM2.5, PM10 and SO_2 concentrations are within the standard. Hourly results of AQ9 described in appendix.

Table 1.2-13 Daily Ambient air quality results at AQ9

Date	**Time**	**CO**	**NO2**	**NO**	**PM2.5**	**PM10**	**RH**	**SO2**	**TmpC**
D.M.Y	**hours**	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	**%**	µg/m3	**Deg. C**
09-10 May, 2018	24	69.01	40.10	0.01	20.63	25.93	72.89	9.09	35.41
10-11 May, 2018	24	111.79	23.69	0.01	25.82	40.89	84.30	11.51	29.17
11-12 May, 2018	24	66.81	41.46	0.00	22.47	26.46	86.00	3.42	29.72
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	

AQ10

Average values of ambient gaseous levels at AQ10 are shown in Table 1.2-14. NO_2, PM2.5, PM10 and SO_2 concentrations are within the standard. By the one calculated result, concentration of PM2.5 is fairly higher than the standard for first day. Hourly results of AQ10 described in appendix.

Table 1.2-14 Daily Ambient air quality results at AQ10

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	**hours**	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	**%**	µg/m3	**Deg. C**
09-10 May, 2018	24	60.90	36.20	15.75	28.10	27.31	71.55	15.64	30.28
10-11 May, 2018	24	48.27	24.16	13.20	20.86	26.63	75.56	4.94	28.42
11-12 May, 2018	24	54.16	43.83	13.09	25.22	31.68	74.12	10.50	28.60
Myanmar emission guideline value		-	200 (1 hour)	-	25	50	-	20	

Wind Speed and Wind Direction

The average wind speed and direction were collected for 72 hours continuous in each location. According to the wind rose diagram, average wind speed of varies from 0.01 to 6.50 m/s in covering the all stations. Generally, Prevailing wind direction of all quality station are blowing from north, northeast and southeast and southwest direction. By the wind rose diagram, the dominant wind direction are southeast and southwest quadrant. Wind speed and direction diagram of each stations are shown in Figure 1.2-11 to 1.2-15.

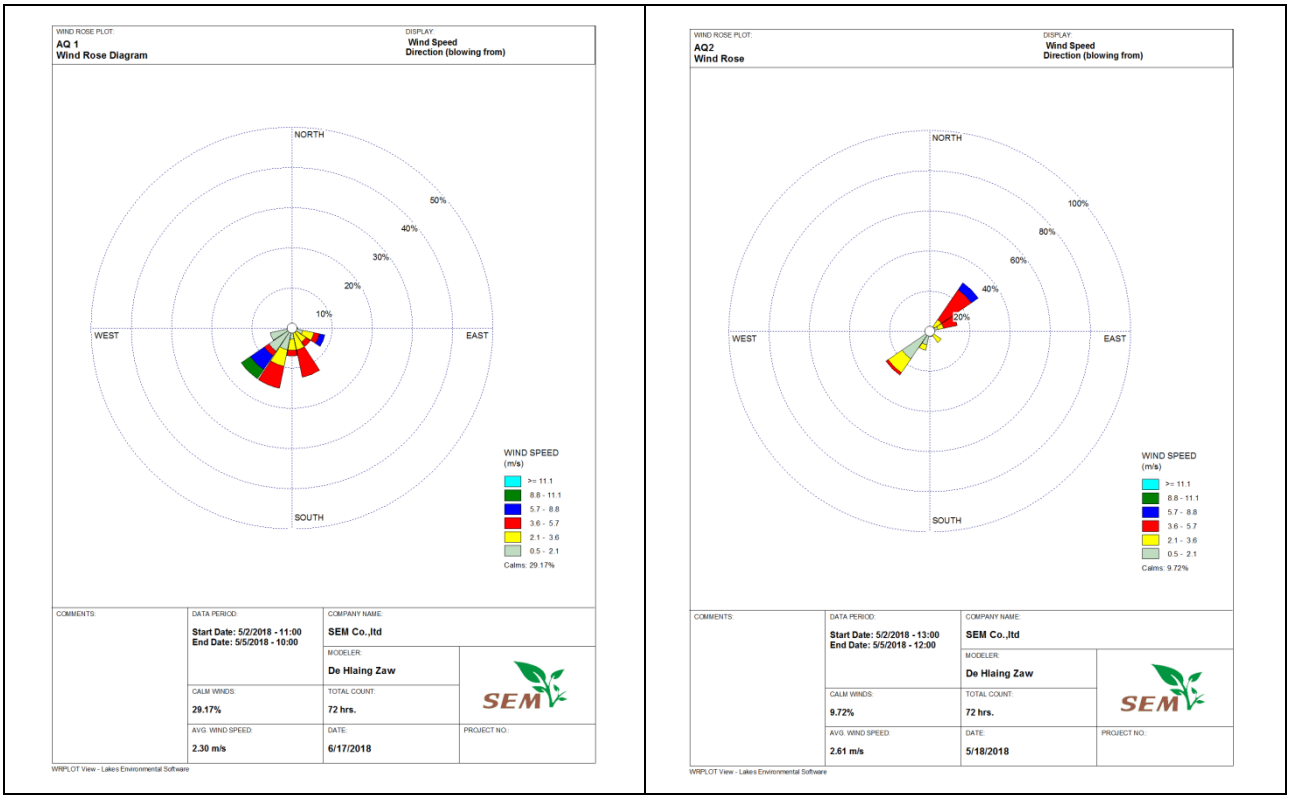

Figure 1.2-11 Wind speed and direction diagram at AQ1 and AQ2

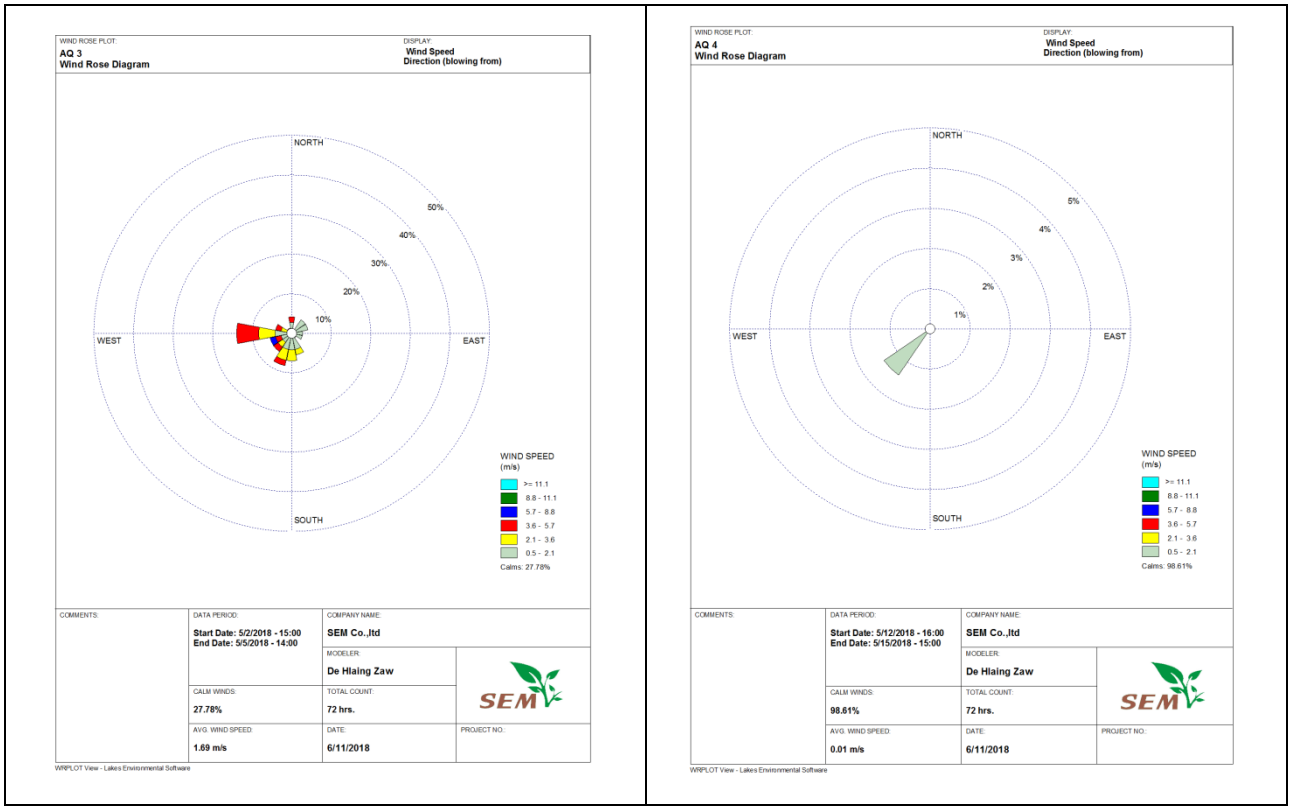

Figure 1.2-12 Wind speed and direction diagram at AQ3 and AQ4

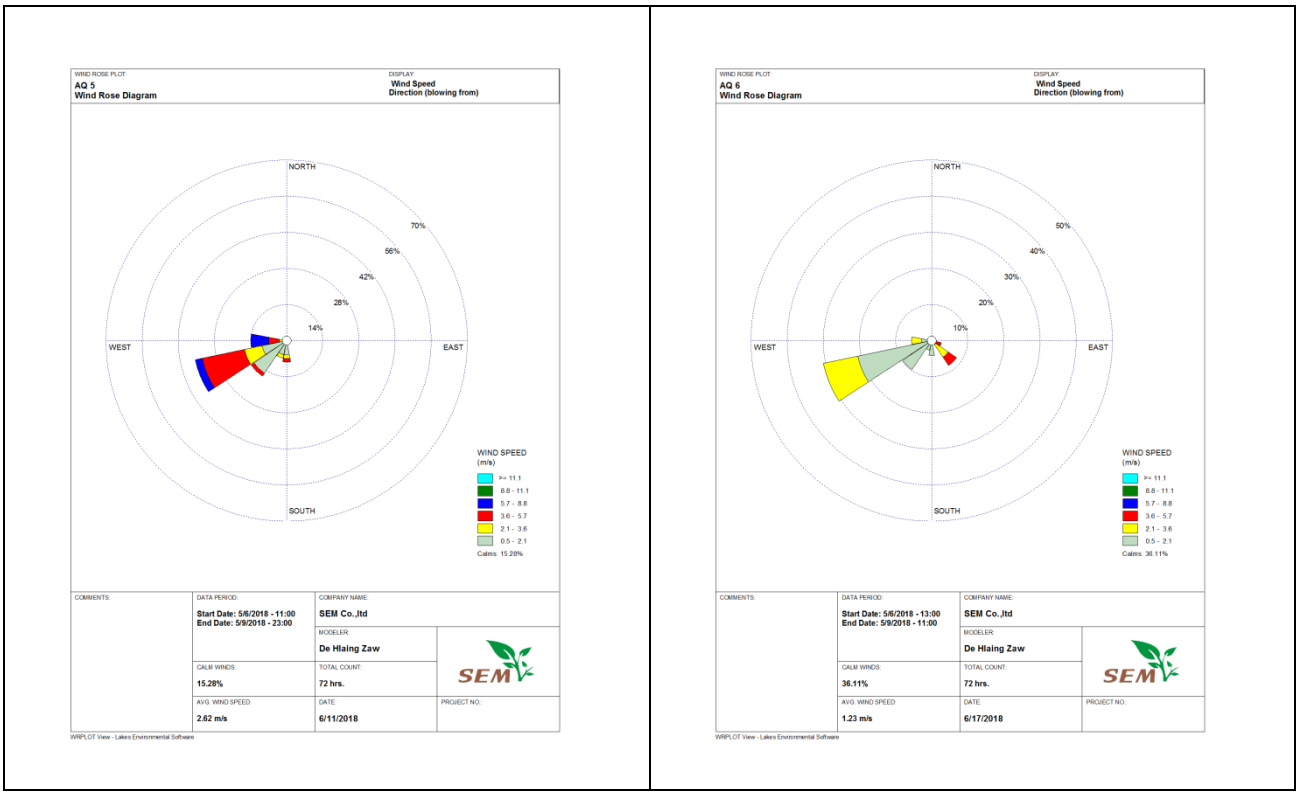

Figure 1.2-13 Wind speed and direction diagram at AQ5 and AQ6

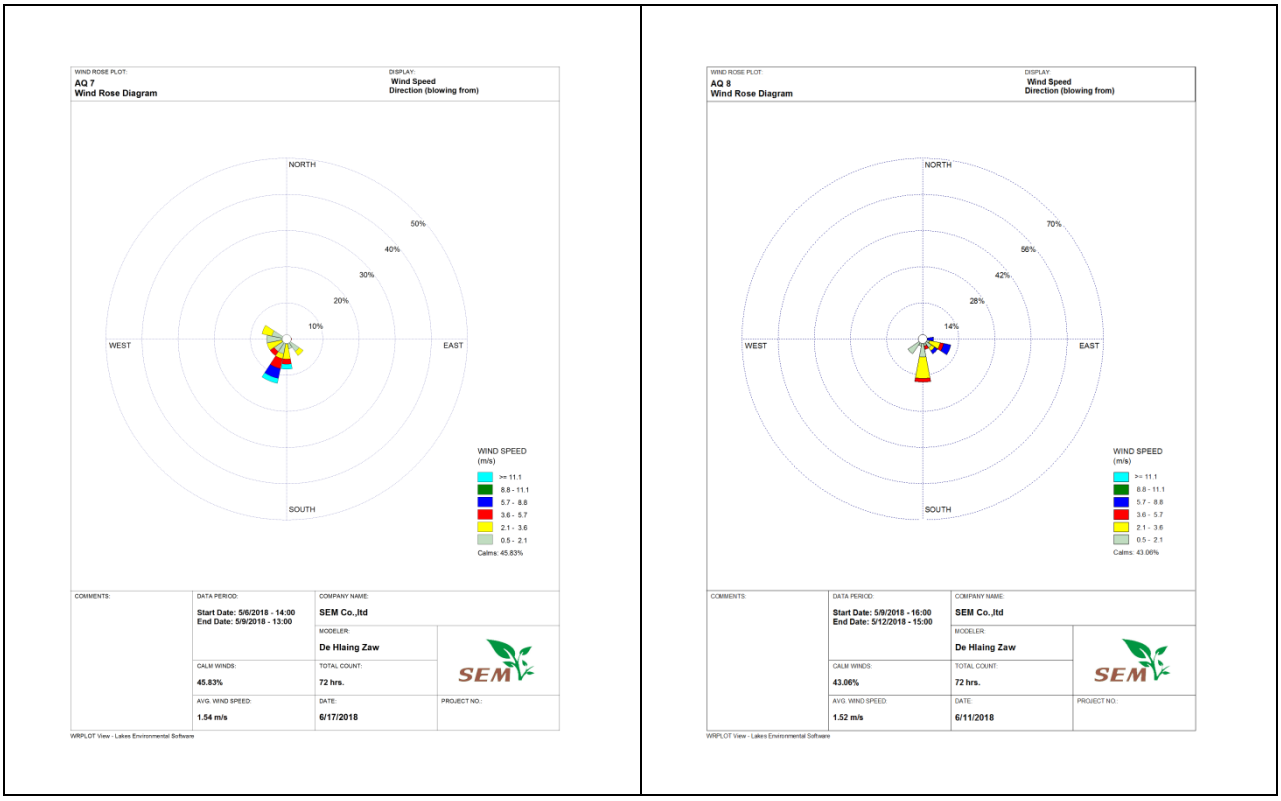

Figure 1.2-14 Wind speed and direction diagram at AQ7 and AQ8

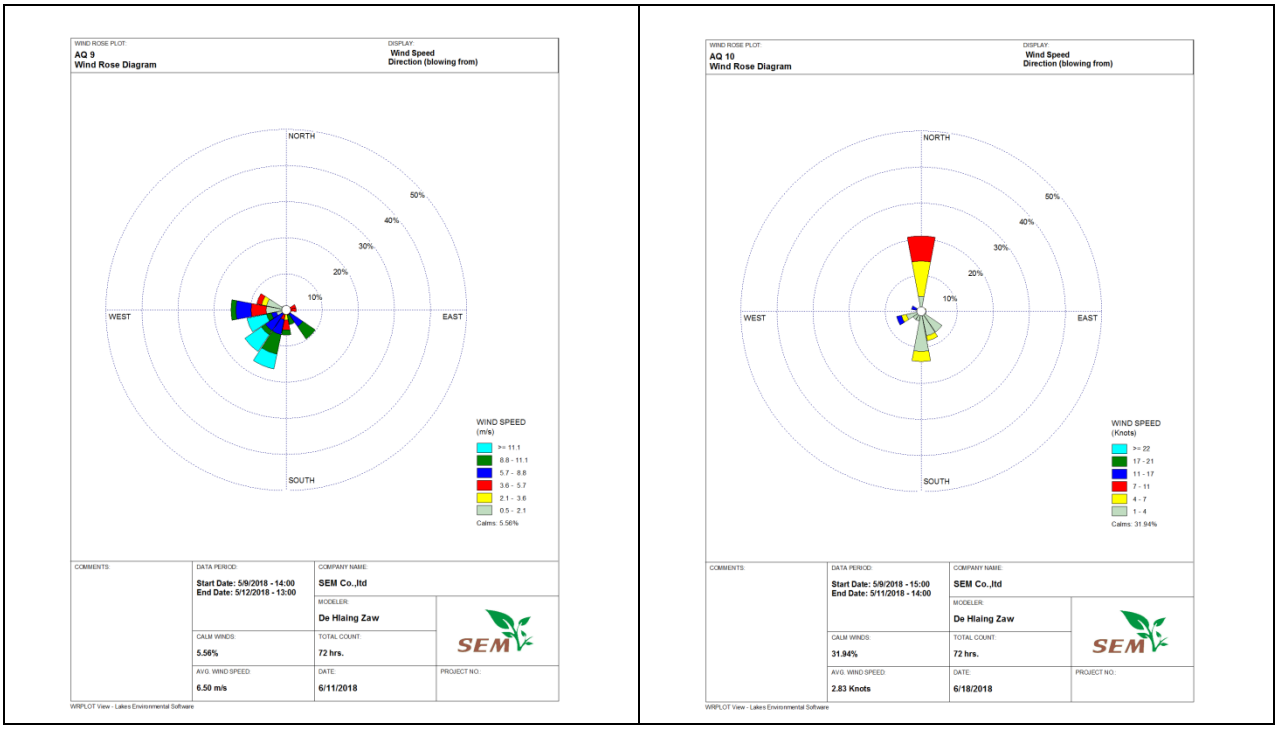

Figure 1.2-15 Wind speed and direction diagram at AQ9 and AQ10

1.3 Noise Level

1.3.1 Survey Item

Myanmar National Environmental Quality (Emission) Guidelines were announced on 29th December, 2015 and guideline value for noise level is as shown in Table 1.3-1.

Table 1.3-1 Guideline Value of Noise Level

No.	Parameter	Unit	Environmental Standard (Myanmar)		
			Category	Day time 7:00-22:00	Night time 22:00-7:00
1	A-weighted loudness equivalent (L_{Aeq})	dB	Residential, educational, institutional	55	45
			Industrial, commercial	70	70

Source: National Environmental Quality (Emission) Guidelines, 2015
Remark: a LAeq = Equivalent continuous sound level in decibels

1.3.2 Survey Location

The locations of Noise Level monitoring survey are as same as the air quality monitoring survey. The details of sampling points are described as Table 1.3-2.

Table 1.3-2. Locations of Noise Level monitoring station.

Sampling Points	Description of Sampling Point
N1	Same as the AQ1
N2	Same as the AQ2
N3	Same as the AQ3
N4	Same as the AQ4
N5	Same as the AQ5
N6	Same as the AQ6
N7	Same as the AQ7
N8	Same as the AQ8
N9	Same as the AQ9
N10	Same as the AQ10

1.3.3 Survey Period

Noise level survey was conducted on 48 hours consecutively. The measurement duration is shown in Table 1.3-3.

Table 1.3-3 Sampling Duration for Noise Level Survey

Point	Period
N1 **N2** **N3**	May 2nd – 4th, 2018 (48 hours)
N5 **N6** **N7**	May 6th – 8th, 2018 (48 hours)
N9	May 10th – 12nd, 2018 (48 hours)
N8 **N10**	May 9th – 11st, 2018 (48 hours)
N4	May 12nd – 14th, 2018 (48 hours)

1.3.4 Survey Method

Measurement of environmental sound level was conducted by referring to the recommendation of International Organization for Standardization (ISO), i.e. ISO 1996-1:2003 and ISO 1996-2:2007. The instrumentation used for noise quality survey is shown in the following Table 1.3-4.

Noise meter was set up to record the log as ten minutes intervals during an hour for one consecutive day.

Table 1.3-4 Instrumentation for noise survey

Instrumentation	Description
Sound level meter	Sound level meter with SD Card, Model SL-4023SD

Source: Sustainable Environment Myanmar Co., Ltd.

Figure 1.3-1 Lutron sound level meter

1.3.5 Survey Result

Noise level (L_{Aeq}) is shown in Table 1.3-5. Within 48 hours was higher than the noise level of Myanmar National Environmental Quality (Emission) guideline as shown in Table 1.3-5 to 1.3-15.

By using the following array formula in the excel sheet was calculated one day L_{Aeq}. This formula is firstly used for hourly L_{Aeq} and then for the 24 hours L_{Aeq}.

10*LOG10 (AVERGAE (10^ ((RANGE)/10)))

As the monitoring is conducted for the residential areas, the results are compared with "Residential, Educational, Institutional" environment of Myanmar National Emission Guideline.

By means of the calculated results, day and night time noise level at N7 is within the standard for 48 hours and day time noise result at N8 is also within the standard for first day. Sampling points (N1, N2, N3, N4, N5, N6, N8, N9 and N10) of day and night time L_{Aeq} are higher than the environmental standard. Generally, the results indicated that area had unusual noises. The origin of sources may come out (power plant generator, traffic activities, human activities and raining) during the survey period.

Measurement of environmental sound level was conducted by referring to the recommendation of Myanmar National Emission Guideline.

Table 1.3-5 A-weighted loudness Equivalent (LAeq) Level

	N1 (2nd -3rd, May 2018)		**N1 (3rd - 4th, May 2018)**	
	Day time	Night time	Day time	Night time
Result	59	57	59	59
	N2 (2nd -3rd, May 2018)		**N2 (3rd - 4th, May 2018)**	
	Day time	Night time	Day time	Night time
Result	74	73	72	73
	N3 (2nd -3rd, May 2018)		**N3 (3rd - 4th, May 2018)**	
	Day time	Night time	Day time	Night time
Result	71	66	70	67
	N4 (12th -13th, May 2018)		**N4 (13th -14th, May 2018)**	
	Day time	Night time	Day time	Night time
Result	55	49	54	48
	N5 (6th -7th, May 2018)		**N5 (7th -8th, May 2018)**	
	Day time	Night time	Day time	Night time
Result	59	57	59	59
	N6 (6th -7th, May 2018)		**N6 (7th -8th, May 2018)**	
	Day time	Night time	Day time	Night time
Result	58	53	57	49
	N7 (6th -7th, May 2018)		**N7 (7th -8th, May 2018)**	
	Day time	Night time	Day time	Night time
Result	48	45	46	40
	N8 (9th -10th, May 2018)		**N8 (10th -11st, May 2018)**	
	Day time	Night time	Day time	Night time
Result	54	47	58	55
	N9 (10th -11nd, May 2018)		**N9 (11th -12nd, May 2018)**	
	Day time	Night time	Day time	Night time
Result	60	53	60	54
	N10 (9th -10th, May 2018)		**N10 (10th -11st, May 2018)**	
	Day time	Night time	Day time	Night time
Result	63	47	63	51
NEQG standard	**55**	**45**	**55**	**45**

Remark: Shaded area is higher than the standard.

Table 1.3-6 Hourly LAeq value in noise monitoring stations (N1)

Unit: dBA

Time	2-3 May, 2018	3-4 May, 2018
7:00-8:00	58	60
8:00-9:00	61	57
9:00-10:00	56	58
10:00-11:00	58	53
11:00-12:00	57	55
12:00-13:00	58	62
13:00-14:00	59	57
14:00-15:00	60	62
15:00-16:00	59	60
16:00-17:00	68	67
17:00-18:00	61	64
18:00-19:00	60	56
19:00-20:00	55	55
20:00-21:00	57	59
21:00-22:00	60	55
Day L_{Aeq}	59	59
22:00-23:00	55	52
23:00-24:00	52	55
24:00-01:00	52	55
01:00-02:00	51	60
02:00-03:00	56	64
03:00-04:00	59	57
04:00-05:00	62	68
05:00-06:00	63	58
06:00-07:00	62	60
Night L_{Aeq}	57	59

Table1.3-7 Hourly (LAeq) value in noise monitoring stations (N2)

Unit: dBA

Time	2-3 May, 2018	3-4 May, 2018
7:00-8:00	74	73
8:00-9:00	73	73
9:00-10:00	71	71
10:00-11:00	72	71
11:00-12:00	73	71
12:00-13:00	73	71
13:00-14:00	76	73
14:00-15:00	75	72
15:00-16:00	75	72
16:00-17:00	74	73
17:00-18:00	75	72
18:00-19:00	75	72
19:00-20:00	73	72
20:00-21:00	73	73
21:00-22:00	72	73
Day L_{Aeq}	74	72
22:00-23:00	72	73
23:00-24:00	72	72
24:00-01:00	73	72
01:00-02:00	71	73
02:00-03:00	73	72
03:00-04:00	74	72
04:00-05:00	74	72
05:00-06:00	74	73
06:00-07:00	73	78
Night L_{Aeq}	73	73

Table1.3-8 Hourly (in LAeq) value noise monitoring stations (N3)

Unit: dBA

Time	2-3 May, 2018	3-4 May, 2018
7:00-8:00	75	71
8:00-9:00	68	70
9:00-10:00	69	68
10:00-11:00	70	69
11:00-12:00	69	72
12:00-13:00	69	70
13:00-14:00	81	71
14:00-15:00	70	71
15:00-16:00	73	70
16:00-17:00	70	70
17:00-18:00	70	79
18:00-19:00	67	71
19:00-20:00	69	69
20:00-21:00	76	66
21:00-22:00	66	68
Day L_{Aeq}	71	70
22:00-23:00	66	73
23:00-24:00	67	69
24:00-01:00	72	67
01:00-02:00	64	68
02:00-03:00	62	62
03:00-04:00	67	69
04:00-05:00	65	62
05:00-06:00	66	66
06:00-07:00	70	68
Night L_{Aeq}	66	67

Table1.3-9 Hourly (LAeq) value in noise monitoring stations (N4)

Unit: dBA

Time	12-13 May, 2018	13-14 May, 2018
7:00-8:00	55	56
8:00-9:00	55	56
9:00-10:00	60	55
10:00-11:00	56	52
11:00-12:00	54	57
12:00-13:00	60	53
13:00-14:00	56	54
14:00-15:00	53	55
15:00-16:00	54	55
16:00-17:00	58	53
17:00-18:00	55	55
18:00-19:00	52	55
19:00-20:00	49	52
20:00-21:00	50	51
21:00-22:00	52	50
Day L_{Aeq}	55	54
22:00-23:00	49	48
23:00-24:00	48	48
24:00-01:00	47	48
01:00-02:00	47	46
02:00-03:00	48	43
03:00-04:00	48	43
04:00-05:00	51	45
05:00-06:00	56	56
06:00-07:00	52	55
Night L_{Aeq}	49	48

Table1.3-10 Hourly (LAeq) value in noise monitoring stations (N5)

Unit: dBA

Time	2-3 May, 2018	3-4 May, 2018
7:00-8:00	58	60
8:00-9:00	61	57
9:00-10:00	56	58
10:00-11:00	58	53
11:00-12:00	57	55
12:00-13:00	58	62
13:00-14:00	59	57
14:00-15:00	60	62
15:00-16:00	59	60
16:00-17:00	68	67
17:00-18:00	61	64
18:00-19:00	60	56
19:00-20:00	55	55
20:00-21:00	57	59
21:00-22:00	60	55
Day L_{Aeq}	59	59
22:00-23:00	55	52
23:00-24:00	52	55
24:00-01:00	52	55
01:00-02:00	51	60
02:00-03:00	56	64
03:00-04:00	59	57
04:00-05:00	62	68
05:00-06:00	63	58
06:00-07:00	62	60
Night L_{Aeq}	57	59

Table1.3-11 Hourly LAeq value in noise monitoring stations (N6)

Unit: dBA

Time	2-3 May, 2018	3-4 May, 2018
7:00-8:00	56	58
8:00-9:00	59	55
9:00-10:00	54	55
10:00-11:00	82	50
11:00-12:00	48	54
12:00-13:00	58	53
13:00-14:00	46	79
14:00-15:00	55	75
15:00-16:00	51	49
16:00-17:00	62	56
17:00-18:00	65	53
18:00-19:00	57	56
19:00-20:00	60	51
20:00-21:00	61	52
21:00-22:00	50	56
Day L_{Aeq}	58	57
22:00-23:00	65	48
23:00-24:00	49	47
24:00-01:00	48	47
01:00-02:00	46	46
02:00-03:00	57	45
03:00-04:00	47	48
04:00-05:00	47	50
05:00-06:00	59	56
06:00-07:00	59	59
Night L_{Aeq}	53	49

Table1.3-12 Hourly LAeq value in noise monitoring stations (N7)

Unit: dBA

Time	6-7 May, 2018	7-8 May, 2018
7:00-8:00	45	47
8:00-9:00	44	45
9:00-10:00	44	42
10:00-11:00	51	43
11:00-12:00	43	47
12:00-13:00	46	45
13:00-14:00	54	52
14:00-15:00	48	47
15:00-16:00	55	51
16:00-17:00	48	46
17:00-18:00	57	54
18:00-19:00	55	51
19:00-20:00	41	41
20:00-21:00	44	38
21:00-22:00	38	36
Day L_{Aeq}	48	46
22:00-23:00	38	35
23:00-24:00	38	36
24:00-01:00	55	36
01:00-02:00	38	37
02:00-03:00	36	36
03:00-04:00	36	38
04:00-05:00	43	39
05:00-06:00	69	51
06:00-07:00	50	49
Night L_{Aeq}	45	40

Table1.3-13 Hourly LAeq value in noise monitoring stations (N8)

Unit: dBA

Time	9-10 May, 2018	10-11 May, 2018
7:00-8:00	59	66
8:00-9:00	58	66
9:00-10:00	52	60
10:00-11:00	49	58
11:00-12:00	70	53
12:00-13:00	55	56
13:00-14:00	51	52
14:00-15:00	52	59
15:00-16:00	51	52
16:00-17:00	55	52
17:00-18:00	53	55
18:00-19:00	57	53
19:00-20:00	46	48
20:00-21:00	52	79
21:00-22:00	44	64
Day L_{Aeq}	54	58
22:00-23:00	44	87
23:00-24:00	44	61
24:00-01:00	44	48
01:00-02:00	47	47
02:00-03:00	44	46
03:00-04:00	46	48
04:00-05:00	45	49
05:00-06:00	58	53
06:00-07:00	55	58
Night L_{Aeq}	47	55

Table1.3-14 Hourly LAeq value in noise monitoring stations (N9)

Unit: dBA

Time	10-11 May, 2018	11-12 May, 2018
7:00-8:00	58	60
8:00-9:00	61	63
9:00-10:00	61	63
10:00-11:00	59	70
11:00-12:00	59	61
12:00-13:00	58	58
13:00-14:00	59	59
14:00-15:00	67	62
15:00-16:00	55	68
16:00-17:00	66	57
17:00-18:00	64	66
18:00-19:00	57	51
19:00-20:00	48	49
20:00-21:00	64	55
21:00-22:00	66	55
Day L_{Aeq}	60	60
22:00-23:00	51	50
23:00-24:00	66	57
24:00-01:00	47	48
01:00-02:00	47	49
02:00-03:00	48	49
03:00-04:00	47	49
04:00-05:00	48	52
05:00-06:00	61	68
06:00-07:00	61	66
Night L_{Aeq}	53	54

Table1.3-15 Hourly LAeq value in noise monitoring stations (N10)

Unit: dBA

Time	9-10 days	10-11 days
7:00-8:00	69	60
8:00-9:00	64	60
9:00-10:00	65	72
10:00-11:00	57	64
11:00-12:00	56	62
12:00-13:00	75	57
13:00-14:00	62	64
14:00-15:00	59	60
15:00-16:00	69	60
16:00-17:00	61	58
17:00-18:00	65	66
18:00-19:00	68	69
19:00-20:00	67	58
20:00-21:00	63	64
21:00-22:00	50	78
Day L_{Aeq}	63	63
22:00-23:00	44	51
23:00-24:00	44	49
24:00-01:00	44	46
01:00-02:00	47	46
02:00-03:00	43	45
03:00-04:00	43	45
04:00-05:00	45	58
05:00-06:00	53	56
06:00-07:00	62	58
Night L_{Aeq}	47	51

1.4 Surface Water Quality

1.4.1 Survey Item

Parameters for water quality survey are determined so as to cover the parameters of existing environmental standards of Myanmar.

Table 1.4-1 Survey Parameters for Water Quality Survey

No.	Parameter	Unit	Myanmar Environmental Guideline Value
1	Temperature	^{o}C	-
2	pH	-	6 – 9
3	Dissolved Oxygen	mg/l	-
4	Electrical Conductivity (EC)	µS/cm	-
5	Total Dissolved Solid (TDS)	Ppm	-
6	Turbidity	FNU	-
7	BOD (5 days)	mg/l	50
8	COD	mg/l	250
9	Total Suspended Solids (TSS)	mg/l	50
10	Oil & Grease	mg/l	10
11	Total Coliform Bacteria	100 ml	400

Source: General Application; Wastewater, Storm water runoff, Effluent and sanitary discharges

(Myanmar National Environmental Guidelines (2015, Dec 29th))

1.4.2 Survey Locations

The coordinate locations of water samples and surveys are shown in Table 1.4-2.

Table 1.4-2 Sampling and survey points of surface water quality survey

Category	Sampling Point	Coordinates	Description of Sampling Points
Surface Water	SW 1	16°46'16.39"N 96° 7'26.42"E	Up stream of Gas Turbine, Yangon River, near about 0.25 kilometers West of Pipe line and south of project area.
Surface Water	SW 2	16° 46' 11.25"N 96° 7' 44.26"E	Upstream of Gas Turbine, Yangon River, near about 0.3 kilometers east of Pipe line.
Surface Water	SW 3	16° 45' 55.62"N 96° 7' 50.73"E	At mouth of Twantae Canal and about near the pipe line.
Surface Water	SW 4	16° 46' 3.46"N 96° 8' 2.27"E	Downstream of Twantae Canal, near near pipe line.
Surface Water	SW 5	16°43'44.85"N 96° 8'14.10"E	Downstream of Naung Ngok To Chaung, near the pipe line.
Surface Water	SW 6	16°43'46.82"N 96° 8'15.25"E	Upstream of Nyaung Ngok To Chaung, near the pipe line.
Surface Water	SW 7	16°40'57.67"N 96° 8'54.64"E	Downstream of Pyaw Bwe Chaung, near the pipe line (Pyaw Bwe Gyi village).
Surface Water	SW 8	16°40'58.36"N 96° 8'56.10"E	Upstream of Pyaw Bwe Chaung, near the pipe line (Pyaw Bwe Gyi village)
Surface Water	SW 9	16°40'14.17"N 96°10'19.41"E	Upstream of water location in Tha Nat Pin Chaung, near the pipe line (Tha Nat Pin bridge)
Surface Water	SW 10	16°40'14.04"N 96°10'18.72"E	Downstream of water location in Tha Nat Pin Chaung, near the pipe line (Tha Nat Pin bridge)
Surface Water	SW 11	16°39'39.81"N 96°11'9.78"E	Upstream of Ya Kaing Chaung, near the pipe line.
Surface Water	SW 12	16°39'40.99"N 96°11'10.60"E	Downstream of Ya Kaing Chaung, near about 0.02 kilometers noutheast of pipe line.
Surface Water	SW 13	16°39'42.26"N 96°13'49.15"E	Near FSRU Option 2 and near about 1.05 kilometers north of pipe line, in Yangon River.
Surface Water	SW 14	16°38'56.46"N 96°14'47.50"E	Near FSRU Option 2 and near about 1.59 kilometers of pipe line, in Yangon River.

SW1

SW1 was surveyed and collected at upstream of gas turbine in Yangon River, near about 0.25 kilometers west of pipe line and south of project area, Alone Township, Yangon. The Yangon River width of SW 1 is about 512.47 meters width (measured in Google Map). The turbidity is high. The flow rate of the river is generally about 0.069 m/s within high tide condition. The survey activities of SW 1 are shown in Figure 1.4-1.


Figure 1.4-1 Water quality survey at SW1

SW2

SW2 was measured Downstream of Gas Turbine, Yangon River and about 300 m east of pipe line, Alone Township, Yangon. SW 2 is near mouth of Twantae Canal and the turbidity is also high. The flow rate of the river is about 0.15 m/s within high tide. This river is mainly used for fishing and transportation. The survey activities of SW 2 are shown in Figure 1.4-2.


Figure 1.4-2 Water quality survey at SW2

SW3

SW3 was surveyed at mouth of Twantae Canal, near about 0.16 kilometers south of pipe line, Alone Township, Yangon. The canal width of SW 3 is about 387.95 meters width and the sampling point is located downstream of Thandwe Canal. The turbidity is high. The flow rate of the canal is about 0.057 m/s in high tide condition. The survey activities of SW 3 are shown in Figure 1.4-3.


Figure 1.4-3 Water quality survey at SW 3

SW4

SW4 was surveyed and collected at mouth of Twantae Canal and about 220 meters nearly northeast of pipe line, Da La Township, Yangon Region. The channel width of SW 4 is about 459.09 meters width and the sampling point is located downstream of Twantae Canal. The flow rate of the river is about 0.135 m/s. The survey activities of SW 4 are shown in Figure 1.4-4.


Figure 1.4-4 Water quality survey at SW4

SW5

SW 5 was surveyed in Nuaung Ngok To Chaung and about 0 kilometer east of pipe line nearly, Da La Township, Yangon Region. The canal width of SW 5 is about 5.36 meters width in dry season. The turbidity is moderate to high. The survey activities of SW 5 are shown in Figure 1.4-5.

Figure 1.4-5 Water quality survey at SW5

SW6

SW6 was surveyed in up stream of Nuaung Ngok To Chaung and about 0.03 kilometers east of pipe line, Da La Township, Yangon Region. The sampling point is located up stream of pipe line and beside the car road. There are a lot of waste disposal near the sampling point. The turbidity is moderate and transparency is low to medium. The survey activities of SW6 are shown in Figure 1.4-6.

Figure 1.4-6 Water quality survey at SW6

SW7

SW7 was collected at middle of Pyaw Bwe Chaung from bridge and it was located southwest of pipe line, near Pyaw Bwe village, Dala Township, Yangon Region. The channel width of SW7 is about 5.56 meters width and the sampling point is located near about 0.01 kilometer of pipe line. The medium transparency of water is found and turbidity is moderate. The survey activities of SW7 are shown in Figure 1.4-7.

Figure 1.4-7 Water quality survey at SW7

SW8

SW8 was surveyed at downstream of the project area in the Pyaw Bwe Chaung, in Pyaw Bwe Gyi village, Dala Township, Yangon Region. It is located near about 20 meter southeast of pipe line. SW 8 was sampling in the Pyaw Bwe Chaung where across from left to right bank distance is about 5.56 meters (measured in Google Map).The turbidity is moderate and the transparency of water is also medium. The survey activities of SW8 are shown in Figure 1.4-8.

Figure 1.4-8 Water quality survey at SW8

SW9

SW9 was collected in the Tha Nat Pin Chaung, in Pyaw Bwe Gyi village, Dala Township, Yangon Region. It is closely located southwest of pipe line. SW 9 was sampling in the upstream of Tha Nat Pin Chaung where across from left to right bank distance is about 5.56 meters (measured in Google Map), near Tha Net Pin bridge. The turbidity is moderate. The survey activities of SW8 are shown in Figure 1.4-9.

Figure 1.4-9 Water quality survey at SW9

SW10

SW10 was surveyed at downstream of Tha Nat Pin Chaung, Dala Township, Yangon Region. It is located near about 0.02 kilometers southwest of pipe line. SW 10 was sampling in the Pyaw Bwe Chaung near Tha Net Pin bridge.The turbidity is moderate and the transparency of water is medium. The survey activities of SW10 are shown in Figure 1.4-10.


Figure 1.4-10 Water quality survey at SW10

SW11

SW 11 was surveyed and collected at upstream of Ya Khaing Chaung, near about 20 meters southwest of pipe line, Dala Township, Yangon Region. The survey location is between Ya Khaing Gyaung village and Ton Tin Kan village. SW11 was sampled at the middle of the Ya Khaing Chaung from the Ya Khaing Chaung Bridge. The turbidity is moderate and transparency is medium. The survey activities of SW11 are shown in Figure 1.4-11.

Figure 1.4-11 Water quality survey at SW11

SW12

SW12 was surveyed and collected at downstream of Ya Khaing Chaung, , Dala Township, Yangon Region. It is located near about 0.02 kilometer northeast of pipe line. The Ya Khaing Chaung width of SW12 is about 45.87 meters width (measured in Google Map). The turbidity is high and transparency is low. The survey activities of SW12 are shown in Figure 1.4-12.

Figure 1.4-12 Water quality survey at SW12

SW 13

SW13 was surveyed and collected at upstream of FSRU option 2, Yangon River and it lies about 1.05 kilometers at northwest of pipe line and northwest of FSRU option 2, Dala Township, Yangon. The Yangon River width of SW 13 is about 2,171.77 meters width (measured in Google Map). The turbidity is high and the flow rate of the river is generally about 0.25 m/s within low tide. The survey activities of SW13 are shown in Figure 1.4-13.

Figure 1.4-13 Water quality survey at SW13

SW14

SW14 was surveyed at downstream of FSRU Option 2,Yangon River, near about 250 meters at southeast of pipe line and southwest of project area, Alone Township, Yangon. The width of Yangon River is 2,003.88 meters (measured in Google Map). The location of SW14 is located near Chaung Oo village and the southwest of proposed FSRU Option 2. The turbidity and transparency of water are high and low. The flow rate of the river is generally about 0.27 m/s within high tide. The survey activities of SW14 are shown in Figure 1.4-14.

Figure 1.4-14 Water quality survey at SW14

1.4.3 Survey Period

The sampling and measuring of the surface water were conducted on 3rd – 5th May, 2018.

1.4.4 Survey Method

Water samples were taken by Alpha horizontal water sampler and collected in plastic and sterilized glass sample containers. All sampling was in strict accordance with recognized standard procedures. The parameters as pH, temperature, dissolved oxygen (DO), electrical conductivity (EC), and total dissolved solid including the odor and color in visual analyzing were measured at each site concurrently with sample collection and. According to the Laboratory standard, some

samples were preserved using the chemicals. All samples were kept in iced boxes and were transported to the laboratory within 24 hours.

Moreover, the river survey; the flow rate, width and depth of river, was also measured using Vale port Flow Meter equipment and depth sounder.

Table 1.4-3 Field Equipment for surface water quality survey

No.	Equipment	Manufacturer	Originate Country	Model/Serial No.
1	SMART TROLL@ MP _Multi parameter for water	In_Situ Inc.	USA	SN - 346054
2	Multi Parameters for water quality	HANNA	USA	H17609823 (Turbidity Sensor)
3	Alpha Bottle (Water Sampler)m	Wildlife Supply Company®	Indonesia	Wildco P/N-1120-G45
4	Flow meter	GLOBAL WATER 800-876-1172	USA	FB211 Serial -1449006336
5	Depth Sounder	Japan	Japan	FP211/1136160536

Table 1.4-4 Analysis Method for Water Samples

No.	Item	Analysis Method
1	Temperature	SMART TROLL@MP _Multi parameter for water (pH sensor)
2	pH	SMART TROLL@MP _Multi parameter for water (DO sensor)
3	Dissolved Oxygen	SMART TROLL@MP _Multi parameter for water (EC/TDS sensor)
4	Electrical Conductivity (EC)	SMART TROLL@MP _Multi parameter for water (EC/TDS sensor)
5	Total Dissolved Solid (TDS)	SMART TROLL@MP _Multi parameter for water (EC/TDS sensor)
6	Turbidity	HANNA Multi Parameters (Turbidity sensor)

1.4.5 Survey Result

Laboratories

Water samples were sent to the STS Green Laboratory in Thailand. Water quality results are shown in following Table 1.4-5.

Table 1.4-5 In-Situ Measurement and laboratory analysis of Surface Water Quality

No.	Sample No./ Physical Parameter	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8
1	Location	Up stream of Yangon River	Downstream of Yangon River	At mouth of Twantae Canal (up)	At mouth of Twantae Canal (below)	Nuaung Ngok To Chaung (down)	Up stream of Nuaung Ngok To Chaung	Downstream of Pyaw Bwe Chaung	Up stream of Pyaw Bwe Gyi Chaung
2	Date/Time	4.5.2018 8:17	4.5.2018 9:30	3.5.2018 15:30	4.5.2018 10:17	5.5.2018 15:10	5.5.2018 15:20	5.5.2018 15:30	5.5.2018 15:35
3	Weather	Sunny	Sunny	Sunny	Sunny	Slightly Cloud	Slightly Rain	Sunny	Sunny
4	Transparency	Low	Low	Low	Low	Low to Medium	Low to Medium	Medium	Medium
5	Color	Buff	Buff	Buff	Buff	Yellowish Brown	Yellowish Brown	Light Green	Light Green
6	Water Depth (m)	10.5	3.5	11.5	5.5	-	-	-	-
7	Depth (of sample taken) (m)	1	1	1	1	-	-	-	-
-	Flow rate/velocity (m/s)	0.069	0.15	0.057	0.135	-	-	-	-
9	Tem (°C) (air & water)	30.7	30.9	31.8	31.0	34.7	35.4	34	34.2
10	pH	7.73	7.65	7.53	7.75	7.5	7.74	7.55	7.76
11	DO (mg/l)	5.2	5.19	4.02	5.01	3.38	5.18	8.02	8.05
12	EC (µs/m)	1061.3	1053.4	662.6	1087.3	11861.7	12502.4	23615.9	24067.1
13	TDS (ppm)	1229.3	1152.7	383.9	1078.8	6559.64	6864.89	13087.5	13240.85
14	Turbidity (FNU)	30.14	30.62	33.00	32.72	-	-	-	-
15	Remark	Sampling and Insitu test	Sampling and Insitu test	Sampling and Insitu test	Sampling and Insitu test	Sampled on 3/5/2018 14:45	Sampled on 3/5/2018 15:00	` Sampled on 3/5/2018 13:40	Sampled on 3/5/2018 14:00

No.	Sample No./ Physical Parameter	SW 9	SW 10	SW 11	SW 12	SW 13	SW 14
1	Location	Up stream of Tha Nat Pin Chaung	Downstream of Tha Nat Pin Chaung	Up stream of Ya Kaing Gyaung	Downstream of Ya Kaing Gyaung	Near FSRU Option 2, Yangon River	Near FSRU Option 2, Yangon River
2	Date/Time	5.5.2018 14:05	5.5.2018 14:18	5.5.2018 13:10	5.5.2018 13:30	3.5.2018 11:17	3.5.2018 12:00
3	Weather	Sunny	Sunny	Sunny	Sunny	Sunny	Slightly Cloud
4	Transparency	Medium	Medium	Medium	Medium	Low	Low
5	Color	Light Green	Light Green	Light Green	Light Green	Buff	Buff
6	Water Depth (m)	-	-	-	-	8.9	7.1
7	Depth (of sample taken) (m)	-	-	-	-	1	1
8	Flow rate/velocity (m/s)	-	-	-	-	0.25	0.27
9	Tem (°C) (air & water)	34.1	34.5	33.2	34.2	31.9	31.7
10	pH	8.14	8.13	7.83	7.65	7.5	7.4
11	DO (mg/l)	5.32	5.19	5.21	5.31	5.68	5.87
12	EC (µs/m)	22858.8	23091.6	22626.7	22885.5	2365	1373
13	TDS (ppm)	12702.8	12817.4	12724.7	12802.45	1370	1306
14	Turbidity (FNU)	-	-	-	-	38	36
15	Remark	Sampled on 3/5/2018 12:40	Sampled on 3/5/2018 12:20	Sampled on 3/5/2018 12:00	Sampled on 3/5/2018 12:10	Sampling and Insitu test	Sampling and Insitu test

1.5 Ground Water Quality

1.5.1 Survey Item

Parameters for water quality survey are determined so as to cover the parameters of existing environmental standards of Myanmar.

Table 1.5-1 Survey Parameters for Underground Water Quality Survey

No.	Parameter	Unit	Myanmar Environmental Guideline Value
1	Temperature	^{o}C	-
2	pH	-	6 – 9
3	Dissolved Oxygen	mg/l	-
4	Electrical Conductivity (EC)	µS/cm	-
5	Total Dissolved Solid (TDS)	Ppm	-
6	Turbidity	FNU	-
7	Total Suspended Solids (TSS)	mg/l	50

Source: General Application; Wastewater, Storm water runoff, Effluent and sanitary discharges (Myanmar National Environmental Guidelines (2015, Dec 29th))

1.5.2 Survey Locations

The locations of water samples and surveys are shown in Table 1.5-2. The detail of each sampling points are described as below.

Table 1.5-2 Sampling and survey points of underground water quality survey

Category	Sampling Point	Coordinates	Description of Sampling Point
Ground water	GW 1	16°40'59.81"N 96° 8'41.28"E	At well, Pyaw Bwe Gyi Village and about 90 meter at south of pipeline
Ground water	GW 2	16°45'0.67"N 96° 8'30.66"E	At well, beside the Botaza road, Dala,Township and about 40 meter at south of pipe line.
Ground water	GW 3	16°46'48.11"N 96° 8'11.26"E	At well, Tha Khin Mya park, Alone and about 1.01 meter at northeast of gas turbine.

GW1

GW1 was measured and collected at domestic well which is not fared from Dala main road and located about 90 meter from the proposed pipe line , Dala Township, Yangon Region. Although the survey location is surrounded by rice mills and houses; the well is used for domestic purposed especially for washing and not for drinking purpose. GW1 was surveyed and collected from the well at depth about 6 m. The transparency of water is high. The survey activities of GW1 are shown in Figure 1.5-1.

Figure 1.5-1 Groundwater quality survey at GW1

GW2

GW2 was located beside the Botaza Road, Dala Township, Yangon Region. The survey location is surrounded by many residential houses. This well is mainly used for domestic purposes and not for drinking. At first, water is colorless after a few minutes later it changes to yellowish colored. GW2 was surveyed and collected from the well at depth about 15 m. The survey activities of GW2 is shown in Figure 1.5-2

Figure 1.5-2 Groundwater quality survey at GW2

GW3

GW3 was surveyed and collected from the well situated in Tha Khin Mya Park, Alone Township, Yangon Region. GW 3 is located at the corner of Lower Kyeemyindaing Road and Aung Yadana Street. This well is mainly used for domestics for residents. GW3 was surveyed and collected from the well at depth about 13.7 m. The transparency of water is high. The survey activities of GW3 is shown in Figure 1.5-3


Figure 1.5-3 Groundwater quality survey at GW 3

1.5.3 Survey Period

The sampling and measuring of the surface water were conducted on 5th May, 2018.

1.5.4 Survey Method

Water samples were taken by Alpha horizontal water sampler for some wells and collected in plastic and sterilized glass sample containers. All sampling was in strict accordance with recognized standard procedures. The parameters as pH, temperature, dissolved oxygen (DO), electrical conductivity (EC), and total dissolved solid including the odor and color in visual analyzing were measured at each site concurrently with sample collection and. According to the Laboratory standard, some samples were preserved using the chemicals. All samples were kept in iced boxes and were transported to the laboratory within 24 hours.

Table 1.5-3 Field Equipment for Ground water quality survey

No.	Equipment	Manufacturer	Originate Country	Model/Serial No.
1	SMART TROLL@ MP _Multi parameter for water	In_Situ Inc.	USA	SN - 346054
2	Multi Parameters for water quality	HANNA	USA	H17609823 (Turbidity Sensor)
3	Alpha Bottle (Water Sampler)	Wildlife Supply Company®	Indonesia	Wildco P/N-1120-G45

The following table provides the test method for water quality.

Table 1.5-4 Analysis Method for Water Samples

No.	Item	Analysis Method
1	Temperature	SMART TROLL@MP _Multi parameter for water (pH sensor)
2	pH	SMART TROLL@MP _Multi parameter for water (DO sensor)
3	Dissolved Oxygen	SMART TROLL@MP _Multi parameter for water (EC/TDS sensor)
4	Electrical Conductivity (EC)	SMART TROLL@MP _Multi parameter for water (EC/TDS sensor)
5	Total Dissolved Solid (TDS)	SMART TROLL@MP _Multi parameter for water (EC/TDS sensor)
6	Turbidity	HANNA Multi Parameters (Turbidity sensor)

1.5.5 Survey Result

Laboratories

Water samples were sent to the STS Green Laboratory in Thailand. Water quality results are shown in following Table 1.5-5.

1.5-5 In-situ groundwater quality results

No.	Sample No./ Physical Parameter	GW-1	GW-2	GW-3
1	Location	Pyaw Bwe Gyi Village	Beside the Botaza Road , Dala	Tha Khin Mya Park
2	Date/Time	5.5.2018 14:45	5.5.2018 15:32	5.5.2018 17:10
3	Weather	Sunny	Slightly Cloud	Slightly Sunny
4	Transparency	High	Low to High	High
5	Color	Colorless	Slightly Yellow	Colorless
6	Water Depth (m)	6	15	34
7	Depth (of sample taken) (m)	-	-	-
8	Flow rate/velocity (m/s)	-	-	-
9	Tem (°C) (air & water)	30.4	28.4	25.1
10	pH	7.37	6.7	7.04
11	DO (mg/l)	1.25	1.15	2.32
12	EC (µs/m)	25986.5	5599.5	184
13	TDS (ppm)	15266.76	3367.46	111.41
14	Turbidity (FNU)	-	-	-
15	Remark	Sampled on 3/5/2018 14:15	Sampled on 3/5/2018 15:15	Sampled on 4/5/2018 14:30

1.6 Soil

1.6.1 Survey Item

Parameters for soil quality survey are determined so as to cover the parameters of existing available environmental standards. Soil sample was taken by the manual hand auger.

1.6.2 Survey Locations

The locations of soil samples and surveys are shown in Table 1.6-1. The detail of each sampling points are described as below.

Table 1.6-1 Sampling and survey points of soil quality survey

Category	Sampling Point	Coordinates	Description of Sampling Point
Soil	S0 1	16°46'29.86"N 96° 07'41.17"E	In the compound of Combined Cycle Power Plant Project (Ahlone), at project area, in Ahlone Township, Yangon Region
Soil	S0 2	16°46'7.14"N 96° 7'31.01"E	In the right bank (Conner of Yangon River) and Twan Te Canal, in Ahlone Township, Yangon Region
Soil	S0 3	16°45'59.11"N 96° 8'0.06"E	In the left bank of Twan Te Canal, Seikkyi Village, Dala Township, Yangon Region
Soil	S0 4	16°45'9.01"N 96° 7'55.77"E	Beside the street which located in Kyansitthar Ward, Ahlone Township, Yangon Region
Soil	S0 5	16°44'59.06"N 96° 8'30.30"E	Beside the road (near the paddy field), in Tapinshwehtee Ward, Ahlone Township, Yangon Region
Soil	S0 6	16°43'47.49"N 96° 8'15.41"E	In the paddy field which located in west of Gwa & Nuaung Ngok To Village, Dala Township, Yangon Region
Soil	S0 7	16°40'57.68"N 96° 8'55.93"E	In the paddy field (near Pyaw Bwe Gyi Village) which located in Dala Township, Yangon Region
Soil	S0 8	16°38'28.81"N 96°12'13.19"E	In the stream (the stream was run dry for now) which located in Shan Gan Village, Dala Township, Yangon Region
Soil	S0 9	16°39'4.89"N 96°14'20.95"E	In the paddy field (near FSRU Option 2), right bank of river, Chaung Oo Village, Dala Township, Yangon Region

S01

S01 was collected in the compound of Combine Cycle power plant Company Limited which located in project area, Ahlone Township, Yangon Region. Surveyed location is generally covered by shrub land and sparely mangrove forest. It situated in the left bank of Hlaing River. The soil sample was collected for top soil (30cm-50cm depth) and sub soil (80cm-100cm depth). The top soil and sub soil are mainly composed of organic materials and mud with dark grey color. Typical soil type is clayey soil. The location of S01 is shown in Figure 1.6-1.

Figure 1.6-1 Soil quality survey at S01

S02

S02 was surveyed in the right bank (corner of Yangon River) and Twan Te Canal located in Ahlone Township, Yangon Region. The survey location is approximately 0.06 kilometers south-east of gas pipeline which will construct later. The soil sample was collected for top soil (30cm-50cm depth) and sub soil (80cm-100cm depth). The top soil and sub soil color are light gray to reddish brown and mainly composed of residual organic materials. Physically soil type is siltly clay. The survey activity of S02 is shown in Figure 1.6-2.

Figure 1.6-2 Soil quality survey at S02

S03

S03 was collected in the left bank of Twan Te Canal which located in Seikkyi Village, Dala Township, and Yangon Region. It lies approximately 0.1 kilometers northeast of gas pipeline which will construct later. The top soil sample was taken from 30cm-50cm depth and sub soil sample was taken from 80cm-100cm depth. The top soil and sub soil are brownish grey color. Soil type is clay. The location of S03 is shown in Figure 1.6-3.

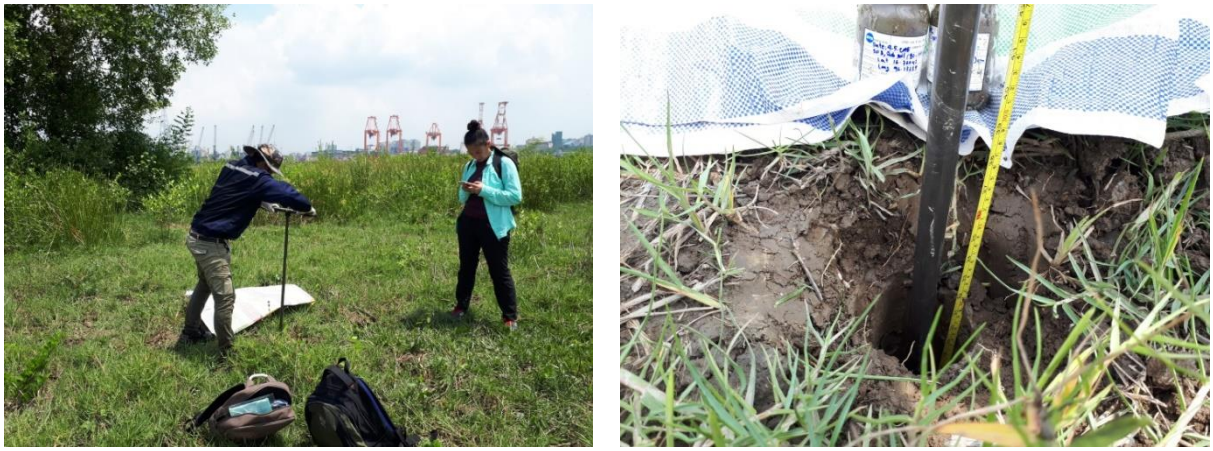

Figure 1.6-3 Soil quality survey at S03

S04

S04 was collected beside the street which located in Kyansitthar Ward, Dala Township, and Yangon Region. The survey location is approximately 0.03 kilometer west of gas pipeline which will construct later. The soil sample was collected for top soil (30cm-50cm depth) and sub soil (80cm-100cm depth). The top soil and sub soil are light brown color, siltly clay. The location of S04 is shown in Figure 1.6-4.

Figure 1.6-4 Soil quality survey at S04

S05

S05 was collected beside the road (near the paddy field) which located in Tapinshwehtee Ward, Dala Township, and Yangon Region. It lies approximately 0.02 kilometers southwest of gas pipeline which will construct later. The soil sample was collected for top soil (30cm-50cm depth) and sub soil (80cm-100cm depth) per location. The top soil and sub soil are greyish brown color clayey soil.

S06

S06 was collected in the paddy field which located in west of Gwa & Nuaung Ngok To Village, Dala Township, and Yangon Region. The survey location is approximately 0.03 kilometers east of gas pipeline which will construct later. S06 is generally covered by agricultural land. The soil sample was collected for top soil (30cm-50cm depth) and sub soil (80cm-100cm depth). The top soil and sub soil are light brown color silty clay.

S07

S07 was collected in the paddy field (near Pyaw Bwe Gyi Village) which located in Dala Township, and Yangon Region. It situated near the gas pipeline. S07 is generally flat terrain covering with agricultural land. The soil sample was collected for top soil (30cm-50cm depth) and sub soil (80cm-100cm depth) per location. The top soil and sub soil are light brown color silty clay.

S08

S08 was collected in the stream (dried in dry season) which located in Shan Gan Village, Dala Township, and Yangon Region. The survey location is approximately 0.01 kilometers south-west of gas pipeline which will construct later. S08 is generally flat terrain covering with agricultural land.

The soil sample was collected for top soil (30cm-50cm depth) and sub soil (80cm-100cm depth). The top soil and sub soil are dark brown color clayey soil. The survey location of S08 is shown in Figure 1.6-5.

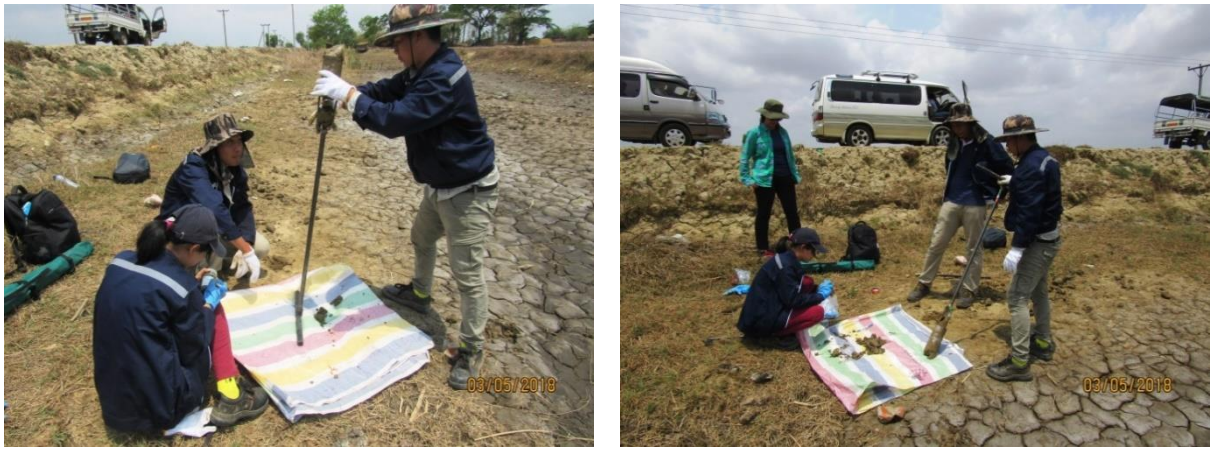

Figure 1.6-5 Soil quality survey at S08

S09

S09 was collected in the paddy field (right bank of river) which located in Chaung Oo Village, Dala Township, and Yangon Region. It lies approximately 0.73 kilometers south-east of gas pipeline which will construct later. S09 is generally flat terrain covering with agricultural land. The soil sample was collected for top soil (30cm-50cm depth) and sub soil (80cm-100cm depth). The top soil and sub soil color are light brown color silty clays. The survey location of S09 is shown in Figure 1.6-6.

Figure 1.6-6 Soil quality survey at S09

1.7 Sediment

1.7.1 Survey Item

Parameters for sediment survey are determined so as to cover the parameters of existing available environmental standards. Sediment sample was taken by the Grab Sampler.

1.7.2 Survey Locations

The locations of sediment samples and surveys are shown in Table 1.7-1. The detail of each sampling points are described as below.

Table 1.7-1 Sampling and survey points of sediment survey

Category	Sampling Point	Coordinates	Description of Sampling Point
Sediment	SE 1	16°46'16.68"N 96° 7'29.64"E	Near about 0.16 kilometers in the left bank of Yangon River (Upstream), Dala Township, Yangon Region
Sediment	SE 2	16°46'12.72"N 96° 7'41.88"E	Near about 0.22 kilometers in the left bank of Yangon River (Downstream), Dala Township, Yangon Region
Sediment	SE 3	16°45'56.19"N 96° 7'47.98"E	Near about 0.19 kilometers in the right bank of Twantae Canal, which located near the mouth of Twantae Canal, Dala Township, Yangon Region
Sediment	SE 4	16°39'40.66"N 96°13'34.87"E	Near about 0.05 kilometers in the left bank of Yangon River which located near That Kai Kwin Village, Dala Township, Yangon Region
Sediment	SE 5	16°39'21.60"N 96°14'21.48"E	Near about 0.09 kilometers in the left bank of Yangon River which located in Dala Township, Yangon Region
Sediment	SE 6	16°39'3.28"N 96°14'36.81"E	Near about 0.03 kilometers in the left bank of Yangon River which located near Chaung Oo Village, Dala Township, Yangon Region

SE1

SE1 was collected in the left of Yangon River (upstream) located about 0.16 kilometers of gas pipeline which will construct later, Dala Township, Yangon Region. It's located at south of project area and southwest of Asia Terminal port. The sample was collected from a boat using grab sampler set up. The survey activities of SE1 is shown in Figure 1.7-1.

Figure 1.7-1 Sediment survey at SE 1

SE 2

SE 2 was collected at downstream of Yangon River, about 0.22 kilometers of proposed gas pipeline, Dala Township, Yangon Region. It's situated south of project area and Asia Terminal port. Sediment was caught to a depth 1m. The survey activities of SE2 is shown in Figure 1.7-2.

Figure 1.7-2 Sediment survey at SE2

SE3

SE3 was collected at upstream of Twantae Canal, about 0.09 kilometers fared from canal bank and near about 0.17 kilometers of proposed gas pipeline Dala Township, Yangon Region. It's situated south of project area and Asia Terminal port. The sample will be taken from a boat using grab sampler set up. Sediment was caught to a depth 5m. The survey activities of SE3 is shown in Figure 1.7-3.

Figure 1.7-3 Sediment survey at SE3

SE4

SE4 was collected near about 0.05 kilometers in the left bank of Yangon River (upstream) which located near That Kai Kwin Village, Dala Township, and Yangon Region. It lies approximately 1.01 kilometers north-west of FSRU Option 2 which will construct later. The survey activities of SE4 is shown in Figure 1.7-4.

Figure 1.7-4 Sediment survey at SE4

SE5

SE5 was collected near about 0.09 kilometers in the left bank of Yangon River (upstream) in Dala Township, Yangon Region. It is lied approximately 0.17 kilometers of proposed FSRU Option 2. The survey activities of SE5 is shown in Figure 1.7-5.

Figure 1.7-5 Sediment survey at SE5

SE6

SE6 was collected near about 0.03 kilometers in the left bank of Yangon River (downstream) which located near Chaung Oo Village, Dala Township, and Yangon Region. It is located approximately 0.43 kilometers of proposed FSRU Option 2. The survey activities of SE6 is shown in Figure 1.7-6.

Figure 1.7-6 Sediment survey at SE6

1.7.3 Survey Period

The sampling and measuring of the sediment samples were conducted on 3rd-5th May, 2018.

1.7.4 Survey Method

Methodology

River sea bed sediments were collected by dive-based sampling method. Six stations were collected in this survey. At each station, sediment was collected in an amber glass bottle. Each benthic sample was then slowly sieved through a mesh size of 2.0, 1and 0.5mm. Firstly, benthic samples were sieved by 2.0 and 1.0mm mesh size. And then, it is continuously being sieved by 0.5mm size. Finally, the benthic samples were collected into the sieve of 1.0 and 0.5mm size. The specimens and coarse sediment that were retained in the sieve were collected in a plastic container and preserved in 10% formalin solution.

AQ1 (hourly wind speed and direction results)				AQ2 (hourly wind speed and direction results)			
Date	**Time**	**Wind Direction(Degree)**	**Wind Speed (kph)**	**Date**	**Time**	**Wind Direction(Degree)**	**Wind Speed (kph)**
2.5.2018	11:00-12:00	149	4.3	2/5/2018	13:00-14:00	52	5.28
2.5.2018	12:00-13:00	166	4.0	2/5/2018	14:00-15:00	54	5.64
2.5.2018	13:00-14:00	181	3.7	2/5/2018	15:00-16:00	51	7.24
2.5.2018	14:00-15:00	166	3.6	2/5/2018	16:00-17:00	47	6.95
2.5.2018	15:00-16:00	152	5.3	2/5/2018	17:00-18:00	49	6.81
2.5.2018	16:00-17:00	162	4	2/5/2018	18:00-19:00	62	4.00
2.5.2018	17:00-18:00	173	3.5	2/5/2018	19:00-20:00	59	3.75
2.5.2018	18:00-19:00	205	3.7	2/5/2018	20:00-21:00	76	2.77
2.5.2018	19:00-20:00	204	3.5	2/5/2018	21:00-22:00	53	2.60
2.5.2018	20:00-21:00	208	2.8	2/5/2018	22:00-23:00	67	1.28
3.5.2018	21:00-22:00	197	1.4	2/5/2018	23:00-00:00	52	1.89
3.5.2018	22:00-23:00	200	0.6	3/5/2018	00:00-01:00	59	1.09
3.5.2018	23:00-00:00	215	1.5	3/5/2018	01:00-02:00	63	1.27
3.5.2018	00:00-01:00	226	0.9	3/5/2018	02:00-03:00	45	3.17
3.5.2018	01:00-02:00	233	2.0	3/5/2018	03:00-04:00	44	3.68
3.5.2018	02:00-03:00	112	0.8	3/5/2018	04:00-05:00	51	4.16
3.5.2018	03:00-04:00	90	1.7	3/5/2018	05:00-06:00	46	4.34
3.5.2018	04:00-05:00	131	1.6	3/5/2018	06:00-07:00	41	4.51
3.5.2018	05:00-06:00	121	1.7	3/5/2018	07:00-08:00	43	4.80
3.5.2018	06:00-07:00	103	2.5	3/5/2018	08:00-09:00	46	4.53
3.5.2018	07:00-08:00	115	2.4	3/5/2018	09:00-10:00	49	3.56
3.5.2018	08:00-09:00	137	2.6	3/5/2018	10:00-11:00	47	4.56
3.5.2018	09:00-10:00	132	2.1	3/5/2018	11:00-12:00	43	4.48
3.5.2018	10:00-11:00	164	2.1	3/5/2018	12:00-13:00	63	4.33
3.5.2018	11:00-12:00	127	4.0	3/5/2018	13:00-14:00	53	4.66
3.5.2018	12:00-13:00	167	2.9	3/5/2018	14:00-15:00	139	3.18
3.5.2018	13:00-14:00	149	3.5	3/5/2018	15:00-16:00	131	2.14
3.5.2018	14:00-15:00	220	8.6	3/5/2018	16:00-17:00	130	2.59
3.5.2018	15:00-16:00	218	7.2	3/5/2018	17:00-18:00	194	2.83
3.5.2018	16:00-17:00	220	6.3	3/5/2018	18:00-19:00	195	3.08
3.5.2018	17:00-18:00	228	9.3	3/5/2018	19:00-20:00	133	1.40
3.5.2018	18:00-19:00	231	10.3	3/5/2018	20:00-21:00	201	0.63
3.5.2018	19:00-20:00	212	5.6	3/5/2018	21:00-22:00	221	1.87
3.5.2018	20:00-21:00	200	1.4	3/5/2018	22:00-23:00	223	2.31
3.5.2018	21:00-22:00	191	0.1	3/5/2018	23:00-00:00	224	2.94
3.5.2018	22:00-23:00	214	0.8	4/5/2018	00:00-01:00	226	3.65
3.5.2018	23:00-00:00	238	1.1	4/5/2018	01:00-02:00	223	3.13
4.5.2018	00:00-01:00	235	1.5	4/5/2018	02:00-03:00	218	2.64
4.5.2018	01:00-02:00	248	0.8	4/5/2018	03:00-04:00	220	1.20
4.5.2018	02:00-03:00	242	0.4	4/5/2018	04:00-05:00	219	1.09
4.5.2018	03:00-04:00	241	0.1	4/5/2018	05:00-06:00	217	0.97
4.5.2018	04:00-05:00	231	0.0	4/5/2018	06:00-07:00	214	0.70
4.5.2018	05:00-06:00	233	0.3	4/5/2018	07:00-08:00	213	1.74
4.5.2018	06:00-07:00	227	0.0	4/5/2018	08:00-09:00	221	1.04
4.5.2018	07:00-08:00	239	0.2	4/5/2018	09:00-10:00	220	1.21
4.5.2018	08:00-09:00	196	0.1	4/5/2018	10:00-11:00	69	2.93
4.5.2018	09:00-10:00	239	0.3	4/5/2018	11:00-12:00	59	4.72
4.5.2018	10:00-11:00	200	2.3	4/5/2018	12:00-13:00	65	4.91
4.5.2018	11:00-12:00	198	4.0	4/5/2018	13:00-14:00	214	3.26
4.5.2018	12:00-13:00	205	4.9	4/5/2018	14:00-15:00	145	3.28
4.5.2018	13:00-14:00	118	8.3	4/5/2018	15:00-16:00	48	3.98
4.5.2018	14:00-15:00	122	3.7	4/5/2018	16:00-17:00	55	3.20
4.5.2018	15:00-16:00	188	3.2	4/5/2018	17:00-18:00	51	1.85
4.5.2018	16:00-17:00	187	1.6	4/5/2018	18:00-19:00	194	1.56
4.5.2018	17:00-18:00	177	0.7	4/5/2018	19:00-20:00	215	2.73
4.5.2018	18:00-19:00	216	4.8	4/5/2018	20:00-21:00	219	0.53
4.5.2018	19:00-20:00	147	2.4	4/5/2018	21:00-22:00	215	0.48
4.5.2018	20:00-21:00	123	0.0	4/5/2018	22:00-23:00	217	0.44
4.5.2018	21:00-22:00	5	0.0	4/5/2018	23:00-00:00	224	0.51
4.5.2018	22:00-23:00	5	0.0	5/5/2018	00:00-01:00	227	0.12
4.5.2018	23:00-00:00	98	0.0	5/5/2018	01:00-02:00	222	0.38
5.5.2018	00:00-01:00	184	0.0	5/5/2018	02:00-03:00	230	0.46
5.5.2018	01:00-02:00	275	0.1	5/5/2018	03:00-04:00	226	0.09
5.5.2018	02:00-03:00	250	0.1	5/5/2018	04:00-05:00	228	0.01
5.5.2018	03:00-04:00	250	0.0	5/5/2018	05:00-06:00	224	0.00
5.5.2018	04:00-05:00	251	0.0	5/5/2018	06:00-07:00	203	0.01
5.5.2018	05:00-06:00	94	0.0	5/5/2018	07:00-08:00	199	0.94
5.5.2018	06:00-07:00	200	0.0	5/5/2018	08:00-09:00	204	1.25

5.5.2018	07:00-08:00	218	0.1	5/5/2018	09:00-10:00	218	1.78
5.5.2018	08:00-09:00	237	0.8	5/5/2018	10:00-11:00	186	2.20
5.5.2018	09:00-10:00	245	0.9	5/5/2018	11:00-12:00	149	2.64
5.5.2018	10:00-11:00	207	1.7	5/5/2018	12:00-13:00	152	2.95

AQ3 (hourly wind speed and direction results)				AQ4 (hourly wind speed and direction results)			
Date	**Time**	**Wind Direction (Degree)**	**Wind Speed (kph)**	**Date**	**Time**	**Wind Direction (Degree)**	**Wind Speed (kph**
2.5.2018	15:00-16:00	274.86	4.77	12.5.2018	16:00-17:00	320	0.00
2.5.2018	16:00-17:00	288.87	5.03	12.5.2018	17:00-18:00	320	0.00
2.5.2018	17:00-18:00	270.25	5.60	12.5.2018	18:00-19:00	263	0.00
2.5.2018	18:00-19:00	256.37	6.00	12.5.2018	19:00-20:00	169	0.00
2.5.2018	19:00-20:00	268.07	3.42	12.5.2018	20:00-21:00	169	0.00
2.5.2018	20:00-21:00	221.68	2.49	12.5.2018	21:00-22:00	169	0.00
2.5.2018	21:00-22:00	210.57	1.96	12.5.2018	22:00-23:00	169	0.00
2.5.2018	22:00-23:00	122.55	1.65	12.5.2018	23:00-00:00	169	0.00
2.5.2018	23:00-00:00	33.88	0.88	13.5.2018	00:00-01:00	169	0.00
3.5.2018	00:00-01:00	64.80	0.62	13.5.2018	01:00-02:00	169	0.00
3.5.2018	01:00-02:00	49.02	0.79	13.5.2018	02:00-03:00	169	0.00
3.5.2018	02:00-03:00	64.16	1.45	13.5.2018	03:00-04:00	169	0.00
3.5.2018	03:00-04:00	232.00	0.00	13.5.2018	04:00-05:00	169	0.00
3.5.2018	04:00-05:00	232.00	0.00	13.5.2018	05:00-06:00	169	0.00
3.5.2018	05:00-06:00	232.00	0.00	13.5.2018	06:00-07:00	272	0.00
3.5.2018	06:00-07:00	232.00	0.00	13.5.2018	07:00-08:00	310	0.00
3.5.2018	07:00-08:00	232.00	1.29	13.5.2018	08:00-09:00	310	0.00
3.5.2018	08:00-09:00	354.00	1.31	13.5.2018	09:00-10:00	218	0.03
3.5.2018	09:00-10:00	360.00	1.25	13.5.2018	10:00-11:00	229	0.00
3.5.2018	10:00-11:00	43.00	1.65	13.5.2018	11:00-12:00	216	0.02
3.5.2018	11:00-12:00	283.00	2.24	13.5.2018	12:00-13:00	249	0.06
3.5.2018	12:00-13:00	257.00	1.60	13.5.2018	13:00-14:00	218	0.10
3.5.2018	13:00-14:00	262.00	2.44	13.5.2018	14:00-15:00	248	0.06
3.5.2018	14:00-15:00	353.00	4.99	13.5.2018	15:00-16:00	242	0.07
3.5.2018	15:00-16:00	263.00	3.57	13.5.2018	16:00-17:00	293	0.10
3.5.2018	16:00-17:00	285.00	3.14	13.5.2018	17:00-18:00	317	0.08
3.5.2018	17:00-18:00	323.00	5.13	13.5.2018	18:00-19:00	289	0.01
3.5.2018	18:00-19:00	332.00	5.39	13.5.2018	19:00-20:00	215	0.01
3.5.2018	19:00-20:00	218.43	4.60	13.5.2018	20:00-21:00	200	0.02
3.5.2018	20:00-21:00	188.10	2.53	13.5.2018	21:00-22:00	236	0.01
3.5.2018	21:00-22:00	172.57	0.47	13.5.2018	22:00-23:00	237	0.00
3.5.2018	22:00-23:00	155.57	0.52	13.5.2018	23:00-00:00	237	0.00
3.5.2018	23:00-00:00	80.47	0.35	13.5.2018	00:00-01:00	237	0.00
4.5.2018	00:00-01:00	160.98	0.44	13.5.2018	01:00-02:00	237	0.00
4.5.2018	01:00-02:00	149.27	0.21	14.5.2018	02:00-03:00	232	0.00
4.5.2018	02:00-03:00	66.82	0.27	14.5.2018	03:00-04:00	232	0.00
4.5.2018	03:00-04:00	46.73	0.03	14.5.2018	04:00-05:00	232	0.00
4.5.2018	04:00-05:00	99.93	0.07	14.5.2018	05:00-06:00	232	0.00
4.5.2018	05:00-06:00	119.68	0.02	14.5.2018	06:00-07:00	231	0.00
4.5.2018	06:00-07:00	217.57	0.08	14.5.2018	07:00-08:00	231	0.00
4.5.2018	07:00-08:00	163.95	0.59	14.5.2018	08:00-09:00	197	0.02
4.5.2018	08:00-09:00	183.07	0.53	14.5.2018	09:00-10:00	151	0.05
4.5.2018	09:00-10:00	164.90	0.76	14.5.2018	10:00-11:00	224	0.02
4.5.2018	10:00-11:00	251.32	1.97	14.5.2018	11:00-12:00	152	0.02
4.5.2018	11:00-12:00	274.83	2.81	14.5.2018	12:00-13:00	187	0.09
4.5.2018	12:00-13:00	280.60	4.14	14.5.2018	13:00-14:00	171	0.01
4.5.2018	13:00-14:00	183.48	2.81	14.5.2018	14:00-15:00	185	0.00
4.5.2018	14:00-15:00	226.55	1.90	14.5.2018	15:00-16:00	218	0.04
4.5.2018	15:00-16:00	269.42	1.95	14.5.2018	16:00-17:00	233	0.18
4.5.2018	16:00-17:00	279.48	1.75	14.5.2018	17:00-18:00	314	0.10
4.5.2018	17:00-18:00	265.73	0.95	14.5.2018	18:00-19:00	235	0.60
4.5.2018	18:00-19:00	209.87	2.89	14.5.2018	19:00-20:00	181	0.07

4.5.2018	19:00-20:00	90.37	1.68	14.5.2018	20:00-21:00	144	0.00
4.5.2018	20:00-21:00	56.65	0.49	14.5.2018	21:00-22:00	144	0.00
4.5.2018	21:00-22:00	90.58	0.49	14.5.2018	22:00-23:00	144	0.00
4.5.2018	22:00-23:00	186.78	0.46	14.5.2018	23:00-00:00	144	0.00
4.5.2018	23:00-00:00	60.12	0.33	15.5.2018	00:00-01:00	144	0.00
5.5.2018	00:00-01:00	67.05	0.22	15.5.2018	01:00-02:00	144	0.00
5.5.2018	01:00-02:00	21.95	0.08	15.5.2018	02:00-03:00	144	0.00
5.5.2018	02:00-03:00	22.10	0.17	15.5.2018	03:00-04:00	144	0.00
5.5.2018	03:00-04:00	19.00	0.03	15.5.2018	04:00-05:00	144	0.00
5.5.2018	04:00-05:00	311.98	0.02	15.5.2018	05:00-06:00	144	0.00
5.5.2018	05:00-06:00	51.10	0.00	15.5.2018	06:00-07:00	144	0.00
5.5.2018	06:00-07:00	321.28	0.07	15.5.2018	07:00-08:00	154	0.00
5.5.2018	07:00-08:00	106.80	0.84	15.5.2018	08:00-09:00	173	0.00
5.5.2018	08:00-09:00	128.07	1.03	15.5.2018	09:00-10:00	130	0.03
5.5.2018	09:00-10:00	191.68	0.56	15.5.2018	10:00-11:00	119	0.04
5.5.2018	10:00-11:00	210.63	1.88	15.5.2018	11:00-12:00	176	0.04
5.5.2018	11:00-12:00	154.27	2.58	15.5.2018	12:00-13:00	159	0.07
5.5.2018	12:00-13:00	204.82	3.00	15.5.2018	13:00-14:00	137	0.13
5.5.2018	13:00-14:00	251.00	4.39	15.5.2018	14:00-15:00	198	0.09
5.5.2018	14:00-15:00	206.17	4.66	15.5.2018	15:00-16:00	273	0.40

AQ5 (hourly wind speed and direction results)				**AQ6 (hourly wind speed and direction results)**			
Date	**Time**	**Wind Direction (Degree)**	**Wind speed (kph)**	**Date**	**Time**	**Wind Direction (Degree)**	**Wind speed (kph)**
6.5.2018	11:00-12:00	140	5.82	6/5/2018	13:00-14:00	228	1.9
6.5.2018	12:00-13:00	245	4.22	6/5/2018	14:00-15:00	189	1.9
6.5.2018	13:00-14:00	248	3.21	6/5/2018	15:00-16:00	120	4.2
6.5.2018	14:00-15:00	209	3.24	6/5/2018	16:00-17:00	134	4.8
6.5.2018	15:00-16:00	167	6.11	6/5/2018	17:00-18:00	129	4.7
6.5.2018	16:00-17:00	172	5.10	6/5/2018	18:00-19:00	131	3
6.5.2018	17:00-18:00	171	3.07	6/5/2018	19:00-20:00	181	1.2
6.5.2018	18:00-19:00	175	1.54	6/5/2018	20:00-21:00	140	0.8
6.5.2018	19:00-20:00	206	1.72	6/5/2018	21:00-22:00	219	0.4
6.5.2018	20:00-21:00	196	0.56	6/5/2018	22:00-23:00	229	0.1
6.5.2018	21:00-22:00	229	1.01	6/5/2018	23:00-00:00	228	0.3
6.5.2018	22:00-23:00	228	0.31	7/5/2018	00:00-01:00	221	0.1
6.5.2018	23:00-00:00	230	0.43	7/5/2018	01:00-02:00	242	0.1
7.5.2018	00:00-01:00	234	0.76	7/5/2018	02:00-03:00	235	0.7
7.5.2018	01:00-02:00	235	1.01	7/5/2018	03:00-04:00	228	0.2
7.5.2018	02:00-03:00	246	2.87	7/5/2018	04:00-05:00	237	0.0
7.5.2018	03:00-04:00	245	3.23	7/5/2018	05:00-06:00	213	0.0
7.5.2018	04:00-05:00	254	1.16	7/5/2018	06:00-07:00	114	0.1
7.5.2018	05:00-06:00	264	0.68	7/5/2018	07:00-08:00	240	1.1
7.5.2018	06:00-07:00	193	0.26	7/5/2018	08:00-09:00	256	2.0
7.5.2018	07:00-08:00	242	1.79	7/5/2018	09:00-10:00	242	2.5
7.5.2018	08:00-09:00	264	5.65	7/5/2018	10:00-11:00	253	1.9
7.5.2018	09:00-10:00	272	5.89	7/5/2018	11:00-12:00	253	2.3
7.5.2018	10:00-11:00	254	5.17	7/5/2018	12:00-13:00	264	2.3
7.5.2018	11:00-12:00	239	5.72	7/5/2018	13:00-14:00	262	2.0
7.5.2018	12:00-13:00	256	5.74	7/5/2018	14:00-15:00	250	2.1
7.5.2018	13:00-14:00	256	5.43	7/5/2018	15:00-16:00	20	0.4
7.5.2018	14:00-15:00	250	4.92	7/5/2018	16:00-17:00	245	1.2
7.5.2018	15:00-16:00	261	3.70	7/5/2018	17:00-18:00	192	1.6
7.5.2018	16:00-17:00	259	3.19	7/5/2018	18:00-19:00	120	3.0
7.5.2018	17:00-18:00	233	4.06	7/5/2018	19:00-20:00	126	2
7.5.2018	18:00-19:00	190	1.51	7/5/2018	20:00-21:00	146	0.3
7.5.2018	19:00-20:00	181	1.23	7/5/2018	21:00-22:00	234	0.7
7.5.2018	20:00-21:00	211	0.57	7/5/2018	22:00-23:00	245	0.2

7.5.2018	21:00-22:00	238	1.92	7/5/2018	23:00-00:00	239	0.8
7.5.2018	22:00-23:00	243	0.97	8/5/2018	00:00-01:00	241	0.4
7.5.2018	23:00-00:00	236	1.62	8/5/2018	01:00-02:00	238	0.4
8.5.2018	00:00-01:00	234	1.54	8/5/2018	02:00-03:00	239	0.8
8.5.2018	01:00-02:00	228	0.38	8/5/2018	03:00-04:00	226	0.4
8.5.2018	02:00-03:00	232	1.83	8/5/2018	04:00-05:00	229	0.0
8.5.2018	03:00-04:00	232	0.93	8/5/2018	05:00-06:00	229	0.0
8.5.2018	04:00-05:00	231	0.39	8/5/2018	06:00-07:00	220	0.0
8.5.2018	05:00-06:00	191	0.08	8/5/2018	07:00-08:00	239	1.2
8.5.2018	06:00-07:00	209	0.15	8/5/2018	08:00-09:00	265	2.0
8.5.2018	07:00-08:00	256	3.89	8/5/2018	09:00-10:00	258	2.8
8.5.2018	08:00-09:00	278	5.88	8/5/2018	10:00-11:00	249	2.7
8.5.2018	09:00-10:00	276	6.55	8/5/2018	11:00-12:00	244	2.6
8.5.2018	10:00-11:00	268	5.98	8/5/2018	12:00-13:00	258	1.7
8.5.2018	11:00-12:00	253	4.98	8.5.2018	13:00-14:00	259	2.2
8.5.2018	12:00-13:00	246	4.22	8.5.2018	14:00-15:00	238	1.8
8.5.2018	13:00-14:00	254	5.39	8.5.2018	15:00-16:00	248	1.8
8.5.2018	14:00-15:00	250	4.16	8.5.2018	16:00-17:00	244	2.0
8.5.2018	15:00-16:00	248	5.59	8.5.2018	17:00-18:00	218	1.3
8.5.2018	16:00-17:00	251	4.78	8.5.2018	18:00-19:00	124	2.8
8.5.2018	17:00-18:00	238	3.42	8.5.2018	19:00-20:00	180	1
8.5.2018	18:00-19:00	187	1.17	8.5.2018	20:00-21:00	224	0.7
8.5.2018	19:00-20:00	211	0.73	8.5.2018	21:00-22:00	226	0.4
8.5.2018	20:00-21:00	222	0.90	8.5.2018	22:00-23:00	244	0.2
8.5.2018	21:00-22:00	233	0.31	8.5.2018	23:00-00:00	234	0.4
8.5.2018	22:00-23:00	256	1.25	9.5.2018	00:00-01:00	225	0.4
8.5.2018	23:00-00:00	255	2.14	9.5.2018	01:00-02:00	234	0.7
9.5.2018	00:00-01:00	252	1.50	9.5.2018	02:00-03:00	224	0.3
9.5.2018	01:00-02:00	241	1.58	9.5.2018	03:00-04:00	234	0.6
9.5.2018	02:00-03:00	227	0.90	9.5.2018	04:00-05:00	169	0.1
9.5.2018	03:00-04:00	231	1.23	9.5.2018	05:00-06:00	231	0.1
9.5.2018	04:00-05:00	227	0.18	9.5.2018	06:00-07:00	115	0.0
9.5.2018	05:00-06:00	238	0.06	9.5.2018	07:00-08:00	194	0.7
9.5.2018	06:00-07:00	218	0.01	9.5.2018	08:00-09:00	243	2.0
9.5.2018	07:00-08:00	235	0.98	9.5.2018	09:00-10:00	237	1.7
9.5.2018	08:00-09:00	275	4.33	9.5.2018	10:00-11:00	253	1.6
9.5.2018	09:00-10:00	263	3.88	9.5.2018	11:00-12:00	254	1.7
9.5.2018	10:00-11:00	246	4.33	9.5.2018	12:00-13:00	254	2.6

AQ7 (hourly wind speed and direction results)				**AQ8 (hourly wind speed and direction results)**			
Date	**Time**	**Wind Direction (Degree)**	**Wind speed (kph)**	**Date**	**Time**	**Wind Direction (Degree)**	**Wind speed (kph)**
6.5.2018	14:00-15:00	218	4.41	9.5.2018	16:00-17:00	188	3
6.5.2018	15:00-16:00	189	12.06	9.5.2018	17:00-18:00	181	2
6.5.2018	16:00-17:00	194	11.77	9.5.2018	18:00-19:00	190	2
6.5.2018	17:00-18:00	197	8.57	9.5.2018	19:00-20:00	190	2
6.5.2018	18:00-19:00	190	4.56	9.5.2018	20:00-21:00	193	1
6.5.2018	19:00-20:00	190	2.16	9.5.2018	21:00-22:00	196	0
6.5.2018	20:00-21:00	193	1.66	9.5.2018	22:00-23:00	193	0
6.5.2018	21:00-22:00	196	0.01	10.5.2018	23:00-00:00	192	0
6.5.2018	22:00-23:00	193	0.00	10.5.2018	00:00-01:00	215	0
6.5.2018	23:00-00:00	192	0.00	10.5.2018	01:00-02:00	221	0
7.5.2018	00:00-01:00	213	0.00	10.5.2018	02:00-03:00	226	1
7.5.2018	01:00-02:00	220	0.00	10.5.2018	03:00-04:00	233	1

7.5.2018	02:00-03:00	225	0.18	10.5.2018	04:00-05:00	229	1
7.5.2018	03:00-04:00	232	0.18	10.5.2018	05:00-06:00	205	0
7.5.2018	04:00-05:00	230	0.05	10.5.2018	06:00-07:00	206	0
7.5.2018	05:00-06:00	209	0.00	10.5.2018	07:00-08:00	245	0
7.5.2018	06:00-07:00	206	0.02	10.5.2018	08:00-09:00	229	0
7.5.2018	07:00-08:00	231	0.48	10.5.2018	09:00-10:00	180	0
7.5.2018	08:00-09:00	252	2.40	10.5.2018	10:00-11:00	267	1
7.5.2018	09:00-10:00	187	2.76	10.5.2018	11:00-12:00	110	3
7.5.2018	10:00-11:00	256	2.45	10.5.2018	12:00-13:00	150	1
7.5.2018	11:00-12:00	135	1.93	10.5.2018	13:00-14:00	130	2
7.5.2018	12:00-13:00	144	2.37	10.5.2018	14:00-15:00	139	1
7.5.2018	13:00-14:00	128	1.88	10.5.2018	15:00-16:00	155	1
7.5.2018	14:00-15:00	128	1.96	10.5.2018	16:00-17:00	165	4
7.5.2018	15:00-16:00	162	0.88	10.5.2018	17:00-18:00	174	4
7.5.2018	16:00-17:00	155	0.64	10.5.2018	18:00-19:00	178	3
7.5.2018	17:00-18:00	196	3.34	10.5.2018	19:00-20:00	180	2
7.5.2018	18:00-19:00	199	5.38	10.5.2018	20:00-21:00	145	6
7.5.2018	19:00-20:00	199	4.61	10.5.2018	21:00-22:00	218	1
7.5.2018	20:00-21:00	201	0.23	10.5.2018	22:00-23:00	115	0
7.5.2018	21:00-22:00	282	0.18	10.5.2018	23:00-00:00	211	0
7.5.2018	22:00-23:00	273	0.05	11.5.2018	00:00-01:00	229	0
7.5.2018	23:00-00:00	263	0.03	11.5.2018	01:00-02:00	229	0
8.5.2018	00:00-01:00	259	0.00	11.5.2018	02:00-03:00	188	0
8.5.2018	01:00-02:00	225	0.00	11.5.2018	03:00-04:00	184	0
8.5.2018	02:00-03:00	224	0.00	11.5.2018	04:00-05:00	147	0
8.5.2018	03:00-04:00	235	0.00	11.5.2018	05:00-06:00	39	4
8.5.2018	04:00-05:00	248	0.00	11.5.2018	06:00-07:00	67	4
8.5.2018	05:00-06:00	240	0.00	11.5.2018	07:00-08:00	93	6
8.5.2018	06:00-07:00	240	0.00	11.5.2018	08:00-09:00	96	8
8.5.2018	07:00-08:00	289	0.48	11.5.2018	09:00-10:00	97	8
8.5.2018	08:00-09:00	303	1.84	11.5.2018	10:00-11:00	115	8
8.5.2018	09:00-10:00	287	2.29	11.5.2018	11:00-12:00	123	6
8.5.2018	10:00-11:00	290	2.25	11.5.2018	12:00-13:00	129	3
8.5.2018	11:00-12:00	242	2.37	11.5.2018	13:00-14:00	119	2
8.5.2018	12:00-13:00	86	3.58	11.5.2018	14:00-15:00	121	1
8.5.2018	13:00-14:00	177	2.39	11.5.2018	15:00-16:00	108	2
8.5.2018	14:00-15:00	274	1.18	11.5.2018	16:00-17:00	171	2
8.5.2018	15:00-16:00	272	1.44	11.5.2018	17:00-18:00	182	2
8.5.2018	16:00-17:00	237	0.71	11.5.2018	18:00-19:00	181	1
8.5.2018	17:00-18:00	218	1.69	11.5.2018	19:00-20:00	176	1
8.5.2018	18:00-19:00	195	5.69	11.5.2018	20:00-21:00	171	0
8.5.2018	19:00-20:00	198	1.24	11.5.2018	21:00-22:00	156	0
8.5.2018	20:00-21:00	225	0.02	11.5.2018	22:00-23:00	179	0
8.5.2018	21:00-22:00	233	0.03	11.5.2018	23:00-00:00	208	1

8.5.2018	22:00-23:00	289	0.01	12.5.2018	00:00-01:00	168	0
8.5.2018	23:00-00:00	299	0.00	12.5.2018	01:00-02:00	171	0
9.5.2018	00:00-01:00	299	0.00	12.5.2018	02:00-03:00	171	0
9.5.2018	01:00-02:00	229	0.00	12.5.2018	03:00-04:00	171	0
9.5.2018	02:00-03:00	232	0.00	12.5.2018	04:00-05:00	171	0
9.5.2018	03:00-04:00	242	0.00	12.5.2018	05:00-06:00	171	0
9.5.2018	04:00-05:00	250	0.00	12.5.2018	06:00-07:00	169	0
9.5.2018	05:00-06:00	250	0.00	12.5.2018	07:00-08:00	91	0
9.5.2018	06:00-07:00	238	0.00	12.5.2018	08:00-09:00	134	0
9.5.2018	07:00-08:00	239	0.10	12.5.2018	09:00-10:00	130	0
9.5.2018	08:00-09:00	292	0.88	12.5.2018	10:00-11:00	184	1
9.5.2018	09:00-10:00	278	0.79	12.5.2018	11:00-12:00	108	4
9.5.2018	10:00-11:00	268	0.87	12.5.2018	12:00-13:00	116	2
9.5.2018	11:00-12:00	229	0.94	12.5.2018	13:00-14:00	235	1
9.5.2018	12:00-13:00	189	1.72	12.5.2018	14:00-15:00	231	0
9.5.2018	13:00-14:00	196	1.88	12.5.2018	15:00-16:00	231	0

AQ9 (hourly wind speed and direction results)				**AQ10 (hourly wind speed and direction results)**			
Date	**Time**	**Wind Direction (Degree)**	**Wind speed (kph)**	**Date**	**Time**	**Wind Direction (Degree)**	**Wind speed (kph)**
9.5.2018	14:00-15:00	217.56	16.32	9.5.2018	15:00-16:00	0	4.87
9.5.2018	15:00-16:00	246.93	14.31	9.5.2018	16:00-17:00	0	5.21
9.5.2018	16:00-17:00	261.92	9.78	9.5.2018	17:00-18:00	0	2.43
9.5.2018	17:00-18:00	245.15	11.81	9.5.2018	18:00-19:00	0	4.01
9.5.2018	18:00-19:00	251.87	10.70	9.5.2018	19:00-20:00	0	3.29
9.5.2018	19:00-20:00	264.03	7.30	9.5.2018	20:00-21:00	0	3.05
9.5.2018	20:00-21:00	268.22	6.99	9.5.2018	21:00-22:00	0	3.13
9.5.2018	21:00-22:00	276.23	4.98	9.5.2018	22:00-23:00	0	3.55
9.5.2018	22:00-23:00	270.02	5.20	9.5.2018	23:00-00:00	0	2.78
9.5.2018	23:00-00:00	277.52	4.29	9.5.2018	00:00-01:00	0	2.93
10.5.2018	00:00-01:00	281.85	2.62	10.5.2018	01:00-02:00	0	3.83
10.5.2018	01:00-02:00	284.37	1.89	10.5.2018	02:00-03:00	0	4.03
10.5.2018	02:00-03:00	288.62	1.15	10.5.2018	03:00-04:00	0	1.81
10.5.2018	03:00-04:00	262.70	7.59	10.5.2018	04:00-05:00	0	0.02
10.5.2018	04:00-05:00	285.13	1.03	10.5.2018	05:00-06:00	0	0.00
10.5.2018	05:00-06:00	77.68	3.63	10.5.2018	06:00-07:00	0	0.12
10.5.2018	06:00-07:00	95.22	4.46	10.5.2018	07:00-08:00	0	0.06
10.5.2018	07:00-08:00	133.12	6.74	10.5.2018	08:00-09:00	0	0.14
10.5.2018	08:00-09:00	143.75	9.50	10.5.2018	09:00-10:00	0	0.19
10.5.2018	09:00-10:00	143.50	9.41	10.5.2018	10:00-11:00	0	0.01
10.5.2018	10:00-11:00	139.15	5.09	10.5.2018	11:00-12:00	0	0.25
10.5.2018	11:00-12:00	120.85	2.55	10.5.2018	12:00-13:00	0	1.12
10.5.2018	12:00-13:00	182.42	5.05	10.5.2018	13:00-14:00	0	1.39

10.5.2018	13:00-14:00	205.15	9.60	10.5.2018	14:00-15:00	153	1.65
10.5.2018	14:00-15:00	208.08	12.00	10.5.2018	15:00-16:00	161	2.30
10.5.2018	15:00-16:00	210.08	16.32	10.5.2018	16:00-17:00	173	2.12
10.5.2018	16:00-17:00	232.40	16.75	10.5.2018	17:00-18:00	182	2.12
10.5.2018	17:00-18:00	235.55	15.94	10.5.2018	18:00-19:00	188	1.85
10.5.2018	18:00-19:00	238.88	14.88	10.5.2018	19:00-20:00	203	1.67
10.5.2018	19:00-20:00	241.42	12.46	10.5.2018	20:00-21:00	238	6.82
10.5.2018	20:00-21:00	193.50	6.09	10.5.2018	21:00-22:00	296	6.78
10.5.2018	21:00-22:00	191.43	3.37	10.5.2018	22:00-23:00	255	1.60
10.5.2018	22:00-23:00	210.88	2.30	10.5.2018	23:00-00:00	288	3.10
10.5.2018	23:00-00:00	291.98	0.32	10.5.2018	00:00-01:00	256	1.19
11.5.2018	00:00-01:00	302.98	0.10	11.5.2018	01:00-02:00	248	0.39
11.5.2018	01:00-02:00	305.30	1.46	11.5.2018	02:00-03:00	209	0.29
11.5.2018	02:00-03:00	262.78	1.03	11.5.2018	03:00-04:00	212	0.13
11.5.2018	03:00-04:00	263.17	0.51	11.5.2018	04:00-05:00	206	0.05
11.5.2018	04:00-05:00	197.15	0.31	11.5.2018	05:00-06:00	67	3.22
11.5.2018	05:00-06:00	77.68	3.63	11.5.2018	06:00-07:00	117	0.72
11.5.2018	06:00-07:00	95.22	4.46	11.5.2018	07:00-08:00	152	0.62
11.5.2018	07:00-08:00	133.12	6.74	11.5.2018	08:00-09:00	138	1.15
11.5.2018	08:00-09:00	143.75	9.50	11.5.2018	09:00-10:00	130	1.54
11.5.2018	09:00-10:00	146.60	9.54	11.5.2018	10:00-11:00	131	1.44
11.5.2018	10:00-11:00	159.03	10.61	11.5.2018	11:00-12:00	143	0.55
11.5.2018	11:00-12:00	178.50	10.28	11.5.2018	12:00-13:00	167	0.18
11.5.2018	12:00-13:00	193.40	8.79	11.5.2018	13:00-14:00	188	0.41
11.5.2018	13:00-14:00	199.10	6.99	11.5.2018	14:00-15:00	181	0.97
11.5.2018	14:00-15:00	214.12	8.14	11.5.2018	15:00-16:00	157	0.88
11.5.2018	15:00-16:00	195.03	9.32	11.5.2018	16:00-17:00	167	1.02
11.5.2018	16:00-17:00	204.23	11.64	11.5.2018	17:00-18:00	178	1.15
11.5.2018	17:00-18:00	232.70	12.75	11.5.2018	18:00-19:00	183	0.56
11.5.2018	18:00-19:00	233.10	9.10	11.5.2018	19:00-20:00	186	0.64
11.5.2018	19:00-20:00	234.85	8.34	11.5.2018	20:00-21:00	184	0.60
11.5.2018	20:00-21:00	232.33	7.40	11.5.2018	21:00-22:00	187	0.40
11.5.2018	21:00-22:00	238.12	7.34	11.5.2018	22:00-23:00	176	0.76
11.5.2018	22:00-23:00	236.40	7.97	11.5.2018	23:00-00:00	252	2.70
11.5.2018	23:00-00:00	295.00	3.84	11.5.2018	00:00-01:00	303	0.13
12.5.2018	00:00-01:00	277.93	0.34	12.5.2018	01:00-02:00	216	0.06
12.5.2018	01:00-02:00	254.72	0.98	12.5.2018	02:00-03:00	215	0.05
12.5.2018	02:00-03:00	241.93	0.74	12.5.2018	03:00-04:00	219	0.60
12.5.2018	03:00-04:00	262.70	0.74	12.5.2018	04:00-05:00	218	0.53
12.5.2018	04:00-05:00	285.13	0.97	12.5.2018	05:00-06:00	212	0.70
12.5.2018	05:00-06:00	259.25	0.70	12.5.2018	06:00-07:00	189	0.09
12.5.2018	06:00-07:00	222.47	1.35	12.5.2018	07:00-08:00	130	0.04
12.5.2018	07:00-08:00	177.08	2.45	12.5.2018	08:00-09:00	169	0.06
12.5.2018	08:00-09:00	199.52	4.82	12.5.2018	09:00-10:00	160	0.05

12.5.2018	09:00-10:00	203.27	6.46	12.5.2018	10:00-11:00	181	1.17
12.5.2018	10:00-11:00	157.15	5.02	12.5.2018	11:00-12:00	155	1.88
12.5.2018	11:00-12:00	125.00	7.82	12.5.2018	12:00-13:00	200	0.18
12.5.2018	12:00-13:00	182.42	5.05	12.5.2018	13:00-14:00	245	1.61
12.5.2018	13:00-14:00	205.15	9.60	12.5.2018	14:00-15:00	145	1.77

Hourly air quality results

AQ1 (first day)

Date	**Time**	**CO**	**NO2**	**NO**	**PM2.5**	**PM10**	**RH**	**SO2**	**TmpC**
D.M.Y	**H.M.S**	**µg/m3**	**µg/m3**	**µg/m3**	**µg/m3**	**µg/m3**	**%**	**µg/m3**	**Deg. C**
2.5.2018	11:00-12:00	47.61	4.25	0.01	2.00	1.00	66.11	0.00	32.43
2.5.2018	12:00-13:00	62.22	3.89	0.00	3.10	15.62	66.20	0.00	33.77
2.5.2018	13:00-14:00	16.61	114.45	0.00	4.30	2.47	66.53	0.00	33.57
2.5.2018	14:00-15:00	25.48	48.16	0.00	9.00	2.57	66.93	0.00	33.63
2.5.2018	15:00-16:00	27.29	15.30	0.00	8.70	2.95	67.05	0.00	33.93
2.5.2018	16:00-17:00	38.36	9.19	0.00	2.92	8.52	67.50	0.00	34.35
2.5.2018	17:00-18:00	65.09	47.41	0.00	33.80	95.02	72.93	31.23	30.63
2.5.2018	18:00-19:00	107.27	68.36	0.00	15.12	40.25	80.85	130.10	27.32
2.5.2018	19:00-20:00	111.56	26.09	0.00	28.33	9.95	83.92	130.66	26.05
2.5.2018	20:00-21:00	97.91	12.76	0.00	20.80	30.58	86.80	0.00	25.28
3.5.2018	21:00-22:00	71.00	11.57	0.00	15.47	1.28	86.33	0.00	25.23
3.5.2018	22:00-23:00	54.21	16.47	0.00	13.57	3.20	86.55	0.00	24.92
3.5.2018	23:00-00:00	74.44	16.52	0.00	5.42	16.85	87.73	0.00	24.70
3.5.2018	00:00-01:00	49.63	9.97	0.00	7.47	3.47	88.40	0.00	24.62
3.5.2018	01:00-02:00	59.26	12.32	0.00	9.93	16.88	89.52	0.00	24.83
3.5.2018	02:00-03:00	40.37	9.72	0.00	9.28	3.70	89.67	0.00	24.30
3.5.2018	03:00-04:00	50.29	10.91	0.00	18.77	30.60	91.80	0.00	23.93
3.5.2018	04:00-05:00	67.66	17.00	0.00	20.13	11.33	93.70	0.00	23.65
3.5.2018	05:00-06:00	65.56	19.75	0.00	14.25	21.17	93.85	0.00	23.63
3.5.2018	06:00-07:00	90.37	12.98	0.01	8.23	8.20	88.38	0.00	24.37
3.5.2018	07:00-08:00	104.69	3.76	0.04	2.93	96.57	77.53	0.00	28.07
3.5.2018	08:00-09:00	35.02	3.76	0.08	2.67	1.00	71.07	0.28	32.05
3.5.2018	09:00-10:00	49.24	4.17	0.06	8.62	1.60	68.28	0.00	34.22
3.5.2018	10:00-11:00	56.69	3.76	0.04	17.93	5.18	65.13	0.00	36.90

AQ1 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
3.5.2018	11:00-12:00	12.03	3.86	0.02	20.31	8.92	63.78	0.00	37.10
3.5.2018	12:00-13:00	46.57	7.84	0.00	16.90	6.07	62.42	0.00	37.42
3.5.2018	13:00-14:00	54.68	5.58	0.00	17.77	1.13	61.72	0.00	38.08
3.5.2018	14:00-15:00	93.24	35.85	0.04	44.67	77.95	72.10	0.00	35.45

3.5.2018	15:00-16:00	70.05	56.38	0.00	19.25	67.63	72.55	0.41	34.12
3.5.2018	16:00-17:00	73.96	12.45	0.02	29.00	9.30	72.10	0.00	34.45
3.5.2018	17:00-18:00	67.47	60.24	0.00	40.73	48.68	76.52	11.88	30.97
3.5.2018	18:00-19:00	69.19	60.27	0.00	26.27	191.55	83.67	72.09	28.12
3.5.2018	19:00-20:00	93.24	41.92	0.00	24.52	65.55	87.05	18.88	27.12
3.5.2018	20:00-21:00	93.81	34.49	0.00	26.78	26.45	88.67	1.32	26.80
3.5.2018	21:00-22:00	76.82	35.59	0.00	26.57	24.47	89.92	0.00	26.33
3.5.2018	22:00-23:00	85.13	40.45	0.00	30.88	42.37	91.30	0.00	26.05
3.5.2018	23:00-00:00	61.46	30.57	0.00	38.27	47.93	94.92	0.00	25.42
4.5.2018	00:00-01:00	56.02	37.13	0.00	46.35	66.77	95.13	0.00	25.48
4.5.2018	01:00-02:00	48.58	40.10	0.00	44.92	50.97	97.17	0.00	25.05
4.5.2018	02:00-03:00	34.26	43.15	0.00	41.68	40.83	97.68	0.00	24.95
4.5.2018	03:00-04:00	48.38	39.54	0.00	34.58	26.90	98.15	0.00	24.62
4.5.2018	04:00-05:00	144.68	29.88	0.00	41.47	43.75	99.68	0.00	24.48
4.5.2018	05:00-06:00	33.69	31.64	0.00	48.33	84.27	98.35	0.00	24.52
4.5.2018	06:00-07:00	39.32	11.58	0.00	35.68	30.18	94.43	0.00	24.90
4.5.2018	07:00-08:00	49.63	13.08	0.03	37.12	21.77	91.55	0.00	25.38
4.5.2018	08:00-09:00	29.49	6.71	0.04	10.88	1.78	81.42	0.50	28.45
4.5.2018	09:00-10:00	36.17	3.95	0.05	5.95	6.48	70.78	3.32	34.87
4.5.2018	10:00-11:00	28.34	3.76	0.09	11.98	1.75	64.72	0.00	39.27

AQ1 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
4.5.2018	11:00-12:00	21.28	4.64	0.05	26.18	4.75	63.55	0.00	38.90
4.5.2018	12:00-13:00	67.95	16.52	0.01	35.08	54.42	64.15	0.00	38.10
4.5.2018	13:00-14:00	160.23	198.99	0.00	68.25	137.73	86.02	81.93	27.75
4.5.2018	14:00-15:00	132.37	43.08	0.01	24.87	1.85	78.68	48.19	28.12
4.5.2018	15:00-16:00	35.50	3.76	0.01	5.70	2.12	69.42	0.00	31.52
4.5.2018	16:00-17:00	34.07	4.17	0.06	20.70	43.65	65.12	2.57	35.13
4.5.2018	17:00-18:00	88.94	68.48	0.02	44.63	63.27	75.70	3.79	31.03
4.5.2018	18:00-19:00	85.13	31.73	0.00	48.37	64.68	80.05	24.99	29.40
4.5.2018	19:00-20:00	90.47	22.01	0.00	46.28	39.92	84.20	42.08	27.48
4.5.2018	20:00-21:00	176.74	27.28	0.00	43.82	37.73	86.80	12.79	25.98
4.5.2018	21:00-22:00	56.50	26.09	0.00	44.40	36.88	87.95	4.80	25.90
4.5.2018	22:00-23:00	59.45	17.59	0.00	38.65	30.72	89.92	0.00	25.48
4.5.2018	23:00-00:00	50.39	25.34	0.00	40.67	43.82	92.17	0.00	25.30
5.5.2018	00:00-01:00	62.13	20.04	0.00	46.73	49.85	95.57	0.00	24.73
5.5.2018	01:00-02:00	62.70	24.49	0.00	62.92	67.98	96.88	0.00	24.53
5.5.2018	02:00-03:00	73.87	15.52	0.00	72.87	68.82	97.03	0.00	24.35
5.5.2018	03:00-04:00	72.15	18.85	0.00	84.68	85.05	98.68	0.00	24.20
5.5.2018	04:00-05:00	119.77	22.23	0.00	75.35	76.10	99.42	0.00	23.93
5.5.2018	05:00-06:00	234.86	5.74	0.00	163.22	156.75	100.00	0.00	23.92
5.5.2018	06:00-07:00	870.35	6.30	0.00	74.47	74.73	92.43	0.00	25.38
5.5.2018	07:00-08:00	41.61	3.76	0.05	27.32	23.95	80.77	5.96	30.17

5.5.2018	08:00-09:00	22.04	3.76	0.04	17.63	7.28	68.97	1.47	35.05
5.5.2018	09:00-10:00	11.64	3.76	0.04	21.58	4.12	65.00	0.00	36.72
5.5.2018	10:00-11:00	25.67	4.89	0.02	4.15	3.23	59.43	0.00	40.02

AQ2 (first day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
2/5/2018	13:00-14:00	8.97	114.45	3.34	2.00	1.00	58.10	0.00	32.88
2/5/2018	14:00-15:00	21.28	47.10	7.23	3.60	2.23	57.73	1.60	33.85
2/5/2018	15:00-16:00	25.58	15.43	10.25	3.70	2.42	56.47	8.75	35.00
2/5/2018	16:00-17:00	37.70	9.16	9.62	11.82	8.73	56.65	10.79	34.43
2/5/2018	17:00-18:00	62.41	48.85	0.70	35.40	39.38	61.87	0.06	30.60
2/5/2018	18:00-19:00	104.59	67.86	1.79	22.05	23.55	67.12	0.00	28.00
2/5/2018	19:00-20:00	110.70	26.75	0.84	15.55	13.48	69.42	3.10	27.00
2/5/2018	20:00-21:00	96.96	12.95	4.32	6.08	4.47	71.95	0.85	26.62
2/5/2018	21:00-22:00	69.19	11.45	2.83	4.15	2.58	72.45	0.19	26.17
2/5/2018	22:00-23:00	52.77	16.93	1.27	3.82	2.32	73.05	0.60	26.00
2/5/2018	23:00-00:00	73.96	16.49	8.70	2.15	1.07	72.87	0.53	26.00
3/5/2018	00:00-01:00	48.67	9.75	3.42	2.10	1.03	73.90	0.53	26.27
3/5/2018	01:00-02:00	58.69	12.32	20.20	4.53	2.83	74.73	0.16	26.00
3/5/2018	02:00-03:00	39.80	9.06	0.91	6.15	16.33	75.68	2.63	26.00
3/5/2018	03:00-04:00	50.20	10.97	0.58	11.50	32.57	77.95	3.70	25.52
3/5/2018	04:00-05:00	67.85	16.81	0.59	12.37	29.57	80.78	0.00	25.00
3/5/2018	05:00-06:00	63.75	19.79	1.11	8.10	5.43	81.57	0.00	25.00
3/5/2018	06:00-07:00	89.42	12.92	12.68	9.65	1.97	77.75	1.07	25.47
3/5/2018	07:00-08:00	103.54	3.76	48.90	4.42	1.20	71.22	23.33	27.28
3/5/2018	08:00-09:00	33.97	3.76	50.17	2.03	1.03	66.32	24.11	29.45
3/5/2018	09:00-10:00	49.63	4.11	54.83	4.32	3.50	62.83	29.63	31.27
3/5/2018	10:00-11:00	55.73	3.76	45.81	8.17	9.43	59.68	17.59	32.97
3/5/2018	11:00-12:00	58.69	4.01	41.90	12.67	9.95	57.62	9.22	33.92
3/5/2018	12:00-13:00	59.65	3.89	35.62	4.88	3.72	56.05	4.55	34.98

AQ2 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
3/5/2018	13:00-14:00	53.92	4.99	28.78	4.42	4.20	54.15	4.48	36.48
3/5/2018	14:00-15:00	92.57	38.51	11.31	44.15	49.72	60.77	0.00	33.27
3/5/2018	15:00-16:00	71.29	55.63	3.25	25.97	18.25	60.97	0.13	34.00
3/5/2018	16:00-17:00	79.02	12.39	26.02	41.37	42.95	60.40	2.32	33.52
3/5/2018	17:00-18:00	66.80	60.08	0.58	40.68	39.05	64.53	0.00	30.30
3/5/2018	18:00-19:00	68.71	59.95	0.65	22.92	29.07	70.78	0.00	28.38
3/5/2018	19:00-20:00	93.81	41.99	0.94	17.92	28.35	73.07	0.00	28.00
3/5/2018	20:00-21:00	96.48	31.23	3.35	14.60	12.73	75.15	0.00	27.08

3/5/2018	21:00-22:00	76.63	35.21	0.80	20.05	33.67	78.27	0.25	26.65
3/5/2018	22:00-23:00	84.65	40.48	0.72	25.83	46.02	79.98	0.00	26.17
3/5/2018	23:00-00:00	60.79	31.76	0.57	32.82	63.10	84.03	0.09	26.00
4/5/2018	00:00-01:00	54.97	37.75	0.57	31.48	51.72	85.68	0.00	26.00
4/5/2018	01:00-02:00	48.48	39.82	0.57	27.00	40.90	87.70	0.00	25.63
4/5/2018	02:00-03:00	33.40	40.95	0.58	22.93	28.47	88.40	0.00	25.73
4/5/2018	03:00-04:00	49.63	38.82	0.70	22.82	28.33	89.60	0.16	25.82
4/5/2018	04:00-05:00	144.96	29.57	1.63	33.97	44.08	89.95	9.47	25.82
4/5/2018	05:00-06:00	27.96	30.98	0.92	34.62	48.02	89.13	1.10	26.00
4/5/2018	06:00-07:00	27.48	12.10	5.35	29.53	16.97	85.07	0.09	26.13
4/5/2018	07:00-08:00	45.33	12.86	8.44	32.18	25.83	83.07	1.25	26.77
4/5/2018	08:00-09:00	27.39	5.30	18.71	16.75	3.47	76.03	8.56	27.80
4/5/2018	09:00-10:00	36.26	3.76	40.73	9.53	12.70	70.00	23.89	29.90
4/5/2018	10:00-11:00	29.11	3.76	86.20	9.73	11.00	59.80	39.82	34.55
4/5/2018	11:00-12:00	6.11	3.86	68.31	26.05	17.55	56.32	14.39	36.27
4/5/2018	12:00-13:00	48.77	8.34	24.71	31.62	27.37	56.07	1.76	35.95

AQ2 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
4/5/2018	13:00-14:00	160.14	198.93	0.88	48.70	50.17	82.12	1.13	26.70
4/5/2018	14:00-15:00	133.80	42.36	35.11	10.55	1.02	66.65	0.82	28.43
4/5/2018	15:00-16:00	19.18	3.76	57.57	2.30	1.27	59.28	14.02	31.88
4/5/2018	16:00-17:00	35.60	4.04	55.75	14.93	16.33	56.07	20.88	34.48
4/5/2018	17:00-18:00	89.99	68.58	3.51	46.38	51.25	64.90	0.31	30.30
4/5/2018	18:00-19:00	86.18	34.62	0.73	41.80	50.30	68.58	0.85	28.55
4/5/2018	19:00-20:00	91.52	21.82	0.70	42.47	52.32	72.02	0.75	27.22
4/5/2018	20:00-21:00	177.41	27.56	0.59	40.52	52.37	73.83	6.27	26.27
4/5/2018	21:00-22:00	57.16	22.45	0.57	35.45	47.45	75.13	0.00	26.00
4/5/2018	22:00-23:00	60.60	16.90	0.60	36.98	56.08	77.98	0.00	26.00
4/5/2018	23:00-00:00	49.53	25.02	0.74	29.63	40.35	79.65	0.00	26.00
5/5/2018	00:00-01:00	62.70	19.91	0.57	40.68	54.40	84.02	0.00	25.23
5/5/2018	01:00-02:00	64.42	24.43	0.57	48.17	71.00	85.33	0.03	25.00
5/5/2018	02:00-03:00	73.48	15.55	0.60	57.63	81.88	86.32	0.03	25.00
5/5/2018	03:00-04:00	72.72	18.69	0.57	60.50	91.08	89.62	0.25	25.00
5/5/2018	04:00-05:00	118.24	22.73	0.64	70.50	95.62	90.43	9.34	25.00
5/5/2018	05:00-06:00	243.64	5.17	0.98	74.93	99.13	90.75	5.61	25.00
5/5/2018	06:00-07:00	159.18	5.80	12.68	59.05	55.22	89.25	8.31	25.72
5/5/2018	07:00-08:00	38.36	3.76	36.11	31.32	12.22	76.87	9.22	27.80
5/5/2018	08:00-09:00	18.13	4.33	63.77	4.72	2.78	67.80	50.42	30.38
5/5/2018	09:00-10:00	2.67	3.76	68.99	4.63	3.27	62.02	40.29	32.40
5/5/2018	10:00-11:00	24.34	4.99	48.35	8.28	6.45	57.13	13.67	35.07
5/5/2018	11:00-12:00	19.56	4.17	51.26	16.23	11.52	55.35	23.61	36.22
5/5/2018	12:00-13:00	68.23	16.09	7.14	31.77	19.60	55.72	2.01	36.73

AQ3 (first day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
2.5.2018	15:00-16:00	311.04	11.78	0.01	2.37	3.56	53.75	20.10	35.35
2.5.2018	16:00-17:00	246.23	33.08	0.00	1.47	4.32	55.10	2.95	34.80
2.5.2018	17:00-18:00	298.72	70.99	0.00	2.00	3.78	67.90	16.78	29.17
2.5.2018	18:00-19:00	272.57	87.42	0.00	5.80	8.13	74.37	13.89	27.50
2.5.2018	19:00-20:00	306.94	86.39	0.01	6.45	9.33	78.72	10.88	27.00
2.5.2018	20:00-21:00	308.10	76.07	0.01	2.62	4.33	81.92	7.21	26.82
2.5.2018	21:00-22:00	259.32	68.48	0.01	2.02	4.95	83.13	11.19	26.02
2.5.2018	22:00-23:00	263.64	69.39	0.00	2.03	4.00	85.92	10.88	26.00
2.5.2018	23:00-00:00	227.76	60.64	0.02	2.00	8.37	87.52	11.73	25.97
3.5.2018	00:00-01:00	214.00	56.10	0.03	2.00	4.52	88.10	12.23	25.87
3.5.2018	01:00-02:00	237.66	72.21	0.01	1.88	12.30	90.93	20.85	25.15
3.5.2018	02:00-03:00	218.16	75.93	0.00	3.08	6.80	92.04	15.47	25.00
3.5.2018	03:00-04:00	210.68	63.56	0.00	2.00	8.10	92.27	27.81	24.45
3.5.2018	04:00-05:00	158.03	87.05	0.00	2.03	11.90	91.83	1.98	24.00
3.5.2018	05:00-06:00	146.16	79.02	0.00	2.00	4.95	89.57	2.13	24.00
3.5.2018	06:00-07:00	149.06	65.75	0.00	2.00	3.60	84.63	9.12	24.00
3.5.2018	07:00-08:00	50.29	44.17	0.00	1.79	8.83	77.67	1.88	26.43
3.5.2018	08:00-09:00	252.32	156.28	0.01	2.12	9.57	71.10	4.52	28.37
3.5.2018	09:00-10:00	260.37	103.29	0.00	2.35	4.88	64.42	8.59	30.35
3.5.2018	10:00-11:00	178.64	83.85	0.00	1.40	3.92	57.55	21.35	32.47
3.5.2018	11:00-12:00	227.24	77.70	0.00	1.68	3.65	54.43	23.80	33.58
3.5.2018	12:00-13:00	196.62	54.62	0.00	2.97	4.75	49.53	23.52	35.48
3.5.2018	13:00-14:00	218.81	33.65	0.00	2.58	5.08	46.40	11.85	37.15
3.5.2018	14:00-15:00	315.75	96.55	0.00	1.27	9.88	61.80	10.25	31.92

AQ3 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
3.5.2018	15:00-16:00	350.66	74.41	0.01	2.78	8.13	62.98	4.11	32.17
3.5.2018	16:00-17:00	374.96	46.31	0.00	1.67	5.13	63.02	3.67	31.60
3.5.2018	17:00-18:00	331.24	89.77	0.00	1.83	6.90	69.58	2.85	28.87
3.5.2018	18:00-19:00	288.52	108.05	0.00	2.55	8.58	78.87	2.73	27.20
3.5.2018	19:00-20:00	290.90	100.72	0.01	2.48	9.18	82.97	3.10	26.02
3.5.2018	20:00-21:00	317.30	83.88	0.01	2.05	9.82	84.75	3.20	26.00
3.5.2018	21:00-22:00	344.18	79.90	0.02	2.47	8.65	84.97	12.42	26.00
3.5.2018	22:00-23:00	351.78	62.24	0.04	2.00	10.17	87.02	34.12	25.88
3.5.2018	23:00-00:00	217.73	67.79	0.01	2.00	3.87	90.18	5.68	25.02
4.5.2018	00:00-01:00	224.85	66.38	0.00	2.13	11.37	91.22	22.17	25.00
4.5.2018	01:00-02:00	208.72	76.89	0.02	2.00	5.63	92.80	13.01	25.00
4.5.2018	02:00-03:00	171.48	71.02	0.00	2.00	8.53	94.03	7.87	25.00

4.5.2018	03:00-04:00	181.46	73.69	0.00	2.02	10.02	94.70	3.54	25.00
4.5.2018	04:00-05:00	209.93	68.76	0.00	2.32	5.48	94.87	9.47	25.00
4.5.2018	05:00-06:00	318.93	73.15	0.03	2.00	3.70	94.22	20.76	25.00
4.5.2018	06:00-07:00	336.30	65.66	0.04	2.33	5.57	91.78	19.79	25.28
4.5.2018	07:00-08:00	395.88	59.67	0.05	2.02	5.75	90.95	35.81	25.92
4.5.2018	08:00-09:00	348.12	13.83	0.11	2.53	4.87	79.45	24.02	27.27
4.5.2018	09:00-10:00	405.94	5.14	0.14	2.38	13.38	74.52	48.48	28.53
4.5.2018	10:00-11:00	271.57	3.79	0.15	2.20	7.05	62.52	48.70	31.52
4.5.2018	11:00-12:00	164.78	3.76	0.28	2.67	3.45	53.37	65.85	34.60
4.5.2018	12:00-13:00	256.82	4.39	0.19	1.52	6.57	53.28	33.43	34.47
4.5.2018	13:00-14:00	385.31	173.09	0.00	4.90	7.00	90.68	45.53	25.53
4.5.2018	14:00-15:00	243.00	38.69	0.01	1.12	5.83	68.70	6.77	28.40

AQ3 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
4.5.2018	15:00-16:00	246.70	5.61	0.04	2.10	7.45	56.53	16.12	31.55
4.5.2018	16:00-17:00	304.33	16.71	0.17	2.17	4.43	52.47	23.64	33.55
4.5.2018	17:00-18:00	562.66	84.57	0.05	1.42	4.07	69.08	28.10	29.30
4.5.2018	18:00-19:00	283.08	72.06	0.00	3.72	8.37	73.28	11.88	27.78
4.5.2018	19:00-20:00	491.05	79.21	0.01	2.65	8.73	77.23	20.66	26.88
4.5.2018	20:00-21:00	395.59	72.18	0.00	2.02	4.70	77.87	22.17	26.00
4.5.2018	21:00-22:00	316.23	64.22	0.02	2.50	5.50	80.12	20.32	26.00
4.5.2018	22:00-23:00	296.29	66.13	0.04	2.00	3.62	82.32	15.90	26.00
4.5.2018	23:00-00:00	294.32	52.99	0.01	2.28	4.60	84.75	23.86	25.45
5.5.2018	00:00-01:00	256.28	56.38	0.00	2.02	6.42	87.45	11.35	25.00
5.5.2018	01:00-02:00	281.91	66.35	0.01	2.02	3.85	90.20	21.95	25.00
5.5.2018	02:00-03:00	254.00	61.43	0.00	2.00	4.30	90.58	17.53	24.87
5.5.2018	03:00-04:00	268.28	65.16	0.00	2.00	8.62	91.58	24.33	24.62
5.5.2018	04:00-05:00	302.22	64.97	0.02	2.02	6.27	92.73	25.18	24.15
5.5.2018	05:00-06:00	430.13	55.19	0.03	2.13	4.77	91.27	49.20	24.98
5.5.2018	06:00-07:00	763.41	59.77	0.06	2.03	8.75	91.30	71.18	25.02
5.5.2018	07:00-08:00	279.43	25.46	0.05	2.00	7.52	83.83	18.34	26.42
5.5.2018	08:00-09:00	230.81	3.76	0.15	2.18	8.98	71.13	42.17	28.83
5.5.2018	09:00-10:00	59.79	3.76	0.20	2.13	10.83	57.55	33.18	31.40
5.5.2018	10:00-11:00	173.12	3.76	0.31	3.93	15.18	54.38	61.65	32.32
5.5.2018	11:00-12:00	259.08	4.04	0.22	2.63	15.37	51.47	85.26	33.90
5.5.2018	12:00-13:00	237.96	12.26	0.00	1.50	7.23	50.00	13.83	34.77
5.5.2018	13:00-14:00	271.06	20.51	0.00	1.87	15.83	51.57	6.84	35.30
5.5.2018	14:00-15:00	260.49	26.78	0.00	1.57	9.18	54.03	8.03	34.10

AQ4 (first day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
12.5.2018	16:00-17:00	177.39	76.76	0.00	2.00	4.73	92.67	1.88	23.93
12.5.2018	17:00-18:00	107.51	46.41	0.00	2.02	6.50	94.48	2.16	23.70
12.5.2018	18:00-19:00	174.08	44.24	0.00	1.85	8.05	89.55	4.26	23.70
12.5.2018	19:00-20:00	358.38	70.65	0.00	1.95	3.03	93.67	6.58	23.12
12.5.2018	20:00-21:00	466.72	73.41	0.00	2.00	4.35	92.07	38.73	23.62
12.5.2018	21:00-22:00	292.59	51.33	0.00	2.00	5.32	90.13	18.25	24.00
12.5.2018	22:00-23:00	422.03	57.29	0.00	2.00	6.27	94.27	103.48	23.15
12.5.2018	23:00-00:00	455.15	77.11	0.00	2.00	7.58	96.52	97.36	23.00
13.5.2018	00:00-01:00	275.30	68.45	0.00	2.00	10.82	100.00	18.34	22.87
13.5.2018	01:00-02:00	484.02	57.88	0.00	2.02	7.88	99.95	48.35	22.90
13.5.2018	02:00-03:00	271.15	57.60	0.00	2.03	4.53	99.62	10.57	22.42
13.5.2018	03:00-04:00	407.22	55.85	0.00	2.02	7.13	100.00	31.29	22.00
13.5.2018	04:00-05:00	935.46	56.16	0.00	2.02	11.28	100.00	25.37	22.00
13.5.2018	05:00-06:00	483.65	53.31	0.00	2.00	10.53	100.00	61.96	22.00
13.5.2018	06:00-07:00	697.81	55.63	0.00	2.13	7.33	97.18	84.47	22.85
13.5.2018	07:00-08:00	461.50	67.13	0.00	4.03	6.40	89.53	14.17	24.73
13.5.2018	08:00-09:00	391.54	40.64	0.06	6.00	12.20	82.80	1.88	26.00
13.5.2018	09:00-10:00	183.50	17.76	0.00	1.00	2.88	68.53	20.22	28.34
13.5.2018	10:00-11:00	245.79	5.30	0.00	1.50	6.72	61.87	28.41	31.27
13.5.2018	11:00-12:00	139.63	6.02	0.00	1.60	10.50	58.37	11.57	32.33
13.5.2018	12:00-13:00	340.80	7.68	0.00	4.53	5.02	53.73	26.68	33.07
13.5.2018	13:00-14:00	147.46	18.06	0.00	2.55	7.77	51.57	2.63	33.43
13.5.2018	14:00-15:00	172.78	36.94	0.00	1.22	7.98	51.82	3.10	32.63
13.5.2018	15:00-16:00	174.55	40.79	0.00	1.30	8.17	58.73	2.67	31.52

AQ4 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
13.5.2018	16:00-17:00	270.16	48.23	0.00	1.40	6.82	63.63	7.15	30.60
13.5.2018	17:00-18:00	288.55	61.93	0.00	1.45	11.62	67.33	27.28	29.27
13.5.2018	18:00-19:00	299.67	82.53	0.00	3.13	14.83	74.62	11.60	28.22
13.5.2018	19:00-20:00	238.75	78.58	0.00	8.43	9.37	78.92	2.19	27.18
13.5.2018	20:00-21:00	219.07	70.55	0.00	2.00	10.98	79.75	2.01	26.67
13.5.2018	21:00-22:00	206.09	66.32	0.00	2.00	4.57	80.65	4.52	26.02
13.5.2018	22:00-23:00	237.67	78.55	0.00	2.05	13.73	84.20	5.02	25.45
13.5.2018	23:00-00:00	233.81	47.35	0.00	2.00	8.43	78.75	18.69	25.03
13.5.2018	00:00-01:00	171.49	47.25	0.00	1.85	11.65	76.85	3.54	25.55
13.5.2018	01:00-02:00	166.60	50.04	0.00	2.55	7.86	79.05	16.48	25.14
14.5.2018	02:00-03:00	152.92	68.39	0.00	2.22	3.37	93.78	17.59	24.00
14.5.2018	03:00-04:00	161.62	64.37	0.00	2.03	4.90	95.72	14.77	24.00

14.5.2018	04:00-05:00	194.07	58.79	0.00	2.47	3.67	96.07	20.82	24.12
14.5.2018	05:00-06:00	200.70	46.09	0.00	4.00	4.17	94.33	31.04	24.33
14.5.2018	06:00-07:00	194.86	63.56	0.00	2.72	7.45	91.35	19.75	25.00
14.5.2018	07:00-08:00	145.04	58.61	0.00	2.02	12.57	81.90	2.60	24.67
14.5.2018	08:00-09:00	117.72	128.35	0.00	2.19	7.15	73.15	2.51	28.04
14.5.2018	09:00-10:00	115.28	42.27	0.00	2.02	4.98	70.75	2.07	28.48
14.5.2018	10:00-11:00	126.76	10.66	0.00	2.95	5.67	59.95	6.05	32.30
14.5.2018	11:00-12:00	78.81	3.92	0.00	3.20	11.57	49.30	9.56	36.23
14.5.2018	12:00-13:00	50.34	6.27	0.00	1.45	14.03	47.70	14.14	36.25
14.5.2018	13:00-14:00	145.75	51.42	0.00	1.07	10.10	55.12	5.30	33.70
14.5.2018	14:00-15:00	185.46	64.44	0.00	1.43	11.60	58.23	1.88	32.17
14.5.2018	15:00-16:00	206.41	68.42	0.00	2.07	4.62	59.78	1.94	31.60

AQ4 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
14.5.2018	16:00-17:00	299.71	72.65	0.00	2.02	11.38	61.70	1.91	29.92
14.5.2018	17:00-18:00	248.94	87.83	0.00	2.03	12.67	65.02	1.98	29.00
14.5.2018	18:00-19:00	228.40	79.39	0.00	1.65	3.62	69.73	2.67	27.08
14.5.2018	19:00-20:00	282.57	121.10	0.00	2.78	14.38	100.00	1.94	21.37
14.5.2018	20:00-21:00	457.15	97.86	0.01	3.02	8.87	100.00	1.91	22.00
14.5.2018	21:00-22:00	483.44	81.50	0.01	2.02	8.27	100.00	2.76	22.00
14.5.2018	22:00-23:00	325.94	70.61	0.05	2.45	9.90	100.00	2.48	22.17
14.5.2018	23:00-00:00	204.76	64.41	0.01	2.00	3.28	99.87	2.73	23.00
15.5.2018	00:00-01:00	209.31	54.65	0.01	2.00	3.50	99.67	17.69	23.00
15.5.2018	01:00-02:00	200.91	69.42	0.02	2.00	3.47	99.97	2.19	23.00
15.5.2018	02:00-03:00	174.38	60.08	0.01	2.00	3.85	99.30	6.30	23.00
15.5.2018	03:00-04:00	176.07	63.50	0.01	2.02	8.62	100.00	25.09	23.00
15.5.2018	04:00-05:00	246.69	55.66	0.00	2.00	11.05	100.00	16.31	23.02
15.5.2018	05:00-06:00	368.24	59.20	0.00	2.00	8.90	100.00	21.35	23.08
15.5.2018	06:00-07:00	395.20	66.57	0.01	2.07	7.62	100.00	28.19	24.03
15.5.2018	07:00-08:00	168.41	49.83	0.03	2.95	9.63	92.97	14.24	25.82
15.5.2018	08:00-09:00	158.88	21.82	0.07	2.43	4.67	83.17	34.40	27.62
15.5.2018	09:00-10:00	129.55	17.15	0.07	1.23	5.75	76.65	7.78	28.35
15.5.2018	10:00-11:00	189.85	147.69	0.08	2.48	8.15	64.33	31.14	31.30
15.5.2018	11:00-12:00	41.58	3.76	0.14	3.47	4.73	49.75	57.98	36.15
15.5.2018	12:00-13:00	47.97	5.14	0.24	2.15	6.53	48.05	57.51	35.73
15.5.2018	13:00-14:00	70.56	25.09	0.08	1.37	6.23	49.92	13.99	34.88
15.5.2018	14:00-15:00	132.57	27.66	0.00	1.20	8.67	53.43	2.95	33.15
15.5.2018	15:00-16:00	156.75	41.89	0.00	1.47	7.90	61.12	1.88	30.67

AQ5 (first day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
6.5.2018	11:00-12:00	0.00	3.76	0.00	1.00	11.89	43.67	19.65	38.44
6.5.2018	12:00-13:00	6.16	3.76	0.00	1.43	8.17	45.73	26.43	36.67
6.5.2018	13:00-14:00	21.18	3.76	0.00	2.57	7.95	40.92	12.20	38.22
6.5.2018	14:00-15:00	63.97	3.76	0.00	1.65	5.10	43.57	8.25	38.25
6.5.2018	15:00-16:00	143.39	33.87	0.00	1.97	6.30	63.70	20.32	32.55
6.5.2018	16:00-17:00	165.98	43.59	0.00	1.93	4.28	64.68	8.43	31.67
6.5.2018	17:00-18:00	179.58	58.26	0.00	1.92	8.22	67.30	6.74	30.18
6.5.2018	18:00-19:00	264.03	82.53	0.00	2.83	3.53	74.22	3.01	28.22
6.5.2018	19:00-20:00	219.36	86.95	0.00	2.83	10.28	76.13	1.94	27.37
6.5.2018	20:00-21:00	208.36	73.03	0.00	2.28	6.37	78.32	4.14	26.60
6.5.2018	21:00-22:00	155.28	81.24	0.00	2.27	4.15	80.48	9.53	26.00
6.5.2018	22:00-23:00	125.85	77.23	0.00	2.47	4.45	83.72	6.08	25.48
6.5.2018	23:00-00:00	127.52	75.82	0.00	2.03	3.88	87.07	2.73	25.00
7.5.2018	00:00-01:00	135.09	79.74	0.00	2.33	6.07	90.38	2.88	25.00
7.5.2018	01:00-02:00	119.28	82.75	0.00	2.03	11.10	92.75	4.20	25.00
7.5.2018	02:00-03:00	111.06	83.94	0.00	2.18	12.02	93.53	3.76	25.00
7.5.2018	03:00-04:00	97.69	88.99	0.00	2.00	9.05	93.48	1.94	25.00
7.5.2018	04:00-05:00	112.14	79.96	0.02	2.00	11.13	95.40	4.39	24.58
7.5.2018	05:00-06:00	143.57	78.05	0.00	2.00	4.93	96.35	2.23	24.05
7.5.2018	06:00-07:00	227.55	63.43	0.01	2.00	8.87	94.13	4.80	25.03
7.5.2018	07:00-08:00	132.64	16.68	0.08	2.63	6.85	78.62	13.80	28.82
7.5.2018	08:00-09:00	51.06	3.76	0.15	2.48	3.52	63.13	9.47	32.48
7.5.2018	09:00-10:00	40.66	3.89	0.08	1.60	4.95	55.32	16.59	34.33
7.5.2018	10:00-11:00	69.98	5.36	0.08	3.13	7.28	52.63	16.84	35.32

AQ5 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
7.5.2018	11:00-12:00	59.72	15.74	0.05	2.28	5.68	47.15	9.25	35.90
7.5.2018	12:00-13:00	92.70	9.88	0.04	3.45	9.82	46.35	8.28	37.08
7.5.2018	13:00-14:00	81.62	9.91	0.10	3.20	7.90	42.98	4.01	38.07
7.5.2018	14:00-15:00	101.40	12.35	0.09	1.70	4.43	42.47	2.70	38.12
7.5.2018	15:00-16:00	112.15	27.84	0.01	1.32	12.13	43.25	1.88	37.12
7.5.2018	16:00-17:00	136.13	28.28	0.01	1.33	11.43	43.23	1.88	36.98
7.5.2018	17:00-18:00	234.88	91.69	0.00	1.77	9.02	53.05	4.08	33.78
7.5.2018	18:00-19:00	280.46	127.93	0.00	2.53	11.87	72.73	10.07	29.65
7.5.2018	19:00-20:00	214.54	120.13	0.00	6.30	10.28	80.52	2.73	28.05
7.5.2018	20:00-21:00	229.05	99.34	0.00	2.67	11.80	83.95	3.42	27.03
7.5.2018	21:00-22:00	202.32	62.78	0.00	2.08	12.87	78.25	2.98	27.00
7.5.2018	22:00-23:00	174.88	64.31	0.00	2.00	11.98	77.40	3.61	26.58

7.5.2018	23:00-00:00	177.93	79.49	0.00	2.00	11.08	82.18	4.33	26.00
8.5.2018	00:00-01:00	134.41	106.17	0.01	2.47	14.38	87.43	1.91	25.47
8.5.2018	01:00-02:00	123.63	84.00	0.02	2.10	14.40	93.13	5.58	25.00
8.5.2018	02:00-03:00	112.66	87.80	0.00	2.02	12.35	94.38	1.91	25.00
8.5.2018	03:00-04:00	112.74	83.97	0.00	2.00	10.82	96.60	5.39	24.53
8.5.2018	04:00-05:00	123.83	88.61	0.00	2.02	5.32	98.63	3.14	24.00
8.5.2018	05:00-06:00	210.04	86.32	0.00	2.00	3.80	99.92	14.05	24.00
8.5.2018	06:00-07:00	218.90	80.81	0.00	2.00	4.10	97.30	18.37	24.53
8.5.2018	07:00-08:00	134.67	25.84	0.06	2.23	10.10	79.63	14.27	28.58
8.5.2018	08:00-09:00	55.93	3.76	0.07	2.73	6.07	66.52	2.98	31.80
8.5.2018	09:00-10:00	55.92	4.26	0.08	1.97	7.18	59.70	4.83	33.52
8.5.2018	10:00-11:00	63.82	4.64	0.06	2.97	8.05	54.85	10.94	34.88

AQ5 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
8.5.2018	11:00-12:00	103.79	20.60	0.00	2.02	7.88	53.85	6.27	34.68
8.5.2018	12:00-13:00	90.13	5.86	0.05	3.50	5.05	47.77	5.71	36.62
8.5.2018	13:00-14:00	84.49	10.35	0.16	2.78	3.15	45.48	2.10	37.90
8.5.2018	14:00-15:00	107.55	32.01	0.03	1.72	4.00	47.90	1.88	36.72
8.5.2018	15:00-16:00	110.56	15.90	0.04	1.83	9.68	44.65	1.88	37.53
8.5.2018	16:00-17:00	139.77	38.29	0.02	1.23	5.78	46.65	1.88	36.25
8.5.2018	17:00-18:00	221.20	86.51	0.00	1.52	7.83	54.07	4.61	33.10
8.5.2018	18:00-19:00	256.07	123.54	0.00	2.02	8.75	71.62	7.62	29.75
8.5.2018	19:00-20:00	255.09	97.27	0.00	9.07	10.65	78.27	4.55	28.43
8.5.2018	20:00-21:00	239.46	88.55	0.00	2.53	8.22	80.45	5.39	27.93
8.5.2018	21:00-22:00	228.91	82.59	0.00	2.07	4.82	78.37	3.01	27.07
8.5.2018	22:00-23:00	176.25	77.70	0.00	2.05	8.45	78.90	2.38	27.00
8.5.2018	23:00-00:00	129.65	80.55	0.03	2.28	12.58	80.37	4.39	26.93
9.5.2018	00:00-01:00	124.70	88.33	0.01	2.00	10.57	83.25	9.34	26.58
9.5.2018	01:00-02:00	114.47	94.35	0.00	2.02	11.80	87.63	7.06	26.00
9.5.2018	02:00-03:00	113.63	83.35	0.00	2.05	9.50	91.30	2.73	25.23
9.5.2018	03:00-04:00	114.15	82.03	0.00	2.03	8.10	93.93	3.07	25.00
9.5.2018	04:00-05:00	132.73	98.52	0.00	2.00	12.37	97.20	7.81	24.03
9.5.2018	05:00-06:00	180.29	93.47	0.00	2.00	4.77	99.48	14.46	24.00
9.5.2018	06:00-07:00	274.82	80.40	0.01	2.07	3.07	97.52	19.69	24.50
9.5.2018	07:00-08:00	158.26	35.62	0.04	2.25	4.28	83.13	9.97	28.02
9.5.2018	08:00-09:00	54.87	4.26	0.11	2.15	7.98	65.95	3.01	32.22
9.5.2018	09:00-10:00	57.98	3.76	0.04	2.47	4.85	57.28	11.82	34.70
9.5.2018	10:00-11:00	59.71	4.83	0.09	2.93	9.53	51.38	15.46	35.88

AQ6 (First day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
6/5/2018	13:00-14:00	0.92	4.89	82.56	2.00	1.00	50.62	16.33	39.28
6/5/2018	14:00-15:00	2.67	44.84	82.36	11.43	18.72	52.78	33.96	38.85
6/5/2018	15:00-16:00	53.06	82.09	1.77	46.75	44.70	61.42	0.31	34.18
6/5/2018	16:00-17:00	77.78	37.31	1.40	49.68	43.50	62.53	0.53	32.57
6/5/2018	17:00-18:00	92.28	55.72	1.28	49.10	47.67	63.67	0.09	31.13
6/5/2018	18:00-19:00	164.34	54.97	1.05	55.58	60.13	67.07	2.19	29.33
6/5/2018	19:00-20:00	116.62	18.88	0.90	39.32	46.82	68.07	0.00	28.42
6/5/2018	20:00-21:00	85.32	9.63	1.36	20.20	17.58	69.57	0.00	27.88
6/5/2018	21:00-22:00	58.40	8.87	0.64	12.72	10.75	70.80	0.00	28.00
6/5/2018	22:00-23:00	57.45	5.08	4.67	12.50	14.18	73.85	0.00	27.03
6/5/2018	23:00-00:00	51.92	15.58	0.63	14.65	17.15	75.92	0.00	27.00
7/5/2018	00:00-01:00	57.36	18.16	0.91	12.95	21.27	79.62	0.09	26.05
7/5/2018	01:00-02:00	50.01	19.22	0.68	10.18	22.20	83.48	0.31	26.00
7/5/2018	02:00-03:00	40.18	21.51	1.01	8.77	24.63	85.63	0.00	26.00
7/5/2018	03:00-04:00	34.36	8.94	1.77	6.88	3.98	86.13	0.00	26.00
7/5/2018	04:00-05:00	103.45	15.80	1.69	24.00	24.38	91.48	36.12	25.23
7/5/2018	05:00-06:00	198.60	12.42	4.07	65.82	91.92	97.98	48.19	25.00
7/5/2018	06:00-07:00	6.87	21.57	3.25	8.32	5.45	93.32	0.19	25.58
7/5/2018	07:00-08:00	43.90	4.23	35.63	3.97	1.37	72.77	16.49	29.65
7/5/2018	08:00-09:00	13.46	3.76	71.54	2.02	1.00	62.48	44.40	33.68
7/5/2018	09:00-10:00	17.94	3.76	100.08	2.00	1.00	58.10	65.66	35.82
7/5/2018	10:00-11:00	33.69	3.76	55.19	5.00	3.28	56.12	24.46	37.08
7/5/2018	11:00-12:00	11.45	3.76	45.66	14.00	2.48	52.45	12.76	38.37
7/5/2018	12:00-13:00	42.18	3.86	30.96	16.33	4.30	52.67	5.58	39.12

AQ6 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
7/5/2018	13:00-14:00	29.21	3.76	45.03	4.51	2.41	50.95	3.32	39.98
7/5/2018	14:00-15:00	37.60	3.76	75.35	8.20	7.23	49.80	22.61	40.75
7/5/2018	15:00-16:00	11.31	0.91	15.81	18.87	21.94	0.60	8.82	0.78
7/5/2018	16:00-17:00	83.03	14.83	0.93	55.42	48.08	50.27	0.00	38.50
7/5/2018	17:00-18:00	151.55	75.76	1.45	57.87	61.57	55.95	0.56	35.07
7/5/2018	18:00-19:00	165.00	115.49	1.08	49.28	48.40	66.40	0.22	30.97
7/5/2018	19:00-20:00	106.41	81.09	0.61	28.50	35.13	71.43	0.00	29.17
7/5/2018	20:00-21:00	150.21	46.72	1.57	18.18	20.82	73.95	1.38	28.95
7/5/2018	21:00-22:00	80.16	10.76	4.00	32.25	33.38	69.32	0.00	28.90
7/5/2018	22:00-23:00	100.01	8.75	4.19	27.28	32.60	69.75	0.69	27.87
7/5/2018	23:00-00:00	76.35	26.40	0.57	27.77	29.83	72.57	1.10	27.00
8/5/2018	00:00-01:00	63.46	32.20	0.57	23.27	27.80	76.48	2.10	26.77

8/5/2018	01:00-02:00	46.67	45.75	0.57	9.95	19.33	81.38	0.00	26.00
8/5/2018	02:00-03:00	43.52	38.66	0.59	7.20	18.43	82.82	0.00	26.00
8/5/2018	03:00-04:00	51.06	26.75	0.64	11.25	14.43	87.00	1.98	26.00
8/5/2018	04:00-05:00	88.85	29.10	0.67	24.85	35.32	91.15	7.53	25.95
8/5/2018	05:00-06:00	131.60	31.23	1.37	40.33	54.35	98.28	25.27	25.00
8/5/2018	06:00-07:00	39.51	28.44	3.60	17.48	8.40	95.15	1.25	25.53
8/5/2018	07:00-08:00	317.60	5.49	29.10	4.00	1.82	73.03	20.51	29.63
8/5/2018	08:00-09:00	31.02	3.76	64.88	2.15	1.12	63.53	44.12	33.12
8/5/2018	09:00-10:00	13.27	3.76	83.77	2.00	1.05	58.52	52.21	35.87
8/5/2018	10:00-11:00	28.63	3.76	77.99	8.07	5.20	55.82	44.21	37.37
8/5/2018	11:00-12:00	43.90	4.39	37.39	23.87	12.68	54.47	15.68	38.28
8/5/2018	12:00-13:00	47.81	3.76	69.09	2.77	1.62	51.57	19.16	40.43

AQ6 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
8.5.2018	13:00-14:00	57.07	8.31	67.80	19.12	18.20	52.28	26.59	39.48
8.5.2018	14:00-15:00	80.64	4.92	3.27	24.22	17.73	52.12	0.00	39.25
8.5.2018	15:00-16:00	70.14	3.76	65.30	25.02	24.58	50.60	10.57	39.90
8.5.2018	16:00-17:00	138.28	26.15	8.03	65.20	62.78	51.45	16.62	38.60
8.5.2018	17:00-18:00	136.85	67.57	0.74	74.30	77.22	55.88	0.00	34.72
8.5.2018	18:00-19:00	171.11	109.09	0.67	55.27	56.48	65.48	0.56	31.08
8.5.2018	19:00-20:00	138.85	74.25	0.57	32.70	35.57	69.47	0.00	29.83
8.5.2018	20:00-21:00	128.93	31.51	0.81	42.78	48.07	70.15	1.98	29.00
8.5.2018	21:00-22:00	101.06	12.51	0.80	38.85	45.92	68.47	0.03	28.75
8.5.2018	22:00-23:00	142.40	27.82	0.75	43.54	52.39	70.05	1.05	28.00
8.5.2018	23:00-00:00	51.15	23.41	0.63	14.97	15.12	71.32	0.03	28.00
9.5.2018	00:00-01:00	53.06	26.40	0.92	12.20	10.27	72.62	0.00	28.00
9.5.2018	01:00-02:00	41.42	36.15	0.57	20.85	21.78	76.53	0.00	27.38
9.5.2018	02:00-03:00	55.45	38.35	0.57	19.33	29.80	81.08	0.03	26.52
9.5.2018	03:00-04:00	54.30	37.57	0.57	16.40	27.65	83.92	0.03	26.00
9.5.2018	04:00-05:00	90.09	33.21	0.60	26.78	39.30	89.48	0.41	26.00
9.5.2018	05:00-06:00	106.31	28.79	1.18	26.22	35.17	94.15	5.80	25.95
9.5.2018	06:00-07:00	73.67	26.03	2.06	13.30	10.38	97.17	0.78	25.82
9.5.2018	07:00-08:00	49.72	5.36	22.83	2.65	1.57	75.92	8.65	29.08
9.5.2018	08:00-09:00	26.43	3.76	64.87	2.10	1.13	63.77	30.51	33.42
9.5.2018	09:00-10:00	6.97	3.76	88.38	2.00	1.00	58.53	44.46	36.15
9.5.2018	10:00-11:00	21.19	3.76	93.72	2.43	1.32	55.20	44.21	38.00
9.5.2018	11:00-12:00	20.33	3.86	52.13	11.80	7.07	54.87	18.44	38.13
9.5.2018	12:00-13:00	47.31	3.76	1.84	9.95	1.16	52.95	0.00	39.79

AQ7 (first day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
6.5.2018	14:00-15:00	134.27	19.76	0.01	32.71	13.63	60.41	0.00	38.90
6.5.2018	15:00-16:00	175.72	25.05	0.00	44.75	18.02	66.65	0.00	36.28
6.5.2018	16:00-17:00	76.02	25.77	0.00	29.83	14.80	68.25	0.00	34.52
6.5.2018	17:00-18:00	70.04	21.87	0.00	36.61	79.44	69.66	0.14	33.46
6.5.2018	18:00-19:00	110.42	25.55	0.00	44.75	3.15	75.12	29.79	30.23
6.5.2018	19:00-20:00	124.21	21.43	0.03	32.17	29.20	77.92	3.14	28.77
6.5.2018	20:00-21:00	165.19	20.93	0.01	25.17	84.45	78.28	4.39	27.77
6.5.2018	21:00-22:00	142.84	25.41	0.00	19.62	43.65	80.78	7.40	27.27
6.5.2018	22:00-23:00	141.45	23.87	0.00	26.50	10.33	84.37	9.38	26.17
6.5.2018	23:00-00:00	136.13	24.54	0.00	26.55	14.60	87.97	10.38	25.68
7.5.2018	00:00-01:00	119.02	21.97	0.00	24.17	13.40	90.90	0.00	25.43
7.5.2018	01:00-02:00	95.00	20.66	0.00	30.95	11.83	94.85	0.00	24.93
7.5.2018	02:00-03:00	88.22	22.45	0.00	20.55	108.85	94.25	0.00	25.08
7.5.2018	03:00-04:00	95.36	22.14	0.00	12.17	38.83	93.93	0.00	25.28
7.5.2018	04:00-05:00	182.73	25.70	0.00	12.47	73.35	94.50	0.00	25.23
7.5.2018	05:00-06:00	148.75	19.36	0.00	22.93	43.30	97.87	0.00	24.42
7.5.2018	06:00-07:00	113.46	9.67	0.00	41.83	37.08	95.78	0.00	25.03
7.5.2018	07:00-08:00	59.10	1.44	0.04	2.22	2.65	75.37	1.98	33.03
7.5.2018	08:00-09:00	60.09	1.17	0.06	2.27	1.00	64.27	0.00	38.90
7.5.2018	09:00-10:00	75.53	2.05	0.02	5.77	28.00	58.52	0.00	41.77
7.5.2018	10:00-11:00	73.35	3.87	0.01	13.30	13.18	54.97	0.00	43.72
7.5.2018	11:00-12:00	93.78	8.46	0.00	39.70	9.38	56.28	0.00	43.35
7.5.2018	12:00-13:00	125.67	13.99	0.00	25.33	2.23	52.77	0.00	43.57
7.5.2018	13:00-14:00	153.06	22.78	0.04	12.30	7.43	50.30	0.00	44.68

AQ7 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
7.5.2018	14:00-15:00	150.64	21.75	0.00	62.65	32.85	49.33	0.00	45.30
7.5.2018	15:00-16:00	124.96	17.02	0.00	114.90	42.88	50.88	0.00	43.83
7.5.2018	16:00-17:00	159.10	28.13	0.00	70.88	42.97	52.25	0.00	42.02
7.5.2018	17:00-18:00	147.25	34.30	0.00	40.85	64.67	64.30	6.68	37.68
7.5.2018	18:00-19:00	127.92	31.33	0.00	53.07	38.93	74.30	6.15	33.18
7.5.2018	19:00-20:00	141.22	14.73	0.00	20.95	30.57	80.93	1.91	30.40
7.5.2018	20:00-21:00	141.13	21.57	0.00	7.87	30.02	82.83	1.25	29.68
7.5.2018	21:00-22:00	134.46	22.17	0.00	16.22	25.92	76.65	22.51	29.50
7.5.2018	22:00-23:00	115.61	18.97	0.00	2.37	28.82	79.30	29.13	28.17
7.5.2018	23:00-00:00	126.04	20.23	0.00	9.35	30.13	83.07	40.07	27.42
8.5.2018	00:00-01:00	110.52	19.56	0.00	36.95	30.98	88.35	14.20	26.50
8.5.2018	01:00-02:00	162.06	20.68	0.00	21.57	17.37	92.23	0.00	26.17

8.5.2018	02:00-03:00	232.23	19.25	0.00	21.90	17.93	95.07	0.00	25.78
8.5.2018	03:00-04:00	121.89	17.22	0.00	24.30	17.85	97.00	0.00	25.52
8.5.2018	04:00-05:00	108.36	15.96	0.00	10.62	16.17	97.10	0.00	25.22
8.5.2018	05:00-06:00	198.24	18.39	0.00	3.47	18.48	99.53	0.00	24.37
8.5.2018	06:00-07:00	143.74	10.33	0.00	2.08	18.82	95.45	0.00	25.22
8.5.2018	07:00-08:00	108.49	6.55	0.03	1.02	2.05	77.73	0.00	32.02
8.5.2018	08:00-09:00	99.05	19.20	0.05	1.00	2.02	66.48	0.00	38.25
8.5.2018	09:00-10:00	161.92	34.25	0.04	1.08	21.45	61.28	0.00	40.97
8.5.2018	10:00-11:00	70.43	1.15	0.00	9.97	19.67	57.78	0.00	42.45
8.5.2018	11:00-12:00	60.67	7.10	6.01	16.20	16.45	55.65	1.51	39.08
8.5.2018	12:00-13:00	66.80	7.52	5.15	27.55	26.80	54.80	0.00	37.53
8.5.2018	13:00-14:00	96.30	9.54	2.37	3.58	3.62	53.97	0.16	39.75

AQ7 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
8.5.2018	14:00-15:00	98.81	9.76	0.04	4.00	38.28	53.53	0.00	45.02
8.5.2018	15:00-16:00	128.99	18.23	0.01	13.27	34.57	52.50	0.00	44.35
8.5.2018	16:00-17:00	138.20	24.79	0.00	18.41	40.66	53.52	0.00	42.52
8.5.2018	17:00-18:00	160.11	31.85	0.02	50.55	71.05	62.60	0.00	37.52
8.5.2018	18:00-19:00	163.28	31.17	0.00	22.23	40.68	74.00	7.78	32.90
8.5.2018	19:00-20:00	129.34	31.10	0.00	42.42	40.32	79.37	82.94	30.23
8.5.2018	20:00-21:00	131.96	25.82	0.00	32.85	40.00	80.53	71.27	29.28
8.5.2018	21:00-22:00	99.21	26.21	0.00	24.65	34.90	78.82	2.63	28.33
8.5.2018	22:00-23:00	96.93	33.73	0.00	37.90	42.73	79.98	4.23	28.20
8.5.2018	23:00-00:00	114.90	19.25	0.00	53.67	61.27	83.82	7.56	27.23
9.5.2018	00:00-01:00	109.68	19.01	0.00	12.82	29.40	86.82	0.50	26.45
9.5.2018	01:00-02:00	93.06	19.02	0.00	21.90	24.05	89.88	0.00	25.90
9.5.2018	02:00-03:00	108.56	20.21	0.00	19.63	22.12	92.45	0.00	25.62
9.5.2018	03:00-04:00	97.34	18.49	0.00	21.13	21.95	94.13	0.00	25.13
9.5.2018	04:00-05:00	241.07	20.48	0.00	24.18	30.25	95.95	0.00	24.92
9.5.2018	05:00-06:00	237.16	19.12	0.00	23.02	38.52	97.73	0.00	23.93
9.5.2018	06:00-07:00	149.35	13.33	0.00	74.38	16.48	96.48	0.00	24.85
9.5.2018	07:00-08:00	167.02	33.77	0.02	1.00	2.78	82.27	0.00	29.83
9.5.2018	08:00-09:00	144.28	9.55	0.06	3.13	3.08	67.55	2.60	37.30
9.5.2018	09:00-10:00	84.35	7.31	0.03	1.00	2.10	61.32	0.00	41.62
9.5.2018	10:00-11:00	114.82	24.72	0.04	7.47	8.40	57.15	0.00	43.85
9.5.2018	11:00-12:00	135.37	19.33	0.01	2.35	15.47	52.85	0.00	44.38
9.5.2018	12:00-13:00	213.30	35.87	0.01	3.82	26.87	52.63	0.00	44.25
9.5.2018	13:00-14:00	319.10	30.52	0.04	5.70	12.32	50.30	0.00	44.68

AQ8 (first day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
9.5.2018	16:00-17:00	1.93	101.02	0.00	1.00	8.73	70.29	1.88	27.88
9.5.2018	17:00-18:00	82.41	129.31	0.00	1.88	5.40	83.68	2.04	27.33
9.5.2018	18:00-19:00	71.70	93.35	0.00	2.05	3.75	82.92	1.88	27.00
9.5.2018	19:00-20:00	78.09	71.74	0.00	2.02	6.98	76.27	1.88	26.95
9.5.2018	20:00-21:00	114.12	85.20	0.00	2.40	9.12	81.80	2.10	26.18
9.5.2018	21:00-22:00	136.52	67.82	0.00	2.25	5.03	82.60	4.23	26.00
9.5.2018	22:00-23:00	157.12	72.43	0.00	2.05	10.15	82.97	5.86	26.00
10.5.2018	23:00-00:00	141.38	85.79	0.00	2.00	12.55	84.83	3.98	25.93
10.5.2018	00:00-01:00	138.93	73.81	0.00	2.00	10.57	87.32	3.51	25.00
10.5.2018	01:00-02:00	135.83	83.69	0.00	2.03	10.98	91.27	2.19	25.00
10.5.2018	02:00-03:00	108.91	64.28	0.00	2.05	12.00	93.47	2.16	25.00
10.5.2018	03:00-04:00	93.77	73.75	0.00	2.00	10.22	93.87	4.36	25.00
10.5.2018	04:00-05:00	86.21	71.62	0.00	2.00	12.32	94.32	3.67	25.00
10.5.2018	05:00-06:00	142.51	78.36	0.00	2.00	12.55	95.27	27.94	25.00
10.5.2018	06:00-07:00	178.74	78.99	0.00	2.25	9.72	94.97	43.93	25.35
10.5.2018	07:00-08:00	178.95	52.24	0.01	2.63	11.32	89.75	27.28	26.57
10.5.2018	08:00-09:00	72.50	16.05	0.10	3.50	10.62	80.18	3.32	28.48
10.5.2018	09:00-10:00	53.81	4.33	0.21	2.33	6.22	70.28	3.23	30.65
10.5.2018	10:00-11:00	69.41	3.95	0.07	2.25	4.18	61.40	3.76	33.32
10.5.2018	11:00-12:00	74.17	6.71	0.08	1.92	5.73	56.95	2.07	35.17
10.5.2018	12:00-13:00	85.93	28.28	0.00	1.95	11.60	59.47	1.98	34.35
10.5.2018	13:00-14:00	104.78	27.59	0.01	3.12	7.08	57.07	1.91	35.38
10.5.2018	14:00-15:00	137.27	63.47	0.00	1.13	4.92	63.32	1.98	33.37
10.5.2018	15:00-16:00	175.72	79.21	0.00	1.97	5.35	66.35	1.91	32.78

AQ8 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
10.5.2018	16:00-17:00	119.68	56.76	0.00	2.92	5.32	66.82	1.88	33.38
10.5.2018	17:00-18:00	152.50	70.77	0.00	2.40	11.75	75.03	1.91	30.62
10.5.2018	18:00-19:00	152.76	109.81	0.00	3.22	8.58	84.73	2.07	28.37
10.5.2018	19:00-20:00	129.23	110.50	0.00	3.70	4.87	87.60	2.73	28.00
10.5.2018	20:00-21:00	134.89	60.83	0.00	2.78	8.43	96.32	3.01	24.65
10.5.2018	21:00-22:00	149.62	68.48	0.00	2.55	12.03	100.00	1.88	21.37
10.5.2018	22:00-23:00	146.33	74.02	0.00	4.07	8.98	100.00	1.88	21.61
10.5.2018	23:00-00:00	119.00	67.70	0.00	1.23	3.27	100.00	1.88	21.68
11.5.2018	00:00-01:00	122.95	62.18	0.00	2.13	4.08	99.30	2.82	21.78
11.5.2018	01:00-02:00	113.37	65.03	0.00	2.08	10.20	98.17	2.07	22.00
11.5.2018	02:00-03:00	138.10	64.97	0.00	2.00	13.27	94.98	2.01	22.32
11.5.2018	03:00-04:00	180.98	65.57	0.00	2.02	8.27	95.73	18.22	22.80

11.5.2018	04:00-05:00	205.87	65.63	0.00	2.03	4.75	98.32	36.44	22.95
11.5.2018	05:00-06:00	105.00	58.29	0.00	2.02	4.35	95.78	1.88	23.00
11.5.2018	06:00-07:00	168.95	59.64	0.00	2.02	3.68	95.18	6.55	23.02
11.5.2018	07:00-08:00	155.14	48.76	0.00	2.83	3.18	89.53	3.01	24.10
11.5.2018	08:00-09:00	120.64	21.60	0.06	2.47	5.33	80.70	2.57	25.48
11.5.2018	09:00-10:00	93.45	26.21	0.00	2.02	7.58	78.95	1.88	26.02
11.5.2018	10:00-11:00	159.14	170.74	0.05	2.55	8.28	72.50	9.19	27.72
11.5.2018	11:00-12:00	121.97	13.95	0.11	1.58	3.75	68.53	9.34	29.62
11.5.2018	12:00-13:00	63.42	7.06	0.00	1.55	4.52	68.63	13.23	30.00
11.5.2018	13:00-14:00	61.09	25.74	0.00	2.00	8.82	67.00	2.01	30.80
11.5.2018	14:00-15:00	87.07	37.03	0.00	1.85	11.15	67.23	1.94	31.22
11.5.2018	15:00-16:00	91.85	27.34	0.00	2.28	11.47	63.13	1.88	33.23

AQ8 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
11.5.2018	16:00-17:00	122.29	46.16	0.00	1.18	14.05	67.55	1.88	30.45
11.5.2018	17:00-18:00	125.57	75.63	0.00	1.43	14.22	71.22	1.88	28.58
11.5.2018	18:00-19:00	162.27	104.04	0.00	8.28	5.90	80.00	1.88	26.80
11.5.2018	19:00-20:00	165.04	99.40	0.00	2.63	12.02	86.53	3.89	26.00
11.5.2018	20:00-21:00	130.27	102.85	0.00	2.02	11.43	89.28	1.88	26.00
11.5.2018	21:00-22:00	132.41	85.13	0.00	2.67	8.80	90.53	1.91	25.92
11.5.2018	22:00-23:00	99.43	86.14	0.00	2.25	7.07	94.45	2.48	25.23
11.5.2018	23:00-00:00	95.03	111.16	0.00	2.03	6.72	100.00	1.88	21.97
12.5.2018	00:00-01:00	114.65	63.25	0.00	2.70	6.75	100.00	1.88	21.98
12.5.2018	01:00-02:00	108.94	62.56	0.00	2.68	4.92	99.98	1.88	22.08
12.5.2018	02:00-03:00	94.05	62.34	0.01	2.02	3.57	100.00	1.88	22.70
12.5.2018	03:00-04:00	110.75	66.76	0.03	2.00	4.15	99.48	2.01	23.00
12.5.2018	04:00-05:00	94.18	59.58	0.00	2.00	4.60	100.00	1.98	23.00
12.5.2018	05:00-06:00	265.00	66.07	0.00	2.07	5.47	99.47	31.92	23.00
12.5.2018	06:00-07:00	231.19	61.40	0.02	2.45	3.50	96.50	22.39	23.88
12.5.2018	07:00-08:00	134.26	40.01	0.04	2.67	10.95	89.35	6.49	25.57
12.5.2018	08:00-09:00	181.23	141.14	0.16	2.08	8.32	83.03	13.04	27.27
12.5.2018	09:00-10:00	133.84	19.91	0.08	1.53	8.87	87.28	12.70	26.72
12.5.2018	10:00-11:00	81.58	35.59	0.00	2.08	11.12	96.10	19.41	24.10
12.5.2018	11:00-12:00	121.47	79.24	0.00	5.33	14.32	86.52	1.88	24.20
12.5.2018	12:00-13:00	110.99	71.65	0.00	7.58	9.33	80.42	1.88	26.08
12.5.2018	13:00-14:00	176.85	87.14	0.00	1.97	11.20	71.55	5.30	26.55
12.5.2018	14:00-15:00	232.83	121.32	0.00	5.42	8.85	90.78	2.45	24.15
12.5.2018	15:00-16:00	434.06	83.28	0.00	3.38	8.18	85.17	9.53	24.88

AQ9 (first day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
9.5.2018	14:00-15:00	61.82	128.44	0.17	21.85	98.76	65.66	0.83	39.76
9.5.2018	15:00-16:00	22.14	79.58	0.02	46.90	71.52	64.88	3.36	34.45
9.5.2018	16:00-17:00	60.60	106.42	0.00	49.62	59.95	69.00	91.22	31.85
9.5.2018	17:00-18:00	48.77	99.46	0.00	21.52	13.58	80.35	107.18	31.65
9.5.2018	18:00-19:00	31.78	41.52	0.00	15.78	8.25	79.62	10.76	31.25
9.5.2018	19:00-20:00	53.25	57.51	0.00	19.02	10.68	76.80	0.00	30.38
9.5.2018	20:00-21:00	86.08	76.79	0.00	30.08	21.83	82.85	0.00	29.57
9.5.2018	21:00-22:00	29.49	15.90	0.00	27.23	6.22	85.98	4.80	29.27
9.5.2018	22:00-23:00	38.27	26.06	0.00	30.02	3.47	82.48	0.00	28.75
9.5.2018	23:00-00:00	58.60	36.34	0.00	26.03	32.52	83.37	0.00	28.12
10.5.2018	00:00-01:00	57.74	35.12	0.00	27.53	37.52	85.68	0.00	27.33
10.5.2018	01:00-02:00	54.30	45.09	0.00	41.05	37.80	87.92	0.00	26.53
10.5.2018	02:00-03:00	40.46	37.97	0.00	15.67	17.32	89.82	0.00	26.82
10.5.2018	03:00-04:00	35.21	27.03	0.00	6.62	5.33	87.40	0.00	28.80
10.5.2018	04:00-05:00	35.98	29.85	0.01	2.17	1.68	66.98	0.00	39.40
10.5.2018	05:00-06:00	129.31	22.58	0.01	8.07	1.60	63.43	0.00	42.08
10.5.2018	06:00-07:00	182.75	10.38	0.00	7.48	27.75	60.95	0.00	44.53
10.5.2018	07:00-08:00	172.83	6.11	0.00	22.52	44.97	60.40	0.00	45.15
10.5.2018	08:00-09:00	14.70	0.88	0.05	10.10	14.20	63.23	0.00	40.12
10.5.2018	09:00-10:00	21.95	16.34	0.02	5.40	2.15	64.18	0.00	39.98
10.5.2018	10:00-11:00	33.50	25.62	0.01	3.37	1.60	64.40	0.00	41.08
10.5.2018	11:00-12:00	151.55	20.70	0.00	7.58	1.63	62.78	0.00	42.82
10.5.2018	12:00-13:00	165.77	5.58	0.00	9.72	41.38	59.80	0.00	45.40
10.5.2018	13:00-14:00	69.37	11.20	0.00	39.83	60.71	61.48	0.00	44.71

AQ9 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
10.5.2018	14:00-15:00	38.94	9.00	0.00	41.40	47.57	64.28	0.00	42.92
10.5.2018	15:00-16:00	1139.23	1.93	0.00	38.42	58.62	69.38	0.00	40.22
10.5.2018	16:00-17:00	108.70	17.57	0.00	40.85	66.77	72.43	0.00	37.90
10.5.2018	17:00-18:00	70.62	29.41	0.00	32.20	37.25	76.52	14.58	34.77
10.5.2018	18:00-19:00	75.04	73.79	0.00	31.65	15.48	83.47	126.84	32.12
10.5.2018	19:00-20:00	62.03	67.46	0.00	26.63	16.83	86.00	70.65	31.00
10.5.2018	20:00-21:00	109.18	45.68	0.00	36.35	17.92	82.30	18.12	29.18
10.5.2018	21:00-22:00	84.80	208.80	0.00	71.43	134.28	88.90	29.63	23.72
10.5.2018	22:00-23:00	66.90	10.24	0.00	57.35	252.72	84.93	16.43	22.63
10.5.2018	23:00-00:00	50.20	8.51	0.00	29.45	161.85	97.20	0.00	22.67
11.5.2018	00:00-01:00	38.94	16.15	0.00	26.93	73.22	100.00	0.00	22.38
11.5.2018	01:00-02:00	272.75	25.74	0.00	18.10	36.92	97.97	0.00	22.90

11.5.2018	02:00-03:00	49.05	5.83	0.00	13.95	3.27	94.47	0.00	23.67
11.5.2018	03:00-04:00	45.62	5.08	0.00	21.23	3.25	95.60	0.00	23.62
11.5.2018	04:00-05:00	67.76	3.29	0.00	33.27	12.25	99.02	0.00	24.08
11.5.2018	05:00-06:00	45.62	3.76	0.00	25.68	10.08	98.12	0.00	23.93
11.5.2018	06:00-07:00	126.88	3.76	0.00	32.12	24.07	97.70	0.00	23.87
11.5.2018	07:00-08:00	92.57	3.76	0.00	4.97	1.00	88.82	0.00	25.18
11.5.2018	08:00-09:00	21.57	3.76	0.03	2.10	1.00	82.10	0.00	27.33
11.5.2018	09:00-10:00	11.64	3.76	0.01	3.77	1.00	79.93	0.00	28.47
11.5.2018	10:00-11:00	52.77	3.76	0.03	2.57	1.00	73.40	0.00	31.10
11.5.2018	11:00-12:00	13.65	3.76	0.04	8.22	1.10	71.12	0.00	34.25
11.5.2018	12:00-13:00	27.20	4.95	0.03	16.83	1.62	71.25	0.00	35.17
11.5.2018	13:00-14:00	11.26	8.72	0.00	4.32	2.20	68.23	0.00	37.02

AQ9 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
11.5.2018	14:00-15:00	37.41	9.00	0.03		20.75	69.40	0.00	36.63
11.5.2018	15:00-16:00	61.08	12.26	0.00	15.67	18.90	71.50	0.00	37.12
11.5.2018	16:00-17:00	91.21	3.83	0.00	38.30	26.13	74.38	0.00	34.53
11.5.2018	17:00-18:00	33.07	32.64	0.00	41.18	30.02	75.27	0.88	31.85
11.5.2018	18:00-19:00	60.03	96.26	0.00	42.25	29.95	83.13	13.36	29.18
11.5.2018	19:00-20:00	62.03	86.45	0.00	38.42	26.85	89.42	25.43	27.68
11.5.2018	20:00-21:00	40.56	77.26	0.00	25.43	15.10	91.85	0.00	27.12
11.5.2018	21:00-22:00	29.78	71.37	0.00	8.65	16.30	93.22	0.00	27.32
11.5.2018	22:00-23:00	26.05	75.63	0.00	7.02	20.45	95.50	0.00	27.83
11.5.2018	23:00-00:00	17.85	32.49	0.00	2.73	29.57	90.97	0.00	26.93
12.5.2018	00:00-01:00	28.34	77.33	0.00	44.58	44.43	93.82	0.72	25.42
12.5.2018	01:00-02:00	38.17	54.84	0.00	26.42	28.72	94.78	1.54	25.28
12.5.2018	02:00-03:00	26.05	45.44	0.00	13.72	26.67	95.72	0.00	25.18
12.5.2018	03:00-04:00	23.29	50.70	0.00	12.77	27.50	95.15	0.00	25.43
12.5.2018	04:00-05:00	33.05	47.44	0.00	15.68	30.87	95.03	0.00	25.13
12.5.2018	05:00-06:00	22.14	36.69	0.00	32.58	37.13	97.30	0.00	25.27
12.5.2018	06:00-07:00	421.62	18.22	0.00	25.67	33.62	94.80	0.00	25.38
12.5.2018	07:00-08:00	31.40	10.38	0.01	6.23	15.83	88.48	2.41	27.85
12.5.2018	08:00-09:00	74.80	14.77	0.05	2.58	18.85	87.17	0.00	29.07
12.5.2018	09:00-10:00	54.49	11.57	0.00	12.83	20.72	86.12	0.00	29.33
12.5.2018	10:00-11:00	19.56	22.67	0.00	17.52	30.67	88.13	0.00	28.60
12.5.2018	11:00-12:00	20.80	93.35	0.00	23.07	25.92	91.72	37.85	25.20
12.5.2018	12:00-13:00	170.13	8.23	0.00	33.83	8.32	60.42	0.00	44.85
12.5.2018	13:00-14:00	180.51	6.26	0.00	29.75	50.74	60.75	0.00	45.05

AQ10 (first day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
9.5.2018	15:00-16:00	41.20	99.51	2.32	97.70	107.89	62.07	2.25	30.57
9.5.2018	16:00-17:00	63.56	113.60	0.84	40.60	50.93	62.67	0.19	29.68
9.5.2018	17:00-18:00	57.83	97.83	0.63	6.83	7.67	70.60	0.00	30.00
9.5.2018	18:00-19:00	31.87	33.99	0.88	18.23	21.07	70.15	0.00	29.32
9.5.2018	19:00-20:00	28.92	39.07	0.66	23.63	26.70	67.55	0.00	29.00
9.5.2018	20:00-21:00	84.36	81.90	0.57	9.83	7.87	73.72	19.35	28.12
9.5.2018	21:00-22:00	48.58	35.62	1.77	14.27	10.98	74.12	1.82	28.00
9.5.2018	22:00-23:00	23.29	21.04	4.67	32.00	26.90	69.67	0.00	28.00
9.5.2018	23:00-00:00	58.69	36.53	0.79	25.73	32.68	71.92	0.00	27.02
9.5.2018	00:00-01:00	57.16	36.03	0.57	28.75	31.68	74.82	0.00	27.00
10.5.2018	01:00-02:00	54.97	46.44	0.57	30.32	44.07	78.87	0.00	26.18
10.5.2018	02:00-03:00	45.71	46.28	0.57	21.78	36.52	82.43	0.13	26.00
10.5.2018	03:00-04:00	41.42	32.30	2.73	12.75	29.12	86.42	0.00	26.00
10.5.2018	04:00-05:00	33.97	27.28	2.01	6.53	3.03	87.25	0.03	26.00
10.5.2018	05:00-06:00	150.31	20.19	12.94	33.87	34.45	88.40	66.07	26.00
10.5.2018	06:00-07:00	178.94	10.50	14.57	67.42	67.83	85.28	47.57	26.65
10.5.2018	07:00-08:00	99.35	8.18	18.04	18.12	5.80	80.98	21.20	27.62
10.5.2018	08:00-09:00	77.30	3.76	26.85	6.28	3.35	74.42	21.86	29.33
10.5.2018	09:00-10:00	72.82	3.76	41.35	8.57	8.10	68.72	42.61	31.67
10.5.2018	10:00-11:00	55.73	3.76	83.84	3.28	2.13	60.18	69.42	36.40
10.5.2018	11:00-12:00	30.16	3.76	121.62	3.15	1.92	57.48	66.85	38.72
10.5.2018	12:00-13:00	14.98	8.00	30.74	36.80	9.23	55.42	10.03	40.28
10.5.2018	13:00-14:00	61.94	6.43	7.36	33.73	28.68	56.27	6.05	40.20
10.5.2018	14:00-15:00	48.48	52.99	1.15	94.20	56.90	57.90	0.00	38.98

AQ10 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
10.5.2018	15:00-16:00	48.53	3.76	0.57	3.98	2.27	60.03	1.02	37.29
10.5.2018	16:00-17:00	111.56	18.28	6.98	35.20	49.50	63.40	17.21	35.02
10.5.2018	17:00-18:00	68.90	29.51	0.59	31.95	16.42	64.07	2.23	34.32
10.5.2018	18:00-19:00	61.17	76.48	0.57	28.30	35.33	72.68	0.25	30.60
10.5.2018	19:00-20:00	64.99	67.45	0.60	17.90	19.97	75.35	0.00	29.93
10.5.2018	20:00-21:00	50.77	46.28	5.14	46.65	59.72	77.02	0.00	27.57
10.5.2018	21:00-22:00	86.56	212.35	0.57	38.57	137.12	89.92	0.00	23.13
10.5.2018	22:00-23:00	62.13	10.32	0.57	7.35	36.68	89.15	0.00	23.02
10.5.2018	23:00-00:00	51.25	8.59	2.72	9.72	2.62	98.20	0.00	23.28
10.5.2018	00:00-01:00	40.46	16.15	0.57	10.20	3.62	93.55	0.00	23.15
11.5.2018	01:00-02:00	44.95	26.18	0.63	13.07	1.85	87.43	0.00	24.00
11.5.2018	02:00-03:00	49.34	5.55	0.96	13.85	7.78	80.65	0.00	24.00

11.5.2018	03:00-04:00	45.62	5.08	1.12	16.93	24.60	82.67	0.00	24.00
11.5.2018	04:00-05:00	71.29	3.76	2.96	19.43	43.32	84.75	4.20	24.57
11.5.2018	05:00-06:00	46.95	3.76	20.44	29.25	24.48	82.53	14.33	24.83
11.5.2018	06:00-07:00	118.15	3.76	13.62	70.62	97.43	84.33	34.84	24.90
11.5.2018	07:00-08:00	9.54	3.76	20.22	28.27	11.63	76.78	0.03	25.85
11.5.2018	08:00-09:00	9.83	3.76	31.99	21.62	16.38	71.53	1.32	27.22
11.5.2018	09:00-10:00	2.29	3.76	20.89	4.10	2.73	69.98	0.00	27.97
11.5.2018	10:00-11:00	54.40	4.33	25.87	5.13	2.67	66.05	19.47	29.65
11.5.2018	11:00-12:00	6.30	3.76	58.54	2.10	1.12	62.17	9.16	33.30
11.5.2018	12:00-13:00	10.88	5.02	55.98	4.77	3.37	61.63	7.27	34.05
11.5.2018	13:00-14:00	4.58	9.38	30.50	3.33	1.88	59.57	1.19	35.42
11.5.2018	14:00-15:00	38.11	8.91	14.18	38.33	36.67	59.92	5.92	34.92

AQ10 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
11.5.2018	15:00-16:00	68.91	12.88	2.48	48.34	33.25	60.59	2.46	34.98
11.5.2018	16:00-17:00	91.16	3.97	26.47	11.99	7.68	59.90	10.54	35.02
11.5.2018	17:00-18:00	28.25	32.30	1.73	51.02	47.47	61.72	1.91	32.35
11.5.2018	18:00-19:00	76.06	97.55	0.67	31.87	39.97	69.40	5.39	28.72
11.5.2018	19:00-20:00	72.72	87.01	0.70	23.35	56.77	74.78	0.00	28.00
11.5.2018	20:00-21:00	46.48	78.11	0.57	10.30	8.63	76.72	0.00	28.00
11.5.2018	21:00-22:00	31.21	71.93	0.60	13.13	33.67	79.63	0.00	27.97
11.5.2018	22:00-23:00	27.87	76.42	0.58	8.02	9.18	80.42	0.00	27.57
11.5.2018	23:00-00:00	20.52	33.18	5.12	32.52	18.88	79.57	0.00	26.27
11.5.2018	00:00-01:00	33.40	79.18	0.57	24.15	39.33	83.43	0.00	24.72
12.5.2018	01:00-02:00	43.33	55.91	0.67	12.05	14.17	81.03	0.00	25.00
12.5.2018	02:00-03:00	31.40	46.31	0.60	13.95	29.22	84.87	0.00	25.00
12.5.2018	03:00-04:00	25.29	50.48	0.61	20.50	48.93	87.37	0.00	25.00
12.5.2018	04:00-05:00	34.55	49.04	0.93	25.15	43.90	84.60	0.03	25.00
12.5.2018	05:00-06:00	28.34	37.03	1.57	22.65	27.37	84.18	0.00	25.00
12.5.2018	06:00-07:00	417.42	19.38	10.42	117.68	127.12	82.33	119.19	25.68
12.5.2018	07:00-08:00	27.87	10.57	23.68	51.55	34.37	78.60	10.88	27.23
12.5.2018	08:00-09:00	80.35	14.74	15.45	31.95	25.20	76.30	17.78	27.57
12.5.2018	09:00-10:00	53.54	11.32	15.70	21.83	22.95	73.50	18.88	28.03
12.5.2018	10:00-11:00	8.97	23.05	9.72	18.47	22.40	73.78	0.00	27.40
12.5.2018	11:00-12:00	17.27	93.03	1.38	25.70	48.50	76.58	0.00	25.57
12.5.2018	12:00-13:00	32.15	26.68	13.73	2.13	1.10	65.87	0.68	28.56
12.5.2018	13:00-14:00	2.69	4.46	76.43	2.07	1.10	50.20	17.19	39.73
12.5.2018	14:00-15:00	0.00	37.35	103.83	8.07	19.19	53.52	47.03	38.11

APPENDIX M PHYSICAL IN-SITU SAMPLING DURING DRY SEASON FROM SEM

Surface Water Analysis Result

Project Name: Ahlone Expansion Combined Cycle Power Plant and FSRU Project to supply power to the Republic of the Union of Myanmar

Sampling by: ERM-Siam Co., Ltd.

Parameter	Unit	Method Analysis	LOQ	Results														Laboratory
				SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10	SW11	SW12	SW13	SW14	
Sampling Date				4/5/2018	4/5/2018	3/5/2018	4/5/2018	3/5/2018	3/5/2018	3/5/2018	3/5/2018	3/5/2018	3/5/2018	3/5/2018	3/5/2018	3/5/2018	3/5/2018	
Alkalinity	mg/L as $CaCO_3$	Titration Method	1.0	110	114	110	117	146	149	86.0	82.1	111	110	112	132	113	94.0	STS Green Co., Ltd.
Biochemical Oxygen Demand (BOD)	mg/L	5-Day BOD Test, Azide Modification Method	-	0.2	0.2	0.4	0.4	1.4	2.0	2.7	3.0	0.8	0.8	0.9	0.6	0.4	0.8	STS Green Co., Ltd.
Total Suspended Solids (TSS)	mg/L	Dried at 103-105 °C Method	10.0	1,169	461	843	1,211	37.2	21.3	26.8	33.3	55.9	48.2	16.1	<10.0	362	543	STS Green Co., Ltd.
Total Dissolved Solids (TDS)	mg/L	Dried at 180 °C Method	50.0	12,470	10,490	4,052	10,065	5,600	6,156	11,800	11,870	12,160	11,680	11,620	12,400	12,105	12,760	STS Green Co., Ltd.
Turbidity	NTU	Nephelometric Method	0.02	393	437	485	646	21.0	4.32	12.1	41.4	64.7	47.2	7.05	4.74	281	430	STS Green Co., Ltd.
Hardness as $CaCO_3$	mg/L as $CaCO_3$	EDTA Titrimetric Method	5.0	1,945	1,838	703	1,821	814	828	1,440	1,531	1,683	1,636	1,400	1,602	1,826	1,844	STS Green Co., Ltd.
Cyanide (CN)	mg/L	APHA (2012), 4500-CN (C),(E)	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	ALS Laboratory Group (Thailand)
Fluoride (F)	mg/L	APHA (2012), 4110B	0.1	<0.1	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ALS Laboratory Group (Thailand)
Sulfide	mg/L	Iodometric Method	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	STS Green Co., Ltd.
Total Organic Carbon	mg/L	Based on APHA (2012), 5310 B	0.05	6.86	3.06	3.54	5.30	4.84	6.34	4.78	4.94	1.63	1.67	2.33	2.47	3.08	3.32	ALS Laboratory Group (Thailand)
Ammonium-Nitrogen	mg/L	Phenate Method	0.010	0.499	0.146	0.082	0.116	0.179	0.169	0.157	0.103	0.035	0.255	0.257	0.304	0.246	0.229	STS Green Co., Ltd.
Sulfate (SO_4)	mg/L	Turbidimetric Method	1.0	534	485	117	523	118	105	404	307	579	513	456	531	531	501	STS Green Co., Ltd.
Nitrate (NO_3)	mg/L	Cadmium Reduction Method	0.005	2.38	1.99	1.70	1.90	0.140	<0.040	<0.040	<0.040	1.41	1.62	0.333	0.201	2.05	2.06	STS Green Co., Ltd.
Chromium (Cr)	mg/L	Electrothermal AAS Method	0.0005	0.0249	0.0252	0.0291	0.0391	0.0034	0.0025	0.0024	0.0027	0.0032	0.0029	0.0022	0.0007	0.0071	0.0380	STS Green Co., Ltd.
Calcium (Ca)	mg/L	Direct Nitrous Oxide-Acetylene Flame Method	0.02	185.98	119.94	59.90	105.26	76.85	86.31	133.72	135.04	138.98	133.16	140.44	135.92	131.21	164.70	STS Green Co., Ltd.
Magnesium (Mg)	mg/L	Direct Air-Acetylene Flame Method	0.003	386.15	320.30	92.04	292.68	162.40	138.72	328.50	307.25	322.00	356.70	317.25	347.25	352.92	358.85	STS Green Co., Ltd.
Sodium (Na)	mg/L	Direct Air-Acetylene Flame Method	0.01	2,158	2,160	903.20	2,258	836.20	1,399	2,988	2,557	2,636	1,820	2,585	2,307	2,651	2,476	STS Green Co., Ltd.
Potassium (K)	mg/L	Direct Air-Acetylene Flame Method	0.01	116.81	96.68	37.89	95.61	53.05	53.01	108.81	102.24	121.05	119.77	108.32	112.72	121.06	123.68	STS Green Co., Ltd.
Mercury (Hg)	mg/L	Cold-Vapor AAS Method	0.0003	0.0005	0.0003	0.0003	0.0006	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.0005	0.0003	STS Green Co., Ltd.
Lead (Pb)	mg/L	Electrothermal AAS Method	0.0020	0.0028	0.0028	0.0078	0.0079	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0071	STS Green Co., Ltd.
Cadmium (Cd)	mg/L	Electrothermal AAS Method	0.00005	0.00005	<0.00005	0.00009	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00014	<0.00005	<0.00005	STS Green Co., Ltd.
Copper (Cu)	mg/L	Direct Air-Acetylene Flame Method	0.05	0.05	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	STS Green Co., Ltd.
Iron (Fe)	mg/L	Direct Air-Acetylene Flame Method	0.10	64.71	19.77	26.21	75.29	2.49	1.93	1.18	1.51	1.77	1.68	0.47	0.36	43.45	1.32	STS Green Co., Ltd.
Tin (Sn)	mg/L	Based on APHA (2012), 3125	0.0001	0.0007	0.001	0.001	0.001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	0.0007	0.001	ALS Laboratory Group (Thailand)
Manganese (Mn)	mg/L	Direct Air-Acetylene Flame Method	0.04	1.04	0.41	0.52	1.40	0.22	0.30	0.64	0.61	0.05	0.05	0.25	0.23	0.91	0.87	STS Green Co., Ltd.
Total Nitrogen	mg/L	Based on APHA (2012), Calculated	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ALS Laboratory Group (Thailand)
Total Phosphorous	mg/L	Acid Digestion/Ascobic Acid Method	0.005	0.331	0.113	0.238	0.015	0.163	0.023	0.052	0.050	0.045	0.054	0.008	0.045	0.005	0.347	STS Green Co., Ltd.
Zinc (Zn)	mg/L	Direct Air-Acetylene Flame Method	0.02	0.17	0.05	0.07	0.13	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.10	0.08	STS Green Co., Ltd.
Nickel (Ni)	mg/L	Electrothermal AAS Method	0.0005	0.0194	0.0196	0.0275	0.0263	0.0042	0.0047	0.0039	0.0045	0.0035	0.0032	0.0019	0.0014	0.0087	0.0275	STS Green Co., Ltd.
Chloride (Cl)	mg/L	Mercuric Nitrate Method	1.0	5,998	5,455	2,094	6,164	2,788	3,014	6,017	6,193	6,321	6,203	6,056	5,998	6,091	6,511	STS Green Co., Ltd.
Oil and Grease	mg/L	Liquid-Liquid, Partition-Gravimetric Metod	2.0	5.8	6.3	3.9	5.2	4.2	5.1	4.9	4.0	6.2	5.4	5.7	5.9	6.1	7.0	STS Green Co., Ltd.
Chemical Oxygen Demand (COD)	mg/L	Open Reflux Method	5.0	61.0	25.0	13.0	29.5	50.0	60.0	71.0	66.0	31.0	24.0	17.0	42.0	61.5	81.0	STS Green Co., Ltd.

Groundwater Analysis Result

Project Name: Ahlone Expansion Combined Cycle Power Plant and FSRU Project to supply power to the Republic of the Union of Myanmar

Sampling by: ERM-Siam Co., Ltd.

Parameter	Unit	Method Analysis	LOQ	Results			Laboratory
				GW1	GW2	GW3	
Sampling Date				3/5/2018	3/5/2018	4/5/2018	
Alkalinity	mg/L as $CaCO_3$	Titration Method	1.0	650	152	17.1	STS Green Co., Ltd.
Biochemical Oxygen Demand (BOD)	mg/L	5-Day BOD Test, Azide Modification Method	-	0.2	0.4	0.2	STS Green Co., Ltd.
Total Suspended Solids (TSS)	mg/L	Dried at 103-105 °C Method	10.0	48.6	<10.0	<10.0	STS Green Co., Ltd.
Total Dissolved Solids (TDS)	mg/L	Dried at 180 °C Method	50.0	14,170	3,242	291	STS Green Co., Ltd.
Turbidity	NTU	Nephelometric Method	0.02	94.5	47.2	1.01	STS Green Co., Ltd.
Total Hardness as $CaCO_3$	mg/L as $CaCO_3$	EDTA Titrimetric Method	5.0	2,117	511	80.4	STS Green Co., Ltd.
Cyanide (CN)	mg/L	APHA (2012), 4500-CN (C),(E)	0.005	<0.005	<0.005	<0.005	ALS Laboratory Group (Thailand)
Fluoride (F)	mg/L	APHA (2012), 4110B	0.1	<0.1	<0.1	<0.1	ALS Laboratory Group (Thailand)
Sulfide	mg/L	Iodometric Method	1.0	<1.0	<1.0	<1.0	STS Green Co., Ltd.
Total Organic Carbon	mg/L	Based on APHA (2012), 5310 B	0.05	4.65	0.55	0.09	ALS Laboratory Group (Thailand)
Ammonium-Nitrogen	mg/L	Phenate Method	0.010	2.85	2.32	0.151	STS Green Co., Ltd.
Sulfate (SO_4)	mg/L	Turbidimetric Method	1.0	320	15.0	8.7	STS Green Co., Ltd.
Nitrate (NO_3)	mg/L	Cadmium Reduction Method	0.005	0.293	0.222	18.61	STS Green Co., Ltd.
Chromium (Cr)	mg/L	Electrothermal AAS Method	0.0005	<0.0005	<0.0005	0.0042	STS Green Co., Ltd.
Calcium (Ca)	mg/L	Direct Nitrous Oxide-Acetylene Flame Method	0.02	206.05	18.35	11.14	STS Green Co., Ltd.
Magnesium (Mg)	mg/L	Direct Air-Acetylene Flame Method	0.003	153.65	74.94	12.46	STS Green Co., Ltd.
Sodium (Na)	mg/L	Direct Air-Acetylene Flame Method	0.01	3,198	644.80	17.90	STS Green Co., Ltd.
Potassium (K)	mg/L	Direct Air-Acetylene Flame Method	0.01	177.57	59.95	3.69	STS Green Co., Ltd.
Mercury (Hg)	mg/L	Cold-Vapor AAS Method	0.0003	<0.0003	<0.0003	<0.0003	STS Green Co., Ltd.
Lead (Pb)	mg/L	Electrothermal AAS Method	0.0020	<0.0020	<0.0020	<0.0020	STS Green Co., Ltd.
Cadmium (Cd)	mg/L	Electrothermal AAS Method	0.00005	<0.00005	0.00010	0.00005	STS Green Co., Ltd.
Copper (Cu)	mg/L	Direct Air-Acetylene Flame Method	0.05	<0.05	<0.05	<0.05	STS Green Co., Ltd.

Parameter	Unit	Method Analysis	LOQ	Results			Laboratory
				GW1	GW2	GW3	
Iron (Fe)	mg/L	Direct Air-Acetylene Flame Method	0.10	9.68	3.86	<0.10	STS Green Co., Ltd.
Tin (Sn)	mg/L	Based on APHA (2012), 3125	0.0001	<0.0001	<0.0001	<0.0001	ALS Laboratory Group (Thailand)
Manganese (Mn)	mg/L	Direct Air-Acetylene Flame Method	0.04	0.40	2.94	<0.04	STS Green Co., Ltd.
Total Nitrogen	mg/L	Based on APHA (2012), Calculated	1.0	12.7	1.3	5.1	ALS Laboratory Group (Thailand)
Total Phosphorous	mg/L	Acid Digestion/Ascobic Acid Method	0.005	0.405	0.051	0.030	STS Green Co., Ltd.
Zinc (Zn)	mg/L	Direct Air-Acetylene Flame Method	0.02	0.02	0.07	<0.02	STS Green Co., Ltd.
Nickel (Ni)	mg/L	Electrothermal AAS Method	0.0005	<0.0005	0.0079	0.0141	STS Green Co., Ltd.
Chloride (Cl)	mg/L	Mercuric Nitrate Method	1.0	7,103	1,438	16.0	STS Green Co., Ltd.

Soil Analysis Result

Project Name: Ahlone Expansion Combined Cycle Power Plant and FSRU Project to supply power to the Republic of the Union of Myanmar

Sampling by: ERM-Siam Co., Ltd.

Parameter	Unit	Method Analysis	LOQ	Results																		Laboratory
				S01		S02		S03		S04		S05		S06		S07		S08		S09		
				Top Soil	Sub Soil	Top Soil	Sub Soil	Top Soil	Sub Soil	Top Soil	Sub Soil	Top Soil	Sub Soil	Top Soil	Sub Soil	Top Soil	Sub Soil	Top Soil	Sub Soil	Top Soil	Sub Soil	
pH	-	Electrometric Method	-	7.3	7.2	7.7	7.3	7.6	7.2	8.0	7.8	7.4	7.4	6.8	8.1	6.7	7.5	7.6	7.8	7.8	7.5	STS Green Co., Ltd.
Arsenic (As)	mg/kg	Hydride Generation AAS Method	0.04	0.30	<0.04	<0.04	<0.04	<0.04	<0.04	3.80	5.90	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	STS Green Co., Ltd.
Cadmium (Cd)	mg/kg	Direct Air-Acetylene Flame Method	1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<0.10	<1.00	<1.00	<1.00	<1.00	<1.00	STS Green Co., Ltd.
Chromium (Cr)	mg/kg	Direct Air-Acetylene Flame Method	2.50	47.54	36.82	74.99	73.34	63.39	71.71	66.66	70.60	56.20	56.87	64.97	68.02	60.84	64.10	63.83	64.62	72.61	74.00	STS Green Co., Ltd.
Copper (Cu)	mg/kg	Direct Air-Acetylene Flame Method	1.50	25.13	9.03	38.29	27.29	36.07	34.78	35.12	37.44	27.74	23.70	29.34	31.95	30.01	29.04	<1.50	29.26	33.64	31.93	STS Green Co., Ltd.
Iron (Fe)	mg/kg	Direct Air-Acetylene Flame Method	2.50	35,912	25,382	67,059	62,391	62,995	57,391	7,449	6,942	8,684	6,068	11,140	9,738	5,703	9,995	59,965	53,394	54,513	55,400	STS Green Co., Ltd.
Lead (Pb)	mg/kg	Direct Air-Acetylene Flame Method	5.00	31.59	8.53	25.51	26.92	26.04	25.62	26.84	33.20	28.74	<5.00	24.56	22.94	23.81	24.05	16.43	21.16	32.49	26.95	STS Green Co., Ltd.
Manganese (Mn)	mg/kg	Direct Air-Acetylene Flame Method	1.00	461.10	229.01	894.26	873.51	1,209	1,448	1,039	536.19	947.18	737.08	1,196	1,662	651.12	829.18	783.22	628.56	641.31	566.36	STS Green Co., Ltd.
Mercury (Hg)	mg/kg	Cold-Vapor Atomic Absorption Spectrometric Method	0.10	<0.10	<0.10	1.04	0.12	0.13	0.15	0.10	0.10	<0.10	0.10	0.12	<0.10	<0.10	0.12	0.10	0.10	0.12	<0.10	STS Green Co., Ltd.
Zinc (Zn)	mg/kg	Direct Air-Acetylene Flame Method	0.50	70.30	39.10	103.96	107.18	105.59	101.36	101.81	100.64	84.50	70.81	87.05	93.86	83.44	84.73	79.25	86.06	96.16	89.28	STS Green Co., Ltd.

Sediment Analysis Result

Project Name: Ahlone Expansion Combined Cycle Power Plant and FSRU Project to supply power to the Republic of the Union of Myanmar

Sampling by: ERM-Siam Co., Ltd.

Parameter	Unit	Method Analysis	LOQ	Results						Laboratory
				SE1	SE2	SE3	SE4	SE5	SE6	
Particle Size Distribution										
- Sand	%	Hydrometer Analysis	-	43.7	48.2	1.2	2.3	5.3	7.1	STS Instrument Co., Ltd.
- Silt	%	Hydrometer Analysis	-	32.1	27.6	61.8	44.5	42.6	39.9	STS Instrument Co., Ltd.
- Clay	%	Hydrometer Analysis	-	24.2	24.2	37.0	53.2	52.1	53.0	STS Instrument Co., Ltd.
Total Organic Carbon (TOC)	%	Based on US EPA, Method 9060	0.01	0.16	<0.10	0.25	0.20	0.27	0.47	ALS Laboratory Group (Thailand)
TPH (C10 – C36)										ALS Laboratory Group (Thailand)
- C10-C14	mg/kg	Based on US EPA, Method 3570 and	5	<5	<5	<5	<5	<5	<5	
- C15-C28	mg/kg	8015B	10	<10	<10	<10	<10	<10	<10	
- C29-C36	mg/kg		10	<10	<10	<10	<10	<10	<10	
Total Oil	mg/kg	Soxhlet Extraction Method	20.0	508	358	105	443	419	132	STS Green Co., Ltd.
Arsenic	mg/kg	Hydride Generation AAS Method	0.04	<0.04	<0.04	<0.04	0.10	<0.04	<0.04	STS Green Co., Ltd.
Barium	mg/kg	Direct Nitrous Oxide-Acetylene Flame Method	5.00	23.17	35.09	39.70	51.17	38.05	49.10	STS Green Co., Ltd.
Cadmium	mg/kg	Direct Air-Acetylene Flame Method	1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	STS Green Co., Ltd.
Chromium	mg/kg	Direct Air-Acetylene Flame Method	2.50	34.44	48.33	53.98	75.67	64.86	67.65	STS Green Co., Ltd.
Copper	mg/kg	Direct Air-Acetylene Flame Method	1.50	15.28	22.68	23.55	31.14	30.24	31.47	STS Green Co., Ltd.
Lead	mg/kg	Direct Air-Acetylene Flame Method	5.00	<5.00	7.17	<5.00	7.23	12.70	15.58	STS Green Co., Ltd.
Mercury	mg/kg	Cold-Vapor AAS Method	0.10	0.12	0.14	0.18	0.14	0.16	0.16	STS Green Co., Ltd.
Nickel	mg/kg	Direct Air-Acetylene Flame Method	2.00	68.12	85.75	101.11	131.96	114.52	127.78	STS Green Co., Ltd.

Benthos Analysis Result

Project Name: Ahlone Expansion Combined Cycle Power Plant and FSRU Project to supply power to the Republic of the Union of Myanmar

Sampling by: ERM-Siam Co., Ltd.

Phylum/Species	Stations		
	SE1	SE2	SE5
PHYLUM ANNELIDA			
Class Polychaeta (ไส้เดือนทะเล)			
Order Sabellida			
Family Oweniidae	72	48	6
Class Sipunculidea			
Order Sipunculiformes			
Family Sipunculidae (หนอนถั่ว)	6		
PHYLUM NEMERTEA			
Class Enopla			
Order Heteronemertea (ริบบิ้น)		12	
PHYLUM ARTHROPODA			
Class Malacostraca			
Order Decapoda			
Family Alpheidae			
Alpheus sp.	42	6	
Family Dorippidae			
Dorippe sp.		6	
PHYLUM MOLLUSCA			
Class Gastropoda (หอยฝาเดียว)			
Order Neogastropoda			
Family Buccinidae	6	6	
Class Bivalvia (หอยสองฝา)			
Order Adapedontada			
Order Adapedontada			
Family Pharidae			
Cultellus sp.	6	6	
Total (Orgs/m^2)	**132**	**84**	**6**
Number of Species	**5**	**6**	**1**
Diversity Index	**1.12**	**1.35**	**-**
Richness Index	**0.82**	**1.13**	**-**
Evenness Index	**0.69**	**0.75**	**-**

APPENDIX N PHYSICAL BASELINE DATA ANALYSIS FOR DRY SEASON FROM STS GREEN

Physical Baseline Studies Report (Wet Season)

For

The Extension of Power Generation Activities (TTCL)

In Ahlone and Dala Townships

TABLE OF CONTACTS

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PHYSICAL ENVIRONMENT BASELINE
For Wet Season

1.1 Outline

The actual physical baseline survey for environmental impact assessment was surveyed at/near gas turbine power plant, Ahlone and Dala Townships, Yangon Region. Ten air qualities, three locations of groundwater quality, fourteen locations of surface water quality, and six locations of sediment survey were measured and collected. The summary of physical environmental survey is shown in Table 1.1-1, and sampling points for environmental survey are shown in Figure 1.1-1.

Table 1.1-1 Summary of Physical Environmental Survey for Wet Season

Air Quality & Meteorology	Parameter	1) Nitrogen Dioxide, 2) Nitric Oxide, 3) Sulphur Dioxide, 4) Particulate Matter PM10, 5) Particulate Matter PM 2.5, 6) Carbon Monoxide, 7) Relative Humidity, 8) Temperature, 9) Wind Speed, and 10) Wind Direction
	Period	10 points for one time within three continuous days
	Location	Residential and rural areas
Surface Water Quality	Parameter	1)Water Depth, 2) Flow rate, 3) Water temperature, 4) pH, 5) Salinity, 6) Electrical Conductivity, 7) Dissolved Oxygen, 8) Total Dissolved Solid, 9) Turbidity, and 10) Color
	Period	One time at 14 locations
	Location	River and Stream
Ground Water Quality	Parameter	1)Tube well Depth, 2) Water temperature, 3) pH, 4) Salinity,5) Electrical Conductivity, 6) Dissolved Oxygen, 7) Total Dissolved Solid, and 8) Color
	Period	One time at 3 locations
	Location	Wells
Sediment	Parameter	In-situ
	Period	One time at 6 locations
	Location	River

Source: Field Survey, June – July, 2018

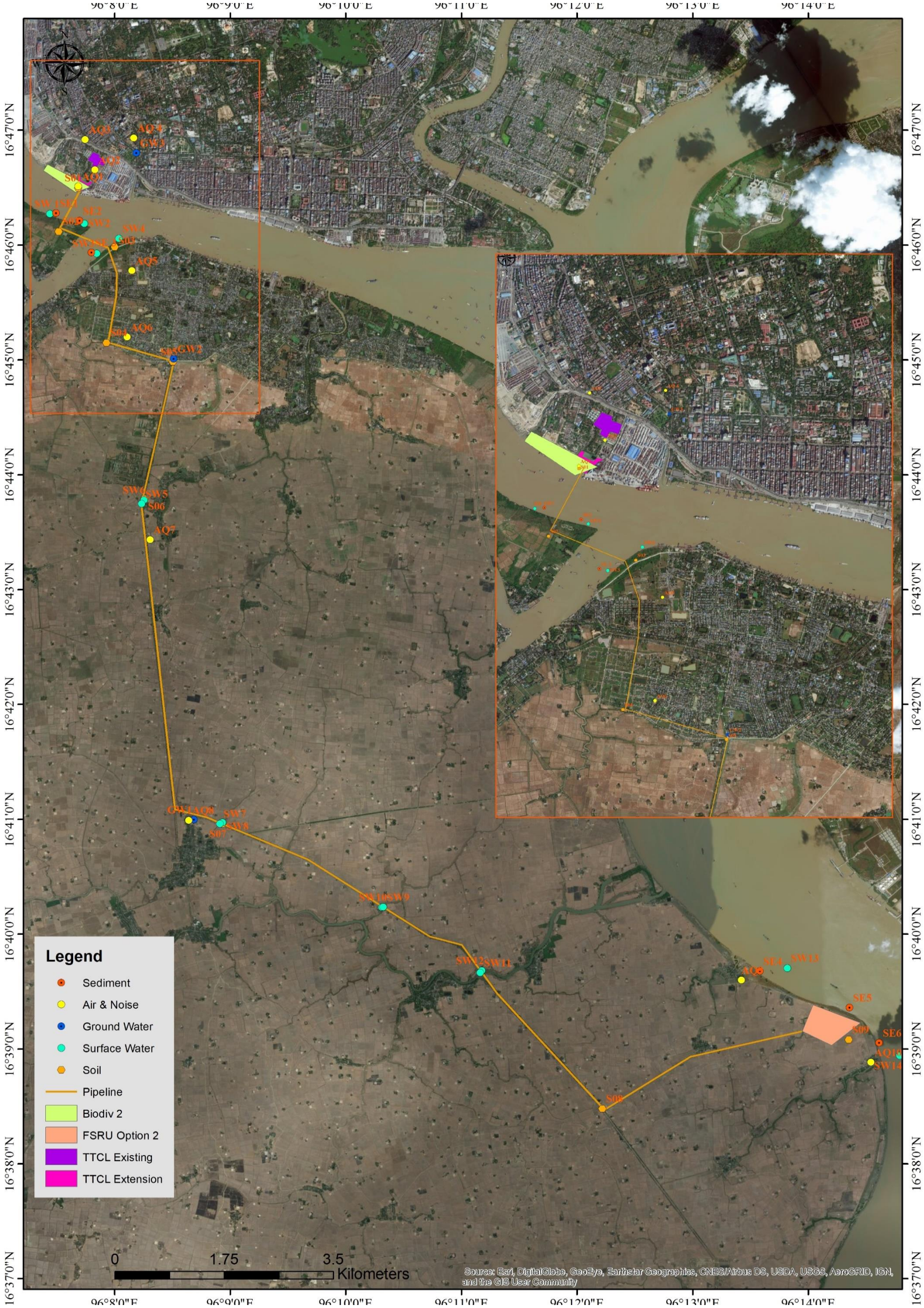


Figure 1.1-1 Location map of river sediment, water and air quality survey

1.2 Air Quality

1.2.1 Survey Item

Myanmar National Environmental Quality (Emission) Guidelines were announced on 29th December, 2015 and guideline values for air pollution level are shown in Table 1.2-1.

Table 1.2-1 Myanmar National Environmental Quality Guideline values for survey parameters of air quality

No	Parameter	Averaging Period	Guideline Value	Units
1.	Nitric oxide	-	-	µg/m3
2.	Nitrogen dioxide	1-hour	200	µg/m3
3.	Sulphur dioxide	24-hour	20	µg/m3
4.	Particulate matter PM_{10} [a]	24-hours	50	µg/m3
5.	Particulate matter $PM_{2.5}$ [b]	24-hours	25	µg/m3
6.	Carbon Monoxide	-	-	-
7.	Relative Humidity	-	-	%
8.	Temperature	-	-	℃
9.	Wind Speed	-	-	-
10.	Wind Direction	-	-	-

1.2.2 Survey Location

The coordinate location of air quality monitoring survey in detail are shown in Table 1.2-2.

Table 1.2-2 Sampling location for air quality survey

Sampling Points	Coordination	Description of Sampling Point
AQ1	16°46'30.69"N 96° 7'41.11"E	In the compound of Combined Cycle Power Plant (at project area) located in Ahlone Township, Yangon Region
AQ2	16°46'39.33"N 96° 7'49.79"E	Same as the AQ1
AQ3	16°46'55.17"N 96° 7'44.70"E	In the compound of Aung Mingalar Monastery (near the Kannar Road) located in Ahlone Township, Yangon Region
AQ4	16°46'56.00"N 96° 8'10.00"E	In the compound of Church (near the Thakhinmya Park) which located in Ahlone Township, Yangon Region
AQ5	16°45'46.67"N 96° 8'8.97"E	In the compound of No. (22) Basic Education Primary School which located in Dala Township, Yangon Region
AQ6	16°45'11.99"N 96° 8'6.46"E	In the compound of Yadanarayeyeikthar Monastery located in Kyansitthar Ward, Dala Township, Yangon Region
AQ7	16°43'26.10"N 96° 8'18.40"E	In the Nuaung Ngok To Village, in Dala Township, Yangon Region

AQ8	16°40'59.48"N 96° 8'38.41"E	In the compound of Pyasu Monastery which located in Pyaw Bwe Gyi Village, Dala Township, and Yangon Region
AQ9	16°39'36.00"N 96°13'25.32"E	In the compound of Aung Mingalar Monastery which located in That Kai Kwin Village, Dala Township, and Yangon Region
AQ10	16°38'53.04"N 96°14'32.48"E	In the Chaung Oo Village which located in Dala Township, Yangon Region

AQ1

AQ1 was measured in the compound of Combined Cycle Power Plant Project (Ahlone) which located in Ahlone Township, Yangon, and the project area. It is also situated in the left bank of Hlaing River and behind the Ahlone gas turbine power plant. The shrub land and Mangrove Forest encircled are occurred at the location. The possible pollution source might be emitted from gas turbine power plant funnel. The activities of AQ1 are shown in Figure 1.2-1.

Figure 1.2-1 Air quality monitoring survey at AQ1

AQ2

AQ2 was observed in the compound of Combined Cycle Power Plant Project (Ahlone) which located in Ahlone Township, Yangon, and the project area. The area is flat terrain with bushes and near power plant generator. The possible air pollution source may be come from gas turbine power plant funnel. The activities of AQ2 are shown in Figure 1.2-2.

Figure 1.2-2 Air quality monitoring survey at AQ2

AQ3

AQ3 was surveyed in the compound of Aung Mingalar Monastery (near the Kannar Street) and about monitoring point is set up at upstairs of monastery with 6 feet in height. There is a generator room behind the monastery and it generally works two times per day. The location is encircled by residential houses. It is possible that pollution source emitted from the human activities. The activities of AQ3 are shown in Figure 1.2-3.


Figure 1.2-3 Air quality monitoring survey at AQ3

AQ4

AQ4 was surveyed in the compound of Church (near the Thakhinmya Park) which located in Ahlone Township, Yangon Region and lies about 1.03 kilometers at northeast of power plant. It is possible that pollution source emitted from the human activities. The activities of AQ4 are shown in Figure 1.2-4.


Figure 1.2-4 Air quality monitoring survey at AQ4

AQ5

AQ5 was measured in the compound of No. (22) Basic Education Primary School which located in Dala Township, Yangon Region. It situated 0.22 kilometers away from proposed gas pipeline. The location is encircled by many residential houses. It is possible that pollution source emitted from

the human activities. The activities of AQ5 are shown in Figure 1.2-5.

Figure 1.2-5 Air quality monitoring survey at AQ5

AQ6

AQ6 was monitored in the compound of Yadanarayeyeikthar Monastery which located in Kyansitthar Ward, Dala Township, and Yangon Region and fared about 0.17 kilometers at north of gas pipeline. The location is surrounded by residential houses. The possible pollution source may be emitted from residences activities. The activities of AQ6 are shown in Figure 1.2-6.

Figure 1.2-6 Air quality monitoring survey at AQ6

AQ7

AQ7 was observed in the Nuaung Ngok To Village, Dala Township, Yangon Region and situated about 0.07 kilometers away from proposed gas pipeline. The location is at flat terrain and encircled with residential houses. It is possible that pollution source emitted from the human activities. The activities of AQ7 are shown in Figure 1.2-7.

Figure 1.2-7 Air quality monitoring survey at AQ7

AQ8

AQ8 was surveyed in the compound of Pyasu Monastery in Pyaw Bwe Gyi Village, Dala Township. It lies about 0.11 kilometers away from proposed gas pipeline. There is a grain mill in front of monastery and it works in the day time. The location is surrounded by many residential houses. It is possible that pollution source emitted from crematorium and the human activities. The activities of AQ8 are shown in Figure 1.2-8.

Figure 1.2-8 Air quality monitoring survey at AQ8

AQ9

AQ9 was measured in the compound of Aung Mingalar Monastery, That Kel Kyin Village, Dala Township, and Yangon Region. It lies about 1.02 kilometers away from proposed gas pipeline. The measured point is situated near bushes, trees, and paddy field. The location is surrounded by residential houses. It is possible that pollution source emitted from the residents' activities. The activities of AQ9 are shown in Figure 1.2-9.

Figure 1.2-9 Air quality monitoring survey at AQ9

AQ10

AQ10 was monitored in the Chaung Oo Village, Dala Township, Yangon Region and sited about 0.59 kilometers at southeast of proposed FSRU Option 2. It situated near paddy field and by the right band of Yangon River. The location is encircled by many residential houses. It is possible that pollution source emitted from the human activities. The field activities of AQ10 are shown in Figure 1.2-10.

Figure 1.2-10 Air quality monitoring survey at AQ10

1.2.3 Survey Period

Air quality survey was conducted from June 27 th – July 9 th, 2018 for baseline studies. Each sampling duration is described in Table 1.2-3.

Table 1.2-3 Sampling Duration for Air Quality Survey

Point	Period
AQ1 **AQ2** **AQ3**	June 27th – 30th, 2018 (72 hours)

AQ5 **AQ6** **AQ7**	June 30th – July 3rd, 2018 (72 hours)
AQ8 **AQ9** **AQ10**	July 3rd – 6th, 2018 (72 hours)
AQ4	July 6th – 9th, 2018 (72 hours)

1.2.4 Survey Method

Methodology

Sampling and analysis of ambient air pollutants were conducted by referring to the recommendation of United States Environmental Protection Agency (U.S. EPA). The Haz-Scanner EPAS Wireless Environmental Perimeter Air Station was used to collect Ambient Air Monitoring data.

Table 1.2-4 Sampling and Analysis Method for Air Quality

No.	Parameter	Analysis Method
1	Nitric oxide (NO_x)	On site reading
2	Nitrogen dioxide (NO2)	On site reading
3	Sulphur dioxide (SO2)	On site reading
4	Particulate matter 10 (PM10)	On site reading
5	Particulate matter 2.5 (PM2.5)	On site reading
6	Carbon Monoxide	On site reading
7	Relative Humidity	On site reading
8	Temperature	On site reading
9	Wind Speed	On site reading
10	Wind Direction	On site reading

1.2.5 Survey Result

AQ1

Average values of ambient gaseous levels at AQ1 are shown in Table 1.2-5. CO and NO values are not specified in Myanmar emission guideline. NO_2 emission standard per 24 hours is not specified in

the Myanmar Emission Guideline. That's why NO_2 emission per 1 hour which is mentioned in guideline is just assessed. NO_2, PM2.5, PM10 and SO_2 concentrations are within the standard. Hourly results of AQ1 described in appendix.

Table 1.2-5 Daily Ambient air quality results at AQ1

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	hours	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
27-28 June, 2018	24	107.81	111.79	0.02	5.38	14.42	85.07	8.37	25.26
28-29 June, 2018	24	106.83	50.56	0.03	10.65	11.53	72.40	1.83	28.21
29-30 June, 2018	24	37.30	26.99	0.01	24.94	16.61	79.44	6.84	27.78
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

AQ2

Average values of ambient gaseous levels at AQ2 are shown in Table 1.2-6. NO_2, PM10 and SO_2 concentrations are within the standard expect PM2.5 for last day of survey period. Generally, it can say the area is lower than the standard except one day period for PM2.5 at the area. Hourly results of AQ2 described in appendix.

Table 1.2-6 Daily Ambient air quality results at AQ2

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	hours	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
27-28 June, 2018	24	42.1565	8.0725	11.8569	24.3583	29.2413	81.2436	4.6447	25.7313
28-29 June, 2018	24	56.0151	10.6284	12.9272	15.3417	19.5396	73.9896	8.6740	28.3660
29-30 June, 2018	24	51.1769	6.3459	28.8233	15.9552	24.6849	76.1600	28.7850	26.8812
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

AQ3

Average values of ambient gaseous levels at AQ3 are shown in Table 1.2-7. CO and NO values are not specified in Myanmar emission guideline. NO_2 emission standard per 24 hours is not specified in the Myanmar Emission Guideline. That's why NO_2 emission per 1 hour which is mentioned in guideline is just assessed. NO_2, PM10 and SO_2 concentrations are within the standard while PM2.5 concentrations occur fairly higher than the standard for two days in 72 hours continuous monitoring.

So, it generally means the area had a few particulates emission source at the area. Hourly results of AQ3 described in appendix.

Table 1.2-7 Daily Ambient air quality results at AQ3

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	**hours**	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	**%**	µg/m3	**Deg. C**
27-28 June, 2018	24	127.06	53.13	0.03	26.26	29.50	84.45	10.04	26.33
28-29 June, 2018	24	150.23	40.52	0.04	28.15	29.05	76.17	11.74	27.56
29-30 June, 2018	24	201.10	59.36	0.08	19.93	21.31	77.79	11.63	27.67
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	-

AQ4

Average values of ambient gaseous levels at AQ4 are shown in Table 1.2-8. CO and NO values are not specified in Myanmar emission guideline. NO_2, PM2.5, PM10 and SO_2 concentrations are within the standard according to the baseline monitoring survey. NO_2 emission standard per 24 hours is not specified in the Myanmar Emission Guideline. That's why NO_2 emission per 1 hour which is mentioned in guideline is just assessed. Hourly results of AQ4 described in appendix.

Table 1.2-8 Daily Ambient air quality results at AQ4

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	**hours**	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	**%**	µg/m3	**Deg. C**
06-07 July, 2018	24	155.4966	27.3400	0.0028	2.0551	6.6591	97.2707	8.2875	23.4201
07-08 July, 2018	24	117.2401	14.3253	0.0120	2.1250	8.1667	94.1806	12.4093	23.8104
08-09 July, 2018	24	139.6970	14.1221	0.0011	2.2097	8.0785	93.3889	8.6165	24.1583
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	

AQ5

Average values of ambient gaseous levels at AQ5 are shown in Table 1.2-9. CO and NO values are not specified in Myanmar emission guideline. NO_2 emission standard per 24 hours is not specified in the Myanmar Emission Guideline. That's why NO_2 emission per 1 hour which is mentioned in guideline is just assessed. NO_2, PM2.5, PM10 and SO_2 concentrations are within the standard

according baseline monitoring survey expect SO_2 for first day of survey period. So, it generally means the area had a few emission source at the area. Hourly results of AQ5 described in appendix.

Table 1.2-9 Daily Ambient air quality results at AQ5

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	hours	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
30-01 June, 2018	24	123.5147	13.5488	0.0376	2.2657	7.6298	87.4824	22.8819	26.3508
01-02 June, 2018	24	135.3313	15.2064	0.0161	2.1042	6.5521	95.2938	11.9965	24.5556
02-03 June, 2018	24	123.1307	14.2016	0.0280	2.1549	8.4132	88.7958	13.9079	25.9868
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	

AQ6

Average values of ambient gaseous levels at AQ6 are shown in Table 1.2-10. CO and NO values are not specified in Myanmar emission guideline. NO_2 emission standard per 24 hours is not specified in the Myanmar Emission Guideline. That's why NO_2 emission per 1 hour which is mentioned in guideline is just assessed. NO_2, PM2.5, PM10 and SO_2 concentrations are within the standard expect PM10 for last day of survey period. So, it generally means the area had few particulates sources at the area. Hourly results of AQ6 described in appendix.

Table 1.2-10 Daily Ambient air quality results at AQ6

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	hours	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
30-01 June, 2018	24	33.9304	3.8849	14.5193	5.3549	11.0063	86.4507	8.9327	26.9139
01-02 June, 2018	24	34.2989	5.3512	11.1005	12.3711	15.0998	85.5412	8.0398	26.4104
02-03 June, 2018	24	21.5327	3.5429	7.8182	9.2618	59.7192	93.2138	5.0873	25.6378
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	

AQ7

Average values of ambient gaseous levels at AQ7 are shown in Table 1.2-11. CO and NO values are not specified in Myanmar emission guideline. NO_2 emission standard per 24 hours is not specified in the Myanmar Emission Guideline. That's why NO_2 emission per 1 hour which is mentioned in guideline is just assessed. NO_2, PM2.5, PM10 and SO_2 concentrations are within the standard.

Concentration of PM10 is higher than the standard for last day. This emission may be come from the landfilling activities. Near the air quality station had the site cleaning to construct the households. So, it generally means the area had few particulates sources at the area. Hourly results of AQ7 described in appendix.

Table 1.2-11 Daily Ambient air quality results at AQ7

Date	**Time**	**CO**	**NO2**	**NO**	**PM2.5**	**PM10**	**RH**	**SO2**	**TmpC**
D.M.Y	**hours**	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	**%**	µg/m3	**Deg. C**
30 June- 01 July, 2018	24	41.5269	20.0397	0.0083	24.3583	29.2413	86.5080	9.8419	28.4248
01 - 02 July, 2018	24	38.9521	17.9618	0.0158	17.8139	19.8501	90.5015	5.8975	24.2873
02 - 03 July, 2018	24	51.7841	18.6754	0.0116	24.8128	70.6468	89.4775	4.3755	27.6118
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	

AQ8

Average values of ambient gaseous levels at AQ8/N8 are shown in Table 1.2-12. CO and NO values are not specified in Myanmar emission guideline. NO_2 emission standard per 24 hours is not specified in the Myanmar Emission Guideline. That's why NO_2 emission per 1 hour which is mentioned in guideline is just assessed. NO_2, PM2.5, PM10 and SO_2 concentrations are within the standard. Hourly results of AQ8 described in appendix.

Table 1.2-12 Daily Ambient air quality results at AQ8/N8

Date	**Time**	**CO**	**NO2**	**NO**	**PM2.5**	**PM10**	**RH**	**SO2**	**TmpC**
D.M.Y	**hours**	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	**%**	µg/m3	**Deg. C**
03-04 June, 2018	24	49.8537	13.5634	0.0081	19.3438	36.4646	94.6361	5.4534	25.3444
04-05 June, 2018	24	71.2967	21.6303	0.0044	21.9167	20.3319	94.7097	6.6437	25.6340
05-06 June, 2018	24	65.3659	15.2836	0.0030	3.6188	23.6257	98.6382	0.0052	24.2382
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	

AQ9

Average values of ambient gaseous levels at AQ9 are shown in Table 1.2-13. CO and NO values are not specified in Myanmar emission guideline. NO_2 emission standard per 24 hours is not specified in the Myanmar Emission Guideline. That's why NO_2 emission per 1 hour which is mentioned in guideline is just assessed. NO_2, PM2.5, PM10 and SO_2 concentrations are within the standard. Hourly

results of AQ9 described in appendix.

Table 1.2-13 Daily Ambient air quality results at AQ9

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	hours	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
03-04 July, 2018	24	25.0949	7.9981	3.1421	24.3583	29.2413	97.7194	1.2164	24.7229
04-05 July, 2018	24	21.3929	1.2931	5.4162	8.0806	17.8910	98.0528	2.1113	24.6500
05-06 July, 2018	24	4.5291	30.3528	0.3993	19.3479	32.5674	88.2083	0.5135	25.0569
Myanmar emission guideline value (24 hours)		-	200 (1 hour)	-	25	50	-	20	

AQ10

Average values of ambient gaseous levels at AQ10 are shown in Table 1.2-14. CO and NO values are not specified in Myanmar emission guideline. NO_2 emission standard per 24 hours is not specified in the Myanmar Emission Guideline. That's why NO_2 emission per 1 hour which is mentioned in guideline is just assessed. NO_2, PM2.5, PM10 and SO_2 concentrations are within the standard. Hourly results of AQ10 described in appendix.

Table 1.2-14 Daily Ambient air quality results at AQ10

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	hours	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
03-04 July, 2018	24	67.1761	15.2012	0.0269	24.3583	29.2413	92.9859	5.6955	25.1116
04-05 July, 2018	24	71.0194	16.9260	0.0081	2.3588	8.9103	95.5035	3.6645	24.5629
05-06July, 2018	24	68.8941	14.2053	0.0077	2.3654	7.6927	98.9014	2.7897	23.6277
Myanmar emission guideline value		-	200 (1 hour)	-	25	50	-	20	

Wind Speed and Wind Direction

The average wind speed and direction were collected for 72 hours continuously in each location. According to the wind rose diagram and average wind speed of stations varies from 0.03 to 11.1 m/s in covering the all stations and varies in high range of wind speed in rainy season. Generally, Prevailing wind direction of all quality station are blowing from west, southwest, and southeast. By the wind rose diagram, the dominant wind direction are southeast and southwest quadrant. Wind speed and direction diagram of each stations are shown in Figure 1.2-

11 to 1.2-15.

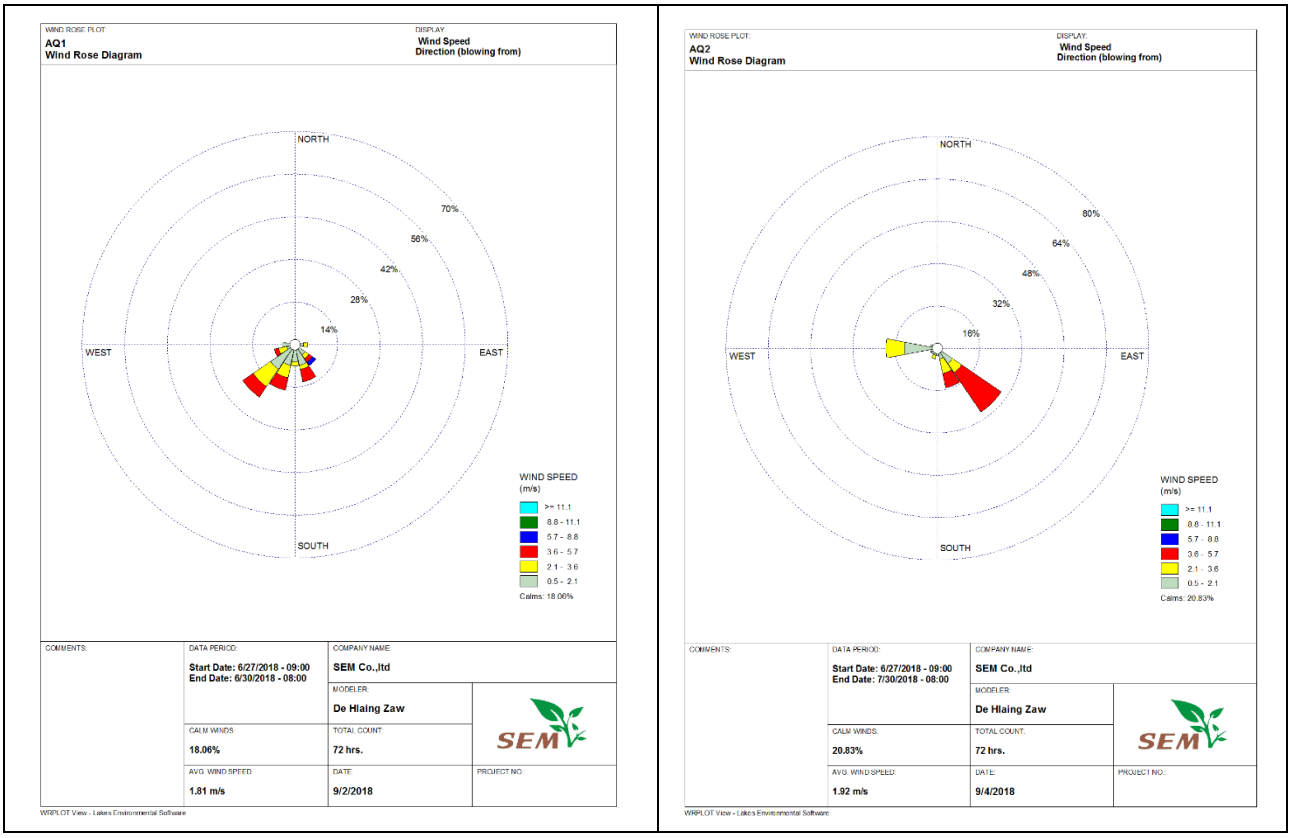


Figure 1.2-11 Wind speed and direction diagram at AQ1 and AQ2

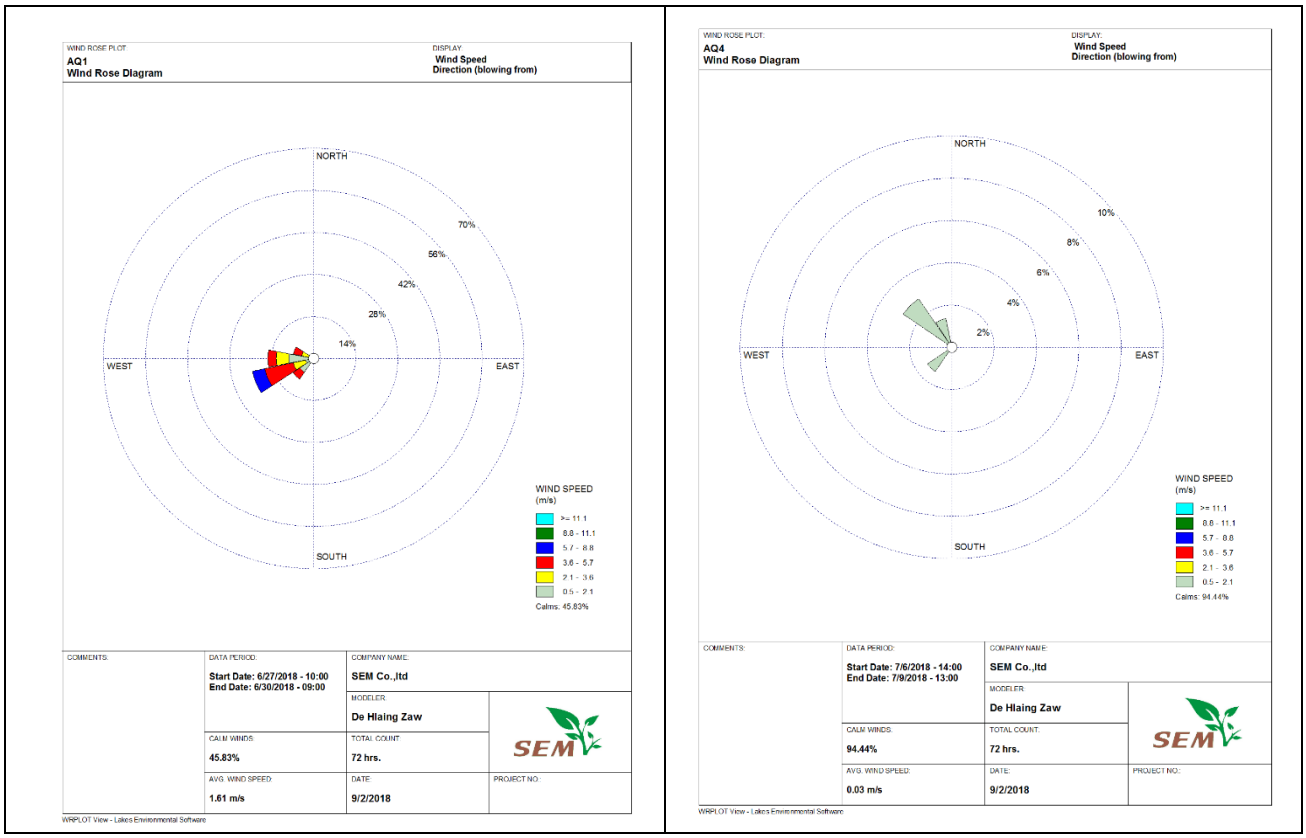


Figure 1.2-12 Wind speed and direction diagram at AQ3 and AQ4

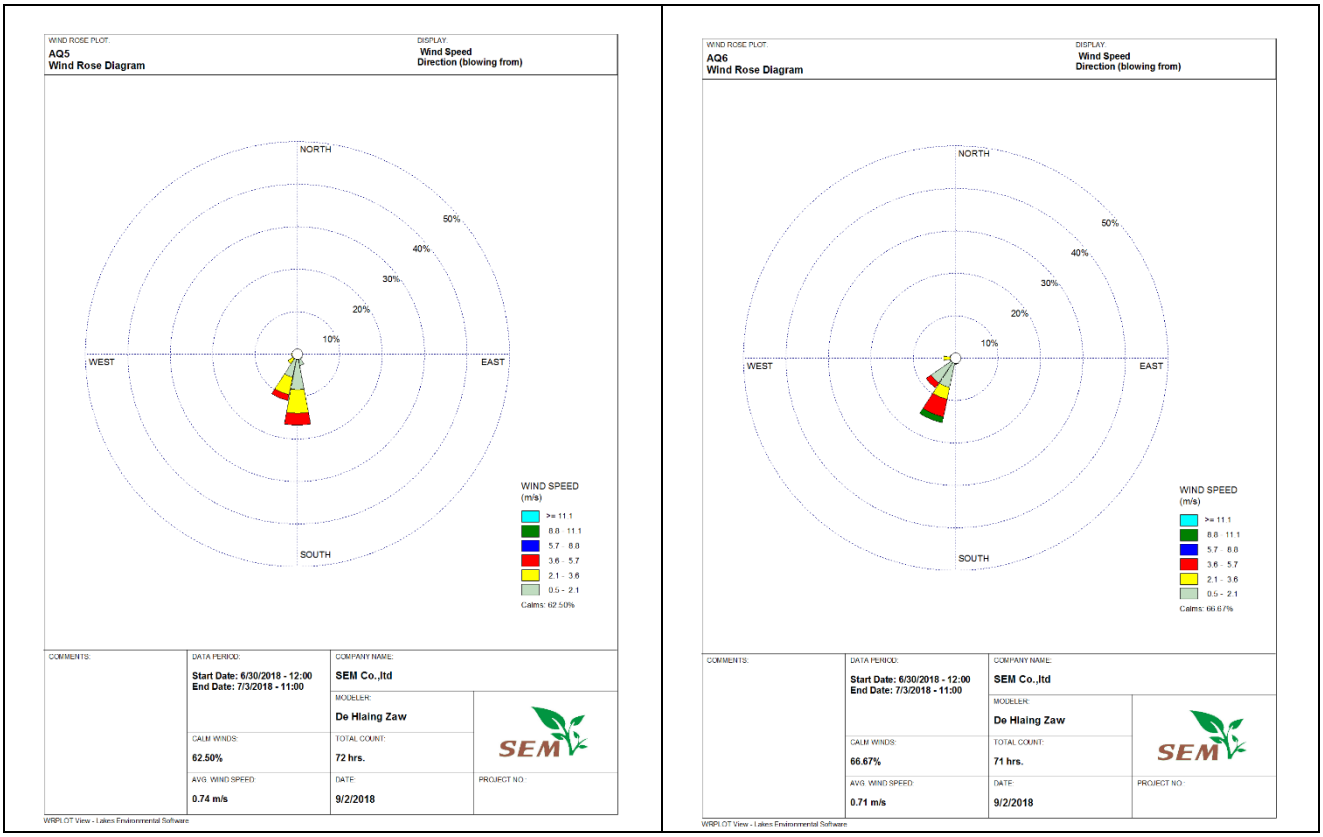


Figure 1.2-13 Wind speed and direction diagram at AQ5 and AQ6

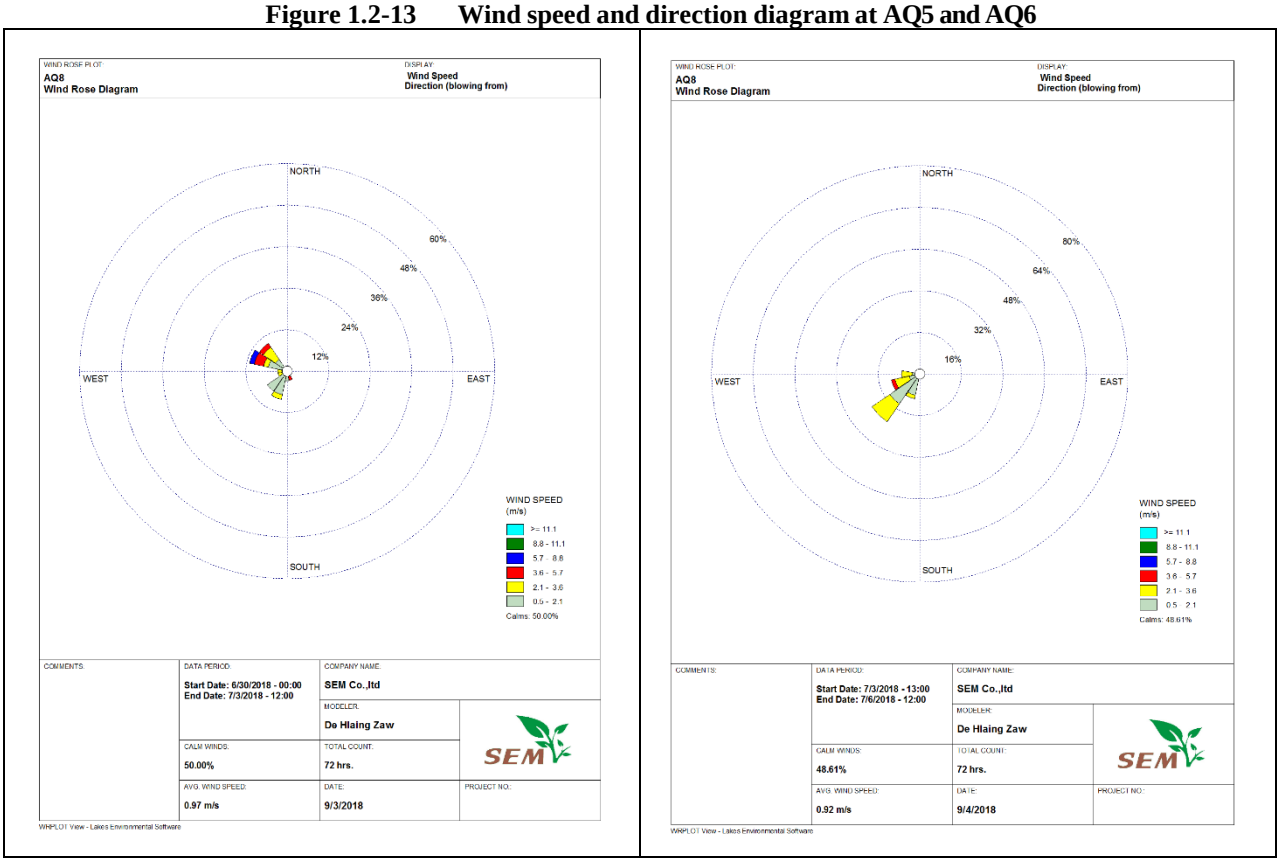


Figure 1.2-14 Wind speed and direction diagram at AQ7 and AQ8

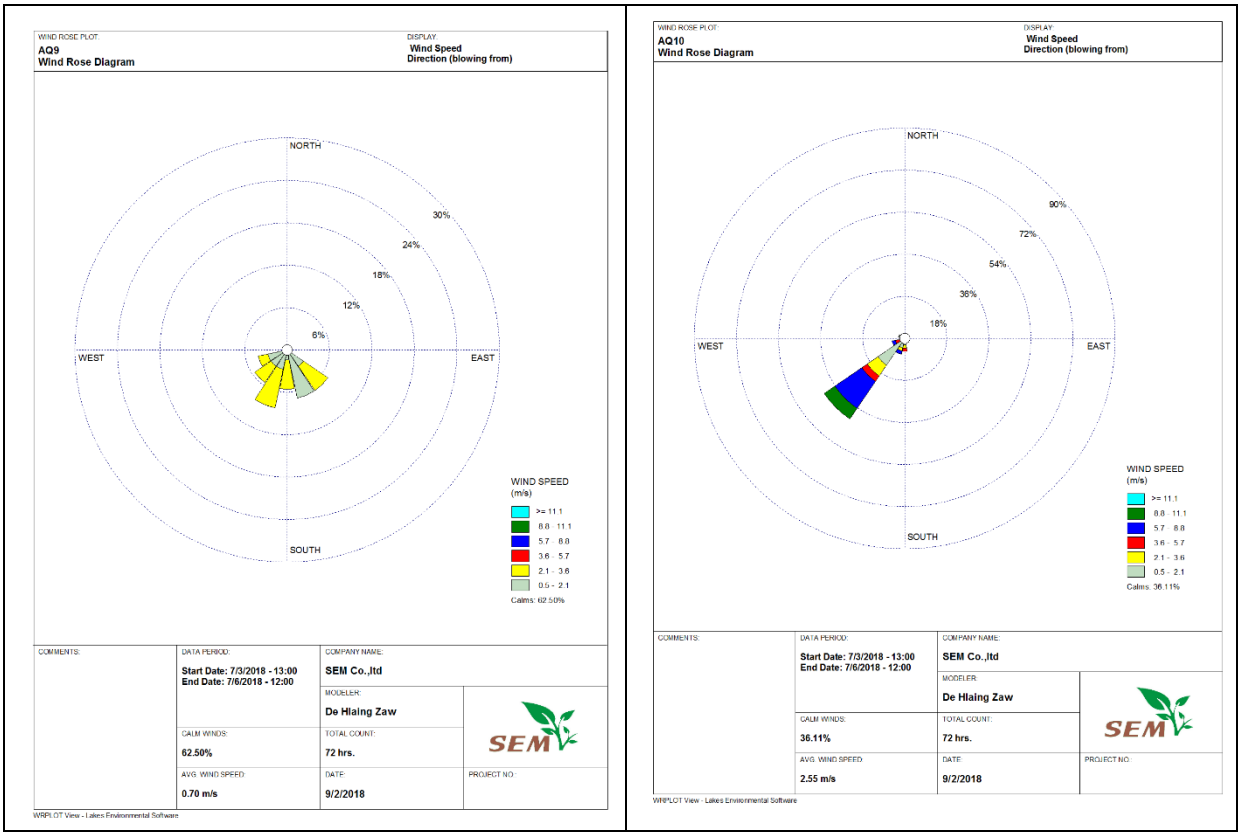


Figure 1.2-15 Wind speed and direction diagram at AQ9 and AQ10

1.3 Surface Water Quality

1.3.1 Survey Item

Parameters for water quality survey are determined so as to cover the parameters of existing environmental standards of Myanmar.

Table 1.3-1 Survey Parameters for Water Quality Survey

No.	Parameter	Unit	Myanmar Environmental Guideline Value
1	Temperature	^{o}C	-
2	pH	-	6 – 9
3	Dissolved Oxygen	mg/l	-
4	Electrical Conductivity (EC)	µS/cm	-
5	Total Dissolved Solid (TDS)	Ppm	-
6	BOD (5 days)	mg/l	50
7	COD	mg/l	250
8	Total Suspended Solids (TSS)	mg/l	50
9	Oil & Grease	mg/l	10
10	Total Coliform Bacteria	100 ml	400

Source: General Application; Wastewater, Storm water runoff, Effluent and sanitary discharges

(Myanmar National Environmental Guidelines (2015, Dec 29th))

1.3.2 Survey Locations

The coordinate locations of water samples and surveys are shown in Table 1.3-2.

Table 1.3-2 Sampling and survey points of surface water quality survey

Category	Sampling Point	Coordinates	Description of Sampling Points
Surface Water	SW 1	16°46'16.39"N 96° 7'26.42"E	Up stream of Gas Turbine, Yangon River, near about 0.25 kilometers West of Pipe line and south of project area.
Surface Water	SW 2	16° 46' 11.25"N 96° 7' 44.26"E	Upstream of Gas Turbine, Yangon River, near about 0.3 kilometers east of Pipe line.
Surface Water	SW 3	16° 45' 55.62"N 96° 7' 50.73"E	At mouth of Twantae Canal and near the pipe line.
Surface Water	SW 4	16° 46' 3.46"N 96° 8' 2.27"E	Downstream of Twantae Canal, near pipe line.
Surface Water	SW 5	16°43'44.85"N 96° 8'14.10"E	In the Ka Ma Aung Stream, in Nuaung Ngok To Village, near the pipe line.
Surface Water	SW 6	16°43'46.82"N 96° 8'15.25"E	In the Ka Ma Aung Stream, in Nuaung Ngok To Village, near about 0.03 kilometers east of gas pipe line.
Surface Water	SW 7	16°40'57.67"N 96° 8'54.64"E	At the middle of Pyaw Bwe Stream from bridge, in Pyaw Bwe Gyi village, near about 0.01 kilometers of pipe line
Surface Water	SW 8	16°40'58.36"N 96° 8'56.10"E	Downstream of Pyaw Bwe Stream, in Pyaw Bwe Gyi village, near about 0.02 kilometer southeast of pipe line
Surface Water	SW 9	16°40'14.17"N 96°10'19.41"E	In Pyaw Bwe Stream, northwest of Ya Kaing Gyaung village, near the gas pipe line
Surface Water	SW 10	16°40'14.04"N 96°10'18.72"E	Downstream of Pyaw Bwe Stream, northwest of Ya Kaing Gyaung Village, near about 0.02 kilometers southwest of pipe line
Surface Water	SW 11	16°39'39.81"N 96°11'9.78"E	Upstream of Ya Kaing Gyaung Stream, in Ya Kaing Gyaung Village, near about 0.02 kilometer southwest of pipe line
Surface Water	SW 12	16°39'40.99"N 96°11'10.60"E	Downstream of Ya Kaing Gyaung Stream, Ya Kaing Gyaung Village, northeast of gas pipe line
Surface Water	SW 13	16°39'42.26"N 96°13'49.15"E	Upstream of FSRU option 2, Yangon River and it lies about 1.05 kilometers at northwest of pipe line
Surface Water	SW 14	16°38'56.46"N 96°14'47.50"E	Downstream of FSRU Option 2, Yangon River, near about 0.25 kilometers at southeast of pipe line

SW1

SW1 was surveyed and collected at upstream of gas turbine in Yangon River, near about 0.25 kilometers west of pipe line and south of project area, Alone Township, Yangon. The Yangon River width of SW 1 is about 512.47 meters width (measured in Google Map). The flow rate of the river is generally about 0.2 m/s. The transparency of water is medium to high. The survey activities of SW1 are shown in Figure 1.3-1.

Figure 1.3-1 Water quality survey at SW1

SW2

SW2 was measured in downstream of gas turbine, Yangon River and near about 0.3 kilometers east of pipe line, Alone Township, Yangon Region. SW2 is near mouth of Twantae Canal. The flow rate of the river is about 0.1 m/s. The transparency of water is medium to high. This river is mainly used for fishing and transportation. The survey activities of SW2 are shown in Figure 1.3-2.

Figure 1.3-2 Water quality survey at SW2

SW3

SW3 was surveyed at mouth of Twantae Canal, near about 0.16 kilometers south of pipe line, Alone Township, Yangon. The canal width of SW 3 is about 387.95 meters width and the sampling point is located downstream of Twantae Canal. The flow rate of the water is about 1.5 m/s. The transparency of water is medium to high. The survey activities of SW3 are shown in Figure 1.3-3.

Figure 1.3-3 Water quality survey at SW3

SW4

SW4 was surveyed and collected at mouth of Twantae Canal and about 220 meters nearly northeast of pipe line, Dala Township, Yangon Region. The channel width of SW4 is about 459.09 meters width and the sampling point is located downstream of Twantae Canal. The flow rate of the river is about 0.2 m/s. The survey activities of SW4 are shown in Figure 1.3-4.

Figure 1.3-4 Water quality survey at SW4

SW5

SW5 was surveyed in the Ka Ma Aung Stream, in Nuaung Ngok To Village, Dala Township, Yangon Region. The stream width of SW5 is about 5.36 meters width. The transparency of water is medium and the salinity is 0.1 psu. The survey activities of SW5 are shown in Figure 1.3-5.

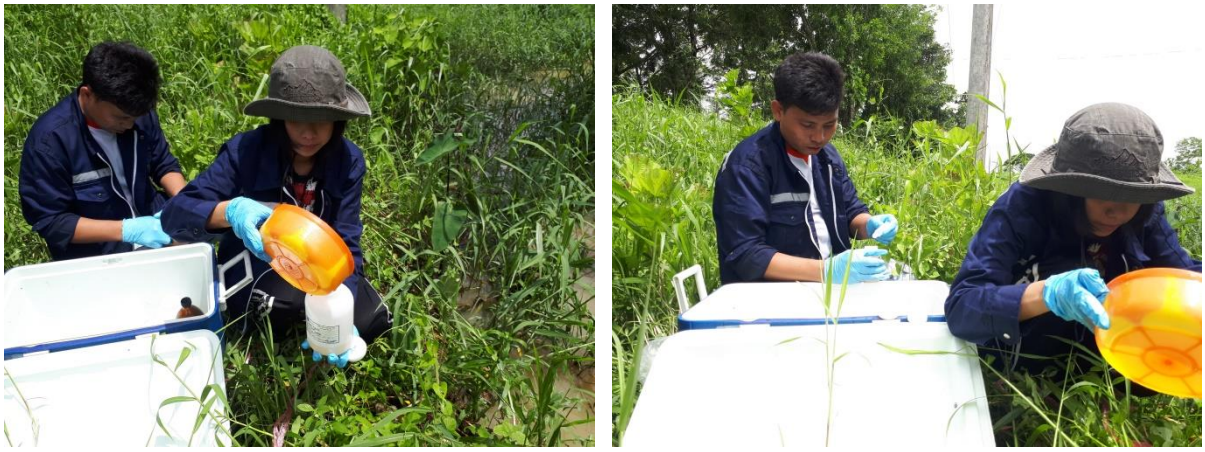


Figure 1.3-5 Water quality survey at SW5

SW6

SW6 was surveyed in the Ka Ma Aung Stream, in Nuaung Ngok To Village, Dala Township, Yangon Region. It is located near about 0.03 kilometers east of pipe line which will construct later. The sampling point is located upstream of pipe line and beside the car road. The transparency of water is medium and the salinity is 0.1 psu. The survey activities of SW6 are shown in Figure 1.3-6.

Figure 1.3-6 Water quality survey at SW6

SW7

SW7 was collected from the left side of Pyaw Bwe bridge, at Pyaw Bwe Gyi stream in Pyaw Bwe Gyi village, Dala Township, Yangon Region. The width of stream is about 5.56 meters width (measure on google map) and the sampling point is located near about 0.01 kilometer of pipe line. The medium transparency of water is found. The survey activities of SW7 are shown in Figure 1.3-7.

Figure 1.3-7 Water quality survey at SW7

SW8

SW8 was collected from the right side of Pyaw Bwe Bridge, at Pyaw Bwe Gyi Stream, in Pyaw Bwe Gyi village, Dala Township, Yangon Region. It is located near about 20 meter southeast of pipe line. SW8 was sampling in the Pyaw Bwe Stream where across from left to right bank distance is about 5.56 meters (measured in Google Map). The transparency of water is medium. The survey activities of SW8 are shown in Figure 1.3-8.

Figure 1.3-8 Water quality survey at SW8

SW9

SW9 was collected in the Pyaw Bwe Stream, northwest of Ya Kaing Gyaung village, Dala Township, Yangon Region. It is closely located southwest of pipe line. SW9 was sampling in the upstream of Pyaw Bwe Stream where across from left to right bank distance is about 5.56 meters (measured in Google Map), near Tha Net Pin bridge. The transparency of water is medium and the salinity is 0.1psu. The survey activities of SW8 are shown in Figure 1.3-9.

Figure 1.3-9 Water quality survey at SW9

SW10

SW10 was surveyed at downstream of Pyaw Bwe Stream, northwest of Ya Kaing Gyaung Village, Dala Township, Yangon Region. It is located near about 0.02 kilometers southwest of pipe line. SW10 was sampling in the Pyaw Bwe Stream near Tha Net Pin Bridge. The transparency of water is medium and the salinity is 0.1 psu. The survey activities of SW10 are shown in Figure 1.3-10.

Figure 1.3-10 Water quality survey at SW10

SW11

SW11 was surveyed and collected at upstream of Ya Kaing Gyaung Stream, in Ya Kaing Gyaung Village, Dala Township, Yangon Region. It is located near about 0.02 kilometers southwest of pipe line. SW11 was sampled at the middle of the Ya Kaing Gyaung Stream from the Ya Khaing Gyaung Bridge. The transparency of water is medium and the salinity is 0.1 psu. The survey activities of SW11 are shown in Figure 1.3-11.

Figure 1.3-11 Water quality survey at SW11

SW12

SW12 was surveyed and collected at downstream of Ya Kaing Gyaung Stream, Ya Kaing Gyaung Village, Dala Township, Yangon Region. It is located near about 0.02 kilometer northeast of pipe line. The Ya Kaing Gyaung Stream width of SW12 is about 45.87 meters width (measured in Google Map). The transparency of water is medium and the salinity is 0.1 psu. The survey activities of SW12 are shown in Figure 1.3-12.

Figure 1.3-12 Water quality survey at SW12

SW13

SW13 was surveyed and collected at upstream of FSRU option 2, Yangon River and it lies about 1.05 kilometers at northwest of pipe line and northwest of FSRU option 2, Dala Township, Yangon. The Yangon River width of SW13 is about 2,171.77 meters width (measured in Google Map). The flow rate of the river is generally about 0.5 m/s. The transparency of water is medium to high. The survey activities of SW13 are shown in Figure 1.3-13.

Figure 1.3-13 Water quality survey at SW13

SW14

SW14 was surveyed at downstream of FSRU Option 2, Yangon River, near about 0.25 kilometers at southeast of pipe line and southwest of project area, Alone Township, Yangon. The width of Yangon River is 2,003.88 meters (measured in Google Map). The location of SW14 is located near Chaung Oo village and the southwest of proposed FSRU Option 2. The flow rate of the river is generally about 0.27 m/s. The transparency of water is medium to high. The survey activities of SW14 are shown in Figure 1.3-14.

Figure 1.3-14 Water quality survey at SW14

1.3.3 Survey Period

The sampling and measuring of the surface water were conducted on 27th – 29th June, 2018.

1.3.4 Survey Method

Water samples were taken by Alpha horizontal water sampler and collected in plastic and sterilized glass sample containers. All sampling was in strict accordance with recognized standard procedures. The parameters as pH, temperature, dissolved oxygen (DO), electrical conductivity (EC), and total

dissolved solid including the odor and color in visual analyzing were measured at each site concurrently with sample collection and. According to the Laboratory standard, some samples were preserved using the chemicals. All samples were kept in iced boxes and were transported to the laboratory within 24 hours.

Moreover, the river survey; the flow rate, width and depth of river, was also measured using Vale port Flow Meter equipment and depth sounder.

Table 1.3-3 Field Equipment for surface water quality survey

No.	Equipment	Manufacturer	Originate Country	Model/Serial No.
1	SMART TROLL@ MP _Multi parameter for water	In_Situ Inc.	USA	SN - 346054
2	Multi Parameters for water quality	HANNA	USA	H17609823 (Turbidity Sensor)
3	Alpha Bottle (Water Sampler)m	Wildlife Supply Company®	Indonesia	Wildco P/N-1120-G45
4	Flow meter	GLOBAL WATER 800-876-1172	USA	FB211- Serial- 1449006336
5	Depth Sounder	Japan	Japan	FP211/1136160536

Table 1.3-4 Analysis Method for Water Samples

No	Item	Analysis Method
1	Temperature	SMART TROLL@MP Multi parameter for water (pH sensor)
2	pH	SMART TROLL@MP Multi parameter for water (DO sensor)
3	Dissolved Oxygen	SMART TROLL@MP Multi parameter for water (EC/TDS sensor)
4	Electrical Conductivity (EC)	SMART TROLL@MP Multi parameter for water (EC/TDS sensor)
5	Total Dissolved Solid (TDS)	SMART TROLL@MP Multi parameter for water (EC/TDS sensor)

1.3.5 Survey Result

Laboratories

Water samples were sent to the STS Green Laboratory in Thailand. Water quality results are shown in following Table 1.3-5.

Table 1.3-5 In-Situ Measurement and laboratory analysis of Surface Water Quality

No.	Sample No./ Physical Parameter	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8
1	Location	Up stream of Yangon River	Downstream of Yangon River	At mouth of Twantae Canal (up)	At mouth of Twantae Canal (below)	Ka Ma Aung Stream (down)	Up stream of Ka Ma Aung Stream	Downstream of Pyaw Bwe Stream	Up stream of Pyaw Bwe Stream
2	Date/Time	27.6.2018 13:04	27.6.2018 12:35	27.6.2018 11:30	27.6.2018 11:15	29.6.2018 13:20	29.6.2018 13:20	29.6.2018 12:10	29.6.2018 12:15
3	Weather	Rainy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Sunny	Sunny
4	Transparency	Medium to high	Medium to high	Medium to high	Medium to high	Medium	Medium	Medium	Medium
5	Color					Light Yellow	Light Yellow	Light Yellow	Light Yellow
6	Water Depth (m)	14	8.1	8.6	8.0	-	-	-	-
7	Depth (of sample taken) (m)	1	1	1	1	-	-	-	-
8	Flow rate/velocity (m/s)	0.2	0.1	1.5	0.2	-	-	-	-
9	Tem (°C) (air & water)	27.54	27.49/31.20	29.82/32	27.61/32	33.00/30.05	32.30/31.59	37.50/29.95	37.60/30.43
10	pH	7.53	7.50	7.86	7.11	6.58	6.68	6.71	6.39
11	DO (mg/l)	7.14	7.26	7.11	76.01	1.29	1.22	3.45	3.65
12	EC (µs/m)	121.0	126.23	241.7	135.51	190.8	129.0	66.4	54.1
13	TDS (ppm)	75.02	76.85	154.74	121.62	113.26	74.33	39.44	31.83
14	Remark	Sampling and In-situ test	Sampling and In-situ test	Sampling and In-situ test	Sampling and In-situ test	Sampled on 28/6/2018 13:15	Sampled on 28/6/2018 13:30	` Sampled on 28/6/2018 12:35	Sampled on 28/6/2018 12:50

No.	Sample No./ Physical Parameter	SW 9	SW 10	SW 11	SW 12	SW 13	SW 14
1	Location	Up stream of Pyaw Bwe Stream	Downstream of Pyaw Bwe Stream	Up stream of Ya Kaing Gyaung Stream	Downstream of Ya Kaing Gyaung Stream	Near FSRU Option 2, Yangon River	Near FSRU Option 2, Yangon River
2	Date/Time	29.6.2018 12:00	29.6.2018 11:50	29.6.2018 11:30	29.6.2018 11:40	28.6.2018 12:41	3.5.2018 12:00
3	Weather	Sunny	Sunny	Sunny	Sunny	Cloudy	Cloudy
4	Transparency	Medium	Medium	Medium	Medium	Medium to high	Medium to high
5	Color	Light Yellow	Light Yellow	Light Yellow	Light Yellow		
6	Water Depth (m)	-	-	-	-	10.5	7.9
7	Depth (of sample taken) (m)	-	-	-	-	1	1
8	Flow rate/velocity (m/s)	-	-	-	-	0.5	1.2
9	Tem (°C) (air & water)	39.00/29.44	37.90/29.29	40.10/29.37	39.50/29.10	32/28	31/28.1
10	pH	6.41	6.54	6.25	6.38	7.58	7.12
11	DO (mg/l)	3.76	4.18	3.65	3.45	6.38	5.65
12	EC (µs/m)	122.1	125.0	221.7	230.4	125.6	135
13	TDS (ppm)	73.19	75.11	132.93	138.89	77.20	64
14	Remark	Sampled on 28/6/2018 11:15	Sampled on 28/6/2018 11:30	Sampled on 28/6/2018 10:25	Sampled on 28/6/2018 10:47	Sampling and Insitu test	Sampling and Insitu test

1.4 Ground Water Quality

1.4.1 Survey Item

Parameters for water quality survey are determined so as to cover the parameters of existing environmental standards of Myanmar.

Table 1.4-1 Survey Parameters for Underground Water Quality Survey

No.	Parameter	Unit	Myanmar Environmental Guideline Value
1	Temperature	^{o}C	-
2	pH	-	6 – 9
3	Dissolved Oxygen	mg/l	-
4	Electrical Conductivity (EC)	µS/cm	-
5	Total Dissolved Solid (TDS)	Ppm	-
6	Total Suspended Solids (TSS)	mg/l	50

Source: General Application; Wastewater, Storm water runoff, Effluent and sanitary discharges (Myanmar National Environmental Guidelines (2015, Dec 29th))

1.4.2 Survey Locations

The locations of water samples and surveys are shown in Table 1.4-2. The detail of each sampling points are described as below.

Table 1.4-2 Sampling and survey points of underground water quality survey

Category	Sampling Point	Coordinates	Description of Sampling Point
Ground water	GW 1	16°40'59.81"N 96° 8'41.28"E	At well, Pyaw Bwe Gyi Village and about 0.09 kilometers at south of pipeline
Ground water	GW 2	16°45'0.67"N 96° 8'30.66"E	At well, beside the Botaza road, Dala,Township and about 0.04 kilometers at south of pipe line.
Ground water	GW 3	16°46'48.11"N 96° 8'11.26"E	At well, Tha Khin Mya park, Alone and about 0.001 kilometers at northeast of gas turbine.

GW1

GW1 was measured and collected at domestic well which is not fared from Dala main road and located about 0.09 kilometers from the proposed pipe line , Dala Township, Yangon Region. Although the survey location is surrounded by rice mills and houses; the well is used for domestic purposed especially for washing and not for drinking purpose. GW1 was surveyed and collected from the well at depth about 6 m. The transparency of water is high and salinity is 14.4psu . The survey activities of GW1 are shown in Figure 1.4-1.


Figure 1.4-1 Groundwater quality survey at GW1

GW2

GW2 was located beside the Botaza Road, Dala Township, and Yangon Region. The survey location is surrounded by many residential houses. It is located near about 0.04 kilometers south of gas pipe line. This well is mainly used for domestic purposes and not for drinking. Water colur is colorless. GW2 was surveyed and collected from the well at depth about 15 m. The transpency is high and salinity 2.8psu. The survey activities of GW2 are shown in Figure 1.4-2.


Figure 1.4-2 Groundwater quality survey at GW2

GW3

GW3 was surveyed and collected from the well situated in Tha Khin Mya Park, Alone Township, and Yangon Region. GW 3 is located at the corner of Lower Kyeemyindaing Road and Aung Yadana Street. This well is mainly used for domestics for residents. GW3 was surveyed and collected from the well at depth about 13.7 m. Water colour of GW3 is colourless. The transparency of water is high and salinity is 0.2psu. The survey activities of GW3 are shown in Figure 1.4-3.

Figure 1.4-3 Groundwater quality survey at GW 3

1.4.3 Survey Period

The sampling and measuring of the ground water were conducted on 28th- 29th June, 2018.

1.4.4 Survey Method

Water samples were taken by Alpha horizontal water sampler for some wells and collected in plastic and sterilized glass sample containers. All sampling was in strict accordance with recognized standard procedures. The parameters as pH, temperature, dissolved oxygen (DO), electrical conductivity (EC), and total dissolved solid including the odor and color in visual analyzing were measured at each site concurrently with sample collection and. According to the Laboratory standard, some samples were preserved using the chemicals. All samples were kept in iced boxes and were transported to the laboratory within 24 hours.

Table 1.4-3 Field Equipment for Ground water quality survey

No.	Equipment	Manufacturer	Originate Country	Model/Serial No.
1	SMART TROLL@ MP _Multi parameter for water	In_Situ Inc.	USA	SN - 346054
2	Multi Parameters for water quality	HANNA	USA	H17609823 (Turbidity Sensor)
3	Alpha Bottle (Water Sampler)	Wildlife Supply Company®	Indonesia	Wildco P/N-1120-G45

The following table provides the test method for water quality.

Table 1.4-4 Analysis Method for Water Samples

No.	Item	Analysis Method
1	Temperature	SMART TROLL@MP _Multi parameter for water (pH sensor)
2	pH	SMART TROLL@MP _Multi parameter for water (DO sensor)
3	Dissolved Oxygen	SMART TROLL@MP _Multi parameter for water (EC/TDS sensor)
4	Electrical Conductivity (EC)	SMART TROLL@MP _Multi parameter for water (EC/TDS sensor)
5	Total Dissolved Solid (TDS)	SMART TROLL@MP _Multi parameter for water (EC/TDS sensor)

1.4.5 Survey Result

Laboratories

Water samples were sent to the STS Green Laboratory in Thailand. Water quality results are shown in following Table 1.4-5.

1.4-5 In-situ groundwater quality results

No.	Sample No./ Physical Parameter	GW-1	GW-2	GW-3
1	Location	Pyaw Bwe Gyi Village	Beside the Botaza Road , Dala	Tha Khin Mya Park
2	Date/Time	30.6.2018 14:21	29.6.2018 13:30	29.6.2018 14:53
3	Weather	Sunny	Slightly Rain	Cloudy
4	Transparency	High	High	High
5	Color	Colorless	Colorless	Colorless
6	Well Depth (m)	6	15	13.7
7	Depth (of sample taken) (m)	-	-	-
8	Flow rate/velocity (m/s)	-	-	-
9	Tem (°C) (air & water)	30.71/34.30	28.63	28.31/31.70
10	pH	6.93	6.19	5.24
11	DO (mg/l)	0.00	1.98	0.00
12	EC (µs/m)	26022.6	5459.5	368.0
13	TDS (ppm)	15249.64	3318.18	224.99
14	Turbidity (FNU)	-	-	-
15	Remark	Sampled on 28/6/2018 12:15	Sampled on 28/6/2018 13:50	Sampled on 27/6/2018 11:20

1.5 Sediment

1.5.1 Survey Item

Parameters for sediment survey are determined so as to cover the parameters of existing available environmental standards. Sediment sample was taken by the Grab Sampler.

1.5.2 Survey Locations

The locations of sediment samples and surveys are shown in Table 1.5-1. The detail of each sampling points are described as below.

Table 1.5-1 Sampling and survey points of sediment survey

Category	Sampling Point	Coordinates	Description of Sampling Point
Sediment	SE 1	16°46'16.68"N 96° 7'29.64"E	Near about 0.16 kilometers in the left bank of Yangon River (Upstream), Dala Township, Yangon Region
Sediment	SE 2	16°46'12.72"N 96° 7'41.88"E	Near about 0.22 kilometers in the left bank of Yangon River (Downstream), Dala Township, Yangon Region
Sediment	SE 3	16°45'56.19"N 96° 7'47.98"E	Near about 0.19 kilometers in the right bank of Twantae Canal, which located near the mouth of Twantae Canal, Dala Township, Yangon Region

Sediment	SE 4	16°39'40.66"N 96°13'34.87"E	Near about 0.05 kilometers in the left bank of Yangon River which located near That Kai Kwin Village, Dala Township, Yangon Region
Sediment	SE 5	16°39'21.60"N 96°14'21.48"E	Near about 0.09 kilometers in the left bank of Yangon River which located in Dala Township, Yangon Region
Sediment	SE 6	16°39'3.28"N 96°14'36.81"E	Near about 0.03 kilometers in the left bank of Yangon River which located near Chaung Oo Village, Dala Township, Yangon Region

SE1

SE1 was collected in the left of Yangon River (upstream) located about 0.16 kilometers of gas pipeline which will construct later, Dala Township, Yangon Region. It's located at south of project area and southwest of Asia Terminal port. The sample was collected from a boat using grab sampler set up. SE1 was collected from the river at depth about 4.5 meters. The survey activities of SE1 are shown in Figure 1.5-1.

Figure 1.5-1 Sediment survey at SE 1

SE 2

SE 2 was collected at downstream of Yangon River, about 0.22 kilometers of proposed gas pipeline, Dala Township, Yangon Region. It's situated south of project area and Asia Terminal port. Sediment was caught to a depth 4.1 meters. The survey activities of SE2 are shown in Figure 1.5-2.

Figure 1.5-2 Sediment survey at SE2

SE3

SE3 was collected at upstream of Twantae Canal, about 0.09 kilometers fared from canal bank and near about 0.17 kilometers of proposed gas pipeline Dala Township, Yangon Region. It's situated south of project area and Asia Terminal port. The sample will be taken from a boat using grab sampler set up. SE3 was collected from the river at depth about 6.5 meters. The survey activities of SE3 are shown in Figure 1.5-3.

Figure 1.5-3 Sediment survey at SE3

SE4

SE4 was collected near about 0.05 kilometers in the left bank of Yangon River (upstream) which located near That Kai Kwin Village, Dala Township, and Yangon Region. It lies approximately 1.01 kilometers north-west of FSRU Option 2 which will construct later. SE4 was collected from the river at depth about 4.5 meters. The survey activities of SE4 are shown in Figure 1.5-4.

Figure 1.5-4 Sediment survey at SE4

SE5

SE5 was collected near about 0.09 kilometers in the left bank of Yangon River (upstream) in Dala Township, Yangon Region. It is lied approximately 0.17 kilometers of proposed FSRU Option 2. SE5 was collected from the river at depth about 5.4 meters. The survey activities of SE5 are shown in Figure 1.5-5.

Figure 1.5-5 Sediment survey at SE5

SE6

SE6 was collected near about 0.03 kilometers in the left bank of Yangon River (downstream) which located near Chaung Oo Village, Dala Township, and Yangon Region. It is located approximately 0.43 kilometers of proposed FSRU Option 2. SE6 was collected from the river at depth about 4.4 meters. The survey activities of SE6 are shown in Figure 1.5-6.

Figure 1.5-6 Sediment survey at SE6

1.5.3 Survey Period

The sampling and measuring of the sediment samples were conducted on 27th-28th June, 2018.

1.5.4 Survey Method

Methodology

River sea bed sediments were collected by dive-based sampling method. Six stations were collected

in this survey. At each station, sediment was collected in an amber glass bottle. Each benthic sample was then slowly sieved through a mesh size of 2.0, 1and 0.5mm. Firstly, benthic samples were sieved by 2.0 and 1.0mm mesh size. And then, it is continuously being sieved by 0.5mm size. Finally, the benthic samples were collected into the sieve of 1.0 and 0.5mm size. The specimens and coarse sediment that were retained in the sieve were collected in a plastic container and preserved in 10% formalin solution.

AQ1 (hourly wind speed and direction results)				AQ2 (hourly wind speed and direction results)			
Date	**Time**	**Wind Direction(Degree)**	**Wind Speed (kph)**	**Date**	**Time**	**Wind Direction(Degree)**	**Wind Speed (kph)**
27.6.2018	09:00-10:00	156	1.51	27.6.2018	09:00-10:00	140.38	1.50
27.6.2018	10:00-11:00	170	1.65	27.6.2018	10:00-11:00	139.57	3.95
27.6.2018	11:00-12:00	175	1.53	27.6.2018	11:00-12:00	138.52	3.71
27.6.2018	12:00-13:00	161	1.48	27.6.2018	12:00-13:00	138.07	3.93
27.6.2018	13:00-14:00	159	1.72	27.6.2018	13:00-14:00	139.83	3.57
27.6.2018	14:00-15:00	162	1.85	27.6.2018	14:00-15:00	135.18	3.73
27.6.2018	15:00-16:00	186	2.29	27.6.2018	15:00-16:00	138.68	4.36
27.6.2018	16:00-17:00	208	2.41	27.6.2018	16:00-17:00	151.72	2.93
27.6.2018	17:00-18:00	200	2.17	27.6.2018	17:00-18:00	158.08	3.07
27.6.2018	18:00-19:00	205	1.79	27.6.2018	18:00-19:00	139.22	2.92
27.6.2018	19:00-20:00	238	2.44	27.6.2018	19:00-20:00	169.72	2.01
27.6.2018	20:00-21:00	201	1.04	27.6.2018	20:00-21:00	189.30	0.58
27.6.2018	21:00-22:00	217	2.08	27.6.2018	21:00-22:00	198.95	0.39
27.6.2018	22:00-23:00	232	0.44	27.6.2018	22:00-23:00	194.23	0.61
27.6.2018	23:00-00:00	203	1.19	27.6.2018	23:00-00:00	150.53	1.97
28.6.2018	00:00-01:00	80	1.43	28.6.2018	00:00-01:00	140.72	1.09
28.6.2018	01:00-02:00	101	2.57	28.6.2018	01:00-02:00	131.57	1.27
28.6.2018	02:00-03:00	137	1.84	28.6.2018	02:00-03:00	142.95	3.17
28.6.2018	03:00-04:00	118	0.89	28.6.2018	03:00-04:00	144.13	3.68
28.6.2018	04:00-05:00	92	0.84	28.6.2018	04:00-05:00	151.10	4.16
28.6.2018	05:00-06:00	133	0.87	28.6.2018	05:00-06:00	145.92	4.34
28.6.2018	06:00-07:00	129	0.60	28.6.2018	06:00-07:00	158.23	4.51
28.6.2018	07:00-08:00	162	1.99	28.6.2018	07:00-08:00	142.62	4.80
28.6.2018	08:00-09:00	127	3.53	28.6.2018	08:00-09:00	146.35	4.53
28.6.2018	09:00-10:00	239	4.83	28.6.2018	09:00-10:00	143.65	3.56
28.6.2018	10:00-11:00	201	4.48	28.6.2018	10:00-11:00	147.23	4.56
28.6.2018	11:00-12:00	198	5.52	28.6.2018	11:00-12:00	144.38	4.48
28.6.2018	12:00-13:00	203	5.43	28.6.2018	12:00-13:00	139.05	4.33
28.6.2018	13:00-14:00	138	5.73	28.6.2018	13:00-14:00	146.92	4.66
28.6.2018	14:00-15:00	155	3.32	28.6.2018	14:00-15:00	163.98	3.18
28.6.2018	15:00-16:00	224	2.94	28.6.2018	15:00-16:00	143.55	2.14
28.6.2018	16:00-17:00	242	0.73	28.6.2018	16:00-17:00	158.97	2.59
28.6.2018	17:00-18:00	178	0.93	28.6.2018	17:00-18:00	193.60	2.83
28.6.2018	18:00-19:00	249	1.83	28.6.2018	18:00-19:00	276.83	1.36
28.6.2018	19:00-20:00	277	0.56	28.6.2018	19:00-20:00	292.85	0.59
28.6.2018	20:00-21:00	268	0.79	28.6.2018	20:00-21:00	296.43	0.19
28.6.2018	21:00-22:00	243	0.43	28.6.2018	21:00-22:00	300.63	0.11
28.6.2018	22:00-23:00	218	1.18	28.6.2018	22:00-23:00	228.55	0.28
28.6.2018	23:00-00:00	214	3.00	28.6.2018	23:00-00:00	145.85	0.52
29.6.2018	00:00-01:00	219	2.82	29.6.2018	00:00-01:00	192.58	0.03
29.6.2018	01:00-02:00	216	1.86	29.6.2018	01:00-02:00	216.93	0.13
29.6.2018	02:00-03:00	200	0.58	29.6.2018	02:00-03:00	129.48	0.71
29.6.2018	03:00-04:00	216	0.61	29.6.2018	03:00-04:00	166.97	1.55
29.6.2018	04:00-05:00	222	0.47	29.6.2018	04:00-05:00	176.05	0.28
29.6.2018	05:00-06:00	235	0.78	29.6.2018	05:00-06:00	164.83	0.46
29.6.2018	06:00-07:00	281	0.05	29.6.2018	06:00-07:00	171.38	0.02
29.6.2018	07:00-08:00	273	0.94	29.6.2018	07:00-08:00	172.42	0.14
29.6.2018	08:00-09:00	250	2.71	29.6.2018	08:00-09:00	213.07	0.65
29.6.2018	09:00-10:00	161	4.81	29.6.2018	09:00-10:00	253.26	1.52
29.6.2018	10:00-11:00	125	4.80	29.6.2018	10:00-11:00	267.05	1.07
29.6.2018	11:00-12:00	160	4.45	29.6.2018	11:00-12:00	219.23	0.97
29.6.2018	12:00-13:00	167	3.69	29.6.2018	12:00-13:00	274.58	2.00
29.6.2018	13:00-14:00	222	3.91	29.6.2018	13:00-14:00	279.77	2.13
29.6.2018	14:00-15:00	220	4.17	29.6.2018	14:00-15:00	280.47	1.93
29.6.2018	15:00-16:00	225	2.80	29.6.2018	15:00-16:00	276.77	1.60
29.6.2018	16:00-17:00	231	0.60	29.6.2018	16:00-17:00	179.04	0.20
29.6.2018	17:00-18:00	226	3.65	29.6.2018	17:00-18:00	249.55	0.16
29.6.2018	18:00-19:00	209	0.13	29.6.2018	18:00-19:00	280.30	0.05
29.6.2018	19:00-20:00	192	0.66	29.6.2018	19:00-20:00	286.03	0.51
29.6.2018	20:00-21:00	196	2.44	29.6.2018	20:00-21:00	227.30	1.95
29.6.2018	21:00-22:00	222	0.54	29.6.2018	21:00-22:00	274.90	0.50

29.6.2018	22:00-23:00	235	0.07	29.6.2018	22:00-23:00	272.90	0.09
29.6.2018	23:00-00:00	272	0.05	29.6.2018	23:00-00:00	166.93	0.02
30.6.2018	00:00-01:00	197	0.00	30.6.2018	00:00-01:00	165.38	0.00
30.6.2018	01:00-02:00	74	0.19	30.6.2018	01:00-02:00	267.83	2.25
30.6.2018	02:00-03:00	73	0.58	30.6.2018	02:00-03:00	252.40	1.60
30.6.2018	03:00-04:00	113	0.04	30.6.2018	03:00-04:00	263.13	1.17
30.6.2018	04:00-05:00	175	0.00	30.6.2018	04:00-05:00	277.62	2.60
30.6.2018	05:00-06:00	175	0.00	30.6.2018	05:00-06:00	271.42	2.08
30.6.2018	06:00-07:00	148	0.00	30.6.2018	06:00-07:00	274.02	2.48
30.6.2018	07:00-08:00	66	0.00	30.6.2018	07:00-08:00	272.78	1.25
30.6.2018	08:00-09:00	186	1.87	30.6.2018	08:00-09:00	268.85	1.99

AQ3 (hourly wind speed and direction results)				**AQ4 (hourly wind speed and direction results)**			
Date	**Time**	**Wind Direction (Degree)**	**Wind Speed (kph)**	**Date**	**Time**	**Wind Direction (Degree)**	**Wind Speed (kph**
27.6.2018	10:00-11:00	215.30	0.24	6.7.2018	14:00-15:00	304.50	0.04
27.6.2018	11:00-12:00	224.98	0.03	6.7.2018	15:00-16:00	307.27	0.31
27.6.2018	12:00-13:00	217.69	0.54	6.7.2018	16:00-17:00	301.00	0.31
27.6.2018	13:00-14:00	291.47	1.77	6.7.2018	17:00-18:00	323.18	0.05
27.6.2018	14:00-15:00	279.20	2.39	6.7.2018	18:00-19:00	283.15	0.24
27.6.2018	15:00-16:00	263.80	3.59	6.7.2018	19:00-20:00	330.67	0.32
27.6.2018	16:00-17:00	276.02	3.96	6.7.2018	20:00-21:00	328.32	0.18
27.6.2018	17:00-18:00	241.20	5.49	6.7.2018	21:00-22:00	319.75	0.14
27.6.2018	18:00-19:00	244.90	5.31	6.7.2018	22:00-23:00	303.75	0.53
27.6.2018	19:00-20:00	245.77	3.59	6.7.2018	23:00-00:00	278.30	0.27
27.6.2018	20:00-21:00	268.85	2.96	7.7.2018	00:00-01:00	270.02	0.10
27.6.2018	21:00-22:00	261.56	1.02	7.7.2018	01:00-02:00	282.92	0.00
27.6.2018	22:00-23:00	250.42	0.03	7.7.2018	02:00-03:00	308.77	0.10
27.6.2018	23:00-00:00	254.53	0.01	7.7.2018	03:00-04:00	253.00	0.00
28.6.2018	00:00-01:00	260.70	0.00	7.7.2018	04:00-05:00	255.50	0.10
28.6.2018	01:00-02:00	258.30	0.00	7.7.2018	05:00-06:00	302.63	0.00
28.6.2018	02:00-03:00	258.00	0.00	7.7.2018	06:00-07:00	327.42	0.46
28.6.2018	03:00-04:00	258.00	0.00	7.7.2018	07:00-08:00	321.10	0.51
28.6.2018	04:00-05:00	252.78	0.01	7.7.2018	08:00-09:00	280.03	0.15
28.6.2018	05:00-06:00	230.88	0.01	7.7.2018	09:00-10:00	270.58	0.20
28.6.2018	06:00-07:00	223.67	0.19	7.7.2018	10:00-11:00	293.15	0.11
28.6.2018	07:00-08:00	264.72	0.06	7.7.2018	11:00-12:00	291.47	0.13
28.6.2018	08:00-09:00	234.88	0.04	7.7.2018	12:00-13:00	285.43	0.12
28.6.2018	09:00-10:00	228.87	0.00	7.7.2018	13:00-14:00	285.08	0.17
28.6.2018	10:00-11:00	191.57	0.08	7.7.2018	14:00-15:00	269.73	0.12
28.6.2018	11:00-12:00	248.82	1.10	7.7.2018	15:00-16:00	224.23	0.17
28.6.2018	12:00-13:00	255.40	2.34	7.7.2018	16:00-17:00	225.23	0.12
28.6.2018	13:00-14:00	270.48	2.72	7.7.2018	17:00-18:00	226.00	0.12
28.6.2018	14:00-15:00	289.55	3.72	7.7.2018	18:00-19:00	233.42	0.14
28.6.2018	15:00-16:00	284.88	2.42	7.7.2018	19:00-20:00	236.00	0.11
28.6.2018	16:00-17:00	249.82	6.82	7.7.2018	20:00-21:00	248.33	0.10
28.6.2018	17:00-18:00	250.27	7.41	7.7.2018	21:00-22:00	274.00	0.00
28.6.2018	18:00-19:00	282.05	3.95	7.7.2018	22:00-23:00	274.10	0.00
28.6.2018	19:00-20:00	265.75	0.96	7.7.2018	23:00-00:00	274.37	0.18
28.6.2018	20:00-21:00	238.52	0.19	8.7.2018	00:00-01:00	285.73	0.14
28.6.2018	21:00-22:00	252.70	1.45	8.7.2018	01:00-02:00	304.75	0.12
28.6.2018	22:00-23:00	248.37	0.27	8.7.2018	02:00-03:00	259.25	0.00
28.6.2018	23:00-00:00	226.23	1.65	8.7.2018	03:00-04:00	280.53	0.00
29.6.2018	00:00-01:00	248.73	2.64	8.7.2018	04:00-05:00	283.18	0.00
29.6.2018	01:00-02:00	234.20	1.20	8.7.2018	05:00-06:00	299.87	0.00
29.6.2018	02:00-03:00	195.42	0.22	8.7.2018	06:00-07:00	253.67	0.18
29.6.2018	03:00-04:00	208.68	0.26	8.7.2018	07:00-08:00	255.63	0.34
29.6.2018	04:00-05:00	256.10	0.08	8.7.2018	08:00-09:00	301.80	0.00
29.6.2018	05:00-06:00	257.98	0.11	8.7.2018	09:00-10:00	318.45	0.16
29.6.2018	06:00-07:00	277.10	0.30	8.7.2018	10:00-11:00	313.02	0.11
29.6.2018	07:00-08:00	277.28	1.53	8.7.2018	11:00-12:00	264.98	0.14
29.6.2018	08:00-09:00	238.52	3.72	8.7.2018	12:00-13:00	287.08	0.14

29.6.2018	09:00-10:00	247.73	4.85	8.7.2018	13:00-14:00	290.93	0.10
29.6.2018	10:00-11:00	240.60	4.93	8.7.2018	14:00-15:00	294.33	0.11
29.6.2018	11:00-12:00	235.47	5.54	8.7.2018	15:00-16:00	287.73	0.14
29.6.2018	12:00-13:00	221.73	4.25	8.7.2018	16:00-17:00	285.45	0.18
29.6.2018	13:00-14:00	246.48	5.83	8.7.2018	17:00-18:00	245.48	0.15
29.6.2018	14:00-15:00	247.47	4.90	8.7.2018	18:00-19:00	224.43	0.18
29.6.2018	15:00-16:00	238.40	3.39	8.7.2018	19:00-20:00	225.70	0.51
29.6.2018	16:00-17:00	102.36	0.31	8.7.2018	20:00-21:00	226.75	0.23
29.6.2018	17:00-18:00	218.36	1.20	8.7.2018	21:00-22:00	236.00	0.00
29.6.2018	18:00-19:00	240.27	0.39	8.7.2018	22:00-23:00	236.00	0.17
29.6.2018	19:00-20:00	195.00	1.28	8.7.2018	23:00-00:00	261.00	0.40
29.6.2018	20:00-21:00	184.97	0.56	9.7.2018	00:00-01:00	274.00	0.13
29.6.2018	21:00-22:00	63.70	0.00	9.7.2018	01:00-02:00	274.10	0.23
29.6.2018	22:00-23:00	60.20	0.00	9.7.2018	02:00-03:00	274.37	0.00
29.6.2018	23:00-00:00	30.47	0.00	9.7.2018	03:00-04:00	293.40	0.00
30.6.2018	00:00-01:00	271.33	1.83	9.7.2018	04:00-05:00	297.00	0.12
30.6.2018	01:00-02:00	261.90	0.46	9.7.2018	05:00-06:00	297.00	0.11
30.6.2018	02:00-03:00	260.68	0.58	9.7.2018	06:00-07:00	297.00	0.00
30.6.2018	03:00-04:00	251.75	0.29	9.7.2018	07:00-08:00	297.00	0.12
30.6.2018	04:00-05:00	246.93	0.02	9.7.2018	08:00-09:00	297.00	0.13
30.6.2018	05:00-06:00	263.03	0.01	9.7.2018	09:00-10:00	297.00	0.12
30.6.2018	06:00-07:00	263.13	0.00	9.7.2018	10:00-11:00	297.00	0.10
30.6.2018	07:00-08:00	253.27	0.00	9.7.2018	11:00-12:00	297.00	0.12
30.6.2018	08:00-09:00	244.48	0.44	9.7.2018	12:00-13:00	297.00	0.13
30.6.2018	09:00-10:00	286.92	2.06	9.7.2018	13:00-14:00	297.00	0.00

AQ5 (hourly wind speed and direction results)				**AQ6 (hourly wind speed and direction results)**			
Date	**Time**	**Wind Direction (Degree)**	**Wind speed (kph)**	**Date**	**Time**	**Wind Direction (Degree)**	**Wind speed (kph)**
30.6.2018	12:00-13:00	200.60	1.29	30.6.2018	12:00-13:00	211.95	1.70
30.6.2018	13:00-14:00	186.83	2.06	30.6.2018	13:00-14:00	209.05	2.75
30.6.2018	14:00-15:00	228.95	2.15	30.6.2018	14:00-15:00	206.28	4.70
30.6.2018	15:00-16:00	42.18	0.00	30.6.2018	15:00-16:00	275.33	2.25
30.6.2018	16:00-17:00	102.67	0.02	30.6.2018	16:00-17:00	283.10	0.16
30.6.2018	17:00-18:00	252.17	0.86	30.6.2018	17:00-18:00	292.35	0.13
30.6.2018	18:00-19:00	201.60	1.78	30.6.2018	18:00-19:00	290.15	0.02
30.6.2018	19:00-20:00	231.30	0.07	30.6.2018	19:00-20:00	213.10	0.04
30.6.2018	20:00-21:00	189.23	0.01	30.6.2018	20:00-21:00	252.22	0.00
30.6.2018	21:00-22:00	182.75	0.01	30.6.2018	21:00-22:00	308.33	0.00
30.6.2018	22:00-23:00	177.00	0.00	30.6.2018	22:00-23:00	220.67	0.02
30.6.2018	23:00-00:00	177.00	0.00	30.6.2018	23:00-00:00	217.00	0.00
1.7.2018	00:00-01:00	182.63	0.00	1.7.2018	00:00-01:00	215.17	0.00
1.7.2018	01:00-02:00	200.00	0.00	1.7.2018	01:00-02:00	213.00	0.00
1.7.2018	02:00-03:00	177.02	0.02	1.7.2018	02:00-03:00	213.00	0.04
1.7.2018	03:00-04:00	168.00	0.00	1.7.2018	03:00-04:00	213.00	0.02
1.7.2018	04:00-05:00	168.00	0.00	1.7.2018	04:00-05:00	213.00	0.00
1.7.2018	05:00-06:00	167.90	0.00	1.7.2018	05:00-06:00	213.00	0.00
1.7.2018	06:00-07:00	164.98	0.09	1.7.2018	06:00-07:00	199.37	0.09
1.7.2018	07:00-08:00	175.22	0.75	1.7.2018	07:00-08:00	183.58	0.26
1.7.2018	08:00-09:00	189.87	0.87	1.7.2018	08:00-09:00	196.93	0.41
1.7.2018	09:00-10:00	180.27	1.86	1.7.2018	09:00-10:00	248.08	0.18
1.7.2018	10:00-11:00	189.47	2.40	1.7.2018	10:00-11:00	281.55	0.64
1.7.2018	11:00-12:00	204.90	3.12	1.7.2018	11:00-12:00	227.55	0.56
1.7.2018	12:00-13:00	156.57	0.80	1.7.2018	12:00-13:00	209.80	9.46
1.7.2018	13:00-14:00	111.00	0.00	1.7.2018	13:00-14:00	211.93	4.84
1.7.2018	14:00-15:00	111.00	0.00	1.7.2018	14:00-15:00	279.35	2.54
1.7.2018	15:00-16:00	111.00	0.00	1.7.2018	15:00-16:00	210.80	0.16
1.7.2018	16:00-17:00	129.83	0.86	1.7.2018	16:00-17:00	236.48	0.22
1.7.2018	17:00-18:00	211.95	3.09	1.7.2018	17:00-18:00	211.55	0.87
1.7.2018	18:00-19:00	272.88	0.00	1.7.2018	18:00-19:00	193.65	0.02
1.7.2018	19:00-20:00	212.90	0.00	1.7.2018	19:00-20:00	196.74	0.22

1.7.2018	20:00-21:00	216.97	0.00	1.7.2018	20:00-21:00	215.64	0.04
1.7.2018	21:00-22:00	203.65	0.00	1.7.2018	21:00-22:00	223.00	0.00
1.7.2018	22:00-23:00	178.00	0.00	1.7.2018	22:00-23:00	234.95	0.00
1.7.2018	23:00-00:00	178.00	0.00	1.7.2018	23:00-00:00	173.35	0.00
2.7.2018	00:00-01:00	178.00	0.00	2.7.2018	00:00-01:00	172.00	0.01
2.7.2018	01:00-02:00	175.65	0.00	2.7.2018	01:00-02:00	172.00	0.00
2.7.2018	02:00-03:00	166.00	0.00	2.7.2018	02:00-03:00	172.00	0.00
2.7.2018	03:00-04:00	166.00	0.00	2.7.2018	03:00-04:00	172.00	0.00
2.7.2018	04:00-05:00	165.38	0.10	2.7.2018	04:00-05:00	173.17	0.00
2.7.2018	05:00-06:00	165.77	0.03	2.7.2018	05:00-06:00	189.45	1.26
2.7.2018	06:00-07:00	169.00	0.00	2.7.2018	06:00-07:00	203.92	2.09
2.7.2018	07:00-08:00	171.58	0.09	2.7.2018	07:00-08:00	214.00	0.60
2.7.2018	08:00-09:00	177.68	0.40	2.7.2018	08:00-09:00	246.87	0.83
2.7.2018	09:00-10:00	177.48	0.62	2.7.2018	09:00-10:00	217.98	1.57
2.7.2018	10:00-11:00	174.23	1.19	2.7.2018	10:00-11:00	208.08	3.80
2.7.2018	11:00-12:00	196.87	1.01	2.7.2018	11:00-12:00	213.65	4.54
2.7.2018	12:00-13:00	227.68	1.56	2.7.2018	12:00-13:00	201.58	0.75
2.7.2018	13:00-14:00	270.92	2.53	2.7.2018	13:00-14:00	220.07	0.32
2.7.2018	14:00-15:00	189.50	4.29	2.7.2018	14:00-15:00	202.43	1.20
2.7.2018	15:00-16:00	179.58	5.48	2.7.2018	15:00-16:00	211.60	1.23
2.7.2018	16:00-17:00	202.70	3.06	2.7.2018	16:00-17:00	224.28	0.49
2.7.2018	17:00-18:00	197.80	0.62	2.7.2018	17:00-18:00	222.20	0.10
2.7.2018	18:00-19:00	167.52	0.10	2.7.2018	18:00-19:00	225.00	0.00
2.7.2018	19:00-20:00	179.88	0.48	2.7.2018	19:00-20:00	225.00	0.00
2.7.2018	20:00-21:00	185.95	0.42	2.7.2018	20:00-21:00	225.00	0.00
2.7.2018	21:00-22:00	178.75	0.19	2.7.2018	21:00-22:00	225.00	0.00
2.7.2018	22:00-23:00	168.28	0.16	2.7.2018	22:00-23:00	224.80	0.00
2.7.2018	23:00-00:00	151.27	0.00	2.7.2018	23:00-00:00	224.00	0.00
3.7.2018	00:00-01:00	151.12	0.00	3.7.2018	00:00-01:00	224.00	0.00
3.7.2018	01:00-02:00	164.68	0.00	3.7.2018	01:00-02:00	224.00	0.00
3.7.2018	02:00-03:00	172.00	0.00	3.7.2018	02:00-03:00	224.00	0.00
3.7.2018	03:00-04:00	172.00	0.00	3.7.2018	03:00-04:00	224.00	0.00
3.7.2018	04:00-05:00	172.00	0.00	3.7.2018	04:00-05:00	222.12	0.03
3.7.2018	05:00-06:00	172.00	0.00	3.7.2018	05:00-06:00	224.42	0.18
3.7.2018	06:00-07:00	159.45	0.00	3.7.2018	06:00-07:00	224.50	0.54
3.7.2018	07:00-08:00	157.33	0.51	3.7.2018	07:00-08:00	207.82	0.29
3.7.2018	08:00-09:00	179.07	2.17	3.7.2018	08:00-09:00	200.20	0.33
3.7.2018	09:00-10:00	191.25	3.32	3.7.2018	09:00-10:00	209.12	0.92
3.7.2018	10:00-11:00	202.57	3.96	3.7.2018	10:00-11:00	245.82	0.01
3.7.2018	11:00-12:00	111.00	0.00	3.7.2018	11:00-12:00	167.96	1.43

AQ7 (hourly wind speed and direction results)				**AQ8 (hourly wind speed and direction results)**			
Date	**Time**	**Wind Direction (Degree)**	**Wind speed (kph)**	**Date**	**Time**	**Wind Direction (Degree)**	**Wind speed (kph)**
30.6.2018	13:00-14:00	227.32	0.840	3.7.2018	13:00-14:00	216.58	1.08
30.6.2018	14:00-15:00	264.28	0.210	3.7.2018	14:00-15:00	248.80	2.69
30.6.2018	15:00-16:00	33.00	1.233	3.7.2018	15:00-16:00	228.90	2.66
30.6.2018	16:00-17:00	109.72	1.897	3.7.2018	16:00-17:00	239.03	2.38
30.6.2018	17:00-18:00	296.33	0.295	3.7.2018	17:00-18:00	231.92	1.77
30.6.2018	18:00-19:00	317.90	0.005	3.7.2018	18:00-19:00	228.20	3.17
30.6.2018	19:00-20:00	305.75	0.103	3.7.2018	19:00-20:00	254.67	3.49
30.6.2018	20:00-21:00	297.22	0.652	3.7.2018	20:00-21:00	268.22	3.50
30.6.2018	21:00-22:00	301.32	0.108	3.7.2018	21:00-22:00	281.32	1.56
30.6.2018	22:00-23:00	302.10	0.178	3.7.2018	22:00-23:00	274.65	2.93
30.6.2018	23:00-00:00	307.00	0.000	3.7.2018	23:00-00:00	284.05	0.74
1.7.2018	00:00-01:00	304.82	0.452	4.7.2018	00:00-01:00	269.42	0.31

1.7.2018	01:00-02:00	312.00	0.000	4.7.2018	01:00-02:00	257.62	0.98
1.7.2018	02:00-03:00	176.40	0.000	4.7.2018	02:00-03:00	235.38	1.49
1.7.2018	03:00-04:00	350.00	0.000	4.7.2018	03:00-04:00	230.90	0.32
1.7.2018	04:00-05:00	350.08	0.000	4.7.2018	04:00-05:00	208.80	0.07
1.7.2018	05:00-06:00	211.40	0.445	4.7.2018	05:00-06:00	204.10	0.76
1.7.2018	06:00-07:00	98.85	0.348	4.7.2018	06:00-07:00	212.72	0.32
1.7.2018	07:00-08:00	197.72	0.110	4.7.2018	07:00-08:00	214.72	0.01
1.7.2018	08:00-09:00	241.47	0.128	4.7.2018	08:00-09:00	216.97	0.19
1.7.2018	09:00-10:00	222.37	0.148	4.7.2018	09:00-10:00	230.43	0.58
1.7.2018	10:00-11:00	210.45	0.152	4.7.2018	10:00-11:00	215.83	0.04
1.7.2018	11:00-12:00	267.15	0.113	4.7.2018	11:00-12:00	215.23	1.87
1.7.2018	12:00-13:00	227.24	0.124	4.7.2018	12:00-13:00	216.67	3.43
1.7.2018	13:00-14:00	0.00	0.000	4.7.2018	13:00-14:00	253.35	0.14
1.7.2018	14:00-15:00	247.54	0.210	4.7.2018	14:00-15:00	212.90	2.10
1.7.2018	15:00-16:00	261.28	0.153	4.7.2018	15:00-16:00	244.93	1.02
1.7.2018	16:00-17:00	239.48	0.157	4.7.2018	16:00-17:00	218.68	2.66
1.7.2018	17:00-18:00	270.47	0.242	4.7.2018	17:00-18:00	244.75	4.63
1.7.2018	18:00-19:00	189.85	0.410	4.7.2018	18:00-19:00	264.80	3.54
1.7.2018	19:00-20:00	222.58	1.227	4.7.2018	19:00-20:00	223.70	3.01
1.7.2018	20:00-21:00	290.00	0.762	4.7.2018	20:00-21:00	211.03	1.20
1.7.2018	21:00-22:00	290.00	0.055	4.7.2018	21:00-22:00	270.30	0.63
1.7.2018	22:00-23:00	290.00	0.253	4.7.2018	22:00-23:00	244.95	0.62
1.7.2018	23:00-00:00	290.00	0.655	4.7.2018	23:00-00:00	239.28	0.10
2.7.2018	00:00-01:00	290.00	0.370	5.7.2018	00:00-01:00	236.08	0.09
2.7.2018	01:00-02:00	202.78	0.348	5.7.2018	01:00-02:00	223.75	0.02
2.7.2018	02:00-03:00	177.00	0.525	5.7.2018	02:00-03:00	217.28	0.00
2.7.2018	03:00-04:00	177.00	1.353	5.7.2018	03:00-04:00	214.90	0.09
2.7.2018	04:00-05:00	259.22	0.788	5.7.2018	04:00-05:00	215.15	0.18
2.7.2018	05:00-06:00	214.88	0.612	5.7.2018	05:00-06:00	211.53	0.00
2.7.2018	06:00-07:00	215.00	0.133	5.7.2018	06:00-07:00	213.32	0.76
2.7.2018	07:00-08:00	208.07	0.508	5.7.2018	07:00-08:00	216.98	0.48
2.7.2018	08:00-09:00	209.18	0.683	5.7.2018	08:00-09:00	223.10	0.57
2.7.2018	09:00-10:00	185.58	0.333	5.7.2018	09:00-10:00	224.80	0.17
2.7.2018	10:00-11:00	227.33	0.267	5.7.2018	10:00-11:00	288.23	0.07
2.7.2018	11:00-12:00	224.05	0.128	5.7.2018	11:00-12:00	267.30	0.07
2.7.2018	12:00-13:00	307.02	0.158	5.7.2018	12:00-13:00	252.53	0.37
2.7.2018	13:00-14:00	300.70	1.998	5.7.2018	13:00-14:00	223.82	0.27
2.7.2018	14:00-15:00	221.28	0.913	5.7.2018	14:00-15:00	221.83	0.14
2.7.2018	15:00-16:00	211.98	2.092	5.7.2018	15:00-16:00	208.55	0.12
2.7.2018	16:00-17:00	313.90	3.415	5.7.2018	16:00-17:00	210.83	0.11
2.7.2018	17:00-18:00	303.82	2.673	5.7.2018	17:00-18:00	213.67	0.26
2.7.2018	18:00-19:00	266.13	2.830	5.7.2018	18:00-19:00	216.88	0.96
2.7.2018	19:00-20:00	282.88	4.122	5.7.2018	19:00-20:00	210.00	0.99
2.7.2018	20:00-21:00	303.53	4.947	5.7.2018	20:00-21:00	212.00	0.49

2.7.2018	21:00-22:00	302.15	5.738	5.7.2018	21:00-22:00	207.12	0.08
2.7.2018	22:00-23:00	325.67	3.495	5.7.2018	22:00-23:00	219.45	0.51
2.7.2018	23:00-00:00	321.42	1.527	5.7.2018	23:00-00:00	218.00	0.04
3.7.2018	00:00-01:00	321.00	1.727	6.7.2018	00:00-01:00	217.33	0.03
3.7.2018	01:00-02:00	240.05	1.702	6.7.2018	01:00-02:00	217.00	0.03
3.7.2018	02:00-03:00	196.00	0.900	6.7.2018	02:00-03:00	216.42	0.01
3.7.2018	03:00-04:00	196.00	0.780	6.7.2018	03:00-04:00	222.53	0.00
3.7.2018	04:00-05:00	196.00	1.487	6.7.2018	04:00-05:00	217.28	0.01
3.7.2018	05:00-06:00	196.00	0.127	6.7.2018	05:00-06:00	217.07	0.01
3.7.2018	06:00-07:00	195.30	0.228	6.7.2018	06:00-07:00	216.95	1.39
3.7.2018	07:00-08:00	159.92	1.422	6.7.2018	07:00-08:00	217.10	0.44
3.7.2018	08:00-09:00	151.05	4.700	6.7.2018	08:00-09:00	203.62	0.55
3.7.2018	09:00-10:00	250.47	2.907	6.7.2018	09:00-10:00	200.68	0.28
3.7.2018	10:00-11:00	301.03	3.263	6.7.2018	10:00-11:00	217.85	0.18
3.7.2018	11:00-12:00	297.27	3.582	6.7.2018	11:00-12:00	215.30	2.11
3.7.2018	12:00-13:00	216.31	1.323	6.7.2018	12:00-13:00	237.45	2.64

AQ9 (hourly wind speed and direction results)				**AQ10 (hourly wind speed and direction results)**			
Date	**Time**	**Wind Direction (Degree)**	**Wind speed (kph)**	**Date**	**Time**	**Wind Direction (Degree)**	**Wind speed (kph)**
3.7.2018	13:00-14:00	210.13	2.16	3.7.2018	13:00-14:00	233.07	8.88
3.7.2018	14:00-15:00	212.60	0.02	3.7.2018	14:00-15:00	225.41	10.19
3.7.2018	15:00-16:00	207.23	2.17	3.7.2018	15:00-16:00	229.44	8.31
3.7.2018	16:00-17:00	235.88	2.40	3.7.2018	16:00-17:00	229.85	7.48
3.7.2018	17:00-18:00	220.15	0.02	3.7.2018	17:00-18:00	233.12	8.57
3.7.2018	18:00-19:00	196.00	0.00	3.7.2018	18:00-19:00	236.39	6.53
3.7.2018	19:00-20:00	226.02	1.41	3.7.2018	19:00-20:00	246.32	0.53
3.7.2018	20:00-21:00	237.22	0.17	3.7.2018	20:00-21:00	246.20	0.18
3.7.2018	21:00-22:00	238.00	0.00	3.7.2018	21:00-22:00	233.98	0.00
3.7.2018	22:00-23:00	238.00	0.00	3.7.2018	22:00-23:00	234.00	0.00
3.7.2018	23:00-00:00	228.68	0.04	3.7.2018	23:00-00:00	211.98	0.00
4.7.2018	00:00-01:00	238.80	0.00	4.7.2018	00:00-01:00	188.88	0.00
4.7.2018	01:00-02:00	231.52	0.00	4.7.2018	01:00-02:00	173.81	0.06
4.7.2018	02:00-03:00	230.00	0.00	4.7.2018	02:00-03:00	193.24	0.17
4.7.2018	03:00-04:00	230.00	0.00	4.7.2018	03:00-04:00	211.03	0.38
4.7.2018	04:00-05:00	228.30	0.01	4.7.2018	04:00-05:00	183.56	0.00
4.7.2018	05:00-06:00	221.00	0.00	4.7.2018	05:00-06:00	220.97	0.14
4.7.2018	06:00-07:00	245.12	0.00	4.7.2018	06:00-07:00	224.61	0.94
4.7.2018	07:00-08:00	221.77	0.16	4.7.2018	07:00-08:00	230.73	3.05
4.7.2018	08:00-09:00	247.90	1.21	4.7.2018	08:00-09:00	232.46	6.74
4.7.2018	09:00-10:00	232.65	1.09	4.7.2018	09:00-10:00	229.25	7.09
4.7.2018	10:00-11:00	243.58	0.02	4.7.2018	10:00-11:00	224.56	6.06
4.7.2018	11:00-12:00	241.33	0.00	4.7.2018	11:00-12:00	217.86	7.34

4.7.2018	12:00-13:00	242.68	0.00	4.7.2018	12:00-13:00	268.47	3.19
4.7.2018	13:00-14:00	244.00	0.00	4.7.2018	13:00-14:00	244.51	3.65
4.7.2018	14:00-15:00	240.95	0.00	4.7.2018	14:00-15:00	234.42	9.27
4.7.2018	15:00-16:00	227.30	0.00	4.7.2018	15:00-16:00	233.61	7.84
4.7.2018	16:00-17:00	221.00	0.00	4.7.2018	16:00-17:00	224.10	9.67
4.7.2018	17:00-18:00	221.00	0.00	4.7.2018	17:00-18:00	257.93	3.63
4.7.2018	18:00-19:00	221.00	0.00	4.7.2018	18:00-19:00	236.20	1.39
4.7.2018	19:00-20:00	221.00	0.00	4.7.2018	19:00-20:00	224.92	0.87
4.7.2018	20:00-21:00	221.00	0.00	4.7.2018	20:00-21:00	224.29	0.29
4.7.2018	21:00-22:00	221.00	0.00	4.7.2018	21:00-22:00	284.63	0.58
4.7.2018	22:00-23:00	221.00	0.00	4.7.2018	22:00-23:00	219.00	0.03
4.7.2018	23:00-00:00	221.00	0.00	4.7.2018	23:00-00:00	194.85	0.01
5.7.2018	00:00-01:00	180.78	0.00	5.7.2018	00:00-01:00	192.32	0.69
5.7.2018	01:00-02:00	131.00	0.00	5.7.2018	01:00-02:00	233.22	4.03
5.7.2018	02:00-03:00	133.30	0.00	5.7.2018	02:00-03:00	227.17	1.25
5.7.2018	03:00-04:00	135.00	0.00	5.7.2018	03:00-04:00	216.83	0.40
5.7.2018	04:00-05:00	135.00	0.00	5.7.2018	04:00-05:00	213.44	0.73
5.7.2018	05:00-06:00	165.60	0.08	5.7.2018	05:00-06:00	230.44	1.27
5.7.2018	06:00-07:00	219.47	0.00	5.7.2018	06:00-07:00	227.19	1.30
5.7.2018	07:00-08:00	206.60	0.00	5.7.2018	07:00-08:00	232.54	1.68
5.7.2018	08:00-09:00	132.65	0.05	5.7.2018	08:00-09:00	231.71	3.01
5.7.2018	09:00-10:00	153.08	0.00	5.7.2018	09:00-10:00	236.78	7.11
5.7.2018	10:00-11:00	209.93	0.67	5.7.2018	10:00-11:00	284.63	1.17
5.7.2018	11:00-12:00	239.72	0.98	5.7.2018	11:00-12:00	239.64	0.21
5.7.2018	12:00-13:00	233.80	0.23	5.7.2018	12:00-13:00	239.32	0.40
5.7.2018	13:00-14:00	182.95	2.23	5.7.2018	13:00-14:00	211.17	0.00
5.7.2018	14:00-15:00	139.73	2.65	5.7.2018	14:00-15:00	192.51	0.20
5.7.2018	15:00-16:00	142.33	2.01	5.7.2018	15:00-16:00	205.24	0.10
5.7.2018	16:00-17:00	134.08	1.97	5.7.2018	16:00-17:00	189.31	2.47
5.7.2018	17:00-18:00	144.35	2.35	5.7.2018	17:00-18:00	208.32	2.35
5.7.2018	18:00-19:00	139.73	2.05	5.7.2018	18:00-19:00	227.85	2.80
5.7.2018	19:00-20:00	156.50	1.86	5.7.2018	19:00-20:00	230.07	1.02
5.7.2018	20:00-21:00	160.90	0.50	5.7.2018	20:00-21:00	225.00	0.11
5.7.2018	21:00-22:00	165.48	0.60	5.7.2018	21:00-22:00	193.19	0.18
5.7.2018	22:00-23:00	133.27	0.40	5.7.2018	22:00-23:00	185.05	0.12
5.7.2018	23:00-00:00	113.65	0.22	5.7.2018	23:00-00:00	204.00	0.06
6.7.2018	00:00-01:00	159.23	0.06	6.7.2018	00:00-01:00	207.15	0.02
6.7.2018	01:00-02:00	167.25	1.32	6.7.2018	01:00-02:00	206.44	0.00
6.7.2018	02:00-03:00	174.12	2.69	6.7.2018	02:00-03:00	168.53	0.04
6.7.2018	03:00-04:00	192.33	2.67	6.7.2018	03:00-04:00	198.15	1.23
6.7.2018	04:00-05:00	221.45	2.27	6.7.2018	04:00-05:00	216.54	1.17
6.7.2018	05:00-06:00	178.12	1.85	6.7.2018	05:00-06:00	218.85	1.46
6.7.2018	06:00-07:00	176.68	3.00	6.7.2018	06:00-07:00	216.14	5.15
6.7.2018	07:00-08:00	48.32	0.10	6.7.2018	07:00-08:00	200.25	6.32

6.7.2018	08:00-09:00	150.52	2.02	6.7.2018	08:00-09:00	186.24	1.48
6.7.2018	09:00-10:00	247.70	3.17	6.7.2018	09:00-10:00	183.76	3.86
6.7.2018	10:00-11:00	196.47	2.69	6.7.2018	10:00-11:00	179.07	1.64
6.7.2018	11:00-12:00	207.98	0.52	6.7.2018	11:00-12:00	215.66	2.78
6.7.2018	12:00-13:00	249.48	0.17	6.7.2018	12:00-13:00	224.61	5.82

Hourly air quality results

AQ1 (first day)

Date	**Time**	**CO**	**NO2**	**NO**	**PM2.5**	**PM10**	**RH**	**SO2**	**TmpC**
D.M.Y	**H.M.S**	**µg/m3**	**µg/m3**	**µg/m3**	**µg/m3**	**µg/m3**	**%**	**µg/m3**	**Deg. C**
27.6.2018	09:00-10:00	129.29	370.16	0.00	2.46	16.59	76.46	2.55	25.83
27.6.2018	10:00-11:00	97.45	336.80	0.00	5.57	17.88	82.80	2.07	25.57
27.6.2018	11:00-12:00	113.31	178.70	0.00	3.00	8.05	74.97	7.09	27.32
27.6.2018	12:00-13:00	83.31	100.34	0.00	3.52	5.75	74.30	8.75	27.88
27.6.2018	13:00-14:00	96.04	82.72	0.00	5.38	15.07	80.25	4.92	26.92
27.6.2018	14:00-15:00	108.71	56.25	0.00	6.50	20.02	81.07	8.56	26.70
27.6.2018	15:00-16:00	113.06	45.59	0.03	4.67	9.45	79.13	14.11	27.23
27.6.2018	16:00-17:00	82.32	31.76	0.05	5.70	10.80	74.17	17.21	28.15
27.6.2018	17:00-18:00	115.94	50.36	0.00	6.82	17.95	73.33	36.66	28.18
27.6.2018	18:00-19:00	137.99	65.72	0.00	7.98	22.35	76.95	16.90	26.85
27.6.2018	19:00-20:00	125.01	39.45	0.00	7.82	23.50	78.28	18.78	26.12
27.6.2018	20:00-21:00	107.80	58.17	0.00	7.20	11.83	81.05	13.01	24.85
27.6.2018	21:00-22:00	83.54	46.34	0.00	6.12	6.80	82.25	10.44	24.67
27.6.2018	22:00-23:00	88.41	79.02	0.00	5.58	9.82	86.38	3.42	24.00
27.6.2018	23:00-00:00	96.89	86.39	0.01	6.03	12.10	95.08	2.44	23.23
28.6.2018	00:00-01:00	86.30	78.92	0.00	6.54	8.63	97.00	2.42	23.00
28.6.2018	01:00-02:00	88.09	85.54	0.01	6.32	18.43	95.85	3.17	22.85
28.6.2018	02:00-03:00	75.74	83.78	0.00	6.18	17.87	92.13	3.14	22.83
28.6.2018	03:00-04:00	93.14	84.32	0.03	4.98	16.47	95.50	2.76	22.50
28.6.2018	04:00-05:00	122.69	105.51	0.03	5.42	34.20	96.22	1.88	22.92
28.6.2018	05:00-06:00	93.44	72.75	0.01	5.53	13.85	99.23	3.45	22.83
28.6.2018	06:00-07:00	144.67	168.73	0.06	4.20	9.75	99.58	2.35	23.00
28.6.2018	07:00-08:00	171.95	169.86	0.08	2.90	13.95	94.38	11.54	24.55
28.6.2018	08:00-09:00	132.44	205.82	0.10	2.65	4.97	75.23	3.29	28.22

AQ1 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
28.6.2018	09:00-10:00	129.36	224.83	0.23	4.78	10.77	59.80	0.09	32.07
28.6.2018	10:00-11:00	113.86	101.81	0.21	5.20	19.32	62.70	1.54	31.40
28.6.2018	11:00-12:00	42.46	51.80	0.01	5.23	15.43	60.12	3.29	31.85
28.6.2018	12:00-13:00	58.71	3.76	0.04	4.50	2.43	56.93	9.00	33.40

28.6.2018	13:00-14:00	55.56	7.09	0.00	8.23	9.10	57.80	1.85	32.92
28.6.2018	14:00-15:00	69.71	41.99	0.00	43.00	32.87	67.95	0.44	28.90
28.6.2018	15:00-16:00	85.94	53.68	0.00	70.98	40.28	73.00	3.36	27.27
28.6.2018	16:00-17:00	100.48	68.92	0.00	35.48	16.80	73.00	1.25	27.23
28.6.2018	17:00-18:00	125.16	66.38	0.00	2.27	5.47	72.32	2.32	27.23
28.6.2018	18:00-19:00	194.65	38.35	0.00	3.62	3.10	73.67	2.35	27.38
28.6.2018	19:00-20:00	130.30	14.36	0.00	5.32	10.38	76.13	1.88	27.00
28.6.2018	20:00-21:00	126.34	15.71	0.00	5.73	12.50	78.35	4.55	26.47
28.6.2018	21:00-22:00	157.62	44.84	0.00	5.68	9.67	79.43	0.34	26.07
28.6.2018	22:00-23:00	225.45	41.33	0.00	5.73	16.28	79.48	0.97	26.08
28.6.2018	23:00-00:00	78.68	50.11	0.00	6.17	10.32	79.23	0.94	26.03
29.6.2018	00:00-01:00	75.94	47.79	0.00	5.85	8.60	78.30	0.47	26.00
29.6.2018	01:00-02:00	83.99	37.25	0.00	5.47	7.45	78.35	1.41	26.00
29.6.2018	02:00-03:00	97.06	40.76	0.00	4.73	3.13	81.62	1.66	25.73
29.6.2018	03:00-04:00	110.40	44.71	0.00	5.30	9.88	82.48	1.22	25.75
29.6.2018	04:00-05:00	84.63	63.40	0.00	5.38	3.85	82.67	0.50	25.80
29.6.2018	05:00-06:00	112.92	75.32	0.00	4.98	8.83	83.55	1.32	25.82
29.6.2018	06:00-07:00	119.70	43.62	0.03	3.15	3.47	74.87	0.75	28.22
29.6.2018	07:00-08:00	107.12	27.19	0.15	5.00	11.97	64.83	0.72	30.85
29.6.2018	08:00-09:00	77.97	8.51	0.03	3.70	4.78	60.90	1.74	31.63

AQ1 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
29.6.2018	09:00-10:00	0.00	3.76	0.00	3.08	13.92	55.85	12.16	33.08
29.6.2018	10:00-11:00	98.64	5.52	0.00	3.70	1.93	55.23	4.01	33.97
29.6.2018	11:00-12:00	74.16	3.76	0.00	3.42	1.37	52.12	4.11	35.58
29.6.2018	12:00-13:00	102.40	3.76	0.00	3.27	1.37	50.13	2.88	36.62
29.6.2018	13:00-14:00	105.00	3.76	0.00	4.53	7.40	51.65	5.52	35.48
29.6.2018	14:00-15:00	40.39	3.76	0.00	4.35	4.73	50.57	11.88	35.63
29.6.2018	15:00-16:00	12.15	10.25	0.00	7.88	31.25	73.28	9.56	28.40
29.6.2018	16:00-17:00	0.00	4.77	0.00	7.33	16.07	91.33	2.16	24.62
29.6.2018	17:00-18:00	14.13	4.01	0.00	6.20	2.83	89.18	4.52	25.00
29.6.2018	18:00-19:00	0.00	8.59	0.00	5.87	2.57	93.12	12.32	24.00
29.6.2018	19:00-20:00	22.87	13.48	0.05	4.10	10.88	92.72	12.07	24.77
29.6.2018	20:00-21:00	30.78	27.84	0.02	7.28	24.62	94.57	8.91	23.22
29.6.2018	21:00-22:00	33.28	15.02	0.00	6.70	7.20	94.35	8.47	23.28
29.6.2018	22:00-23:00	24.93	20.63	0.05	4.90	11.50	93.23	6.49	24.00
29.6.2018	23:00-00:00	46.31	18.37	0.01	7.93	15.22	93.63	2.45	23.60
30.6.2018	00:00-01:00	34.53	71.93	0.01	11.03	17.27	93.55	1.22	24.10
30.6.2018	01:00-02:00	56.54	91.72	0.00	59.27	28.12	91.08	1.98	25.00
30.6.2018	02:00-03:00	20.04	43.12	0.00	62.25	29.22	90.67	18.41	25.00
30.6.2018	03:00-04:00	25.62	4.86	0.00	63.83	26.75	90.33	7.24	25.13
30.6.2018	04:00-05:00	20.00	71.93	0.00	67.65	27.25	88.23	4.39	26.00

30.6.2018	05:00-06:00	19.93	57.10	0.00	67.57	28.23	86.03	5.86	26.70
30.6.2018	06:00-07:00	18.28	52.15	0.00	75.15	38.85	84.47	4.26	27.00
30.6.2018	07:00-08:00	51.07	85.16	0.04	66.75	28.88	79.52	4.73	27.65
30.6.2018	08:00-09:00	44.14	22.39	0.07	44.63	21.33	71.60	8.65	28.85

AQ2 (first day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
27.6.2018	09:00-10:00	63.34	36.18	5.80	43.44	10.13	77.56	3.29	25.00
27.6.2018	10:00-11:00	43.33	38.33	1.81	3.78	14.87	87.00	1.38	24.78
27.6.2018	11:00-12:00	18.80	7.48	5.35	6.50	1.00	83.17	0.06	25.52
27.6.2018	12:00-13:00	13.84	4.68	10.63	5.05	5.07	82.03	0.03	26.00
27.6.2018	13:00-14:00	12.02	9.10	3.15	9.73	31.85	85.52	0.00	25.87
27.6.2018	14:00-15:00	10.59	8.83	7.14	11.52	35.12	89.53	0.00	25.52
27.6.2018	15:00-16:00	13.46	10.87	11.16	8.40	55.47	86.13	3.42	26.17
27.6.2018	16:00-17:00	24.72	1.40	49.64	2.78	1.95	75.97	35.68	27.22
27.6.2018	17:00-18:00	24.14	1.16	24.23	10.23	7.88	75.85	4.17	27.02
27.6.2018	18:00-19:00	60.31	8.42	8.94	27.62	55.20	79.53	0.16	26.07
27.6.2018	19:00-20:00	21.00	1.83	1.64	10.07	27.08	82.80	0.13	25.52
27.6.2018	20:00-21:00	41.90	5.53	3.93	9.10	17.95	87.15	0.00	24.00
27.6.2018	21:00-22:00	30.92	11.34	5.36	15.53	23.92	91.58	0.75	24.00
27.6.2018	22:00-23:00	8.49	12.57	0.00	27.20	21.48	94.48	5.93	24.00
27.6.2018	23:00-00:00	69.00	5.85	7.21	4.05	2.65	90.47	0.94	24.90
28.6.2018	00:00-01:00	48.67	2.97	3.42	2.10	1.03	75.07	0.53	26.27
28.6.2018	01:00-02:00	58.69	3.75	20.20	4.53	2.83	74.73	0.16	26.00
28.6.2018	02:00-03:00	39.80	2.76	0.91	6.15	16.33	75.68	2.63	26.00
28.6.2018	03:00-04:00	50.20	3.34	0.58	11.50	32.57	77.95	3.70	25.52
28.6.2018	04:00-05:00	67.85	5.12	0.59	12.37	29.57	80.78	0.00	25.00
28.6.2018	05:00-06:00	63.75	6.02	1.11	8.10	5.43	81.57	0.00	25.00
28.6.2018	06:00-07:00	89.42	3.93	12.68	9.65	2.15	77.75	1.07	25.47
28.6.2018	07:00-08:00	103.54	1.15	48.90	4.42	1.20	71.22	23.33	27.28
28.6.2018	08:00-09:00	33.97	1.15	50.17	2.03	1.03	66.32	24.11	29.45

AQ2 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
28.6.2018	09:00-10:00	41.80	3.76	26.01	12.40	10.47	64.78	26.46	30.10
28.6.2018	10:00-11:00	86.65	4.26	42.26	9.25	8.20	60.15	17.81	32.43
28.6.2018	11:00-12:00	46.00	7.00	37.33	13.05	10.32	57.95	9.12	33.57
28.6.2018	12:00-13:00	37.22	1.18	34.90	5.03	6.78	57.15	4.30	34.10
28.6.2018	13:00-14:00	53.92	2.14	28.78	5.30	4.77	57.52	5.24	33.62
28.6.2018	14:00-15:00	92.57	13.45	11.31	36.88	41.43	63.73	7.37	31.32
28.6.2018	15:00-16:00	71.29	21.10	0.86	23.22	18.83	67.63	7.43	30.32

28.6.2018	16:00-17:00	79.02	8.29	4.78	40.33	42.58	69.28	4.23	29.68
28.6.2018	17:00-18:00	66.80	19.31	0.58	37.60	40.57	70.30	8.43	29.00
28.6.2018	18:00-19:00	19.09	10.13	0.57	26.28	24.65	75.13	1.63	27.07
28.6.2018	19:00-20:00	37.89	7.04	1.85	18.47	33.58	79.12	0.44	25.75
28.6.2018	20:00-21:00	66.61	4.96	0.61	9.10	42.67	84.27	3.07	25.00
28.6.2018	21:00-22:00	62.13	4.80	0.88	9.27	39.18	88.88	0.22	25.00
28.6.2018	22:00-23:00	50.39	3.01	14.53	10.78	2.37	88.62	2.48	25.00
28.6.2018	23:00-00:00	4.29	2.52	53.74	7.43	1.87	87.27	0.00	25.00
29.6.2018	00:00-01:00	15.84	1.15	21.18	3.23	1.00	86.47	1.72	25.00
29.6.2018	01:00-02:00	19.09	2.14	17.41	4.18	2.98	85.67	2.51	25.00
29.6.2018	02:00-03:00	21.95	3.00	12.42	2.78	14.58	89.13	0.06	25.00
29.6.2018	03:00-04:00	18.45	22.81	0.25	10.67	14.47	93.37	4.92	24.70
29.6.2018	04:00-05:00	12.98	20.91	0.00	10.08	12.62	88.07	17.47	25.47
29.6.2018	05:00-06:00	24.51	12.85	0.00	10.80	18.08	77.98	16.96	27.37
29.6.2018	06:00-07:00	188.58	19.40	0.00	25.22	34.22	63.48	24.43	29.47
29.6.2018	07:00-08:00	210.05	26.80	0.00	23.48	29.02	61.55	18.75	30.25
29.6.2018	08:00-09:00	17.26	33.08	0.00	13.35	13.72	58.25	23.11	31.58

AQ2 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
29.6.2018	09:00-10:00	24.38	1.15	37.63	15.87	29.16	62.32	57.59	31.19
29.6.2018	10:00-11:00	33.69	1.15	82.22	7.37	29.80	67.25	54.65	31.12
29.6.2018	11:00-12:00	8.78	1.15	67.89	2.08	1.08	64.97	58.82	32.32
29.6.2018	12:00-13:00	0.86	1.15	18.58	23.70	16.62	64.98	23.86	32.08
29.6.2018	13:00-14:00	31.87	1.96	0.91	18.60	15.13	64.93	0.69	31.90
29.6.2018	14:00-15:00	12.88	2.18	10.86	21.37	16.80	63.40	9.44	31.85
29.6.2018	15:00-16:00	34.93	28.66	1.92	39.90	79.38	82.95	1.54	25.88
29.6.2018	16:00-17:00	181.56	34.98	0.57	2.00	56.48	88.81	0.00	24.02
29.6.2018	17:00-18:00	5.85	21.23	1.58	47.94	45.30	53.64	0.00	24.09
29.6.2018	18:00-19:00	28.15	13.60	1.76	17.65	14.30	68.27	0.00	24.00
29.6.2018	19:00-20:00	306.05	5.32	8.34	23.70	23.48	72.45	47.88	24.00
29.6.2018	20:00-21:00	4.10	4.28	10.62	20.88	8.70	70.42	0.28	23.15
29.6.2018	21:00-22:00	19.47	8.03	8.68	4.55	3.20	70.90	0.00	23.00
29.6.2018	22:00-23:00	49.15	9.25	19.74	6.88	5.07	72.53	0.00	23.00
29.6.2018	23:00-00:00	131.79	4.77	38.88	7.92	6.22	76.03	2.19	23.00
30.6.2018	00:00-01:00	57.45	1.24	53.75	7.32	5.52	78.07	4.42	23.22
30.6.2018	01:00-02:00	32.64	1.44	46.18	8.18	31.93	85.78	56.13	24.00
30.6.2018	02:00-03:00	33.59	2.88	42.82	10.40	30.97	88.57	54.65	24.00
30.6.2018	03:00-04:00	11.07	1.49	36.50	11.17	31.80	86.13	61.99	24.98
30.6.2018	04:00-05:00	27.48	1.15	41.93	16.35	28.25	89.80	44.53	25.70
30.6.2018	05:00-06:00	25.00	1.58	44.34	9.90	29.95	90.92	53.02	26.00
30.6.2018	06:00-07:00	24.14	1.15	33.75	10.87	29.35	86.08	58.67	26.40
30.6.2018	07:00-08:00	73.20	1.15	39.98	24.85	22.57	88.95	60.14	27.47
30.6.2018	08:00-09:00	70.14	1.39	42.32	23.48	31.38	89.68	40.32	38.78

AQ3 (first day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
27.6.2018	10:00-11:00	29.00	35.37	0.00	20.05	25.00	85.00	2.16	25.70
27.6.2018	11:00-12:00	103.51	39.76	0.00	31.17	32.30	84.72	6.15	25.57
27.6.2018	12:00-13:00	76.11	51.51	0.00	23.05	28.38	80.05	5.29	26.24
27.6.2018	13:00-14:00	56.24	11.70	0.00	27.55	36.97	72.70	4.89	28.57
27.6.2018	14:00-15:00	89.18	3.76	0.16	14.90	17.93	69.95	11.79	28.78
27.6.2018	15:00-16:00	23.81	4.83	0.33	19.05	23.02	76.95	4.58	28.32
27.6.2018	16:00-17:00	0.00	3.76	0.04	19.25	15.08	72.67	24.58	29.18
27.6.2018	17:00-18:00	54.22	19.32	0.10	25.97	26.50	73.15	6.71	28.03
27.6.2018	18:00-19:00	105.19	112.79	0.04	22.50	16.38	76.02	2.38	28.25
27.6.2018	19:00-20:00	185.70	86.01	0.00	19.95	14.72	72.30	4.61	28.57
27.6.2018	20:00-21:00	130.43	20.13	0.00	26.22	29.80	83.13	4.86	25.87
27.6.2018	21:00-22:00	188.81	144.29	0.00	10.77	10.15	93.10	2.46	24.38
27.6.2018	22:00-23:00	312.97	120.57	0.00	17.67	29.07	93.43	3.14	25.00
27.6.2018	23:00-00:00	256.62	88.36	0.00	32.27	50.10	92.65	17.34	25.00
28.6.2018	00:00-01:00	265.11	84.10	0.00	29.33	46.37	91.68	24.43	25.00
28.6.2018	01:00-02:00	193.51	76.07	0.00	37.62	44.77	91.63	14.96	25.00
28.6.2018	02:00-03:00	170.08	67.82	0.00	40.10	42.12	90.77	24.55	25.00
28.6.2018	03:00-04:00	47.62	37.22	0.00	30.42	33.22	90.28	1.98	25.00
28.6.2018	04:00-05:00	20.30	30.35	0.00	25.17	24.35	90.00	2.01	25.00
28.6.2018	05:00-06:00	72.32	26.40	0.02	22.52	25.58	89.78	17.94	25.50
28.6.2018	06:00-07:00	74.89	51.39	0.02	21.82	22.62	89.67	7.34	25.87
28.6.2018	07:00-08:00	100.62	56.57	0.02	25.07	28.88	89.17	3.17	26.00
28.6.2018	08:00-09:00	219.18	52.71	0.04	43.27	40.83	89.12	18.88	26.00
28.6.2018	09:00-10:00	274.09	50.39	0.03	44.53	43.85	88.83	24.83	26.00

AQ3 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
28.6.2018	10:00-11:00	294.95	65.70	0.00	45.92	54.84	85.73	41.39	27.14
28.6.2018	11:00-12:00	190.58	29.88	0.01	43.22	44.42	71.25	10.16	29.50
28.6.2018	12:00-13:00	105.99	4.45	0.02	38.77	37.85	68.07	25.52	30.00
28.6.2018	13:00-14:00	131.02	6.68	0.02	38.47	31.78	66.45	18.25	30.33
28.6.2018	14:00-15:00	96.61	3.76	0.01	24.82	18.15	67.98	8.09	30.08
28.6.2018	15:00-16:00	86.50	3.83	0.18	23.92	27.53	68.85	4.70	29.65
28.6.2018	16:00-17:00	60.93	3.76	0.29	21.12	21.62	65.60	12.01	30.65
28.6.2018	17:00-18:00	170.78	15.80	0.05	21.93	22.75	73.23	17.31	28.40
28.6.2018	18:00-19:00	312.82	85.76	0.00	20.02	15.52	76.63	4.23	27.17
28.6.2018	19:00-20:00	317.03	89.90	0.00	24.87	18.32	77.02	2.51	26.00
28.6.2018	20:00-21:00	294.54	99.84	0.00	33.50	18.77	80.17	1.98	26.00
28.6.2018	21:00-22:00	159.41	85.89	0.00	28.03	20.97	81.47	5.68	26.00

28.6.2018	22:00-23:00	143.42	70.27	0.00	31.32	30.08	80.75	6.24	26.00
28.6.2018	23:00-00:00	67.79	31.04	0.00	17.27	22.08	81.23	8.50	26.00
29.6.2018	00:00-01:00	12.51	28.47	0.00	18.05	22.17	84.25	6.02	25.25
29.6.2018	01:00-02:00	47.46	41.08	0.00	15.73	15.12	84.33	6.90	25.33
29.6.2018	02:00-03:00	87.04	71.78	0.01	14.68	12.27	82.72	3.20	25.98
29.6.2018	03:00-04:00	34.76	54.12	0.00	15.42	16.53	82.60	3.29	25.40
29.6.2018	04:00-05:00	120.25	41.99	0.00	26.18	25.13	81.30	24.21	26.00
29.6.2018	05:00-06:00	270.41	74.57	0.03	55.78	62.98	82.65	11.48	26.00
29.6.2018	06:00-07:00	183.81	41.83	0.00	31.62	48.48	80.03	5.86	26.48
29.6.2018	07:00-08:00	202.01	12.79	0.00	33.20	48.02	73.28	21.89	27.78
29.6.2018	08:00-09:00	101.03	5.61	0.02	29.22	33.87	66.27	13.95	29.72
29.6.2018	09:00-10:00	113.80	3.76	0.35	22.63	28.07	66.13	18.50	30.52

AQ3 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
29.6.2018	10:00-11:00	155.78	13.55	1.15	18.47	17.85	64.42	13.01	31.33
29.6.2018	11:00-12:00	120.27	3.98	0.03	21.18	20.82	61.05	22.89	33.53
29.6.2018	12:00-13:00	170.82	6.21	0.33	17.25	20.12	58.73	22.29	35.03
29.6.2018	13:00-14:00	165.56	10.32	0.21	12.78	19.33	57.80	25.05	35.12
29.6.2018	14:00-15:00	186.13	24.43	0.02	14.25	21.25	53.75	22.45	36.37
29.6.2018	15:00-16:00	320.96	296.57	0.05	18.60	16.88	67.30	1.91	30.25
29.6.2018	16:00-17:00	314.96	114.36	0.00	9.36	13.05	80.57	2.08	26.45
29.6.2018	17:00-18:00	365.72	121.18	0.00	21.43	19.66	89.00	5.05	24.93
29.6.2018	18:00-19:00	500.91	42.21	0.00	19.42	17.20	88.08	14.20	25.00
29.6.2018	19:00-20:00	327.70	23.71	0.00	30.02	36.77	85.55	23.45	25.23
29.6.2018	20:00-21:00	128.44	77.61	0.00	8.93	7.20	89.60	14.86	24.25
29.6.2018	21:00-22:00	124.16	46.19	0.00	15.38	17.42	89.95	1.88	24.00
29.6.2018	22:00-23:00	85.39	13.11	0.00	20.50	20.73	89.68	5.49	24.00
29.6.2018	23:00-00:00	130.45	9.19	0.00	17.60	21.35	89.97	25.18	24.00
30.6.2018	00:00-01:00	206.68	95.70	0.07	17.02	18.17	86.77	1.91	25.05
30.6.2018	01:00-02:00	316.46	103.82	0.00	15.22	18.27	84.13	4.52	26.00
30.6.2018	02:00-03:00	214.99	68.23	0.00	25.17	31.03	82.02	2.88	26.00
30.6.2018	03:00-04:00	175.79	72.18	0.00	30.27	27.05	82.20	5.24	26.00
30.6.2018	04:00-05:00	197.59	78.39	0.00	23.87	23.90	81.32	10.28	26.00
30.6.2018	05:00-06:00	144.18	57.19	0.00	22.63	24.57	81.93	7.71	26.00
30.6.2018	06:00-07:00	113.99	49.67	0.00	22.68	21.80	81.93	2.07	26.00
30.6.2018	07:00-08:00	77.12	47.94	0.03	18.83	18.47	75.43	13.86	27.00
30.6.2018	08:00-09:00	158.08	45.25	0.00	29.18	32.03	75.68	18.03	27.32
30.6.2018	09:00-10:00	124.22	3.76	0.02	28.17	26.52	70.10	12.73	29.18

AQ4 (first day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
6.7.2018	14:00-15:00	29.33	207.70	0.00	1.15	2.55	100.00	1.88	23.00
6.7.2018	15:00-16:00	126.47	33.68	0.00	2.00	4.33	100.00	2.79	23.80
6.7.2018	16:00-17:00	145.40	26.37	0.00	2.00	12.43	100.00	21.01	24.00
6.7.2018	17:00-18:00	136.82	22.65	0.00	2.02	4.43	95.15	16.12	24.00
6.7.2018	18:00-19:00	151.52	17.91	0.00	2.00	6.27	95.35	3.10	24.00
6.7.2018	19:00-20:00	181.44	15.59	0.00	2.02	8.05	96.02	4.14	24.00
6.7.2018	20:00-21:00	124.85	10.24	0.00	2.02	5.82	97.28	8.94	23.72
6.7.2018	21:00-22:00	78.22	14.57	0.00	1.90	6.97	100.00	6.74	22.00
6.7.2018	22:00-23:00	95.48	18.23	0.00	2.57	9.30	100.00	1.94	22.07
6.7.2018	23:00-00:00	90.13	20.48	0.00	2.02	9.78	100.00	8.00	22.00
7.7.2018	00:00-01:00	73.01	20.39	0.00	2.02	10.60	100.00	9.22	22.05
7.7.2018	01:00-02:00	79.40	21.20	0.00	2.03	4.98	100.00	4.55	22.17
7.7.2018	02:00-03:00	81.82	19.26	0.00	2.00	4.68	100.00	3.73	22.87
7.7.2018	03:00-04:00	71.83	16.63	0.00	2.00	11.07	100.00	3.92	22.85
7.7.2018	04:00-05:00	160.90	21.40	0.00	2.02	3.57	100.00	10.41	22.38
7.7.2018	05:00-06:00	178.86	23.94	0.00	2.00	7.83	100.00	2.85	22.98
7.7.2018	06:00-07:00	191.62	22.57	0.00	2.04	8.88	100.00	5.14	23.00
7.7.2018	07:00-08:00	391.42	18.22	0.03	2.00	4.00	99.96	19.23	23.67
7.7.2018	08:00-09:00	261.57	16.68	0.03	2.02	5.82	96.47	10.19	24.00
7.7.2018	09:00-10:00	178.44	16.11	0.00	2.02	8.42	90.97	8.94	24.00
7.7.2018	10:00-11:00	345.93	17.59	0.00	2.00	6.15	96.47	26.87	23.67
7.7.2018	11:00-12:00	177.78	19.37	0.00	2.47	3.83	94.88	12.70	24.00
7.7.2018	12:00-13:00	172.87	18.28	0.01	3.33	4.17	84.13	3.36	25.87
7.7.2018	13:00-14:00	206.80	17.09	0.00	1.70	5.88	87.82	3.14	26.00

AQ4 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
7.7.2018	14:00-15:00	74.59	14.84	0.00	3.83	9.52	90.17	1.88	25.58
7.7.2018	15:00-16:00	198.65	15.16	0.00	2.57	5.07	100.00	9.19	22.00
7.7.2018	16:00-17:00	212.15	18.60	0.00	1.63	7.33	95.97	27.37	23.10
7.7.2018	17:00-18:00	123.88	9.90	0.00	1.37	7.92	87.70	4.14	25.00
7.7.2018	18:00-19:00	131.87	10.15	0.00	2.00	11.47	89.10	16.46	25.00
7.7.2018	19:00-20:00	148.64	15.05	0.00	2.00	4.22	92.78	19.47	24.42
7.7.2018	20:00-21:00	129.50	20.39	0.00	2.00	7.73	96.43	1.88	23.00
7.7.2018	21:00-22:00	52.70	17.26	0.00	2.00	3.70	96.53	2.13	23.00
7.7.2018	22:00-23:00	142.26	14.97	0.00	2.00	13.28	98.53	15.05	22.63
7.7.2018	23:00-00:00	95.85	20.55	0.00	2.02	13.72	100.00	2.51	23.00
8.7.2018	00:00-01:00	57.76	17.02	0.00	2.00	6.20	100.00	5.08	22.97

8.7.2018	01:00-02:00	48.85	12.65	0.00	2.05	9.67	100.00	12.10	22.42
8.7.2018	02:00-03:00	63.75	15.45	0.00	2.00	11.50	100.00	7.49	22.00
8.7.2018	03:00-04:00	76.15	14.05	0.00	2.00	10.75	100.00	6.21	22.00
8.7.2018	04:00-05:00	87.52	13.55	0.00	2.00	7.30	100.00	8.40	22.00
8.7.2018	05:00-06:00	180.11	15.09	0.00	2.02	3.88	100.00	7.75	22.00
8.7.2018	06:00-07:00	189.94	20.62	0.00	2.02	6.27	100.00	6.84	22.13
8.7.2018	07:00-08:00	194.28	20.05	0.00	2.02	10.33	99.97	21.07	23.00
8.7.2018	08:00-09:00	120.28	29.31	0.04	2.60	3.68	96.50	7.81	23.97
8.7.2018	09:00-10:00	99.82	15.07	0.10	2.88	9.00	87.77	15.80	25.63
8.7.2018	10:00-11:00	132.77	5.31	0.08	2.00	5.27	85.72	30.16	26.00
8.7.2018	11:00-12:00	66.36	2.72	0.00	2.33	4.22	82.97	30.45	26.12
8.7.2018	12:00-13:00	88.82	4.00	0.05	2.10	10.50	81.03	21.10	26.98
8.7.2018	13:00-14:00	97.26	2.04	0.03	1.57	13.48	79.17	17.47	27.50

AQ4 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
8.7.2018	14:00-15:00	119.89	2.62	0.00	1.92	11.93	79.20	6.77	27.08
8.7.2018	15:00-16:00	98.18	2.81	0.00	2.00	11.75	79.27	7.96	26.97
8.7.2018	16:00-17:00	88.40	8.12	0.00	2.00	9.87	80.02	2.35	26.33
8.7.2018	17:00-18:00	103.96	15.23	0.00	2.00	5.92	82.07	1.91	26.00
8.7.2018	18:00-19:00	243.86	16.40	0.00	1.92	4.73	86.45	10.82	25.40
8.7.2018	19:00-20:00	200.88	12.99	0.00	2.45	8.57	87.15	13.55	25.12
8.7.2018	20:00-21:00	131.68	17.22	0.00	2.02	12.37	90.87	5.11	24.72
8.7.2018	21:00-22:00	159.81	19.60	0.00	2.12	12.35	94.75	3.39	24.00
8.7.2018	22:00-23:00	166.17	19.04	0.00	2.35	8.53	95.60	3.57	24.05
8.7.2018	23:00-00:00	50.07	16.97	0.00	2.02	2.92	93.65	3.76	24.83
9.7.2018	00:00-01:00	68.59	15.78	0.00	2.03	4.08	92.55	10.25	24.23
9.7.2018	01:00-02:00	75.33	13.25	0.00	2.03	7.63	93.22	3.45	24.08
9.7.2018	02:00-03:00	87.12	16.30	0.00	2.02	3.15	94.78	2.54	24.00
9.7.2018	03:00-04:00	87.00	15.82	0.02	2.03	8.08	95.88	3.42	24.00
9.7.2018	04:00-05:00	110.48	16.34	0.00	1.88	10.65	98.63	4.11	23.98
9.7.2018	05:00-06:00	126.13	20.90	0.00	2.85	11.15	99.83	2.41	24.00
9.7.2018	06:00-07:00	263.05	15.05	0.00	2.53	8.88	99.93	16.68	23.07
9.7.2018	07:00-08:00	108.55	9.35	0.00	2.65	9.08	99.77	11.79	23.50
9.7.2018	08:00-09:00	121.80	9.96	0.00	2.80	5.92	97.72	24.18	23.90
9.7.2018	09:00-10:00	56.42	19.61	0.00	2.75	4.73	100.00	9.19	22.00
9.7.2018	10:00-11:00	200.17	10.76	0.00	2.00	10.07	100.00	6.77	22.00
9.7.2018	11:00-12:00	178.54	13.97	0.00	2.40	4.58	100.00	3.70	22.00
9.7.2018	12:00-13:00	239.15	16.23	0.00	2.18	8.05	100.00	32.86	22.00
9.7.2018	13:00-14:00	267.50	14.61	0.00	2.08	8.88	100.00	16.24	22.53

AQ5 (first day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
30.6.2018	12:00-13:00	143.38	68.75	0.00	2.09	10.35	58.63	35.70	33.19
30.6.2018	13:00-14:00	13.33	1.15	0.00	1.17	7.35	57.88	95.76	33.08
30.6.2018	14:00-15:00	44.86	1.63	0.00	1.88	5.40	83.07	35.43	26.53
30.6.2018	15:00-16:00	331.98	20.28	0.00	2.87	7.08	96.27	21.64	25.63
30.6.2018	16:00-17:00	223.54	4.59	0.00	2.87	9.60	80.55	22.95	27.97
30.6.2018	17:00-18:00	198.50	1.71	0.00	2.13	8.78	78.40	34.90	27.68
30.6.2018	18:00-19:00	77.10	14.10	0.00	1.82	11.83	94.05	5.27	24.60
30.6.2018	19:00-20:00	158.87	22.01	0.00	2.50	10.30	96.85	3.23	24.00
30.6.2018	20:00-21:00	145.28	15.21	0.00	2.87	5.08	96.68	4.04	24.00
30.6.2018	21:00-22:00	83.20	13.55	0.00	2.07	5.58	97.60	2.19	23.98
30.6.2018	22:00-23:00	89.07	17.64	0.00	2.02	13.05	98.17	1.88	23.97
30.6.2018	23:00-00:00	85.37	17.45	0.00	2.08	11.12	99.72	10.25	24.00
1.7.2018	00:00-01:00	70.08	11.67	0.00	2.03	4.85	99.33	4.14	24.00
1.7.2018	01:00-02:00	114.56	14.70	0.00	2.20	3.78	100.00	8.59	23.03
1.7.2018	02:00-03:00	92.13	19.11	0.00	2.02	5.55	100.00	17.03	23.17
1.7.2018	03:00-04:00	84.94	19.01	0.00	2.15	5.13	100.00	18.12	23.00
1.7.2018	04:00-05:00	246.13	15.02	0.00	2.37	7.65	100.00	42.64	23.00
1.7.2018	05:00-06:00	280.88	14.03	0.00	2.07	8.08	100.00	27.56	23.00
1.7.2018	06:00-07:00	137.84	15.05	0.00	2.53	4.38	99.15	8.84	23.90
1.7.2018	07:00-08:00	81.52	9.41	0.05	2.85	8.70	90.32	24.21	25.77
1.7.2018	08:00-09:00	71.20	1.92	0.10	3.65	10.43	76.55	31.73	28.58
1.7.2018	09:00-10:00	60.31	1.15	0.25	2.50	10.77	68.38	40.17	31.03
1.7.2018	10:00-11:00	63.47	1.29	0.46	1.57	4.20	65.77	36.47	32.23
1.7.2018	11:00-12:00	66.80	4.76	0.04	2.08	4.05	62.22	16.40	33.07

AQ5 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
1.7.2018	12:00-13:00	193.90	12.02	0.00	2.15	9.57	86.07	12.17	26.37
1.7.2018	13:00-14:00	78.71	12.61	0.00	2.00	4.60	100.00	4.77	23.00
1.7.2018	14:00-15:00	164.25	13.99	0.00	2.02	4.17	100.00	11.76	22.77
1.7.2018	15:00-16:00	151.33	11.60	0.00	2.00	6.68	100.00	2.51	23.00
1.7.2018	16:00-17:00	118.88	20.38	0.00	1.65	5.82	92.23	11.85	24.57
1.7.2018	17:00-18:00	101.25	20.59	0.00	1.38	2.50	91.42	4.58	24.73
1.7.2018	18:00-19:00	114.51	25.91	0.00	2.02	10.48	100.00	2.54	23.00
1.7.2018	19:00-20:00	229.17	25.26	0.00	2.00	5.15	100.00	2.54	23.23
1.7.2018	20:00-21:00	176.41	20.78	0.00	2.02	6.53	100.00	9.44	23.72
1.7.2018	21:00-22:00	226.82	19.22	0.00	2.02	6.42	100.00	16.74	23.52
1.7.2018	22:00-23:00	133.13	16.95	0.00	2.00	5.57	100.00	14.17	23.08
1.7.2018	23:00-00:00	141.70	17.84	0.00	2.03	4.75	100.00	16.24	23.00

2.7.2018	00:00-01:00	108.49	17.24	0.00	2.00	6.53	100.00	8.40	23.00
2.7.2018	01:00-02:00	84.25	16.49	0.00	2.00	10.28	100.00	2.19	23.00
2.7.2018	02:00-03:00	89.08	16.47	0.00	2.05	8.23	100.00	5.49	23.08
2.7.2018	03:00-04:00	93.22	18.08	0.00	2.18	5.55	100.00	8.53	23.63
2.7.2018	04:00-05:00	123.64	18.61	0.00	2.00	4.30	100.00	16.46	24.00
2.7.2018	05:00-06:00	129.38	17.50	0.00	2.28	9.08	100.00	11.95	24.00
2.7.2018	06:00-07:00	314.51	16.98	0.00	2.13	4.98	100.00	38.38	24.00
2.7.2018	07:00-08:00	144.74	13.88	0.00	2.80	3.50	97.67	9.25	25.08
2.7.2018	08:00-09:00	97.48	5.46	0.04	2.68	9.82	88.93	29.73	26.75
2.7.2018	09:00-10:00	91.55	3.75	0.09	2.72	7.30	82.37	19.32	28.42
2.7.2018	10:00-11:00	73.03	1.42	0.18	2.40	9.92	75.60	17.21	30.00
2.7.2018	11:00-12:00	68.53	1.92	0.07	1.97	5.52	72.77	11.70	30.38

AQ5 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
2.7.2018	12:00-13:00	54.29	1.80	0.00	1.63	6.82	64.45	13.80	32.38
2.7.2019	13:00-14:00	64.56	1.27	0.21	1.58	11.40	63.60	30.92	32.63
2.7.2020	14:00-15:00	61.04	2.52	0.00	2.13	10.38	63.80	8.65	32.53
2.7.2021	15:00-16:00	74.63	10.97	0.00	2.38	10.67	78.98	2.79	27.27
2.7.2022	16:00-17:00	95.75	17.67	0.00	2.47	8.85	84.37	2.73	25.53
2.7.2023	17:00-18:00	138.79	22.21	0.00	2.43	12.20	89.97	2.38	23.90
2.7.2024	18:00-19:00	185.21	25.42	0.00	2.45	9.90	94.30	3.07	23.88
2.7.2025	19:00-20:00	126.40	19.97	0.00	2.28	9.25	95.23	2.23	24.00
2.7.2026	20:00-21:00	89.37	17.01	0.01	2.03	9.77	94.33	1.98	24.00
2.7.2027	21:00-22:00	113.12	17.87	0.00	2.02	11.62	95.25	4.42	24.00
2.7.2028	22:00-23:00	86.99	18.49	0.00	2.05	8.45	96.12	3.48	24.00
2.7.2029	23:00-00:00	85.73	20.31	0.00	2.00	4.28	96.83	1.91	24.00
2.7.2030	00:00-01:00	90.04	19.62	0.00	2.02	5.30	99.28	3.04	24.00
3.7.2030	01:00-02:00	81.40	17.52	0.00	2.00	5.07	100.00	5.93	23.60
3.7.2030	02:00-03:00	134.02	23.66	0.00	2.02	10.05	100.00	24.36	23.57
3.7.2030	03:00-04:00	84.97	16.39	0.00	2.05	10.23	100.00	31.04	23.10
3.7.2030	04:00-05:00	272.96	19.53	0.00	2.02	11.55	100.00	29.16	23.00
3.7.2030	05:00-06:00	211.49	16.74	0.00	2.00	9.38	100.00	10.91	23.57
3.7.2030	06:00-07:00	282.27	18.56	0.03	2.37	5.97	99.00	8.09	24.28
3.7.2030	07:00-08:00	192.90	12.53	0.04	2.93	3.85	93.52	13.77	25.58
3.7.2030	08:00-09:00	68.82	4.37	0.08	3.47	4.35	81.13	20.44	28.88
3.7.2030	09:00-10:00	94.97	2.59	0.19	2.17	4.38	74.47	50.52	30.60
3.7.2030	10:00-11:00	70.05	1.55	0.11	1.18	11.92	66.47	22.67	32.65
3.7.2030	11:00-12:00	195.38	12.28	0.00	2.03	6.28	100.00	35.50	22.72

AQ6 (First day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
30.6.2018	12:00-13:00	44.95	2.65	4.98	2.17	13.15	83.78	2.95	26.55
30.6.2018	13:00-14:00	54.87	1.45	21.19	2.28	1.17	77.98	13.11	27.80
30.6.2018	14:00-15:00	32.54	1.99	25.40	14.20	40.35	77.35	11.54	28.13
30.6.2018	15:00-16:00	32.07	12.83	1.24	26.67	53.50	88.08	0.38	25.35
30.6.2018	16:00-17:00	53.63	9.30	0.75	5.20	67.43	90.17	0.00	25.00
30.6.2018	17:00-18:00	7.25	1.83	2.32	2.15	1.00	87.00	0.00	25.85
30.6.2018	18:00-19:00	40.56	3.01	1.91	4.00	1.27	87.22	0.19	25.75
30.6.2018	19:00-20:00	13.17	5.64	1.12	7.72	12.05	88.58	0.00	25.00
30.6.2018	20:00-21:00	23.29	5.90	1.00	5.87	13.68	89.67	0.00	25.00
30.6.2018	21:00-22:00	12.98	5.54	0.69	4.67	5.63	92.20	0.00	25.00
30.6.2018	22:00-23:00	20.52	7.10	0.57	7.33	29.45	94.17	0.00	25.00
30.6.2018	23:00-00:00	16.89	6.24	0.65	3.07	1.50	95.47	0.00	25.00
1.7.2018	00:00-01:00	23.38	7.64	1.07	2.37	1.22	96.40	0.00	25.00
1.7.2018	01:00-02:00	19.95	6.79	2.65	3.32	1.63	97.45	0.00	25.00
1.7.2018	02:00-03:00	36.26	2.09	1.17	7.17	4.53	97.97	0.53	25.00
1.7.2018	03:00-04:00	78.83	2.33	1.84	7.40	5.17	98.50	6.55	25.00
1.7.2018	04:00-05:00	143.15	2.73	5.15	5.73	2.35	99.60	15.33	25.08
1.7.2018	05:00-06:00	62.13	1.15	14.64	3.00	1.07	92.88	12.82	26.38
1.7.2018	06:00-07:00	22.33	1.30	23.69	3.30	2.35	86.75	9.66	27.15
1.7.2018	07:00-08:00	13.07	1.15	25.38	2.32	1.23	82.00	5.36	28.17
1.7.2018	08:00-09:00	16.61	1.15	34.91	2.03	1.02	76.60	10.88	29.47
1.7.2018	09:00-10:00	21.85	1.15	43.36	2.25	1.10	69.78	27.12	31.33
1.7.2018	10:00-11:00	13.84	1.15	45.36	2.17	1.17	62.72	39.38	34.33
1.7.2018	11:00-12:00	10.21	1.15	87.43	2.15	1.13	62.50	58.57	34.58

AQ6 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
1.7.2018	12:00-13:00	25.67	19.93	19.17	47.27	43.75	75.02	12.92	28.22
1.7.2018	13:00-14:00	58.79	32.29	1.23	29.75	29.50	78.23	0.44	26.73
1.7.2018	14:00-15:00	32.26	2.58	0.57	17.92	11.43	78.07	0.00	25.80
1.7.2018	15:00-16:00	123.59	12.30	0.57	4.02	61.05	85.77	16.49	24.92
1.7.2018	16:00-17:00	48.96	2.92	0.69	4.00	13.37	85.53	16.24	25.00
1.7.2018	17:00-18:00	23.19	3.16	0.68	4.65	1.17	86.55	1.35	25.00
1.7.2018	18:00-19:00	38.65	1.92	1.58	4.75	1.83	85.13	1.94	25.07
1.7.2018	19:00-20:00	21.87	1.57	2.00	3.74	1.57	87.59	0.93	25.00
1.7.2018	20:00-21:00	19.99	2.49	2.08	7.12	3.31	87.90	0.10	25.00
1.7.2018	21:00-22:00	18.70	1.99	3.37	4.07	1.45	90.03	0.00	25.23
1.7.2018	22:00-23:00	12.12	1.70	0.59	8.25	6.30	91.98	0.00	25.25
1.7.2018	23:00-00:00	25.10	1.36	0.75	8.40	11.98	93.47	0.00	25.00

2.7.2018	00:00-01:00	16.41	2.11	0.57	9.90	14.98	94.85	0.00	25.00
2.7.2018	01:00-02:00	17.56	1.91	0.66	8.50	8.42	94.40	0.00	25.00
2.7.2018	02:00-03:00	51.53	1.56	0.58	7.65	19.82	97.07	2.98	25.00
2.7.2018	03:00-04:00	89.23	1.78	0.94	12.60	28.53	97.98	4.92	25.00
2.7.2018	04:00-05:00	107.17	1.15	3.88	10.82	4.60	97.22	15.15	25.08
2.7.2018	05:00-06:00	5.54	1.15	10.95	6.88	1.42	92.12	2.79	26.27
2.7.2018	06:00-07:00	9.93	1.15	35.50	2.10	1.07	81.45	25.52	28.08
2.7.2018	07:00-08:00	4.58	1.15	39.86	4.17	2.68	73.25	5.68	30.30
2.7.2018	08:00-09:00	14.41	1.15	71.54	2.58	1.52	66.52	41.36	32.37
2.7.2018	09:00-10:00	12.12	15.46	1.73	51.27	50.12	82.87	1.16	27.38
2.7.2018	10:00-11:00	32.07	14.52	13.44	11.48	1.57	77.55	11.98	29.22
2.7.2018	11:00-12:00	13.74	1.15	53.48	25.03	40.97	72.45	31.01	28.93

AQ6 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
2.7.2018	12:00-13:00	22.14	4.42	3.29	5.47	4.60	95.58	0.85	24.47
2.7.2019	13:00-14:00	25.86	1.77	6.66	4.72	1.80	99.67	0.06	25.00
2.7.2020	14:00-15:00	9.83	3.28	0.63	8.68	16.72	99.98	0.00	24.25
2.7.2021	15:00-16:00	12.02	5.97	0.70	5.77	35.27	98.40	0.00	24.00
2.7.2022	16:00-17:00	3.34	2.89	0.73	10.38	1169.10	92.02	0.00	24.00
2.7.2023	17:00-18:00	16.89	5.49	0.96	2.23	7.98	94.30	0.00	24.00
2.7.2024	18:00-19:00	17.18	2.23	0.94	2.12	1.60	97.95	0.09	24.00
2.7.2025	19:00-20:00	21.19	2.19	1.65	2.02	1.02	100.00	0.00	24.12
2.7.2026	20:00-21:00	15.17	3.15	2.92	3.53	1.22	100.00	0.13	24.00
2.7.2027	21:00-22:00	18.80	2.61	2.54	3.92	2.27	100.00	0.00	24.08
2.7.2028	22:00-23:00	20.71	3.36	0.91	2.92	1.40	99.38	0.03	24.32
2.7.2029	23:00-00:00	13.55	5.48	0.67	2.82	7.38	100.00	0.00	24.00
2.7.2030	00:00-01:00	31.59	6.24	0.85	4.40	14.83	100.00	0.13	24.00
3.7.2030	01:00-02:00	62.70	1.28	2.46	16.65	15.55	100.00	17.78	24.88
3.7.2030	02:00-03:00	93.43	1.29	5.07	40.10	39.83	100.00	26.34	24.98
3.7.2030	03:00-04:00	15.46	1.22	6.16	12.05	10.02	99.77	0.16	25.55
3.7.2030	04:00-05:00	12.88	1.15	29.76	2.02	1.00	93.95	14.93	26.73
3.7.2030	05:00-06:00	4.68	1.15	39.31	2.00	1.03	82.75	26.43	28.33
3.7.2030	06:00-07:00	0.48	1.18	46.50	12.47	9.97	77.08	22.04	29.22
3.7.2030	07:00-08:00	2.58	4.07	1.19	27.58	23.88	76.40	0.47	29.12
3.7.2030	08:00-09:00	13.55	1.20	1.31	22.48	25.12	76.55	0.38	29.00
3.7.2030	09:00-10:00	19.95	6.46	5.29	22.33	32.15	87.72	1.47	27.15
3.7.2030	10:00-11:00	32.16	9.20	1.34	2.30	5.90	84.32	0.41	27.83
3.7.2030	11:00-12:00	30.65	7.76	25.81	3.33	3.63	81.31	10.40	28.27

AQ7 (first day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
30.6.2018	13:00-14:00	22.27	1.50	0.02	10.87	23.43	66.28	1.00	35.72
30.6.2018	14:00-15:00	40.19	2.82	0.00	57.30	164.32	82.90	6.55	29.70
30.6.2018	15:00-16:00	32.58	11.29	0.00	38.87	13.35	86.93	213.91	27.35
30.6.2018	16:00-17:00	39.12	27.24	0.00	11.90	1.85	82.17	0.00	29.12
30.6.2018	17:00-18:00	10.93	23.97	0.00	13.38	24.90	79.63	0.00	29.18
30.6.2018	18:00-19:00	24.22	33.56	0.00	14.63	50.15	93.35	0.00	25.43
30.6.2018	19:00-20:00	61.52	33.29	0.00	15.73	30.43	94.28	0.09	24.93
30.6.2018	20:00-21:00	81.62	31.10	0.00	16.02	13.85	93.67	0.00	24.25
30.6.2018	21:00-22:00	54.61	32.53	0.00	5.00	2.98	94.82	0.00	24.52
30.6.2018	22:00-23:00	36.58	27.09	0.00	8.38	10.17	94.65	0.00	24.83
30.6.2018	23:00-00:00	50.10	28.30	0.00	33.67	1.20	96.62	0.00	24.57
1.7.2018	00:00-01:00	36.67	30.97	0.00	29.13	10.63	96.90	0.00	24.33
1.7.2018	01:00-02:00	75.57	21.07	0.00	19.97	9.93	100.00	0.00	23.82
1.7.2018	02:00-03:00	72.77	20.27	0.00	21.13	18.43	100.00	0.00	24.12
1.7.2018	03:00-04:00	40.30	28.15	0.00	8.15	27.87	100.00	0.00	23.95
1.7.2018	04:00-05:00	47.03	26.20	0.00	62.68	38.18	100.00	0.00	23.50
1.7.2018	05:00-06:00	54.01	19.37	0.00	61.98	41.22	100.00	0.00	23.42
1.7.2018	06:00-07:00	28.94	13.18	0.00	17.68	8.80	98.97	0.00	23.92
1.7.2018	07:00-08:00	44.76	11.09	0.03	2.33	1.00	85.40	0.41	28.05
1.7.2018	08:00-09:00	40.10	35.51	0.08	3.53	2.10	77.55	3.26	30.80
1.7.2018	09:00-10:00	43.88	12.22	0.05	18.80	3.70	69.68	3.76	34.78
1.7.2018	10:00-11:00	22.34	2.15	0.01	2.00	14.48	58.60	4.73	42.50
1.7.2018	11:00-12:00	20.21	3.09	0.00	37.47	1.27	60.17	2.13	41.28
1.7.2018	12:00-13:00	16.32	5.00	0.00	39.92	23.41	63.63	0.35	38.12

AQ7 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
1.7.2018	13:00-14:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.7.2018	14:00-15:00	20.04	3.17	0.13	6.65	139.77	91.27	1.16	25.35
1.7.2018	15:00-16:00	34.07	16.64	0.04	3.27	9.33	89.12	1.03	26.37
1.7.2018	16:00-17:00	37.12	20.58	0.01	3.80	2.17	86.28	4.73	27.85
1.7.2018	17:00-18:00	51.98	22.38	0.00	30.17	43.07	94.82	53.49	25.60
1.7.2018	18:00-19:00	16.40	32.00	0.00	27.23	48.28	100.00	47.16	22.95
1.7.2018	19:00-20:00	49.80	21.17	0.00	19.23	40.52	99.92	0.31	23.10
1.7.2018	20:00-21:00	74.26	33.74	0.00	34.22	36.57	99.88	0.00	23.15
1.7.2018	21:00-22:00	53.98	30.49	0.00	22.10	4.37	100.00	0.00	23.12
1.7.2018	22:00-23:00	50.35	30.66	0.00	20.98	15.73	100.00	0.00	23.45
1.7.2018	23:00-00:00	38.61	24.76	0.00	29.72	20.90	100.00	0.00	22.67

2.7.2018	00:00-01:00	43.29	25.12	0.00	19.42	3.35	100.00	0.00	22.92
2.7.2018	01:00-02:00	39.72	34.34	0.00	19.07	6.48	100.00	0.00	22.95
2.7.2018	02:00-03:00	13.71	3.84	0.00	16.77	7.98	100.00	0.00	22.90
2.7.2018	03:00-04:00	21.84	3.70	0.00	14.58	5.17	100.00	0.00	22.93
2.7.2018	04:00-05:00	45.17	3.57	0.00	42.37	27.95	100.00	0.00	23.07
2.7.2018	05:00-06:00	31.03	5.12	0.00	34.23	16.42	100.00	0.00	23.13
2.7.2018	06:00-07:00	45.26	20.54	0.00	28.52	9.85	100.00	0.00	23.25
2.7.2018	07:00-08:00	69.15	35.47	0.01	11.93	9.12	99.27	0.00	24.63
2.7.2018	08:00-09:00	72.62	16.40	0.04	3.27	1.02	91.83	0.00	26.77
2.7.2018	09:00-10:00	27.82	2.77	0.05	3.00	1.03	86.40	3.10	28.62
2.7.2018	10:00-11:00	25.93	3.17	0.08	3.53	2.82	80.32	8.28	31.55
2.7.2018	11:00-12:00	25.33	15.78	0.02	6.27	1.82	79.30	16.56	32.37
2.7.2018	12:00-13:00	47.37	25.68	0.00	9.40	2.85	73.63	5.71	34.22

AQ7 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
2.7.2018	13:00-14:00	22.12	25.77	0.03	18.35	22.30	68.97	0.03	37.48
2.7.2019	14:00-15:00	65.42	31.42	0.05	56.08	96.67	75.17	0.00	34.72
2.7.2020	15:00-16:00	50.16	35.27	0.00	21.65	30.37	84.48	35.37	29.25
2.7.2021	16:00-17:00	15.87	17.32	0.00	26.27	37.05	84.52	23.74	27.40
2.7.2022	17:00-18:00	49.93	12.68	0.00	18.77	13.07	88.13	24.71	25.00
2.7.2023	18:00-19:00	31.14	13.90	0.00	12.98	17.20	93.00	19.28	24.73
2.7.2024	19:00-20:00	66.76	25.40	0.00	13.40	26.47	94.23	0.00	24.78
2.7.2025	20:00-21:00	68.33	24.39	0.00	11.48	9.70	92.55	0.00	24.95
2.7.2026	21:00-22:00	70.72	23.70	0.00	14.40	7.93	94.53	0.00	24.90
2.7.2027	22:00-23:00	65.18	28.70	0.00	14.55	15.78	95.68	0.00	24.83
2.7.2028	23:00-00:00	62.88	28.31	0.00	20.75	28.08	96.83	0.00	25.00
3.7.2030	00:00-01:00	60.52	30.09	0.00	20.80	7.27	99.62	0.00	24.58
3.7.2030	01:00-02:00	63.51	23.39	0.00	23.85	9.50	99.92	0.00	24.40
3.7.2030	02:00-03:00	47.95	19.66	0.00	32.20	17.33	100.00	0.00	23.65
3.7.2030	03:00-04:00	59.58	26.48	0.00	34.58	25.72	100.00	0.00	23.87
3.7.2030	04:00-05:00	59.17	16.71	0.00	66.75	43.13	100.00	0.00	23.43
3.7.2030	05:00-06:00	66.63	18.30	0.00	54.58	19.35	100.00	0.00	23.82
3.7.2030	06:00-07:00	64.53	14.04	0.00	30.10	13.82	98.77	0.00	24.37
3.7.2030	07:00-08:00	64.64	8.15	0.03	16.55	6.82	92.00	0.00	26.82
3.7.2030	08:00-09:00	45.67	4.16	0.05	4.92	1.00	80.40	1.54	32.13
3.7.2030	09:00-10:00	50.26	1.64	0.08	37.58	346.53	80.00	0.00	32.97
3.7.2030	10:00-11:00	17.20	2.75	0.01	10.32	743.47	72.32	0.34	35.82
3.7.2030	11:00-12:00	53.33	7.13	0.02	32.59	103.82	73.73	0.00	35.09
3.7.2030	12:00-13:00	21.32	8.85	0.00	2.00	53.15	82.62	0.00	28.69

AQ8 (first day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
3.7.2018	13:00-14:00	67.42	9.20	0.06	10.97	22.78	84.70	0.91	28.50
3.7.2018	14:00-15:00	62.39	5.28	0.00	25.12	48.93	93.13	0.85	25.40
3.7.2018	15:00-16:00	21.19	5.15	0.00	16.10	230.27	99.32	122.82	23.40
3.7.2018	16:00-17:00	56.57	17.09	0.00	22.00	1.00	99.93	0.00	23.72
3.7.2018	17:00-18:00	72.83	16.30	0.00	10.98	58.42	100.00	0.00	22.98
3.7.2018	18:00-19:00	72.46	20.96	0.00	12.98	43.22	100.00	0.00	22.73
3.7.2018	19:00-20:00	30.73	10.59	0.00	5.65	36.65	96.43	0.00	22.92
3.7.2018	20:00-21:00	32.97	6.01	0.00	7.93	92.32	96.72	0.00	22.77
3.7.2018	21:00-22:00	41.96	19.45	0.00	8.57	50.77	97.37	0.00	23.03
3.7.2018	22:00-23:00	15.47	3.27	0.00	13.48	4.78	99.45	0.00	23.12
3.7.2018	23:00-00:00	47.31	14.09	0.00	16.55	20.42	100.00	0.00	23.50
4.7.2018	00:00-01:00	60.88	33.52	0.00	19.87	7.97	100.00	0.00	23.57
4.7.2018	01:00-02:00	54.48	32.27	0.00	22.90	16.40	100.00	0.00	23.43
4.7.2018	02:00-03:00	18.97	11.42	0.00	21.72	36.70	100.00	0.00	23.98
4.7.2018	03:00-04:00	21.83	9.05	0.00	19.83	9.57	100.00	0.00	24.07
4.7.2018	04:00-05:00	33.92	12.96	0.00	20.12	25.70	100.00	0.00	24.42
4.7.2018	05:00-06:00	38.66	20.52	0.00	43.20	20.22	100.00	0.00	23.95
4.7.2018	06:00-07:00	19.96	1.80	0.00	40.77	39.92	99.43	0.00	24.70
4.7.2018	07:00-08:00	67.75	18.94	0.00	14.47	1.05	94.18	0.00	25.45
4.7.2018	08:00-09:00	89.98	21.45	0.02	4.82	1.03	88.28	0.00	27.98
4.7.2018	09:00-10:00	98.93	26.39	0.04	21.18	4.47	78.70	3.95	32.20
4.7.2018	10:00-11:00	56.49	4.27	0.06	60.33	47.27	82.70	1.60	30.65
4.7.2018	11:00-12:00	53.73	4.00	0.00	3.35	2.75	80.97	0.75	30.70
4.7.2018	12:00-13:00	59.61	1.55	0.01	21.37	52.57	79.95	0.00	31.10

AQ8 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
4.7.2018	13:00-14:00	67.99	15.74	0.00	8.07	19.32	84.83	32.42	30.03
4.7.2018	14:00-15:00	60.77	15.55	0.00	2.73	6.80	82.13	7.53	30.75
4.7.2018	15:00-16:00	76.79	23.51	0.00	30.45	21.85	88.08	0.13	27.53
4.7.2018	16:00-17:00	79.02	21.89	0.03	24.47	2.97	83.17	0.22	29.27
4.7.2018	17:00-18:00	72.56	19.46	0.06	73.50	14.62	86.00	0.28	28.68
4.7.2018	18:00-19:00	81.08	27.59	0.00	29.63	19.62	90.30	60.05	25.88
4.7.2018	19:00-20:00	54.68	18.22	0.00	71.18	19.15	89.63	33.83	25.53
4.7.2018	20:00-21:00	60.13	18.40	0.00	24.75	11.82	94.13	0.00	25.25
4.7.2018	21:00-22:00	57.11	20.75	0.00	29.00	13.85	96.13	0.00	24.85
4.7.2018	22:00-23:00	62.84	19.96	0.00	11.03	31.10	98.68	0.00	24.00
4.7.2018	23:00-00:00	64.20	27.90	0.00	21.62	9.10	99.80	0.00	24.25
5.7.2018	00:00-01:00	35.80	18.17	0.00	37.47	27.40	100.00	0.00	24.78

5.7.2018	01:00-02:00	62.79	22.32	0.00	19.12	17.27	98.93	0.00	25.12
5.7.2018	02:00-03:00	73.92	22.26	0.00	27.32	19.15	99.80	0.00	25.02
5.7.2018	03:00-04:00	76.60	23.33	0.00	19.27	31.95	100.00	0.00	25.02
5.7.2018	04:00-05:00	75.92	27.32	0.00	13.10	27.25	100.00	0.00	24.87
5.7.2018	05:00-06:00	74.59	29.79	0.00	18.23	29.57	100.00	0.00	24.53
5.7.2018	06:00-07:00	75.95	22.07	0.00	5.08	34.78	98.42	0.00	24.57
5.7.2018	07:00-08:00	88.25	17.86	0.00	4.25	31.42	96.20	0.00	24.97
5.7.2018	08:00-09:00	85.29	21.39	0.01	2.70	21.88	94.73	0.00	25.75
5.7.2018	09:00-10:00	87.72	22.46	0.00	13.18	27.07	93.95	0.00	25.77
5.7.2018	10:00-11:00	84.43	17.38	0.00	37.77	20.58	98.10	0.00	23.52
5.7.2018	11:00-12:00	85.45	22.82	0.00	1.08	22.90	100.00	24.99	22.68
5.7.2018	12:00-13:00	67.24	23.01	0.00	1.00	6.57	100.00	0.00	22.60

AQ8 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
5.7.2018	13:00-14:00	76.17	13.03	0.00	1.00	6.13	100.00	0.00	22.73
5.7.2018	14:00-15:00	79.33	16.34	0.00	1.00	9.50	100.00	0.00	23.05
5.7.2018	15:00-16:00	74.34	13.65	0.00	1.00	14.30	100.00	0.00	23.52
5.7.2018	16:00-17:00	66.20	10.77	0.00	1.00	13.28	99.42	0.00	23.65
5.7.2018	17:00-18:00	75.64	15.33	0.00	1.00	13.70	97.75	0.00	24.73
5.7.2018	18:00-19:00	69.78	13.90	0.00	1.00	16.22	98.28	0.00	24.73
5.7.2018	19:00-20:00	71.96	20.85	0.00	1.00	45.47	98.93	0.00	24.55
5.7.2018	20:00-21:00	70.93	21.54	0.00	1.00	18.70	99.95	0.00	23.98
5.7.2018	21:00-22:00	71.26	21.83	0.00	1.00	13.92	99.95	0.00	24.15
5.7.2018	22:00-23:00	50.87	12.61	0.00	1.00	27.62	99.65	0.00	24.12
5.7.2018	23:00-00:00	40.38	12.83	0.00	1.00	25.58	100.00	0.00	23.93
6.7.2018	00:00-01:00	41.96	12.55	0.00	1.00	16.85	100.00	0.00	23.43
6.7.2018	01:00-02:00	60.18	17.34	0.00	1.00	24.67	100.00	0.00	23.77
6.7.2018	02:00-03:00	63.00	24.83	0.00	1.00	28.25	99.97	0.00	23.90
6.7.2018	03:00-04:00	71.82	13.88	0.00	1.00	3.73	98.83	0.00	24.32
6.7.2018	04:00-05:00	69.41	15.71	0.00	1.00	22.83	99.88	0.00	23.77
6.7.2018	05:00-06:00	80.84	21.67	0.00	1.00	41.07	99.80	0.00	23.92
6.7.2018	06:00-07:00	79.33	20.82	0.00	1.00	34.40	99.22	0.00	23.32
6.7.2018	07:00-08:00	60.47	15.45	0.00	1.00	73.70	100.00	0.00	23.32
6.7.2018	08:00-09:00	55.13	13.37	0.00	1.00	53.65	99.97	0.00	23.90
6.7.2018	09:00-10:00	71.60	22.13	0.02	4.65	12.85	98.60	0.00	24.47
6.7.2018	10:00-11:00	73.02	9.02	0.01	1.00	4.23	93.75	0.00	26.10
6.7.2018	11:00-12:00	48.34	3.60	0.03	1.00	17.58	88.85	0.00	27.87
6.7.2018	12:00-13:00	46.83	3.78	0.01	60.20	28.78	94.52	0.13	26.50

AQ9 (first day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
3.7.2018	13:00-14:00	87.61	73.90	0.57	22.83	94.47	100.00	0.00	24.67
3.7.2018	14:00-15:00	44.38	8.91	1.01	2.95	136.45	98.02	0.22	25.23
3.7.2018	15:00-16:00	10.40	1.15	27.28	2.18	1.15	85.90	19.66	26.73
3.7.2018	16:00-17:00	0.00	1.15	0.99	19.22	45.17	87.67	0.56	25.00
3.7.2018	17:00-18:00	15.36	1.15	1.57	5.28	15.15	86.78	0.00	25.00
3.7.2018	18:00-19:00	25.19	1.15	0.58	2.55	21.42	98.38	0.00	25.00
3.7.2018	19:00-20:00	10.12	1.15	2.73	10.52	5.28	96.05	0.00	24.68
3.7.2018	20:00-21:00	8.88	4.92	0.57	17.20	66.02	99.97	0.00	24.00
3.7.2018	21:00-22:00	29.11	6.74	0.67	2.60	1.43	100.00	0.03	24.22
3.7.2018	22:00-23:00	17.27	4.09	1.79	2.58	1.20	100.00	0.00	24.80
3.7.2018	23:00-00:00	9.07	2.42	1.73	2.62	7.43	100.00	0.06	25.00
4.7.2018	00:00-01:00	15.36	1.38	1.84	3.70	1.92	100.00	0.06	25.00
4.7.2018	01:00-02:00	15.36	1.32	2.19	6.18	4.35	100.00	0.16	25.00
4.7.2018	02:00-03:00	33.21	1.66	2.00	10.87	10.87	100.00	2.48	25.00
4.7.2018	03:00-04:00	18.13	1.15	2.11	8.98	6.83	100.00	1.00	25.00
4.7.2018	04:00-05:00	16.51	1.20	1.43	7.10	5.35	100.00	0.28	25.00
4.7.2018	05:00-06:00	21.47	1.15	4.30	8.93	16.75	100.00	0.41	25.02
4.7.2018	06:00-07:00	21.38	1.15	9.58	5.62	12.42	100.00	2.04	25.80
4.7.2018	07:00-08:00	8.21	1.15	8.67	6.85	14.85	100.00	0.03	26.00
4.7.2018	08:00-09:00	64.61	34.52	1.48	19.50	87.13	99.97	2.19	24.18
4.7.2018	09:00-10:00	27.77	36.89	0.57	6.85	85.83	98.42	0.00	23.00
4.7.2018	10:00-11:00	35.02	1.20	0.57	2.00	4.73	97.50	0.00	23.00
4.7.2018	11:00-12:00	20.23	1.17	0.57	2.13	230.93	97.18	0.00	23.40
4.7.2018	12:00-13:00	47.62	1.29	0.58	2.50	30.68	99.43	0.00	23.62

AQ9 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
4.7.2018	13:00-14:00	40.85	1.15	0.57	3.23	62.43	100.00	0.00	23.78
4.7.2018	14:00-15:00	63.75	1.24	0.57	8.47	46.25	97.88	0.03	23.90
4.7.2018	15:00-16:00	58.02	1.15	1.03	9.38	3.00	98.60	0.00	24.27
4.7.2018	16:00-17:00	46.57	1.15	0.85	6.40	6.05	100.00	0.00	25.00
4.7.2018	17:00-18:00	9.16	1.15	0.57	8.63	48.47	100.00	0.00	24.98
4.7.2018	18:00-19:00	50.29	1.15	0.57	9.08	24.57	100.00	0.31	24.08
4.7.2018	19:00-20:00	66.13	1.15	0.71	11.78	1.00	100.00	0.09	24.00
4.7.2018	20:00-21:00	7.63	1.15	5.16	8.87	5.42	100.00	1.41	24.03
4.7.2018	21:00-22:00	1.34	1.15	5.19	8.80	6.97	100.00	4.48	24.00
4.7.2018	22:00-23:00	1.05	1.15	5.07	6.35	3.97	100.00	2.26	24.00
4.7.2018	23:00-00:00	7.73	1.15	5.56	5.42	3.32	100.00	2.82	24.03
5.7.2018	00:00-01:00	4.01	1.15	2.82	3.98	17.65	100.00	0.41	24.00

5.7.2018	01:00-02:00	7.73	1.15	3.07	6.63	4.63	100.00	0.06	24.00
5.7.2018	02:00-03:00	3.05	1.15	3.04	6.00	27.65	100.00	0.41	24.00
5.7.2018	03:00-04:00	31.59	1.15	7.35	8.32	9.35	100.00	11.92	24.00
5.7.2018	04:00-05:00	44.66	1.15	6.07	20.25	20.62	100.00	11.51	24.07
5.7.2018	05:00-06:00	3.82	1.15	7.89	6.32	4.93	99.98	0.00	24.62
5.7.2018	06:00-07:00	18.99	1.17	11.97	3.32	4.62	97.45	0.38	25.20
5.7.2018	07:00-08:00	27.20	1.15	20.11	10.10	19.35	94.63	7.37	25.97
5.7.2018	08:00-09:00	3.34	1.15	17.36	6.92	16.70	91.22	1.00	26.02
5.7.2018	09:00-10:00	3.24	1.15	4.19	5.50	13.02	92.25	4.42	26.20
5.7.2018	10:00-11:00	0.29	1.15	16.96	2.42	1.62	88.93	0.63	26.78
5.7.2018	11:00-12:00	8.59	4.55	0.86	25.67	76.82	100.00	1.16	25.00
5.7.2018	12:00-13:00	4.39	1.16	2.44	2.10	1.00	92.32	0.00	25.67

AQ9 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
5.7.2018	13:00-14:00	5.63	22.23	9.21	16.98	22.13	82.75	1.54	26.82
5.7.2018	14:00-15:00	0.00	32.65	0.00	16.35	26.28	82.20	0.00	27.00
5.7.2018	15:00-16:00	1.05	36.50	0.00	16.17	29.18	81.78	2.95	26.70
5.7.2018	16:00-17:00	0.00	34.47	0.00	15.57	28.50	82.23	0.00	26.82
5.7.2018	17:00-18:00	2.96	35.30	0.00	17.98	27.28	83.32	0.00	26.63
5.7.2018	18:00-19:00	0.00	38.08	0.00	23.77	33.45	85.05	0.06	26.25
5.7.2018	19:00-20:00	5.25	36.45	0.00	30.35	42.43	84.93	0.69	26.07
5.7.2018	20:00-21:00	4.39	36.66	0.01	31.97	45.98	83.27	0.00	26.00
5.7.2018	21:00-22:00	0.00	30.42	0.00	19.88	34.62	82.20	0.00	26.12
5.7.2018	22:00-23:00	10.31	21.79	0.00	9.95	21.23	82.57	0.00	25.03
5.7.2018	23:00-00:00	14.31	32.92	0.00	23.00	32.67	83.10	0.00	24.25
6.7.2018	00:00-01:00	5.06	28.38	0.01	26.87	47.95	83.72	0.00	24.00
6.7.2018	01:00-02:00	0.00	34.57	0.05	30.30	60.42	82.58	1.19	23.83
6.7.2018	02:00-03:00	8.97	31.30	0.00	33.37	56.88	82.18	0.47	23.00
6.7.2018	03:00-04:00	0.00	28.66	0.04	33.38	52.92	78.77	0.47	23.00
6.7.2018	04:00-05:00	3.63	30.34	0.02	33.40	56.25	94.57	0.19	23.23
6.7.2018	05:00-06:00	8.49	41.20	0.03	9.90	24.45	100.00	0.00	24.15
6.7.2018	06:00-07:00	8.02	14.36	0.07	23.80	47.95	96.80	0.60	25.33
6.7.2018	07:00-08:00	10.78	30.43	0.00	7.63	16.92	100.00	1.57	26.37
6.7.2018	08:00-09:00	3.05	28.87	0.08	25.73	41.35	87.25	0.28	26.20
6.7.2018	09:00-10:00	1.62	25.47	0.00	3.88	11.60	97.88	0.38	22.97
6.7.2018	10:00-11:00	5.06	30.67	0.00	4.07	6.87	99.93	0.38	23.45
6.7.2018	11:00-12:00	4.49	23.17	0.01	3.45	5.57	99.92	0.22	24.00
6.7.2018	12:00-13:00	5.63	23.58	0.03	6.60	8.73	100.00	1.35	24.15

AQ10 (first day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
3.7.2018	13:00-14:00	11.72	13.91	0.00	1.29	11.14	86.61	2.42	26.51
3.7.2018	14:00-15:00	55.11	30.55	0.00	2.00	4.98	99.41	2.01	24.02
3.7.2018	15:00-16:00	67.33	21.83	0.00	2.56	7.69	99.85	1.88	23.76
3.7.2018	16:00-17:00	73.81	19.59	0.00	2.69	8.85	100.00	1.88	23.00
3.7.2018	17:00-18:00	68.79	17.14	0.00	2.00	9.56	100.00	1.98	22.93
3.7.2018	18:00-19:00	71.12	18.30	0.00	2.02	7.85	100.00	3.57	22.73
3.7.2018	19:00-20:00	70.77	13.74	0.00	2.00	10.93	100.00	2.07	22.71
3.7.2018	20:00-21:00	71.44	17.00	0.00	2.02	11.03	100.00	2.87	22.95
3.7.2018	21:00-22:00	74.57	12.81	0.00	2.30	7.73	100.00	2.54	23.00
3.7.2018	22:00-23:00	74.84	15.72	0.00	2.00	4.10	100.00	2.90	23.00
3.7.2018	23:00-00:00	72.35	18.20	0.00	2.02	4.61	100.00	2.71	23.00
4.7.2018	00:00-01:00	74.82	16.28	0.00	2.00	8.51	100.00	2.46	23.00
4.7.2018	01:00-02:00	69.58	17.55	0.00	2.00	11.15	100.00	1.88	23.00
4.7.2018	02:00-03:00	71.39	15.59	0.00	2.00	5.31	100.00	2.04	23.00
4.7.2018	03:00-04:00	69.59	14.27	0.00	2.00	8.90	100.00	3.64	23.00
4.7.2018	04:00-05:00	75.30	12.25	0.00	2.00	11.68	100.00	14.25	23.32
4.7.2018	05:00-06:00	85.79	15.72	0.00	2.00	7.25	100.00	5.13	23.81
4.7.2018	06:00-07:00	77.98	12.48	0.02	2.08	10.07	95.36	2.74	25.15
4.7.2018	07:00-08:00	72.50	8.32	0.06	2.46	5.00	82.83	6.15	27.92
4.7.2018	08:00-09:00	59.05	1.37	0.25	2.75	8.69	67.46	18.75	32.29
4.7.2018	09:00-10:00	115.32	36.44	0.31	1.98	11.05	68.97	18.24	31.83
4.7.2018	10:00-11:00	28.68	1.83	0.01	1.64	4.61	75.08	25.16	30.10
4.7.2018	11:00-12:00	43.52	1.31	0.00	4.53	5.24	71.83	7.53	30.75
4.7.2018	12:00-13:00	56.89	12.64	0.00	1.75	11.54	84.27	1.88	27.90

AQ10 (second day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
4.7.2018	13:00-14:00	76.91	12.62	0.00	3.97	13.20	86.36	2.04	27.76
4.7.2018	14:00-15:00	63.10	13.29	0.04	1.00	5.61	86.34	2.87	27.12
4.7.2018	15:00-16:00	68.49	17.04	0.01	2.39	10.25	92.19	2.04	25.98
4.7.2018	16:00-17:00	66.66	6.01	0.10	2.42	11.73	84.59	2.30	27.53
4.7.2018	17:00-18:00	64.90	15.77	0.00	1.78	10.10	88.00	1.98	25.34
4.7.2018	18:00-19:00	75.55	18.45	0.00	2.86	5.76	90.05	2.07	25.00
4.7.2018	19:00-20:00	73.71	22.57	0.00	2.29	7.68	92.39	1.98	24.54
4.7.2018	20:00-21:00	80.61	20.93	0.00	1.92	12.69	96.63	7.49	24.44
4.7.2018	21:00-22:00	67.24	19.49	0.00	3.10	13.24	96.92	4.40	23.63
4.7.2018	22:00-23:00	68.03	23.01	0.00	2.61	6.81	99.92	2.17	23.97
4.7.2018	23:00-00:00	71.22	17.43	0.00	2.36	10.20	100.00	1.88	23.49

5.7.2018	00:00-01:00	77.12	15.06	0.00	2.00	9.56	100.00	1.88	23.58
5.7.2018	01:00-02:00	69.51	15.61	0.00	2.00	5.24	100.00	1.88	24.00
5.7.2018	02:00-03:00	65.82	15.78	0.00	2.00	4.75	100.00	2.26	24.00
5.7.2018	03:00-04:00	70.55	17.05	0.00	2.00	5.29	100.00	2.30	24.00
5.7.2018	04:00-05:00	70.63	13.50	0.00	2.00	13.17	100.00	1.88	24.00
5.7.2018	05:00-06:00	83.10	32.74	0.00	2.41	14.19	100.00	1.88	24.00
5.7.2018	06:00-07:00	87.36	23.27	0.00	2.12	9.44	99.02	4.62	24.53
5.7.2018	07:00-08:00	70.89	17.00	0.01	2.56	4.07	94.92	7.69	25.00
5.7.2018	08:00-09:00	71.14	11.21	0.02	2.31	9.47	92.90	17.57	25.98
5.7.2018	09:00-10:00	61.87	8.06	0.01	2.98	11.14	92.56	7.81	25.24
5.7.2018	10:00-11:00	64.99	14.43	0.00	3.49	8.68	99.32	2.58	22.39
5.7.2018	11:00-12:00	72.98	19.19	0.00	2.02	7.95	100.00	2.17	22.00
5.7.2018	12:00-13:00	62.08	16.70	0.00	2.03	3.63	100.00	2.20	22.00

AQ10 (third day)

Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y	H.M.S	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	%	µg/m3	Deg. C
5.7.2018	13:00-14:00	71.29	13.98	0.00	2.80	4.83	100.00	1.88	22.90
5.7.2018	14:00-15:00	78.15	16.57	0.00	1.68	7.24	100.00	1.88	22.92
5.7.2018	15:00-16:00	75.82	14.86	0.00	3.69	5.14	100.00	1.88	23.00
5.7.2018	16:00-17:00	77.20	14.99	0.01	2.88	7.71	100.00	3.38	23.12
5.7.2018	17:00-18:00	76.99	14.56	0.00	2.44	8.00	99.93	5.87	24.00
5.7.2018	18:00-19:00	73.21	11.14	0.00	2.00	8.69	99.97	3.70	24.00
5.7.2018	19:00-20:00	76.13	12.61	0.00	2.00	11.88	100.00	2.42	24.00
5.7.2018	20:00-21:00	83.77	15.23	0.00	2.00	10.97	100.00	2.23	23.46
5.7.2018	21:00-22:00	76.04	14.68	0.00	2.00	9.00	100.00	1.88	23.00
5.7.2018	22:00-23:00	56.83	11.46	0.00	2.90	4.64	100.00	1.88	23.00
5.7.2018	23:00-00:00	64.32	14.92	0.00	2.17	5.22	100.00	2.58	23.00
5.7.2018	00:00-01:00	69.45	17.87	0.00	2.15	4.20	100.00	1.95	23.00
6.7.2018	01:00-02:00	68.75	16.78	0.00	2.17	4.78	100.00	1.88	23.00
6.7.2018	02:00-03:00	68.74	14.05	0.00	2.02	6.59	100.00	1.88	23.00
6.7.2018	03:00-04:00	62.66	14.90	0.00	2.00	9.71	100.00	1.88	23.00
6.7.2018	04:00-05:00	54.14	15.95	0.00	2.00	10.05	100.00	2.77	23.00
6.7.2018	05:00-06:00	62.08	17.13	0.00	2.08	10.71	100.00	3.48	23.00
6.7.2018	06:00-07:00	64.02	17.28	0.00	2.00	5.93	100.00	3.41	22.90
6.7.2018	07:00-08:00	67.10	20.50	0.00	2.80	8.19	100.00	1.88	23.00
6.7.2018	08:00-09:00	72.65	13.88	0.00	2.61	7.05	100.00	1.98	23.20
6.7.2018	09:00-10:00	61.90	12.68	0.03	2.15	11.73	100.00	2.68	24.00
6.7.2018	10:00-11:00	63.99	10.34	0.02	2.62	10.15	97.62	6.33	25.12
6.7.2018	11:00-12:00	64.28	7.07	0.06	4.42	8.75	87.42	4.59	27.47
6.7.2018	12:00-13:00	63.94	7.51	0.06	1.19	3.46	88.69	2.65	26.98

APPENDIX O PHYSICAL IN-SITU SAMPLING DURING WET SEASON FROM SEM

Surface Water Analysis Result

Project Name: Ahlone Expansion Combined Cycle Power Plant and FSRU Project to supply power to the Republic of the Union of Myanmar

Sampling by: ERM-Siam Co., Ltd.

Parameter	Unit	Method Analysis	LOQ	Results							Laboratory
				SW1	SW2	SW3	SW4	SW5	SW6	SW7	
Sampling Date				27/6/2018	27/6/2018	27/6/2018	27/6/2018-	28/6/2018	28/6/2018	29/6/2018	
Alkalinity	mg/L as $CaCO_3$	Titration Method	1.0	42.8	42.4	49.3	47.0	27.4	24.2	13.8	STS Green Co., Ltd.
Biochemical Oxygen Demand (BOD)	mg/L	5-Day BOD Test, Azide Modification Method	-	0.6	0.6	1.8	0.8	1.8	2.8	1.0	STS Green Co., Ltd.
Total Suspended Solids (TSS)	mg/L	Dried at 103-105 °C Method	10.0	557	574	831	904	165	117	437	STS Green Co., Ltd.
Total Dissolved Solids (TDS)	mg/L	Dried at 180 °C Method	50.0	76.0	86.0	108	94.0	198	164	202	STS Green Co., Ltd.
Turbidity	NTU	Nephelometric Method	0.02	902	887	959	893	295	329	752	STS Green Co., Ltd.
Hardness as $CaCO_3$	mg/L as $CaCO_3$	EDTA Titrimetric Method	5.0	59.5	60.5	68.0	70.0	27.4	24.4	15.2	STS Green Co., Ltd.
Cyanide (CN)	mg/L	APHA (2012), 4500-CN (C),(E)	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	ALS Laboratory Group (Thailand)
Fluoride (F)	mg/L	APHA (2012), 4110B	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ALS Laboratory Group (Thailand)
Sulfide	mg/L	Iodometric Method	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	STS Green Co., Ltd.
Total Organic Carbon	mg/L	Based on APHA (2012), 5310 B	0.05	4.27	5.82	5.04	5.67	6.99	8.99	9.61	ALS Laboratory Group (Thailand)
Ammonium-Nitrogen	mg/L	Phenate Method	0.010	0.047	0.132	0.148	0.077	0.259	0.362	0.398	STS Green Co., Ltd.
Sulfate (SO_4)	mg/L	Turbidimetric Method	1.0	4.7	1.2	4.7	3.4	5.3	7.5	4.5	STS Green Co., Ltd.
Nitrate (NO_3)	mg/L	Cadmium Reduction Method	0.005	2.40	2.00	2.21	2.22	0.694	0.725	0.576	STS Green Co., Ltd.
Chromium (Cr)	mg/L	Electrothermal AAS Method	0.0005	0.0427	0.0508	0.0798	0.0669	0.0200	0.0207	0.0396	STS Green Co., Ltd.
Calcium (Ca)	mg/L	Direct Nitrous Oxide-Acetylene Flame Method	0.02	7.32	8.16	10.56	9.91	<0.02	<0.02	<0.02	STS Green Co., Ltd.
Magnesium (Mg)	mg/L	Direct Air-Acetylene Flame Method	0.003	8.99	9.94	13.29	14.85	4.47	3.66	4.89	STS Green Co., Ltd.
Sodium (Na)	mg/L	Direct Air-Acetylene Flame Method	0.01	4.43	5.01	5.24	5.86	13.72	9.27	7.39	STS Green Co., Ltd.
Potassium (K)	mg/L	Direct Air-Acetylene Flame Method	0.01	2.38	2.46	3.01	3.25	2.37	2.60	3.04	STS Green Co., Ltd.
Mercury (Hg)	mg/L	Cold-Vapor AAS Method	0.0003	0.0023	0.0021	0.0020	0.0024	0.0030	0.0025	0.0019	STS Green Co., Ltd.
Lead (Pb)	mg/L	Electrothermal AAS Method	0.0020	0.0062	0.0082	0.0131	0.0116	0.0097	0.0089	0.0155	STS Green Co., Ltd.
Cadmium (Cd)	mg/L	Electrothermal AAS Method	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00009	<0.00005	<0.00005	STS Green Co., Ltd.
Copper (Cu)	mg/L	Direct Air-Acetylene Flame Method	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	STS Green Co., Ltd.
Iron (Fe)	mg/L	Direct Air-Acetylene Flame Method	0.10	27.35	26.32	44.89	44.92	13.32	13.82	27.12	STS Green Co., Ltd.
Tin (Sn)	mg/L	Based on APHA (2012), 3125	0.0001	0.0008	0.0003	0.0003	0.0002	<0.0001	0.0001	0.0001	ALS Laboratory Group (Thailand)
Manganese (Mn)	mg/L	Direct Air-Acetylene Flame Method	0.04	0.34	0.40	0.85	0.76	0.14	0.16	0.22	STS Green Co., Ltd.
Total Nitrogen	mg/L	Based on APHA (2012), Calculated	1.0	1.1	<1.0	<1.0	<1.0	<1.0	1.2	1.1	ALS Laboratory Group (Thailand)
Total Phosphorous	mg/L	Acid Digestion/Ascorbic Acid Method	0.005	0.279	0.290	0.456	0.400	0.156	0.268	0.220	STS Green Co., Ltd.
Zinc (Zn)	mg/L	Direct Air-Acetylene Flame Method	0.02	0.04	0.06	0.10	0.08	<0.02	0.03	0.06	STS Green Co., Ltd.
Nickel (Ni)	mg/L	Electrothermal AAS Method	0.0005	0.0503	0.0545	0.1297	0.1059	0.0160	0.0191	0.0336	STS Green Co., Ltd.
Chloride (Cl)	mg/L	Mercuric Nitrate Method	1.0	3.3	3.8	4.3	5.0	17.9	10.4	9.2	STS Green Co., Ltd.
Oil and Grease	mg/L	Liquid-Liquid, Partition-Gravimetric Method	2.0	3.0	5.0	4.0	<2.0	2.0	3.1	2.1	STS Green Co., Ltd.

Parameter	Unit	Method Analysis	LOQ	Results							Laboratory
				SW1	SW2	SW3	SW4	SW5	SW6	SW7	
Sampling Date				27/6/2018	27/6/2018	27/6/2018	27/6/2018-	28/6/2018	28/6/2018	29/6/2018	
Chemical Oxygen Demand (COD)	mg/L	Open Reflux Method	5.0	37.8	22.0	25.2	18.9	63.0	75.6	81.9	STS Green Co., Ltd.

Parameter	Unit	Method Analysis	LOQ	Results							Laboratory
				SW8	SW9	SW10	SW11	SW12	SW13	SW14	
Sampling Date				28/6/2018	28/6/2018	28/6/2018	28/6/2018	28/6/2018	-	-	
Alkalinity	mg/L as $CaCO_3$	Titration Method	1.0	9.5	8.2	10.8	11.9	10.8	46.0	43.1	STS Green Co., Ltd.
Biochemical Oxygen Demand (BOD)	mg/L	5-Day BOD Test, Azide Modification Method	-	2.1	1.4	1.6	1.2	2.2	0.5	0.8	STS Green Co., Ltd.
Total Suspended Solids (TSS)	mg/L	Dried at 103-105 °C Method	10.0	268	355	360	376	369	475	597	STS Green Co., Ltd.
Total Dissolved Solids (TDS)	mg/L	Dried at 180 °C Method	50.0	212	216	180	212	246	112	108	STS Green Co., Ltd.
Turbidity	NTU	Nephelometric Method	0.02	683	754	751	693	704	769	968	STS Green Co., Ltd.
Hardness as $CaCO_3$	mg/L as $CaCO_3$	EDTA Titrimetric Method	5.0	21.0	30.5	23.7	25.0	23.3	54.4	54.6	STS Green Co., Ltd.
Cyanide (CN)	mg/L	APHA (2012), 4500-CN (C),(E)	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	ALS Laboratory Group (Thailand)
Fluoride (F)	mg/L	APHA (2012), 4110B	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ALS Laboratory Group (Thailand)
Sulfide	mg/L	Iodometric Method	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	STS Green Co., Ltd.
Total Organic Carbon	mg/L	Based on APHA (2012), 5310 B	0.05	8.89	6.88	11.1	9.52	9.17	3.12	5.91	ALS Laboratory Group (Thailand)
Ammonium-Nitrogen	mg/L	Phenate Method	0.010	0.543	0.621	0.403	0.462	0.347	0.171	0.190	STS Green Co., Ltd.
Sulfate (SO_4)	mg/L	Turbidimetric Method	1.0	7.6	<1.0	5.5	9.4	6.0	9.8	14.4	STS Green Co., Ltd.
Nitrate (NO_3)	mg/L	Cadmium Reduction Method	0.005	0.431	0.420	0.598	0.814	0.622	1.70	2.04	STS Green Co., Ltd.
Chromium (Cr)	mg/L	Electrothermal AAS Method	0.0005	0.0349	0.0383	0.0405	0.0386	0.0382	0.0441	0.0562	STS Green Co., Ltd.
Calcium (Ca)	mg/L	Direct Nitrous Oxide-Acetylene Flame Method	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	6.41	5.67	STS Green Co., Ltd.
Magnesium (Mg)	mg/L	Direct Air-Acetylene Flame Method	0.003	3.83	2.01	4.85	5.83	6.13	9.30	10.92	STS Green Co., Ltd.
Sodium (Na)	mg/L	Direct Air-Acetylene Flame Method	0.01	6.41	4.52	10.38	18.61	18.10	5.56	7.84	STS Green Co., Ltd.
Potassium (K)	mg/L	Direct Air-Acetylene Flame Method	0.01	2.61	1.46	3.07	3.18	3.04	2.52	2.75	STS Green Co., Ltd.
Mercury (Hg)	mg/L	Cold-Vapor AAS Method	0.0003	0.0023	0.0053	0.0026	0.0038	0.0027	0.0023	0.0028	STS Green Co., Ltd.
Lead (Pb)	mg/L	Electrothermal AAS Method	0.0020	0.0139	0.0142	0.0136	0.0128	0.0124	0.0109	0.0102	STS Green Co., Ltd.
Cadmium (Cd)	mg/L	Electrothermal AAS Method	0.00005	0.00011	<0.00005	<0.00005	0.00007	0.00013	0.00031	0.00008	STS Green Co., Ltd.
Copper (Cu)	mg/L	Direct Air-Acetylene Flame Method	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	STS Green Co., Ltd.
Iron (Fe)	mg/L	Direct Air-Acetylene Flame Method	0.10	22.15	26.16	27.34	30.38	26.38	24.56	32.24	STS Green Co., Ltd.
Tin (Sn)	mg/L	Based on APHA (2012), 3125	0.0001	<0.0001	<0.0001	0.0001	0.0002	0.0002	0.0001	<0.0001	ALS Laboratory Group (Thailand)
Manganese (Mn)	mg/L	Direct Air-Acetylene Flame Method	0.04	0.17	0.22	0.24	0.28	0.25	0.33	0.43	STS Green Co., Ltd.
Total Nitrogen	mg/L	Based on APHA (2012), Calculated	1.0	1.2	1.6	1.4	1.6	1.4	<1.0	1.2	ALS Laboratory Group (Thailand)
Total Phosphorous	mg/L	Acid Digestion/Ascorbic Acid Method	0.005	0.155	0.226	0.234	0.263	0.242	0.283	0.287	STS Green Co., Ltd.
Zinc (Zn)	mg/L	Direct Air-Acetylene Flame Method	0.02	0.05	0.05	0.06	0.06	0.06	0.05	0.06	STS Green Co., Ltd.
Nickel (Ni)	mg/L	Electrothermal AAS Method	0.0005	0.0312	0.0317	0.0337	0.0338	0.0338	0.0168	0.0554	STS Green Co., Ltd.
Chloride (Cl)	mg/L	Mercuric Nitrate Method	1.0	7.5	14.1	16.0	31.1	31.5	6.2	8.8	STS Green Co., Ltd.
Oil and Grease	mg/L	Liquid-Liquid, Partition-Gravimetric Method	2.0	<2.0	<2.0	2.0	2.8	2.7	<2.0	2.2	STS Green Co., Ltd.
Chemical Oxygen Demand (COD)	mg/L	Open Reflux Method	5.0	72.4	72.4	75.6	69.3	44.1	69.3	58.3	STS Green Co., Ltd.

Groundwater Analysis Result

Project Name: Ahlone Expansion Combined Cycle Power Plant and FSRU Project to supply power to the Republic of the Union of Myanmar

Sampling by: ERM-Siam Co., Ltd.

Parameter	Unit	Method Analysis	LOQ	Results			Laboratory
				GW1	GW2	GW3	
Sampling Date				28/6/2018	28/6/2018	27/6/2018	
Alkalinity	mg/L as $CaCO_3$	Titration Method	1.0	596	199	11.5	STS Green Co., Ltd.
Biochemical Oxygen Demand (BOD)	mg/L	5-Day BOD Test, Azide Modification Method	-	0.1	0.2	0.2	STS Green Co., Ltd.
Total Suspended Solids (TSS)	mg/L	Dried at 103-105 °C Method	10.0	42.2	12.4	<10.0	STS Green Co., Ltd.
Total Dissolved Solids (TDS)	mg/L	Dried at 180 °C Method	50.0	14,440	3,722	246	STS Green Co., Ltd.
Turbidity	NTU	Nephelometric Method	0.02	265	236	0.36	STS Green Co., Ltd.
Total Hardness as $CaCO_3$	mg/L as $CaCO_3$	EDTA Titrimetric Method	5.0	2,816	417.0	75.9	STS Green Co., Ltd.
Cyanide (CN)	mg/L	APHA (2012), 4500-CN (C),(E)	0.005	<0.005	<0.005	<0.005	ALS Laboratory Group (Thailand)
Fluoride (F)	mg/L	APHA (2012), 4110B	0.1	<0.1	<0.1	<0.1	ALS Laboratory Group (Thailand)
Sulfide	mg/L	Iodometric Method	1.0	<1.0	<1.0	<1.0	STS Green Co., Ltd.
Total Organic Carbon	mg/L	Based on APHA (2012), 5310 B	0.05	4.79	0.90	0.32	ALS Laboratory Group (Thailand)
Ammonium-Nitrogen	mg/L	Phenate Method	0.010	2.51	1.91	0.081	STS Green Co., Ltd.
Sulfate (SO_4)	mg/L	Turbidimetric Method	1.0	322	11.6	17.6	STS Green Co., Ltd.
Nitrate (NO_3)	mg/L	Cadmium Reduction Method	0.005	0.612	0.280	18.65	STS Green Co., Ltd.
Chromium (Cr)	mg/L	Electrothermal AAS Method	0.0005	<0.0005	<0.0005	0.0049	STS Green Co., Ltd.
Calcium (Ca)	mg/L	Direct Nitrous Oxide-Acetylene Flame Method	0.02	150.77	19.91	13.57	STS Green Co., Ltd.

Parameter	Unit	Method Analysis	LOQ	Results			Laboratory
				GW1	GW2	GW3	
Magnesium (Mg)	mg/L	Direct Air-Acetylene Flame Method	0.003	494.94	66.97	6.21	STS Green Co., Ltd.
Sodium (Na)	mg/L	Direct Air-Acetylene Flame Method	0.01	3,694	780.63	29.43	STS Green Co., Ltd.
Potassium (K)	mg/L	Direct Air-Acetylene Flame Method	0.01	111.62	33.63	3.49	STS Green Co., Ltd.
Mercury (Hg)	mg/L	Cold-Vapor AAS Method	0.0003	<0.0003	<0.0003	<0.0003	STS Green Co., Ltd.
Lead (Pb)	mg/L	Electrothermal AAS Method	0.0020	<0.0020	<0.0020	<0.0020	STS Green Co., Ltd.
Cadmium (Cd)	mg/L	Electrothermal AAS Method	0.00005	0.00006	<0.00005	<0.00005	STS Green Co., Ltd.
Copper (Cu)	mg/L	Direct Air-Acetylene Flame Method	0.05	<0.05	<0.05	<0.05	STS Green Co., Ltd.
Iron (Fe)	mg/L	Direct Air-Acetylene Flame Method	0.10	0.31	1.28	<0.10	STS Green Co., Ltd.
Tin (Sn)	mg/L	Based on APHA (2012), 3125	0.0001	0.0002	<0.0001	<0.0001	ALS Laboratory Group (Thailand)
Manganese (Mn)	mg/L	Direct Air-Acetylene Flame Method	0.04	0.41	1.90	<0.04	STS Green Co., Ltd.
Total Nitrogen	mg/L	Based on APHA (2012), Calculated	1.0	12.1	1.1	5.2	ALS Laboratory Group (Thailand)
Total Phosphorous	mg/L	Acid Digestion/Ascorbic Acid Method	0.005	1.63	0.036	0.036	STS Green Co., Ltd.
Zinc (Zn)	mg/L	Direct Air-Acetylene Flame Method	0.02	<0.02	0.53	0.02	STS Green Co., Ltd.
Nickel (Ni)	mg/L	Electrothermal AAS Method	0.0005	<0.0005	0.0036	0.0191	STS Green Co., Ltd.
Chloride (Cl)	mg/L	Mercuric Nitrate Method	1.0	6,861	1,516	73.6	STS Green Co., Ltd.

Sediment Analysis Result

Project Name: Ahlone Expansion Combined Cycle Power Plant and FSRU Project to supply power to the Republic of the Union of Myanmar

Sampling by: ERM-Siam Co., Ltd.

Parameter	Unit	Method Analysis	LOQ	Results						Laboratory
				SED1	SED2	SED3	SED4	SED5	SED6	
Particle Size Distribution										
- Sand	%	Hydrometer Analysis	-	51.7	6.5	2.4	1.3	1.0	5.7	STS Instrument Co., Ltd.
- Silt	%	Hydrometer Analysis	-	27.4	69.4	60.6	61.7	49.2	38.2	STS Instrument Co., Ltd.
- Clay	%	Hydrometer Analysis	-	20.9	24.1	37.0	37.0	49.8	56.1	STS Instrument Co., Ltd.
Total Organic Carbon (TOC)	%	Based on US EPA, Method 9060	0.1	0.15	0.19	0.30	0.29	0.37	0.63	ALS Laboratory Group (Thailand)
TPH (C10 – C36)										ALS Laboratory Group (Thailand)
- C10-C14	mg/kg	Based on US EPA, Method 3570 and 8015B	5	<5	<5	<5	<5	<5	<5	
- C15-C28	mg/kg	Based on US EPA, Method 3570 and 8015B	10	<10	<10	<10	<10	<10	<10	
- C29-C36	mg/kg	Based on US EPA, Method 3570 and 8015B	10	<10	<10	<10	<10	<10	<10	
Total Oil	mg/kg (wet)	Soxhlet Extraction Method	20.0	34.97	264	125	145	200	232	STS Green Co., Ltd.
	mg/kg (dry)	Soxhlet Extraction Method	20.0	70.72	431	198	273	321	410	
Arsenic	mg/kg	Hydride Generation AAS Method	0.04	0.34	0.40	0.35	0.39	0.30	0.42	STS Green Co., Ltd.
Barium	mg/kg	Direct Nitrous Oxide-Acetylene Flame Method	5.00	12.65	24.39	25.72	24.99	17.06	12.41	STS Green Co., Ltd.
Cadmium	mg/kg	Direct Air-Acetylene Flame Method	1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	STS Green Co., Ltd.
Chromium	mg/kg	Direct Air-Acetylene Flame Method	2.50	16.49	26.96	30.99	32.74	31.47	31.04	STS Green Co., Ltd.
Copper	mg/kg	Direct Air-Acetylene Flame Method	1.50	14.12	21.61	27.21	24.04	26.09	28.99	STS Green Co., Ltd.
Lead	mg/kg	Direct Air-Acetylene Flame Method	5.00	14.57	20.84	23.96	24.08	21.92	26.50	STS Green Co., Ltd.
Mercury	mg/kg	Cold-Vapor AAS Method	0.10	0.14	0.18	0.23	0.21	0.24	0.27	STS Green Co., Ltd.
Nickel	mg/kg	Direct Air-Acetylene Flame Method	2.00	47.63	68.88	81.12	78.37	80.58	78.57	STS Green Co., Ltd.

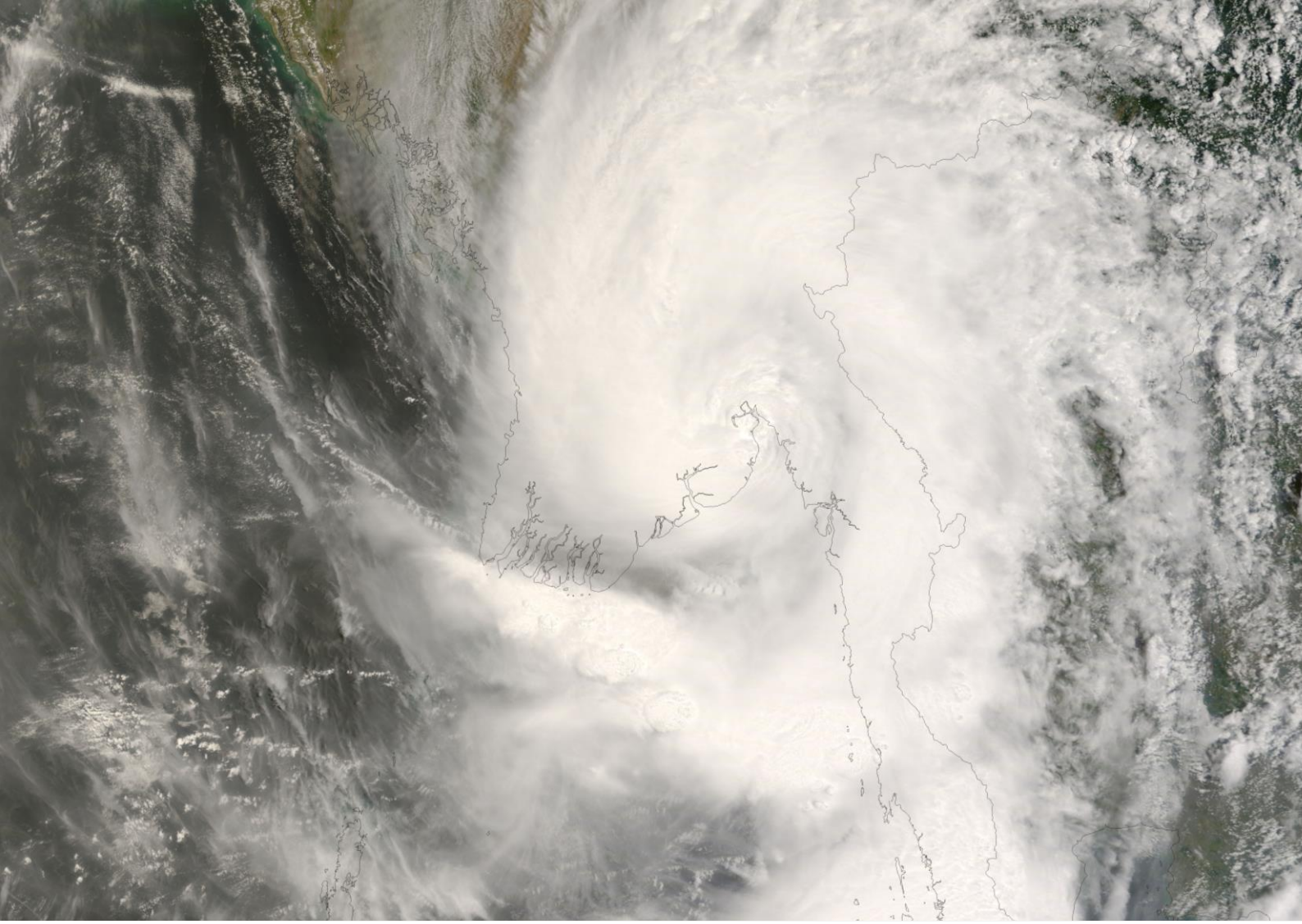
Benthos Analysis Result

Project Name: Ahlone Expansion Combined Cycle Power Plant and FSRU Project to supply power to the Republic of the Union of Myanmar

Sampling by: ERM-Siam Co., Ltd.

Phylum/Species	Stations				
	SED1	SED3	SED4	SED5	SED6
PHYLUM ANNELIDA					
Class Polychaeta (ไส้เดือนทะเล)					
Order Sabellida					
Family Oweniidae	16				
Class Sipunculidea					
Order Sipunculiformes					
Family Sipunculidae (หนอนถั่ว)					8
PHYLUM NEMERTEA					
Class Enopla					
Order Heteronemertea (ริบบิ้น)		8			
PHYLUM ARTHROPODA					
Class Malacostraca					
Order Decapoda					
Family Alpheidae					
Alpheus sp.	24				
Family Dorippidae					
Dorippe sp.	8				
Family Penaeidae					
Penaeus sp.			24	8	
Order Isopoda					
Family Cymothoidae (เห็บปลา)				8	8
PHYLUM MOLLUSCA					
Class Gastropoda (หอยฝาเดียว)					
Order Neogastropoda					
Family Nassariidae					
Nassarius sp.		8			
Total (Orgs/m^2)	**48**	**16**	**24**	**16**	**16**
Number of Species	**3**	**2**	**1**	**2**	**2**
Diversity Index	**1.01**	**0.69**	**-**	**0.69**	**0.69**
Richness Index	**0.52**	**0.36**	**-**	**0.36**	**0.36**
Evenness Index	**0.92**	**1.00**	**-**	**1.00**	**1.00**

APPENDIX P PHYSICAL BASELINE DATA ANALYSIS FOR WET SEASON FROM STS GREEN



Climate Vulnerability Assessment of LNG Power Plant (Ahlone) Project in Yangon, Myanmar Climate Vulnerability Assessment of LNG Power Plant (Ahlone) Project in Yangon, Myanmar

ESIA Report

23 June 2020

Project No.: 0439461

The business of sustainability

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Climate Vulnerability Assessment of LNG Power Plant (Ahlone) Project in Yangon, Myanmar Climate Vulnerability Assessment of LNG Power Plant (Ahlone) Project in Yangon, Myanmar

ESIA Report

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1. INTRODUCTION

Toyo Thai Power Myanmar Company Limited ('TPMC') is planning the Ahlone development (hereafter referred to as 'the Project') which involves the construction and operation of a 388 MW liquefied natural gas (LNG) power plant, LNG receiving terminal, natural gas pipeline and transmission line in Ahlone Township, Yangon, Myanmar.

According to Global Climate Risk Index 2020, Myanmar is among the top countries most affected by extreme weather events (Ekstein et al., 2019). As demonstrated by recent natural disasters such as Cyclone Nargis in 2008, the extreme heat waves in 2010, and major flooding in 2015, climate change could yield higher risk of catastrophic impacts on Myanmar. This study aims to support TPMC in understanding climate threats and vulnerability of the Project as well as to provide primary adaptation recommendations.

1.1 Scope of this report

The scope of this study encompasses LNG Receiving Terminal, Combined Cycle Power Plant (hereafter, 'Power Plant'), Natural Gas Pipeline (hereafter, 'Pipeline') and Transmission Line, with the locations as shown in **Table 1**. Considering an overall project lifetime of 25 years, the future perspective of climate threats covered in this study spans until around 2050.

Table 1 Location of Four Main Project Components

Component	Latitude	Longitude	Area (ha)
Power Plant	16.775458°	96.128207°	3.63 approx.
LNG Receiving Terminal	16.655321°	96.232693°	6.07 approx.
Pipeline	Start: 16.656065° End: 16.775192°	Start: 96.231374° End: 96.127198°	Length: 24.9 km
Transmission Line	Start: 16.766651° End: 16.883596°	Start: 96.123958° End: 96.004889°	Length: 25 km

1.2 Methodology

The rapid assessment methodology employed in this study is adapted from climate change adaptation and mitigation methodology (CAM) developed by International Centre for Environmental Management (ICEM, 2011) and recognized by Asian Development Bank (ADB, 2012b). Three major steps includes climate threats analysis, project vulnerability assessment and adaptation recommendation formulation. In the first step, climate threats analysis, trends and future climate projections of each climate threat are reviewed. The climate scenarios applied in in various sources of information are shown in **Table 2**.

Table 2 Climate Scenarios Applied in Climate Projections

Sources	Scenarios applied
Horton et al., 2017a, 2017b	RCP8.5
World Bank Group, 2020	RCP8.5
ThinkHazard 2017, 2020	Not specified*
IPCC, 2013	Not specified

* Future projections reported are based on expert judgement of frequency and severity.

2. CLIMATE THREATS ANALYSIS

According to literature review, four major climate threats relevant for the Project site in Yangon are; air temperature rise and heat waves, storms, flooding and drought (ADB, 2012a, 2012b; Horton et al., 2017a, 2017b.; NAPA, 2012; ThinkHazard, 2020; USAID, 2017). Trends and future projections of these threats towards 2050 are summarized in **Table 3**.

Based on the Project timeline, site preparation activities started from April 2018 with constructions beginning in January 2020. The Project lifetime is 25 years from the Commercial Operation Date (COD) of Power Plant, tentative in April 2022. Thus, timeframe of future projections until approximately 2050 of climate threats analysis is considered relevant for this study.

Table 3 Trends and Future Projections Towards 2050 of Four Climate Threats Influencing the Project Site

Climate Threats	Trends and Future Projections Towards 2050	
Air temperature rise and heat waves	Increase ⬆	■ Annual mean temperature in Yangon deltaic region is expected to increase 1.2 - 2.4°C (reaching 28.8°C – 30.0°C) in 2041 – 2070 compared to 1980 – 2005 baseline (Horton et al., 2017a). ■ At the Project site, annual mean temperature is likely to hit 28.7 – 30.1°C in 2040–2059, compared to 27.6°C baseline in 1986-2005 (RCP8.5) (World Bank Group, 2020). ■ Referring to extreme heat days as those exceeding 38.3°C, the number of extreme heat day in coastal areas of Myanmar including Yangon is expected to increase from 1 day per month (1981-2010 baseline) up to 8 - 17 days in 2041 – 2070 (Horton et al., 2017b). ■ At the Project site, the number of days with temperature exceeding 40°C, would increase to 15 days annually in 2040 – 2059 (RCP8.5), with high estimate up to 63 days (90th Percentile), compared to 1980 – 2005 baseline (World Bank Group, 2020). ■ Yangon area's extreme heat hazard is classified as 'high' meaning that heat stress (WetBulb Globe Temperature above 32°C), is expected to occur at least once in the next five years (ThinkHazard, 2017, 2020).
Storms	Increase ⬆	■ Globally, it is possible that average tropical cyclone wind speed and rainfall will increase in the future, while the frequency of tropical cyclones will decrease or remain unchanged. The frequency of the most intense tropical cyclones will increase substantially in some ocean regions (IPCC, 2013). ■ Growth in intensity and frequency of cyclone/strong winds in Myanmar has been observed. Since 2000, the landfall frequency of cyclones along Myanmar's coast has shifted from once every three years to once every year (World Bank Group, 2020). ■ In terms of cyclone hazard, Yangon area has more than 20% chance to experience potentially-damaging wind speeds (exceeding 80 km per hour) in the next 10 years (ThinkHazard, 2017, 2020).
Flooding (including sea level rise, river flooding, storm surge and flash flood from heavy rainfall)	Increase ⬆	■ Extreme rain during monsoon is expected to increase in East, South, and Southeast Asia (IPCC, 2013). ■ Myanmar has observed an increase in the occurrence of flooding and storm surge. Between 1910 and 2000, there have been 12 major floods in the country (World Bank Group, 2020).

Climate Threats	Trends and Future Projections Towards 2050	
		■ As cited in Notice of High Tide by Myanmar Port Authority, the recent serious level of high tides which caused serious flooding (higher than 6.71 m above the chart datum) nearby the Project area was recorded in year 2014 and 2015 (MPA, 2020). Nonetheless, in 2018, media also reported a major flooding in various Township in Yangon including the Project site with the upper estimate of 6.56 above the chart datum (Myanmar Water Portal, 2018). ■ Annual average precipitation in Yangon deltaic region is expected to increase by 5 – 24% (reaching 2,730 mm – 3,224 mm) in 2041 – 2070 compared to 1980 – 2005 baseline (Horton et al., 2017). ■ Projections in sea level rise for Myanmar indicate a rise of 20 – 40 cm or 56 cm in a high estimate by 2041 – 2070 and 37-81 cm in 2071 - 2100, with the potential to be as high as 121 cm at the end of the century, compared to 2000 – 2004 baseline (Horton et al., 2017). ■ Coastal flood in Yangon area is classified as high meaning that potentially-damaging floods (>2 m) are expected to occur at least once in the next 10 years (ThinkHazard, 2017, 2020). ■ There is more than 10% chance that potentially damaging and life-threatening river floods (>0.5 m) will occur in Yangon area in the coming 10 years (ThinkHazard, 2017, 2020).
Drought	Increase ⬆	■ Severe droughts in South-East Asia are often triggered by El Niño events and they are likely to become more intense owing to the variation in rainfall and projected high temperature (UNESCAP, 2020). ■ Although it is projected that the annual average precipitation in Yangon deltaic region will increase in 2041 – 2070, the low estimates suggest that the precipitation in hot season (March to May) and Cool season (November to February) could be as low as 288 mm and 95 mm, respectively, (- 4% and - 5% below 1980 – 2005 baseline) (Horton et al., 2017). ■ Episodes of extreme drought in Myanmar (i.e. 2010, 2014-2015) have had severe impacts in many regions including Yangon (Yi et al., 2013; UNESCAP, 2020). However, there has yet been any reports on problematically low water level in major rivers such as Yangon river where the project site is located.

3. PROJECT VULNERABILITY ASSESSMENT

Based on our analysis on the sensitivity of four main project components against climate threats altogether with adaptation and mitigation capabilities, in order to assess the project vulnerability, the result suggests that Power Plant and LNG Receiving Terminal are particularly vulnerable to two climate threats; storms and flooding (**Table 4**). Therefore, the following section will mainly focus on these two project components.

Table 4 Vulnerability Assessment of Project Components

Climate Threats	LNG Receiving Terminal		Power Plant	
Air temperature rise and heat waves	Low	Increased air temperature lowers the efficiency of heat exchanger in a gas engine generator which results in a minor decrease in energy efficiency. Heated river water due to increased air temperature could have a slightly positive impact on regasification unit. The overall impact and vulnerability is considered marginal.	Low	Increased air temperature lowers the efficiency of combined cycle gas turbine, electrical generator and transformers. Heated river water due to increased air temperature can also reduce the efficiency of cooling system. Although the impact is more pronounced in Power Plant than LNG Receiving Terminal, the overall impact on net energy efficiency remains relatively low. Likewise, for the vulnerability.
Storms	High	Storms may result in property damage in various degrees, depending on the wind speed. Strom induced heavy rainfall may result in riverine flooding, storm surge and flash flood that inundate property and equipment. Less complex equipment at LNG Receiving Terminal and a possibility to halt the operation in preparation for the storm would make it less vulnerable compared to Power Plant.	High	The impact of storms on Power Plant is similar to LNG Receiving Terminal but more severe due to its relatively more sensitive equipment and system. Furthermore, lightning strike which causes power surge is particularly concerned in Power Plant. This renders the vulnerability of Power Plant high in case of storms.
Flooding	High	Flooding might make LNG Receiving Terminal out of service for a certain period of time and cause property damage. This results in an additional maintenance cost and potential of supply interruption. With help of onsite LNG storage, the vulnerability to flooding is considered medium.	High	Complex electricity generation equipment at Power Plant makes it highly vulnerable to floods. This can result in property damage, extra maintenance cost, efficiency drop, and operational disruption with higher costs and greater consequences than LNG receiving terminal. Therefore, the vulnerability is considered high.
Drought	Low	LNG Receiving Terminal relies on water for regasification of natural gas. So far, droughts in Yangon have been problematic for inland areas that have no direct access to major stream. Since LNG Receiving Terminal is located on a major river bank near delta area, the vulnerability to drought, if any, is considered low.	Low	Availability of water is crucial for cooling process of Power Plant. A constrain on warm water discharge in alignment with environmental standard may emerge in case of extremely low tide. Droughts in Yangon so far have been problematic only for inland areas without direct access to major stream. Because Power Plant is located on a major river bank, albeit higher up on a smaller stream compared to LNG Receiving Terminal, the vulnerability to drought, if any, remains low.

4. DISCUSSION AND RECOMMENDATION

4.1 Air temperature rise and heat waves

Gradual increase in average air temperature and acute occurrences of extreme heat days (aka heat waves) can have minor but appreciable impact on the project. While the air temperature and river water temperature are linked together, the literature suggests that water temperature could have a greater impact on CCGT plant's efficiency compared to air temperature. Some studies indicated that every 1°C rise of air temperature can result in 0.01% drop in net efficiency of CCGT, compared to 0.06% for water (ADB, 2012b). Regarding the transformers present in Power Plant, a loss of 1% load may be expected for every 1 °C rise (ADB, 2012b). While these may seem negligible, it is noteworthy that peak electricity demands may coincide with hot periods.

Mitigation and Adaptation Opportunities

Energy-efficient measures to lower the temperature of air and water intake may deserve to be considered along with economic feasibility. Furthermore, since the change in temperature and climate patterns can affect both the efficiency, lifetime and maintenance of various components, mean temperature rise and climate variability (range of temperature and humidity) should be considered in purchasing and design criteria of machines and devices. These include but not limited to; cryogenic Pipeline, LNG storage tanks, regasification unit, gas engine generator and monitoring and control devices at LNG Receiving Terminal. For Power Plant, these include cooling system, electrical generators, transformers, switchyard, and monitoring and control devices.

4.2 Storms and flooding

Degrees of damage caused by storms and flooding are highly variable depending on the intensity, duration and frequency. Communities residing in coastal and delta area of Myanmar are among the most vulnerable over the next decades, due to a mix of exposure to sea level rise, storm surge, winds, and intense rainfall (Rao et al., 2013). With higher certainty than tropical cyclone, flood risk in the Project area is coherently classified by many sources of information as 'high.' Temporary flooding (i.e. flash flood, storm surge) may render the facility unavailable for a certain period of time and/or compromise operational efficiency. Permanent flooding as a result of sea level rise would lower the threshold of temporary flooding, thus, increasing the frequency and severity of temporary flooding.

Mitigation and Adaptation Opportunities

In case of thunderstorm, ensuring that construction of buildings and structures is in line with recognized wind-resilience standards is recommended. Sensitive areas (i.e. valves, emergency systems, control rooms) should be well-protected from wind, water, as well as air- and waterborne objects. Lightning and power surge protection system should be in place.

Furthermore, property elevation and/or installation of flood defence barrier are highly recommended along with the use of flood control measures i.e., well-maintained drainage channels and water pumps.

Key considerations for property elevation/ flood barrier

- A midrange estimation of sea level rise in 2041 – 2070 is 20 - 40 cm above 2000 – 2004 baseline with a possibility to reach 56 cm in a high estimate (Horton et al., 2017).
- There is more than 10% chance that potentially damaging and life-threatening river floods (>0.5 m) will occur in Yangon area in the coming 10 years (baseline year not available) (ThinkHazard, 2017, 2020).
- A rare case of extremely high water level during cyclone Nagis in 2009 was estimated to be +7.10 m above Low Water Spring Tide (LWST) at Yangon port (NK & OCDI, 2015) See **Appendix A**.

The height of property elevation/ flood barrier of both LNG Receiving Terminal and Power Plant should be at least 1.30 m above High Water Level Springs (HWLS), equivalent to +7.50 m above LWST gauge datum measured at Yangon port (Sule Pagoda Wharf), in order to withstand the worst case scenario of coincidental 0.56 m sea level rise and 0.5 m river flood. Additionally, one may consider using concrete instead of metal in property elevation for maximum durability against wind and erosion.

Regarding the management side, emergency response plan in case of flood and cyclone (as well as other non-climate change related natural hazards) should be implemented with periodic refreshment trainings. Finally, an insurance policy covering natural hazards is strongly recommended.

4.3 Drought

Among four main project components, only LNG Receiving Terminal and Power Plant rely on river water for regasification and cooling process – for heat transfer proposes without major consumptive uses. Extremely low level of river water caused by drought may prohibit water withdrawal and constrain water discharge due to water temperature exceeding environmental standards. Although drought issue does occur in Yangon area (i.e. Dala Township), it is restricted to inland areas where people lack water utility and equipment to transport river water to agricultural lands. Records of extremely low water level in Yangon river as well as its upstream rivers, Bago and Hliang river, were not found, reflecting a consistent availability of river water even during extreme drought periods. With climate projections suggesting a higher precipitation in the future and the locations of LNG Receiving Terminal and Power Plant on the river bank, the vulnerability of the Project regarding drought is limited.

Mitigation and Adaptation Opportunities

With a small likelihood of low water level that could prohibit warm water discharge, it is recommendable to reserve some space for installation of additional discharge water cooling system which might become necessary in the future.

Despite the low physical impact, the perception of surrounding communities on plant's water usage could potentially lead to social licence-to-operate issues. We therefore recommend that the company engage with local community to provide support on water access along with information on plant's usage of water for cooling and not for large-scale consumption. Community relation programs such as pond construction and/or maintenance as well as water purification facilities might be highly beneficial for local community.

5. SUMMARY

Based on Climate Change Adaptation and Mitigation methodology (CAM), four climate threats are identified; air temperature rise and heat waves, storms, flooding and drought. Vulnerability assessment was carried out against four project components of Ahlone development project including Power Plant, LNG receiving terminal, Pipeline and Transmission line. The result highlights that Power Plant and LNG receiving terminal are particularly vulnerable to storms and flooding. Key recommendations on mitigation and adaptation opportunities are summarized **Table** 5**5**.

Table 5 Summary of Mitigation and Adaptation Opportunities

Climate Threats	Project Components	
	LNG Receiving Terminal	Power Plant
Storms	■ Implement storm protection measures in sensitive areas (i.e. valves, emergency systems, control rooms) ■ Implement emergency response plan	■ Implement storm protection measures in sensitive areas (i.e. valves, emergency systems, control rooms) ■ Install lightning and power surge protection system ■ Implement emergency response plan
Flooding	■ Elevate property level or construct flood barrier using concrete (+7.50 m above LWST gauge datum measured at Yangon port, Sule Pagoda Wharf) ■ Ensure effective flood control measures (i.e. drainage channels, water pumps) ■ Implement emergency response plan ■ Insurance policy covering natural hazards	■ Elevate property level or construct flood barrier using concrete (+7.50 m above LWST gauge datum measured at Yangon port, Sule Pagoda Wharf) ■ Ensure effective flood control measures (i.e. drainage channels, water pumps) ■ Implement emergency response plan ■ Insurance policy covering natural hazards

N/A = Not Available

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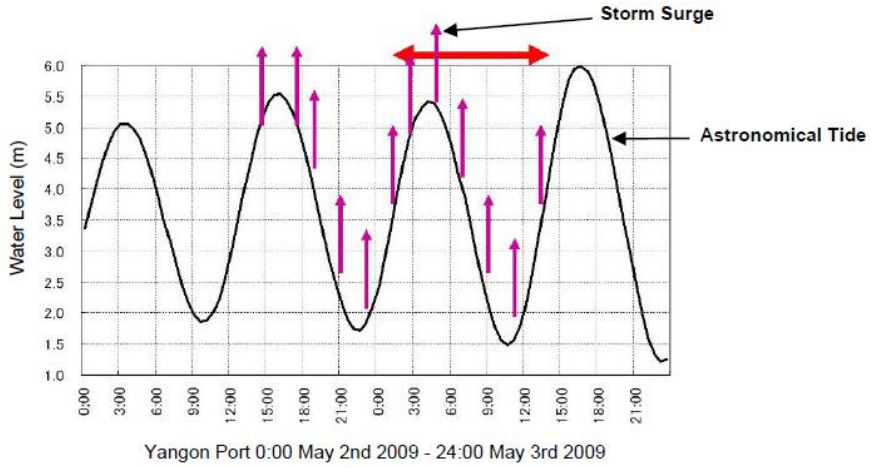
APPENDIX A – HISTORIAL WATER LEVELS IN PROJECT AREA

The information in APPENDIX A is obtained from: The Urgent Project for Rehabilitation of Yangon Port and Main Inland Water Transport in the Republic of the Union of Myanmar FINAL REPORT Retrieved from http://open_jicareport.jica.go.jp/pdf/12230678_01.pdf and http://open_jicareport.jica.go.jp/pdf/12230678_04.pdf.

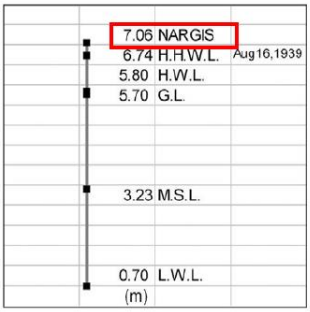
Tidal levels based on the available tide table and information obtained from Myanmar Port Authority

- Extremely High Water Level: +7.10 m (Nargis estimate)
- Highest High Water Level: +6.74 m (Sule Pagoda Wharf on 16 Aug. 1939)
- High Water Level Springs (HWLS) : +6.20 m
- Mean Water Level: +3.23 m (Sule Pagoda Wharf in 1954)
- Low Water Level Springs (LWLS): +0.34 m
- Low Water Spring Tide: ±0.00 m
- Lowest Low Water Level: -0.24 m (Bo Aung Kyaw Wharf in Dec. 1902)

Figure 1 Astronomical and Actual Water Level During Storm Surge

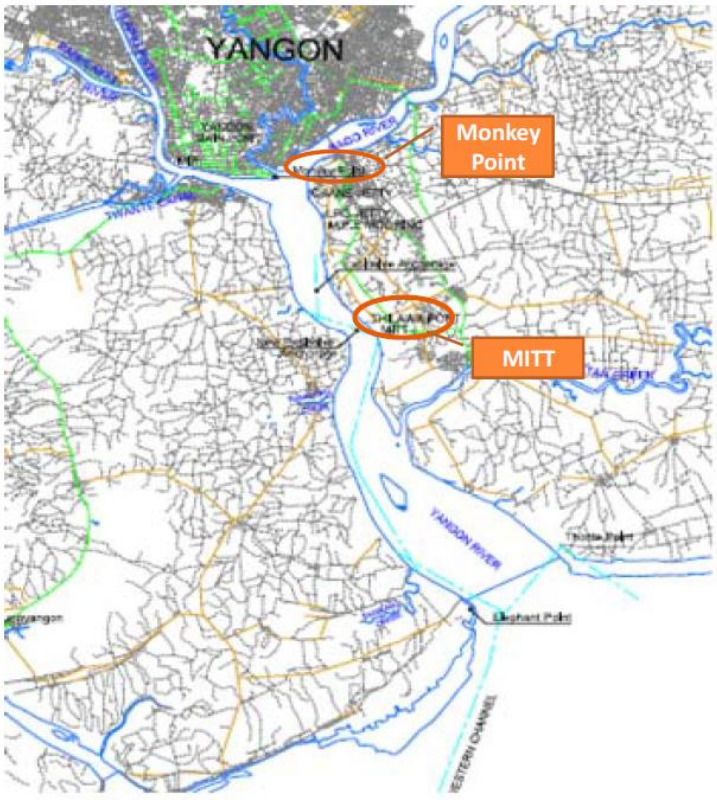


Source: Port and Airport research Institute (PARI), No.1192, 2009



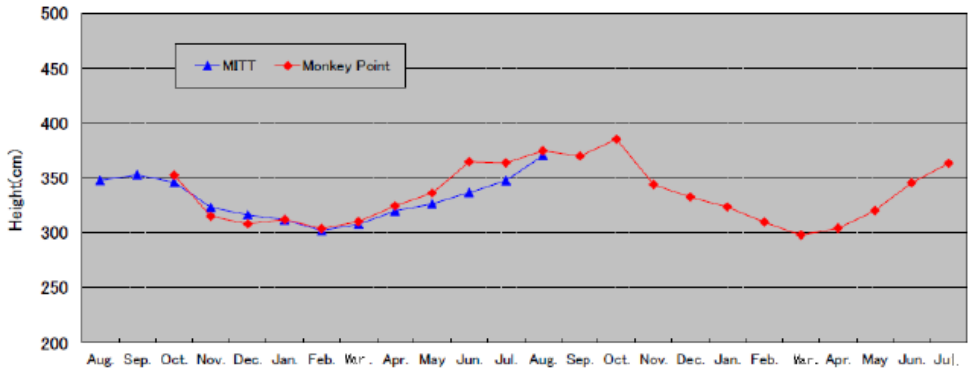
Source: Port and Airport research Institute (PARI), No.1192, 2009

Figure 2 Location of Two Tidal Guages Nearby LNG Receiving Terminal and Power Plant



Source: JICA Project Team

Figure 3 Variation of Monthly Mean Water Level at MITT and Monkey Point Station



Source: JICA Project Team

Figure 12.2.13 Variation of Mean Water Level

Table 4 Comparison of Datum Level

Datum	MPA Tide Table	Monkey Point Observation
Highest H-W at Sule Pagoda Wharf (1899)	+6.74	
Highest H-W at Bo Aung Kyaw Street Wharf (1939)	+6.664	
HWL		+6.441
NHHW		+6.188
MSL(Mean Water Level)		+3.384
Mean Water Level at No.7 Sule Pagoda Wharf (1954)	+3.234	
Mean Water Level at Bo Aung Kyaw Street Wharf (1936)	+3.121	
Mean Water Level at Pilakat Creek	+2.966	
Amherst MSL	+2.73	
LWL		+0.640
NLLW (Indian Spring Low Water Mark)	+0.338	+0.58
Datum of soundings = LWST (Dry season)	+0.000	
Lowest L.W at Bo Aung Kyaw Street Wharf (1902)	-0.24	

Source: MPA and JICA Project Team

APPENDIX Q CLIMATE VULNERABILITY ASSESSMENT

APPENDIX R INVASIVE SPECIES IN MYANMAR

Taxonomic group	Species	Common name	IUCN Red List Category
Bacteria	*Yersinia pestis*	Bubonic Plague	NL
Birds	*Acridotheres tristis*	Common Myna	LC
Birds	*Anas platyrhynchos*	Mallard	NL
Birds	*Anser anser*	Greylag Goose	LC
Birds	*Columba livia*	Rock Dove	LC
Birds	*Gallus gallus*	Red Junglefowl	LC
Birds	*Passer domesticus*	House Sparrow	LC
Birds	*Porphyrio porphyrio*	Purple Swamphen	LC
Birds	*Psittacula krameri*	Rose-ringed Parakeet	LC
Birds	*Pycnonotus jocosus*	Red-whiskered Bulbul	LC
Birds	*Streptopelia decaocto*	Eurasian Collared-dove	LC
Birds	*Zosterops japonicus*	Japanese White-eye	LC
Coral	*Tubastraea coccinea*	Orange-Cup Coral	NL
Fish	*Clarias gariepinus*	African Catfish	LC
Fish	*Ctenopharyngodon idella*	Myak sar nga chin	NL
Fish	*Cyprinus carpio*	Shwe war nga gyin	NL
Fish	*Gambusia affinis*	Western Mosquitofish	LC
Fish	*Hypophthalmichthys nobilis*	Bighead Carp	DD
Fish	*Oreochromis aureus*	Blue Tilapia	NL
Fish	*Oreochromis spp.*	Freshwater Snapper	NL
Fish	*Poecilia reticulata*	Guppy	NL
Fish	*Carassius auratus*	Goldfish	LC
Fish	*Channa marulius*	Nga-yan-daing	LC
Fish	*Clarias batrachus*	Nga-khoo	LC
Fish	*Lutjanus kasmira*	Common Bluestripe Snapper	LC
Fish	*Misgurnus anguillicaudatus*	Pond loach	LC
Fish	*Monopterus albus*	Rice swampeel	LC
Fungi	*Raffaelea lauricola*	-	NL
Invertebrates	*Aedes aegypti*	Yellow Fever Mosquito	NL
Invertebrates	*Brontispa longissima*	Coconut Hispid Beetle	NL
Invertebrates	*Paratrechina longicornis*	Crazy Ant	NL
Invertebrates	*Solenopsis geminata*	Fire Ant	NL
Invertebrates	*Tapinoma melanocephalum*	Black-Headed Ant	NL
Invertebrates	*Trogoderma granarium*	Khapra Beetle	NL

Taxonomic group	Species	Common name	IUCN Red List Category
Invertebrates	*Anoplolepis gracilipes*	Yellow Crazy Ant	NL
Invertebrates	*Anoplophora chinensis*	Citrus Longhorn Beetle	NL
Invertebrates	*Bellamya chinensis*	Chinese Mystery Snail	LC
Invertebrates	*Diaphorina citri*	Asian citrus psyllid	NL
Invertebrates	*Maconellicoccus hirsutus*	Hirsutus mealybug	NL
Invertebrates	*Monomorium floricola*	Bicoloured trailing ant	NL
Invertebrates	*Oryctes rhinoceros*	Coconut rhinoceros beetle	NL
Invertebrates	*Xyleborus glabratus*	Redbay ambrosia beetle	NL
Invertebrates	*Xylosandrus mutilatus*	Camphor shoot beetle	NL
Mammals	*Rattus exulans*	Polynesian rat	LC
Mammals	*Herpestes auropunctatus*	Small Indian Mongoose	LC
Mammals	*Macaca mulatta*	Rhesus Monkey	LC
Mammals	*Rusa unicolor*	Sambar	VU
Mammals	*Suncus murinus*	House Shrew	LC
Mammals	*Viverricula indica*	Small Indian Civet	LC
Plants	*Acacia longifolia*	Alpine Wattle	LC
Plants	*Acacia mangium*	Black Wattle	NL
Plants	*Alternanthera philoxeroides*	Alligatorweed	NL
Plants	*Cardamine flexuosa*	Wavy Bittercress	NL
Plants	*Chromolaena odorata*	Bitter Bush	NL
Plants	*Eichhornia crassipes*	Water Hyacinth	NL
Plants	*Imperata cylindrica*	Blady Grass	NL
Plants	*Leucaena leucocephala*	Lead Tree	NL
Plants	*Limnocharis flava*	Sawah-Flower Rush	NL
Plants	*Prosopis spp.*	Mesquite	NL
Plants	*Ziziphus mauritiana*	Indian jujube	NL
Plants	*Acanthophora spicifera*	Red Alga	NL
Plants	*Adenanthera pavonina*	Bead Tree	NL
Plants	*Abrus precatorius*	Bead Vine	NL
Plants	*Albizia julibrissin*	Mimosa	NL
Plants	*Alpinia zerumbet*	Shell-Ginger	NL
Plants	*Alternanthera sessilis*	Sessile Joyweed	LC
Plants	*Ardisia crenata*	Coral Berry Tree	NL
Plants	*Arundo donax*	Giant Reed	NL

Taxonomic group	Species	Common name	IUCN Red List Category
Plants	*Caesalpinia decapetala*	Mauritius thorn	NL
Plants	*Casuarina equisetifolia*	Australian pine tree	NL
Plants	*Colubrina asiatica*	Asian nakedwood	NL
Plants	*Dalbergia sissoo*	Indian Rosewood	NL
Plants	*Dioscorea bulbifera*	Air Yam	NL
Plants	*Epipremnum pinnatum*	Centipede Tongavine	NL
Plants	*Ficus microcarpus*	Chinese banyan	NL
Plants	*Hiptage benghalensis*	Hiptage	NL
Plants	*Hygrophila polysperma*	Dwarf Hygrophila	LC
Plants	*Lespedeza cuneata*	Chinese bush-clover	LC
Plants	*Limnophila sessiliflora*	Asian marshweed	LC
Plants	*Lotus corniculatus*	Common Bird's-foot-trefoil	NL
Plants	*Melilotus alba*	White Sweet Clover	NL
Plants	*Neyraudia reynaudiana*	Burma reed	NL
Plants	*Nypa fruticans*	Nypa Palm	NL
Plants	*Paederia foetida*	Chinese fever vine	NL
Plants	*Paspalum scrobiculatum*	Kodo Millet	LC
Plants	*Persicaria perfoliata (L.) H. Gross*	Asiatic tearthumb	NL
Plants	*Rottboellia cochinchinensis*	Corn grass	NL
Plants	*Rubus niveus*	Snowpeaks raspberry	NL
Plants	*Rumex crispus*	Curly Dock	NL
Plants	*Senegalia catechu*	Black catechu	NL
Plants	*Syzygium cumini*	Java Plum	NL
Plants	*Terminalia catappa*	Indian-almond	NL
Plants	*Trachycarpus fortunei*	Chinese fan palm	NL
Plants	*Zizania latifolia*	Manchurian wild rice	NL
Reptiles	*Hemidactylus frenatus*	Asian house gecko	LC
Reptiles	*Python molurus bivittatus*	Burmese Python	VU
Virus	*Babuvirus: Banana bunchy top virus*	-	NL

Notes: *NE – Not Evaluated*
VU – Vulnerable
DD – Data Deficient
LC – Least Concern
NL – Not Listed

INSTRUCTIONS

ညွှန်ကြားချက်

1) The interviewer(s) should first make contact with the village/ward leader/representative who may wish to accompany the Interviewer(s) or to nominate a representative to do so. Stakeholder Engagement will have been done previously but upon arrival in the village, contact should be made with leaders anyway.
2) The HH survey questionnaire is to be used in 7 townships including Dala, Ahlone, Seikgyikanaungto, Thanlyin, Seikkan, Dagon, Lanmadaw.
3) The survey will focus on households located close to the project.
4) If a household is considered vulnerable, it/ they should be prioritized. During meeting with village/Ward leader, question should be asked whether there are more vulnerable households in the village (women headed household, household with handicapped people, chronic diseases etc.)
5) The interviewee may be any adult over 18 years of age. Identity of the respondent should be recorded as well as his link to the head of the household.
6) Throughout this survey, *** in the margin indicates instructions to interviewer. These instructions are not to be read to the interviewee.
7) This survey questionnaire includes six parts: basic household information (Part A), socio-economic information (Part B); housing information (Part C); health profile (Part D); access to infrastructure and energy (Part E); and understanding and perceptions of the project (Part F).
8) Read the following to interviewees.

၁လူတွေ့မေးမြန်းမည့်သူနှင့် (လိုက်ပါဆောင်ရွက်ရန်ဆန္ဒရှိသူ ရွာ/ရပ်ကွက် လူကြီးတာဝန်ခံဖြင့် ပထမဦးစွာ ဆက်သွယ်ဆောင်ရွက်ရန် သို့မဟုတ် လိုက်ပါဆောင်ရွက်မည့် ကိုယ်စားလှယ်ခံထားရန်။

၂ (ဒလ၊ အလုံ၊ ဆိပ်ကြီးခနောင်တို၊ သန်လျင်၊ ဆိပ်ကမ်း၊ ဒဂုံ၊ လမ်းမတော် (၇) မြို့နယ်ကို လူမှုစီးပွားအခြေအနေများနှင့် ပတ်သက်သည့်စစ်တမ်းကို ပြုလုပ်ပါမည်။

၃ (ယခုစစ်တမ်းသည်စီမံကိန်း၏အနီးအနားတွင်ရှိသောအိမ်ထောင်စုများကို အဓိကထား၍ ဆန်းစစ်ပါမည်။

၄ (အိမ်ထောင်စုတစ်စုတွင် ထိခိုက်လွယ်သူများကို ထည့်သွင်းစဉ်းစား၍

၄င်းတို့ကို ဦးစားပေးဆောင်ရွက်သင့်ပါသည်။ ကျေးရွာရပ်ကွက်ခေါင်းဆောင်များနှင့် တွေ့ဆုံစဉ်တွင်လည်း/ ထိုကဲ့သို့ ထိခိုက်လွယ်သူများရှိသည့် အိမ်ထောင်စုများဖြစ်သော (အမျိုးသမီးဦးဆောင်သော အိမ်ထောင်စု၊ အားနည်းသူများကို အားပေးသော အိမ်ထောင်စုနှင့် သက်ကြီးရွယ်အို၊ နာမကျန်းသူများကဦးဆောင်သော အ
°မ်ထောင်စု အစရှိသည်တို့ ကို (ပို၍မေးမြန်းသင့်ပါသည်။

၅ (မေးခွန်းဖြေဆိုမည့်သူသည် အသက် ၁၈နှစ် ပြည့်ပြီးသူဖြစ်ရပါမည်။

၆ (ထိုစစ်တမ်း၏ မျဉ်းအတွင်း ပြထားသောကြယ်များသည် မေးခွန်းဖြေဆိုသူကို ရည်ညွှန်းရေးသားထားပါသည်။ ဤညွှန်ကြားချက်များအား ဖြေကြားသူမမဖတ်ရပါ။

၇ (ဤစစ်တမ်းတွင် အ ပိုင်းခြောက်ပိုင်း ပါဝင်ပါသည်။ အခြေခံအိမ်ထောင်စု သတင်းအချက်အလက်(အပိုင်း က), လူမှုစီးပွားရေးဆိုင်ရာ သ တင်းအချက်အလက်(အပိုင်း ခ), အိမ်အမျိုးအစား(အပိုင်း ဂ), ကျန်းမာရေးဆိုင်ရာသတင်း အချက်အလက်(အပိုင်း ဃ), စွမ်အင်နှင့်အခြေခံအဆောက်အအုံဂှရှိမှု အပိုင်း င)) စီမံကိန်းအပေါ်နားလည်မှုနှင့် သဘောထား(အပိုင်း စ)

၈ (ဖော်ပြပါအချက်လက်များအား လူတွေ့မေးမြန်းခြင်း ဖြေဆိုမည့်သူမှဖတ်ရန်။

As discussed in the Public participation engagement done earlier this week, we are here to conduct a survey on the social and socio-economic environment in the Project area to inform the Impact assessment study for Combine Cycle Power Plant (388 MW CCPP).

The proposed Project site is located Dala, Ahlone, Seikgyikanaungto, Thanlyin, Seikkan, Dagon, Lanmadaw Township

Environmental Resources Management (ERM), with Sustainable Environment Myanmar (SEM), have been asked by TTCL to conduct the independaygent EIA for the coal fired power plant project to satisfy the New EIA Procedure and other relevant requirements.

The purpose of the ESIA process is to assess the potential impacts of the Project activities on the biophysical and socio-economic environments and establish measures to mitigate the impacts.

The ESIA involves:

-Baseline studies, which are undertaken to establish an understanding of the existing environment.

-An impact assessment, which identifies what impacts that are likely to occur as a result of the Project – i.e. how will the baseline change.

-Development of management measures, which are designed to minimise the likely negative impacts and enhance the potential positive benefits of the Power Plant.

This survey forms a part of the socio-economic baseline study. The intention is to better understand the local communities. The ERM/ SEM team will spend time with members of the community to better understand local livelihoods and lifestyles.

Participation in this survey is voluntary and you may choose not to answer any of the questions. You may answer the questions in any way you like; there is no right or wrong answer. You may bring up other topics related to the Project.

Please note that your participation in this survey is not linked in any way to determination of entitlements for compensation.

Thank you for your help.

မကြာသေးခင်က ပြုလုပ်ခဲ့သည့် လူထုနှင့် ညှိနှိုင်းဆွေးနွေးပွဲအရ ထိုကြောင့် ၃၈၈ မဂ္ဂါဝပ်ထွက်ရှိမည့် ပေါင်းစပ်လည်ပတ်စွမ်းအင်စက်ရုံ စီမံကိန်းအတွက် စီမံကိန်းနှင့် သက်ဆိုင်သည့် နေရာများတွင် လူမှုစီးပွားရေးနှင့် ပတ်ဝန်းကျင်ဆိုင်ရာ ထိခိုက်မှု ဆန်းစစ်လေ့ခြင်းများ ပြုလုပ်မည် ဖြစ်ပါသည်။

အဆိုပြုစီမံကိန်း ဇရိယာသည် ဒဂ၊ အလုံ၊ ဆိပ်ကြီးခနောင်တို့၊ သန်လျင်၊ ဆိပ်ကမ်း၊ ဒဂုံ၊ လမ်းမတော် မြို့နယ်များတွင် တည်ရှိပါသည်။

TTCL မှ Environmental Resources Management (ERM) နှင့် Sustainable Environment Myanmar (SEM) တို့ကို ၃၈၈ မဂ္ဂါဝပ်ထွက်ရှိမည့် ပေါင်းစပ်လည်ပတ်စွမ်းအင်စက်ရုံ တည်ဆောက်ရန်အတွက် ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်း လုပ်ထုံးလုပ်နည်း နှင့် အခြားဆက်စပ်နေသည့် လိုအပ်ချက်များကို ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းပြုလုပ်ရန် တာဝန်ပေးခဲ့ပါသည်။

လူမှုပတ်ဂန်းကျင်လေ့လာဆန်းစစ်ရခြင်းရည်ရွယ်ချက်မှာ စီမံကိန်းလုပ်ဆောင်ရာတွင် ဇီဂရုပ်ပိုင်းဆိုင်ရာ နှင့် ပတ်ဂန်းကျင်လူမှုစီးပွားရေးဆိုင်ရာ ဖြစ်ပေါ်လာနိုင်သည့် ထိခိုက်မှုများကို လေ့လာဆန်းစစ်ခြင်းနှင့် ထိခိုက်မှုများကို လျော့ချနိုင်မည့်နည်းလမ်းများ ရှာဖွေခြင်း ဖြစ်ပါသည်။

လူမှုပတ်ဂန်းကျင်လေ့လာဆန်းစစ်ခြင်းတွင် အောက်ပါလုပ်ငန်းစဉ်များ ပါဂင်ပါသည်။

အခြေခံအလျက်အလက်များလေ့လာရာတွင် လက်ရှိပတ်ဝန်းကျင်ကို နားလည်ရန် ဆောင်ရွက်ရမည်။

-စီမံကိန်းကြောင့်ဖြစ်လာနိုင်မည့် ထိခိုက်မှုများကို အမျိုးအစားခွဲခြားခြင်း။ (ဥပမာ-မူလပတ်ဂန်းကျင်ဆိုင်ရာ အခြေခံအချက်အလက်များ စီမံကိန်းကြောင့်ပြောင်းလဲသွားမှု ရှိ၊ မရှိ)

-ဆိုးကျိုးထိခိုက်မှုများကို လျော့ချမည့်စီမံခန့်ခွဲရေးနှင့် လျှပ်စစ်ဓာတ်အားပေးစက်ရုံ၏ ကောင်းကျိုးများ ပိုမိုတိုးပွားစေရန် အစီအစဉ်များရေးဆွဲခြင်း။

ယခုမေးခွန်းကောက်ခံခြင်းသည် လူမှုစီးပွားရေးဆိုင်ရာအခြေခံအချက်အလက်များ ကောက်ယူခြင်း၏ အစိတ်အပိုင်းတစ်ခုဖြစ်ပါသည်။ သက်ဆိုင်ရာဒေသခံများအကြောင်း ပိုမိုနားလည်စေရန် ရည်ရွယ်ပါသည်။ သက်ဆိုင်ရာဒေသခံများ၏ လူနေမှုဘဂ၊ နေထိုင်စားသောက်မှုပုံစံများကို ပိုမိုနားလည်နိုင်ရန်အတွက် ERM/SEM အဖွဲ့များမှ လေ့လာမည်ဖြစ်ပါသည်။ ထို့အပြင် တခြားအဖွဲ့များမှ ဒေသတွင်းရှိ အခြေခံအချက်များဖြစ်သော အသံဆူညံမှု၊ လေအရည်အသွေး နှင့် ဇီဂမျိုးစုံမျိုးကွဲဆိုင်ရာအချက်အလက်များကို အသေးစိတ်လေ့လာမည် ဖြစ်ပါသည်။

ဤလေ့လာဆန်းစစ်ခြင်းသည် ဆန္ဒသဘောထားရယူခြင်းသာဖြစ်၍ မဖြေဆိုချင်သောမေးခွန်းများကို ရွေးချယ်နိုင်ပါသည်။ မည်သည့်သဘောထားမျိုးကိုမဆို ဖြေဆိုနိုင်ပြီး အဖြေမှန် (သို့) အဖြေမှား ဟူ၍မရှိပါ။ စီမံကိန်းနှင့် သက်ဆိုင်သည့် မည်သည့်အကြောင်းအရာကိုမဆို ဖြေဆိုနိုင်ပါသည်။

ကျေးဇူးပြု၍ ဤလေ့လာဆန်းစစ်ခြင်းသည် နှစ်နာကြေး၊ခံစားခွင့်များနှင့် မသက်ဆိုင်ပါကြောင်း သတိပြုပေးစေချင်ပါသည်။

ပါဂင်ကူညီပေးသည့်အတွက် ကျေးဇူးတင်ပါသည်။

Environmental and Social Impact Assessment (ESIA) Study for 388 MW Combine Cycle Power Plant, TTCL Power Myanmar Company Limited

Household Survey Questionnaire, 2018

TTCL Power Myanmar Company Limited မှ အကောင်ထည်ဖော်ဆောင်ရွက်မည့် ၃၈၈
မဂ္ဂါဝပ်ထွက်ရှိသည့် ပေါင်းစပ်လည်ပတ်စွမ်းအင်စက်ရုံ၏ ပတ်ဝန်းကျင် ထိခိုက်မှု ဆန်းစစ်ခြင်း
အိမ်ထောင်စုစစ်တမ်းမေးခွန်းလွှာ၊ ၂၀၁၈ခုနှစ်

PART A: *BASIC HOUSEHOLD INFORMATION*

အပိုင်း(က)း အိမ်ထောင်စု၏ အခြေခံအချက်အလက်များ

Q1. *Please record the interviewee information.*
မေးခွန်း(၁) ဖြေဆိုသူ၏ အချက်အလက်များကို မှတ်တမ်းပယူပါ။

Questionnaire Number မေးခွန်းလွှာအမှတ်	
Address လိပ်စာ	_____ State/Division (ပြည်နယ်/တိုင်းဒေသကြီး) _____ District (ခရိုင်) _____ Township (မြို့နယ်) _____ Ward/Village Tract (ရပ်ကွက်/ကျေးရွာအုပ်စု) _____ Village/Community (ကျေးရွာ/အစုအဖွဲ့) _____
Length of time living in this location နေထိုင်ခဲ့သည့်အချိန်	_____ years (နှစ်)
Interviewee Name ဖြေဆိုသူ၏အမည်	
Interviewee Gender ဖြေဆိုသူသည် ကျား/မ	□Male □Female □Decline to state □ကျား □မ □မဖော်ပြချင်ပါ
Telephone Number ဖုန်းနံပါတ်	

Q2. *Please describe the demographic profile of your household members:*
မေးခွန်းနံပါတ်(၂) သင့်အိမ်ထောင်စုဝင်များ၏ အချက်အလက်များကို ဖြေဆိုပေးပါ

Total number of household members: _____ persons;

အိမ်ထောင်စု၏မိသားစုဝင်စုစုပေါင်း : _____ ဦး

No. (စဉ်)	1 (၁)	2(၂)	3(၃)	4(၄)	5(၅)	6(ခြောက်)
Relation to interviewee (1) ဖြေဆိုသူနှင့်တော်စပ်ပုံ(၁)	Interviewee ဖြေဆိုသူ					
Gender (2) ကျား/မ(၂)						
Year of Birth သက္ကရာဇ်						
Age အသက်						
Ethnicity (3) လူမျိုး(၃)						
Highest Educational Attainment (4) ပညာသင်ယူခဲ့သော အမြင့်ဆုံး အဆြေအနေ(၄)						
Marital status (5) အိမ်ထောင်ရေးရှိ/မရှိ(၅)						
Vulnerability (6) အားနည်းချက်(၆)						

(1) Relation to interviewee: 1. Spouse, 2. Son, 3. Daughter, 4. Father, 5. Mother, 6. Other (Specify)

(၁) ဖြေဆိုသူနှင့်တော်စပ်ပ - ၁.ဇနီး/ခင်ပွန်း၊ ၂.သား၊ ၃.သမီး၊ ၄.အဖေ၊ ၅.အမေ

(2) Gender: 1. Male, 2. Female, 3. Decline to state

(၂) ကျား/မ- ၁.ကျား၊ ၂.မ၊ ၃.မဖော်ပြချင်ပါ

(3) Ethnicity includes: (specify)

1. Kachin, 2. Kayah, 3. Kayin, 4. Chin, 5. Buma, 6. Mon, 7. Rakhine, 8. Shan, 9. Other (specify)

(၃) လူမျိုး - ၁.ကချင်၊ ၂.ကယား၊ ၃.ကရင်၊ ၄.ချင်း၊ ၅.ဗမာ၊ ၆.မွန်၊ ၇.ရခိုင်၊ ၈.ရှမ်း၊ ၉ .အခြား(ဖော်ပြပါ)_____

(4) Highest Educational attainment: 1. Kindergarten, 2. Primary school, 3. Junior High School, 4. Senior High school 5. College (Vocational, technical, trade), 6. University, 7. N/A

(၄) ပညာသင်ယူခဲ့သော အမြင့်ဆုံး အဆြေအနေ- ၁.မူကြို၊ ၂.မူလတန်းပညာ၊ ၃.အလယ်တန်းပညာ ၄.အထက်တန်းပညာ၊ ၅.ကောလိပ်(အလုပ်အကိုင်ဆိုင်ရာ၊ နည်းပညာပိုင်းဆိုင်ရာ၊ ကုန်သွယ်မှု ဆိုင်ရာ)၊ ၆.တက္ကသိုလ်၊ ၇. မဖြေပါ။

(5) Marital status 1. Never married, 2. Married, 3. Widowed, 4. Divorced, 5. Separated

(၅) အိမ်ထောင်ရှိ/မရှိ- ၁.အပျို/လူပျို၊ ၂.အိမ်ထောင်ရှိ၊ ၃.မုဆိုးဖို/မ၊ ၄.ကွာရှင်းထားသည်၊ ၅. ခွဲနေရသည်

(6) *Vulnerability includes: 1. Chronic or critical diseases, 2. Mentally disabled, 3.Elderly over 60 years old, without adult working household member, 4. Physically disabled, 5. Female household head with juvenile child, 6. Orphan, 7. Other (specify).*

(၆) အားနည်းချက်- ၁.နာတာရှည်ရောဂါများ (သို့) ဆိုးဝါးသောရောဂါများ၊ ၂.စိတ်ပိုင်းဆိုင်ရာ ချို့.ယွင်းမှု၊ ၃.အရွယ်ရောက်၍အလုပ်လုပ်သောမိသားစုဝင်မရှိသောအသက်၆၀ကျော်သက်ကြီး ရွယ်အို၊ ၄.ရုပ်ပိုင်းဆိုင်ရာချို့.ယွင်းမှု၊ ၅.အသက်ငယ်ရွယ်သောကလေးရှိကာမိန်းမဦးဆောင်သော အိမ်ထောင်စု၊ ၆.မိဘမဲ့ကလေး၊ ၇.အခြား(ဖော်ပြပါ)။

Q3. Please describe the occupation and working experience of each of your family members over 18 years old.

မေးခွန်း၃ အသက်၁၈နှစ်အထက်သင့်မိသားစုဝင်များ၏ အလုပ်အကိုင်နှင့် အတွေ့အကြုံ အသီးသီးကို ဖော်ပြပေးပါ။

No. of family member မိသားစုဝင် အရေအတွက်	Occupation အလုပ်အကိုင်	Skill /Experience ကျွမ်းကျင်မှု/ အတွေ့.အကြုံ	Location of work အလုပ်တည် နေရာ	Working time per year (months) တစ်နှစ် အလုပ်ချိန် (လဖြင့်)	Average monthly income လစဉ်ပျမ်းမျှ ဝင်ငွေ

(1) Occupation incudes: 1. Student, 2.Farmer, 3. Fisherman, 4. Wage employee, 5. Own business, 6.Day labor, 7.Retired, 8. Unemployed, 9. N/A (refers to those above 18 years old but without capacity to work.)

(၁) အလုပ်အကိုင် : ၁. ကျောင်းသူ/သား ၂. တောင်သူ ၃. တံငါသည် ၄. လခစားအလုပ်သမား
၅. ကိုယ်ပိုင်လုပ်ငန်းလုပ်ကိုင်သူ ၆. နေ့စား အလုပ်သမား ၇. အငြိမ်းစား ၈. အလုပ်လက်မဲ့ ၉. N/A (အသက် ၁၈နှင့် ပြည့်ပြီး အလုပ်မလုပ်နိုင်သူများ.)

(2) Skill/experience includes: 1. General construction, 2. Carpentry, 3. Cook, 4. Waiter/waitress in restaurant or supermarket, 5. Teacher, 6. Driver, 7. Vehicle/machinery maintenance, 8. Welding, 9. Electrician, 10. Manual labor, 11. House keeper, 12. O&G industry, 13. Hair dressing, 14. Nurse, 15. Doctor, 16. Government officer, 17. Security guard, 18. Trading/shop keeping, 19. Other (specify).

(၂) ကျွမ်းကျင်မှု/အတွေ့.အကြုံ : ၁. ဆောက်လုပ်ရေးလုပ်ငန်း ၂.လက်သမားလုပ်ငန်း
၃. အချက်အပြုတ်လုပ်ငန်း ၄. စားဆောက်ဆိုင်(သို့)စျေးတွင် စာပွဲထိုးခြင်းလုပ်ငန်း ၅. ကျောင်းဆရာ/မ
၆. ကားမောင်းခြင်း ၇. ယာဉ်ယန္တရားပြုပြင်ခြင်း ၈. ဂရိန်ဆော်ခြင်း ၉. လျှပ်စစ်လုပ်ငန်း ၁၀. ကျပန်း
၁၁. အိမ်သန့်.ရှင်းရေး ၁၂. လောင်စာဆီစက်ရုံ ၁၃. အလုပြင်လုပ်ငန်း ၁၄. သူနာပြု ၁၅. ဆရာဝန်
၁၆. အစိုးရဝန်ထမ်း ၁၇. လုံခြုံရေး ၁၈. ကုန်သည်လုပ်ငန်း ၁၉. အခြားလုပ်ငန်း

(3) Location of work: 1.Within Village Tract/ Ward, 2.Within Township, 3.Within Division, 4.Outside Division

(၃) အလုပ်တည်နေရာ : ၁) ကျေးရွာတွင်း/ရုပ်ကွက် ၂) မြို့နယ်တွင်း ၃) တိုင်းဒေသကြီးတွင်း ၄) အခြားတိုင်းဒေသတွင်း

Q4. Has anyone in the household received any formal vocational training or qualifications?
မေးခွန်း(၄) အိမ်ထောင်စုတွင်း အသက်မွေးဝမ်းကြောင်းဆိုင်ရာ သင်တန်းများ (သို့) တက်ဖူးပါသလား။

No. of Family Member မိသားစုအရေအတွက်						
Training/Qualifications (with certificate) သင်တန်း (အောင်လက်မှတ်ဖြင့်)						

(1) Certification includes: 1. Diver license, 2. Cooker certificate, 3. Accountant certificate, 4. Electrician certificate, 5. Welding certificate, 6. Teacher certificate, 7. Nurse license, 8. Doctor license, 9. Other (specify).
(၁) အောင်လက်မှတ် : ၁) ကားလိုင်စင် ၂) အချက်အပြုတ်သင်တန်းဆင်းလက်မှတ်
၃) စာရင်းကိုင်သင်တန်းဆင်းလက်မှတ် ၄) လျှပ်စစ်ကျွမ်းကျင်လက်မှတ် ၅) ဂရိန်ကျွမ်းကျင်လက်မှတ်
၆) ဆရာအတတ်သင်လက်မှတ် ၇) သူနာပြုလက်မှတ် ၈)ဆမလက်မှတ် ၉) အခြား

Q5. What languages do you speak?
မေးခွန်း(၅) မည်သည့်ဘာသာစကားပြောပါသနည်း။

□Myanmar (မြန်မာ) □ *Others (please specify)* ***အခြား*** _____

Q6. Can you read and write in any language?
မေးခွန်း(၆) အခြားဘာသာစကားကိုရေးတတ်/ဖတ်တတ်ပါသလား။

□Yes (ဖတ်/ရေးတတ်သည်) □No (မဖတ်/ရေးတတ်ပါ)

Please specify language…

Q7. How long have you lived in this village we are in now?
မေးခွန်း(၇) ဤရွာတွင်နေထိုင်သည်မှာဘယ်လောက်ကြာပြီလည်း။

□Less than one year (တစ်နှစ်အောက်) □2 to 5 years (၂ နှစ်မှ ၅ နှစ်အတွင်း)
□Over 5 years (၅နှစ် နှင့်အထက်) □Over 10 years (all life, born here)
၁၀ နှစ်နှင့်အထက် (မွေးစမှစ၍)

□ *Others (please specify)* ***အခြား*** _____

PART B: SOCIO-ECONOMIC INFORMATION

အပိုင်း(ခ) လူမှုစီးပွားရေးဆိုင်ရာအချက်အလက်များကောက်ယူခြင်း

Q8. Please list the land resources owned by the household

မေးခွန်း(၈) မြေယာပိုင်ဆိုင်မှုများကိုစာရင်းပြုစုပါ

	Paddy Field **လယ်မြေ** *(acre)* *(ဧက)*	*Dry land* **ခြောက်သွေ့မြေ** *(acre)* *(ဧက)*	Orchard **သီးစားခြံ** *(acre)* *(ဧက)*	Forest **သစ်တော** *(acre)* *(ဧက)*	Fishpond **ငါးကန်** *(acre)* *(ဧက)*	Others **အခြား (specify)** *(acre)* *(ဧက)*
Land Area *(acre)* *မြေဧရိယာ (ဧက)*						
Does the household have legal title to the land it occupies? မြေပိုင်ဆိုင်မှုတရားဝင်အထောက်အထားများရှိပါသလား။	☐ Yes, we hold title to all the land we occupy ရှိ၊ ပိုင်ဆိုင်သမျှအကုန်လုံး ☐ Yes, partial (please elaborate) _____ ရှိ၊ တစ်စိတ်တစ်ပိုင်း (အကျယ်ချဲ့၍) ☐ No, we are leasing it from another owner မရှိ၊ ပိုင်ရှင်ဆီမှငှားရမ်းထားခြင်း ☐ No, we occupy the land without formal title မရှိ၊ စာချုပ်စာတမ်းမရှိဘဲပိုင်ဆိုင်သည်					
Does the household engage in farming? လယ်ယာစိုက်ပျိုးခြင်းလုပ်ကိုင်ပါသလား။	☐ Yes (လုပ်ကိုင်သည်) ☐ No (မလုပ်ကိုင်ပါ) (If No, please go to Q10 directly). (မလုပ်ကိုင်ပါက မေးခွန်းနံပါတ်-၁၀)					
Is the farmland irrigated? လယ်မြေတွင်ရေသွင်းရန် ရေရရှိပါသလား။	☐ Yes (ရှိ) ☐ No (မရှိ) Specify proportion of irrigated farmland: _____ (ရေသွင်းရန်ရေရရှိသည့်အချိုးအစားဖော်ပြချက်)					

Q9. What are the main cash crops grown in this village? Specify yield/year

မေးခွန်း(၉) ဤရွာတွင်အဓိကအထွက်များသောသီးနှံမှာဘာလည်း။

☐ Paddy (စပါး)

☐ Beans (ပဲအမျိုးအမျိုး)

☐Betel nuts (ကွမ်း)

☐Mangoes (သရက်)

☐ *Others (please specify)* ***အခြား***

_____

Q10. What kind of livestock do household members own?

မေးခွန်း(၁၀) မည်သည့်တိရစ္ဆာန်မွေးမြူသနည်း။

What kind of livestock do household members own? မည်သည့်တိရစ္ဆာန်မွေးမြူထားသနည်း။	☐Pig (ဝက်) ☐Chicken (ကြက်) ☐Goats (ဆိတ်) ☐Cattle (ကျွဲ ၊ နွား) ☐Sheep (သိုး) ☐Others (please specify) **အခြား**_____
How the livestock are used? မွေးမြူရေးကိုမည်သို့ အသုံးပြုသနည်း။	☐Milk (**နို့**) ☐Meat (**အသား**) ☐Others (Specify) **အခြား** :_____
Is livestock used for self-consumption or sale? မွေးမြူရေးကို စားသုံးခြင်း (သို့မဟုတ်) ရောင်းချခြင်းများ ပြုလုပ်ပါသလား။	☐Self-Consumption **ကိုယ်တိုင်စားသုံးခြင်း** ☐Sale **ရောင်းချခြင်း** ☐Both **နှစ်မျိုးစလုံး**
If sale, total income from livestock. ရောင်းချခဲ့လျှင်, စုစုပေါင်းဝင်ငွေ ဘယ်လောက်ရပါသလဲ။	_____

Q11. Does the household engage in fishing?

မေးခွန်း(၁၁) ငါးဖမ်းလုပ်ငန်းလုပ်ကိုင်ပါသလား။

Does the household engage in fishing? ငါးဖမ်းလုပ်ငန်းလုပ်ကိုင်ပါသလား။	☐ *Yes, for household consumption only* လုပ်ကိုင်သည်၊ အိမ်တွင်းစားသုံးရန် ☐ *Yes, for household consumption and for sale* *လုပ်ကိုင်သည်၊ အိမ်တွင်းစားသုံးရန်နှင့် ရောင်းရန်* ☐ *No (If No, please go to Q12 directly).* *မလုပ်ကိုင်ပါ (မလုပ်ကိုင်ပါက မေးခွန်းနံပါတ်-၁၂)*
How regularly do you/they go fishing? ငါးဖမ်းနေ့တိုင်းသွားသလား။	☐ *Daily* (***နေ့စဉ်***) ☐ *Every few days (**ရက်အနည်းငယ်ခြားချီ**)* ☐ *Once a week* (***တစ်ပတ်တစ်ကြိမ်***) ☐ *Others (Specify) **အခြား*** :_____
What method do they use to collect fish? ငါးဖမ်းရာတွင် မည်သည့်နည်းကို အသုံးပြုပါသနည်း။	☐ *Hook and Line (**ငါးမျှားချိတ်**)* ☐ *Drift Netting (**ပိုက်ကွန်**)* ☐ *Fish Trap (**ငါးဖမ်းသောပြွန်**)* ☐ *Potting (**ပုဇွန်ဖမ်းသောပြွန်**)* ☐ *Gillnetting (**ဆွဲပိုက်**)* ☐ *Others (Specify) **အခြား*** :_____
Where is the fishing ground? ငါးဖမ်းခြင်းကိုဘယ်မှာလုပ်လည်း။	☐ Yangon River (**ရန်ကုန်မြစ်**) Bago River (**ပဲခူးမြစ်**) ☐ *Others (Specify) **အခြား*** :_____

Does the household engage in fishing? ငါးဖမ်းလုပ်ငန်းလုပ်ကိုင်ပါသလား။	☐ *Yes, for household consumption only* လုပ်ကိုင်သည်၊ အိမ်တွင်းစားသုံးရန် ☐ *Yes, for household consumption and for sale* *လုပ်ကိုင်သည်၊ အိမ်တွင်းစားသုံးရန်နှင့် ရောင်းရန်* ☐ *No (If No, please go to Q12 directly).* *မလုပ်ကိုင်ပါ (မလုပ်ကိုင်ပါက မေးခွန်းနံပါတ်-၁၂)*
What fish or other species are you/they looking to catch mostly? မည်သည့်အမျိုးအစားကို အများဆုံးတွေ့ရှိရသနည်း။	☐ *Catfish* (***ငါးခူ***) ☐ *Shrimp / Prawn* (***ပုဇွန်အသေး၊ပုစွန်ထုပ်***) ☐ *Eel* (**ငါးရှဉ့်**) ☐ *Others (Specify)* ***အခြား*** :_____
What's the average fish catch per season? တစ်ရာသီကို ပျမ်းမျှ ငါး မည်မျှ ဖမ်းမိပါသလဲ။	_____kgs/year (ကီလိုဂရမ်/ နှစ်)

Q12. Non Timber Forest Product

မေးခွန်း(၁၂) အခြားသစ်တောထွက်ပစ္စည်းများ

Does the household engage in the collection of forest products? သစ်တောထွက်ပစ္စည်းများစုဆောင်းခြင်း ရှိပါသလား။	☐ *Yes, for household consumption only* ရှိ၊ အိမ်တွင်းသုံးစွဲရန် ☐ *Yes, for household consumption and for sale* *ရှိ၊ အိမ်တွင်းသုံးစွဲရန် နှင့် ရောင်းချရန်* ☐ *No (If No, please go to Q13 directly).* *မရှိ (မရှိပါက မေးခွန်းနံပါတ်-၁၃)*
Non-timber Forest Product အခြားသစ်တောထွက်ပစ္စည်းများ	☐Nuts (အခွံမာသီး) ☐Seeds (သစ်စေ့) ☐Mushrooms (မှို) ☐Medicinal plants (ဆေးဖက်ဝင်အပင်) ☐Fuelwood (ထင်း) ☐Others (Specify) အခြား :_____
How regularly do you/they go to the forest? တောထဲသို့ မည်သို့သွားလေ့ရှိသနည်း။	☐Daily (နေ့စဉ်) ☐Every few days (ရက်အနည်းငယ်ခြား၍) ☐Once a week (တစ်ပတ်တစ်ကြိမ်) ☐Others (Specify) အခြား :_____
Where is the forest? သစ်တောကဘယ်နားမှာရှိသနည်း။	☐ Yangon River (ရန်ကုန်မြစ်) Bago River (ပဲခူးမြစ်) ☐Others (Specify) အခြား :_____

Q13. Does the household have private business?

မေးခွန်း(၁၃) ကိုယ်ပိုင်စီးပွားလုပ်ကိုင်ပါသလား။

Do you have private business? ကိုယ်ပိုင်စီးပွားလုပ်ကိုင်ပါသလား။	☐Yes (လုပ်ကိုင်သည်) ☐No (မလုပ်ကိုင်ပါ) If yes, since when? လုပ်ကိုင်ပါက ဘယ်အချိန်မှစလုပ်ကိုင်စားသောက်သနည်း : _____
Where are you doing business? စီးပွားရေးလုပ်ငန်းကို မည်သည့်နေရာတွင် လုပ်ကိုင်သနည်း။	☐Within the village/ ward (ကျေးရွာ/ ရပ်ကွက်အတွင်း) ☐Within the township (မြို့နယ်အတွင်း) ☐Within the District (ခရိုင်အတွင်း) ☐Out of the District (အခြားခရိုင်)
If so, what kind of business you are operating? ထို့အပြင် မည်သည့်စီးပွားရေးလုပ်ကိုင်စားသောက်သနည်း။	☐Livestock raising (မွေးမြူရေးလုပ်ငန်း) ☐Dried fish (ငါးခြောက်လုပ်ငန်း) ☐Farming (လယ်ယာလုပ်ငန်း) ☐Shops/market (ကုန်သွယ်လုပ်ငန်း) ☐Fishing/fish farming (ငါးဖမ်းလုပ်ငန်း) ☐Taxi/Motor bike taxi (မော်တော်ယာဉ်လုပ်ငန်း) ☐Machine maintenance (စက်ပြင်လုပ်ငန်း) ☐Restaurant/Tea House (စားသောက်ကုန်လုပ်ငန်း) ☐Teakwood (သစ်လုပ်ငန်း) ☐Others (Specify) အခြား :_____

Q14. Does the household have informal mining activities?

မေးခွန်း (၁၄) တရားမဝင်သတ္တုတူးဖော်ခြင်းများ လုပ်ဆောင်ပါသလား။

Do you have informal mining activities? ***တရားမဝင်သတ္တုတူးဖော်ခြင်းများ လုပ်ဆောင်ပါသလား။***	☐Yes (တူးဖော်သည်) ☐No (မတူးဖော်ပါ) If yes, since when?: တူးဖော်ပါက မည်သည့်အချိန်မှ စ၍ တူးဖော်ပါသနည်း။ _____
Where are you doing informal mining activities? မည်သည့်နေရာတွင် တရားမဝင်သတ္တုတူးဖော်ခြင်းများ လုပ်ဆောင်ပါသနည်း။	☐ *Within the* village (ကျေးရွာအတွင်း) ☐Within the township (မြို့နယ်အတွင်း) ☐Within the District (ခရိုင်အတွင်း) ☐Out of the District (အခြားခရိုင်)
If so, what kind of informal mining activities you are operating?	☐ *Gold* ☐ *Tin* ☐ *Tantalum* ☐ *Others (Specify)*:_____

Q15. Please describe your household's assets and utilities

မေးခွန်း(၁၅) ပိုင်ဆိုင်မှုနှင့် အသုံးပြုမှုများကို ဖော်ပြပါ။

Item(အမျိုးအစား)	Quantity(အရေအတွက်)	Item(အမျိုးအစား)	Quantity(အရေအတွက်)
Digital TV (တီဗွီ)		*Tractor (ထွန်စက်)*	
		Car (ကား)	
Jewellery (လက်ဝတ်ရတနာများ)		*Other types of Vehicle (e.g. van and truck) အခြားယာဉ်အမျိုးအစား (ဥပမာ-ဗမ်၊ထရက်)*	
Cell phone (ဖုန်း)		*Refrigerator (ရေခဲသေတ္တာ)*	
Landline (အိမ်ဖုန်း)		*Flush Toilet (ယင်လုံအိမ်သာ)*	☐Yes ☐No *(ရှိ) (မရှိ)*
Air Conditioner (လေအေးပေးစက်)		*Tap Water (ဘုံပိုင်ရေ)*	☐Yes ☐No (ရှိ) (မရှိ)
Laundry Machine (အဝတ်လျှော်စက်)		*Electricity (လျှပ်စစ်)*	☐Yes ☐No (ရှိ) (မရှိ)
Sewing Machine (အပ်ချုပ်စက်)		*Gas (ဂက်စ်)*	☐Yes ☐No (ရှိ) (မရှိ)
Gas Cooker (ဂက်စ်မီးဖို)		*Internet (အင်တာနက်)*	☐Yes ☐No (ရှိ) (မရှိ)
Motorbike (ဆိုင်ကယ်)		*Paved road access to home (ကျောက်ခင်းလမ်း)*	☐Yes ☐No (ရှိ) (မရှိ)

Q16. What is your household's income per year from different sources? (Please complete all appropriate)?

မေးခွန်း(၁၆) တစ်နှစ်လျှင် မည်မျှဝင်သနည်း။ (သြဇာရှိစွာဖြည့်စွက်ရန်)

Income Source (ဝင်ငွေရရှိမှု)	Ks/Year (ကျပ်/နှစ်)
Crop farming (သီးနှံစိုက်ပျိုးခြင်း)	
Fishing/ Fish Farming (ငါးဖမ်းလုပ်ငန်း၊ငါးမွေးမြူခြင်း)	
Livestock raising (မွေးမြူရေးလုပ်ငန်း)	
Forestry (သစ်တောလုပ်ငန်း)	
Business (စီးပွားရေးလုပ်ငန်း)	
Local Wage Employment (ဒေသတွင်းနေ့စားလုပ်ငန်း)	
Part time job (အချိန်ပိုင်းလုပ်ငန်း)	
Government Assistance (pension or other government benefits) အစိုးရအထောက်အပံ့ (အငြိမ်းစား သို့ အခြားအခွင့်ရေးများ)	
Other (အခြား)	

Q17. Other income

မေးခွန်း(၁၇) အခြားဝင်ငွေရရှိမှု

Does the household receive any remittances / money from anyone who lives elsewhere? **တခြားတစ်နေရာမှ ငွေလွှဲများလက်ခံရရှိပါသလား။**	☐ *Yes* (ရှိ) ☐ *No* (မရှိ) *If No, please go to Q18.* မရှိပါက မေးခွန်းနံပါတ်-၁၈
Does he/she currently have paid employment in or outside the local area? ***ဒေသအတွင်း နှင့် အပြင်တွင် တာဝန်ထမ်းဆောင်သူရှိပါသလား။***	☐ *In the local area (ဒေသတွင်း)* ☐ *Outside the local area (Please specify):_____* *(ဒေသအပြင်ဘက်)*
Who has employed the member of your household? ***သင့်မိသားစုတွင်းမည်သူ အလုပ်ခန့်.သနည်း။***	☐ *Government (အစိုးရ)* ☐ *Others အခြား* :_____
How much does the household receive any remittances / money from anyone who lives elsewhere? ***တခြားတစ်နေရာမှ ငွေလွှဲများဘယ်လောက် လက်ခံရရှိပါသလား။***	_____Ks/Year (ကျပ်/နှစ်)

Q18. What is your household's expenditure per year?

မေးခွန်း(၁၈) တစ်နှစ်အသုံးစရိတ်ကိုဖော်ပြပါ။

Item* (အမျိုးအစား)	(Ks/Year) (*ကျပ်/နှစ်*)	Item (အမျိုးအစား)	(Ks/Year) (*ကျပ်/နှစ်*)
Expenditure for the household members living in the village/ ward ကျေးရွာ/ ရပ်ကွက်တွင်းရှိအိမ်ထောင်စုများ၏အသုံးစရိတ်		*Transportation* *လမ်းပန်း ဆက်သွယ်ရေး*	
Farming cost (e.g. fertilizer, pesticides, feeds, seeds, irrigation etc.) *မြေယာလုပ်ငန်း(ဥပမာ- မြေဩဇာ၊ပိုးသတ်ဆေး၊ မြေစာ၊ဘိုးစေ့၊ရေရရှိရန်ရေပို့ချခြင်း.အစရှိသဖြင့်)*		*Food* *အစားအသောက်*	
Fishing costs *ငါးဖမ်းလုပ်ငန်း*		*Donations* *အလှူအတန်း*	
Livestock input *တိရစ္ဆာန်မွေးမြူရေး*		*Others, specify* (1) အခြား(၁)	
Forestry production costs *သစ်တောထုတ်လုပ်ခြင်း*			
Business costs *စီးပွားရေး*			

Item* (အမျိုးအစား)	(Ks/Year) (ကျပ်/နှစ်)	Item (အမျိုးအစား)	(Ks/Year) (ကျပ်/နှစ်)
Housing *နေထိုင်မှု*			
Medical care *ကျန်းမာရေး*			
Education *ပညာရေး*			
Family ceremonies (wedding/festivals) *မိသားစု အခမ်းအနား (မင်္ဂလာပွဲ/ ပျော်ပွဲရွှင်ပွဲ)*			

(1) Other expenditure incudes: 1. Soft drink e.g. Ranger etc., 2. Cigarettes, 3. Alcohol (homebrew), 4. Sugar/ Salt, 5. Lollies/sweets, 6. Others

(၁) အခြားအသုံးစရိတ် ၁) အချိုရည် (Ranger) ၂) စီးကရက် ၃) အရက် (ချက်အရက်)
၄) သကြား၊ဆား ၅) ရေခဲချောင်းလုပ်ငန်း ၆) အခြား

Q19. If the annual net income is obviously negative, what are the underlying reasons for this? (Please tick all the appropriate(s))

မေးခွန်း(၁၉) နှစ်စဉ်ဝင်ငွေကို မည်သည့်အကြောင်းတို့ကြောင့်သုံးစွဲပါသနည်း။

☐Medical expenses
ကျန်းမာရေးအသုံးစရိတ်

☐Housing expenses
အိမ်အသုံးစရိတ်

☐Educational expensesပညာရေးအသုံးစရိတ်

☐Others အခြား (please specify)_____

Q20. Do you have a bank account? သင့်တွင်ငွေစုစာအုပ်ရှိပါသလား။

☐Yes ရှိ

☐No မရှိ

Q21. Credit Facility ချေးငွေပံ့ပိုးမှု

Has the household accessed credit/borrowed money in the last 12 months?လွန်ခဲ့သည့်၁၂လအတွင်း ငွေချေးထားသည့်အကြွေးရှိပါသလား။	☐ *Yes* ရှိ ☐ *No* မရှိ *If No, please go to Q22.* မရှိပါက-မေးခွန်းနံပါတ်၂၂
Credit Sources in the village ရွာတွင်းရှိအကြွေးယူသည့်နေရာ	☐ *Bank* ဘဏ် ☐ *Informal credit* တရားမဝင်သောအကြွေး ☐Family မိသားစု ☐Friends/ Neighbours မိတ်ဆွေ/အိမ်နီးချင်း ☐Others (Specify):အခြား :_____
Why people borrow money? အဘယ့်ကြောင့်ငွေချေးရသနည်း။	☐ *For field preparation* လယ်ယာမြေပြင်ဆင်ရန် ☐For Business စီးပွားရေးပြုလုပ်ရန် ☐For marriage လက်ထပ်ပွဲပြုလုပ်ရန် ☐For house construction အိမ်ပြင်ဆောက်ရန် ☐ *Others* *(Specify)*:အခြား :_____
What is the interest rate? အတိုးနှုန်းမည်မျှနည်း။	☐_____%per year တစ်နှစ်လျှင်_____ရာခိုင်နှုန်း ☐No interest အတိုးမပေးရပါ
Have you repaid any loan? ချေးငွေ ပြန်ဆပ်ပြီးပြီလား။	☐Yes, _____% ပြန်ဆပ်ပြီး_____% ☐No ပြန်မဆပ်ရသေးပါ

Q22. Markets ဈေး

Name the markets that you normally go to buy or sell goods ဈေးဟယ် (သို့) ဈေးရောင်း သွားလေ့ ရှိသော ဈေးအမည် ကို ဖော်ပြပါ	☐_____
What do you sell at the market? ဈေးတွင် ဘာရောင်းသနည်း။	☐Fish ငါး ☐Rice ဆန် ☐Others (Specify)အခြား:_____
What do you purchase at the market?ဈေးတွင်ဘာဟယ်သနည်း။	☐ *Fish* ငါး ☐Rice ဆန် ☐Others (Specify)အခြား:_____

Name the markets that you normally go to buy or sell goods ဈေးဝယ် (သို့) ဈေးရောင်း သွားလေ့ ရှိသော ဈေးအမည် ကို ဖော်ပြပါ	□_____
How often do you normally go to these markets to buy or sell goods? ထိုဈေးသို့ ကုန်ပစ္စည်း ဝယ်ခြင်း (သို့ ဧ)ရောင်းခြင်းကို မည်သို့သွားသနည်း။	□Daily နေ့စဉ် □Every few days ရက်အနည်းငယ်ကြာသော် □Once a week တစ်ပတ်လျှင်တစ်ကြိမ် □Others (Specify) အခြား :_____

Q23. Are you a regular member (actively participating on a weekly basis) of any of the following organisations? သင်သည်အောက်ပါအဖွဲ့ အစည်းများ၏ အဖွဲ့ ဝင်ဖြစ်ပါသလား(အပတ်စဉ်လုပ်ရှားမှုများတွင်တက်ကြွစွာပါဝင်ခြင်း)

□ *Monastery* ဘုန်းကြီးကျောင်း

□Fishing Group ရေလုပ်ငန်းအဖွဲ့

□Youth Group လူငယ်အဖွဲ့

□Sports team အားကစားအဖွဲ့

□Women's group အမျိုးသမီးအဖွဲ့

□Others (please specify)အခြား _____

PART C HOUSING INFORMATION အိုးအိမ်အချက်အလက်

Q24. Housing condition အိုးအိမ်အခြေအနေ

No. of Floors အထပ် အရေအတွက်	No. of Rooms အခန်း အရေအတွက်	House Structure အိမ်တည်ဆောက်ပုံ	Year of Construction ဆောက်လုပ်သည့် နှစ်	Year of latest renovation ပြန်ပြင်သည့်နှစ်	Ownership ပိုင်ဆိုင်မှု
		□ Wood သစ် □ Brick-Wood အုတ်-သစ် □ Brick-Concrete အုတ်-ဘိလပ်မြေ □Con Concrete သံကူကွန်ကရစ်			□ Owned အိမ်ပိုင် □ Rented အိမ်ငှား □ Other (specify) အခြား_____

PART D HEALTH PROFILE ကျန်းမာရေးရှုထောင့်

Q25. Please describe the health condition of family members listed in Q1.

ကျေးဇူးပြု၍ မေးခွန်းနံပါတ်၁တွင်ဖြေကြားခဲ့သော သင့်မိသားစုဝင်များ၏ ကျန်းမာရေး အခြေအနေကိုဖော်ပြပါ။

No. of Family Member မိသားစုဝင်အရေအတွက်						
Health Status (1) *ကျန်းမာရေးအခြေအနေ*						
Diseases had in the last 6 month (2) *လွန်ခဲ့သည့်ဖိလအတွင်းရှိခဲ့သည့်ရောဂါများ*						

(1) Health status: *1. Good, 2. neither poor nor good, 3. Poor.*

ကျန်းမာရေးအခြေအနေ : ၁.ကောင်း၊ ၂.သင့်၊ ၃. ညံ့

(2) Diseases: *1. Diarrhoea, 2. Malaria, 3. Skin rash/itches, 4. Respiratory tract infection (cold, cough etc.) 5. Cholera 6. Tuberculosis 7. Sexually transmitted infection 8. HIV/AIDS 9. High blood pressure 10. Common Fever 11. Others (Specify).*

ရောဂါများ : *၁. ဝမ်းလျှောရောဂါ၊ ၂. ငှက်ဖျားရောဂါ၊ ၃.အရေပြားယားယံခြင်း/အင်ပြင်၊ ၄.အသက်ရှူလမ်းကြောင်းပိုးဝင်ခြင်း (အအေးမိ၊ချောင်းဆိုး အစရှိသဖြင့်)၊ ၅.ကာလဝမ်းရောဂါ၊ ၆.အဆုတ်နာရောဂါ၊ ၇.လိင်မှတစ်ဆင့်ကူးစက်သောရောဂါ၊ ၈. HIV/AIDS၊ ၉.သွေးတိုးရောဂါ၊ ၁၀.အဖျားရောဂါ၊ ၁၁.အခြား*

Q26. How many times did you have diarrhoea on average last year?
လွန်ခဲ့သည့်နှစ်များတွင် ဝမ်းလျှောရောဂါ ဘယ်နှစ်ကြိမ်ဖြစ်ပွားခဲ့သနည်း။

☐ *None မရှိ* ☐ *Once တစ်ကြိမ်* ☐ *2-3 times ၂-၃ ကြိမ်* ☐ *4 times or more လေးကြိမ် (သို့) လေးကြိမ်နှင့် အထက်*

Q27. Have you recently consulted a doctor? If Yes, when was it?
မကြာသေးခင်က ဆရာဝန်ထံတွင် ကုသခဲ့ဖူးပါသလား။ ကုသခဲ့ဖူးပါက ဘယ်အချိန်ကနည်း။
☐ *Yes, ကုသခဲ့ဖူးပါက*_____ ☐ *No မကုသခဲ့ဖူးပါ*

Q28. Where does your family usually go to see a doctor when you are sick?
နေထိုင်မကောင်းပါက မည်သည့်နေရာသို့သွားရောက်ကုသလေ့ရှိပါသနည်း။

Types of medical institution	Travelling Method
☐ *Rural/ Sub-rural* Health Center* ဒေသတွင်း ကျန်းမာရေးဌာန	*Distance__km အကွာအဝေး* _____*ကီလိုမီတာ* *Travel:* ☐ *By foot ခြေလျင်* ☐ *By motor bike ဆိုင်ကယ်* ☐ *bus/car ဘတ်စ်/ကား* ☐ *Other အခြား*_____

Types of medical institution	Travelling Method
☐ *Traditional/Private/Mobile* Clinic* တိုင်းရင်းဆေးခန်း/အပြင်ဆေးခန်း	*Distance km အကွာအဝေး* *_____ကီလိုမီတာ* *Travel: ☐By foot ခြေလျင်* *☐By motor bike ဆိုင်ကယ်* *☐bus/car ဘတ်စ်/ကား* *☐ Other အခြား_____*
☐ *Township/Station* Hospital* မြို့နယ်ဆေးရုံ	*Distance km အကွာအဝေး* *_____ကီလိုမီတာ* *Travel: ☐By foot ခြေလျင်* *☐By motor bike ဆိုင်ကယ်* *☐bus/car ဘတ်စ်/ကား* *☐ Other အခြား_____*
☐ *Other (please specify)*_____ အခြား _____	

**Please delete as appropriate*

Q29. Please provide the information for water use
ရေအသုံးပြုမှု

1. Drinking Water
၁. သောက်ရေ

Water Sources ***ရေအရင်းအမြစ်***	☐ *Tap water ဘုံပိုင်ရေ* ☐ *Well (please indicate well depth:__m)* *ရေတွင်း (အနက် _____မီတာ)* ☐ *Spring ရေတွင်း* ☐ *Reservoir ရေလှောင်ကန်* ☐ *Pond ရေကန်* ☐ *Yangon River (ရန်ကုန်မြစ်)* *Bago River (ပဲခူးမြစ်)* ☐ *Others အခြား* :_____
If water is not supplied to the household, how far is the nearest water source? ရေမလာပါက အနီးဆုံးရေအရင်းအမြစ်နှင့် မည်မျှဝေးသနည်း။	*Distance km အကွာအဝေး _____ကီလိုမီတာ* *Travel: ☐By foot ခြေလျင်* *☐By motor bike ဆိုင်ကယ်* *☐bus/car ဘတ်စ်/ကား* *☐ Other အခြား_____*
Availability of water supply ရေပေးဝေမှုအခြေအနေ	☐ *Sufficient လုံလောက်သည်* ☐*Insufficient မလုံလောက်ပါ*

	If insufficient, please state the period of insufficiency *မည်သည့်လများတွင် မလုံလောက်သနည်း။* _____
Water Quality *ရေအရည်အသွေး*	□ *Good ကောင်း* □ *Fair သင့်* □ *Odorous အနံ့ရှိ* □ *Dirty ညစ်ပတ်* □ *Other comments* *အခြားဖော်ပြချက်:*

2. Other Water Use

၂. အခြားရေသုံးစွဲမှု

Does the household use the same source for drinking water and for water for domestic use (e.g. washing, livestock raising) **သောက်ရေနှင့် သုံးရေကို တစ်နေရာထဲမှ သုံးစွဲပါသလား။** (ဥပမာ-အဝတ်လျှော်ခြင်း၊မွေးမြူရေး)	□ *Yes* ရှိ □ *No* မရှိ *If Yes, please go to* ***Q30.*** *သုံးစွဲပါက မေးခွန်းနံပါတ်-၃၀*
Water sources *ရေအရင်းအမြစ်*	□ *Tap water ဘုံပိုင်ရေ* □ *Well (please indicate well depth:__m)* *ရေတွင်း (အနက်_____မီတာ)* □ *Spring စမ်းရေ* □ *Reservoir ရေလှောင်ကန်* □ *Pond ရေကန်* □ *Yangon River (ရန်ကုန်မြစ်)* *Bago River (ပဲခူးမြစ်)* □ *Others အခြား* :_____
Availability of water supply *ရေရရှိမှုအခြေအနေ*	□ *Sufficient* လုံလောက်သည် □Insufficient မလုံလောက်ပါ If insufficient, please state the period of insufficiency မည်သည့်လများတွင် မလုံလောက်သနည်း။ _____ _____
Water Quality *ရေအရည်အသွေး*	□Good ကောင်း □Fair သင့် □Odorous အနံ့ရှိ □Dirty ညစ်ပတ် □Other comments အခြားဖော်ပြချက်:
Type of Latrine, then please specify *အိမ်သာအမျိုးအစား*	□ Dry pit Latrine ယင်လုံအိမ်သာ □ Pour flush latrine(septic tank)ရေလောင်းအိမ်သာ (မိလ္လာကန်) □ Flush latrine (u/g sewer connection) □ Open defecation (တွင်းဖွင့်)

PART E: ACCESS TO INFRASTRUCTURE & ENERGY

Q30. Irrigation Water Availability
ရေသွင်းရန်ရေရရှိမှု

Does your household's farmland get irrigation water **အိမ်ထောင်စု၏စိုက်ပျိုးမြေအတွက် ရေသွင်းရန်ရေရရှိပါသလား။**	☐ *Yes* ရှိ ☐ *No* မရှိ *If No, please go to Q31.* *မရှိပါက မေးခွန်းနံပါတ်-၃၁*
Irrigation Water sources ***ရေသွင်းရန်ရေရရှိနိုင်သည့်အရင်းအမြစ်***	☐Public *Well (please indicate well depth:__m)* *ဘုံပိုင်တွင်း (အနက်_____မီတာ)* ☐Private *Well (please indicate well depth:__m)* *ကိုယ်ပိုင်တွင်း (အနက်_____မီတာ)* ☐ *Spring စမ်းရေ* ☐ *Reservoir ရေလှောင်ကန်* ☐ *Pond ကန်ရေ* ☐ *River မြစ်ရေ* ☐ *Others အခြား* :_____
Irrigation Channels ***ရေသွင်းရန်ရေရရှိသည့်ရေမြောင်း***	☐Private ကိုယ်ပိုင် ☐ *Communal အများပိုင်* ☐ *Open Trench အဖုံးပါသောမြောင်း* ☐ *Covered Trench အဖုံးမပါသောမြောင်း* ☐ *Pipes ပိုက်လိုင်း* ☐ *Others အခြား* :_____
Availability of water supply ***ရေရရှိမှုအခြေအနေ***	☐Sufficient လုံလောက်သည် ☐Insufficient မလုံလောက်ပါ If insufficient, please state the period of insufficiency မည်သည့်လများတွင် မလုံလောက်သနည်း။ _____
Water Quality ***ရေအရည်အသွေး***	☐Good ကောင်း ☐Fair သင့် ☐Odorous အနံ့ရှိ ☐Dirty ညစ်ပတ် ☐Other comments အခြားဖော်ပြချက်:

Q31. Traffic

What is the main mode of transport in the village **ရွာတွင် မည်သည့် သယ်ယူပို့ဆောင်ရေးသည် အဓိကဖြစ်သနည်း။**	☐ *By bike စက်ဘီး* ☐ *By motor bike ဆိုင်ကယ်* ☐ *By foot ခြေလျင်* ☐ *Other (Please specify)* *အခြား* :_____
How do you usually travel to other places from your village? **ရွာမှအခြားသို့ မည်သို့သွားလေ့ရှိသနည်း။**	☐ *By shuttle bus ကြိုး/ပို့ ယာဉ်* ☐ *By motor bike ဆိုင်ကယ်* ☐ *By foot ခြေလျင်* ☐ *By van operated by other villagers*

	အခြားရွာများသို့ပြေးဆွဲသည့်အလုံပိတ်ဝ မ်တော်ယာဉ် *□ Other (Please specify)* *အခြား :_____*
How often do you travel out of the village? **ရွာမှဘယ်နှစ်ကြိမ်သွားလေ့ရှိသနည်း။**	*□ Daily နေ့စဉ်* *□ Every few days ရက်အနည်းငယ်ကြာသော်* *□ Once a week တစ်ပတ်တစ်ကြိမ်* *□ Others (Specify) အခြား :_____*
How long does it take to travel to the nearest market? **အနီးဆုံးဈေးသို့သွားလျှင် ဘယ်လောက်ကြာသနည်း။**	*Distance__km* အကွာအဝေး _____ ကီလိုမီတာ *Travel: □ By foot ခြေလျင် □ By motor bike ဆိုင်ကယ်* *□ bus/car ဘတ်စ်ကား □ Other အခြား_____* How long does it take *(Specify)* *ကြာချိန် :_____*
Road surface **လမ်းအမျိုးအစား**	*□ Dirt မြေသားလမ်း □ Stone ကျောက်ခဲင်းလမ်း* *□ Asphalt ကတ္တရာလမ်း □ Concrete ကွန်ကရစ်လမ်း* *□ Other (Please specify)* *အခြား :_____*
Would people say the overall quality and condition of the area's transportation system is good, fair, or poor? လမ်းပန်းဆက်သွယ်ရေးအခြေအနေသည် ကောင်းမွန်၊ အသင့်အတင့် ၊ ညံ့ ပါသလား။	*□ Good ကောင်းသည် □ Fair အသင့်အတင့် □ Poor မကောင်းပါ* *□ Other comments အခြားဖော်ပြချက် :* _____

Q32. Do you have distributed (grid) electricity access?
မီးရရှိပါသလား။

□ *Yes ရှိ* □ *No မရှိ*

If "Yes", specify daily duration of grid electricity access: _____*hours/day*
ရရှိပါက လျှပ်စစ်မီး နေ့စဉ်သုံးစွဲသည့်အချိန် : တစ်ရက်လျှင်_____နာရီ

Q33. What fuel do you generally use for domestic use?

What type of fuel do you use for cooking? **ဟင်းချက်ရာတွင် မည်သည့်လောင်စာကို အသုံးပြုသနည်း။**	*□ Wood ထင်း □ Charcoal မီးသွေး* *□ Gas, CNG, LPG ဂက်စ် □ Kerosene ရေနံဆီ*

	□ *Other (Please specify) အခြား* _____
What type of fuel do you use for other household activities (e.g. lightening)? **အခြားအိမ်ထောင်စုများအတွက် မည်သည့်လောင်စာကိုအသုံးပြုသနည်း။(ဥပမာ-အလင်းရောင်ပေးခြင်း)**	□Wood ထင်း □Charcoal မီးသွေး □Gas, CNG, LPG ဂက်စ် □Kerosene ရေနံဆီ □Other (Please specify) အခြား _____
Where is the fuel sourced from? **လောင်စာကိုမည်သည့်နေရာမှ ရရှိသနည်း။**	□Within the village/ ward ကျေးရွာ/ရပ်ကွက်အတွင်းမှ □Outside the village/ ward ကျေးရွာ/ရပ်ကွက် ပြင်ပမှ (Please specify) _____

Q34. ***Do you have mobile telephone signal coverage?***
တယ်လီဖုန်းဆက်သွယ်ရေးရှိပါသလား။

□ *Yes ရှိ* □ *No မရှိ*

Q35. ***How and where household waste is disposed?***
အမှိုက်များကို မည်သည့်နေရာတွင် မည်သို့ စွန့်ပစ်သနည်း။

How household waste is disposed? **အမှိုက်များကိုမည်သို့စွန့်ပစ်သနည်း။**	□ *Burn မီးရှို့ခြင်း* □ *Land field မြေမြှုပ်ခြင်း* □ *Other (Please specify) အခြား* _____
Where household waste is disposed? **အမှိုက်များကို မည်သည့်နေရာတွင် စွန့်ပစ်သနည်း။**	□ *Within household အိမ်ခြံဝင်းတွင်း* □ *In the village/ ward ရွာ/ ရပ်ကွက်တွင်း* □ *Other (Please specify) အခြား* _____

PART F: ***UNDERSTANDING AND PERCEPTIONS OF THE PROJECT***

စီမံကိန်းအကြောင်းသိရှိမှု နှင့် အမြင်သဘောထား

Q36. ***Have you heard of the Project?***
စီမံကိန်းအကြောင်းကြားဖူးပါသလား။

□ *Yes ကြားဖူးသည်* □ *No မကြားဖူးပါ*

**** If "No", this is the end of the Survey*
မကြားဖူးပါက မေးမြန်းခြင်းပြီးဆုံးသည်။

Q37. ***What have you heard about the Project?*** *(Record up to three concepts)*
စီမံကိန်းနှင့်ပတ်သက်၍ ဘာများသိထားပါသနည်း။ (ထင်မြင်ချက်သုံးခုနှင့်အထက်)

_____

_____

_____

Q38. ***Where did you hear about the project?*** *(Tick all appropriate)*

စီမံကိန်းအကြောင်းမည်သည့်နေရာမှကြားခဲ့သနည်း။ (အမှန်ခြစ်ပါ)

☐ *Government (အစိုးရ)*

☐ *Village Leaders (လူထုအဖွဲ့ ခေါင်းဆောင်)*

☐ *Friends/ Neighbours* သူငယ်ချင်း။အိမ်နီးချင်းများ

☐ *Newspaper (သတင်းစာ)*

☐ *TV (တီဗွီ)*

☐ *Radio (ရေဒီယို)*

☐ *Internet (အင်တာနက်)*

☐

☐ *Other (Please specify) အခြား*

_____

☐ *NGO (Please Specify):*

_____

Q39. ***What are your views about the Project?***

စီမံကိန်းနှင့်ပက်သက်၍အမြင်သဘောထား

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Women's Focus Group Discussion (အမျိုးသမီးများနှင့် အုပ်စုတွေ့ဆုံနေးပွဲ)

We are conducting a survey on behalf of Tun Thwin Minning Company Limited (TTMC intends to develop a 600MW coal Fire Power Plant (CCPP) to supply power to the Republic Union of Myanmar through a Power Purchase Agreement (PPA) with the Ministry of Electric Power (MOEP) in Kalewa. A Public meeting will be held in the coming weeks to explain more about the Proposed Project

MUPA ၏ကုမ္ပဏီခွဲတစ်ခုဖြစ်သော ကိုယ်စား လေ့လာဆန်းစစ်ခြင်းလုပ်ငန်းများကို ကျွန်တော်တို့က ဆောင်ရွက်မည်ဖြစ်ပါသည်။
ထားဝယ်အထူးစီးပွားရေးဇုံ ဖွံ့ဖြိုးမှုကနဦးအဆင့်တွက် MIEH နှင့် ထားဝယ်အထူးစီးပွားရေးဇုံ
ဖွံ့ဖြိုးမှုကော်မတီတို့သည် ပြုလုပ်ခွင့်သဘောတူညီမှုအား လက်မှတ်ရေးထိုးခဲ့ပါသည်။

The proposed Project site is located in Kalewa Township, Kale District, Sagaing Region, Myanmar. The closest villages to the Project site are Nan Maw Ke, Ma Htu and Yaw Su.

ရေသန့်စင်စက်ရုံမှ စက်မှုဇုံ၏ အသေးစားနှင့် အလတ်စားစက်မှုလုပ်ငန်းတွေကို စက်ရုံသုံးရေ ပိုမိုထောက်ပံ့ပေးနိုင်မှာ ဖြစ်ပါသည်။
အဆိုပြုထားသော ရေသန့်စင်စက်ရုံမှာ ပယ်မိန်းဖြူရေလှောင်တမံအနီး ထားဝယ်အထူးစီးပွားရေးဇုံ၏ အရှေ့ ၁၅ ကီလိုမီတာခန့်အကွာတွင် တည်ဆောက်ရန်လျာထားပါသည်။

Environmental Resources Management (ERM), with Sustainable Environment Myanmar (SEM), has been asked by TTMC to do the ESIA Study of the Project to satisfy the New EIA Procedure and other relevant requirements.

MUPA မှ Environmental Resources Management (ERM) နှင့် Sustainable Environment Myanmar (SEM) တို့ကို
ကနဦးပတ်ဝန်းကျင်ဆန်းစစ်လေ့လာခြင်းပြုလုပ်ရန် တာဝန်ပေးခဲ့ပါသည်။

The purpose of the ESIA process is to assess the potential impacts of the Project activities on the biophysical and socio-economic environments and establish measures to mitigate the impacts.

ကနဦးပတ်ဝန်းကျင်လေ့လာဆန်းစစ်ရခြင်းရည်ရွယ်ချက်မှာ စီမံကိန်းလုပ်ဆောင်ရာတွင် ဇီဝရုပ်ပိုင်းဆိုင်ရာ နှင့်
ပတ်ဝန်းကျင်လူမှုစီးပွားရေးဆိုင်ရာ ဖြစ်ပေါ် လာနိုင်သည့် ထိခိုက်မှုများကို လေ့လာဆန်းစစ်ခြင်းနှင့်
ထိခိုက်မှုများကို လျော့ချနိုင်မည့်နည်းလမ်းများ ရှာဖွေခြင်း ဖြစ်ပါသည်။

The ESIA involves:

ကနဦးပတ်ဝန်းကျင်လေ့လာဆန်းစစ်ခြင်းတွင် အောက်ပါလုပ်ငန်းစဉ်များ ပါဝင်ပါသည်။

-Baseline studies, which are undertaken to establish an understanding of the existing environment.

-မူလပတ်ဝန်းကျင်ဆိုင်ရာ အခြေခံအချက်အလက်များလေ့လာခြင်း။

-An impact assessment, which identifies what impacts that are likely to occur as a result of the Project – i.e. how will the baseline change.

-စီမံကိန်းကြောင့်ဖြစ်လာနိုင်မည့် ထိခိုက်မှုများကို အမျိုးအစားခွဲခြားခြင်း။(ဥပမာ-မူလပတ်ဝန်းကျင်ဆိုင်ရာအခြေခံအချက်အလက်များ
စီမံကိန်းကြောင့်ပြောင်းလဲသွားမှု ရှိ၊ မရှိ)

-Development of management measures, which are designed to minimise the likely negative impacts and enhance the potential positive benefits of the Power Plant.

-ဆိုးကျိုးထိခိုက်မှုများကို လျော့ချမည့်စီမံခန့်ခွဲရေး နှင့် ရေသန့်စင်စက်ရုံ၏ ကောင်းကျိုးများ ပိုမိုတိုးပွားစေရန် အစီအစဉ်များရေးဆွဲခြင်း။

This survey forms a part of the socio-economic baseline study. The intention is to better understand the local communities. The ERM/ SEM team will spend time with members of the community to better understand local livelihoods and lifestyles.

ယခုမေးခွန်းကောက်ခံခြင်းသည် လူမှုစီးပွားရေးဆိုင်ရာအခြေခံအချက်အလက်များကောက်ယူခြင်း၏အစိတ်အပိုင်းတစ်ခုဖြစ်ပါသည်။
သက်ဆိုင်ရာဒေသခံများအကြောင်း ပိုမိုနားလည်စေရန် ရည်ရွယ်ပါသည်။ သက်ဆိုင်ရာဒေသခံများ၏ လူနေမှုဘဝ၊
နေထိုင်စားသောက်မှုပုံစံများကို ပိုမိုနားလည်နိုင်ရန်အတွက် ERM/SEM အဖွဲ့များမှ လေ့လာမည်ဖြစ်ပါသည်။ ထို့အပြင် တခြားအဖွဲ့များမှ
ဒေသတွင်းရှိ အခြေခံအချက်များဖြစ်သော အသံဆူညံမှု၊ လေအရည်အသွေး နှင့် ဇီဝမျိုးစုံမျိုးကွဲဆိုင်ရာအချက်အလက်များကို
အသေးစိတ်လေ့လာမည်ဖြစ်ပါသည်။

Participation in this survey is voluntary and you may choose not to answer any of the questions. You may answer the questions in any way you like; there is no right or wrong answer. You may bring up other topics related to the Project.

ဤလေ့လာဆန်းစစ်ခြင်းသည် ဆန္ဒသဘောထားရယူခြင်းသာဖြစ်၍ မဖြေဆိုချင်သောမေးခွန်းများကို ရွေးချယ်နိုင်ပါသည်။
မည်သည့်သဘောထားမျိုးကိုမဆို ဖြေဆိုနိုင်ပြီး အဖြေမှန် (သို့) အဖြေမှား ဟူ၍မရှိပါ။ စီမံကိန်းနှင့် သက်ဆိုင်သည့်
မည်သည့်အကြောင်းအရာကိုမဆို ဖြေဆိုနိုင်ပါသည်။

Please note that your participation in this survey is not linked in any way to determination of entitlements for compensation.

ကျေးဇူးပြု၍ ဤလေ့လာဆန်းစစ်ခြင်းသည် နစ်နာကြေးခံစားခွင့်များနှင့် မသက်ဆိုင်ပါကြောင်း

Enumerator Details:					
Name: အမည်	1) 2) 3) 4) 5)	Contact Phone No: *ဖုန်းနံပါတ်-*	1) 2) 3) 4) 5)	*Signature: လက်မှတ်*	1) 2) 3) 4) 5)
Date: (DD/MM/YY) နေ့စွဲ					
Location Details					
Village: ကျေးရွာအမည်			*Township: မြို့နယ်*		
Village Tract: ကျေးရွာအုပ်စုအမည်			*District: ခရိုင်*		
State/Region/ပြည်နယ်/တိုင်း			*Coordinates: ကိုအော်ဒိနိတ်*		

GENERAL		
1.	How many women are there in the village? ရွာထဲတွင် အမျိုးသမီးအရေအတွက် ဘယ်လောက်ရှိလဲ။	
	What percentage of women's vote in the village? (eg. vote in election process)	
	How many widowed women in the village? ရွာထဲတွင် မုဆိုးမ အရေအတွက် ဘယ်လောက်ရှိလဲ။	
2.	Are there any women headedhouseholds? If yes, how many in the village? အမျိုးသမီး ဦးဆောင်သော အိမ်ထောင်စု ရှိပါသလား။ ရှိလျှင် အရေအတွက်ကို ဖော်ပြပါ။	
3.	What role do women play in: အမျိုးသမီးများ၏ အခန်းကဏ္ဍက ဘာလဲ။ - Their roles in the community? - ရပ်ရွာအဖွဲ့အစည်း - Their roles in the local leadership/politics? - ဒေသအတွင်းဦးဆောင်မှု / နိုင်ငံရေး လှုပ်ရှားမှု	
4.	What is the regular daily schedule? နေ့စဉ်လှုပ်ရှားမှု ပျမ်းမျှ အချိန်ဇယား။ မည်သည့်အချိန်တွင်အလုပ်စတင်၍မည်သည့်အချိန်တွင်အလုပ်ပီးဆုံးသနည်း။ အဓိက လုပ်ငန်းတာဝန်များကို လုပ်ဆောင်ရာတွင် တစ်ရက်လျှင် အချိန်မည်မျှ ကြာသနည်း။ အမျိုးသားများကအိမ်မှုကိစ္စများတွင် ကူညီလုပ်ဆောင်ပေးပါသလား။	

	For a day, how much time do women spend in doing domestic chores?	
	Do men help women with domestic chores?	
Leadership Roles		
5.	How many women are in leadership position in the community? ရပ်ရွာအဖွဲ့အစည်းတွင် အမျိုးသမီးဦးဆောင်မှုအရေအတွက် ဘယ်လောက်ရှိလဲ။	
Ownership		
	What are the ownership patterns in the village? ရွာထဲတွင် ပိုင်ဆိုင်မှုပုံစံကို ဖော်ပြပါ။	
6.	What are the typical assets owned by women in the family (e.g. land, property, jewelry, etc.) မိသားစုအတွင်းအမျိုးသမီးများ ပိုင်ဆိုင်မှုများကို ဖော်ပြပါ။ (မြေ၊ ပစ္စည်းဥစ္စာ၊ ရတနာ..အစရှိသည့်)	
7.	Are the ownership rights for girl child defined? မိန်းကလေးများတွက် သတ်မှတ်ထားသည့် ပိုင်ဆိုင်သည့်အခွင့်အရေး ရှိပါသလား။ လက်ထပ်ပြီးကာစ မိန်းကလေးများအတွက် ပိုင်ဆိုင်မှု ဘာတွေ ရှိပါသလဲ။	
Social Status		
8.	Do you think men and women are given equal opportunities? မိန်းကလေးနှင့် ယောကျ်ားလေး တန်းတူအခွင့်အရေး ရှိသင့်သည်ဟု ထင်ပါသလား။	
9.	What influence do women have in decisions, made within the household? (e.g. marriage, children, other family issues) အိမ်ထောင်စုအတွင်း ဆုံးဖြတ်ရာတွင် အမျိုးသမီးများ၏ အရေးပါမှုကို ဖော်ပြပါ။ (ဥပမာ- လက်ထပ်ပွဲ၊ သားသမီးအရေး၊ အခြားမိသားစုပြဿနာများ)	
10.	If there is a dispute to resolve between a husband and wife? ဇနီးနှင့်ခွန်ပွန်းကြား အငြင်းပွားမှုများကို ပြန်ဖြေရှင်းမှုများရှိလျှင်၊ ဘယ်လိုဖြေရှင်းတာလဲ၊ ဘယ်သူတွေက ကူညီဖြေရှင်းပေးလဲ။	
	How is this resolved?	
	Who helps resolve that dispute?	
	Do girls access formal education? Until what level? မိန်းကလေးများတွင် ပုံမှန်ပညာအရည်အချင်းရှိလား။ ဘယ်အတန်းထိ ရှိလဲ။ ယောကျ်ားလေးများနှင့် ဘယ်လိုနှိုင်းယှဉ်မလဲ။ ကွဲပြားမှုရှိလျှင် ဘာကြောင့်ဖြစ်ရသနည်း၊ ၎င်းနှင့် ပတ်သက်၍ မည်သို့ ထင်သနည်း။	
	How does it compare with boys?	
	If there is a difference, why does it exist and what do you think about it?	

12.	What are the main problems faced by women/girls in general? အမျိုးသမီးများ၏ အဓိက ကြုံတွေ့နေရသော ပြဿနာများကို ဖော်ပြပါ။ အကြောင်းပြချက်က ဘာလို့ထင်ပါသလဲ။	
	What do you think the reason of that problem is?	
13.	How would you rate your quality of life (good, average, bad)? သင်တို့၏ ဘဝ အရည်အသွေးကို သတ်မှတ်ပြပါ။ (ကောင်း၊ သင့်၊ ဆိုး) သင် ရရှိထားသည့် ဘဝကို ကျေနပ်လား/ မကျေနပ်ဘူလား။	
	What do you like/dislike about your quality of life?	
14.	What wishes and hopes do you have for your daughters? သင်တို့၏ သမီးများနှင့် သူတို့၏ဘဝအတွက် မျှော်မှန်းချက်နှင့် ဆန္ဒများ ရှိပါသလား။	
15.	Are there any women's associations / groups? အမျိုးသမီးအဖွဲ့အစည်းများ/ အုပ်စုများ ရှိပါသလား။ ဘာတွေ လုပ်ဆောင်ပါသလဲ။	
	What do they do?	
Access to Services		
16.	What are the main health problems faced by women in the community? (*Ask the group to priorities the top three.)* *ရပ်ရွာအတွင်း အမျိုးသမီးများ ရင်ဆိုင်နေရသော အဓိက ကျန်းမာရေးပြဿနာများက ဘာလဲ။ အဖြစ်များဆုံး ရောဂါသုံးမျိုးကို ဦးစားပေး ဖော်ပြပါ။*	
17.	Have there been any serious disease outbreaks in your community in the past year? လွန်ခဲ့သောနှစ်အတွင်း သင့်ရပ်ရွာတွင် ပြင်းထန်သောရောဂါဖြစ်ပွားမှုများ ရှိပါသလား။	
18.	What are the main causes of death in your village? သင်ကျေးရွာတွင် အဓိက သေဆုံးသည့်အကြောင်းအရင်းက ဘာလဲ။ ဘာကြောင့်လဲ။ ဘယ်သူတွေက အဖြစ်များလဲ။(အမျိုးသား၊အမျိုးသမီး၊ကလေး)	
	Why?	
	What groups?*(men, women, children)*	
19.	Is smoking or drinking alcohol common within your village? ကျေးရွာအတွင်း ဆေးလိပ်သောက်ခြင်း သို့မဟုတ် အရက်သေစာသောက်စာခြင်းများ ရှိလား။ ရှိလျှင် ဘယ်သူတွေလဲ(အမျိုးသား၊အမျိုးသမီး၊ကလေး)။ အသက်အရွယ် ဘယ်လောက်လဲ။ အမျိုးသမီးအပေါ် မည်သို့ သက်ရောက်မှု ရှိသနည်း။	
	If so, among which groups and what ages?	
	How does it affect the women?	
20.	Where do you access your healthcare? Indicate distance and time taken to walk/travel. ကျန်းမာရေးစောင့်ရှောက်မှုများကို ဘယ်နေရာတွင် ရရှိသနည်း။	

	ဘယ်လိုအမျိုးအစားတွေလဲ (ပုဂ္ဂလိက၊ အစိုးရ၊ ဘာသာရေး၊ တိုင်းရင်းဆေး..စသည့်)။ ရွာနှင့်ဘယ်လောက်ဝေးသလဲ (မိုင်နှင့်ဖော်ပြရန်)။ လမ်းလျှောက်/ ယာဉ်လမ်း များ အသုံးပြုပါက ကြာချိန်နှင့်အကွာအဝေးကို ဖော်ပြပါ။	
	What type of facility is it? *(Private, government, religious, traditional etc.)*	
	How far is it from the village (miles)?	
	Indicate distance and time taken to walk/travel.	
21.	Are you satisfied with the levels of healthcare available to you and your family? *သင်နှင့် သင်မိသားစု* ရရှိထားသည့် ကျန်းမာရေးဆိုင်ရာစောင့်ရှောက်မှုများကို ကျေနပ်ပါသလား။ အဓိကပြဿနာများ ရှိပါသလား (ဥပမာ- အကွာအဝေး၊ စောင့်စားချိန်ကြာရှည်ခြင်း၊ ဖွင့်ချိန်များ၊ ဆေးရုံး/ဆေးခန်းအခြေအနေ၊ ဆေးဘတ်ဆိုင်ရာထောက်ပံ့မှုများ၊ ကုန်ကျစရိတ်များ)	
	What are the main problems, if any? *(e.g. distance, long queues, opening hours, condition of hospital or clinic, medical supplies, costs)*	
22.	Do you have to pay for healthcare? ကျန်းမာရေးဆိုင်ရာစောင့်ရှောက်မှုများအတွက် ငွေပေးချေရသလား။ ဘယ်လိုစောင့်ရှောက်မှုအတွက် ပေးရလဲ။ ကုန်ကျစရိတ်ကို ပြောပြပေးနိုင်ပါသလား။	
	Which type of care do you pay for?	
	Can you tell us the price that you have to pay for the diseases or treatment, which you have to afford commonly?	
23.	Are there any health programmes in the area? ဤဒေသတွင် ကျန်းမာရေးဆိုင်ရာ အစီအစဉ်များ ရှိသလား။ ရှိလျှင် ဘာတွေလဲ။	
	If yes, which ones?	
24.	Are Sexually Transmitted Infections (STIs) common? လိင်ဒိုင်ဆိုင်ရာ ကူးစက်ရောဂါတွေ ရှိပါသလား။ အဖြစ်များဆုံးက ဘာတွေလဲ (ဥပမာ- ကာလသားရောဂါ၊ အသဲရောင်အသားဝါရောဂါ၊ HIV)။	
	Which ones are more common *(e.g. syphilis, Hepatitis, HIV)*?	
25.	What sexual health and family planning services are provided to women in the village? ကျေးရွာတွင် အမျိုးသမီးများကို လိင်ဒိုင်ဆိုင်ရာကျန်းမာရေးနှင့် မိသားစုအစီအစဉ် ဝန်ဆောင်မှုများကို ထောက်ပံ့ပေးထားပါသလား။	
26.	How is knowledge regarding sexual health transferred to the younger generation? လူငယ်များကို လိင်ဒိုင်ဆိုင်ရာကျန်းမာရေးနှင့် ပတ်သက်ပြီး အသိပညာပေးနိုင်ရန် ဗဟုသုတ ဘယ်လောက်ရှိလဲ။	
27.	How do you avoid getting pregnant? မည်သည့်သားဆက်ခြားနည်းကို အသုံးပြုသနည်း။ ခေတ်ပေါ်နည်း/ ရှေးရိုးနည်း။	
	What are the modern/traditional ways?	

28.	What is the practice of birth deliverygenerally practiced? (e.g. Home based through traditional nurses or institutional delivery in the hospitals) ကလေးမွေးဖွားသည့်အခါ အိမ်မှာမွေးရင် လက်သည်နှင့်မွေးဖွားသလား။ ဆေးရုံမှာမွေးဖွားခြင်း သို့မဟုတ် အိမ်တွင်	
LIVELIHOOD & INCOME		
	What are the income generating sources for women in the community? Which are the main economicactivities undertaken by women? ရပ်ရွာတွင် အမျိုးသမီးများ၏ ဝင်ငွေရရှိသည့် အရင်းအမြစ်က ဘာလဲ။ အမျိုးသမီးများ၏ အဓိက စီးပွားရေးလှုပ်ရှားမှုများက ဘာတွေလဲ။	Please describe the special roles of women.
29.	On the farm? လယ်ယာလုပ်ငန်း	
	Firewood collection and selling? ထင်းခုတ်/ရောင်း	
	Gathering of non-timber forest products? အခြားသစ်တောထွက်ပစ္စည်းကို စုဆောင်းခြင်း။	
30.	How many women in the community are working in the formal sector? ပုံမှန်ကဏ္ဍများတွင် အလုပ်လုပ်နေသော ရပ်ရွာရှိအမျိုးသမီး အရေအတွက်ကိုဖော်ပြပါ။ အခြားသော စက်ရုံများတွင် အလုပ်လုပ်နေသော အရေအတွက်ကိုဖော်ပြပါ။ အလုပ်အမျိုးအစားကို ဖော်ပြပါ။	
	How many are working in various industries?	
	What are types of their jobs?	
31.	What is approximate women's contribution to family income? အကြမ်းအားဖြင့် မိသားစုဝင်ငွေအတွက် အမျိုးသမီးများ၏ အထောက်အပံ့ ဘာလဲ။ မိသားစုတွင်ငင်းတို့၏ အရေးပါမှု တိုးတက်လာသလား သို့မဟုတ် ဆုံးဖြတ်ချက်ချတဲ့အခါများတွင် သူတို့၏ ပြောစကားများအရေးပါမှု တိုးတက်လာပါသလား။	
	Does it increase their status in the family, or increase their say or influence in the decision-making process?	
32.	Are there households where men or other family members, who migrate seasonally or annually for work? အလုပ်အတွက် နှစ်စဉ် သို့မဟုတ် ရာသီအလိုက် အခြားမိသားစုဝင် သို့မဟုတ် အမျိုးသားများ ပြောင်းရွေ့လုပ်ကိုင်နေသည့် အိမ်ထောင်စုများ ရှိပါသလား။ မိသားစုတွင် ဘယ်လိုသက်ရောက်မှုများ ရှိပါသလဲ။	
	How does this impact on the family?	
33.	What significant changes have taken place in women's role since previous generations? အမျိုးသမီးများ၏ အခန်းကဏ္ဍတွင် ဘာတွေက သိသိသာသာ ပြောင်းလဲစေလဲ။	

	ဘာကြောင့်လဲ။ အနာဂတ်မှာ နောက်ထပ် ပြောင်းလဲမှု ရှိလာနိုင်မလဲ။ ဘာကြောင့်လဲ။	
	Why?	
	Will this change again in the future?	
	Why?	
34.	What is the main problem faced by working women, especially in formal employment or informal employment? အလုပ်လုပ်နေသည့်အမျိုးသမီးများ၏ ရင်ဆိုင်နေသည့်အဓိက ပြဿနာများက ဘာတွေလဲ။ အထူးသဖြင့် တရားဝင်အလုပ် သို့မဟုတ် တရားမဝင်အလုပ်လား။	
FARMING (AGRICULTURE, Livestock) ***(if farming community)***		
35.	How many women in the village are engaged in farming? • % of HHs where women are engaged in farming. • % of HHs where women are engaged as paid farm workers • ကျေးရွာတွင် လယ်ယာလုပ်ငန်းလုပ်ကိုင်နေသော အမျိုးသမီး အရေအတွက် ဘယ်လောက်လဲ။ • လယ်ယာလုပ်ငန်းလုပ်ကိုင်နေသော အမျိုးသမီးပါဝင်သည့် အိမ်ထောင်စုရာခိုင်နှုန်း • လယ်ယာလုပ်ငန်းလုပ်ကိုင်နေသည့်အလုပ်သမားအဖြစ် အမျိုးသမီးပါဝင်သော အိမ်ထောင်စုရာခိုင်နှုန်း •	
36.	Do women have ownership over land? အမျိုးသမီးများ ကိုယ်ပိုင်မြေ ရှိပါသလား ကျေးရွာတွင် ကိုယ်ပိုင်မြေ ပိုင်ဆိုင်သောအမျိုးသမီးအချိုးအစားကို ဖော်ပြပါ။ အမျိုးသမီးများပိုင်ဆိုင်သည့် ကိုယ်ပိုင်မြေသည် သီးသန့်လူတန်းစား/အုပ်စုခွဲများတွင် အတွေ့များလား။	
	What proportions of women in the village have their own lands?	
	Is the women ownership over land is more common in certain caste/sub groups?	

37.	What is the role of women in various agricultural activities? အမျိုးမျိုးသော စိုက်ပျိုးရေး လုပ်ရှားမှုများတွင် အမျိုးသမီးများ၏ အခန်းကဏ္ဍ။ Examples of agricultural activities: • Land preparation • မြေယာပြုပြင်ခြင်း • Buying of seeds and fertilizers • ဓါတ်မြေဩဇာနှင့် မျိုးစေ့များ ဝယ်ယူခြင်း • Sowing • သီးနှံကျဲခြင်း • Weeding • ပေါင်းသတ်ခြင်း • Harvesting • ရိတ်သိမ်းခြင်း • Winnowing and Packaging • အညှံဖယ်ရှားခြင်းနှင့် ထုတ်ပိုးခြင်း • Taking to the market for sale • ရောင်းချရန် ဈေးသို့ပို့ဆောင်ခြင်း • Managing finance • ငွေကြေးစီမံခန့်ခွဲခြင်း	
38.	What are the normal working hours for women working in the field? ကွင်းထဲတွင် လုပ်ကိုင်နေသောအမျိုးသမီးများအတွက် ပုံမှန်အလုပ်လုပ်ချိန် ဘယ်လောက်လဲ • Own farm • ကိုယ်ပိုင်မြေ/ အကျိုးအမြတ်များ • Others' farm • အခြားသောမြေ/ လုပ်ခအကျိုးအမြတ်များ/ ထိုစိုက်ပျိုးရေးအမျိုးသမီးများအတွက် တူညီသော လုပ်ခလစာ ရရှိပါသလား။ မိသားစုအလိုက် သို့မဟုတ် သီးခြား ငွေပေးချေပါသလား။	
	Are the wages equal for female agricultural worker?	
	Are they separately paid or paid as a family?	
39.	Do children support the farming process? လယ်ယာစိုက်ပျိုးရေးလုပ်ငန်းကို ကလေးများက ကူညီပေးပါသလား။ မည်သို့နည်း၊ မည်သည့်အချိန်တွင် (ဥပမာ- ကျောင်းပိတ်ရက်များတွင်)။ ဘယ်လိုလုပ်ရှားမှုများ လုပ်ဆောင်ပေးပါသနည်း။ ပိုးသတ်ဆေး/ပေါင်းသတ်ဆေးများအသုံးပြုခြင်းဖြင့် ကူညီပေးပါသလား။	
	How children support the farming process?	
	When they support? (e.g. during school holidays)	
	What activities do they do?	

	Do they help with the use of pesticides/herbicides?	
40.	What are the main crops grown & in what months? အဓိက မည်သည့် သီးနှံများ ကြီးထွားပြီး မည်သည့်လများတွင် ကြီးထွားသနည်း။	
41.	What are the main livestock reared? What are the roles and responsibility of women in livestock rearing? အဓိကမွေးမြူသော တိရစ္ဆာန်များကို ဖော်ပြပါ။ မွေးမြူရေးတွင် အမျိုးသမီးများ၏ အခန်းကဏ္ဍနှင့် တာဝန်ဝတ္တရားများကို ဖော်ပြပါ။ Examples of roles and/or responsibilities of women in livestock rearing: • Fodder collection • ကျွဲစာ၊ နွားစာ စုဆောင်းခြင်း • Buying and selling of cattle • ကျွဲ၊ နွား ရောင်းဝယ်ရေး • Grazing • စားကျက်မြေ စီမံခန့်ခွဲမှု • Shed management မွေးမြူရေးခြံ စီမံခန့်ခွဲမှု • Dung cakes preparation • မစင်သန့်စင်ခြင်း • Milking • နို့ညှစ်ခြင်း • Selling of milk or taking it to cooperatives နွားနို့ရောင်းခြင်း • Vaccination and veterinary services- health management • ကာကွယ်ဆေး နှင့် တိရစ္ဆာန်ဆရာဝန်များမှ ဝန်ဆောင်မှုများ-ကျန်းမာရေးစီမံခန့်ခွဲမှု	
42.	Is agricultural/farming produce used for self-consumption or selling in the market? စိုက်ပျိုးရေးထုတ်လုပ်မှုများသည် ဈေးကွက်တွင် ရောင်းချရန် (သို့) ကိုယ်တိုင်စားသုံးရန်။ အချိုးအစားကိုဖော်ပြပါ။ သီးနှံတွေကွဲပြားမှုရှိလား။ စိုက်ပျိုးထားသည့် သီးနှံများကို ခွဲခြားပြနိုင်သလား။	
	How many percentage of using for self-consumption or selling in the market? (amount of portion)	
	Does this differ from crop to crop?	
	Can youspecify in terms of the crops that they grow?	
43.	Where are the fields located? • ကွင်း၏တည်နေရာကိုဖော်ပြပါ။ ကျေးရွာမှ အကွာအဝေးနှင့် အချင်းဝက်ကိုဖော်ပြပါ။ အမျိုးသမီးလယ်လုပ်သူများ အလုပ်အတွက်သွားရသည့် အကွာအဝေး။ • တစ်နှစ်ပတ်လုံး လယ်လုပ်သည့်အလုပ်သမားများ ရှိပါသလား။ • သင်သည် ရွှေ့ပြောင်းလုပ်ကိုင်မှုများနှင့် ရင်ဆိုင်နေရပါသလား။	

	Indicate distance and radius from the village:	
	How far women farm workers have to travel for work?	
	Is the farm labour work available throughout the year?	
	Do you face competition with the migrant?	
44.	What are the main challenges faced by women farmers in the village? ကျေးရွာတွင် အမျိုးသမီး လယ်လုပ်သူများရင်ဆိုင်နေရသည့် အဓိကစိန်ခေါ်မှုများ	
G. Project related impacts- perceptions on Industry, expectations and Concerns		
45.	What do you know about the proposed project? အဆိုပြုစီမံကိန်းနှင့် ပက်သတ်ပြီး မည်သည်တို့ကို သိရှိသနည်း။	
46.	Do you anticipate any positive impacts (benefits) from the project? စီမံကိန်းမှ ကောင်းမွန်သောသက်ရောက်မှုများကို မျှော်မှန်းထားပါသလား။ ဖော်ပြပါ။	
	Please describe	
47.	Do you anticipate any negative impacts from the project? စီမံကိန်းမှ ဆိုးကျိုး သက်ရောက်မှုများကို မျှော်မှန်းထားပါသလား။ ဖော်ပြပါ။	
	Please describe	
48.	Do you have any ideas for mitigation / enhancement measures for the issues described above (project impacts / benefits), especially in relation towomen? အထူးသဖြင့် အမျိုးသမီးများနှင့်ဆက်နွယ်နေသော (စီမံကိန်းကြောင့် ထိခိုက်မှုများ/ အကျိုးကျေးဇူးများ) အထက်တွင်ဖော်ပြထားသည့် ပြဿနာများ ကို လျော့ချခြင်း/တိုးချဲ့ခြင်းနည်းလမ်းများနှင့် ပက်သတ်သည့် အကြံဉာဏ်များရှိပါသလား။	
49.	Do you think that there will be any impact on your life owing to the following? (please provide details on the slot given below) အောက်ပါတို့နှင့် ပက်သတ်၍ သင့်၏ဘဝနေထိုင်မှုအပေါ် သက်ရောက်မှုရှိနိုင်သည်ဟု ထင်ပါသလား။	
	a) Forest as a source of resources like medicines, firewood, food, and other income generation sources ဆေး၊ ထင်း၊ အစားအစာကဲ့သို့ ကုန်ကြမ်းများ၏ အရင်းအမြစ်တစ်ခုဖြစ်သည့် သစ်တောနှင့် အခြားဝင်ငွေအရင်းအမြစ်များ	
	b) Traditional Forest	
	c) Religious sites ဘာသာရေးဆိုင်ရာ နေရာများ (The ones you pray including graves, shrines, etc.) (ဘုရားကျောင်း၊ အလေးအနက်ထားသည့်နေရာအစရှိသည်တို့ပါဝင်သော ဆုတောင်းသည့်နေရာ)	
	d) Agricultural land and related food insecurity စိုက်ပျိုးမြေ နှင့် အစားအသောက်များ မလုံခြုံမှုနှင့် သက်ဆိုင်သည့်အရာများ	

	e) Availability of land မြေယာရရှိမှု	
	f) Pollution ညစ်ညမ်းမှု	
	g) Increased crime in the area ထိုနေရာတွင်း ပြစ်မှုများ များပြားလာမှု	
	h) Increased influx of the people in the area ထိုနေရာတွင်း လူဦးရေထူထပ်မှု တိုးပွားလာခြင်း	
	i) Market in the area ဒေသတွင်းရှိဈေးများ	
	j) Increase in the food prices in the area ဒေသတွင်း အစားအစာဈေးနှုန်းများ တိုးပွားလာမှု	
	k) Any other traditional livelihood အခြားသော ရှေးရိုးအသက်မွေးဝမ်းကြောင်းမှုများ	
	m) Any other issue of significant concern for the women အမျိုးသမီးများနှင့် သက်ဆိုင်သော သိသာထင်ရှားသည့် ပြဿနာများ	

APPENDIX S EXAMPLE TOOLS USED FOR SOCIAL BASELINE PRIMARY DATA COLLECTION

Air Quality Impact Assessment for LNG Power Plant (Ahlone) Project

Technical Report

3 April 2019

Project No.: 0439461

The business of sustainability

ERM

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Air Quality Impact Assessment for LNG Power Plant (Ahlone) Project

Technical Report

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Acronyms and Abbreviations

ASR	Air Sensitive Receptor
AQIA	Air Quality Impact Assessment
AQM	Air Quality Monitoring
AQS	Air Quality Standard
BAT	Best Available Techniques
CCGT	Combined Cycle Gas Turbine
CO	Carbon Monoxide
DA	Degraded Air Shed
DEFRA	Department of Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges
EHS	Environment, Health and Safety
EPAS	Haz-Scanner Environmental Perimeter Air Station
EPUK	Environmental Protection United Kingdom
EU	European Union
GIIP	Good International Industry Practice
HGV	Heavy Goods Vehicles
IAQM	Institute of Air Quality Management
IFC	International Finance Corporation
IQR	Interquartile Range
kPa	Kilopascal
LNG	Liquefied Natural Gas
MW_{th}	Megawatt Thermal
NDA	Non Degraded Air Shed
NEQEG	National Environmental Quality (Emission) Guidelines
NO_x	Oxides of Nitrogen
NO_2	Nitrogen Dioxide
NPi	Australian National Pollution Inventory
O_2	Oxygen
PC	Process Contribution
PEC	Predicted Environmental Concentration
PM_{10}	Particulate Matter <10 micrometers
$PM_{2.5}$	Particulate Matter <2.5 micrometers
SO_2	Sulphur Dioxide
SRTM	Shuttle Radar Topographic Mission
TSP	Total Suspended Particulate
UB	Upper Bound
USEPA	United States Environmental Protection Agency
WHO	World Health Organisation

1. INTRODUCTION

1.1 Overview

The Ahlone development (hereafter referred to as 'the Project') involves the construction and operation of a 388 MW liquefied natural gas (LNG) power plant, LNG receiving terminal including a small power generation facility, and a 24.4 km onshore pipeline.

Emissions to air from the Project have the potential for adverse effects on human health, agricultural and sensitive ecology. This air quality impact assessment (AQIA) assesses these potential impacts against relevant air quality standards, objectives and guidelines where relevant.

The assessment of potential air quality impacts associated with the Project considers:

- sources, nature and quantity of emissions to air;
- a qualitative assessment of construction and decommissioning phase impacts;
- a detailed quantitative assessment of process emissions;
- an assessment of potential impacts on relevant sensitive receptors; and
- mitigation measures to reduce the impacts where necessary.

2. LEGAL FRAMEWORK AND BEST PRACTICE

2.1 Overview

The International Finance Corporation (IFC) Environmental, Health and Safety (EHS) guidelines are considered throughout this AQIA. The IFC guidelines provide the overarching guidance and principles for undertaking the assessment. The key documents considered are:

- IFC General EHS Guidelines for Air Emissions and Ambient Air Quality[1];
- IFC General EHS Guidelines for Construction and Decommissioning[2]; and
- IFC EHS Guidelines for Thermal Power Plants[3].

Where necessary, reference is made to other internationally recognised sources of information. These include, but are not necessarily limited to guidelines published by:

- the World Health Organisation (WHO);
- the European Union (EU);
- the United States Environmental Protection Agency (USEPA);
- the Australian National Pollution Inventory (NPi);
- the Department of Environment, Food and Rural Affairs (DEFRA); and
- reputable air quality institutes and working groups such as the Institute of Air Quality Management (IAQM).

2.2 Air Quality Standards and Guidelines

2.2.1 Human Health

The IFC's General EHS guideline for air emissions and ambient air quality states that:

- *Projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that:*

  - *emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines, or other internationally recognised source; and*

  - *emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed.*

[1] International Finance Corporation (IFC) (2007) Environmental, Health and Safety Guidelines, General EHS Guidelines: Environmental Air Emissions and Ambient Air Quality [Online] Available at: http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines [Accessed 13 February 2019]

[2] International Finance Corporation (IFC) (2007) Environmental, Health and Safety Guidelines, General EHS Guidelines: Construction and Decommissioning [Online] Available at: http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines [Accessed 13 February 2019]

[3] International Finance Corporation (IFC) (2007) Environmental, Health and Safety Guidelines for Thermal Power Plants [Online] Available at: http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines [Accessed 13 February 2019]

Myanmar has established ambient air quality standards (AQS) published in the National Environmental Quality (Emission) Guidelines (NEQEG)[4] for common species related to anthropogenic emissions. The air quality standards are based on reliable scientific evidence and are comparable to other national and international standards and guidelines such as those specified by the WHO[5]. In accordance with the IFC's General EHS guidelines, the NEQEG ambient air quality criteria presented in ***Table 2.1*** should be considered the appropriate standards, and are therefore used for comparison of baseline data and predicted impacts in this AQIA.

A summary of the relevant air quality standards used in this assessment are shown in ***Table 2.1***. This information provides the basis for regulation and control of air emissions from the Project in order to prevent pollution and protect the environment and public health.

Table 2.1: Ambient Air Quality Standards

Parameter	Averaging Period	NEQEG - Air Quality Standard (µg/m^3) [a]
Nitrogen Dioxide (NO_2)	1-hour	200
	Annual	40
Sulphur Dioxide (SO_2)	10-minute	500
	24-hour	20
Particulate Matter (PM_{10})[b]	24-hour	50
	Annual	20
Particulate Matter ($PM_{2.5}$)[c]	24-hour	25
	Annual	10
Ozone	8-hour daily maximum	100

Note: [a] *National Environmental Quality (Emission) Guidelines (NEQEG)*
[b] *PM10 is particulate matter with an aerodynamic diameter no greater than 10 micrometres*
[c] *PM2.5 is particulate matter with an aerodynamic diameter no greater than 2.5 micrometres*

2.2.2 Emission Limits

2.2.2.1 International Finance Corporation: Thermal Power Plants

The IFC EHS guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by using existing technology at reasonable costs. The IFC Performance Standard for 'Resource Efficiency and Pollution Prevention'[6] states that:

- *When host country regulations differ from the levels and measures presented in the World Bank Group EHS Guidelines, projects are required to achieve whichever is the more stringent. If less stringent levels or measures than those provided in the EHS Guidelines are appropriate in view of specific project circumstances, a full and detailed justification must be provided for any proposed alternatives through the environmental and social risks and impacts identification and assessment process. This justification must demonstrate that the choice for any alternate performance levels is consistent with the objectives of this performance standard.*

[4] National Environmental Quality (Emission) Guidelines (NEQEG) (2015) [Online] Available at: http://www.myanmar-responsiblebusiness.org/pdf/2015-12-29-National-Environmental-Quality_Emission_Guidelines_en.pdf [Accessed 13 February 2019]
[5] World Health Organisation (WHO) (2000) Air Quality Guidelines for Europe, 2nd Edition [Online] Available at: http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf [Accessed 13 February 2019]
[6] International Finance Corporation (IFC) (2012) Resource Efficiency and Pollution Prevention [Online] Available at: http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/performance-standards/ps3 [Accessed 13 February 2019]

The relevant emission limits applicable to the project for NOx, SO2 and PM as per the IFC EHS Guideline for natural gas fired turbine (>50MW thermal input (MWth)) and gas engine (3-50MWth) are presented in ***Table 2.2*** and ***Table 2.3*** respectively.

Table 2.2: IFC Air Emission Guidelines for Gas Turbine

Combustion Technology / Fuel	Particulate Matter (PM)		Sulphur Dioxide (SO_2)		Nitrogen Oxides (NO_x)		Dry Gas, Excess O_2 content (%)
	mg/Nm^3						
	NDA [a]	DA [b]	NDA [a]	DA [b]	NDA [a]	DA [b]	
Natural Gas (all turbine types of Unit > 50MW$_{th}$) [c]	-	-	-	-	51	51	15%

Note: [a] *Non-Degraded Airshed*
[b] *Degraded Airshed*
[c] *Megawatt thermal input*

Table 2.3: IFC Air Emission Guidelines for Gas Engine

Combustion Technology / Fuel	Particulate Matter (PM)	Sulphur Dioxide (SO_2)	Nitrogen Oxides (NO_x)	Dry Gas, Excess O_2 content (%)
	mg/Nm^3			
Gas Engine (3-50MW$_{th}$) [a]	-	-	200 (Spark Ignition) 400 (Dual Fuel) 1,600 (Compression Ignition)	15%

Note: [a] *Megawatt thermal input*

2.2.2.2 National Environmental Quality (Emission) Guidelines: Thermal Power

Myanmar has established regulation to determine maximum permissible emissions from thermal power plants and small combustion facilities.[7] The relevant emission limit guidelines applicable to the project are presented in ***Table 2.4*** and ***Table 2.5***.

Table 2.4: NEQEG Air Emission Guidelines for Combustion Turbine

Combustion Technology / Fuel	Particulate Matter (PM)	Sulphur Dioxide (SO_2)	Nitrogen Oxides (NO_x)
	mg/Nm^3		
Natural gas (all turbine types; unit > 50 MW)	-	-	100mg/Nm^3

Note: the Nm^3 conditions are not specified in NEQEG, however reference is made to the IFC environmental, health, and safety guidelines for thermal power (2007) that specifies reference conditions at 0°C, 101.3kPa, 6% O_2, dry gas.

[7] National Environmental Quality (Emission) Guidelines (NEQEG) (2015) [Online] Available at: http://www.myanmar-responsiblebusiness.org/pdf/2015-12-29-National-Environmental-Quality_Emission_Guidelines_en.pdf [Accessed 13 February 2019]

Table 2.5: NEQEG Air Emission Guidelines for Small Combustion Facilities

Combustion Technology / Fuel	Particulate Matter (PM)	Sulphur Dioxide (SO_2)	Nitrogen Oxides (NO_x)
	mg/Nm^3		
Gas (3-50MW$_{th}$)	-	-	200 (Spark Ignition) 400 (Dual Fuel) 1,600 (Compression Ignition)
Note: the Nm^3 conditions are not specified in NEQEG, however reference is made to the IFC environmental, health, and safety guidelines for thermal power (2007) that specifies reference conditions at 0°C, 101.3kPa, 15% O_2, dry gas.			

2.2.2.3 Applicable Emission Limits

The emission limits applicable to the Project are provided in ***Table 2.6***.

Table 2.6: Applicable Emission Limits

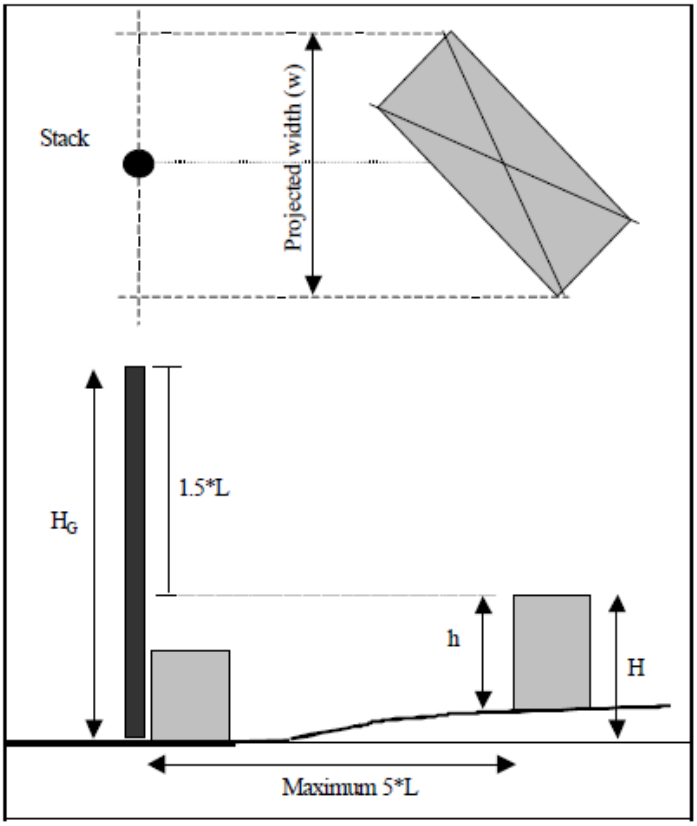
Combustion Technology / Fuel	Particulate Matter (PM)	Sulphur Dioxide (SO_2)	Nitrogen Oxides (NO_x)	Dry Gas, Excess O_2 content (%)
	mg/Nm^3			
Natural gas (all turbine types; unit > 50 MW)	-	-	51	15
Gas Engine (3-50MW$_{th}$)	-	-	200	15

2.2.3 Stack Height

The IFC EHS guideline for ambient air quality and air emissions set out the Good International Industry Practice (GIIP) general approach for determining the required stack height using the following calculation:

- $H_G = H + 1.5L$; where
  - HG = GEP stack height measured from the ground level elevation at the base of the stack
  - H = Height of nearby structure(s) above the base of the stack
  - L = Lesser dimension, height (h) or width (w), of nearby structures
  - "Nearby structures" = Structures within/touching a radius of 5L but less than 800 m.

Figure 2.1: Good International Industry Practice (GIIP)



Note: Stack Height (Based on United States 40 CFR, part 51.100 (ii)).

The IFC guidance specifically states that:

- *The stack height for all point sources of emissions, whether 'significant' or not, should be designed according to GIIP to avoid excessive ground level concentrations due to downwash, wakes, and eddy effects, and to ensure reasonable diffusion to minimize impacts.*

The main nearby structures and their dimensions are presented in ***Table 2.7***. The data indicates that a stack height of 28.4 m is necessary to comply with GIIP. The Project design includes 2 x 40 m stacks and is thus compliant with the GIIP requirements.

Table 2.7: Approximate Building Dimensions

Building	Height (m)	Width (m)	Length (m)	GIIP Stack Height Requirement (m)
Demin Water Treatment Buiding	8.5	10	24.3	23.5
Workshop Building	8	10	24	23.0
Admin Building	5	10	30	20.0
ECB Building	10.4	45	12	28.4
Filter Press Building	9.7	7	10.2	20.2
Guardhouse Building	5	2.8	4	9.20
Rack Room Building	5.45	9.2	5	19.3

3. PRELIMINARY SCREENING ASSESSMENT

3.1 Overview

This section presents the findings of a preliminary qualitative/semi-quantitative screening assessment undertaken to identify Project activities, processes and emissions that require consideration within the scope of the detailed AQIA presented in ***Section 5***.

3.2 Screening Assessment

A preliminary screening assessment has been undertaken using a combination of quantitative and semi quantitative techniques, project specific information, international guidelines and methodologies, and professional experience and opinion (refer to ***Table 3.1***). The assessment identifies the processes and emissions that have the potential to adversely affect ambient air quality and require detailed assessment to inform the level of mitigation necessary to reduce impacts, if any, to an acceptable level throughout the lifetime of the Project.

The processes and activities that will result in emission to air during the construction, operation and decommissioning phase include:

- Shipping;
- The use of diesel powered vehicles and equipment;
- Vehicles travelling over unpaved access roads;
- On site earthworks, clearing of land, material handling, stockpiling, vehicle use on unpaved surfaces, and construction of the main infrastructure;
- The operation of the LNG power plant;
- The operation of the gas receiving terminal;
- The use of diesel generators for back-up power; and
- Decommissioning related activities.

Table 3.1: Preliminary Air Quality Screening Assessment

Project Activity, Process or Emission Source	Project Phase	Potential Impact to Air Quality	Preliminary Impact Assessment
Shipping	Construction, Operation	Elevated ambient concentrations of NO_x, NO_2, SO_2, PM_{10} and $PM_{2.5}$ from ship exhausts.	The UK technical guidance document (TG16)[a] recommends that a detailed air quality assessment is only required for large ports, defined as: ■ More than 5,000 movements per year and where there is relevant public exposure within 250m of berthing and manoeuvring; or ■ More than 15,000 movements per year and where there is relevant public exposure within 1km of berthing and manoeuvring. The exact number of ships necessary for the construction of the Project is unknown. However, the exhaust emissions from ships will be intermittent, short term and transient in nature, and no receptors exist within 250m of the indicative jetty location and power plant site, thus a detailed assessment is not considered necessary. During the operation phase, the Project predicts that approximately six 8,500 tonne ships will arrive every month (i.e. 72 ships per year) to deliver 440,000 tonnes of LNG per year to the Project. This is less than the TG16 screening criteria, thus impacts to ambient air quality and not likely and a detailed assessment has not been considered in this AQIA.
Diesel Powered Vehicles and Equipment (onsite & offsite)	Construction, Operation	Elevated ambient concentrations of NO_x, NO_2, SO_2, PM_{10} and $PM_{2.5}$ from vehicle and heavy equipment exhaust emissions.	The Institute of Air Quality Management (IAQM)[b] states that: ■ Exhaust emissions from on-site plant (also known as non-road mobile machinery or NRMM) and site traffic suggests that they are unlikely to make a significant impact on local air quality, and in the vast majority of cases they will not need to be quantitatively assessed. For site plant and on-site traffic, consideration should be given to the number of plant/vehicles and their operating hours and locations to assess whether a significant effect is likely to occur. For site traffic on the public highway, if it cannot be scoped out (for example by using the EPUK's criteria), then it should be assessed using the same methodology and significance criteria as operational traffic impacts. The Environmental Protection UK (EPUK)[c] indicative criterion to proceed with a detailed air quality impact assessment is as follows:

Project Activity, Process or Emission Source	Project Phase	Potential Impact to Air Quality	Preliminary Impact Assessment
			■ Daily traffic flows increase by more than 500 vehicles/day; and/or ■ Heavy goods vehicles (HGV) flows increase by more than 100 vehicles/day. The Design Manual for Roads and Bridges (DMRB)[d] states that: ■ Only properties and Designated Sites within 200m of roads affected by the project need be considered. The detailed construction schedule including locations of individual sources in any given period of time is not known. Emissions to air from onsite mobile and non-mobile plant will be intermittent and spatially variable throughout the construction phase period as different activities take precedence. The impacts to air quality will be highly dependable on the operating time of individual mobile and non-mobile plant, meteorological conditions and the relative distance to sensitive receptors. On this basis, it is recognised that a representative and accurate dispersion model is difficult to define. Instead, whilst it is acknowledged that exhaust emissions will have some impact on air quality, the assumption is that with the implementation of internationally recognised good practice air quality management measures (refer to ***Table 5.10***) the impacts to ambient air quality at relevant sensitive receptors in the study area will be negligible and are not considered further.
Vehicles travelling over unpaved access roads	Construction and Operation	Elevated ambient concentrations of dust, PM_{10} and $PM_{2.5}$ from vehicles operating on unpaved access roads. Dust deposition and/or visible dust plumes can cause nuisance[e] affecting local amenities and quality of life	The main access roads to the Project and all internal roads will be paved. Impacts to ambient air quality from dust rising from unpaved access roads during the construction and operation of the Project are not expected and are not considered further in this AQIA.
On site earthworks, clearing of land, material handling,	Construction	Elevated ambient concentrations of dust and particulate matter (PM_{10}	Elevated ambient concentrations of TSP and PM_{10} from earthwork activities, construction of the Project infrastructure, and trackout of dusty materials onto the public road network has the potential to cause impacts on sensitive receptors in the vicinity of the named activities if

Project Activity, Process or Emission Source	Project Phase	Potential Impact to Air Quality	Preliminary Impact Assessment
stockpiling, vehicle use on unpaved surfaces, construction of the main infrastructure.		and $PM_{2.5}$) from construction related activities. Dust deposition and/or visible dust plumes can cause nuisance affecting local amenities and quality of life.	not managed accordingly. Dust deposition and/or visible dust plumes arising from construction sites can also cause nuisance[e] affecting local amenities and quality of life. Dust emissions can vary substantially from day to day and will depend on the level of activity, the specific operations being undertaken and the meteorological conditions at the time of release. Given the complexity and specific nature of fugitive dust emissions, the potential impacts to air quality from construction related activities could lead to significant adverse impacts on air quality and have therefore been given further consideration in ***Section 5*** of this AQIA.
Power Generation at Power Plant	Operation	Elevated ambient concentrations of NO_x and NO_2 resulting from the combustion of gas.	The Project will be equipped with 2 x 117MW natural gas fired turbines. The combustion of natural gas to generate power has the potential to impact air quality at sensitive receptors across a wide area depending on operating and meteorological conditions. The European Commission Best Available Techniques (BAT) Reference Document for Large Combustion Plants[f] specifies that the emissions from the combustion of natural gas are principally NO_x and CO with mostly negligible dust and SO_2 emissions. The document further states that dust and SO_2 emissions are not an environmental concern under normal and controlled combustion conditions. Myanmar does not specify an ambient air quality standard for CO, and experience suggests that impacts to ambient air quality because of CO emissions from natural gas fired power plants are negligible. An evaluation of the expected impacts to ambient air quality is presented in ***Section 5*** of this AQIA.
Continuous power generation at the LNG terminal	Operation	Elevated ambient concentrations of NO_x and NO_2 resulting from the combustion of gas.	The LNG receiving terminal will be equipped with four Cummins C1160 N5C 1160kW natural gas fired generators required for continuous power generation during the operation phase. An evaluation of the expected impacts to ambient air quality is presented in ***Section 5*** of this AQIA.
Intermittent power generation including	Start-up / emergency	Elevated ambient concentrations of NO_x, NO_2, SO_2, CO, PM_{10} and	The use of the auxiliary boiler and diesel engine generators for power plant start-up and emergency power is expected to be infrequent, short term and mostly unplanned thus

Project Activity, Process or Emission Source	Project Phase	Potential Impact to Air Quality	Preliminary Impact Assessment
auxiliary boiler and emergency generators		$PM_{2.5}$, from the combustion of fuel oil.	defining a representative dispersion model and quantifying the impact on ambient air quality is challenging. Given the relatively low release heights typically associated with these source types, an assumption of continuous operation would in most cases result in unacceptable impacts to ambient air quality and result in them becoming the controlling emissions scenario for demonstrating compliance against the short-term air quality standards. On this, the USEPA[g h] states: ■ "*the intermittent nature of the actual emissions associated with emergency generators and startup/shutdown in many cases, when coupled with the probabilistic form of the standard, could result in modelled impacts being significantly higher than actual impacts would realistically be expected to be for these emission scenarios. The potential overestimation in these cases results from the implicit assumption that worst-case emissions will coincide with worst-case meteorological conditions based on the specific hours on specific days of each of the years associated with the modelled design value based on the form of the hourly standard*" and ■ "*compliance demonstrations for the 1-hour NO_2 and SO_2 NAAQS be based on emission scenarios that can logically be assumed to be relatively continuous or which occur frequently enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations*". Emissions to air from the auxiliary boiler and generators are short-term, intermittent and infrequent in nature and are unlikely to contribute significantly to the annual distribution of daily maximum 1-hour concentrations. No further consideration of these emissions sources is therefore provided in this AQIA.
Decommissioning	Decommissioning	The decommissioning of the proposed Project will likely include deconstruction of structures and buildings and include similar activities and impacts as during the construction phase.	The decommissioning of the proposed Project will likely include deconstruction of structures and buildings and include similar activities and impacts as during the construction phase. It is assumed that mitigation and management implemented during construction will be similarly applied during decommissioning; therefore, decommissioning impacts are not assessed further.

Note: [a] *Department for Environment Food and Rural Affairs (DEFRA) Local Air Quality Management Technical Guidance (TG16) (2016) [Online] Available at: https://laqm.defra.gov.uk/documents/LAQM-TG16-April-16-v1.pdf [Accessed 04 January 2019]*
[b] *Institute of Air Quality Management (IAQM) (2014) Guidance on the Assessment of Dust from Demolition and Construction [Online] Available at: http://iaqm.co.uk/guidance/ [Accessed 04 January 2019]*
[c] *Guidance from the Environmental Protection UK and Institute of Air Quality Management (IAQM) (2017) Land-Use Planning & Development Control: Planning for Air Quality [Online] Available at: http://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf [Accessed 04 January 2019]*
[d] *The Design Manual for Roads and Bridges (2007) [Online] Available at: http://www.standardsforhighways.co.uk/ha/standards/dmrb/index.htm [Accessed 04 January 2019]*
[e] *Nuisance shall be used as a general term to describe annoyance to local communities from dust deposition and visible dust plumes from construction activities affecting local amenities and quality of life.*
[f] *European Commission (2017) Best Available Techniques (BAT) Reference Document for Large Combustion Plants [Online] Available at: http://eippcb.jrc.ec.europa.eu/reference/BREF/LCP/JRC107769_LCP_bref2017.pdf [Accessed 13 February 2019]*
[g] *The United States Environmental Protection Agency (USEPA) (2011) Additional Clarification Regarding Application of Appendix W Modelling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard [Online] Available at: https://www.epa.gov/sites/production/files/2015-07/documents/appwno2_2.pdf [Accessed 13 February 2019]*
[h] *The United States Environmental Protection Agency (USEPA) (2016) SO_2 NAAQS Designations Modelling Technical Assistance Document [Online] Available at: https://www.epa.gov/sites/production/files/2016-06/documents/so2modelingtad.pdf [Accessed 13 February 2019]*

4. RECEIVING ENVIRONMENT

4.1 Overview

A critical part of the AQIA is to establish the state of the existing environment, also referred to as the baseline. This section defines the study area and existing air quality.

4.2 Study Area

The study area is spatially different for the construction and operation phase and is defined based on:

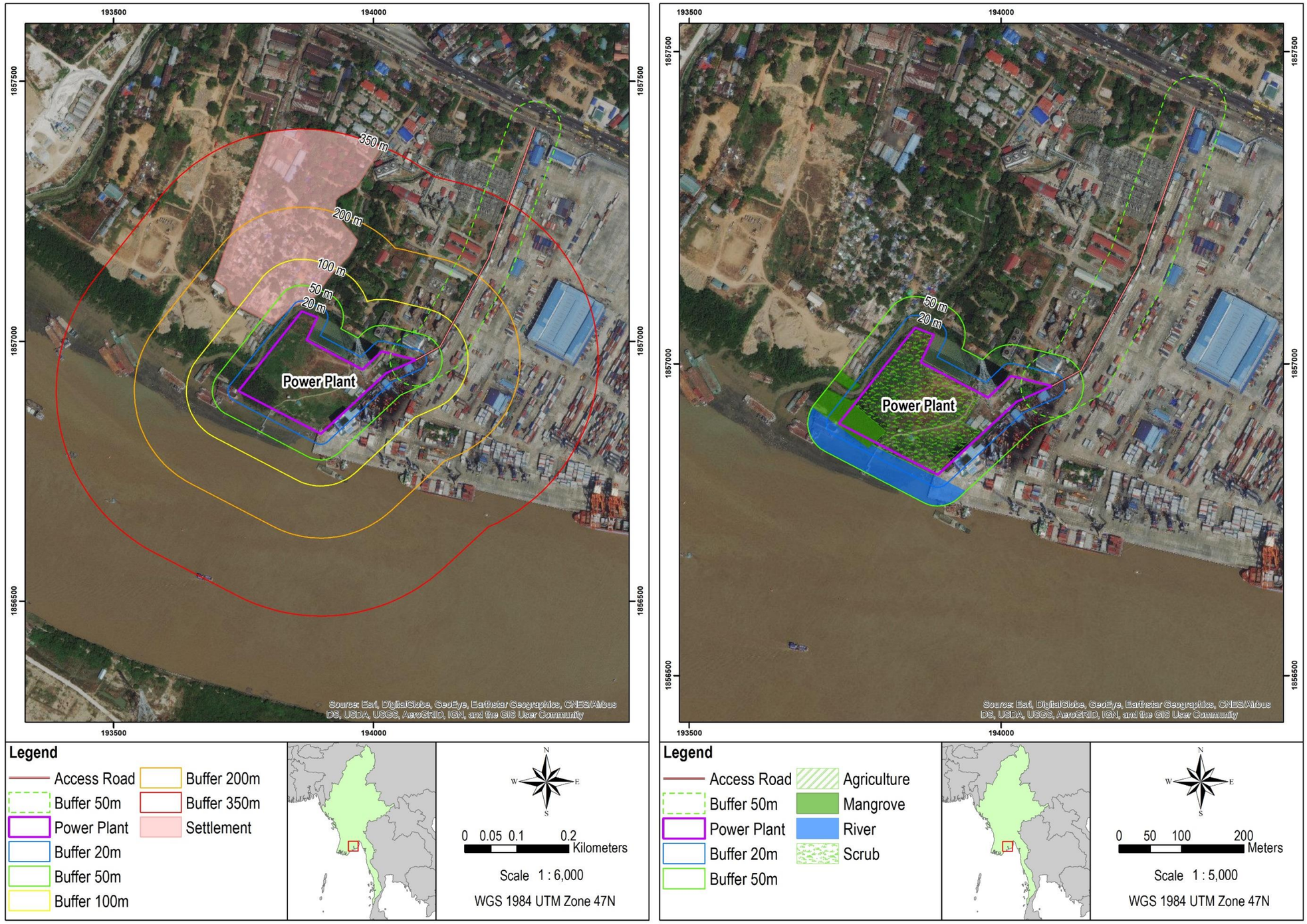
- available guidance documents;
- the nature of activities;
- the relative locations of sensitive receptors; and
- professional experience.

4.2.1 Construction Phase

The study area, for the construction phase, is defined using the IAQM guidance on the assessment of dust from demolition and construction[8]. The guidance states than a risk assessment is normally required when there is a human receptor within 350m and 50m of the construction site boundary and access road respectively; and an ecological receptor within 50m of the boundary or access road. The study area for the power plant, gas receiving terminal and onshore pipeline based on the IAQM guidance is presented in ***Figure 4.1***, ***Figure 4.2***, and ***Figure 4.3*** for human and ecological receptors respectively.

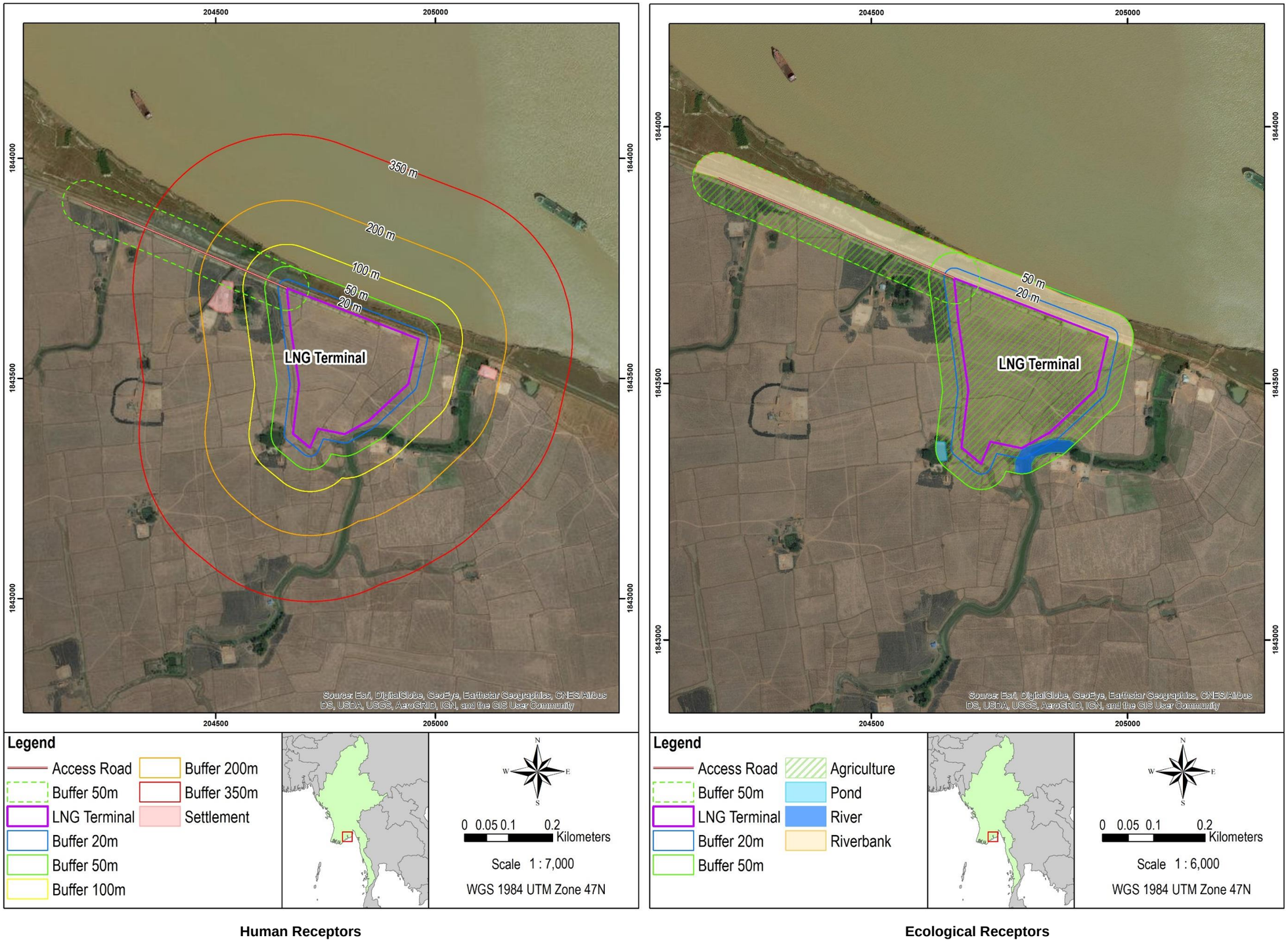
[8] Institute of Air Quality Management (IAQM) (2014) Guidance on the Assessment of Dust from Demolition and Construction [online] Available at: http://iaqm.co.uk/text/guidance/construction-dust-2014.pdf [Accessed 13 February 2019]

Figure 4.1: CCGT Site Sensitivity



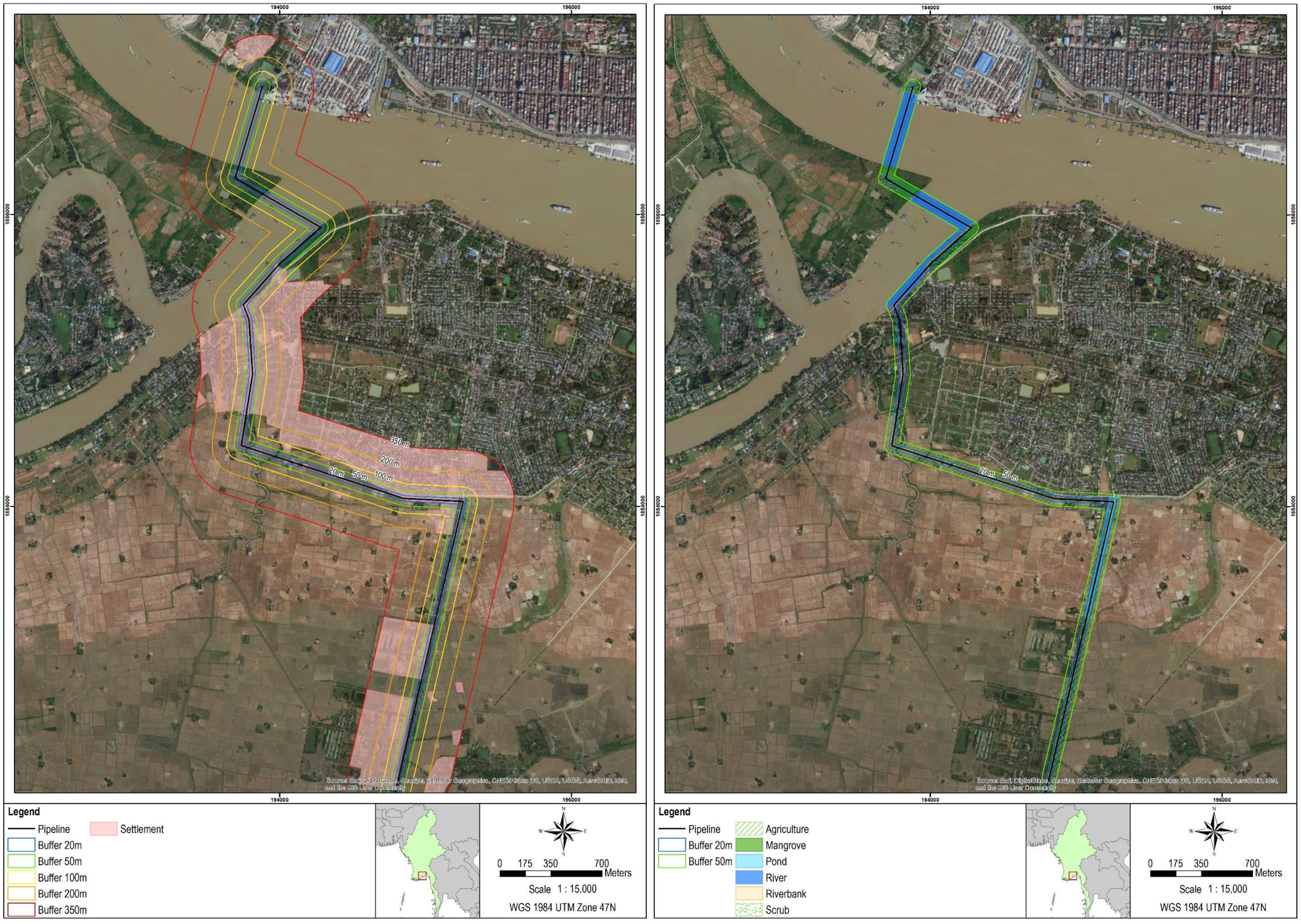
Human Receptors **Ecological Receptors**

Figure 4.2: LNG Terminal Site Sensitivity

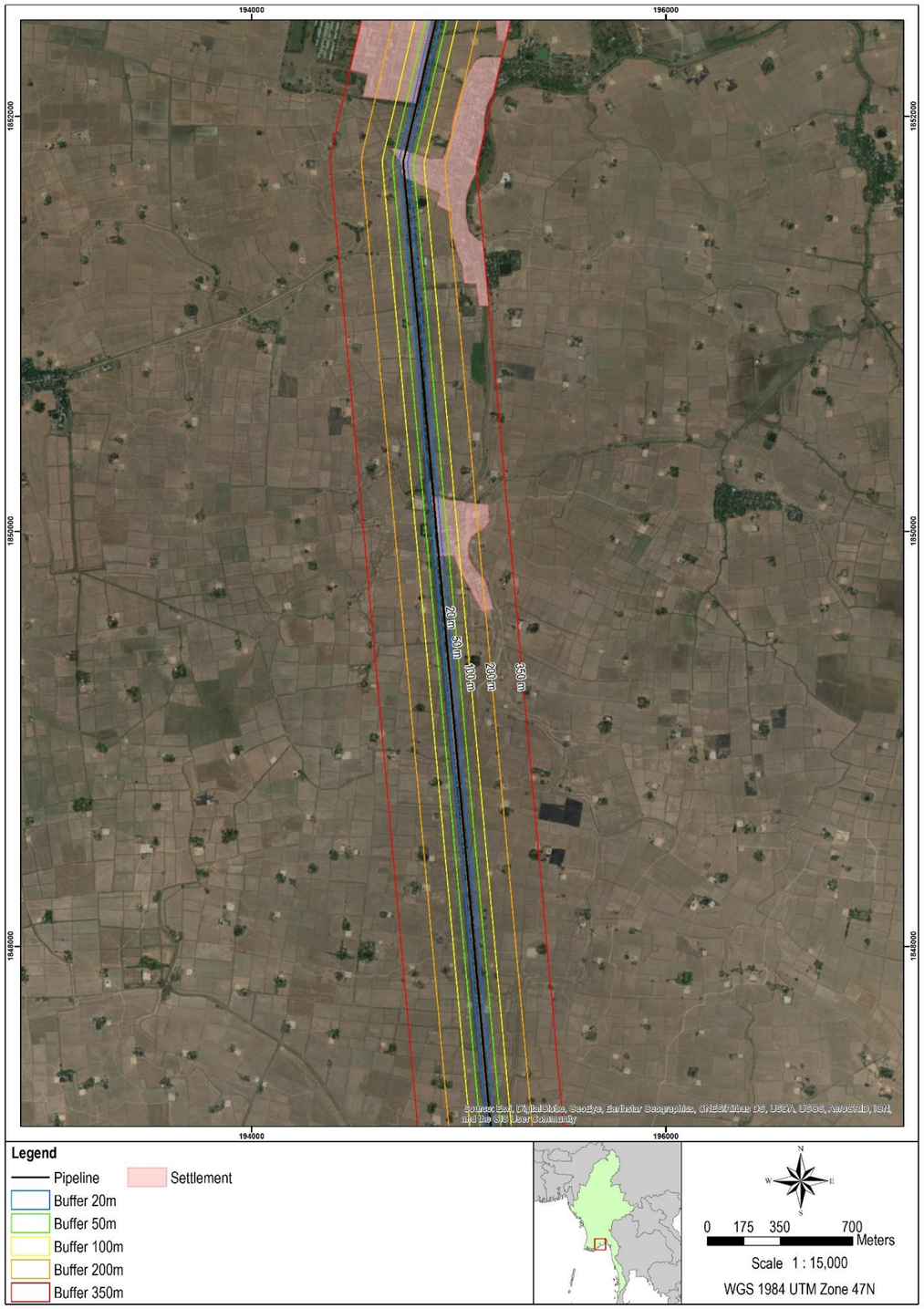


Human Receptors **Ecological Receptors**

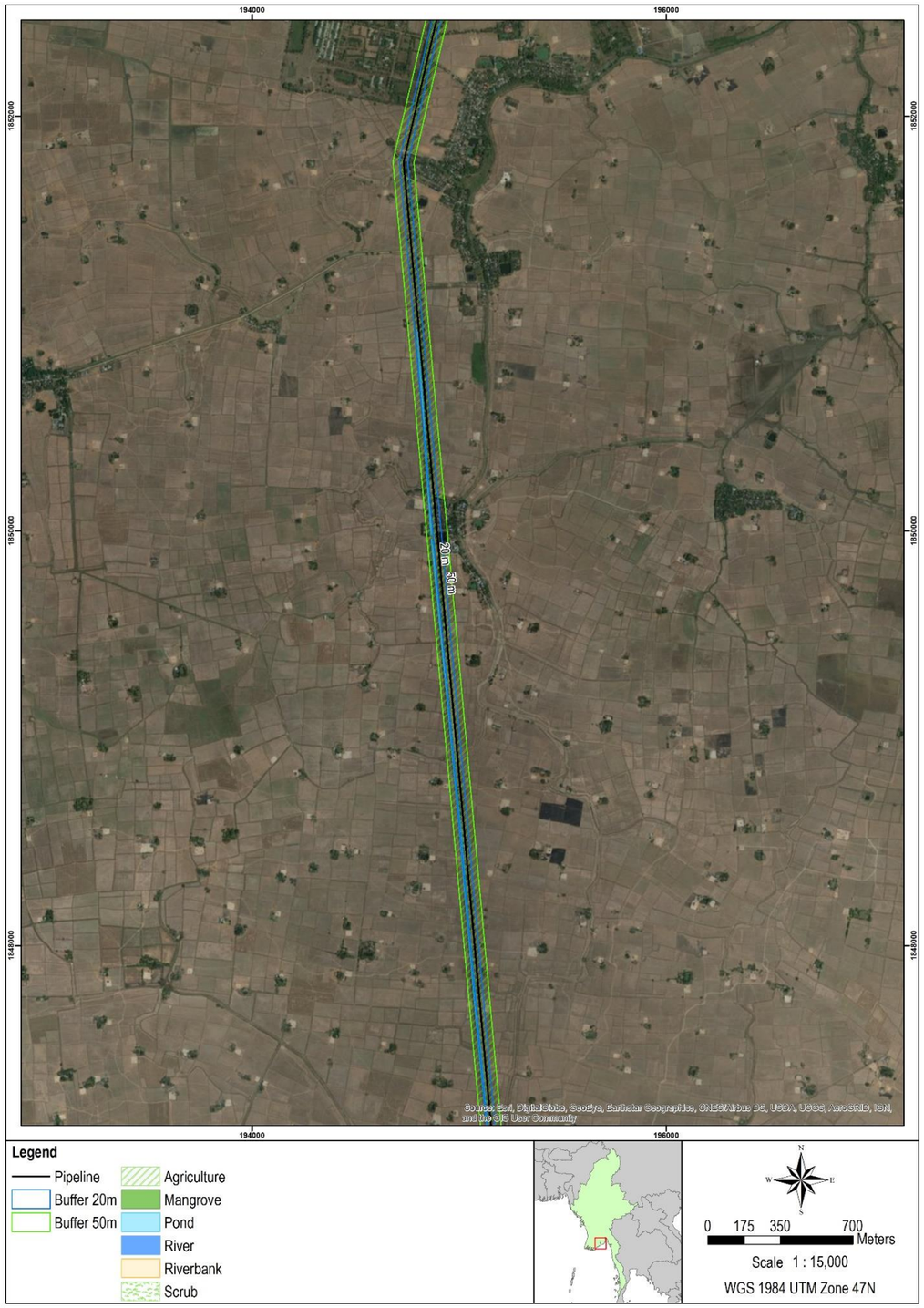
Figure 4.3: Pipeline Route Sensitivities



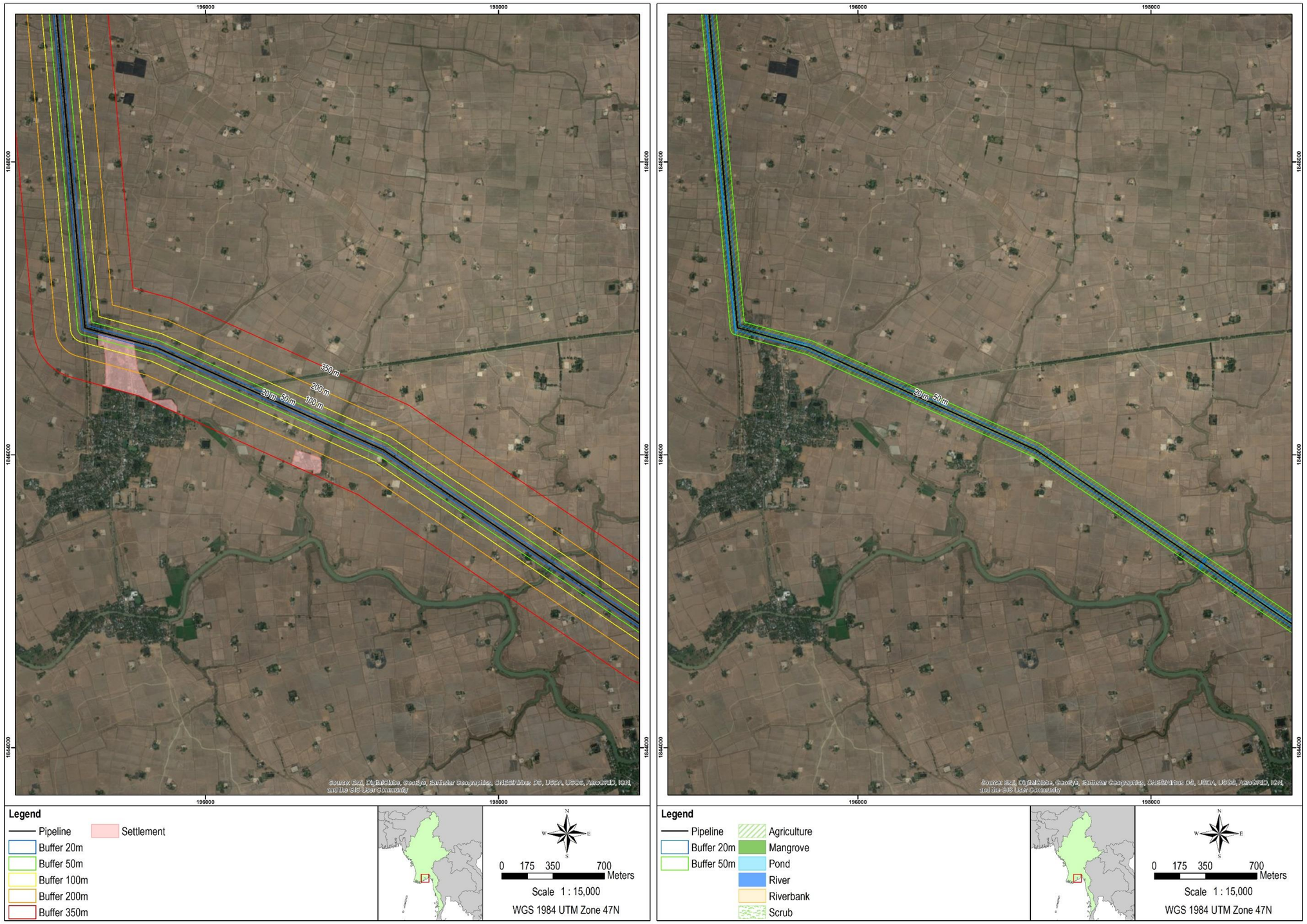
Human Receptors **Ecological Receptors**



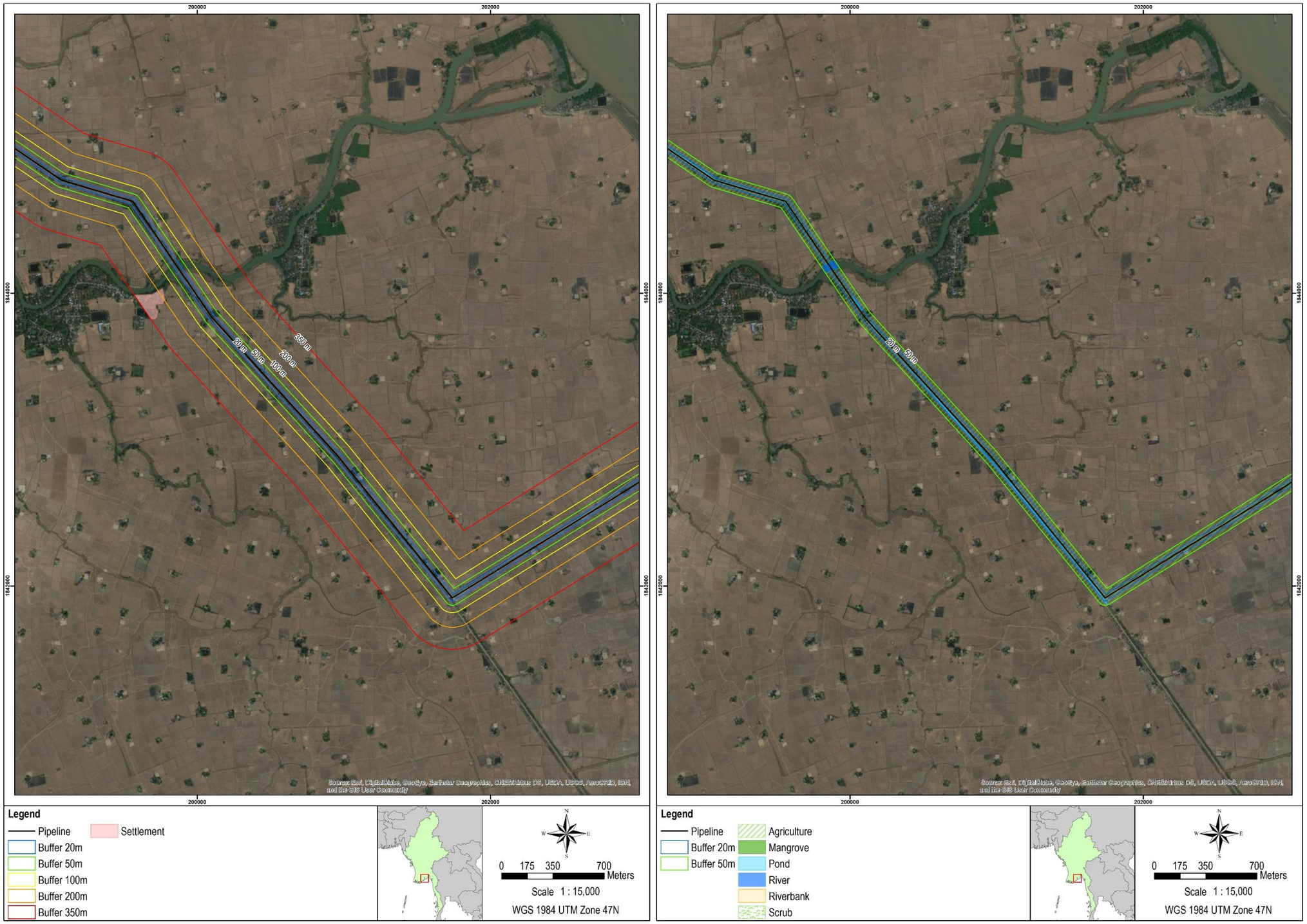
Human Receptors



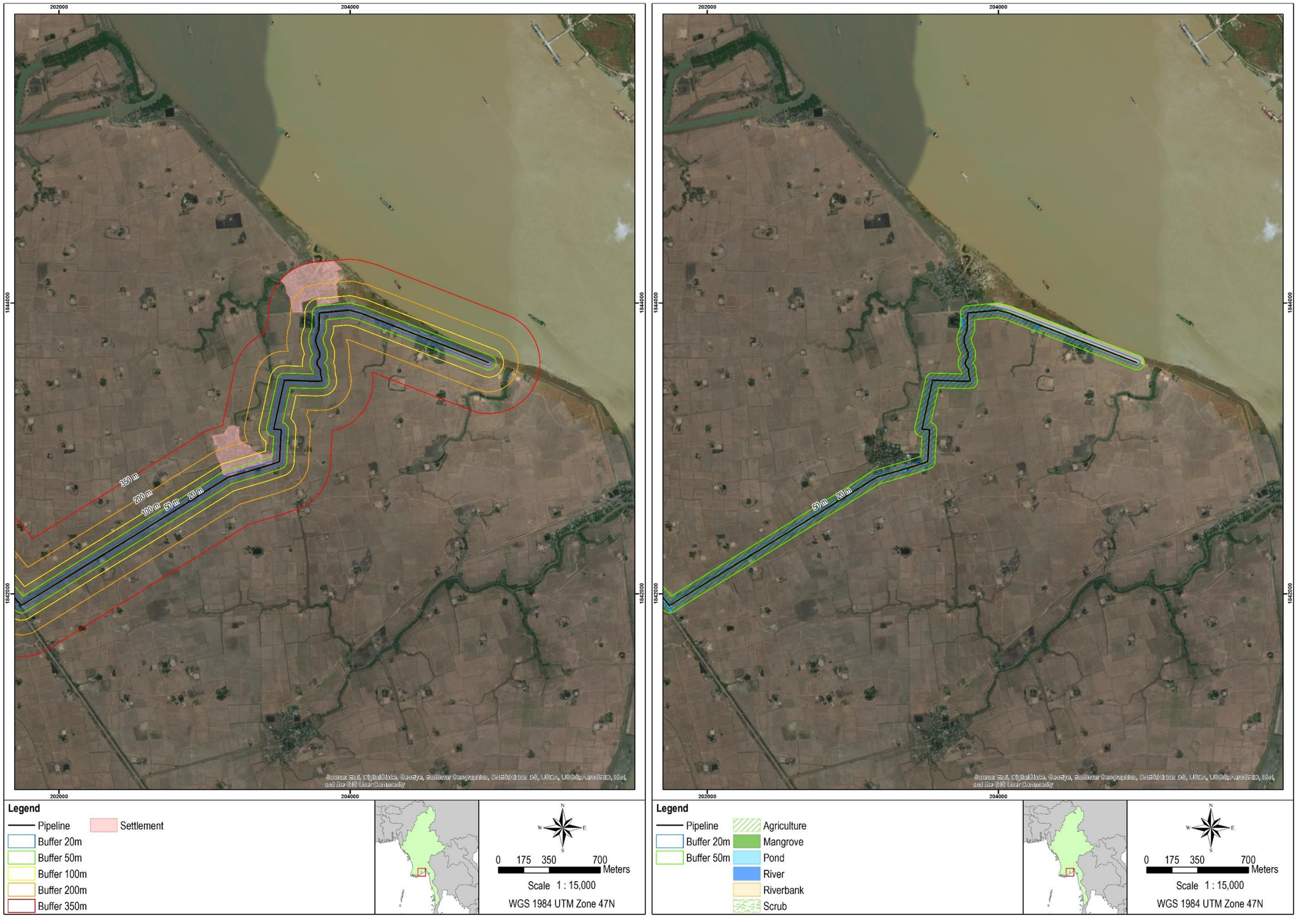
Ecological Receptors



Human Receptors **Ecological Receptors**



Human Receptors **Ecological Receptors**



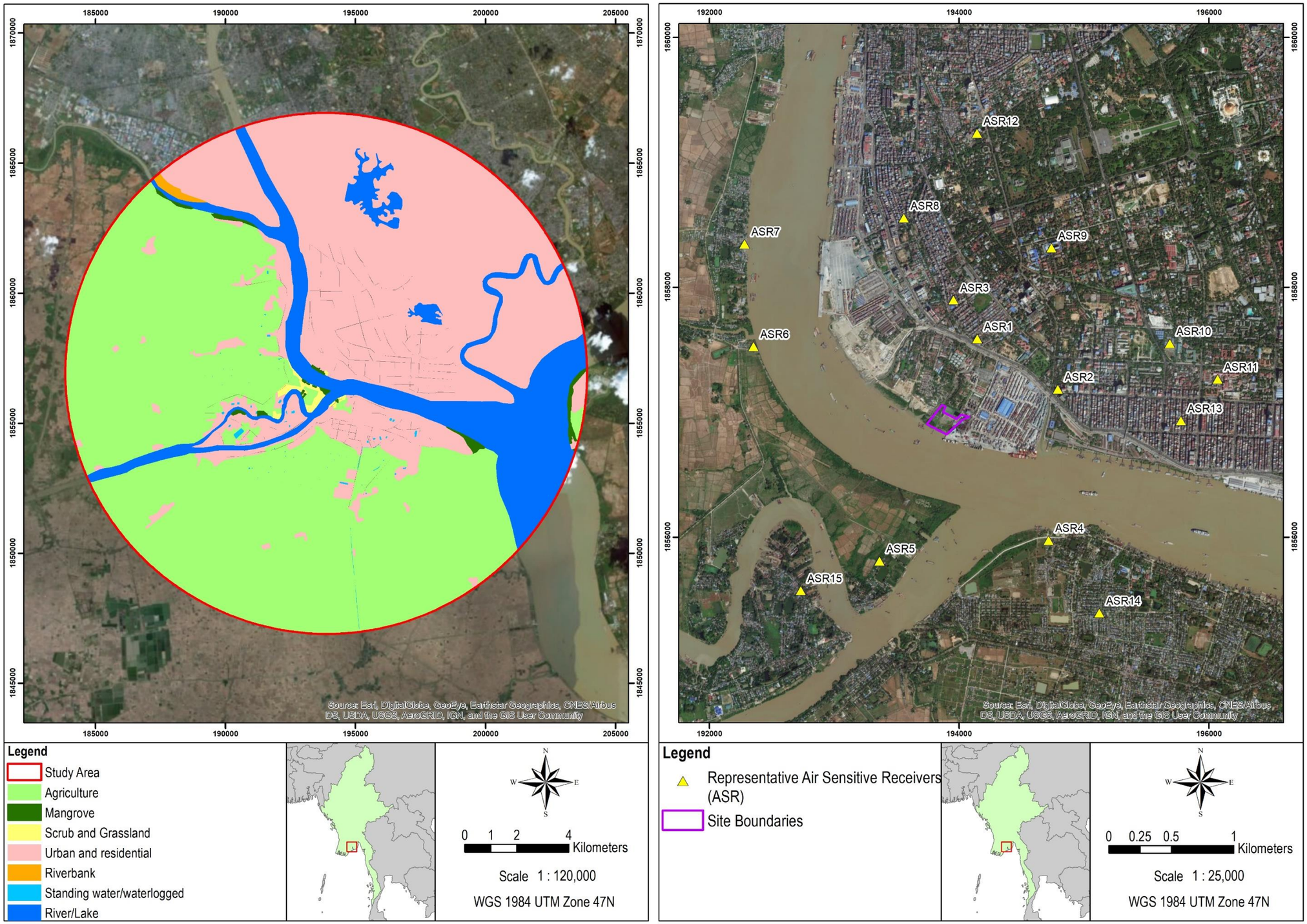
Human Receptors **Ecological Receptors**

4.2.2 Operation Phase

4.2.2.1 Power Plant

Discharge emission to air will occur continuously from the 2x117MWth power plant. A study area of 10km x 10km is used in this AQIA to ensure the spatial extent of the plume and the resulting worst-case ground level concentrations are suitably considered. The study area and a select number of representative air sensitive receptors (ASR) is presented in ***Figure 4.4***.

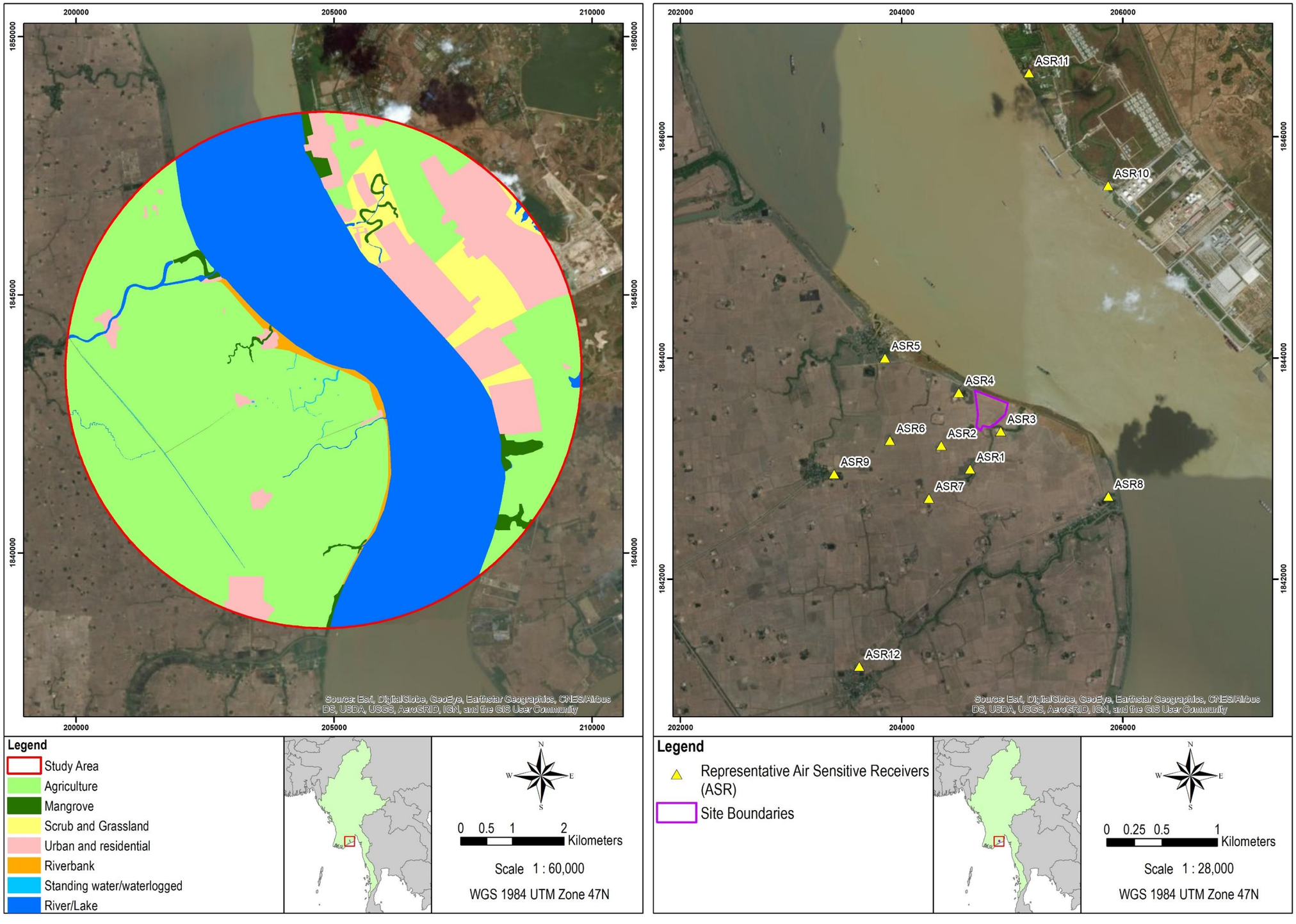
Figure 4.4: Study Area, Land-Use Type and Representative Air Sensitive Receptor Locations at Power Plant Site



4.2.2.2 Liquefied Natural Gas Receiving Terminal

Discharge emission to air will occur continuously from four 1160 kW gas fired generators. A study area of 5 km x 5 km is used in this AQIA to ensure the spatial extent of the plume and the resulting worst-case ground level concentrations are suitably considered. The study area and a select number of representative ASRs is presented in ***Figure 4.5***.

Figure 4.5: Study Area, Land-Use Type and Representative Air Sensitive Receptor Locations at LNG Receiving Terminal Site



4.3 Air Quality Baseline

4.3.1 Overview

In accordance with IFC guidelines, measurement of existing air quality is required for emissions associated with the Project processes over time that have potential to impact the surrounding land use. The IFC EHS guideline for Thermal Power Plants requires seasonal manual sampling for mid-sized projects (i.e. <1,200 MWth).

As discussed in ***Section 3***, the primary focus of this AQIA relates to NO_x emissions from natural gas combustion. On this basis, a project specific monitoring survey was commissioned to provide an indication of ambient concentrations of NO_2 in the study area and to inform the AQIA presented in ***Section 5.3***.

4.3.2 Monitoring Methodology

4.3.2.1 Haz-Scanner Environmental Perimeter Air Station (EPAS)

Ten air quality-monitoring (AQM) sites were established in the study area to determine general background concentrations of NO_2. Monitoring locations were initially selected using aerial photography, local available knowledge about villages, accessibility and security to determine the location of operations and nearby sensitive receptors. The final monitoring locations were decided in the field so that the most suitable and representative locations for monitoring equipment could be identified.

At each of the air quality monitoring locations, the Haz-Scanner Environmental Perimeter Air Station (EPAS) was deployed for a continuous 72-hour period in both the wet and dry season. Information regarding the monitoring locations and duration of monitoring are presented in ***Table 4.1*** and aerial mapping showing the location of the monitoring sites relative to the Project site is presented in ***Figure 4.6***.

Table 4.1: Haz-Scanner Environmental Perimeter Air Station Monitoring Summary

Site	Land-use	Location		Start Date	End Date	Season
		Latitude	Longitude			
AQM1	Inside Project boundary	16° 77'51.92"N	96°12'80.86"E	02/05/2015	05/05/2018	Dry
				27/06/2018	30/06/2018	Wet
AQM2	Inside Project boundary	16° 77'75.91"N	96°13'04.98"E	02/05/2015	05/05/2018	Dry
				27/06/2018	30/06/2018	Wet
AQM3	Monastery grounds	16° 78'19.91"N	96°12'90.84"E	02/05/2015	05/05/2018	Dry
				27/06/2018	30/06/2018	Wet
AQM4	Church grounds	16° 78'22.22"N	96°13'61.11"E	12/05/2018	15/05/2018	Dry
				06/07/2018	09/07/2018	Wet
AQM5	School	16° 76'29.65"N	96°13'58.25"E	06/05/2015	09/05/2018	Dry
				30/06/2018	03/07/2018	Wet
AQM6	Monastery	16° 75'33.31"N	96°13'51.29"E	06/05/2015	09/05/2018	Dry
				30/06/2018	03/07/2018	Wet
AQM7	Village	16° 72'39.16"N	96°13'84.45"E	06/05/2015	09/05/2018	Dry
				30/06/2018	03/07/2018	Wet
AQM8	Monastery	16° 68'31.90"N	96°14'40.02"E	09/05/2018	12/05/2018	Dry
				03/06/2018	06/06/2018	Wet
AQM9	Monastery	16° 66'00.00"N	96°22'37.00"E	09/05/2018	12/05/2018	Dry
				03/06/2018	06/06/2018	Wet
AQM10	Village	16° 64'80.66"N	96°24'23.56"E	09/05/2018	12/05/2018	Dry
				03/06/2018	06/06/2018	Wet

4.3.2.2 Diffusion Tubes

Palmes diffusion tubes were deployed in triplicate to monitor ambient concentrations of NO2 at three locations within and adjacent to the power plant site boundary. The diffusion tubes were exposed between the 27 February 2018 and the 2 May 2018, and again from the 12 June 2018 to the 26 June 2018. Diffusion tubes are passive samplers that consist of small plastic tubes that contain a chemical reagent to absorb the pollutant to be measured directly from the air. The preparation and analysis of the diffusion tubes is undertaken to British Standard BS EN 13528. The technique is widely recognised internationally, including by the USEPA[9] and the UK Department for the Environment, Food and Rural Affairs (DEFRA).[10] The analysis of the exposed tubes is completed through Ion Chromatography (United Kingdom Accreditation Service (UKAS) Accredited Method ISO/IEC 17025:2005). Diffusion tubes were selected for the following reasons:

- Tubes are inexpensive, lightweight, robust, easy to deploy and non-intrusive;
- No power source is required making them ideal in remote project locations; and
- Can be located at several sites around the project location increasing the spatial variability of the assessment.

Information regarding the monitoring locations and duration of monitoring are presented in ***Table 4.2*** and aerial mapping showing the location of the monitoring sites relative to the Project site is presented in ***Figure 4.6***.

It should be noted that due to unforeseen circumstances the first round of diffusion tubes were deployed beyond the recommended exposure period. The results may therefore be compromised however; they were still used to inform the assessment.

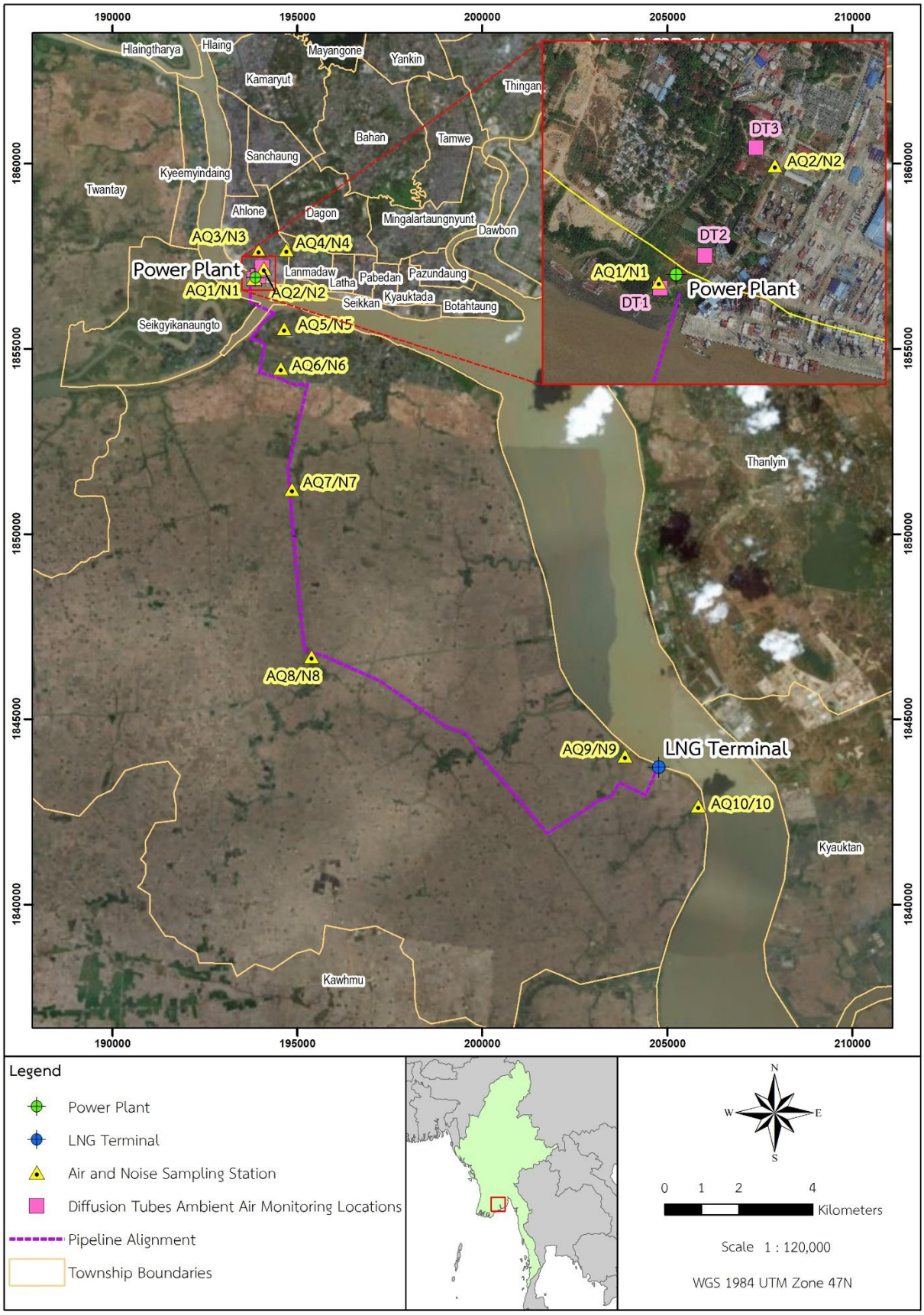
Table 4.2: Diffusion Tube Monitoring Summary

Site Name	Location		Period 1		Period 2	
	Latitude	Longitude	Start Date	End Date	Start Date	End Date
DT1	16 º 46’ 30.253” N	96º 07’ 41.228” E	27/02/18	02/05/18	12/06/18	26/06/18
DT2	16 º 46’ 32.700” N	96 º 07’ 44.600” E	27/02/18	02/05/18	12/06/18	26/06/18
DT3	16 º 46’ 40.636” N	96 º 07’ 48.370” E	27/02/18	02/05/18	12/06/18	26/06/18

[9] United States Environmental Protection Agency (USEPA) Air Monitoring Methods - Passive Monitoring [Online] Available at: https://www3.epa.gov/ttn/amtic/passive.html [Accessed 13 February 2019]

[10] Department for Environment, Food and Rural Affairs (Defra) Diffusion Tubes [Online] Available at: https://laqm.defra.gov.uk/diffusion-tubes/diffusion-tubes.html [Accessed 13 February 2019]

Figure 4.6: Ambient Air Quality Monitoring Locations



4.3.3 Nitrogen Dioxide Monitoring Results

4.3.3.1 Haz-Scanner Environmental Perimeter Air Station (EPAS)

Dry Season

The NO2 1-hour average monitoring results at each monitoring location are presented below as a series of line graphs (refer to ***Figure 4.7*** to ***Figure 4.16***). The upper bound (UB) has been calculated for each data set by multiplying the interquartile range (IQR) by 1.5 and adding the result to Quartile 3 (Q3). Monitoring results above the UB are considered outliers and are not considered in the AQIA. The monitoring results including the upper bound and the resulting maximum monitored 1-hour average at each monitoring location are presented in ***Table 4.3***.

Figure 4.7: Site AQ1 NO_2 1-hour Average (Dry Season)

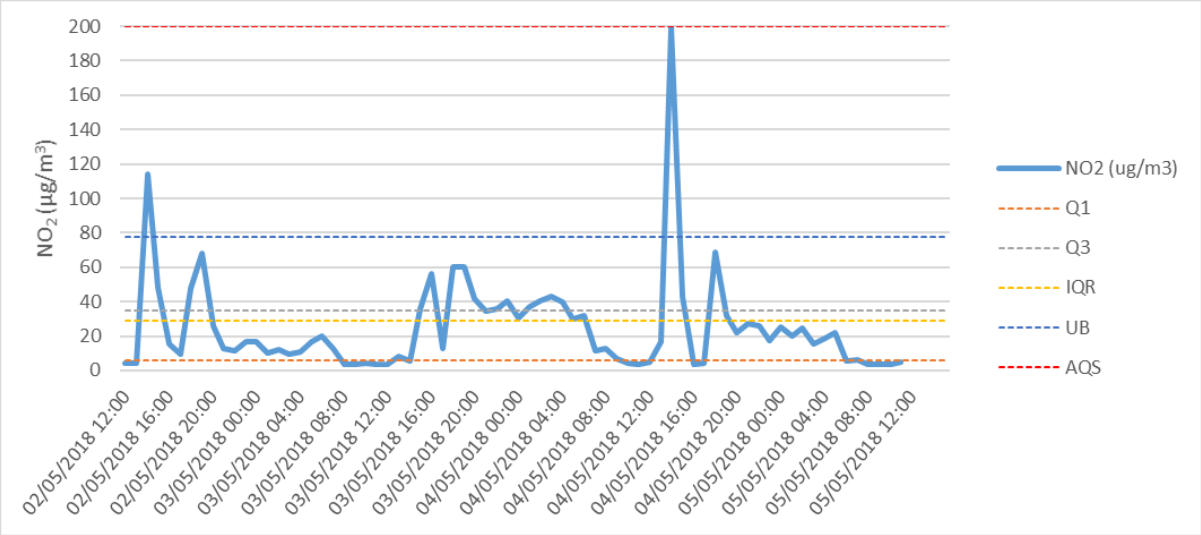


Figure 4.8: Site AQ2 NO_2 1-hour Average (Dry Season)

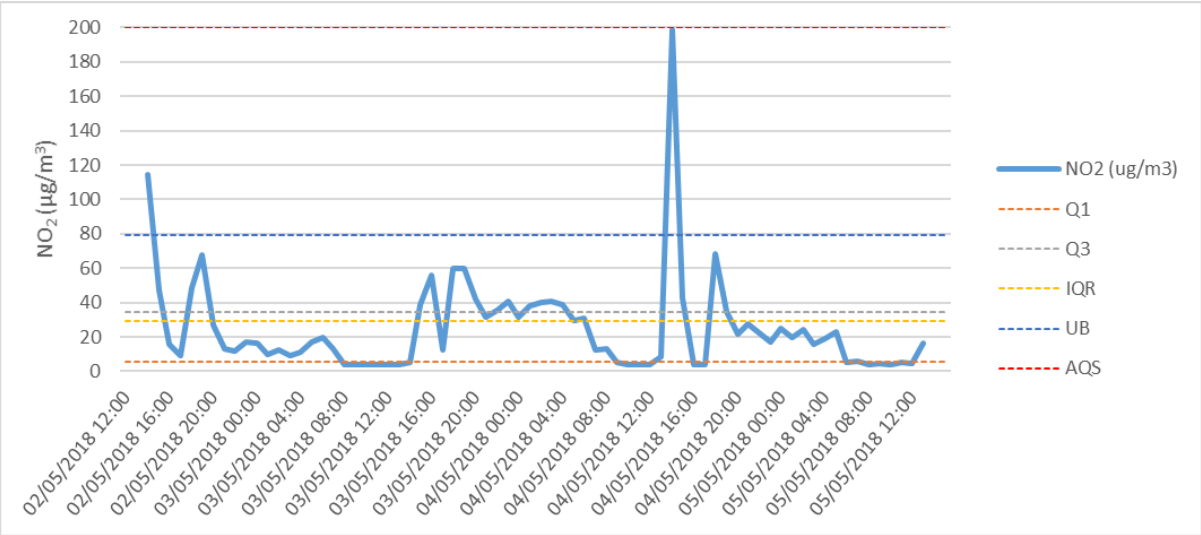


Figure 4.9: Site AQ3 NO_2 1-hour Average (Dry Season)

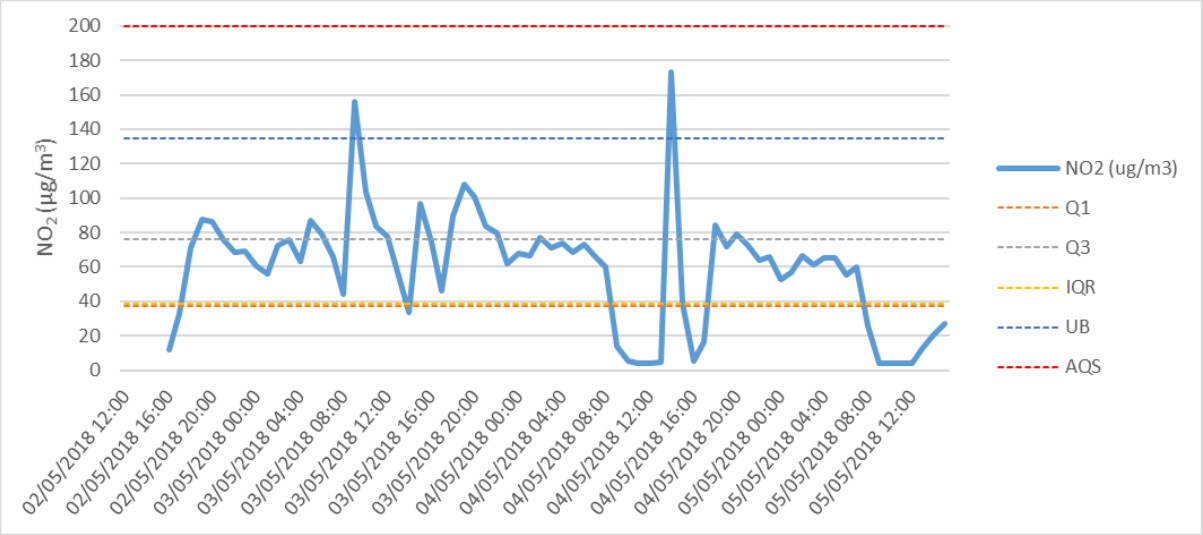


Figure 4.10: Site AQ4 NO_2 1-hour Average (Dry Season)

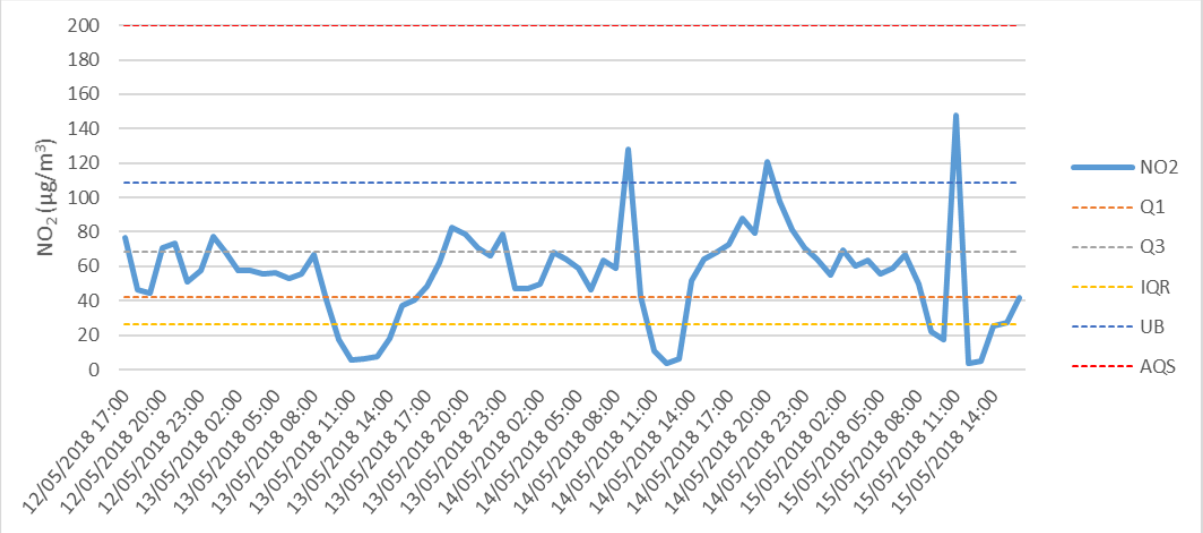


Figure 4.11: Site AQ5 NO_2 1-hour Average (Dry Season)

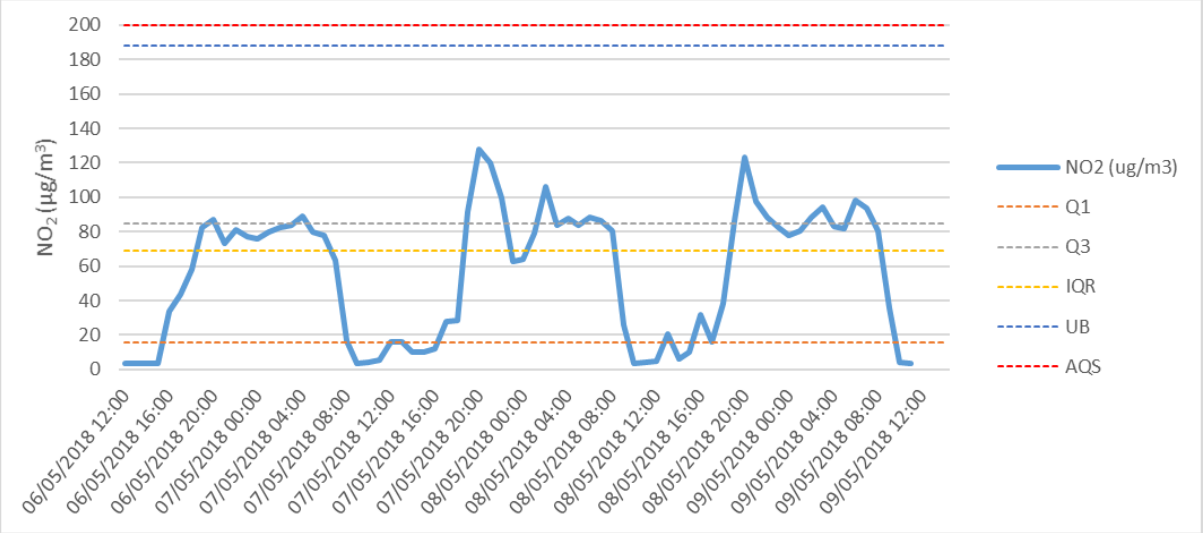


Figure 4.12: Site AQ6 NO_2 1-hour Average (Dry Season)

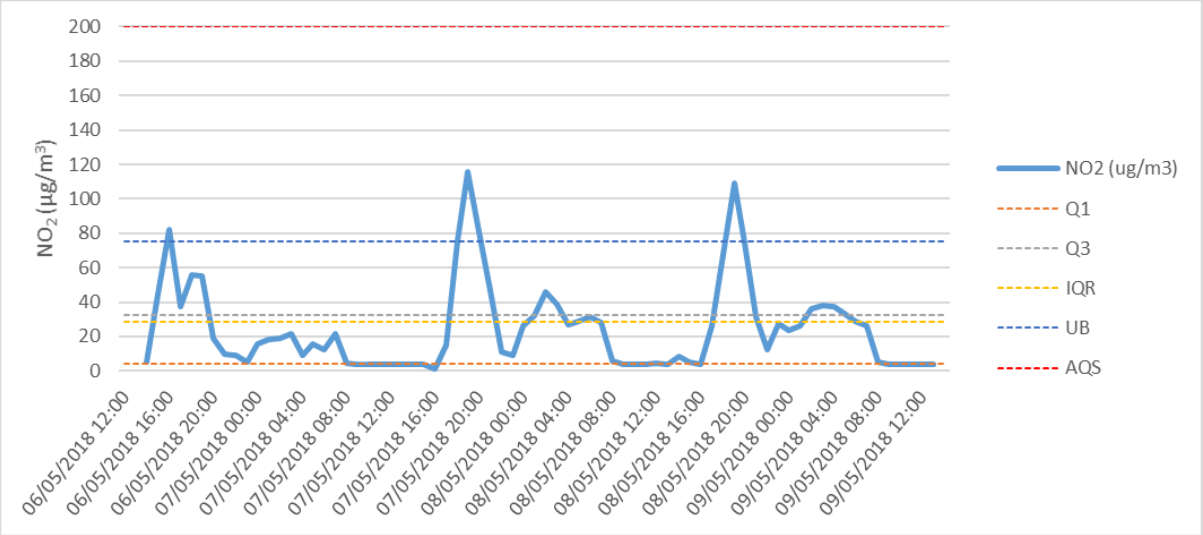


Figure 4.13: Site AQ7 NO_2 1-hour Average (Dry Season)

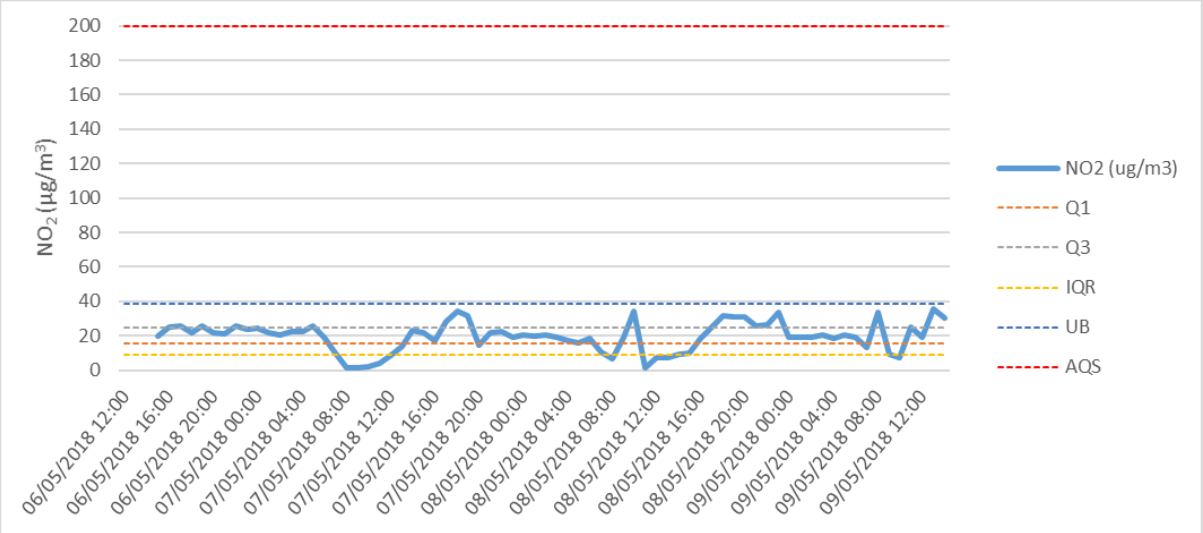


Figure 4.14: Site AQ8 NO_2 1-hour Average (Dry Season)

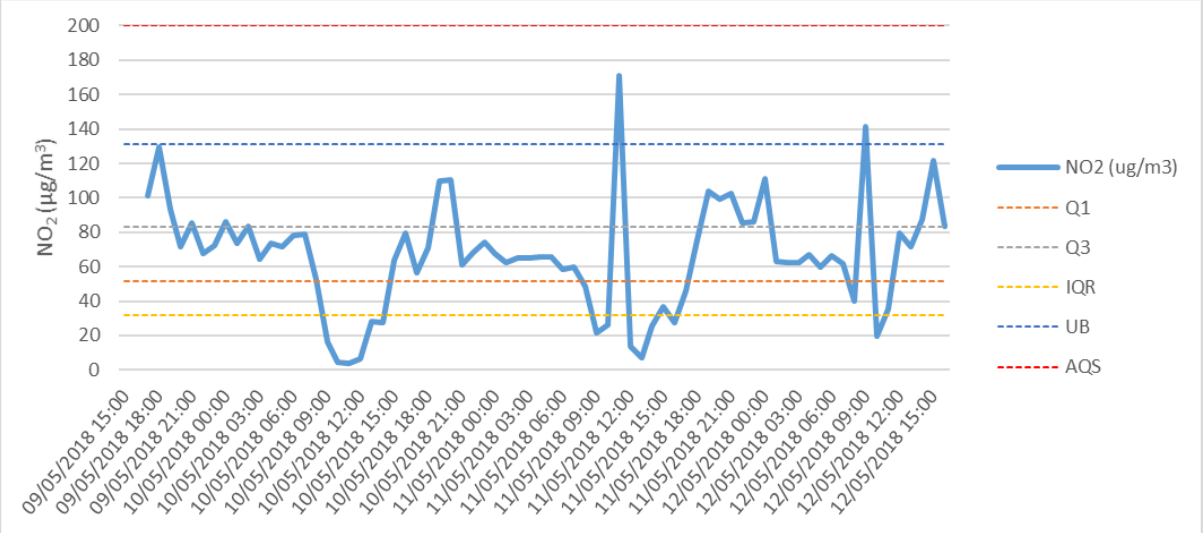


Figure 4.15: Site AQ9 NO_2 1-hour Average (Dry Season)

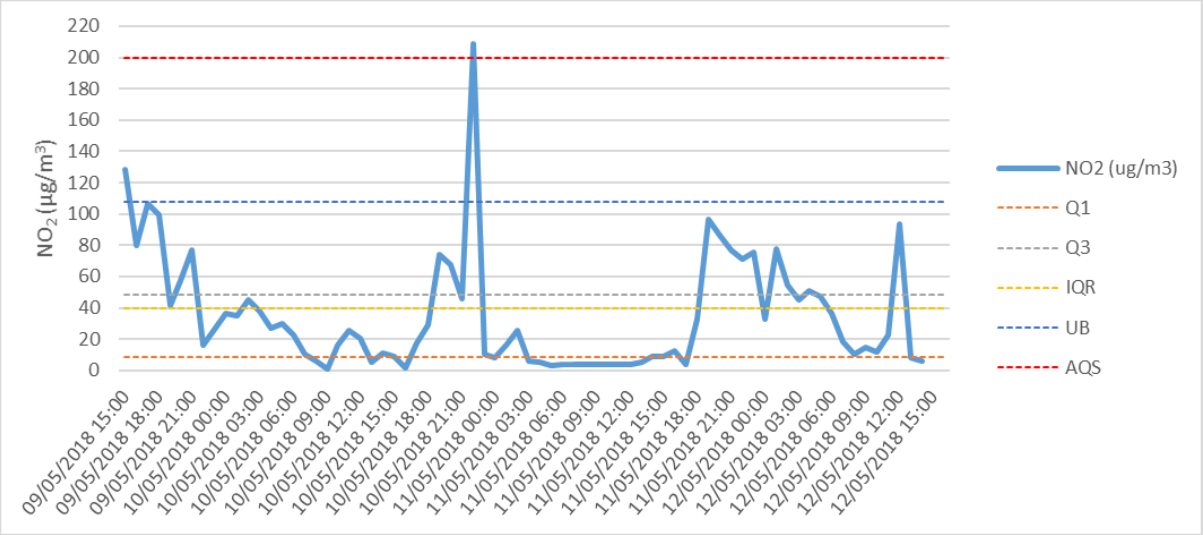


Figure 4.16: Site AQ10 NO_2 1-hour Average (Dry Season)

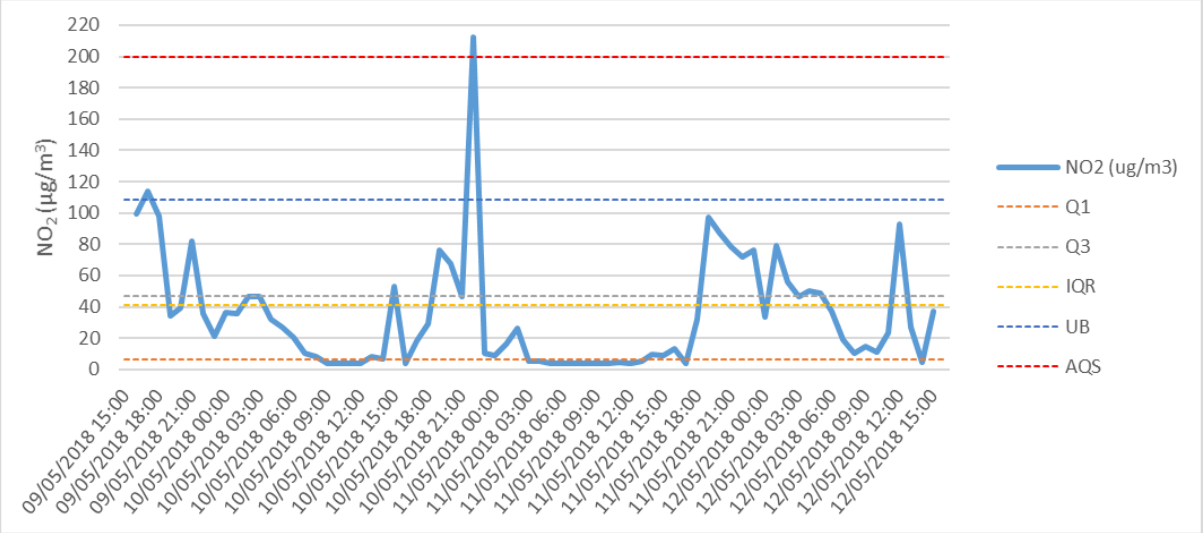


Table 4.3: Dry Season NO_2 Monitoring Result Summary

Site	NO_2 Upper Bound ($\mu g/m^3$)	NO_2 1-hour Average Maximum ($\mu g/m^3$)	1-hour Mean Air Quality Standard (AQS) ($\mu g/m^3$)	% of AQS
AQ1	77.7	68.5	200	34%
AQ2	79.0	68.6	200	34%
AQ3	135	108	200	54%
AQ4	108	97.9	200	49%
AQ5	188	128	200	64%
AQ6	74.9	74.3	200	37%
AQ7	38.7	35.9	200	18%
AQ8	131	129	200	65%
AQ9	108	106	200	53%
AQ10	108	100	200	50%

Wet Season

The NO2 1-hour average monitoring results at each monitoring location are presented below as a series of line graphs (refer to ***Figure 4.17*** to ***Figure 4.26***). The upper bound (UB) has been calculated for each data set by multiplying the interquartile range (IQR) by 1.5 and adding the result to Quartile 3 (Q3). Monitoring results above the UB are considered outliers and are not considered in the AQIA. The monitoring results including the upper bound and the resulting maximum monitored 1-hour average at each monitoring location are presented in ***Table 4.4***.

Figure 4.17: Site AQ1 NO_2 1-hour Average (Wet Season)

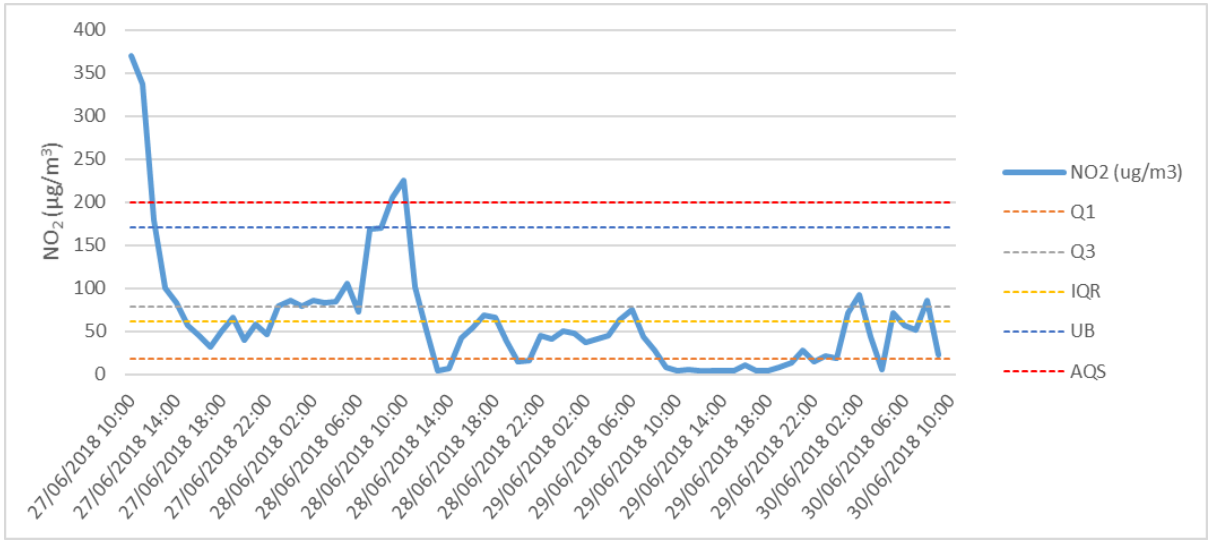


Figure 4.18: Site AQ2 NO_2 1-hour Average (Wet Season)

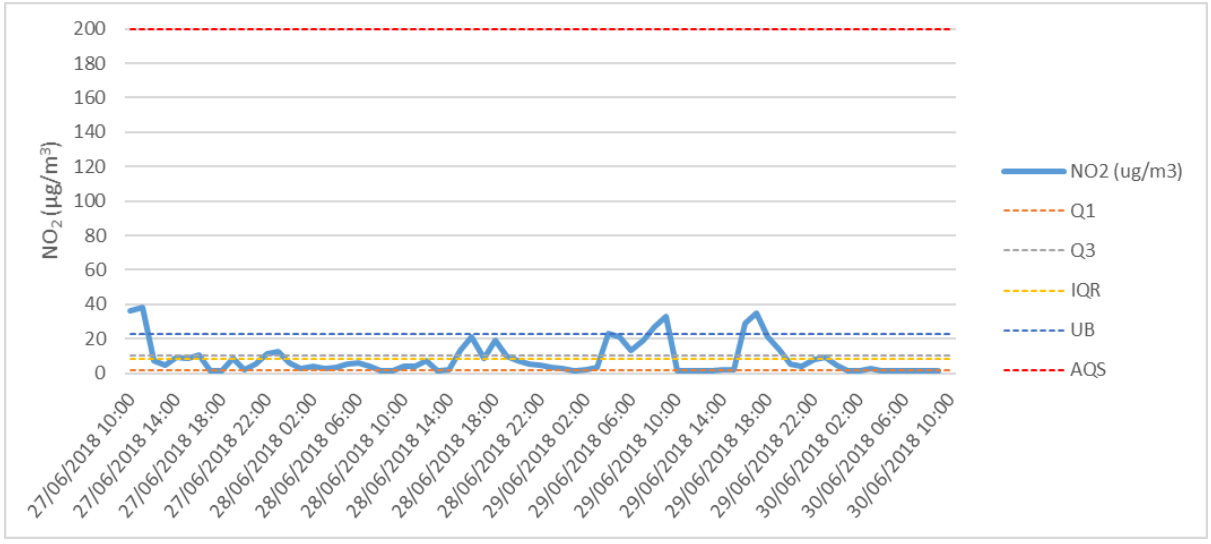


Figure 4.19: Site AQ3 NO_2 1-hour Average (Wet Season)

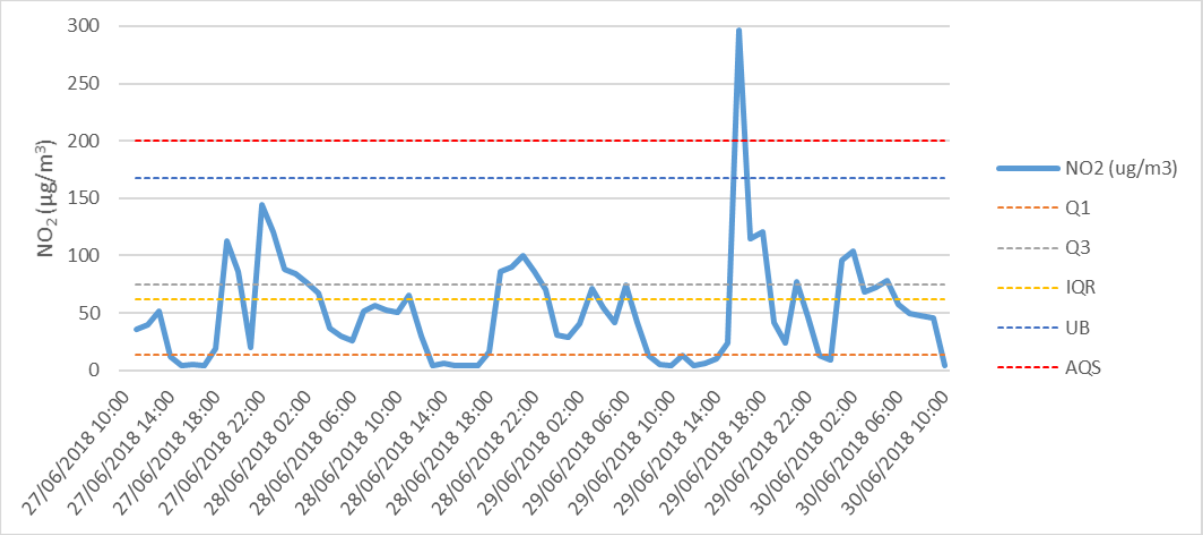


Figure 4.20: Site AQ4 NO_2 1-hour Average (Wet Season)

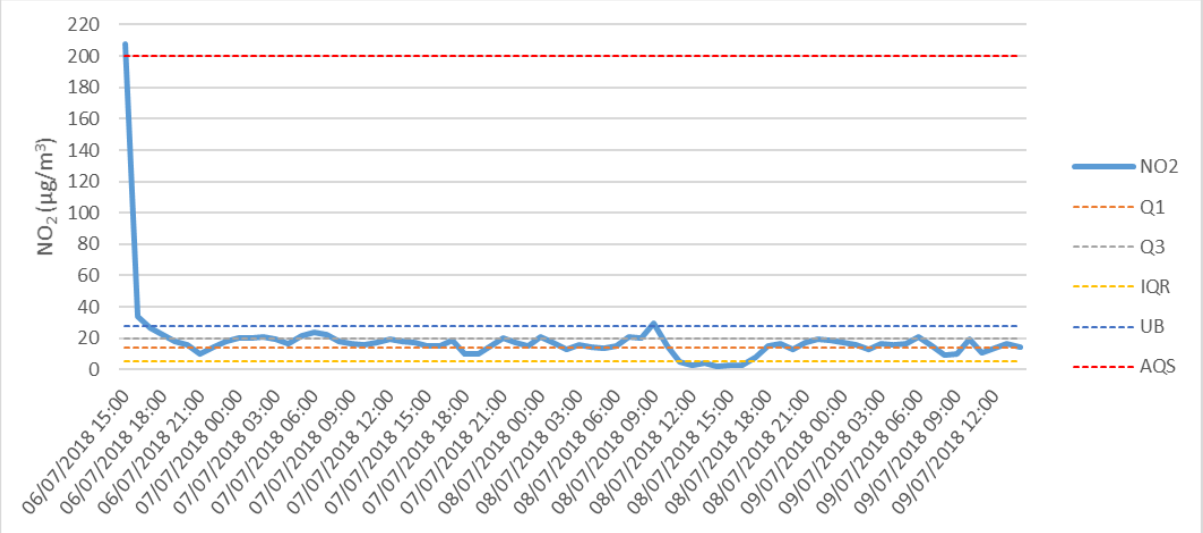


Figure 4.21: Site AQ5 NO_2 1-hour Average (Wet Season)

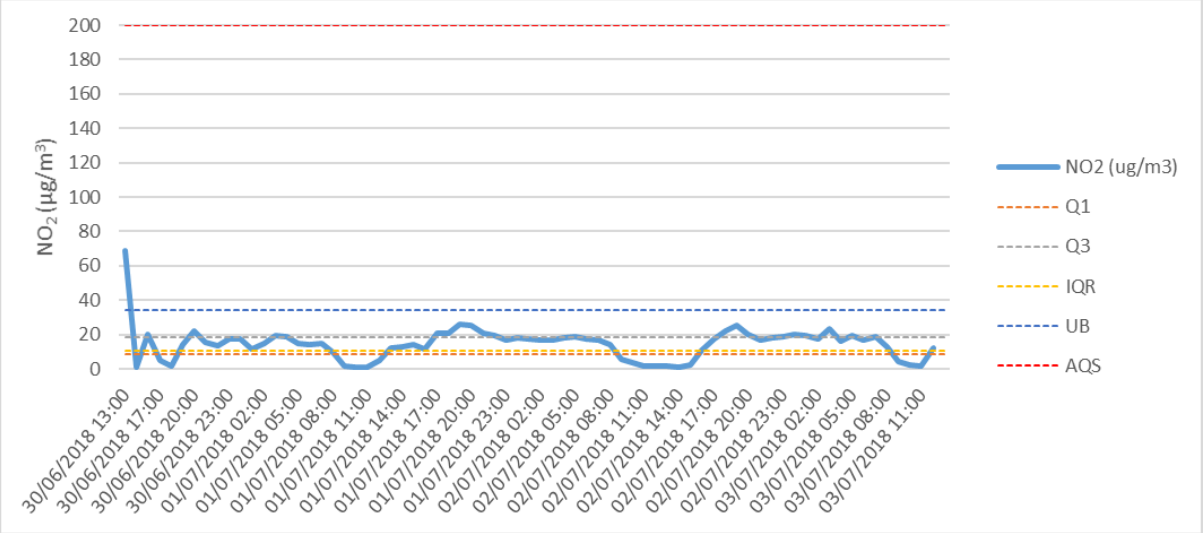


Figure 4.22: Site AQ6 NO_2 1-hour Average (Wet Season)

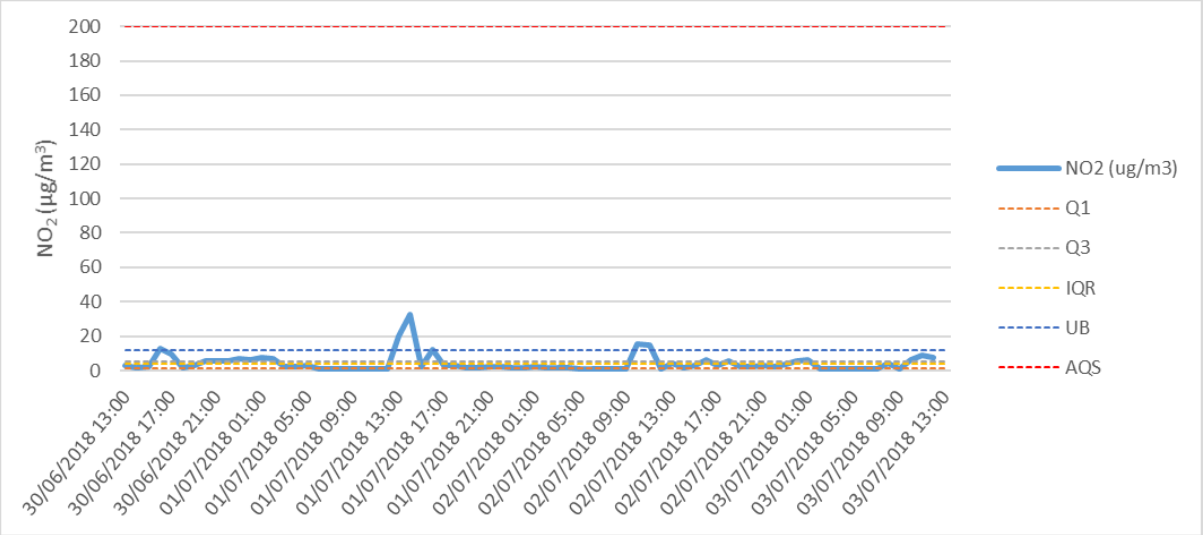


Figure 4.23: Site AQ7 NO_2 1-hour Average (Wet Season)

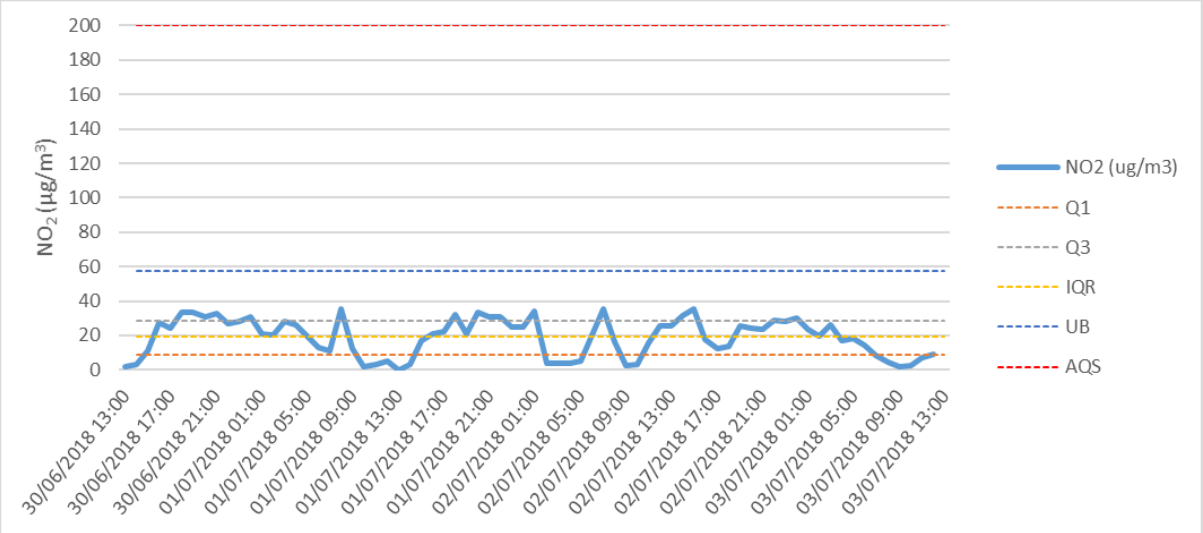


Figure 4.24: Site AQ8 NO_2 1-hour Average (Wet Season)

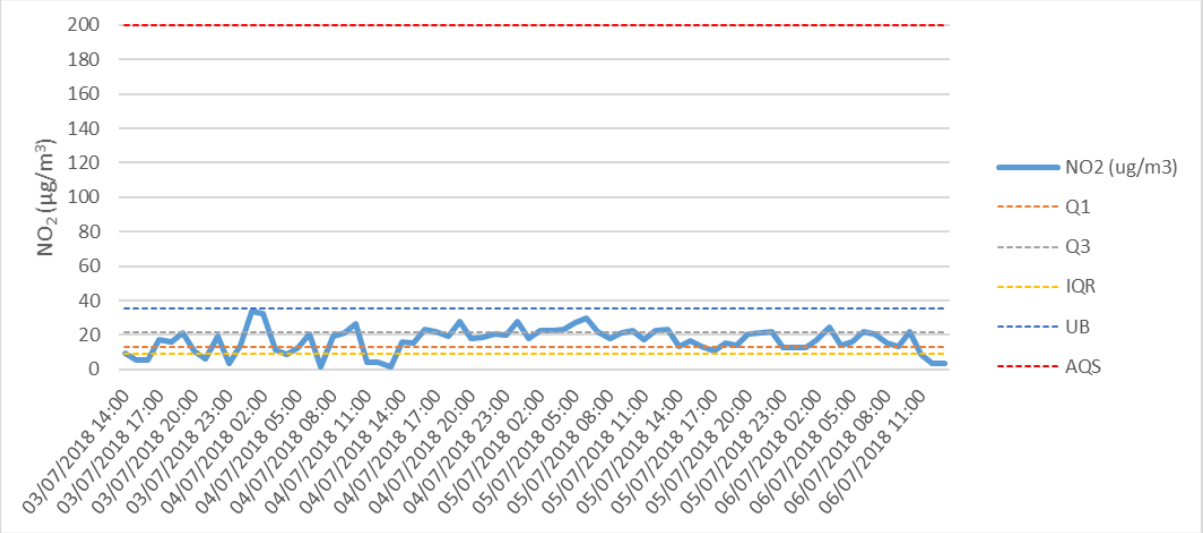


Figure 4.25: Site AQ9 NO_2 1-hour Average (Wet Season)

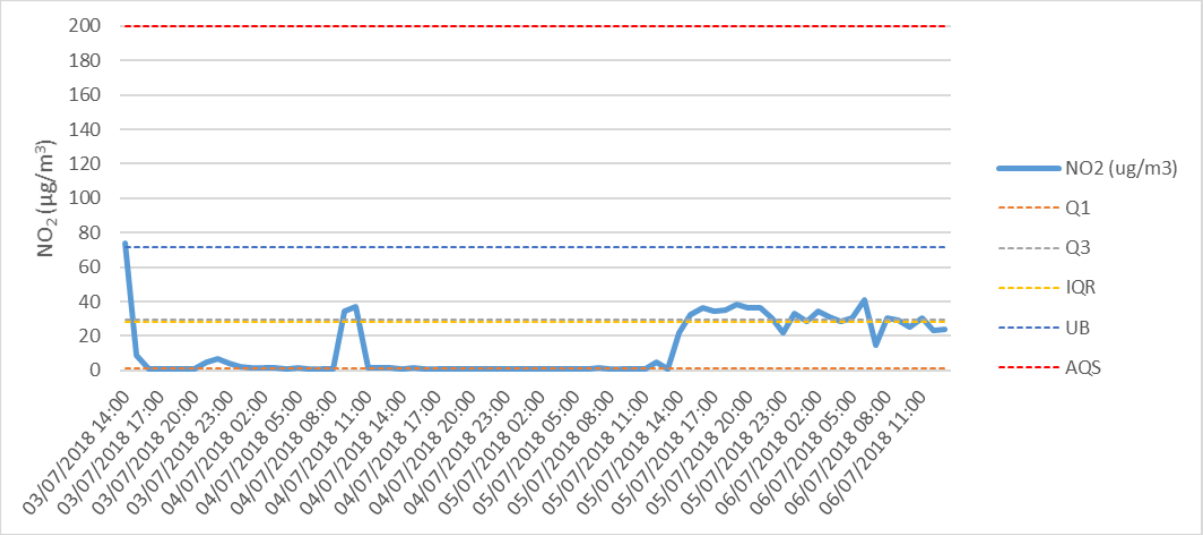


Figure 4.26: Site AQ10 NO_2 1-hour Average (Wet Season)

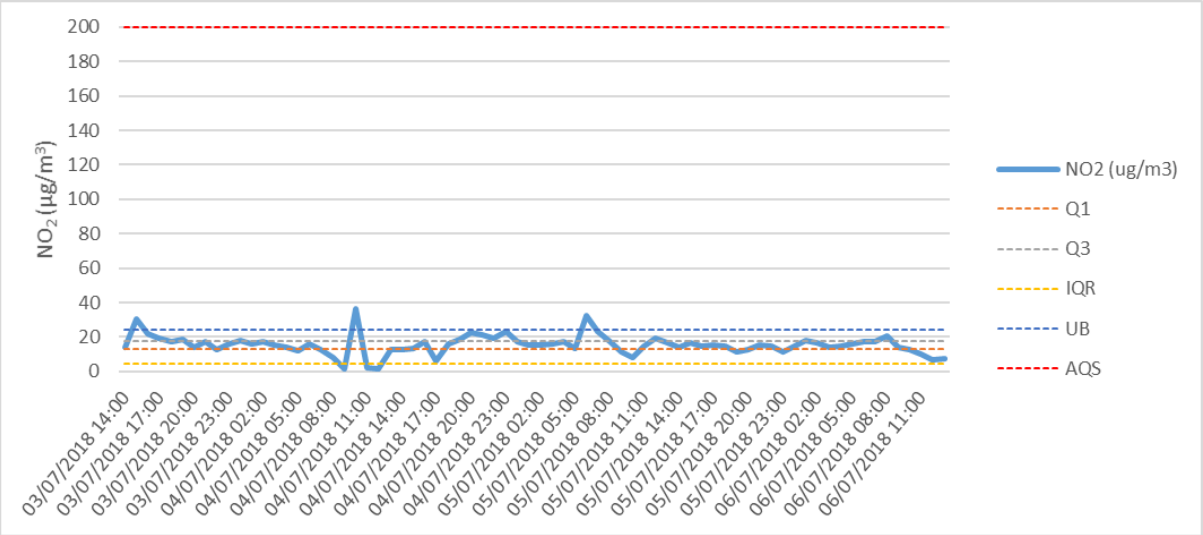


Table 4.4: Wet Season NO_2 Monitoring Result Summary

Site	NO_2 Upper Bound (µg/m³)	NO_2 1-hour Average Maximum (µg/m³)	1-hour Mean Air Quality Standard (AQS) (µg/m³)	% of AQS
AQ1	171	170	200	85%
AQ2	23.1	22.8	200	11%
AQ3	167	144	200	72%
AQ4	27.5	26.4	200	13%
AQ5	34.1	25.9	200	13%
AQ6	12.0	9.30	200	4.6%
AQ7	57.5	35.5	200	18%
AQ8	35.4	33.5	200	17%
AQ9	71.4	41.2	200	21%
AQ10	24.1	23.3	200	12%

4.3.3.2 Diffusion Tubes

The diffusion tube monitoring results sampled in the dry and wet season are presented in ***Table 4.5*** and ***Table 4.6*** respectively.

Table 4.5: Diffusion Tube Monitoring Dry Season

Location	Tube Number	Date on	Date off	NO_2 (µg/m^3)	Annual Mean AQS [a]	% of AQS
DT1	1	27/02/2018	02/05/2018	19.0	40	48%
	2	27/02/2018	02/05/2018	18.9	40	47%
	3	27/02/2018	02/05/2018	17.6	40	44%
DT2	1	27/02/2018	02/05/2018	24.6	40	61%
	2	27/02/2018	02/05/2018	21.6	40	54%
	3	27/02/2018	02/05/2018	22.4	40	56%
DT3	1	27/02/2018	02/05/2018	19.8	40	50%
	2	27/02/2018	02/05/2018	15.3	40	38%
	3	27/02/2018	02/05/2018	15.7	40	39%

Note: [a] *National Environmental Quality (Emission) Guidelines (NEQEG) (2015)*
Due to unforeseen circumstances, the diffusion tubes were deployed beyond the recommended exposure period. The results may be compromised and should be treated with caution.

Table 4.6: Diffusion Tube Monitoring Wet Season

Location	Tube Number	Date on	Date off	NO_2 (µg/m^3) [a]	Annual Mean AQS [b]	% of AQS
DT1	1	12/06/2018	26/06/2018	3.02	40	7.6%
	2	12/06/2018	26/06/2018	0.853	40	2.1%
	3[c]	12/06/2018	26/06/2018	-	40	-
DT2	1	12/06/2018	26/06/2018	2.48	40	6.2%
	2	12/06/2018	26/06/2018	2.27	40	5.7%
	3	12/06/2018	26/06/2018	3.24	40	-
DT3	1	12/06/2018	26/06/2018	0.960	40	8.1%
	2	12/06/2018	26/06/2018	1.54	40	2.4%
	3[c]	12/06/2018	26/06/2018	-		-

Note: [a] *The monitoring results are considered low given the urban environment in which they were located. The results have been treated with caution.*
[b] *National Environmental Quality (Emission) Guidelines (NEQEG) (2015)*
[c] *Tubes 1177604 & 1177610 could not be analysed as they did not contain any grids upon arrival in the laboratory.*

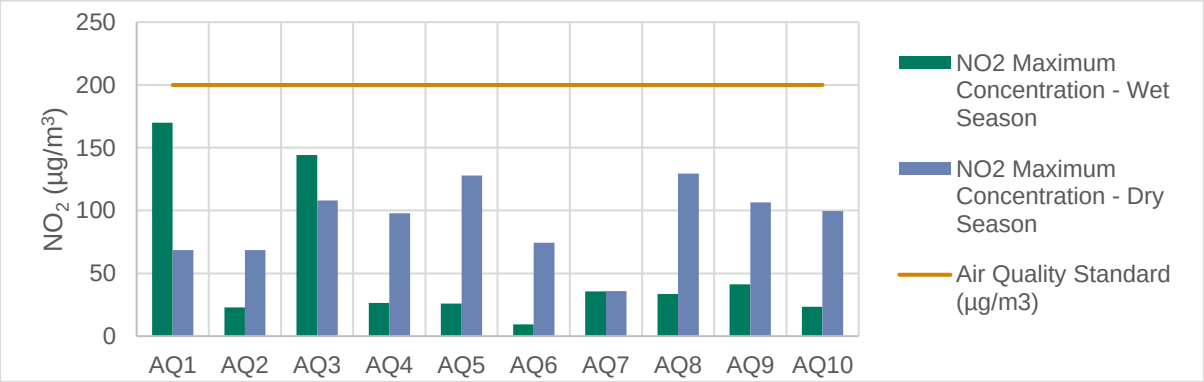
4.3.4 Nitrogen Dioxide (NO_2) Monitoring Final Summary

The maximum 1-hour average baseline concentration recorded at each monitoring site is compared to the NEQEG 1-hour air quality standard and the findings are presented in ***Figure 4.27***.

The data indicates that the maximum 1-hour average concentration at any monitoring location is below the NEQEG air quality standard. On this basis, the air shed is considered non-degraded.

The diffusion tube data is considered indicative of long-term NO_2 concentration at the monitoring locations. The diffusion tube results presented in ***Table 4.5*** and ***Table 4.6*** are below the annual mean air quality standard and suggest that the air shed is non-degraded.

Figure 4.27: NO_2 1-Hour Maximum Baseline Concentration Summary



5. IMPACT ASSESSMENT AND MITIGATION

5.1 Overview

The AQIA approach utilises qualitative and quantitative methods, including detailed air dispersion modelling, to assess potential impacts to sensitive receptors from the key processes identified in ***Section 3***. Where appropriate, the assessment considers existing ambient air quality baseline and assesses predicted impacts at sensitive receptors by comparing them to the relevant air quality standards and guidelines presented in ***Section 2***.

The main sources of emissions associated with the Project that require further more detailed assessment have been identified as follows:

- Construction activities: These activities are specifically associated with demolition, earthworks, the construction of the Project infrastructure, and track-out (carrying and contamination) of materials onto public roads leading to increased ambient concentrations of TSP and PM_{10};
- Power Plant Operation: The continuous operation of the 388 MW gas turbines used for power generation during the normal operation of the Project resulting in elevated ambient concentrations of NO_2; and
- Gas Receiving Terminal Operation: The continuous operation of four-1160 kW natural gas fired generators required during the normal operation of the Project resulting in elevated ambient concentrations of NO_2.

5.2 Impacts to Air Quality from Construction Related Activities

5.2.1 Overview

The activities associated with the construction phase of the Project have the potential to generate TSP and PM_{10} that can result in adverse impacts on sensitive receptors if not managed accordingly. Activities include ground excavation, site levelling, material transfer, material stockpiling, construction of the main infrastructure and track out of dusty materials and dirt onto the public road network.

The following section qualitatively assesses the potential impacts on human health and ecology as well as potential nuisance concerns from dust emissions associated with construction phase activities.

5.2.2 Assessment Methodology

The IAQM[11] provide specific guidance for defining the dust impact risk from construction sites based on the dust emissions magnitude and the sensitivity of the receiving area. The IAQM guidance is used as the main reference document for determining the potential risk of impact from the anticipated construction works in order to determine the level of site-specific mitigation that should be applied. The premise of the guidance is that with the implementation of effective site-specific mitigation and management measures, the environmental effect will not be significant in most cases.

The potential dust impact risk from the different project components and activities and the specific mitigation measures that are required are considered. Professional judgement is used where necessary to estimate the impact magnitude from the different project components and activities.

5.2.2.1 Determining the Magnitude of the Impact

The IAQM defines the dust emission magnitude based on the scale of the anticipated works. The criteria for estimating the magnitude of dust impacts from demolition, earthworks, construction and track-out as per the IAQM guidance note is presented in ***Table 5.1*** and is used to inform this impact assessment.

[11] Institute of Air Quality Management (IAQM) (2014) Guidance on the Assessment of Dust from Demolition and Construction [Online] Available at: http://iaqm.co.uk/guidance/ [Accessed 13 February 2019]

5.2.2.2 Determining the Sensitivity of the Area

The IAQM define the sensitivity of the area based on receptor type and the number of receptors within a certain distance from the source. Residential properties, schools, and hospitals are classified as high sensitivity to dust soiling and health effects. Locations where there are particularly important plant species (i.e. rice paddy) are classified as medium sensitivity. The criteria for estimating the sensitivity of the area as per the IAQM guidance is presented in ***Table 5.2***, ***Table 5.3*** and ***Table 5.4***. The guidance provides a screening criterion of 350 m and 50 m from the construction site and access road respectively beyond which impacts are not considered likely.

5.2.2.3 Determining the Risk of Impact

The impact magnitude is combined with the sensitivity of the area to determine the risk of the impact with no mitigation. The matrices in ***Table 5.5***, ***Table 5.6***, ***Table 5.7*** and ***Table 5.8*** provide the approach for defining the impact risk due to demolition, earthworks, construction and track-out respectively. The findings from this risk assessment inform the level of mitigation that is necessary to reduce impacts to an acceptable level.

Table 5.1: Dust Emission Magnitude

Activity	Impact Magnitude		
	Small	Medium	Large
Demolition	Total building volume <20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10 m above ground, demolition during wetter months.	Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level; and	Total building volume >50,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level
Earthworks	Total site area <2 ,500 m^2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4m in height, total material moved <20,000 tonnes, earthworks during wetter months	Total site area 2,500 m^2 – 10,000 m^2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4 m – 8 m in height, total material moved 20,000 tonnes – 100,000 tonnes	Total site area >10,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8 m in height, total material moved >100,000 tonnes
Construction	Total building volume <25,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber).	Total building volume 25,000 m^3 – 100,000 m^3, potentially dusty construction material (e.g. concrete), on site concrete batching;	Total building volume >100,000 m^3, on site concrete batching, sandblasting
Trackout	<10 HDV (>3.5 t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50 m.	10-50 HDV (>3.5 t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m	>50 HDV (>3.5 t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m

Table 5.2: Sensitivity of the Area to Dust Soiling Effects on People and Property

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Note: For trackout the distances should be measured from the side of the roads used by construction traffic. Without site specific mitigation, trackout may occur from roads up to 500 m from large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit. The impact declines with distance from the site, and it is only necessary to consider trackout impacts up to 50 m from the edge of the road.

Table 5.3: Sensitivity of the Area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM_{10} concentration	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	>32 µg/m^3	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m^3	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m^3	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low

Receptor Sensitivity	Annual Mean PM_{10} concentration	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
		1-10	Low	Low	Low	Low	Low
Medium	>32 µg/m^3	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	28-32 µg/m^3	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	24-28 µg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<24 µg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>=1	Low	Low	Low	Low	Low

Note: For trackout the distances should be measured from the side of the roads used by construction traffic. Without site specific mitigation, trackout may occur from roads up to 500 m from large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit. The impact declines with distance from the site, and it is only necessary to consider trackout impacts up to 50 m from the edge of the road.

Table 5.4: Sensitivity of the Area to Ecological Impacts

Sensitivity of the Area	Distance from the Source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Table 5.5: Risk of Dust Impacts – Demolition

Sensitivity of the Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table 5.6: Risk of Dust Impacts – Earthworks

Sensitivity of the Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 5.7: Risk of Dust Impacts – Construction

Sensitivity of the Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 5.8: Risk of Dust Impacts – Trackout

Sensitivity of the Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

5.2.3 Construction Phase Impacts from the Combined Cycle Gas Turbine Power Plant (pre mitigation)

Information regarding demolition, earthworks, construction, and trackout associated with the Project is summarised in ***Table 5.9***. The magnitude of the impact and the sensitivity of the area is defined based on the IAQM approach outlined in ***Section 5.2.2***.

Table 5.9: Construction Dust Risk Assessment of Combined Cycle Gas Turbine Power Plant

Activity	Magnitude of Impact	Site Sensitivity (Human)	Site Sensitivity (Ecology)
Demolition	■ Buildings require demolition include one x wooden building (1,140 m^3) and one x concrete building (350 m^3). Total building volume demolished is 1,490 m^3. ■ The dust emission magnitude from demolition during construction will be **small** (refer to ***Table 5.1***).	■ A review of aerial imagery indicates that to the north of the site there are approximately 10-100 human receptors <100 m from the site boundary and between 1-10 human receptors <50 m from the site boundary (refer to ***Table 4.1***). ■ The sensitivity of the area to dust soiling and human health impacts will be **low** as a worst case (refer to ***Table 5.2*** and ***Table 5.3***).	■ Mangroves exist within 20 m from the site boundary (refer to ***Table 4.1***). ■ The sensitivity of the mangroves to dust soiling from earthwork activities will be **medium** (refer to ***Table 5.4***).
Earthworks	■ Development of the Project will occur on approximately 36,300 m^2 of existing land. ■ 84,560 tons of soil required for landscaping ■ Clay/silt soil type ■ The dust emission magnitude from earthworks will be **large** (refer to ***Table 5.1***).	■ A review of aerial imagery indicates that to the north of the site there are approximately 10-100 human receptors <100 m from the site boundary and between 1-10 human receptors <50m from the site boundary (refer to ***Table 4.1***). ■ The sensitivity of the area to dust soiling and human health impacts will be **low** as a worst case (refer to ***Table 5.2*** and ***Table 5.3***).	■ Mangroves exist within 20 m from the site boundary (refer to ***Table 4.1***). ■ The sensitivity of the mangroves to dust soiling from earthwork activities will be **medium** (refer to ***Table 5.4***).
Construction	■ Total expected building volume is 12,100 m^3. ■ Construction materials will primarily consist of concrete and steel. ■ On-site concrete batching. ■ The dust emission magnitude from construction of infrastructure will be **medium** (refer to ***Table 5.1***).	■ A review of aerial imagery indicates that to the north of the site there are approximately 10-100 human receptors <100 m from the site boundary and between 1-10 human receptors <50 m from the site boundary (refer to ***Table 4.1***). ■ The sensitivity of the area to dust soiling and human health impacts will be **low** as a worst case (refer to ***Table 5.2*** and ***Table 5.3***).	■ Mangroves exist within 20 m from the site boundary (refer to ***Table 4.1***). ■ The sensitivity of the mangroves to dust soiling from construction activities will be **medium** (refer to ***Table 5.4***).
Track-out	■ While the exact number of vehicles exiting the site per day is unknown, this assessment assumes between 10-50 HDV	■ A review of the aerial imagery indicates that there are no sensitive receptors adjacent to the	■ A review of the aerial imagery indicates that there is no sensitive ecology adjacent to the

Activity	Magnitude of Impact	Site Sensitivity (Human)	Site Sensitivity (Ecology)
	resulting in a **medium** dust emission magnitude.	access road (refer to ***Table 4.1***). ■ The sensitivity of the area to track-out is therefore not applicable.	access road (refer to ***Table 4.1***). ■ The sensitivity of the area to track-out is therefore not applicable.

5.2.4 Construction Phase Impacts from the LNG Terminal (pre mitigation)

Information regarding demolition, earthworks, construction, and track out associated with the Project is summarised in ***Table 5.10***. The magnitude of the impact and the sensitivity of the area is defined based on the IAQM approach outlined in ***Section 5.2.2***.

Table 5.10: Construction Dust Risk Assessment of Liquefied Natural Gas Receiving Terminal

Activity	Magnitude of Impact	Site Sensitivity (Human)	Site Sensitivity (Ecology)
Demolition	■ No demolition is necessary.	■ Not applicable.	■ Not Applicable.
Earthworks	■ Development of the Project will occur on approximately 64,414 m^2 of existing land. ■ 126,702 tons of soil required for landscaping. ■ Clay/silt soil type. ■ The dust emission magnitude from earthworks will be **large** (refer to ***Table 5.1***).	■ A review of aerial imagery indicates that there are 1-10 human receptors <350 m from the site boundary (refer to ***Table 4.2***). ■ The sensitivity of the area to dust soiling and human health impacts will be **low** (refer to ***Table 5.2*** and ***Table 5.3***).	■ Agriculture exist within 20 m from the site boundary (refer to ***Table 4.2***). ■ The sensitivity of the agriculture to dust soiling from earthwork activities will be **medium** (refer to ***Table 5.4***).
Construction	■ Total expected building volume is 12,100 m^3. ■ Construction materials will primarily consist of concrete and steel. ■ On-site concrete batching. ■ The dust emission magnitude from construction of infrastructure will be **medium** (refer to ***Table 5.1***).	■ A review of aerial imagery indicates that there are 1-10 human receptors <350 m from the site boundary (refer to ***Table 4.2***). ■ The sensitivity of the area to dust soiling and human health impacts will be **low** (refer to ***Table 5.2*** and ***Table 5.3***).	■ Agriculture exist within 20 m from the site boundary (refer to ***Table 4.2***). ■ The sensitivity of the agriculture to dust soiling from construction activities will be **medium** (refer to ***Table 5.4***).
Track-out	■ While the exact number of vehicles exiting the site per day is unknown, this assessment assumes between 10-50 HDV resulting in a **medium** dust emission magnitude.	■ A review of aerial imagery indicates that there is one human receptors <50 m from the road (refer to ***Table 4.2***). ■ The sensitivity of the area to dust soiling and human health impacts will be low (refer to ***Table 5.2*** and ***Table 5.3***).	■ A review of aerial imagery indicates that there are no ecological receptors <50 m from the road (refer to ***Table 4.2***). ■ The sensitivity of the area to dust soiling is not applicable.

5.2.5 Construction Phase Impacts from the Onshore Pipeline (pre mitigation)

Information regarding demolition, earthworks, construction, and trackout associated with the onshore pipeline is summarised in ***Table 5.11***. The magnitude of the impact and the sensitivity of the area is defined based on the IAQM approach outlined in ***Section 5.2.2***.

Table 5.11: Onshore Pipeline Dust Risk Assessment

Activity	Magnitude of Impact	Site Sensitivity (Human)	Site Sensitivity (Ecology)
Demolition	■ No demolition required	■ Not applicable	■ Not applicable
Earthworks	■ The installation of the pipeline is expected to require >10,000 m^2 of land ■ More than 10 heavy earth moving vehicles are expected to be active at any one time ■ The dust emission magnitude from earthworks will be **large** (refer to ***Table 5.1***).	■ A review of aerial imagery indicates that there are potentially 10-100 human receptors <20 m from the site boundary (refer to ***Table 4.3***). ■ The sensitivity of the area to dust soiling and human health impacts will be **large** (refer to ***Table 5.2*** and ***Table 5.3***).	■ Agriculture exists <20 m from the pipeline route (refer to ***Table 4.3***). ■ The sensitivity of the agriculture to dust soiling from construction activities will be **medium** (refer to ***Table 5.4***).
Construction	■ No physical construction is required.	■ Not applicable	■ Not applicable
Track-out	■ The exact number of outward movements is unknown, however it is assumed >50 HDV as a worst case ■ The dust emission magnitude from earthworks will be **large** (refer to ***Table 5.1***).	■ The access roads to the pipeline construction area are not known. This impact assessment assumes the site sensitivity will be high as a worst case (refer to ***Table 5.2*** and ***Table 5.3***).	■ The access roads to the pipeline construction area are not known however it is assumed that agriculture will exist within 20 m of the road. This impact assessment therefore classifies the site sensitivity as medium (refer to ***Table 5.4***).

5.2.5.1 Summary of Dust Risk

The summary of the dust risk associated with the construction of the Project pre-mitigation is presented in ***Table 5.12***.

Table 5.12: Summary of Dust Risk

Project Component	Activity	Impact	Impact Magnitude	Sensitivity of the Area	Impact Significance
CCGT Power Plant	Demolition	Dust Soiling	Small	Low	Negligible
		Human Health	Small	Low	Negligible
		Ecological	Small	Medium	Low
	Earthworks	Dust Soiling	Large	Low	Low
		Human Health	Large	Low	Low
		Ecological	Large	Medium	Medium
	Construction	Dust Soiling	Medium	Low	Low
		Human Health	Medium	Low	Low
		Ecological	Medium	Medium	Medium
	Trackout	Dust Soiling	Medium	*n/a*	*n/a*
		Human Health	Medium	*n/a*	*n/a*
		Ecological	Medium	*n/a*	*n/a*
LNG Terminal	Demolition	Dust Soiling	*n/a*	*n/a*	*n/a*
		Human Health	*n/a*	*n/a*	*n/a*
		Ecological	*n/a*	*n/a*	*n/a*
	Earthworks	Dust Soiling	Large	Low	Low
		Human Health	Large	Low	Low
		Ecological	Large	Medium	Medium
	Construction	Dust Soiling	Medium	Low	Low
		Human Health	Medium	Low	Low
		Ecological	Medium	Medium	Medium
	Trackout	Dust Soiling	Medium	Low	Low
		Human Health	Medium	Low	Low
		Ecological	*n/a*	*n/a*	*n/a*
Onshore Pipeline	Demolition	Dust Soiling	*n/a*	*n/a*	*n/a*
		Human Health	*n/a*	*n/a*	*n/a*
		Ecological	*n/a*	*n/a*	*n/a*
	Earthworks	Dust Soiling	Large	Large	Large
		Human Health	Large	Large	Large
		Ecological	Large	Medium	Medium
	Construction	Dust Soiling	*n/a*	*n/a*	*n/a*
		Human Health	*n/a*	*n/a*	*n/a*
		Ecological	*n/a*	*n/a*	*n/a*
	Trackout	Dust Soiling	Large	Large	Large
		Human Health	Large	Large	Large
		Ecological	Large	Medium	Medium

5.2.6 Recommended Mitigation, Management and / or Monitoring Measures

A series of project specific mitigation measures for demolition, earthworks, construction and trackout are suggested based on the outcome of the dust risk assessment summarised in ***Table 5.13***. Where the assessment predicts negligible impacts, no site-specific mitigation measures are proposed.

Table 5.13: Proposed Construction Phase Mitigation and Management Measures

Activity	Mitigation
General Construction	■ Develop and Implement a Dust Management Plan (DMP). The DMP will contain the measures outlined in this document and a plan for implementation. ■ Regular site inspections will be performed to monitor compliance with the DMP. All inspection results will be recorded and corrective actions taken where mitigation and management measures are not being implemented effectively (i.e. to reduce dust emissions). ■ Daily onsite and offsite inspections will be undertaken to visually assess the dust emissions from earthwork and construction activities, and from vehicles exiting the construction sites. Results from the inspection will be recorded and appropriate measures such as those presented in this table will be taken to reduce emissions where necessary. ■ All dust and air quality complaints will be recorded, the cause identified and appropriate measures such as those presented in this table will be implemented or intensified to reduce dust emissions in a timely manner. ■ The frequency of site inspections will be increased when activities with a high potential to produce dust are being carried out and during prolonged dry and windy conditions. ■ Watering will be used to suppress wind and physical disturbance dust generation. ■ Ensure an adequate water supply on site for effective dust suppression and mitigation. ■ The site layout will be planned so that dust causing activities are located away from receptors as far as is possible. ■ Screens or barriers will be erected around dusty activities or the site boundary that are at least the height of any stockpile on site. ■ All stockpiles will be covered or fenced off to prevent wind whipping. ■ Only cutting, grinding, or sawing equipment fitted with suitable dust suppression techniques such as water sprays will be used. ■ All chutes, conveyors and skips will be covered at all times. ■ Drop heights from conveyors, loading shovels and hoppers will be minimised. ■ No waste will be burned on site.
Demolition	■ Ensure effective water suppression is used during demolition operations. ■ Avoid explosive blasting, using appropriate manual or mechanical alternatives. ■ Bag and remove any biological debris or damp down such material before demolition.
Earthworks	■ Re-vegetate earthwork and exposed areas as soon as is practicable. ■ Use hessian, mulches or trackifiers where it is not possible to revegetate, or cover with top soil as soon as is practicable.
Construction	■ Sand and other aggregates will be stored in bunded areas and will not be allowed to dry out unless this is required for a particular process, in which case additional control measures such as those discussed in ‘General Construction’ will be applied.
Track out	■ Ensure that all vehicles entering and leaving the site are covered to avoid fugitive emissions during transport. ■ Inspect on-site haul roads for integrity and instigate the necessary repairs to the surfaces as soon as reasonable practicable. ■ Implement a wheel washing system. ■ Regularly dampen/clean the site access and local roads to remove any materials tracked out of the site. ■ All site access gates will be located at least 10m away from air sensitive receptors where possible.

Activity	Mitigation
Operation of Vehicles/Machinery	■ The site layout will be planned so that machinery is located away from receptors as far as is possible. ■ All vehicles will switch off engines when stationary. ■ A regular vehicle and machinery maintenance and repair programme will be implemented. ■ Mains electricity or battery powered equipment will be used instead of diesel/petrol generators where practicable.

5.2.7 Residual Impact (post mitigation)

The IAQM guidance suggest that when correctly applying and actively managing the mitigating controls outlined in ***Table 5.13***, the impacts to receptors located within 350m downwind of any construction activity are not likely to be significant for the large majority of the time. However, due to the nature of construction activities, the scale and duration of the construction phase, and the possibility of extreme weather conditions, it is possible that communities will experience occasional, short-term dust annoyance. The IAQM states, "*the likely scale of this would not normally be considered sufficient to change the conclusion that with mitigation the effects will be 'not significant'*. On this basis, it can be concluded that construction phase activities are likely to result in a negligible impact at worst post mitigation.

5.3 Impacts to Ambient Air Quality during Operations

5.3.1 Overview

The operation of the Project will generate emissions to air that can result in adverse health impacts at sensitive receptors in the study area. The following section quantitatively assesses the potential impacts at sensitive receptors using detailed dispersion modelling.

5.3.2 Assessment Methodology

5.3.2.1 Magnitude and Significance of Impacts

There is no Project specific approach for determining the magnitude and the significance of impacts during the operation phase of the Project. This AQIA, therefore, makes specific consideration to the guidance set out by the IFC when defining the magnitude and significance of impacts to air quality.

The magnitudes of impacts during the operation phase were quantified using detailed dispersion modelling. The magnitude of the impact was ascertained by means of comparison to the Myanmar air quality standards. Magnitude is based on both the 'Project Contribution (PC)'; this is the impact arising solely from project related emissions, and the Predicted Environmental Concentration (PEC); this is the PC added to the existing baseline.

In order to determine the significance of those impacts, consideration is then required to the sensitivity of the area in question, based on sensitivity of human health and ecology within the study area. Examples of receptor type and sensitivity for the purpose of this AQIA are presented in ***Table 5.14***.

In general, the approach assumes that sensitivity within the general study area is 'Medium' for human health. There are a small number of specific cases where the sensitivity may be defined as 'High'; these include hospitals, for example, where there are intensive care units or high dependency wards. Under no circumstances is the sensitivity for human health described as 'Low'.

Table 5.14: Receptor Sensitivity

Receptor Sensitivity	Human Health	Ecology
High	■ Hospitals; and ■ Schools	■ Internationally Designated Sites
Medium	■ General Population	■ Nationally Designated Site
Low	■ n/a	■ Locally Designated Sites (Areas of specific ecological interest not subject to statutory protection)

The IFC make a differentiation in the significance of impacts, based upon the existing baseline. Essentially, this is whether air quality guidelines or standards are exceeded or not due to baseline concentrations.

The IFC General EHS Guideline states:

- *Projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimise impacts by ensuring that:*
  - *Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines, or other internationally recognised sources.*
  - *Emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed [i.e. in an undegraded airshed].*
- *An airshed should be considered as having poor air quality [degraded] if nationally legislated air quality standards or WHO Air Quality Guidelines are exceeded significantly.*
- *Facilities or projects located within poor quality airsheds, and within or next to areas established as ecologically sensitive (e.g. national parks), should ensure that any increase in pollution levels is as small as feasible, and amounts to a fraction of the applicable short-term and annual average air quality guidelines or standards as established in the project-specific environmental assessment.*

The significance of impacts are therefore defined in terms of the sensitivity of the receptors (refer to ***Table 5.14***), the impact magnitude (i.e. the PC) (refer to ***Table 5.15***), and whether the baseline pollution concentrations are above or below the air quality standards (i.e. degraded or non-degarded). This approach has been used to define the AQIA significance criteria for a non-degraded and degraded airshed (refer to ***Table 5.16***).

Table 5.15: Impact Magnitude

Magnitude of Impact	Non-degraded airshed (i.e. baseline < AQS)	Degraded airshed (i.e. baseline > AQS)
Negligible	■ PC <25% of AQS	■ PC <10% of AQS
Small	■ PC between 25% and 50% of AQS and PEC <100% of AQS	■ PC between 10% and 30% of AQS
Medium	■ PC between 50% and 100% of AQS, and PEC <100% AQS; or ■ PC between 25% and 50% of AQS, and PEC >100% of AQS	■ PC between 30% and 50% of AQS
Large	■ PC > 100% of AQS; or ■ PC > 50% of AQS, and PEC >100% of AQS	■ PC > 50% of AQS

Note: PC: Process Contribution; PEC: Predicted Environmental Concentration; AQS: Air Quality Standard/Guideline

Table 5.16: Determination of Significance

Impact Magnitude	Receptor Sensitivity		
	Low	Medium	High
Negligible	Negligible	Negligible	Negligible
Small	Negligible	Minor	Moderate
Medium	Minor	Moderate	Major
Large	Moderate	Major	Major

5.3.2.2 Dispersion Model

The AQIA approach uses air dispersion modelling to assess potential impacts to sensitive receptors from the stack emissions from the CCGT power plant.

The dispersion model used in the assessment was the latest USEPA AERMOD dispersion model version 18081 released in April 2018. AERMOD is a state of the art detailed dispersion model that can represent complex multiple emission sources and predict air quality at receptor locations taking into account meteorology. The model is widely recognised for use in this type of application, including by the IFC, USEPA, UK Environment Agency and state based EPA's throughout Australia.

5.3.2.3 Modelling Scenarios

The assessment on air quality during normal operation considers emissions to air from gas turbines at the power plant and gas generators at the LNG receiving terminal. The power plant and the terminal area are approximately 17km apart and cumulative impacts are unlikely given the design of the Project. On this basis, two separate modelling scenarios were considered as follows:

- Scenario A: The modelling scenario considers the continuous operation of the 388 MW natural gas fired turbines. The emissions from the turbines are derived from the manufactures guaranteed NO_x emission concentration of 51 mg/Nm^3. The modelling scenario assumes continuous emissions throughout one entire year comprising of 365 days. In practice, the power plant will operate below the guaranteed emission level, thus the modelling scenario is an absolute worst-case representation of the potential impact on ambient air quality; and
- Scenario B: The modelling scenario considers the continuous operation of four-1160 kW natural gas fired engines at the gas-receiving terminal. The modelling scenario assumes continuous emissions for 365 days per year. The emissions from the generators are based on the Cummins C1160 N5C natural gas fired generator at 100% rated load.

5.3.2.4 Modelling Methodology

Detailed dispersion modelling was used to predict concentrations of emitted substances at ground level locations. Three years of hourly sequential meteorological data was used so that inter annual variability was incorporated into the model. The modelling methodology including receptor grid spacing, meteorological data information, NO_x to NO_2 conversion and the treatment of buildings, land use and terrain is discussed in the following Section. The stack design parameters and emission data for the Project are presented in ***Table 5.17*** and ***Table 5.18***.

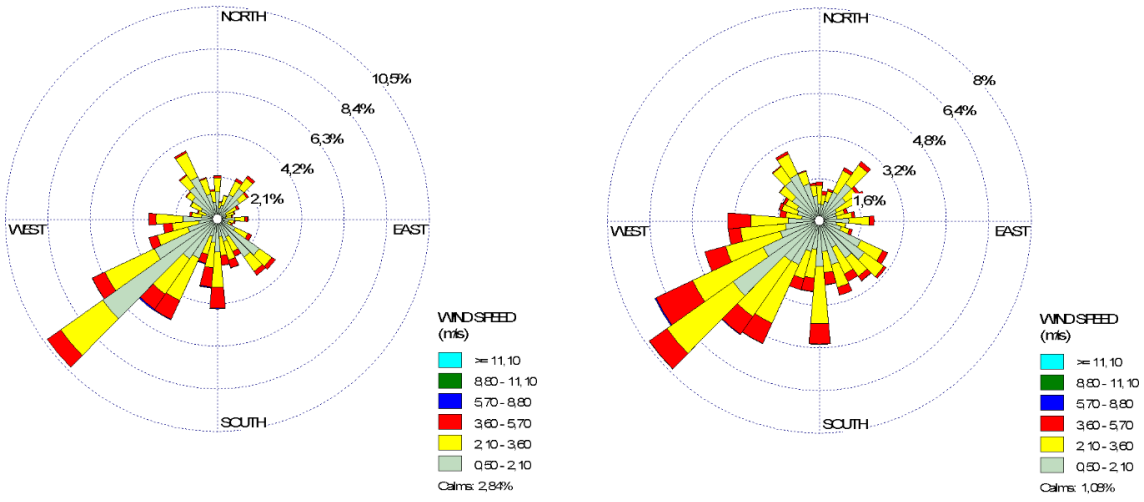
Meteorological Data

Meteorological data representative of the study area is crucial for supporting the detailed dispersion modelling assessment. Following IFC recommendations, three to five years of data is necessary in order to capture year on year variability. Hourly sequential meteorological data is required for wind speed; wind direction; precipitation; relative humidity; temperature; and cloud cover.

A meteorological station at Yangon Airport, approximately 15 km north-northwest of the power plant location, was identified as having sufficient data availability for all parameters. Three years (2015-2017) of meteorological data was sourced from the site and used to inform the dispersion model.

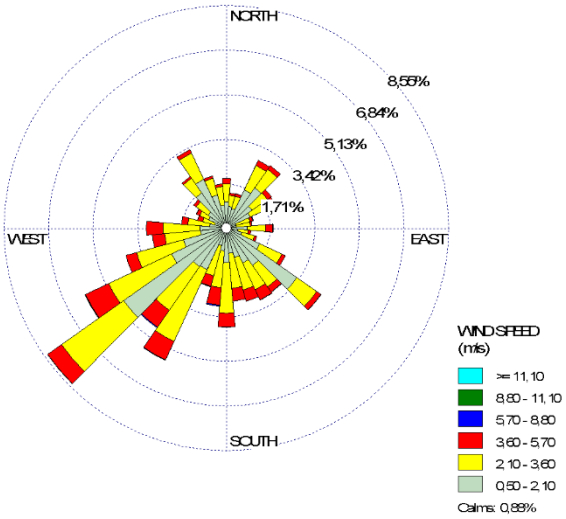
The wind roses for each year are presented in ***Table 5.1***. The data shows that the prevailing wind in the study area is predominantly from the southwest.

Figure 5.1: Wind Rose Yangon Airport 2015-2017



2015

2016



2017

Percentiles

Modelling guidelines in a number of jurisdictions around the world including Victoria in Australia[12], Alberta in Canada[13], and the New Zealand Ministry[14] for the Environment recognise that the 100th percentile 1-hour average concentration has the potential to be highly skewed. Research indicates that indicates that the absolute worst hour (100th percentile) may have a concentration twice that of the second-worst hour, and 10 times that of the ninth-highest hour; however, the ninth-highest hour may only be fractionally above the tenth-highest hour. Consequently, a modelling result taken as a peak value (100th percentile) in comparison to ambient air quality criteria is greatly sensitive to 'modelling uncertainty' as a result of extreme, rare and transient meteorological conditions. To mitigate modelling uncertainty and provide a more accurate representation of the likely impact on ambient air quality, the use of the ninth highest or 99.9th percentile is considered. Use of the ninth highest 1-hour average value means that from the model predictions, results for 8751 hours of the year are equal to or lower than the value presented.

For averaging periods longer than an hour, the modelling uncertainty is reduced as the averaging process over multiple hours reduces the peak 1-hour values, and longer averaging periods are therefore not subject to the same modelling uncertainty. Consequently, for criteria with averaging periods of greater than 1-hour, the highest (100th percentile) value has also been reported.

NO_x to NO_2 Conversion

The stack emissions from the Project contain oxides of nitrogen, occurring as both nitric oxide (NO) and NO2. The ratio of these two gases in the exhaust gases from combustion processes varies, but is typically in the ratio of 90-95% NO to 5–10% NO_2. With regard to the assessment of impact on human health NO2 is the pollutant of interest as NO has little effect on human health at concentrations typically encountered in ambient air.

Within the atmosphere, various processes oxidise NO to create NO_2. This process is largely dependent on the amount of oxidant in the atmosphere at the time of release. It is, therefore, overly pessimistic to assume 100% conversion from NO to NO_2, and it is necessary to use a factor to estimate ground level concentrations of NO_2 based upon total NO_x emitted.

Based on the UK Environment Agency[15] suggested worst-case scenario for NO_x to NO_2 conversion, a 35% conversion rate for short term and a 70% conversion rate for long term concentrations was used.

Receptor Grid

A meteorological grid extending 10 km from the power plant and 5 km from the LNG terminal was used to ensure that all impacts from the Project were captured in the model. The receptor spacing varies with distance from the point source locations in order to provide sufficiently dense receptors close to the site, and suitable spatial coverage further afield (refer to ***Figure 5.2***). Furthermore, specific receptor points

[12] Environmental Protection Agency Victoria (2013) Guidance notes for using the regulatory air pollution model AERMOD in Victoria [Online] Available at: https://www.epa.vic.gov.au/~/media/Publications/1551.pdfhttp://www.mfe.govt.nz/sites/default/files/atmospheric-dispersion-modelling-jun04.pdf [Accessed 13 February 2019]

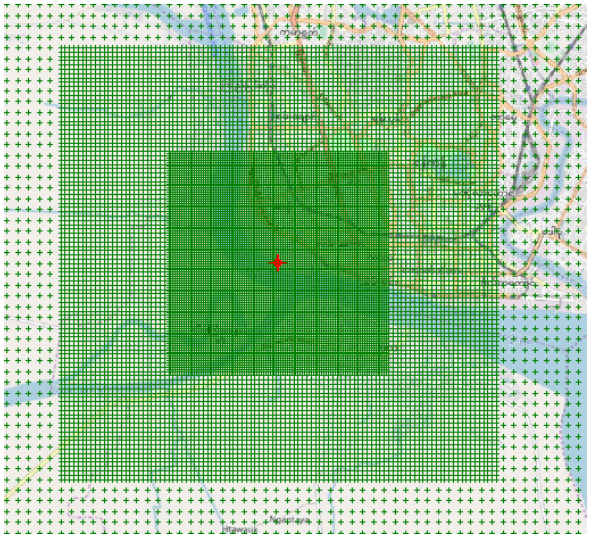
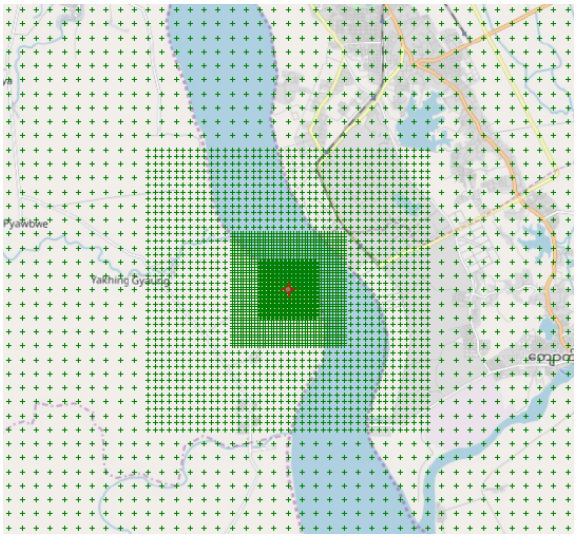
[13] Alberta Government (2013) Air Quality Model Guideline [Online] Available at: https://open.alberta.ca/dataset/e796eeb3-4e88-456c-9dcb-79808c4f926a/resource/3f30ef73-eb06-4deb-a033-5a018d42d24a/download/2013-airqualitymodelguideline-oct1.pdf [Accessed 13 February 2019]

[14] New Zealand Ministry for the Environment (2004) Good Practice Guide for Atmospheric Dispersion Modelling [Online] Available at: http://www.mfe.govt.nz/sites/default/files/atmospheric-dispersion-modelling-jun04.pdf [Accessed 13 February 2019]

[15] Environment Agency (EA) Air Quality Modelling and Assessment Unit (AQMAU) Conversion ratios for NOx and NO2 [Online] Available at: http://webarchive.nationalarchives.gov.uk/20140328232919/http://www.environment-agency.gov.uk/static/documents/Conversion_ratios_for__NOx_and_NO2_.pdf [Accessed 13 February 2019]

were included in the model to reflect the locations of representative human sensitive receptors (refer to ***Figure 4.4*** and ***Figure 4.5***).

Figure 5.2: Receptor Grid

Power Plant	LNG Receiving Terminal
	
Grid spacing as follows: ■ 50 meter grid spacing from 0 to 2,500 meters; ■ 100 meter grid spacing from 2,500 to 5,000 meters; and ■ 250 meter grid spacing from 5,000 to 10,000 meters.	Grid spacing as follows: ■ 50 meter grid spacing from 0 to 1,000 meters; ■ 100 meter grid spacing from 1,000 to 2,000 meters; ■ 250 meter grid spacing from 2,500 to 5,000 meters; and ■ 500 meter grid spacing from 5,000 to 10,000 meters.

Terrain

Hills, mountains and valleys can affect dispersion by directing the plume. The terrain pre-processor AERMAP using the Shuttle Radar Topographic Mission (SRTM) 30 x 30 m imagery was run to provide information on a) the base elevation of each receptor and source defined in the model; and b) the terrain height that has the greatest influence on dispersion for each individual receptor, otherwise known as the hill height scale. Both the base elevation and hill height scale were incorporated into AERMOD.

Buildings

When airflow passes over buildings, a phenomenon known as building downwash occurs where the air is entrained in the lee of the building and drawn down to ground level. This effect can bring the plume from the stack down to ground level quicker than would otherwise be the case, and therefore increase the ground level concentration relative to a case where there are no buildings. The USEPA[16] suggest that emissions from stacks greater than 2.5 times the height of the highest nearby structure would escape building influences on dispersion. A review of the power plant design indicates that the highest building is 10.4m (refer to ***Table 2.6***) therefore building downwash is not expected and buildings were considered in the model set up. No building information was available for the LNG terminal, thus no

[16] United States Environmental Protection Agency (USEPA) (1985) Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) [Online] Available at: https://www3.epa.gov/scram001/guidance/guide/gep.pdf [Accessed 01 November 2018]

buildings were included in the model set up. Considering the heights of the stacks and the distance to receptors, this is not considered a limitation to the study.

Stack Parameters

The Project includes emissions to air from a number of stationary stacks. The stacks has been treated in the model as point sources and the height, temperature, volume flow rates and exit velocity used to define the source are presented in ***Table 5.17*** and ***Table 5.18*** for modelling Scenario A and B respectively.

Table 5.17: Scenario A – Power Plant Stack Parameters

Stack Parameters	Unit	Stack A	Stack B
Stack Coordinates	Lat/Long	16°46'42.25"N 96° 7'44.47"E	16°46'42.25"N 96°13'4.98"E
Actual Stack Data a			
Stack height	m	40	40
Internal flue diameter	m	5	5
Gas exit velocity	m/s	22.5	22.5
Actual exit temperature	K	376	376
Actual oxygen (O2) content (dry)	%	13.4	13.4
Actual moisture (H2O) content (wet)	%	7.88	7.88
Actual volume flow rate	Am^3/s	442	442
Reference Conditions b			
Temperature	K	273	273
Oxygen content (dry gas)	%	15	15
Moisture content (dry gas)	%	0	0
Volume Flow Rate at Reference Conditions c			
Normalised volume flow rate	Nm^3/s	320	320
Manufactures Guaranteed Emission Concentrations a			
NOx	mg/Nm^3	51	51
Emission Rates at Manufacturers Guarantee			
NOx	g/s	16.3	16.3

Note: [a] *Data supplied by Project Proponent*
[b] *International Finance Corporation (IFC) (2008) Environmental, Health and Safety Guidelines for Thermal Power Plants [Online] Available at: http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines [Accessed 13 February 2019].*
[c] *Calculated using the Environment Agency (2013) Pollution Inventory Reporting – Combustion Activities Guidance Note [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/296994/LIT_7825_e97f48.pdf [Accessed 13 February 2019].*

Table 5.18: Scenario B – Generator Stack Parameters

Stack Parameters	Unit	Generator 1 [a]	Generator 2 [a]	Generator 3 [a]	Generator 4 [a]
Stack Coordinates	Lat/Long	16°39'20.47"N 96°13'56.08"E	16°39'20.38"N 96°13'56.29"E	16°39'20.38"N 96°13'56.39"E	16°39'20.30"N 96°13'56.60"E
Stack height b	m	12	12	12	12
Internal flue diameter b	m	0.35	0.35	0.35	0.35
Gas exit velocity b	m/s	33.4	33.4	33.4	33.4
Actual exit temperature c	K	740	740	740	740
Volume Flow Rate d	Am^3/s	3.21	3.21	3.21	3.21
NOx Concentration (wet)	ppm	125	125	125	125
NOx Concentration @ 5%O2, 25°C	mg/Nm^3	355 [e]	355 [e]	355 [e]	355 [e]
NOx Concentration @ 15%O2, 0°C	mg/Nm^3	144 [f]	144 [f]	144 [f]	144 [f]
NOx emission rate g	g/s	0.599	0.599	0.599	0.599

Note: *[a] Assumptions based on Cummins C1160 N5C 1160 kW natural gas generator set*
[b] Data provided by Project Proponent
[c] As per Cummins C1160 N5C 1160 kW specification sheet [Online] Available at: https://powersuite.cummins.com/PS5/PS5Content/SiteContent/en/Binary_Asset/pdf/Commercial/SparkIgnited/d-3243.pdf [Accessed 13 February 2019]
[d] Volume flow rate at actual moisture, oxygen and temperature conditions
[e] mg/Nm^3 is assumed to be dry gas
*[f] Corrected for oxygen and temperature. NO_x concentration complies with emission standard in **Table 2.5**.*
[g] NO_x emission rate calculated based on concentration of 125 ppm and exhaust gas mass flow rate of 1.98 kg/s (as specified in the generator specification sheet). The calculation assumes the molecular weight of NO_x is 46.01 g/mol, and the average molecular weight of natural gas is 19 g/mol.

5.3.3 Assessment of Impacts

5.3.3.1 Scenario A

The potential short and long-term impacts to ambient air quality were assessed based on the impact assessment methodology detailed in ***Section 5.3.2.4***. The detailed modelling results at each discrete receptor point and the maximum on the modelling grid are presented in ***Table 5.19*** and ***Table 5.20***. Contour plots showing plume dispersion from the stack are presented in ***Figure 5.3*** and ***Figure 5.4***.

The maximum 1-hour and annual average PC and PEC is expected to be less than 25% and 100% of the relevant AQS throughout the study area respectively. The resulting impact significance is therefore considered **Negligible**.

Table 5.19: Nitrogen Dioxide (NO_2) 1-hour Average – 99.9 Percentile

Site	Baseline (µg/m³) [a]	Airshed classification	AQS [b] (µg/m³)	PC [c] (µg/m³)	PC/AQS (%)	PEC [d] (µg/m³)	PEC/AQS (%)	Impact Significance
Maximum [e]	170	ND	200	9.92	5.0%	180	90%	Negligible
ASR1				6.68	3.3%	177	88%	Negligible
ASR2				5.77	2.9%	176	88%	Negligible
ASR3				5.95	3.0%	176	88%	Negligible
ASR4				2.71	1.4%	173	86%	Negligible
ASR5				3.90	1.9%	174	87%	Negligible
ASR6				2.88	1.4%	173	86%	Negligible
ASR7				2.62	1.3%	172	86%	Negligible
ASR8				3.08	1.5%	173	86%	Negligible
ASR9				3.83	1.9%	174	87%	Negligible
ASR10				2.77	1.4%	173	86%	Negligible
ASR11				2.39	1.2%	172	86%	Negligible
ASR12				2.74	1.4%	173	86%	Negligible
ASR13				2.97	1.5%	173	86%	Negligible
ASR14				2.16	1.1%	172	86%	Negligible
ASR15				2.85	1.4%	173	86%	Negligible

Note: [a] *Maximum 1-hour baseline concentration from AQM1 – AQM 6 (refer to* ***Figure 4.27****)*
[b] *Air Quality Standard*
[c] *Process Contribution*
[d] *Predicted Environmental Concentration*
[e] *The maximum ground level concentration found anywhere on the modelling grid*

Figure 5.3: NO_2 1-hour (99.9%ile) Average Ground Level Concentrations

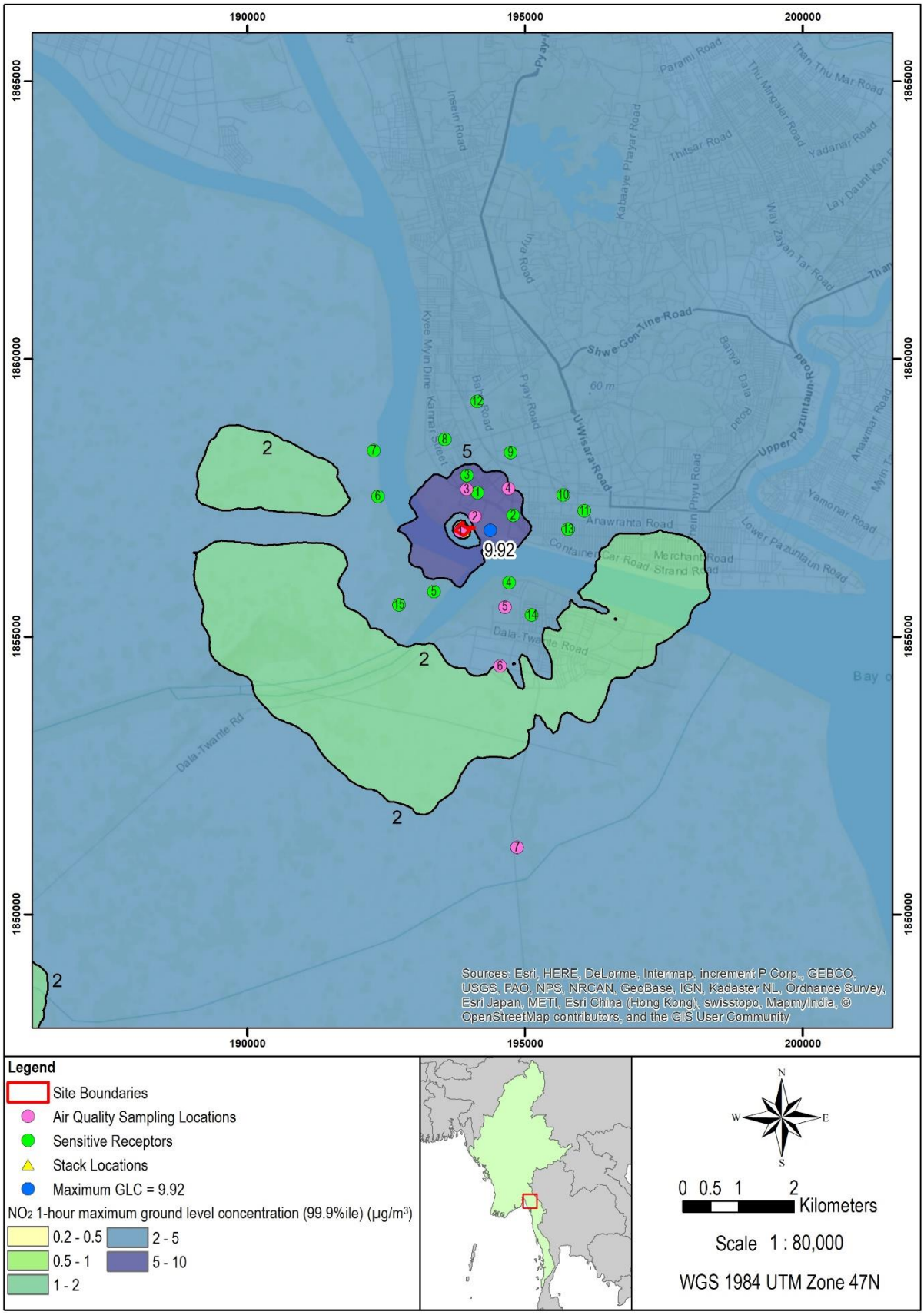
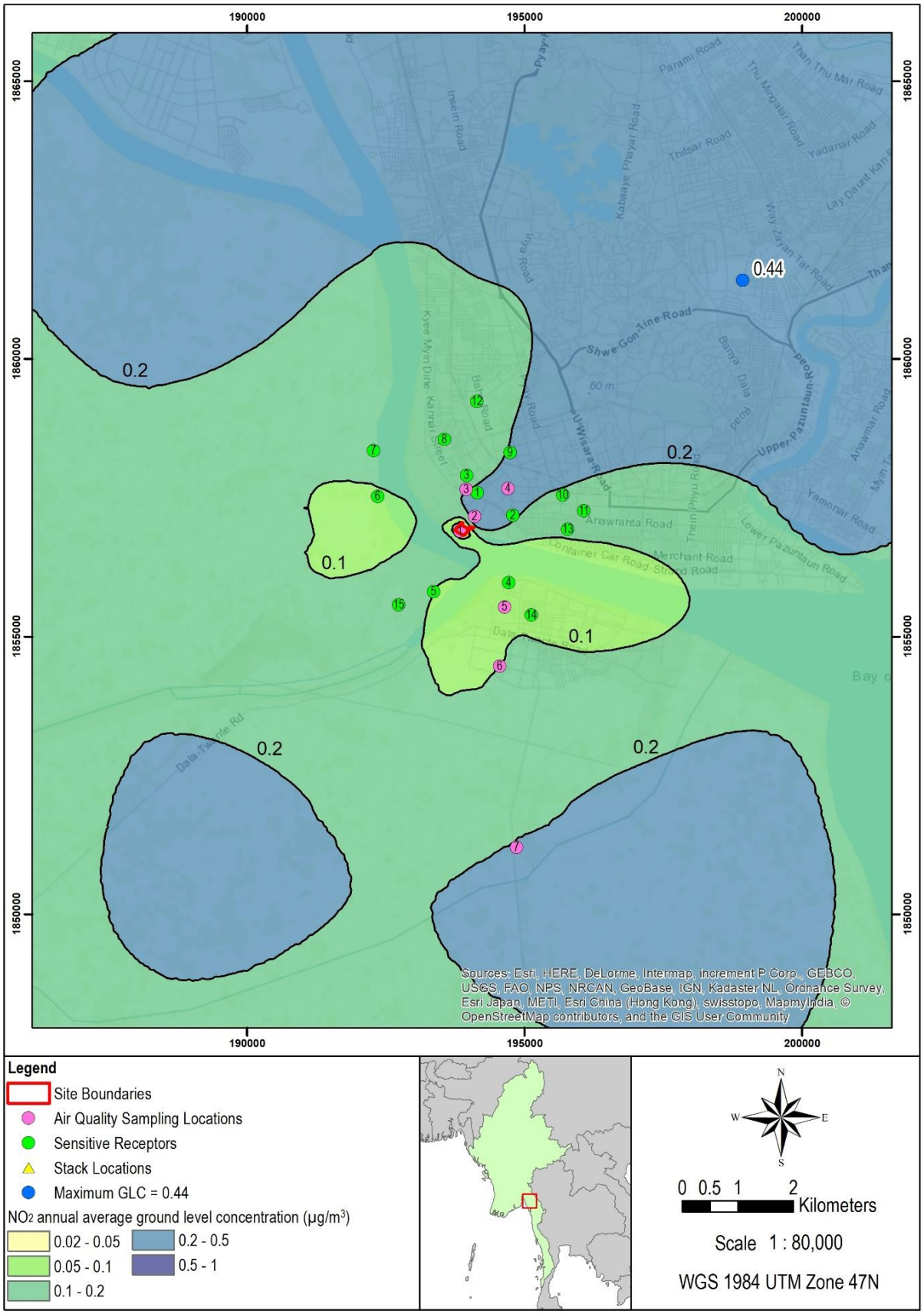


Table 5.20: Nitrogen Dioxide (NO_2) Annual Average

Site	Baseline [a] ($\mu g/m^3$)	Airshed classification	AQS [b] ($\mu g/m^3$)	PC [c] ($\mu g/m^3$)	PC/AQS (%)	PEC [d] ($\mu g/m^3$)	PEC/AQS (%)	Impact Significance
Maximum e	24.6	ND	40	0.446	1.1%	25.0	63%	Negligible
ASR1				0.233	<1%	24.8	62%	Negligible
ASR2				0.228	<1%	24.8	62%	Negligible
ASR3				0.170	<1%	24.7	62%	Negligible
ASR4				0.0704	<1%	24.6	62%	Negligible
ASR5				0.102	<1%	24.7	62%	Negligible
ASR6				0.091	<1%	24.7	62%	Negligible
ASR7				0.131	<1%	24.7	62%	Negligible
ASR8				0.130	<1%	24.7	62%	Negligible
ASR9				0.215	<1%	24.8	62%	Negligible
ASR10				0.192	<1%	24.8	62%	Negligible
ASR11				0.153	<1%	24.7	62%	Negligible
ASR12				0.157	<1%	24.7	62%	Negligible
ASR13				0.122	<1%	24.7	62%	Negligible
ASR14				0.0874	<1%	24.7	62%	Negligible
ASR15				0.117	<1%	24.7	62%	Negligible

Note: [a] *Maximum result from diffusion tube survey (refer to **Table 4.5** and **Table 4.6**)*
[b] *Air Quality Standard*
[c] *Process Contribution*
[d] *Predicted Environmental Concentration*
[e] *The maximum ground level concentration found anywhere on the modelling grid*

Figure 5.4: NO_2 Annual Average Ground Level Concentrations



5.3.3.2 Scenario B

The potential short and long-term impacts to ambient air quality were assessed based on the impact assessment methodology detailed in ***Section 5.3.2.4***. The detailed modelling results at each discrete receptor point and the maximum on the modelling grid are presented in ***Table 5.21*** and ***Table 5.22***. Contour plots showing plume dispersion from the stack are presented in ***Figure 5.5*** and ***Figure 5.6***.

The maximum 1-hour and annual average PC and PEC is expected to be less than 25% and 100% of the relevant AQS throughout the study area respectively. The resulting impact significance is therefore considered negligible.

Table 5.21: Nitrogen Dioxide (NO_2) 1-hour Average – 99.9 Percentile

Site	Baseline (µg/m³) [a]	Airshed classification	AQS [b] (µg/m³)	PC [c] (µg/m³)	PC/AQS (%)	PEC [d] (µg/m³)	PEC/AQS (%)	Impact Significance
Maximum [e]	129	ND	200	37.7	19%	167	84%	Negligible
ASR1				10.1	5.1%	139	70%	Negligible
ASR2				12.1	6.1%	141	71%	Negligible
ASR3				22.0	11%	151	76%	Negligible
ASR4				20.4	10%	150	75%	Negligible
ASR5				7.37	3.7%	137	68%	Negligible
ASR6				7.53	3.8%	137	68%	Negligible
ASR7				7.93	4.0%	137	69%	Negligible
ASR8				6.38	3.2%	136	68%	Negligible
ASR9				4.98	2.5%	134	67%	Negligible
ASR10				4.53	2.3%	134	67%	Negligible
ASR11				3.41	1.7%	133	66%	Negligible
ASR12				3.80	1.9%	133	67%	Negligible

Note: [a] *Maximum 1-hour baseline concentration from AQM7 - AQM10 (refer to* ***Figure 4.27****)*
[b] *Air Quality Standard*
[c] *Process Contribution*
[d] *Predicted Environmental Concentration*
[e] *The maximum ground level concentration found anywhere on the modelling grid*

Figure 5.5: NO_2 1-hour (99.9%ile) Average Ground Level Concentrations

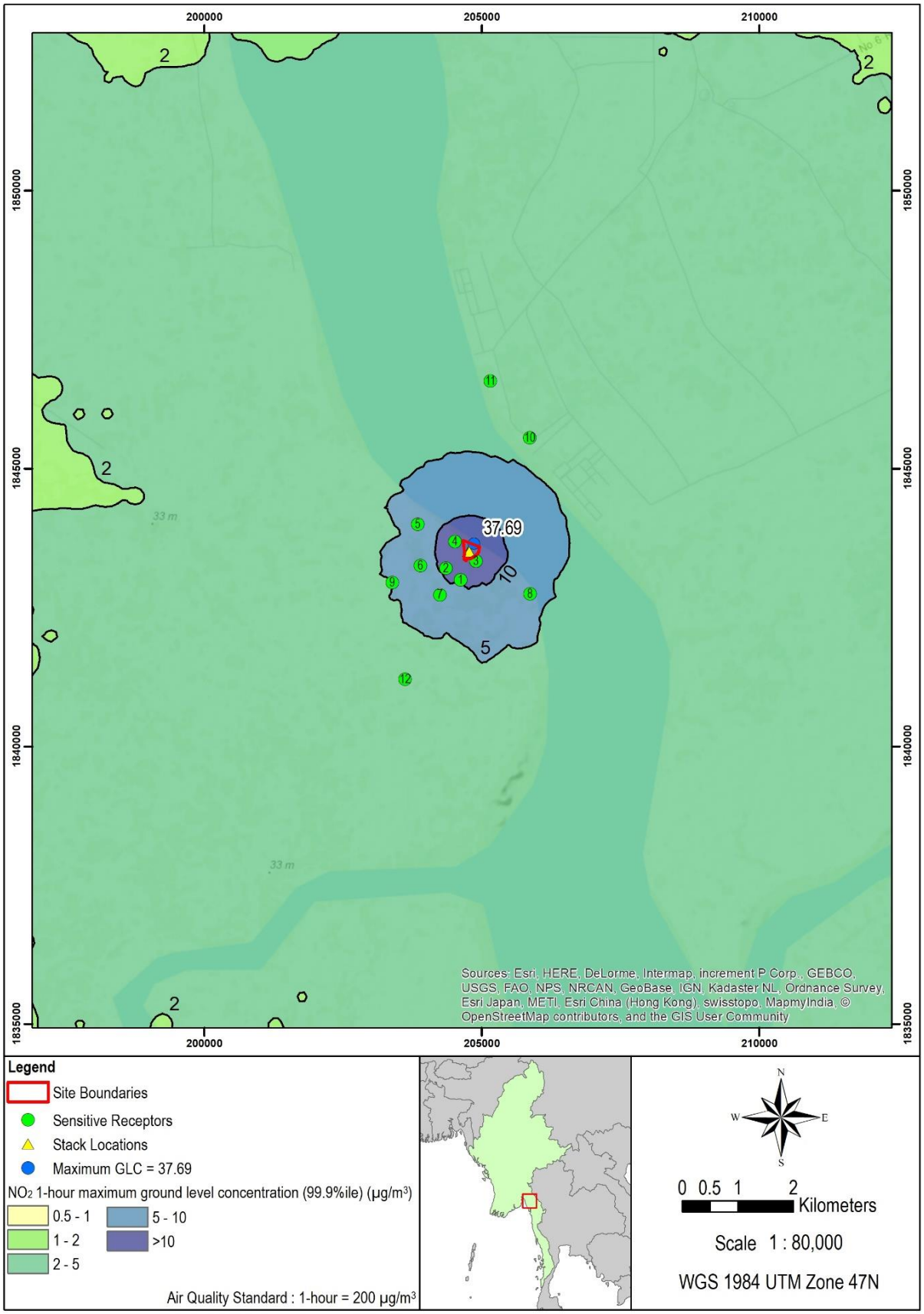
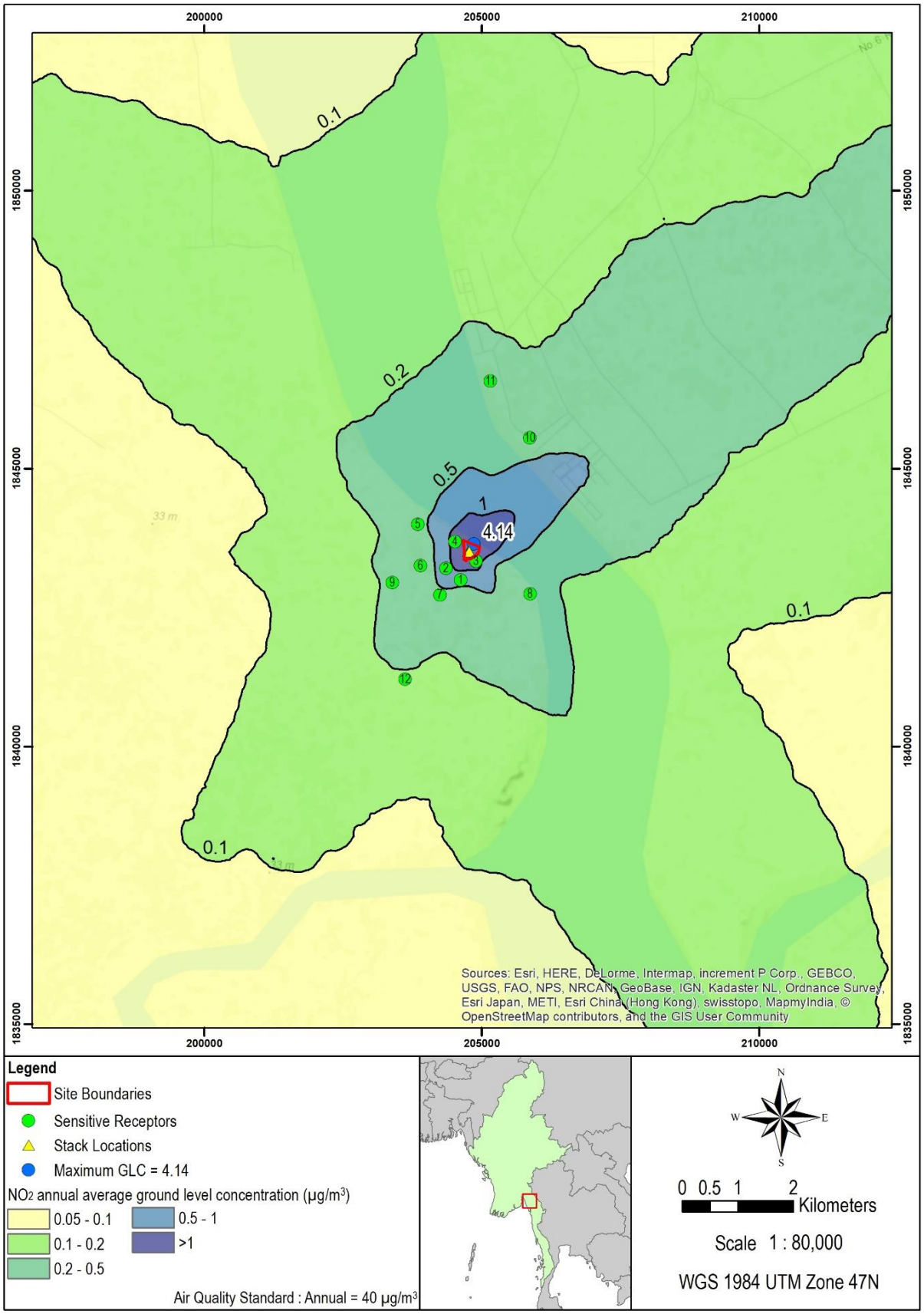


Table 5.22: Nitrogen Dioxide (NO_2) Annual Average

Site	Baseline (µg/m³) [a]	Airshed classification	AQS [b] (µg/m³)	PC [c] (µg/m³)	PC/AQS (%)	PEC [d] (µg/m³)	PEC/AQS (%)	Impact Significance
Maximum [e]	24.6	ND	40	4.14	10%	29.2	73%	Negligible
ASR1				0.624	1.6%	25.2	63%	Negligible
ASR2				0.748	1.9%	25.3	63%	Negligible
ASR3				1.55	3.9%	26.1	65%	Negligible
ASR4				1.38	3.4%	26.0	65%	Negligible
ASR5				0.405	1.0%	25.0	62%	Negligible
ASR6				0.351	<1%	24.9	62%	Negligible
ASR7				0.438	1.1%	25.0	63%	Negligible
ASR8				0.282	<1%	24.9	62%	Negligible
ASR9				0.224	<1%	24.8	62%	Negligible
ASR10				0.396	1.0%	25.0	62%	Negligible
ASR11				0.252	<1%	24.8	62%	Negligible
ASR12				0.186	<1%	24.8	62%	Negligible

Note: [a] *Maximum result from diffusion tube survey (refer to **Table 4.5** and **Table 4.6**)*
[b] *Air Quality Standard*
[c] *Process Contribution*
[d] *Predicted Environmental Concentration*
[e] *The maximum ground level concentration found anywhere on the modelling grid*

Figure 5.6: NO_2 Annual Average Ground Level Concentrations



5.3.4 Recommended Mitigation, Management and / or Monitoring Measures

The impact assessment defines the impacts on air quality as negligible based on the design parameters presented in ***Table 5.17*** and ***Table 5.18***. However, the following mitigation and management measures should be used to minimize impacts to air quality during the operation of the Project:

- Implementation of continuous stack emission monitoring throughout the operational lifetime of the CCGT power plant to confirm that the NO_x emission concentration does not exceed the turbine manufacturer guarantee of 51mg/Nm^3.
- Annual stack emission testing at the CCGT power plant will be undertaken to counter check the performance of the continuous emission monitoring system.
- The natural gas fired generators at the terminal will be serviced and maintained in accordance with the manufacturer's specification to maintain high performance.

5.3.5 Residual Impact (post mitigation)

The residual impact to ambient air quality during normal operation will be negligible.

6. CUMULATIVE IMPACTS AND MITIGATION

6.1 Introduction

The IFC Performance Standard 1 (Paragraph 5) defines the broader Project area to include "… areas potentially impacted by cumulative impacts from further planned development of the Project, any existing project or condition, and other project-related developments that are realistically defined at the time the Social and Environmental Assessment is undertaken."

In addition, the IFC Performance Standard 1 (Paragraph 6) states that the "… assessment will also consider potential trans-boundary effects, such as pollution of air, or use or pollution of international waterways, as well as global impacts, such as the emission of greenhouse gases."

Cumulative impacts are those impacts that act together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors as the proposed Project. Cumulative impacts are therefore generally impacts that act with others in such a way that the sum is greater than the parts. This is, however, not always the case – sometimes they will simply be the sum of the parts, but that sum becomes significant.

This chapter considers the cumulative impacts that would result from the combination of the Project and other actual or proposed future developments in the broader Project Area.

6.2 Identified Cumulative Impacts

The development of the Project is proposed in an industrial area of Yangon City. The existing TTCL Ahlone 120MW CCGT power plant and a government owned 275MW CCGT power plant exist close to the Project. Accurately quantifying emissions from these existing units is challenging and the results would likely result in unrealistic impact predictions. Consideration of the cumulative impacts was instead undertaken by way of an ambient air quality monitoring survey. The survey, commissioned to collect existing ambient air quality data prior to the Project becoming operational (otherwise known as the baseline), was undertaken at several sites in the vicinity of the Project (refer to ***Section 4***). It is considered acceptable to assume that emission from the existing industry will have been captured within the baseline and as such have already been assessed within the AQIA presented in ***Section 5***.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Construction

During the construction phase of the Project, the potential impacts to air quality are primarily associated with TSP and PM_{10} from demolition, earthwork activities, construction of the Project infrastructure, and trackout of dusty materials onto the public road network. The significance of the impact to ambient air quality associated with these activities can be major adverse at sensitive receptor locations within 350 m if not managed accordingly.

Based on the magnitude and risk of potential impacts during the construction phase, a series of process specific management and mitigation measures have been identified. Assuming that the stated management and mitigation presented in this assessment is implemented correctly and diligently, the residual impacts are expected to be negligible for the majority of the construction phase. However, due to the nature of construction activities, the scale and duration of the construction phase, and the possibility of extreme weather conditions, it is possible that communities will experience occasional, short-term dust annoyance. Therefore, although the proposed mitigation is designed to be effective and reduce dust emissions as far as possible, it is recognised that in practice, infrequent short-term minor adverse impacts are possible.

Emissions from mobile and non-mobile plant as well increased traffic movements on the public road network were also considered and the resulting impacts are found to be negligible.

7.2 Operation

The potential impacts to ambient air quality from the continuous operation of the combined cycle gas turbine power plant and gas generators at the liquefied natural gas receiving terminal were assessed quantitatively using the USEPA approved dispersion model AERMOD.

The assessment concludes that the residual impact on ambient air quality during normal operation is expected to be negligible. Good practice management and monitoring measures are advised, including continuous emissions monitoring, annual stack testing and regular maintenance and servicing.

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APPENDIX T FULL AIR QUALITY IMPACT ASSESSMENT (AQIA)

CORMIX Modelling TPMC's Planned Power Plant and LNG Surface Water Discharges

Prepared for TTCL Power Myanmar Co., Ltd.

12 April 2019

Project No.: 0439461

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12 April 2019

CORMIX Modelling TPMC's Planned Power Plant and LNG Surface Water Discharges

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Acronyms and Abbreviations

Name	Description
°C	Degrees Celsius
ΔT	Change in temperature
CORMIX	Cornell Mixing Zone Expert System
IFC	International Finance Corporation
m	metres
m/s	metres per second
m^3/hr	Cubic metres per hour
MBtu h^{-1}	Million British Thermal Units per hour
TPMC	TTCL Power Myanmar Company
USEPA	United States Environmental Protection Agency
W/(m^2 °C)	Watt per square metre per degree Celsius

1. BACKGROUND

The primary purpose of this study is to determine the size and configuration of the plumes resulting from TPMC's heated power plant discharge and cold water LNG process water discharge to the Yangon River.

CORMIX, a United States Environmental Protection Agency (U.S. EPA) approved steady-state model, was selected to evaluate surface water discharge thermal plumes from TPMC's Power and LNG plants. CORMIX, primarily a design tool for discharges, is often used to evaluate water quality impacts from point source discharges. The system emphasizes the role of boundary interaction to predict steady-state mixing behavior and plume geometry (http://www.cormix.info/). This report summarizes the application of the CORMIX model to TPMC's planned thermal and cold water discharges.

With the use of CORMIX, key limitations relevant to this study included:

1. For all inputs, CORMIX has specific data ranges where the model is most accurate, and these should be followed. To ensure accuracy of results, CORMIX is limited to computations within these ranges. For example, the horizontal angle, theta, may range between -45° and 90°.
2. Average depth and the depth at the discharge cannot differ from each other by +/- 30%. CORMIX is limited to performing computations within this condition. For a submerged single pipe, there are two cases. For deeply submerged cases the height of the discharge port above the bottom has to be less than or equal to one-third the depth of the discharge. For near surface cases the height of the discharge above the bottom has to be greater than or equal to two thirds of the depth of the discharge, but less than or equal to the depth of the discharge.
3. CORMIX, being a steady-state model, only uses constant inputs for temperature, velocity, etc.

Some of these limitations required ERM to make assumptions related to the discharge and ambient properties. Additionally, limited data and information for the design and ambient conditions necessitated assumptions. Finally, assumptions were made to make the analysis and the results a conservative representation of reality to address any uncertainty related to all assumptions made. Key assumptions and reference standards used in this study are summarized as follows (by location):

1.2 Power Plant Site

- ERM assumed the Power Plant discharge pipe enters perpendicular to the Yangon River and is resting along the river channel bottom. The discharge pipe was assumed to be located at the shoreline as a simplification for CORMIX modelling, as the tidal nature of the ambient waterbody can result in varying shoreline extents.
- As a conservative approach to modelling, it was assumed that the intermittent flow stream was excluded from diluting the heated effluent from the power plant, that there is no heat loss within the facility prior to entering the Yangon River, and that effluent conditions provided by TPMC are worst case.

1.3 LNG Site

- ERM assumed the Power Plant discharge pipe enters perpendicular to the Yangon River and is resting along the river channel bottom. At low tide, the pipe is 39.9 meters from the shoreline, and at high tide, the pipe is 28.5 meters from the shoreline, as estimated by ERM from the engineering drawings.
- As a conservative approach to modelling, it was assumed that no additional flow would be included that would dilute the cooled effluent from the LNG plant, that cooled water exiting the facility is preserved to the point where the flow enters the Yangon River, and that effluent conditions provided by TPMC are worst case.

- Lastly, for the LNG, it was assumed that a less than 3 °C temperature change from the ambient would be the appropriate criteria. This is based on IFC (2015), which specifies limits for temperature increase above ambient.

1.4 Both Sites

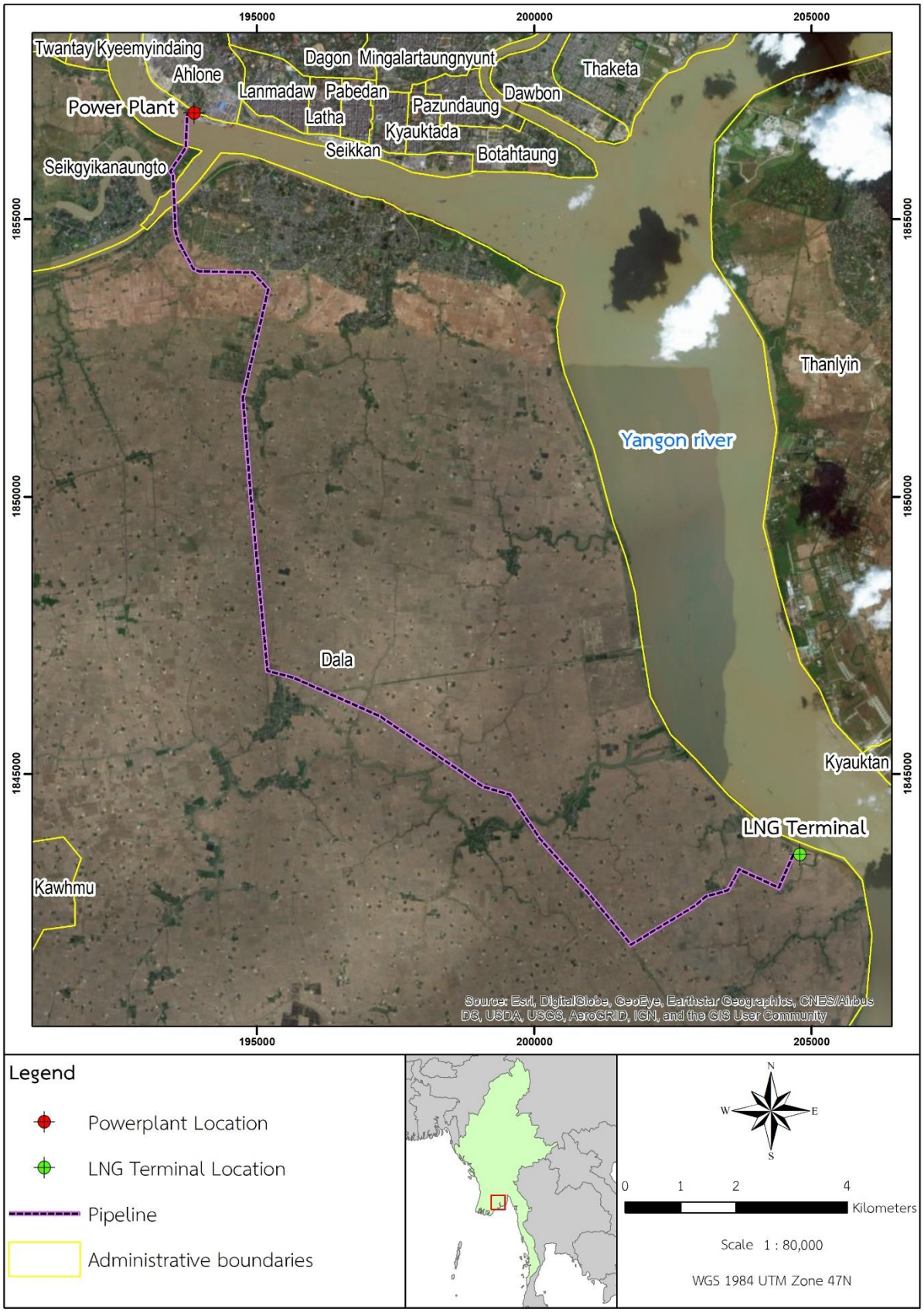
- It was assumed background temperatures and salinity values based on data collected as part of the broader ESIA were reflective of a wide variety of conditions (high and low extreme values).
- Assumed that the ambient wind speed was 1 m/s to minimize surface heat loss, a conservative assumption.

As a conservative approach, the discharge plume estimates are based on the maximum anticipated effluent rate and heat load, extreme seasonal Yangon River temperatures, variant high/low Yangon River velocities, and corresponding depths. The thermal plume was modelled as a single port discharge using CORMIX's single port discharge ("CORMIX1") module. For the Power plant: The continuous, 210 cubic metre per hour effluent discharge has a temperature value of 42 °C. The effluent was modelled for comparison to IFC standards, which state that the effluent should result in a temperature increase of no more than 3 °C within 100 meters from the point of discharge. For the LNG: the continuous effluent discharge was modelled based on a temperature reduction value of 10 °C below the ambient, as provided by TPMC. The effluent was modelled for comparison to modified IFC standards for cooling water. While the standard requires "the effluent should result in a temperature increase of no more than 3 °C" within 100 meters from the point of discharge", the same temperature differential (3 °C) was considered for temperature decrease for the LNG modelling analysis.

Eight scenarios were developed for each of the Power Plant and the LNG. The scenarios were based on the minimum and maximum ambient velocity, ambient temperature, and water depth. The ambient velocity ranged from 0.057 m/s to 3.1 m/s, while the ambient temperature ranged from 25.1 to 31.3 °C for both the Power Plant and LNG. While the depth ranged from 2.25 m to 10.4 m for the Power plant, and 7.1 m to 10.5 m for the LNG. Example of a scenario includes: Low velocity, Low temperature, and Low depth.

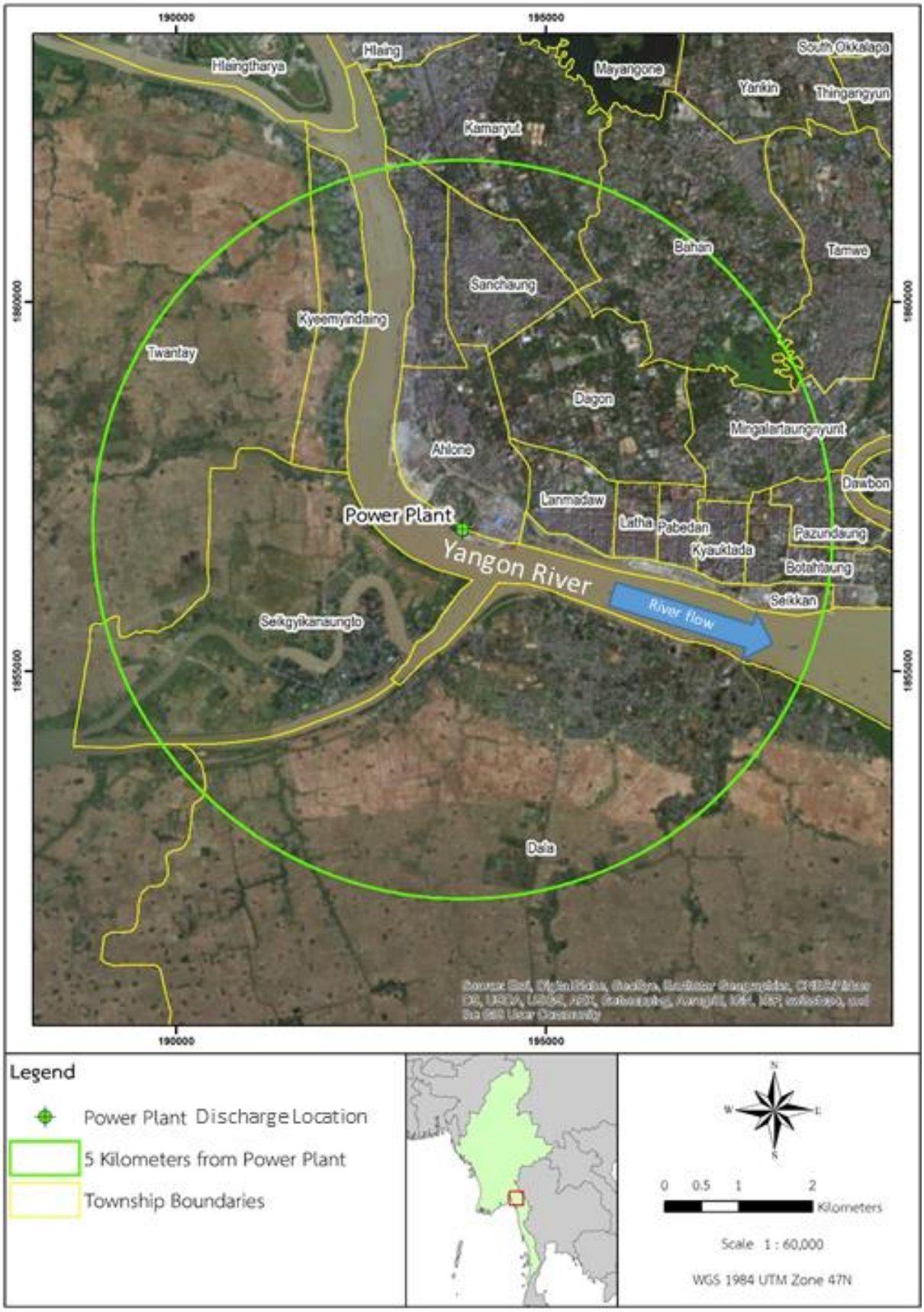
The locations of the power plant and LNG process water discharge along the Yangon River are shown in ***Figure 1.1***. A detailed view of the power plant location and entrance to the Yangon River are shown in ***Figure 1.2*** with the ambient flow direction. A detailed view of the power plant location and entrance of the Yangon River are shown in ***Figure 1.3*** with the ambient flow direction.

Figure 1.1: Site Overview Showing Power Plant and LNG locations



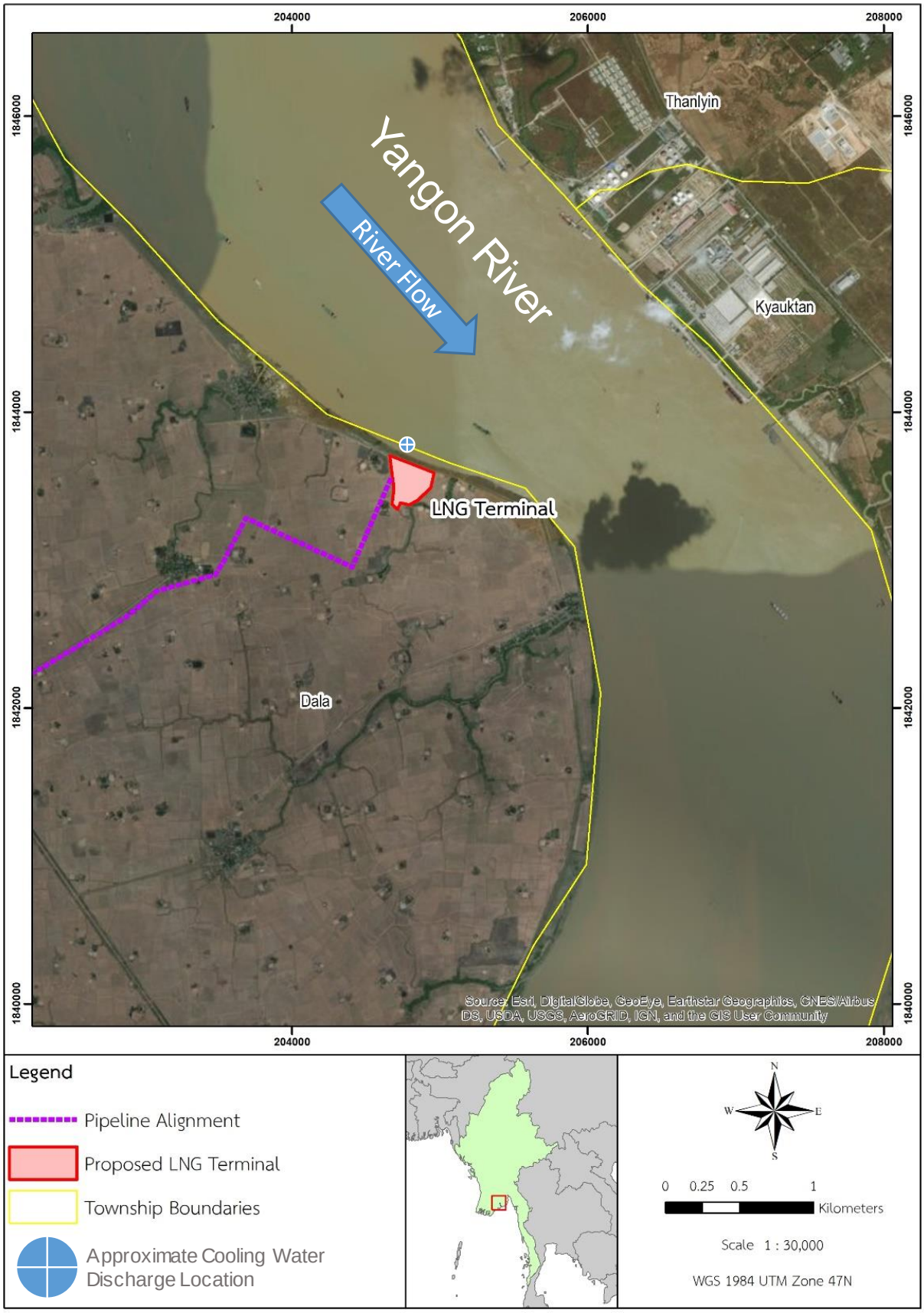
Source: TPMC, 2019. (Modified by ERM)

Figure 1.2: Location of Power Plant Discharge Structure (Detail)



Source: TPMC, 2018. (Modified by ERM)

Figure 1.3: Location of LNG Discharge Structure (Detail)



Source: TPMC, 2019. (Modified by ERM)

2. CORMIX APPLICATION TO PLANT BOWEN'S EFFLUENT

A typical CORMIX application requires three types of data as inputs:

- A description of the effluent (i.e., its flow and temperature);
- The dimensions, location, and configuration of the discharge structure; and
- The properties and characteristics of the receiving waterbody, in this case, the Yangon River (i.e., width, depth, flow rate, and temperature).

TPMC supplied information used as input to CORMIX in the form of reports, drawings, maps, electronic files, and website-accessible data files. Ambient Yangon River data were obtained from daily satellite readings provided by the National Oceanic and Atmospheric Administration (NOAA) of USA, and from field efforts conducted by ERM.

2.1 Receiving Waterbody Characteristics

2.1.1 River Dimensions and Waterbody Velocity

The Yangon River width at the power plant discharge used for the purposes of this study was 500 metres (m), as estimated by ERM using Google Earth. The Yangon River width at the LNG process water discharge used for the purposes of this study was 1985 metres, also estimated by ERM using Google Earth.

Water depth in the region of interest varies between the power plant and LNG. The water depth of the power plant ranges from 3.1 m to 10.4 m, due to tides; surface water sampling points 1 and 2 (SW1 and SW2) were compared for minimum/maximum values during wet and dry season sampling. For application to CORMIX, a low value of 2.25 m was selected, an extra level of conservativeness added to aid with CORMIX model's stability (inherent CORMIX limitations).

While the water depth of the LNG ranges from 7.1 m to 10.5 m; surface water sampling points 13 and 14 (***Section 5.1.5.2***) were compared for the minimum/maximum values during wet and dry season sampling. All surface water sampling locations were reported in ERM's 2018 Dry Season Physical Baseline Report and Wet Season Physical Baseline Report.

The waterbody velocity for the Yangon River ranges from 0.057 to 3.10 metres per second (m/s). The low velocity value is reported by **Sustainable Environment Myanmar Co., Ltd. (SEM)** in their 2018 Dry Season Physical Baseline Report (***Section 5.1.5.2***); it is the lowest velocity of all the sites for both wet and dry seasons. The high velocity value is reported by Myanmar port authority (***Section 5.1.5.1***); the maximum value of a current velocity range was used. The high velocity value was reported for an average tidal range of 2.55 m to 5.85 m, and doesn't include near-zero velocities in a normal tide cycle. These ambient velocities were applied in the CORMIX modelling to simulate critical discharge conditions.

The CORMIX User Manual suggests that the difference between depth at the discharge and average depth in the region of interest is not to be modelled as greater than 30%. Therefore, for this application it was assumed that the average depth and the depth at the discharge location are equal to the ranges specified above.

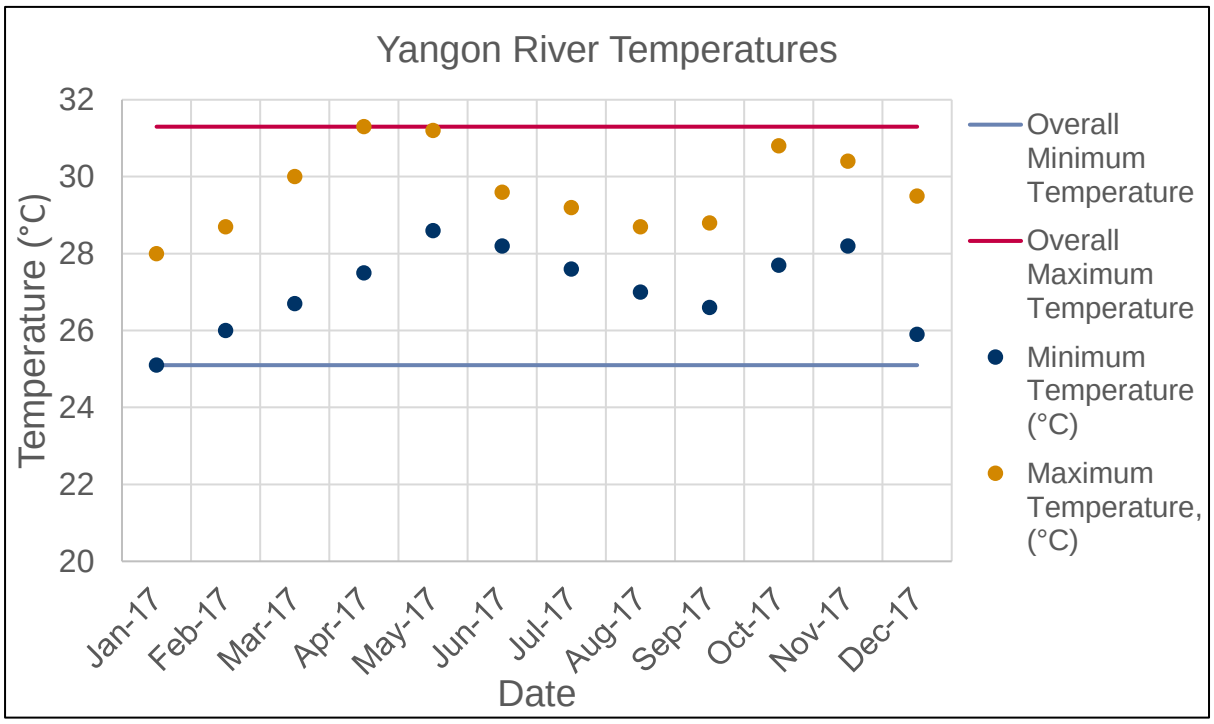
2.1.2 Temperature

Relevant water quality standards reported by environmental standards of Myanmar does not include a guideline value for temperature. Ambient temperatures for modelling were selected to demonstrate mixing zones corresponding to this standard.

Ambient water quality data were available for the Yangon River nearby the Power Plant and LNG. The measurements for the water temperature are provided by National Oceanic and Atmospheric

Administration's (NOAA) daily satellite readings, and are shown in ***Figure 2.1***. Overall, it was determined that the minimum ambient water temperature is 25.1 °C, while the maximum ambient water temperature is 31.3 °C.

Figure 2.1: Comparison of Yangon River Temperature Datasets



Source: NOAA, 2017.

2.2 Configuration of the Power Plant Discharge Structure

The discharge from the power plant ultimately enters the Yangon River through a DN250 millimetre nominal diameter pipe, as specified by TPMC. The discharge pipe was assumed by ERM to be located at the shoreline. The pipe is 1.5 metres above the receiving waterbody bottom, as specified by TPMC.

The discharge pipe enters perpendicular to the Yangon River, and was assumed by ERM to be resting along the channel bottom (vertical angle of 0°). The discharge pipe is along the left river bank as seen by an observer facing downstream.

2.3 Configuration of the LNG Process Water Discharge Structure

The discharge from the LNG ultimately enters the Yangon River through a DN350 millimetre nominal diameter pipe, as specified by TPMC. The discharge pipe shoreline distance varies depending on the tide according to "LNG Terminal plot plan rev 0D," engineering drawing provided by TPMC. At low tide, the pipe is 39.9 metres from the shoreline, and at high tide, the pipe is 28.5 metres from the shoreline, as estimated by ERM from the engineering drawings.

The vertical configuration of the LNG pipe was unavailable at the time of this study, so the discharge pipe was assumed to be resting on the channel bottom and aligned perpendicular to the river bank. Thus, the vertical angle used in modelling was 0° and horizontal angle was 90°. The discharge pipe is along the right river bank, as seen by an observer facing downstream.

2.4 Properties of the Power Plant Effluent

The effluent discharge exits the power plant at a total flow rate of 210 cubic metres per hour (m^3/hour). This flow excludes an intermittent discharge stream with flow rate of 630 m^3/hour. As a conservative

approach to modelling, the intermittent flow stream was excluded from diluting the heated effluent from the power plant. It was also assumed that there is no heat loss within the facility prior to entering the Yangon River.

The continuous, 210 cubic metre per hour effluent discharge has a temperature value of 42 °C. The effluent was modelled for comparison to IFC standards which state that: "the effluent should result in a temperature increase of no more than 3 °C" within 100 metre from the point of discharge (IFC, 2007).

2.5 Properties of the LNG Effluent

The effluent discharge exits the LNG at a total flow rate of 1300 m^3/hour, as provided by TPMC. As a conservative approach, it was assumed that no additional flow would be included that would dilute the cooled effluent from the LNG plant, and it was assumed that cooled water exiting the facility is preserved to the point where the flow enters the Yangon River.

The continuous effluent discharge was modelled based on a temperature reduction value of 10 °C below the ambient, as provided by TPMC. The effluent was modelled for comparison to modified IFC standards for cooling water. While the standard requires "the effluent should result in a temperature increase of no more than 3 °C" within 100 metre from the point of discharge", the same temperature differential (3 °C) was considered for temperature decrease for the LNG modelling analysis.

2.6 Power Plant Scenario Information

IFC water quality standards limit thermal discharges by the temperature increase in the receiving waterbody. These standards are given by temperature increases no more than 3 °C above ambient beyond 100 m from the discharge point.

An estimate of the TPMC Power Plant's maximum thermal loading to the Yangon River results in a 10.7 °C increase above ambient temperatures during the warmer summer months (based on Yangon River temperature of 31.3 °C) and a 16.9 °C increase above ambient temperatures during the cooler winter months (based on a Yangon River temperature of 25.1 °C).

A summary of all power plant CORMIX modelling input parameters, including the winter and summer cases, are reproduced in ***Table 2.1***.

Table 2.1: CORMIX1 Power Plant Input Data

Parameter	Value
Port type (surface/subsurface)	Surface discharge (CORMIX1)
Discharge pipe diameter	0.25 m.
Discharge Pipe height above receiving waterbody bottom	1.5 m.
Port orientation (horizontal angle, sigma)	270°
Port distance from shoreline	0 m
Effluent flow rate	210 m^3/hr
Effluent temperature	42 °C
Effluent temperature rise	Summer: 10.7°C; Winter: 16.9 °C
Waterbody type (bounded/unbounded)	Bounded
Bounded width	500 ft.
Bed roughness (Manning or Chezy coefficient)	Manning: 0.01
Average water depth range	2.25 m to 10.4 m.
Water depth at discharge structure	2.25 m to 10.4 m.
Ambient waterbody velocity	0.057 m/s to 3.1 m/s
Ambient Waterbody Temperature	Summer: 31.3 °C; Winter: 25.1 °C
Ambient Salinity	1 parts per thousand
Wind Speed	1 m/s
Surface heat exchange coefficient	10 W/(m^2 °C)

Source: TPMC, 2019.

Mixing zone dimensions for the thermal discharge from TPMC's Power Plant have been modelled with CORMIX for eight different scenarios, as defined in ***Table 2.2***. The mixing zone computations are based on the maximum anticipated effluent rate and heat load, extreme seasonal Yangon River temperatures, variant high/low Yangon River velocities, and depths. The thermal plume was modelled as a single port discharge using CORMIX's single port discharge ("CORMIX1") module.

Table 2.2: Power Plant Scenario Definitions

Scenario	1	2	3	4	5	6	7	8
Ambient Velocity (m/s)	0.057	0.057	0.057	0.057	3.1	3.1	3.1	3.1
Ambient Temperature (°C)	25.1	25.1	31.3	31.3	25.1	25.1	31.3	31.3
Water Depth (m)	2.25	10.4	2.25	10.4	2.25	10.4	2.25	10.4

2.7 LNG Scenario Information

IFC water quality standards limit thermal discharges by the temperature increase in the receiving waterbody. These standards are given by temperature increases more than 3 °C above ambient within 100 m from the discharge point.

An estimate of the TPMC Power Plant's maximum thermal loading to the Yangon River results in a 10.7 °C decrease below ambient temperatures during the warmer summer months (based on Yangon River temperature of 31.3 °C) and 16.9 °C decrease below ambient temperatures during the cooler winter months (based on a Yangon River temperature of 25.1 °C).

A summary of all LNG plant CORMIX modelling input parameters, including the winter and summer cases, are reproduced in ***Table 2.3***.

Table 2.3: CORMIX1 LNG Input Data

Parameter	Value
Port type (surface/subsurface)	Surface discharge (CORMIX1)
Discharge pipe diameter	0.336 m.
Port distance from shoreline	Low tide: 5 m , High tide: 21.2 m
Port orientation (horizontal angle, sigma)	90°
Bottom slope	0%
Effluent flow rate	1300 m^3/hr
Effluent temperature reduction	10 °C
Waterbody type (bounded/unbounded)	Bounded
Bounded width	1985 ft.
Bed roughness (Manning or Chezy coefficient)	Manning: 0.01
Average water depth range	7.1 m to 10.5 m.
Water depth at discharge structure	7.1 m to 10.5 m.
Ambient waterbody velocity	0.057 m/s to 3.1 m/s
Ambient waterbody temperature	Summer: 31.3 °C; Winter: 25.1 °C
Ambient Salinity	1 ppt
Wind Speed	1 m/s
Surface heat exchange coefficient	10 W/(m^2 °C)

Source: TPMC, 2019.

Mixing zone dimensions for the cold water discharge from TPMC's LNG have been modelled with CORMIX for eight different scenarios, as defined in ***Table 2.4***. The mixing zone computations are based on the maximum anticipated effluent rate and heat load, extreme seasonal Yangon River temperatures, variant high/low Yangon River velocities, and depths. The thermal plume was modelled as a single port discharge using CORMIX's single port discharge ("CORMIX1") module.

Table 2.4: LNG Scenario Definitions

Scenario	1	2	3	4	5	6	7	8
Ambient Velocity (m/s)	0.0057	0.0057	0.0057	0.0057	3.1	3.1	3.1	3.1
Ambient Temperature (°C)	25.1	25.1	31.3	31.3	25.1	25.1	31.3	31.3
Effluent Temperature (°C)	15.1	15.1	21.3	21.3	15.1	15.1	21.3	21.3
Water Depth (m)	7.1	10.5	7.1	10.5	7.1	10.5	7.1	10.5
Tide; distance from shoreline (m)	Low; 5	High 21.2	Low; 5	High 21.2	Low; 5	High 21.2	Low; 5	High 21.2

3. RESULTS

3.1 CORMIX Model Results

3.1.1 Power Plant Results

The most critical scenario, scenario 8, involves high ambient velocity, high ambient temperature, and large depth. The summer Yangon River temperature applied for this scenario was 31.3°C and the corresponding discharge temperature is 42°C; consequently, the summer scenario was evaluated for the distance needed to decrease the temperature difference less than 3 °C within 100 m from the discharge. This temperature criteria is met within 4.2 metres for scenario 8 and is met in less than 4.2 m for all other scenarios.

Table 3.1 summarizes the results of each scenario, as characterized by two indicators:

- Length of the plume downstream (centreline); and
- Width of the plume

Table 3.1: Mixing Zone Dimensions Based on Plume Centreline for Critical Condition Power Plant Scenarios

Scenario	Criteria	Plume length (m)	Width (m)
1	ΔT < 3°C	1.7	2.2
2	ΔT < 3°C	0.96	1.4
3	ΔT < 3°C	0.72	1.5
4	ΔT < 3°C	0.46	1.0
5	ΔT < 3°C	2.27	0.3
6	ΔT < 3°C	3.4	0.6
7	ΔT < 3°C	0.82	0.3
8	ΔT < 3°C	4.2	0.6

The CORMIX simulation shows that the < 3 °C excess temperature requirement in scenario 8 is met approximately 4.2 m downstream and 0.6 m across. The buoyant, heated effluent plume rises to the

surface while mixing throughout the water column, causing relatively uniform spreading in the vertical direction.

The plume area exceeding a 3 °C temperature increase in summer is shown in ***Figure 3.1***.

Figure 3.1: Mixing Zone Resulting from Power Plant Scenario 8 Critical Conditions

Source: Google Earth, 2018.

The dimensions shown represent the centreline temperature downstream extent and width; temperatures decrease away from the centreline.

Additional depictions of the two dimensional plume are presented in ***Figure 3.2*** through ***Figure 3.3***.

Figure 3.2: Lateral (X-Y) View of the Thermal Plume Resulting from Power Plant Scenario 8 Critical Conditions

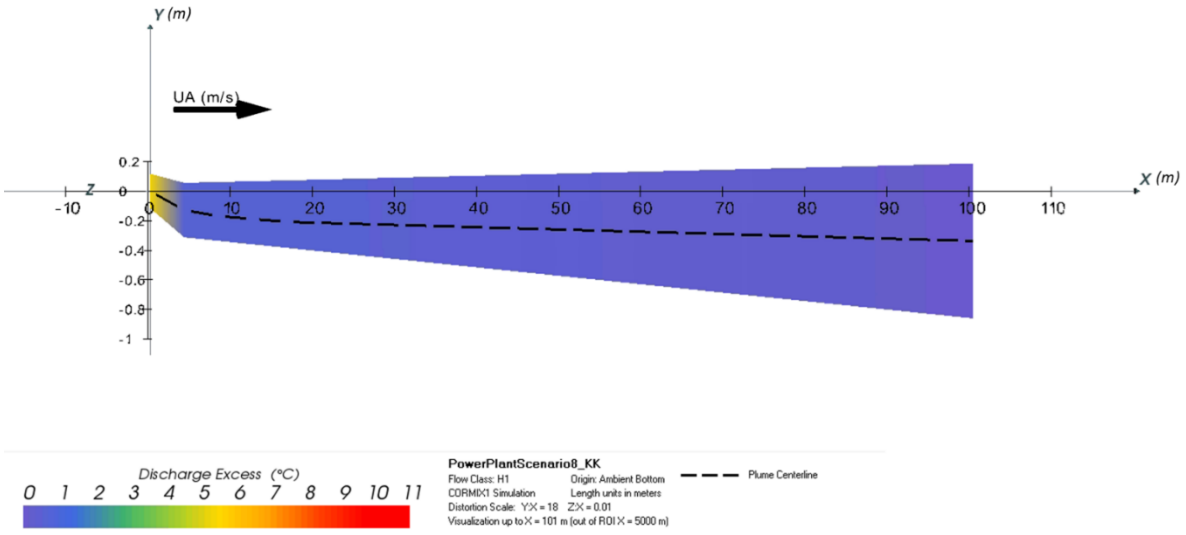
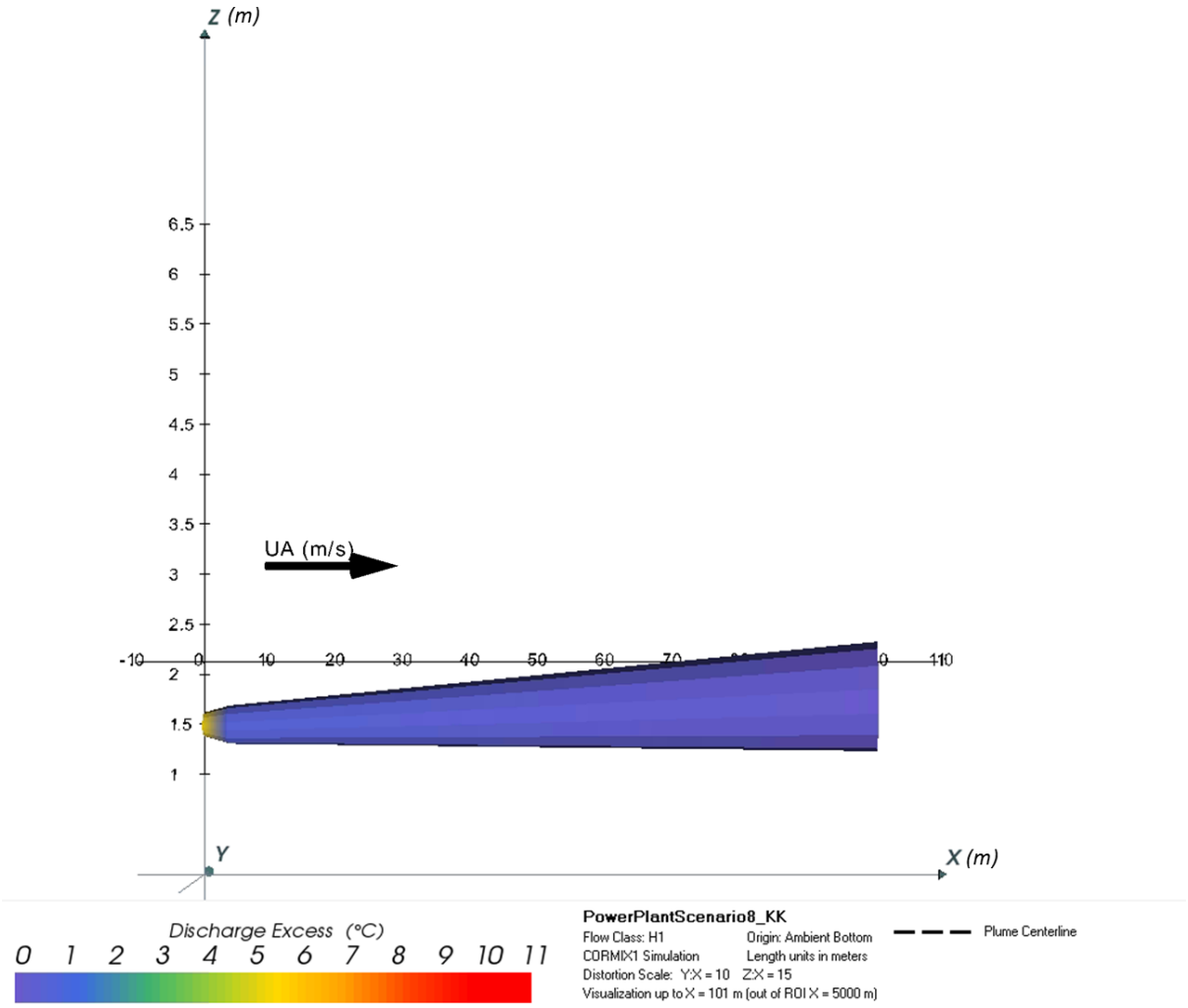
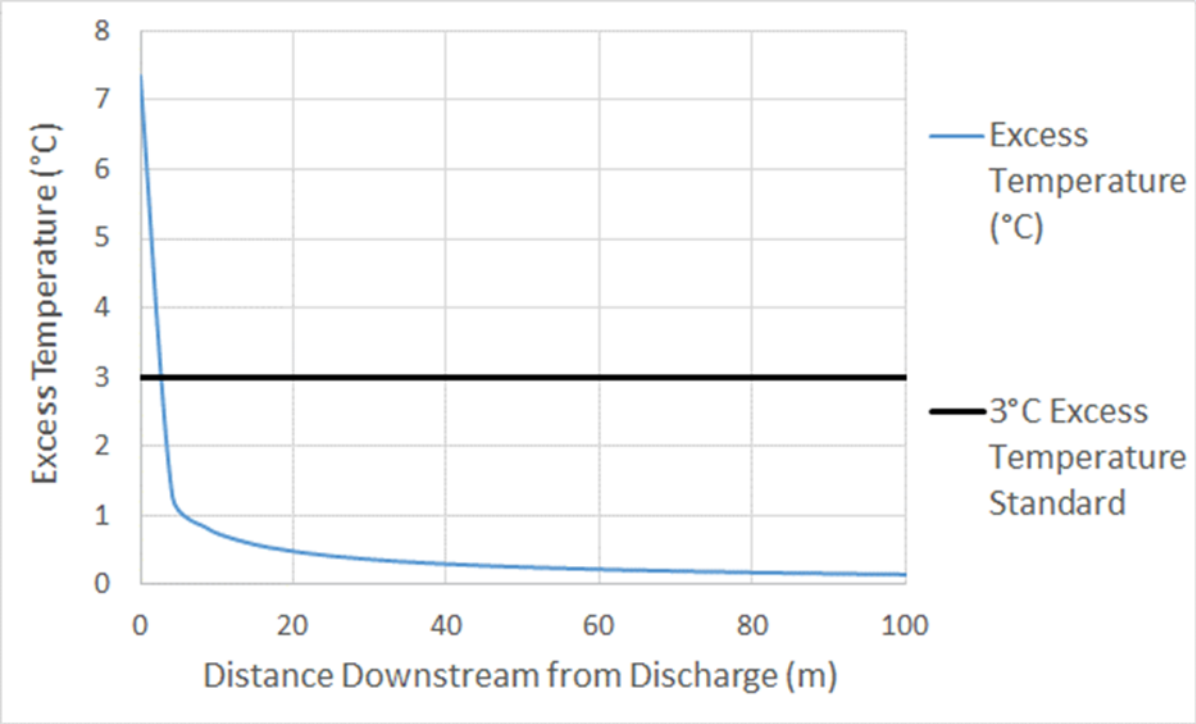


Figure 3.3: Depth (X-Z) View of the Thermal Plume Resulting from Power Plant Scenario 8 Critical Conditions



The plume centreline is also shown in ***Figure 3.4*** as a line plot. This plot includes excess temperature at the centreline versus distance downstream.

Figure 3.4: Line Plot of the Thermal Plume Resulting from Power Plant Scenario 8 Critical Conditions Compared to the Excess Temperature Standard



3.1.2 LNG Results

The most critical scenario, scenario 8, involves high ambient velocity, high ambient temperature, and large depth. The summer Yangon River temperature was determined to be 31.3 °C and the corresponding discharge temperature is 21.3 °C; consequently, the summer scenario was evaluated for the distance needed to decrease the temperature difference less than 3 °C within 100 m from the discharge. This temperature criteria is met within 9.16 metres for scenario 8 and is met in less than 9.1 m for all other scenarios.

Table 3.2 summarizes the results of each scenario, as characterized by two indicators:

- Length of the plume downstream (centreline); and
- Width of the plume.

Table 3.2: Mixing zone dimensions based on plume centerline for critical condition LNG scenarios

Scenario	Criteria	Plume length (m)	Width (m)
1	ΔT < 3°C	0.24	1.90
2	ΔT < 3°C	0.24	1.9
3	ΔT < 3°C	0.24	1.9
4	ΔT < 3°C	0.24	1.9
5	ΔT < 3°C	2.4	2.2
6	ΔT < 3°C	6.8	2.6
7	ΔT < 3°C	2.4	2.2
8	ΔT < 3°C	9.1	2.6

The CORMIX simulation shows that the < 3 °C temperature differential requirement in scenario 8 is met approximately 9.1 m downstream and 2.6 m across.

The plume area exceeding a 3 °C temperature differential in summer is shown in ***Figure 3.5***. The dimensions shown represent the centreline temperature downstream extent and width; temperature differential decreases away from the centreline.

Figure 3.5: Mixing Zone During LNG Scenario 8 Critical Conditions

Source: Google Earth, 2019.

The denser, cooler effluent is discharged near the bottom of the water column but mixes vertically throughout the water column, causing relatively uniform spreading in the vertical direction.

Additional depictions of the two dimensional plume are presented in ***Figure 3.6*** through ***Figure 3.7***.

Figure 3.6: Lateral (X-Y) View of the Thermal Plume Resulting from LNG Scenario 8 Critical Conditions

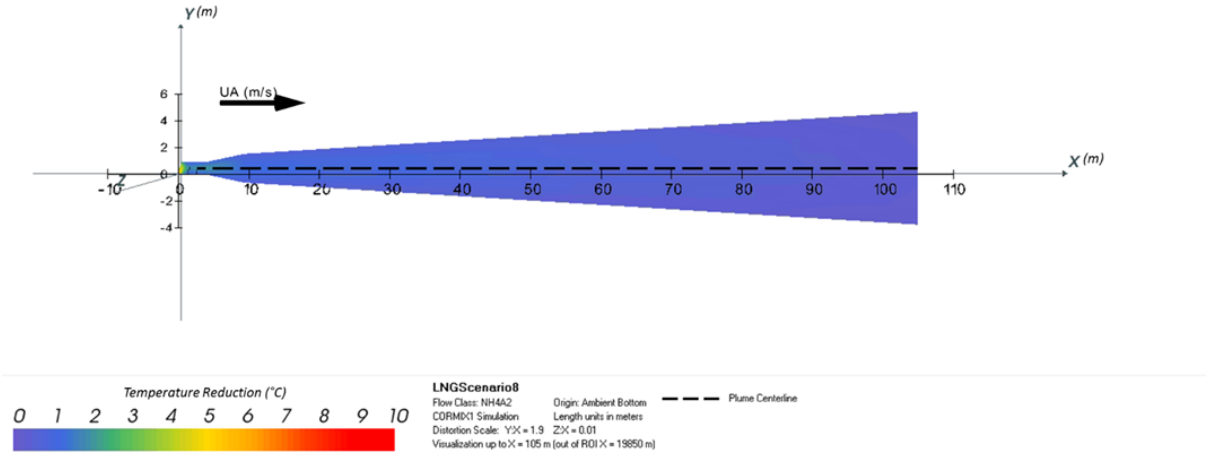
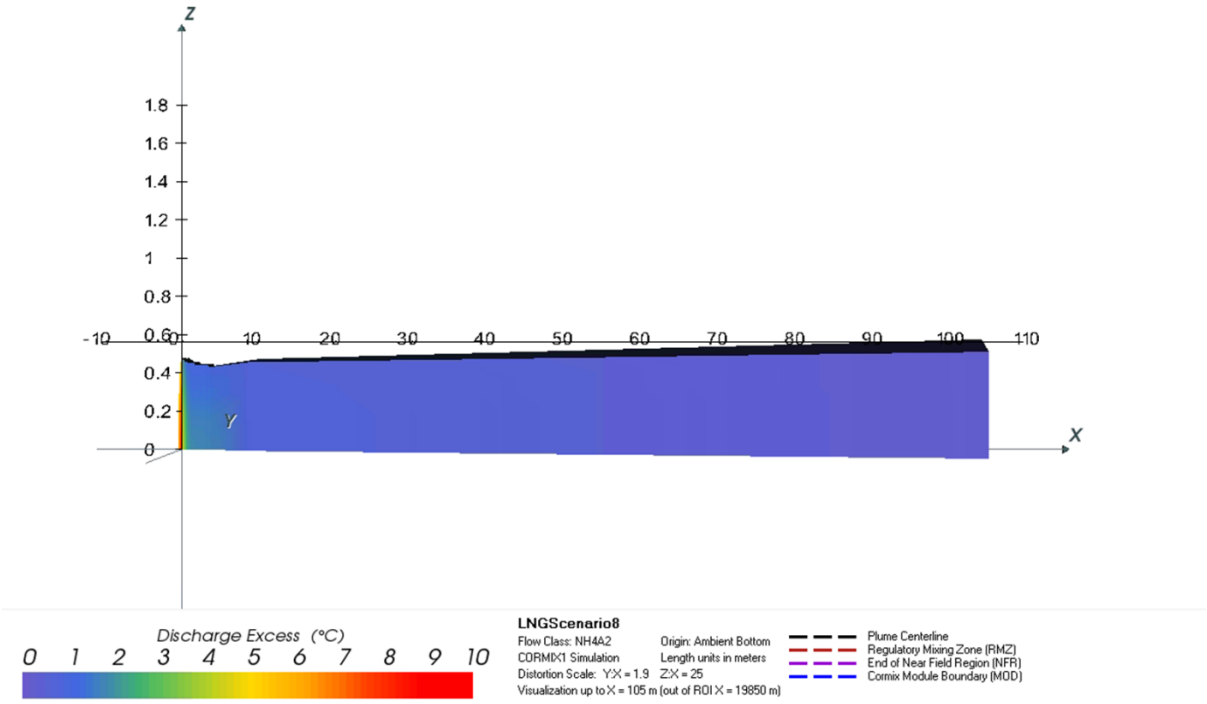
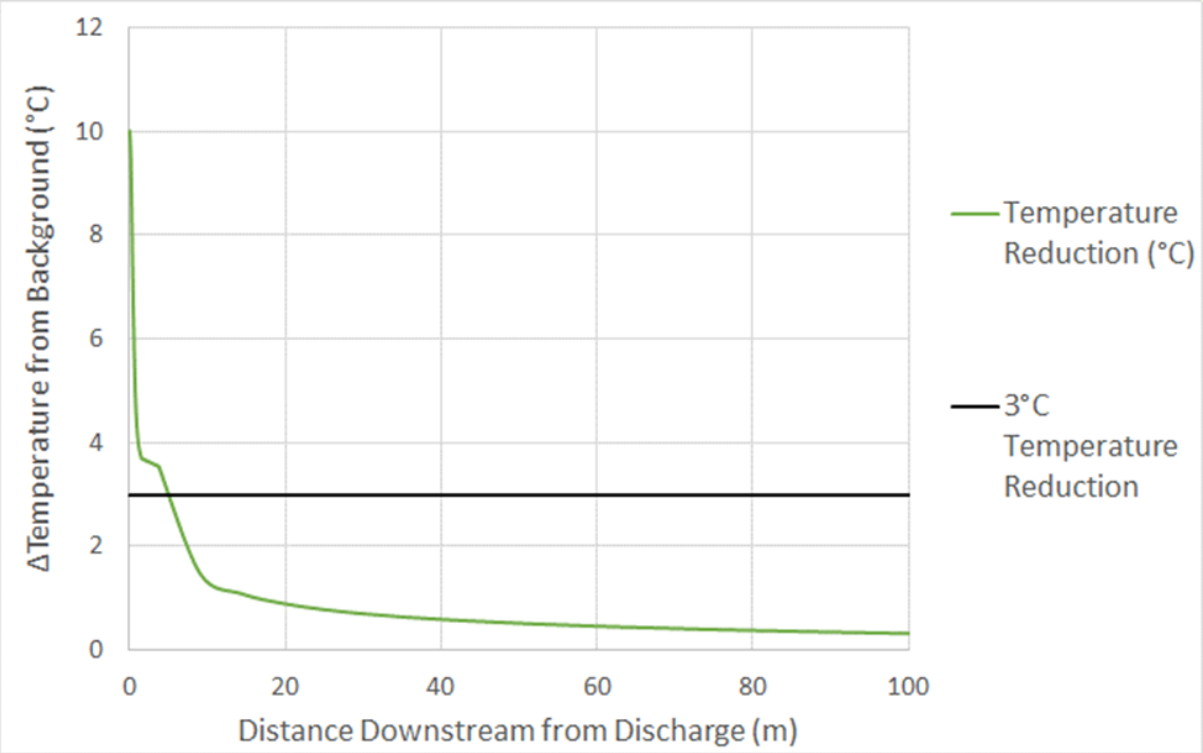


Figure 3.7: Vertical (X-Y) View of the Thermal Plume Resulting from LNG Scenario 8 Critical Conditions



The plume centreline is also shown in ***Figure 3.8*** as a line plot. This plot includes excess temperature at the centreline versus distance downstream.

Figure 3.8: Line Plot of the Thermal Plume Resulting from LNG Scenario 8 Critical Conditions Compared to the Excess Temperature Standard



3.2 Conclusions

Conclusions are summarized as follows:

- All eight of the Power Plant scenarios modelled with CORMIX fall below the 3 °C excess temperature criteria within 4.2 m, and All eight of the LNG scenarios modelled with CORMIX fall below the 3 °C excess temperature criteria within 9.1 m; thus, the **IFC temperature** standard for excess temperatures below 3 °C **is met** within 100 m from the discharge point for the conditions considered in this study for **both the Power Plant and LNG sites**.
- Specific compliance requirements and regulatory process related uncertainties should be noted while considering the results of this study. Furthermore, the discharge configuration and specific location are assumed based on best available information. ERM recommends **using the results of this study as indication of potential for compliance** and not as a comprehensive compliance or impact analysis, as certain assumptions (e.g., the vertical configuration of the LNG discharge structure) may not necessarily be the most conservative of possible discharge options. Once certain site-specific details are confirmed, ERM recommends a more detailed modelling study aligned with the local regulatory permitting process be conducted.

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APPENDIX U CORMIX MODELLING REPORT

LNG Power Plant (Ahlone) Project in Yangon Myanmar

Stakeholder Engagement Plan

23 June 2020

Project No.: 0439461

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Document details	
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23 June 2020

LNG Power Plant (Ahlone) Project in Yangon Myanmar

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Acronyms and Abbreviations

ADB	Asian Development Bank
CCPP	Combined Cycle Power Plant
CDP	Community Development Plan
CEO	Chief Executive Officer
ECC	Environmental Compliance Certificate
ECD	Environment Conservation Department
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESSF	Environmental and Social Safeguards Framework
FGD	Focus Group Discussion
GAD	General Administration Department
GRM	Grievance Redress Mechanism
IEE	Initial Environmental Examination
IFC	International Finance Corporation
KII	Key Informant Interviews
LNG	Liquefied Natural Gas
MOEE	Ministry of Electricity and Energy
MOGE	Myanma Oil and Gas Enterprise
MONREC	Ministry of Natural Resources and Environmental Conservation
NG	Natural Gas
NGO	Non-Governmental Organisation
PAP	Project-affected Party
PS	Performance Standard
SEP	Stakeholder Engagement Plan
SPS	Safeguard Policy Statement
TL	Transmission Line
TPMC	Toyo Thai Power Myanmar Company Limited

1. INTRODUCTION

1.1 Context of the Document

TTCL Power Myanmar Company Limited ('TPMC' and/or 'the Project Proponent') is planning to develop the **LNG Power Plant (Ahlone) Project** (also referred to as 'the Project'). The Project Proponent is planning to import the Liquefied Natural Gas (LNG) from overseas LNG sources (LNG Sources will be determined at the later stage) and install an LNG Receiving Terminal (including Jetty, LNG Storage Tank(s) and Regasification Unit) on the Yangon River. This is in order to convert the LNG to Natural Gas (NG) and provide NG as fuel supply to Ahlone CCPP Expansion through a Natural Gas Pipeline ('the Project' or 'LNG Power Plant (Ahlone) Project'). Further details about the Project can be found in the Environmental and Social Impact Assessment (ESIA) study.

In addition to the ESIA study, the electricity generated by the proposed Power Plant will be transferred to a sub-station in Hlaingthayar via a 230 kV Transmission Line (TL) which approximately half of the route run in parallel with the existing 230 kV transmission line transferring power for the existing Ahlone CCPP, with an approximate length of 28 km. In accordance with the Myanmar Environmental Impact Assessment (EIA) Procedures (2015), a 230 kV transmission line will require an Initial Environmental Examination (IEE) Study.

TPMC acknowledges the importance of establishing and maintaining a proactive engagement of the Project's key stakeholder, thus the development of this Stakeholder Engagement Plan (SEP). The SEP is a "living document" that will be updated and refined throughout all phases of the Project. The SEP will be revised prior to the construction and operation phases so that it continues to be fit for purpose.

1.2 Objectives

This SEP provides a framework for stakeholder engagement throughout the course of the Project. It is designed to demonstrate that the Project will undertake consultation and participation that is meaningful, consistent, comprehensive, coordinated and culturally appropriate, in line with all the relevant legal and regulatory commitments including international good practice, and national and TPMC requirements.

The stakeholder engagement process include various engagement levels and phases. Given the current Project phase, the main engagements conducted to date were in the context of the ESIA an IEE process, mainly as part of consultations with key stakeholders and host communities. The consultation process is designed to be iterative, such that mitigation and implementation of measures is informed by stakeholder views, is tailored to local needs, and identifies appropriate mechanisms for sharing development benefits and opportunities.

Overall, the main objectives of engagement process are:

- Identify: All those affected or interested in the Project to ensure they are included in the engagement process.
- Understand: Give an understanding of key stakeholder. Ensure stakeholders understand potentially harmful (negative) impacts and benefits (positive) of the Project.
- Relationship & Trust: Build relationships through supporting open dialogue and engagement with stakeholders. Establish transparency the Project's activities and build trust with stakeholders.
- Inform: Inform the Project to help identify local benefits and partnership opportunities.
- Engage: Engaging vulnerable people by having an inclusive approach to consultation. Use of differentiated measure to ensure effective participation of vulnerable stakeholders.
- Manage: Provide a mechanism for managing expectations and addressing concerns about the project. Provide a mechanism for receiving document and addressing comments received.

- Compliance: Design the process to ensure compliance with Myanmar regulatory requirements, international good practice and Project Proponent's guidelines.

The SEP outlines the approach and plans to be adopted and implemented for engagement. This includes the identification and mapping of stakeholders, and of mechanisms through which they are included in the process of identifying issues, interests and concerns, and being able to respond to and manage potential impacts to both stakeholders and the Project itself. This plan serves as a way to analyse information gathered during desktop research and direct engagement, and to document the process and steps forward.

The data presented in this document result from the consultation and disclosure activities that have been undertaken during the ESIA and IEE. The consultation and disclosure activities and data collection were designed to:

- Be free of external manipulation or coercion and intimidation;
- Be undertaken in a timely way and prior to decisions being made so that views expressed can be taken into account;
- Disclose relevant, clear and accessible Project information to enable stakeholders to understand the risks, impacts and opportunities of the project; and
- Provide stakeholders with opportunities to express their view on the project risks, impacts and mitigation measures. These will be considered and responded to throughout the engagement process.

1.3 Project Description

The proposed Project is the development and operation of 388 MW combined cycle power plant which consists of:

- 2 x 128.5 MW Gas Turbines; and
- 1 x 131 MW Steam Turbine.

The electricity generated by the Project will be sold to the Ministry of Electricity and Energy (MOEE) via the Myanmar National Grid, using the existing Ahlone Power Plant sub-station.

The Project also consists of an LNG Receiving Terminal, including a jetty, LNG Storage Tank(s) and onshore Regasification Unit, and approximately 24.9 km NG Pipeline from the Regasification Unit to the Ahlone Power Plant.

The proposed LNG Power Plant (Ahlone) and TL Project is located in Yangon, the Republic of the Union of Myanmar (***Figure 1.1***). The Ahlone Power Plant is located on the North bank of the Yangon River at the following coordinates: 193875 E, 1856918 N.

A total area of approximately 23.97 acres of land is allocated for the Project Facilities. The LNG Power Plant (Ahlone) Project covers a total area of approximately 15 acres.

The proposed LNG receiving terminal is located on the West bank of the Yangon River, downstream of the Ahlone CCPP Expansion's proposed location, in the Dala Township of Yangon region in the Republic of the Union of Myanmar (***Figure 1.1***). It covers an area of approximately 15 acres.

It is noted that the Project location may be subject to change during the detailed design stage of the Project. Brief Project details and locations are shown in ***Table 1.1*** and ***Table 1.2***.

The duration of construction for Power Plant, LNG terminal, pipeline, and transmission line are 38, 23, 18, 25 months, respectively.

Table 1.1: Project Summary

Component	Details
Name of the Project	LNG Power Plant (Ahlone) Project
Project Proponent	TTCL Power Myanmar Company Limited
Power Plant Capacity	388 MW
LNG Consumption (per day)	1,300 ton (approx.) @ 100% Load
LNG Carrier Capacity	16,000 ton (approx.)
Area of Ahlone power plant to be set up and operated	8.8 acres (approx.)
LNG Unloading Jetty	Centre Platform with walkway, mooring dolphin and Trestle, 100 metres from river shore line Concrete Structure
LNG Cryogenic Pipeline	■ Stainless steel pipe with cold insulation; ■ 291 metres (approx.); from unloading arm to a LNG storage tank; ■ 160 metres (approx.); from LNG storage tank to the BOG recondenser; ■ 86 metres (approx.); from BOG recondenser to regasification unit
LNG Storage Tanks	Two (2) Full containment tanks with 25,000 m^3 capacity each (working volume)
Regasification Unit (RU) Capacities	Appx. 63 million standard cubic feet per day (MMSCFD), Heating source by river water Intermediate fluid vaporizers (IFV)
Area of LNG Storage Tanks and RU to be set up and operated	15.0 acres (approx.)
NG Pipeline	24.9 km (approx.) with 20 inches diameter.
Plans after commencement of the Project operation	The Project will generate electricity and dispatch to Myanmar National Grid.
Transmission Line	230kV, 28 km (approx.)

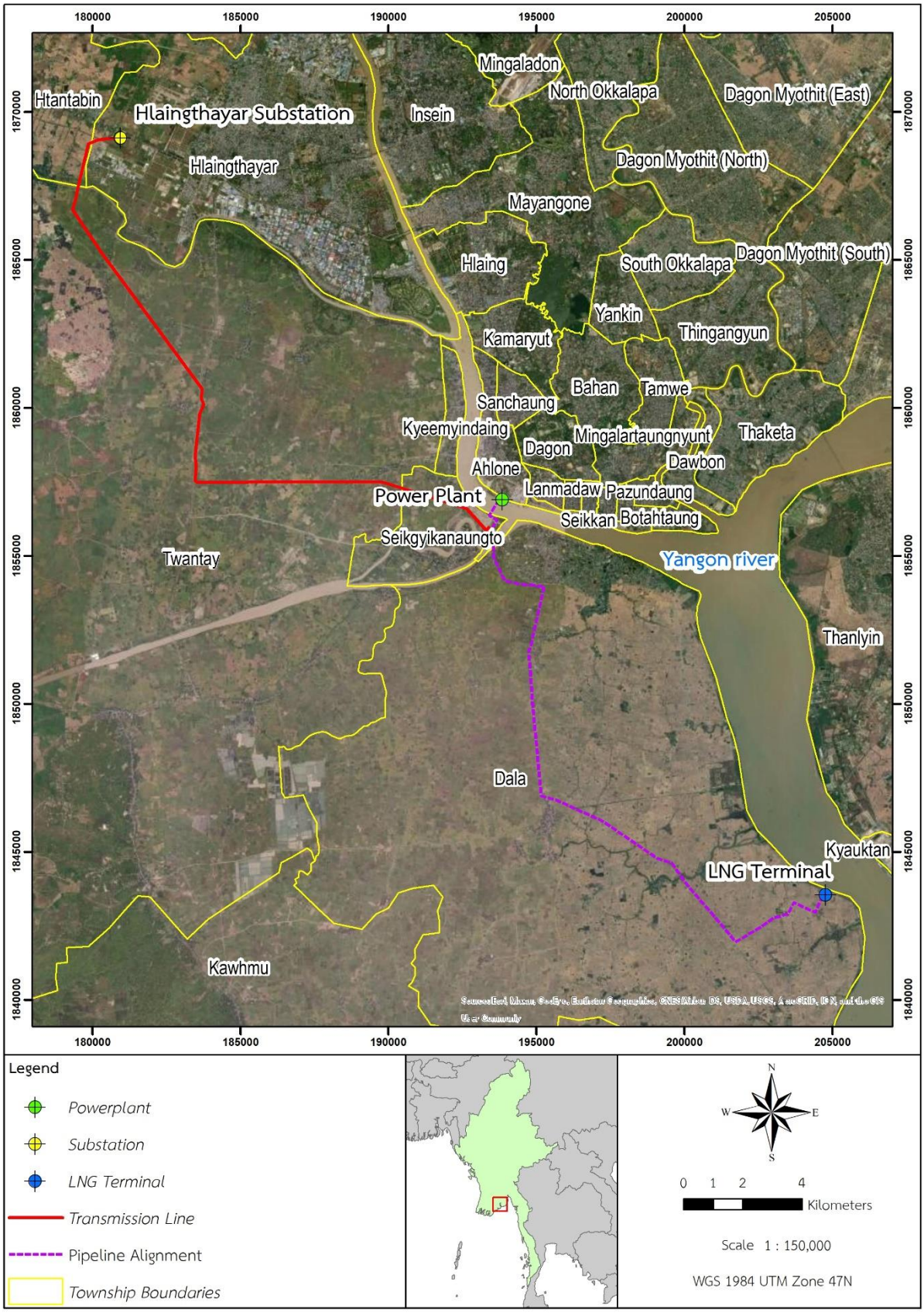
Source: TPMC, 2020

Table 1.2: Project Component Location

Project Component	Project Location (Township)
LNG terminal	Dala Township
LNG Pipeline	Dala, Seikgyikanaungto, Township
Ahlone Power Plant	Ahlone Township
Transmission Line	Seikgyikanaungto, Twantay, and Hlaingtharya Township

Source: TPMC, 2020

Figure 1.1: Project Location



Source: ERM, 2020

1.4 Structure of this Plan

The remainder of this document is structured as follows:

- Section 2: Key Standards and Legislation Guiding Stakeholder Engagement;
- Section 3: Previous Engagement by the Project
- Section 4: Project Stakeholders;
- Section 5: Proposed Stakeholder Engagement Activities;
- Section 6: Disclosure Mechanism
- Section 7: Grievance Redress Mechanism;
- Section 8: Monitoring and Reporting;

2. KEY STANDARDS AND LEGISLATION GUIDING STAKEHOLDER ENGAGEMENT

This section presents a summary of the regulatory requirements applicable to the SEP. The Project will conform to the legal and administrative requirements of the Republic of the Union of Myanmar. The Project will also conform to international treaties to which Myanmar is signatory, and international standards and guidelines including the Equator Principles, the Asian Development Bank's (ADB) Environmental and Social Safeguards Framework (ESSF), the International Finance Corporation (IFC) Performance Standards (2012). In addition, the Project will conform to TPMC's corporate policies, including those relating to stakeholder engagement.

2.1 Overview of Myanmar Regulation on Stakeholder Engagement

Stakeholder engagement requirements are mainly mentioned within the EIA and IEE framework established by Myanmar's Ministry of Natural Resources and Environmental Conservation (MONREC).

Under Section 7 of the Environmental Conservation Law and Articles 52 and 53 of the Environmental Conservation Rules of the Republic of the Union of Myanmar, the Project Proponent is required to conduct ESIA and IEE studies to obtain the Environmental Compliance Certificate (ECC) for the proposed LNG Receiving Terminal development and operations. At the time of initial Project planning, the EIA Procedure (2015) set out the requirements for development, assessment and subsequent monitoring of an EIA which are illustrated in ***Figure 2.1***, including the consultation requirements which are discussed below.

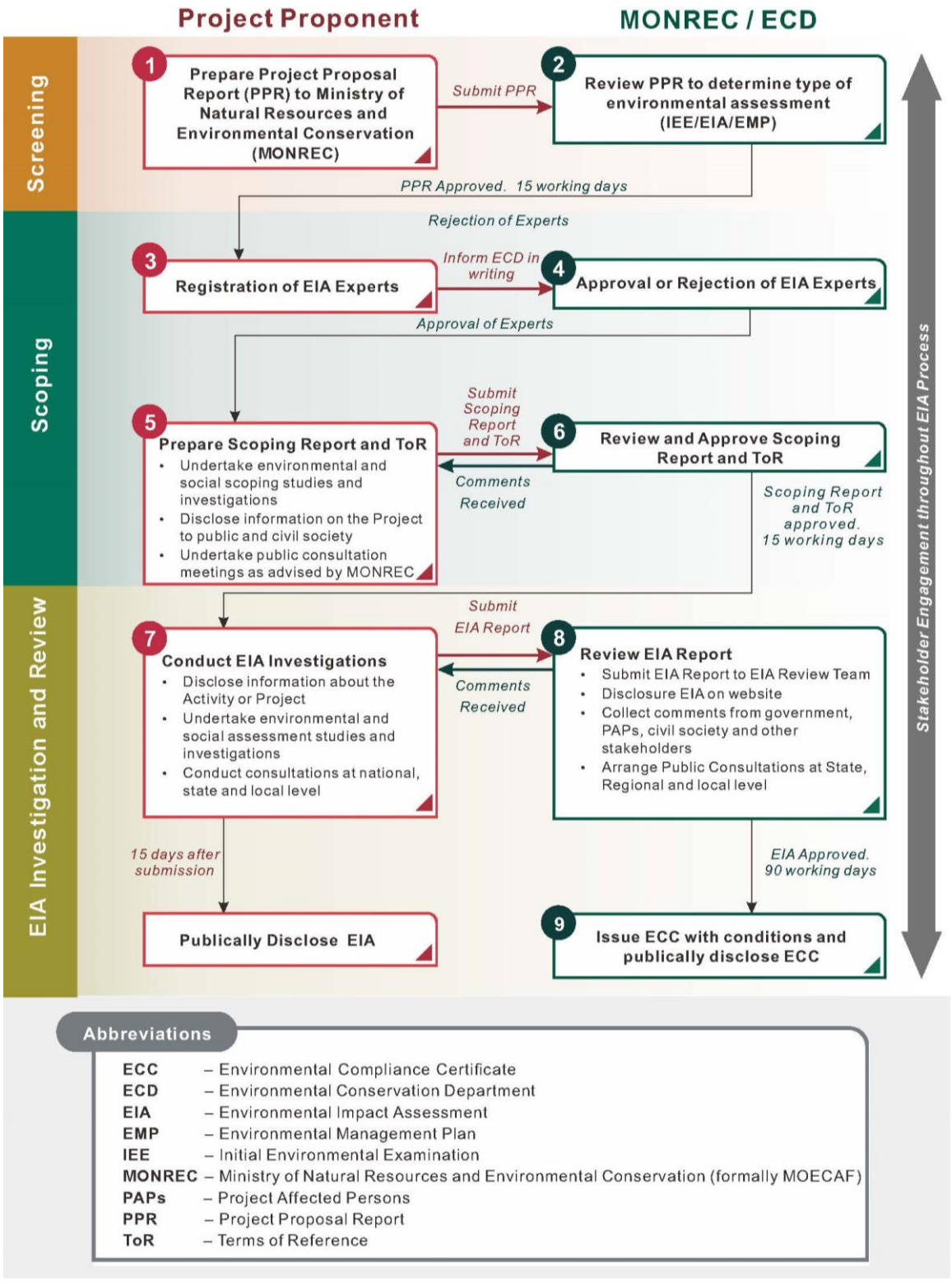
According to Article 50 of the EIA Procedure (2015), as part of the Scoping exercise, the Project Proponent shall ensure the following public consultation and participation process are carried out:

- Disclose information about the proposed Project to the public and civil society through posting on the Project or Project Proponent's website(s) and local media, including by means of the prominent posting of legible sign boards and advertising boards at the Project site which are visible to the public; and
- Arrange the required consultation meetings as advised by the Ministry, with local communities, potential Project-affected parties (PAPs), local authorities, community based organisations, and civil society, and provide appropriate and timely explanations in press conferences and media interviews.

According to Article 61, as part of the EIA investigations the Project Proponent shall undertake the following consultation process:

- Timely disclosure of all relevant information about the proposed Project and its likely Adverse Impacts to the public and civil society through local and national media, the website(s) of the Project or Project Proponent, at public places such as libraries and community halls, and on sign boards at the Project site visible to the public, and provide appropriate and timely explanations in press conferences and media interviews;
- Arrange consultation meetings at national, regional, state, Nay Pyi Taw Union Territory and local levels, with PAPs, authorities, community based organisations and civil society;
- Consultations with concerned government organisations including the Ministry, the concerned sector ministry, regional government authorities and others; and
- Field visits for the Ministry and concerned government organisations.

Figure 2.1: Project Proponent Roles



Source: ERM, 2019

Note: Roles with regards to stakeholder engagement under the EIA process, as defined by the Myanmar's EIA Procedure (2015).

The EIA/IEE Guideline was updated in 2019 to ensure that stakeholder engagement is inclusive (i.e. the use of local language) and continuous throughout the project life. The EIA/IEE Guideline (2019) states that:

> 'The EIA should demonstrate how stakeholder engagement has been an inclusive and will be a continuous process throughout the life of a project. The EIA should outline how the project proponent will encourage local stakeholders including women, vulnerable groups and people of national race to participate in the project. The stakeholder engagement plan should demonstrate the commitment of the proponent to a process of ongoing consultation.'

The guideline also requires the Project proponent to organise proper engagement to conform with IFC Performance Standards, (2012)…

2.2 International Framework

The main international standards considered when developing this document, include:

- ADB Safeguard Policy Statement (SPS) (2009); and
- IFC Performance Standards (2012)

The ***ADB Safeguard Policy Framework*** is a set of operational policies that seek to avoid, minimise or mitigate adverse environmental and social impacts, including protecting the rights of those likely to be affected or marginalised by the development process.

'*Safeguard Requirements 1: Environment'* requires the Project to properly address various requirements including: 1.3 Information disclosure, 1.4 Consultation and Participation, 1.5 Grievances Redress Mechanism, and 1.6 Monitoring and reporting.

- **Safeguard 1.4** requires the proponent to carry out meaningful consultation with all concerned stakeholders in a manner commensurate with the impacts, including keeping record of the consultation process and its result.
- **Safeguard 1.5** requires the borrower/client to establish a mechanism to receive and facilitate resolution of affected peoples' concerns, complaints, and grievances about the project's environmental performance.
- **Safeguard 1.6** requires the borrower/client to monitor the implementation of Environmental Management Plan (EMP) and undertake inspection to verify compliance with the plan. The result will be to document and identify actions to close gaps in the corrective action plan. The monitoring report should be submitted periodically.

The ***IFC Performance Standards*** on Environmental and Social Sustainability and Stakeholder Engagement Handbook, Performance Standard (PS) 1 require project proponents to engage with affected communities through disclosure of information, consultation, and informed participation. The proponent is to develop and implement a SEP that includes those identified as disadvantaged or vulnerable from the project risks and impacts according to the characteristics and interests of the affected communities. The SEP should include different measures to enable effective communication. The disclosure should include:

(i) the purpose, nature, and scale of the project;

(ii) the duration of proposed project activities;

(iii) any risks to and potential impacts on such communities and relevant mitigation measures;

(iv) stakeholder engagement process; and

(v) the grievance mechanism.

The Project Proponent should tailor its consultation process to the language preferences of the PAPs and Affected Communities, their decision-making process, and the needs of disadvantaged or vulnerable groups.

In addition to PS1, the following standards must be considered by the Project:

- **IFC PS 2:** Engagement with regards to Labour and Working Conditions;
- **IFC PS 5:** Stakeholder Engagement as part of Land Acquisition process, resettlement planning, grievance mechanism for PAPs; and
- **IFC PS 8:** Engagement with regards to cultural heritage.

It has been determined that the requirements outlined in IFC PS 7, which relate to engagement with Indigenous Peoples, do not apply to the Project's local context.

2.3 TPMC Corporate Social Responsibility and Sustainable Development Policy

With the aim to create and maintain good relationship base on trust, mutual respect, and aware of possible impact toward all related stakeholders (e.g. shareholders, employees, clients, etc.). Therefore, TMPC have set out the following policies:[1]

- **Compliance with code of conduct and code of business ethics**: encourage employees to maintain integrity and transparency of economy, society and environment under the corporate governance framework.
- **Human rights and labour practices:** prioritise human rights and advocates non-discrimination in gender and social class.
- **Responsibility for stakeholders and other concerned persons:** prioritise stakeholders and other concern persons with business operation concerning the least impact.
- **Social responsibility activity**
- **Responsibility for environment and safety standard**:
- **Company innovation concerning with corporate social responsibility:** encourage any innovation and research and to develop any business operation that creates value to the organization and stakeholders.

[1] TTCL, 2019, Corporate Social Responsibility and Sustainable Development Policy. Retrieved from https://www.ttcl.com/sustainability/corporate_social_responsibility/policy

3. PREVIOUS ENGAGEMENT BY THE PROJECT

This section describes the engagement activities undertaken so far for the Project, during the environmental and social assessment process, and additional baseline collection after submission of the ESIA and IEE reports. Stakeholders for this SEP were identified based on this prior engagement. Engagement activities undertaken to-date were critical for identifying stakeholders and formulating the SEP for the remaining life of the project.

3.1 Engagement undertaken as part of the ESIA and IEE process

Main engagement activities undertaken as part of the impact assessment process involved public meetings, consultations and field survey.[2]

3.1.1 Engagement during Scoping Process

In March 2018, a scoping trip was conducted in the Project area by the Project Management Team (Project Director and Project Manager). Key stakeholders (e.g. village leaders, farmers, fishermen, and women groups) were engaged, to gain better understanding of the Project area and the stakeholders' profile. The results were integrated into the scoping report and the Term of Reference of the ESIA.

In addition, a meeting was held on 25 June 2018 with the Environment Conservation Department (ECD) of the MONREC in Naypyidaw. During the meeting, ERM Project Director and TPMC Business Development Manager met with the ECD management director as well as the sub-committee in charge of reviewing the proposed project in order to discuss the approval process and ECD requirements for the ESIA.

Some specification regarding the scoping reports and third party consultant letter were also shared during the meeting.

3.1.2 ESIA Baseline Data Collection Survey

In November 2018, primary data was collected following the first Public Consultation session. The methods for primary data gathering comprised of household questionnaires, face-to-face interviews with key informants, and Focus Group Discussions (FGDs). Key stakeholders included village leaders, women, fishermen, health care and education professionals, and famers from the local villages. A total of 150 household questionnaires, and 11 FGDs and Key Informant Interviews (KIIs) were conducted in Dala, Seikgyikanaungto and Ahlone Townships. The location and number of household questionnaires are presented in ***Table 3.1.***

[2] Refer to ESIA and IEE reports for additional details on engagement activities.

Table 3.1: Household Questionnaires, by Village

Township	Village	No. of Households (HH)
Ahlone	Thit Taw	23
	Saw Yan Paing	17
Dala	Ta Pin Shwe Hti	11
	Kyansisthar	8
	Tha Pyae Kone	15
	Ye Chaung Wa	15
	Tone Tin Gan	10
	Thet Kal Kwin	7
	Tone Tin Gun	2
Seikgyikanaungtoe	Nyaung Ngok To	12
	Seikgyi (East)	19

Source: ERM, 2019.

3.1.3 1st ESIA Public Consultation Meetings

The first round of ESIA Public Consultation Meetings were conducted between 30 October and 11-12 December 2018. Various stakeholders were invited including Chief Minister and State Government, concerned Regional level ECD and the General Administration Department (GAD), Members of Parliament, Township GAD, village administrators, and local communities. The details of each meeting is provided in ***Table 3.2***. The consultations were communicated in both Myanmar language and English.

The consultation objectives included data collection on potentially affected people and potential data gaps in the ESIA Report, communicate Project details to various stakeholders, and to collect and record their concerns and suggestions.

Representatives from 8 Townships and Villages were invited to attend public consultation meeting: Ahlone, Dagon, Lanmadaw, Sekikan, Seikgyikanaungto, Dala, Thanlyin, and Kyauktan.

Table 3.2: Details of 1st ESIA Public Consultation Meetings

Date	Location	Number of Participants
29 October 2018	Ahlone Township hall	182
10 December 2018	Dala Township hall	211
11 December 2018	Thanlyin Township hall	208

Source: ERM, 2018

Most of the questions, comments and concerns raised during the 1st Public Consultation Meetings related to Project design, Project schedule, Project impact, health and safety, compensation, job opportunities, and the emergency response plan.

3.1.4 2nd ESIA Public Consultation Meetings

The second round of ESIA Public Consultation Meetings were held during 12-14 June 2019. Various stakeholders were invited including Chief Minister and State Government, concerned Regional level ECD and GAD, Members of Parliament, Township GAD, village administrators, and local communities. The details of each meeting is provided in ***Table 3.3.*** The consultations were communicated in Myanmar language and English.

Representatives from 8 Townships and Villages were invited to attend public consultation meeting: Ahlone, Dagon, Lanmadaw, Sekikan, Seikgyikanaungto, Dala, Thanlyin, and Kyauktan.

The consultation objectives included data collection on potentially affected people and potential data gaps in the ESIA Report, communicate Project details to various stakeholders, and to collect and record their concerns and suggestions.

Table 3.3: Details of 2nd ESIA Public Consultation Meeting

Date	Location	Number of Participants
12 June 2019	Ahlone Township hall, Ahlone Township	187
13 June 2019	Thardana Beikmann Hall, Thanlyin Township	180
14 June 2019	Thin Zaya Naw Ya Htar Hall, Dala Township	143

Source: ERM, 2019

The main questions, comments and concerns raised during the 2nd Public Consultation Meetings related to benefit sharing, impact and mitigation measures, health and safety, monitoring process, Project schedule and compensation.

3.1.5 IEE Public Consultation Meetings

IEE Public Consultation Meetings were conducted on 29 and 30 October 2019. Stakeholders invited included Chief Minister and state Government, concerned regional level ECD and GAD representatives, Members of Parliament, Township GAD, village administrators, and local communities. The schedule of each meeting is provided in ***Table 3.4***. It is noted that the consultation activities undertaken on 14 June 2019, in Dala Township, were combined with the second round of ESIA Public Consultation (refer to ***Section 3.1.4***).

Representatives from the four townships affected by the Project were invited to attend public consultation meetings. Representatives from the following 13 villages were invited, and attended the relevant township meeting: Tet Thit, Kin, Kyi Seik, Kha Yan Wa, Ka Pyo, Kha Lauk Kha Lu, Ma Myo Su, Auk Ta Mar Ta Kaw, Ta Man Gyi Ta Khun Taing, Kun Tar, Htein Kone, Kyaun Ka Lay, and Gyaung Waing Gyi.

The objectives of consultation were to communicate Project details to various stakeholders, and to collect and record their concerns and suggestions to be addressed in the IEE report.

Most of the questions, comments and concerns raised during the IEE Public Consultation Meetings referred to Project schedule, Project Design, Project impacts, and compensation.

Table 3.4: Schedule IEE Public Consultation Meetings

Date, time	Location	Number of Participants
14 June 2019	Thin Zaya Naw Ya Htar Hall, Dala Township	143
29 October 2019	Hlaing Thar Yar Township: Kanphyar Monestery, Apyin Padan Village Group	160
30 October 2019	Twantay Township: GAD Office, Tawwin Sandakuu Hall	90

Source: ERM, 2019

3.2 Additional Survey and Engagement Activities

An additional field survey was conducted from 11 to 20 February 2020 in Ahlone, Twantay, and Dala Townships[3] to collect supplementary baseline data from village tracts and villages located along the Project area. In addition to data collection, the survey included FGDs and KIIs that covered the following topics: land use and ownership, livelihoods (i.e. agriculture, fishing, and small business), gender and vulnerable groups, preferred communication and engagement channels, and socio-economic profiling (i.e. education and health). Survey methods comprised of semi-structured questionnaires, field observation and ground truth, and formal and informal interviews.

Details of main engagement activities as additional survey are shown in the ***Table 3.5***.

Table 3.5: Details of Additional Field Survey

Date, time	Location	Activities Conducted (FGDs/KIIs)	Number of Participants	Male	Female
11 February 2020	Kha Lauk Kha Lu Village, Yaykyaw Village Tract, Twantay Township	3	24	12	12
13 February 2020	Ta Man Gyi Ta Khun Taing Village, Ta Man Gyi Village Tract, Twantay Township	4	6	3	3
14 February 2020	Byauk Yoe Village, Twantay Township	2	10	7	3
15 February 2020	Gyaung Waing Gyi Village & Kyun Ka Lay Village, Twantay Township	3	9	3	6
17 February 2020	Nyaung Ngoke To Village & Pyawbwe Gyi Village, Dala Township	3	14	10	2
19 February 2020	That Kal Kwin Village, Tone Tin Gan (South) Village Tract, Dala Township Bo Yan Pyay Ward, Dala Township	4	18	12	6
20 February 2020	Ka Mar Ka Sik Ward and Hmaw Set Ward, Dala Township	2	9	5	4

Source: ERM, 2020

The main questions, comments and concerns raised during the engagement activities related to health and safety, Project schedule and design.

[3] Hlaingtharya and Seikgyikanaungto were not included in the additional survey because the area only covered the existing substation and the transmission route that are distant from residential areas.

4. PROJECT STAKEHOLDERS

This section presents the Project stakeholders identified through an identification and mapping exercise that involved identifying the relevant Project stakeholders or groups of stakeholders, characterising the key stakeholder issues and concerns, and mapping the Project stakeholders to determine the appropriate level of engagement, and consequently the most appropriate engagement and communication channels.

4.1 Stakeholder Identification

For the purposes of this SEP, stakeholders are defined as 'persons or groups who are directly or indirectly affected by the Project, as well as those who have interests/and or the ability to influence its outcomes either positively or negatively' *(IFC, Stakeholder Engagement Handbook 2009).*

Project stakeholders were identified based on primary and secondary data collection, previous engagement conducted for the Project, analysis of baseline data, and impact assessment of social receptors. Identified stakeholders were grouped in categories, as shown in ***Table 4.1*** below. This includes all stakeholders identified during ESIA and IEE studies.

Table 4.1: Project Stakeholders

Group	Stakeholder
Regional Authorities **-** Regional government (Yangon)	Chief Minister Electric Power Generation Enterprise (EPGE) Myanmar Port Authorities (MPA) Ministry of Electricity and Energy (MOEE) Myanma Oil and Gas Enterprise (MOGE) New Yangon City Development Company Ltd
Township Authorities **-** Township government (Dala,Seikgyikanaungto, Ahlone, Twantay, Hlaingtharya)	General Administration Department (GAD) Department of Fisheries and Rural Development Department of Irrigation and Agriculture Department of Trade Department of Social Welfare, Relief and Resettlements Department of Labour Water Utilisation Department Municipal Department Tax and Revenue Department Development Committee
Local Communities **-** Communities within a 5 km radius from Project sites or within a 500m buffer along the pipeline and the transmission line	Village Tract Leaders Villagers Project affected household Farmers within local villages Fishermen within local villagers Women's representatives within local villages Education institutions Youth within local villages Healthcare workers within local villages and regional health care facilities Community based organisations Vulnerable groups[4] within the local villages
Others	Media & Non-Governmental Organisations (NGOs) in the area Local business/providers and recruitment agencies Subcontractors

[4] The IFC (2012) defines vulnerable groups as *"…social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalised and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development".* Vulnerable groups typically include women, children, the elderly and people with special needs.

Group	Stakeholder
Internal Stakeholders	Project Team

Note: Additional stakeholders may be identified as the Project progresses and is refined

In addition to formal and official stakeholders, the identification process also considered individuals and groups who may find it more difficult to participate and those who may be differentially or are disproportionately affected by the Project because of their marginalised or vulnerable status. It is the Project team's responsibility to ensure that to these groups are considered and are given the opportunity to properly participate in the engagement process and activities.

4.2 Stakeholder Mapping

Stakeholder mapping is a process of examining the level of influence of different individuals and groups over the Project as well as the influence of the Project over them. The purpose of stakeholder mapping is to:

- Identify stakeholder groups;
- Identify and understand interests, issues, concerns and expectations related to the Project;
- Understand stakeholders' level influence; and
- Define the most appropriate engagement process, tools and channels.

The mapping exercise has considered the following:

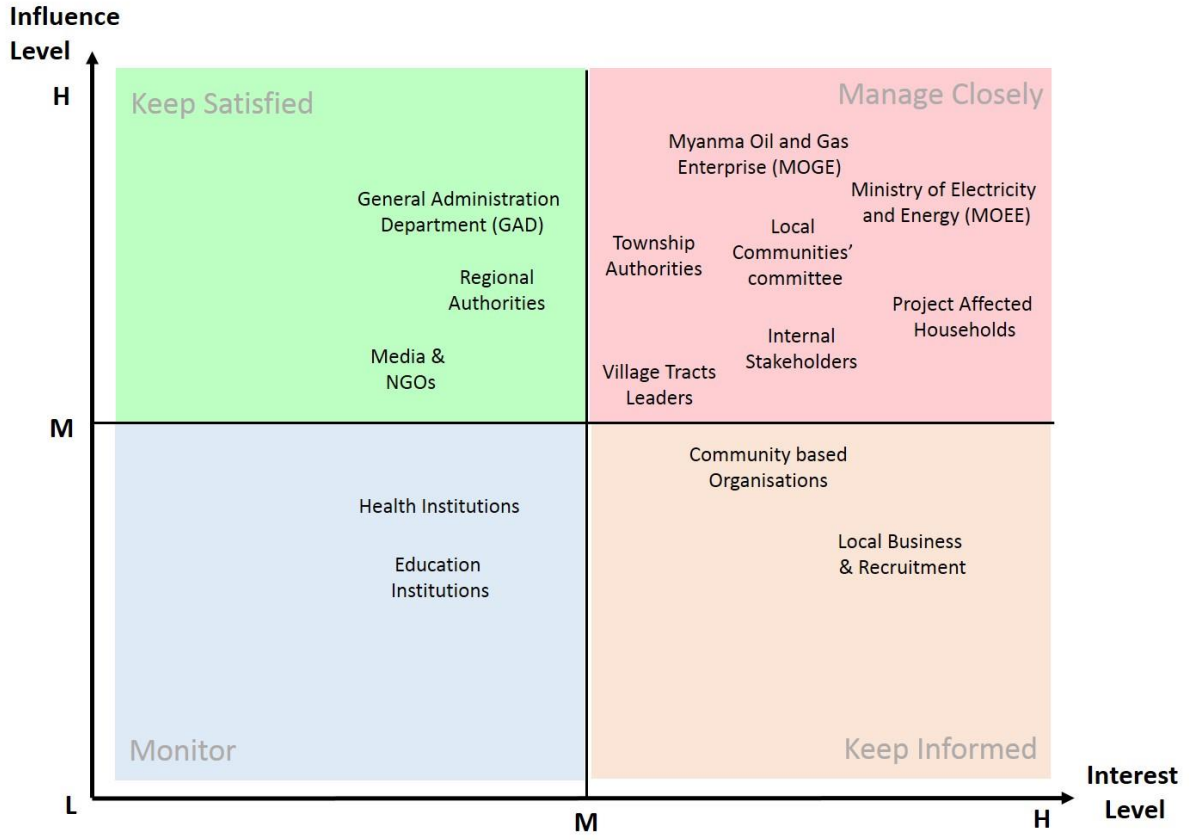
- Stakeholder influence or ability to influence based on the potential to influence the Project derived from the stakeholder's position or resource power, or their actual influence derived from their credibility as a leader or expert.
- Stakeholder interest in the Project as measured by the extent to which stakeholders are active or passive.

The stakeholder matrix (***Figure 4.1***) shows the distribution of stakeholders in four different quadrants. The stakeholders in the top right need to be managed closely and are considered to have high influence and interest. These stakeholders need to be proactively engaged on a regular basis because these are the stakeholders that are most interested in the Project and have the greatest potential to impact its outcome (i.e. the ability of the Project to go ahead).

The stakeholders in the top left and bottom right quadrants have either high interest or high influence and need to be engaged in order to be informed and consulted on issues of their interest.

The stakeholders in the bottom left need to be monitored and informed of key Project aspects. It is important to track if their level of interest or impact changes.

Figure 4.1: Stakeholder Matrix



Source: ERM, 2020

The Project recognises that there may be vulnerable individuals or sub-groups within each of the stakeholder groups who should to be identified and supported throughout the engagement process in order to enable them to voice their opinions and concerns.

In addition, stakeholder identification and mapping consist of an on-going process, which requires regular review and update as the Project moves into the construction phase. It is expected that the Project Team will update this matrix based on feedback, as detailed in ***Section*** 8***.***

4.3 The Stakeholder Engagement Process

All stakeholder engagement activities will be informed by an iterative process of stakeholder identification, analysis and mapping. This process ensures that all relevant parties are considered as part of the engagement process. The stakeholder engagement process is illustrated in

Figure 4.2: Stakeholder Engagement Process

Source: ERM, 2018

4.4 Communication Methods and Consideration for Engagement

A variety of communication methods will be used throughout all engagement. The methods will be determined by the level and objective of engagement, as well as the target group. Communication materials will include: a) a presentation outlining the Project and ESIA process; and b) a Background Information Document that is left with stakeholders and provides more detail on the Project, the ESIA and IEE, stakeholder engagement and how to provide feedback. All engagement materials will be in the Myanmar language.

5. STAKEHOLDER ENGAGEMENT ACTIVITIES

5.1 Proposed Engagement Activities

In keeping with the applicable reference framework and the expectations of the stakeholders, the Project will undertake regular engagement with key stakeholder groups identified and occur throughout the Project cycle. The primary objective of these engagement activities is to allow for stakeholders to interact with, and contribute towards, project planning, in an effective and culturally appropriate manner. The engagement activities proposed, their frequency, location and *modus operandi* will be updated as required, based on the monitoring process and stakeholders feedback. Furthermore, the following table and engagement plan will not limit the project from interacting with the stakeholders when required.

The Project is divided into two (3) main phases; 1) pre-construction, 2) construction, and 3) operation phases. Based on the previous engagement activities and stakeholders' profile proposed engagement activities have been identified for the project going forward, as presented below.

5.1.1 Prior to Construction

Prior to construction and in conjunction with the ESIA and IEE process, it is important that stakeholders be consulted and informed about the Project and its development and potential impacts. Information should include:

- Approval of the ESIA and IEE and where to access the full report;
- Schedule of workers mobilisation and location of workers accommodation;
- Grievances mechanism channel and process; and
- Planned engagement schedule during the construction phase.

This is to ensure that stakeholders, especially those at Township and local levels, acknowledge and understand the scope of upcoming Project activities and also to provide opportunity to raise concerns and expectations.

5.1.2 Construction Phase

Engagement activities during the construction has are designed to seamlessly continue the engagement process as the Project transitions from the ESIA/IEE to construction. This will include engagement in the lead-up to and during the construction process.

The main objectives of the consultation process during the construction phase are to:

- Provide regular updates to stakeholders on construction activities, in particular activities that may cause disruptions (e.g. road disruption, noisy activities, etc.), changes to the construction schedule, and changes in the design;
- Identify new issues, concerns or needs of the Project affected communities related to construction and address them promptly;
- Provide resolution of community grievances in an expedited manner whenever possible;
- Help assess the effectiveness of the SEP, Environmental and Social Management Plans (ESMPs), and community development plan (CDP) through monitoring; and

Identify opportunities for the Project to make a sustainable contribution to local communities and Township. ***Table 5.1*** describes the main activities for consultation anticipated during construction.

Table 5.1: Engagement Activities – Construction

Engagement Activities	Details
Updates about the Project	Factsheet or newsletter made available to stakeholders, including Region and Township government offices as well as village tract or village representatives. Local media notices and updates of construction activities and progress. Establish a Project website for stakeholders and update regular with information on the Project.
Community relations activities	Consultation and disclosure activities will form part of day-to-day functions. Community relations staff will be in place throughout the life of the Project to maintain relationships with local communities and other stakeholders
Manage community issues and monitor community attitudes	Following initial consultation, continue ongoing community relation activities including meetings, group discussions, household visits, community perception surveys, as required to inform stakeholders and manage concerns.
Complaints handling and management	A formal grievance mechanism shall be introduced (***Section 7***).

Once the Project construction begins, the construction contractors may be the first point of contact with the PAP and Affected Communities on many issues during the construction period. TPMC will work closely with the construction contractors to ensure that communications are consistent and that information is provided on hiring opportunities and practices, local workforce training, worker camps and codes of conducts, and upcoming construction activities.

TPMC will remain in charge of stakeholder engagement although it will require construction contractors to have appropriate personnel who will undertake consultation activities in parallel, particularly in relation to providing information about construction schedule updates, local job opportunities and emerging issues related to their scope of work.

The frequency and method of engagement will vary based on the targeted audience and key messages to be presented. A tentative plan is outlined ***Table 5.2***; however, the frequency of engagement will be updated based on stakeholder feedback during the planning and approvals process of the engagement.

Table 5.2: Engagement Activities – Construction Phase

Stakeholder Group	Actions	Timing	Purpose
Government, Central Authorities	Progress updates via email or telephone	Bi-yearly*	Continue to engage with relevant authorities responsible for Project approval (e.g. reporting against management commitments)
	Progress updates via a face-to-face meeting	As required	
Government, Region and Township Authorities	Progress updates via email or telephone	Bi-yearly*	Continue to engage with authorities involved in the Project approval process
	Progress updates via a face-to-face meeting	As required	

Stakeholder Group	Actions	Timing	Purpose
Local Committees	Progress updates telephone	Quarterly*	Provide regular updates to authorities connected to local communities potentially impacted by the Project. This should include updates on Project schedule, ESMP implementation/ effectiveness, and local content opportunities.
	Progress updates via a face-to-face meeting	As required	
	Seek input on relevant management plans	As required	
	Notification in advance of undertaking noisy activities (e.g. pile driving)	As required	
	Notification in advance of transportation of heavy machinery	As required	
Villagers and Local Communities	Progress updates via telephone or factsheet distributed to the Village Tract and Village leaders	Monthly	Provide regular updates on progress to keep potentially impacted communities informed and provide opportunities for feedback, particularly in advance of any key changes or impacts by the Project. This should include updates on Project schedule, ESMP implementation/ effectiveness, and local content opportunities.
	Progress updates via a face-to-face meeting	Quarterly	
	Seek input on relevant management plans	As required	
	Notification in advance of noise activities (*Note: This may occur during the progress updates identified above*)	As required	

** Engagement may occur more frequently with government depending on the final approvals and the commitments made in the various management plans.*

Special measures will need to be taken to ensure that vulnerable groups are included in the engagement activities. This will involve working with Village Leaders to ensure that invitations are extended to vulnerable groups (e.g. women headed households) to participate. From time to time, this may involve undertaking face-to-face meetings with key vulnerable groups (e.g. women, elderly).

At the end of construction, a final construction phase engagement should be held with stakeholders. The purpose of this engagement is to provide:

- A final update on the monitoring results of the ESMPs;
- A review of the operation phase, including key impacts and management measures; and
- An update on the frequency at which engagement will occur during the operation phase.

Each group of stakeholders should be engaged at this stage, with particular attention given to the local resident. The level of intensity and tone to be given to this engagement should be determined by the Project team based on the previous construction and informal engagement activities.

5.1.3 Operation Phase

Consultation at this phase will focus on day-to-day operation of the Project. The main objectives of the consultation process during operation are to:

- Provide updates on the progress of the Project;
- Maintain constructive relationships with the communities adjacent to the Project facilities;
- Manage concerns and complaints from stakeholders;
- Monitor community attitudes towards the Project and TPMC; and
- Help assess the effectiveness of the SEP, ESMPs, and the CDP.

Table 5.3 describes the main activities for consultation anticipated during operation.

Table 5.3: Engagement Activities – Operation Phase

Engagement Activities	Details
Updates about the Project	Factsheet or newsletter made available to stakeholders, including Region and Township government offices. Local media notices and updates. Regular revision of information on the Project website.
Community relations activities	Consultation and disclosure activities will form part of day-to-day functions. Community relations staff will be in place throughout the life of the Project to maintain relationships with local communities and other stakeholders
Manage community issues and monitor community attitudes	Through a range of community relation activities including meetings, group discussions, household visits, community perception surveys.
Complaints handling and management	A formal grievance mechanism has been introduced (***Section 7***) and will continue through to the operational phase

5.2 Engagement Methods

The methods of engagement incorporate individual profiles, concerns, and expectations of the groups. The primary need for different modes of engagement is because different stakeholders require different approaches and methods of communication. Using the incorrect engagement methods may result in the failure of the engagement process in achieving its goals. The following methods have been identified for the purpose of this project ***Table 5.4***

Table 5.4: Engagement Methods

Engagement method	Description	Project phase		
		Pre- construction	Construction	Operation
Focus Group Discussions (FGD)	An FGD refers to a discussion carried out amongst a group of people (6 to 8) from a similar background/profile on a specific topic while being guided by a moderator. The primary purpose of such discussions is to gather insight into the thought process of the group in regards to a particular issue. Apart from FGDs, general discussions with either the community or individual representatives are also part of the engagement process. This method allows for the collective opinion of these groups to be captured and assessed. This method of consultation is imperative for the vulnerable groups because consultations that involve the entire community run the risk of some group's views dominating discussions. FGDs can be undertaken either at the villager's residences, the Project site office, or any other location agreed upon with the stakeholders. If a location apart from the villager's residence is chosen, it is good practice to consider the comfort of the stakeholders (e.g. provide food) and the discussions should be timed to allow the other stakeholder representatives to reach their residences before sunset.	x	x	
Semi-structured and Structured Interviews and Questionnaires	In semi-structured interviews and questionnaires, a pre-determined set of open questions or check points are used to gather information pertaining to specific themes or issues. Similar to the FGDs, these interviews can be undertaken either at the villager's residences, the project site office, or any other location agreed upon with the representatives.	x		
Public Meetings	These meetings and consultations not only form a part of certain regulatory requirements (such as public hearing) but also serve as useful tools for gathering information from larger groups. These meetings and consultations typically involve a notification (to publicise the matter to be consoled upon) and a consultation (a two way flow of information).	x	x	x
Information Disclosure	The disclosure process is not only part of certain regulatory requirements but also a requirement of the partners in the Project. The process of information disclosure can be undertaken in two manners, either voluntary disclosure or	x	x	x

Engagement method	Description	Project phase		
		Pre- construction	Construction	Operation
	disclosure as part of the regulatory requirements.			
Informal Engagement	Regular informal engagement by the Project team with stakeholders, particularly households within the local residents, helps to create, maintain and strengthen relationships and prevents grievances from escalating. Although informal, these engagement opportunities need to be captured in the stakeholder database. There is a risk that commitments or promises made during informal engagement opportunities that are not followed through (because they are not captured in minutes of meetings or other similar record). To reduce this risk, outputs should be captured in the stakeholder database and engagement should be undertaken by trained individuals.	x	x	x

Note: Additional examples of engagement methods are Face-to-face individual meeting, Face-to-face group meeting, workshops, Correspondence (i.e. phone, letter, email), and website. Methods will be tailored to fit the stakeholders' profile.

5.3 Stakeholder Database

Implementation of this SEP will be supported by a stakeholder database. A stakeholder database is a tool that can be used to track stakeholder activities and grievances. The stakeholder database will help track the following information:

- The stakeholder – i.e. an organisation or individual;
- A contact person's name and position or title;
- Contact details – i.e. address, telephone, email, website;
- The main interests / issues / concerns of the organisation as they may relate to the Project; and
- Details of engagement activities – i.e. date, location, attendees and key issues raised – and responses/actions agreed.

The outputs from the mapping process (***Section 4.2***) should be captured in the stakeholder database as well as the outputs from the engagement activities described in ***Section 5.2***, above. This will help ensure that issues and concerns are captured and can be fed into decision-making process, and that commitments made are met.

6. DISCLOSURE MECHANISM

The process of information disclosure can be undertaken in two manners, either voluntary disclosure or disclosure as part of the regulatory requirements (EIA requirements, public hearing). While regulatory disclosure involves the provisioning of information as required by the authorities and agencies involved in the project, voluntary disclosure refers to the process of disclosing information to the various stakeholders in a voluntary manner. This disclosure allows trust building among the stakeholders and more constructive participation in the other processes of consultation and resolution of grievances due to availability of accurate and timely information. One of the most critical components of the disclosure process is the disclosure of project process, and receiving feedback from the stakeholders.

Disclosure should be provisioned in a timely and accessible manner to various stakeholders in a project. All information disclosure will be undertaken in both Myanmar and English languages. It is essential to ensure that any disclosure undertaken is done in a manner that allows stakeholders to comprehend the information being shared and participate in the feedback process.

7. GRIEVANCE REDRESS MECHANISM

The Grievance Redress Mechanism (GRM) is another critical component of effective stakeholder engagement. The GRM will be accessible and understandable for all stakeholders, for the entire project life. The GRM will be communicated to all relevant stakeholders and will also be applicable to any contractor that will occupy and/or use land during the construction and operation phases.

The main objectives of the GRM are:

- To address grievances promptly and effectively, in a transparent manner resulting in outcomes that are seen as fair, effective and lasting;
- To provide grievance forums that are culturally appropriate and readily accessible to all PAPs (both internally and externally) to voice their opinions, suggestion, concerns, queries and issues with the project.;
- To build trust as integral component of the Project community relations activities; and
- To enable a systematic identification of emerging issues facilitating correcting actions and pre-emptive engagement.

This section defines grievances and categories, GRM principles, and the process of receiving, documenting, addressing and closing grievances.

7.1 Grievance Definition and Categories

A grievance is a concern or complaint raised by an individual or a group within communities affected by the Project or company's operations. Both concerns and complaints can result from either real or perceived impacts of a Project or company's operations, and may be filed in the same manner and handled with the same procedure. Grievances may take the form of specific complaints for actual damages or injury, general concerns about project activities, incidents and impacts or perceived impacts.

Based on the understanding of the Project area and the stakeholders, an indicative list of the types of grievances have been identified for the project, as can be seen below:

- **Internal Grievances:** Grievances from Employees (including both direct and indirect employees, including local workers and migrant workers through contractors):
  - Complaints pertaining to amount of wage, salary, other remuneration or benefits as per Company's human resource policy;
  - Timely disbursement of remuneration;
  - Gender discrimination;
  - Issues related to worker's organisation;
  - Labour accommodation;
  - Health and safety issues; and/or
  - Extended working hours.
- **External Grievances**
  - Damage of trees and property;
  - Issues related to transportation and traffic;
  - Increase in environment pollution;
  - Impact on community health;
  - Disturbances to locals due to influx of migrant workers in the area;

- Issues arising out of sharing of employment and business opportunity; and/or
- Concerns over the impact on local cultures and customs.

The indicative list of grievances will be regularly updated as and when the new one arises.

7.2 The Process

The guiding principles of the ESIA feedback mechanism, including the five key steps through which it operates and the communication and feedback channels available to stakeholders**.** These elements of the feedback mechanism will be clearly explained to all stakeholders during engagement activities at all Project phases.

All feedback that is gathered will be recorded in a stakeholder database in which relevant responses or resolutions will also be recorded. The feedback evaluation form will be used to identify and analyse issues, including any unforeseen issues. A detailed stakeholder database has the advantage of strengthening the continuity of the Project, building on the experience and lessons learned from the stakeholder engagement process, and understanding stakeholder needs and expectations.

The GRM consists of five (5) steps (see ***Figure 7.1***):

1. **Receive stakeholder grievances** throughout the different Project stages in writing. This includes face-to-face meeting, written communication, and telephone. The Project's contact details, including physical address, email address and telephone number, have been communicated at all public participation meetings as well as on the website and in the brochures handed-out to stakeholders.

   Grievances will be registered in the stakeholder database by a TPMC public relations team member. The TPMC public relations team member will provide the complainant with a **verbal acknowledgement** of the receipt of the complaint within 3 working days (phone call, text message, or a meeting) and a written acknowledgement within 10 days (email or letter). If the grievance is not well understood or if additional information is required, clarification should be sought from the complainant during this step.

2. **Grievance is screened and assessed** within 5 days of receipt. The significance of the grievance will then be assessed using the criteria in Box 7.1.

   If the grievance is related to the Project and can be resolved locally then proceed to the next step.

   If the complaint is not related to the Project, then it is to be refer to the relevant government department or organisation as appropriate, reject the complaint, and communicate decision to the complainant with the explanation.

Box 7.1: Significance Criteria

Level 1 Complaint: A complaint that is isolated or 'one-off' (within a given reporting period - 1 year) and essentially local in nature (e.g. light traffic accident involving construction vehicle).

Note: Some one-off complaints may be significant enough to be assessed as a Level 3 complaint e.g. when a national or international law is broken (see Level 3).

Level 2 Complaint: A complaint that is widespread and repeated (e.g. dust from construction vehicles).

Level 3 Complaint: A one-off complaint, or one which is widespread and/or repeated that, in addition, has resulted in a serious breach of Myanmar policies or National law and/or has led to negative national/international media attention, or is determined to have the potential to generate negative comment from the media or other key stakeholders (e.g. inadequate waste management).

3. Notify relevant Project Team of the grievance and investigate the grievance.

4. **Develop resolution** options no later than 15 days after acknowledging the grievance. The response is signed-off by the Managing Director (MD) for level 3 grievances and TPMC public relations team for Level 2 and Level 1. The TPMC public relations team will ask the complainant for written acceptance of the resolution (or verbal if the complainant has difficult reading/writing) for close off.

   If the complainant does not accept the proposed solution, the relevant Project Team should look for new or additional corrective actions. Alternatively, the relevant Project Team can introduce an independent third party as a mediator to facilitate in order to achieve an agreeable resolution. As the last resort, the complainant can take action in a court of law.

5. Once the resolution is accepted by the complainant, **the solution is implemented.** Where possible, the resolution should be implement within 15 days after the resolution is accepted by the complainant. Following implementation of the solution, the complainant should be notified.

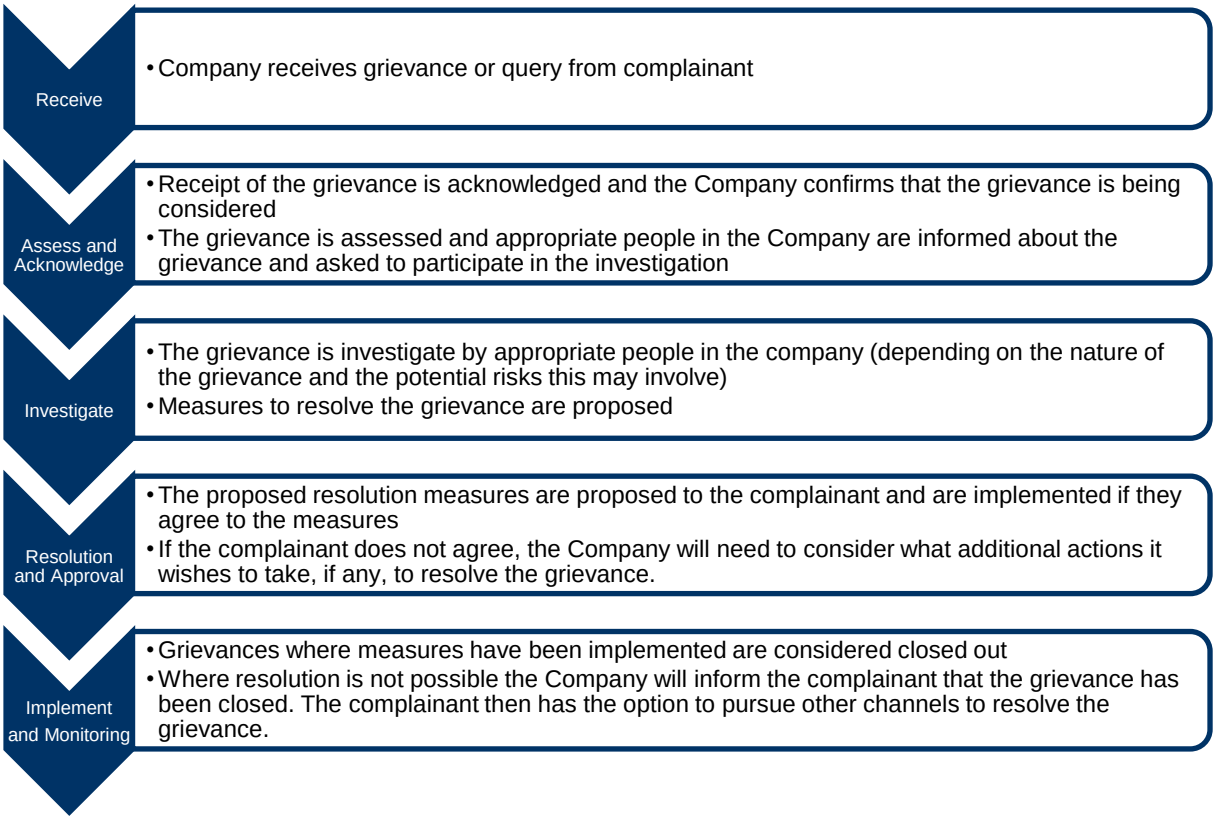
   For solutions that take longer than 15 days to implement, where the complainants are not satisfied with the resolution, or additional corrective actions are required, the relevant Project Team will inform the complainant of the progress on a regular basis (e.g. weekly or monthly, as agreed with the complainant) until the solution is completely implemented. The complainant should be notified after the solution is implemented.

6. **Monitor, document the grievance resolution process and close the grievance** with sign-off from the team with Managing Director approval to close out level 3 grievances. A grievance close-out form will be used. If further attention is required, the TPMC public relation team should return to Step 2 to re-assess the grievance.

All correspondence related to the grievance must be documented in the stakeholder database for monitoring, reporting and learning. This will help drive continual improvement.

TPMC should also consider contacting the complainant at a later stage to ensure that there are no further problems. If there is a residual problem, the issue should be treated as a new grievance and recorded as such in the stakeholder database.

Figure 7.1: Grievance Mechanism



Source: ERM, 2020.

8. Monitoring and Reporting

8.1 Monitoring Stakeholder Engagement Activities

To ensure that the desired outcomes are being achieved, stakeholder engagement will be monitored throughout the Project life. This will be supported by the records kept in this SEP (stakeholder database).

The stakeholder engagement process will be monitored through two methods:

1. Review of engagement activities in the field:

- During engagement with stakeholders the Project team will assess meetings using a feedback evaluation form or by asking questions to participations, to ensure that information is being conveyed clearly.
- Responsible Project teams will conduct debriefing sessions with the engagement team to assess whether the required outcomes of the stakeholder engagement process are being achieved, and to provide the opportunity to amend the process where necessary.

2. Systematic, formal evaluation will occur on an annual basis. This will involve a review of the information captured in the stakeholder database, including stakeholder feedback and grievances.

8.2 Evaluation of Stakeholder Engagement Activities

Performance will be reviewed on an ongoing basis to determine the effectiveness of the SEP, including the efficacy of the engagement methods being used and the accuracy of the stakeholder mapping process.

A formal evaluation will conducted annually, during which the performance indicators set out in ***Table 8.1*** will be used to determine the extent to which the objectives of the SEP have been met.

Information from the stakeholder database and formal/informal feedback from stakeholders will be used to assess against the performance indicators. The evaluation results will be used to update the SEP, and inform changes in the engagement process, as needed. The SEP review will also provide a timely opportunity to review the stakeholder mapping results to ensure that the stakeholder mapping remains accurate. Updated version of the SEP may also be made available to key external stakeholders upon request.

Table 8.1: Performance Indicators

Objectives	Performance Indicators
Stakeholders are provided with information about the Project in a timely manner	■ Number of materials disseminated ■ Number of people attending engagement opportunities ■ Comments received on engagement materials, positive or negative
Stakeholders have an opportunity to share their views and concerns about the Project development	■ Number and type of engagement opportunities provided ■ Topics of engagement activities ■ Attendance rates and level of participation ■ Accessibility of the engagement opportunities ■ Numbers of grievances related to lack of opportunity to participate in Project development
Informed participation by Vulnerable Groups	■ Number and type of engagement opportunities provided to vulnerable groups ■ Attendance rates and level of participation ■ Accessibility engagement opportunities ■ Representation of sub-groups
Positive working relationships are built and maintained over time	■ Number and type of grievances lodged by stakeholders ■ Number of satisfactorily closed out grievances ■ Percentage of stakeholders taking part in engagement efforts ■ Community attitudes and perceptions

Objectives	Performance Indicators
Engagement continues to be transparent, inclusive and appropriate throughout the Project lifecycle	■ Number and type of engagement opportunities provided ■ Representation of vulnerable groups in engagement opportunities ■ Number and type of grievances lodged by community members ■ Community attitudes and perceptions ■ Number of visitors to the Project website

8.3 Reporting Stakeholder Engagement Activities

The annual reports will allow the Project to track the status of the SEP implementation and to address any pressing issues/concerns in a timely manner. The TPMC Public Relations team will create a monthly grievances report for internal purposes, and consolidate stakeholder engagement activities on a six monthly basis.

The reports should include:

- Total number of stakeholders engaged in each group;
- Geographical location of such engagement activities;
- Key concerns and risks identified and reasons for the concerns and risks;
- Actions taken to address these concerns and report back to the people in the next engagement phase; and
- Recommendations developed to improve stakeholder engagement and/or the SEP.

Community engagement is vital in building trust and respect with stakeholders. Letting affected people and interested parties know what has happened with the feedback provided during consultation, the importance of their contribution to the project, and what the next step will be, is not only a good practice, but also a common courtesy.

Reporting back to the community also has other benefits such as: double checking information, observing stakeholder's reaction to the proposed mitigation measures, and obtaining further feedback to refine the measures before implementation.

Outcomes of the reporting process will be shared with stakeholders via existing engagement channels.

9. ROLES AND RESPONSIBILITIES

The TPMC Public Relations team will lead the stakeholder engagement work, and implementation and monitoring of the SEP. To be specific, the TPMC public relations team will be responsible for:

- Being the interface between TPMC and the Project stakeholders;
- Hiring, training, and deploying staff to undertake stakeholder engagement work;
- Having oversight of the SEP;
- Monitoring and reporting on the SEP, including updates (as required) to the stakeholder mapping results and the tools used to engage with stakeholders; and
- Communicating with Contractors to ensure their engagement activities are in accordance with the SEP.

The team will ensure that the SEP is implemented and that grievances are resolved in a timely manner. The Managing Director (MD) will be responsible for approving the SEP, including the annual budget required for implementation.

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APPENDIX V STAKEHOLDER ENGAGEMENT PLAN

AHLONE 2

Environmental Control and Management Plan

PROJECT DOC. NO. F050-MNL-024

LNG POWER PLANT (AHLONE) PROJECT

TTCL JOB NO. F-050

Total (Including this Page): 56 sheets

0	26-Sep-19	For Information	Phakin P.	Nimit A.	Anuchit P.	Peerapat T.
REV.	DATE	DESCRIPTION	MADE	CHECKED	APPROVED	AUTH'D

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TTCL PUBLIC COMPANY LIMITED

Revision History Sheet

Rev.	Date	Description
0	September 26, 2019	For Information

CONTENTS

1. SCOPE

This plan describes the Environmental control and management compliance activities for CONTRACTOR and SUBCONTRACTORS, during construction, commissioning until Commercial Operation Date (COD) of LNG POWER PLANT (AHLONE) PROJECT. This plan addresses field implementation and controls for environmental management as well as the processes for monitoring and mitigation of construction activities that could potentially impact the environment.

This plan will be updated if conditions or environmental aspects are changed. In addition, environmental issues are governed by laws and local regulations.

2. PURPOSE

The purpose of this plan is to achieve of the HSE objectives of project and to comply with environmental legal and applicable requirements. The Environmental Control & Management Plan has been prepared in conformance with ISO 14001:2015 requirements. The key purpose of Environmental Control & Management Plan is to:

- Ensure compliance with environmental requirements of "LNG POWER PLANT (AHLONE) PROJECT"
- Implement HSE Policy.
- Minimize the potential impact from construction & commissioning work to the environmental and community.

3. DEFINITION& ABBREVIATION

3.1 DEFINITION

"CONTRACTOR" means **TTCL PUBLIC COMPANY LIMITED (TTCL)** and **TTCL MYANMAR ENGINEERING AND CONSTRUCTION COMPANY LIMITED (TTMEC)** who perform the "Engineering Procurement and Construction (EPC) of the project.

"OWNER" means **TTCL POWER MYANMAR COMPANY LIMITED (TPMC)** who employ CONTRACTOR in connection with the "Engineering Procurement and Construction (EPC) of the project.

"SUBCONTRACTOR(S)" means the subcontractor(s) employed by CONTRACTOR or OWNER in connection with the construction of the project.

"Sensitive receptor**"** means residential premises, school or other locations that are susceptible to disturbed impact from project site activities.

3.2 ABBREVIATION

PM	Project Manager
CM	Construction Manager
HSEM	Occupational Health, Safety and Environmental Manager/Leader
EMS	Environmental Management System
IEE	Initial Environmental Evaluation
EIA	Environmental Impact Assessment
HSE	Occupational Health, Safety and Environment

4. STANDARD AND REGULATION

4.1 General

The project shall be constructed and commissioned in accordance with the following principles:

(1) Compliance with all applicable legal requirements and regulatory constraints for environmental protection mandated by applicable Myanmar environmental laws, International standards and guidelines.

(2) Compliance with additional environmental requirements as specified by the contract scope of service.

(3) Minimization of negative impacts on the environment with respect to releases to air, water and land including sensitive receptor.

(4) Prohibition of products which create or consist with Greenhouse gas such as Halons, CFCs, PCBs, and asbestos using on the project site construction for any purpose unless its absence would "cause immediate loss of life, which would have a probability of occurrence greater than that, which is normally acceptable". Any proposed use (e.g. where no suitable alternative exists) shall be submitted to CONTRACTOR for approval.

4.2 Myanmar Regulations, ESIA mitigation measure and International Standard(ISO14001:2015 requirements)

A copy of applicable Myanmar laws and regulations will be kept at the HSE department at project site. CONTRACTOR will work within the framework of all relevant legislation and standards and all SUBCONTRACTORS must apply these laws and requirements as well.

CONTRACTOR and SUBCONTRACTORS are responsible for ensuring they obtain and comply with Myanmar Authorities permits , ESIA mitigation measure and International Standard.

5. ORGANIZATION AND RESPONSIBILITY

5.1 General

All personnel of **LNG POWER PLANT (AHLONE) PROJECT** shall be responsible to follow all applicable laws and regulations and conduct their work in accordance with all permit requirements and this procedure.

5.2 CONTRACTOR and SUBCONTRACTORS

CONTRACTOR and SUBCONTRACTORS will comply with all project environmental requirements relevant to their scope of work. CONTRACTOR and SUBCONTRACTORS are responsible to read and understand all relevant environmental documents, adhere to **LNG POWER PLANT (AHLONE) PROJECT** environmental requirements, and perform all their work in accordance with these requirements as detailed in Sections 1.0: Scope and 4.2.: Myanmar Regulations , ESIA mitigation measure and International Standard(ISO14001:2015 requirements). CONTRACTOR has the responsibility to formally communicate the requirements applicable to their work to their personnel and lower-tier subcontractors.

6. ENVIRONMENTAL MANAGEMENT CONTROL

6.1 Environment awareness & knowledge training

In the orientation training, there are sections on environmental protection and related knowledge including;

(1) SDS : Safety Data Sheet
(2) Hazardous material storage and transportation
(3) Waste separation and transportation to waste temporary storage area
(4) Noise control

The environment awareness and knowledge communication will be continued through the environment posts and HSE weekly topics. Issues, which have been addressed during environmental awareness, will include:

(1) Awareness of the EMS and its importance;
(2) Environmental protection - protect the environment from the effects of construction by making personnel aware of sensitive environmental resources on or near construction site.
(3) Regulatory compliance – complying with Myanmar regulations, , ESIA mitigation measure and International Standard(ISO14001:2015 requirements), permits, and other project requirements,

(4) Problem recognition and communication – training personnel to recognize potential environmental problems (e.g., spills, improper waste management) and to communicate the problem to the right person for resolution,

(5) Liability control – demonstrating that noncompliance with regulatory requirements can lead to personal and corporate liability,

(6) Environmental compliance reviews/coordination meetings. Typically, these meetings will conduct as part of project weekly progress review meetings.

6.2 Environment Compliance Inspections

CONTRACTOR shall implement the environmental impact mitigation and control measures in order to comply with Environmental Impact Assessment (EIA) of LNG POWER PLANT (AHLONE) PROJECT. Environmental compliance inspections are a necessary part of an overall environmental compliance program.

CONTRACTOR and SUBCONTRACTORS will perform and document periodic inspections to verify that the environmental requirements are being implemented during construction and commissioning period. Inspection will be carried out weekly as per environmental impact mitigation measure audit checklist form (ATTACHMENT 1). If necessary, "stop work" orders will be issued via CONTRACTOR HSEM.

6.3 Environmental Auditing

CONTRACTOR audit team and SUBCONTRACTORS will undertake regularly auditing of the EMS on weekly basis. SUBCONTRACTORS will provide all necessary assistance by performing audit their activities.

6.4 Environmental Resource Monitoring

OWNER may engaged Third Party Environmental Monitoring Service Contractor to perform environmental monitoring, within their scope of work, as dictated by Environmental Impact Assessment (EIA) of LNG POWER PLANT (AHLONE) PROJECT and permit requirements.

7. ENVIRONMENTAL REQUIREMENT

7.1 Air Quality Control

Air quality impact on sensitive receptor has been identified & evaluated as the Environmental Aspects Identification and Impacts Determination including mitigation measures as following;

Dust Control

The major potential dust emission sources are anticipated to include, but not limited to:

- General surface earthworks during site preparation.
- Excavation and Trenching work.
- Vehicle movement on the worksite over unpaved surface area.
- Tracking of dirt onto roads resulting in offsite.
- Concrete Cutting or Concrete Finishing work activities.
- Construction Traffic.

Construction & Commissioning dust monitoring and reporting will be undertaken in accordance with the Project EIA or IEE requirement.

Construction staffs to be properly trained as appropriate in order to follow suitable measures to minimize emission.

The table as below describes mitigation and control measures which are used to minimize particulate dust emission. The table summarizes the potential environmental impacts occurrence as relevant Environmental Aspects Identification and Impacts Determination (QP-690).

Location	Potential Impact	Mitigation Measure
LNG Terminal/Pipe line/Power Plant	Dust emissions from project activities have the potential to impact to air quality, human health, and ecology	1) Develop and Implement a Dust Management Plan (DMP) detailing mitigation measures and a plan for implementation. 2) Watering will be used to suppress wind and physical disturbance dust generation. 3) Ensure an adequate water supply on site for effective dust suppression and mitigation. 4) The site layout will be planned so that dust-causing activities are located away from receptors as far as is possible. 5) Screens or barriers will be erected around dusty activities or the site boundary that are at least the height of any stockpile on site. 6) All stockpiles will be covered or fenced off to prevent wind whipping. 7) Only cutting, grinding, or sawing equipment fitted with suitable dust suppression techniques such as

Location	Potential Impact	Mitigation Measure
		water sprays will be used. 8) All chutes, conveyors and skips will be covered at all times. 9) Drop heights from conveyors, loading shovels and hoppers will be minimised. 10) No waste will be burned on site. 11) Re-vegetate earthwork and exposed areas as soon as is practicable. 12) Use hessian, mulches or trackifiers where it is not possible to revegetate, or cover with top soil as soon as is practicable. 13) Sand and other aggregates will be stored in bunded areas and will not be allowed to dry out unless this is required for a particular process, in which case additional control measures such as those detailed in this section will be applied. 14) Ensure that all vehicles entering and leaving the site are covered to avoid fugitive emissions during transport. 15) Inspect on-site haul roads for integrity and instigate the necessary repairs to the surfaces as soon as reasonable practicable. 16) Implement a wheel washing system. 17) Regularly dampen and clean the site access and local roads to remove any materials tracked out of the site. 18) All site access gates will be located at least 10m away from air sensitive receptors where possible. 19) The site layout will be planned so that machinery is located away from receptors as far as is possible. 20) All vehicles will switch off engines when stationary. 21) A regular vehicle and machinery

Location	Potential Impact	Mitigation Measure
		maintenance and repair programme will be implemented. 22) Mains electricity or battery powered equipment will be used instead of diesel/petrol generators where practicable.

7.2 Greenhouse gas

The major potential vehicle emission sources are anticipated to include, but note be restricted to:

- Machinery& Vehicle exhaust emissions at engine startup and during operating.
- Machinery& Vehicle running or idling when not used.

Location	Source of Impact	Mitigation Measure
LNG Terminal/Pipe line/Power Plant	Impact on climatic condition due to GHG emissions.	1) Implement the same mitigation measures to minimize impacts to Air Quality. 2) Develop and implement preventive maintenance plan for machines, and engines to ensure combustion efficiency. 3) Develop vehicle and machine maintenance plan.

7.3 Noise Control

- The major potential noise sources are anticipated to include, but not limited to:
- General surface earthworks, vehicle transportation
- Excavation work, piling work, grinding work (construction activities).
- Air blowing, steam blowing (commissioning activities).
- The majority approved permit to work (PTW) of night work are low-noise activities with low environmental noise risk to surrounding receptors.
- Regular noise levels audits and tests will be carried out by trained competent personnel using a calibrated noise level meter to record noise levels site wide and enable OWNER/CONTRACTOR to take timely to prevent noise pollution in the environment.
- The table as below describes mitigation and control measures used to minimize and manages potential noise impact. The table summarizes the potential environmental impacts of will be occurrence as relevant with Environmental Aspects Identification and Impacts Determination.

Location	Project Activity and affected area	Mitigation Measure
LNG Terminal/Pipe line/Power Plant	Transportation and operation of workers, equipment and materials.	1) Schedule transportation of materials evenly throughout the day (to minimize accumulative noise impact from multiple noise sources); 2) Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components should be conducted; 3) Avoid transportation of materials on- and off-site through existing community areas. 4) Workers operating near loud equipment/machines will wear appropriate PPE equipment.
LNG Terminal/Pipe line/Power Plant	Foundation work and civil constructions	1) Noise barriers should be installed at the site boundary (facing the villages) and high enough which completely hides the noise sources from the NSR. It is anticipated that at least a 10 dB(A) noise reduction can be provided[1]. The noise barrier material should have a superficial surface density of at least 7 kg/m^{-2} and have no openings or gaps; 2) Well-maintained equipment to be operated on-site; 3) Normal working hours of the contractor should be between 07:00 and 17:00 hours from Monday to Saturday (except holiday). If work needs to be undertaken outside these hours, it should be limited to activities that do not lead to exceedance of noise criteria at nearby NSRs and avoid early morning and night time construction; 4) Regular maintenance of equipment such as lubricating moving parts,

Location	Project Activity and affected area	Mitigation Measure
		tightening loose parts and replacing worn out components; 5) Shut down or throttled down between work periods for machines and construction plant items (e.g. trucks) that may be in intermittent use ; 6) Reduce the number of equipment operating simultaneously as far as practicable; 7) Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable; 8) Locate noisy plant (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable; 9) Avoid transportation of materials on- and off-site through existing community areas; and 10) Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site construction activities.
Power Plant	Per-commissioning, commissioning, and testing	11) Noise barriers should be installed at the site boundary (facing the closest NSRs) and high enough which completely hides the noise sources from the NSR. It is anticipated that at least a 10 dB(A) noise reduction can be provided. The noise barrier material should have a superficial surface density of at least 7 kg/m^2 and have no openings or gaps; 12) Well-maintained equipment to be operated on-site; 13) Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components; 14) Reduce the number of equipment

Location	Project Activity and affected area	Mitigation Measure
		operating simultaneously as far as practicable; 15) Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable; 16) Locate noisy plant (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable;

7.4 Surface Water Quality Control

According to the CONTRACTOR environmental aspect has been identified & evaluated the following circumstance that could cause contamination of offsite waterway:

- Water and soil contamination are caused by fuel or oil spill,
- Run Off water contaminated suspended solid,
- Dewatering water during excavation work,
- Hydrostatic test,
- Water flushing work.

Discharge water quality from project site must comply in accordance with legal requirement.

Surface water& groundwater monitoring during construction & commissioning phase must be conducted in order to comply with project site EIA or IEE requirement. Monitoring must be undertaken by Third Party qualified Company (Project Environmental Consultant) in accordance with appropriate standards and guideline as specified in EIA or IEE and law.

The table below describes mitigation and control measures which used to minimize and manage potential waste water impact. The table summarizes the potential environmental impacts occurrence as relevant with Environmental Aspects Identification and Impacts Determination.

Location	Project Activity and affected area	Mitigation Measure
LNG terminal	Water Intake Requirements during construction phase	1. Not required
Pipe line	Water discharge from hydrostatic testing	2. Implement a hydrostatic test monitoring plan; 3. After the hydrostatic testing is

Location	Project Activity and affected area	Mitigation Measure
		complete, analyse the test water for contamination and appropriately treat before it is returned to the environment. Alternatively, the water can be treated/ disposal/ treatment company; 4. Ensure minimum erosion during discharge of hydrostatic test water; 5. Carry out monitoring and reporting of water consumption; 6. Reduce water need by optimizing the hydrostatic testing operation.
LNG terminal / Pipe line/Power Plant	Sedimentation caused by soil erosion during construction activities	7. Install silt trap to treat surface run-off from bunded areas prior to discharge to the stormwater system; 8. Exposed soil surfaces should be protected by paving or fill material as soon as possible to reduce the potential of soil erosion and subsequent sedimentation; 9. Use methods for minimising sediment runoff, as appropriate to the conditions on-site, including: wheel cleaning facilities, sand bag barriers, mulching, and re-vegetation, protect temporary trafficked areas on-site with coarse stone ballast or equivalent, open stockpiles of construction materials or construction wastes on-site should be covered with tarpaulin or similar fabric during rainstorms; 10. Regularly, and particularly following rainstorms, inspect and maintain drainage systems and erosion control and silt removal facilities to ensure proper and efficient operation at all times; and 11. Surface run-off from bunded areas should pass through oil/water separators prior to discharge to the storm water system.
LNG terminal/Power	Sedimentation caused by	12. Evenly spread out the scheduling of

Location	Project Activity and affected area	Mitigation Measure
Plant	piling activities	piling activities to reduce the potential amount of sedimentation caused during one pilling session.

7.5 Soil and Groundwater

This section presents an evaluation of the potential impacts on soil and groundwater associated with the construction and operation of the proposed LNG Receiving Terminal based on the impacts identified during scoping. During the construction and operation phases, various LNG Receiving Terminal activities have the potential to change soil structure, and generate wastewater or accidental leaks, which could potentially lead to impacts on the quality of soil, or to groundwater due to leaching.

Potential impacts that have been identified and will be assessed under the soil and groundwater impact assessment include the following:

- Accidental leaks of cold water from the regasification unit; and
- Loss of soil due to improper management during site clearance and excavation activities.

This section also presents management, mitigation and monitoring measures needed to ensure that any identified impacts can be reduced to as low as reasonably practical. Such measures will form part of the Environmental and Social Management Plan for the LNG Receiving Terminal.

The table below describes mitigation and control measures which used to minimize and manage potential impact. The table summarizes the potential environmental impacts occurrence as relevant with Environmental Aspects Identification and Impacts Determination.

Location	Project Activity and affected area	Mitigation Measure
Pipe line	Water Leakage from Hydrostatic Testing	1. Control erosion through diversion drains, sediment fences, and sediment retention basins; 2. Drain all hydrostatic testing fluid at the designated discharge point as soon as possible, once all leaks have been identified, to minimize soil erosion.
Pipe line	Loss of containment of the sending and receiving station for HDD	3. Place/install a buffer zone (such as sandbags, trenches, or other appropriate barriers) around the sending and receiving pits to reduce the potential of soil contamination in adjacent area;

Location	Project Activity and affected area	Mitigation Measure
		4. Place the sending and receiving station at least 7.5 metres from any water source, to reduce the effect from leakage. 5. Use mobile pumps, vacuum trucks, and other appropriate equipment to clean any bentonite spills; 6. Stop HDD activities, and other associated activities until the spill has been cleaned; 7. Re-evaluate appropriate drilling pressure for the specific area conditions before continuing HDD activities; 8. Conduct preventive maintenance for HDD and spill clean-up equipment; 9. Use sandbags to quarantine any bentonite spills beyond the planned buffer zone; and 10. Spill response plans should be prepared and implemented to address the potential accidental release of bentonite.
Pipe line	Loss of containment of waste bentonite storage	11. Use appropriate waste containers and build secondary containment around chemical or waste storage on-site to avoid spillage or leakage of bentonite; 12. Obtain permission from the land owner to use selected land for bentonite waste storage; 13. Provide waste sub-contractor or land owner with the bentonite MSDS, and the bentonite's properties, such as Electrical Conductivity (ECe), Exchangeable Sodium, and Exchangeable Sodium Percentage; 14. Ensure bentonite waste storage is not located on agricultural, and aquaculture land; 15. Ensure bentonite waste storage is at

Location	Project Activity and affected area	Mitigation Measure
		least 30 metres away from any groundwater sources; 16. Spill response plans should be prepared and implemented to address the potential accidental release of bentonite; 17. Prepare only the require amount of bentonite needed for HDD activities, to prevent excess amounts of bentonite to be disposed
Pipe line/Power Plant	Improper management during site clearance and excavation activities	1. Delineation of clearance boundaries to limit the areas to be cleared; 2. Scheduling clearance activities (if possible) to avoid extreme weather events such as heavy rainfall, extreme dry and high winds; 3. Re-vegetation areas with temporary land use, conducting progressive rehabilitation; 4. Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers; 5. Reuse topsoil as much as possible within rehabilitation activities; 6. Control erosion through diversion drains, sediment fences, and sediment retention basins; 7. Where topsoil is to be stored for later use in rehabilitation activities, the following basic principles are to be applied: a. Stockpiles to be separated into topsoil and sub-soil and be located at least 50m from any surface water source or groundwater well; b. To the extent possible, stockpiles are to be located in areas surrounded by natural wind barriers to minimise the potential for wind erosion;

Location	Project Activity and affected area	Mitigation Measure
		c. Stockpile storage areas are to be prepared in advance of the removal of topsoil as much as possible; and d. Topsoil heights are to be restricted in height to 2m above ground level to minimise wind erosion, and they are only to be partially compacted on the upper layer in order to promote aeration, maintain soil vertical structures, reduce runoff and encourage infiltration.
LNG Terminal	Improper management during site clearance and excavation activities can lead to loss of soil.	18. Delineation of clearance boundaries to limit the areas to be cleared; 19. Scheduling clearance activities (if possible) to avoid extreme weather events such as heavy rainfall, extreme dry and high winds; 20. Re-vegetation areas with temporary land use, conducting progressive rehabilitation; 21. Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers; 22. Reuse topsoil as much as possible within rehabilitation activities; 23. Control erosion through diversion drains, sediment fences, and sediment retention basins; and 24. Where topsoil is to be stored for later use in rehabilitation activities, the following basic principles are to be applied: 25. Stockpiles to be separated into topsoil and sub-soil and be located at least 50m from any surface water source or groundwater well; 26. To the extent possible, stockpiles are to be located in areas surrounded by natural wind barriers to minimise the potential for wind erosion;

Location	Project Activity and affected area	Mitigation Measure
		27. Stockpile storage areas are to be prepared in advance of the removal of topsoil as much as possible; and 28. Topsoil heights are to be restricted in height to 2m above ground level to minimise wind erosion, and they are only to be partially compacted on the upper layer in order to promote aeration, maintain soil vertical structures, reduce runoff and encourage infiltration.

7.6 Landscape and visual impact

Visual screening e.g. surround perimeter of site with native trees (can be compensatory trees for any felled during construction);

- Maintain soft landscaping (i.e. tree, low shrub and ground cover planting) within available space in the project site;
  - Minimise overall lighting use and manage lighting on site to consider minimization of light pollution and horizon glow;
  - Identify zones of high and low lighting requirements and contain light to areas that need illumination most;
  - Prevent light spill/ glare with shielding i.e. All security and street/road lighting shall have “blinkers” or be specifically designed to ensure light is directed downwards while preventing side spill;
  - Prevent light spill/ glare with directional lighting to focus on necessary area/object (e.g. reduce the height from which floodlights are fixed and with the focus of the lights being inward, rather than outward);
  - Keep light intensity to as low as reasonably practicable;
  - All external light fittings shall not allow light to shine upwards;
  - Area lighting on any tall buildings/ masts should be confined to the lower landform elevations.
- Maintain all structural facilities in good repair;

The table below describes mitigation and control measures which used to minimize and manage potential visual impact. The table summarizes the potential environmental impacts occurrence as relevant with Environmental Aspects Identification and Impacts Determination.

Location	Project Activity and affected area	Mitigation Measure
LNG Terminal/ Pipe line / Power Plant	Earthworks, light emissions, disturbance and physical presence of new facilities	1. Provide soft landscaping (i.e. tree, low shrub and ground cover planting) within available space within the Project Site. Plant as soon as practical during construction phase; 2. Minimize the extent of construction areas, including for dredging and including temporarily affected areas; 3. Minimize clearing of vegetation as far as practical. Existing large trees (if any) should be retained as far as practical. Those that fall outside the earthworks area must be retained. Felled trees should be compensated for where possible; 4. Reinstatement of temporarily affected areas which will no longer be required for the operational stage (e.g. contractor camp, laydown areas, etc.), to suitable pre-construction condition as soon as practical after use (e.g. using landscaping with suitable vegetation).

7.7 Biodiversity

The table below describes mitigation and control measures which used to minimize and manage potential impact to biodiversity. The table summarizes the potential environmental impacts occurrence as relevant with Environmental Aspects Identification and Impacts Determination.

Location	Project Activity and affected area	Mitigation Measure
LNG Terminal/Pipe line	Impacts to biodiversity values (habitats and species) due to permanent and temporary habitat loss	1. Strict rules against clearing vegetation will be imposed on all Project staff, workers, and all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution

Location	Project Activity and affected area	Mitigation Measure
		under the relevant laws; 2. The Project Proponent shall be directly responsible for dissemination to its staff and workers of all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation, as well as the punishment that can expected if any staff or worker or other person associated with the Project violate rules and regulations; 3. The planned clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing; 4. Use of the access road should be restricted to construction vehicles only. Checkpoints should be used to manage access and inspect vehicles for timber and forest products taken from the Project Area.
LNG Terminal/Pipe line	Temporary disturbance or displacement of fauna	5. Construction vehicles will be maintained in accordance with industry standard to minimise unnecessary noise generation; 6. Traffic signs will be maintained on all roads depicting speed limits; 7. Access to facilities, including the access road should be restricted to construction vehicles only; and 8. Commitment will be made to raise awareness of the operator work force regarding flora and fauna values and make arrangements for restriction of hunting and poaching.
	Degradation of Habitat	9. Construction and domestic waste will be appropriately stored and disposed of to avoid attracting native and alien species to the construction and worker camp areas; 10. For areas in direct runoff path to a watercourse, sediment and erosion

Location	Project Activity and affected area	Mitigation Measure
		control devices will be installed and maintained until vegetation replanting can occur to stabilise disturbed soil surfaces; 11. Oil, chemical and solid waste will be stored, and handled and disposed of by appropriately licenced waste management contractors; 12. Invasive species management measures should be implemented in accordance to avoid introduction of weeds to natural and modified habitat areas; 13. Speed limits to maximum of 40 km/hr for construction vehicles will be enforced to limit noise and dust generation; and 14. Construction materials and chemicals will be appropriately secured to avoid accidental release to the natural environment (wind and water erosion).
LNG Terminal/Pipe line	Mortality of Resident Species	1. Speed limits to maximum of 40 km/hr for construction vehicles will be enforced to minimise potential for fauna strike; 2. Commitment will be made to raise awareness of values of important species and habitat areas to construction work force and arrangements will be made for restriction of poaching and forest product collection by staff; 3. Access restriction should be applied to Project facilities for non-construction vehicles; 4. Hunting wild animals will be strictly prohibited for all staff; and 5. Fishing and using of illegal fishing gear anywhere along the stream will be prohibited.

8. COMMISSIONING AND START-UP ACTIVITY

8.1 General

During the commissioning and start-up activities, the unit is tested, cleaned and brought to a state of operational readiness. Piping and fittings are closely inspected for potential failure (e.g., leaks). Additionally, fuels, liquids, and gases are brought on to LNG POWER PLANT (AHLONE) PROJECT and added to the different systems.

The start-up activities consist of three sub-phases:

(1) Pre-commissioning;
(2) Commissioning;
(3) Startup (including raw materials introduction) and operation.

Commissioning is the operation of individual systems to ensure they function properly. Introduction of raw materials includes fuels, liquids, and gases normally required for full operation of the unit. Operations consist of running the unit under different loads. Although all systems are thoroughly checked to prevent leaks and ruptures prior to adding the fuels, liquids, and gases, accidental leaks and spills may occur.

The volume and types of materials used during start-up activities are not finalized at this time because designed unit is on-going. Permits/approvals specific to commissioning and start-up activities will be obtained by the CONTRACTOR as required.

8.2 Pre-Commissioning

CONTRACTOR shall ensure that:

(1) An adequate supply of absorbent material and cleanup equipment (e.g., personnel protective equipment, shovels, brooms, spill kits) shall be securely staged at key locations within the structures and units for immediate use. Commissioning personnel will be trained how to perform response correctly to small releases.

(2) Hazardous materials will not be introduced to the various unit systems until the appropriate equipment and systems have been approved by PM.

(3) Chemical cleaned water will be managed in accordance with applicable Myanmar environmental laws, International standards and guidelines. Alternatively, wastewater characteristics are under permissible limits for discharge into a water body, or can be treated on LNG POWER PLANT (AHLONE) PROJECT to make it compliant with these limits, it might be possible to obtain permission to discharge the wastewater into the nearby water. Each such proposed discharge will be evaluated by the CM on a case by case basis as

presented by CONTRACTOR. At no time will chemical cleaned water be discharged into the storm water management system (i.e. the Non Contaminated drain system).

(4) CONTRACTOR and SUBCONTRACTORS will make arrangements to offsite dispose of the waste water.

(5) Any leak testing water will not be changed or otherwise chemically altered, if possible, which will allow for safe and easy disposal. Clean hydro testing water may be disposed into the storm water management system, as long as it is monitored to ensure that oil sheen is not presented in the release and has been tested and approved by OWNER.

(6) Water that used for hydro testing will be recycled/ reused to the extent possible.

(7) The "Waste Management Plan (Document No. F050-MNL-026) will be used during pre-commissioning activities. Hazardous wastes have never been mixed with, or disposed to non-hazardous waste streams.

(8) All requirements for temporary storage of hazardous materials and hazardous wastes will be followed during start-up.

(9) The timing of steam blows and other typical noise generation activities will be coordinated with CONTRACTOR so they can have enough time to notify local residents, if necessary.

9. NON-COMPLIANCE

Subcontractor who fails to comply with the CONTRACTOR plans, specifications and procedures will remedy any damage caused by the noncompliance and has to implement mitigation measure to the extent necessary and to prevent future non-compliance. SUBCONTRACTORS will also be liable for the costs incurred in the subsequent remedial actions. This procedure will include payment of any legal costs, fines and compensation claims incurred by CONTRACTOR through the SUBCONTRACTORS incorrect and unsafe or illegal activity.

10. MANAGEMENT REVIEW

A documented CONTRACTOR management review of the EMS shall take place once a year. For expediency, it may form part of other meetings. The review will be chaired by PM or nominated representative. Where practicable, suitably qualified environmental, quality assurance, and construction representative will attend. CONTRACTOR will utilise their community relations plan to address any issues with regards to the environmental impact of construction work on neighbours and the local community and general environment.

11. ATTACHMENT

ATTACHMENT 1 ENVIRONMENTAL IMPACT MITIGATION MEASURE AUDIT CHECKLIST FORM

ATTACHMENT 1

TTCL Public Company Limited

Project "F050 LNG POWER PLANT (AHLONE) PROJECT"

ENVIRONMENTAL IMPACT MITIGATION MEASURE AUDIT CHECKLIST FOR LNG TERMINAL

Date. ……

Importance: This document will develop accordance with Mitigation and Measurement Section of Project Site EIA/IEE Study Report.

Item	Environmental Prevention and Mitigation Measure				Document and Record			Risk			Immediately Corrective Action	Target Date	Responsible By
	Result	C	NC	N/A	Result	Y	N	L	M	H			
1. Air Quality	■ Develop and Implement a Dust Management Plan (DMP) detailing mitigation measures and a plan for implementation.											Start / / Due / /	Sign Print
	■ Watering will be used to suppress wind and physical disturbance dust generation.											Start / / Due / /	Sign Print
	■ Ensure an adequate water supply on site for effective dust suppression and mitigation.											Start / / Due / /	Sign Print
	■ The site layout will be planned so that dust-causing activities are located away from receptors as far as is possible.											Start / / Due / /	Sign Print
	■ Screens or barriers will be erected around dusty activities or the site boundary that are at least the height of any stockpile on site.											Start / / Due / /	Sign Print
	■ All stockpiles will be covered or fenced off to prevent wind whipping.											Start / / Due / /	Sign Print
	■ Only cutting, grinding, or sawing equipment fitted with suitable dust suppression techniques such as water sprays will be used.											Start / / Due / /	Sign Print
	■ All chutes, conveyors and skips will be covered at all times.											Start / / Due / /	Sign Print
	■ Drop heights from conveyors, loading shovels and hoppers will be minimised.											Start / / Due / /	Sign Print
	■ No waste will be burned on site.											Start / / Due / /	Sign Print
1. Air Quality (Continue)	■ Re-vegetate earthwork and exposed areas as soon as is practicable											Start / / Due / /	Sign Print

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	Result	C	NC	N/A	Result	Y	N	L	M	H			
1. Air Quality (Continue)	■ Use hessian, mulches or trackifiers where it is not possible to revegetate, or cover with top soil as soon as is practicable.											Start / / Due / /	Sign Print
	■ Sand and other aggregates will be stored in bunded areas and will not be allowed to dry out unless this is required for a particular process, in which case additional control measures such as those detailed in this section will be applied.											Start / / Due / /	Sign Print
	■ Ensure that all vehicles entering and leaving the site are covered to avoid fugitive emissions during transport.											Start / / Due / /	Sign Print
	■ Inspect on-site haul roads for integrity and instigate the necessary repairs to the surfaces as soon as reasonable practicable.											Start / / Due / /	Sign Print
	■ Implement a wheel washing system.											Start / / Due / /	Sign Print
	■ Regularly dampen and clean the site access and local roads to remove any materials tracked out of the site.											Start / / Due / /	Sign Print
	■ All site access gates will be located at least 10m away from air sensitive receptors where possible.											Start / / Due / /	Sign Print
	■ The site layout will be planned so that machinery is located away from receptors as far as is possible.											Start / / Due / /	Sign Print
	■ All vehicles will switch off engines when stationary.											Start / / Due / /	Sign Print

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	Result	C	NC	N/A	Result	Y	N	L	M	H			
	■ A regular vehicle and machinery maintenance and repair programme will be implemented.											Start / / Due / /	Sign Print
	■ Mains electricity or battery powered equipment will be used instead of diesel/petrol generators where practicable.											Start / / Due / /	Sign Print
2. Greenhouse gas	■ Implement the same mitigation measures to minimize impacts to Air Quality											Start / / Due / /	Sign Print
	■ Develop and implement preventive maintenance plan for machines, and engines to ensure combustion efficiency.											Start / / Due / /	Sign Print
	Develop vehicle and machine maintenance plan.											Start / / Due / /	Sign Print
3. Noise quality	■ Schedule transportation of materials evenly throughout the day (to minimize accumulative noise impact from multiple noise sources);											Start / / Due / /	Sign Print
	■ Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components should be conducted;											Start / / Due / /	Sign Print
	■ Avoid transportation of materials on- and off-site through existing community areas.											Start / / Due / /	Sign Print
	■ Workers operating near loud equipment/machines will wear appropriate PPE equipment.											Start / / Due / /	Sign Print
3. Noise quality (Continue)	■ Noise barriers should be installed at the site boundary (facing the villages) and high enough which completely hides the noise sources from the NSR. It is anticipated that at least a 10 dB(A) noise reduction can be provided . The noise barrier material should have a superficial surface density of at least 7 kg/m-2 and have no openings or gaps;											Start / / Due / /	Sign Print

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	Result	C	NC	N/A	Result	Y	N	L	M	H			
3. Noise quality (Continue)	■ Well-maintained equipment to be operated on-site;											Start / / Due / /	Sign Print
	■ Normal working hours of the contractor should be between 07:00 and 22:00 hours from Monday to Saturday (except holiday). If work needs to be undertaken outside these hours, it should be limited to activities that do not lead to exceedance of noise criteria at nearby NSRs and avoid early morning and night time construction;											Start / / Due / /	Sign Print
	■ Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components											Start / / Due / /	Sign Print
	■ Shut down or throttled down between work periods for machines and construction plant items (e.g. trucks) that may be in intermittent use											Start / / Due / /	Sign Print
	■ Reduce the number of equipment operating simultaneously as far as practicable;											Start / / Due / /	Sign Print
	■ Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable											Start / / Due / /	Sign Print
	■ Locate noisy plant (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable;											Start / / Due / /	Sign Print
	■ Avoid transportation of materials on- and off-site through existing community areas; and											Start / / Due / /	Sign Print
	Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site construction activities.											Start / / Due / /	Sign Print

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	Result	C	NC	N/A	Result	Y	N	L	M	H			
4. Surface Water quality	■ Install silt trap to treat surface run-off from bunded areas prior to discharge to the stormwater system											Start / / Due / /	Sign Print
	■ Exposed soil surfaces should be protected by paving or fill material as soon as possible to reduce the potential of soil erosion and subsequent sedimentation;											Start / / Due / /	Sign Print
	■ Use methods for minimising sediment runoff, as appropriate to the conditions on-site, including: wheel cleaning facilities, sand bag barriers, mulching, and re-vegetation, protect temporary trafficked areas on-site with coarse stone ballast or equivalent, open stockpiles of construction materials or construction wastes on-site should be covered with tarpaulin or similar fabric during rainstorms;											Start / / Due / /	Sign Print
	■ Regularly, and particularly following rainstorms, inspect and maintain drainage systems and erosion control and silt removal facilities to ensure proper and efficient operation at all times; and											Start / / Due / /	Sign Print
4. Surface Water quality (continue)	■ Surface run-off from bunded areas should pass through oil/water separators prior to discharge to the storm water system.											Start / / Due / /	Sign Print
	■ Evenly spread out the scheduling of piling activities to reduce the potential amount of sedimentation caused during one pilling session.											Start / / Due / /	Sign Print
4. Soil and Groundwater	■ Delineation of clearance boundaries to limit the areas to be cleared;											Start / / Due / /	Sign Print

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	Result	C	NC	N/A	Result	Y	N	L	M	H			
	■ Scheduling clearance activities (if possible) to avoid extreme weather events such as heavy rainfall, extreme dry and high winds;											**Start / /** **Due / /**	**Sign** **Print**
	■ Revegetation areas with temporary land use, conducting progressive rehabilitation											**Start / /** **Due / /**	**Sign** **Print**
	■ Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers											**Start / /** **Due / /**	**Sign** **Print**
	■ Reuse topsoil as much as possible within rehabilitation activities											**Start / /** **Due / /**	**Sign** **Print**
	■ Control erosion through diversion drains, sediment fences, and sediment retention basins; and											**Start / /** **Due / /**	**Sign** **Print**

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4. Soil and Groundwater (Continue)	■ Where topsoil is to be stored for later use in rehabilitation activities, the following basic principles are to be applied: - Stockpiles to be separated into topsoil and sub-soil and be located at least 50m from any surface water source or groundwater well; - To the extent possible, stockpiles are to be located in areas surrounded by natural wind barriers to minimise the potential for wind erosion; - Stockpile storage areas are to be prepared in advance of the removal of topsoil as much as possible; and - Topsoil heights are to be restricted in height to 2m above ground level to minimise wind erosion, and they are only to be partially compacted on the upper layer in order to promote aeration, maintain soil vertical structures, reduce runoff and encourage infiltration.											Start / / Due / /	Sign Print
5. Visual Impact	■ Provide soft landscaping (i.e. tree, low shrub and ground cover planting) within available space within the Project Site. Plant as soon as practical during construction phase											Start / / Due / /	Sign Print
	■ Minimize the extent of construction areas, including for dredging and including temporarily affected areas											Start / / Due / /	Sign Print

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5. Visual Impact (continue)	■ Minimize clearing of vegetation as far as practical. Existing large trees (if any) should be retained as far as practical. Those that fall outside the earthworks area must be retained. Felled trees should be compensated for where possible											**Start** / / **Due** / /	**Sign** **Print**
	■ Reinstatement of temporarily affected areas which will no longer be required for the operational stage (e.g. contractor camp, laydown areas, etc.), to suitable pre-construction condition as soon as practical after use (e.g. using landscaping with suitable vegetation).											**Start** / / **Due** / /	**Sign** **Print**
6. Biodiversity	■ Strict rules against clearing vegetation will be imposed on all Project staff, workers, and all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws											**Start** / / **Due** / /	**Sign** **Print**
	■ The Project Proponent shall be directly responsible for dissemination to its staff and workers of all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation, as well as the punishment that can expected if any staff or worker or other person associated with the Project violate rules and regulations;											**Start** / / **Due** / /	**Sign** **Print**
	■ The planned clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing											**Start** / / **Due** / /	**Sign** **Print**

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6. Biodiversity (Continue)	■ Use of the access road should be restricted to construction vehicles only. Checkpoints should be used to manage access and inspect vehicles for timber and forest products taken from the Project Area.											Start / / Due / /	Sign Print
	■ Construction vehicles will be maintained in accordance with industry standard to minimise unnecessary noise generation;											Start / / Due / /	Sign Print
	■ Traffic signs will be maintained on all roads depicting speed limits;											Start / / Due / /	Sign Print
	■ Access to facilities, including the access road should be restricted to construction vehicles only; and											Start / / Due / /	Sign Print
	■ Commitment will be made to raise awareness of the operator work force regarding flora and fauna values and make arrangements for restriction of hunting and poaching.											Start / / Due / /	Sign Print
	■ Construction and domestic waste will be appropriately stored and disposed of to avoid attracting native and alien species to the construction and worker camp areas;											Start / / Due / /	Sign Print
	■ For areas in direct runoff path to a watercourse, sediment and erosion control devices will be installed and maintained until vegetation replanting can occur to stabilise disturbed soil surfaces;											Start / / Due / /	Sign Print
	■ Oil, chemical and solid waste will be stored, and handled and disposed of by appropriately licenced waste management contractors;											Start / / Due / /	Sign Print

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6. Biodiversity (Continue)	■ Invasive species management measures should be implemented in accordance to avoid introduction of weeds to natural and modified habitat areas;											Start / / Due / /	Sign Print
	■ Speed limits to maximum of 40 km/hr for construction vehicles will be enforced to limit noise and dust generation; and											Start / / Due / /	Sign Print
	■ Construction materials and chemicals will be appropriately secured to avoid accidental release to the natural environment (wind and water erosion).											Start / / Due / /	Sign Print
	■ Speed limits to maximum of 40 km/hr for construction vehicles will be enforced to minimise potential for fauna strike;											Start / / Due / /	Sign Print
	■ Commitment will be made to raise awareness of values of important species and habitat areas to construction work force and arrangements will be made for restriction of poaching and forest product collection by staff											Start / / Due / /	Sign Print
	■ Access restriction should be applied to Project facilities for non-construction vehicles											Start / / Due / /	Sign Print
	■ Hunting wild animals will be strictly prohibited for all staff; and											Start / / Due / /	Sign Print
	■ Fishing and using of illegal fishing gear anywhere along the stream will be prohibited.											Start / / Due / /	Sign Print

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	Result	C	NC	N/A	Result	Y	N	L	M	H			
1. Air Quality	■ Develop and Implement a Dust Management Plan (DMP) detailing mitigation measures and a plan for implementation.											Start / / Due / /	Sign Print
	■ Watering will be used to suppress wind and physical disturbance dust generation.											Start / / Due / /	Sign Print
	■ Ensure an adequate water supply on site for effective dust suppression and mitigation.											Start / / Due / /	Sign Print
	■ The site layout will be planned so that dust-causing activities are located away from receptors as far as is possible.											Start / / Due / /	Sign Print
	■ Screens or barriers will be erected around dusty activities or the site boundary that are at least the height of any stockpile on site.											Start / / Due / /	Sign Print
	■ All stockpiles will be covered or fenced off to prevent wind whipping.											Start / / Due / /	Sign Print
	■ Only cutting, grinding, or sawing equipment fitted with suitable dust suppression techniques such as water sprays will be used.											Start / / Due / /	Sign Print
	■ All chutes, conveyors and skips will be covered at all times.											Start / / Due / /	Sign Print
	■ Drop heights from conveyors, loading shovels and hoppers will be minimised.											Start / / Due / /	Sign Print
	■ No waste will be burned on site.											Start / / Due / /	Sign Print
1. Air Quality (Continue)	■ Re-vegetate earthwork and exposed areas as soon as is practicable											Start / / Due / /	Sign Print

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	Result	C	NC	N/A	Result	Y	N	L	M	H			
1. Air Quality (Continue)	■ Use hessian, mulches or trackifiers where it is not possible to revegetate, or cover with top soil as soon as is practicable.											Start / / Due / /	Sign Print
	■ Sand and other aggregates will be stored in bunded areas and will not be allowed to dry out unless this is required for a particular process, in which case additional control measures such as those detailed in this section will be applied.											Start / / Due / /	Sign Print
	■ Ensure that all vehicles entering and leaving the site are covered to avoid fugitive emissions during transport.											Start / / Due / /	Sign Print
	■ Inspect on-site haul roads for integrity and instigate the necessary repairs to the surfaces as soon as reasonable practicable.											Start / / Due / /	Sign Print
	■ Implement a wheel washing system.											Start / / Due / /	Sign Print
	■ Regularly dampen and clean the site access and local roads to remove any materials tracked out of the site.											Start / / Due / /	Sign Print
	■ All site access gates will be located at least 10m away from air sensitive receptors where possible.											Start / / Due / /	Sign Print
	■ The site layout will be planned so that machinery is located away from receptors as far as is possible.											Start / / Due / /	Sign Print
	■ All vehicles will switch off engines when stationary.											Start / / Due / /	Sign Print

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	Result	C	NC	N/A	Result	Y	N	L	M	H			
	■ A regular vehicle and machinery maintenance and repair programme will be implemented.											Start / / Due / /	Sign Print
	■ Mains electricity or battery powered equipment will be used instead of diesel/petrol generators where practicable.											Start / / Due / /	Sign Print
2. Greenhouse gas	■ Implement the same mitigation measures to minimize impacts to Air Quality											Start / / Due / /	Sign Print
	■ Develop and implement preventive maintenance plan for machines, and engines to ensure combustion efficiency.											Start / / Due / /	Sign Print
	Develop vehicle and machine maintenance plan.											Start / / Due / /	Sign Print
3. Noise quality	■ Schedule transportation of materials evenly throughout the day (to minimize accumulative noise impact from multiple noise sources);											Start / / Due / /	Sign Print
	■ Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components should be conducted;											Start / / Due / /	Sign Print
	■ Avoid transportation of materials on- and off-site through existing community areas.											Start / / Due / /	Sign Print
3. Noise quality (Continue)	■ Noise barriers should be installed at the site boundary (facing the villages) and high enough which completely hides the noise sources from the NSR. It is anticipated that at least a 10 dB(A) noise reduction can be provided . The noise barrier material should have a superficial surface density of at least 7 kg/m-2 and have no openings or gaps;											Start / / Due / /	Sign Print
	■ Well-maintained equipment to be operated on-site;											Start / / Due / /	Sign Print

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	Result	C	NC	N/A	Result	Y	N	L	M	H			
	■ Normal working hours of the contractor should be between 07:00 and 22:00 hours from Monday to Saturday (except holiday). If work needs to be undertaken outside these hours, it should be limited to activities that do not lead to exceedance of noise criteria at nearby NSRs and avoid early morning and night time construction;											Start / / Due / /	Sign Print
	■ Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components											Start / / Due / /	Sign Print
	■ Shut down or throttled down between work periods for machines and construction plant items (e.g. trucks) that may be in intermittent use											Start / / Due / /	Sign Print
	■ Reduce the number of equipment operating simultaneously as far as practicable;											Start / / Due / /	Sign Print
	■ Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable											Start / / Due / /	Sign Print
3. Noise quality (Continue)	■ Locate noisy plant (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable;											Start / / Due / /	Sign Print
	Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site construction activities.											Start / / Due / /	Sign Print
4. Surface Water quality	■ Implement a hydrostatic test monitoring plan;											Start / / Due / /	Sign Print

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4. Surface Water quality (continue)	■ After the hydrostatic testing is complete, analyse the test water for contamination and appropriately treat before it is returned to the environment. Alternatively, the water can be treated/ disposed of by a licensed wastewater disposal/treatment company;												
	■ Ensure minimum erosion during discharge of hydrostatic test water;												
	■ Carry out monitoring and reporting of water consumption;												
	■ Reduce water need by optimizing the hydrostatic testing operation.												
	■ Install silt trap to treat surface run-off from bunded areas prior to discharge to the stormwater system												
	■ Exposed soil surfaces should be protected by paving or fill material as soon as possible to reduce the potential of soil erosion and subsequent sedimentation;											Start / / Due / /	Sign Print
	■ Use methods for minimising sediment runoff, as appropriate to the conditions on-site, including: wheel cleaning facilities, sand bag barriers, mulching, and re-vegetation, protect temporary trafficked areas on-site with coarse stone ballast or equivalent, open stockpiles of construction materials or construction wastes on-site should be covered with tarpaulin or similar fabric during rainstorms;											Start / / Due / /	Sign Print
	■ Regularly, and particularly following rainstorms, inspect and maintain drainage systems and erosion control and silt removal facilities to ensure proper and efficient operation at all times; and											Start / / Due / /	Sign Print

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Project "F050 LNG POWER PLANT (AHLONE) PROJECT"

ENVIRONMENTAL IMPACT MITIGATION MEASURE AUDIT CHECKLIST FOR PIPE LINE

Date. ……

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	Result	C	NC	N/A	Result	Y	N	L	M	H			
	■ Surface run-off from bunded areas should pass through oil/water separators prior to discharge to the storm water system.											Start / / Due / /	Sign Print
4. Soil and Groundwater	■ Control erosion through diversion drains, sediment fences, and sediment retention basins;											Start / / Due / /	Sign Print
	■ Drain all hydrostatic testing fluid at the designated discharge point as soon as possible, once all leaks have been identified, to minimize soil erosion.											Start / / Due / /	Sign Print
	■ Place/install a buffer zone (such as sandbags, trenches, or other appropriate barriers) around the sending and receiving pits to reduce the potential of soil contamination in adjacent area;											Start / / Due / /	Sign Print
4. Soil and Groundwater (continue)	■ Place the sending and receiving station at least 7.5 metres from any water source											Start / / Due / /	Sign Print
	■ Use mobile pumps, vacuum trucks, and other appropriate equipment to clean any bentonite spills											Start / / Due / /	Sign Print
	■ Stop HDD activities, and other associated activities until the spill has been cleaned;											Start / / Due / /	Sign Print
	■ Re-evaluate appropriate drilling pressure for the specific area conditions before continuing HDD activities											Start / / Due / /	Sign Print
	■ Conduct preventive maintenance for HDD and spill clean-up equipment;											Start / / Due / /	Sign Print
	■ Use sandbags to quarantine any bentonite spills beyond the planned buffer zone; and											Start / / Due / /	Sign Print
	■ Spill response plans should be prepared and implemented to address the potential accidental release of bentonite.											Start / / Due / /	Sign Print

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4. Soil and Groundwater (continue)	■ Use appropriate waste containers and build secondary containment around chemical or waste storage on-site to avoid spillage or leakage of bentonite;											Start / / Due / /	Sign Print
	■ Obtain permission from the land owner to use selected land for bentonite waste storage;											Start / / Due / /	Sign Print
	■ Provide waste sub-contractor or land owner with the bentonite MSDS, and the bentonite's properties, such as Electrical Conductivity (ECe), Exchangeable Sodium, and Exchangeable Sodium Percentage;											Start / / Due / /	Sign Print
	■ Ensure bentonite waste storage is not located on agricultural, and aquaculture land;											Start / / Due / /	Sign Print
	■ Ensure bentonite waste storage is at least 30 metres away from any groundwater sources;											Start / / Due / /	Sign Print
	■ Spill response plans should be prepared and implemented to address the potential accidental release of bentonite;											Start / / Due / /	Sign Print
	■ Prepare only the require amount of bentonite needed for HDD activities, to prevent excess amounts of bentonite to be disposed.											Start / / Due / /	Sign Print
	■ Delineation of clearance boundaries to limit the areas to be cleared;											Start / / Due / /	Sign Print
	■ Scheduling clearance activities (if possible) to avoid extreme weather events such as heavy rainfall, extreme dry and high winds											Start / / Due / /	Sign Print
	■ Revegetation areas with temporary land use, conducting progressive rehabilitation;											Start / / Due / /	Sign Print

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4. Soil and Groundwater (continue)	■ Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers;											Start / / Due / /	Sign Print
	■ Reuse topsoil as much as possible within rehabilitation activities;											Start / / Due / /	Sign Print
	■ Control erosion through diversion drains, sediment fences, and sediment retention basins;											Start / / Due / /	Sign Print
	■ Where topsoil is to be stored for later use in rehabilitation activities, the following basic principles are to be applied: - Stockpiles to be separated into topsoil and sub-soil and be located at least 50m from any surface water source or groundwater well; - To the extent possible, stockpiles are to be located in areas surrounded by natural wind barriers to minimise the potential for wind erosion; - Stockpile storage areas are to be prepared in advance of the removal of topsoil as much as possible; and - Topsoil heights are to be restricted in height to 2m above ground level to minimise wind erosion, and they are only to be partially compacted on the upper layer in order to promote aeration, maintain soil vertical structures, reduce runoff and encourage infiltration.											Start / / Due / /	Sign Print

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	Result	C	NC	N/A	Result	Y	N	L	M	H			
5. Biodiversity	■ Strict rules against clearing vegetation will be imposed on all Project staff, workers, and all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws											Start / / Due / /	Sign Print
5. Biodiversity (Continue)	■ The Project Proponent shall be directly responsible for dissemination to its staff and workers of all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation, as well as the punishment that can expected if any staff or worker or other person associated with the Project violate rules and regulations;											Start / / Due / /	Sign Print
	■ The planned clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing											Start / / Due / /	Sign Print
	■ Use of the access road should be restricted to construction vehicles only. Checkpoints should be used to manage access and inspect vehicles for timber and forest products taken from the Project Area.											Start / / Due / /	Sign Print
	■ Construction vehicles will be maintained in accordance with industry standard to minimise unnecessary noise generation;											Start / / Due / /	Sign Print
	■ Traffic signs will be maintained on all roads depicting speed limits;											Start / / Due / /	Sign Print
	■ Access to facilities, including the access road should be restricted to construction vehicles only; and											Start / / Due / /	Sign Print

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5. Biodiversity (Continue)	■ Commitment will be made to raise awareness of the operator work force regarding flora and fauna values and make arrangements for restriction of hunting and poaching.											Start / / Due / /	Sign Print
	■ Construction and domestic waste will be appropriately stored and disposed of to avoid attracting native and alien species to the construction and worker camp areas;											Start / / Due / /	Sign Print
	■ For areas in direct runoff path to a watercourse, sediment and erosion control devices will be installed and maintained until vegetation replanting can occur to stabilise disturbed soil surfaces;											Start / / Due / /	Sign Print
	■ Oil, chemical and solid waste will be stored, and handled and disposed of by appropriately licenced waste management contractors;											Start / / Due / /	Sign Print
	■ Invasive species management measures should be implemented in accordance to avoid introduction of weeds to natural and modified habitat areas;											Start / / Due / /	Sign Print
	■ Speed limits to maximum of 40 km/hr for construction vehicles will be enforced to limit noise and dust generation; and											Start / / Due / /	Sign Print
	■ Construction materials and chemicals will be appropriately secured to avoid accidental release to the natural environment (wind and water erosion).											Start / / Due / /	Sign Print
	■ Speed limits to maximum of 40 km/hr for construction vehicles will be enforced to minimise potential for fauna strike;											Start / / Due / /	Sign Print

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5. Biodiversity (Continue)	■ Commitment will be made to raise awareness of values of important species and habitat areas to construction work force and arrangements will be made for restriction of poaching and forest product collection by staff											**Start / /** **Due / /**	**Sign** **Print**
	■ Access restriction should be applied to Project facilities for non-construction vehicles											**Start / /** **Due / /**	**Sign** **Print**
	■ Hunting wild animals will be strictly prohibited for all staff; and											**Start / /** **Due / /**	**Sign** **Print**
	■ Fishing and using of illegal fishing gear anywhere along the stream will be prohibited.											**Start / /** **Due / /**	**Sign** **Print**

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1. Air Quality	■ Develop and Implement a Dust Management Plan (DMP) detailing mitigation measures and a plan for implementation.											Start / / Due / /	Sign Print
	■ Watering will be used to suppress wind and physical disturbance dust generation.											Start / / Due / /	Sign Print
	■ Ensure an adequate water supply on site for effective dust suppression and mitigation.											Start / / Due / /	Sign Print
	■ The site layout will be planned so that dust-causing activities are located away from receptors as far as is possible.											Start / / Due / /	Sign Print
	■ Screens or barriers will be erected around dusty activities or the site boundary that are at least the height of any stockpile on site.											Start / / Due / /	Sign Print
	■ All stockpiles will be covered or fenced off to prevent wind whipping.											Start / / Due / /	Sign Print
	■ Only cutting, grinding, or sawing equipment fitted with suitable dust suppression techniques such as water sprays will be used.											Start / / Due / /	Sign Print
	■ All chutes, conveyors and skips will be covered at all times.											Start / / Due / /	Sign Print
	■ Drop heights from conveyors, loading shovels and hoppers will be minimised.											Start / / Due / /	Sign Print
	■ No waste will be burned on site.											Start / / Due / /	Sign Print
1. Air Quality (Continue)	■ Re-vegetate earthwork and exposed areas as soon as is practicable											Start / / Due / /	Sign Print

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1. Air Quality (Continue)	■ Use hessian, mulches or trackifiers where it is not possible to revegetate, or cover with top soil as soon as is practicable.											Start / / Due / /	Sign Print
	■ Sand and other aggregates will be stored in bunded areas and will not be allowed to dry out unless this is required for a particular process, in which case additional control measures such as those detailed in this section will be applied.											Start / / Due / /	Sign Print
	■ Ensure that all vehicles entering and leaving the site are covered to avoid fugitive emissions during transport.											Start / / Due / /	Sign Print
	■ Inspect on-site haul roads for integrity and instigate the necessary repairs to the surfaces as soon as reasonable practicable.											Start / / Due / /	Sign Print
	■ Implement a wheel washing system.											Start / / Due / /	Sign Print
	■ Regularly dampen and clean the site access and local roads to remove any materials tracked out of the site.											Start / / Due / /	Sign Print
	■ All site access gates will be located at least 10m away from air sensitive receptors where possible.											Start / / Due / /	Sign Print
	■ The site layout will be planned so that machinery is located away from receptors as far as is possible.											Start / / Due / /	Sign Print
	■ All vehicles will switch off engines when stationary.											Start / / Due / /	Sign Print

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	■ A regular vehicle and machinery maintenance and repair programme will be implemented.											Start / / Due / /	Sign Print
	■ Mains electricity or battery powered equipment will be used instead of diesel/petrol generators where practicable.											Start / / Due / /	Sign Print
2. Greenhouse gas	■ Implement the same mitigation measures to minimize impacts to Air Quality											Start / / Due / /	Sign Print
	■ Develop and implement preventive maintenance plan for machines, and engines to ensure combustion efficiency.											Start / / Due / /	Sign Print
	Develop vehicle and machine maintenance plan.											Start / / Due / /	Sign Print
3. Noise quality	■ Schedule transportation of materials evenly throughout the day (to minimize accumulative noise impact from multiple noise sources);											Start / / Due / /	Sign Print
	■ Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components should be conducted;											Start / / Due / /	Sign Print
	■ Avoid transportation of materials on- and off-site through existing community areas.											Start / / Due / /	Sign Print
3. Noise quality (Continue)	■ Noise barriers should be installed at the site boundary (facing the villages) and high enough which completely hides the noise sources from the NSR. It is anticipated that at least a 10 dB(A) noise reduction can be provided . The noise barrier material should have a superficial surface density of at least 7 kg/m-2 and have no openings or gaps;											Start / / Due / /	Sign Print
	■ Well-maintained equipment to be operated on-site;											Start / / Due / /	Sign Print

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3. Noise quality (Continue)	■ Normal working hours of the contractor should be between 07:00 and 22:00 hours from Monday to Saturday (except holiday). If work needs to be undertaken outside these hours, it should be limited to activities that do not lead to exceedance of noise criteria at nearby NSRs and avoid early morning and night time construction;											Start / / Due / /	Sign Print
	■ Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components											Start / / Due / /	Sign Print
	■ Shut down or throttled down between work periods for machines and construction plant items (e.g. trucks) that may be in intermittent use											Start / / Due / /	Sign Print
	■ Reduce the number of equipment operating simultaneously as far as practicable;											Start / / Due / /	Sign Print
	■ Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable											Start / / Due / /	Sign Print
	■ Locate noisy plant (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable;											Start / / Due / /	Sign Print
	■ Avoid transportation of materials on- and off-site through existing community areas; and											Start / / Due / /	Sign Print
	Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site construction activities.											Start / / Due / /	Sign Print
4. Surface Water quality	■ Install silt trap to treat surface run-off from bunded areas prior to discharge to the stormwater system											Start / / Due / /	Sign Print

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4. Surface Water quality (continue)	■ Exposed soil surfaces should be protected by paving or fill material as soon as possible to reduce the potential of soil erosion and subsequent sedimentation;											Start / / Due / /	Sign Print
	■ Use methods for minimising sediment runoff, as appropriate to the conditions on-site, including: wheel cleaning facilities, sand bag barriers, mulching, and re-vegetation, protect temporary trafficked areas on-site with coarse stone ballast or equivalent, open stockpiles of construction materials or construction wastes on-site should be covered with tarpaulin or similar fabric during rainstorms;											Start / / Due / /	Sign Print
	■ Regularly, and particularly following rainstorms, inspect and maintain drainage systems and erosion control and silt removal facilities to ensure proper and efficient operation at all times; and											Start / / Due / /	Sign Print
	■ Surface run-off from bunded areas should pass through oil/water separators prior to discharge to the storm water system.											Start / / Due / /	Sign Print
	■ Evenly spread out the scheduling of piling activities to reduce the potential amount of sedimentation caused during one pilling session.											Start / / Due / /	Sign Print
4. Soil and Groundwater	■ Delineation of clearance boundaries to limit the areas to be cleared;											Start / / Due / /	Sign Print
	■ Scheduling clearance activities (if possible) to avoid extreme weather events such as heavy rainfall, extreme dry and high winds;											Start / / Due / /	Sign Print

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4. Soil and Groundwater (Continue)	■ Revegetation areas with temporary land use, conducting progressive rehabilitation											Start / / Due / /	Sign Print
	■ Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers											Start / / Due / /	Sign Print
	■ Reuse topsoil as much as possible within rehabilitation activities											Start / / Due / /	Sign Print
	■ Control erosion through diversion drains, sediment fences, and sediment retention basins; and											Start / / Due / /	Sign Print
	■ Where topsoil is to be stored for later use in rehabilitation activities, the following basic principles are to be applied: - Stockpiles to be separated into topsoil and sub-soil and be located at least 50m from any surface water source or groundwater well; - To the extent possible, stockpiles are to be located in areas surrounded by natural wind barriers to minimise the potential for wind erosion; - Stockpile storage areas are to be prepared in advance of the removal of topsoil as much as possible; and - Topsoil heights are to be restricted in height to 2m above ground level to minimise wind erosion, and they are only to be partially compacted on the upper layer in order to promote aeration, maintain soil vertical structures, reduce runoff and encourage infiltration.											Start / / Due / /	Sign Print

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5. Visual Impact	■ Provide soft landscaping (i.e. tree, low shrub and ground cover planting) within available space within the Project Site. Plant as soon as practical during construction phase											Start / / Due / /	Sign Print
	■ Minimize the extent of construction areas, including for dredging and including temporarily affected areas											Start / / Due / /	Sign Print
5. Visual Impact (continue)	■ Minimize clearing of vegetation as far as practical. Existing large trees (if any) should be retained as far as practical. Those that fall outside the earthworks area must be retained. Felled trees should be compensated for where possible											Start / / Due / /	Sign Print
	■ Reinstatement of temporarily affected areas which will no longer be required for the operational stage (e.g. contractor camp, laydown areas, etc.), to suitable pre-construction condition as soon as practical after use (e.g. using landscaping with suitable vegetation).											Start / / Due / /	Sign Print
6. Biodiversity	■ Strict rules against clearing vegetation will be imposed on all Project staff, workers, and all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws											Start / / Due / /	Sign Print

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	Result	C	NC	N/A	Result	Y	N	L	M	H			
6. Biodiversity (Continue)	■ The Project Proponent shall be directly responsible for dissemination to its staff and workers of all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation, as well as the punishment that can expected if any staff or worker or other person associated with the Project violate rules and regulations;											Start / / Due / /	Sign Print
	■ The planned clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing											Start / / Due / /	Sign Print
	■ Use of the access road should be restricted to construction vehicles only. Checkpoints should be used to manage access and inspect vehicles for timber and forest products taken from the Project Area.											Start / / Due / /	Sign Print
	■ Construction vehicles will be maintained in accordance with industry standard to minimise unnecessary noise generation;											Start / / Due / /	Sign Print
	■ Traffic signs will be maintained on all roads depicting speed limits;											Start / / Due / /	Sign Print
	■ Access to facilities, including the access road should be restricted to construction vehicles only; and											Start / / Due / /	Sign Print
	■ Commitment will be made to raise awareness of the operator work force regarding flora and fauna values and make arrangements for restriction of hunting and poaching.											Start / / Due / /	Sign Print
	■ Construction and domestic waste will be appropriately stored and disposed of to avoid attracting native and alien species to the construction and worker camp areas;											Start / / Due / /	Sign Print

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	Result	C	NC	N/A	Result	Y	N	L	M	H			
6. Biodiversity (Continue)	■ For areas in direct runoff path to a watercourse, sediment and erosion control devices will be installed and maintained until vegetation replanting can occur to stabilise disturbed soil surfaces;											Start / / Due / /	Sign Print
	■ Oil, chemical and solid waste will be stored, and handled and disposed of by appropriately licenced waste management contractors;											Start / / Due / /	Sign Print
	■ Invasive species management measures should be implemented in accordance to avoid introduction of weeds to natural and modified habitat areas;											Start / / Due / /	Sign Print
	■ Speed limits to maximum of 40 km/hr for construction vehicles will be enforced to limit noise and dust generation; and											Start / / Due / /	Sign Print
	■ Construction materials and chemicals will be appropriately secured to avoid accidental release to the natural environment (wind and water erosion).											Start / / Due / /	Sign Print
	■ Speed limits to maximum of 40 km/hr for construction vehicles will be enforced to minimise potential for fauna strike;											Start / / Due / /	Sign Print
	■ Commitment will be made to raise awareness of values of important species and habitat areas to construction work force and arrangements will be made for restriction of poaching and forest product collection by staff											Start / / Due / /	Sign Print
	■ Access restriction should be applied to Project facilities for non-construction vehicles											Start / / Due / /	Sign Print
	■ Hunting wild animals will be strictly prohibited for all staff; and											Start / / Due / /	Sign Print

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	Result	C	NC	N/A	Result	Y	N	L	M	H			
	■ Fishing and using of illegal fishing gear anywhere along the stream will be prohibited.											**Start** / / **Due** / /	**Sign** **Print**

APPENDIX W ENVIRONMENTAL CONTROL AND MANAGEMENT PLAN

AHLONE 2

HSE PLAN PROCEDURE

PROJECT DOC. NO. F050-MNL-028

LNG POWER PLANT (AHLONE) PROJECT

TTCL JOB NO. F-050

Total (Including this Page): 33 sheets

1	19-Aug-19	For Information	Phakin P.	Nimit A.	Anuchit P.	Peerapat T.
0	24-Sep-18	For Information	Original Signed			
REV.	DATE	DESCRIPTION	MADE	CHECKED	APPROVED	AUTH'D

For Project Use only

Originator	Distribution	PW	PR	MA	ME	PP	EE	IN	CV	QC	PC	Proj	Site	Owner	Total
Project	No. of Copy	-	-	-	-	-	-	-	-	-	-	ORG.	1	1	2

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

Revision History Sheet

Rev.	Date	Description
0	September 24, 2018	For Information
1	August 19,2019	The revision has been made as following; - Project Incident Rates has changed from IFR to TRIR and IST to LTIFR follow the standard of company as mark 1. - Updated the latest revision of HSE Policy. - Add item 2.2.2 Drug and Alcohol Policy as mark 2. - Revise in order to comply with ISO45001 the detail as mark 3. - Item 4.3.1 OCCUPATIONAL, SAFETY REQUIREMENTS has revised some detail in part of PPE that was classified to Mandatory basic PPE and Specific PPE. As mark 4. - Item 4.4 ENVIRONMENTAL REQUIREMENTS has revise some detail as mark 5. - Item 6. Hazard and Environmental Aspect Communication was change into item 7. Communication. Detail as mark 6. - Item 7 HSE Training has revised in some detail as mark 7. - Item 12. Management of change was added comply with ISO45001 regulation see as mark 8. - Item 14. Supportive Procedure has been added some procedure.

CONTENTS

1. GENERAL

1.1 PURPOSE

The purpose of this plan is to establish HSE management System, HSE requirements, HSE rules and regulations, HSE organization and responsibilities, and provide guidelines for accident and incident prevention including environmental impact protection.

This plan establishes the minimum requirements for HSE execution of **LNG POWER PLANT (AHLONE) PRJECT** and establishes safe working practices and standards which shall be implemented on the site.

Depending upon the location of the site, it is likely that some conflict will arise between the requirements of the procedure and the Laws governing HSE at work in the country. In such even, the subcontractors shall apply the more stringent of the regulations at all times.

1.2 SCOPE

The scope of this document is to establish the minimum requirements for HSE execution, define the HSE standard, HSE organization, plan, rules and regulation, responsibilities and implementation guideline for construction phase of **LNG POWER PLANT (AHLONE) PRJECT**

1.3 DEFINITION

In this HSE plan, the following words and expressions are used, and they have the respective meaning hereby assigned to them, except where the context otherwise requires:

"CONTRACTOR" means **TTCL Public Company Limited** who performing the "Engineering Procurement and Construction (EPC) of the project.

"OWNER" means **TTCL POWER MYANMAR COMPANY LIMITED (TPMC)** *who* employing contractor in connection with the "Engineering Procurement and Construction (EPC) of the project.

"SITE" means the place or places so designated by owner for construction of the project including places adjacent thereto which are for storage and assembly of equipment and materials.

"SUBCONTRACTOR(S)" means the subcontractor(s) employed by contractor or the owner in connection with the construction of the project.

“HSE” means Occupational Health, Safety and Environment.

“HSE MS” means Occupational Health, Safety and Environmental Management System

“Standard” means HSE standard which requires condition, or the adoption or use of one or more practices, operations or process, reasonably necessary or appropriated to safe employee healthful and environmental impact protection, such as TIS etc.

“Construction Phase” means Construction activities comprising direct (prefabrication assembly, pre-commissioning up to mechanical completion, and other activity specified in Contract) and indirect (scaffolding, transport at site, maintenance of equipment etc.).

“ISO” means International Organization for Standardization

“ESIA” means Environmental Social Impact Assessment. The ESIA report is identify the environmental sensitivities and social impacts relevant to the project and environmental social impact protection requirement.

“Hazard” means intrinsic property or ability of something (e.g. work materials, equipment, work methods and practices) with potential to cause harm.

“Risk” means compiling result of hazard severity and its likelihood that has potential to cause harm.
“Interested party” means person or organization that can affect, be affected by, or perceive itself to be affected by a decision or activity.

“Risks and Opportunities” means potential adverse effects (Risk) and potential beneficial effects (Opportunities)

“3R Principle” means Waste Management Principle: Reduce, Reuse and Recycle.

“PTA” means Pre Task Analysis.

“PPE” mean Personnel Protective Equipment.

“ERT” means Emergency Response Team.

“Number of Recordable Cases” means the total number of recordable incidents within a given define period including fatalities, lost time incident, restricted work case, and medical treatment case.

"Total Number of Hours Worked" means the total accumulated number of hours worked in the same accounting period.

"Number of Lost Time Injuries" means the number of incidents within a given accounting period with resulted in a fatality, permanent disability or time lost from work of one day/shift or more.

2. HSE MANAGEMENT SYSTEM

The HSE Management System is summarized in this plan which defines the HSE principle requirements associated with the TTCL / Subcontractor and concerned parties to be practiced at construction sites of the project at all time, to ensure safely working environment for occupational health preservation, accident / incident prevention and environmental impact protection would be achieved.

2.1 HSE GOAL AND OBJECTIVE

LNG POWER PLANT (AHLONE) PRJECT HSE Goal is to maintain an injury free workplace with minimum adverse impact of the environment.

The project HSE objectives are established followings;

1) TTCL shall carry out project management and construction management activities in compliance with the applicable legal and other HSE requirements as specified in the contract.

2) Project incidence rates should not exceed the following value;

1

TRIR (Total Recordable Incident Rate), 3.1
LTIFR (Lost Time Incident Frequency Rate), 1.2

$$\text{TRIR Calculation: } \frac{\text{Number of Recordable Cases} \times 200{,}000}{\text{Total Number of Hours Worked}}$$

$$\text{LTIFR Calculation: } \frac{\text{Number of Lost Time injuries cases} \times 200{,}000}{\text{Total Number of Hours Worked}}$$

3) TTCL shall perform construction work by taking into account for the environmental impact protection and complaint from the community shall be "Zero",

The Project HSE Objectives are shown in Appendix 1 and 2.

2.2 HSE POLICY, MANAGEMENT SYSTEM STANDARD AND REFERENCE DOCUMENTS

2.2.1 TTCL HSE POLICY

TTCL Top Management considers Occupational Health, Safety and Environment issues concerned with all employees, subcontractors, customers and community to be the utmost importance. TTCL Top Management has developed, implemented and maintained the Occupational Health, Safety and Environmental Management system and committed to provide direction and necessary resource to ensure the desirable HSE goal and objectives, including the full compliance with applicable HSE regulation, relevant standards and requirements would be achieved.

To clearly and concisely communicated; the TTCL HSE policy and objectives are communicated to all project's personnel, subcontractor and vender through TTCL Management messages, newsletters, Pre-Mobilization Meeting, HSE awareness or HSE training program and HSE campaigns.

The TTCL HSE policy shows as the following:

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED
COMPANY REGISTRATION NO. 0107551000185
27th-30th FLOOR, SERMMIT TOWER, 159/41-44 SUKHUMVIT 21, ASOKE ROAD,
NORTH KLONGTOEY, WATTANA, BANGKOK 10110 THAILAND
TEL. +66 (0) 2260-8505 FAX. +66 (0) 2260-8525-6

As of July 23rd, 2018

Health, Safety and Environment (HSE) Policy

TTCL Public Company Limited is a leading integrated EPC contractor that specializes in design, engineering, procurement, construction and commissioning of turnkey projects for both industrial and process plants including related facilities, mainly in the fields of petrochemicals, chemicals, energy and power industries.

As safety of our employees and concerned parties including environmental protection are our highest priorities. Then the company has implemented the Occupational Health, Safety and Environmental Management Systems to establish and maintain safe and healthy working conditions. Thus, the President& CEO has established the HSE Policy Statement as following;

1. TTCL committed to establish and maintain safe and healthy working conditions in order to prevent injury or ill health of employees and concerned parties including environmental protection.

2. TTCL shall execute project and construction management activities in compliance with applicable legal and other HSE requirements including company and project's procedures.

3. TTCL regards that the compliance with company and project's procedures to establish and maintain safe and healthy working conditions including environmental protection are duty and responsibility of employees and concerned parties which included subcontractors and business partners. Supervisor and manager at all levels have to act as role models by leading, supporting and encouraging their subordinates to be aware of working safely and environmentally conscious.

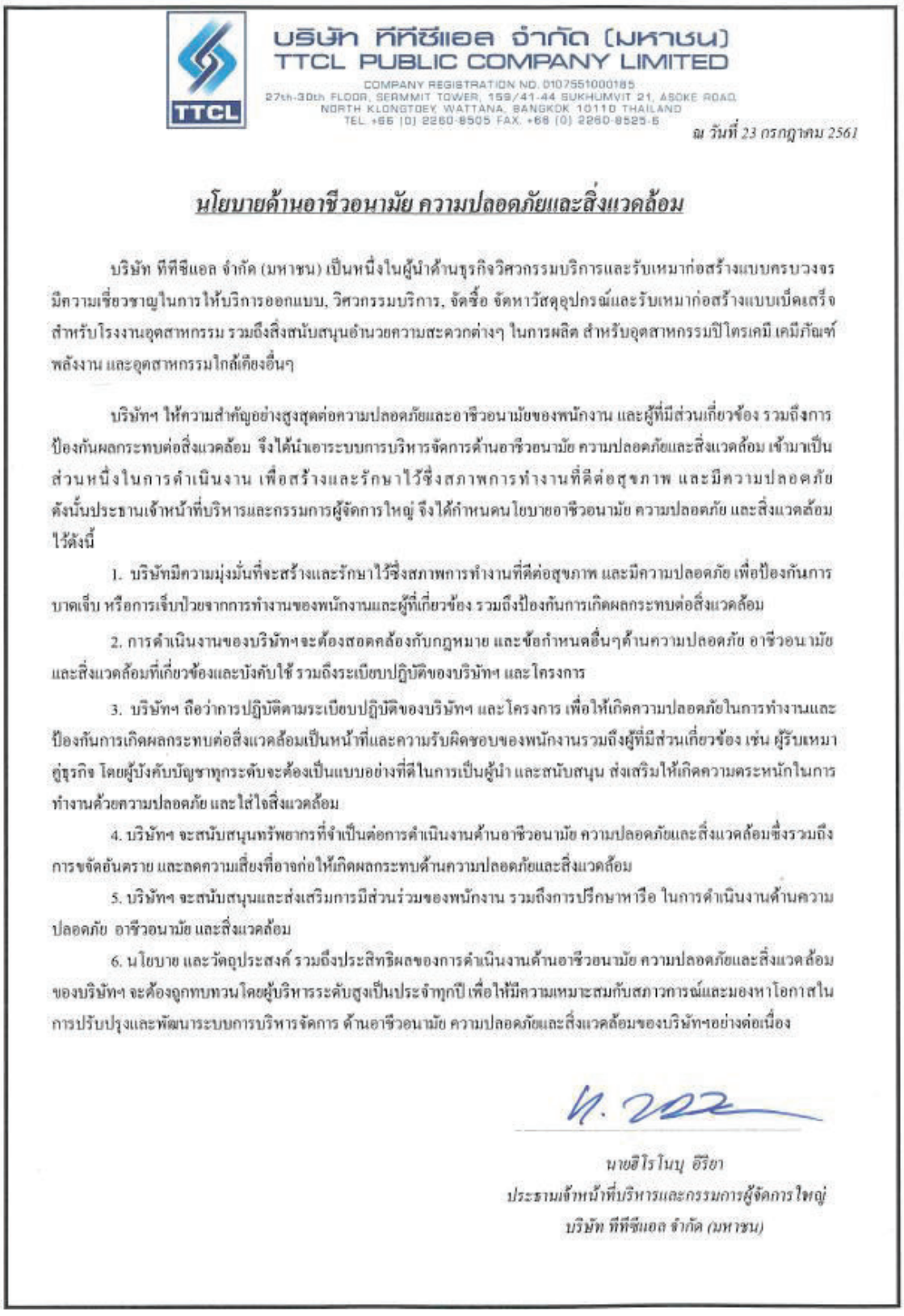
4. TTCL shall provide the necessary resources to support the implementation of the Occupational Health, Safety and Environmental Management Systems including hazard elimination and hazards and HSE risks reduction.

5. TTCL shall support and promote employees' participation and consultation in the implementation of the Occupational Health, Safety and Environmental Management.

6. HSE Policy, Objectives and its effectiveness shall be reviewed annually by Top management for theirs suitability and determine the opportunity for continual improvement of the Occupational Health, Safety and Environmental Management Systems.

Mr. Hironobu Iriya
President & CEO
TTCL Public Company Limited

The TTCL HSE policy shows as the following:



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ณ วันที่ 23 กรกฎาคม 2561

นโยบายด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อม

บริษัท ทีทีซีแอล จำกัด (มหาชน) เป็นหนึ่งในผู้นำด้านธุรกิจวิศวกรรมบริการและรับเหมาก่อสร้างแบบครบวงจร มีความเชี่ยวชาญในการให้บริการออกแบบ, วิศวกรรมบริการ, จัดซื้อ จัดหาวัสดุอุปกรณ์และรับเหมาก่อสร้างแบบเบ็ดเสร็จ สำหรับโรงงานอุตสาหกรรม รวมถึงสิ่งสนับสนุนอำนวยความสะดวกต่างๆ ในการผลิต สำหรับอุตสาหกรรมปิโตรเคมี เคมีภัณฑ์ พลังงาน และอุตสาหกรรมใกล้เคียงอื่นๆ

บริษัทฯ ให้ความสำคัญอย่างสูงสุดต่อความปลอดภัยและอาชีวอนามัยของพนักงาน และผู้ที่มีส่วนเกี่ยวข้อง รวมถึงการป้องกันผลกระทบต่อสิ่งแวดล้อม จึงได้นำเอาระบบการบริหารจัดการด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อม เข้ามาเป็นส่วนหนึ่งในการดำเนินงาน เพื่อสร้างและรักษาไว้ซึ่งสภาพการทำงานที่ดีต่อสุขภาพ และมีความปลอดภัย ดังนั้นประธานเจ้าหน้าที่บริหารและกรรมการผู้จัดการใหญ่ จึงได้กำหนดนโยบายอาชีวอนามัย ความปลอดภัย และสิ่งแวดล้อม ไว้ดังนี้

1. บริษัทมีความมุ่งมั่นที่จะสร้างและรักษาไว้ซึ่งสภาพการทำงานที่ดีต่อสุขภาพ และมีความปลอดภัย เพื่อป้องกันการบาดเจ็บ หรือการเจ็บป่วยจากการทำงานของพนักงานและผู้ที่เกี่ยวข้อง รวมถึงป้องกันการเกิดผลกระทบต่อสิ่งแวดล้อม

2. การดำเนินงานของบริษัทฯจะต้องสอดคล้องกับกฎหมาย และข้อกำหนดอื่นๆด้านความปลอดภัย อาชีวอนามัย และสิ่งแวดล้อมที่เกี่ยวข้องและบังคับใช้ รวมถึงระเบียบปฏิบัติของบริษัทฯ และโครงการ

3. บริษัทฯ ถือว่าการปฏิบัติตามระเบียบปฏิบัติของบริษัทฯ และโครงการ เพื่อให้เกิดความปลอดภัยในการทำงานและป้องกันการเกิดผลกระทบต่อสิ่งแวดล้อมเป็นหน้าที่และความรับผิดชอบของพนักงานรวมถึงผู้ที่มีส่วนเกี่ยวข้อง เช่น ผู้รับเหมาคู่ธุรกิจ โดยผู้บังคับบัญชาทุกระดับจะต้องเป็นแบบอย่างที่ดีในการเป็นผู้นำ และสนับสนุน ส่งเสริมให้เกิดความตระหนักในการทำงานด้วยความปลอดภัย และใส่ใจสิ่งแวดล้อม

4. บริษัทฯ จะสนับสนุนทรัพยากรที่จำเป็นต่อการดำเนินงานด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อมซึ่งรวมถึงการขจัดอันตราย และลดความเสี่ยงที่อาจก่อให้เกิดผลกระทบด้านความปลอดภัยและสิ่งแวดล้อม

5. บริษัทฯ จะสนับสนุนและส่งเสริมการมีส่วนร่วมของพนักงาน รวมถึงการปรึกษาหารือ ในการดำเนินงานด้านความปลอดภัย อาชีวอนามัย และสิ่งแวดล้อม

6. นโยบาย และวัตถุประสงค์ รวมถึงประสิทธิผลของการดำเนินงานด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อมของบริษัทฯ จะต้องถูกทบทวนโดยผู้บริหารระดับสูงเป็นประจำทุกปี เพื่อให้มีความเหมาะสมกับสภาวการณ์และมองหาโอกาสในการปรับปรุงและพัฒนาระบบการบริหารจัดการ ด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อมของบริษัทฯอย่างต่อเนื่อง

นายฮิโรโนบุ อิริยา
ประธานเจ้าหน้าที่บริหารและกรรมการผู้จัดการใหญ่
บริษัท ทีทีซีแอล จำกัด (มหาชน)

2

2.2.2 Drug and Alcohol Policy

(a) Drug and Alcohol Policy is applied in **LNG POWER PLANT (AHLONE) PRJECT** during construction and/or commissioning phase.

(b) TTCL and Subcontractors employees shall comply with Drug and Alcohol Procedure.

2.2.3 HSE MANAGEMENT SYSTEM STANDARD

The Occupational Health, Safety and Environmental Management system apply to **LNG POWER PLANT (AHLONE) PRJECT.** All personnel who involved with "the Project" sites and activities are required to comply with the requirements of these HSE Management systems.

2.2.4 REFERENCE DOCUMENTS

The followings documents shall be used for reference in this HSE Plan.

(a) TTCL HSE Manual and Company Procedure (QM-130 and QPs)

(b) Contract Documents / Project Specifications

(c) TTCL Supportive Procedure and Supportive Reference (SP and SR) which applicable for the project.

(d) Occupational Health and Safety Management system standards ISO 45001 current revision and Environmental Management System Standards ISO 14001current revision.

(e) Others specific requirements and standards applicable to the project.

3. HSE ORGANIZATION AND RESPONSIBILITIES

3.1 HSE ORGANIZATION

TTCL Project Management shall establish Project HSE Organization sufficiently resourced and assigned competent person, to manage the HSE aspects of the Project within TTCL responsibility. For implementation and measure the effectiveness of the HSE system. Typical Project Organization is shown in Appendix 3.

3.2 HSE RESPONSIBILITY

3.2.1 TTCL PROJECT MANAGER (PM)

PM is responsible for assuring the implementation of HSE Policy, HSE Plan, HSE procedure and instruction to ensure that safe operation are performed by TTCL, Subcontractors including the compliance with applicable HSE regulation, relevant standards and requirements.

PM also responsible for Environmental Management during project construction with aims to minimize environmental impact and increase efficiently preventive measurement and ensuring all persons in project have environmental awareness.

PM shall coordinate with HSEM for provide the preventive plan for hazardous material handling and the demarcation and lay-out of areas for storage of various materials, in the particular where dangerous materials or substances are concerned.

3.2.2 TTCL CONSTRUCTION MANAGER (CM)

CM is responsible for the execution of HSE procedure and instruction that safe operations are performed by TTCL, Subcontractors including visitors and concerned persons.

CM in cooperative with HSEM, is responsible to appoint the competent persons to carry out routine or periodic inspection to construction equipment and activities inclusive of following; (but not limited to)

- Electrical equipment and appliance including hand tools.
- Scaffolding, temporary platforms ladders (Access and Egress).
- Cranes, Lifting appliance and Lifting gear / shackle.
- Heavy vehicle and Fork lift.
- Excavation including support and access
- Confined Space working
- Radiography Work
- Fire Fighting
- Spill kit

TTCL Commissioning Manager
Commissioning Manager shall supersede CM function on handed over and equipment. For grey area concern which its scope is not clear separated then it shall be co responsible by Commissioning Manager and CM. Following are Commissioning Manager responsible (but not limit to);

a) Ensure that hazards of working in commissioning are or equipment are identified and adequate preventive / protective measures are in place prior to work.
b) Approve JSA and risk assessment and Permit to Work for commissioning work and work which will be performed in commissioning area.
c) Provide adequate protection for person working on commissioning equipment from hazardous stored energy e.g. Training , LOTO, warning sign, hard barricade, appropriate PPE,etc.

TTCL Commissioning Engineer
Commissioning Engineer shall be responsible (but not limit to);

a) Review JSA and risk assessment and Permit to Work for commissioning work any work performed in commissioning area or equipment.
b) Administrative control of LOTO.
c) Check and confirm that the equipment is complete isolated and de-energized them release the Permit to Work.

3.2.3 TTCL SUPERVISOR/ENGINEER

Supervisor who supervising work at project site shall responsible to

(1) Direct and supervise employees in the responsible unit to follow the regulation and guidance as HSE Procedures.

(2) Analyze the work of the responsible unit to primarily find risks or dangers.

(3) Teach correct working procedures to the employees in the responsible unit for working safely.

(4) Check working conditions of machinery, tools and equipment to be in safe condition before starting daily work .

(5) Direct and supervise the use of personal protective equipment of the employees in the responsible unit.

(6) Report the accidents or illness or annoyance caused by working of the Employees to the employer, and report it to the safety officer.

(7) Investigate the cause of the accident, illness or annoyance caused by working of the employees in collaboration with the safety officer.

(8) Promote, support and conduct HSE activities for safety at work.

3.2.4 TTCL HSE MANAGER/ LEADER (HSEM)

HSEM is responsible to develop an effective HSE management program;

- To establish project HSE procedures and instruction covering project activities, to ensure effective compliance with the company HSE policy, Project HSE requirements.
- Develop and implement the HSE program, organize HSE meetings, collect and report and analyze HSE performance against objective and identify initiative for implement where necessary with training.
- To establish and implement HSE promotion program.
- To implement risk assessment and environmental impacts determination and control.

HSEM shall responsible to following;

1. Ensure risk identified and risk assessment, environmental aspects identification and impacts determination are communicated to TTCL PM and Subcontractor Representatives.
2. Monitor and maintain the HSE performance of the Project.
3. Close contact with TTCL PM, Subcontractor Representative on the Project to enforces HSE standard practice and responsible to provide HSE feedback to TTCL PM.
4. Ensure all TTCL's Subcontractors are complying with the Project HSE requirements.
5. Ensure that Subcontractor's appointed Safety Officers who are qualified and capable of performing the duties assigned.
6. Appoint HSE competent persons or inspectors to carry out routine or periodic HSE inspection to identify unsafe action, unsafe condition, environmental aspects and take corrective action, to assure reporting of all incident and accident.
7. Ensure TTCL, Subcontractors are carry out periodic inspections of all tools and equipment and relevant records are maintained.
8. Ensure all HSE meetings; PTA toolbox talks and any required meetings are conducted and reported to all concerned.

3.2.5 TTCL SAFETY OFFICER (SFO)

Safety Officer Professional level (SFO) shall responsible to

1. Provide HSE training to project personnel and ensure that all project personnel have attended the HSE induction and others specific HSE training required.
2. Ensure that TTCL, Subcontractors are in full compliance with the HSE requirements under scope of works being conducted on the project, in relation to Project specific HSE rule and regulation, HSE Plans and Procedures.
3. Ensure all first aid equipment, safety equipment, spill kit, security facilities are maintained in good condition and in sufficient quantities and necessary training provided.
4. Report to HSEM for HSE matter within the project.
5. Analysis HSE statistic and provide the report to HSEM.

3.2.6 TTCL Environmental Engineer

Environmental Engineer (ENV) shall responsible to

1. Provided environment training to project personnel and ensure that all project personnel have attended the training and others specific environment training required.
2. Ensure that TTCL, Subcontractors are in full compliance with the environment requirements under scope of works being conducted on the project, in relation to Project specific HSE rule and regulation, HSE Plans and Procedures.
3. Overall implementation of Waste Management, monitoring and report to HSEM and PM of any issue concerns.
4. Assist Subcontractor plans and coordinates the works for effectively implement the requirements of the procedure.
5. Ensure the required HSE records are generated and available for review by TTCL HSEM.
6. Ensure that waste management data shall be reported in weekly basis.
7. Prepare supportive document and coordinate with Project Owner for waste generator licensed requisition from DIW.

3.2.7 TTCL SAFETY SUPERVISOR (SSV)

Safety technician level (SSV) shall responsible to

1. Ensure that the project HSE policy, requirements, procedure and HSE working practice are fully understood and being effectively applied.
2. Create healthy and safely working condition and environmental impact prevention throughout the project.
3. Conduct HSE inspection and reporting to Safety Officer.

3.2.8 SUBCONTRACTOR MANAGEMENT REPRESENTATIVE

Subcontractor Management Representatives shall responsible to

1. Ensure that Subcontractor's project HSE plan and procedure has been established and that it is adequate for Project HSE requirement,
2. Ensure that Subcontractor's project HSE plan and procedure are fully implemented and maintained,
3. Monitor their HSE performance and take appropriate corrective / preventive action as needed.

3.2.9 SUBCONTRACTOR SAFETY OFFICER/ENVIRONMENTAL ENGINEER

Subcontractor Safety Officer/Environmental engineer shall responsible to

1. Ensure that their HSE Plan and Procedures are fully implemented and comply with the project HSE requirements,
2. Ensure that all risk assessment and significant environmental aspect are identified on the project and communicate to their employees,
3. Implement and maintain Daily Tool Box Talk and HSE Meeting,
4. Practice in the HSE inspection program and HSE promotion programs,
5. Report all HSE matter to Subcontractor Representatives.

3.2.10 EMPLOYEES / WORKER

All employees / workers at all levels are involved in accident prevention and environmental impact protection. Individual employee actions are the key to achievement of HSE Goal and objectives. They have a duty to themselves and their follow employees to exercise care and good judgment in preventing accidents, avoiding hazards to health and environmental protection.

Each employee / worker is responsible for their health protection, safety and environmental impact protection and that of their co-worker whilst on the project, the responsibilities of individual worker / employee is following;

- To attend project HSE training.
- To attend a daily / weekly toolbox talk to be aware and understand the HSE requirement in the area.
- To correctly use/equip provided PPE, clean and maintain the PPE in good condition as instructed by PPE manual or supervisor.
- To ensure all tools and equipment work properly and have been inspected before used.
- To execute work in accordance with the HSE procedure and instruction.
- To report any unsafe action or unsafe condition or environmental aspect& impact to their immediate supervisor and / or HSE personnel immediately.
- Participate in and support the HSE Policy, and their site HSE promotion program.

4. HSE REQUIREMENTS

3

4.1 GENERAL REQUIREMENTS

4.1.1 Context of organization

An understanding of the context of an organization is used to establish, implement, maintain and continually improve its HSE management systems. TTCL determines

internal and external issues (which can be positive or negative) that are relevant and may affect to ability to achievement of the HSE management systems. TTCL uses tool to analyze both internal and external issues following;

Internal issues

2S 4M Analysis (Structure, Services, Man, Money, Material and Management System) is tool used to identify and analyze the internal issues that can have an impact on organization

External issues

A PESTLE analysis is strategic management tool used to identify and analyze the external issues that can have an impact on an organization. The framework examines opportunities and threats due to Political, Economic, Social, Technological, Legal and Environmental force, to inform planning and decision-marking.

The process to identify and analyze internal and external issues shall be conducted in accordance with SP-610-002 Risks and Opportunities.

4.1.2 Need and Expectation of Interested Party

TTCL shall identify the interested parties that are relevant to the environmental management system which may include, but not limit to; Customer, Subcontractor, Vendor, Employees, Neighbors and Community.

The needs and expectations (i.e. requirements) of interested parties shall be determined and considered which need that have to or choose to comply with.

4.1.3 Compliance Obligation

TTCL shall identify and assess the legal and other requirements which are applicable to TTCL or which TTCL chooses to comply with in order to ensure that TTCL and subcontractor are acknowledge and complied with the Legal and other requirements

The result of evaluation compliance with Legal requirements and other requirements can result in risks and opportunities.

4.2 HEALTH REQUIREMENTS

TTCL develop the health requirement for occupational health preservation and protection to ensuring good occupational health for project's personnel.

General Provision

Project's personal hygiene is importance, so the temporary office and all facilities, working area, equipment / tools and storage area shall be kept in hygienic conditions.

Health Medical Facilities and First Aid

- TTCL shall provide First Aid Center, First Aid Staff and First Aid Equipment in accordance with Thailand Regulation or applicable local legislation.
- TTCL shall provide personnel First Aid instruction and training such as basic CPR/First Aid from Professional Nurse according to specific work risk.
- TTCL shall manage to acquire medical service from nearest hospital as need.

Welfare Facilities

- TTCL shall establish and managed canteen, food services process and related facilities at location acceptable to Owner and in accordance with Thailand regulation.

Sanitation

- TTCL shall provide sufficient covered garbage container at the proper location to ensure adequate storage capacity and prevent litter accumulating.
- TTCL shall provide sufficient signage and containers for materials to be reused or recycled to ensure proper segregation and storage capacity, enabling the maximum reuse and recycling of material.
- TTCL shall provide sufficient signage and containers for hazardous waste and hazardous materials to avoid spillage to the environment, By safe storage, collection and disposal in accordance with Thailand regulation.
- TTCL shall collect and dispose of all wastes and recycle them in accordance with Thailand regulation.
- TTCL shall treatment of each area as necessary to prevent the breeding of insects and vermin.
- TTCL shall assure that canteen workers are medically approved for handing food.

Substances Hazardous to Health

- TTCL establish the minimum requirements for controlling substances that may be hazardous to health, which will address the instruction for handling of chemical, potentially toxic and hazardous materials required at each worksite.

4.3 OCCUPATIONAL, SAFETY AND SECURITY REQUIREMENTS

4.3.1 OCCUPATIONAL, SAFETY REQUIREMENTS

- TTCL shall develop and implement HSE Management System.
- TTCL Project Manager responsible for maintain ratio of Safety Supervisor per project workforce at 1:50.
- The qualified safety supervisor shall as a minimum, be qualified by having attend a course approved by Ministry of Labor for Safety Practitioner.
- TTCL shall develop the project HSE procedure and instruction for identification and elimination of construction hazards, HSE incentives which focus on recognizing and awarding positive HSE activities which eliminate potential hazard incidents, the enhancement of workforce HSE behavior and awareness, and elimination of all personnel injury.

The project's HSE procedures, HSE instructions would be covered owner' HSE requirements and communicated to subcontractors by various methods such as class room training, Tool box talk, documents, CD Rom etc., to ensure that all subcontractors are acknowledged and comply with HSE procedures shall be at least as followings (But not limited to);

- Risk Assessment & JSA
- PPE provided and using guidelines.
- Incident and Emergency Response Plan
- Fire Prevention
- Excavation
- Scaffolding
- Fall Protection
- Lifting Rigging and Crane Operation
- Equipment Inspection
- Electrical Inspection and Grounding
- Compressed Gas Cylinder Handling
- Permit to Work
- Energy Isolation

- Hazard Communication
- Pressure Test
- Etc.

- TTCL will develop and implement necessary HSE Training Program for project personnel.
- TTCL will implement Work Permit system associate with Risk Assessment and Job Safety Analysis.
- TTCL will develop and implement HSE inspection and audit program to ensure project worksite achieves a safe working condition for accident and incident prevention.
- TTCL will maintain HSE statistics and generate weekly, monthly report to all concerned.
- TTCL and Subcontractors shall provide the PPE as defined standard by legal for their employee as followings;

Mandatory basic PPE;

4

- Safety Helmet with chin strap (Bearing the name or logo of company and color to be agreed with TTCL).
- Safety Shoes
- Safety Glasses

Specific PPE as required by circumstance (SDS or JSA);

- Hearing Protection
- Specific Hand protection as required
- Goggle
- Rubber boots with toe protection
- Safety harness and lifeline, include fall arrester
- Filtered eye protection for welding
- Respirator equipment as required by circumstance
- Chemical suit
- Etc. as work related.

4.3.2 PROJECT SITE SECURITY

TTCL shall arrange appropriate security system and develop site security plan for the project and lay down area.

4.4 ENVIRONMENTAL REQUIREMENTS

5

Project Environmental Social Impact Assessment (ESIA) mitigation measure shall be implement by all project's personnel.

Environmental Impact Control
TTCL shall provide the "Environmental Control and Management Plan" for environmental impact control system of the project, this plan will meet the following principle:

- Air Quality Management
- Dust Management
- Marine Safety Management
- Noise and Vibration Management
- Surface water Management
- Soil and Groundwater Management
- Biodiversity

And this management plan shall address the ESIA mitigation measure issue; this plan will be included environmental monitoring and testing program such as water sampling, noise monitoring, and emission monitoring and ambient monitoring.

5. HAZARD IDENTIFICATION, RISK ASSESSMENT AND ENVIRONMENTAL ASPECTS IDENTIFICATION& IMPACTS DETERMINATION

The identification of hazards, risk assessment/ environmental aspect identification& impact determination and management of the risk/ impact in order to achieve the HSE a goal is incorporated into the general management principles and working procedure. The system is designed to identify hazards/ environmental aspects during associated with construction activities and execution of the work. In addition, the system is also designed to cover identification of hazard/ environmental aspect in the facilities.

The planning, identification and communication of risk assessment/ environmental aspect & impact determination and risk/ impact management takes place in a number of forums, e.g.

- Routine and non-routine activities.
- Department meeting.
- Supervision of work activities.
- Job Safety Analysis (JSA).
- Internal, second party and third party audits.

- Management review meetings.
- Planned inspection and patrol.
- Project and contract meetings

All project employees and line supervisors are responsible for identification and elimination of hazards/ environmental aspects.

Communications of hazards/ environmental aspects and controls: individuals identifying a hazard/ environmental aspect are responsible for taking immediate action and eliminate the hazard/environmental aspect it selves whenever possible. If unable to eliminate the hazard/ environmental aspect, the individual will ensure that the situation is highlighted as a warning to others and will notify concerned supervisor, HSE personnel or management to initiate the corrective action.

The recording of hazards/ environmental aspects identification and corrective actions taken or planned will be maintained in a number of ways, e.g. JSA records, Accident reports, HSE Audit Reports, Inspection reports, Minutes of meetings, Tool box Talk records, etc. The HSE Department will maintain these records and, in addition, will maintain a Corrective Action Log, which will summarize all corrections, which have been identified and indicate the current status of corrective actions.

All outstanding corrective actions with regard to HSE record in the various records will be assigned to a responsible person for close-out and will be followed up by the HSE Department to ensure that they are closed out in a timely manner.

All hazards and risks/ environmental aspects and impacts identified will be reviewed and objectives and priorities set for their resolution. Personal will be identified as responsible for successful resolution in a timely manner.

The determination of controls uses the results of risk assessment/ environmental impact determination for consideration which is given to reduce the risks/ environmental impacts according to the following hierarchy as Elimination, Substitution, operational controls, Signage or warnings, PPE etc.

6. RISK AND OPPORTUNITIES

3

TTCL determine risks and opportunities that can be identified from context of organization, need and expectation of interested parties, compliance obligation, hazards (OH&S risks), other risks related to HSE and significant environmental aspect, in order to ensure company is able to achieve the intended outcomes of HSE Management Systems.

Risks are managed with a focus on decreasing their likelihood and minimizing their impact if they should occur. Opportunities are managed to maximize their benefits if they should occur.

The process to identify and assess risks and opportunities should be carried out in compliance with SP-610-002 (Risks and Opportunities Procedure)

The result form risks and opportunities identification and assessment are considered for prioritization of planning actions and established the HSE objectives and programs.

Risks and opportunities determination should be periodically reviewed to ensure that they remain relevant and up to date.

7. COMMUNICATION

6

TTCL shall determine HSE information required to communicate to staffs and concerned person, communication channel and schedule, responsible persons and retain communications evidences as appropriate. Communication plan shall be followed as APPENDIX 4. (This document shall be properly modified as project requirement.)

8. HSE TRAINING

7

TTCL is responsible for conducting preliminary and continuous HSE training for all personnel in order to develop and maintain personal interest in the HSE program and to train personnel in the safe practices and work procedures.

TTCL HSEM shall establish the HSE Training Program before commencing the work. This guidance provides essentials of establishing the HSE Training Program following two categories including Basic Safety Training and Specific HSE Training.

The guidance for establishing the HSE Training Program shall follow within APPENDIX 5. This document will develop accordance with HSE Legal and Project Site requirements.

9. HSE INSPECTION AND AUDIT PROGRAM

9.1 PROJECT HSE INSPECTION AND MANAGEMENT PATROL

TTCL shall develop the HSE inspection and management patrol program which Site HSE inspection shall be conducted daily by TTCL and subcontractor Safety officer/Environmental Engineer.

In addition periodical management patrol, which performed by TTCL Site Managements, Superintendents, Supervisors, HSE personals and Subcontractor's representative should be conducted weekly, to observe and verify the effectiveness of HSE control measure employed on site.

All discrepancies noticed during HSE inspection and Management Patrol shall be promptly report to TTCL Project Manager, Subcontractor Representatives and concerned HSE personnel who will take immediately correction and provide corrective / preventive action to prevent recurrence. The records shall be properly filed.

TTCL as well as owner representative has the right to stop any work or acts which are considered to be dangerous without any obligation. All TTCL and Subcontractors personnel shall promptly comply with the instructions of TTCL and/or owner representative at all times.

9.2 TTCL INTERNAL AUDIT

The "Internal Audit" shall be performed to verify the effective implementation of Occupational Health and Safety Management System (OH&S, ISO 45001), Environmental Management System (EMS, ISO 14001) to ensure that the control measures applied to associate risk/ environmental impact and HSE activities are properly executed.

"Internal Audit" shall be performed in accordance with the predetermined schedule on the certain scope, taking the project activities into consideration.
The audit findings shall be recorded and the audit result shall be sent to the TTCL PM, and project organization concerned. In case Nonconformity has been found in the audit, the "Corrective Action Request" (CAR) shall be issued to concerned person for correction or rectification and prevention of recurrence.

9.3 CONSTRUCTION EQUIPMENT INSPECTION

Construction Equipment such as cranes, lifting equipment, electrical appliances and vehicles shall be inspected when brought into the site.

Related certification or third party / authority inspection documents (if any) shall be submitted and proven identification shall be displayed on the equipment. And also this construction equipment on the site shall be inspected by designated personnel at specified intervals (minimum 3 month / time). Inspection records on check lists shall be kept as evidences.

10. HSE MEETING

TTCL considers HSE meetings a highly important part of the HSE Management System in that they permit HSE communication to take place between management and employees, and vice versa.

AIMS AND PURPOSE OF HSE MEETINGS

- A team orientated and transparent communication tool.
- An economical use of time in disseminating HSE information.
- An opportunity to contribute ideas, suggestions for HSE improvements.
- A tool for continuing education and motivation of the workforce.
- A tool to maximize proactive HSE performance at work.
- To openly discuss sound HSE practice and emphasize areas that needs improvement.
- Better understanding of SITE related HSE issues for line Management/ supervision.

AGENDA

HSE meetings provide a communications flow on HSE matters. Topics to be discussed shall include, but are not limited to:-

- Review/ Discuss Management HSE concerns.
- Review/ Discuss Employee HSE concerns.
- Review/ Discuss Accident/incident investigation.
- Reporting and follow-up status of unsafe acts, conditions and practices with discuss action and corrective action (s) to expedite closure.
- Review/ Discuss all fire and emergency situations and potential hazards/ significant environmental aspects since the last HSE meeting.
- Review/ Discuss Work procedures.
- To remind the important objective of personal protective equipment.
- Additional Requisition HSE awareness training program.
- Propose the HSE Incentive program, and related campaign(s).
- Review/Discuss Site Security program.

ATTENDANCE

1) HSE Weekly Meeting

The meetings to invite owner representative to attend and shall be attended by TTCL

and all subcontractors HSE representatives and consider to invite concerned Subcontractors Supervisors.

2) HSE Committee Monthly Meeting

The Committee meeting to invite owner representative to attend and shall be attended by TTCL PM /CM, HSEM, Safety officers/Environmental Engineer and all Subcontractor Representatives and HSE personnel.

The committee agenda shall focus on the following:

- Review of past months meeting minutes.
- Actions taken.
- High-risk work or activity/ high significant environmental aspects
- Current activities and problem areas.
- Accident review and corrective actions.
- Future activities.

HSE committee meeting attendance is mandatory for each Subcontractor.

MINUTES OF MEETING
Minutes of Meeting shall be recorded by TTCL Safety officer/Environmental Engineer, reviews by TTCL HSEM and approved by TTCL PM then distributed to all members. It shall be responsibility of all committee members to ensure that the topics discussed at these meeting are, where required, disseminated appropriately and effectively. Subcontractors shall take the necessary action to promptly implement HSE committee directives and recommendations.

11. ACCIDENT/INCIDENT REPORT

All accident / incident, which occur at or in association with the Project, will be reported and investigated as following.

- Initial incident information shall be reported to TTCL CM via TTCL HSEM within 24 hrs after incident occurred.
- Investigation report shall be submitted to TTCL CM via TTCL HSEM within 7 days after incident occurred.

TTCL shall develop the incident investigation procedure to identify the primary causes and prevention the re-occurrence by root cause analysis method.

12. MANAGEMENT OF CHANGE

8

A management of change procedure will be implemented to ensure that any proposed changes which may affect the safety or execution of site activities are thoroughly assessed prior to implementation. The change procedure should ensure that all necessary amendments and modifications to existing safety control measures and equipment will be identified and Implemented in appropriated manner.

A management of change (MOC) must be implemented covering HSE-relevant changes.

This refers to permanent and temporary changes e.g. in

-Technology (processes, technical equipment, process parameters)

- Materials (specification, packaging, supplier)

- Buildings and other structures

- Procedures

- Organization

- Logistics

These changes must be adequately managed, documented, and archived. They must be adequately communicated to relevant stakeholders.

13. EMERGENCY PREPAREDNESS AND RESPONSE

TTCL shall develop the project emergency response plan and procedure which suitable for project requirements and situation.

Project's Emergency Response Team (ERT) would be appointed and trained and resourced with required rescues equipment.
Emergency drill including all fires case, spills, other environmental& safety related issues would be conducted once a year.

14. SUPPORTIVE PROCEDURES

Specific details of HSE implementation would be described in the following supportive procedures;

1. F050-MNL-047 : Risk Assessment, JSA &EIA Tool Box Talk Procedure
2. F050-MNL-049 : Confined Space Entry Procedure
3. F050-MNL-061 : Pressure Test Procedure
4. F050-MNL-048: Permit to Work Procedure

5. F050-MNL-051 : Control of Hazardous (Lockout/ Tagout) Procedure

6. F050-MNL-024 : Environmental Control and Management Plan

7. F050-MNL-026: Waste Management Plan

8. F050-MNL-029 : Site Security Procedure

9. F050-MNL-050 : Personal Protective Equipment Procedure

10. F050-MNL-083: Security Plan and Decommissioning Management Plan Framework

11. F050-MNL-084: Traffic Management Plan

12. F050-MNL-085: Community Health Management Plan

13. F050-MNL-030: Project Incident and Emergency Response Plan

14. F050-MNL-086: Fire Prevention Plan

14. APPENDIX

APPENDIX 1: Project HSE Objective (English Version)

APPENDIX 2: Project HSE Objective (Thai Version)

APPENDIX 3: Draft Project Organization

APPENDIX 4: Communication Plan

APPENDIX 5: Training Matrix

HSE OBJECTIVE

FOR PROJECT " LNG POWER PLANT (AHLONE) PROJECT"

JOB NO. "F-050"

The HSE Objectives, for Project "NAME" are defined as follow;

1) *TTCL shall carry out project management and construction management activities in compliance with the applicable legal, and other HSE requirements as specified in the contract.*

2) *Project incidence rates should not exceed the following value;*

TRIR (Total Recordable Incident Rate), 3.1

LTIFR (Lost Time Incident Frequency Rate), 1.2

3) *TTCL shall perform construction work by taking into account for the environmental impact protection and complaint from the community shall be "**Zero**",*

.....

(Mr. Peerapat T.)

Project Manager

TTCL Public Company Limited

APPENDIX 2

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

PROJECT TITLE

วัตถุประสงค์ด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อม

โครงการ "LNG POWER PLANT (AHLONE) PROJECT"

โครงการเลขที่ "F-050"

โครงการฯ ได้กำหนดวัตถุประสงค์ด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อมของโครงการ "ชื่อโครงการ" ไว้ดังต่อไปนี้

1) บริษัท ทีทีซีแอลฯ จะบริหารและดำเนินการก่อสร้างโครงการฯภายใต้การดำเนินการที่สอดคล้องกับกฎหมายและข้อกำหนดด้านอาชีวอนามัย ความปลอดภัยและสิ่งแวดล้อมอื่นๆที่บังคับใช้กับโครงการหรือตามที่ได้ตกลงกันไว้ในสัญญาจ้าง

2) บริษัท ทีทีซีแอลฯ จะควบคุมค่าดัชนีด้านความถี่ และความรุนแรงของอุบัติเหตุ ในโครงการฯ ตามที่ได้ตั้งเป้าหมายไว้ ดังต่อไปนี้

TRIR (อัตราการเกิดอุบัติการ), 3.1

LTIFR (อัตราการบาดเจ็บถึงขึ้นหยุดงาน), 1.2

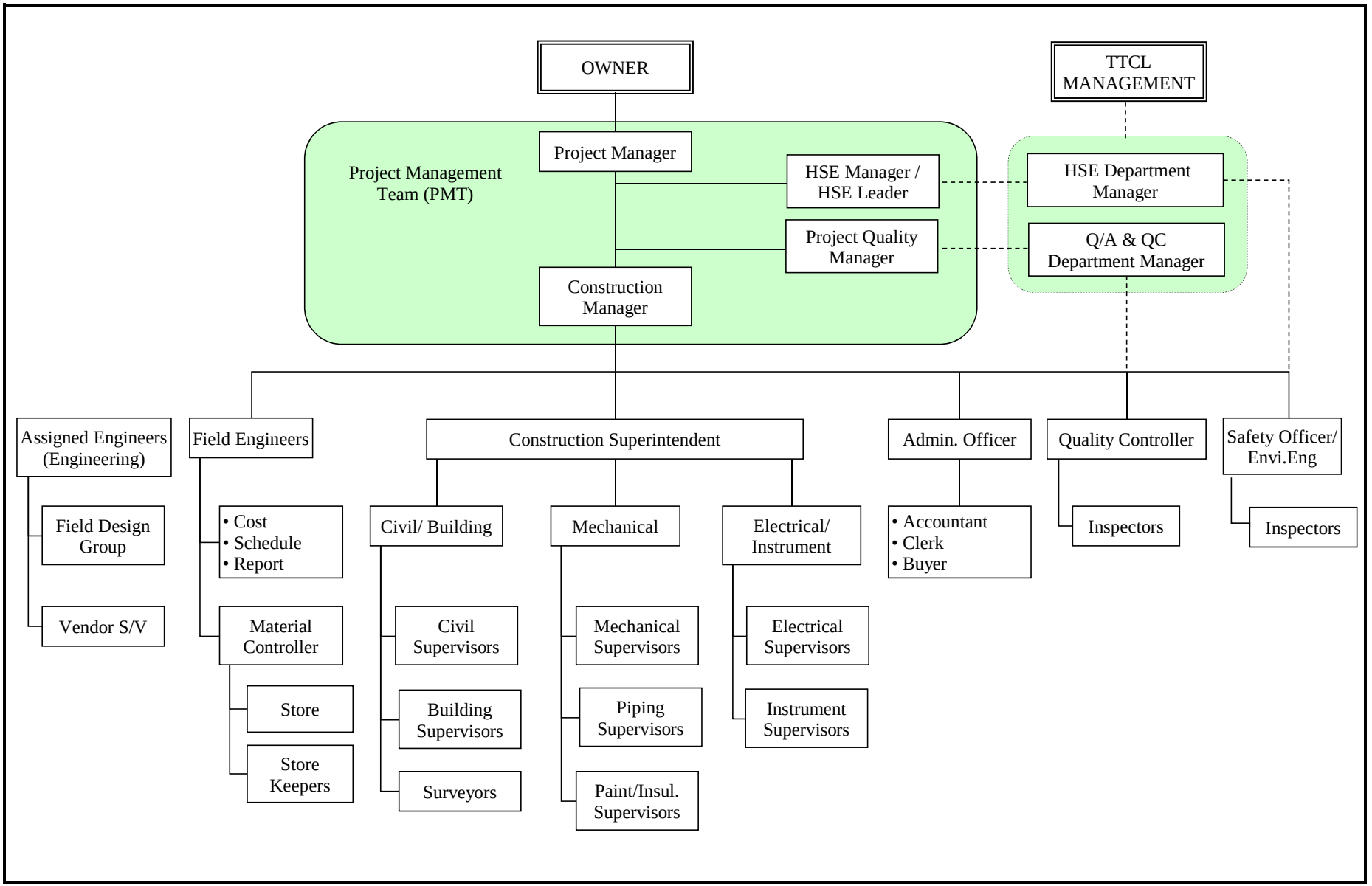
3) บริษัท ทีทีซีแอลฯ จะดำเนินการก่อสร้างโดยความตระหนักถึงความสำคัญในการบริหารจัดการด้านการป้องกันผลกระทบต่อสิ่งแวดล้อม ทั้งนี้จะต้องไม่มีข้อร้องเรียนจากชุมชน

.....
(Mr. Peerapat T.)

ผู้จัดการโครงการ

บริษัท ทีทีซีแอล จำกัด(มหาชน)

Draft Project Organization



บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

HSE Communication Plan (External)

Appendix-4

External party	Information to be communicated	Action by	Method / Channel	Evidence	Time
1. Owner	1. Project HSE rules	HSE department	Document transfer	Submit for approval	Prior to start project
	2. HSE Procedure	Project department	Document transfer	Submit for approval	Prior to start project
	3. HSE Policy/Objective&Target	HSE department	Included in HSE procedure	Submit for approval	Prior to start project
	4. HSE Weekly Report	HSE department	Email	Email	Weekly basis
2. Subcontractor/ Vendor	1. Project HSE rules	HSE department	Induction training	Training record	Pre-job mobilization
	2. Procedure	HSE department	Hard copy / email	Communication record	Prior to start project
	3. Kick off meeting agenda and minutes	HSE department	Hard copy / email	Communication record	Prior to start project
3. Community	1. Public relation announcement - Project time frame	Project department	Project sign board	Photo	Prior to start project
	- Activity that may disturb community e.g. steam blow, commissioning	Project, HSE, ADMIN	Bill board / Notice letter	Photo / mail	Prior to start the activity
	- Heavy equipment transportation	HSE department	Bill board / Notice letter	Photo / mail	Prior to start the activity
4. Neighbor establishment / factory	1. Public relation announcement - Project time frame	HSE department	Bill board	Photo	Prior to start project
5. Authority	1. Public relation announcement - Project time frame	HSE department	Bill board	Photo	Prior to start project

TTCL PUBLIC COMPANY LIMITED
TTCL HSE TRAINING MATRIX

Appendix-5

TTCL HSE Training Matrix

Construction Phase

	HSE for Management Level	HSE Management	Legal of HSE	Safety Management System	HSE for Supervisor Level	HSE Foundation and Responsibility	HSE Laws	Hazard Identification	Hazardous Control And Protection	HSE for New Commer	HSE Foundation	HSE Laws	Rules and regulation	HSE for New workplace environmental	Risk element for working	Site Regulation	Waste Management	Working at Height	Permit to Work (PTW)	Job Safety Analysis (JSA)&Environmental Impact Analysis (EIA)	Confined Space Entry	Hot work & Fire Watcher**	Crane Operator **	Crane supervisor	Signalman	Rigger	Vehicle Driver & Banksman	First Aid and CPR	LOTO (Commissioning Phase)	Basic Fire Fighting **	Hazard Communication	Basic Scaffolding (BS Standard)	Electrical safety
Time spending (hr.)	<12>	3	3	6	<12>	3	3	3	3	<6>	1.5	1.5	3	<8>	1.5	1.5	1	1	2	1.5	16	1	24	18	18	18	1	1	1	6	1	14	3
	BASIC SAFETY TRAINING (INDUCTION)																		SPECIFIC SAFETY TRAINING														
Management Level & Project Team																																	
PM		X	X	X							X	X	X		X	X	X	X	X														
CM		X	X	X							X	X	X		X	X	X	X	X														
PEM		X	X	X							X	X	X		X	X	X	X	X														
PE						X	X	X	X		X	X	X		X	X	X	X	X	X														
FE						X	X	X	X		X	X	X		X	X	X	X	X	X														
Structure - Civil Work																																	
Supervision Level / Engineer Level Up (* If required)						X	X	X	X		X	X	X		X	X	X	X	X	X	*			*	*	*				*			
General worker											X	X	X		X	X	X	X			*			*	*	*				*			
Surveyer											X	X	X		X	X	X	X															
Excavation Worker											X	X	X		X	X	X	X						*	*	*			X				
Structure erection / demolition (* If required)											X	X	X		X	X	X	X															
Truck Driver & Banksman											X	X	X		X	X	X	X									X						
Piping & Mechanical Work																																	
Supervision Level / Engineer Level Up (* If required)						X	X	X	X		X	X	X		X	X	X	X	X	X	*	*		*	*	*				*	*		
Welder											X	X	X		X	X	X	X			*	X		*	*	*				*	*		
Fitter											X	X	X		X	X	X	X			*	X		*	*	*				*			
Crane Operator											X	X	X		X	X	X	X					X										
Rigger											X	X	X		X	X	X	X								X							
Electrical Work																																	
Supervision Level / Engineer Level Up (* If required)						X	X	X	X		X	X	X		X	X	X	X	X	X	*			*	*	*			X	*			X
Cable pulling / Cable tray installation											X	X	X		X	X	X	X			*			*	*	*			X				X
Electrical installation / demolition											X	X	X		X	X	X	X			*			*	*	*			X				X
Electrician											X	X	X		X	X	X	X			*			*	*	*			X				X
Instrumentation											X	X	X		X	X	X	X			*			*	*	*			X				X
Scaffolding work																																	
Supervision Level / Engineer Level Up (* If required)						X	X	X	X		X	X	X		X	X	X	X	X	X	*			*	*	*			X			X	
Worker											X	X	X		X	X	X	X			*			*	*	*			X			X	
Painting																																	
Supervision Level / Engineer Level Up (* If required)						X	X	X	X		X	X	X		X	X	X	X	X	X				*	*	*			X				
Worker											X	X	X		X	X	X	X											X				
Insulation Work																																	
Supervision Level / Engineer Level Up (* If required)						X	X	X	X		X	X	X		X	X	X	X	X	X	*			*	*	*			X				
Worker											X	X	X		X	X	X	X			*			*	*	*			X				
Safety&Environmental																																	
Safety Officer/Safety Engineer											X	X	X		X	X	X	X	X	X	X	X		X	X	X			X	*	*		*
Environmental Engineer											X	X	X		X	X	X	X	X	X	X	X		X	X	X			X	*	*		
Safety Technician											X	X	X		X	X	X	X	X	X	X	X		X	X	X			X	*	*		*
Emergency Response Team																																	
Rescue											X	X	X		X	X	X	X			*								X				
Fire Figthing											X	X	X		X	X	X	X			*								X		X		
Paramedic											X	X	X		X	X	X	X			*								X				
Fire Watcher											X	X	X		X	X	X	X				X							X				

Remark:

X Required for all

* As required per the task

** Outsource Training

Updated 5/9/2020

APPENDIX X HSE PLAN PROCEDURE

AHLONE 2

SITE SAFETY RULES AND REGULATIONS PROCEDURE

PROJECT DOC. NO. F050-MNL-059

LNG POWER PLANT (AHLONE) PROJECT

TTCL JOB NO. F-050

Total (Including this Page): 18 sheets

0	27 Apr 20	For Information	Phakin P.	Nimit A.	Anuchit P.	Peerapat T.
REV.	DATE	DESCRIPTION	MADE	CHECKED	APPROVED	AUTH'D

For Project Use only

Originator	Distribution	PW	PR	MA	ME	PP	EE	IN	CV	QC	PC	Proj	Site	Owner	Total
Project	No. of Copy	-	-	-	-	-	-	-	-	-	-	ORG.	1	1	2

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

Revision History Sheet

Rev.	Date	Description
0	Apr 27'20	For Information

CONTENTS

1. PURPOSE

To establish site safety rules and regulations to preserve Occupational Health and Safety of CONTRACTOR employees, subcontractors and other concerned parties including environment impact protection.

2. SCOPE

This procedure provides the minimum requirement of Health, Safety and Environment rules and regulation to which CONTRACTOR employees, subcontractor employees and other concerned parties shall comply during construction and pre-commissioning and commissioning in LNG POWER PLANT (AHLONE) PROJECT

3. RESPONSIBILITY

3.1 CONTRACTOR PROJECT MANAGER (PM)

(a.) PM in responsible for assuring implementation of Site Safety Rules and Regulations to ensure that safe operation are performed by CONTRACTOR, Subcontractors and other concerned parties in the project.

(b.) Lead by an example, modeling the behavior expected from all personnel performing work at the jobsite.

3.2 CONTRACTOR CONSTRUCTION MANAGER (CM)

(a.) CM in responsible for construction execution of Site Safety Rules and Regulations that make safe operation by CONTRACTOR employees, Subcontractors employees including visitors and concerned persons.

(b.) Lead by example, modeling the behavior expected from all personnel performing work at the jobsite.

3.3 CONTRACTOR HSE MANAGER (HSEM)

HSEM is responsible to develop an effective site safety rules and regulations as following

(a.) Establish Site Safety Rules and Regulations covering project activities risk.

(b.) Ensuring effective compliance with this Site Safety Rules and Regulations.

(c.) Ensuring this procedure is administered properly and developed Site Safety Rules and Regulations procedure where necessary.

(d.) Ensure that all site personal (CONTRACTOR and Subcontractor employees) are received "Site Safety Rules and Regulation procedure" training and adhere to its entire requirement.

(e.) Lead by an example, modeling the behavior expected from all personnel performing work at the jobsite.

3.4 SUBCONTRACTOR MANAGEMENT REPRESENTATIVE

Subcontractor management representatives shall responsible to ensure that;

(a.) Subcontractor employees absolutely follow Site Safety Rules and Regulation.

(b.) All supports as need with Site Safety Rules and Regulations requirements are appropriate response and collaborate.

(c.) Subcontractor Management Representatives shall monitor their employee safety performance and take appropriate corrective / preventive action as need.

3.5 EMPLOYEES / WORKERS

(a) All employees / workers at all levels are involved in Site Safety Rules and Regulations procedure. The objectives are preventing accidents, avoiding hazards to health and environmental impact protection.

(b) Know, understand and carry out duty in accordance with Site Safety Rules and Regulations by completed study this procedure.

4. PROCEDURE

4.1 GENERAL SAFETY RULES

(1) Primary responsibility shall perform duties in a safe manner in order to prevent injury to yourself and others.

(2) All workers shall strictly follow rules regulations and instructions at all time. If do not understand any points, ask your Supervisor or Safety Officer.

(3) All hazardous and unsafe acts/conditions shall be reported to Supervisor or Safety Officer immediately.

(4) Basic PPE shall be worn at all time in construction field and additional PPE shall equip with their type of work site.

(5) Good housekeeping standards shall be maintained at all time. Smoking outside of designated area is prohibited.

(6) Safety signs, warning signs and prohibit signs shall be observed and followed at all time. Unauthorized person shall not enter to restricted area without permission.

(7) In case of working in off-hour, all workers shall inform Supervisor or Safety Officer for an emergency rescue preparation.

(8) Work with suitable dress. Short pants, t-shirt or undershirt, slippers are prohibited in the site and the project. Do not take off clothing during working.

(9) Horseplay, practical joking or fighting is prohibited.

(10) Drugs and alcohol used on the construction site are absolutely forbidden at any time.

(11) Firearms, explosive materials and illegal substances used on the construction site are absolutely forbidden at any time. Photography without permission is prohibited.

(12) Tools usage shall be fit with type of work. Be carefully using shall be alert at all time.

(13) Never stand or walk under any suspended load. Used tag lines at all times.

(14) Machines driving, tuning, repairing shall be carried out by authorized person only. Electrical appliances repairing shall be carried out by authorized electrician.

(15) Machine guards must be in place and good condition shall be maintained.

(16) Flammable materials or Fuel oil shall be kept at designated area only.

(17) Do not obstruct emergency equipment.

(18) CONTRACTOR / subcontractor supervisors shall be familiar with the contents of this plan & procedures and learn to improve safe practice applies applicable to the job and observe them at all times.

(19) Before undertaking any special operations all supervisors shall review the appropriate section of this manual in detail, and ensure all concerned workers are familiar with the content of the manual.

(20) All personnel shall maintain an active interest in the HSE programmed.

4.2 GUEST AND VISITOR

(1) Guests and Visitors who requesting contact personnel in project office shall register with security officer at specify gate prior being allowed to enter project office.

(2) Guests and Visitors who requesting for site visit in construction areas shall get the permission from CONTRACTOR PM or CM and they shall be properly trained or shortly briefed about HSE regulations before entering to the areas. Appropriated Personal Protective Equipment (PPE) shall be complied.

(3) Guests and visitors who entering construction areas shall be escorted by CONTRACTOR employees or Safety Officer

4.3 BARRICADE AND NOTICE OF WORK ACTIVITY

(1) CONTRACTOR and/or subcontractor are responsible for provide personal injury protection by barricades and warning signs installation.

(2) Barricades and warning signs are required around excavations, holes or floors opening roofs, elevated platforms, around certain types of overhead work, and where it is necessary to warning and protects people from falling to lower level. Hard barricade shall be used for this purpose.

(3) Yellow and black barrier caution tape shall be used for warning purpose in an area that hazard remains medium, less risk or operation procedure can control concern people limitation.

(4) Red and white barrier prohibit tape will cordon off an areas where entry is prohibited. Signs must be posted, stating "Danger–Do Not Enter*"* (No authorized person shall enter any area posted with red and white barrier tape or specific "Do not enter" signs).

4.4 CONFINED SPACE

(1) CONTRACTOR and Subcontractor Discipline Supervisor are responsible for prepared risk assessment and completing the confined space entry permit included any associated documents such PTW and emergency rescue plan.

(2) Employees shall pass health examination, government mandatory training that comply with his/her specify duty and pre-qualification check to perform work by CONTRACTOR safety officer prior entry to confined space.

(3) Nobody shall enter confined space until the confined space entry permit has been issued, approved and prominent posted at workplace. Authorized entrant name list for confined space shall be observed through work process.

(4) Major requirements to be adhered prior entering to confine space is atmospheric testing for explosive, flammable, toxic gases and respiratory air level shall be carried out and recorded. Rescue equipment shall be prepared.

4.5 PORTABLE EQUIPMRNT AND HAND TOOL

(1) All hand tools and portable power tools shall be of recognized industrial manufacture and be kept in good repair and used only for the purpose for which designed. All power tools must be pass TTCL inspection program before work at site and verified by CONTRACTOR inspection sticker, hand tools that do not have inspection sticker shall not be allowed at site, the inspection period in every 3 months.

(2) Tools having mushroomed heads, split or defective handles, worn parts or other defects that will impair their strength or render them unsafe for use, shall be removed from service and shall not be reissued until the necessary repairs have been made.

(3) Tools shall not be left on scaffolds, ladders or overhead working spaces when not in use. When work is being performed or such overhead on scaffolds or ladders, containers will be being performed or such overhead on scaffolds or ladders, containers shall be used to hold tools and prevent them from falling.

(4) The practice of throwing tools from one location to another, from one employee to another or dropping them to lower levels is prohibited. When necessary to tools or material forward under the above conditions, suitable containers and/or ropers shall be used.

(5) Wooden tool handles shall be sounded and shall be kept smooth in good condition and securely fastened to the tool.

(6) Homemade tool is prohibited.

(7) Each Employee is responsible for daily inspection of all hand tools and portable power tool prior to each use.

(8) All tools shall be kept clean and must be inspected prior to use, those tools found to be defective shall not be used, must be properly repaired or replaced immediately.

(9) All tools are always returned to their proper storage place and not left where they be caused a hazard or can become damaged.

(10) Employee shall be training in the safe use of tool and compliance with equipment manual.

(11) Machine or guard shall not be remove and "Handmade" tool is permitted unless it is approved by CONTRACTOR HSEM.

(12) Don't force tool beyond their capability or use cheater increase capability.

(13) Use tool intended purpose.

(14) Portable electrical equipment or tool must be grounded or unless double insulation

(15) Air supply to pneumatic tool shall be shut off the bleed down prior disconnect.

(16) Not allowed jointing on electrical cables.

(17) Do not use or touch electrical equipment while you're wetting.

(18) If you found machine or electrical equipment was damaged, immediately report to electrician or supervisor and hang a tagged

4.6 EXCAVATION

(1) Prior to any excavation or trenching work commence, excavation work permit shall be obtained which properly executed Excavation procedure.

(2) Property barricade and warning sign are posted at workplace is a standard to the edge.

(3) No one is allowed in an excavation area while equipment is working closed to the edge.

(4) Excavation pit with exceed 1.2 m shall provide ladders for ingress and egress.

(5) All dirt must be piled at least 1 m back from edge of excavation.

(6) Inspections are required after rainstorms or any other change in conditions that can increase the possibility of a cave –in or slide.

(7) Before excavating, the ground condition and underground facility shall be assessed if drawing found the cable or other facilities are closed. Excavation shall not be done by machinery that damage to the cable or underground facilities. It can cause electric shock or serious damage.

(8) No work is allowed nearby machine excavator working. It can cause human injury.

(9) Adequate Warning lights shall provide at night for excavated area, floor or ground opening and road obstruction. Safety work execution shall be followed

4.7 FIRE PREVENTION

(1) Employee shall not obstruct in access way to fire extinguishers, fire hose stations or other fire fighting apparatus and other emergency equipment response.

(2) Employee shall know the location of designated fire exits and shall not block access to those exits.

(3) Employee shall know the location of the nearest fire alarm station and fire extinguisher, how to activate or use.

(4) Employee shall not refuel equipment or vehicle while it is running or when it is hot.

(5) Employee shall keep combustible and flammable materials away from heat source, hot surfaces or ignition sources.

(6) Employee shall store flammable materials in an approved storage with properly labeled, and containers type.

4.8 HAZARDOUSE SUBSTANCE

(1) Chemical or hazard substance shall have Safety Data Sheet (SDS)

(2) Employee shall properly handle toxic or hazardous substances and be appropriated utilization their materials in workplace.

(3) Employee shall study and comply safety requirements for hazardous materials handling.

(4) Employee shall not be pouring or dumping any chemicals in drainage.

4.9 HOT WORK

(1) All hot work permits obtained shall be valid for only scope of work and specified working time.

(2) Available Fire extinguisher shall available in the welding & cutting place.

(3) Welder shall inspect all leads, ground, clamps, hoses, gauges, torches, and cylinders before they put into operation.

(4) Only competent and authorize person can use welding and cutting equipment.

(5) Welder or gas cutting competent person shall dressed in the correct personal protective equipment.

(6) A flash back arrester (non-return valve) shall be properly fitted in each gas in each gas supply system (Oxygen & Acetylene). 2 flash back arresters shall be installed on each of gas hose. One fitted with downstream of pressure regulator and other one fitted with upstream of torch.

(7) Compressed gas cylinder valve shall away in closed position and secure by protection cap when it is not used. It can be protecting from falling object as well.

(8) Compressed gas cylinder shall always be chained in the upright position to prevent falling. It shall be protecting from excessive heat or being struck by moving equipment

(9) Oxygen gas cylinder in storage shall be separated from flammable gas cylinders and combustion material by at least 6 m safe distance or by a fire resistant wall 2 m height and fire resistance hour.

4.10 HOUSEKEEPING

(1) Workers shall always clear obstructions, tripping hazards, and debris for all walkways and working areas

(2) All solvent waste , Oily rage and flammable liquids such paint shall be kept in fire resistance covered containers until remove from the project or facility.

(3) Chemicals or oil spillage shall be immediately clean to prevent hazards from fire, slippery surfaces, etc.

(4) All cord, ropes, or wires shall be put out of the way of walkways to prevent tripping hazard.

(5) All working areas shall be clear from debris and unnecessary chemicals at all times.

(6) Lunch or eating areas shall be kept clean and free of all food scraps, wrappers, cups, and other disposable items.

(7) Housekeeping requirements and details shall be followed housekeeping Procedure.

4.11 LADDERS

(1) All ladders shall be inspected and approved by CONTRACTOR HSEM prior use or being put into service. Users shall visually inspect the ladders prior each of use.

(2) Make sure the ladder is suited for job you plan to do.

(3) Before using a ladder, especially a ladder that has been stored for a while,

Inspect it for cracks or broken joints.

(4) Place your ladder on a stable, even, flat surface. Never place a ladder on top of another object.

(5) Use the 1:4 ratios to ensure a stable working platform. Place the base of the ladder 1 foot away of whatever it leans against for every 4 feet of height to the point where the ladder contacts at the top.

(6) When using an A-frame stepladder, make sure the brace is locked in place.

(7) If climbing onto another surface, make sure the ladder extends at least three feet past the platform which climbing onto.

(8) Secure tall ladders by lashing or fastening the ladder to prevent movement.

(9) Always face the ladder when climbing or descending.

(10) Keep both feet on the ladder - never put one foot on a rung and the other foot on a different surface.

(11) Do not climb higher than the second rung on stepladders or the third rung on straight or extension ladders.

(12) Never stand on the top or the paint shelf of a stepladder.

(13) Safety Harness does not hook with a ladder.

(14) Ladder on top of a scaffold or close to the edge of an elevated platform (such roof or floor opening) the top of ladder shall be extending at least 1 m (3 feet) and secured.

(15) When working with electricity, use a ladder made of wood or fiberglass. Electrical work must used to non-conductive ladders.

(16) Ladder in or over a doorway, barricaded the door and/or post safety warning signs shall be provided.

4.12 SCAFFOLDS

(1) Make sure scaffold was constructed by a qualified individual.

(2) Make sure scaffold can withstand a great amount of weight.

(3) Make sure scaffold is properly inspected before each use.

(4) Make sure scaffold was stayed clear from power lines or electrical sources.

(5) Make sure not to perform any job on scaffold under severe temperatures or weather.

(6) Make sure an alternative exit route exists once on a scaffold such as a ladder or hoist.

(7) Make sure the scaffold is level at all times.

(8) Make sure to use only a scaffold with ladder, guardrails and toe boards.

(9) Make sure employees are properly trained to operate and work with a scaffold.

4.13 LOCK OUT /TAG OUT (LOTO)

(1) The LOTO program is intended to prevent accidental energy sources while performing connection, repairs or maintenance system.

(2) All concerned employees shall be known and used the LOTO program.

(3) Critical to any energy sources safety program and its participants is a well-planned and enforced lock-out tag-out (LOTO) program.

(4) Any piece of equipment to be worked on shall be disconnected from its energy sources. That access will be locked to prevent it from being reconnected.

(5) The lock will be tagged with the name of the person conducting the connections, repairs, maintenance and only that person shall have a key to that lock.

(6) Remote operations which cannot equipment visible shall be strictly enforced lock-out tag-out (LOTO) program.

(7) When used properly, a LOTO system prevents anyone from accidentally energizing or engagement a piece of equipment which is being worked on.

4.14 PERSONAL PROTECTIVE EQUIPMENT (PPE)

(1) PPE shall be divided with 2 types. Basic PPE (worn at all time) and specific PPE (worn at specific working time).

(2) A hard hat is a basic PPE that shall be properly worn by all employees and visitors throughout the construction area. It would be except in an office and in other designated areas.

(3) Safety glasses with side shields is a basic PPE that shall be properly worn by all employees and visitors throughout the construction area, It would be except in an office and in other designated areas.

(4) Goggles and face shields are specific PPE that shall be worn both when working with dust or any chemicals material.

(5) Suitable hand protection is a specific PPE such cotton/ lather/ rubber/ synthetic materials gloves shall be properly worn by employee who works with activity where possible cause to hand injury.

(6) Safety shoes is a basic PPE that shall be worn by employee who working on construction area. Slipper or general shoes (canvas, lather, plastic) are prohibited in construction area.

(7) Approved full body harnesses and lanyards are a specific PPE that shall be properly used when working in areas where a potential fall hazard exists.

(8) Hearing protection equipment is a specific PPE that shall be provided for employees engaged in activities where the noise level above 85 dB (A).

(9) Respiratory protection is a specific PPE that shall be properly used where breathless air contaminant is exceeding prescribed limits.

(10) Employee shall be worn appropriated PPE prior work commencement.

5. SAFETY VIOLATION AND PENALTY WITH BALANCE OF CONSEQUENCE (BOC)

	Penalty with BOC on HSE rule violation		
Activities	*1st Written Warning*	***2nd Written Warning***	***Dismissal***
1. Serious HSE Rules			
a). Unauthorized disposal of hazardous wastes			**1st Time**
b). Not comply with lock out and tag out procedures			**1st Time**
c). Work without permit when permit is required - Hot work - Confined Space Entry - Works At Elevation - Excavation - Disabling Major Safety Equipment - Damages to such equipment because of negligence shall be deemed as a violation.			**1st Time**
d). Smoking in outside designated area.			**1st Time**
e). Failure to comply with site safety rule and cause or may cause accident.			**1st Time**
2. General HSE Rules			
a). Not use PPE. (Basic and / or Specific)	**1st Time**	**2nd Time**	**3rd Time**
b). Not follow safe working procedures	**1st Time**		**2nd Time**
c). Not comply to work permit requirements	**1st Time**		**2nd Time**
d). Unauthorized use of fire-fighting equipment	**1st Time**		**2nd Time**
e). Obstruct passageways, fire exits, safety showers, fire-fighting equipment and electrical panel.	**1st Time**		**2nd Time**
f). Not comply with safety signs	**1st Time**		**2nd Time**
g). Use compressed air to clean clothing and body	**1st Time**		**2nd Time**
h). Unauthorized driving of forklifts & pinion-riding	**1st Time**		**2nd Time**
i). Not comply with other safety rules and site regulation	**1st Time**		**2nd Time**

APPENDIX Y SITE SAFETY RULES AND REGULATION PROCEDURE

AHLONE 2

SECURITY PLAN AND DECOMMISSIONING PLAN FRAMEWORK PROCEDURE

PROJECT DOC. NO. F050-MNL-083

LNG POWER PLANT (AHLONE) PROJECT

TTCL JOB NO. F-050

Total (Including this Page): 40 sheets

0	23-Sep-19	For Information	Phakin P.	Nimit A.	Anuchit P.	Peerapat T.
REV.	DATE	DESCRIPTION	MADE	CHECKED	APPROVED	AUTH'D

For Project Use only

Originator	Distribution	PW	PR	MA	ME	PP	EE	IN	CV	QC	PC	Proj	Site	Owner	Total
Project	No. of Copy	-	-	-	-	-	-	-	-	-	-	ORG.	1	1	2

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

Revision History Sheet

Rev.	Date	Description
0	September 23, 2019	For Information

CONTENTS

1. PURPOSE

It is the policy of the company that each location shall establish a security program designed to provide a secure working environment. Every employee has the responsibility to conduct themselves in such a way as to protect the company's assets. This document describes the various elements of the security plan and the details within each element.

This document is to define the control access into and out of secured areas and all access into restricted zones inside secured areas. So, it shall provide the protection of property from theft and fire.

2. SCOPE

This document is designed to cover the Project Site Security Plan for the Project site. Every employee should be trained and understand the project safety rules.

3. DEFINITION

Secure Area	Project site is concerning in working area and warehouse that shall be entry restricted and/or secured for unauthorized person entry and project asset lost prevention purpose.
Restricted Zone	Construction area which is being hazard exists during working such as areas of scaffold erection, crane operation, machine, electrical operation and process operation which accidental protection and/or property stolen prevention purpose.
Security Officer (SCO)	The employee who is responsible for security matters which is protect unauthorized person entry and loss of project asset in working area, gate pass control for entrance & exit of personal, material or equipment in project site.
Chief Security Guard	The SUBCONTRACTOR employees who were employed by security service provider (SUBCONTRACTOR) for security supervisor duty. He shall work in shift operation and responsibility for routine security matters during on duty.

CONTRACTOR	**TTCL PUBLIC COMPANY LIMITED (TTCL)** and **TTCL MYANMAR ENGINEERING AND CONSTRUCTION COMPANY LIMITED (TTMEC)** who perform the "Engineering Procurement and Construction (EPC) of the project.
OWNER	**TTCL POWER MYANMAR COMPANY LIMITED (TPMC)** who employ CONTRACTOR in connection with the "Engineering Procurement and Construction (EPC) of the project.
SUBCONTRACTOR(S)	The subcontractor(s) employed by CONTRACTOR or OWNER in connection with the construction of the project.

4. RESPONSIBILITY

4.1 CONTRACTOR PROJECT MANAGER (PM)

(a) PM is responsible for assuring implementation of site security procedure to ensure that security operation are performed by CONTRACTOR, SUBCONTRACTORS and other concerned parties in the project.

(b) Lead by an example, modeling the behavior expected from all personnel performing work at the jobsite.

4.2 CONTRACTOR CONSTRUCTION MANAGER (CM)

(a) CM is responsible for construction execution of site security procedure that make collaboration by CONTRACTOR employees, SUBCONTRACTORS employees including visitors and concerned persons.

(b) Lead by an example, modeling the behavior expected from all personnel performing work at the jobsite.

4.3 CONTRACTOR HSE MANAGER (HSEM)

HSEM is responsible to execute an effective site security covering construction area, warehouse, parking, lay down, except CONTRACTOR site office (which will be control by CONTRACTOR admin) as following;

(a) To establish site security procedure covering project activities risk.

(b) To ensure effective compliance with this site security procedure.

(c) To ensure that this procedure is administered properly and develop site security procedure where necessary.

(d) To ensure that all site personal (CONTRACTOR and SUBCONTRACTOR employees) are received "site safety rules and regulation procedure" training and adhere to its entire requirement.

(e) Lead by an example, modeling the behavior expected from all personnel performing work at the jobsite.

4.4 CONTRACTOR SECURITY OFFICER (CSO)

CONTRACTOR Security Officer is responsible for;

(a) Provide direction and oversight to the site security CONTRACTOR / SUBCONTRACTOR and to facilitate interface with local security and police officials for all activities associated with the project.

(b) Manage, control and co-ordinate with security guards for security provisional activities and being the universal guard / site security center for his entire site area.

(c) Overall security and the implementation of the secure assets work processes and appropriate supporting work processes.

(d) Ensuring that all employees process ID badges and reporting to the site with picture ID badge displayed visibly on their body.

(e) Ensuring only construction material delivery employees equipped with Basic PPE; steel toe cap safety shoes, long sleeve shirt, full length trousers, approved safety glasses, and hard hat can be allowed to enter the site.

(f) Perform random searches on employees (lunch boxes and carry on items) to prevent employee from bringing alcohol, firearms or illegal drugs onto the jobsite or to prevent theft of project materials as employees leave the site.

(g) Ensuring that all vehicles and equipment have a valid inspection and access pass to gain access to the project site.

(h) Ensuring that vendors delivery vehicle is in safe operating condition in order to be allowed on the project.

4.5 CONTRACTOR Site Admin

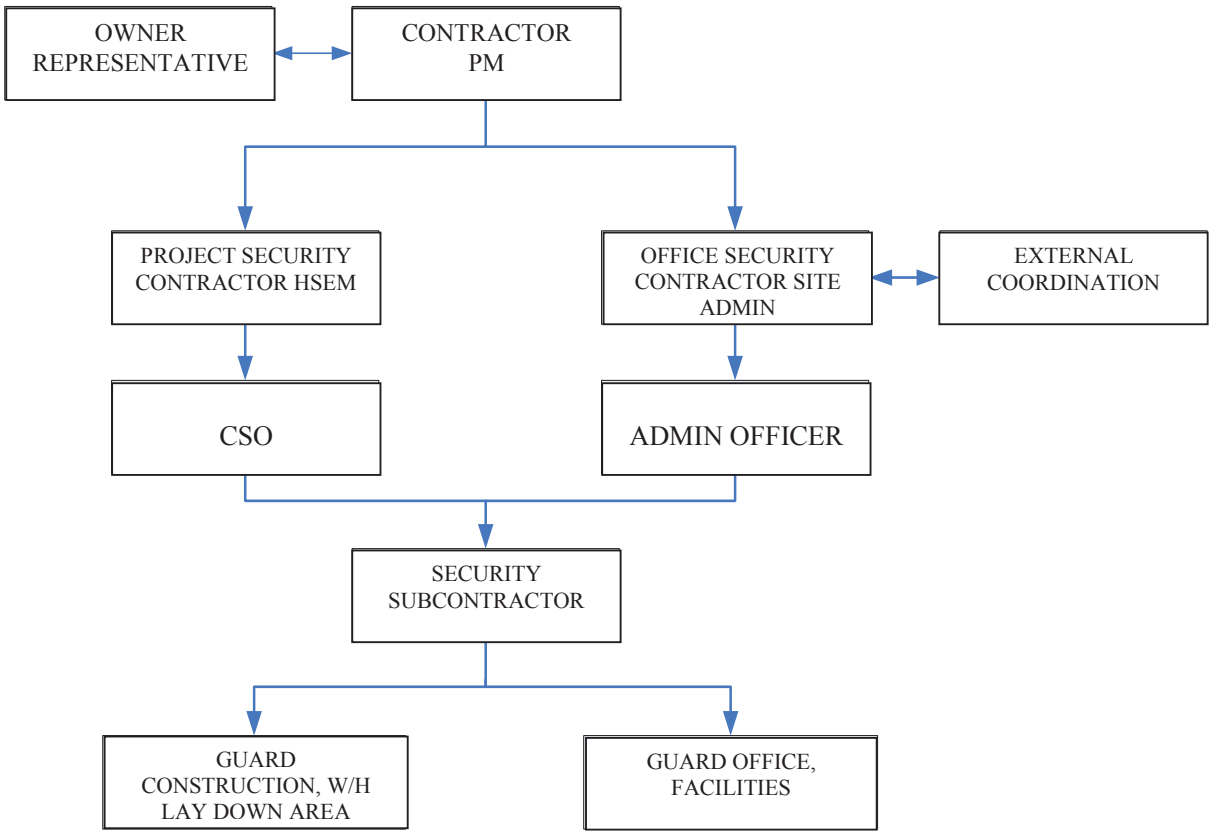
CONTRACTOR site admin is responsible for external coordination project security matters and CONTRACTOR site office security such office building, office facilities and being the spare key keeper for regularly or emergency entire site office.

4.6 CONTRACTOR / SUBCONTRACTOR EMPLOYEES

Conduct themselves in such a way as to protect the company's assets. Each SUBCONTRACTOR is responsible for the security of his own tools, equipment and material.

Understand security processes and their individual role in protecting the assets of the company; for example, confidential information, travel to high risk areas and reporting (crime and theft).

5. SITE SECURITY ORGANIZATION



6. SYSTEM REQUIREMENTS

The main components of this document are:

A. Physical barriers (fence, gates).

B. Badging (personal access control)

C. Mobilization and demobilization of employees

D. Asset control

E. Guards

F. Vehicular policy

G. Security supervision

H. Photography control

A. PHYSICAL BARRIERS

(1) Fences

Outer (perimeter) & Inner temporary fences shall be installed for project boundary and to separate construction area and site office area for security & safety purpose.

(2) Gates

(a) PM in conjunction with CONTRACTOR HSEM shall determine project access requirements for construction activities and locate suitable temporary gates to support the construction effort.

(b) These gates shall be controlled by the security guards. (CONTRACTOR security officer and SUBCONTRACTOR guards)

(c) Security guards shall ensure at the gate that employees authorized personnel, visitor, vehicle, material and equipment shall be effective entry and exit control;

i. Authorized employees – Personal badge

ii. Visitor – ID card swap to temporally personal gate pass

iii. Authorized vehicle – Vehicle gate pass sticker

iv. Vehicle – Generally driving license card swap to temporally personal and vehicle gate pass when required inspection (if applicable) is satisfied as following;

- Mobile crane: load test certificate and project inspection are required
- Delivery truck: check general condition by guard. Any doubt be found then call project inspector for advise
- Pick up truck: check general condition by guard. Reversing alarm is required to access construction area. Unroofed pick up truck is not allowed personnel transportation (person can be only in the cabin) in the site.

(d) Security guards shall perform random checks at the gate on personnel and vehicles requesting entry to ensure contraband (drugs, alcohol, firearms, photographic equipment etc.) are not brought into project site.

B. BADGE (Personal Access Control)

(1) All employees who work for the project shall have own personal badge after passed safety indoctrination training. This course shall be carried out by CONTRACTOR trainer. The personal badge shall allow access to project site permission zone.

(2) Personal badge shall be issued in bilingual (Myanmar and English) and shall contain minimum information as following:

Name – surname	Issue date	Sex / Age
Company	Expire date	Entry permission zone
Badge register no.	Blood group	Photo, etc.

(3) Project groups classification shall be identified by different colors badge such;

(a) OWNER / Consultant (with photo)

(b) Main CONTRACTOR (with photo)

(c) SUBCONTRACTOR (with photo)

(d) Temporary worker (without photo)

(e) Visitor (without photo)

Remark: Identify badge colors shall be designed on kick off meeting.

(4) Personal badge shall be prominently displayed at all times while within the project area.

(5) For visitors, they shall inform entry purpose to security guard.

(6) In case of personal contact, guard needs to be confirmed by destination person prior entry permission.

(7) In case of 1st time visit, visitor shall entry with destination personal escort. After entry request is granted,

i. Visitor shall fill up his information in visitor log book.

ii. Read and understand through the "proper entry and instruction for visitor"

iii. Change his personal ID card to "visitor" badge

iv. Prominent post "visitor" badge prior entry to project site.

C. MOBILIZATION AND DEMOBILIZATION OF EMPLOYEES

(1) Prior CONTRACTOR and SUBCONTRACTOR employee mobilization to project site. Safety & security system shall be ready prepared to implementation.

(2) Safety training (approx. 1:30 hrs.) & personal badge making shall be conducted to all employees.

(3) TTCL discipline and SUBCONTRACTOR management representative shall beforehand three (3) days in advance submit employees name list which is approved by CONTRACTOR discipline to training center. After that, safety trainer shall arrange training day and time for them.

(4) CONTRACTOR discipline and SUBCONTRACTOR management representative are responsible for enforcement they nominated employees to attend booked up course.

(5) Employee without personal badge shall not be allowed entry to project site.

(6) Employee whom is not yet done safety training shall not be allowed to work on project site.

(7) Incase short term period working or temporally working in an office, safety brief training course shall be conducted by CONTRACTOR safety officer. (15 minutes brief)

(8) Employee, who has completed of work, transferred to other project or terminated and demobilization from project site shall return his personal badge to CONTRACTOR HSEM.

(9) SUBCONTRACTORS management representative is responsible to return individual employee personal badge and vehicle gate pass sticker (if any) to CONTRACTOR HSEM in case of individual employee is demobilization from project site.

D. ASSET CONTROL

(a) Procedures are required to control and document material entering and leaving the Project site. Typical activities include purchasing, shipping, receiving, storage, salvage, donations, employee sales, scrap and waste.

(b) Separation of authority shall be in place for the following functions: authorizing, approving, shipping and receiving. Exceptions shall be documented and approved.

(c) Compliance audits are required to assure policies are followed and controlled.

(d) All packages for delivery to personnel on site shall be inspected by the security guards at the access gates. The addressee shall be informed about the arrival of the package prior to inspection. After inspection, the package may be collected by the addressee or stored in the security office, depending on the addressee's advice or the contents of the package.

(e) All vehicles leaving the work site with materials of any description (except for waste) shall be required to submit an authorized material gate pass to the gate house. The authorized list of LNG POWER PLANT (AHLONE) PROJECT material gate pass signatories shall be provided to all concerned parties. For the procedure how to transport waste see the F050-MNL-030 Waste Management Plan.

(f) All incoming deliveries of supplies, materials and equipment for the project shall be accompanied by a material entry pass or a delivery note, if from a vendor. Security shall examine the material and/or equipment and compare with the delivery note or material entry pass and notify CONTRACTOR project management which concerns of the delivery. Security shall retain a copy of the material entry pass or delivery note if necessary.

(g) The material equipment gate pass (see ATTACHMENT 4) shall:

i. State the date on which the materials are to be removed.

ii. State the full description of the materials, including quantities.

iii. Be signed by the authorized person concerned.

(h) Be endorsed by an approved authorized signatory. The list of authorized signatures shall be provided and retain at egress gate house.

(i) The gate guards shall check that the quantity and nature of the materials detailed on the material gate pass matches those contained within the vehicle and where any discrepancies are found, the vehicle shall not be allowed to leave/enter the work site.

(j) Material gate passes shall be prepared by the remover authorized personal. The original material gate pass form shall be submitted to the gatehouse and a copy shall be retained by the remover authorized personal.

(k) The original of each material gate pass shall be given daily to the CONTRACTOR SCO by the security guard.

(l) Employees, vendor, visitor, etc., who bringing their own personal equipment (or non project owned) into the jobsite shall be informed and / or registered with the gate guards.

E. SECURITY GUARDS

(a) Security guards shall be sufficient provided for overall security matters execution and the implementation of the secure assets work process, lay down area and appropriate supporting work processes for **LNG POWER PLANT (AHLONE) PROJECT** on 24 hours per day, 7 days/ week.

(b) Ensuring that all employees process ID badges and report to the site with picture ID badge displayed visibly on their body.

(c) Ensuring employees equipped with basic PPE, wear long sleeve shirt and full length trousers can enter the construction site.

(d) Perform random searches on employees (lunch boxes and carry-on items) to prevent employee from bringing alcohol, firearms or illegal drugs onto the jobsite or to prevent theft of project materials as employees leave the site.

(e) Ensuring that all vehicles and equipment have a valid inspection and access pass to gain access to the project site.

(f) Ensuring that vendors make deliveries to the project with vehicles that are in safe operating condition in order to be allowed on the project.

(g) Fire alarm trigger and first attack firefighting volunteer.

(h) Guard is responsibility in APPENDIX B, instructions for security guards.

F. TRAFFIC CONTROL POLICY

Traffic regulations - The following traffic rules are in place on the project site.

(a) Driver's license

Motor vehicle drivers and equipment operators shall be qualified and licensed in accordance with the regulations of Myanmar Law. Vehicle drivers shall be in possession of a valid Myanmar driver’s license and equipment operators shall be in possession of a valid equipment operator license specific to the type of equipment operated and a competency certificate issued by management.

(b) Warning flags and lights

Red flags shall be used during hours of daylight and red lights during the hours of darkness on any load that extends beyond the front, side or rear of any vehicle.

(c) Traffic signs

All traffic signs and signals, whether fixed or portable, shall be obeyed and drivers shall cooperate with representatives appointed to direct traffic.

(d) Speed limit

All vehicles shall be operated within the 20-kilometer per hour posted speed limits on the project. Within the construction area speed limit is 10 km/hr (walking speed)

(e) Walks and Roadways

All personnel and / or SUBCONTRACTORS will use only designated walk path. The use of short cuts or undesignated pathways is prohibited.

(f) Driving and parking

- Motorcycles are not allowed to enter the site.
- All vehicles need to switch on headlights whilst driving in the project site.
- Parking will be permitted in designated area only and not be parked so as to block or interfere with the use of fire hydrants or emergency equipment.
- Reversed parking rule shall be respected for all vehicles.
- Vehicles shall not be left unattended with the motor running.
- All vehicles parking in the project with his/her own risk.
- Overtaking is prohibited on the project site.

(g) Right-of-way

All motor vehicles shall give right-of-way to pedestrians, ambulances and firefighting equipment and other emergency vehicles. All drivers of motor vehicles shall practice extra ordinary driving courtesy.

(h) Passengers

- Passengers shall be limited to the number according to the design of the vehicle and manufacturer specification and the vehicle shall not be overcrowded.
- Drivers of motor vehicles shall not permit passengers to ride on fenders, running boards, tops or bumpers of motor vehicles.
- Passengers shall keep all parts of their bodies inside the cab or body of vehicles and must be seated while vehicle is in motion.

- Tailgates must be kept closed. Passengers shall not get on or off a vehicle while it is in motion.

(i) Windshield or window obstruction

Vehicles having nontransparent window materials, which interfere with clear visibility through any side window or windshields with cracks in the windshield shall not be operated on the project. All vehicles shall be equipped with adequate rear-view mirrors.

(j) Back-up alarm

All construction vehicles and motorized equipment shall be equipped with a back-up alarm that is audible at a distance of 10 meters. And a flag man is required to assist in construction area and / or in narrow pass.

(k) Obstructing streets, roads and fire equipment or firefighting facilities. Roads/streets shall not be blocked without permission from CM. When work obstructs a road or street, approved lights, barriers, warning devices, and/or signalmen shall be provided. Parked vehicles shall not block fire equipment, firefighting facilities and fire hydrants.

(l) Regularly Vehicles Gate Pass

- In the interests of safety and security, the number of vehicles permitted entry onto the work site shall be minimized. Normal means to move to the worksite will be walking.
- In case vehicle movements are required, all SUBCONTRACTORS shall be required to submit transport plans which will be reviewed by CM to ensure that the maximum usage is made of pool car such as buses and van.
- CONTRACTOR / SUBCONTRACTOR employee driving vehicles onto the project shall be required to submit an application (ATTACHMENT 9) for a project vehicle pass to the CONTRACTOR SCO for 3 days in advance prior to requesting admittance to the site. CONTRACTOR SCO shall screen reasonable permission gate pass prior submit for approve by CM. these included subcontractors pick up or trucks to transport materials as well. Defensive driving training requirements for people driving on site shall be arranged as necessary.

- Vehicle gate pass applications (see ATTACHMENT 9) shall be inspection required by CONTRACTOR HSE dept. prior submitted completed correctly with valid copies of driver license and/or equipment operator's competency certification and equipment, third party inspection certificate where required, license plate number and description of vehicle and current insurance documents.
- All vehicles and equipment entering the project site and lay-down facilities shall be in safe operating condition and will therefore be subjected to a safety inspection by CONTRACTOR project HSE department. The inspection shall at a minimum include the proper safe working of (1) brakes; (2) lights; two headlights; taillights, brake light; (3) horn; (4) muffler; (5) safety glass; (6) windshield wiper and rear view mirror.
- The vehicle passes shall be displayed on the inside of the windshield on the left side. Equipment passes shall be displayed on the outside to the right side of the equipment. Vehicles and equipment without a valid pass shall not be allowed access to the site or lay-down facilities.
- Vehicle passes and equipment passes shall not be issued if documentation is incomplete or if all requirements are not met.

(m) Temporary Vehicle Gate Pass

- Temporary gate passes can be obtained at the security main gates.
- Vehicle driver shall inform entering purpose to the guard.
- After check and approved, driver shall issue and swap driving license with temporary personal and vehicle gate passes.
- This vehicle gate passes shall be displayed clearly visible inside the windshield on the vehicle right side.
- The validation period is 1 day max.
- When driver is return to the main gate for exit, temporary personal and gate passes shall be swapped back with previous driving license.

(n) The guards will collect the badge and temporary vehicle gate pass for checking in case of an emergency occurred.

(o) Depending on the security level, searches shall be performed by the security guards (use of mirrors and inspection of hood and rear trunk will be performed) on incoming and outgoing vehicles to check all waste, material and goods being transported are in line with the appropriate process and documentation. Metal detectors shall be used for that.

G. SECURITY SUPERVISION

CONTRACTOR shall secure supervision by install lighting at the project site construction and lay down area in order to enhance surveillance and deter theft. Security guards shall make scheduled and unscheduled patrol security survey. The patrol timing, frequency and routing shall be reported to CONTRACTOR HSEM.

H. PHOTOGRAPHY CONTROL

(a) Photographic equipment shall get permission by CM.

(b) Photography permission shall be prepared by photographer according with camera permit form (see Attachment 5).

(c) All cameras or camcorders shall be inspected by CONTRACTOR HSE Department and get approved sticker on camera or camcorder prior brings to use.

(d) Cellular phones which build-in camera are not allowed to take photography at site, if not following above (a) and (b) items. It is hard security control for ignite explosive atmosphere or easily interfere electronic control system.

(e) Approved photographic equipment shall be used only by authorized photographer.

(f) A list of the regularly authorized photographer shall be approved by CM.

(g) The regularly authorized photographer shall be maintained and provided camera permitted card (ATTACHMENT 5) by the CONTRACTOR SCO.

(h) For temporary photographer such visitors, vendors, etc., shall be approved by CM prior taking photographic equipment in to site construction. Photographic equipment shall be passed inspection according with item (b).

(i) Temporary photographer such visitors, vendors, etc., shall be passed safety precaution training or briefing by CONTRACTOR HSE Department prior photography commencement.

7. GENERAL GUIDELINE FOR SECURITY

7.1 GROUP MEETING

(a) Daily meeting shall be carried out for each shift security. Updated information shall be communicated to coming fresh shift. Otherwise, guards number and health examine shall be observed.

(b) Weekly meeting shall be conducted between CONTRACTOR SCO and security subcontractor representative. Meeting purpose is for security problem discussion, problem solving and review the shift security performance. In case of decision making required, CONTRACTOR HSEM will be a decision maker.

7.2 SECUIRTY REPORT

(a) Daily security report log book shall be conducted by individual guard. It is guard responsibility to first contact with visitor, personal-vehicles entry-exit registration and control, security check, inspection, observe, verification or investigation any abnormal event (which called security incident) and shall be immediate verbal reported to Chief Security Guard (SUBCONTRACTOR employee shift supervisor) and recorded those incident detail in his written daily report log book.

(b) In case of abnormal event which called security incident occurred, incident initial report shall be applied according with Incident Investigation Procedure (SP-670-001)

Chief Security Guard shall review and completed information with quality on written daily report log book and incident initial report prior submits to CONTRACTOR SCO for next step execution.

7.3 SECURITY COMMUNICATION

(a) Hand-held radio transmitter (CB radio), including a charger, shall be provided by security SUBCONTRACTOR and located at each gate, check points and equipped for patrol guard to establish effective project security system and facilitate project radio communication network.

(b) Guards shall immediately report any incident found by radio to Chief Security Guard (SUBCONTRACTOR employee shift supervisor). A message will be short (with radio code), meaningful and polite.

(c) Chief Security Guard shall review and completed information with quality on brief description and report to CONTRACTOR SCO by radio for problem solving or decision making. A message will be short (with radio code), meaningful and polite.

(d) There is no secret on radio transmission; therefore company or project confidential message shall not be transmitted via CB radio. Cellular phone shall be used if necessary.

(e) Security transceivers shall standby in specified channel only.

(f) For explosion prove zone and/or secure transmission; trunk radio (intrinsically safe type) shall be considered, not CB radio.

(g) During emergency; incident controller may give instruction/command via radio. Security guards shall give full support accordingly.

(h) All transceivers shall comply with standard radio amateur ethics requirements.

(i) Before Push-to-Talk (PTT); transmitter shall be waited for 5 seconds to ensure there is nobody sending message then start calling.

(j) Maximum 3 calls per a transmission, if no reply then wait for a few minutes to let other use.

(k) Everyone shall respect other more priority message especially emergency message shall be transmitted as first priority.

(l) Guards shall not talkative or chatty behavior without work concerns. A message will be short (with radio code), meaningful and polite. Violator guard shall be rejected from project site.

8. APPENDIX

APPENDIX A General Basic Rules for Visitors

APPENDIX B Instruction for security

9. ATTACHMENTS

ATTACHMENT 1 Visitors Log

ATTACHMENT 2 Access Badge

ATTACHMENT 3 Visitor Badge

ATTACHMENT 4 Material Equipment Gate Pass

ATTACHMENT 5 Camera Permit

ATTACHMENT 6 Vehicle Gate Pass

ATTACHMENT 7 Safety Induction Request

ATTACHMENT 8 Visitor Gate Pass Form

ATTACHMENT 9 Regular Vehicle Gate Pass Request

APPENDIX A

LNG POWER PLANT (AHLONE) PRJECT
General Basic Rules for Visitors

All site visitors will be escorted by project personnel at all time when outside the OWNER/ TTCL Office Zone.

1. Visitor is prohibited to visit the site alone unless accompanied by the assigned project personnel and shall wear safety shoe/ Safety helmet/Safety glasses and long sleeve shirt with long trousers.



2. The vehicle speed in project is limited at 20 km/hr and limited at 10 km/hr in construction area .
3. During the visit, photographing is forbidden.
4. Smoking and toilet shall be limited to the specified place.
5. Keep away from working mobile equipment and vehicles.
6. Never cross over or enter a barricaded or red flag area.
7. Immediately report any type of accident, injury or hazard.
8. If any accident happen go to designated “Muster Point” obey instruction from TTCL management, supervisors and security personnel.
9. Ensure that you report to security before entering and leaving.
10. After the visit, please change back visitor ID card with entrance permit.

INSTRUCTION FOR SECURITY GUARD

1. GENERAL INSTRUCTION

1.1 Basic Conduct

Guards represent the company that employs them as well as all companies working at the **LNG POWER PLANT (AHLONE) PROJECT** as well as contributing to the publicimage of the company. It is essential that guards display a spirit of friendliness, courtesy and cooperation and present a businesslike appearance. They shall behave in a manner to command respect.

Guards shall be firm, calm and courteous in enforcing the rules adopted by the management in this procedure or set force.

1.2 Property Protection

Guards shall be thoroughly familiar with the property they are protecting, including name or number designation of yard areas, buildings, doors and fire exits. Guards shall be aware of the locations of materials, offices, warehouses and other physical site assets.

1.3 Fire Protection

Guards shall be familiar with the location and method of operation of fire extinguisher, hand hoses, standpipes, hydrants, sprinkler control valves, sectional valves, fire pumps and other parts of the job site’s own fire protection system.

2. EMERGENCY PROCEDURE

2.1 Plans for Emergency

Guards shall be familiar with the general procedures for dealing with fires and related emergencies.

2.2 Responsibilities

Guards shall not leave their assigned duties except in an emergency. In such cases, they shall either notify their superior or another guard as soon as possible or send a prearranged signal to a constantly attended location.

Guards are expected to use judgment in certain situations, e.g. assisting another guard or an injured person or dealing with a dangerous condition requiring their immediate attention.

2.3 Turning on Alarms

Guards shall know the exact procedure to report a fire or other emergencies. Where appropriate, they shall report exact locations, the extent of the fire and the emergencies and direct responding parties/equipment to the scene.

2.4 Extinguishing Fires

Guards shall give an alarm before fighting a fire. They shall be prepared to take appropriate action as the only person present when a fire is discovered. They shall fight the fire with proper fire equipment when their experience tells them that they can use it effectively.

2.5 Calling Management

Guards shall have instructions on which management personnel to call in an emergency and their day and night phone numbers.

3. RESPONSIBILITIES

3.1 Patrolman

A guard assigned to patrol shall:

(1) Check his equipment before starting his round including flashlight, time check and paging Project. He shall carry a pen or pencil and the necessary report forms with him.

(2) Perform operations on each round such as closing windows and doors during certain periods. Removing obstructions to fire doors, building exits or fire equipment and other appropriate matters. If duties include starting any equipment or machinery, he should be instructed thoroughly in the safety procedures.

(3) Operate guard reporting stations on the route as required, reporting to his superior any abnormal conditions discovered but not covered by instructions.

3.2 Gate Guard

A guard assigned to an entrance shall:

(1) Know how to direct the fire department responding to a fire. He shall be familiar with the general fire plans, especially which entrance are to be opened to admit firemen and equipment. He shall know how to direct traffic within the property to expedite movement of apparatus.

(2) Know who may be admitted in an emergency. He shall be able to recognize management personnel who may respond during an emergency. He shall direct outsiders such as the press and interested public officials to the prearranged information.

(3) Make a thorough check of all personnel coming to the site and courteously challenge suspicious persons.

(4) Keep a list of lost badges for screening their unauthorized use.

(5) Issue temporary passes and badges to visitors after telephoning the person(s) whom they wish to see.

(6) Check all vehicles leaving site and if necessary entering the site also, including the driver's cab and back of the vehicle. If anything unauthorized is found, it shall be confiscated and details included in the guard's reports.

3.3 Chief Security Guard

The chief guard assigned to operate the guard house shall:

(1) Assure by a posted checklist that all equipment is working.

(2) Promptly transmit fire alarms. Upon receipt of a fire or an emergency alarm signal, he shall promptly call the public fire department or the police station and summon local assistance where available. He shall notify his superior as instructed

(3) Make reports as instructed. He shall record rounds or stations missed by patrolmen, giving the reason. He shall make reports of incidents and record significant activities for review by his superior. Records of patrol rounds and fire incidents shall be reviewed and filed.

4. DUTY

4.1 Reporting for Duty

Guards shall report for duty at times specified by their superior. When a guard is unable to report for duty due to illness, injury or other causes, he shall notify his superior as soon as possible. Unnecessary delay in such notification is justification for disciplinary action.

4.2 Relief

Guards shall remain on duty until relieved. Guards shall relay any special orders or pertinent information to their relief.

Guards shall not accept relief by another guard who is not in a condition to work for any reason. The guard must assume responsibility for reasonable diligence in judging that his relief man is fit for duty.

4.3 Notice Board

Any fresh orders or instructions will be posted on the notice board at the guard house. Security guards should frequently check the notice board for any orders or instructions.

Written orders or instructions are to be removed or replaced by the chief security guard only or on his instruction, by a shift leader. Written orders or instructions on the notice board should not be erased or torn. Disciplinary action may be taken against guards who disregard this rule.

If any security guard fails to carry out orders or instructions posted on the notice board, he shall be penalized. After three warnings, the guard will be dismissed. If any false information in any report is found by the chief security guard, the guard concerned will be disciplined up to and including termination for intentional false reporting.

5. CONDUCT AND APPEARANCE

5.1 Conduct

(1) Information

In giving information, guards shall be certain that it is accurate and not privileged information. Guards shall not discuss details of their assignments except with authorized persons.

(2) Conversations

Guards shall converse with fellow guards or other persons only in the line of duty except during rest periods.

(3) Alertness

Guards shall not sleep on duty and shall be fit for duty at all times. They shall report to work adequately rested.

(4) Smoking and Eating

Guards shall smoke, eat and drink in designated areas only. In some very dangerous locations, even carrying matches or cigarettes lighters may be restricted for the protection of the patrolmen as well as others.

5.2 Appearance

(1) Guards

Guards shall wear clothing specified for their particular assignment. Clothing shall be clean and in good repair. Such requirements may apply to wearing coats buttoned, ties not loosened, shoe polished and other features to make the guard's appearance professional.

Guards shall wear Hard Hats at all times while on site, carry a night stick on night shift and carry a whistle on a lanyard while on duty. Guards shall have the following at all times:

(a) Hard Hat

(b) Safety Shoes

(c) Hearing Protection

(d) Eye Protection

(e) Whistle

(f) Night stick

(g) Flash light

(2) Guard House

Security guards shall not throw any paper or cigarette butts in any place except in the dustbin or wastepaper basket. The guard house must be maintain good housekeeping at all time.

LNG POWER PLANT (AHLONE) PRJECT

VISITORS LOG

PRINT LEGIBLY	PLEASE USE MILITARY TIME
PROJECT NUMBER *F-050*	PROJECT NAME **LNG POWER PLANT (AHLONE) PROJECT**

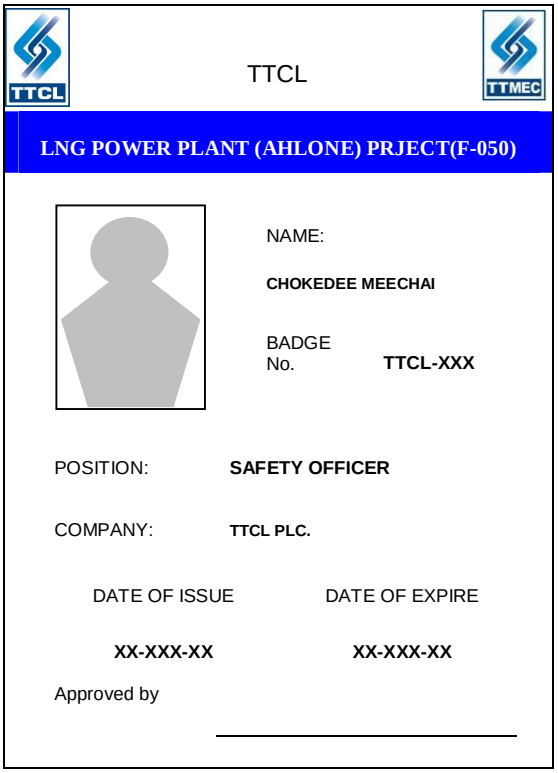
I have read and agree to abide by the Project SAFETY & SECURITY RULES and any others which may be communicated to me while visiting or working at the project site.

NAME	COMPANY	DISTINATION OR PERSON TO SEE	TIME IN	TIME OUT	PPE ISSUED?	VEHICLE/VISITOR PASS NUMBER

* This form will provide by Security guard in Visitor Log Book

LNG POWER PLANT (AHLONE) PROJECT

ACCESS BADGE (1/3)



BLUE

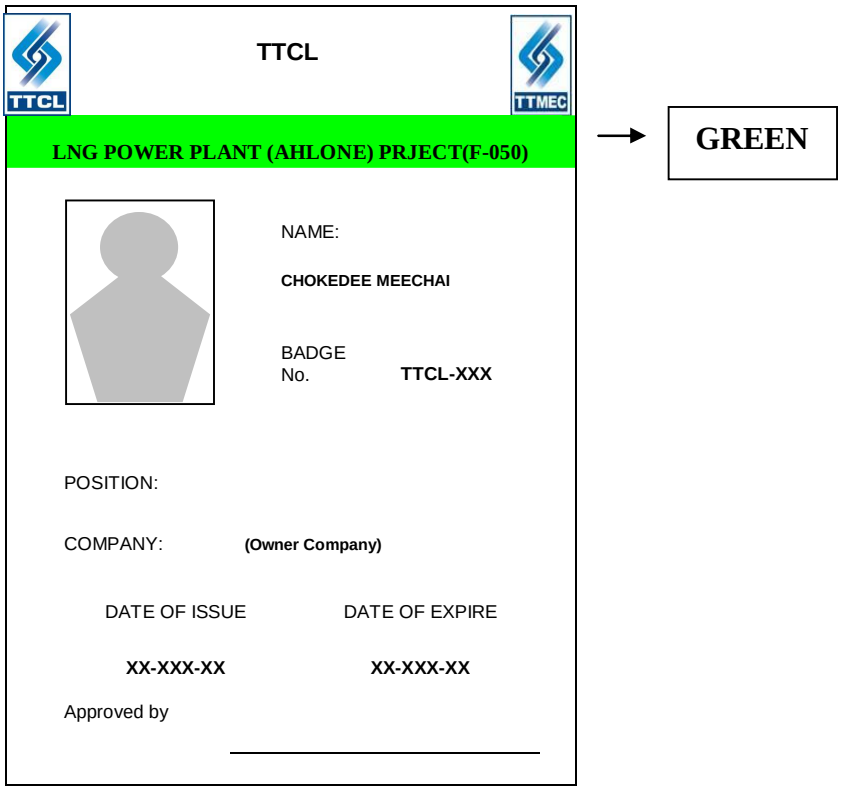
(SUGGESTION)

1. Display badge at all time while being in Project site.
2. Follow HSE regulations of Project site.
3. Return this badge to TTCL Admin when employee finished.

For TTCL Public Company Limited.

LNG POWER PLANT (AHLONE) PRJECT

ACCESS BADGE (2/3)



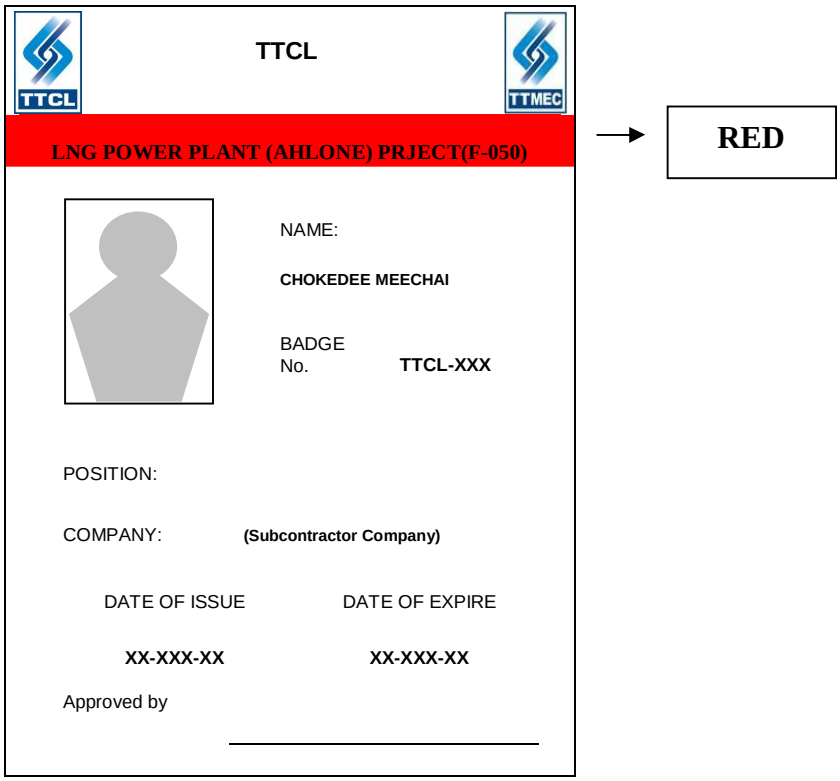
(SUGGESTION)

1. Display badge at all time while being in Project site.
2. Follow HSE regulations of Project site.
3. Return this badge to TTCL Admin when employee finished.

For TPMC

LNG POWER PLANT (AHLONE) PRJECT

ACCESS BADGE (3/3)



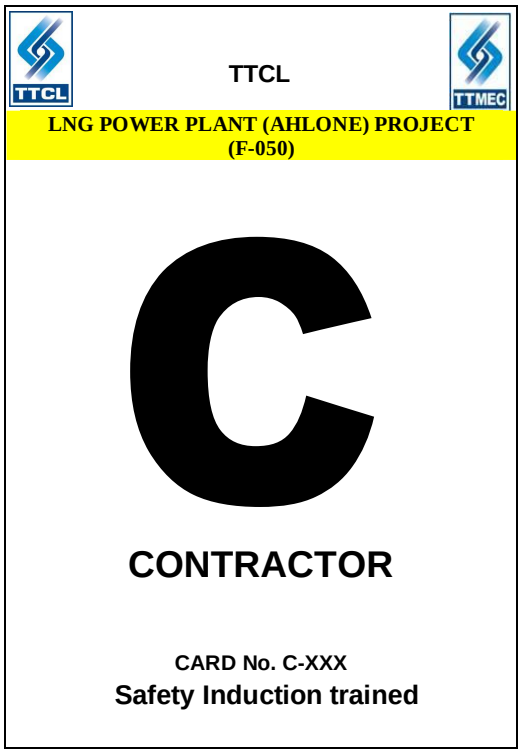
(SUGGESTION)

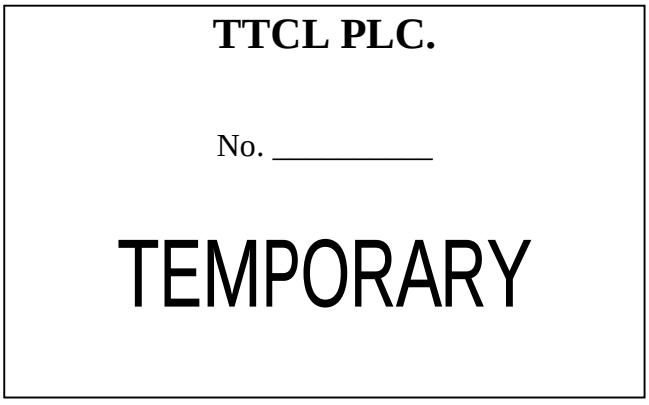
1. Display badge at all time while being in Project site.
2. Follow HSE regulations of Project site.
3. Return this badge to TTCL Admin when employee finished.

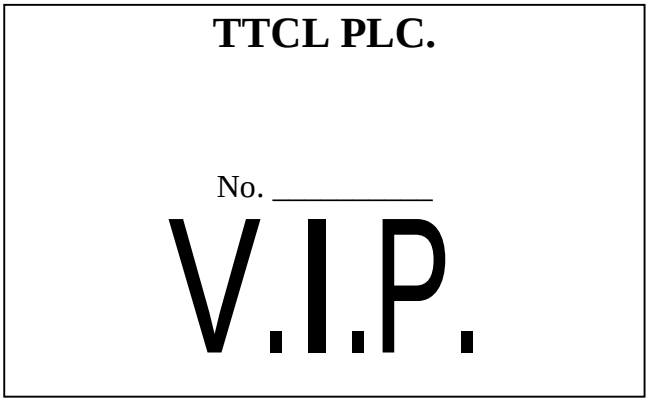
For Subcontractor

LNG POWER PLANT (AHLONE) PROJECT

Visitor/ Temporary Worker and Government Authority badge







LNG POWER PLANT (AHLONE) PROJECT

CONTRACTOR **DATE :_____/_____/___**

MATERIAL / EQUIPMENT REMOVAL GATE PASS		
MATERIAL / EQUIPMENT	**QUANTITY**	**REASON FOR REMOVAL FROM SITE**
METHOD OF REMOVAL FROM SITE : TRUCK TRAILER OTHER_____(SPECIFY)		
DRIVER NAME:	**DRIVER I.D. CARD NO.:**	
NAME OF COMPANY:	**VEHICLE REG. NO.**	
REQUESTER : **CONTRACTOR / SUBCONTRACTOR**	**APPROVED :** **(CONTRACTOR' S DEPARTMENT IN CHARGE)**	**APPROVED :** **(CONTRACTOR'S SITE REPRESENTATIVE)**
DISTRIBUTION: **ORIGINAL - SECURITY OFFICER** **PINK - DEPARTMENT IN CHARGE BLUE - REQUESTER / DRIVER**		**CHECK & SIGN. :** **(CONTRACTOR'S SECURITY OFFICER)**

ATTACHMENT 5

Serial No:

CAMERA PERMIT	
SERIAL No:	**DATE:**
PROJECT NAME:	
USERNAME:	**BADGE NUMBER:**
☐ **CONTRACTOR EMPLOYEE** ☐ **SUBCONTRACTOR** ☐ **VENDOR RESPESENTATIVE** ☐ **VISITOR**	
THIS PASS VALID FROM:	**TO:**
PLANNED USAGE:	
RESTRICTIONS:	
REQUESTED BY:	**DATE:**
APPROVED BY:	**DATE:**

LNG POWER PLANT (AHLONE) PRJECT

CAMERA PERMIT

Serial No. _____

Badge No. _____

Username. _____

Expiry Date : _____

LNG POWER PLANT (AHLONE) PRJECT
VEHICLE GATE PASS

CONTRACTOR

LNG POWER PLANT (AHLONE) PRJECT

Job No. : _____

TEMPORARY VEHICLE PASS

CONTRACTOR

LNG POWER PLANT (AHLONE) PRJECT

VEHICLE GATE PASS

ISSUED TO : _____

COMPANY: _____

VEHICLE REG. : _____

VEHICLE TYPE: _____

VALIDITY TO: _____:_____

APPROVED BY: _____

SAFETY INDUCTION / ID CARD REQUES

DATE...../...../.....

APPLICANT'S NAME (BLOCK CAPITALS)	: _____
POSITION	: _____
APPLICANT'S SEX	MALE FEMALE BLOOD TYPE :_____
DATE OF BIRTH	:_____/_____/_____ RELIGION:_____ DAY MONTH YEAR
NATIONALITY	: _____
HOME ADDRESS	: _____ _____
PRESENT ADDRESS	: _____ _____
EMERGENCY CONTACT	: _____ _____
I.D. or PASSPORT NO.	: _____
COMPANY'S NAME	: _____
TELEPHONE No.	: _____
HEALTH CHECK UP STATUS	: _____
CONGETAL DISEASE	☐ High Blood Pressure ☐ Diabetes ☐ Heart disease ☐ Other _____
SIGN (COMPANY'S REPRESENTATIVE)	SIGN (APPLICANT)

NOTE: TWO (2) PHOTOGRAPHS (2cm X 3cm) AND ONE COPY OF I.D. CARD TO BE ATTACHED.
IF APPLICANT IS FOREIGN NATIONAL, ONE COPY OF WORK PERMIT TO BE ATTACHED.

FOR TTCL CERTIFICATION OF SAFETY INDUCTION
DATE OF SAFETY INDUCTION

_____/_____/_____

CERTIFIED BY

TTCL USE ONLY.

I.D.CARD No.:

_____

CHECKED	**APPROVED**

CONTRACTOR DATE :_____/_____/_____

VISITOR GATE PASS

VISITOR'S NAME :		COMPANY :
PERSON / COMPANY TO BE VISITED :		
PURPOSE OF VISIT :		
VISITOR I.D. NO.		TEMPORARY VEHICLE PASS NO.
TIME (IN) : _____: AM/PM	TIME (OUT) : _____: AM/PM	ISSUED BY :
SIGN (VISITOR)		SIGN (PERSON VISITED)

– TO BE SIGNED UPON COMPLETION OF THE VISIT, AND SUBMITTED BY THE VISITOR TO THE GATE HOUSE UPON LEAVING.

ATTACHMENT 9

CONTRACTOR DATE:_____/_____/_____

REGULAR VEHICLE GATE PASS REQUEST

COMPANY NAME		VEHICLE TYPE
Requested Category of Gate Pass : ☐ A : Office Area only (Private Vehicle of Office Staff) ☐ B : A + Const. Area (Const. Vehicle and Vehicle for access to Site)		
MODEL	COLOR	VEHICLE REG. NO.
ENGINE TYPE DIESEL / PETROL		REQUESTED BY
For CONTRACTOR use only. PASS NO.: _____	Checked	Approved

THE FOLLOWING DOCUMENT TO BE ATTACHED:

1. DRIVING LICENSE'S PHOTO COPIED
2. ROAD TAX REGISTRATION'S PHOTO COPIED
3. INSURANCE'S PHOTO COPIED

NOTE : THE REGULAR VEHICLES GATE PASS MUST BE DISPLAYED INSIDE THE WIND SHIELD AT ALL TIMES

APPENDIX Z SECURITY PLAN AND DECOMMISSIONING MANAGEMENT PLAN FRAMEWORK

AHLONE 2

TRAFFIC MANAGEMENT PLAN

PROJECT DOC. NO. F050-MNL-084

LNG POWER PLANT (AHLONE) PROJECT

TTCL JOB NO. F-050

Total (Including this Page): 17 sheets

0	23-Sep-19	For Information	Phakin P.	Nimit A.	Anuchit P.	Peerapat T.
REV.	DATE	DESCRIPTION	MADE	CHECKED	APPROVED	AUTH'D

For Project Use only

Originator	Distribution	PW	PR	MA	ME	PP	EE	IN	CV	QC	PC	Proj	Site	Owner	Total
Project	No. of Copy	-	-	-	-	-	-	-	-	-	-	ORG.	1	1	2

บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

Revision History Sheet

Rev.	Date	Description
0	September 23, 2019	For Information

CONTENTS

1. SCOPE

This procedure is describes the TRAFFIC AND TRANSPORTATIONS activities inside the **LNG POWER PLANT (AHLONE) PROJECT** for CONTRACTOR and their SUBCONTRACTORS employees during construction, commissioning until Commercial Operation Date (COD)

This procedure addresses field implementation and controls for traffic and transportation management during construction and commissioning. It shall be updated if conditions or traffic and transportation requirements change.

These traffic and transportation arrangements are depend on the provision of agreed site access control.

2. PURPOSE

The purpose of this plan is to assist CONTRACTOR and their SUBCONTRACTORS employees in complying with all applicable traffic and transportation requirements during construction and commissioning state.

3. DEFINITIONS

"CONTRACTOR" means **TTCL PUBLIC COMPANY LIMITED (TTCL)** and **TTCL MYANMAR ENGINEERING AND CONSTRUCTION COMPANY LIMITED (TTMEC)** who perform the "Engineering Procurement and Construction (EPC) of the project.

"OWNER" means **TTCL POWER MYANMAR COMPANY LIMITED (TPMC)** who employ CONTRACTOR in connection with the "Engineering Procurement and Construction (EPC) of the project.

"SUBCONTRACTOR(S)" means the subcontractor(s) employed by CONTRACTOR or OWNER in connection with the construction of the project.

VEHICLEmeans a small personal automobile such sedan, van, pick-up, SUV etc.

TRUCKmeans an automobile or machine that larger than vehicle such truck, tank car, trailer or a combination.

CRANEmeans a lifting machine that to be used for construction activity.

CONSTRUCTION EQUIPMENT means any machines that to be used for construction activities

such excavator, backhoe, compactor, mobile compressor, motor grader, tractor, etc.

4. RESPONSIBILITY

CONTRACTOR take overall responsibility for the implementation and monitoring of the traffic and transportation regulation including the effective management and control which are conducive to safe traffic transportation on site.

4.1 CONTRACTOR PROJECT MANAGER (PM)

(a) PM is responsible for assuring implementation of traffic and transportation procedure to ensure that safe traffic and transportation inside LNG POWER PLANT (AHLONE) PROJECT are followed by CONTRACTOR, SUBCONTRACTORS and other concerned parties in the project.

(b) PM is responsible for providing the personnel, facilities and other resources necessary to effectively implement this procedure.

(c) Lead by an example, modeling the behavior expected from all personnel performing work at the jobsite.

4.2 CONTRACTOR CONSTRUCTION MANAGER (CM)

(a) CM is responsible for construction execution and collaboration with CONTRACTOR PM and HSEM to encourage CONTRACTOR employees, SUBCONTRACTOR employees, vendor and visitor to follow traffic and transportation procedure.

(b) Lead by an example, modeling the behavior expected from all personnel performing work at the jobsite.

4.3 CONTRACTOR HSE MANAGER (HSEM)

HSEM is responsible to execute an effective traffic and transportations covering included construction area, warehouse and lay down area, parking area and around CONTRACTOR site office area as following;

(a) Establish traffic and transportation procedure covering project activities risk.

(b) Ensuring effective compliance with traffic and transportation procedure.

(c) Ensuring that this procedure is administered properly and developed traffic and transportation procedure where necessary.

(d) Ensuring that all site personal (CONTRACTOR and SUBCONTRACTOR employees) are received traffic management plan training and adhere to entire requirement.

(e) Assist SUBCONTRACTOR to plan and coordinate for the work to effectively implement the requirements of the procedure.

(f) Audit SUBCONTRACTORS to ensure the requirements of this procedure are implemented and shall provide feedback on performance to CONTRACTOR and SUBCONTRACTOR management.

(g) Ensure the required traffic and transportation records are generated and available for review by management and authorities as appropriate.

(h) Review the incidents, accidents and community complaints that occur by traffic and transportation activities in yearly.

(i) Lead by an example, modeling the behavior expected from all personnel performing work at the jobsite.

4.4 CONTRACTORSECURITY OFFICER (SCO)

CONTRACTOR security officer is responsible for;

(a) Provide direction and oversight to the traffic and transportation policy and to facilitate interface with local police officials for traffic and transportation activity associated with the project.

(b) Manage, control and co-ordinate with security guards for traffic and transportation provisional activities.

(c) Ensuring that all vehicles and equipment have a valid inspection and access to the determination gate.

(d) Ensuring that vendors delivery vehicle is in safe operating condition in order to be allowed on the project.

4.5 SUBCONTRACTOR MANAGEMENT REPRESENTATIVE

(a) The SUBCONTRACTOR management representative has the responsibility for compliance with this procedure and shall provide the personnel, facilities and other resources necessary to effectively implement, administer and enforce this procedure as far as procedure applies to the SUBCONTRACTOR.

(b) The SUBCONTRACTOR management representative is responsible for effective dissemination and education of the traffic and transportation requirements throughout his organization and lower tier SUBCONTRACTOR'S organization and shall ensure that all employees would be comply with the requirements.

4.6 SUBCONTRACTORS SUPERVISOR

(a) SUBCONTRACTORS supervisor shall be thoroughly familiar with this procedure and with their individual responsibilities regarding its implementation and enforcement.

(b) SUBCONTRACTORS supervisor shall ensure that only authorized driver or operator are assigned work tasks. This includes ensuring the worker has the skills, physique and knowledge to safely execute the work task.

4.7 EMPLOYEES

(a) Absolutely follow all traffic rules and traffic signs while driving inside of the **LNG POWER PLANT (AHLONE) PROJECT.**

(b) Provide its own vehicles for routine performance of its work.

(c) Daily inspect vehicles before use and on the required schedule.

(d) Visibly display at all times a current vehicle authorization gate pass on the vehicle directed location.

(e) Transportation of materials & workers at the same time on rear bed of pick-up or truck is prohibited inside project.

4.8 AUTHORIZED DRIVER OR OPERATOR

(a) The authorized driver is the person who has the legal driving license qualifications

according with type of vehicle.

(b) The specific vehicle, truck or construction equipment which is operating in restricted or hazardous area shall determine authorized driver.

(c) An authorized driver is responsible for safely operating the assigned vehicle at all times.

(d) A driver shall comply with the following requirements of the traffic and transportation procedure:

i. Driver or construction equipment operator shall not drive or operate under the influence of alcohol or drugs.

ii. Conduct pre-trip, end route and post-trip vehicle / construction equipment inspections.

iii. Test communication for construction equipment before departure.

iv. Wear seat belts and other required PPE at the appropriate times.

v. Follow procedures regarding driving hours and rest periods.

vi. Follow defensive driving principles.

vii. Work carry out in abide with project safety rules and regulation.

viii. Instruct their authorized passengers on safety and emergency requirements.

AUTHORIZED PASSENGER

An authorized passenger is the permissible person who was conveying by authorized vehicle or truck or construction equipment. The authorized passenger in a vehicle shall:

(a) Ride only in authorized vehicles.

(b) Wear seat belts and other required PPE at the appropriate times.

(c) Ride only in the vehicle which provided seats. Standing is prohibited.

(d) Not interfere concentration to driver or distract driver attention.

(e) Know and obey emergency procedures.

5.INSTRUCTION

5.1 GENERAL REQUIREMENTS

The project shall implement the traffic and transportation procedure in such a way as to take foremost account of the health, safety, environmental protection and security for employees and SUBCONTRACTORS included the surrounding communities.

(a) CONTRACTOR and SUBCONTRACTOR will not transport equipment and materials during the local traffic peak time.

(b) CONTRACTOR and SUBCONTRACTOR will limit time for construction activities that will take place on or near local roads.

5.2 DRIVER / CONSTRUCTION EQUIPMENT OPERATOR

(a) Competent and Selection

The candidates position of transportation driver/construction equipment operator shall:

a) Be at least 25 years old.

b) Prefer experience with the types of vehicles that be driving in the project and possess a valid commercial driver's license (CDL) for each class of vehicle, truck or construction equivalent;

c) Passed a defensive driving training or specific training for construction equipment operation,

d) Have an aptitude toward the task to be assigned;

e) Be physically qualified for the work assignments;

f) Reflect a positive attitude toward the nonuser of drugs and alcohol and/or pass a screening test where applicable;

g) Be advised any related skills and experience (if necessary), such as:

- Work at height training,
- Four wheels driving

- Tandem lift or trailers(double/triple),
- Heavy hauling,
- Multi-language skills (Driver for foreigner);

(b) Project Driving /Operating Permission

a) Each driver/operator shall hold a valid CDL or equivalent.

b) Each project driving shall pass a defensive driving training course (in-house training) after completing the basic training program.

c) Project driver permit card shall detail record such name – surname, age, employment, photo, types and classes of vehicles authorized to drive.

d) Each driver will carry both license and permit card at all times

e) In case of driving / operating serious violation occurred, the Balance of Consequence-BOC (see F050-MNL-059 SITE RULES AND REGULATION PROCEDURE) shall be applied and the permission shall be immediately revoked. That means the driver / operator shall be suspended from driving / operating in the project.

5.3 JOURNEY MANAGEMENT FOR TRIP, ROUTE, HAZARDS AND CONDITIONS

Drivers / operator shall be full cognizance of all routes, hazards, and conditions that are likely to be encountered on journeys. They shall:

(a) Ensure that drivers / operators are apprised of these facts

(b) Prepare a realistic schedule to complete the journey

(c) Check obstructions and distances

(d) Check hours and timing to ensure drivers do not work outside defined route and authorized driving hours.

5.4 SPEED LIMT:

(c) All vehicles travel in the project must keep speed limit under 20 Km/Hr.

(b) All vehicles travel in the construction area keep speed limit under 10 Km/Hr.

(c) All vehicles that travel inside project area but outside construction area shall keep speed limit under 30 Km/Hr.

5.5 DIRECTION OF TRAVEL FOR INGRESS AND EGRESS:

All vehicles shall strictly follow the traffic signs and CONTRACTOR instructions.

5.6 WHEEL WASHING STATION :

To prevent illegal problems concerning with traffic accident, community interference and environmental impacts, it shall provide the wheel washing station at the exit gate for project trucks or vehicles. It shall be washed dirty wheel prior leave from project site. This mitigation is to be ensuring that mud or soil shall not drop off on public road which lead to road surface slippery or dust dispersion.

5.7 BARRICADE AND WARNING SIGN :

When barricade and warning sign are used for notification of excavated area in the project site, all vehicle drivers shall be aware of that warning sign before entry to the excavated area.

5.8 VEHICLE / CONSTRUCTION EQUIPMENT INSPECTION AREA :

The inspection area for vehicle and construction equipment shall define by CONTRACTOR safety inspector. Inspection checklist shall be followed Equipment Inspection Procedure. When inspection is completed, the inspection sticker shall be issued to driver. It is allowed entry to project site by showing valid inspection sticker at entrance gate.

5.9 FLAG MEN :

SUBCONTRACTORS shall provide sufficient number of flag men that assist vehicle, truck drivers or construction equipment operators for movement inside construction area and problem prevention at entrance and exit gate that connecting with public road during rush hours such morning time and evening time or critical transportation mission.

5.10 GATE PASS VALIDITY :

(a) All vehicles, trucks and construction equipment which required regularly entry in to project site shall get "Vehicle Gate Pass Sicker" refer to F050-MNL-083 Security plan and Decommissioning Management Plan Framework.

(b) Vendor, visitors, supplier etc. who required temporally entry in to project site shall get "Temporally Vehicle Gate Pass Card" refer to F050-MNL-083 Security plan and Decommissioning Management Plan Framework.

6. Mitigation Measure

Table 6.1 Mitigation Measure of Traffic Management Plan

No.	Description of Measure	Responsibility	Monitoring	Frequency	Reporting	Ref. Document
Environmental and Social Management Plan for the LNG Terminal/ Power Plant						
1.	CONTRACTOR and SUBCONTRACTOR will not transport equipment and materials during the local traffic peak time.	PM/CM	One Time Approval	-	Procedure	F050-MNL-084 Traffic management plan
2.	CONTRACTOR will develop and implement a Stakeholder Engagement Plan as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on or near local road. This will ensure that stakeholders can anticipate and can appropriately respond to the change and limitation of uses on local roads. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular transportation is affected by the Project activities.	HSEM	One Time Approval	-	Procedure	F050-MNL-090 Stakeholder Engagement Plan

Environmental and Social Management Plan for Pipe Line						
1.	CONTRACTOR and SUBCONTRACTOR will not transport workers, equipment and materials during the local traffic peak time;	PM/CM	One Time Approval	-	Procedure	F050-MNL-084 Traffic management plan
2.	CONTRACTOR will limit time for construction activities that will take place on or near local roads; and (specified by project site)	PM/CM	One Time Approval	-	Procedure	F050-MNL-084 Traffic management plan
3.	CONTRACTOR will develop and implement a Stakeholder Engagement Plan as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on or proximate to local road. This will ensure that stakeholders can anticipate (and can appropriately respond to) the change and limitation of uses on local roads. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular transportation is affected by the Project activities.	PM/CM	One Time Approval	-	Procedure	F050-MNL-090 Stakeholder Engagement Plan

7. Monitoring Plan

Project Stage/Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility
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 and yearly	HSEM

8. ATTACHMENT

ATTACHMENT 1 **LNG POWER PLANT (AHLONE) PROJECT** Gate Location

(Specified later by Project HSE department)

PROJECT NAME GATE LOCATION

(Specified later by Project HSE Department)

APPENDIX AA TRAFFIC MANAGEMENT PLAN

AHLONE 2

COMMUNITY HEALTH MANAGEMENT PLAN

PROJECT DOC. NO. F050-MNL-085

LNG POWER PLANT (AHLONE) PROJECT

TTCL JOB NO. F-050

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Originator	Distribution	PW	PR	MA	ME	PP	EE	IN	CV	QC	PC	Proj	Site	Owner	Total
Project	No. of Copy	-	-	-	-	-	-	-	-	-	-	ORG.	1	1	2

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TTCL PUBLIC COMPANY LIMITED

Revision History Sheet

Rev.	Date	Description
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1. SCOPE

This Procedure has been developed based upon the outcomes of the ESIA, ongoing base-line data.

2. PURPOSE

To avoid or limit risks to, and impacts on, the health and safety of the community from the project activities during the construction phase. This is achieved through implementing targeted prevention program to reduce risks, along with the implementation of an effective monitoring and evaluation program and to improve the existing health of the local community.

3. DEFINITIONS

"CONTRACTOR" means **TTCL PUBLIC COMPANY LIMITED (TTCL)** and **TTCL MYANMAR ENGINEERING AND CONSTRUCTION COMPANY LIMITED (TTMEC)** who perform the "Engineering Procurement and Construction (EPC) of the project.

"OWNER" means **TTCL POWER MYANMAR COMPANY LIMITED (TPMC)** who employ CONTRACTOR in connection with the "Engineering Procurement and Construction (EPC) of the project.

"SUBCONTRACTOR(S)" means the subcontractor(s) employed by CONTRACTOR or OWNER in connection with the construction of the project.

4. RESPONSIBILITY

4.1 CONTRACTOR Project Manager (PM)

PM is responsible to conduct the project execution in the safe practices. In conjunction with CONTRACTOR HSE Manager to ensure the safety and health of workers is complied with this procedure.

4.2 CONTRACTOR Construction Manager (CM)

CM is responsible to conduct the construction execution in the safe practices. In conjunction with CONTRACTOR HSE Manager to ensure the safety and health of workers is complied with this procedure.

4.3 CONTRACTOR HSE Manager

(a) Ensure that all mitigation measure shall be effectively implemented.

5. PROCEDURE

5.1 Impact to health and safety of the community

- CONTRACTOR shall arrange the training for all workers on the transmission routes and common symptoms of communicable diseases. This can help reduce the potential for workers to unknowingly transmit communicable diseases.
- CONTRACTOR shall establish amenities at the worker camp to help minimize the interaction between the workforces (particularly temporary construction workers) and local villagers. This includes recreation facilities and health care infrastructure.
- CONTRACTOR shall establish a workforce code of conduct, which include the specific measures that target anti-social behaviour, such as becoming involved with commercial sex workers;
- CONTRACTOR shall undertake pre-employment screening to ensure fitness for work. It is important that the pre-screening process does not result in discrimination, but instead is used as a tool to minimize the transmission of communicable diseases.
- CONTRACTOR shall remain the sanitation at project site in good condition, reduce the presence of vector habitat and consideration of whether pesticides will be utilized to reduce the presence of vectors onsite;
- CONTRACTOR shall provide onsite health care and medical facilities, to ensure that basic medical attention and first aid treatment can be sought during the hours that the work is being undertaken at the project site.
- Pre-placement medical examination of all workers, supported by periodic medical examinations. A regular voluntary worker medical screening program onsite and a monitoring and evaluation (M&E) system. In addition a workplace policy and training and awareness programme on risks described above and prevention and mitigation of HIV impacts will be implemented with project staff;
- In collaboration with the local and regional government, local emergency providers and local health care facilities, OWNER will develop and implement emergency prevention, preparedness and response plans (EPPRPs) to cover all incidents presenting risks to public

safety and the affected communities in proximity to the project sites and the environment;

- CONTRACTOR shall develop and implement a workforce code of conduct which will be adhered to by all CONTRACTORS and OWNER employees. Any employee or CONTRACTOR found in violation of the code shall face disciplinary hearing which may result in dismissal;
- CONTRACTOR shall ensure the access to free condoms (including female condoms) at the worker camp to promote safe sexual practices;
- CONTRACTOR shall conduct information, education and communication campaigns amongst project personnel on hygiene and sanitation;
- CONTRACTOR shall develop an effective Waste Management Plan that ensures adequate and legally acceptable control and management of transport and disposal of all wastes on and off site;
- Security personnel will be contracted and trained in line with the voluntary principles on security and human rights;
- Accommodation should be provided to external workers in accordance with international good practice on workers' accommodation, including IFC standard to prevent transmission of diseases associated with poor living conditions;
- The project should implement measures to reduce the presence of standing water onsite through environmental controls and source reduction to avoid the creation of new breeding grounds;
- All the mitigation presented in the air quality and noise impact assessment chapter will be implemented;
- The project should develop a Traffic Management Plan covering vehicle safety, speed limits on roads, driver and passenger behaviour, use of drugs and alcohol, hours of operation, rest periods and location of rest stops and accident reporting and investigations;
- Require project drivers to be trained in defensive driving within the previous 3 years;
- All vehicles used for the project should be regularly serviced and maintained;

- Local speed limits should be adhered to when travelling through communities by all project related traffic. Such speed limits will have the added advantage of reducing dust emissions;
- Undertake consultation with communities along key transport routes to inform them about the potential for increased traffic movements prior to any changes;
- CONTRACTOR will develop and implement a stakeholder engagement plan as part of the project. The project will also include a grievance mechanism to collect grievances from local stakeholder affected by the project activities;
- The project will ensure that signs are put up around construction sites advising people of the risks associated with trespass. All signs should be in diagram form to ensure those with low levels of literacy understand the signs;
- The project will ensure that there is adequate fencing around construction site to minimise the risk of trespass. Fencing will be checked daily to ensure that it is in good condition and to look for any signs of entry.

5.2 Reducing the capacity of the existing facilities and utilities

- CONTRACTOR shall provide appropriate amenities at the workforce accommodation camp – e.g. recreational opportunities. This will help reduce the need for workers to utilize local infrastructure and services;
- CONTRACTOR will ensure that company medical services have sufficient capacity and capability to treat a reasonable amount of workers at the same time.
- CONTRACTOR shall develop and implement a worker code of conduct for all employees, SUBCONTRACTORS and visitors directly related to the project. This will be a contractual and enforced requirement for all staff and SUBCONTRACTORS.
- CONTRACTOR will communicate on its recruitment approach emphasising that priority for unskilled position will be given to inhabitant from project.
- CONTRACTOR shall develop and implement a traffic management plan to minimize the impact experienced by road users as a result of the project. The traffic management plan should be developed in consultation with local stakeholders. Stakeholders should be

notified in advance of the project commencing of traffic routes that will be utilised and, where known, periods of increased traffic volumes. Where possible, traffic movements will be coordinated so as to limit disruptions to local activities;

- CONTRACTOR shall develop and implement a community health management plan and an occupational health and safety plan in consultation with relevant stakeholders (e.g. local health practitioners). These plans will ensure that appropriate and adequate health care services are provided on site and at the accommodation camp to address/ manage worker illnesses and injuries.

CONTRACTOR will develop and implement a stakeholder engagement plan as part of the project. The plan should include measures to notify local stakeholders in advance of any particularly activities on public infrastructures. This will ensure that stakeholders can anticipate and appropriately respond to the change and limitation of uses. The project should also develop a grievance mechanism to collect grievances from local stakeholder whose regular use of public services and infrastructures is affected by the project activities.

6. Monitoring plan

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Measurements	Frequency	Responsibility
Social	Impacts to health and safety of the community	Worker training, grievances, accident log, implementation of community H&S monitoring and surveillance programme, implementation of worker code of conduct	Compliance against plan	Bi monthly review of training log; Monitoring and review of accidents due to construction (daily monitoring and monthly review). Community health and safety monitoring and surveillance program.	HSEM

				Daily monitoring of construction area, worker camp and surrounding; Regular unplanned audit on worker code conduct; Monthly visual inspection of first aid facilities and records. Weekly review of grievance log.	
Community Health and Safety	Community disturbance and potential safety hazard due to road traffic	Accidents, incidents and complaints	Incidents, accidents and community complaints	Based on occurrence and yearly	HSEM
	Public concerns	Complaints from community	As per the grievance redress mechanism	Continuous	HSEM

APPENDIX BB COMMUNITY HEALTH MANAGEMENT PLAN

AHLONE 2

COMMUNICABLE DISEASE MANAGEMENT PLAN FOR COVID-19

PROJECT DOC.NO.F050-MNL-095

LNG POWER PLANT (AHLONE) PROJECT

TTCL Job No. F050

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TTCL PUBLIC COMPANY LIMITED

Revision History Sheet

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1. PURPOSE

This plan provides for the prevention and control of infection disease, including outbreaks management for COVID-19, the purpose of this plan is to;

- Provide basic guidance on controls needed to prevent disease outbreaks,
- Recommend surveillance practices to quickly identify potential outbreaks,
- Recommend steps to take to limit or interrupt infectious disease transmission among the workers when an outbreak occurs, or is suspected to have occurred.

2. SCOPE

This Plan addresses:

- Disease prevention, facility preparation for an outbreak, and control measures to take when an outbreak occurs,
- Investigation of an outbreak,
- Management of suspected personnel,
- Sharing of lesson learned.

The requirements established in this plan are applicable to all areas of the *LNG Power Plant (Ahlone) Project* worksite and comply with Myanmar's Laws and Regulations.

3. RESPONSIBILITY

3.1 PROJECT MANAGER (PM)

He shall be overall responsible for this plan and supporting to ensure that all entities at the project site actively participate.

3.2 HSE MANAGER

He shall be responsible for periodically reviewing and revising/updating its contents and to distribute the revised/updated document to relevant end users.

3.3 SUBCONTRACTOR

a. Subcontractor and their Subcontractors shall ensure compliance with local government legislation and industry standards even if they are not stated in this procedure.

b. Subcontractor and their Subcontractors shall ensure that they have the adequate resources for the implementation of Communicable Disease Plan

c. Subcontractor and their Subcontractors shall ensure that the necessary records are kept for review and audit tracing purposes.

3.4 EMPLOYEES / WORKERS

a. All employees shall ensure that he/she is physically fit

b. All employees shall ensure that his/her health condition does not compromise the health and safety of other employees and/or the safety of the operations at all times.

4. OVERVIEW

4.1 Introduction

Coronaviruses (CoV) are a family of RNA (ribonucleic acid) viruses. They are called coronaviruses because the virus particle exhibits a characteristic 'corona' (crown) of spike proteins around its lipid envelope. CoV infections are common in animals and humans. Some strains of CoV are zoonotic, meaning they can be transmitted between animals and humans, but many strains are not zoonotic.

The CoV which causes COVID-19 has been designated as SARS-CoV-2 by the International Committee on Taxonomy of Viruses (ICTV); this is the scientific name. The virus may also be referred to as "the COVID-19 virus" or "the virus responsible for COVID-19". COVID19 refers to the disease caused by the virus.

4.2 Control of Communicable Diseases

- All communicable diseases are preventable.
- In general, control measures depend on:
  a. Clean and healthy environment. This will minimize the exposure to the causal agents

  b. Health of the exposed workers' community; healthy individual will increase their resistance against the causal agents.

  c. Competent healthcare services to ensure timely diagnosis and intervention or management of the illness

5. PROCEDURE

This procedure provides detailed description of prevention, preparation, control and follow-up for a communicable disease especially COVID-19, either single affected personnel or an outbreak. It is divided into 'before', 'during' and 'after'.

5.1 BEFORE

This section describes the type of program and activities that shall be put in place for the prevention of the illness from taking place and preparedness to respond if an outbreak occurs.
TTCL and subcontractor shall stay abreast of guidance from federal, state, local, tribal, and/or territorial health agencies, and consider how to incorporate those recommendations and resources into workplace-specific plans.

5.1.1. Preventive Measures

All TTCL's and subcontractor's employees shall depend on emphasizing basic infection prevention measures and implement good hygiene and infection control practices, including:

- Clean the potential exposes spots such as fingerprint scanner, door handle, personal desk, conference table and chairs, computer and devices in workplace etc.
- Encourage worker to use the personnel food/water container at site.
- Promote frequent and thorough hand washing, including by providing workers, customers, and worksite visitors with a place to wash their hands. If soap and running water are not immediately available, provide alcohol-based hand rubs containing at least 70% alcohol.
- Provide the contaminated trash receptacles at worksite.
- Cleaning the vehicle by focusing on areas that frequently contact such as door handrails, seat cushions, and armrests with 70% alcohol that can destroy the virus.
- Ensure the employees are at least 1-2 meters away from other individuals while working in office, meeting, and lunching at canteen.
- Project manager shall consider managing time lapse for lunch break by dividing the section to 50:50 of workers.(Group of workers shall be identified by difference sticker color that post on their safety helmet for easy screening)

5.1.1.2 Regular Periodic Inspection

Cleanliness and housekeeping are critical in prevention of communicable diseases.
Subcontractor shall ensure regular periodic inspections of the workplace are carried out and the results of inspections recorded.
Areas that shall be inspected shall include but not be limited to:

- Temporary Office
- Toilet
- Pantry room
- Drinking water cooler
- Worker Accommodation
- Kitchen/Food Preparation/Mess Hall. This shall include off-site food preparation (caterer) where relevant.

5.1.1.3 Workers Awareness

All workers should be given awareness training on all the endemic disease within the project and any new or emerging diseases. The training can in the form of, toolbox talk, health promotional material (such as brochure, alerts, advisories, banners, posters, multimedia etc.)

- Aware to employees and subcontractors to understand the risk of contamination by giving importance to self-protection such as wearing a mask or cloth mask and glove while working and cleaning.
- Employees who do not comply or intentionally violate this procedure are considered to penalties.

5.1.1.4 Screening visitors.

Visitor or Vender who entering to project site must pass screening test for symptoms of acute respiratory illness (e.g., fever over 37.5 ^{o}C, cough, difficulty breathing) before entering project site. The suspected person will not be allowed to entry project site.

5.1.2 Response Preparedness

Subcontractor and their Subcontractors shall be adequately prepared to respond to a potential outbreak of infectious disease.

5.1.2.1 Key Preparedness

Key preparedness measures shall include the following:

- made aware of the need to promptly notify the Site HSE Manager if the suspected person is identified similar with COVID-19 symptoms.
- Subcontractor has identified an isolation and quarantine facility at the Workers' accommodation camp.
- Medical evacuation (Medevac) and referral protocols for infectious diseases shall be developed.
- Advise on enhanced cleaning and disinfection practices to use during an outbreak.
- Subcontractor shall have adequate supplies of items for handling and managing infectious diseases. Examples of the items are:
    a. Face mask
    b. Gloves
    c. Disposable gowns
    d. Cleaning and disinfecting supplies
    e. Biohazards disposable bag

5.2 DURING

All suspected communicable diseases (single case or outbreak) shall be notified by Subcontractors to the TTCL HSE Manager, who in turn shall notify Project Manager and TPMC Health & Medical Manager ,within 24 hours of diagnosis made.

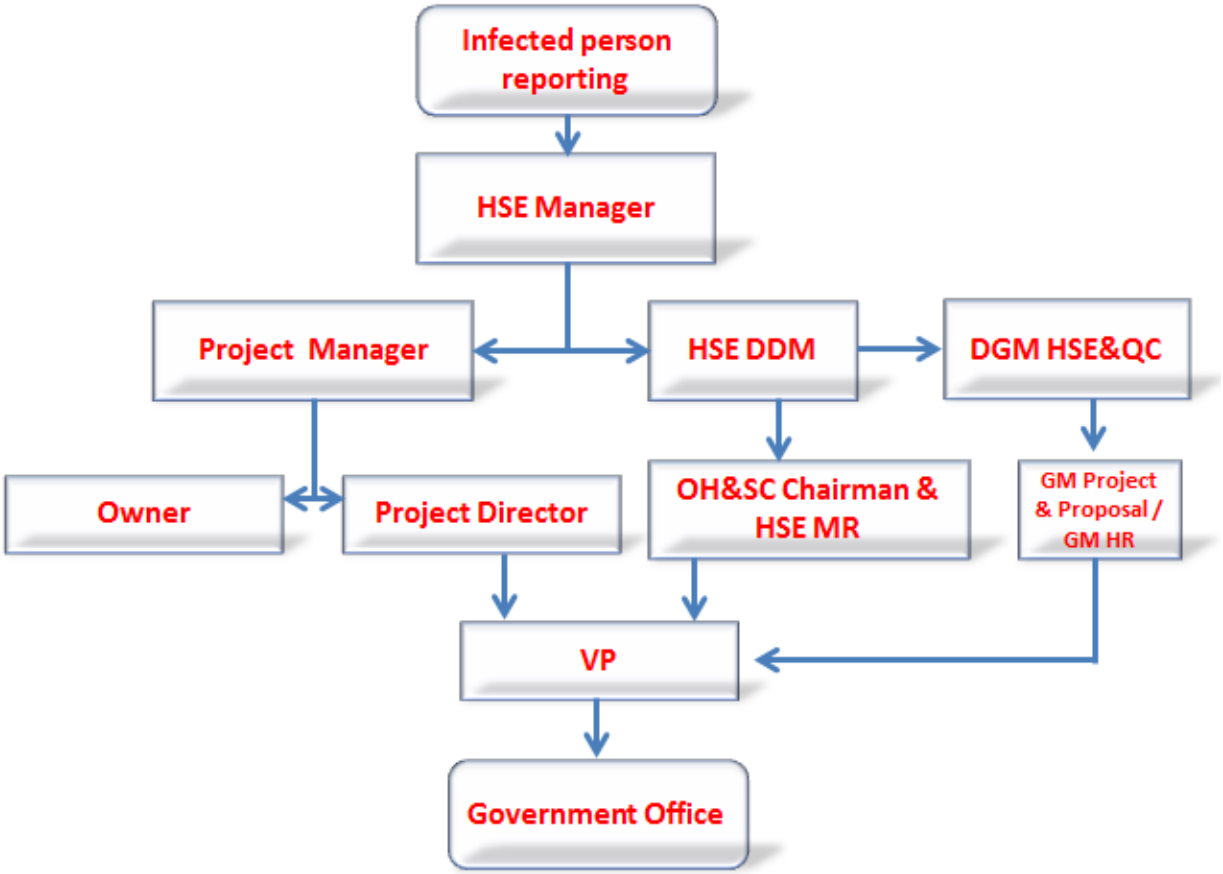
5.2.1 Management of Suspected person(s)

Suspected person shall be promptly isolated from others in an isolation room. The purpose of the isolation is to disrupt the outbreak by reducing the probability of the pathogens being transmitted between individuals. Then transfer Suspected person to hospital for Doctor Diagnosis respectively.

5.2.2 Infected person confirmation

In case of confirmation by Doctor that Suspected Person is COVID-19 Infected person. Project Manager shall consider to process as following step;

A. Announcement to all workers, the official instruction shall be announced by Project Manager. Then report to management as flow chart.
B. Site office or Construction area where were working area of infected person shall be considered to close temporally.
C. Clean working area where infected person has worked or used. Moreover, the common area such as panty room, toilet and van shall be cleaned also.
   The cleaning shall be performed by specialist who has been trained for infected area cleaning especially.
D. Isolate his/her colleague who has worked with infected person for 14 days, they shall report temperature and symptom monitoring to their supervisor in every day.



Project Communication Flow Chart

5.2.3 Investigation

Investigation of a Communicable Disease incident shall follow the Investigation Procedure Investigation shall be initiated as soon as is reasonably practicable. It is recognized that outbreak investigations are different than most other incidents. It may be difficult to determine a clear and specific cause of the outbreak and it may involve confidential medical data and information. The investigation shall be aimed to:

a. Confirm the disease or outbreak

b. Determine the source of the disease agent/infection

c. Determine how the agents were transmitted

d. Determine any failure of control, and

e. Provide recommendations for improvement to prevent recurrence

Investigation team for a communicable disease shall contain at least one medical personnel as their role is essential to determine the source of infection through the incubation period, clinical presentation and control measures as they might understand better the mechanism of the illness being investigated.

5.3 AFTER

5.3.1 Declare the outbreak is over

The project must always update information about COVID-19 outbreak by referring from the government official announcement. If the outbreak is over, project shall communicate or distribute information to all employees in site.

5.3.2 Review Lesson Learned

The effectiveness illness or outbreak management shall be reviewed. It should cover from the first recognition of the illness, implementation of the management until incident investigation. This review should identify:

a. Improvement on the response
b. Corrective actions identified from the investigation shall be implemented as soon as possible

The lesson learned should be shared throughout the Project.

6. EMERGENCY CONTACT LIST

No.	Full name	Position	Phone	E-mail

APPENDIX CC COMMUNICABLE DISEASE MANAGEMENT PLAN FOR COVID-19

AHLONE 2

FIRE PREVENTION PLAN

PROJECT DOC. NO. F050-MNL-086

LNG POWER PLANT (AHLONE) PROJECT

TTCL JOB NO. F-050

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TTCL PUBLIC COMPANY LIMITED

Revision History Sheet

Rev.	Date	Description
0	October 1, 2019	For Approve
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CONTENTS

1. PURPOSE

The purpose of this plan is to assist CONTRACTOR and their SUBCONTRACTORS in complying with all applicable fire prevention requirements during construction and commissioning until Commercial Operating Date (COD).

2. SCOPE

This construction plan describes the fire prevention compliance activities for CONTRACTOR and their SUBCONTRACTORS, during construction and commissioning until Commercial Operating Date (COD) of the LNG POWER PLANT (AHLONE) PROJECT.

This plan addresses field implementation and controls for fire prevention management as well as the processes for monitoring and mitigation of construction activities that could potentially impact the environment. This plan will be updated if conditions on fire prevention requirements change.

3. DEFINITION

"CONTRACTOR" means **TTCL PUBLIC COMPANY LIMITED (TTCL)** and **TTCL MYANMAR ENGINEERING AND CONSTRUCTION COMPANY LIMITED (TTMEC)** who perform the "Engineering Procurement and Construction (EPC) of the project.

"OWNER" means **TTCL POWER MYANMAR COMPANY LIMITED (TPMC)** who employ CONTRACTOR in connection with the "Engineering Procurement and Construction (EPC) of the project.

"SUBCONTRACTOR(S)" means the subcontractor(s) employed by CONTRACTOR or OWNER in connection with the construction of the project.

"HSE" means Health Safety and Environment.

"SDS" means Safety Data Sheet.

"GFCI" means Ground Fault Circuit Interrupter.

"ELCB" means Earth Leakage Circuit Breaker.

4. RESPONSIBILITY

When an activity is defined for a certain position in this procedure, the responsibilities remain with that person although a designee may perform the implementation of that activity. The appointed designee must report directly to the assigned individual.

4.1 CONTRACTOR Project Manager (PM)

The PM has the overall responsibility for this procedure and is responsible for supporting it and for ensuring that all entities at the jobsite actively participate, responsible for providing the personnel, facilities, and other resources necessary to effectively implement this procedure. The PM and management team will lead by example, modeling the behavior expected from all personnel performing work at the jobsite.

4.2 CONTRACTOR Construction Manager (CM)

The CM is responsible to conduct the construction execution in the safe practices. In conjunction with CONTRACTOR safety manager to ensure the safety and health of employees include environmental impact control in every aspect related to works.

4.3 CONTRACTORHSE Manager

HSE Manager in collaboration with PM & CM, is responsible for implementing and administering this procedure by;

(1) Function as an adjudicator on any issues from the implementation of this procedure
(2) Audit SUBCONTRACTORS to ensure the requirements of this procedure are implemented and will provide feedback on performance to CONTRACTOR and SUBCONTRACTOR management.
(3) Assist SUBCONTRACTOR to plan and coordinate the work to effectively implement the requirements of the procedure.
(4) Ensure the required HSE records are generated and available for review by management and authorities as appropriate.

4.4 SUBCONTRACTOR Management Representative

The SUBCONTRACTOR management representative has the responsibility for compliance with this procedure and shall provide the personnel, facilities, and other resources necessary to effectively implement, administer and enforce this procedure.

The SUBCONTRACTOR management representative is responsible for the effective dissemination and education or the requirements throughout the SUBCONTRACTOR'S and its SUBCONTRACTOR'S organizations. The SUBCONTRACTOR representative shall ensure that all SUBCONTRACTOR employees and all lower tier SUBCONTRACTORS comply and actively participate with its requirements.

4.5 SUBCONTRACTOR Safety Officer

SUBCONTRACTOR safety officer shall be responsible for the continuous monitoring of the implementation of this procedure. SUBCONTRACTOR safety officer will provide feedback on performance and assist SUBCONTRACTOR representative to plan and coordinate the work for effectively implement of this procedure.

4.6 CONTRACTOR & SUBCONTRACTOR Supervisor

CONTRACTOR & SUBCONTRACTOR supervisor shall be thoroughly familiar with this procedure and with their individual responsibilities regarding its implementation and enforcement.

CONTRACTOR & SUBCONTRACTOR supervisor shall ensure that only competent persons are assigned work tasks. This includes ensuring the worker has the skills, physique and knowledge to safely execute the work task.

4.7 Employees

Employees must know, understand and comply with the health, safety and environmental requirements of this procedure as applicable to the work they perform.

Employees must report to their supervisor any equipment malfunction that may effect the safe operation of the equipment.

Employee must advise their immediate supervisor whenever unsure of the instructions for a task or where concerned about the safety status of any task.

5 INSTRUCTION

5.1 Material Storage

5.1.1 Materials will be stored in a manner so as not to obstruct access to fire protection equipment, control valves, fire doors, alarm devices or panels, electrical panels, Motor Control Centers (MCCs), ladder base area or aisles and hallways that serve as a means of exit. A minimum clearance of 36 inches (91 cm) radius shall be maintained around the base of ladders.

5.1.2 Materials will not obstruct sprinkler heads. A minimum clearance of 36 inches (91 cm) will be maintained.

5.1.3 Materials in work areas will be limited to actual needs and will be stored in a manner to protect combustible material from ignition sources.

5.1.4 Materials will not be stored within 6 feet (1.8 m) of any inside opening or hoist way.

5.1.5 Materials will be stacked, racked, blocked, or interlocked so as to prevent sliding, falling, or collapse.

5.1.6 Storage areas will be kept clean, and materials will be neatly stacked or placed.

5.1.7 Construction materials shall be stored or placed in an orderly manner.

5.1.8 Warning signs shall be display “DANGER”, “NO SMOKING”, “NO SPARK”, “NO FIRELIGHTER” at the flammable, explosive storage area.

5.2 Flammable and Combustible Liquids

5.2.1 Flammable/combustible solvents will not be used near ignition sources. Flammable liquids (e.g., gasoline, acetone, denatured alcohol will not be used for cleaning).

5.2.2 Flammable liquids will be handled and used only in approved, properly labeled, containers.

5.2.3 Approved, properly labeled, storage cabinets will be supplied for the storage of flammable liquids in quantities exceeding 15 gallons (56.8 L).

5.2.4 Flammable and combustible liquids will not be stored in areas used as exits, stairways, or passageways, and will not adversely affect a means of egress.

5.2.5 Portable storage tanks will be maintained in a dike and lined area, with provisions made for the handling of spills and groundwater. The proximity of tanks to buildings and flammables will comply with site HSE regulations.

5.2.6 Smoking will be prohibited where refueling activities are in progress. Clear and legible signs will be posted.

5.2.7 Fuel loading hoses shall have a shutoff valve fitted at the hose nozzle to eliminate fuel spillage.

5.2.8 No equipment will be fueled while the engine is running.

5.2.9 Combustible liquids, including oil or grease, will be stored in containers or storage tanks labeled with contents and tank capacity. Each tank will be:

- Capable of withstanding working pressures and stresses compatible with the type of liquid stored
- Maintained in a manner that prevents leakage
- Located in an area free of combustible materials
- Vented or otherwise constructed to prevent development of pressures or vacuum as a result of filling, emptying, or atmospheric temperature changes.

5.2.10 All piping valves and fittings will be capable of withstanding working pressures and stresses compatible with the type of liquid stored and will be maintained in a manner to prevent leaks.

5.2.11 Fuel lines will be equipped with valves capable of stopping the flow of fuel at the source and will be located and maintained to minimize fire hazards. This does not apply to fuel lines on self-propelled equipment.

5.2.12 Appropriate firefighting equipment will be located adjacent to all locations where flammable substances are stored or transferred.

5.2.13 Particular care will be taken when welding and cutting in locations where combustibles are exposed. When such welding or cutting is done, the surrounding area will be inspected. Combustible material will be removed or protected with fire-resistant blankets or equivalent, and an adequate number of approved fire extinguishers will be immediately available.

5.2.14 All chemical which mobilize to LNG POWER PLANT (AHLONE) PROJECT shall be declare with SDS and submit to CONTRACTOR prior used on site.

5.3 Compressed Gas Cylinders

5.3.1 Introduction

There are a number of inherent hazards involved with oxy-fuel cutting, heating, and welding operations. It is necessary that proper safety procedures be understood prior to the use of such equipment.

A thorough understanding and adherence to the following safety procedures will serve to minimize the hazards involved and undoubtedly reduce the likelihood of injury.

5.3.1.1 Acetylene: Gas composes of two parts of carbon and two parts of hydrogen. The acetylene is stored in specialized cylinders, which has a porous filter and is saturated with acetone. Acetylene becomes unstable when compressed in its gaseous state above 15 psi.

5.3.1.2 Backfire: A backfire is an explosion confined in the torch head and is usually accompanied by a popping sound. It generally occurs when the heating tip is too close to the work. Loose connections, leaking hoses, incorrect gas pressures or anything that causes oxy/fuel gas starvation at the tip can cause a

backfire.

5.3.1.3 Check Valve: Is a device installed in the gauge/hose/torch assembly designed to reduce the possibility of a reverse flow of gases. Check valves are not intended to act as fire stop.

5.3.1.4 Cracking the cylinder valve: momentarily opening and closing the cylinder valve to dislodge any loose contaminant that is present.

5.3.1.5 Flashback: an explosion that progresses through the torch and gas supply equipment. It usually is accompanied by a whistling sound caused when gases mix and burn inside the torch head. Flashbacks can travel extremely fast, actually getting past a check valve.

5.3.1.6 Flashback Arrestors: are designed to present a flashback from reaching upstream equipment and causing a fire or explosion. They are usually installed in the oxygen and fuel systems between the torch and the hose.

5.3.1.7 Fume Plume: A clearly visible column of fumes which rises directly from the spot of welding or cutting. Avoid breathing metal fumes produced from molten metal.

5.3.1.8 Methyl Acetylene Propadium Gas: An alternative fuel gas used for the same operations as acetylene but it is more stable.

5.3.1.9 Metal Fume Fever: Certain alloys and metals containing zinc compounds can produce symptoms of nausea, dizziness, or fever. Exposure to high concentrations shall be avoided.

5.3.1.10 Reverse flow: Reverse flow of fuel gas can occur when the oxygen cylinder is low or empty. Fuel gas, at a higher pressure than the oxygen, can travel up the oxygen equipment to mix with gas in the hose, regulator, and possibly the cylinder is low or empty.

5.3.1.11 Rosebud: A large multi-port torch tip used for heavy heating processes.

5.3.1.12 Ultraviolet radiation: Injurious light radiation produced during are welding, insert gas are welding, are gouging and cutting that shall be avoided by wearing clothing to protect the skin and the correct shade filter lenses for eye protection.

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5.3.2 Training

All employees using oxy-fuel cutting, heating, or welding equipment shall be instructed in the proper use and safety procedures outlined in this procedure.

5.3.3 Inspection

5.3.3.1 All oxy-fuel cutting, heating, and welding equipment shall be kept clean, in good repair and must be inspected by the user prior to each use.

5.3.3.2 Any tools or equipment found to be detective shall not be used. They must be properly repaired or replaced immediately (return them to the tool room or supervisor).

5.3.3.3 Inspect hoses carefully at least once every shift for leaks, worn places, and loose connection. Whenever you suspect there may be a leak and each time before you pressurize the equipment for use, you shall turn the cylinder valves to the on position and then back to the off position. Then observe the high pressure gauges on each regulator to see if there is a pressure loss. If so, then you must find the source of the leak and make the necessary repairs.

5.3.3.4 All oxy-fuel cutting, heating & welding equipment must be inspected visually every month & a record kept for filing.

5.3.4 Storage

Cylinder storage must be in definitely assigned locations.

5.3.4.1 Cylinders must be stored in a vertical (upright/valve end up) position, and positively secured from falling, being knocked over, or damaged by passing or falling objects.

5.3.4.2 Cylinders shall be kept away from radiators, stoves, furnaces, of other sources of heat.

5.3.4.3 Empty cylinders, cylinders not in use, or cylinders in storage shall have their valves closed and gauges/hoses removed.

5.3.4.4 Valve protections caps shall always be in place, hand tight, except when cylinders are in use or connected for use.

5.3.4.5 Oxygen and fuel cylinders (full or empty) in storage shall be separated by a minimum distance of 6 m. or 5' non-combustible fire wall with a rating of at least ½ hour.

5.3.4.6 Oxygen cylinders shall not be stored near highly combustible material, especially oil and grease, or any other substance likely to cause or accelerate fire.

5.3.4.7 Inside of buildings, cylinders shall be stored in well- protected, well ventilated, dry location, at least 6 m. from highly combustible materials. No more than 2,000 cubic feet or 300 pounds of fuel gas may be stored inside a building.

5.3.4.8 Where cylinders are stored in the open, they shall be protected from the direct rays of the sun, in localities where extreme temperatures prevail.

5.3.5 Protective Apparel / Personal Protective Equipment (PPE)

5.3.5.1 Employees shall protect themselves from sparks, flying slag, and flame brilliance at all times.

5.3.5.2 Protective sleeves, aprons, and shoes shall be worn to protect skin and clothing from sparks and slag. Keep all clothing and protective apparel free of oil and grease.

5.3.5.3 Protective gloves must be worn by torch operators and any helpers of employees in close proximity, exposed to hot metal or slag during oxy-fuel cutting, heating and welding operations.

5.3.5.4 ANSI Z-87.1 TIS Standard is minimum required to design burning goggles shall be worn to provide employee protection from injurious light radiation. A number 4 to 6 lens shade is considered adequate for routine torch cutting activities.

5.3.5.5 Ear muffs or plugs shall be worn when overhead work is necessary or when

circumstances require you to lie on your side. This will prevent foreign material (possibly hot) from entering the ear canal.

5.3.5.6 Adjust clothing where necessary to keep out flying sparks and slag. Sparks may lodge in rolled-up sleeves, in pockets of clothing, or in cuffs of trousers. Keep sleeves and collars buttoned when necessary. Low shoes with unprotected tops are not suitable for work where there is possibility of sparks or slag getting inside shoes.

5.3.6 Use of cylinders and Regulators

5.3.6.1 Keep wrenches used to open valves of gas cylinders in place.

5.3.6.2 Do not use a hammer or wrench to open oxygen cylinder valves.

5.3.6.3 Close the valve of the gas cylinder and release all gas from the regulator before removing the regulator.

5.3.6.4 Always close cylinder valves when work is finished, and always close valves of empty cylinders while in storage and prior to return to the supplier.

5.3.6.5 Do not use the top of any cylinder as a place for storing tools or clothing. This might interfere with quick closing of the valve, and it might also damage the fusible safety plugs. Never let the recessed top become filled with water when using the cylinder.

5.3.6.6 Keep all gas cylinders in their upright position and secured against falling during use.

5.3.6.7 Do not place cylinders below work where sparks or slag could fall on top of them, or protect them from these hazards.

5.3.6.8 Gas cylinders shall not be hoisted using a sling or electric magnet nor shall they be lifted by the valve protection cap.

5.3.6.9 Do not move cylinders by their valves or use them for any purpose for which they were not designed.

5.3.6.10 Never use cylinders as rollers or supports.

5.3.6.11 Do not drop cylinders or handle them roughly.

5.3.6.12 Never allow cylinders to come in contact with live wires, third rails, or ground wires from electrical equipment.

5.3.6.13 Regulators shall be removed and valve protection caps shall be put in place hand tight when cylinders are not in use or when they are being transported.

5.3.6.14 Keep oxygen cylinders and fittings away from oil or grease. Oil or grease may ignite violently in presence of oxygen under pressure. Oily or greasy substances must be kept away from cylinders, cylinders valves, couplings, regulators, hose, and apparatus. Do not handle on the same platform with oil or be placed in a position where or grease from overhead cranes or belts are likely to fall upon them.

5.3.6.15 A jet of oxygen shall never strike an oily surface, greasy clothes, or enter a fuel oil or storage tank that has contained flammable substances.

5.3.6.16 When a pressure-reducing regulator is attached, crack open the oxygen cylinder valve slightly at first to dislodge any trash that may be in the valve. Then turn the adjusting screw counterclockwise to relieve pressure on the diaphragm. Next attach the gauges and open the cylinder valve slowly. If the high pressure is suddenly released, it is liable to damage the regulator and its pressure gauges. Stand to one side of the regulator front (gauge face) when opening the cylinder valve. When the oxygen cylinder is in use, the valve shall be opened fully.

5.3.6.17 Never tamper with or attempt to repair oxygen cylinder valves.

5.3.6.18 If trouble is experienced, notify the supplier.

5.3.6.19 Serious injury may easily result if oxygen is used as substitute for compressed air. Never use oxygen:

a) In pneumatic tools

b) In oil pre-heating burners

c) To start internal combustion engines

d) To blow out pipelines

e) To dust off clothing or work area. The fabric can become saturated and burst into flames if touched off by an ignition source.

f) To create pressure

g) For ventilation

h) To supply breathing air equipment

5.3.6.20 Always stand acetylene cylinders with valve end up. Acetylene cylinders shall not be allowed to lie on their side sides while being used or when is storage.

5.3.6.21 Never tamper with fusible plugs. The fusible safety plugs with which all acetylene cylinders are provided act as safety releases when the cylinder is exposed to excessive temperatures. They melt at about the temperature of boiling water and release acetylene from the cylinder.

5.3.6.22 Always use special T-wrench or key for opening or closing the cylinder valve. Open fuel gases no more than one and one-half turns and leave the T-wrench or key in position ready for immediate use so that the acetylene can be quickly tuned off in case of emergency.

5.3.6.23 Do not use acetylene at operating pressures above 15 psi. This is the maximum working pressure permitted by regulations. As a gas, acetylene becomes unstable above 15 psi.

5.3.6.24 Do not empty an oxygen cylinder below 25 to 50 psi. If the oxygen cylinder is allowed to become completely empty, it will loose its positive pressure, and fuel gas may enter the cylinders, which can lead to an explosion.

5.3.6.25 Stand with the cylinder between yourself and the regulator (cylinder valve facing away) when opening the cylinder valve.

5.3.6.26 Purge hose lines individually before lighting the torch tip. This will ensure that no oxy-fuel gas mixture is present in the hoses, which could cause an explosion.

5.3.6.27 Ensure that the hose line check valves and flash arrestors are inspected routinely so they function as intended. Attaching them to the outlet side of the regulator opposite from the intended flow direction can achieve this. Back off the pressure adjusting screw on the regulator, open the cylinder valve, turn up the pressure to 14 psi, then apply a leak detector such as soap over the entire device including the inlet area. If the check valves or flashback arrestors are found to be leaking more than one bubble in 10 seconds, then they shall be

replaced.

5.3.6.28 Back off the pressure adjusting screw of the regulator to release spring force before opening the cylinder valve. This will protect the diaphragm and seating surface from damage.

5.3.6.29 Inspect the oxygen regulator and cylinder valve for contaminants before use.

5.3.7 Oxy-Fuel Torches and Hoses

5.3.7.1 Torches must be lit with a friction lighter or other approved device and not by matches, cigarette lighters, or from hot work.

5.3.7.2 As a minimum, flashback arrestors shall be connected between both oxygen and fuel hose connections at the torch. When using a rosebud for heating or a large cutting tip, it may be necessary to remove the flashback arrestor because of flow restrictions (check with manufacturer recommendations). This may lead to a dangerous situation of gas starvation at the tip.

5.3.7.3 If the torch is equipped with built-in flashback arrestors, then do not add an external flashback device. This may lead to dangerous situation of gas starvation at the tip.

5.3.7.4 Reverse flow check valves shall be installed to the outlet of both regulators.

5.3.7.5 Use only hoses and connections made especially for oxy-acetylene welding and cutting.

5.3.7.6 Examine hoses carefully at least once every shift for leaks, worn places, and loose connections.

5.3.7.7 Every time the cylinder valves are opened to pressurize the hoses, immediately close the cylinder valve and observe the high pressure gauge to see if you can detect a pressure loss. If a pressure loss is identified, then you must locate the source of the leak and make any necessary repairs.

5.3.7.8 Leaks in the hose at the nipple connection shall be repaired at once by cutting off the hose a few inches from the end and remaking the connection. Leaks at other locations shall be repaired by cutting off the bad section and inserting a hose coupling as a splice.

5.3.7.9 Never repair a hose with tape. When hoses are taped together for convenience

and to prevent tangling, not more than four out of 12 inches shall be covered by tape.

5.3.7.10 Do not use white lead, oil, grease, or other pipe fitting compounds for making joints.

5.3.7.11 Shall a flashback occur, immediately turn off the oxygen valve at the torch. If the hose is damaged, discard that length of hose and replace it.

5.3.7.12 The torch and hoses must be purged every time prior to lighting a torch. When replacing a near – empty cylinder with a full cylinder, be sure to purge both lines before lighting a torch. Regulators, torch, and hoses may contain mixed gases. Before lighting the torch, open the oxygen and preheat control valves on the torch. Adjust the regulator to the desired operating pressure then close the preheat oxygen control valve. Open the fuel valve on the torch and adjust to the desired range then depress the cutting oxygen lever to purge the cutting oxygen passage, close the fuel valve. Now the system is purged and ready to light.

5.3.7.13 To light the torch open the fuel valve first approximately 1/8 turn. Ignite the gas with a spark lighter. Be sure the spark lighter is away from the Tip and not obstructing the gas flow. Continue to increase the flame until it stops smoking. Next, slowly open the preheat oxygen control valve until the flame established a sharp inner cone. Depress the cutting lever. If the cutting oxygen is not straight, turn off the torch and clean the tip. To shut the torch down properly the oxygen is turned off first then the fuel gas.

5.3.7.14 Always protect hoses from damage or interference. Protect hoses from being trampled on or run over. Avoid tangles and kinks, and place hoses so they will not be tripped over. Connections might be pulled off or the cylinders and equipment might be pulled over by a sudden strong tug on the hose. Do not allow hoses to come in contact with oil or grease. These deteriorate the rubber and constitute a hazard with oxygen. Protect hoses from flying sparks, or other hot objects and open flames.

5.3.8 Welding/Cutting

5.3.8.1 Valves on fuel gas will not be opened more than 1-1/2 turns. If a special wrench is required for closing the valve, the wrench will be left in position on the stem at all times or until the task is completed and the caps are replaced.

5.3.8.2 Fuel gas hose and oxygen hoses will be easily distinguishable and will not be interchangeable.

5.3.8.3 Hoses and torches will be inspected before use, and any defective hose, regulator, regulator gauge or hand-piece will be removed from service.

5.3.8.4 The operator will conduct a pressure drop test on the gas cutting equipment before use each day.

5.3.8.5 Containers used to store fuel gas hoses that have been in use will be ventilated.

5.3.8.6 Torches will be lighted by friction lighters or other approved devices only. Cylinders, all hose apparatus, and connectors will be kept free of oil and grease, and not handled with oily or greasy hands or gloves.

5.3.8.7 Oxygen/fuel gas systems will be equipped with approved backflow prevention valves, flash arresters, and pressure relief devices.

5.3.8.8 Fuel gas/oxygen equipment will be disconnected from the source when left unattended, such as at lunch or at completion of the task. Fuel gas/oxygen equipment will not be left inside a confined space unattended.

5.3.8.9 All employees will use project approved, commercially manufactured personal protective equipment and clothing when performing or assisting in cutting and welding operations. i.e. (Oxy goggles with correct grade lens, electric welding shields fitted with correct grade lens and attached to their safety helmet, and gloves, aprons, spats etc as necessary).

5.3.8.10 Welding leads and equipment will be properly maintained and inspected before use. Exposed conductors to be withdrawn from use and repaired. Defective equipment will not be used and will be reported to supervision for repair or removal from site.

5.3.8.11 Arc welding and cutting operations will be shielded by noncombustible or flameproof screens, shields, or other safeguards for the protection of personnel or materials exposed to sparks, slag, falling objects, or the ultraviolet

(UV)/infrared (IR) radiation of the arc.

5.3.8.12 Pipelines containing flammable liquids or gases, or electrical cables will not be used as a ground.

5.3.8.13 The frame of all arc welding or cutting machines will be effectively grounded when the machine's power outlets are being employed as a power source. ELCB or GFCI device with trip load of no more than 30 milliamps will be fitted and fully operational.

5.3.8.14 If electrode holders are to be left unattended, the electrodes will be removed and the holder placed where it is protected from unintentional contact.

5.3.8.15 Electrode stubs are to be placed into waste container not dropped onto working surfaces.

5.3.8.16 Welding machines will be turned off when being moved or when the welder must leave his/her works for any length of time.

5.3.8.17 No welding or cutting will be done where flammable paints, compounds, or dust may create a hazard.

5.3.8.18 fire extinguisher with a 2A 30 lb (13.6 kg) Class A, B, C rating will be positioned within 3m of the work location during welding, cutting, soldering, etc.

5.3.8.19 If normal fire prevention methods are not sufficient to adequately ensure the prevention of fires, additional personnel will be added (fire watch) to guard against potential fires. Fire watches will be trained and will remain at the location a sufficient amount of time after work is stopped to ensure that no possibility of fire exists.

5.3.8.20 Tanks, vessels, drums, etc., which have contained flammable or toxic liquids will be made safe and the internal atmosphere tested for LEL (Lower Explosive Limit) before welding, cutting, or heating is undertaken on them. Safety & Toolbox talk with the supervisor will precede any such hot work activity. If a toxic material is involved, the operation will additionally be evaluated by the HSE.

5.3.8.21 Sufficient ventilation will be provided as needed to maintain welding fumes and smoke within permissible exposure limits. Where sufficient ventilation

cannot be achieved, alternative methods will be developed.

5.3.8.22 Where a preservative coating is present, the coating will be removed or alternative methods used for a sufficient distance in each direction to prevent appreciable heating of the coating.

5.3.8.23 A suitable, approved fire extinguisher will be ready for instant use in any location where welding is being performed.

5.3.8.24 Welders will wear approved eye and head protection. Persons assisting the welder will also wear protective glasses/lenses. Welders will wear a safety helmet while performing welding operations.

5.3.8.25 Electric welding equipment including cable shall meet the requirements of the International Electric Code.

5.3.8.26 Electric welding leads will be kept off the walking surface in an elevated position.

5.3.8.27 Welding leads or cords that cross a pathway or roadway will be protected from damage.

5.3.8.28 Grounding cable clamps shall be positioned as close to the site of the welding as possible (within 2m considered acceptable in most cases).

5.3.8.29 Welding leads with broken insulation will be taken out of service or repaired by the electrical department. Ground leads can be repaired with tape as long as the safe current carrying capacity is not compromised.

5.4 Fire Protection Equipment

5.4.1 Fire-fighting equipment (hose, nozzles, fire buckets, and fire extinguishers) will be available when the project begins.

5.4.2 Fire extinguishers will be provided and maintained at the following locations:

- For each 3,000 square feet (278.7 square meters) of a protected building and within 75 feet (22.9 m) of uninterrupted travel
- Within 50 feet (15.2 m) of where more than 5 gallons (18.9 L) of flammable or combustible liquids or 5 pounds (2.3 kg) of flammable gases are being used
- In open storage yards within 75 feet (22.9 m) of uninterrupted travel.

- At storage areas for flammable or combustible liquids
- At any fuel dispensing or service area
- On all motorized equipment
- At all locations where electric welding or oxy fuel gas equipment is in use.

5.4.3 Fire extinguishers will be conspicuously marked and clear access to each will be maintained.

5.4.4 Employees will be trained in the use of fire extinguishers.

5.4.5 Fire extinguishers will be periodically inspected, tested and maintained.

5.4.6 Each fire extinguisher will be replaced immediately after discharge with another fire extinguisher that is fully charged and of the proper size and type.

5.4.7 A water supply of sufficient volume and pressure will be made available.

5.4.8 If sprinkler systems are being installed, their installation will closely follow construction and they will be placed in service as soon as practical or as local/state building codes require.

5.4.9 Charged fire hoses will be made available during demolition operations involving combustible materials.

5.4.10 Smoking will be permitted only in designated areas. Smoking will be prohibited at or in the vicinity of operations which constitute a fire hazard. A sign reading “No Smoking” or “No Open Flame,” will be conspicuously posted.

5.4.11 Electrical wiring and equipment for light, heat, or power purposes will be installed in compliance with government requirements.

5.4.12 No temporary building will be erected where it will adversely affect any means of exit. Clearance will be maintained around lights and heating units to prevent ignition of combustible materials.

5.4.13 Temporary buildings, when located within another building or structure, will be of either noncombustible construction or of combustible construction having a fire resistance not less than 1 hour.

5.4.14 If a temporary building is not located inside another structure and is not employed for the storage, handling, or use of flammable or combustible liquids,

flammable gases, explosives, or blasting agents, or similar hazardous occupancies, then said building will be placed at a distance of not less than 10 feet (3 m) from another building or structure.

5.4.15 Groups of temporary buildings not exceeding 2,000 square feet (185.8 square meters) in aggregate for the purpose of this part are considered a single temporary building.

5.4.16 The CONTRACTOR project facilities will be kept free from accumulation of unnecessary combustible materials. Weeds and grass will be kept down, and a regular procedure will be established for the periodic cleanup of the entire area.

5.4.17 Only approved containers and portable tanks will be used for the storage and handling of flammable and combustible liquids. Approved metal safety can be employed for the handling and use of flammable liquids in quantities greater than 1 US gallon (3.8 L). This rule will not apply to those flammable liquid materials which are highly viscous (extremely hard to pour); such materials may be used and handled in their original shipping containers. For quantities of 1 US gallon (3.8 L) or less, only the original container or approved metal safety cans will be employed for storage, use, and handling.

5.4.18 Flammable or combustible liquids will not be stored in areas used for exits or stairways, or normally used for the safe passage of people.

5.4.19 Flammable liquids will be transferred from one container to another only when containers are electrically interconnected (bonded).

5.4.20 The dispensing units will be protected against collision damage.

5.5 Fire Fighting Training

Basic firefighting training will be provided by CONTRACTOR HSEM. The firefighting emergency drill will be conducted as per *Project Incident and Emergency Response Plan (F050-MNL-030)* and site safety requirements.

6 MITIGATION MEASURE

6.1 Develop a preventive maintenance program for process equipment and pipelines in order to avoid failures and implement program regularly;

6.2 Ensure the staff working to standard and strictly follow working procedures in order to prevent any incident;

6.3 Install leak detecting and alarming system in operating areas and tank farm;

6.4 Establish an emergency centre with 24 hours standby staff and firemen. This centre will be equipped with a communication system such as hot (emergency) line telephone, trunk radios, paging, inter-com, different alarm tones correspondence with each kind of situation, CCTV monitors those can view different areas of the complex, etc.

6.5 Install fire protection and firefighting system including but limited following items:

6.5.1 Gas detection system: gas detector and fire alarm devices will be installed in potential leakage area of toxic chemicals and flammable substances like large size valves, flanges, major rotating equipment and high temperature fluctuation area;

6.5.2 Fire water system: fire water pond and pumps will distribute fire water to all plants in the complex via fire water pipeline;

6.5.3 Water firefighting system in all plants: water hydrants, water monitors, fixed water spray system;

6.5.4 Foam firefighting system in tank farm area: foam monitors, foam chamber equipped at heavy hydrocarbon storage tanks;

6.5.5 Fire extinguishing system: portable fire extinguishers (foam, powder and CO2) in plants and buildings at appropriate locations;

6.5.6 Extinguishing system will be provided in some areas such as control rooms and substations; and

6.5.7 Fire alarm system (automatic fire detectors and manual fire call points) will be provided in required areas

6.6 All fire prevention and firefighting systems shall be routinely inspected and maintained the by responsible persons.

6.7 Establish a first-aid centre with 24 hours standby nurse. The first-aid centre must be equipped with sufficient first-aid equipment, first-aid kit and medicines.

6.8 To establish emergency plan and evacuation plan with a clear emergency procedure set up. The procedure will include explanation of steps and guidelines that everybody

has to follow such as below items;

6.9 Witness should first control the emergency situation or extinguish fire based on emergency activity plan and report to Boardman or shift supervisor or foreman of that unit immediately to request the support team from the emergency centre of the complex

6.10 The event shall be reported to the higher management level and emergency team shall be immediately formed according to the procedure set forth for providing support

6.11 When the emergency signal rings, all workers have to stop all activities to a safe condition and move to assembly point immediately

6.12 Assembly point shall be assigned for head counting and stand by for providing support

6.13 The workers who first witness the accident have to put on the necessary personal protective equipment and enter the incident area from upwind only

6.14 Limit the fire areas by utilizing the appropriate firefighting equipment

6.15 All firefighting technique has to be exercised routinely during normal situation

6.16 Coordination with outside organizations such as nearby plants, hospitals, outside fire brigade team and so on

6.17 Proper communication equipment of either station or mobile type will be provided in the plant such as hot (emergency) line telephones, trunk radios, paging, inter-com and different alarm tones correspondence with each kind of situation

APPENDIX DD FIRE PREVENTION PLAN

AHLONE 2

TYPHOON RESPONSE PLAN AND TYPHOON EVACUATION PLAN

PROJECT DOC. NO. F050-MNL-092

LNG POWER PLANT (AHLONE) PROJECT

TTCL JOB NO. F-050

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TTCL PUBLIC COMPANY LIMITED

Revision History Sheet

Rev.	Date	Description
0	October 21, 2019	For Approve
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CONTENTS

1. PURPOSE

To institute measures that will prevent accidents and minimize the effects of Typhoon. To establish a crisis preparedness program and delineate the roles and responsibility. To create an incident management structure that should provide comprehensive organizational framework designed for foreseeable types of emergencies.

2. SCOPE

This plan describes the typhoon response plan and evacuation plan for CONTRACTOR and their SUBCONTRACTORS, during construction and commissioning until Commercial Operating Date (COD) of the LNG POWER PLANT (AHLONE) PROJECT.

3. DEFINITION

"CONTRACTOR" means **TTCL PUBLIC COMPANY LIMITED (TTCL)** and **TTCL MYANMAR ENGINEERING AND CONSTRUCTION COMPANY LIMITED (TTMEC)** who perform the "Engineering Procurement and Construction (EPC) of the project.

"OWNER" means **TTCL POWER MYANMAR COMPANY LIMITED (TPMC)** who employs CONTRACTOR in connection with the "Engineering Procurement and Construction (EPC) of the project.

"SUBCONTRACTOR(S)" means the subcontractor(s) employed by CONTRACTOR or OWNER in connection with the construction of the project.

ERT meaning Emergency Response Team.

4. RESPONSIBILITY

4.1 CONTRACTOR Project Manager (PM)

The PM has the overall responsibility for this procedure and is responsible for supporting it and for ensuring that all entities at the jobsite actively participate, responsible for providing the personnel, facilities, and other resources necessary to effectively implement this procedure. The PM and management team will lead by example, modeling the behavior expected from all personnel performing work at the jobsite.

4.2 Construction Manager (CM)

The CM is responsible to conduct the construction execution in the safe practices. In conjunction with CONTRACTOR to ensure the safety and health of employees include environmental impact control in every aspect related to works.

4.3 CONTRACTOR HSE Manager

HSE manager in collaboration with PM & CM, is responsible for implementing and administering this procedure by;

(1) Function as an adjudicator on any issues from the implementation of this procedure

(2) Assist SUBCONTRACTOR to plan and coordinate the work to effectively implement the requirements of the procedure.

(3) Arrange typhoon response and evacuation training to CONTRACTOR employee and SUBCONTRACTOR's worker.

(4) Monitor weather forecast and alert key persons of incoming storm/typhoon

5. PROCEDURE

5.1 Pre-typhoon preparation

5.1.1 Confirm ERT attend typhoon response and evacuation training.

5.1.2 Remind and ensure CONTRACTOR employee and SUBCONTRACTOR's workers are good understood to typhoon response and evacuation procedure.

5.1.3 Check and ensure that the radio is good operation.

5.1.4 Spare the essential items (such as cable rope, padlock etc.) are ordered and are in stock for immediately use.

5.1.5 Ensure evacuate coordinators are assigned and understand their role especially CONTRACTOR representatives who will serve as evacuate coordinators.

5.1.6 Arrange a site walk down with area supervisors to find out preventive actions:

- Tower crane: check instruction in crane manual regarding storm and ensure the crane operator understanding,

- Mobile cranes: individual talk with crane operators, all booms shall be lower / shorten and find out safe location to place the crane during storm,
- Check electrical equipment and assign responsible person to isolate power supply to non-used equipment during storm,
- Check and provide emergency lighting at necessary point.

5.2 Emergency alerting & communication system

5.2.1 HSE manager on site determines the severity of the emergency situation and instructs the security officer to trigger the emergency alerting system.

5.3 During the Storm/Typhoon

5.3.1 Tune in the transistor radio to a nearby radio station for up to the minute storm reports. A batter operated radio is recommended.

5.3.2 Maintenance staff and ERT unit on standby.

5.3.3 Close all windows, skylights, shutters, doors, and other openings.

5.3.4 Remove all loose boards, ash cans and other items which might be easily blown about and cause damage during the storm/typhoon.

5.3.5 Tie down with heavy cable or ropes, all equipment that can be moved or blown by the wind.

5.3.6 Remove all unfastened equipment from the roof, if any.

5.3.7 Provide emergency supplies to key points where they can be distributed.

5.3.8 If practicable, move materials that might be damaged by water to safer places. Stocks or equipment near windows on windward side should be covered with tarpaulin or canvas if there is possibility that windows might break.

5.3.9 Check fire protection apparatus and emergency equipment. Also check electrically operated alarms and other safety devices.

5.3.10 If necessary, the electric power furnaces and boilers should be shut off.

5.3.11 Provide materials for quick, temporary repairs to protect equipment.

5.4 During Evacuation

5.4.1 Continually monitor local weather condition and liaise with evacuation unit leader as required.

5.4.2 Establish a time line plan.

5.4.3 Liaise directly with emergency controller.

5.4.4 If possible suggest evacuation to start and be completed during day light hours.

5.4.5 Ensure all worker are briefed about safety and expectations during evacuate.

5.4.6 Confirm that all CONTRACTOR representatives are notified and available to support their personnel.

5.5 After the Storm/Typhoon

5.5.1 Check structural damage and make necessary repairs. If welding or cutting is necessary, be sure all required precautions are taken to prevent fire.

5.5.2 Check the power-operated equipment and make sure that the motors are dried.

5.5.3 Check the fire protection equipment in the stores/offices and warehouse and make sure it operates properly. Check the water and fire pumps.

5.5.4 If the fire protection equipment is impaired, notify the concerned department and take immediate action to correct the impairment.

5.5.5 Check the stocks and contents in the building for water damage.

5.5.6 Start necessary salvage operations or drying out. Keep in mind that some materials, when damp, will spontaneously catch fire.

5.5.7 If the property or contents have been damaged, notify the insurance agent or insurance company immediately.

5.5.8 Reinforce security to prevent pilferage of company property.

5.5.9 Re-inspect scaffolding / working platform for safe use.

5.5.10 Re-inspect electrical equipment prior to energize the systems.

APPENDIX EE TYPHOON RESPONSE PLAN AND TYPHOON EVACUATION PLAN

AHLONE 2

WORKER'S ACCOMMODATION MANAGEMENT PLAN

PROJECT DOC. NO. F050-MNL-093

LNG POWER PLANT (AHLONE) PROJECT

TTCL JOB NO. F-050

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CONTENTS

Page

1. PURPOSE

This procedure includes specifications for the design and management of camp infrastructure and sleeping accommodation to which CONTRACTOR and SUBCONTRACTORS will comply with when housing their workforce;

Ensure that the construction workers of the project have accommodation that is healthy, clean and safe through the entire construction period of the project; and

Ensure that workers are housed in a way that minimizes potentially harmful impacts on host communities and the surrounding environment and optimizes local residents' opportunities to participate in benefits.

2. SCOPE

This plan describes the worker's accommodation management for CONTRACTOR and their SUBCONTRACTORS, during construction and commissioning until Commercial Operating Date (COD) of the LNG POWER PLANT (AHLONE) PROJECT.

3. DEFINITION

"CONTRACTOR" means **TTCL PUBLIC COMPANY LIMITED (TTCL)** and **TTCL MYANMAR ENGINEERING AND CONSTRUCTION COMPANY LIMITED (TTMEC)** who perform the "Engineering Procurement and Construction (EPC) of the project.

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4. RESPONSIBILITY

4.1 CONTRACTOR Project Manager (PM)

The PM has the overall responsibility for this procedure and is responsible for supporting it and for ensuring that all entities at the jobsite actively participate, responsible for providing the personnel, facilities, and other resources necessary to effectively implement this

procedure. The PM and management team will lead by example, modeling the behavior expected from all personnel performing work at the jobsite.

4.2 CONTRACTOR Construction Manager (CM)

The CM is responsible to conduct the construction execution in the safe practices. In conjunction with CONTRACTOR safety manager to ensure the safety and health of employees include environmental impact control in every aspect related to works.

4.3 Camp Boss

Camp Boss will:

(1) Overseeing all staff working within the camps, including catering personnel. They will have overall accountability for food hygiene and housekeeping standards.

(2) Develop a routine internal audit protocol covering all aspects for camp management and assist in any internal and other external audits that are conducted. Results of all internal audits will be recorded on a monthly basis.

(3) Ensure that all persons employed within the camp are suitably qualified, trained periodically and capable of carrying out the duties for which they are employed.

(4) Ensure that workers' accommodation is in compliance with IFC standard. Checklist of IFC standard regulation (ATTACHMENT 1) shall be inspected at least once per 3 months.

4.4 SUBCONTRACTOR Construction Manager

SUBCONTRACTOR construction manager has the responsibility for compliance with this procedure and shall provide the personnel, facilities, and other resources necessary to effectively implement, administer and enforce this procedure. Ensure that workers' accommodation is in compliance with IFC standard. Checklist of IFC standard regulation (ATTACHMENT 1) shall be inspected at least once per 3 months.

5. PROCEDURE

This procedure shall be read in conjunction with the IFC Guidance on workers' accommodation, which provides further information of specific aspect of the requirements specified in this document.

5.1 LOCATION

When establishing the location for workers accommodation the following issues must be taken into consideration:

- There should be sufficient access for vehicles to enable workers to be transported to and from site within the minimum time possible.
- Bus services should be considered to transport workers to the work sites each day. Where workers use their own cars or bicycles for travel to and from the worksite, adequate parking will be provided at each construction site and accommodation camp.
- The site should not be exposed to potential flooding or landslips.
- There should be no stagnant water or potential for the pooling of water therefore reducing the possibility of vector disease transmission.
- Consideration should be given to the prevailing wind direction to reduce the potential for noise, dust and other emissions from the construction site or support facilities if necessary.
- Wherever possible, sleeping accommodation should be located away from main highways for through roads to reduce road noise.
- The site should be situated as far away from other residential areas as feasible and be sited with consideration of social impacts.

5.2 ELECTRICAL

With regards to electrical safety:

- All electrical circuits and equipment should be earthed and fitted with residual current device or similar earth protective devices to reduce the possibility of electrocution.
- A quarterly inspection should be carried out on all electrical fitting installed in workers accommodation to ensure their continued integrity and serviceability.
- No additional heating or cooking apparatus should be permitted in sleeping accommodation or recreational areas. This does not apply to equipment authorized by camp management as part of the camp specifications.

5.3 FIRE

With regards to fire safety:

- All accommodation should be provided with adequate means of escape for persons sleeping in the case of a fire. A place of safety on fire prevention and firefighting is defined as follows:
  - A protected stairway, which leads directly to open air;
  - A fully separate compartment within building which leads directly to open air; or
  - The nearest available exit to open air.
- All buildings should be fitted with a fire alarm system, which incorporates fire detection, and emergency lighting system.
- Emergency lighting should be provided in all sleeping areas, escape routes, provide illumination for exit route signs/doors and muster areas outside the buildings.
- Emergency lighting should have a battery backup supply capable of maintaining full illumination for two hours if mains electrical supply fails.
- Fire alarm call points should be provided on all final exit doors from buildings.
- Fire extinguishers will be provided by all exit doors from buildings and adjacent to any specific areas of high risk. The type of extinguisher should be appropriate for the type of risk it is protecting. Consideration should be given for the provision of fixed fire protection system in areas such as kitchens, cooking ranges and other areas.
- Routine fire evacuation drill and exercise for operation of extinguisher should be undertaken in conjunction with the testing of equipment and alarms. All tests and exercises should be recorded and reported to the HSE managers yearly as basis.

5.4 CONSTRUCTION AND MATERIALS

With regards to construction and the use of construction materials:

- The design and construction of all buildings must take into consider local geological and climatic conditions, being able to withstand wind, rain, landslips or earthquakes, as appropriate.
- All accommodation should be provided with adequate ventilation and light.
- Where necessary, adequate air conditioning may be provided to provide safe and healthy conditions for occupants.
- All flooring should be easily cleanable.

- Adequate lighting should be provided in all building plus all external walkways and common circulation routes.
- Construction must take into consideration the regeneration of the site upon completion of the contract together with the removal of buildings and infrastructure as required.

5.5 WASTE MATERIALS DISPOSAL

With regards to disposal of waste materials:

- Approved waste management plans will be applied in full for all camps and its component facilities.
- Waste types and amounts need to be identified and a detailed plan for the collection and recycling of rubbish and waste materials must be developed. The plan must cover the route collection of waste from all areas of the camp to ensure that waste materials are not allowed to accumulate.
- The plans must have due regard to the collection of organic and other waste from kitchens and food preparation areas to ensure that there is no possibility of rats; flies or other pests are drawn to such areas.
- The plans must have due regard for the recycling of as much waste as practical, including waste stream segregation and composting of organic waste. All waste that cannot be recycled waste must be disposed of in a responsible manner.

5.6 WATER AND WASTEWATER FACILITIES

With regards to the provision of water and disposal of wastewater:

- All water supplies should meet as a minimum the standards specified by the World Health Organization drinking-water quality, fourth edition 2011.
- Wastewater treatment and discharge must meet the requirements of the Project‘s Environmental Control and Management Plan (F050-MNL-024).
- Wastewater generated at the worker accommodation will be treated to achieve the required standards prior to effluents discharge. If wastewater discharge permits are required, CONTRACTOR or SUBCONTRACTOR will obtain the necessary permits from the relevant authorities.

5.7 PEST CONTROL

With regards to pest control:

- CONTRACTOR must establish plans for the control of rats, mice, snakes and mosquito. Nominated persons should be responsible for the controlling of all pests and

ensuring they do not congregate around bins and other areas where waste can accumulate.

- Consideration should be given to the development of a mosquito eradication program by the use of fogging, use of pesticides and removal of stagnant water around camps to eradicate insect breeding areas. Sprayed bed nets may be used.

5.8 ROOMS AND LIVING FACILITIES

Configuration of rooms and facilities will be at the discretion of CONTRACTOR and SUBCONTRACTOR. However, the following criteria will be complied with irrespective of room configuration:

- Every attempt should be made to minimize the use of dormitories; the preference should be for single or twin room where possible.
- Any dormitory design should maximize the degree of privacy of occupants by the use of screens the placing of wardrobes and other furniture.
- Rooms or dormitories should be single sex occupancy. Exception will be permitted for married couples to stay in the same room.
- Each person should have a minimum personal space of 10-12.5m3 or 4-5.5m2 floor area (IFC Workers' Accommodation: Processes and Standards, 2009).
- Sleeping accommodation should have a minimum ceiling height of 2.1m.
- There should be a minimum space of 1m between beds.
- The use of bunk beds are not advisable but where necessary there should be a minimum space between top and lower bunk of 0.7 m-1.10 m. Triple bunks are not permitted.
- Where shared accommodation is necessary, ideally rooms should accommodate 2-8 persons, and never more than 8 people. (In that case the space shall not be less than 3 m2 /person, assuming a height of 2.4 m).
- Hammocks or sleeping mats might be used instead of beds where this is preferred by the occupants.
- Windows should be lockable and fitted with fly screens.
- Sanitary facilities should possible be located close to the sleeping accommodation and shall be segregated for male and female.
- A program must be developed to provide adequate routine and preventative maintenance of buildings, fixtures and fittings.
- A suitable daily cleaning schedule should be implemented and recorded for all buildings to ensure that all areas remain clean, tidy and clear of rubbish or other waste. This

cleaning should be scheduled so it does not interfere with persons sleeping on routine shift patterns and to minimize contact between cleaning staff and workers.

- Bedding should be changed on a regular basis and be part of the routine cleaning program.

5.9 SANITATION AND TOILET FACILITIES

With regards to sanitation and toilet facilities:

- Separate sanitation, toilet and shower facilities will be developed for male and female workers.
- All toilets, shower/bath area and washing facilities should be designed to be easily cleanable with non-slip wipe clean flooring.
- Adequate facility should be provided for privacy, screens and doors should be full height and lockable.
- The number of facilities according to IFC Workers' Accommodation: Processes and Standards, 2009 provided should be as follows:
- 1 toilet to 15 persons (per gender) and should be located easily accessible, approximately range 30-60 m from room/dormitories;
- 1 urinal to 15 persons;
- 1 hand wash basin to 6 to 15 persons and should consist of a tap, soap; and
- 1 shower/bathroom to 6 to 15 persons.
- Shower and bathrooms should be provided with adequate water supply.
- Shower/bath areas should be provided at a convenient distance from sleeping accommodation and must provide privacy for workers who are bathing.
- The SUBCONTRACTOR will develop a water supply program for the provision of drinking water for camp occupants and cooking. The program should include requirements for delivery, storage and testing water quality.
- Wastewater treatment and disposal shall meet the requirements specified in HSSE Plan, as well as the dispositions in Environmental Control and Management Plan (F050-MNL-024). The wastewater treatment facilities have not been defined at this stage but they will be appropriate to the size and expected life of the camp. SUBCONTRACTOR should propose arrangement when submitting this procedure. CONTRACTOR will determine whether wastewater will be stored or processed by a third party in line with Myanmar regulations and in accordance with IFC Guidance on Workers' Accommodation.

5.10 CANTEEN AND COOKING FACILITIES

With regards to the provision of canteen, cooking facilities:

- No cooking will be permitted in sleeping areas.
- Kitchens, food preparation areas and laundry must be designed to be easily cleanable with non-slip wipe clean flooring. Worktops should be easily wiped clean with minimum joints and gaps.
- Ceiling of food preparation areas should be smooth, fire resistant, and lit coloured, and its wall joint to be covered.
- Site canteens should provide a minimum of 1.0 – 1.5 m^2 floor area per person.
- Hand basins with soap, and running clean water will be provided to enable workers to wash their hands prior to eating.
- Kitchen equipment and cookers should possibly be freestanding to enable them to be moved for cleaning.
- All floor, wall and ceiling should have easy clean surfaces.
- Adequate waste disposal facilities and bins should be provided in kitchen and dining areas for the containment of waste.
- Facilities should be in place for the removal of waste in sealed containers to a dedicated waste storage area located away from the building. Waste should be collected on a regular basis; no accumulation of waste should be permitted in kitchen areas.

5.11 LEISURE AND SOCIAL FACILITIES

With regards to the provision of leisure and social facilities:

- Sufficient social/leisure rest faculties for all persons on the camp, should be provided, which should include radio, TV and video faculties and where possible internet access.
- Recreation facilities should be provided, which could include exercise equipment, sports ground, library and/or educational facilities.
- Separate areas will be designated for leisure/socializing where tobacco (and if applicable) alcohol is permitted, and those areas where alcohol is not permitted.

5.12 SITE MANAGEMENT

Camp boss will prepare a written management policy for the accommodation site, which includes but not limited to:

- Accommodation criteria.
- Health and safety policy for occupants.
- HIV/AIDS, Sexually Transmitted Infections (STIs), and other communicable diseases prevention policy including contraception guidance.
- Traffic management.
- Training and orientation.
- Medical care standards.
- Food hygiene standards.
- Visitor policy.
- Entrance and exit policy and protocols.
- Alcohol and drug policy.
- Security.
- Fire and evacuation.
- Camp rules and regulations, disciplinary procedures and sanctions.

Camp boss shall employ a suitably qualified and experienced camp boss who will have overall responsibility and authority to manage all aspects of the camps.

5.13 SECURITY

CONTRACTOR and SUBCONTRACTORS will develop a security policy, which takes appropriate measures to protect camp staff and workers against theft and attack. The policy will be managed by a qualified individual supported by team of properly trained security specialists. The security policy must align with the overall of security plan, emergency response plan and worker training management plan of the project.

The policy will also address contingences for the impact that the camp may have upon the neighboring communities with regard to security and possible civil disturbance as well as other security risks that are properly managed.

The policy shall provide a protocol for the employment of security staff, which includes:

- Numbers of staff required.
- Employment policy for security staff including background checks and suitability for employment.

- Training requirements for staff to include clear requirements on duties and responsibilities, use of force and violence and the importance of respecting workers and community human rights.

5.14 MEDICAL

CONTRACTOR and SUBCONTRACTORS shall ensure that there are sufficient medical contingencies available to meet all foreseeable emergencies; these shall be provided by the internal of CONTRACTOR and SUBCONTRACTORS where external project or government support is not available.

Medical provisions shall include as a minimum:

- A number of first aid kits adequate to the number of residents are available.
- First aid kits are adequately stocked. Where possible a 24/7 first aid service/facility is available.
- An adequate number of staff/workers are trained to provide first aid.
- Where possible and depending on the medical infrastructures existing in the community, other medical facilities are provided (nurse rooms, minor surgery).

CONTRACTOR and SUBCONTRACTORS will ensure that there are adequate numbers of staff and worker are trained to provide first aid on site who are trained in first aid and first aid kits are immediately available in all areas of the site. The provision of the required number of trained first aiders shall take into consideration persons being unavailable due to shift patterns, holidays or illness.

CONTRACTOR and SUBCONTRACTORS shall provide a first aid kit in every occupied building plus one additional for kitchens and food preparation areas. These kits must be inspected on a regular basis for the replacing of used items; the camp boss shall keep records of all such inspections.

5.15 WORKERS'RIGHTS AND CAMP RULES AND REGULATIONS

Camp rules will be prepared for each camp: This responsibility falls to:

- CONTRACTOR for the CONTRACTOR camps.
- The SUBCONTRACTORS (with oversight by CONTRACTOR) for SUBCONTRACTOR camps; and,

The completion of camp rules are done by the project. CONTRACTOR and SUBCONTRACTORS will be responsible for communicating these rules to all workers upon their arrival on site and reinforcing them with ongoing communications strategies.

All grievances shall be recorded in the grievance register even if grievance is resolved, so that the project is aware of the level and types of unresolved grievances and can intervene to facilitate resolution.

Any site rules must take into consideration and address the following issues:

- An explanation on how accommodation is allocated, this process shall be non-discriminatory, with the exception that mixed accommodation will not be allowed and, to the extent possible male and female employees accommodation will be separate.
- Wherever possible, workers shall have 24/7 access to and from the site, any deviation from this due to security or other issues must be fully justified.
- Withholding an individual's ID papers is prohibited.
- Workers' gender, religious, cultural and social backgrounds shall be respected particularly with respect to religious holidays and observances. Separate leisure/socializing areas may be designated for workers of difference genders, religious, cultural or social backgrounds as required considering the results of the influx assessment.
- Copies of rules and regulations shall be provided in writing (in Burmese and in any other major languages that are required (e.g., Thai, English (for workforce and/or lenders if required)) and fully explained to persons of different languages and cultural backgrounds. Rules and regulations shall be provided in a form comprehensible to the least educated workers.
- Encouragement shall be given to the provision of a workers committee or trade union to represent camp personnel. Any committee or trade union must be convened within the requirement of governmental codes or laws.
- Where possible visitor access to the camp should be permitted. A separate and safe area shall be available for families.
- Any decision regarding the prohibition of tobacco, alcohol or other restrictions must be clearly communicated to all camp occupants and proper procedures put in place to ensure compliance. If smoking and alcohol use are permitted, designated areas should be assigned for these activities in ways that guarantee that non-smokers and non-drinkers are not negatively impacted by these activities. There should be clear limits on acceptable amounts to drink; drug use shall not be permitted.

6. ATTACHMENT

ATTACHMENT 1 CHECKLIST ON WORKERS' ACCOMMODATION

ATTACHMENT 1 : CHECKLIST ON WORKERS' ACCOMMODATION

Date of Inspection:_____ Company:_____
Inspected by:_____ Position:_____

General regulatory framework	Y	N	N/A	Remarks
Have the internation/national/local regulatory frameworks been reviewed?				
Are mendatory provisions on workers' accommodation identified?				
Assessing the need for workers' accommodation				
Availability of the workforce	Y	N	N/A	Remarks
Has there been an assessment of workers' availability in the neighbouring communities?				
Has there been an assessment of the skills and competencies of the loval workforce and how do those skills and competencies fit the project's need?				
Has there been an assessment of the possibility of training a local workforce in order to fulfil the project's needs?				
Availability of Housing	Y	N	N/A	Remarks
Has there been a comprehensive assessment of the different type of housing available in the surrounding communities prior to building any workers' accommodation?				
For a larger project: is that assessment included in the Environmental and Social Impact Assessment?				
Has there been an assessment of the impact on the communities of using existing housing opportunities?				
Have measures to mitigate adverse impacts on the local housing market been identified and included in the Environmental and Social Action Plan (ESAP) or other relevant action plan?				
Assessing Impacts of workers' accommodation on communities	Y	N	N/A	Remarks
Has a community impact assessment been carried out as part of the Environmental and Social Assessment of the overall project with a view to mitigate the negative impacts of the workers' accommodation on the surrounding communities and to enhance the positive ones?				
Have the potential health and safety impacts and consequences of land acquisition and involuntary resettlement occurring during the construction phase of the workers' accommodation been includeed in the assessment?				
Have the impacts of workers' accommodation on community infrastructures, services and facilities been included in the assessment?				
Have the impacts on local community's businesses and local employment been included in the assessment?				

ATTACHMENT 1 : CHECKLIST ON WORKERS' ACCOMMODATION

Date of Inspection:_____ Company:_____
Inspected by:_____ Position:_____

Have general impacts of workers' accommodation on communities' health, (notably the imcreased risk of road accidents and of communicable diseases), and community social cohesion been included in the assessment?				
Does the assessment include appropriate mitigation measures to address any adverse impacts identified?				
Types of workers' accommodation	Y	N	N/A	Remarks
Has consideration been given to provision of family accommodation?				
Are individual accommodations comprising bedrooms, sanitary and cooking facilities provided as part of the family accommodation?				
Are adequate nursery/school facilities provided?				
Is special attention paid to providing adequate safety for children?				
Standards for workers' accommodation				
National/local standards	Y	N	N/A	Remarks
Have the relevant national/local regulations been identified and implemented?				
General living facilities	Y	N	N/A	Remarks
Is the location of the facilities designed to avoid flooding or other natural hazards?				
Are the living facilities located within a reasonable distance from the worksite?				
Is transport provided to worksite safe and free?				
Are the living facilities built using adequate materials, kept in good repair and kept clean and free from rubbish and other refuse?				
Drainage	Y	N	N/A	Remarks
Is the site adequately drained?				
Heating, air conditioning, ventilation and light	Y	N	N/A	Remarks
Depending on climate are living facilities procided with adequate heating, ventilation, air conditioning and light systems including emergency lighting?				
Water	Y	N	N/A	Remarks
Do workers have easy access to a supply of clean/portable water in adequate quantities?				
Does the quality of the water comply with national/local requirements or WHO standard?				
Are tanks used for the storage of drinking water constructed and covered to prevent water stored therein from becoming polluted or contaminated?				
Is the quality of the drinking water regular monitored?				
Wastewater and solid waste	Y	N	N/A	Remarks

ATTACHMENT 1 : CHECKLIST ON WORKERS' ACCOMMODATION

Date of Inspection:_____ Company:_____
Inspected by:_____ Position:_____

Are wastewater, sewage, food and any other waste materials adequately discharged in compliance with local or World Bank standards and without causing any significant impacts on camp residents, the environment or surrounding communities?				
Are specific containers for rubbish collection provided and emptied on a regular basis?				
Are pest extermination, vector control are disinfection undertaken throughout the living facilities?				
Room/dormitories facilities	Y	N	N/A	Remarks
Are the room/dormitories kept in good condition?				
Are the room/dormitories aired and cleaned at regular intervals?				
Are the room/dormitories built with easily cleanable flooring material?				
Are the room/dormitories and sanitary facilities located in the same building?				
Are residents provided with enough space?				
Is the ceiling heigh high enough				
Is the number of workers sharing the same room/dormitory minimised?				
Are the doors and windows lockable and provided with mosquito screens when necessary?				
Are mobile partitions or curtains provided?				
Is suitable furniture such as table, chair, mirror, bedside light provided for every workers?				
Are separate sleeping areas provided for men and women?				
Bed arrangement and storage facilities	Y	N	N/A	Remarks
Is there a separate bed provided for every worker?				
Is the practive of "hot-bedding" prohibited?				
Is there a minimum space of 1 metre between beds?				
Is the use of double deck bunks minimised?				
When double deck bunks are in use, is there enough clear space between the lower and upper bunk of the bed?				
Are triple deck bunks prohibited?				
Are workers provided with comfortable mattresses, pillows and clean bed linens?				
Are the bed linen washed frequently and applied with adequate repellents and disinfectants (where conditions warrant)?				
Are adequate facilities for the storage of personal belongings provided?				
Are there separate storages for work cloths and PPE and depending on condition, drying/airing areas?				

ATTACHMENT 1 : CHECKLIST ON WORKERS' ACCOMMODATION

Date of Inspection:_____ Company:_____
Inspected by:_____ Position:_____

Sanitary and toilet facilities	Y	N	N/A	Remarks
Are sanitary and toilet facilites constructed from materials that are esily cleanable?				
Are sanitary and toilet cleaned frequently and kept in working condition?				
Are toilets, showers/bathrooms and other sanitary facilities designed to provide workers with adequate privacy including ceiling to floor partitions and lockable doors?				
Are separate sanitary and toilet facilities provided for men and women?				
Toilet facilities	Y	N	N/A	Remarks
Is there an adequate number of toilets and urinals?				
Are toilet facilities conveniently located and easily accessible?				
Showers/Bathrooms and other sanitary facilities	Y	N	N/A	Remarks
Is the shower flooring made of anti-slip hard washable materials?				
Is there an adequate number of hand wash basins and showers/bathrooms facilities provided?				
Are the sanitary facilities conveniently located?				
Are shower facilities provided with an adequate supply of cold and hot running water?				
Canteen, cooking and laundry facilities	Y	N	N/A	Remarks
Are conteen and cooking facilities built with adequate and easy to clean materials?				
Are the canteen and cooking facilities kept in clean and sanitary condition?				
If workers cook their own meals, is kitchen space provided separately from the sleeping areas?				
Laundry facilities	Y	N	N/A	Remarks
Are adequate facilities for washing and drying clothes provided?				
Canteen and cooking facilities	Y	N	N/A	Remarks
Are workers provided with enough space in the canteen?				
Are canteens adequately furnished?				
Are kitchen provided with the facilities to maintain adequate personal hygiene?				
Are places for food preparation adequately ventiated and equipped?				
Are kitchen floor, ceiling and wall surfaces adjacent to or above food preparation and cooking areas built in non-absorbent, durable, non-toxic, easily cleanable materials?				

ATTACHMENT 1 : CHECKLIST ON WORKERS' ACCOMMODATION

Date of Inspection:_____ Company:_____
Inspected by:_____ Position:_____

Are wall surfaces adjacent to cooking areas made of fire-resistant materials and food preparation tables equipped with a smooth, durable, non-corrosive, non-toxic, washable surface?				
Are adequate facilities for cleaning, disinfecting and storage of cooking utensils and equipment provided?				
Are there adequate sealable containers to deposit food waste and other refuse? Is refuse frequently removed from the kitchen to avoid accumulation?				
Standards for nutrition and food safety?	Y	N	N/A	Remarks
Is there a special sanitary provess such as the WHO "5 keys to safer food" implemented in relation to food" implemented in relation to food safety?				
Does the food provided contain appropriate nutritional value?				
Does the food provided take into account workers' religious/cultural backgrounds?				
Medical facilities	Y	N	N/A	Remarks
Are first aid kits provided in adequate numbers?				
Are first aid kits adequately stocked?				
Is there an adequate number of staff/workers trained to provided first aid?				
Are there are other medical facilities/services provided on site? If not, why?				
Leisure, social and telecommunications facilites	Y	N	N/A	Remarks
Are basic social collective spaces and adequate recreational areas provided to workers?				
Are workers provided with dedicated places for religious observance?				
Can workers access a telephone at an affordable/public price?				
Are workers provided with access to internet facilities?				
Managing workers' accommodation				
Management and staff	Y	N	N/A	Remarks
Are there carefully designed worker camp management plans and policies especially in the field of health and safety (including emergency responses), security, workers' rights and relationships with the communities?				
Where contractors are used, have they clear contractual management responsbilities and duty to report?				

ATTACHMENT 1 : CHECKLIST ON WORKERS' ACCOMMODATION

Date of Inspection:_____ Company:_____
Inspected by:_____ Position:_____

Does the person appointed to manage the accommodation have the required background, competency and experience to conduct his mission and is he/she provided with the adequest responsibility and authority to do so?				
Is there enough staff to ensure the adequate implementation of housing standards (cleaning, cooking and security in particular)?				
Are staff members recruted from surrounding communities?				
have the staff received basic health and safety training?				
Are the persons in charge of the kitchen particularly trained in nutrition and food handling and adequately supervised?				
Charging fees for accommodation and services	Y	N	N/A	Remarks
Are the renting arrangements fair and transparent?				
Are workers provided with adequate information about parment made?				
Where apropriate, are renting arrangements and regulations clearly included in workers' employment contracts?				
Are food and other services provided for free or reasonably priced, that is, not above the local market price?				
Is the payment in kind for accommodation and survices prohibited?				
Health and Safety on site	Y	N	N/A	Remarks
Have health and safety management plans including electrical, mechanical, structural and food safety been designed and implemented?				
Has the accommodation manager a duty to report to the health authority specific deseases, food poisoning or casualties?				
Is there an adequate number of staff/workers trained in providing first aid?				
Has a specific and adequate fire safety management plan been designed and implement?				
is guidance on alcohol, drug and HIV/AIDS and other health risk-related activities provided to workers?				
Are contraception measures (condoms in particular) and mosquito nets (where relevant) provided to workers?				
Do worker have an easy access to medical facilities and medical staff, including female doctors/nurses where appropriate?				

ATTACHMENT 1 : CHECKLIST ON WORKERS' ACCOMMODATION

Date of Inspection:_____ Company:_____
Inspected by:_____ Position:_____

Have emergency plans on health and fire safety been prepared?				
Security on workers' accommodation	Y	N	N/A	Remarks
Has a security plan including clear measures to protect workers against theft and attack been designed and implemented?				
Has a security plan including clear provisions on the use of force been designed and implemented?				
Have the backgrounds of security staff been checked for previous crimes or abuses?				
Has the recruitment of security staff from both genders been considered?				
Have security staff received clear instruction about their duty and respobsibility?				
Have security staff been adequately trained in dealing with domestic violence and the use of force?				
Are body searches only performed in exceptional cricumstances by specifically trained security staff of both genders?				
Do security staff have a good understanding about the importance of respecting workers' rights and the rights of the surrounding communities and adopt appropriate conduct?				
Do workers and communites have specific means to raise concerns about security arrangements and staff?				
Workers' rights, rules and regulatins on workers' accommodation	Y	N	N/A	Remarks
Are limitations on workers' freedom of movement limited and justified?				
Is an adequate transport system to the surrounding communities provided?				
Is the practice of withholding workers' ID papers prohibited?				
Is freedom of association expressly respected?				
Are workers' religious, cultural and social backgrounds respected?				
Are workers made aware of their rights and obligations and provided with a copy of the accommodation' internal rules, procedures and sanction mechanisms in a language or through a media they understand?				
Are house regulations non discriminatory, fair and reasonable?				
Are regulations on alcohol, tobacco and third parties' access to the camp clear and communicated to workers?				

ATTACHMENT 1 : CHECKLIST ON WORKERS' ACCOMMODATION

Date of Inspection:_____ Company:_____
Inspected by:_____ Position:_____

Is a fair and non-discriminatory procedure to implement disciplinary procedures, including the right for workers to defend themselves, set up?				
Consultation and grievance mechanisms	Y	N	N/A	Remarks
Have mechanisms for workers' consultation been designed and implemented?				
Are workers provided with processes and mechanisms to articulate their grievances in accordance with PS2/PR2?				
Have workers subjected to disciplinary proceedings arising from conduct in the accommodation had access to a fair and transparent hearing with the possibility to appral the decision?				
Are there fair conflict resolution mechanisms in place?				
In cases where serious offences occur, are there mechanisms to ensure full cooperation with police authorities?				
Management of community relations	Y	N	N/A	Remarks
Have community relation management plans addressing issues around community development, community needs, community health and safety and community social and cultural cohesion been designed and implemented?				
Do community relation management plans include the setting up of liaison mechanisms to allow a constant exchange of information and consultation of the surrounding communities?				
Is there a senior manager in charge of implementing the community relation management plan?				
Is there a senior manager in chart of liaising with the surrounding communities?				
Are the impacts generated by workers' accommodation periodically reviewed, mitigated or enhanced?				
Are community representatives provided with easy means to voice their opinions and lodge complaints?				
Is there a transparent and efficient process for dealing with community grievances, in accordance with PS1/PR10?				

APPENDIX FF WORKER'S ACCOMMODATION MANAGEMENT PLAN

AHLONE 2

CULTURAL HERITAGE CHANCE FIND PROCEDURE

PROJECT DOC. NO. F050-MNL-094

LNG POWER PLANT (AHLONE) PROJECT

TTCL JOB NO. F-050

Total (Including this Page): 7 sheets

1	23-Sep-20	For Approve	Kamonphat Y.	Phakin P.	Suchet W.	Peerapat. T
0	28 Oct 19	For Approve	Kamonphat Y.	Nimit A./ Phakin P.	Anuchit P.	Manasphong P.
REV.	DATE	DESCRIPTION	MADE	CHECKED	APPROVED	AUTH'D

For Project Use only

Originator	Distribution	PW	PR	MA	ME	PP	EE	IN	CV	QC	PC	Proj	Site	Owner	Total
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บริษัท ทีทีซีแอล จำกัด (มหาชน)
TTCL PUBLIC COMPANY LIMITED

Revision History Sheet

Rev.	Date	Description
0	October 28, 2019	For Approve
1	September 23, 2020	For Approve

CONTENTS

1. PURPOSE

The purpose of this document is to provide an overarching chance find procedure to be applied for the project. Specific objectives include:

- Detail the procedure will be followed when cultural resources are discovered,
- Detail the procedure will be followed when unmarked graves are discovered.

2. SCOPE

This plan describes the cultural heritage chance find for CONTRACTOR and their SUBCONTRACTORS, during construction and commissioning until commercial operation date (COD) of the LNG POWER PLANT (AHLONE) PROJECT.

3. DEFINITION

"Archaeological Heritage" means objects accidentally discovered during archaeological exploration and excavation that are valued in terms of historical, cultural or scientific aspects. It is considered tangible cultural heritage located on the earth's surface, beneath the surface or underwater.

"CONTRACTOR" means **TTCL PUBLIC COMPANY LIMITED (TTCL)** and **TTCL MYANMAR ENGINEERING AND CONSTRUCTION COMPANY LIMITED (TTMEC)** who perform the "Engineering Procurement and Construction (EPC) of the project.

"OWNER" means **TTCL POWER MYANMAR COMPANY LIMITED (TPMC)** who employs CONTRACTOR in connection with the "Engineering Procurement and Construction (EPC) of the project.

"SUBCONTRACTOR(S)" means the subcontractor(s) employed by CONTRACTOR or OWNER in connection with the construction of the project.

"UXO (Unexploded ordnance)" means explosive weapons (bombs, bullets, shells, grenades, land mines, naval mines, etc.) that did not explode when they were employed and still pose a risk of detonation, potentially many decades after they were used or discarded.

4. RESPONSIBILITY

4.1 CONTRACTOR Project Manager (PM)

The PM has the overall responsibility for this procedure and is responsible for supporting it and for ensuring that all entities at the jobsite actively participate, responsible for providing the personnel, facilities, and other resources necessary to effectively implement this procedure. The PM and management team will lead by example, modeling the behavior expected from all personnel performing work at the jobsite.

4.2 Construction Manager (CM)

The CM is responsible to conduct the construction execution in the safe practices. In conjunction with TTCL safety manager to ensure the safety and health of employees include environmental impact control in every aspect related to works.

4.3 CONTRACTOR HSE Manager

HSE manager in collaboration with PM & CM, is responsible for implementing and administering this procedure by;

(1) Function as an adjudicator on any issues from the implementation of this procedure

(2) Assist SUBCONTRACTOR to plan and coordinate the work to effectively implement the requirements of the procedure

5. PROCEDURE

5.1 RECOGNIZING CHANCE FINDS

All employees and SUB-CONTRACTORS will be trained to identify archaeological heritage relevant to the area (i.e. recognition of heritage) and their obligations under this procedure. CONTRACTOR and SUBCONTRACTOR will be made aware of the following information in order to be able to recognize archaeological heritage that may be found with the project site:

- Items of cultural and archaeological heritage significance will likely be found throughout the project site and its associated facilities, even on exposed ground and especially on elevated ground;
- Artifact scatters comprising stone and terracotta objects.
- Remains of structural foundation reinforced by layers of soil mixed with seashells and terracotta debris (i.e. pottery shards).

- Ancient burial tombs, jar tombs and normal soil tombs. However, earlier assessment of the main site indicates a low likelihood of the presence of burial sites. Should human remains be found for which the death be attended with suspicious or unusual circumstances, local police should be immediately notified.

- Remains of UXOs explosive weapons (bombs, bullets, shells, grenades, land mines, naval mines, etc.). Whilst the main site and offshore area have been cleared for UXOs, should any metal objects be encountered, work should be stopped immediately, the worker should notify their supervisor.

5.2 PROCEDURE PRIOR TO CONSTRUCTION

Before any ground-disturbing construction activity commences, CONTRACTOR will:

- Provide training in the chance finds procedure to appropriate CONTRACTOR personnel and SUBCONTRACTORS (such as those operating earth-moving equipment) to identify archaeological heritage, unmarked graves and UXO relevant to the area and familiarize contractors with their obligations under this procedure. Training will be provided by HSE department.

5.3 PROCEDURE DURING CONSTRUCTION (UNMARKED GRAVES)

During the construction phase (and land clearance period) in the instance that any unmarked graves are uncovered, the following steps are to be undertaken:

Where CONTRACTOR and SUBCONTRACTOR (any worker at any level) discovers an unmarked grave they will immediately stop work, and report it to their immediate supervisor.

The supervisor will verify the grave, immediately contact security to secure the area, and inform HSE manager.

HSE manager will contact PM to inform the local government for operation in next step.

5.4 PROCEDURE DURING CONSTRUCTION FOR UNMARKED ORDNANCE

During the construction phase (and land clearance period) in the instance that any metal items are uncovered which may be UXO, the following steps are to be undertaken:

- Where CONTRACTOR and SUBCONTRACTOR (any worker at any level) notes any items that may be UXO, they will immediately stop what work in the area of the find and report it to their immediate supervisor.

- The supervisor will verify the potential find, immediately contact security to secure the area (establishing a perimeter), and inform HSE manager, providing all relevant details (such as the exact location, name of person discovering and context of discovery).

HSE manager will contact to PM for inform the local relevant authority e.g. police and military.

6. RECORD KEEPING

All corresponding documents related to a case of chance find should be kept on record at throughout the construction phase, including but not limited to.

APPENDIX GG CULTURAL HERITAGE CHANCE FIND PROCEDURE

LNG POWER PLANT (AHLONE) PROJECT

COMMUNITY DEVELOPMENT PLAN

TTCL POWER MYANMAR COMPANY LIMITED

Revision History Sheet

Rev.	Date	Description
0	September 15, 2020	1st Issue

CONTENTS

1. INTRODUCTION

TTCL Power Myanmar Company Limited ('TPMC') is planning to develop the LNG Power Plant (Ahlone) Project. The project involves the construction and operation of a 388MW gas-fired power plant, LNG receiving terminal, gas pipeline and transmission line on a Build-Operate-Transfer ("**BOT**") basis at Ahlone Township, Yangon, Myanmar.

The project will use imported Liquefied Natural Gas (LNG) as the fuel source. The selected technology for the Power Plant, combined cycle power plant (CCPP), is an efficient form of power generation, proven and acknowledged as a clean form of natural gas power generation due to its efficient gas utilisation and lower environmental impact.

2. SCOPE

This Procedure has been developed based upon the outcomes of the ESIA, ongoing base-line data and aligned with TTCL's Corporate Social Responsibility and Sustainable Development Policy.

3. PURPOSE

The community development plant (CDP) aim (i) to establish appropriate sustainable development activities that will benefit the local communities within the Project's Area of Influence (AoI) during Project's construction and operations phases, (ii) to improve the income-earning capacity, production levels and standards of living of vulnerable groups affected by project's land acquisition and (iii) to address the Project's challenges and opportunities to the impacted local communities within AoI. Main beneficiaries of the CDP are impacted local communities within AoI, with a focus on the vulnerable groups and their households throughout the Project life-cycle. The CDP also serves to fulfil the local requirement of having a Corporate Social Responsibility Programme via the proposed Community Development method.

4. TTCL'S CORPORATE SOCIAL RESPONSIBILITY AND SUBSTAINABLE DEVELOPMENT POLICY

TTCL Power Myanmar Company Limited is doing the business together with concern about Corporate Social Responsibility (CSR).

TPMC aim to create and maintain good relationship based on trust and mutual respect and be aware of any possible impact on the Company's stakeholders. We have also placed high priority on environmental conservation and continuously supported Corporate Social Responsibility activities.

However, in order to create the sustainable development and have the explicit regulation, the company has adjusted and arranged Corporate Social Responsibility and Sustainable Development Policy for the comprehensiveness in sustainability issues of the company operation and subsidiaries as following;

Compliance with Code of Conduct and Code of Business Ethics

Since the Company complies work with Code of Conduct and Code of Business Ethics, all employees are encouraged to understand Code of Business Ethics of the company in order to maintain integrity and transparency of economy, society and environment under the Corporate Governance framework.

Human Rights and Labor Practices

The Company prioritizes Human Rights and advocates non-discrimination in gender and social class. The Company is also against child labor and manages the compensation for employees to be at the same level with other business in the same industry. Moreover, the improvement, structural change and organization management of the company are strictly operated under the Company Regulation and Thai and International law.

Responsibility for Stakeholders and Other Concerned Persons

The Company prioritizes stakeholders and other concerned persons with the business operation concerning the least impact on both direct and indirect way. We aim to manage the risk management with the international standard and create the sustainable benefit to all stakeholders.

Social Responsibility Activity

To the society and community, the Company has continuously supported any activity and project which thoroughly covers economy, society, and environment.

Responsibility for Environment and Safety Standards

The Company operates the business with adopting the provisions of Occupational Health and Safety Management System. The Company also advocates any activity concerning the environmental conservation and efficient resource usage for enhancing the quality and environmental capabilities.

Company Innovation Concerning with Corporate Social Responsibility

Meanwhile, the Management and all employees have advocated, pushed forward and complied with Corporate Social Responsibility and Sustainable Development Policy for the development and efficiently growth.

5. RESPONSIBILITY

The main responsibility in implementing the CDP lies within TTCL Power Myanmar Company Limited (TPMC), supported by its EPCs and relevant third-parties relating to the community management, public consultation and local communication. Local governments and authorities are also identified as one of the main stakeholders in CDP's co-operation, regulation and available resources to the CDP programmes; particularly in the area of Apprenticeship Programme, Local Business Development, Education Facilities Support, Community Infrastructure Support Programme. Additionally, in ensuring a smooth implementation throughout Project life cycle, the CDP comprises an integrated implementation and action plans such as the internal policies, Communication methods, grievance redress mechanisms, monitoring and evaluation tools, and reporting tools.

6. TARGET COMMUNITY

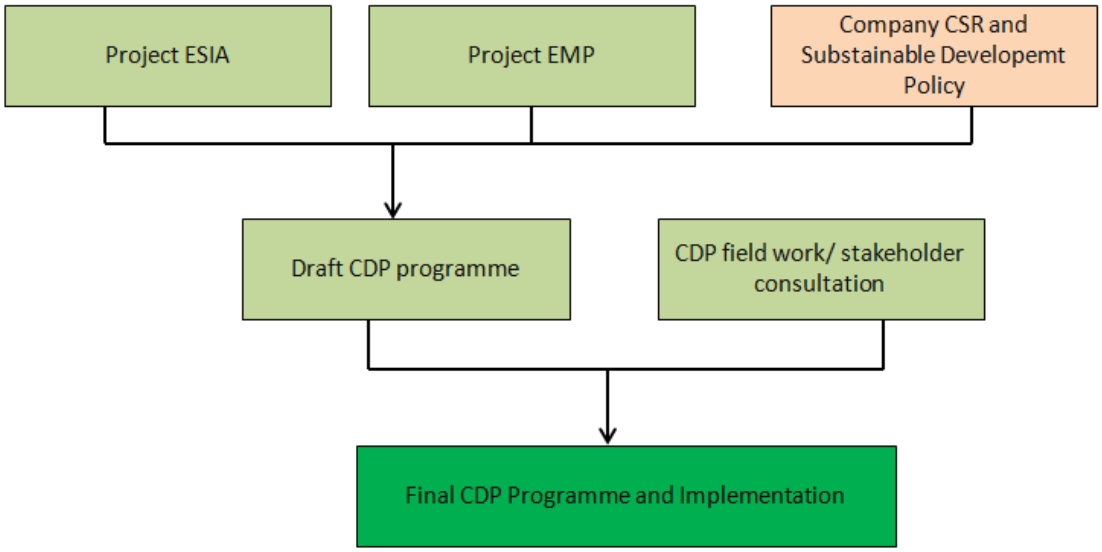
Below table summarises the location of the potentially impacted villages in relation to the Project components (as per the Project's ESIA). Propsoed Community Development Programs are targeted to benefit for these villages based on their proximity to the site facilities and sensitivity.

Target Community in Relation to the Project Component

Target Community		Related Project Components
That Kal Kwin Village	Dala Township	LNG Terminal , Gas Pipe Line
Shan kan Village		
Chaung Oo Village		
Rakhine Chaung Village		
Pyawbwe Gyi village		
Ye chaung Wa Village		
Tha Pyay Kone Village		
Dala Town		
Seikyikhanaungto	SeikyikhanaungtoTownship	
Tat Thit Village	Twantay Township	Power Plant, Transmission Line
Kyi Sate Village		
Kha Yan Wa Village		
Kha Lauk Kha Lu Village		
Tu Chaung Village	Htantabin Township	
Hlaing Thar Yar	Hlaing Thar Yar Township	
Ahlone	Ahlone Township	

7. PROPOSED STRATEGIC COMMUNITY DEVELOPMENT PROGRAMMES

Below figure illustrates the process flow in establishing a strategic and sustainable CDP appropriate for this Project.



Based on the initial discussions held to date with Projects representatives and findings during the field survey six (5) main strategic programmes will be implemented, which are selected based on their potential success rate i.e. Addresses the current community challenges or most needs, as well as reflecting the commitments identified in ESIA/ESMP. The proposed CDP programme includes:

- Strategic Programme 1: Community Relations Programme to be implemented as part of the Projects SEP activities
- Strategic Programme 2: Apprenticeship Programme
- Strategic Programme 3: Local Business Development Programme
- Strategic Programme 4: Education Facilities Support
- Strategic Programme 5: Community Infrastructure Support

Strategic Programme 1: Community Relations Programme

The Community Relations Programme is designed to provide a platform for the Project in addressing the short-term community or societal challenges, with the following specific objectives:

- To improve or retain community and key stakeholders' acceptance; and
- To address short-term community needs or challenges.

It should be undertaken in coordination with the Project's overall SEP activities. This will benefit the Project in maintaining and further building positive relationships with external stakeholders, as well as to gain community acceptance, support and social license to operate. Acceptance and a positive relationship with local communities and key stakeholders is vital in ensuring the Project proceeds as per the designated plan

Strategic Programme 2: Apprenticeship Programme

The Community-based Apprenticeship Programme is related to the Project's aims to equip local low and semi-skilled workers (especially affected communities, including women) with relevant technical skills and job experience through an apprenticeship programme.

Examples of activities proposed under this Programme may include technical and skills assessments, training, certification, job information services, and recruitment and mentorship sessions.

Strategic Programme 3: Local Business Development Programme

The Local Business Development Programme outlines how the Project could assist in the sustainable economic growth by supporting the development and competitiveness of localised Small and Medium Enterprises (SMEs).

Examples of activities proposed under this program may include micro and SME management training, access to credit services, marketing, certifications, and business mentoring and advisory sessions.

Strategic Programme 4: Education Facilities Support

The programme is proposed to improve the relatively poor conditions of existing education institutions within the target community. i.e. inadequate or outdated education facilities or curriculum, under qualified teachers, etc.).

Examples of activities proposed under this Programme may include mapping for appropriate education facilities support, recipient assessment, selections, disbursement or provision of facilities, construction of infrastructure, and creation of Project-related curriculums, tutorials, apprenticeship opportunity and job opportunity.

Strategic Programme 5: Community Infrastructure Support

The programme is proposed to improve the relatively poor conditions of existing infrastucture within the target community. i.e. poor road condition or outdated community facilites, damaged irrigation canal etc.)

Examples of activities proposed under this Programme may include mapping for appropriate infrastructure support, recipient assessment, selections, disbursement or provision of facilities, construction of infrastructure.

8. PROPOSED IMPLEMENTATION AND ACTION PLAN

Project Community Development Policy

Community Development Plan is essentially about building the capacity of the local community; hence, the Community Development Policy will incorporate the following:

- The CDP is to be built on a balanced approach that addresses and integrates a common vision in economic, social, community health and well-being, environmental and cultural values and considerations. The affected local community members, regardless of gender, age, disability, race, culture, language or social and economic status shall have the opportunity to become engaged in the community development process and are able to access its benefits;

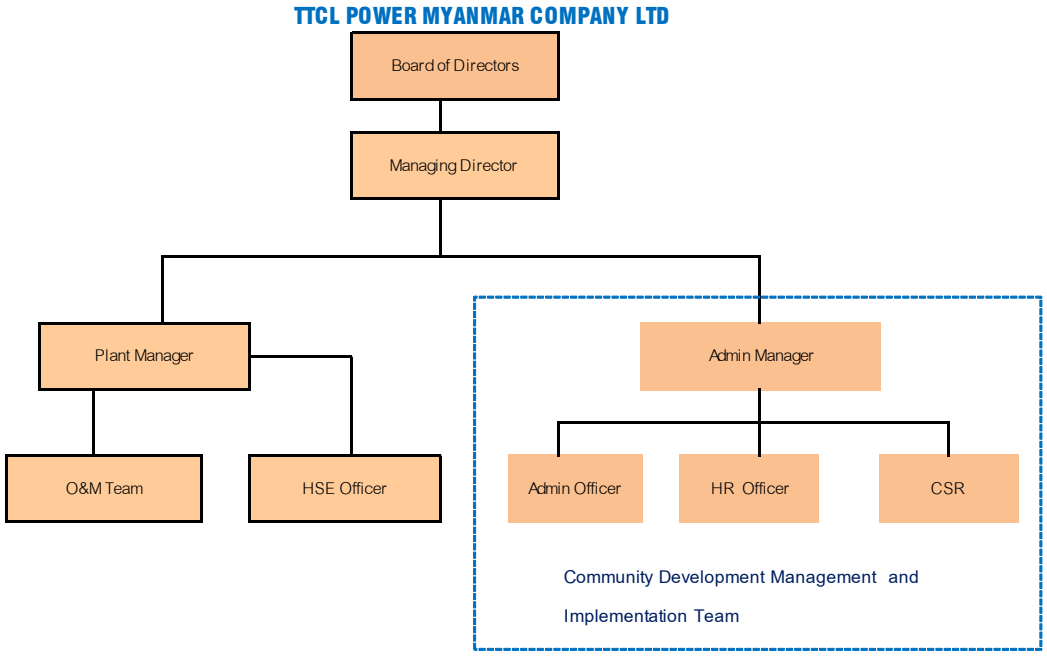
- Community Development Programmes shall collaborate and co-operate with reputable partners through the provision of information, expertise, guidance, and other resources, as appropriate ;and

- The Project encourages the cultures of transparency, accountability, participation and evidence based decision-making in improving the climate of the CDP and Programmes.

Organizational Structure

Roles and responsibilities and implementation of the CDP are illustrated through an organizational structure provided in below.

CDP management and implementation team will be responsible to develop further the CDP activities or any other required action plans to the affected community, and to coordinate with field staff, EPCs and relevant third-parties/technical experts which may be appointed by TPMC for the implementation and monitoring of the CDP.



APPENDIX HH COMMUNITY DEVELOPMENT PLAN

LNG ဓာတ်အားပေးစက်ရုံ စီမံကိန်း (အလုံ) ၊ ရန်ကုန်

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The business of sustainability

ERM

ရည်ရွယ်ချက်များ

- စီမံကိန်းအကြောင်းနှင့် ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်လေ့လာမည့် အဖွဲ့အစည်းကို တင်ပြမိတ်ဆက်ပေးရန်
- စီမံကိန်းအချက်အလက် များကို ထုတ်ဖော်ပြသပေးရန်
- ပတ်ဝန်းကျင်ထိခိုက်မှု ရှိမရှိ ဆန်းစစ်လေ့လာသွားမည့် နေရာနှင့်လုပ်ငန်းစဉ်များကို တင်ပြ သွားရန်
- စီမံကိန်း နှင့် သက်ဆိုင်သူများနှင့် ညှိနှိုင်းဆွေးနွေးသွားမည့် လုပ်ငန်းစဉ်များအကြောင်း တင်ပြရန်
- အထက်ပါလုပ်ငန်းစဉ်များနှင့် ပတ်သက်၍ သက်ဆိုင်သူ အများပြည်သူ သဘောထားအဆိုပြုချက်များကို ခံယူရန်

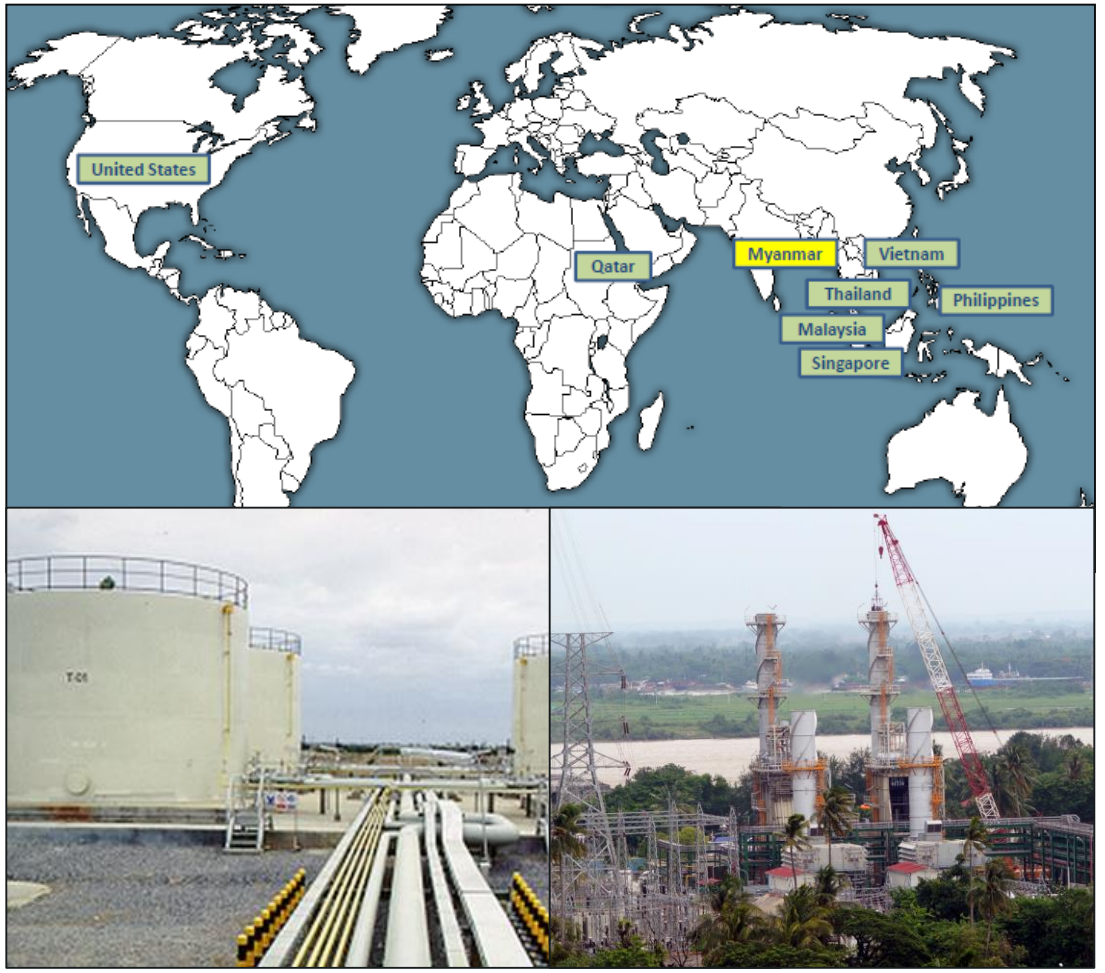
TTCL Power Myanmar Company Limited (TPMC)

TPMC

TPMC is a subsidiary of TTCL Public Company Limited . TPMC was established to carry out the Operation & Maintenance of this proposed project.

TTCL

- TTCL Public Company Limited (TTCL) is the first integrated Engineering, Procurement and Construction company in Thailand as well as an investor especially in power sector.
- Established in 1985 by Toyo Engineering Corporation (TEC), a leading Engineering Company from Japan.
- 8 Subsidiary and Affiliate Companies in 3 continents around the world.
- Its experience in Myanmar include:
  - Aviation Fuelling System for the Mandalay International Airport in 1997.
  - 121MW Combined Cycle Gas Turbine Power Plant in Ahlone, Yangon in 2012.
  - Oil & Gas Terminal Construction in Thilawa Industrial Zone in 2018



TTCL's Business

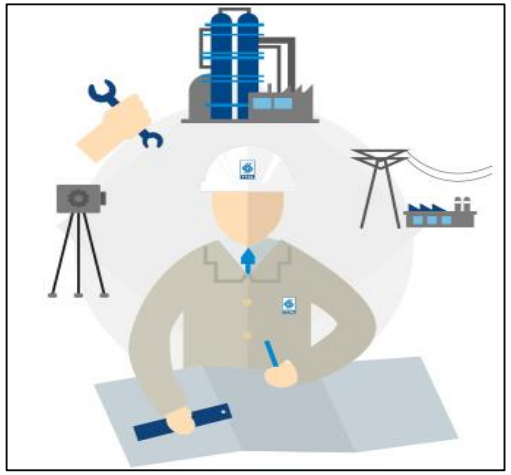
Engineering – **2,700 staffs**, Offer all areas of engineering fields.

Procurement – **30 years experience**, Strong network with suppliers.

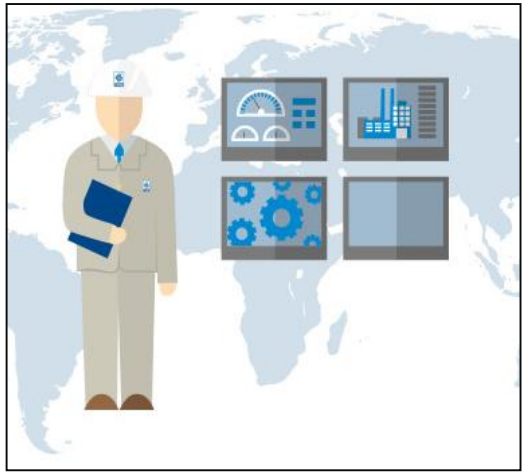
Construction – **230 successful projects**, Proven work quality records.

Investment –.**7 projects worldwide,** especially in power sector

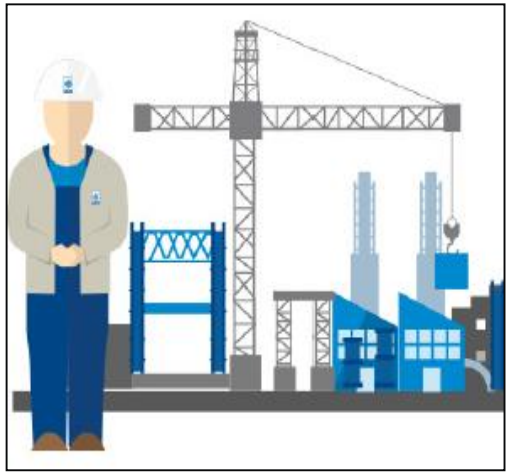
Engineering



Procurement



Construction



TTCL Worldwide Experiences

TTCL is trusted by many leading international company around the world.

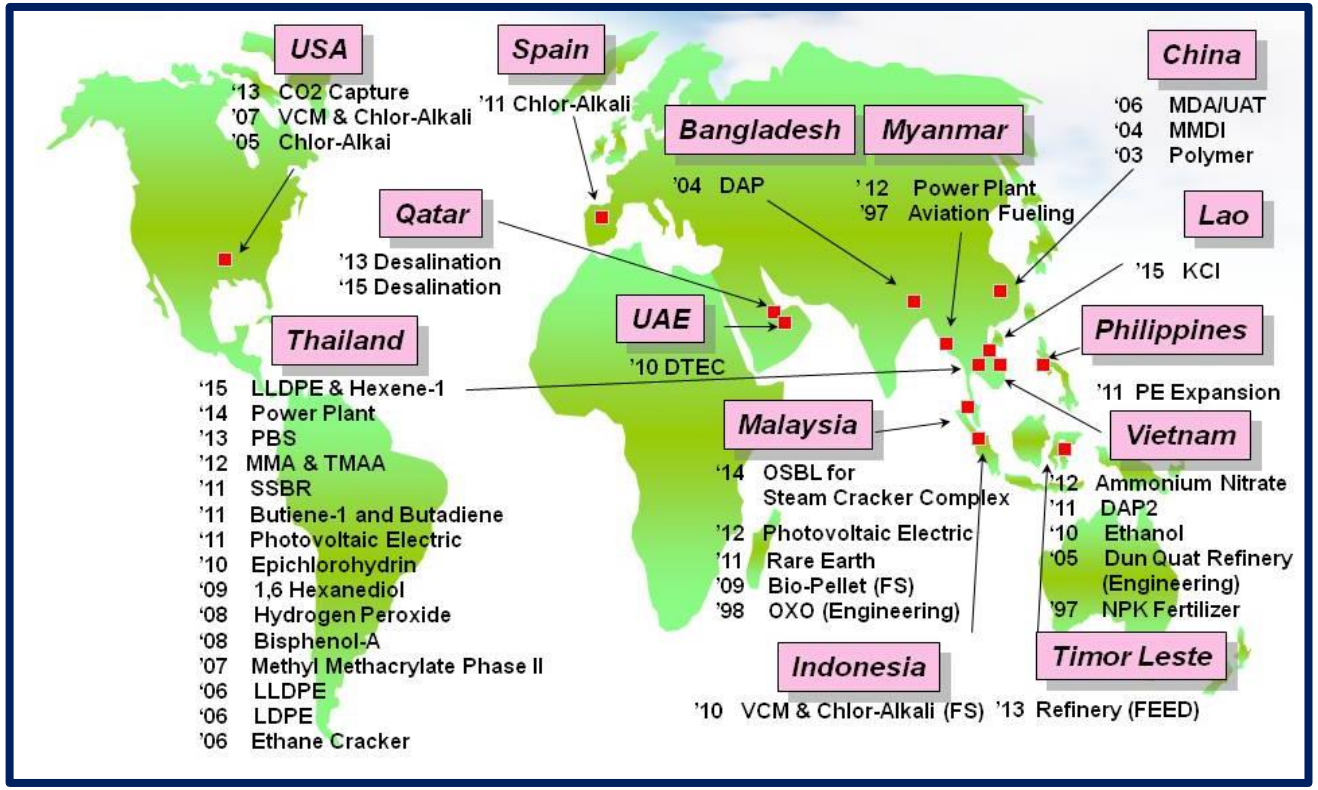
PETRONAS

SOLVAY

ptt GLOBAL CHEMICAL

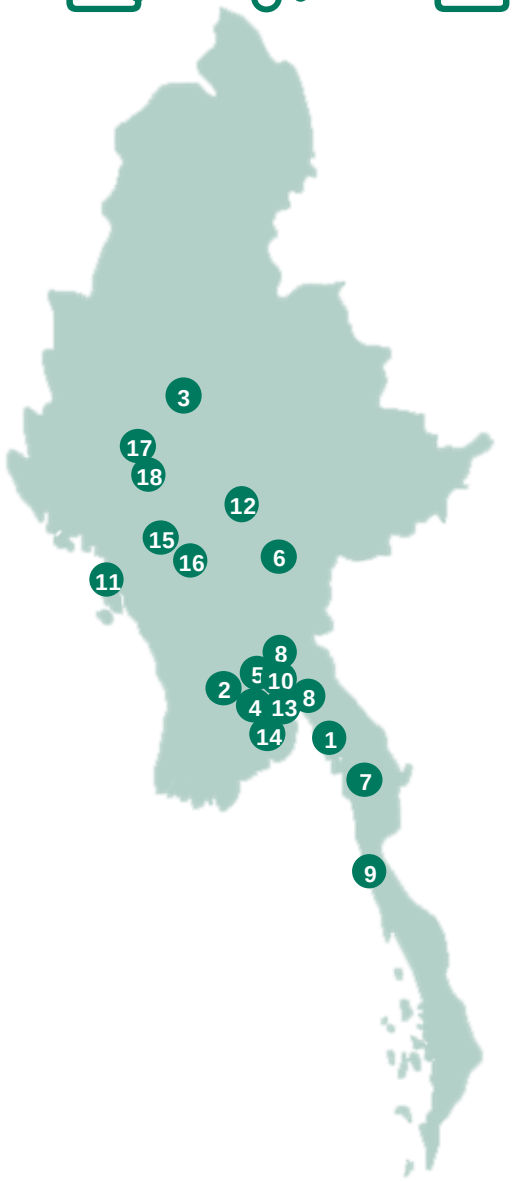
TOSHIBA

Bayer



ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်မည့် အဖွဲ့အစည်း

ဤစီမံကိန်းပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း
လေ့လာချက်များကို မြန်မာ့သယံဇာတနှင့်
ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဌာန၏
အသိအမှတ်ပြု လက်မှတ်ရ
တတိယအဖွဲ့အစည်းဖြစ်သည့် Environmental
Resources Management (ERM) က
ဆောင်ရွက်မည်ဖြစ်ပါသည်။



ERM's Selected Project Experience – Power Sector:

1. Scoping and High-level Environmental and Social Impact Assessment (ESIA) ESIA - 1,280 MW Thermal (Coal) Power Plant - Mon State
2. Initial Environmental Evaluation (IEE) - 500 MW Thermal (Combined Cycle Gas) Power Plant - Ayeyarwady Region
3. Scoping and ESIA – Myingyan 250 MW Thermal (Combined Cycle Gas) Power Plant - Mandalay Region
4. ESIA – 300 MW HFO Power Plant - Yangon
5. IEE – 50 MW HFO Power Plant – Bago Region
6. ESIA – 1280 MW Thermal (Coal) Power Plant – Kayin State
7. ESIA – 200 MW Thermal (Gas) Power Plant - Tanintharyi Region
8. EIA – 60 MW HFO Power Plant – Bago Region
9. ESIA – FSRU, 1,200 MW Thermal (Gas) Power Plant and 400km 500kV Transmission Line - Tanintharyi Region
10. ESIA – FSRU, 1,000 MW Thermal (Gas) Power Plant and 135 km 500kV Transmission Line – Yangon Region
11. ESIA – FSRU and 2,300 MW Thermal (Gas) Power Plant and 500km 500kV Transmission Line – Rakhine State
12. ESIA – 230 MW Hydropower Plant – Shan State
13. EIA - Gas to Power Plant Project - Yangon Region
14. ESIA - Power plant, Gas Pipeline and LNG Terminal - Yangon Region
15. ESIA - 113 MW Wind Farm and 58km Transmission Line - Magway Region
16. ESIA - 50 MW Wind Farm and 115km Transmission Line - Magway Region
17. ESIA - 50 MW Wind Farm and 19km Transmission Line - Magway Region
18. ESIA - 50 MW Wind Farm and 49km Transmission Line - Magway Region

ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်မည့် အဖွဲ့အစည်း

Environmental Resources Management (ERM) ၏ မြန်မာကုမ္ပဏီအဖြစ် Sustainable Environmental Myanmar Co., Ltd (SEM) က ဆောင်ရွက် မည်ဖြစ်ပါသည်။

SEM သည် ပတ်ဝန်းကျင်ဆန်းစစ်မှုဆိုင်ရာ လုပ်ငန်းများနှင့် ပတ်သတ်၍ (ERM) ကို ကူညီပံ့ပိုးပေးမည့် မြန်မာလုပ်ငန်းလိုင်စင် ကိုင်ဆောင်ထားသည့် အတွေ့အကြုံရင့် အဖွဲ့အစည်းဖြစ်သည်။

ERM Key Personnel involved in Preparation of the Scoping Study

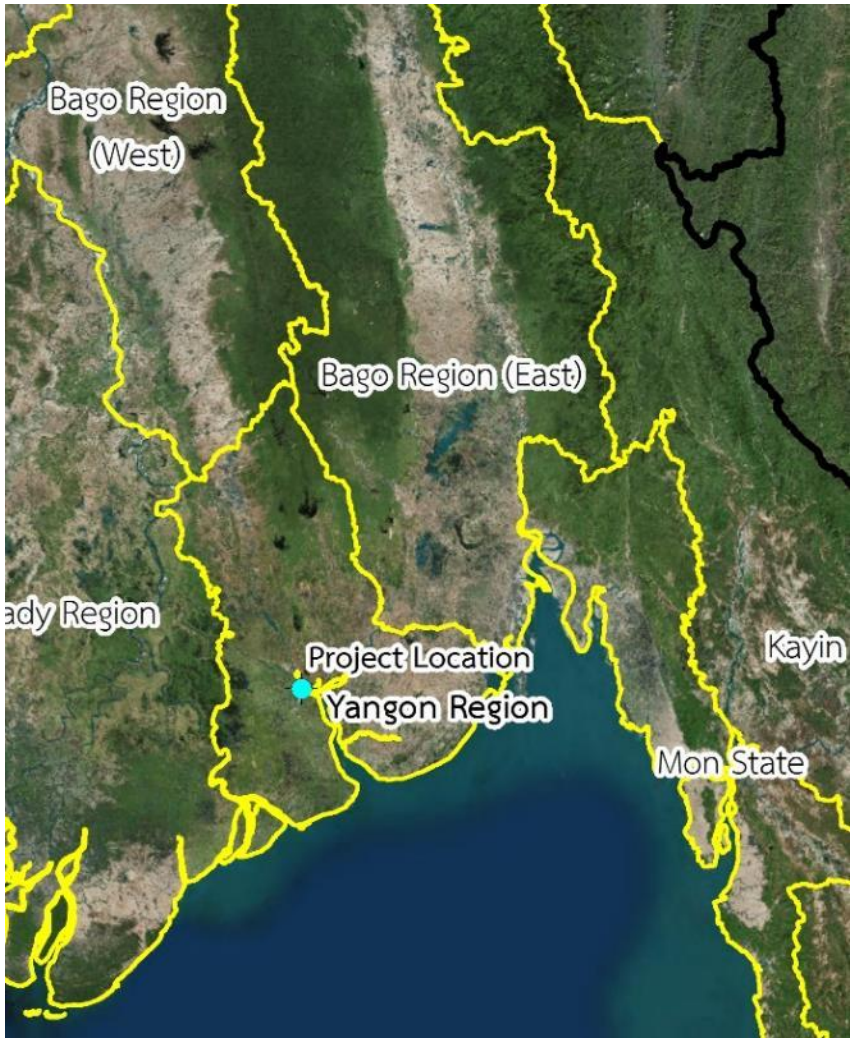
Name	Project Role
Ms. Kamonthip Ma-oon	Partner in Charge
Dr. Robin Kennish	Project Technical Director
Mr. Vincent Lecat	Project Manager and Social Specialist
Mr. Chris Brown	Soil / Water Specialist
Mr. David Nicholson	Biodiversity Specialist
Mr. Edmund Taylor	Air Quality Specialist
Ms. Khinsusu Naing	Public Consultation Specialist
Ms. Sarinya Rangsipatcharayut	GHG Specialist
Ms. Sylvia Jagerroos	Marine Specialist
Ms. Mandy To	Noise Specialist
Ms. Peggy Wong	Cultural Heritage Specialist
Ms. Kanokphorn Chaivoraphorn	Health Specialist

SEM Key Personnel involved in Preparation of the Scoping Study

Name	Project Role
Mr Zaw Naing Oo	Managing Director
Mr Maung Chit	Project Manager
Ms Nan Cherry	Social Specialist
Daw Naing Naing Win	Local Ecology Expert

စီမံကိန်း၏အဓိကအစိတ်အပိုင်းများ

- □□□ မဂ္ဂါဝပ် သဘာဝဓာတ်ငွေ့သုံး ပေါင်းစပ်လည်ပတ်စွမ်းအင်စက်ရုံတစ်ခုကို လက်ရှိအလုံဓာတ်အားပေးဝင်းတွင်းအတွင်း တပ်ဆင်ခြင်း
- အဓိကလောင်စာဖြစ်သော သဘာဝဓာတ်ငွေ့ရည် (LNG)ကို ပြည်ပမှ လောင်စာရည်သယ် သင်္ဘောများဖြင့် တင်သွင်းသယ်ယူခြင်း
- LNG သိုလှောင်ဆိပ်ကမ်းနှင့် ဓာတ်အားပေးရုံသို့ သွယ်တန်းမည့် ဂက်စ်ပိုက်လိုင်း တည်ဆောက်ခြင်း
- ၂၃၀ ကေဗွီ ဓာတ်အားပေးလိုင်း အသစ် သွယ်တန်းခြင်း
- ထွက်ရှိသော လျှပ်စစ်ဓာတ်အားကို မြန်မာမဟာဓာတ်အားလိုင်းသို့ တင်ပို့သွားမည်ဖြစ်ပါသည်။

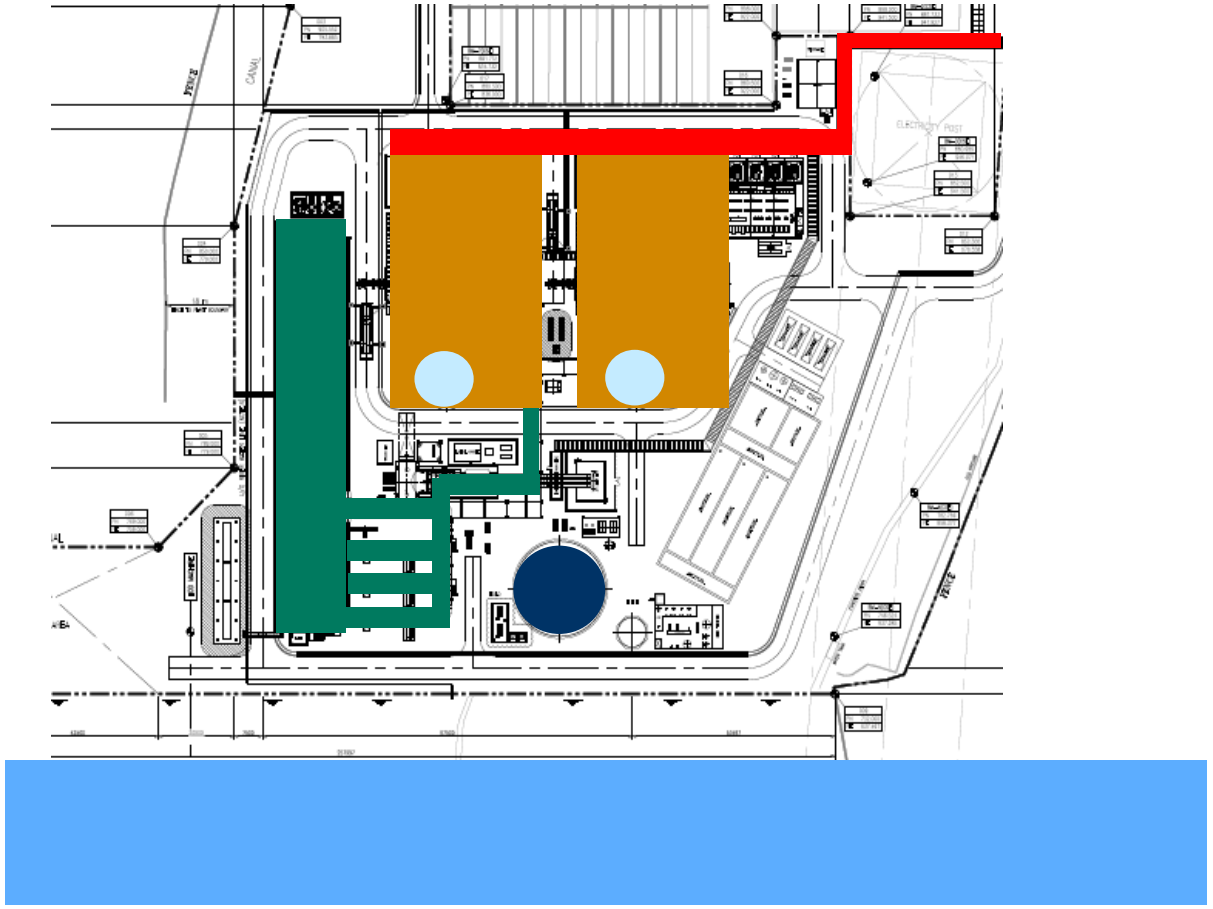


စီမံကိန်းပြ မြေပုံ (ပုံကြမ်း)

သင်္ကေတ

- LNG လက်ခံဂိတ်
- သဘာဝဓာတ်ငွေ့ပိုက်လိုင်း
- ဓာတ်အားပေးစက်ရုံ

လျှပ်စစ်ဓာတ်အားပေး စက်ရုံ

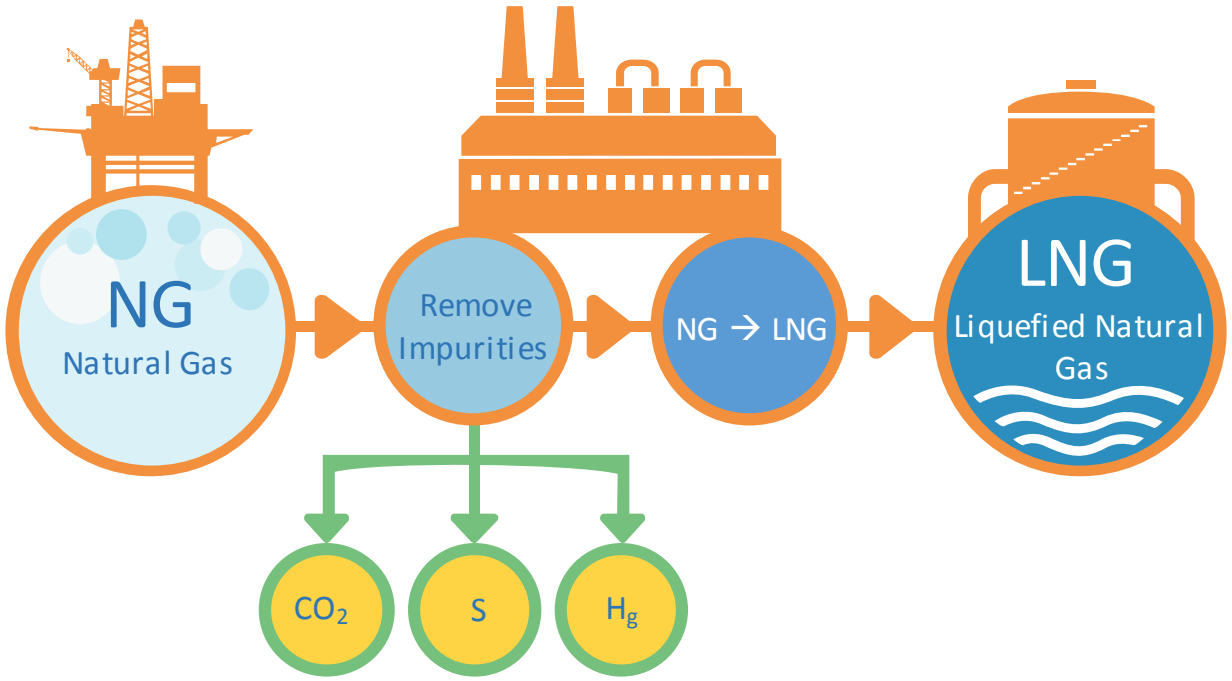


အညွှန်း

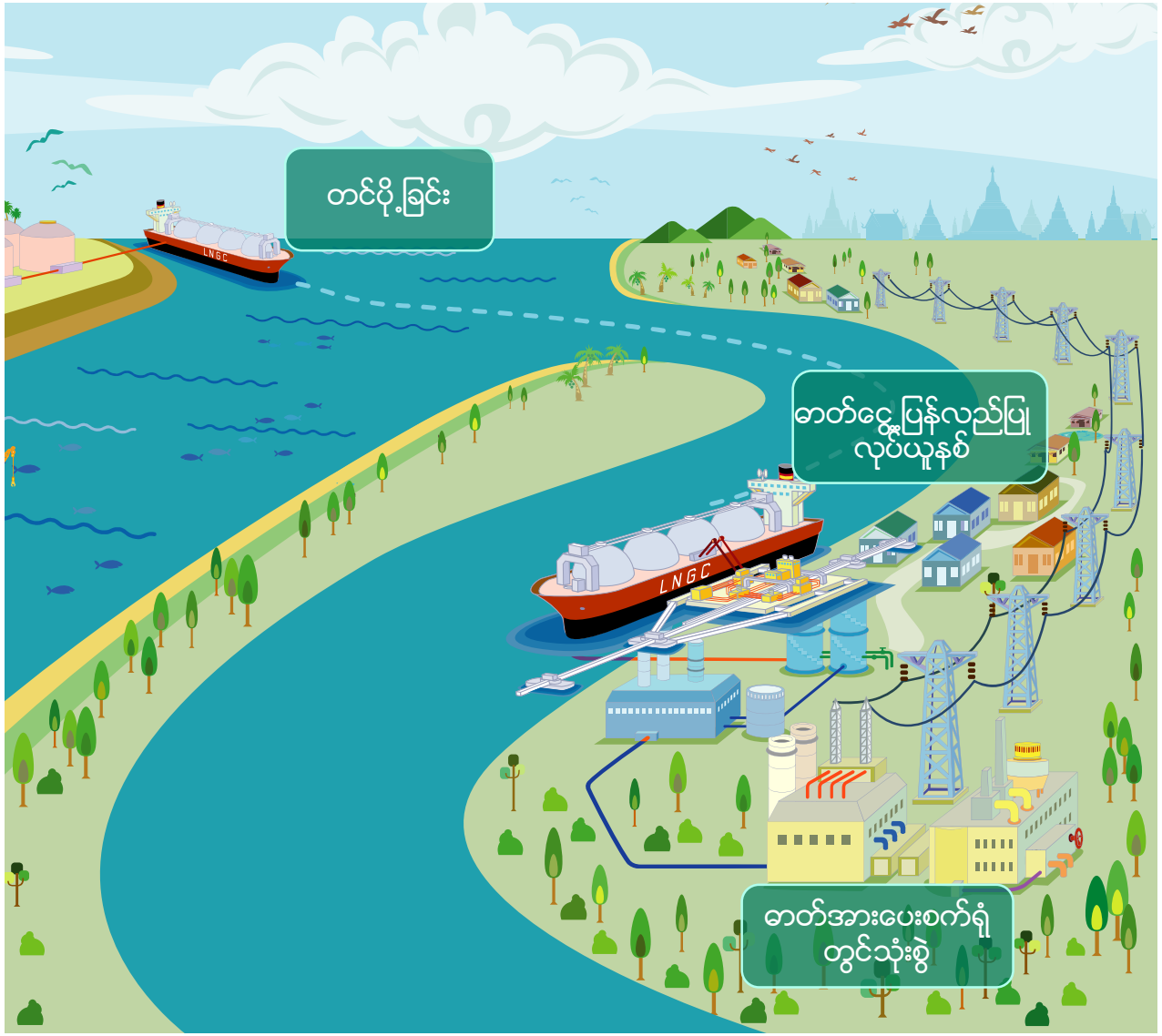
- ရန်ကုန်မြစ်
- ရေတိုင်ကီ
- ဓာတ်အားလိုင်း
- ရေအအေးခံ စင်မြင့်
- ဓာတ်ငွေ့တာဘိုင် နှင့် ရေနွေးငွေ့တာဘိုင်
- ခေါင်းတိုင်

LNG ဆိုတာဘာလဲ

LNG (Liquefied Natural Gas) ဆိုသည်မှာ သဘာဝဓာတ်ငွေ့ကို အပူချိန် (-၁၆၀) ဒီဂရီ ဆဲလ်စီးယပ် ခန့်ထိလျော့ချ၍ အရည်ပုံစံဖြင့် ထိန်းသိမ်းထားသော ဓာတ်ငွေ့အရည် ဖြစ်ပါသည်။ အထူးတည်ဆောက်ထားသော သင်္ဘောများဖြင့် သယ်ယူပို့ဆောင်ကြသည်။ အခြားသော လောင်စာရည် (ဥပမာ ဓာတ်ဆီ၊ဒီဇယ်) တို့နှင့် နှိုင်းယှဉ်လျှင် LNG ဓာတ်ငွေ့ရည်မှာ အလွယ်တကူ မီးလောင်နိုင်စွမ်း နည်းပါးပါသည်။



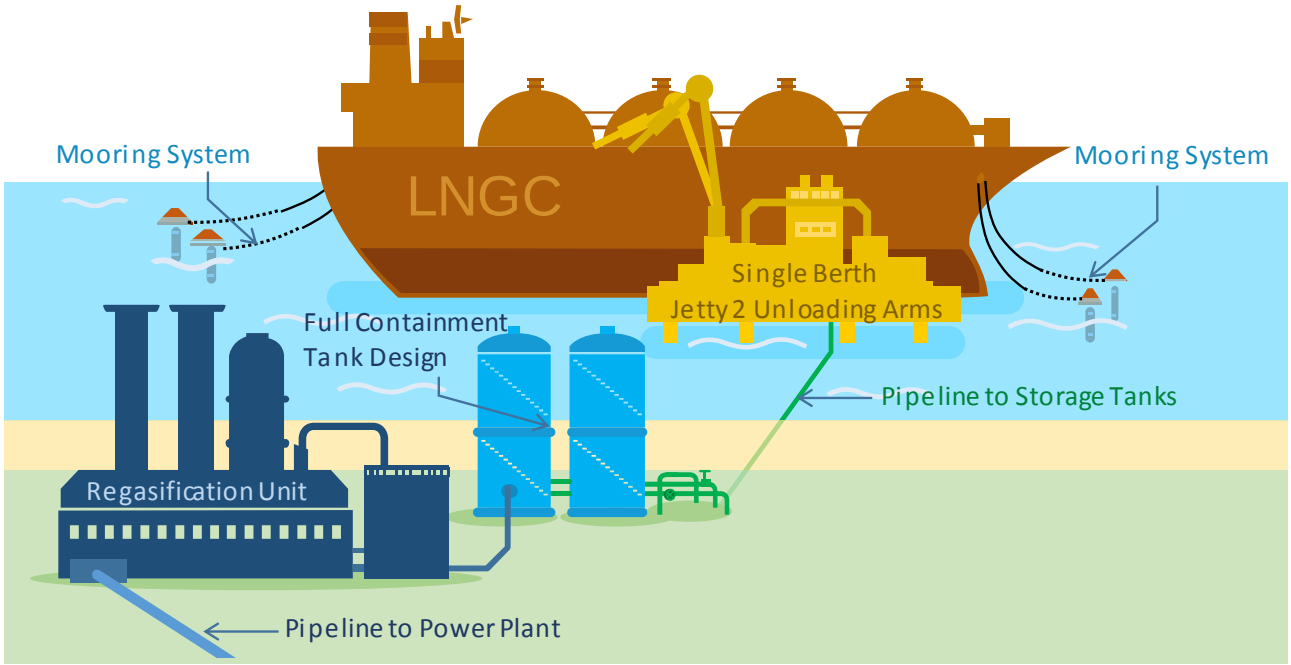
LNG ထုတ်လုပ် သယ်ယူ သုံးစွဲခြင်း



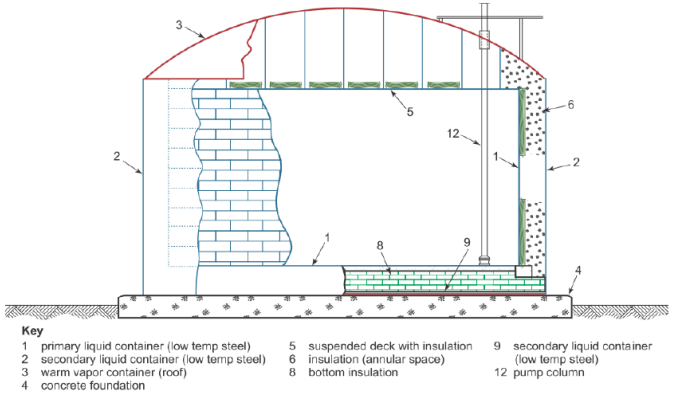
LNG လက်ခံဆိပ်ကမ်း

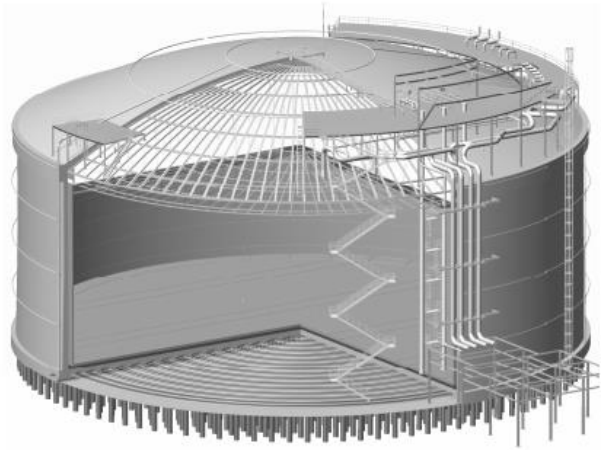
အဓိက ပါဂင်အစိတ်အပိုင်းများ

- LNG အတင်အချ ဆိပ်ခံတံတား
- LNG သိုလှောင်တိုင်ကီ ၂ လုံး
  (တစ်လုံးလျှင် ၁၉,၀၀၀ ကုဗမီတာ)
- သဘာဝဓာတ်ငွေ့ ပြုလုပ်သည့် ယူနစ်



LNG Tank (Full Containment)



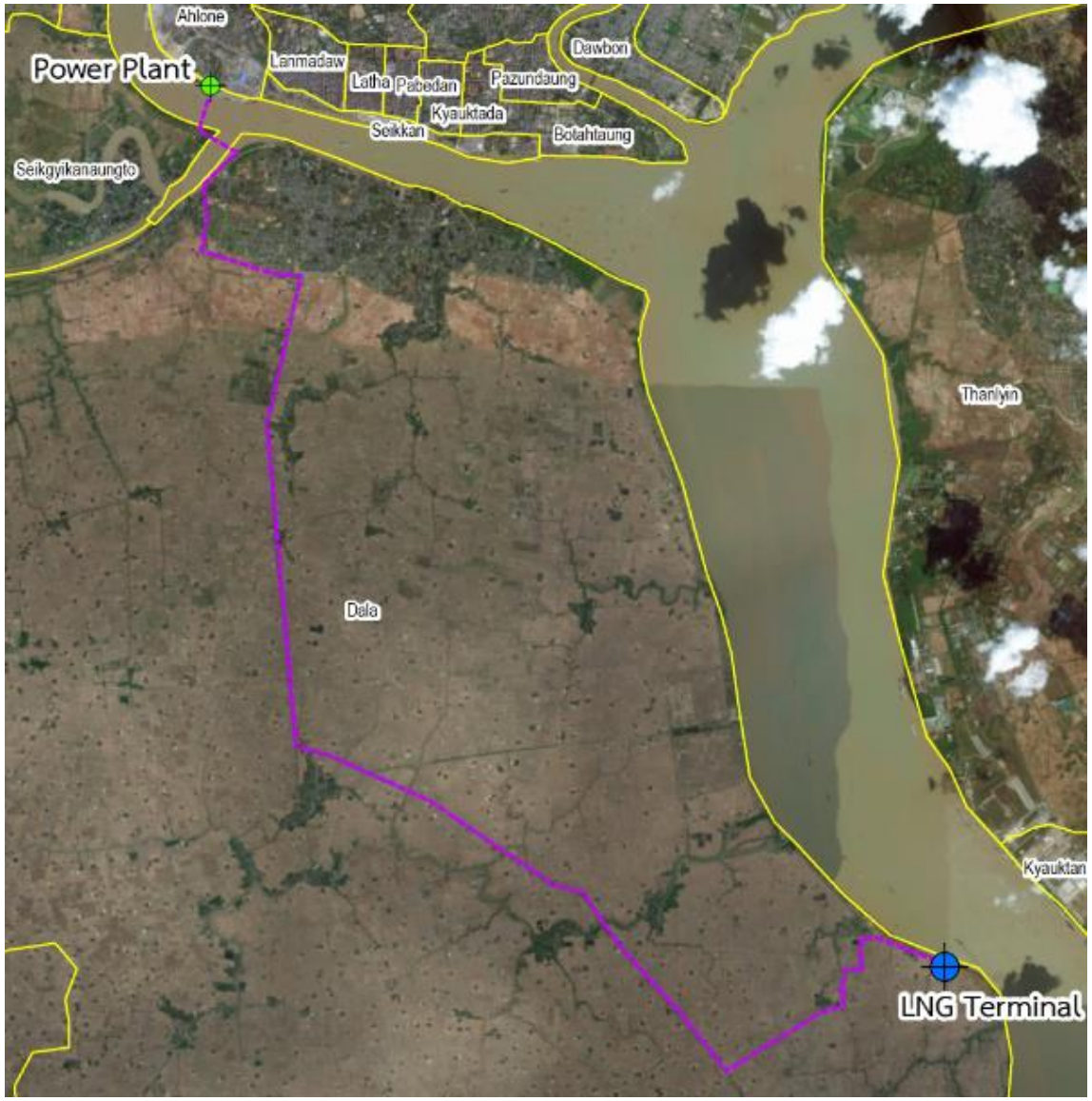


သဘာဝဓာတ်ငွေ့ပိုက်လိုင်း

- ၁၄ လက်မ အချင်းရှိ သံပိုက်လိုင်း
- ပိုက်လိုင်းအတွင်း ဓာတ်ငွေ့ဖိအား (52.6 barG)

ကျန်းမာရေးနှင့်ဘေးကင်းလုံခြုံရေးနှင့် အရေးပေါ်ထိန်းချုပ်မှု

- ဓာတ်ငွေ့ဖိအား ထောက်လှမ်းရေးစနစ် တပ်ဆင်ထားခြင်း
- အရေးပေါ်အခြေအနေ တစ်စုံတစ်ရာ ဖြစ်ပေါ်လာပါ ဓာတ်ငွေပို့လွှတ်မှုကို ရပ်ဆိုင်းခြင်း
- အရေးပေါ်အခြေအနေ တွင်ဓာတ်ငွေ့ပိုက်လိုင်း ကို ပိတ်ဆို့ ဖြတ်တောက်နိုင်သော Main Block Valve များ တပ်ဆင်ထားခြင်း
- ပိုက်လိုင်း တိုက်စားခြင်း မဖြစ်စေရန် Cathodic protection ဖြင့် ကာကွယ်ထားခြင်း

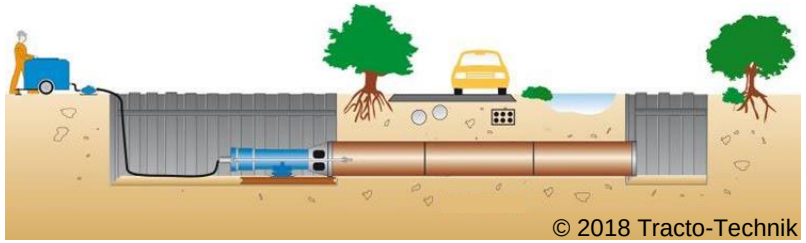


သင်္ကေတ

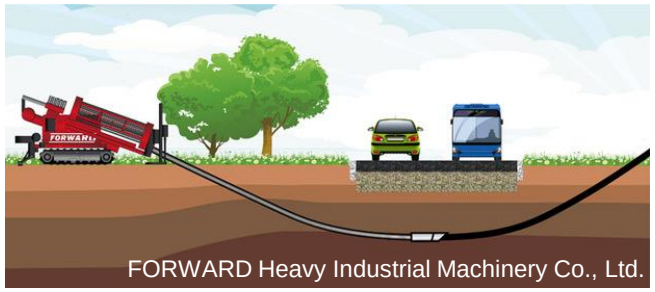
----- သဘာဝဓာတ်ငွေ့ပိုက်လိုင်း

ဓာတ်ငွေ့ပိုက်လိုင်းသွယ်တန်းပုံ အမျိုးမျိုး

တူးဖော်သွယ်တန်းခြင်း–သွယ်တန်းရာ လမ်းကြောင်းတလျှောက် သင့်တော်သော အနက်တစ်ခုအထိ မြေတူးဖော်၍ ပိုက်လိုင်းမြှုပ်နှံသော နည်းစနစ်ဖြစ်သည်။ ပိုက်လိုင်းပေါ်မှ မြေပြန်ဖုံး၍ လမ်းကြောင်းတစ်လျှောက် သတိပေးဆိုင်းပုဒ် များတပ်ဆင်ထားရမည်။ ပိုက်လိုင်းမြှုပ်နှံရာ ဇရိယာကိုလည်း မူလပကတိ အနေအထားအတိုင်း ပြန်လည်ပြုပြင်ပေးရပါသည်။

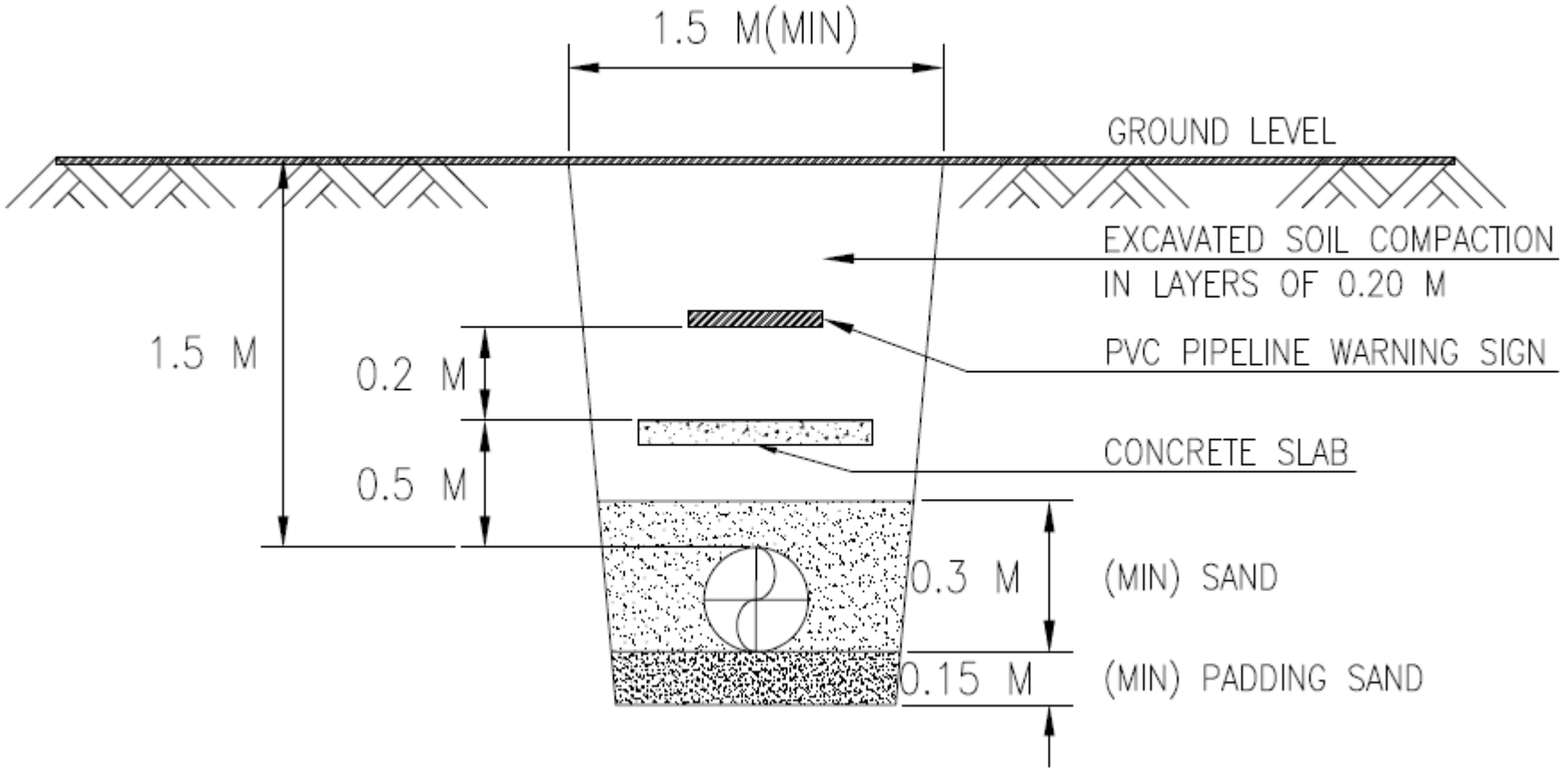


ထိုးသွင်းသွယ်တန်းခြင်း – မြစ်ကြောင်း၊လမ်း၊အဆောက်အဦး ကဲ့သို့သော ထုထည်အတားအဆီးများအောက်မှ ပိုက်လိုင်းကို ထိုးသွင်းသွယ်တန်းသော စနစ်ဖြစ်သည်။. ပိုက်လိုင်း၏ အစွန်းနှစ်ဖက်တွင်သာ မြေတူးဖော်ရန် လိုအပ်၍ တစ်ဖက်တွင်မြေတူးလွှန်စက်ဖြင့် ထိုးသွင်း၍ သွယ်တန်းသော စနစ်ဖြစ်သည်။



အကြီးစားလွှန်စက်ဖြင့် သွယ်တန်းခြင်း– လိုအပ်သလို ထိန်းကြောင်းနိုင်သော လွှန်စက်ဖြင့် ထုထည်အတားအဆီးများအောက်မှ ရေပြင်ညီအတိုင်း ပိုက်လိုင်းကို ထိုးသွင်းသွယ်တန်းသော စနစ်ဖြစ်သည်။. ထုထည်ကြီးမားသော (၅၀၀ မှ ၂၀၀၀ မီတာ ခန့်) အဆောက်အဦးများအောက်မှ ပိုက်လိုင်းဖြတ်သန်းရန် လိုအပ်သောအခါ ဤနည်းလမ်းကို အသုံးပြုကြပါသည်။

ပိုက်လိုင်း၏ ဖြတ်ပိုင်းပုံ : (တူးဖော်သွယ်တန်းခြင်း)

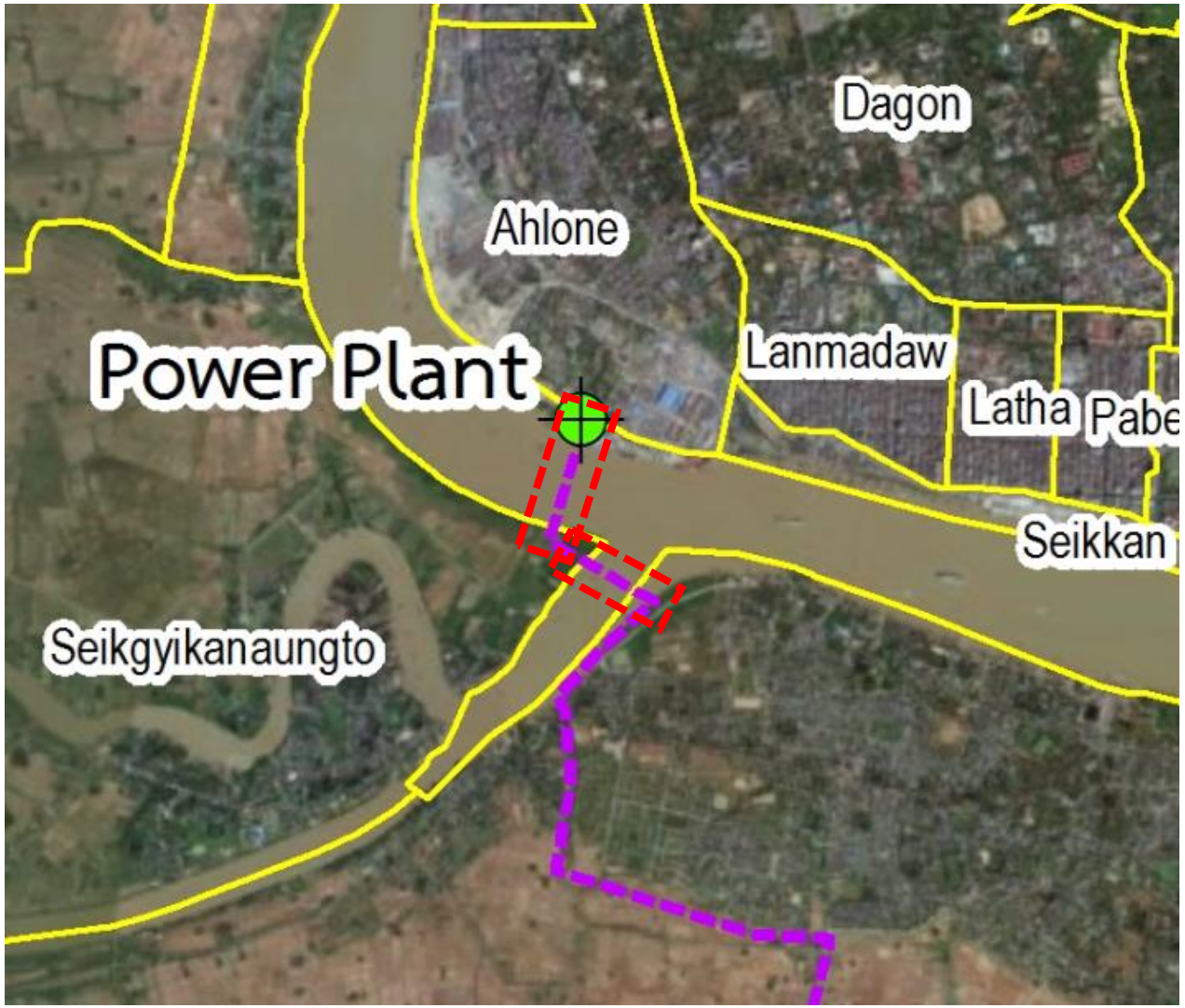


သဘာဝဓာတ်ငွေ့ပိုက်လိုင်း လမ်းကြောင်း

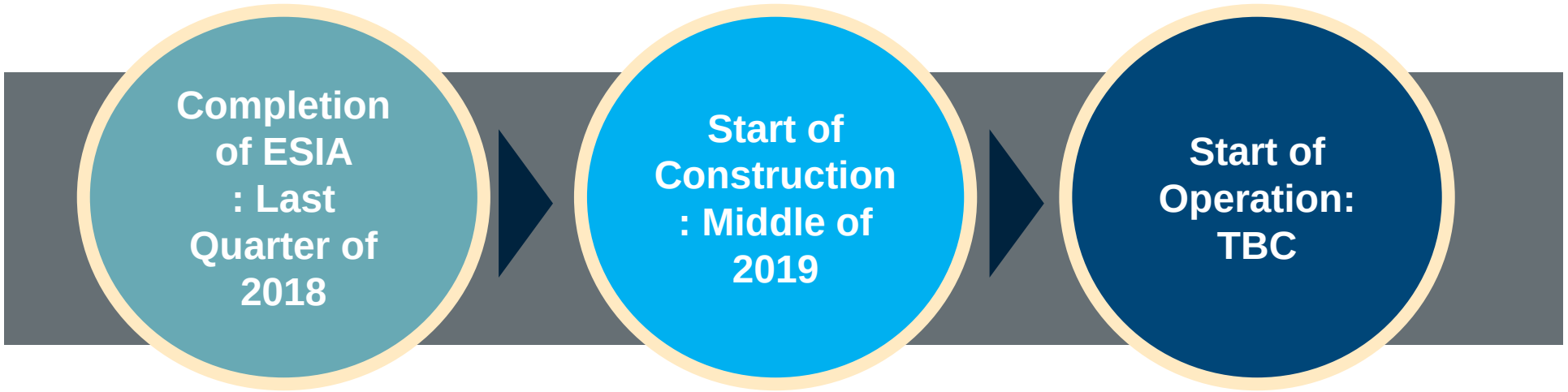
အကြီးစားလွန်စက်ဖြင့် သွယ်တန်းမည့်နေရာ

ပိုက်လိုင်း

ဓာတ်အားပေးစက်ရုံ



စီမံကိန်း လုပ်ငန်းစဉ်များ (အခြေပြ ဇယား)



သဘာဝပတ်ကျင် နှင့် လူမှုဝန်းကျင်တို့အကြား ဖြစ်ပေါ်လာနိုင်သည့် သက်ရောက်မှုများကို လေ့လာခြင်း

စီမံကိန်းနှင့်စပ်လျဉ်း၍ သဘာဝပတ်ဝန်းကျင် နှင့် လူမှုဝန်းကျင်တို့အကြားဖြစ်ပေါ်လာနိုင်သည့် သက်ရောက်မှုများကို ကောင်းမွန်စွာ သိရှိနားလည်နိုင်ပါရန် လေ့လာဆန်းစစ်ခြင်း လုပ်ငန်းစဉ်များကို တတိယအဖွဲ့ အစည်းဖြစ်သော (ERM) မှ ဆောင်ရွက်လျက်ရှိပါသည်။

အဆိုပါ ဆန်းစစ်မှုများကို မြန်မာနိုင်ငံ၏ သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာ ဥပဒေ၊ International Finance Corporation (IFC)□ World Bank Group တို့၏ နိုင်ငံတကာ စံချိန်စံညွှန်းများ အတိုင်း ဆောင်ရွက်လျက်ရှိပါသည်။

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ESIA လုပ်ငန်းစဉ်များ

၁။ နယ်ပယ်အတိုင်းအတာသတ်မှတ်ခြင်း (Scoping Report) အစီရင်ခံစာကို ပြင်ဆင်ရေးသားရန်။

၂။ ကနဦးကွင်းဆင်းလေ့လာခြင်း (Baseline Studies) စီမံကိန်းလေ့လာမှု ဧရိယာအတွင်း ခြောက်သွေ့ရာသီနှင့် စိုစွတ်ရာသီ နှစ်ခုလုံး၏ လက်ရှိပတ်ဝန်းကျင်အနေအထား အချက်အလက်များကို ကောက်ယူရန်။

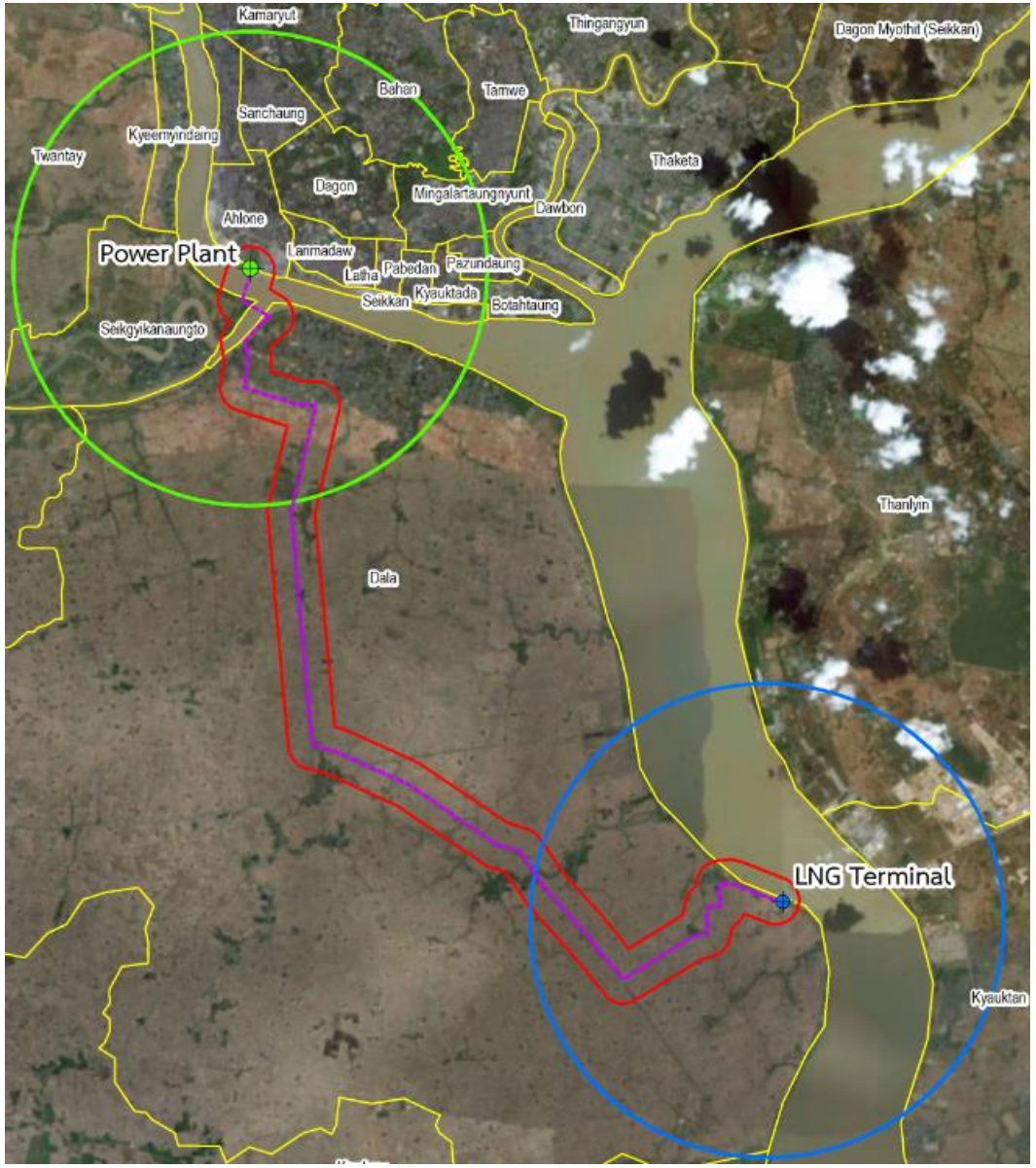
၃။ သက်ရောက်နိုင်မှုများကို တွက်ထုတ်ခြင်း (Impact Assessment) စီမံကိန်းနှင့်ပတ်သတ်၍ ကနဦးပတ်ဝန်းကျင် အခြေအနေများ ပျက်ယွင်းနိုင်ခြေ ရှိမရှိကို တွက်ချက်ဖော်ထုတ်ရန်။

၄။ သက်ရောက်မှုကို ထိန်းချုပ်ခြင်း (Management Measures) စီမံကိန်းနှင့်စပ်လျဉ်းကာ ဆိုးကျိုးသက်ရောက်နိုင်ခြေများကို လျော့ချ၍ ကောင်းကျိုးသက်ရောက်နိုင်ခြေများကို တိုးမြှင့်ပေးနိုင်ရန် အစီအစဉ်များ ရေးဆွဲရန်။

၅။ အစီရင်ခံစာ (Report) သက်ရောက်မှုလျော့ချခြင်း အစီအစဉ်များ လက်တွေ့ကျခြင်း မကျခြင်းများကို သုံးသပ် တင်ပြရန်။

လေ့လာသည့် ဧရိယာ

- စွမ်းအင်စက်ရုံမှ ၅ ကီလိုမီတာအချင်း
- LNG လက်ခံဂိတ်မှ ၅ ကီလိုမီတာအချင်း
- ပိုက်လိုင်းတစ်ဖက်တစ်ချက် ၅၀၀ မီတာ



ကနဦး အခြေအနေ သုံးသပ်မှု

စီမံကိန်းလေ့လာမှု ဧရိယာအတွင်း ကနဦး အခြေအနေ သုံးသပ်မှုများကို ခြောက်သွေ့ရာသီနှင့် စိုစွတ်ရာသီ နှစ်ခုလုံးမအတွက် ကွင်းဆင်းလေ့လာခဲ့ပြီးဖြစ်ပါသည်။ ကနဦး ဆန်းစစ်မှုကာလအတွင်း အောက်ပါအချက်အလက်များ ကို ကောက်ယူခဲ့ပါသည်။

- မြေပေါ်ရေ အရည်အသွေး
- နုန်း
- မြေအောက်ရေ
- မြေအမျိုးအစား
- လေထု အရည်အသွေး

LNG လက်ခံဆိပ်ကမ်းတွင် လုပ်ဆောင်မည့် လှုပ်ရှားမှုများ

ဆောက်လုပ်ရေးကာလ	■ မြေပေါ်ရေအရည်အသွေး ■ ရေနေဇီဝ ■ ရေယာဉ်အသွားအလာ ■ လေထု ■ ဆူညံသံ
လည်ပတ်မောင်းနှင်ကာလ	■ ရေအေးစွန့်ထုတ်မှု ■ မြေပေါ်ရေအရည်အသွေး ■ ရေနေဇီဝ ■ နှုန်းတင်ပို့ချမှု ■ လေထု ■ အများပြည်သူကျန်းမာရေးနှင့်ဘေးကင်းလုံခြုံရေး ■ မထင်မှတ်သည့် ဖြစ်ရပ်

ဓာတ်ငွေ့ပိုက်လိုင်းဧရိယာအတွင်း လုပ်ဆောင်မည့် လေ့လာမှုများ

ဆောက်လုပ်ရေးကာလ	■ လေထု ■ ဆူညံသံ ■ မြေပေါ်ရေ အရည်အသွေး နှင့် အကြီးစားလွှန်ထိုးစက်မှ မြေထွက်ပေါ်မှု
လည်ပတ်မောင်းနှင်ကာလ	■ အများပြည်သူကျန်းမာရေးနှင့်ဘေးကင်းလုံခြုံရေး ■ မထင်မှတ်သည့် ဖြစ်ရပ်

လျှပ်စစ်ဓာတ်အားပေး စက်ရုံ ဧရိယာအတွင်း လုပ်ဆောင်မည့် လေ့လာမှုများ

ဆောက်လုပ်ရေး ကာလ	■ လေထု ■ ဆူညံသံ ■ ယာဉ်အသွားအလာ
လည်ပတ်မောင်းနှင် ကာလ	■ လေထု ■ အပူစွန့်ထုတ်မှု ■ မြေပေါ် ရေအရည်အသွေး

စီမံကိန်း နှင့် သက်ဆိုင်သူများအား ညှိနှိုင်းဆွေးနွေးသွားမည့် လုပ်ငန်းစဉ်

- စီမံကိန်းအချက်အလက်များကို သက်ဆိုင်သူများထံ ဖော်ပြပေးရန် နှင့် သက်ဆိုင်သူများမှလည်း စီမံကိန်းနှင့်စပ်လျဉ်း၍သိလိုသည်များကို မေးမြန်းစုံစမ်းခွင့်ရှိစေရန်
- သက်ဆိုင်သူများ၏ အကြံပြုချက်များကို ပတ်ဂန်းကျင်၊ လူမှုဝန်းကျင် ထိခိုက်မှု ဆန်းစစ်လေ့လာရာတွင် ထည့်သွင်းစဉ်းစားပေးသွားရန်။
- မြန်မာ့စံချိန်စံညွှန်း ၊ နိုင်ငံတစ်ကာစံညွှန်းများနှင့် ကိုက်ညီသော ပတ်ဂန်းကျင်၊လူမှုဝန်းကျင် ထိခိုက်မှု ဆန်းစစ်ခြင်း ရရှိစေရန်။

စီမံကိန်း နှင့် သက်ဆိုင်သူများအား ညှိနှိုင်းဆွေးနွေးခြင်း

ညှိနှိုင်းဆွေးနွေးခြင်း လုပ်ငန်းများကို ပတ်ဝန်းကျင်ဆန်းစစ်မှု ကာလ မှ စတင်ကာ စီမံကိန်း သက်တမ်းတစ်လျှောက် ဆောင်ရွက်ပေးသွားမည်ဖြစ်ပါသည်။ ဆက်လက်ဖော်ဆောင်ရမည့် အစီအစဉ်များမှာ

- တိုင်ကြားချက်များအတွက် လုပ်ထုံးလုပ်နည်း ချမှတ်ခြင်း
- ကနဦး လူမှုစီးပွားလက္ခဏာများ လေ့လာခြင်း (သက်ဆိုင်ရာ ရပ်ကွက်၊ကျေးရွာ အဖွဲ့အစည်း ၊ဌာနဆိုင်ရာတို့နှင့် ပူးပေါင်း၍)
- သက်ရောက်နိုင်ခြေ အကဲဖြတ်ခြင်း မူကြမ်းကို တင်ပြရန် အတွက် အများပြည်သူနှင့် တိုင်ပင်ဆွေးနွေးခြင်း နှင့် ထုတ်ဖော်တင်ပြခြင်း အစည်းအဝေး (၂)
- သက်ရောက်နိုင်ခြေ အကဲဖြတ်ခြင်း များ အစီရင်ခံစာကို ထုတ်ဖော်ပြသပေးခြင်း (Final ESIA Report)

Grievance Mechanism

တိုင်ကြားချက်များအတွက် လုပ်ထုံးလုပ်နည်းချမှတ်ပေးခြင်းသည်လည်း ဖော်ပြခဲ့ပြီးသော ညှိနှိုင်းဆွေးနွေးလုပ်ငန်းစဉ်များ၏ အစိတ်အပိုင်းတစ်ခု ဖြစ်ပါသည်။

- စီမံကိန်း နှင့်ပတ်သတ်၍ သက်ရောက်မှုခံရသူအားလုံးမှ တိုင်ကြားလိုခြင်း၊ အကြံပေးလိုခြင်းများ ရှိပါက အချိန်မရွေး တင်ပြ နိုင်ပါသည်။
- ပတ်ဂန်းကျင်၊ လူမှုဂန်းကျင်ထိခိုက်မှု ဆန်းစစ်သည့် လုပ်ငန်းစဉ်အတွင်း တစ်စုံတစ်ရာ မကျေနပ်ချက်၊ အကြံပေးလိုချက် ၊ မေးလိုချက် များ ရှိပါကလည်း လုပ်ထုံးလုပ်နည်းလျော်ညီစွာ တင်ပြနိုင်ပါသည်။
- အသေးစိတ်ကို လက်ကမ်းစာစောင်တွင် ကြည့်ရှုလေ့လာနိုင်ပါသည်။

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Q & A section

ကျေးဇူးတင်ရှိပါသည်။

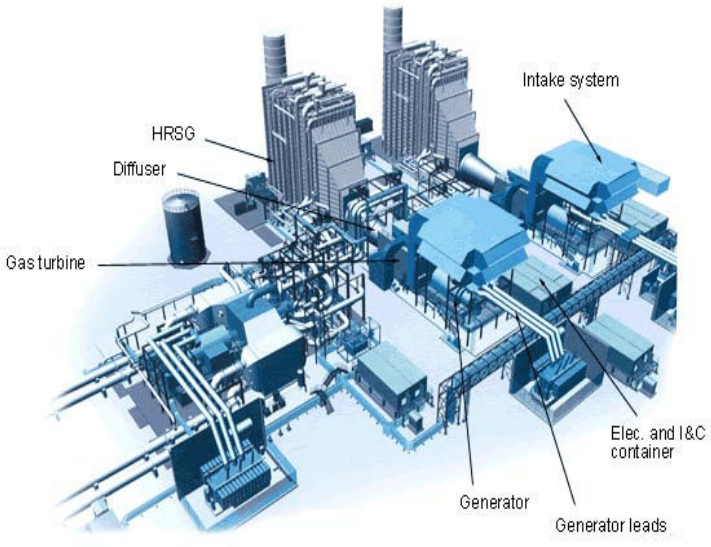
The business of sustainability

ERM

APPENDIX II PUBLIC PARTICIPATION NO.1 PRESENTATION (BURMESE)

TTCL POWER MYANMAR COMPANY LIMITED (TPMC)

TTCL Power Myanmar Company Limited (TPMC) မှာ ထိုင်းနိုင်ငံအခြေစိုက် Engineering Company ကြီးဖြစ်သော TTCL Public Company Limited ၏ လက်အောက်ခံ ကုမ္ပဏီတစ်ခုဖြစ်ပြီး ယခုအဆိုပြု LNG ဓာတ်အားပေးစက်ရုံ စီမံကိန်း၏ operation & maintenance ကို တာဝန်ယူ လုပ်ဆောင်သွားမည် ဖြစ်မည်။



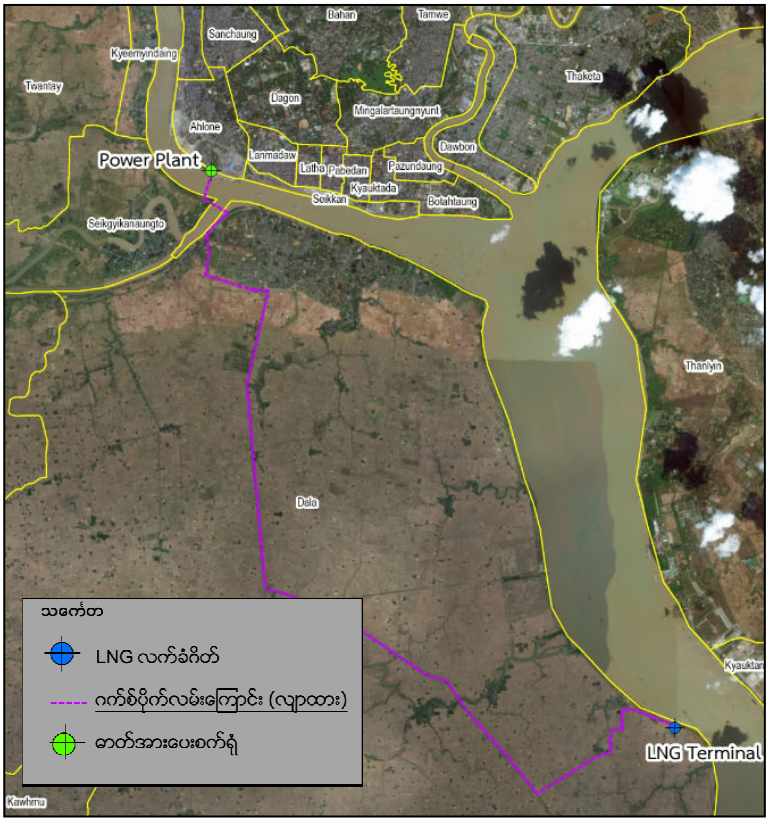
စီမံကိန်း

မြန်မာနိုင်ငံ၏ လျှပ်စစ်စွမ်းအင် ကဏ္ဍ ကိုထောက်ပံ့ဖြည့်ဆီးပေးရန်အတွက် ၃၈၈ မီဂါဝပ် ထွက်ရှိထွက်ရှိမည့် ပေါင်းစပ်လည်ပတ်စွမ်းအင်စက်ရုံ (Combine Cycle Power Plant) တစ်ခုကိုလက်ရှိအလုံဓာတ်အားပေးဝင်းတွင်းတွင် အသစ်တည်ဆောက်သွားမည်ဖြစ်ပါသည်။ စီမံကိန်းတွင် LNG လက်ခံဆိပ်ကမ်း၊ ဓာတ်အားပေးရုံသို့ သွယ်ယူမည့် ဂက်စ်ပိုက်လိုင်း နှင့် ၂၃၀ ကေဗွီ ဓာတ်အားပေးလိုင်း အသစ် သွယ်တန်းခြင်း တို့လည်းပါဝင်မည်ဖြစ်ပါသည်

အဓိကလောင်စာအတွက် သဘာဝဓာတ်ငွေ့ရည် (L N G) ကို ပြည်ပမှ တင်သွင်းအသုံးပြုသွားမည်ဖြစ်သည်။ အထူးတည်ဆောက်ထားသော သင်္ဘောများဖြင့် တင်သွင်းလာသော သဘာဝဓာတ်ငွေ့အရည်ကို LNG လက်ခံဆိပ်ကမ်းမှ တ စ်ဆင့် သဘာဝဓာတ်ငွေ့အဖြစ်ပို့ဆောင်သွားမည်ဖြစ်သည်။စီမံကိန်းဆောက်လုပ်ရေးကာလကို ၂၀၁၉ နှစ်လယ်လောက်တွင် စတင်မည်ဟု ခန့်မှန်းထားပြီး၊ စက်ရုံစတင်လည်ပတ်မည့် ကာလကိုတော့အတည်မပြုရသေးပါ။

July 2017 စီမံကိန်းကို လျှပ်စစ်နှင့်စွမ်းအင်ဝန်ကြီးဌာန (MOEE) သို့ TTCL ကုမ္ပဏီက စတင်အဆိုပြုတင်ပြခဲ့ပြီး ဝန်ကြီးဌာနနှင့် ဆွေးနွေးမှုအကြိမ်ကြိမ် ဆောင်ရွက်ခဲ့ပါသည်။

January 2018 မြန်မာ့လျှပ်စစ်နှင့်စွမ်းအင်ဝန်ကြီးဌာန (MOEE)က စီမံကိန်းအားဆက်လက်ဆောင်ရွက်ရန် အသိအမှတ်ပြုလွှာ Notice to Proceed (NTP) ကို TTCL အား အပ်နှင်းခဲ့ပါသည်။



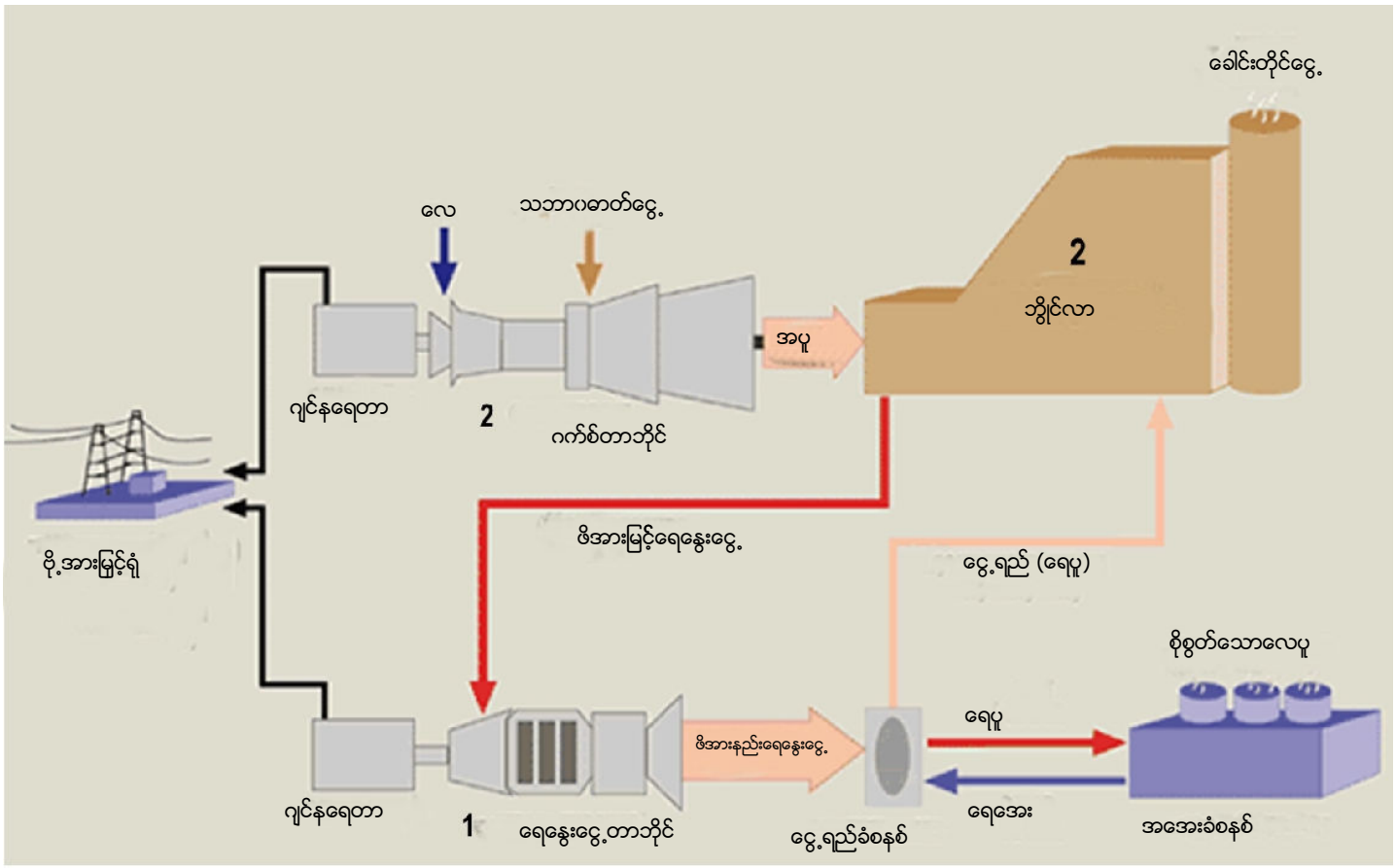
လျာထားစီမံကိန်းနေရာ

၃၈၈ မီဂါဝပ် ထွက်ရှိမည့် ဓာတ်အားပေးစက်ရုံ အသစ်(Combine Cycle Power Plant) မှာ လက်ရှိ ၁၂၀ မီဂါဝပ် ဓာတ်အားပေးရုံ လည်ပတ်နေသည့် အလုံမြို့နယ် လျှပ်စစ်ဝင်းအတွင်းတည်ရှိမည် ဖြစ်ပါသည်။ မြေ ၈.၁၆ ဧက ခန့်
ခန့် ရယူအသုံးပြု၍ တည်ဆောက် သွားမည်ဖြစ်သည်။

LNGလက်ခံဆိပ်ကမ်းမှ ၁ ဒေသမြို့နယ်၏တောင်ဘက်ပိုင်း ရန်ကုန်မြစ်ကမ်းေ ဘးတွင် တည်ရှိမည်ဖြစ်၍ မြေ ၁၅ ဧက ခန့်အသုံး ပြု၍ တည်ဆောက်သွားမည်ဖြစ်သည်။

သဘာဝဓာတ်ငွေ့ပိုက်လိုင်းမှာLNGလက်ခံဆိပ်ကမ်းမှစတင်ကာ ကားလမ်းမဘေးမှ မှတစ်လျှောက် ထိုမှတစ်ဆင့်တွဲတေးတူးမြောင်းကို ဖြတ်သန်း၍ ဆိပ်ကြီးခနောင်တိုဆိပ်ကမ်းဘက်ခြမ်းမှ အလုံစက်ရုံဆီသို့ ရန်ကုန်မြစ်အောက်ခြေမှ သွယ်တန်းတည်ဆောက်မည်ဟု လက်တစ်လောတွင်လျာထားပါသည်။ ပိုက်လိုင်း၏ စုစုပေါင်းအရှည်မှာ ၂၄.၄ ကီလိုမီတာ ခန့်ရှိမည်ဖြစ်သည်။

ပေါင်းစပ်လည်ပတ်စွမ်းအင်စက်ရုံ (Combine Cycle Process)

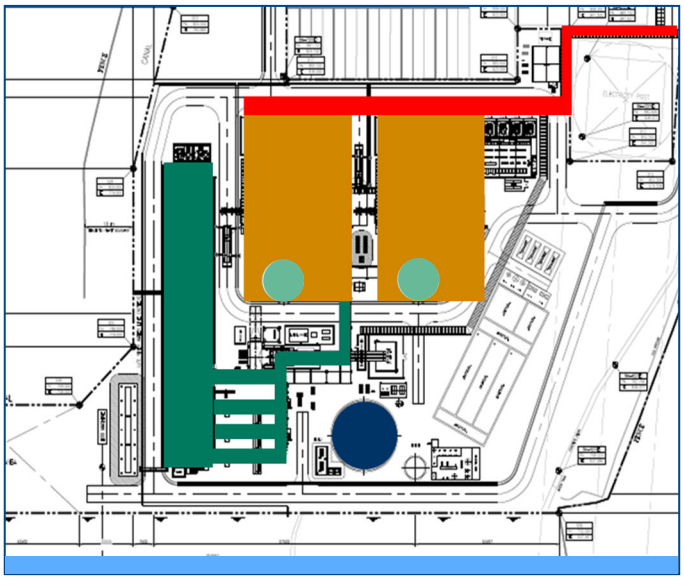


ပေါင်းစပ်လည်ပတ်စွမ်းအင်စက်ရုံ (Combine Cycle Power Plant) ဆိုသည်မှာ ဂက်စ်တာဘိုင် ၊ ရေနွေးငွေ့တာဘိုင် တို့တို့ကို အသုံးပြု၍ လျှပ်စစ်ဓာတ်အားကို နည်းလမ်းနှစ်သွယ် (တစ်နည်းအားဖြင့်) နှစ်ဆင့်ထုတ်ယူခြင်းဖြစ်သည်။

ပထမအဆင့်တွင် သဘာဝဓာတ်ငွေ့လောင်စာသုံး ဂက်စ်တာဘိုင်ကို မောင်းနှင်၍ ချိတ်ဆက်ထားသော ဂျင်နရေတာကို လည်ပတ်စေကာ ဓာတ်အားထွက်ရှိလာသည်။

ဒုတိယအဆင့်တွင် ဂက်စ်တာဘိုင်မှ ထွက်ရှိလာသော အပူစွမ်းအင်ကို ဘွိုင်လာတွင် အသုံးချ၍ ရေနွေးငွေ့ထုတ်ယူကာ ရေနွေးငွေ့တာဘိုင် ကို လည်ပတ်စေသည်။ ထိုမှတစ်ဆင့် ချိတ်ဆက်ထားသော ဂျင်နရေတာကို လည်ပတ်စေကာ ဓာတ်အား နောက်တစ်ဆင့် ထွက်ရှိလာသည်။

စွမ်းအင်စက်ရုံ (Power Plant Layout)



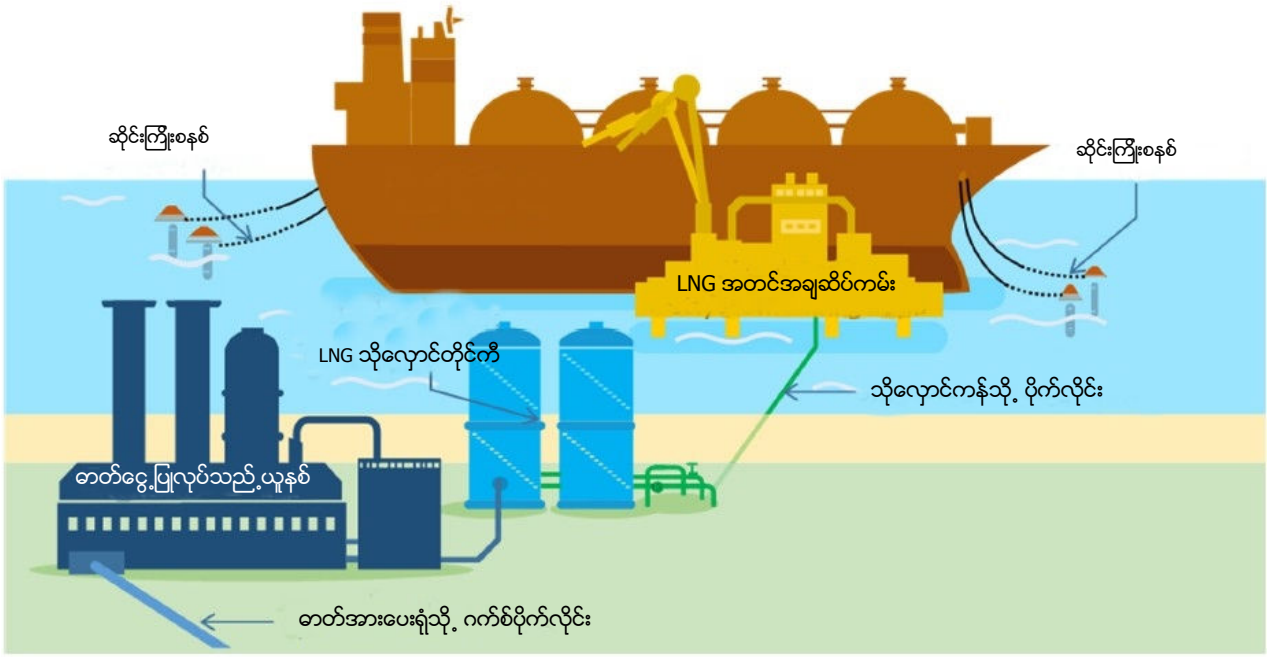
အညွှန်း

- ရန်ကုန်မြစ်
- ရေတိုင်ကီ
- ဓာတ်အားလိုင်း
- ရေအအေးခံ စင်မြင့်
- ဓာတ်ငွေ့တာဘိုင် နှင့် ရေနွေးငွေ့တာဘိုင်
- ခေါင်းတိုင်

LNGလက်ခံဆိပ်ကမ်း

အဓိကလောင်စာအတွက်သဘာဝဓာတ်ငွေ့ရည် (LNGကို ပြည်ပမှသဘော်ကြီးများဖြင့်တင်သွင်းရမည်ဖြစ်၍LNGအကူးအပြောင်းအခြေခံအဆောက်အဦးများ တည်ဆောက်ရန်လို လိုအပ်ပါသည်။

လက်ခံဆိပ်ကမ်းတွင် LNG အတင်အချ ဆိပ်ခံတံတား ၊ LNG သိုလှောင်တိုင်ကီ ၂ လုံး (တစ်လုံးလျှင် ၁၉,၀၀၀ ကုဗမီတာ) နှင့် သဘာဝဓာတ်ငွေ့ ပြုလုပ်သည့် ယူနစ် Open rack vaporizers (ORV) or Intermediate fluid vaporizers (IFV). စသည်တို့ ပါဝင်တည်ဆောက်မည်ဖြစ်သည်။



သဘာဝပတ်ဝန်းကျင် နှင့် လူမှုဝန်းကျင်တို့အကြား ဖြစ်ပေါ်လာနိုင်သည့် သက်ရောက်မှုများကို လေ့လာခြင်း

စီမံကိန်းနှင့်စပ်လျဉ်း၍ ဖြစ်ပေါ်လာနိုင်သည့် သဘာဝပတ်ဝန်းကျင် နှင့် လူမှုပတ်ဝန်းကျင်တို့အကြား ဖြစ်ပေါ်လာနိုင်သည့် သက်ရောက်မှုများကို ကောင်းမွန်စွာ သိရှိသဘောပေါက်နိုင်ရန်အတွက် လေ့လာဆန်းစစ်ခြင်း လုပ်ငန်းစဉ်များကို ဆောင်ရွက်လျက်ရှိပါသည်။

အဆိုပါ ဆန်းစစ်မှုများကို လုပ်ဆောင်ရာတွင် ပြဌာန်းထားသော မြန်မာနိုင်ငံ၏ သဘာဝပတ်ဝန်းကျင်ဥပဒေ အပါအဝင် **Finance Corporation (IFC), World Bank Group** ကဲ့သို့သော နိုင်ငံတစ်ကာ စံချိန်စံညွှန်း လမ်းညွှန်ချက်များနှင့်လည်း လျော်ညီစွာ ဆောင်ရွက်နေပါသည်။

သဘာဝပတ်ဝန်းကျင်ဆန်းစစ်မှု အစီရင်ခံစာကို သယံဇာတနှင့်ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဝန်ကြီးဌာန ၊ ပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဦးစီးဌာနသို့ တင်ပြကာခွင့်ပြုချက် ရယူရပါမည်။

သက်ရောက်မှုဆန်းစစ်မည့် အကြောင်းအရာ

ရေနေဇီဝ	မြေပေါ်ရေ အရည်အသွေး	ဆူညံသံ
လူမှုဝန်းကျင်နှင့် ကျန်းမာရေး	မြေဆီလွှာ အရည်အသွေး	စွန့်ပစ်ပစ္စည်း
ယဉ်ကျေးမှုဆိုင်ရာ	လေထုအရည်အသွေး	ယာဉ်အသွားအလာ

ပတ်ဂန်းကျင်ဆန်းစစ်ခြင်းလုပ်ငန်းစဉ်များ

သက်ဆိုင်ရာလူထုနှင့် ညှိနှိုင်းခြင်းများ

ပတ်ဂန်းကျင်ဆန်းစစ်ခြင်းဆိုင်ရာEIAလုပ်ငန်းစဉ်များနှင့် ပတ်သတ်၍ သက်ဆိုင်ရာဒေသခံလူထုနှင့် ညှိနှိုင်းခြင်းများကို အလုံ၊ ဒဂုံ ၊ လမ်းမတော် ၊ ဒဂဝ ဆိပ်ကြီးခနောင်တို ၊ ဆိပ်ကမ်းနှင့် သန်လျင်မြို့နယ်တို့တွင် ပြုလုပ်သွားမည်ဖြစ်သည်။

ညှိနှိုင်းခြင်းလုပ်ဆောင်ရာတွင် လူထုပါဂင်ဆွေးနွေးပွဲ ပြုလုပ်ခြင်း ၊ အသိပေးဆိုင်းဘုတ်များ ဖော်ပြပေးခြင်း၊ အချက်အလက်များကို စီမံ အချက်အလက်များကို စီမံကိန်းwebsite တွင် ဖော်ပြပေးခြင်းတို့ ပါဂင်သည်။

စီမံကိန်းနှင့်ပတ်သက်၍ ဆက်သွယ်မေးမြန်း အကြံပေးရန်

TTCL Power Myanmar Co., Ltd. (TPMC)

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APPENDIX JJ BUSINESS INFORMATION DOCUMENT (BURMESE)

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www.erm.com

Minutes of Meeting

To	Tun Lin Kyaw
CC	ERM-Siam: Vincent Lecat
From	Environmental Resources Management (ERM-Siam)
Date and Location of Meeting	29th October 2018 Ahlone Township Hall, Ahlone Township, Yangon Region
Project Reference	0439461 TTCL Ahlone Expansion
Subject	Ahlone Township Public Consultation Meeting No.1

Agenda

- Registration
- Introduction of meeting by TTCL Meeting Coordinators
- Introductory words
- Presentation by TTCL (Htet Aung Mon)
- Presentation by ERM (Khinsusu Naing)
- Questions and Answers Period
- Closing Comments/Conclusion speech

No.	Key Discussion	Response
1	**Daw Khin Thwe Thwe Tun (Mr.), (Ward Administrator), Dagon Township** ■ How much is the tariff rate? ■ How will you prevent Accidents? ■ How will you manage the compensation for local? ■ How do you plan to ensure safety of operations?	**Htet Aung Mon (Mr.), TTCL & Thurein Than (Mr.), TPMC** ■ At the moment, we cannot disclose the tariff rate as we are under discussion with MOEE for the Power Purchase Agreement. The final tariff rate from discussion with MOEE is only the rate between producer and purchaser for long terms contract. Distribution to households and tariff rate for public is in the scope of MOEE.
		Kin Su Su Naing (Ms.), ERM ■ The accidents is what we call in ESIA term unplanned event. Mitigation measures for unplanned events are

No.	Key Discussion	Response
		included as a part of ESIA report. Project design will input in the assessment process and management plan. Then, we will study what kind of accidents are likely to occur and how to manage them properly. Providing of emergency responses training program are also included in the unplanned management plan.
		Thurein Than (Mr.), TPMC ■ Regarding to compensation, it is true we need to make compensation if there is any impact especially from our gas pipeline construction. However, we can confirm that our compensation with stakeholders will be accordingly with the Myanmar Laws and guidelines from relevant authorities. ■ We, TTCL have separated EHS organization for safety management .It's function includes developing risk assessments and identifying risk factors. Such safety management plan will always developed in cooperation with international safety organization and specialists. Our mother company TTCL hold ISO-9001, ISO-14001 certificates.
2	**U San Tun, (Ward of Administrator), Dagon Township** ■ Could you explain more about the EIA process and procedure? ■ Please explain about gas pipeline material, manufacture and detail gas pipe routing. Will there be any disturbance in water traffic if the gas pipe route line cross the Yangon River.	**Htet Aung Mon (Mr.), TTCL** ■ Thank you the suggestion, bigger screen will be used in the next meeting. ■ Attendants might get bored with detail technical data, therefore only some data were presented but we are available for any specific questions.

No.	Key Discussion	Response
	■ Suggest that the screen is too small to see the presentation, and would like to hear more about technical data such as gas pipeline material, manufacture and piping construction detail.	**Khin Su Su Naing (Ms.), ERM** ■ There is Myanmar EIA procedure published in 2015 by Ministry of Natural Resources and Environmental Conversation (MONREC) previously known as MOECAF. Myanmar EIA procedure has included the categorization of project for EIA process as well as review timeline for each steps. We have to seek for the Ministry approval for respective EIA process (e.g EIA third party appointment, scoping report). For your information, final ESIA report will be reviewed by EIA review committee, which is formed with specialists from each relevant ministries.
		Thurein Than (Mr.), TPMC ■ Both Terminal & gas pipe line of this project are designed in accordance with international standard & guidelines for LNG facilities, as well as implementation of advices from LNG business specialists. Gas pipeline construction will carry out under guideline and supervision from MOGE. Gas pipe construction beneath the Yangon River will take place by using HDD machine. Therefore, no disturbance will occur to water traffic.
3	**U Nay Zar Kyaw, Engineer/ Observer** ■ May I know the project timeline of Terminal and new transmission line? The new transmission line circuit will place on existing towers or new tower line will construct? ■ According to presentation, we have seen 500 m each side of gas pipe in ESIA study area. Will there be prohibited area (safety factor) not to construct any basic infrastructure	**Kyi Thar Zaw Win (Ms.), TTCL** ■ We are in the middle of PPA discussion with MOEE. Project tentative timeline is 28 months after PPA effective. Construction work are expected to start in the middle of 2019. New transmission line towers will be built for 230 KV line. ■ Gas pipeline construction will carry out under the guideline and supervision from MOGE.

No.	Key Discussion	Response
	beside the gas pipeline after construction period?	
4	**U Sit Maung, Ward elder, Ahlone Township** ■ Who will be in charge of monitoring post ESIA? Another third party or ERM? ■ Are there CSR activities carry out by TTCL in previous project? What kind of CSR program will be implemented in this project? ■ Is there long-term contract with supplier for main fuel LNG from substantial sources?	**Khin Su Su Naing (Ms.), ERM** ■ The company who prepare the ESIA report shall not be in charge of ESIA monitoring. The project proponent company shall report to relevant authority in every (6) months to make sure all the mitigation measures are implemented. ECD department is the main responsible ministry for monitoring of post ESIA. In addition, IFC will be one of the monitoring in charge if the project is in line with IFC guidelines and financed by IFC. Every stakeholders have the opportunity to participate in monitoring plan and able to report if there is any issue or concern. **Ni Ni San (Ms.), TTCL & Htet Aung Mon (Mr.), TTCL** ■ In our previous projects, we have organized "CSR committee" which consists of people from local communities. Then we have had contributed and cooperated for local needs in project area such as educational, traditional & health supports. **Hlaing Phone Tint (Mr.), TPMC** ■ We have to contract with LNG supplier for the long-term purchase. We may have to talk with more than one supplier in order to ensure the availability of fuel in long term. It is also important for us to have substantial LNG supplier along the operation period. As we have to compensate MOEE in the case of power could not be produced as per the contract agreement.

No.	Key Discussion	Response
5	**U Than Aye, Resident, Ahlone Township** ■ As per the presentation, I assumed the LNG terminal is located on the riverbank of where Twante Canal meet Yangon River. The current flow in that area is about 7mile/hr. There is high water way traffic every day. Another concern is your proposed terminal location is very close to Dala Town area. So, will it be possible to relocate the LNG terminal to another safer area?	**Kyi Thar Zaw Win (Ms.), TTCL** ■ Our LNG terminal will be located on the riverbank of southern Dala Township, opposite side of Thilawa Industrial Zone. So, it is far from Dala downtown area. The LNGC berthing will take place about once a week .The jetty will be located only in where the Myanmar Port Authorities allowed us, so it will not disturb the river waterway.
6	**U Thet Aung Soe, Engineer** ■ What are the code & standard of gas pipeline construction? API standard or MOGE guideline. ■ What are the code & practice of MOGE? ■ What are the vertical, horizontal clearance of existing and new 230 kV transmission line? Are they in line with right of way guideline from Department of Power Transmission and System Control (DPTSC).	**Kyi Thar Zaw Win (Ms.), TTCL** ■ We are studying API at the moment for gas pipe line construction. However, gas pipeline right of way have not been finalized yet with MOGE. Code and standard for gas pipeline construction will follow MOGE direction. ■ For transmission line right of way, I think the allowed clearance is published on MOEE's website. Our New transmission line right of way is led by DPTSC and their guidance.
7	**U Win Kyaw, Resident, Dagon Township** ■ I am from Dagon township where the furthest township from Power Plant. Why you invited people from 5km radius of project? Does the project have high risk for the residents in nearest Ahlone Township?	**Vincent Lecat (Mr.), ERM & Khin Su Su Naing (Ms.), ERM** ■ We have to determine the potential Area of Influence for the project (appropriate study area) for the project in accordance with IFC guideline and ECD guideline. The study area of this project have been determined at 5km radius to ensure all potential impacts are accounted for and the base line data have been collected for that area. Then, we will carry out the modeling work to identify the potential impact from project to resources. As per the results from EIA modeling study, we will

No.	Key Discussion	Response
		decide whether extension of study area are required.

■ Attendance list

169 persons from Government Organizations and Village Responsibilities and 13 persons from company attend the meeting.

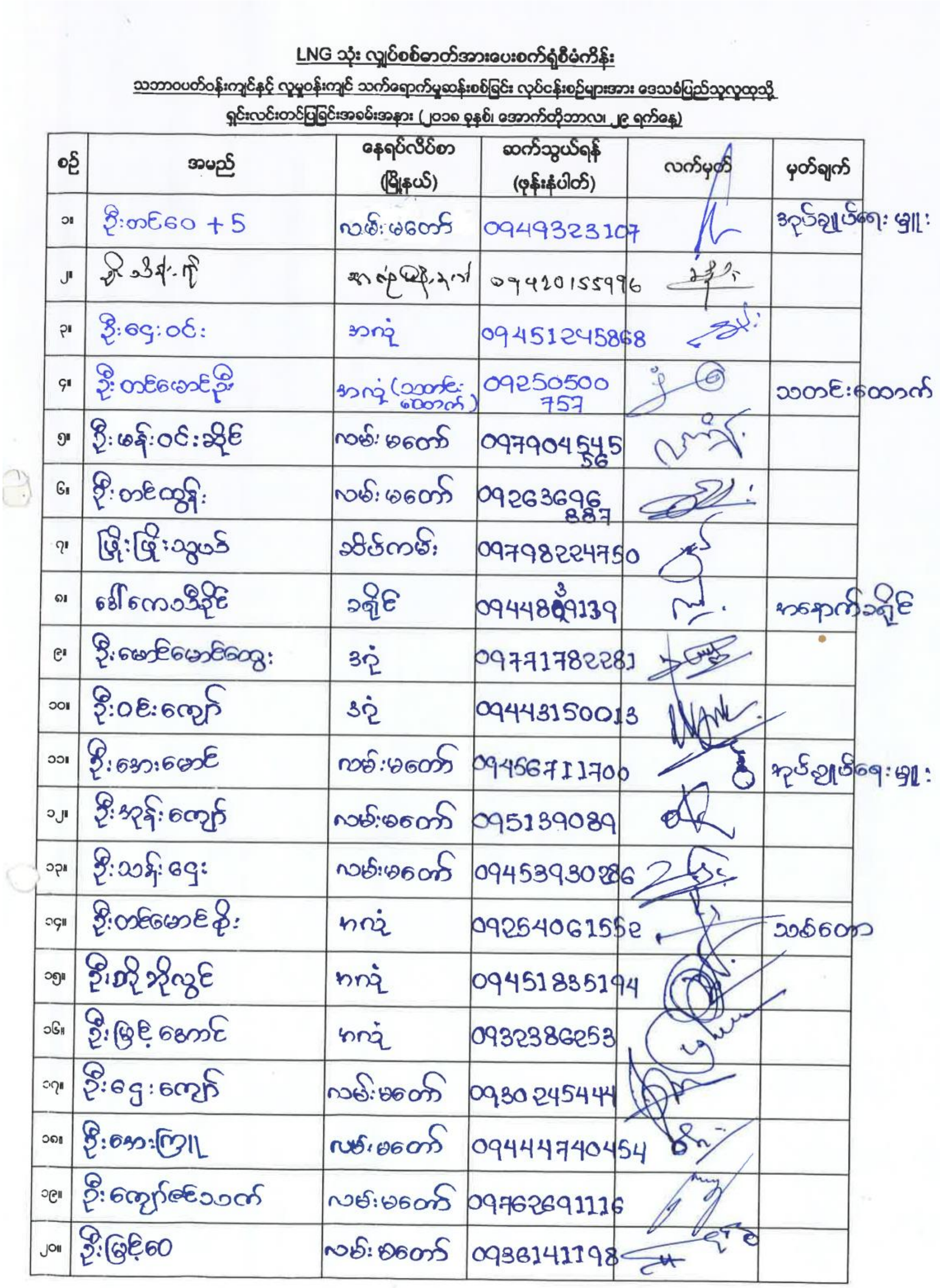
No.	Name	Position/Occupation	Department/Organization	Contact No.
1	U Tin Wai + 5	Township Chief Officer (GAD)	Lanmadaw	0949323107
2	U Thein Yi	-	Ahlone	09420155996
3	U Htay Win	-	Ahlone	09451245868
4	U Tin Maung Oo	Journalist	Ahlone	09250500757
5	U Mann Win Saing	-	Lanmadaw	09790454556
6	U Tin Tun	-	Lanmadaw	09263696887
7	Daw Phyo Phyo Thwal	-	Seik Kan	09798224750
8	Daw Kay Thi Khine	-	Yangon West District	09448039139
9	U Maung Maung Htway	-	Dagon	09771782281
10	U Win Kyaw	-	Dagon	09443150013
11	U Aye Maung	-	Lanmadaw	09456711700
12	U Ohn Kyaw	-	Lanmadaw	095139089
13	U Than Htay	-	Lanmadaw	09453930286
14	U Tin Maung Soe	Forestry Department	Ahlone	09254061552
15	U Bo Bo Lwin	-	Ahlone	09451835194
16	U Myint Aung	-	Ahlone	0932386253
17	U Htay Kyaw	-	Lanmadaw	0930245444
18	U Aye Kyu	-	Lanmadaw	09444740454
19	U Kyaw Zin Thet	-	Lanmadaw	09762691116
20	U Myint Wai	-	Lanmadaw	0936141198
21	U Win Myint	-	Ahlone	0978118015
22	U Than Htay	-	Dagon	-
23	U Kyaw Ngwe	-	Dagon	-
24	U Hla Soe	-	Dagon	09954307182
25	U Thike Soe	-	Dagon	09443027446
26	U Thein Soe	-	Lanmadaw	09456711700
27	U Sann Tun	-	Dagon	095021124
28	U Aung Myo Minn	-	Lanmadaw	09443225545
29	U Sein Hote	-	Lanmadaw	095171799
30	U Thein Han	-	Lanmadaw	09254515725
31	U Myint Sein	-	Lanmadaw	09250050091
32	Dr. L Ni Win	-	Ahlone	095042935
33	U Ye Lwin	Yangon Parliament	Ahlone	09973061147
34	U Kyi Aye	-	Ahlone	09254015856
35	U Htein Linn	-	Ahlone	09440520215
36	U Sitt Maung	-	Ahlone	09254315189
37	U Mya Kyaw	-	Ahlone	09442444496
38	U Thann Aye	-	Ahlone	09781996171
39	U Tin Tun	-	Mingalardon	09793374849
40	Ma Kay Kay	-	Pazundaung	0996831669
41	Daw Tin Tin Thann	-	Ahlone	09254315056
42	U Thann Tun	-	Ahlone	09251045754
43	U Saw Maung Chaw	-	Ahlone	09455680245
44	U Jet Li	-	Ahlone	-
45	U Aung Khin Win	-	-	0989800470

46	U Myo Tint	-	Ahlone	-
47	U Thein Myint Zaw	-	Ahlone	09443879966
48	U Soe Myint Aung	-	Lanmadaw	0973011123
49	U Maung Maung Cho	-	-	09251044744
50	U Ko Ko	-	Ahlone	-
51	U Pauk Kyee	-	Ahlone	-
52	U Tin Sein	-	Ahlone	095003273
53	U Thet Lwin Oo	ECD	-	-
54	U Aung Thu Kyaw	Deputy Director (ECD)	-	-
55	U Soe Win	-	(8) Ward	-
56	U Kyaw Htet Aung	-	Kamaryut	09420004733
57	Ma Swe Swe Aung	-	Ahlone	09421061496
58	U Depa Aung	Ministry of Energy (YESC)	Lanmadaw	09977275722
59	U Bhone Naing + 4	YESC	Dagon	-
60	Daw Moe Moe Win	-	Ahlone	-
61	U Thaung Aye	-	Ahlone	-
62	Daw May Thet Hnin	-	-	-
63	U Soe Moe Thein	-	Ahlone	-
64	U Soe Yarzar	-	Ahlone	-
65	Daw Ei Ei Mon	-	Ahlone	-
66	Daw Thiri Myat Zin	-	Ahlone	-
67	Daw Nwe War	-	Ahlone	-
68	U Ye Min Tun	-	Ahlone	-
69	Daw Myo Myo Sann	-	Ahlone	-
70	U Phyo Chit Aung	-	Ahlone	-
71	Daw Thandar Aung	-	Ahlone	-
72	U Nyan Zin Soe	MRTV – 4 TV Channel	-	09250164659
73	U Moe Zaw Soe	-	Ahlone	-
74	U Myo Tint Zaw	-	Ahlone	-
75	U Than Kyaw Satt	-	Ahlone	-
76	U Shwe Ya Aung	ELEVEN Journal	-	0945042880
77	U Nay Win + 2	-	Dagon	-
78	Daw Pyie Oo Khin	-	Dagon	-
79	Daw May Thati Oo	-	Dagon	-
80	U Nay Zar Kyaw	-	Mayangone	09420220468
81	U Aung Ko Ko	-	Dagon	09451052253
82	U Tin Shwe	-	Lanmadaw	095041442
83	U Tint Swe Aung	-	Lanmadaw	0943038934
84	U Naing Win	-	Lanmadaw	09284349496
85	U Myo Chit	-	Lanmadaw	09799338030
86	U Myo Thein	-	Lanmadaw	0943119897
87	U Yaung Kyaing	-	Lanmadaw	09251037979
88	Ar Bar Han	-	Lanmadaw	09794015568
89	U Shwe Maung	-	Lanmadaw	09428038785
90	U Sann Win	-	Lanmadaw	09420260371
91	U Thann Nyunt	-	Lanmadaw	09783210680
92	U Han Tin	-	Lanmadaw	09254112600
93	U Ye Latt	-	Lanmadaw	09778875670
94	U Ngwe Moung	-	Lanmadaw	0930004624
95	U Thann Htay	-	Lanmadaw	09443184769
96	U Mozert	-	-	-
97	U Zaw Win	-	Lanmadaw	09759650350
98	Daw Aye Aye Mon	-	Lanmadaw	09781193063
99	U Hla Minn	-	Ahlone	0973002674
100	U Soe Myint	-	Dagon	0973222615
101	Daw Win Myint	-	Dagon	09428015254
102	U Thar Shwe	-	Dagon	09401600752
103	Daw Khin Thwal Thwal Htut	-	Dagon	09795163242
104	U Tin Aung Lwin	-	Lanmadaw	095013878

105	U Thann Soe	-	Mingalardon	09779907751
106	U Han Tint	-	(1) Ward, Lanmadaw	09795415318
107	U Khine Gyi	-	(1) Ward, Lanmadaw	09795415318
108	U Pyae Phyo Aung	-	-	09795415318
109	U Thet Shein Win	-	(1) Ward, Lanmadaw	09795415318
110	U Myo Tun	-	(1) Ward, Lanmadaw	09795415318
111	U Myint Oo	-	Anar Gyi Kone, Ahlone	09250155655
112	U Kyaw Wai Minn + 5	-	-	09404413949
113	U Soe Win	-	Aye St., Ahlone	09444437046
114	U Chit Mal	-	Aye St., Ahlone	-
115	U Taung Soe	-	1/507, Thit Taw street, Ahlone	095109855
116	U Maung Maung Swe	-	Saw Yan Paing (East) Ward, Ahlone	09250271383
117	U Tin Nyunt	-	Sin Min St., Ahlone	09254010206
118	U Zaw Lin	-	Saw Yan Paing (East) Ward, Ahlone	095106140
119	U Phyo Kyaw	-	Ahlone	09969661678
120	U Myo Lwin	-	Lanmadaw	09250274655
121	U Swe Aung	-	Lanmadaw	09250274655
122	U Kyaw Win	-	Lanmadaw	09250274655
123	UNREADABLE	-	Lanmadaw	09250274655
124	U Myint Zaw	-	Saw Yan Paing (East) Ward, Ahlone	09250637427
125	U Htin Zaw Latt	-	Htarna St., Ahlone	09795610720
126	U Zaw Win	Township Chief Officer (NLD Party)	-	09420045092
127	U Thein Zaw Lwin	-	Ahlone	0931070217
128	U Thann Htike	Ward (GAD)	Ahlone	095011648
129	U Hla Thein Hlaing	-	Thit Taw St., Ahlone	09250500731
130	U Tun Tun	-	Saw Yan Paing (West) Ward, Ahlone	09921109324
131	U Linn Aung Khaing	Ayeyarwaddy Journal		09403365612
132	U Zin Phyo Htet	-	Thit Taw St., Ahlone	09762299069
133	U Saw Minn Thann	-	Dagon	09425004921
134	Daw Yin Yin Kyi	-	Dagon	09250253823
135	U Minn Lwin	Ayeyarwaddy Journal	-	09254991260
136	Daw Nilar Win	-	Ahlone	09425744327
137	Daw Tin Tin Aung	-	Ahlone	09450012471
138	Daw Thida Khaing	-	Ahlone	09441901722
139	Daw Tin Aye Yi	-	Dagon	095411579
140	Daw Hla Hla Win	-	Dagon	09449783075
141	U Tun Myint	-	Ahlone	09793536716
142	U Yan Naing Oo	-	Ahlone	09445339442
143	U Sein Lwin	-	Bahan	09448016667
144	U Zaw Pyae	-	Ahlone	09785308212
145	Daw May Thet Mon	-	Ahlone	09456366410
146	U Thann Naing	-	Seik Kann	09456880141
147	U Bhone Wai	-	24, Sadan St., Ahlone	0949336913
148	Daw May Hlaing Phyu	-	Ahlone	09799633964
149	U Win Shwe	-	Ahlone	09420118943
150	Daw Kay Zin Oo	-	Ahlone	09977838542
151	U Myint Aung	-	Ahlone	09956031750
152	U Thann Kyaw Sein	-	Ahlone	09262645256
153	Daw Thuzar Linn	Democratic Voice of Burma - DVB TV	Lanmadaw	09420017396
154	U Moe Zaw Swe	-	Ahlone	0943181468
155	Daw Suzzan	-	Ahlone	09421032193
156	U Thurein Tun	-	Ahlone	09400722405
157	Daw Honey Myint Aung	-	Ahlone	09262427296

158	Daw Win Kay Khaing	-	Ahlone	09258545776
159	Daw Myint Myint Kyi	GAD	Ahlone	09250178207
160	Daw Sandar Myo	-	16, Nant Thar St., Ahlone	09250178225
161	U Phyo Thura Myint	Elite Tech Development	-	09421062467
162	U Phyo Chit Aung	GAD	69, Ngu War St., Ahlone	09401639556
163	Daw Theint Nwe Ni Tun	GAD	69, Ngu War St., Ahlone	09442537313
164	U Aung Myint Myat	Lion Energy	40th St., lower block, Kyauktada	09256649488
165	Daw Phyo Pa Pa	-	133, Aung Zay Ya St., Ahlone	09420122315
166	U Ko Ko Latt	-	91-G, 7th St. Lanmadaw	095163051
167	Daw Nyunt Nyunt Myaing	-	UNREADABLE	09421069660
168	Daw Zarni Tun	Fire Departmemt	Ahlone	09950020188
169	Daw Myint Thet Khaing	-	-	09782077190
170	Daw Zin Mar Kyaw	EPC	Ahlone	09421068835
171	U Soe Thein Win	EPC	Ahlone	09448022130
172	U Aung Myo Minn	EPC	Ahlone	09797898951
173	Daw Cherry Wint Thu	GAD	Ahlone	09796769706
174	U Phyo Thainkha	GAD	Ahlone	09402722062
175	U Aung Kyaw Zaul	EPC	Ahlone	09420094249
176	U Wai Tun Naung	-	Tarmwe	09897145732
177	U Thein Soe	-	Ahlone	095084203
178	Dar Thuzar	7 Day TV	-	09422488833
179	U Htway Win	-	Ahlone	09971246779
180	Daw Nay Chi Hlaing	-	Ahlone	09420133291
181	U Zaw Myo Tun	-	Ahlone	09450065106
182	Daw Khin Mar Thann	-	70, Ngu War Street, Ahlone	09400983644

List of Participation (Photos)



LNG သုံး လျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

သဘာဝပတ်ဝန်းကျင်နှင့် လူမှုဝန်းကျင် သက်ရောက်မှုဆန်းစစ်ခြင်း လုပ်ငန်းစဉ်များအား ဒေသခံပြည်သူလူထုသို့

ရှင်းလင်းတင်ပြခြင်းအခမ်းအနား (၂၀၁၈ ခုနှစ်၊ အောက်တိုဘာလ၊ ၂၉ ရက်နေ့)

စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဆက်သွယ်ရန် (ဖုန်းနံပါတ်)	လက်မှတ်	မှတ်ချက်
၁။	ဦးတင်ဝေ + 5	လမ်းမတော်	09449323107	[signature]	ဒုဥက္ကဋ္ဌ၊ ရေးမှူး
၂။	[illegible]	[illegible]	09420155996	[signature]	
၃။	ဦးဖေဝင်း	အလုံ	09451245868	[signature]	
၄။	ဦးတင်မောင်ဦး	အလုံ (သင်္ဘောကျင်း)	09250500757	[signature]	[illegible]
၅။	ဦးဖန်ဝင်းဆိုင်	လမ်းမတော်	09790454556	[signature]	
၆။	ဦးတင်ထွန်း	လမ်းမတော်	09263696887	[signature]	
၇။	မြိုးမြိုးသွယ်	ဆိပ်ကမ်း	09798224750	[signature]	
၈။	ဒေါ်ကေသီနိုင်	ဒဂုံ	0944889139	[signature]	[illegible]
၉။	ဦးမောင်မောင်မွေး	အလုံ	09771782281	[signature]	
၁၀။	ဦးဝင်းကျော်	အလုံ	09443150013	[signature]	
၁၁။	ဦးအေးမောင်	လမ်းမတော်	09456711700	[signature]	ဒုဥက္ကဋ္ဌ၊ ရေးမှူး
၁၂။	ဦးသန်းကျော်	လမ်းမတော်	095139084	[signature]	
၁၃။	ဦးသန်းဆွေ	လမ်းမတော်	09453930286	[signature]	
၁၄။	ဦးတင်မောင်စိုး	အလုံ	09254061552	[signature]	[illegible]
၁၅။	ဦးတိုးအိုလွင်	အလုံ	09451885194	[signature]	
၁၆။	ဦးမြင့်အောင်	အလုံ	0932386253	[signature]	
၁၇။	ဦးဆွေကျော်	လမ်းမတော်	0930245444	[signature]	
၁၈။	ဦးအေးကြူ	လမ်းမတော်	09444740454	[signature]	
၁၉။	ဦးကျော်စိုးသက်	လမ်းမတော်	09762691116	[signature]	
၂၀။	ဦးမြင့်ဝေ	လမ်းမတော်	0986141198	[signature]	

LNG သုံး လျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

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ရှင်းလင်းတင်ပြခြင်းအစမ်းအနား (၂၀၁၈ ခုနှစ်၊ အောက်တိုဘာလ၊ ၂၉ ရက်နေ့)

စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဆက်သွယ်ရန် (ဖုန်းနံပါတ်)	လက်မှတ်	မှတ်ချက်
၁။	ဦးဝင်းမြင့်	အလုံ	0978118015	[signature]	
၂။	ဦးသန်းဌေး	ဒဂုံ	–	[signature]	
၃။	ဦးကျော်ငွေ	ဒဂုံ	–	[signature]	
၄။	ဦးလှစိုး	ဒဂုံ	09954307182	[signature]	
၅။	ဦးသိုက်စိုး	ဒဂုံ	09443027446	[signature]	
၆။	ဦးသိန်းစိုး	လမ်းမတော်	09456711700	[signature]	လမ်းမတော်ရပ်ကွက် [illegible]
၇။	ဦးဆန်းထွန်း	ဒဂုံ	095021124	[signature]	
၈။	ဦးအောင်မျိုးမင်း	လမ်းမတော်	09443225545	[signature]	
၉။	ဦးမိုးဟုတ်	လမ်းမတော်	095171799	[signature]	
၁၀။	ဦးသိန်းဟန်	လမ်းမတော်	09254515725	[signature]	
၁၁။	ဦးမြင့်စိန်	လမ်းမတော်	09250050091	[signature]	
၁၂။	ဒေါက်တာ[illegible]ဝင်း	အလုံ	095042935	[signature]	
၁၃။	ဦးဂုဏ်လွင်	အလုံ	09973061147	[signature]	ပြည်သူ့လွှတ်တော်
၁၄။	ဦးကြည်အေး	အလုံ	09254015856	[signature]	
၁၅။	ဦးထိန်လင်း	အလုံ	09440520215	[signature]	
၁၆။	ဦးစိန်အောင်	အလုံ	09254315189		[signature]
၁၇။	ဦးမြကျော်	အလုံ	09442444496	[signature]	
၁၈။	ဦးသန်းအေး	အလုံ	0978199611	[signature]	
၁၉။	ကိုတင်ထွန်း	မင်္ဂလာဒုံ	09793374849	[signature]	
၂၀။	မကေကေ	ပုဇွန်တောင်	099683166?	kay	

LNG သုံး လျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

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ရှင်းလင်းတင်ပြခြင်းအစမ်းအနား (၂၀၁၈ ခုနှစ်၊ အောက်တိုဘာလ၊ ၂၉ ရက်နေ့)

စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဆက်သွယ်ရန် (ဖုန်းနံပါတ်)	လက်မှတ်	မှတ်ချက်
၁။	ဒေါ်တင်တင်သိန်း	အလုံ	0925481 5056	[signature]	
၂။	ဦးသန်းထွန်း	အလုံ	09251045754	[signature]	
၃။	ဦးစောစော[illegible]	အလုံ	09455680245	[signature]	
၄။	ဦးကျော်လှ	အလုံ	-	[signature]	
၅။	ဦးအောင်ဇော်ဝင်း		0989800470	[signature]	
၆။	ဦးမျိုးတင့်	အလုံ	-	[signature]	
၇။	ဦးသိန်းမြင့်ဇော်	အလုံ	09448879966	[signature]	
၈။	ဦးစိုးမြင့်အောင်	လသာ	73011123	[signature]	
၉။	ဦးမောင်မောင်ချို		2510444744	[signature]	
၁၀။	ဦးကိုကို	အလုံ	-	[signature]	
၁၁။	ဦးပေါက်ကြီး	အလုံ	-	[signature]	
၁၂။	ဦးတင်စိန်	အလုံ	095003273	[signature]	[illegible]ရေးမှူး
၁၃။	ဦးသက်လျှင်ဦး	သဘာဝပတ်ဝန်းကျင်	-	[signature]	
၁၄။	ဦးအောင်ဘုန်းကျော်	သဘာဝပတ်ဝန်းကျင်	-	[signature]	ဒုတိယညွှန်ကြားရေး[illegible]
၁၅။	ဦးစိုးဝင်း	ရပ်ကွက်	-	[signature]	
၁၆။	ကိုကျော်ထက်အောင်	ကမာရွတ်	09428004733	[signature]	
၁၇။	မဆွေဆွေအောင်	အလုံ	09421061496	[signature]	
၁၈။	ကို[illegible]အောင်	လမ်းမတော်	0997727572?		MOE YESC.
၁၉။	ဦးဘုန်းနိုင်	ဒဂုံ	-	[signature]	YESC
၂၀။					*4

LNG သုံး လျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဆက်သွယ်ရန် (ဖုန်းနံပါတ်)	လက်မှတ်	မှတ်ချက်
၁။	မဆိုးဆိုးဝေ	အလုံ	-	[illegible]	
၂။	ဦးသောင်းအေး	အလုံ		[illegible]	
၃။	[illegible]		-	[illegible]	
၄။	ဦးမိုးမိုးထိုက်	အလုံ		[illegible]	
၅။	ဦးမိုးရာဇာ	အလုံ		[illegible]	
၆။	[illegible]	〃		[illegible]	
၇။	ဒေါ်သီရိမြတ်ဇေ	အလုံ	-	[illegible]	
၈။	ဒေါ်နွဲ့ဝါ	အလုံ		[illegible]	
၉။	ဦးဂျမ်းခင်ထွန်း	အလုံ		[illegible]	
၁၀။	မမိုးမိုးဇင်	အလုံ	-	[illegible]	
၁၁။	ဦးဖြိုးချမ်းအောင်	အလုံ	-	[illegible]	
၁၂။	မသဇင်အောင်	အလုံ		[illegible]	
၁၃။	ဥက္ကာဇော်မိုး	MRTV - 4	09250164 659	[illegible]	
၁၄။	ဦးစိုးမိုးကျော်ဦး	အလုံ		-	[illegible]
၁၅။	ဦးမျိုးတင့်ဝေ	အလုံ		-	[illegible]
၁၆။	ဦးသန်းကျော်ဆက်	အလုံ		[illegible]	
၁၇။	[illegible]	Eleven	09-4504 2880	[illegible]	
၁၈။	[illegible]	[illegible]		[illegible]	[illegible]
၁၉။	[illegible]	[illegible]		Pgie.	
၂၀။	[illegible]	〃		May.	

LNG သုံး လျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

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၁။	U Nay Zaw Kyaw	Mayangone Township	09-420220468		
၂။	[illegible]	[illegible]	09. 451052253		
၃။	[illegible]	[illegible]	09 5041442		
၄။	[illegible]	〃	09.45088554		
၅။	[illegible]	〃	09324849940		
၆။	[illegible]	〃	[illegible]		
၇။	[illegible]	〃	09.45119897		
၈။	[illegible]	〃	092510379		
၉။	[illegible]	〃 〃	09794015568		
၁၀။	[illegible]	〃 〃	09.420.387885		
၁၁။	[illegible]	〃	09-420260371		
၁၂။	[illegible]	〃	09-78327660		
၁၃။	[illegible]	〃	0925411280		
၁၄။	[illegible]	〃	09778875670		
၁၅။	[illegible]	〃	0930004624		
၁၆။	[illegible]	〃	09445184769		
၁၇။	[illegible]				
၁၈။	[illegible]	[illegible]	759650356		
၁၉။	[illegible]	[illegible]	0978119306 3		
၂၀။	[illegible]	[illegible]	73002674		

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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဆက်သွယ်ရန် (ဖုန်းနံပါတ်)	လက်မှတ်	မှတ်ချက်
၁။	[illegible]	[illegible]	7322261	[signature]	
၂။	[illegible]	"	[illegible]	[signature]	
၃။	[illegible]	[illegible]	0941160752	[signature]	
၄။	[illegible]	[illegible]	09795143242	[signature]	
၅။	[illegible]	[illegible]	095013878	[signature]	
၆။	[illegible]	[illegible]	0977990775	[signature]	
၇။	[illegible]	[illegible]	0979541598	[signature]	
၈။	[illegible]	"	"	[signature]	
၉။	[illegible]	"	"	[signature]	
၁၀။	[illegible]	"	"	[signature]	
၁၁။	[illegible]	"	"	[signature]	
၁၂။	[illegible]	[illegible]	09-250155655	[signature]	
၁၃။	[illegible]	[illegible]	09-404413949	[signature]	
၁၄။	[illegible]	[illegible]	09-44443744	[signature]	
၁၅။	[illegible]	[illegible]		[signature]	
၁၆။	[illegible]	[illegible]	09-5109855	[signature]	
၁၇။	[illegible]	[illegible]	09280271385	[signature]	
၁၈။	[illegible]	[illegible]	09/1990014	[signature]	
၁၉။	U Zaw Lin	[illegible]	09510140	[signature]	
၂၀။	U PHYO Kyaw	[illegible]	09969661 678	[signature]	

LNG သုံး လျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဆက်သွယ်ရန် (ဖုန်းနံပါတ်)	လက်မှတ်	မှတ်ချက်
၁။	[illegible]	[illegible]	09250274655	[signature]	
၂။	[illegible]	လမ်းမတော်	〃	[signature]	
၃။	ဦးကျော်ဝင်း	လမ်းမတော်	〃	[signature]	
၄။	[illegible]	လမ်းမတော်	〃	[signature]	
၅။	[illegible]	[illegible]	09250634424	[signature]	
၆။	[illegible]	[illegible]	09795610720	[signature]	
၇။	ဦးစောဝင်း	[illegible]	0942004195	[signature]	
၈။	[illegible]	[illegible]	09310702	[signature]	
၉။	[illegible]	[illegible]	095011648	[signature]	
၁၀။	[illegible]	[illegible]	[illegible]	[signature]	
၁၁။	[illegible]	[illegible]	09421109324	[signature]	
၁၂။	[illegible]	[illegible]	09403365612	[signature]	
၁၃။	[illegible]	[illegible]	09762299069	[signature]	
၁၄။	[illegible]	[illegible]	[illegible]	[signature]	
၁၅။	[illegible]	〃	[illegible]	[signature]	
၁၆။	[illegible]	[illegible]	[illegible]	[signature]	
၁၇။	[illegible]	[illegible]	09428742427	[signature]	
၁၈။	[illegible]	〃	0945001247	[signature]	
၁၉။	[illegible]	〃	[illegible]	[signature]	
၂၀။	[illegible]	[illegible]	[illegible]	[signature]	

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၁။	ဒေါ်ရှုရှုဝင်း	[illegible]	44978830	[signature]	
၂။	[illegible]	အလုံ	09-793536716	[signature]	
၃။	[illegible]	အလုံ	09-445339442	[signature]	
၄။	[illegible]	[illegible]	09-448016667	[signature]	
၅။	[illegible]	အလုံ	0978830842	[signature]	
၆။	[illegible]	"	09-456366410	[signature]	
၇။	[illegible]	[illegible]	09456880141	[signature]	
၈။	[illegible]	အလုံ [illegible]	49336913	[signature]	
၉။	[illegible]	[illegible]	09499633904	[signature]	
၁၀။	[illegible]	[illegible]	094201189493	[signature]	
၁၁။	[illegible]	[illegible]	09-977838542	[signature]	
၁၂။	[illegible]	[illegible]	09.956081750	[signature]	
၁၃။	[illegible]	"	09-2626645256	[signature]	
၁၄။	[illegible]	[illegible]	09420017396	[signature]	✓
၁၅။	[illegible]	[illegible]	09-4318 1468	[signature]	
၁၆။	[illegible]	[illegible]	09421032193	[signature]	
၁၇။	[illegible]		[illegible]	[signature]	
၁၈။	[illegible]	[illegible]	[illegible]	[signature]	
၁၉။	[illegible]	"	[illegible]	[signature]	
၂၀။	[illegible]	[illegible]	0925017828	[signature]	

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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဆက်သွယ်ရန် (ဖုန်းနံပါတ်)	လက်မှတ်	မှတ်ချက်
၁။	[illegible]	၁၆-၂၊ ဘာလမ်း	၂၅၀၀၇၈၂၂၉		
၂။	ဦးမြို့သူရမြင့်	Elite Tech Development	09421062467		
၃။	ဦးမြို့ချစ်အောင်	[illegible]	09401639396		
၄။	[illegible]	〃	09-44263719		
၅။	ဦးအောင်မြင့်မြတ်	Lion Energy. [illegible]	09-256649488	29/10.	
၆။	ဒေါ်ဖြိုးပပ	(၁၃၃) အောင်ဇေယျ [illegible]	၀၉-၄၂၀၁၁၃၃၅	Phyo	
၇။	[illegible]	[illegible]	09.516305	29/10/19	
၈။	[illegible]	[illegible]	09 4 210 [illegible]		
၉။	[illegible]	[illegible]	09-450020188		
၁၀။	[illegible]	[illegible]	၀၉၇၈၂၀၇၇၃၉၀		
၁၁။	[illegible]	အလုံ - [illegible]	09-421068835		
၁၂။	[illegible]	[illegible]	09448022130		
၁၃။	ဦးအောင်မျိုးမင်း	အလုံ - [illegible]	09797898951		
၁၄။	[illegible]	အလုံဈေး/[illegible]	09-796769706		
၁၅။	ဦးဖြိုးသိဒ္ဓိ	အလုံဈေး/[illegible]	09402722062		
၁၆။	[illegible]	[illegible]	09-420094249		
၁၇။	[illegible]	[illegible]	09[illegible]32		
၁၈။	[illegible]	[illegible]	[illegible]		
၁၉။	Thuzar	7 Day TV	0942248885		
၂၀။	[illegible]	[illegible]	0997124 6779		

LNG သုံး လျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

သဘာဝပတ်ဝန်းကျင်နှင့် လူမှုဝန်းကျင် သက်ရောက်မှုဆန်းစစ်ခြင်း လုပ်ငန်းစဉ်များအား ဒေသခံပြည်သူလူထုသို့

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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဆက်သွယ်ရန် (ဖုန်းနံပါတ်)	လက်မှတ်	မှတ်ချက်
၁။	[illegible]	အလုံ	09420153291	[illegible]	
၂။	[illegible]	〃	09450065106	[illegible]	
၃။					

LNG သုံး လျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဆက်သွယ်ရန် (ဖုန်းနံပါတ်)	လက်မှတ်	မှတ်ချက်
၁။	[illegible]	၈၀/၉၅ [illegible] အလုံ	09-400983644	[illegible]	
၂။					

Photo

ERM

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South Sathorn Road,
Thungmahamek, Sathorn, Bangkok
10120 | Thailand |

Telephone: (662) 679 5200

www.erm.com

Minutes of Meeting

To	Tun Lin Kyaw
CC	ERM-Siam: Vincent Lecat
From	Environmental Resources Management (ERM-Siam)
Date and Location of Meeting	10th December 2018 Dala Township Hall, Dala Township, Yangon Region
Project Reference	0439461 TTCL Ahlone Expansion
Subject	Dala Township Public Consultation Meeting No.1

Agenda

- Registration
- Introduction of meeting by TTCL Meeting Coordinators
- Introductory speech
- Presentation by TTCL (Htet Aung Mon)
- Presentation by ERM (Khinsusu Naing)
- Questions and Answers Period
- Closing Comments/Conclusion speech

No.	Key Discussion	Response
1	**N/A, Ward Elder, Dala** ■ Have you considered the natural disasters like Earthquake in your terminal design? ■ Will the jetty from your terminal make impact to riverbank and river waterway? ■ Are there any impact from vessel anchored to the jetty? ■ Suggested to proceed the Project with none (or) minimum impact to environment.	**Toshihiro Sakai (Mr.), TTCL** ■ When we design the foundation of Terminal, we have to implement the earthquake zone information (seismic factor) in design. Also, there is Myanmar National Building Code (MNBC 2016) to implement in associated building design **Kyi Thar Zaw Win (Ms.),TTCL** ■ Unlike ordinary jetty, the width of LNG receiving jetty is just about 60 feet, only the jetty mooring area is about 200m. Also, our selected terminal area has 10m water depth .So, dredging work is

No.	Key Discussion	Response
		not required and it will not make impact to water way.
		Htet Aung Mon (Mr.), TTCL ■ LNG vessel will come to anchor at the jetty approximately 3 times/ month. Maximum anchoring time is about 1.5 days for LNG unloading process. So, it will not make impact to traffic in river and water way.
2	**U Hla Maung, Red Cross member, Seikkyikhanaungto** ■ Since your proposed gas pipeline will be passing through residential area and agriculture lands, how will you compensate people?	**Kyi Thar Zaw Win (Mr.), TTCL** ■ Considering minimum impact to residential area & agriculture land, our current gas pipeline has been designed to route in parallel with Dala - Danote main road. We will seek approval of our pipeline route from YESC, MOGE and other relevant ministries. In the case of impact to privately owned land, we will directly and properly engage with owner in accordance with the guideline from Land Compensation committee. Additionally, as we have mentioned earlier, HDD method will deploy to avoid the damage to road & public properties.
3	**U Tin Maung Aye, (Resident), Seikkyikhanaungto** ■ Will public electricity tariff rate increase just because of the investment costs from this Project?	**Htet Aung Mon (Mr.), TTCL** ■ As we are independent power producer, all the produced power will be sold out to MOEE. Distribution to households and electric charge for public is in the scope of MOEE.
4	**N/A** ■ Why don't you construct both Terminal and power plant at the same location near Letkokkon beach? That would be better for storage and operation as well as safer for people since you don't have to construct the	**Htet Aung Mon (Mr.), TTCL** ■ We do not have the right to select our prefer location to develop the Project. We have to develop Project components only on permitted land/ area by government. The reason why we selected to build up the terminal and jetty in Dala townships is that selected

No.	Key Discussion	Response
	gas pipe line through the residential area.	location has enough water depth to construct the jetty not requiring dredging work. Another reason is Yangon regional government suggested us to locate LNG carrier docking a little further from crowded residential area. As we have mentioned, we are doing our field survey to construct our gas pipeline with minimum impact to public area.
5	**U Thaung, Resident, Kyine kyii village** ■ Are there impact to soil due to gas pipe construction? ■ How would you take Responsibility for Project stakeholder? ■ Are there Job opportunities for local? ■ When construction start and operation period?	**Khin Su Su Naing (Ms.), ERM & Htet Aung Mon (Mr.), TTCL** ■ To determine impacts from Project, the existing soil, and air quality data from study area that are needed were collected to study the potential impact from Project. Depending on the existing air, soil , water quality and potential impact study, mitigation measures and monitoring plan will proposed if necessary. ESIA report including monitoring plan have to submit to MONREC for approval. ■ As the Project will be developed in collaboration with MOEE, we are fully taking responsibilities and seek transparency of the Project. The purpose of this public participation meeting is to inform the stakeholders about our Project and gather any concerns. That is a sign of the transparency of our Project. We will arrange the second time public participation meeting and further detail information will be presented. ■ This Project will create job opportunities for local business and people throughout the construction to operation phases. Due to the plan to hire the local contractors during construction, phase of Project. Local people will also have the chance to be employed in our Project along the operation period. For example, in the Ahlone 1 Project, during

No.	Key Discussion	Response
		first three years of operation phase, foreign technician were working together with locals. Job training were also provided. After 3 years, the plant is running with 95% local employees ■ The Project is estimated to start construction work in the middle of 2019. Project construction will take about 28 months.
6	**Ko Swe Oo Aung, Resident, Thet Kal Kwin Village.** ■ Would you not allow to construct any building in the 5km radius of Project? ■ Does TTCL have plan to make improvement of road access and development of villages near by terminal?	**Khing Su Su Naing (Ms.), ERM** ■ The 5 km radius we mentioned is only the study area for environmental impact for this Project. We are not going to acquire 5km radius of land from Project. We will manage only in our terminal boundary. So, our Project will not make any restriction to adjacent lands.
		Kyi Thar Zaw Win (Ms.), TTCL ■ Environmental impact study area will vary depends on Project type and size. For this Project, we have determined the study area as 5km and base line study has been conduct within this area.
7	**U Myint Htay, Resident, Thet Kal Kwin Village.** ■ Are there going to be any impact to grazing ground and canals nearby Project? ■ Are there going to be any impact on fishing activities in the river?	**Khing Su Su Naing (Ms.), ERM** ■ ESIA assessment will also look into all potential impacts from the Project on existing livelihoods of local people. If there is any impact, ERM will propose mitigation measures in order to reduce impact on existing livelihoods. We will present the results of these studies along with the analysis of potential impacts and proposed management strategies at the second round of public participation.

No.	Key Discussion	Response
		Kyi Thar Zaw Win (Ms.), TTCL ■ Our third party EIA organization will first study the fishing activities in this area. Then management strategies will be developed according to impact study as well as guidance from relevant government authorities.
8	**U Tin Nyunt, Resident, Seikkyikhanaungto** ■ Since Seikkyikhanaungto Township is surrounded by water, we are experiencing river bank collapsing from every aspect. So, how it will affect with your gas pipe construction?	**Kyi Thar Zaw Win (Ms.), TTCL** ■ As we have mentioned, we are in progress of ESIA assessment. We will consider your suggestions for our study and will present the results of these studies along with the analysis of potential impacts and proposed management strategies at the second round of public participation.
9	**U Lay Naing, Resident, Seikkyikhanaungto** ■ Expressed thanks to Project Company for proposing this kind of development in our region. I would urge the Project to proceed successfully.	**N/A**
10	**U Chit Naing Win, Ward leader, Seikkyikhanaungto** ■ In my experience, local farmers were not able to carry on their plantation due to construction material deposit in farmland during gas pipe construction. Moreover, leakage from old gas pipeline are noticed during wet season. ■ I would like to suggest related authorities and Project Company to be aware of this issue and manage for minimum impact to farmers.	**Htet Aung Mon (Mr.), TTCL & Kyi Thar Zaw Win (Ms.), TTCL** ■ We are working on the selection of proper gas pipeline right of way. Once we have concluded the gas pipe right of way with relevant ministries, we will directly engage with impacted landowner. ■ In addition, using quality material for gas pipe is also mandatory for our company. If fuel shortage occurs, we will also have to suffer for not meeting promised power capacity. Therefore, we are fully aware of this matter.

Attendance list

205 persons from Government Organizations and Village Responsibilities and 6 persons from company attend the meeting.

No.	Name	Position/Occupation	Department/Organization	Contact No.
1	U San Thein	-	Seikgyikanaungto Township	09777410703
2	U Tin Win	-	Seikgyikanaungto Township	09781180894
3	U Khin Hlaing	-	Seikgyikanaungto Township	09420197763
4	U Soe Yin	-	Seikgyikanaungto Township	09420197100
5	U Ngwe Hlaing	-	Seikgyikanaungto Township	09765444652
6	U Myint Oo	-	Seikgyikanaungto Township	09420229328
7	U Aung Kyaw Oo	-	Seikgyikanaungto Township	09420229187
8	U Than Nyunt	-	Seikgyikanaungto Township	09956683236
9	U Kyaw Win	-	Seikgyikanaungto Township	09252474994
10	U Kyaw Aung	-	Seikgyikanaungto Township	09458444301
11	U Tin Tun	-	Seikgyikanaungto Township	09255264946
12	U Myio Kyaw	-	Seikgyikanaungto Township	09781468547
13	U Maung Sann	-	Seikgyikanaungto Township	0973901086
14	U Win Naing	-	Tone Tin Gan (North) Village	09796241409
15	U Thaung Tin	-	-	09781340209
16	U Hla Kyaing	-	Tone Tin Gan (South) Village	09798010543
17	U Khin Soe	-	Tone Tin Gan (South) Village	0976558232
18	U Myint Thein	-	Tone Tin Gan (South) Village	09784818489
19	U Chit Hla	-	Tone Tin Gan (South) Village	-
20	U Min Hla	-	Tone Tin Gan (South) Village	09786722102
21	U Tin Aye	-	Kamar Kathwe Ward	09420624086
22	U Tun Myint	-	Kamar Kathwe Ward	09257600121
23	U Myo Thant	-	Tone Tin Gan (South) Village	09976456861
24	U Htay Lwin	-	Dala Township Township (South)	09420014331
25	U Aye Min	-	Seikgyikanaungto Township	09798116165
26	U Zaw Win	-	Dala Township	09450410646
27	U Aung Myint	-	Dala Township	09778575334
28	Daw Su Hlaing Win	-	Dala Township	0943071638
29	U Tun Tun Naing	-	Dala Township	09692229868
30	U Zaw Thein	-	Seikgyikanaungto Township	09448017374
31	U Aung Khaing Htay	-	Seikgyikanaungto Township	09420022392
32	U Than Naing	-	Seikgyikanaungto Township	09420260420
33	U Aung Myo Kyaw	Myawady (Media)	Yangon	09422479283
34	U Win Thein	-	Tar Gyi Village	09777433857
35	U Kyaw Swar	-	Dala Township	09794729372
36	U Zaw Zaw	-	Dala Township	09764597435
37	U Hla Myint	-	Dala Township	09786484305
38	U Soe Hlaing	-	Dala Township	09448032269
39	U Kyaw Thura	-	Dala Township	09455305519
40	U Soe Tint	-	Dala Township	09784521443
41	U Ye Naing	-	Tone Tin Gan (South) Village	0942114469
42	U Nyan Win	-	Seikgyikanaungto Township	09799300373
43	U Thann Zaw Oo	-	Seikgyikanaungto Township	09252056464
44	U Aung Myint	-	Seikgyikanaungto Township	09786673312
45	U Kyaw Lwin	-	Seikgyikanaungto Township	09975781399

46	U Lay Naing	-	Seikgyikanaungto Township	09975781399
47	U Soe Win	-	Seikgyikanaungto Township	09895090116
48	U Khin Maung	-	Seikgyikanaungto Township	-
49	U Mying Thein	-	Seikgyikanaungto Township	-
50	U Kyaw Zin Oo	Ministry of Sports and Physical Education	-	09250847853
51	U Soe Hlaing	-	Tone Tin Gan (South) Village	-
52	U Moe Win	-	Tone Tin Gan (South) Village	09773165952
53	U San Aung	-	Tone Tin Gan (South) Village	09799560041
54	U Win New	-	Tone Tin Gan (South) Village	0932419498
55	U Kyin Thein	-	Tone Tin Gan (North) Village	09494438539
56	U Kyi Thein	-	Tone Tin Gan (South) Village	09787283814
57	U Tun Tun Oo	-	Tone Tin Gan (South) Village	09775541315
58	Daw Zar Zar Linn	-	Seikgyikanaungto Township	09781496210
59	U Thann Tun	-	Seikgyikanaungto Township	09761586906
60	U Thein Han	-	Kamar Kasit Ward	09250054006
61	U Khin Maung Myint	-	Dala Township	09760414351
62	U Kyi Lwin	-	Dala Township	09762712779
63	U Tin Hlaing	-	Dala Township	09798412011
64	U Soe Thein	-	Seikgyikanaungto Township	09799301048
65	U Maung Maung Aye	-	Dala Township	09420149540
66	U Aye Ko	-	Ye Chaung Village	09420195008
67	U Htay	-	Ye Chaung Village	0931699600
68	U Khin Maung Htay	-	Dala Township	09263894752
69	U Hla Htay	-	Ye Chaung Village	0931090607
70	Daw Win Ei Khaing	Township Officer (GAD)	Dala Township	09420090224
71	U Tint Lwin	Posts and Telecommunication Department	-	09423006019
72	UNREADABLE	-	Dala Township	09420119805
73	U Aye Win	-	Dala Township	09799304514
74	U Saw Thein	-	Myo Ma (3) Ward	0943068338
75	U Thein Zaw	-	Dala Township	09798321112
76	U Aung Ko Linn	-	Tha Yaw Tan Village	09450235636
77	U Hla Win	-	Kyar Hpyu Kan Village	-
78	U Thann Zaw Oo	-	Thamata Kan Chay Ward	09773961219
79	U Nay Win	-	Ye Chaung Village	09451119015
80	U Myint Sann	-	Ye Chaung Village	-
81	U Yin Htwe	-	Seikgyikanaungto Township	09251069653
82	U Thann Htike Aung	-	Shwe Pyi Thar Township, Yangon	09420086285
83	Daw Kay Thi	-	Seikgyikanaungto Township	09795521725
84	U Aung Myat Htut	-	Bo Yan Pyay Ward	09262174606
85	U Arkar	Democratic Voice of Burma - DVB TV	-	09420039683
86	U Wai Yan Tun	-	Seikgyikanaungto Township	09972005405
87	U Kyaw Nyi Nyi Paing	-	Thin Gan Gyun Township, Yangon	09696900086
88	U Maung Maung Lwin	-	Seikgyikanaungto Township	09448022946
89	U Aung Naing Myo	-	Seikgyikanaungto Township	09420197913
90	U Kyi Htway	-	Seikgyikanaungto Township	-
91	U Mya Thein	-	Seikgyikanaungto Township	09523050844
92	U Hla Wai	-	Seikgyikanaungto Township	09420260800
93	U Tin Yi	-	Seikgyikanaungto Township	-
94	U Thaung Htay	-	Tone Tin Gan (South) Village	-
95	U Yin Htway	-	Tone Tin Gan (South) Village	09254215856
96	U Win Tun	-	Unknown	09420965286
97	U Htay Aung	-	Unknown	-
98	U Myint Htay	-	Unknown	-

99	U Kyaw Zeyar Tun	-	Tha Ke Ta Township	09972297782
100	U Aung Thann Oo	-	Pu Zun Daung Township	09401529462
101	U Tin Shwe	-	Tha Khin Ba Thaung	-
102	U Aye Hlaing	-	Tha Khin Ba Thaung	-
103	U Tun Win	-	Tha Khin Ba Thaung	-
104	U Khin Maung Win	-	Seikgyikanaungto Township (East)	09772618207
105	U Khin Zaw Aye	-	Seikgyikanaungto Township	09260918092
106	U Soe Hlaing	-	Seikgyikanaungto Township (West)	09260202698
107	U Naing Linn Aung	-		09799298958
108	U Sein Nay Tun	-	Seikgyikanaungto Township (West)	0924052600
109	U Thein Naing Soe	-	Seikgyikanaungto Township (West)	09420197307
110	U Tin Maung Yi	-	Seikgyikanaungto Township (East)	09251069686
111	U Win Myint	-	Seikgyikanaungto Township	095165936
112	U Tint Wai	-	Dala Township	09692929149
113	U Aung Shwin	-	Nyaung Kone Ward	09783514634
114	U Tun Yi	-	Nyaung Pin Village	09798852817
115	U Bo Thann	-	Boe Hpyu Chaung Village	09454526403
116	U Kan wint	-	Seikgyikanaungto Township	09402067617
117	Daw Shu Tin	-	Seikgyikanaungto Township	-
118	Daw Sann Sann	-	-	-
119	U Shwe La Win	-	Seikgyikanaungto Township	09250267178
120	U Hla Soe	-	Seikgyikanaungto Township	09792535029
121	U Hla Nyein	-	Seikgyikanaungto Township	09444774813
122	U Ye Win	-	Seikgyikanaungto Township	09772617924
123	U Khin Maung Zaw	-	Seikgyikanaungto Township	09420243748
124	U Hla Maung	-	Seikgyikanaungto Township	09421109705
125	U Nyi Nyi Oo	-	Seikgyikanaungto Township	09781789331
126	U Hla Tin	-	Seikgyikanaungto Township	09425025717
127	U Kyaw Myo Aung	-	Dala Township	09448044660
128	Daw Sandar Myint	Dala Township Project	-	09450043358
129	U James	Dala Township News	-	09252078662
130	U Tun Lwin	-	Kamar Kathwe Ward	0973197905
131	U Mya Win	-	Kamar Kathwe Ward	-
132	U Bhone Kywal	-	Ba Nyar Da La Ward	04269144
133	Daw Amy	-	Tha Ke Ta Township	09421154121
134	U Zaw Myint	-	Seikgyikanaungto Township	09420197194
135	U Tin Win	-	Nyaung Ngoke To Village	09442220305
136	U Khin Minn Latt	-	Sar Par Chaung Ward	09444088004
137	U Aung Kyi Han	-	Tar Gyi / Tha Pyay Kone Village	0977264910
138	U Win Maung Phyu	-	Rakhine Chaung Village	09794440622
139	U Tin Maung Tun	-	Tone Tin Gan (North) Village	09780995800
140	U Myint Soe	-	-	-
141	U Ko Kin	-	Seikgyikanaungto Township	09422933123
142	U Thein Naing	-	Nyaung Ngoke To Village	09451119148
143	U Yin Tun Lwin	YESC (DYGM)	-	095129480
144	U Mya Shwe	YESC (Dala Township)	-	09780008640
145	U Kyaw Sann oo	-	Shwe Hlay Chaung Village	09799278089
146	U Kyin Tun	-	Seikgyikanaungto Township	097675443
147	U Nay Linn	-	Rakhine Chaung Village	095412325
148	U Soe Win	The Mirror - Newspaper	-	09250149039
149	U Hla Myint	-	Tar Gyi / Tha Pyay Kone Village	09259627660
150	U Thaung Oo	-	Pyaw Bwe Gyi Village	09777295391

151	U Ko Ko Naing	-	Seikgyikanaungto Township	09420197998
152	U Tun Lwin	Village Officer (GAD)	Shan Kan Village	09777202492
153	U Zaw Naing Win	-	-	09785866511
154	U Aye Nwai	-	Myo Ma	09420226386
155	U Myo Tin	-	Yarma Thingyan	09796240423
156	U Shwe Hlaing	-	Ba Nyar Dala Ward	09251046247
157	U An Kyee Maung	Township Journalist	Ant Gyi (West) Ward	09254530674
158	U Thein tun	-	Dala Township	-
159	U Hla Myaing	-	Dala Township	-
160	U Myint Shwe	-	Dala Township	-
161	U Kyaw Aye	-	Seikgyikanaungto Township	-
162	U Minn Minn Tun	-	Seikgyikanaungto Township	-
163	U Tin Tin Win	-	Seikgyikanaungto Township	-
164	U Tin Hla	-	Seikgyikanaungto Township	-
165	U Win Sein	-	Seikgyikanaungto Township	-
166	U Myint Sann	-	Seikgyikanaungto Township	-
167	U Aung Minn Oo	-	Seikgyikanaungto Township	-
168	Daw Sann Sann Myint	-	Seikgyikanaungto Township	-
169	U Thann Htay	-	Seikgyikanaungto Township	09448039964
170	U Nyein Chann Aung	-	Seikgyikanaungto Township	09420243742
171	U Tun Tun Thann	-	Seikgyikanaungto Township	09252693309
172	U Win Hlaing	Officer (GAD)	Myo Ma (1) Ward	-
173	U Maung Soe	Government Employee	Dala Township	-
174	U Tin Sein	-	Dala Township	09761766712
175	U Kyaw Kyaw Han	-	Rakhine Chaung Village	09787037338
176	U Myint Naing	-	Tar Gyi / Tha Pyay Kone Village	09254215660
177	Daw Khin Win Myint	-	Dala Township	0931129124
178	U Sann Yi	-	Htaw (Lower) Village	09420179870
179	U Tun Win Oo	Deputy Officer	-	09795869954
180	U Yin Htway	Township Officer (GAD)	Dala Township	095202659
181	U Tin Hla	Member of Parliament	Dala Township	09421153709
182	U Ye Swe	Environmental Conservation Department		095149810
183	U Tin Maung Htwe	-	Shan Kan Village	09401546340
184	U Tin oo	-	Dala Township	09789323911
185	U Myo Thant	-	Dala Township	09421028018
186	U Thann Win	Myanmar Anti-Narcotics Association		09262604431
187	U Aung Kyaw Soe	Township Chief Officer	Kyaung Su	-
188	U Tin Tun	-	Ye Chaung Village	09787958780
189	U OK	-	Nyaung Ngoke To Village	0943077599
190	U Sann Htoo Maung	-	Bo Yan Pyay Ward	0973190317
191	U Kyi Lwin	-	Dala Township	09799278567
192	U Aung Thura Oo	-	Dala Township	09444088834
193	U Kyaw Tint	-	Da Noke Village	09450023306
194	U Tin Aung Moe	-	Shan Kan Village	09251574006
195	U Thet Naing Aye	Police Department	Myo Ma Ward	09252293869
196	U Kyi Soe	Village Officer (GAD)	Kha Naung Ywar Ma Village	09420077443
197	U Aung Zaw Ohn	-	Seikgyikanaungto Township	0997727519
198	U Khin Maung Kywai	Township Authority (EO), YCDC	Dala Township	-
199	Maung	-	Dala Township	-
200	Daw Thin Thin Maw	-	Seikgyikanaungto Township	0943116004
201	Daw Aye Aye Maw	-	Seikgyikanaungto Township	09770005028
202	Daw Htay Htay Win	-	Seikgyikanaungto Township	-
203	U Hein Latt	-	Seikgyikanaungto Township	09424573849
204	U Aung Sann	-	Seikgyikanaungto Township	09410141848

205	U Tun Tun Win	-	Seikgyikanaungto Township	-
206	U Win Hlaing	-	Seikgyikanaungto Township	09456864008
207	U Hla Win Myint	-	Pyaw Bwe Gyi Village	09798535997
208	U Lay Win Oo	-	Pyaw Bwe Gyi Village	095082179
209	U Htay Lwin	-	Seikgyikanaungto Township	09254075588
210	U Win Naing	-	Rakhine Chaung (North) Village	09799847663
211	U Swe Oo	-	Rakhine Chaung (North) Village	095067938

List of Participation (Photos)

LNG သုံးလျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

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ရှင်းလင်းတင်ပြသော အစည်းအဝေး (Public Participation Meeting No. 1)

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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
၁။	ဦး[illegible]	[illegible]	09777410703		
၂။	ဦးဘုန်းဝင်း	"	09781180894		
၃။	ဦးခင်မြိုင်	"	09420497763		
၄။	ဦးစိုး[illegible]	"	0942019710		
၅။	" [illegible]	"	09765444652		
၆။	" မြင့်ဦး	"	09420229328		
၇။	" [illegible]	"	09420229187		
၈။	[illegible]	"	09956683286		
၉။	ဦးကျော်ဝင်း	"	09252474994		
၁၀။	ဦးကျော်အောင်	"	09958444301		
၁၁။	ဦးတင်ထွန်း	"	09255264946		
၁၂။	ဦးမျိုးကျော်	"	09781468547		
၁၃။	ဦးအောင်ဝင်း	"	0973901086		
၁၄။	ဦးဝင်းနိုင်	တွံ့တေးကိုင်(မ)	09796241409		
၁၅။	ဦးသောင်းတင်		09781340209		
၁၆။	ဦးလှကြိုင်	" (တ)	09798010543		
၁၇။	ဦးခင်စိုး	" (တ)	0976558232		
၁၈။	ဦးမြင့်သိန်း	" (တ)	09784818489		
၁၉။	ဦးဉာဏ်လှ	" (တ)	09 –		
၂၀။	ဦးမင်းအောင်	" (တ)	09786722102		

LNG သုံးလျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
၁။	ဦးတင်အေး	ကဆကဘွယ်	09420624086		
၂။	ဦးထွန်းမြင့်	။	09257600121		
၃။	ဦးစိုးသိန်း	တုတကိုင် (တ)	09976456861		
၄။	ဦးရွှေလှိုင်	ဒလ (တ)	09420014331		
၅။	ဦးအေးမင်း	ဆိပ်ကြီးခနောင်တို	09798116165		
၆။	ဦးဇော်ဝင်း	ဒလ	09450410646		
၇။	ဦးအောင်မြင့်	ဒလ	09778575334		
၈။	ဒေါ်ရှုလှိုင်ဝင်း	ဒလ	0943071638		
၉။	ဦးထွန်းနိုင်	ဒလ	09692229868		
၁၀။	ဦးဇော်သိန်း	ဆိပ်ကြီးခနောင်တို	09448017374		
၁၁။	ဦးအောင်ခိုင်မြေ	။	09420022392		
၁၂။	ဦးဝင်းနိုင်	။	09420260420		
၁၃။	ဦးအောင်မိုးကျော်	ရန်ကုန် (ဆိပ်ကမ်းသာ)	09422479283		မြဝတီ
၁၄။	ဦးဝင်းသိန်း	တာကြီး (ဒလ)	09777433857		
၁၅။	ဦးကျော်ကြည်	ဒလ	09794729372		
၁၆။	ဦးဇော်ဇော်	ဒလ	09764597438		
၁၇။	ဦးလှမြင့်	ဒလ	09786484305		
၁၈။	ကိုစိုးလှိုင်	ဒလ	09448052269		
၁၉။	ကိုကျော်သူရ	ဒလ	09455305519		
၂၀။	ဦးမိုးတင့်	ဒလ	09784522443		

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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
၁။	[illegible]	[illegible]	[illegible]		
၂။	[illegible]	[illegible]	[illegible]		
၃။	[illegible]	〃 〃	[illegible]		
၄။	[illegible]	〃 〃	09-786673312		
၅။	[illegible]	〃 〃	09975781399		
၆။	[illegible]	〃	099757781399		
၇။	[illegible]	〃	09895090116		
၈။	[illegible]	[illegible]	09 —		
၉။	[illegible]	〃 〃			
၁၀။	[illegible]	[illegible]	09.258841853		
၁၁။	[illegible]	[illegible]			
၁၂။	[illegible]	[illegible]	0977316 5952		
၁၃။	[illegible]	[illegible]	0977791[illegible]1		
၁၄။	[illegible]	[illegible]	[illegible]		
၁၅။	[illegible]	[illegible]	09794438859		
၁၆။	[illegible]	[illegible]	0975728384		
၁၇။	[illegible]	[illegible]	09775541315		
၁၈။	[illegible]	[illegible]	09.781496210		
၁၉။	[illegible]	[illegible]	0976158696		
၂၀။	[illegible]	[illegible]	09/250054006		

LNG သုံးလျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
၁။	[illegible]	ဒလမြို့နယ်	09 760414351		
၂။	[illegible]	〃	09-76271277[illegible]		
၃။	[illegible]	〃	09-798478011		
၄။	[illegible]	[illegible]	09 799301048		
၅။	[illegible]	ဒလမြို့	09.420149540		
၆။	[illegible]	ရှဲကြောင်း (ဒလ)	09420195008		
၇။	[illegible]	〃	0931699600		
၈။	[illegible]	ဒလ	09263894752		
၉။	[illegible]	ရှဲကြောင်း (ဒလ)	0931090607		
၁၀။	[illegible]	[illegible]	09420090224		
၁၁။	[illegible]	[illegible]	09425006019		
၁၂။	[illegible]	[illegible] (ဒလ)	09420119805		
၁၃။	[illegible]	[illegible] (ဒလ)	09499504514		
၁၄။	[illegible]	[illegible]	09430683838		
၁၅။	[illegible]	ဒလ	09798321112		
၁၆။	[illegible]	[illegible] ဒလ	[illegible]		
၁၇။	[illegible]	[illegible]	—		
၁၈။	[illegible]	[illegible]	773901219		
၁၉။	[illegible]	[illegible]	09-451119015		
၂၀။	[illegible]	[illegible]			

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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
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၁။	[illegible]	[illegible]	09972297782		
၂။	[illegible]	[illegible]	09461529462		
၃။	[illegible]	[illegible]			
၄။	[illegible]	[illegible]			
၅။	[illegible]	[illegible]			
၆။	[illegible]	[illegible]	0977261820[illegible]		
၇။	[illegible]	[illegible]	09260918092		
၈။	[illegible]	[illegible]	0926020269[illegible]		
၉။	[illegible]	[illegible]	09799298958		
၁၀။	[illegible]	[illegible]	240·52·600		
၁၁။	[illegible]	[illegible]	0942019730[illegible]		
၁၂။	[illegible]	[illegible]	0925106[illegible]		
၁၃။	[illegible]	[illegible]	[illegible]		
၁၄။	[illegible]	[illegible]	09-692929149		
၁၅။	[illegible]	[illegible]	09 7835[illegible]		
၁၆။	[illegible]	[illegible]	0979885281[illegible]		
၁၇။	[illegible]	[illegible]	[illegible]		
၁၈။	[illegible]	[illegible]	[illegible]		
၁၉။	[illegible]	[illegible]			[illegible]
၂၀။	[illegible]				

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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
၁။	ဦးဌေးဝင်း	ဆိပ်/တို့	09.250267178		
၂။	ဦးမြအိ	ဆိပ်/တို့	[illegible]		
၃။	ဦး[illegible]	ဆိပ်/တို့	094444.774813		
၄။	ဦးဂိုဝင်	ဆိပ်တို့	09.772611924		
၅။	ဦးခင်မောင်ထော်	ဆိပ်/တို့	09.42024078		
၆။	ဦး[illegible]	ဆိပ်/တို့	09421109775		
၇။	[illegible]	ဆိပ်/တို့	09781789331		
၈။	ဦး[illegible]	"	09425025717		
၉။	ဦး[illegible]	3ရ	09-44804460		
၁၀။	ဒေါ်[illegible]	[illegible]	09.450043358		
၁၁။	ဦး[illegible]	[illegible]	09252078682		
၁၂။	ဦး[illegible]	[illegible]	0973197995		
၁၃။	" [illegible]	"	"		
၁၄။	ဦး[illegible]	[illegible]	09.269144		
၁၅။	[illegible]	[illegible]	0942154121		
၁၆။	[illegible]	[illegible]	09.420197194		
၁၇။	[illegible]	[illegible]	09442220805		
၁၈။	[illegible]	[illegible]	09-444088004		
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၂၀။	ဦး[illegible]	[illegible]	09.794440622		

LNG သုံးလျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

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၂။	[illegible]			[signature]	
၃။	[illegible]	[illegible]	[illegible]	[signature]	
၄။	[illegible]	[illegible]	09 45119148	[signature]	
၅။	[illegible]	YESC (ဒဂုံ)	09-5129480	[signature]	
၆။	[illegible]	YESC (Dalo)	097800008648	[signature]	
၇။	[illegible]	[illegible]	09-799127[illegible]	[signature]	
၈။	[illegible]	[illegible]	[illegible]	[signature]	
၉။	[illegible]	[illegible]	095412328	[signature]	
၁၀။	[illegible]	[illegible]	09250149039	[signature]	
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၁၄။	[illegible]	[illegible]	09.7772024492	[signature]	
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၁၆။	[illegible]	[illegible]	09.420226386	[signature]	
၁၇။	[illegible]	[illegible]	09.796249428	[signature]	
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LNG သုံးလျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

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၂။	[illegible]	[illegible]	[illegible]	[signature]	
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၁၅။	[illegible]	ဒလ	09799278567	[signature]	
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Minutes of Meeting

To	Tun Lin Kyaw
CC	ERM-Siam: Vincent Lecat
From	Environmental Resources Management (ERM-Siam)
Date and Location of Meeting	11st December 2018 Thardana Beikmann Hall, Thanlyin Township, Yangon Region
Project Reference	0439461 TTCL Ahlone Expansion
Subject	Thanlyin Township Public Consultation Meeting No.1

Agenda

- Registration
- Introduction of the meeting by TPMC Meeting Coordinator
- Introductory speech
- Presentation about the Project by TTCL (Htet Aung Mon)
- Presentation by ERM (Susu)
- Questions and Answers Period
- Closing Comments/Conclusion speech

No.	Key Discussion	Response
1	**N/A, Ward Elder, Kyauktan** ■ Where is TTCL headquarter based? ■ Is the unit price of electricity generation with LNG expensive? ■ How long is the project construction period? ■ How much is the investment cost?	**Htet Aung Mon (Mr.), TTCL** ■ TTCL is a joint venture company of Japan -Thai, headquarter is located in Bangkok, Thailand. TTCL organization is formed with international technician. ■ As we are independent power producer, all the produced power will be sold out to MOEE. Distribution to households and electric charge for public is in the scope of MOEE. ■ The project is estimated to start construction work in the middle of 2019. Project construction will take about 28 months. The operation period is 25 to 30 years.

No.	Key Discussion	Response
		■ Estimated project investment cost is 500 MUSD.
2	**U Nay Win, (Resident), Kyauktan Township** ■ How will you control for the noise, air & water pollution? We are experiencing constantly the noise from one of the power plant from Thilawa Zone.	**Khin Su Su Naing (Ms.), ERM** ■ To determine impacts from project, we have to collect the existing soil, air quality and noise data from study area as well as need to study the potential impact from project. Depends on the existing air, soil , water quality and potential impact study, mitigation measures and monitoring plan will be proposed if necessary. ESIA report including monitoring plan have to be submitted to MONREC for approval. Project Proponent Company have to comply with our proposed impact management plan. Environmental monitoring report is required to be submit to MONREC department minimum every six month.
3	**Khin Su Su Nai (Ms.)** ■ Is there any punishment procedure from ECD if the project company does not follow the limitation of ESIA law? ■ Due to third party is hired by Project Company, how can we ensure the transparency of information? ■ Are there emergency response plan?	**ECD Department (Thanlyin Township)** ■ Local residents are allowed to report to ECD department in the case of experience impact from project. ECD department will monitor and make sure the project is running within the given environmental guidelines. We will also have surprise check procedure to monitor the emission from project. If we found out the project company do not follow their mitigation measures, we may severely punished the project company, from WARNING stage to terminating the plant/factory entirely.
		Khin Su Su Naing (Ms.), ERM ■ EIA Third Party Company is hired by project Proponent Company. However, EIA organization has to work on their own principles and regulatory guidelines. Environmental impact studies and mitigation measure proposed to Project Company will indicated in Impact assessment report.

No.	Key Discussion	Response
		Final ESIA report will be reviewed by EIA review committee, which is formed with experts from each relevant ministries. ■ Yes, mitigation measures for unplanned events and emergency responses will be included as a part of ESIA report.

Attendance list

204 persons from Government Organizations and Village Responsibilities and 4 persons from company attend the meeting.

No.	Name	Position/Occupation	Department/Organization	Contact No.
1	U Nyunt Win	-	Kyauk Tan	-
2	U Han Myint	-	Kyauk Tan	-
3	U Han Myint	-	Kyauk Tan	-
4	U Tin Shwe	-	Kyauk Tan	-
5	U Khin Maung	-	Kyauk Tan	-
6	U Kan Myint	-	Kyauk Tan	-
7	U Soe Min Oo	-	Kyauk Tan	-
8	U Htay Aung	-	Kyauk Tan	-
9	U Kyaw Sann	-	-	-
10	U Hla Win	-	-	-
11	U Tin Lwin	-	-	-
12	U Ohn Cho	-	-	-
13	U Myint Oo	-	-	-
14	U Hla Win	-	-	-
15	U Zaw Nyunt	-	Yae Nan Ward	-
16	U Han Nyunt	-	Yae Nan Ward	-
17	U Thein Oo	-	South Myoma Ward	-
18	U Aung Naing Oo	-	Thauk Taw Twin Ward	-
19	U Thet Win Hlaing	-	Kyauk Tan	-
20	U Maung Maung Ohn	-	Kyauk Tan	-
21	U Khin Maung Lwin	-	Kyauk Tan	-
22	U Kan Kaung	-	Kyauk Tan	-
23	U Htein Linn	-	Kyauk Tan	-
24	U Myo Hlaing	-	Kyauk Tan	-
25	U Myint Maung	-	Kyauk Tan	--
26	U Myint Hlaing	-	Thanlyin	09778448085
27	U Myint Naing	-	Thanlyin	-
28	U Kyi Thant	-	Thanlyin	-
29	U Maung Maung Lwin	-	Thanlyin	-
30	U Tin Maung Htay	-	Thanlyin	-
31	U Aye Cho	-	Thanlyin	-
32	U Aye Maung	-	Thanlyin	-
33	U Kyaw Ni	-	West Myothit Ward	09443179898
34	U Aung Minn Oo	-	Aung Chanthar Ward	09254264501
35	U Yan Naing Oo	-	Kyauk Tan	09420191815
36	U Than Htike Aung	-	Shwe Pyi Thar	09420086285
37	U Aung Myint Zaw	-	Bago Su Ward Ward	0943178601

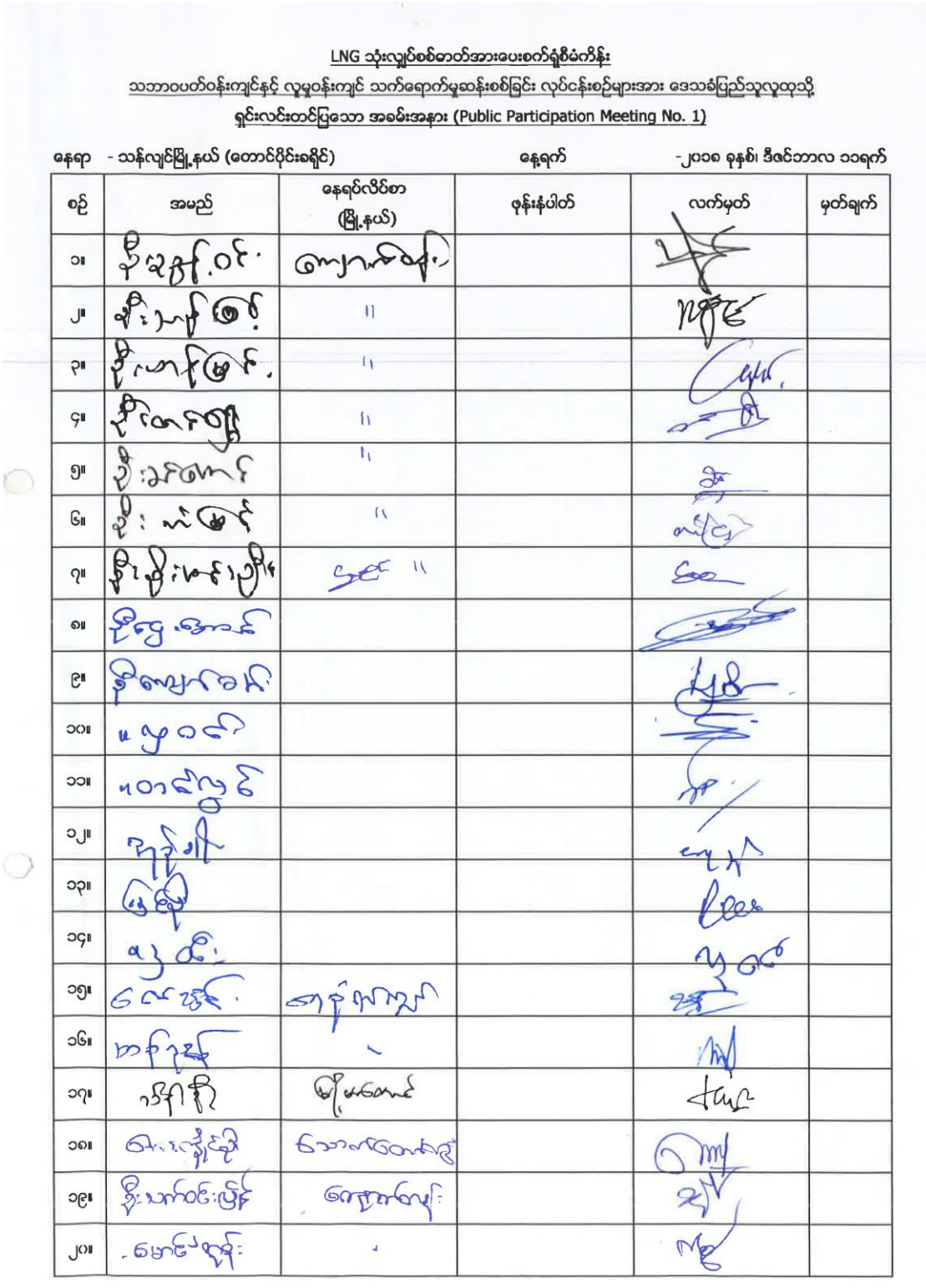
38	U Wai Linn Phyo	-	Bago Su Ward Ward	09763493809
39	U Myint Khaing	-	Paya Kone Village	09778605010
40	U Soe Thein	-	Aung Mingalar Ward	09126885834
41	U Khin Maung Swe	-	Paya Kone Village	09454901218
42	U Sann Win	-	Htan Pin Kone Village	0973179898
43	Daw Thida Soe	-	Oak Pho Su Ward	09422466252
44	U Myint Zaw Oo	-	Bago Su Ward	09456942040
45	U Zin Aung	Media	-	09761557795
46	Daw Ohnmar Thu	-	Aye Myittar Ward	-
47	Daw Khin Sann	-	Aye Myittar Ward	-
48	Daw Kyi Win	-	Aye Myittar Ward	-
49	Daw Sann Sann Khaing	-	Aye Myittar Ward	-
50	Daw Hla Hla Win	-	Aye Myittar Ward	-
51	Daw Win Yi	-	Aung Chanthar Ward	-
52	U Sann Ko Aung	-	Aye Myittar Ward	09777190306
53	Daw Sann Myint	-	Aye Myittar Ward	-
54	U Zaw Minn Htay	-	Aye Myittar Ward	09777395542
55	Daw Win	-	Aye Myittar Ward	-
56	Daw Hla Hla Maw	-	Aye Myittar Ward	-
57	Daw Nwe	-	Aye Myittar Ward	-
58	Daw Zin Mar Win	-	Aye Myittar Ward	-
59	U Kyaw Swar	-	Aye Myittar Ward	-
60	U Hla Han	-	Kyauk Tan	09951517761
61	U Myint Lwin	-	Kyauk Tan	0979946072
62	U Aye Lwin	-	Kyauk Tan	09794605137
63	U Myaing Tun	-	Kyauk Tan	-
64	U Ohn Mya	-	Kyauk Tan	-
65	U Aung Kyaw Soe	-	Kyauk Tan	-
66	U Nay Tun	-	Kyauk Tan	-
67	U Myint Win	-	Kyauk Tan	-
68	U Mya Aye	-	-	-
69	U Chit Sein	-	-	-
70	U Naing Naing Soe	EPC	Kyouk Tan	-
71	U Sithu Naung	EPC	Kyouk Tan	-
72	U Aung Maung	-	Oak Pho Su Ward	-
73	U Aung Ko Ko Oo	-	Kyouk Tan	09796351715
74	U Wai Tun Myat	-	Aung Chanthar Ward	0943087614
75	U Myo Myat Thu	Township Officer	GAD	09795353972
76	U Soe Min Naing	-	Ministry of Electricity and Energy	09425323164
77	U Maung Win	-	-	09798272114
78	U Naing Win	-	Bago Su Ward	09421065651
79	U Maung Naing	-	Thanlyin	-
80	U Than Lwin	-	-	09794605137

81	U Khin Maung Lwin	-	Kyouk Tan	-
82	U Khin Soe	-	Kyouk Tan	-
83	U Chit Aye	-	Kyouk Tan	-
84	U Tin Nyunt Win	-	Kyouk Tan	-
85	U Hla Than	-	-	-
86	U Tun Tun	Government Officer	-	0943182243
87	U Than Aung	-	Oak Pho Su Ward	09420301698
88	U Aung Lwin Soe	-	Aung Chanthar Ward	09420126126
89	U Kyaw Naing	-	Aung Chanthar Ward	09799437097
90	U Ko Ko Naing	-	Aung Chanthar Ward	09799437097
91	U Zin Maung Htoo	-	East Myothit Ward	094202251212
92	U Bo Gyi	-	Ah Hmu Htan Ward	095061951
93	U Aung Soe	-	Ah Hmu Htan Ward	09253321663
94	U Mya Aye	-	Ah Hmu Htan Ward	-
95	U Win Maung	-	Ah Hmu Htan Ward	-
96	U Aung Win	Township Officer	-	09785078675
97	U Soe Naing	-	Dhakar Ward	09789960172
98	Daw Khin Khin Win	Officer	Engineer Department (Roads & Bridges)	095002044
99	Daw Ei Thazin Naing	-	South Dagon township	09970951973
100	U Tin Aye	-	Kyouk Tan	09444403472
101	U Maung Maung Myint + 6	-	Nyanung Thone Pin Village	09443123878
102	U Thein Kyaing	-	Nyanung Thone Pin Village	-
103	U Maung Soe	-	Nyanung Thone Pin Village	097094433
104	Daw Mya Sann Yi + 5	-	Shwe Pyauk Village	09790145883
105	Daw Khin Aye Nyunt	-	Kyouk Tan	09420191815
106	Daw Sann Sann Kyu	-	Kyouk Tan	-
107	Daw Ohnmar Kyaw	-	Kyouk Tan	09414206889
108	U Myint Thein	-	Kyouk Tan	-
109	U Aye Kywal	-	Thanlyin	09260584447
110	U Soe Thann	-	-	-
111	U Win Thein	-	-	09420300326
112	U Hla Maw	-	Kyouk Tan	09254002533
113	U Htin Kyaw	-	Kyouk Tan	0977553888
114	U Thein	-	Kyouk Tan	-
115	U Maung Shwe	-	Kyouk Tan	0996542395
116	U Tin Oo	-		-
117	U Shein Win	-	Kyouk Tan	-
118	U Maung Aung	-	Kyouk Tan	09261205024
119	U Thann Zaw Oo	-	Kyouk Tan	09784575944
120	U Aung Thu	-	Kyouk Tan	-
121	Daw Myint Zu	-	Kyouk Tan	-
122	Daw Thet Thet Khaing	-	Kyouk Tan	-
123	Daw Htay Htay	-	Kyouk Tan	-

124	Daw Khin Yu May	-	Kyouk Tan	-
125	Daw Hnin Sann Yu	-	Kyouk Tan	-
126	U Kyaw Oo	-	-	-
127	U Thura Linn Tun	-	-	-
128	U Kyaw Myint	-	-	-
129	U Phyo Wai Aung	-	-	-
130	U Thinn Aung	-	-	-
131	U Zin Aung	-	-	-
132	U Kyaw Win	-	-	-
133	U Kan Win	-	-	-
134	U Khin Maung Myint	-	-	-
135	U Myint Shwe	-	-	-
136	U Sann Tint	-	-	-
137	U Naing Oo	-	-	-
138	U Kyaw Shwe	-	-	-
139	Daw San San Win	-	Kyouk Tan	09799433472
140	Daw Khin Than Win	-	Kyouk Tan	09251872792
141	Daw Than Than Soe	-	Kyouk Tan	09796271958
142	U Tun Wai	-	Kyouk Tan	09788132079
143	U Sein Thann	-	Kyouk Tan	0926209072
144	U Aye Tun	-	Kyouk Tan	0973317114
145	U Soe Naing	-	Kyouk Tan	09420011331
146	U Myint Shwe	-	-	-
147	U Tin Win Maung	-	Thanlyin	09254405100
148	U Tin Aung Gyi	-	Thanlyin	09773170730
149	U Khin Shwe	-	Thanlyin	-
150	U Nyunt Win	-	Thanlyin	09450706656
151	U Myint Swe	-	Shwe Pyi Thar Yar Ward	-
152	U Khin Maung Thein	-	Kyouk Tan	-
153	U Thann Naing	-	Kyouk Tan	-
154	U Khin Maung Nyo	-	Kyouk Tan	-
155	U Aye Thwin	-	Kyouk Tan	09254265262
156	U Maung Maung Lwin	-	Kyouk Tan	-
157	U Khin Maung Htay	-	Myothit Middle Ward	09696685829
158	U Khin Hote	-	Aung Chanthar Ward	-
159	U Mya Win	-	Aung Chanthar Ward	0945683034
160	U Yan Paing Shwe	-	Kyouk Tan	09799434246
161	U Ko Ko Naing	-	Bogyoke Village	-
162	U Tin Win	-	Bogyoke Village	-
163	U Soe Myint	-	Bogyoke Village	-
164	U Tun Tun Win	-	Bogyoke Village	-
165	U Kyaw Thu Tun	-	Bogyoke Village	-
166	U Myint Aung	-	Bogyoke Village	-
167	U Aye Win	-	Bogyoke Village	-

168	U Than Lwin	-	Bago Su Ward Ward, Thanlyin	09421124906
169	Daw Khin Saw Mon	-	Road Transport Administration	095161266
170	Daw Khin Ma Ma	-	(AD Project) Thanlyin	09448036817
171	U Bone Kyaw Thu	-	Phayar Kone Ward	-
172	U Zaw Aung	-	Phayar Kone Ward	-
173	U Myat Ko Ko	Assistant Engineer	Kyouk Tan	09795438270
174	U Tun Tun Aung	-	Thanlyin	09250963649
175	U Aye Aung	-	North Myoma Ward	09254528677
176	UNREADABLE	-	North Myoma Ward	-
177	U Hla Thein	-	Kyouk Tan	09263671525
178	U Tun Lwin	-	Bago Su Ward	09254264217
179	Daw Hnin Toe Toe	Township Officer	Engineer Department (Roads & Bridges)	09791660636
180	U Aung Zaw Linn Tun	-	YCDC office	09261496042
181	U San Tun Aung	Regional Officer	GAD	098600694
182	U Yin Tun Lwin	Assistant General Manager	-	-
183	U Aung Myo Oo	Regional Manager	-	098600987
184	U Aung Kyaw Moe	Manager	-	095402839
185	U Tin Thein	-	Bago Su Ward	0979944054
186	Daw Mu Mu Khaing	-	Kyouk Tan	09421050003
187	U Su Win	-	Kyouk Tan	095502768
188	U Khaing Myint	-	(YCDC office) Kyouk Tan	09404751280
189	Daw Sann Sann Myint	-	Ah Lwan Sut Village	09777165448
190	Daw Hla Win Htwe	-	Ah Lwan Sut Village	09795995062
191	Daw Khin Mar Aye	-	Ah Lwan Sut Village	09420165130
192	Daw Win Win Mar	-	Ah Lwan Sut Village	09420291223
193	Daw Kyi Myint	-	Ah Lwan Sut Village	-
194	Daw Kyin Thein	-	Ah Lwan Sut Village	-
195	Daw Sann Win	-	Ah Lwan Sut Village	09254878057
196	U Kyaw Myint	-	Ah Lwan Sut Village	UNREADABLE
197	U Myint Sein	-	Ah Lwan Sut Village	09789182572
198	Daw Tin Tin Ei	-	Aye Myittar Ward	09967247598
199	U Tun Wai	-	Aye Myittar Ward	-
200	Daw Thida	-	Aye Myittar Ward	-
201	Daw Myint Myint Aye	-	Aye Myittar Ward	-
202	Daw Nan Yu Hlaing	-	Aye Myittar Ward	-
203	Daw Sa Nay Ma	-	Aye Myittar Ward	-
204	Daw Aye Aye Sann	-	Aye Myittar Ward	-
205	Daw Kyi WIn	-	Aye Myittar Ward	-
206	Daw Thann Thann Oo	-	Aye Myittar Ward	-
207	Daw Htay	-	Aye Myittar Ward	-
208	Daw Soe Soe	Veterinarian	Kyouk Tan	09448017595

List of Participation (Photo)



LNG သုံးလျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

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ရှင်းလင်းတင်ပြသော အစမ်းအနား (Public Participation Meeting No. 1)

နေရာ - သန်လျင်မြို့နယ် (တောင်ပိုင်းစရိုင်) နေ့ရက် - ၂၀၁၈ ခုနှစ်၊ ဒီဇင်ဘာလ ၁၁ရက်

စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
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၃။	[illegible]	-	[illegible]		
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၅။	[illegible]		[illegible]		
၆။	[illegible]	[illegible]	09-778448085	[illegible]	
၇။	[illegible]	〃		[illegible]	
၈။	[illegible]	〃		[illegible]	
၉။	[illegible]	〃			
၁၀။	[illegible]	〃		[illegible]	
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၁၂။	[illegible]	〃		[illegible]	
၁၃။	[illegible]	[illegible]	443179898	[illegible]	
၁၄။	[illegible]	[illegible]	254264501	[illegible]	
၁၅။	[illegible]	[illegible]	09.420191815	[illegible]	
၁၆။	[illegible]	[illegible]	09.420086285	[illegible]	
၁၇။	[illegible]	[illegible]	0943178601	[illegible]	
၁၈။	[illegible]	[illegible]	09763493809	[illegible]	
၁၉။	[illegible]	[illegible]	[illegible]	[illegible]	
၂၀။	[illegible]	[illegible]	09426885884	[illegible]	

LNG သုံးလျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
၁။	ဦးအေးမောင်ဆွေ	ဘုရားကျော်	09454490218		
၂။	ဦးခိုင်ဝင်း	ထန်းပင်ကျုံး	09.73179898		
၃။	ဒေါ်သီတာစိုး	ဘုရားဖြူ	09422466252		
၄။	ဦးမြင့်ဆွေဦး	ပဲခူး	09456945040		
၅။	ဦးကျော်ဇော	[illegible]	0912677770		
၆။	ဒေါ်ဥမ္မာ	ဈေးမကြာ			
၇။	ဒေါ်ခင်စန်း	"			
၈။	ဒေါ်ကြည်ဝင်း	"			
၉။	ဒေါ်စန်းစန်းနွဲ့	"			
၁၀။	ဒေါ်လှမြင့်	"			
၁၁။	ဒေါ်ဝင်းကြိုင်	မောင်ဦးမြိုင်			
၁၂။	ဦးတင့်ကြိုင်	ဈေးမကြာ	09.777.190306		
၁၃။	ဒေါ်တင့်မြင့်	"			
၁၄။	ကျော်မင်းထွေး	"	09.777395542		
၁၅။	ဒေါ်ဝင်း	"			
၁၆။	ဒေါ်လှလှမော်	"			
၁၇။	ဒေါ်စိ	"			
၁၈။	ဒေါ်တင်အောင်ဝင်း	"			
၁၉။	ဦးကျော်ဖွား	ဈေးမကြာ	-		
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LNG သုံးလျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

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၂။	[illegible]	[illegible]		[signature]	
၃။	[illegible]	[illegible]		[signature]	
၄။	[illegible]	〃		[signature]	
၅။	[illegible]	〃		[signature]	
၆။	[illegible]			[signature]	
၇။	[illegible]	[illegible]	0943182243	[signature]	
၈။	[illegible]				
၉။	[illegible]	[illegible]	420301698	[signature]	
၁၀။	[illegible]	[illegible]	09.420126126	[signature]	
၁၁။	[illegible]	〃	09-799437097	[signature]	
၁၂။	[illegible]	〃	〃	[signature]	
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၁၅။	[illegible]	[illegible]	09253321663	[signature]	
၁၆။	[illegible]	〃 [illegible]		[signature]	
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Photo

APPENDIX KK PUBLIC CONSULTATION MINUTES OF MEETING (SCOPING PROCESS)

LNG Power Plant (Ahlone) Project in Yangon, Myanmar

12, 13, and 14 June , 2019

The business of sustainability

ERM

Objective

- To present the Project proponent.
- To present the latest Project information.
- To present the ESIA Team.
- To present the result of the Impact Assessment studies.
- To collect stakeholders comments and feedback on the draft Environmental and Social Impact Assessment (ESIA) report, in particular the relevance of the proposed mitigation measures

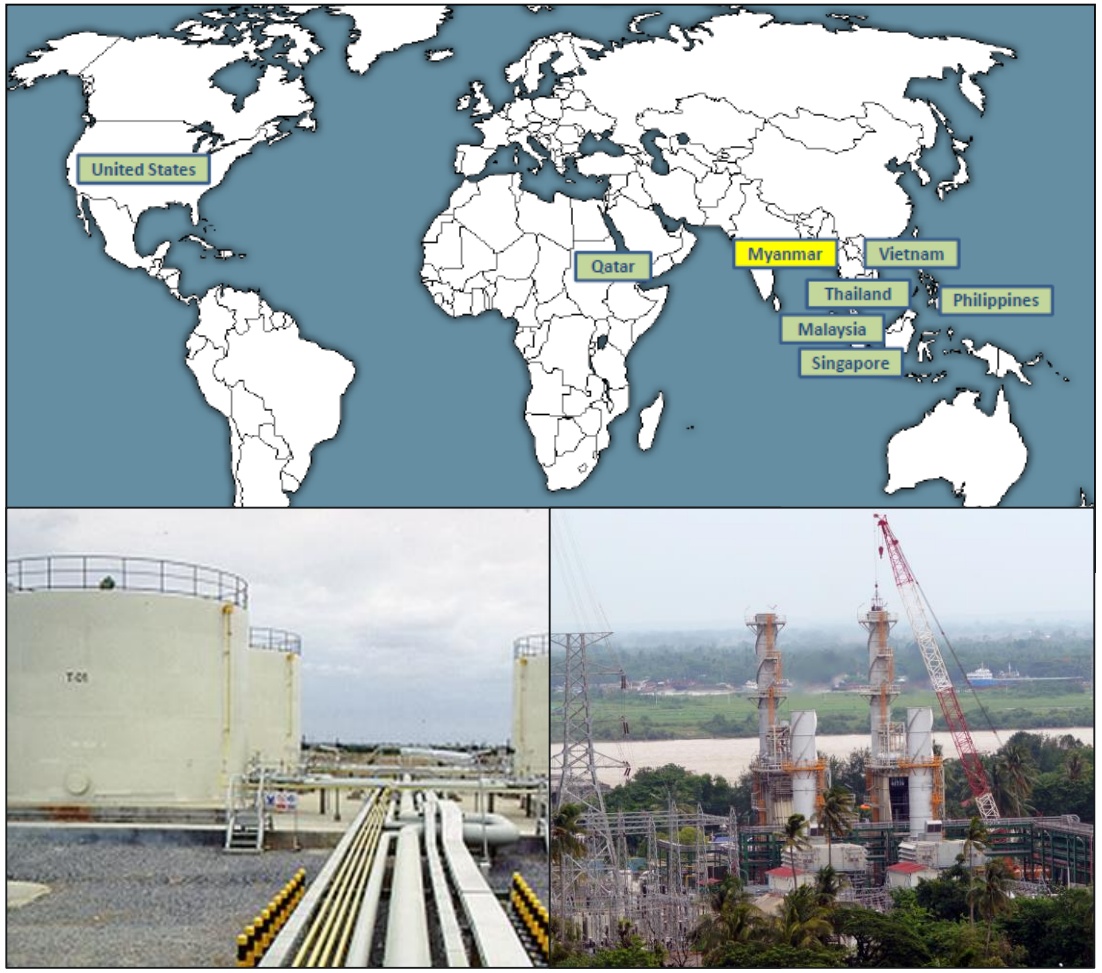
TTCL Power Myanmar Company Limited (TPMC)

TPMC

TPMC is a subsidiary of TTCL Public Company Limited. TPMC was established to carry out the Operation & Maintenance of this proposed project.

TTCL

- TTCL Public Company Limited (TTCL) is the first integrated Engineering, Procurement and Construction company in Thailand as well as an investor especially in power sector.
- Established in 1985 by Toyo Engineering Corporation (TEC), a leading Engineering Company from Japan.
- 8 Subsidiary and Affiliate Companies in 3 continents around the world.
- Its experience in Myanmar include:
  - Aviation Fuelling System for the Mandalay International Airport in 1997.
  - 121MW Combined Cycle Gas Turbine Power Plant in Ahlone, Yangon in 2012.
  - Oil & Gas Terminal Construction in Thilawa Industrial Zone in 2018



TTCL's Business

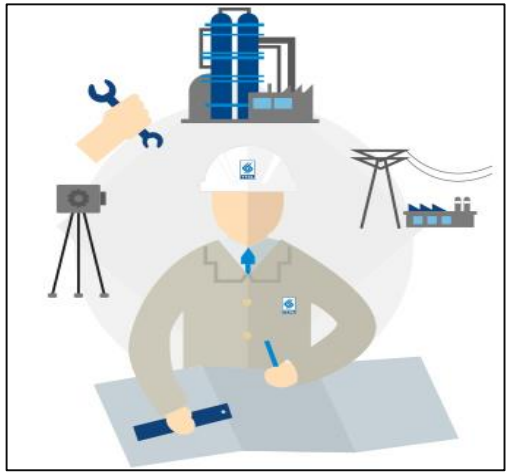
Engineering – **2,700 staffs**, Offer all areas of engineering fields.

Procurement – **30 years experience**, Strong network with suppliers.

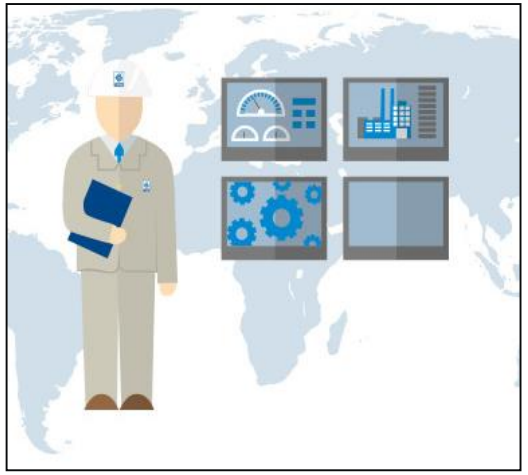
Construction – **230 successful projects**, Proven work quality records.

Investment – **7 projects worldwide,** especially in power sector

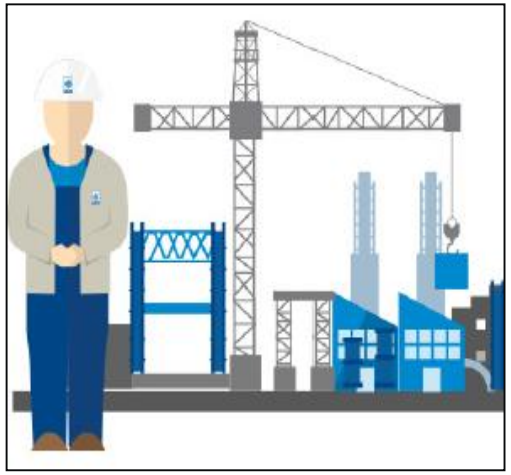
Engineering



Procurement



Construction



TTCL Worldwide Experiences

TTCL is trusted by many leading international company around the world.

PETRONAS

SOLVAY

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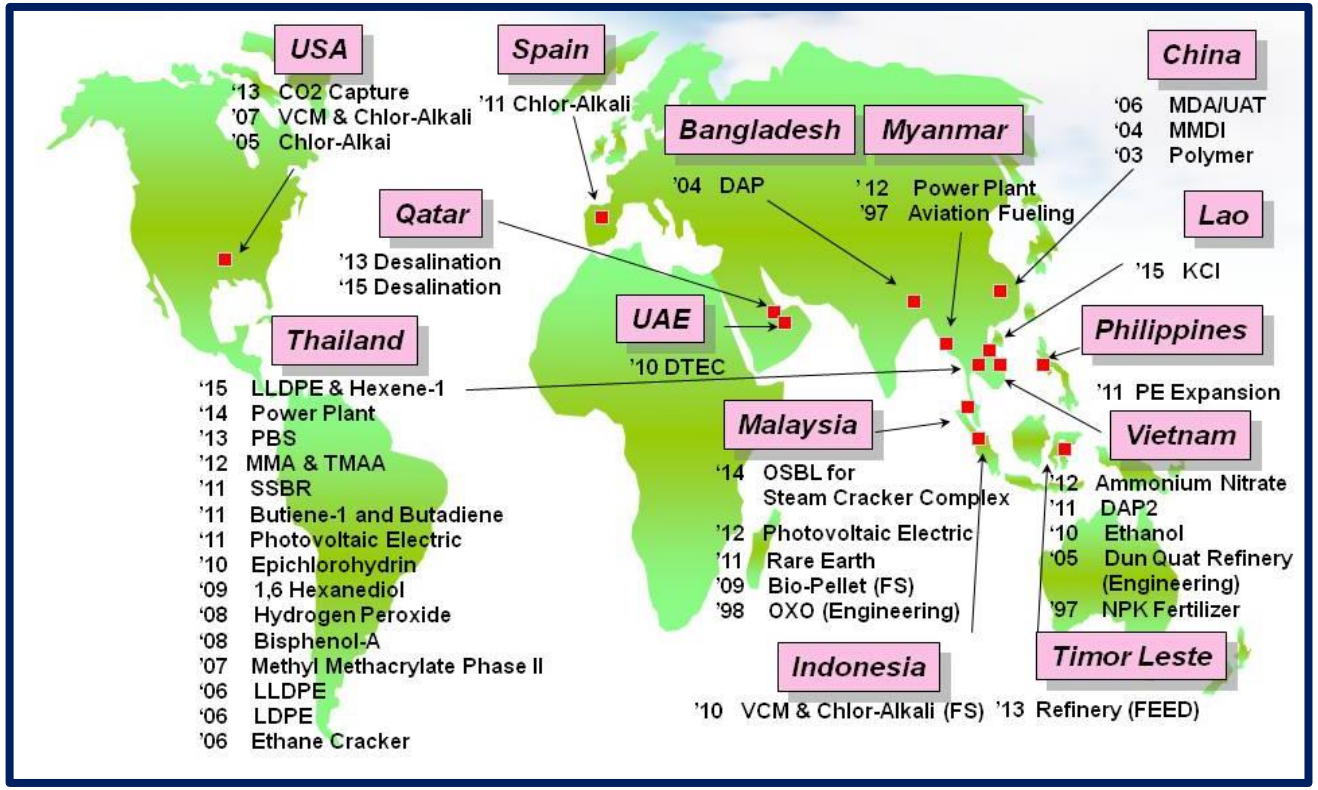
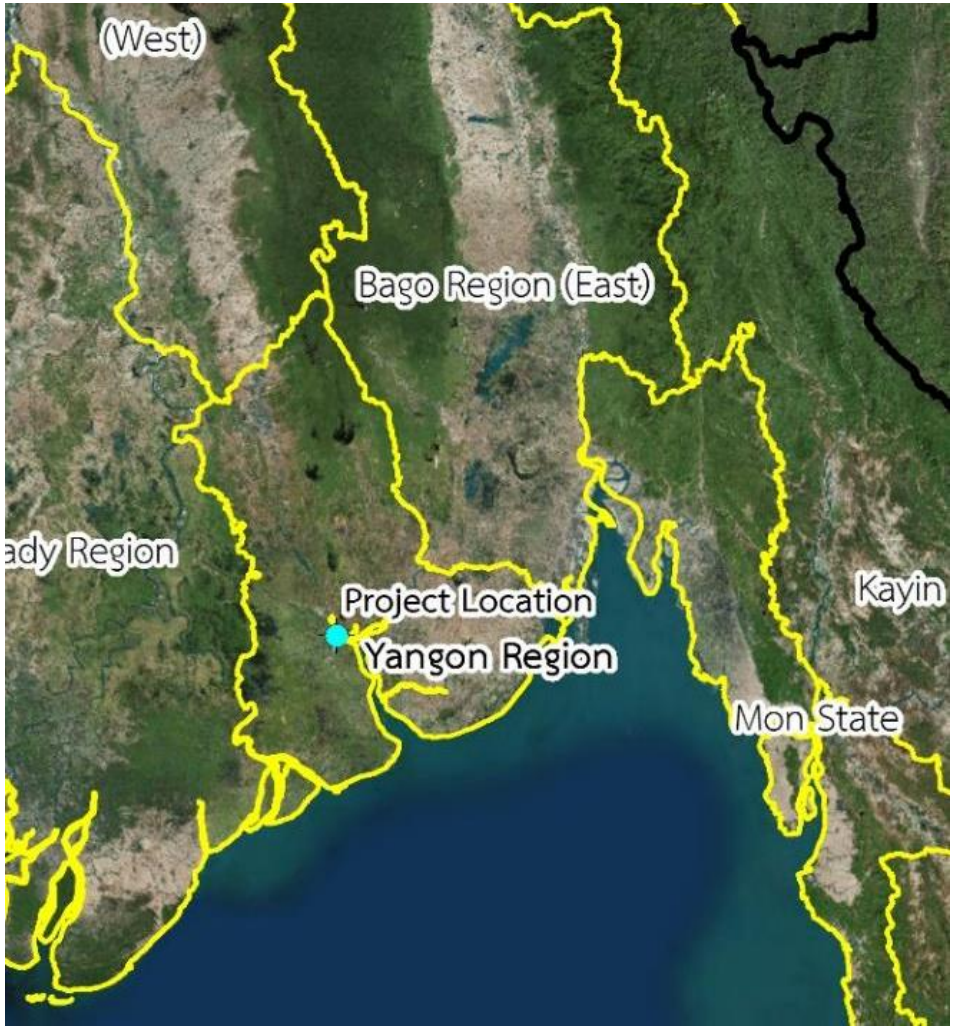
TOSHIBA

Bayer



Project Components

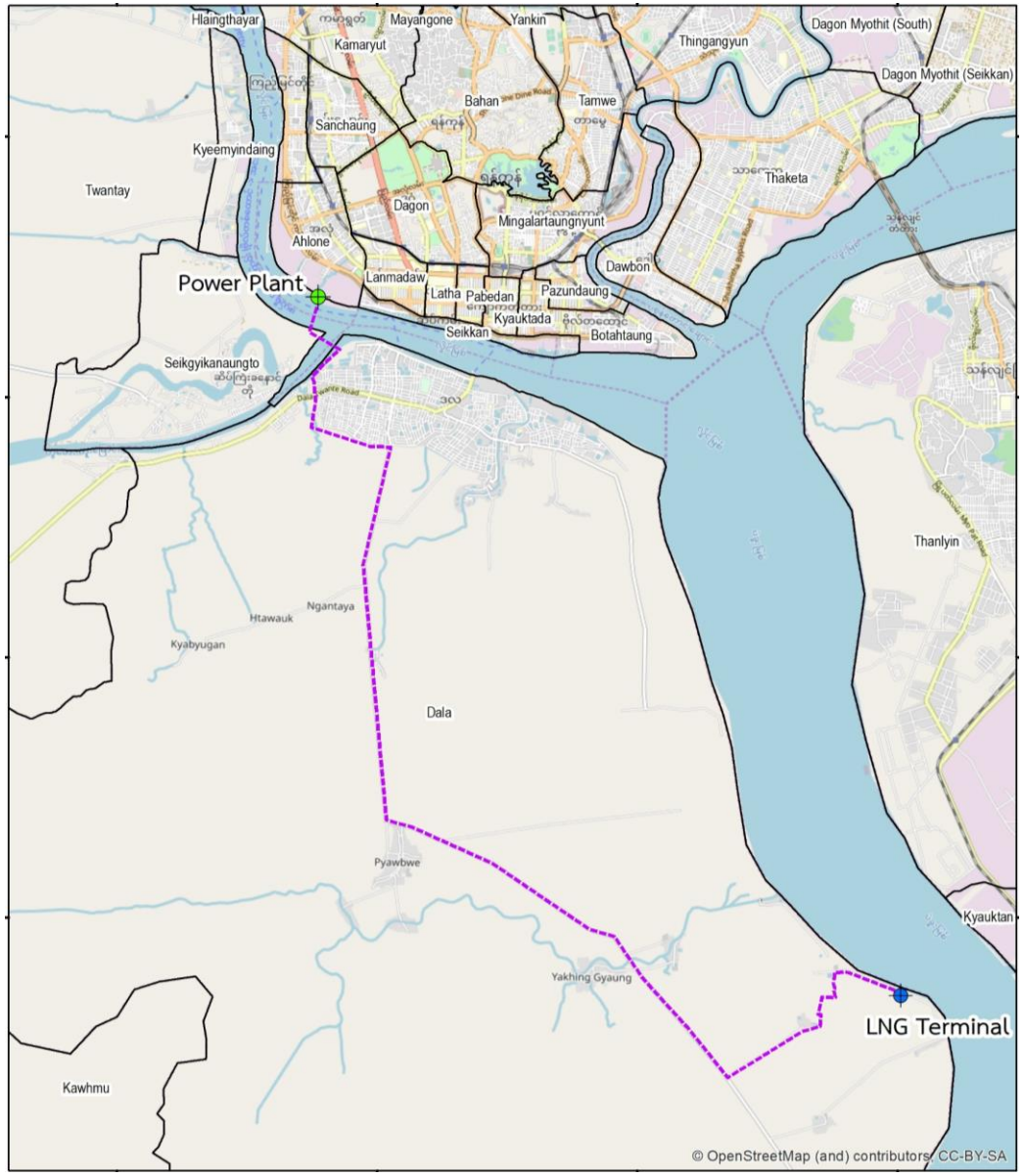
- 388MW Combined Cycle Gas Turbine Power Plant.
- Fuel is imported Liquefied Natural Gas (LNG).
- Fuel is transported by LNG Carrier to LNG Receiving Terminal.
- LNG receiving Terminal, and natural gas (NG) pipeline to Power Plant.
- 230 kV Transmission line
- The generated electricity from the project will supply to Yangon Region through Myanmar Grid.



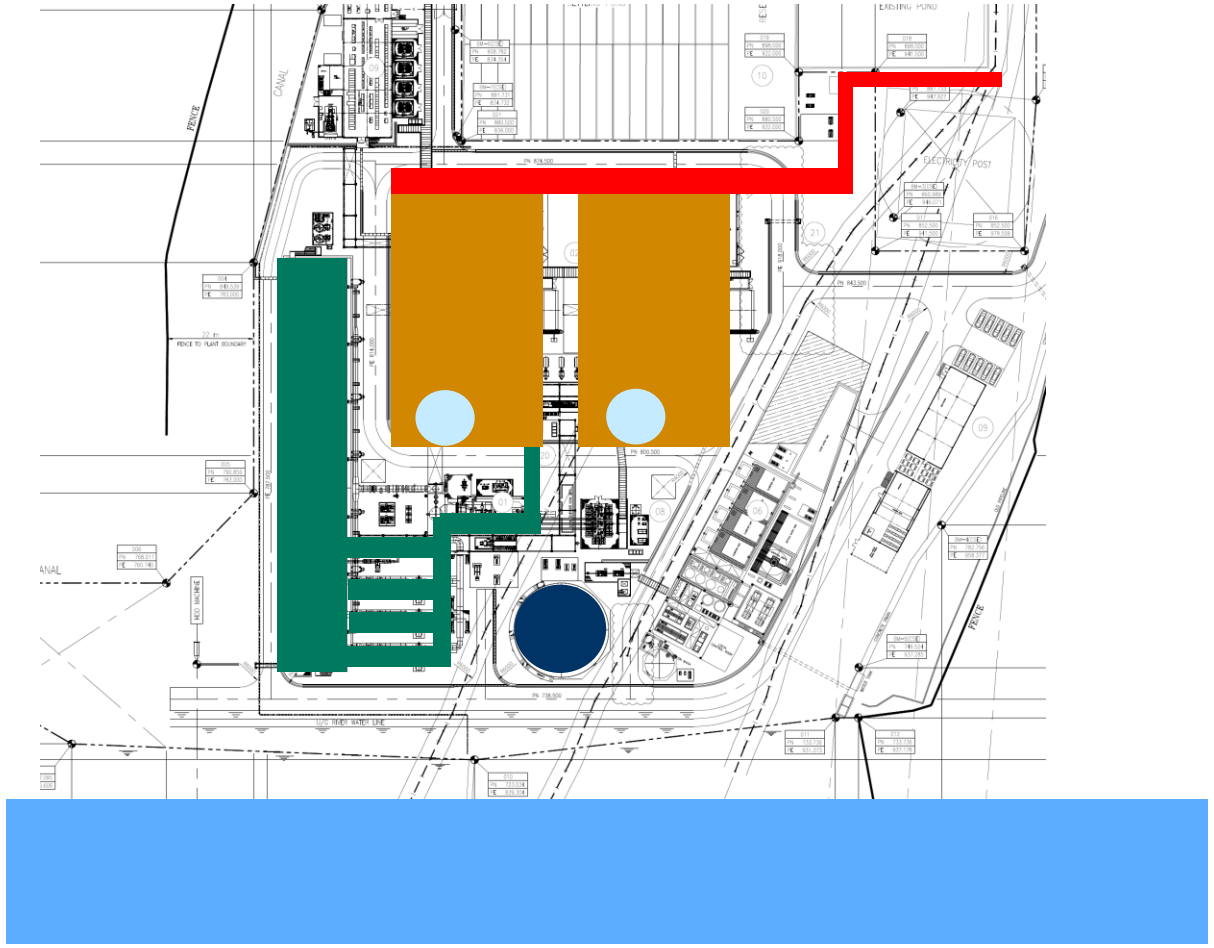
Project Overview and Location

LEGEND

- LNG Terminal
- Pipeline
- Power Plant



LNG Power Plant (Ahlone) Project CCGT

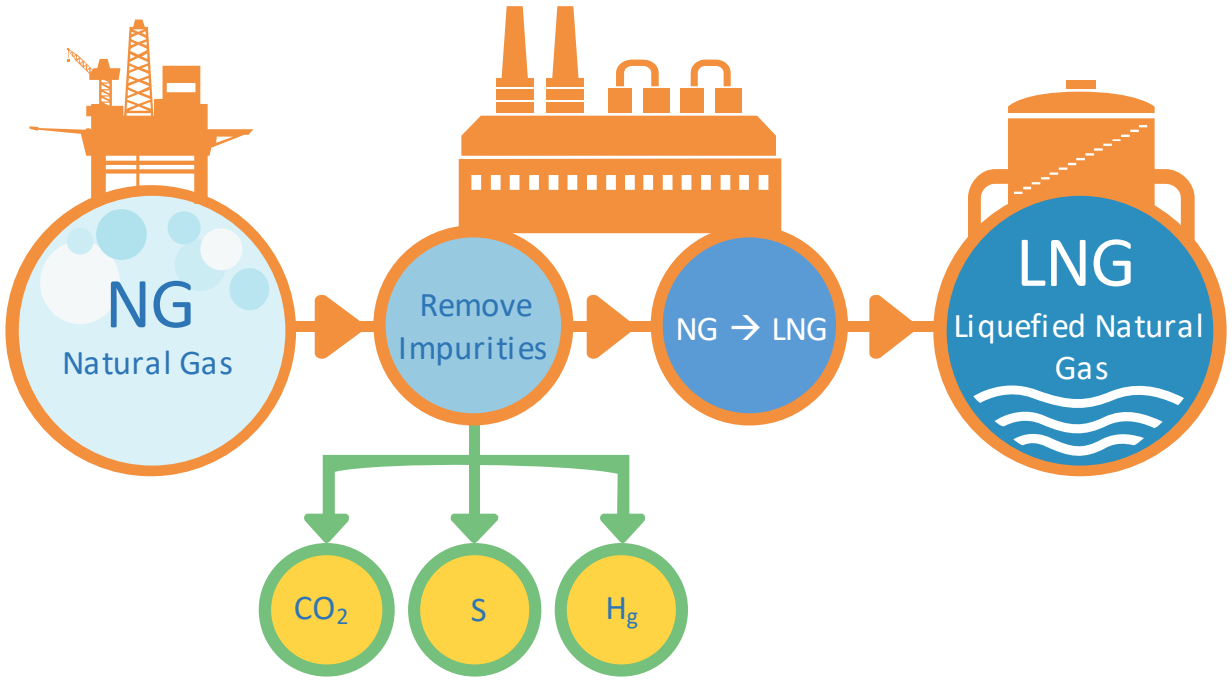


LEGEND

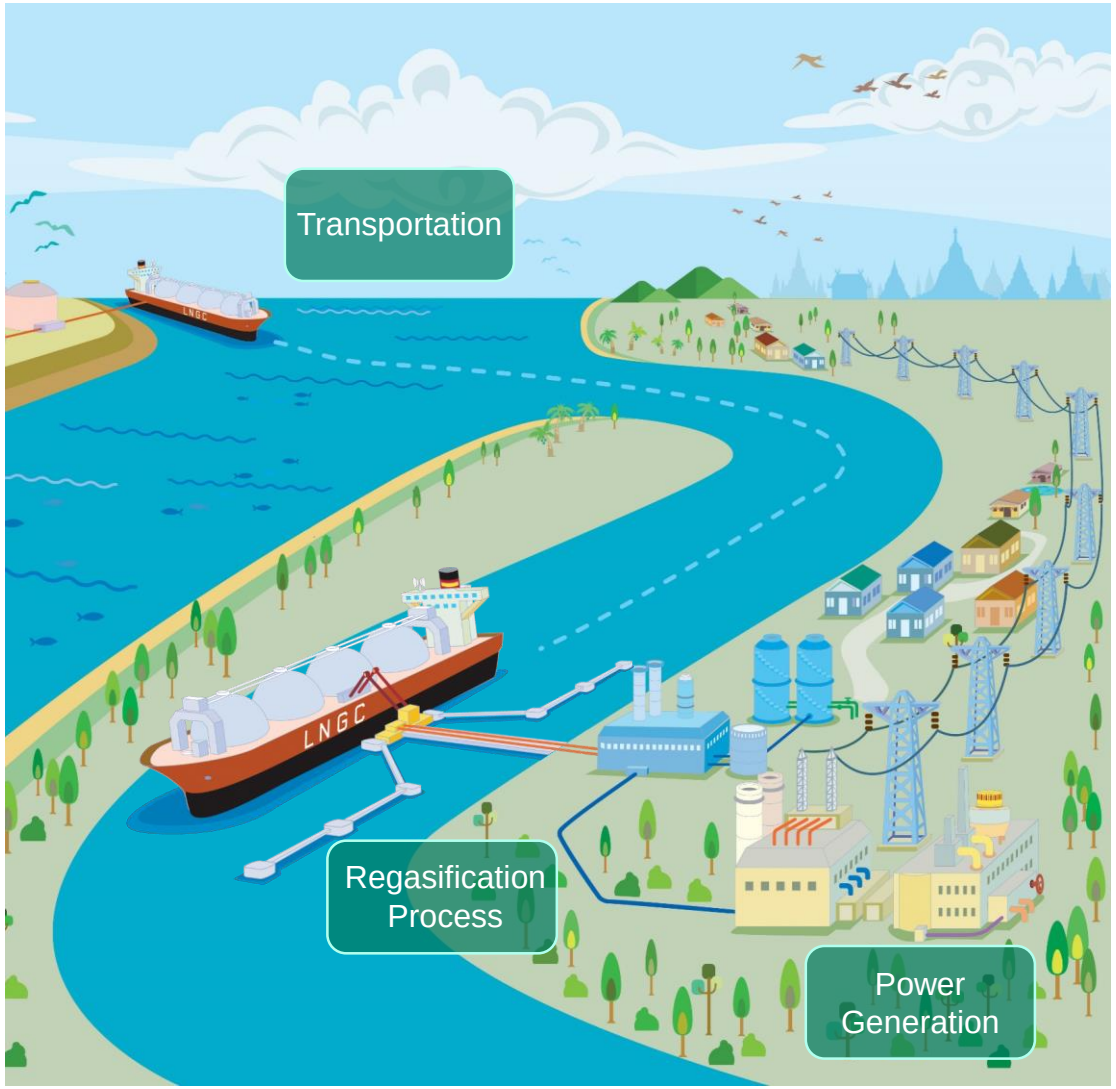
- Yangon River
- Water Tank
- Extension of switch yard
- Cooling Tower and Water System
- Gas and Steam Turbines
- Stack

What is LNG?

- Liquefied Natural Gas (LNG) is natural gas that has been converted into liquid form.
- Takes up 1/600th the volume of natural gas.
- -160 degrees Celsius, for ease of transportation.



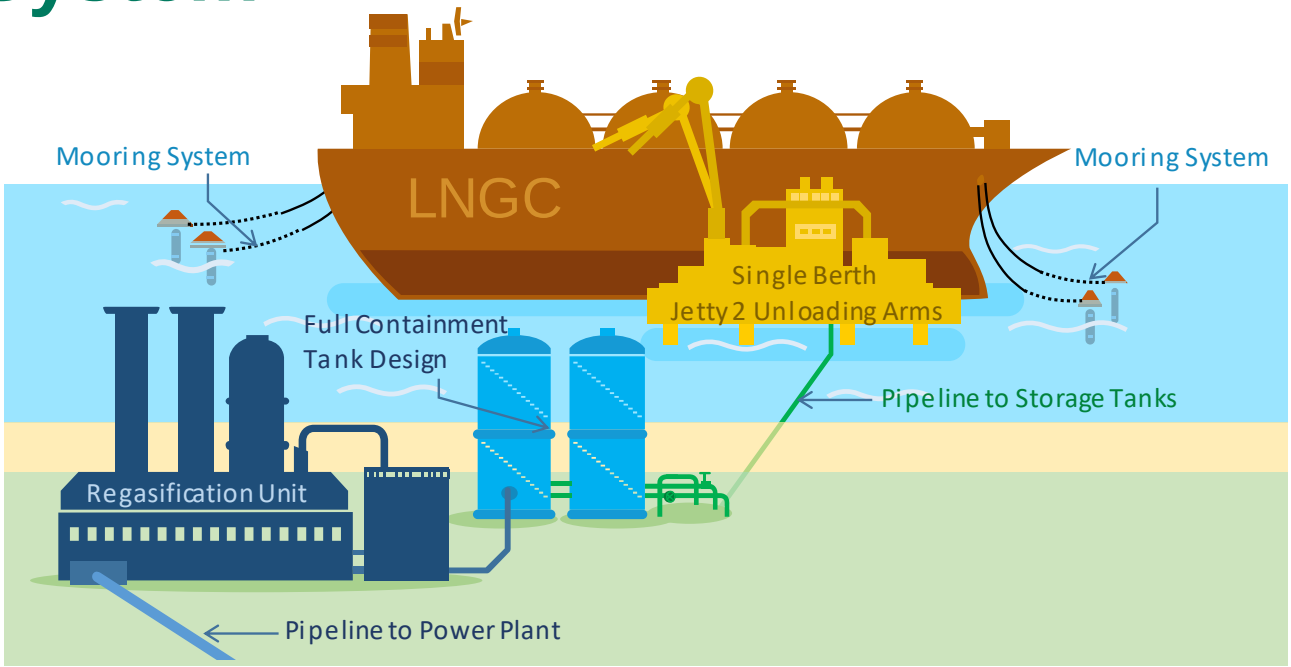
LNG Value Chain



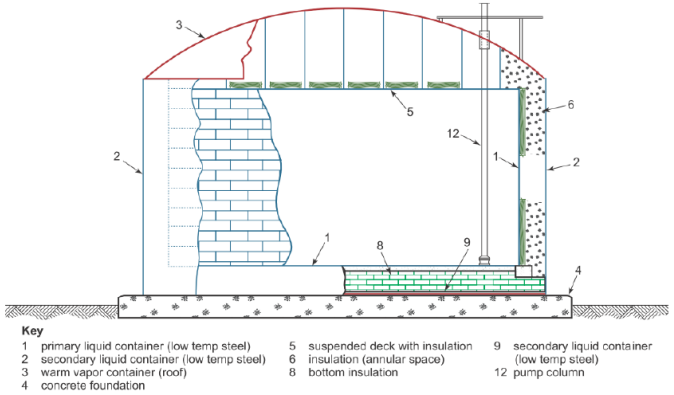
LNG Terminal & Mooring System

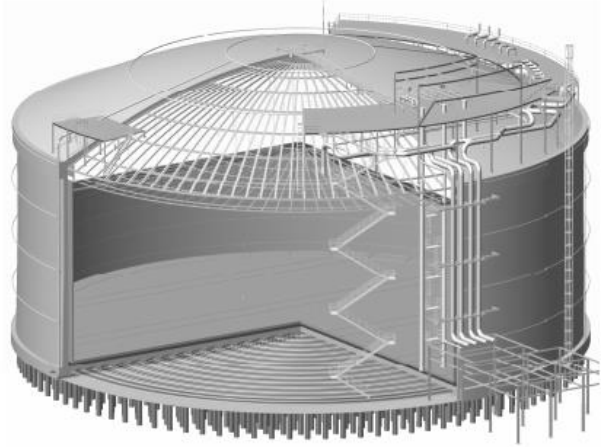
Key Components:

- Jetty – Single Berth
- 2 x LNG Tanks (Full containment type double wall tank)
  - Capacity (per tank): 25,000 m^3
- Regasification Unit (RU)
  - Intermediate Fluid Vaporizers (IFV)



LNG Tank (Full Containment)





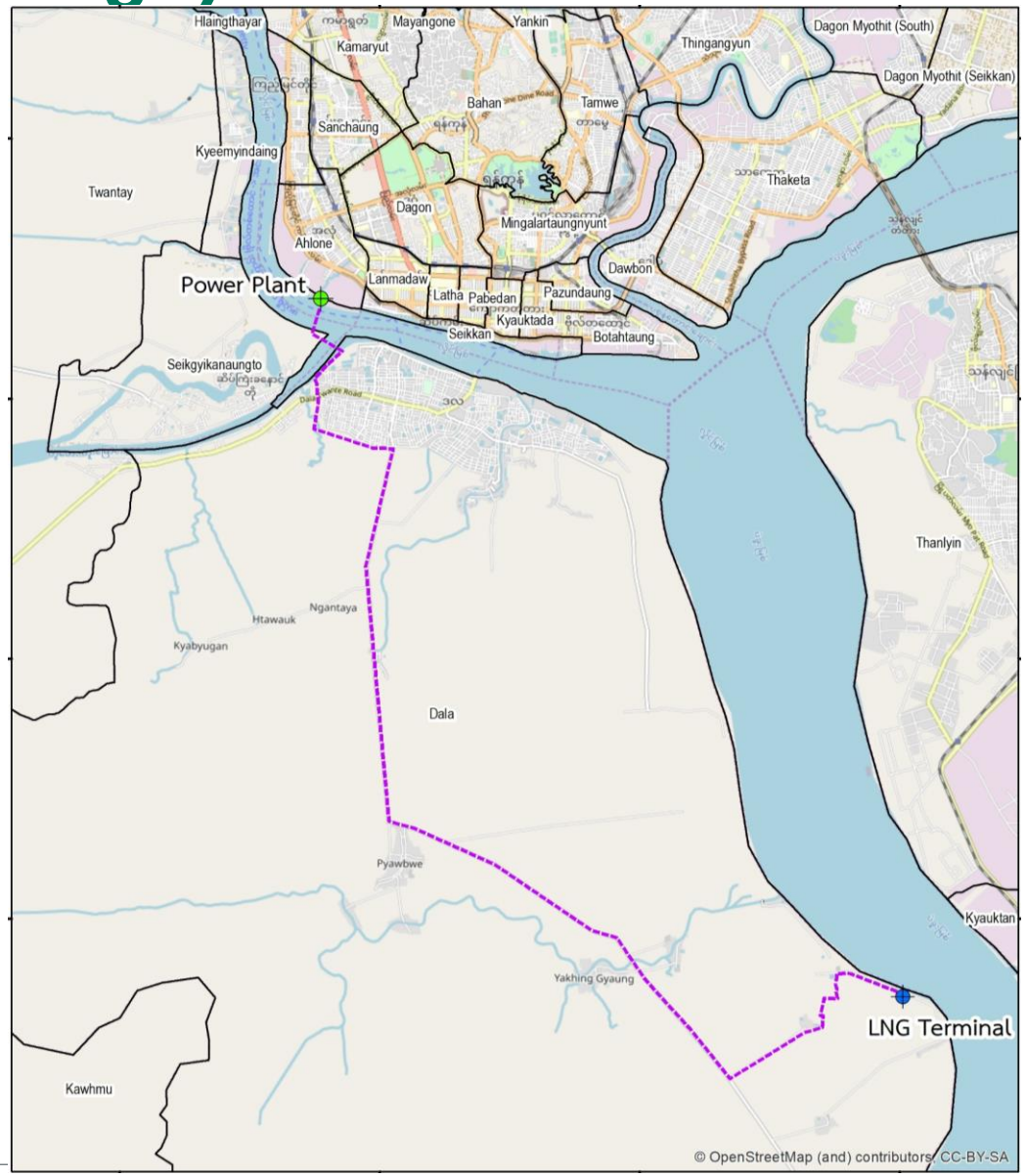
Natural Gas Pipeline (Tentative Design)

Key Components:

- Carbon steel material pipe (Diameter 20 inches)
- Design pressure of approximately 64 bar.
- Health & Safety System
  - Pressure detection
  - Emergency shutdown system
  - Two (2) block valves located at each end
  - Impressed current cathodic protection system for pipeline

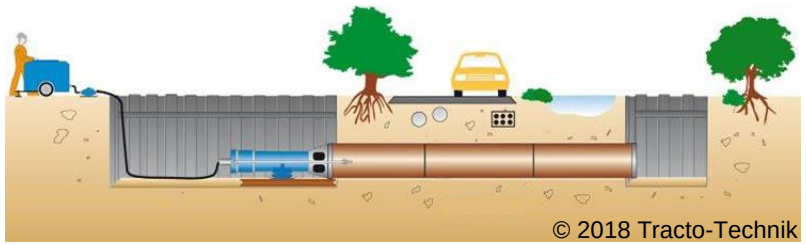
LEGEND

----- Pipeline

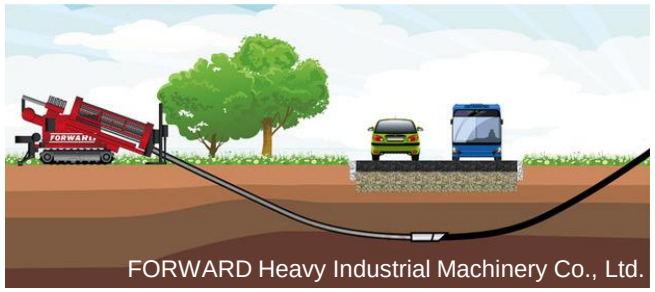


Pipeline Construction Method

Open Cut – A method that involves excavating down to a specified depth, to place pipeline line underground. Excavated material is then backfilled, and warning signs are places along the pipeline path. The backfilled area is also remediated back to its natural condition.

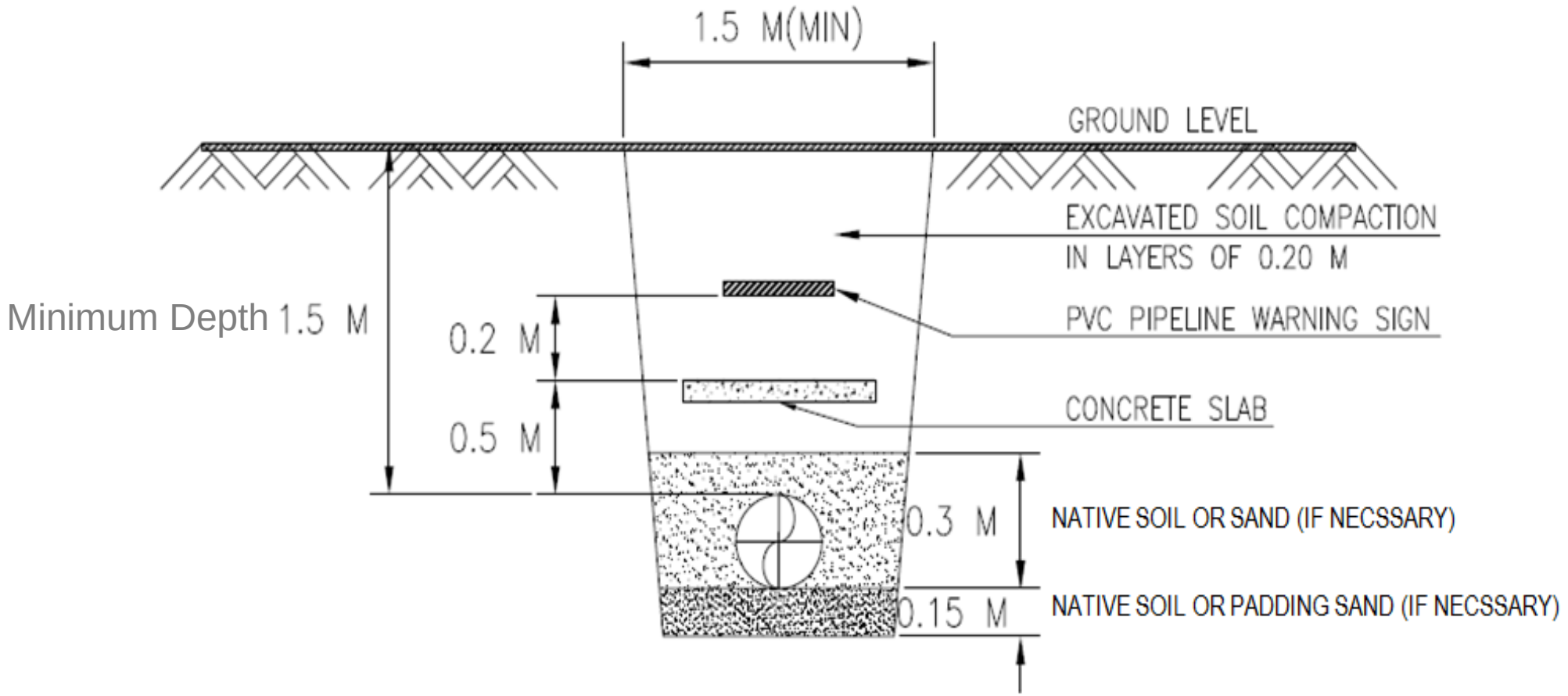


Boring – A method used to install pipes below physical obstructions such as rivers, roads, buildings, infrastructure, and other obstacles. Involves excavating at each end of where the pipe will enter and exit. Drilling equipment is lowered into one of the excavated areas, and will on the pipeline alignment. Pipes can then be inserted into the drilled hole.



Horizontal Directional Drilling (HDD) – A method used for installing pipes below physical obstructions, by a guidable drill head. This method is effective for large physical obstructions (approximately 500-2,000 meters), or when open cut method is not practical.

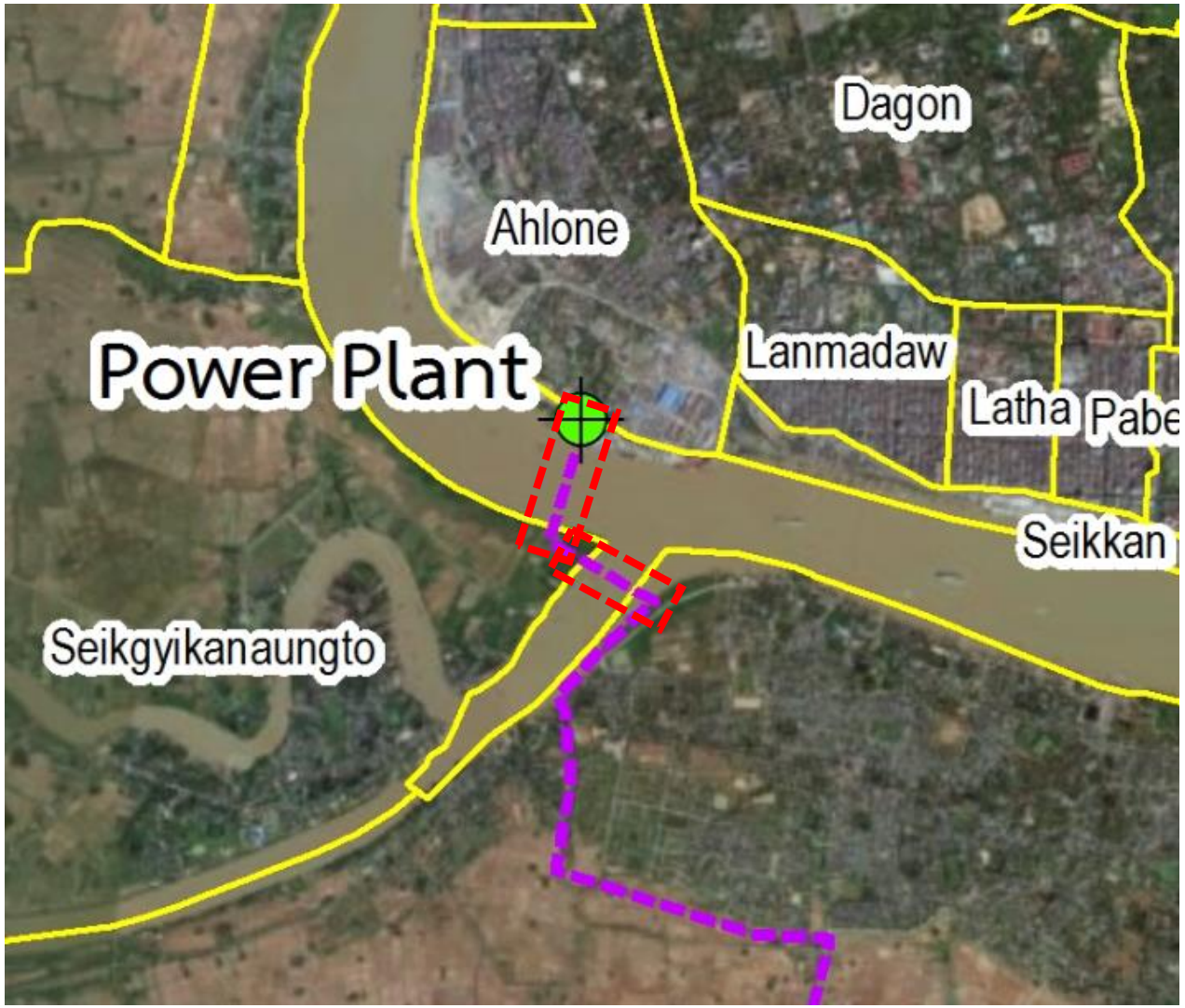
Pipeline Construction: Typical Open cut design



Pipeline Construction

LEGEND

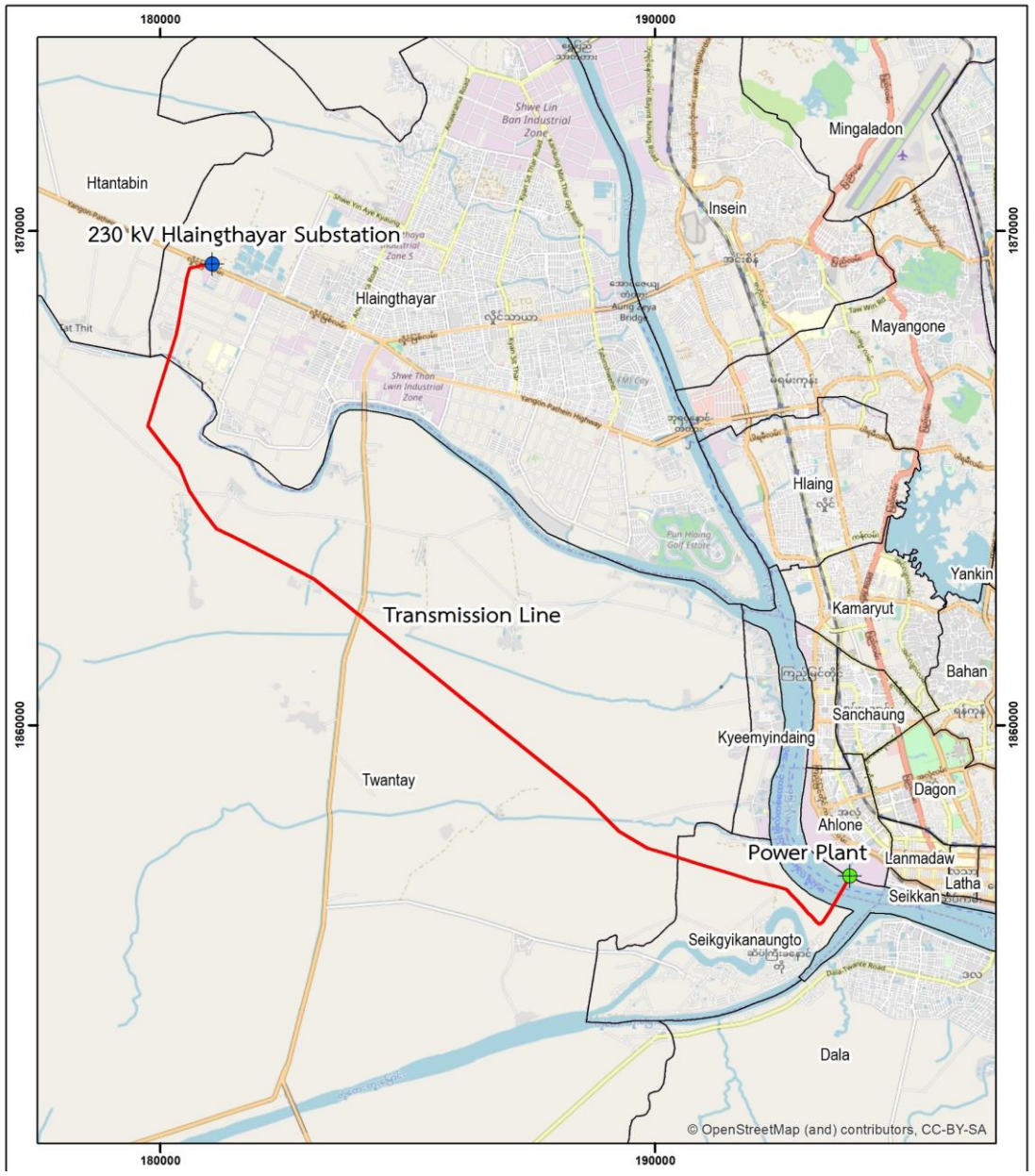
- Pipeline sections that will use HDD method
- Pipeline
- Power plant



Transmission Line (Tentative route)

A Transmission Line connecting the 388 MW Combined Cycle Power Plant (CCPP) in Ahlone Township, Yangon to the sub-station in Hlaingthayar.

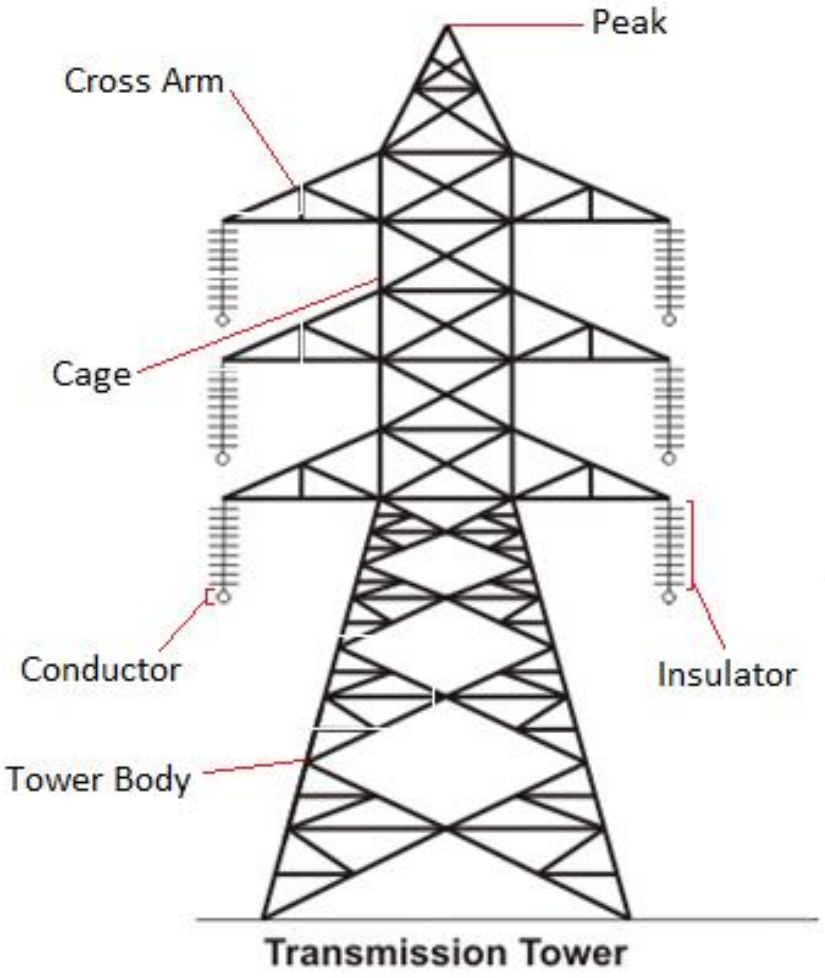
- Distance: Approximately 22.34 km
- Voltage Level: 230 kV



Legend

- Powerplant
- Substation
- Transmission Line

Transmission Line



Typical Key Components:

- Peak - earth shield wire and OPGW are connected here
- Cross Arm- hold the insulator
- Cage - portion between tower body and peak
- Tower Body
- Conductor - deliver electricity from one point to another
- Insulator - holds the conductor

Assessment Requirement

Under Section 7 of the Environmental Conservation Law and Articles 52 and 53 of the Environmental Conservation Rules of the Republic of the Union of Myanmar, TPMC is required to undertake an Environmental Evaluation of the Project

According to the Annex 1 of the EIA Procedure (2015), the scope of the proposed Projects require:

- An EIA study for LNG Receiving Terminal + Pipeline + Power Plant
- An IEE Study for the Transmission Line

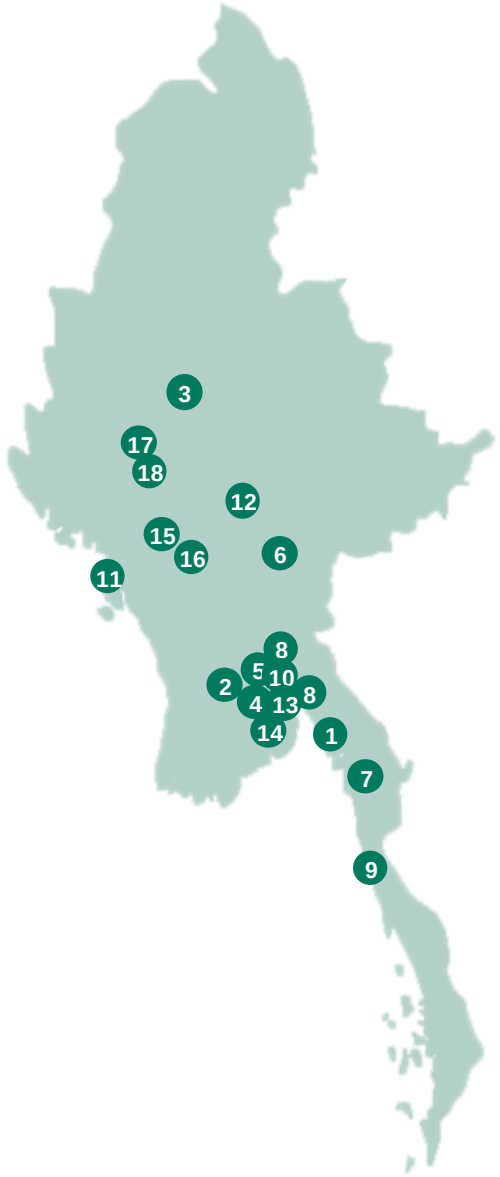
Environmental and Social Impact Assessment (ESIA/IEE) Study

Both the EIA and IEE studies have been undertaken in line with:

- Myanmar regulations
- International standards, such as International Finance Corporation (IFC), World Bank Group, and other associated guidelines.

The ESIA Team

ERM is the certified independent third party consultant responsible for conducting the Environmental and Social Impact Assessment (ESIA) for this project.



ERM's Selected Project Experience – Power Sector:

1. Scoping and High-level Environmental and Social Impact Assessment (ESIA) ESIA - 1,280 MW Thermal (Coal) Power Plant - Mon State
2. Initial Environmental Evaluation (IEE) - 500 MW Thermal (Combined Cycle Gas) Power Plant - Ayeyarwady Region
3. Scoping and ESIA – Myingyan 250 MW Thermal (Combined Cycle Gas) Power Plant - Mandalay Region
4. ESIA – 300 MW HFO Power Plant - Yangon
5. IEE – 50 MW HFO Power Plant – Bago Region
6. ESIA – 1280 MW Thermal (Coal) Power Plant – Kayin State
7. ESIA – 200 MW Thermal (Gas) Power Plant - Tanintharyi Region
8. EIA – 60 MW HFO Power Plant – Bago Region
9. ESIA – FSRU, 1,200 MW Thermal (Gas) Power Plant and 400km 500kV Transmission Line - Tanintharyi Region
10. ESIA – FSRU, 1,000 MW Thermal (Gas) Power Plant and 135 km 500kV Transmission Line – Yangon Region
11. ESIA – FSRU and 2,300 MW Thermal (Gas) Power Plant and 500km 500kV Transmission Line – Rakhine State
12. ESIA – 230 MW Hydropower Plant – Shan State
13. EIA - Gas to Power Plant Project - Yangon Region
14. ESIA - Power plant, Gas Pipeline and LNG Terminal - Yangon Region
15. ESIA - 113 MW Wind Farm and 58km Transmission Line - Magway Region
16. ESIA - 50 MW Wind Farm and 115km Transmission Line - Magway Region
17. ESIA - 50 MW Wind Farm and 19km Transmission Line - Magway Region
18. ESIA - 50 MW Wind Farm and 49km Transmission Line - Magway Region

The ESIA Team

For this Project, ERM has teamed up with Sustainable Environment Myanmar Co., Ltd (SEM).

SEM is the Myanmar EIA license holder supporting ERM on the development of the ESIA.

ERM Key Personnel involved in Preparation of the Scoping Study

Name	Project Role
Ms. Kamonthip Ma-oon	Partner in Charge
Dr. Robin Kennish	Project Technical Director
Mr. Vincent Lecat	Project Manager and Social Specialist
Mr. Chris Brown	Soil / Water Specialist
Mr. David Nicholson	Biodiversity Specialist
Mr. Edmund Taylor	Air Quality Specialist
Ms. Khinsusu Naing	Public Consultation Specialist
Ms. Sarinya Rangsipatcharayut	GHG Specialist
Ms. Sylvia Jagerroos	Marine Specialist
Ms. Mandy To	Noise Specialist
Ms. Peggy Wong	Cultural Heritage Specialist
Ms. Kanokphorn Chaivoraphorn	Health Specialist

SEM Key Personnel involved in Preparation of the Scoping Study

Name	Project Role
Mr Zaw Naing Oo	Managing Director
Mr Maung Chit	Project Manager
Ms Nan Cherry	Social Specialist
Daw Naing Naing Win	Local Ecology Expert

Indicative EIA and Project Schedule

March 2018 — Submission of PPR

Apr 18 — Sep 18 — Baseline studies

November 2018 — Public Participation Meeting 1

December 2018 — Submission of scoping report

May 2019 — Public Participation Meeting 2

June 2019 — Submission of EIA reports to ECD

Indicative IEE and Project Schedule

Apr 18 — Sep 18

November 2018

December 2018

May 2019

June 2019

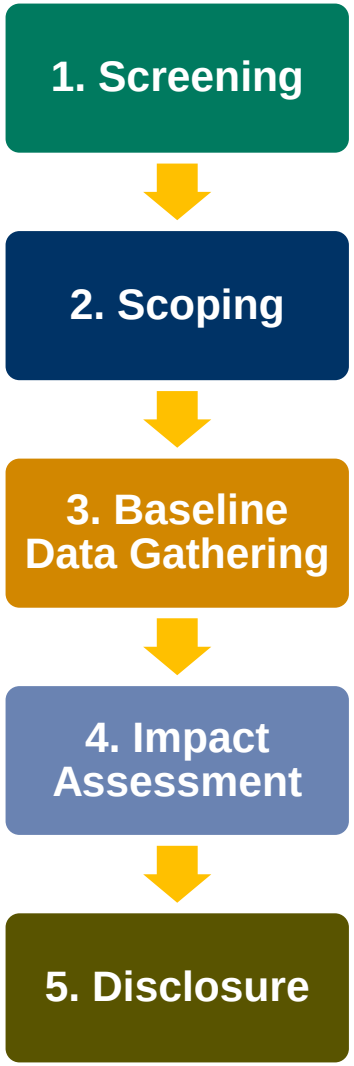
Submission of PPR

Public Participation Meeting 1

Submission of EIA reports to ECD

ESIA Process

Stakeholder Engagement



1. Screening characterises the Project and a decision is made on whether a full EIA is required. Project Proposal Report was submitted to ECD on 14th December 2017.

2. Scoping considers the likely changes (impacts) that will happen because of the proposed Project and defines the scope of the assessment. Scoping Report was submitted to ECD on 9th January 2019 and approved in April 2019.

PP1

3. Baseline Data Gathering is to collect information to understand what the environment and people in the area are like, and how the proposed Project is likely to affect them. Two seasons survey (wet and dry) have been conducted.

4. The *Impact Assessment* describes and assesses how significant (important) the changes (impacts) are likely to be, and identifies ways to manage these changes (mitigation).

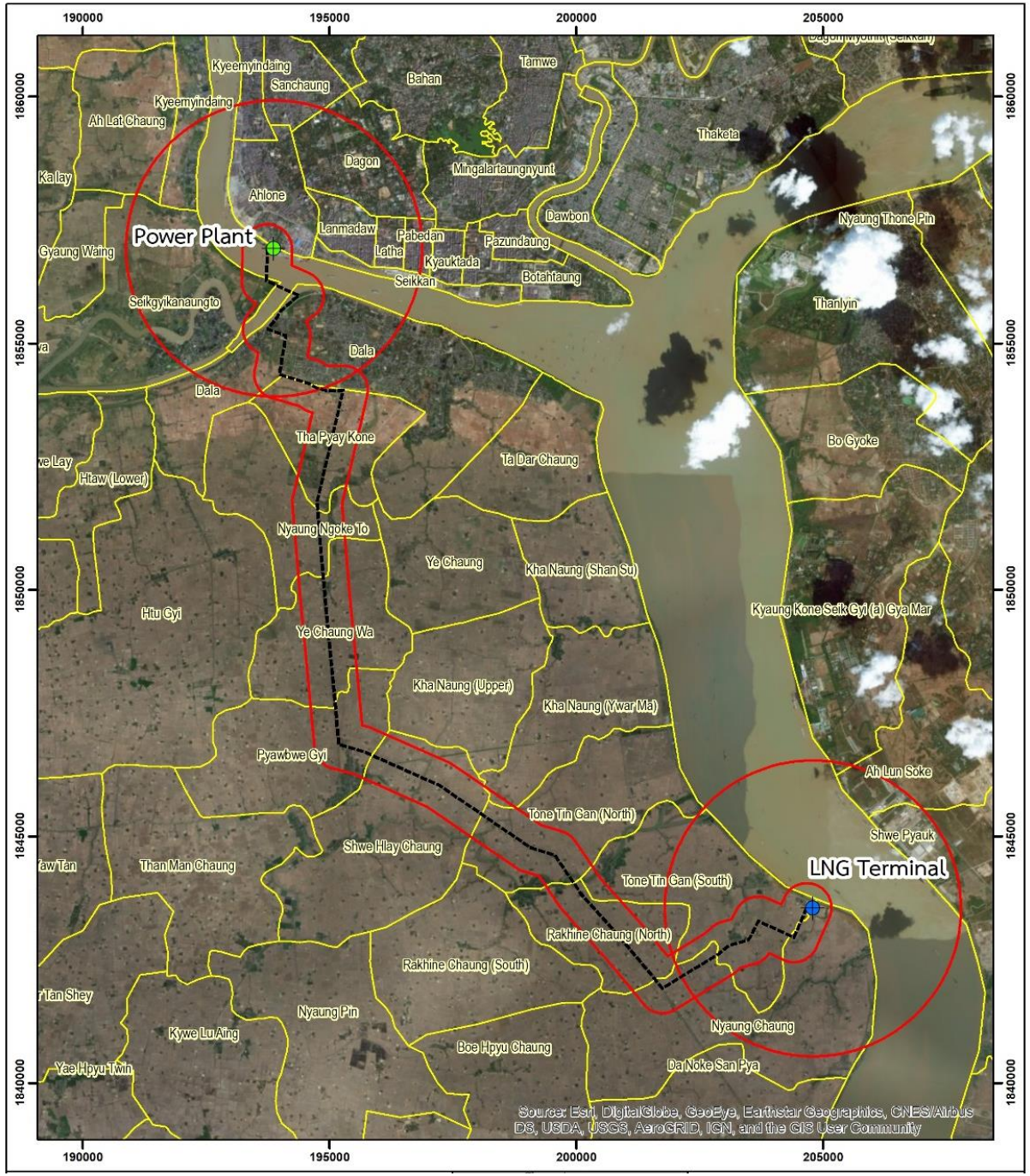
5. Disclosure is divided into two stages.
Stage 1: disclosure of draft EIA report to stakeholders
Stage 2: Final EIA report is submitted to the Government who will review the report and make a decision about the proposed Project.

We are here: PP2

Baseline

Summary

Study Area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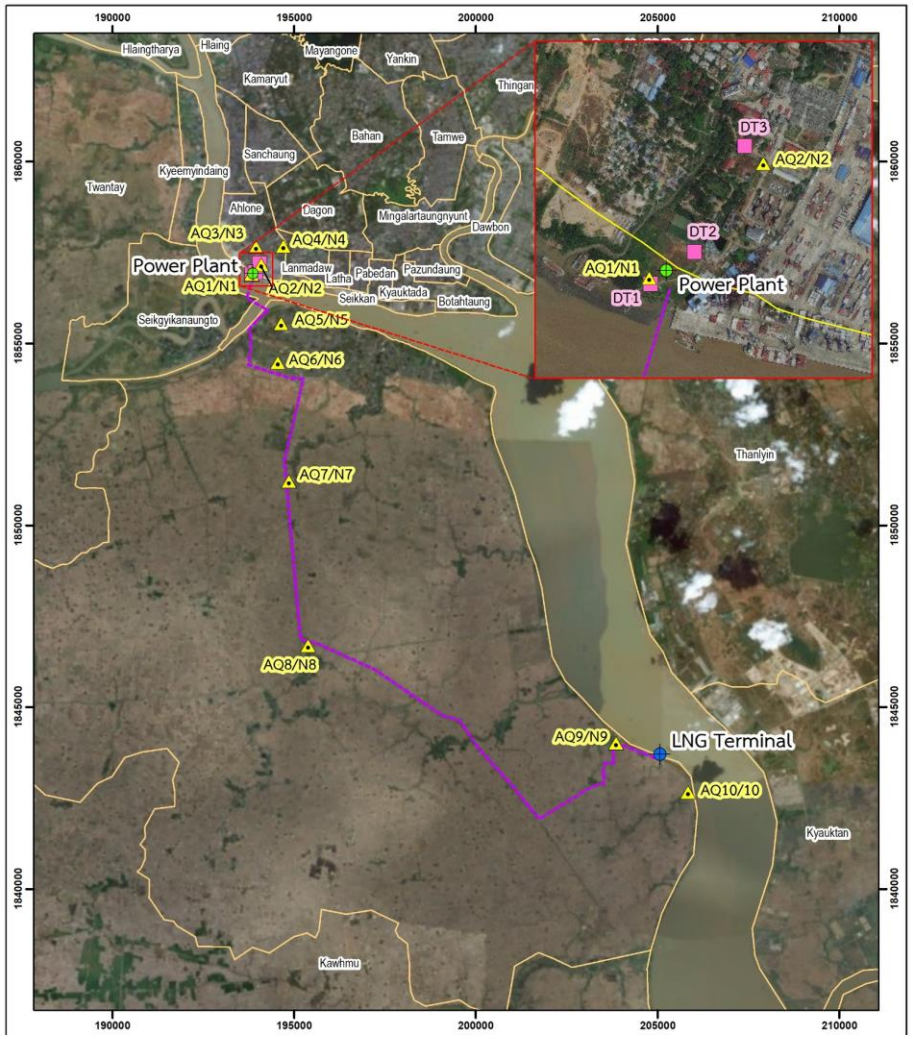
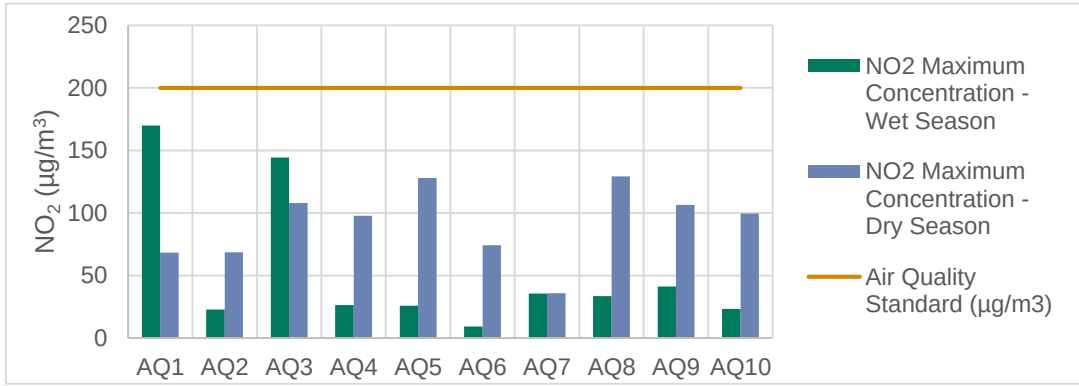
Tamwe
Kyeemyindaing
Ah Lat Chaung
Thaketa
Ka lay
Dagon
Mingalartaungnyunt
Ahlone
Dawbon
Nyaung Thone Pin
Power Plant
Lanmadaw
Pabedan
Pazundaung
Gyaung Waing
Latha
Kyauktada
Botahtaung
Seikkan
Thanlyin
Seikgyikanaungto
Dala
Dala
Tha Pyay Kone
Bo Gyoke
Ta Dar Chaung
Hlaw (Lower)
Nyaung Ngoke To
Ye Chaung
Kha Naung (Shan Su)
Htu Gyi
Kyaung Kone Seik Gyi (a) Gya Mar
Ye Chaung Wa
Kha Naung (Upper)
Kha Naung (Ywar Ma)
Pyawbwe Gyi
Ah Lun Soke
Tone Tin Gan (North)
Shwe Pyauk
Shwe Hlay Chaung
Than Man Chaung
LNG Terminal
Tone Tin Gan (South)
Rakhine Chaung (North)
Rakhine Chaung (South)
Nyaung Pin
Nyaung Chaung
Kywe Lu Aing
Boe Hpyu Chaung
Yae Hpyu Twin
Da Noke San Pya
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Air Quality

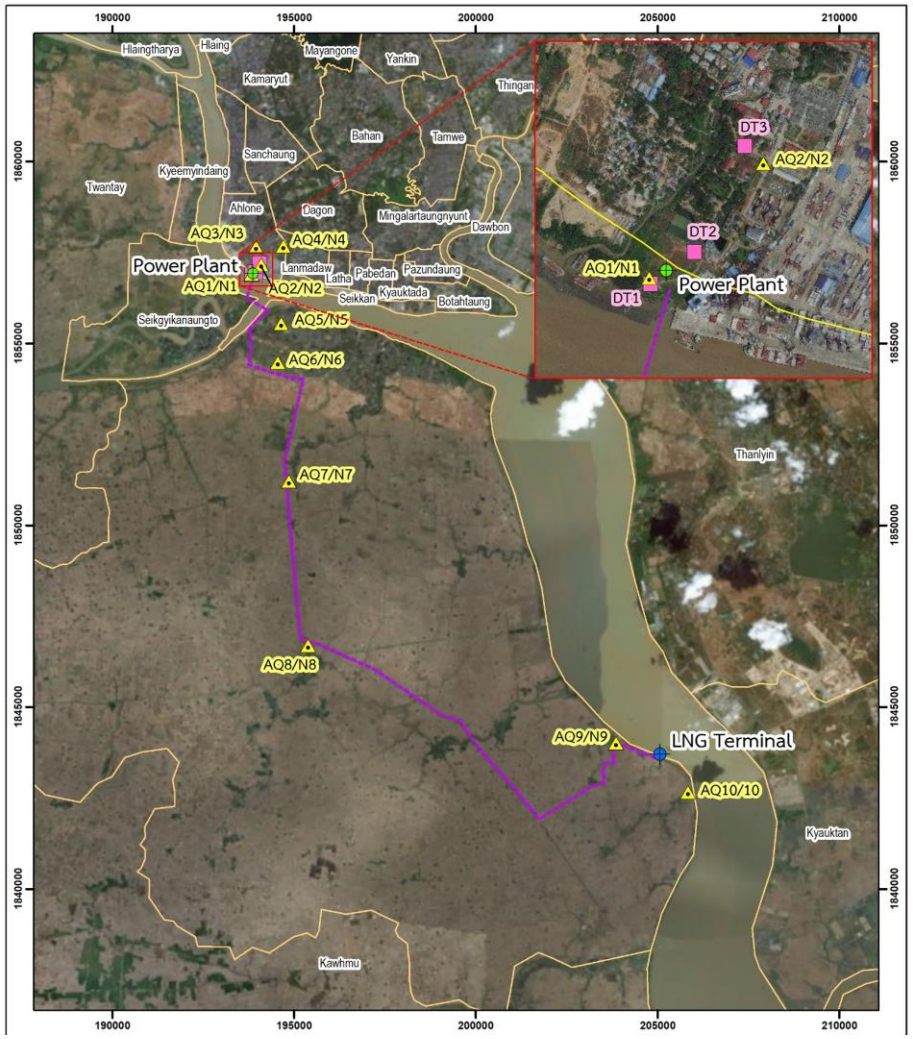




Results show that the air quality in the studied areas is above Myanmar and International Standard

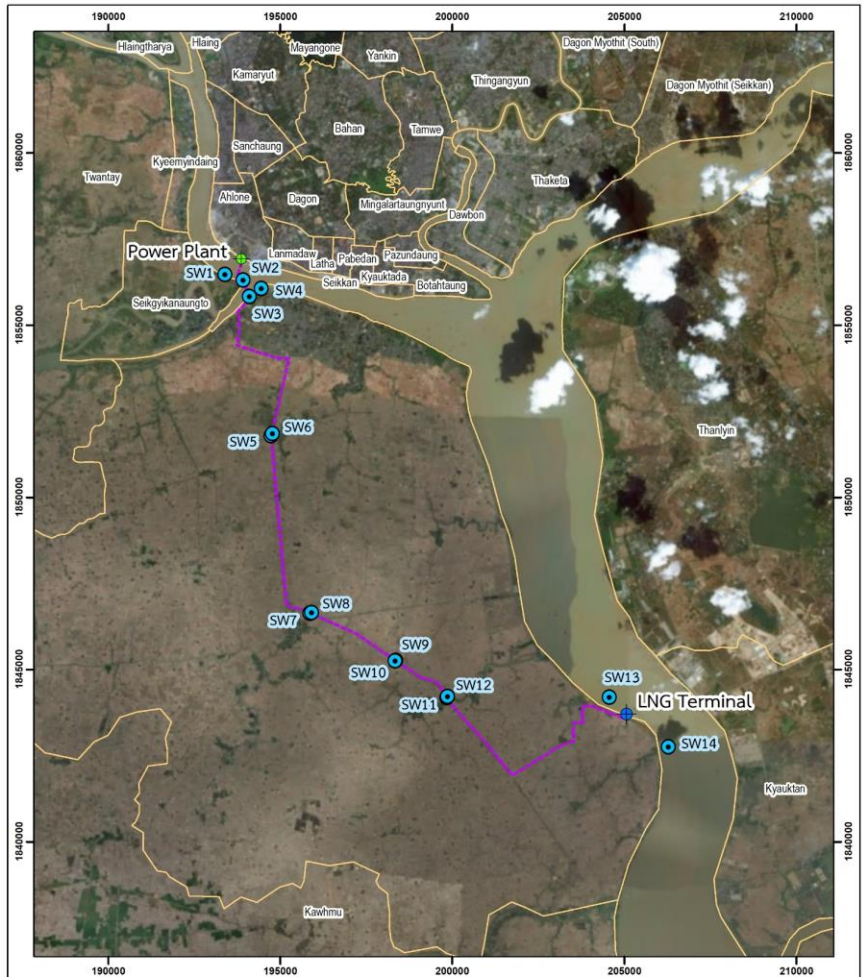
Therefore study has been conducted for a Non-degraded Airshed.

Noise



Results show that most stations exceed the Myanmar standard already due to industrial or local activities (transport)

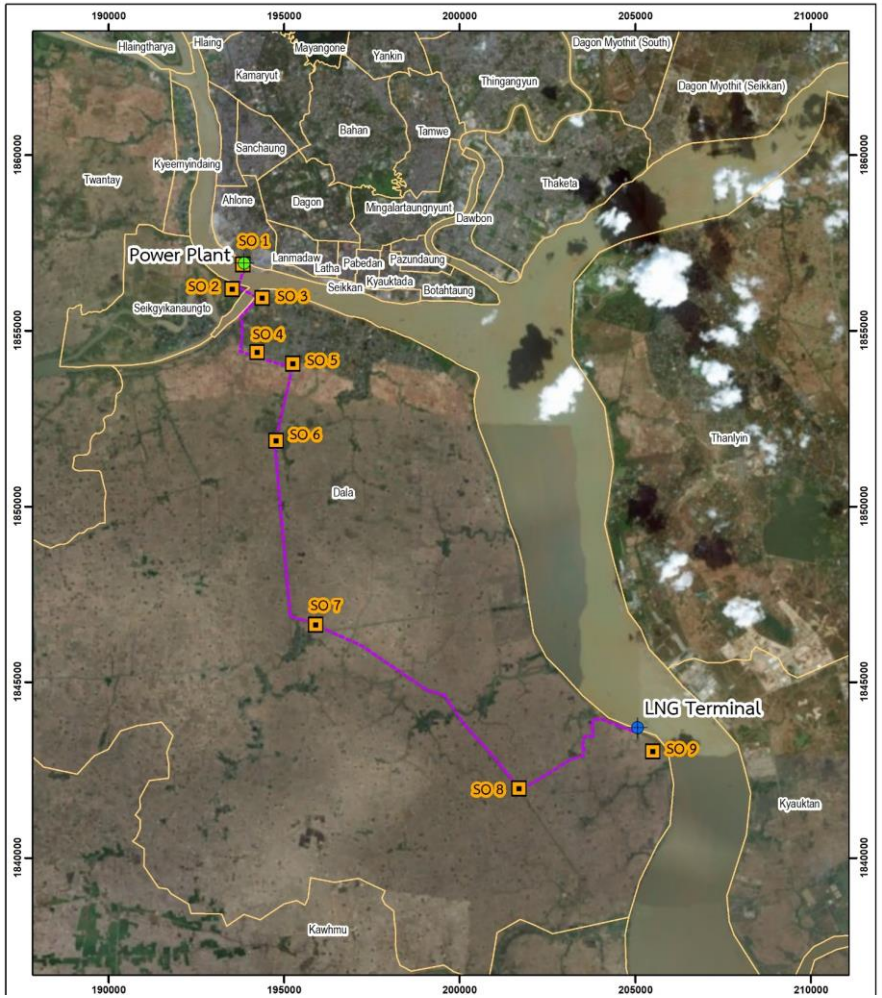
Surface Water



During both season and at most sites, some parameters (Total Suspended and Dissolved Solid, Manganese) were found to be above Myanmar standard requirements.

All other parameters were all under Myanmar standard requirements

Soil

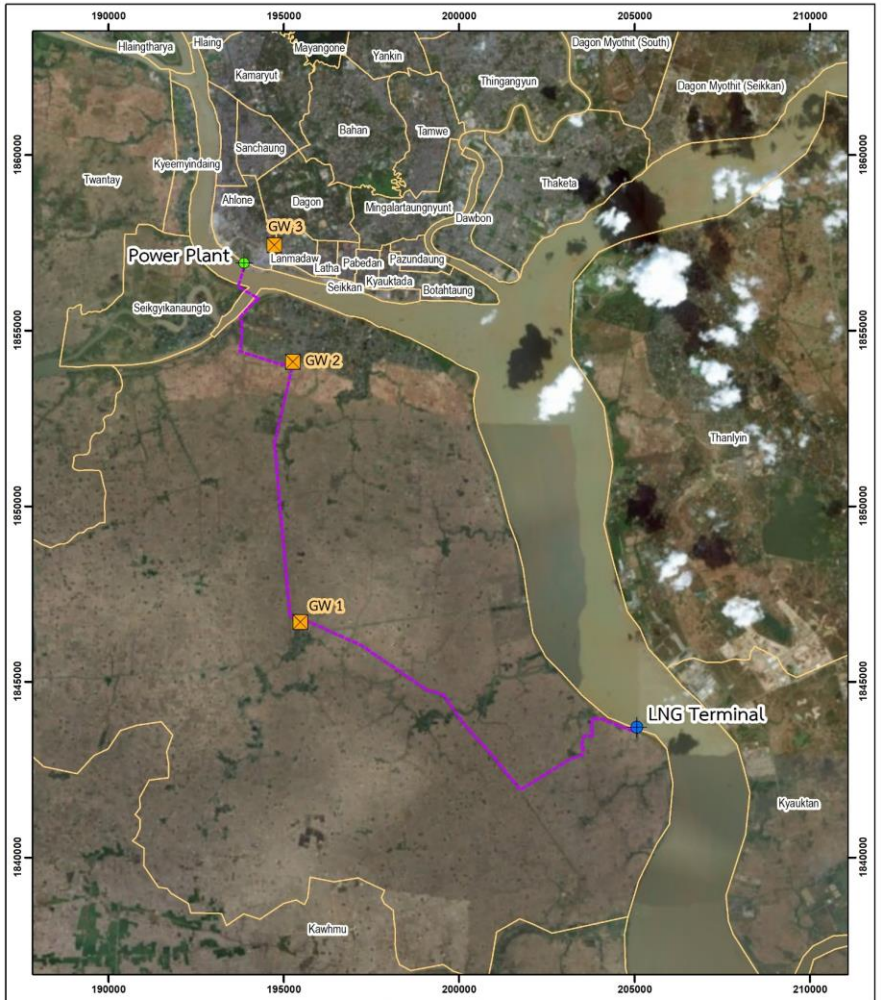


Sampling site SO 2 exceeded the target value for copper in top soil and Mercury in sub-soil.

Sampling site SO 4 exceeded the target value for copper in subsoil

Other sampling sites and parameters were found to be within the Standard.

Ground Water

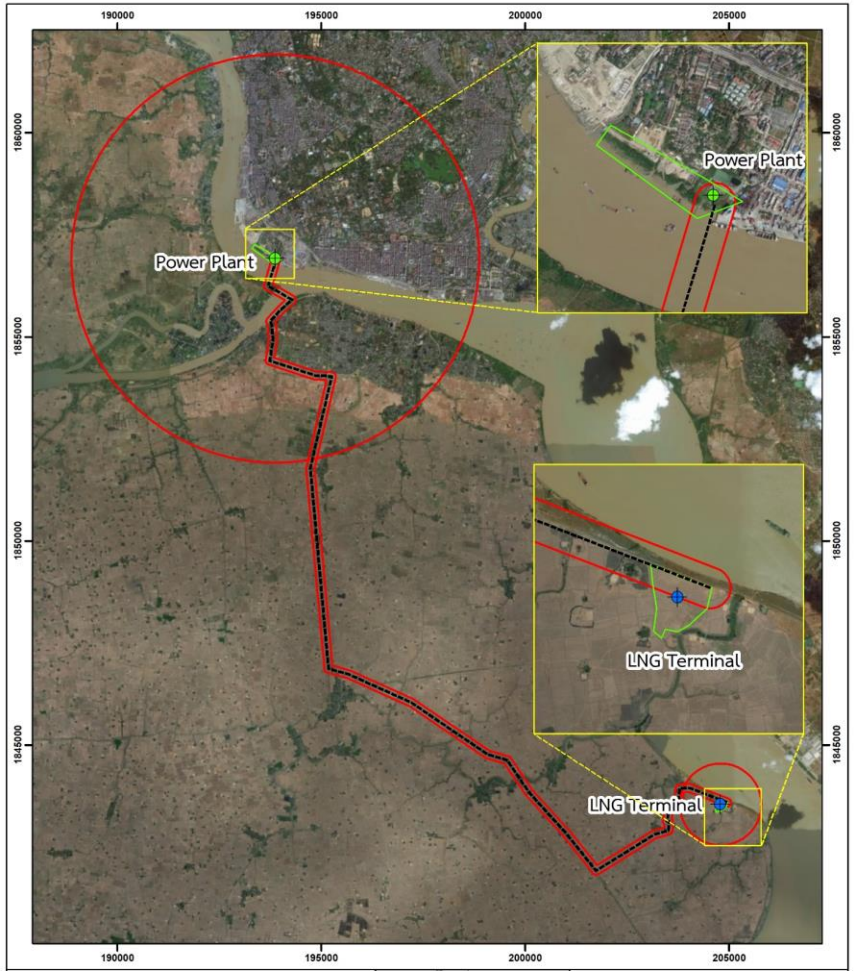


The iron (Fe) concentration at GW1 and GW2 exceeds the Myanmar Standard

The TDS concentrations at GW1 and GW2 exceeds the EPA Standard

All other parameters were all under Myanmar standard requirements

Biodiversity



Habitat Type	Study Area (ha)
Natural Habitat	0.20
Modified Habitat	3.02

Natural habitats consist of the Yangon River and small mangrove area near the Power Plant Site

The majority of the area is modified habitats

Public Participation 1

Summary

PP1 Summary

Date	Location	Stakeholder
29/10/2018	Ahlone Township hall	GAD, Parliament Member (Regional Gov't), Regional ECD, Village Leader, Elder people, Villagers
10/12/2018	Dala Township hall	GAD, Concerned Departments, Ward Administrator, Village Leader, Villagers
11/12/2018	Thanlyin Township hall	GAD, Concerned Departments, Village Leader, CSOs, Elder people, Villagers

Key Concerns:

- Public health and safety (ERP, natural disaster, unplanned events)
- Jobs opportunity for locals
- Project timeline, schedule and planned operation date/duration
- Mitigation Measures and Monitoring of Project activities (including compensations)
- CSR activities
- Transparency of information

Stakeholder Engagement

Activities conducted:

- Household questionnaires (150) in Ahlone, Seikgyikanaungto and Dala Townships
- Interview with Key Informant (village leader, Health care practitioner)
- Focus Group Discussions with interest groups (women, farmers)

Project Potential Impacts Construction

Summary of Impacts: LNG Terminal Construction

Receptor	Source	Impact Significance
Air Quality	Dust	Minor to Moderate
Green House Gas	GHG Emissions	Negligible
Noise	Transport and Construction	Negligible to Minor
Surface Water	Water Intake and Sedimentation	Negligible
Soil and Ground Water	Site Clearance	Negligible
Waste	Biomass, Hazardous and non-hazardous wastes	Minor to Moderate
Visual	Construction	Minor
Social	Employment	Positive
Social	Impact on Livelihood, Health, Navigation and existing facilities	Minor to Moderate
Social	Traffic, Transport and Cultural Heritage	Negligible

Summary of Impacts: Pipeline Construction

Receptor	Source	Impact Significance
Air Quality	Dust	Major
Green House Gas	GHG Emissions	Negligible
Noise	Transport and Excavation	Minor
Surface Water	Water Intake and Sedimentation	Negligible
Soil and Ground Water	Site Clearance	Negligible
Waste	Biomass, Hazardous and non-hazardous wastes	Minor
Social	Employment	Positive
Social	Community and Occupational Health and Safety	Minor to Moderate
Social	Traffic, Transport and Cultural Heritage	Negligible
Social	Economical Displacement	Major

Summary of Impacts: Power Plant Construction

Receptor	Source	Impact Significance
Air Quality	Dust	Minor to Moderate
Green House Gas	GHG Emissions	Negligible
Noise	Transport, Construction, commissioning	Minor to Moderate
Surface Water	Water Intake and Sedimentation	Negligible
Soil and Ground Water	Site Clearance	Negligible
Waste	Biomass, Hazardous and non-hazardous wastes	Moderate
Visual	Construction	Minor
Social	Employment	Positive
Social	Existing facilities, community and occupational Health and Safety	Minor to Moderate
Social	Traffic, Transport, Navigation and Cultural Heritage	Negligible

Proposed Mitigation: Construction Phase

Air Quality Proposed Mitigations Measures

- Develop and Implement a Dust Management Plan (DMP);
- Watering of cleared areas and roads;
- Dust-causing activities located away from receptors;
- Set screens or barriers and cover stockpiles;
- Only use construction equipment with dust suppression techniques;
- No waste will be burned on site;
- Cover the bare soil with plants or other materials;
- Implement a wheel washing system;

Biodiversity Proposed Mitigations Measures

- Implementation of strict rules against vegetation clearing and invasive species management measures ;
- Construction and operation materials and chemicals will be appropriately secured.
- Access road to be used by construction vehicles only;
- Wastes to be appropriately stored and disposed of by appropriately licenced waste management contractors;
- Sediment and erosion control measures to be used in all areas of construction;
- Awareness campaign on biodiversity value and protection amongst all staff
- Speed limits; and
- Area to be cleared to be clearly marked;

Noise Proposed Mitigations Measures

- Schedule material transportation evenly throughout the day and outside community areas;
- Noise barriers;
- Limited working hours from 07:00 to 22:00, Monday to Saturday (except holiday);
- Control the number and position of operation machines in the construction site to reduce noise impact; and
- Only well and regularly maintained equipment, machine and construction items will be use on-site.

Visual Impacts Proposed Mitigations Measures

- Provide soft landscaping (i.e. tree, low shrub and ground cover planting) within available space within the Project Site;
- Minimise the clearing of construction areas and vegetation as practical as possible; and
- Reinstatement of temporarily affected areas.

Waste Proposed Mitigation Measures

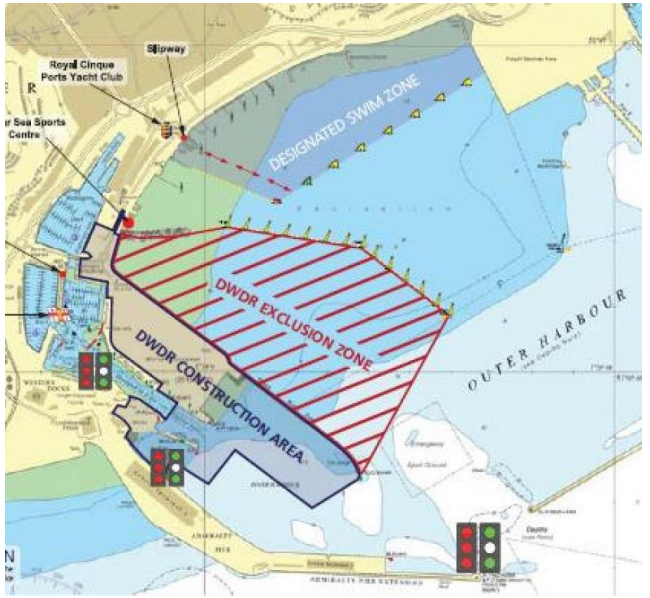
- Site clearance and preparation is to be designed with minimum removal of vegetation and unused biomass will be kept for site stabilisation and rehabilitation activities;
- Develop and implement wastes management plans for waste storage and disposal;
- Monitor and audit waste contractor to make sure that all waste management processes go according to the regulations;
- Effluent from chemical cleaning of the equipment during the pre-commissioning phase will be collected in an appropriate drainage system and transported off-site to a licensed Hazardous Waste Treatment Facility.
- All hazardous materials required during the construction phase will be appropriately transported, stored and handled.
- Regular training and monitoring of all workers; and
- Contorl the integrity of wastewater storage unit;

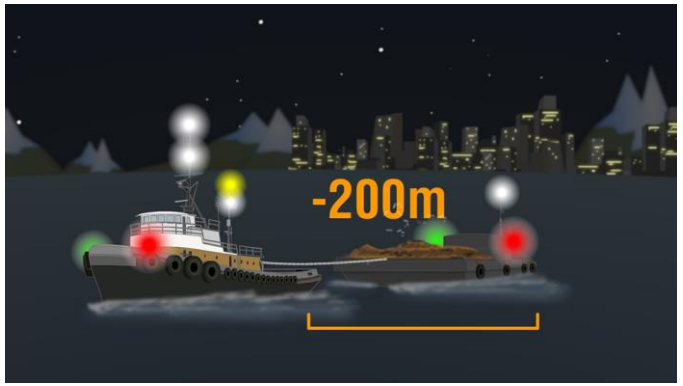
Livelihood Proposed Mitigation Measures

- Recruitment of workforces from the nearest areas of the project first and information, training and engagement sessions;
- Land take will be as minimal as practical;
- Engagement of a third party to develop a Resettlement Action Plan that identify all impacted assets and provide mitigations and compensation measures;
- Implement the engagement plan and grievance management plan for any Project impact;
- TPMC will provide passages for local people to access local shops when trench is opened; and
- TPMC will compensate stakeholders whose business is affected during the construction;

Navigation Proposed Mitigation Measures

- Establish exclusion zone and safety zone around the construction area along with support vessels to prevent collision and inform stakeholder; and
- Provide light and warning signals on construction vessels. Ensure all project related captain and skippers are trained with permits and certificate to operate vessels;
- Implement the engagement plan and grievance management plan for any impact related to Fishing and Navigation Activities.



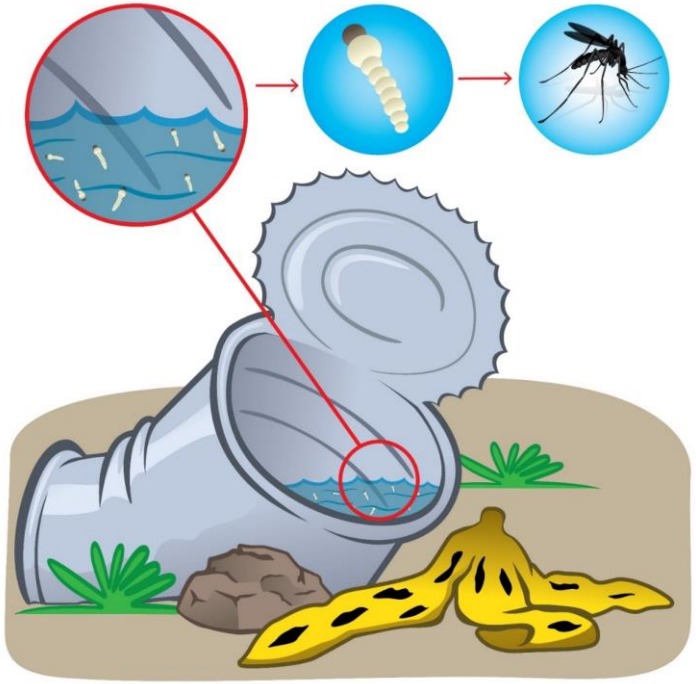


Existing Infrastructures Proposed Mitigations Measures

- Establish amenities at the worker camp;
- Ensure that company medical services have sufficient capacity and capability to treat a reasonable amount of workers at the same time;
- Develop and implement a Workforce Code of Conduct;
- Develop traffic Management plan that cover vehicle safety, driver training speed limited, operation hours, use of drugs and alcohol, rest stops, and accident report;
- Implement the engagement plan and grievance management plan for any impact related to Existing Facilities.

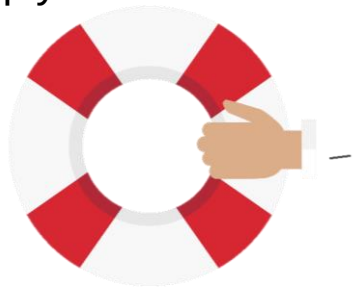
Health and Safety Proposed Mitigation Measures

- Awareness training for workers on hygiene and sanitation; diseases and how to prevent them;
- Undertake pre-employment screening to ensure fitness for work and used as a tool to minimize the transmission of communicable diseases;
- Reduction of vector habitat (mosquitoes breeding ground);
- Promote safe practices and interactions;



- Accommodation should be provided to external workers in accordance with international good practice;
- Security personnel will be contracted and trained in line with the Voluntary Principles on Security and Human Rights;
- Put clearly understandable warning signs around the construction sites; and
- Ensure of enough fencing around the construction site to minimise trespass include daily patrolling.

- Prepare and implement a Health and Safety Plan;
- Create a Permit to Enter system to filter only project relevant persons into the site;
- All persons working on the construction site will be provided information about risks on Site;
- All workers will be properly informed, consulted and trained on health and safety issues;
- Personal Protective Equipment (PPE) should be worn at all times on the construction Site;
- All safety equipment will be properly maintain and examined at least once a month and after used;
- Contractor will provide appropriate safety barriers with warning signs around dangerous spaces;
- TPMC will develop and monitor an internal standard to guide labour practices and apply this to its supply chain.



Project Potential Impacts Operation

Summary of Impacts: LNG Terminal Operation

Receptor	Source	Impact Significance
Air Quality	Dust	Minor to Moderate
Green House Gas	GHG Emissions	Minor
Noise	Operations	Negligible
Surface Water	Water Intake and discharge and waste water	Negligible
Soil and Ground Water	Site Clearance	Negligible
Waste	Domestic, Hazardous and non-hazardous wastes	Minor to Moderate
Visual	Buildings	Minor
Social	Employment	Positive
Social	Impact on Livelihood, Health, Navigation	Negligible
Social	Existing facilities and occupational Health	Minor to Moderate

Summary of Impacts: Pipeline Operation

Receptor	Source	Impact Significance
Social	Economical Displacement	Negligible

Summary of Impacts: Power Plant Operation

Receptor	Source	Impact Significance
Air Quality	Dust	Minor to Moderate
Green House Gas	GHG Emissions	Moderate
Noise	Operation	Minor to Moderate
Surface Water	Water Intake and Sedimentation	Negligible
Soil and Ground Water	Site Clearance	Negligible
Waste	Domestic, non-hazardous and hazardous wastes	Minor to Moderate
Visual	Operation	Minor
Social	Employment	Positive
Social	Community Health and Safety	Negligible
Social	Occupational Health and Safety	Minor

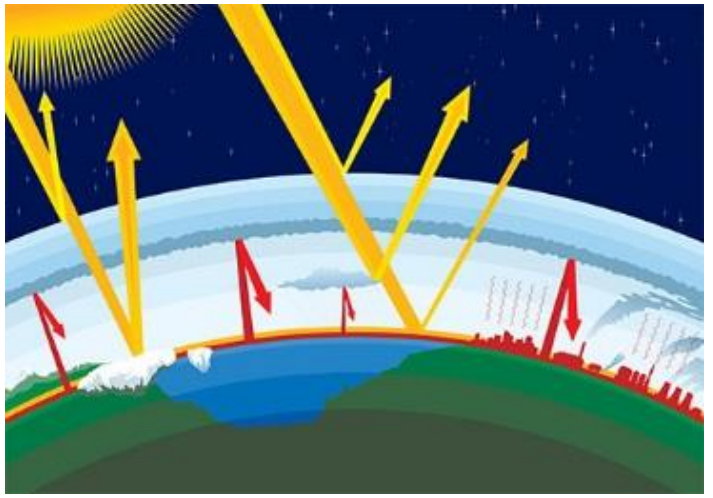
Proposed Mitigation: Operation Phase

Air Quality Proposed Mitigations Measures

- The site layout will be planned so that machinery is located as far as is possible away from receptors;
- All vehicles will switch off engines when stationary;
- A regular vehicle and machinery maintenance and repair programme will be implemented; and
- Mains electricity or battery powered equipment will be used instead of diesel/petrol generators where practicable.

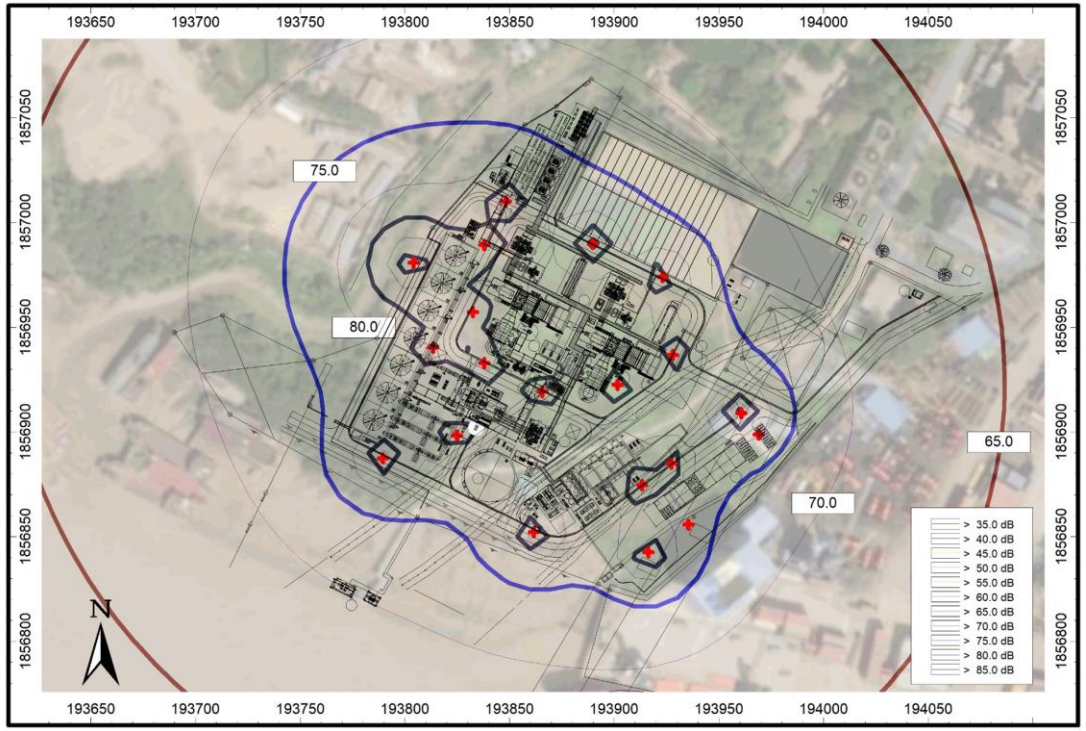
Greenhouse Gas Proposed Mitigations Measures

- Annual GHG emission will be monitored according to the applicable requirements.
- Develop and implement maintenance plan for machines, engines, and vehicle for combustion efficiency.



Noise Proposed Mitigations Measures

- Installed Noise barriers;
- Only well and regularly maintained equipment and machine will be use on-site; and
- Control the number and position of operation machines in the operation site to reduce noise impact.



Visual Impacts Proposed Mitigations Measures

- Visual screening e.g. surround perimeter of site with native trees;
- Maintain soft landscaping (i.e. tree, low shrub and ground cover planting) within available space in the Project Site;
- Minimise the use of lighting by identify the lighting areas, equipments, shielding, and lighting level and position properly;
- Maintain all structural facilities in good repair

Waste Proposed Mitigations Measures

- A Waste Management Plan (WMP) is to be developed by TPMC. The WMP will include specific requirements to manage, avoid, reduce and reuse waste;
- Regular training and monitoring of all workers action on site;
- Waste clean-up will be arrange once every two weeks (collected waste and unused material from the construction site);
- Monitoring and Audit of the waste management contractors; and
- The appointed waste contractor shall report on an annual basis to the Project proponent on any cross-boundary transport of waste

Employment Proposed Mitigations Measures

- The project will develop a Sourcing, Procurement and Recruitment Management Plan which focus on
  - Recruiting workforces from the nearest areas of the project first; and
  - Arrange information, training and engagement sessions.

Occupational Health and Safety Proposed Mitigations Measures

- The mitigation measures developed for the construction phase apply to the operation phase;
- Upgrade the Occupational Health and Safety Management Plan (OHSMP) and linked to the Emergency Response Plan for unplanned event; and
- Maintained the grievance mechanism for workers.

Unplanned Event Impacts

Unplanned Event

Impact : **Vessel Collision (Construction and Operation Phase)**

Impact Significance (Pre-mitigation): **Moderate Impact**

Impact Significance (Post-mitigation): **Minor Impact**

- A dedicated safe area will be provided to relevant authorities and local fisherman during construction;
- The contractor shall coordinate with relevant authorities to disseminate information regarding the construction schedule, construction area, and activities;
- The contractor will install warning equipments and navigation aids at the construction area including safety boats;
- The navigation schedule will be communicated to relevant stakeholders; and
- Establish a maritime safety management plan.

Unplanned Event

Impact : **Fire and Explosion (Construction and Operation Phase)**

Impact Significance (Pre-mitigation): **Minor to Moderate Impact**

Impact Significance (Post-mitigation): **Negligible to Minor Impact**

- Develop a preventive maintenance program for process equipment and pipelines;
- Ensure staffs strictly follow the working standard and procedures;
- Install leak detecting and alarming system in operating areas and tank farm;
- Establish an Emergency Centre with 24 hours standby staff and firemen.

Unplanned Event

- Install fire protection and firefighting systems
- Pipelines will be built and maintained according to international standards;
- Install a system pressure monitor to detect leaks;
- Conduct routine inspections and maintenance for all pipelines and associated equipment at least once per year;
- All fire prevention and firefighting systems shall be routinely inspected and maintained the by responsible persons;

Unplanned Event

Impact : **Seismic and Earthquake (Construction and Operation Phase)**

Impact Significance (Pre-mitigation): **Moderate Impact**

Impact Significance (Post-mitigation): **Minor Impact**

- The Project facilities should be designed to meet the seismic design standard for instance NFPA 59A, ASME, API, etc;
- Construct the LNG storage tank and other critical structures on driven pile foundations; and
- Prepare emergency response procedures for seism and severe weather condition.

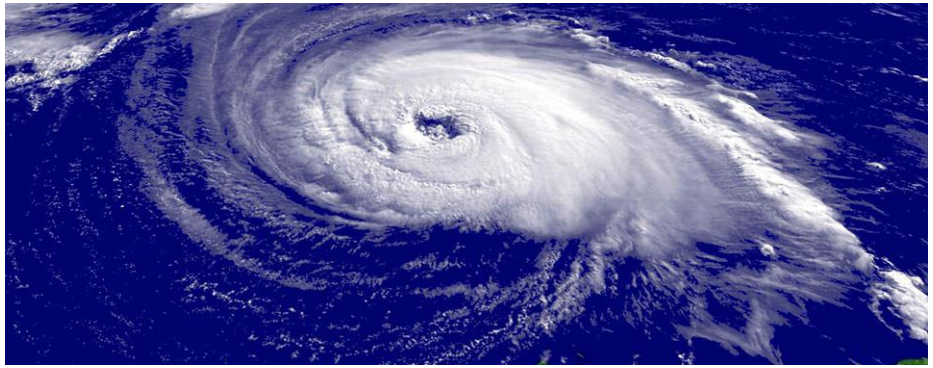
Unplanned Event

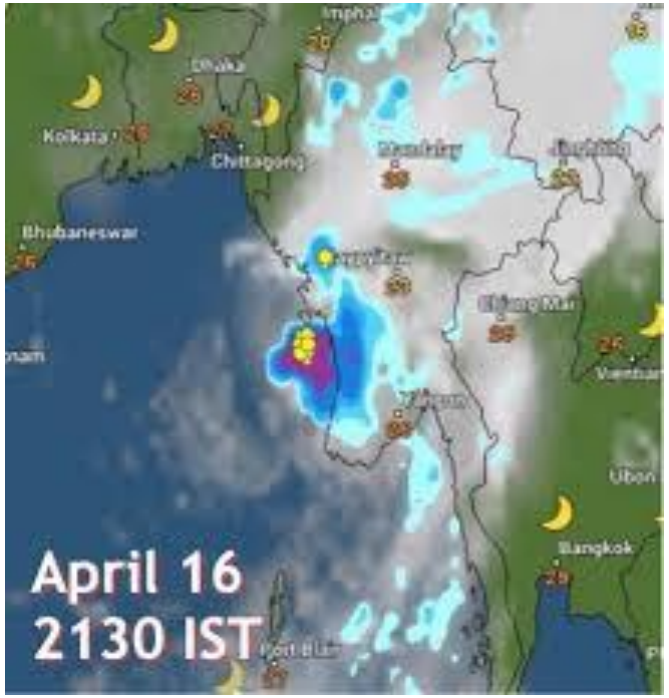
Impact : **Tropical Storm and Extreme Weather Conditions (Construction and Operation Phase)**

Impact Significance (Pre-mitigation): **Moderate Impact**

Impact Significance (Post-mitigation): **Minor Impact**

- Review weather forecast and monitor weather condition on a daily basis;
- Prepare typhoon response plan and typhoon evacuation plan and conduct evacuation drill and at least once a year.





Unplanned Event

Impact : **Loss of Containment of Waste Storage Facilities On-site (Construction and Operation Phase)**

Impact Significance (Pre-mitigation): **Minor to Moderate Impact**

Impact Significance (Post-mitigation): **Negligible to Minor Impact**

- Ensure the integrity of wastewater storage unit to avoid leaking of wastewater and odor to the surrounding receptors;
- Use appropriate waste containers and build secondary containment around chemical or waste storage;
- Siting of chemical and waste storage should consider nearby receptors, i.e. site away from watercourses or portable water sources;

Unplanned Event

- Hazardous waste should be stored so as to prevent or control accidental releases to air, soil and water resources. Where practicable:
- Spill response and emergency plans should be prepared and implemented to address the potential accidental release of hazardous waste;

Unplanned Event

- On-site and off-site transportation of waste should be conducted so as to prevent or minimise spills, release and exposures to employees and public;
- Maintenance facilities should be located on hard standing surfaces within a bunded area. Sumps and oil interceptors should be provided.; and
- Design discharge point to be furthest away from sensitive receptors.

Unplanned Event

Impact : **Chemical Spill or Leak (Construction and Operation Phase)**

Impact Significance (Pre-mitigation): **Minor Impact**

Impact Significance (Post-mitigation): **Negligible Impact**

- Contractor will prepare protocols, guildelines, and training for staff to prevent and prepare for any possible spills and leaks of oils, fuels, or chemicals;
- Use spill or drip trays and spill control kits to contain and clean spills and leaks;
- Fuel tanks and chemical strorage areas will located in sealed areas for security perpose, and surrounded by containment device to prevent spilled and leaks to the environment.

Unplanned Event

- Arrangement of inventory/storage management system to minimise the materials damage or over-supply;
- Ensure storage areas have impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest storage container;
- Provision of grounding and lightning protection for equipment that handles flammable materials;
- Establish a first-aid centre with first-aid trained staff on site. The first-aid centre shall be equipped with sufficient first-aid equipment, first-aid kit and medicines;
- Employee and contractor must be trained on emergency response plan of which involve informing the public and relevant parties.

Transmission Line Potential Impacts Construction

Summary of Impacts: Transmission Line Construction

Receptor	Source	Impact Significance
Air Quality	Dust	Negligible to Moderate
Green House Gas	GHG Emissions	Negligible
Noise	Construction	Moderate
Surface Water	Construction	Moderate
Soil and Ground Water	Site Clearance	Moderate
Waste	Domestic, Hazardous and non-hazardous wastes	Minor to Moderate
Visual	Buildings	Moderate
Social	Employment	Positive
Social	Economic Displacement and Occupational Health and Safety	Moderate
Social	Traffic, Community Health and Safety and Cultural Heritage	Negligible to Minor

Proposed Mitigation: Construction Phase

Air Quality Proposed Mitigations Measures

- Grievances on air quality issues will be adressed with implementation or itensification of mitigation measures (e.g: more watering of roads to avoid dust emission);
- Watering of cleared areas and roads to avoid durst emission;
- sand and other dust generate materials will be stored in a bunded (walled) area and kept wet when possible;
- Ensure that all vehicles entering and leaving the site are covered to avoid fugitive emissions during transport;
- All vehicles will switch off engines when stationary; and
- Cover the bare soil with plants or other materials;

Biodiversity Proposed Mitigations Measures

- Create community programs of replanting mangrove forest and coastal vegetation;
- Implementation of strict rules against vegetation clearing for all Project staff, workers and contractors;
- Area to be cleared will be clearly marked to avoid accidental clearing;
- Access road to be used by construction vehicles only with speed limits;
- Awareness campaigning on biodiversity value and protection amongst all staff
- Placed and maintained sediment and erosion control devices in direct runoff path to water sources, until vegetation replanting is successful;

Noise Proposed Mitigations Measures

- Schedule material transportation evenly throughout the day and outside community areas;
- Noise barriers;
- Limited working hours from 07:00 to 22:00, Monday to Saturday (except holiday);
- Control the number and position of operation machines in the construction site to reduce noise impact; and
- Only well and regularly maintained equipment, machine and construction items will be use on-site.

Soil and Groundwater Proposed Mitigations Measures

- Exposed soil surfaces, open stockpiles, construction material, waste, and temporary trafficked areas should be filled or covered or dampened;
- Minimize the amount of soil handling;
- Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers; and
- Control erosion through diversion drains, sediment fences, and sediment retention basins;

Surface Water Proposed Mitigations Measures

- Use appropriate methods on-site to minimise sediment runoff e.g. wheel cleaning facilities and control drainage system;
- Inspect, maintain and monitor drainage systems, erosion control, and slit removal facilities;
- Used and stored oil, fuels and chemicals in the assign areas with pollution prevention facilities;
- Installed oil-water separators and holding facilities on-site. If not, oil contaminated water will be collected and handled by proper contractors; and

Visual Proposed Mitigations Measures

- Provide soft landscaping (i.e. tree, low shrub and ground cover planting);
- Minimise the clearing of construction areas and vegetation; and
- Reinstatement of temporarily affected areas to suitable pre-construction condition.

Waste Proposed Mitigations Measures

- Cover the waste loads on truck during in-site and off-site transportation to reduce possible spill, dust generation, and contamination;
- Separate and keep wastes in the appropriated containers and away from the water sources;
- Non-used biomass will be kept for site stabilisation and rehabilitation activities;
- Site clearance and preparation is to be designed and conducted in a manner that requires minimum removal of vegetation;
- Hazardous wastes will be disposed at appropriate facilities;
- Segregate hazardous waste from non-hazardous waste;

Waste Proposed Mitigations Measures

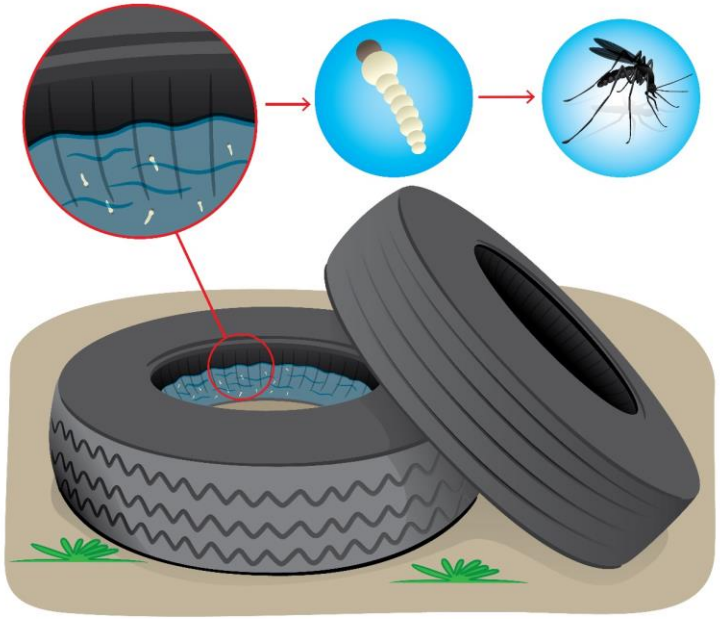
- Develop appropriate wastes management plan for waste storage and disposal;
- Training of all workers on site about waste management regulation;
- Monitor and audit waste contractor to make sure that all waste management processes go according to the regulations;
- Construction processes will be design to operate with minimal waste production;
- Design recycling plans according to the materials (including biomass) recycling potential in the project to reduce number of waste generate;

Livelihood Proposed Mitigation Measures

- Recruitment of workforces from the nearest areas of the project first and information, training and engagement sessions;
- Land take will be as minimal as practical and temporarily impacted land will be returned to its initial state after construction phase;
- Engagement of a third party to develop a Resettlement Action Plan that identify all impacted assets and provide mitigations and compensation measures;
- Implement the engagement plan and grievance management plan for any Project impact;
- TPMC will provide passages for local people to access local shops when trench is opened; and
- TPMC will compensate stakeholders whose business is affected during the construction;

Community and Occupational Health and Safety Proposed Mitigation Measures

- Notify local people about location of accommodation camp and construction activities of the Transmission Line;
- Annually check quality and condition of both electric wire, transmission legs and transmission tower;
- Provide warning sign and warning equipment near the project areas (500 meters) to notify risk areas and safe areas;
- Reduction of vector habitat (mosquitoes breeding ground);
- Provision of onsite health care and medical facilities;



- Conduct information, education and communication campaigns amongst Project personnel on hygiene and sanitation;
- Accommodation should be provided to external workers in accordance with international good practice;
- Develop traffic Management plan;
- TPMC will implement the engagement plan and grievance management plan for any impact related to community health and safety; and

- Prepare and implement a Health and Safety Plan prior to construction;
- All persons working on the construction site will be provided information about risks on Site;
- Personal Protective Equipment (PPE) should be worn at all times on the construction Site;
- Contractor will provide appropriate safety barriers with warning signs around dangerous spaces;
- The EPC contractor will comply with the IFC Performance Standard 2, local regulation and ILO conventions signed by Myanmar;

Monitoring

- Monitoring Programmes during construction (air, noise, surface water, ground water, soil)
- Monitoring Programmes during operation (air, noise, surface water, ground water)
- Site Audit;
- Contractor practice audit;
- Reporting;
- Inspection;
- Grievance Mechanism;
- Stakeholder Engagement.

Stakeholder Engagement

Stakeholder Engagement

Engagement will continue until the approval of the ESIA/IEE and during the life of the Project. Next steps include:

- Continued implementation of the grievance mechanism
- Inclusion of stakeholder comments on draft mitigation measures in the final ESIA
- Disclosure of the final ESIA
- Engagement during construction phase
- Engagement during operation phase

Grievance Mechanism

A part of the engagement process, a grievance mechanism has been established.

- The Grievance Mechanism is available to all stakeholders.
- You can use it if you have any issue, concern, comment or question on the ESIA process.
- Details included in the brochure provided during PP1.
- Comment form provided for this presentation.

Contact:

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Vincent.lecat@erm.com
MyatMon.swe@erm.com

TPMC
Tel: +95 997 495 3914
Mail: htetaung.m@ttcl.com

Thank you

The business of sustainability

ERM

APPENDIX LL PUBLIC PARTICIPATION NO.2 PRESENTATION (ENGLISH)

ERM

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179 Bangkok City Tower 24th Floor |
South Sathorn Road,
Thungmahamek, Sathorn, Bangkok
10120 | Thailand |

Telephone: (662) 679 5200

www.erm.com

Minutes of Meeting

To	Tun Lin Kyaw
CC	ERM-Siam: Vincent Lecat
From	Environmental Resources Management (ERM-Siam)
Date and Location of Meeting	12nd June 2019 Ahlone Township Hall, Ahlone Township, Yangon Region
Project Reference	0439461 TTCL Ahlone Expansion
Subject	Ahlone Township Public Consultation Meeting No.2

Agenda

- Registration
- Introduction of meeting by TTCL Meeting Coordinators
- Introductory words by Township GAD administrator (Mr. U Myo Tint Zaw)
- Introductory words by MOGE General Manager (Mr. U Hla Win Htay)
- Presentation by TTCL (Htet Aung Mon)
- Presentation by ERM (Khinsusu Naing)
- Questions and Answers Period
- Closing Comments/Conclusion speech by the parliament member (Mr. U Ye Lwin)

No.	Key Discussion	Response
1	**U Tin Lin, Lut Latt Yay Ward Administrator, Ahlone** ■ Has any construction started in Dala? ■ Why is the power plant not constructed in Hlaingtharya?	**Htet Aung Mon (Mr.), TTCL** ■ There is an existing 121MW power plant near i MOEE's electricity supply and distribution office (Ahlone)by which constructed and operated by TTCL since 2012. It is MOEE's guidance and instruction to construct this new combine cycle power plant on the vacant land next to existing power plant. That is why the power plant is located in Ahlone. Additionally, the reason of building the terminal and jetty in Dala townships is that the selected location's water depth is deep enough to construct the jetty for LNG carrier vessel.

No.	Key Discussion	Response
2	**U Hla Win, (Ward Administrator), Ahlone** ■ When will the gas from Terminal in Dala transport to power plant? How will the electricity be transferred from Ahlone to Hlaingtharyar? ■ Which Township will benefit from the project? ■ What are the possible impact of the project on electricity cost?	**Worrawut Thoungdee (Mr.), TTCL & Htet Aung Mon (Mr.), TTCL** ■ The underground gas pipeline will start from LNG receiving Terminal in Dala, follow the existing Dala-Danote main road to the Seikkyikhanaungto township and directly to the power plant located on Ahlone river bank by crossing the Yangon river from below. Therefore, gas pipe will not pass through downtown townships. ■ The power produce from this 388 MW new power plant is not compatible with low voltage substation and transmission line. Therefore we will have to construct new 230KV transmission line to transmit the power to Hlaingtharyar high-voltaage substation which is capable to receive the power produced from this new power plant. ■ As TTCL is an independent power producer, our scope of work is to build and operate the plant. All the produced power will be sold out to MOEE with power purchase agreement. Distribution to households is in the scope of MOEE. ■ Therefore, it is under the management of MOEE whether there will be impact on electricity cost or not.
	U Mg Mg, Former MOEE, Ahlone ■ Suggestion on the safety of the installation of the power plant and pipeline, and on the process of unloading the LNG ■ How will the maintenance of the underground pipeline be done? ■ Suggested TTCL to recruit and seek advise by local engineer ■ Suggested operating the power plant safely and sustainably.	**Worrawut Thoungdee (Mr.), TTCL & Htet Aung Mon (Mr.), TTCL** ■ Since initial design stage, we have been applied good engineering practices and standards for LNG Terminal, gas Pipeline and Power Plant. We also have long-term service agreement with very experienced equipment Supplier Company for the operation phase. In this way, we will be able to manage the operation of the plant until the end of plant lifetime. ■ For the process of unloading and storage of LNG, We will required advised from experienced safety Consultant Company (experience in Japan, china, Korea, etc,). We will utilize their technical know-how and experiences in our terminal design for safety operations. ■ Our gas Pipeline standard followed minimum compliance of MOGE's practices. However, international code and standards such as ASME are also complied by monitor and maintain the gas Pipeline every year to ensure the good condition.

No.	Key Discussion	Response
		■ Company has to put a huge amount of investment on the Project. Therefore, the sustainable operation of project is a very crucial point for the Company. Regarding to safety concerns of the Projects, we have hired experts from safety Consultant Company. With their support, we have already presented about our project safety precautions to Yangon Regional Government & MOEE.

Attendance list

167 persons from Government Organizations and Village Responsibilities and 20 persons from company attend the meeting.

No.	Name	Position/Occupation	Department/Organization	Contact No.
1	Mr.Htay Ni Aung	Resident	Galone Quarter (Ahlone)	
2	Mr.Than Htike Aung	Engineer in Charge	MOGE	09-420086285
3	Mr.Kyi Aye	Resident	Ahlone Township	09-254015856
4	Ms.Kay Zin Oo	Resident	Ahlone Township	09-977838542
5	Mr.Zaw Myo Tun	Resident	Ahlone Township	09-450065106
6	Mr.Aung Kyaw Zay	Resident	Ahlone Township	
7	Mr.Than Kyaw Sett	Resident	Ahlone Township	09-420170458
8	Mr.Myo Min Htay	Resident	Ahlone Township	09-252073737
9	Ms.Honey Myint Aung	General Aminstration Officer	Ahlone Township	09-262427296
10	Mr. Maung Maung	Resident	Ahlone Township	09-5059716
11	Ms.May Thet Mon	General Aminstration Officer	Ahlone Township	09-456366410
12	Mr.Lin Aung Khine	General Aminstration Officer	Ahlone Township	09-403365612
13	Ms.Ei Ei Zin	Teacher	Ministry of Education	09-250675243
14	Mr.Chan Aye Zaw	Resident	Galone Quarter (Ahlone)	09-426493023
15	Mr.Ba Myint	DTEO	Ministry of Education	09-424821742
16	Mr.Myo Oo	Staff	Ministry of Education	09-420127504
17	Mr.Win Aung	Staff	Ministry of Education	09-448042071
18	Ms.Yin May	Resident	Ahlone Township	09-253070966
19	Ms.Khine Lin Myint	Resident	Ahlone Township	09-421109330
20	Mr.Maung Aye	Resident	Saw/North Quarter (Ahlone)	09-795959365
21	Ms.Myat Nilar	Resident	Ahlone Township	09-73027408
22	Ms.Soe Soe Mar	Resident	Galone Quarter (Ahlone)	09-250227262
23	Mr.Tin Maung Yee	Journalist	Kyay Hmone Newspaper	09-250500757
24	Ms.Kyi Kyi Win	Resident	Galone Quarter (Ahlone)	09-795413664
25	Ms.Aye	Resident	Ahlone Township	
26	Ms.Khin Htay	Resident	Ahlone Township	
27	Mr.Than Min Aung	Resident	Ahlone Township	
28	Mr.Tin Htut	Resident	Saw/South Quarter (Ahlone)	09-250500140
29	Mr.Maung Maung Swe	Resident	Saw/East Quarter (Ahlone)	09-28071383
30	Mr.Win Myint	Resident	Ahlone Township	09-761534116
31	Mr.Soe Myint	Resident	Ahlone Township	09-31691139
32	Mr.Shin An	Resident	Ahlone Township	09-31691139
33	Mr.Zaw Zaw Tin	Resident	Ahlone Township	09-260276250
34	Ms.Phyo Pa Pa	Resident	Ahlone Township	09-420122315

35	Mr.Ye Min Tun	General Aminstration Officer	Ahlone Township	09-898048050
36	Mr.Tin Maung Oo	General Aminstration Officer	Ahlone Township	09-489981786
37	Mr.Tun Win	Office Staff	Project Dep't (Ahlone)	09-4217413475
38	Mr.Win Shwe	General Aminstration Officer	Sin Min Quarter (Ahlone)	09-420118943
39	Ms.Sandar Khine	General Aminstration Officer	Ahlone Township	09-250178225
40	Mr.Saw Myo Thant	Resident	Ahlone Township	09-976487298
41	Mr.Htay Htay Myint	Resident	Ahlone Township	09-421622733
42	Mr.Kyaw Myint	Resident	Ahlone Township	09-5149449
43	Mr.Tun Aung Phyu	Resident	Ahlone Township	09-445003282
44	Mr.Kyaw Ye Lin	Resident	Hlaingtharyar Township	09-796124184
45	Mr.Kyaw Kyaw Lin	Resident	Ahlone Township	09-264444301
46	Mr.Maung Maung Latt	Resident	Ahlone Township	09-5041911
47	Mr.Kyaw Swar Win	Resident	Galone Quarter (Ahlone)	09-426221399
48	Mr.Zaw Win Tun	Resident	Galone Quarter (Ahlone)	09-795569081
49	Mr.Saw Than Oo	Resident	Galone Quarter (Ahlone)	09-42112731
50	Mr.Soe Yar Zar	Resident	Galone Quarter (Ahlone)	09-259928537
51	Mr.Aung Myint	Resident	Kayin Chan Qurter (Ahlone)	09-427156323
52	Ms.Swe Swe Pyone	Resident	BEHS (2) Ahlone	09-32277333
53	Mr.Thein Yee	Resident	Saw/East Quarter (Ahlone)	09-9420153996
54	Mr.Htay Win	Resident	Saw/East Quarter (Ahlone)	09-451245868
55	Mr.Than Zaw	Resident	Ahlone Township	
56	Mr.Kyaw Kyaw	Government Staff	Ministry of Agriculture, Livestock and Irrigation	09-260414817
57	Mr.Aung Oo	General Aminstration Officer	Ahlone Township	09-5109855
58	Mr.Hla Moe	Resident	Ahlone Township	09-41006522
59	Ms. Naing	Resident	Ahlone Township	09-251204994
60	Ms.Thandar Aung	Resident	Ahlone Township	
61	Mr.Thura Kyaw	Resident	Ahlone Township	09-696696857
62	Mr.Myint Aung	Resident	Ahlone Township	09-956031750
63	Mr.Kyaw Swe	Resident	Ahlone Township	09-254116821
64	Ms.Phyu Phyu Sein	Resident	Ahlone Township	09-254516292
65	Ms.Sandar Kyi	Resident	Ahlone Township	09-443002612
66	Mr.Kyaw San Naing	Resident	Sin Min Quarter (Ahlone)	09-254784741
67	Mr.Than Oo	Resident	Ahlone Township	09-420158400
68	Ms.Myint Myint Kyi	Resident	Latha Township	09-250178237
69	Ms.Win Kya Khine	Resident	Ahlone Township	09-258545176

70	Mr.Htain Lin	Adminstration Officer	Ahlone Township	09-44052045
71	Mr.Sithu Soe Lwin	Government Staff	Township Committee	09-954491988
72	Mr.Thandar Aung	Resident	Ahlone Township	
73	Ms.Ngu Wah	Resident	Ahlone Township	09-400013603
74	Ms.Nyunt Nyunt Khine	Resident	Ahlone Township	09-421059660
75	Ms.Nay Chi Hlaing	Resident	Ahlone Township	09-420133291
76	Ms.Myint Thet Khine	Resident	Ahlone Township	09-782077190
77	Ms.Ye Htet Aung	Resident	Ahlone Township	09-400785054
78	Mr.Than Kyaw Sein	Resident	Ahlone Township	09-262645256
79	Mr.Kyaw Zin Win	Resident	Ahlone Township	09-404922900
80	Mr.Thura Zaw	Resident	Insein Township	09-421117935
81	Mr. Soe Lwin	Government Staff	Moe Kaung Electrical Compound	09-42520542
82	Ms.Ei Ei Mon	Resident	Ahlone Township	09-254061203
83	Mr.Zin Phyo Htet	Resident	Ahlone Township	09-762299069
84	Mr.Hla Than	Resident	Ahlone Township	09-254061169
85	Mr.Khin Kway	Resident	Moe Kaung Electrical Compound	
86	Mr.Soe Nyunt	Resident	Ahlone Township	
87	Mr.Naing Lin Tun	Resident	Ahlone Township	
88	Mr.Kyaw Soe	Resident	Ahlone Township	
89	Mr.Myo Win	Resident	Ahlone Township	
90	Mr.Tin Nyunt	Resident	Ahlone Township	09-254061216
91	Mr.Ohm Thein	Resident	Ahlone Township	09-310701117
92	Mr.Zayar Myint Soe	Resident	Ahlone Township	09-5021071
93	Ms.Ma Ma Lay	Resident	Ahlone Township	
94	Mr.Aung Aung	Resident	Ahlone Township	
95	Mr.Naing Zaw	Resident	Ahlone Township	
96	Mr.Thurein Tun	Resident	Saw/South Quarter (Ahlone)	09-400722405
97	Mr.Zay Yar	Resident	Ahlone Township	
98	Ms.Htay Htay Win	Resident	Ahlone Township	09-401444510
99	Ms.Mar Lar Myo	Resident	Ahlone Township	09-2216421
100	Mr.Ye Htut	Resident	Ahlone Township	
101	Ms.Hnin Hnin Oo	Resident	Ahlone Township	
102	Mr.Aung Aung	Resident	Ahlone Township	
103	Mr.Khin Hlaing Win	Resident	Ahlone Township	
104	Ms.Zin Myat Thu	Resident	Ahlone Township	09-894425188
105	Ms.Khin Yee	Teacher	Ministry of Education	
106	Mr.Aung Khine Myint	Resident	Saw/West Quarter (Ahlone)	09-793113090
107	Mr.Tun Tun	Resident	Saw/West Quarter (Ahlone)	09-421109324
108	Mr.Kalar	Resident	Saw/West Quarter (Ahlone)	09-795335243

109	Ms.Theint New Ni Tun	General Aminstration Officer	Ahlone Township	09-442537313
110	Ms.Moe Moe Win	Resident	Ahlone Township	09-5189751
111	Mr.Soe Min	Journalist	Kyay Hmone Newspaper	09-250149039
112	Mr.Maung Myo Kyaw	Journalist	Myawaddy Daily	09-422429203
113	Mr.Kon Lin Aung	General Aminstration Officer	Ahlone Township	09-421109361
114	Mr.Sein Lin	Resident	Ahlone Township	09-32186032
115	Mr.Myint Htay	Government Staff	Ministry of Agriculture, Livestock and Irrigation	09-421045033
116	Mr.Hla Win	Resident	Saw/South Quarter (Ahlone)	01-211010
117	Mr.Than Htike	Resident	Saw/South Quarter (Ahlone)	09-5011648
118	Ms.Thae Phyu Khine	Resident	Saw/West Quarter (Ahlone)	09-250085203
119	Mr.Phyo Theinkha	Resident	Kayin Chan Qurter (Ahlone)	09-402722062
120	Mr.Ba Maung	Resident	Ahlone Township	09-799633602
121	Ms.Lum Hone	Resident	Ahlone Township	09-250500494
122	Ms.Ei Ei Swe	Resident	Ahlone Township	09-781878070
123	Ms.Myat Mar Lar	Resident	Ahlone Township	09-440725118
124	Ms.Zin Mar Kyaw	Government Staff	Ministry of Electrictiy & Energy	09-421068835
125	Ms.Khin Cho Win	Resident	Ahlone Township	09-420599595
126	Ms.Cherry Wint Thu	Resident	Ahlone Township	09-421001784
127	Mr.Tin Aung	Government Staff	Myanmar Industrial Port	09-425306162
128	Ms.Aye Than	Government Staff	Yangon City Development Committee	
129	Ms.Cho May Lin	Government Staff	Yangon City Development Committee	
130	Ms.Zin Mar Kyaw	Government Staff	Yangon City Development Committee	
131	Ms.San Yee	Government Staff	Yangon City Development Committee	
132	Ms.Chit Su	Government Staff	Yangon City Development Committee	
133	Ms.Tin Mar Htwe	Government Staff	Yangon City Development Committee	
134	Ms.Soe	Government Staff	Yangon City Development Committee	
135	Mr.Soe Tint	Government Staff	Yangon City Development Committee	
136	Mr.Aung Myint	Resident	Ahlone Township	09-5075608
137	Mr.Nyan Win	Resident	Ahlone Township	09-254116642
138	Mr.San Lin	Resident	Ahlone Township	
139	Mr.Thiha Kyaw	Resident	Ahlone Township	

140	Mr.Kaung Htet Aung	Resident	Ahlone Township	09-423976628
141	Mr.Tin Oo Lwin	Resident	Ahlone Township	09-250050083
142	Mr.Hla Win Htay	General Manager	MOGE	09-5021649
143	Ms.Hla Hla Kyi	Government Staff	Myanmar Maternal and Child Welfare Association	09-31643198
144	Ms.Than Than Nwe	Government Staff	Myanmar Maternal and Child Welfare Association	09-788299665
145	Mr.Zaw Aung	Government Staff	Myanmar Maternal and Child Welfare Association	
146	Mr.Soe Than	Government Staff	Myanmar Maternal and Child Welfare Association	
147	Mr.Hla Moe	Government Staff	Myanmar Maternal and Child Welfare Association	09-252029150
148	Mr.Hla Htay	Resident	Galone Quarter (Ahlone)	09-250043450
149	Mr.Ye Phyo Aung	Resident	Saw/West Quarter (Ahlone)	09-251046256
150	Ms.San Nyunt Tun Myint	Deputy Officer	Department of Social Security Welfare	
151	Ms.Zay Yar Win	Resident	Kyauktada Township	09-454276066
152	Ms.San San Myint	Resident	Ahlone Township	
153	Ms.Kyi Lae Lae Oo	Resident	Ahlone Township	09-266018739
154	Mr.Kaung Sett	Resident	Ahlone Township	09-250638547
155	Mr.Phyo Thit Aung	Resident	Ahlone Township	09-250638547
156	Mr.Myint Oo	Resident	Ahlone Township	09-250155655
157	Mr.Soe Htoo Aung	Resident	Ahlone Township	09-421011795
158	Mr.Win Myint	Resident	Saw/South Quarter (Ahlone)	09-5126067
159	Mr.Kyaw Thura Win	Resident	Thuwana Township	09-978970447
160	Mr.Soe Thein Win	Government Staff	Ahlone EPC Compound	09-448022130
161	Mr.Thit Lwin	Resident	Ahlone Township	09-43075290
162	Mr.Si Thu Tun	Company Staff	IGE Power	09-253070217
163	Mr.Swe Swe Aung	General Aminstration Officer	Ahlone Township	09-421061496
164	Ms.Aye Myint	Resident	Ahlone Township	
165	Ms.Tin Moe Moe Khine	Resident	Dagon Township	09-450044115
166	Mr.Maung Maung Soe	Journalist	Irrawaddy	09-5048151
167	Mr.Kyaw Thu	Government Staff	Ahlone EPC Compound	09-5312936

List of Participation (Photo)

LNG သုံးလျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

သဘာဝပတ်ဝန်းကျင်နှင့် လူမှုဝန်းကျင် သက်ရောက်မှုဆန်းစစ်ခြင်း လုပ်ငန်းစဉ်များအား ဒေသခံပြည်သူလူထုသို့

ရှင်းလင်းတင်ပြသော အခမ်းအနား (Public Participation Meeting No. 2)

နေရာ - အလုံမြို့နယ် (အနောက်ပိုင်းခရိုင်) နေ့ရက် - ၂၀၁၉ ခုနှစ်၊ ဇွန်လ ၁၂ရက်

စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
၁။	[illegible]	[illegible]		[signature]	
၂။	[illegible]	[illegible]	09.420086285	[signature]	
၃။	[illegible]	[illegible]	09.254015856	[signature]	
၄။	[illegible]	အလုံ	09-977838542	[signature]	
၅။	[illegible]	〃	09-450065106	[signature]	
၆။	[illegible]	〃	09-[illegible]	[signature]	
၇။	[illegible]	〃	09.420170458	[signature]	
၈။	[illegible]	〃	09-252073737	[signature]	
၉။	[illegible]	[illegible]	09-262427296	[signature]	
၁၀။	[illegible]	[illegible]	[illegible]	[signature]	
၁၁။	[illegible]	[illegible]	09.456366410	[signature]	
၁၂။	[illegible]	〃	09-403365612	[signature]	
၁၃။	[illegible]	[illegible]	09-250475243	[signature]	
၁၄။	[illegible]	[illegible]	09426493025	[signature]	
၁၅။	[illegible]	DTEO	09424821742		
၁၆။	[illegible]	[illegible]	09420127584	[signature]	
၁၇။	[illegible]	[illegible]	094418042671	[signature]	
၁၈။	[illegible]	[illegible]	09.253070966	[signature]	
၁၉။	[illegible]	〃	09.421409333	[signature]	
၂၀။	[illegible]	[illegible]	09,795959365	[signature]	

LNG သုံးလျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

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ရှင်းလင်းတင်ပြသော အခမ်းအနား (Public Participation Meeting No. 2)

နေရာ - အလုံမြို့နယ် (အနောက်ပိုင်းခရိုင်)

နေ့ရက် - ၂၀၁၉ ခုနှစ်၊ ဇွန်လ ၁၂ရက်

စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
၁။	[illegible]	[illegible]	09.73027408	[illegible]	
၂။	[illegible]	[illegible]	09250227262	[illegible]	
၃။	[illegible]	[illegible]	09250520257	[illegible]	
၄။	[illegible]	[illegible]	09.795413664	[illegible]	
၅။	[illegible]				
၆။	[illegible]	[illegible]	-	[illegible]	
၇။	[illegible]	[illegible]		[illegible]	
၈။	[illegible]	[illegible]	09.250580140	[illegible]	
၉။	[illegible]	[illegible]	0928071383	[illegible]	
၁၀။	[illegible]	[illegible]	781534116	[illegible]	
၁၁။	[illegible]	[illegible]	09-31691139.	[illegible]	
၁၂။	[illegible]	[illegible]	09799632 / 046	[illegible]	
၁၃။	[illegible]	[illegible]	09 260271250	[illegible]	
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၁၅။	[illegible]	[illegible]	09 89804808	[illegible]	
၁၆။	[illegible]	[illegible]	09429981786	[illegible]	
၁၇။	[illegible]	[illegible]	09421715475	[illegible]	
၁၈။	[illegible]	[illegible]	0942011 8943	[illegible]	
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LNG သုံးလျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

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ရှင်းလင်းတင်ပြသော အခမ်းအနား (Public Participation Meeting No. 2)

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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
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နေရာ - အလုံမြို့နယ် (အနောက်ပိုင်းခရိုင်)

နေ့ရက် - ၂၀၁၉ ခုနှစ်၊ ဖွန်လ ၁၂ရက်

စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
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နေ့ရက် - ၂၀၁၉ ခုနှစ်၊ ဖွန်လ ၁၂ရက်

စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
၁။	[illegible]	[illegible] အလုံမြို့နယ်		[illegible]	
၂။	[illegible]	〃		[illegible]	
၃။	[illegible]	〃		[illegible]	
၄။	[illegible]	[illegible]	09-894425188	[illegible]	
၅။	[illegible]	[illegible]		[illegible]	
၆။	[illegible]	[illegible]	09793113090	[illegible]	
၇။	[illegible]	〃	09421109324	[illegible]	
၈။	[illegible]	〃	09795335243	[illegible]	
၉။	[illegible]	[illegible]	09-442687919	[illegible]	
၁၀။	[illegible]	[illegible]	09.5189751	[illegible]	
၁၁။	[illegible]	[illegible]	09250149039	[illegible]	
၁၂။	[illegible]	[illegible]	0947224[illegible]	[illegible]	
၁၃။	[illegible]	[illegible]	09421109361	[illegible]	
၁၄။	[illegible]	[illegible]	0932186032	[illegible]	
၁၅။	[illegible]	[illegible]	094210450[illegible]	[illegible]	
၁၆။	[illegible]	[illegible]	01211919	[illegible]	
၁၇။	[illegible]	— 〃 —	0995011648	[illegible]	
၁၈။	[illegible]	[illegible]	09 ·25008528	[illegible]	
၁၉။	[illegible]	[illegible]	09-402722062	[illegible]	
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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
၁။	[illegible]	အလုံ	0978187870	[signature]	
၂။	ဒေါ်မြတ်မာလာ	"	09440725118	[signature]	
၃။	[illegible]	[illegible]	09-421068835	[signature]	
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၅။	[illegible]	"	09-421001784	[signature]	
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၇။	[illegible]	[illegible] " ([illegible])		[signature]	
၈။	[illegible]	" "		[signature]	
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LNG သုံးလျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

သဘာဝပတ်ဝန်းကျင်နှင့် လူမှုဝန်းကျင် သက်ရောက်မှုဆန်းစစ်ခြင်း လုပ်ငန်းစဉ်များအား ဒေသခံပြည်သူလူထုသို့

ရှင်းလင်းတင်ပြသော အစမ်းအနား (Public Participation Meeting No. 2)

နေရာ - အလုံမြို့နယ် (အနောက်ပိုင်းခရိုင်)

နေ့ရက် - ၂၀၁၉ ခုနှစ်၊ ဖွန်လ ၁၂ ရက်

စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
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LNG သုံးလျှပ်စစ်ဓာတ်အားပေးစက်ရုံစီမံကိန်း

သဘာဝပတ်ဝန်းကျင်နှင့် လူမှုဝန်းကျင် သက်ရောက်မှုဆန်းစစ်ခြင်း လုပ်ငန်းစဉ်များအား ဒေသခံပြည်သူလူထုသို့

ရှင်းလင်းတင်ပြသော အခမ်းအနား (Public Participation Meeting No. 2)

နေရာ - အလုံမြို့နယ် (အနောက်ပိုင်းခရိုင်) နေ့ရက် - ၂၀၁၉ ခုနှစ်၊ ဖွန်လ ၁၂ရက်

စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
၁။	U Si Thu Tun	IGE Power	09-253070217	[illegible]	
၂။	Swe Sue Aung	ဈေး/၄၅.	09-421061496.	[illegible]	
၃။	ဒေါ်စအားမြင့်	၈၀/ကျွန်းကုန်း		[illegible]	
၄။	Daw Tin Moe Moe Khine	United Condo Dagon	09450044115	[illegible]	
၅။	Mg Mg Soe	B, Irrawaddy	0950048151	[illegible]	
၆။	U Kyaw Thu	Ahl. E.P.C.	095312936	[illegible]	
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Photo


TTPMC
MOEE
ERM


အလုံမြို့နယ်ခန်းမ
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LNG လျှပ်စစ်ဓာတ်အားပေးစက်ရုံ(အလုံ) စီမံကိန်း
စီမံကိန်းဆိုင်ရာအချက်အလက်များ၊
(TPMC)
ERM


MOEE
ERM
TTMC

ERM

ERM
179 Bangkok City Tower 24th Floor |
South Sathorn Road,
Thungmahamek, Sathorn, Bangkok
10120 | Thailand |

Telephone: (662) 679 5200

www.erm.com

Minutes of Meeting

To	Tun Lin Kyaw
CC	ERM-Siam: Vincent Lecat
From	Environmental Resources Management (ERM-Siam)
Date and Location of Meeting	14th June 2019 Thiri Zaya Naw Ya Htar Hall, Dala Township, Yangon Region
Project Reference	0439461 TTCL Ahlone Expansion
Subject	Dala Township Public Consultation Meeting No.2

Agenda

- Registration
- Introduction of meeting by TTCL Meeting Coordinators
- Introductory speech by parliament member (Dr. Sein Mya Aye)
- Presentation by ECD assistant Director (Miss Daw Thin Thin Nu)
- Introductory speech by Gas Pipeline Officer in-charge, MOGE (Mr. U Than Htike Aung)
- Presentation by TTCL (Htet Aung Mon)
- Presentation by ERM (Khinsusu Naing)
- Questions and Answers Period
- Closing Comments/Conclusion speech by the parliament member (Mr. U Ye Lwin)

No.	Key Discussion	Response
1	**Dr. Sein Mya Aye, Parliament member, Dala** ■ Project information should be displayed to Township parliament office. ■ Suggested TTCL to inform people more about their rights toward the Project. ■ What kind of CSR activities will contribute to local?	**Htet Aung Mon (Mr.), TTCL** ■ During the first round of public consultation we have distributed project information documents to all attended stakeholders. In which, we have described all the project progress and way forward. We have also informed about the grievance mechanism Local communities were invited to report if there is any issues or comments on ESIA process. Comments and suggestions from first meeting are recorded and implemented in the ESIA report.. ■ Our project will be developed only after MIC permit is granted. In order to obtain MIC permit from, Project Company is required to develop and

No.	Key Discussion	Response
	■ In which contract ESIA commitment are included? ■ Suggested TTCL to strictly implement the mitigation measures through legal provision that TTCL will be responsible for any accidents or leakage from the Project	comply with the CSR program. We are going to implement CSR program with the collaboration from local level. ■ Laws and regulations related to environmental protection are included in the power purchase agreement with MOEE. Project Company is obliged to follows the environmental laws as per the contract requirements.
	■ How was the third party recruited? ■ Is ERM a local or international company? ■ Why TTCL decided to use ERM for ESIA?	**Khin Su Su Naing (Ms.), ERM** ■ When the project company appointed a environmental consultant third party company, they have to submit the detail of third party organization to the Ministry of Natural Resources and Environmental Conversation (MONREC) in order to verify the numbers of specialist and their specialized field. Third Party EIA consulting organization are required to be registered in Myanmar. Environmental assessment work can proceed only after approval is granted from MONREC. ■ ERM is an international EIA consulting company with approximately5,000 staffs all over the world. In this project, ERM has cooperated with local EIA consulting company SEM.
	■ How will the company activities will be verified or monitor? What would be the punishment and penalties if Project Company does not follow the ESIA law? ■ In case of gas leakage, TTCL should bear full responsibility and measure should be included in the EIA.	**Miss Daw Thin Thin Nu, ECD** ■ There are Myanmar Environmental conversation law, Environmental Conversation Rule & Environment Impact Assessment procedure 2015. ECD department will determined the necessary level of environmental assessment for the proposed project. Project proposed company is responsible to comply with the applicable environmental law. If company fail to follow environmental management, the company is punishable to pay fine or other severe punishment according to law.
2	**N/A, Resident** ■ Suggested the impact to public road should be repair by the company ■ Why the construction of power plant is not in Dala?	**Toshio Sakai (Mr.), TTCL & Htet Aung Mon (Mr.), TTCL** ■ Our gas pipeline route is currently designed to be along the Dala-Danote main road. However, it is subjected to change depending to detail survey that we are about to do with the cooperation from

No.	Key Discussion	Response
		relevant government departments. In the case of road damage occurred by Machinery/Vehicles used in pipeline construction, company will be responsible to repair.
		Htet Aung Mon (Mr.), TTCL ■ We have to develop project components only on permitted land/ area by government. We have decided to build up the terminal and jetty in Dala townships following the instruction from Yangon regional government and Myanmar Port Authority. The selected location's water depth is deep enough to construct the jetty for LNG carrier vessel.
3	**N/A, Resident** ■ Where is the budget for this project coming from and how much is it? ■ What is the project schedule?	**Worrawut Thoungdee (Mr.), TTCL & Htet Aung Mon (Mr.), TTCL** ■ Project investment cost approximately 500 million USD. ■ Commercial operation of project will commence 28 months after PPA effective date.
4	**N/A, Police Department, Dala** ■ TTCL should be fully legally responsible to impact that occurred ■ TTCL should include the risk management plan ■ If project affect the paddy field people should receive fair compensation.	**Htet Aung Mon (Mr.), TTCL** ■ Company will be responsible for every impact occurred by project activities during construction and operation phase. Company will compensate fair amount of compensation.
5	**N/A, Village Administrator, Pyaw Bwe Gyee Village** ■ What are the measures to prevent gas leakage? ■ What are the measures in the case of gas leakage?	**Htet Aung Mon (Mr.), TTCL & Khin Su Su Naing (Ms.), ERM** ■ ERM has proposed specific mitigation measures for an un-planned event of spill or leakage of oil, fuel and gas. The measures including how to prevent and prepare for the leakage, and providing training for staffs to properly respond in the case of gas leakage. ■ Detection system is implemented in gas pipeline design to detect the gas leakage. Block valve stations located between terminal and power plant will also implemented for emergency response.

No.	Key Discussion	Response
		When the gas leakage is detected, company will be able to take immediate action to prevent the people and environment.
6	**N/A (Medical personnel)** ■ Which part of the Seikkyikhanaungto Township will be impacted by the project? ■ How will traffic be managed during the project phase?	**Worrawut Thoungdee (Mr.), TTCL & Htet Aung Mon (Mr.), TTCL** ■ Underground gas pipe from Dala township will be connected to Seikkyikhaunaungto Township crossing the Twantay Canal by deploying HDD machine. The gas pipe will then directly connected to Power plant from the below of Yangon River. Therefore, a small portion of Seikkyikhanaungto townships is concerned in project components.

Attendance list

123 persons from Government Organizations and Village Responsibilities and 20 persons from company attend the meeting.

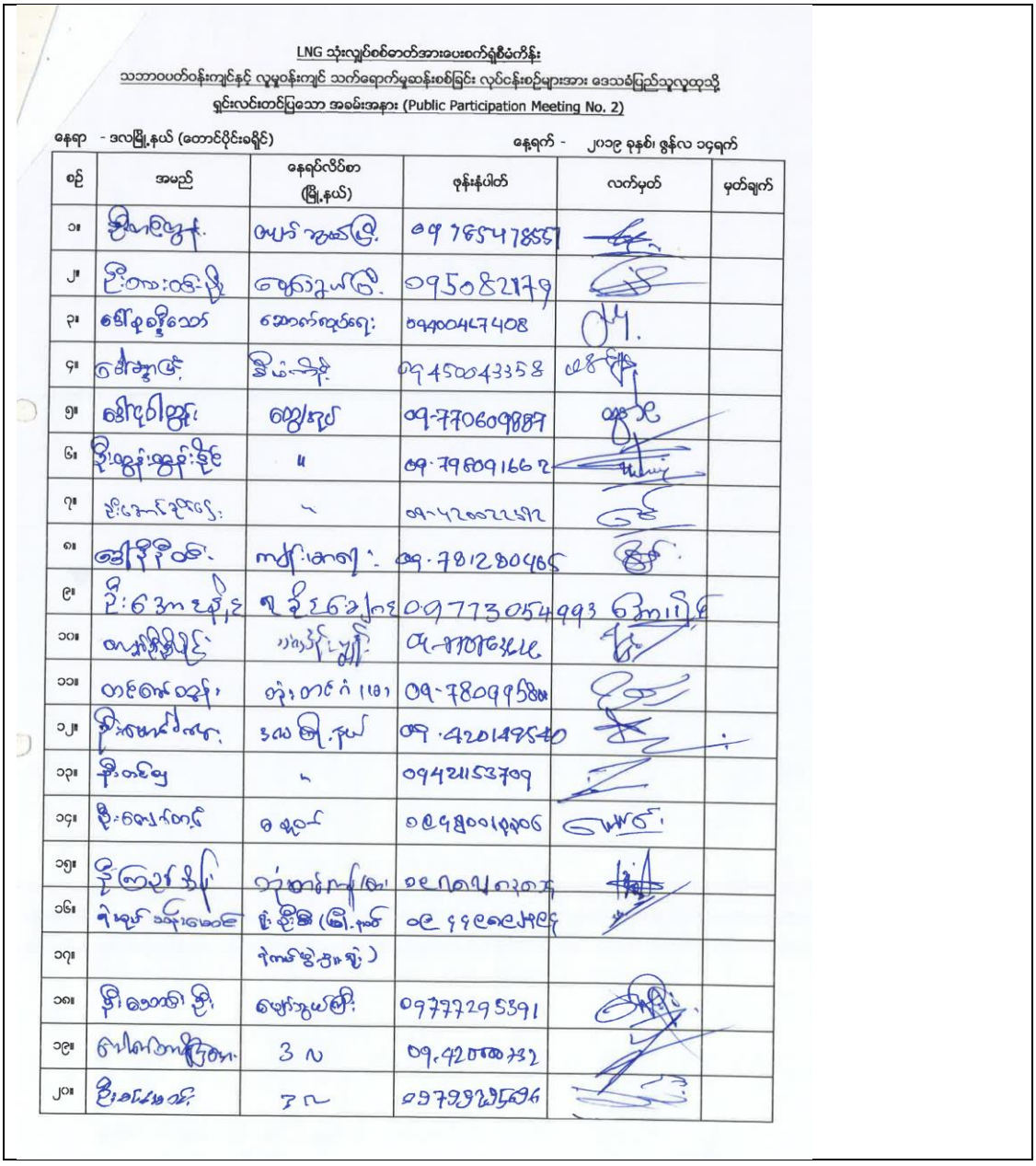
No.	Name	Position/Occupation	Department/Organization	Contact No.
1	Mr. Tin Htun	Resident	Pyaw Bwal Gyi	09-785478557
2	Mr. Aye Win Oo	Resident	Pyaw Bwal Gyi	09-5082179
3	Ms. Su Sandi Thaw	Government Staff	Construction Dep't, YCDC	09-400467408
4	Ms. Sandar Myint	Government Staff	Project Dep't, YCDC	09-450043358
5	Ms. Ngu War Htun	General Administrator	Dala Township	09-770609887
6	Mr. Tun Tun Naing	General Administrator	Dala Township	09-798091662
7	Mr. Aung Khaing Htay	General Administrator	Dala Township	09-420022392
8	Ms. Ni Ni Win	Government Staff	Health Care Dep't, Dala Tsp.	09-781280465
9	Mr. Aung Naing	Resident	Rakhine Chaung , Dala Tsp.	09-773054993
10	Mr. Kyaw Oo Oo Paing	Resident	Thingangyung Township	09-770763616
11	Mr. Tin Zaw Htun	Resident	Tone Tin Kan	09-780995380
12	Mr. Maung Maung Aye	Resident	Dala Township	09-420149540
13	Mr. Tin Hla	Resident	Dala Township	09-421153709
14	Mr. Kyaw Tint	Resident	Da Note, Dala Tsp.	09-450023306
15	Mr. Kyi Thein	Resident	Tone Tin Kan	09-787283814
16	Mr. Than Maung	Police Officer	Dala Township	09-449892394
17	Mr. Thaung Oo	Resident	Pyaw Bwal Gyi	09-777295391
18	Mr. Naing Aye	Doctor	Dala Township	09-420000732
19	Mr. Khin Maung	Resident	Dala Township	09-799295696
20	Mr. Soe Yin	Government Staff	Seikgyikanaungto	09-420197100
21	Mr. Than Htike Aung	Government Staff	Piping Dep't	09-420086285
22	Mr. Thant Zin	Resident	Seikgyikanaungto	09-426623241
23	Mr. Tin Yee	Resident	Htun O	-
24	Mr. Hla Wai	Resident	Htun O	09-420260800
25	Mr. Phyo Chit Htun	Resident	Htun O	-
26	Mr. Kyaw Htwe	Resident	Htun O	-
27	Mr. Kyi Lwin	Resident	Pann Pin Chaung	-
28	Mr. Myo Win	Resident	Pann Pin Chaung	-
29	Mr. Kyaw Lwin	Government Staff	Agriculture Dep't	-
30	Mr. Nay Soe	Government Staff	Administration Dep't (Township)	-
31	Mr. Aung Thant	Resident	Seikgyikanaungto	-
32	Mr. Aung Myint	Resident	Seikgyikanaungto	-
33	Mr. Kyaw Oo	Resident	Seikgyikanaungto	-
34	Mr. Yin Htwe	Resident	Thet Kal Kwin	09-254215856
35	Mr. Myint Oo	Government Staff	Fire Service Dep't	-
36	Mr. San Aung	Government Staff	Fire Service Dep't	-

37	Mr. Min Min Lat	Township Administrator	Administration Dep't (Township)	09-444088004
38	Mr. Zaw Win	Resident	Seikgyikanaungto	09-420288821
39	Mr. Kyi Yin	Resident	Pyaw Bwal Gyi	09-250282904
40	Mr. Hla Myo	Resident	Seikgyikanaungto	09-420147017
41	Mr. Hla Maung	Staff	Red Cross Society	09-420908890
42	Mr. Myo Thant Htun	Staff	Red Cross Society	-
43	Mr. Kyaw San Min	Staff	Red Cross Society	09-975122157
44	Ms. Than Than Myint	Staff	Red Cross Society	09-786833422
45	Mr. Tin Htun	Staff	Red Cross Society	09-255249446
46	Mr. Kyaw Myaing	Staff	Red Cross Society	-
47	Mr. Ngwe Tun	Resident	Seikgyikanaungto	09-250266917
48	Mr. Ye Win	Resident	Seikgyikanaungto	09-772617924
49	Mr. Maung Maung Lwin	Resident	Seikgyikanaungto	09-966353985
50	Mr. Nyan Win	Resident	Seikgyikanaungto	09-799300373
51	Mr. Kyaw Win	Resident	Seikgyikanaungto	09-252474994
52	Mr. Sai	Resident	Seikgyikanaungto	-
53	Ms. Aye Aye Thein	Resident	Seikgyikanaungto	09-773294195
54	Mr. Htay Aung	Resident	Tone Tin Kan	-
55	Mr. San Oo	Resident	Pyaw Bwal Gyi	-
56	Ms. Thel Nu Khaing	Government Staff	Construction Dep't, YCDC	09-790153524
57	Mr. Win Naing	Resident	Rakhine Chaung	09-799847663
58	Mr. Hein Thu	Resident	Dala Township	09-799408326
59	Ms. Than Than Lwin	Government Staff	Water & Sanitation Dep't, YCDC	09-971132851
60	Ms. Khin San Myint	Resident	Kyan Sitt Tharr	09-450024959
61	Ms. Thaung Aye	Resident	Kyan Sitt Tharr	09-793351814
62	Ms. Cho Cho	Resident	Kyan Sitt Tharr	09-698044254
63	Ms. Thin Thin Nu	Government Staff	MONREC Dep't	09-450541359
64	Ms. Yu Yu Phyo	Government Staff	MONREC Dep't	09-951088421
65	Mr. Aung Thein Than	Government Staff	MONREC Dep't	09-250382505
66	Mr. Tin Khine	Resident	Dala Township	09-258998400
67	Mr. Hla Min Thu Paing	Government Staff	MOE	09-795806561
68	Mr. Tin Hla	Resident	Seikgyikanaungto	-
69	Mr. Sein Hla Tun	Resident	Seikgyikanaungto	09-796444108
70	Mr. Myint San	Resident	Seikgyikanaungto	09-963658697
71	Ms. Ye Ye Myint	Resident	Seikgyikanaungto	-
72	Ms. Hla Shwe	Resident	Seikgyikanaungto	-
73	Ms. Hla Kyi	Resident	Pyaw Bwal Gyi	-
74	Mr. Kyaw Moe Zaw	Resident	Pyaw Bwal Gyi	09-782760757
75	Mr. Aung Chit	Resident	Shan Kan	-
76	Mr. Htun Lwin	Resident	Shan Kan	09-777202492
77	Mr. Aung Lwin	Resident	Rakhine Chaung	09-449668952
78	Mr. Maung Maung Myo	Resident	Rakhine Chaung	09-791951342
79	Mr. Zaw Win	Resident	Rakhine Chaung	09-777422208

80	Mr. Tin Htun Aung	Resident	Dala Township	09-5173047
81	Mr. Zaw Myint	Resident	Seikgyikanaungto	-
82	Mr. Aung Myo Aye	Resident	Seikgyikanaungto	-
83	Mr. Chit Han	Resident	Seikgyikanaungto	-
84	Mr. Chit Ko	Resident	Seikgyikanaungto	-
85	Mr. Sein Hla Maung	Resident	Seikgyikanaungto	-
86	Mr. Kan Win	Resident	Seikgyikanaungto	-
87	Mr. Ye Yint Htun	Resident	Seikgyikanaungto	-
88	Mr. Zaw Min Htike	Police Officer	Seikgyikanaungto	-
89	Mr. Than Naing	Ward Administration Office	Ward Administration dep't	09-420260420
90	Mr. Moe Sett	Police	Seikgyikanaungto	-
91	Mr. Than Htay	Township Administrator	Administration Dep't (Township)	-
92	Mr. Shwe La Win	Resident	Seikgyikanaungto	-
93	Mr. Hla Nyein	Resident	Seikgyikanaungto	-
94	Ms. San San Myint	Resident	Seikgyikanaungto	-
95	Ms. Tin Tin Win	Resident	Seikgyikanaungto	-
96	Mr. Nyunt Kyi	Resident	Pyaw Bwal Gyi	-
97	Mr. Nay Win	Resident	Pyaw Bwal Gyi	-
98	Mr. Tin Shein	Resident	Mhaw Sett	09-261906466
99	Mr. Tun Tun Aye	Resident	Dala Township	09-73144539
100	Mr. Thein Han	Resident	Sein Pan	09-250054006
101	Mr. Myint Swe	Resident	Ka Mar Ka Sit	09-25067255
102	Mr. Thein Htike	Resident	Yangon	-
103	Mr. Than Oo	Resident	Dala Township	09-251171496
104	Mr. Khin Maung Myint	Resident	Da Note	09-7705001
105	Mr. Shwe Gyi	Resident	Da Note	09-792577385
106	Mr. Thein Htun	Resident	Nyaung Chaung	-
107	Mr. Than Swe	Township Administrator	Dala Township	-
108	Mr. Naing Myo Lin	Resident	Dala Township	09-420179870
109	Mr. Kyaw Myo	Resident	Kyan Sitt Tharr	09-5174692
110	Mr. Aung Than Oo	Resident	Pazundaung	09-401529462
111	Mr. Nay Lin	Resident	Tone Tin Kan	09-698084585
112	Mr. Zaw Naing Win	Resident	Shwe Lay Chaung	09-425297596
113	Mr. Tin Soe	Resident	Ta Pin Shwe Htee	09-250667199
114	Mr. San Ye	Resident	Dala Township	09-420179870
115	Mr. Shwe Htun	Resident	Dala Township	09-425289168
116	Mr. Htun Htun Zaw	Resident	Nyaung Chaung	09-420305508
117	Mr. Kyaw Kyaw Khine	Resident	Nyaung Chaung	09-779202382
118	Mr. Kyaw Htoo	Resident	Shwe Lay Chaung	-
119	Mr. Soe Zaw Thein	Resident	Seikgyikanaungto	09-448007374
120	Mr. Than Lwin	Resident	Dala Township	09-697315126
121	Mr. Than Htay	Resident	Dala Township	-
122	Mr. Naing Lin Kyaw	Resident	Dala Township	09-780498529

123	Mr. Win Aye	Resident	Dala Township	-

Lists of Participation (Photo)



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ရှင်းလင်းတင်ပြသော အစမ်းအနား (Public Participation Meeting No. 2)

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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
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ရှင်းလင်းတင်ပြသော အစည်းအနား (Public Participation Meeting No. 2)

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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
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ရှင်းလင်းတင်ပြသော အစမ်းအနား (Public Participation Meeting No. 2)

နေရာ - ဒလမြို့နယ် (တောင်ပိုင်းခရိုင်) နေ့ရက် - ၂၀၁၉ ခုနှစ်၊ ဖွန်လ ၁၄ ရက်

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Environmental Resources Management


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(TPMC)
TTCL Power Myanmar Company Limited

ERM

ERM
179 Bangkok City Tower 24th Floor |
South Sathorn Road,
Thungmahamek, Sathorn, Bangkok
10120 | Thailand |

Telephone: (662) 679 5200

www.erm.com

Minutes of Meeting

To	Tun Lin Kyaw
CC	ERM-Siam: Vincent Lecat
From	Environnemental Ressources Management (ERM-Siam)
Date and Location of Meeting	13rd June 2019 Thardana Beikmann Hall, Thanlyin Township, Yangon Region
Project Reference	0439461 TTCL Ahlone Expansion
Subject	Thanlyin Township Public Consultation Meeting No.2

Agenda

- Registration
- Introduction of the meeting by TPMC Meeting Coordinator
- Introductory speech by Township GAD Deputy Administrator (Daw Aye Mya Win)
- Presentation by ECD assistant Director (Miss Daw Thin Thin Nu)
- Presentation about the Project by TTCL (Htet Aung Mon)
- Presentation by ERM (Khinsusu Naing)
- Questions and Answers Period
- Closing Comments/Conclusion

No.	Key Discussion	Response
1	**U Ye Myint Soe, Parliament member** ■ What sorts of impacts are expected from LNG operation? ■ In term of impact, where does the LNG rank compared with other type of fuel? ■ How will the impacts be mitigated? ■ Have there been any accident with LNG in the past? What system are in place to prevent these accidents? ■ What is the potential impact on electricity cost per unit of using LNG compare to other sources?	**Toshio Sakai (Mr.), TTCL & Htet Aung Mon (Mr.), TTCL** ■ There are various source of energy such as coal, hydro, natural gas. LNG is a liquid natural gas which is one of the energy sources with minimum impact to the environment. In terms of safety, this project will applied IFC and other international standard/guidelines. ■ LNG unloading and storage process will be complied with the International fire prevention and safety guideline such as NFPA. Equipment such as fire prevention and leakage detection sensors will be equipped in terminal to prepare for the immediate actions of

No.	Key Discussion	Response
		any event. In the case of unplanned event, LNG storage layout is properly designed to handle the impact within the terminal area only. ■ There was a LNG accident occurred in 1944 and caused some impacts within terminal boundary. There were no accidents reported since 1944 as the result of upgraded LNG related standard & guidelines.
		Khin Su Su Naing (Ms.), ERM ■ Our unplanned event mitigation measures are prepared according to applicable international guideline and analysing what is likely to occur in LNG fuel power plant. These measures included how to prevent the accidents, how to properly respond in the case of accidents, and train project personnel for the emergency response plan. As our measures are prepared for the worst-case scenario, such unplanned accidents will be properly handle.
	N/A, Electrics Engineer from the Electricity Distribution Department ■ Will there be impact to the cost of electricity per unit (cost/ kwh), as the LNG power is about to be included in the electricity generation system?	**Toshio Sakai (Mr.), TTCL & Htet Aung Mon (Mr.), TTCL** ■ As we have not yet concluded the final negotiation of Power Purchase Agreement with MOEE, we are not able to describe the cost per unit at this moment.

■ Attendance list

160 persons from Government Organizations and Village Responsibilities and 20 persons from company attend the meeting.

No.	Name	Position/Occupation	Department/Organization	Contact No.
1	Mr.Tun Wai	Resident	Pardagyi Township	09-788132074
2	Mr.Myat Htay	Resident	Pardagyi Township	09-254220714
3	Mr.Zaw Tin	Resident	Pardagyi Township	09-262090796
4	Mr.Ngway Thein	Resident	Pardagyi Township	09-444967644
5	Mr.Aye Han	Resident	Pardagyi Township	09-788131310
6	Mr.Myint Shwe	Resident	Pardagyi Township	09-264884255
7	Mr.Aung Myint	Resident	Pardagyi Township	09-26390519
8	Mr.Jorny	Resident	Pardagyi Township	09-894741685
9	Mr.Khin Maung	Resident	Sin Kan Township	
10	Mr.Myint Swe	Resident	Pardagyi Township	
11	Mr.Zaw Min	Resident	Kyauktan Township	09-42006794
12	Mr.Kyaw Kyi	Resident	Kyauktan Township	
13	Mr.Kyaw Chit	Government Staff	Health Care Department	09-450011463
14	Mr.Myint Myint Maw	Deputy Officer	Finance Department	09-799461596
15	Mr.Sein Lwin	Resident	Kyauktan Township	09-420172571
16	Mr.Mya Aye	Resident	Kyauktan Township	
17	Mr.Maung Aung	Resident	Thanlyin Township	09-782275550
18	Mr.Win Myint	Resident	Thanlyin Township	09-420233447
19	Ms.Thin Thin Nu	Government Staff	MONREC Dep't	09-450541359
20	Ms.Thazin Phyu Phyu Zaw	Government Staff	MONREC Dep't	09-795899384
21	Mr.Than Aung	Resident	Oak Pho Su Township	09-420301698
22	Mr.Aung Naing Oo	Resident	Bauk Htaw Twin Township	09-787659822
23	Mr.Myat Ko Ko	Government Staff	EPC (Kyauktan Township)	09-795438270
24	Mr.Thein Oo	Resident	Myoma/South Township	09-786612598
25	Mr.Aung Myint Zaw	Resident	Bago Su Township	09-43178001
26	Mr.Kyaw	Resident	Nyaung Thone Pin Township	
27	Mr.Hla Win Tun	Resident	Nyaung Thone Pin Township	
28	Mr.Zin Aung Gyi	Resident	Myo Haung/West Township	
29	Ms.Tin Maw Maw Tun	Resident	Kyauktan Township	09-783971455
30	Ms.Aye Aye Tun	Resident	Kyauktan Township	09-250070150
31	Ms.Yadanar Khine	Resident	Thanlyin Township	09-969651517
32	Mr.Thein Tun Oo	General Adminstration Officer	Kyauktan Township	09-777535425
33	Mr.Min Aung	Government Staff	Thanlyin Township	
34	Mr.Thein Myint	Resident	Myoma/North Township	
35	Mr.Aye Thaung	Resident	Myoma/North Township	

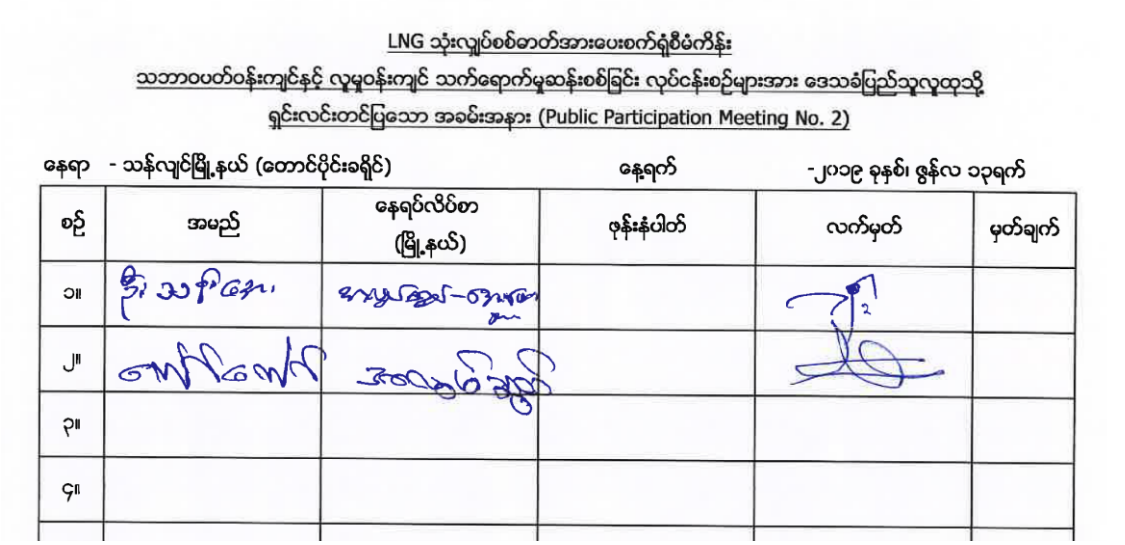
36	Mr.Tin Aung Ko	Resident	Myoma/North Township	
37	Mr.Myo Nyunt	Resident	Myoma/North Township	
38	Mr.Han Zar Tun	Resident	Bago Su Township	09-5311076
39	Ms.Mya San Yee	Resident	Shwe Pyout Township	09-790145883
40	Mr.Nyunt Win	Resident	Kyauktan Township	09-793256041
41	Mr.Tint Shwe	Resident	Kyauktan Township	09-973167869
42	Mr.Thet Naing Ko	Resident	Kyauktan Township	
43	Mr.Mo	Resident	Kyauktan Township	
44	Mr.Win	Resident	Kyauktan Township	
45	Mr.Zaw Tun	Resident	Kyauktan Township	
46	Mr.Myo Hlaing	Resident	Nyaung Wine Township	
47	Mr.Than Lwin	Resident	Shwe Pyi Thar Yar Township	
48	Mr.Khin Maung Lwin	Resident	Shwe Kone Township	09-799431556
49	Mr.Htay Aung	Resident	Thanlyin Township	09-5090336
50	Mr.Soe Naing	General Adminstration Officer	Thanlyin Township	09-420011381
51	Mr.Aung Thein	Resident	Shwe Kone Township	09-420090001
52	Mr.Aye San	Resident	Thidar Myine Township	
53	Mr.Win Ko Naing	Resident	Kyauktan Township	
54	Mr.Yan Aung Shin	Resident	Phayar Kone Township	09-252427117
55	Mr.Htin Lin	Resident	Phayar Kone Township	09-773781097
56	Mr.Saw Paing	Resident	Phayar Kone Township	09-8148370
57	Mr.Tin Maw	Resident	Oak Pho Township	09-8148370
58	Mr.Maung Oo	Resident	Nyaung Thone Pin Township	09-799443433
59	Mr.San Hlaing	Resident	Thanlyin Township	
60	Mr.Win Thein	Resident	Thanlyin Township	
61	Mr.San Oo	Resident	Thanlyin Township	
62	Mr.San Wai	Resident	Bago Su Township	
63	Mr.Tin Thein	Resident	Bago Su Township	
64	Mr.Hla Oo	Resident	Bago Su Township	
65	Mr.Mya Shwe	Resident	Bago Su Township	09-443032646
66	Mr.Than Lwin	Resident	Bago Su Township	09-261658348
67	Mr.Augn Kyaw Oo	Government Staff	EPC (Kyauktan Township)	09-5402839
68	Mr.Win Thein	Resident	Myo Haung/East Township	09-420300326
69	Mr.Aung Min Oo	Resident	Bago Su Township	09-420267272
70	Ms.San San Aye	Resident	Kyauktan Township	09-5155225
71	Mr.Tin Shwe	Resident	Amhuhtan Township	09-254254833
72	Mr.Bo Gyi	Resident	Amhuhtan Township	09-5061951
73	Mr.Mya Aye	Resident	Amhuhtan Township	
74	Mr.Hla Moe	Resident	Thout Taw Twin Township	
75	Mr.Than Aye	Resident	A Lwan Swut Township	
76	Mr.Kyaw Kyaw	Resident	A Lwan Swut Township	
77	Mr.Myint Swe	Resident	Kyauktan Township	

78	Mr.Tin Oo	Resident	Kyauktan Township	
79	Mr.Tin Moe Win	Resident	Kyauktan Township	
80	Mr.Si Thu	Resident	Kyauktan Township	
81	Mr.Lin Lin Htike	Resident	Shwe Pyout Township	09-795687652
82	Mr.Soe Naing Oo	Resident	Shwe Pyout Township	
83	Mr.Shwe Myint	Resident	Kyauktan Township	
84	Mr.Zin Win	Resident	Kyauktan Township	
85	Mr.Chit Oo	Resident	Kyauktan Township	
86	Mr.Myint Naing	Resident	Shwe Kone Township	
87	Mr.Aung Myint Sein	Resident	Thanlyin Township	
88	Mr.Ye Swe	Resident	Kyauktan Township	
89	Mr.Hlaing Bwar Hein	Resident	Kyauktan Township	09-794184763
90	Mr.Myine Tun	Resident	Kyauktan Township	
91	Mr.San Tint	Resident	Kyauktan Township	
92	Mr.Myint Lwin	Resident	Thanlyin Township	09-788304560
93	Mr.Zaw Min	Resident	Myo Haung/Middle Township	
94	Mr.Min Kyi Tun	Resident	Myo Haung/Middle Township	
95	Mr.Win Kyine	Resident	Oak Pho Su Township	
96	Mr.Aye Lwin	Resident	Nyaung Thone Pin Township	09-769090127
97	Mr.Soe Thiha	Resident	Nyaung Thone Pin Township	09-162966796
98	Mr.Thein Zaw	General Adminstration Officer	Kyauktan Township	
99	Mr.Kyaw Thura Myo	Fireman	Fire Service Dep't (Kyauktan)	
100	Mr.Aung Win	Township Office Aminstrator	Thanlyin Township	09-785078675
101	Mr.Zaw Nyunt	Township Office Aminstrator	Yaynan Township	09-73068506
102	Mr.Aung Soe	Resident	Thanlyin Township	09-253321663
103	Mr.San Win	Resident	Htan Pin Kone Township	09-73230546
104	Mr.Nyunt Zin	Resident	Myo Thit/West Township	09-799899049
105	Mr.Myo Nyunt	Resident	Bauk Htaw Twin Township	09-798011612
106	Mr.Myint Kyine	Resident	Bauk Htaw Twin Township	09-252579719
107	Mr.Myint Hlaing	Resident	Kyaung Oak Sake Township	
108	Mr.Khin Maung Nyo	Government Staff	Thanlyin Township	09-420161862
109	Mr.Thant Zin	Resident	A Lwan Swut Township	
110	Mr.Hla Soe	Resident	Kyauktan Township	09-253805268
111	Mr.Tin Shwe	Resident	Kyauktan Township	09-77301509
112	Mr.Than Gae	Resident	Kyauktan Township	
113	Mr.Khin	Resident	Kyauktan Township	
114	Mr.Phyo	Resident	Kyauktan Township	
115	Mr.Tun Myint Naing	Resident	Kyauktan Township	
116	Mr.Khin Maung Lwin	Resident	Nyaung Wine Township	
117	Mr.Win Tun	Resident	Nyaung Wine Township	

118	Mr.Kyaw Htay	Resident	Shwe Kone Township	
119	Mr.Ohm Myint	Resident	Thidar Myine Township	
120	Mr.Swe Oo	Resident	Shwe Kone Township	
121	Mr.Kan Win	Resident	Shwe Kone Township	
122	Mr.Myint Oo	Resident	East Township	
123	Mr.Hla Win	Resident	East Township	
124	Mr.Myo Myat Thu	General Adminstration Officer	Kyauktan Township	
125	Mr.Hla Win	General Adminstration Officer	Kyauktan Township	
126	Mr.Tin Aung	General Adminstration Officer	Kyauktan Township	
127	Mr.Tin Win	General Adminstration Officer	Kyauktan Township	
128	Mr.Zon Ye Tun	General Adminstration Officer	Kyauktan Township	
129	Mr.Tint Lwin	Resident	Thanlyin Township	09-792848146
130	Mr.Tin Win Maung	Resident	Myo Haung/Middle Township	09-790277409
131	Mr.Myo Myint Aung	Resident	Myo Haung/East Township	09-776110450
132	Mr.Thet Naing	Resident	Oak Pho Su Township	09-420259256
133	Mr.Tin Maung	Resident	Oak Pho Su Township	09-763371224
134	Mr.Khin Maung Nyo	Resident	Oak Pho Su Township	09-776117355
135	Mr.Khin Maung Oo	Resident	Nyaung Thone Pin Township	09-799451088
136	Mr.Tin Saung	Resident	Nyaung Thone Pin Township	
137	Mr.Tin Po	Resident	Nyaung Thone Pin Township	
138	Ms.Nilar Tun	Resident	Nyaung Thone Pin Township	
139	Mr.Hla Win Tun	Resident	Nyaung Thone Pin Township	
140	Mr.Kyaw Kyaw	Resident	Nyaung Thone Pin Township	
141	Mr.San Hlaing	Resident	Nyaung Thone Pin Township	
142	Mr.Tun Win	Resident	Nyaung Thone Pin Township	
143	Ms.Khin Ma Ma	Resident	Thanlyin Township	09-448036817
144	Ms.Nwe Ni Aye	Resident	Kyauktan Township	09-3416764
145	Mr.Khine Myint	Assistant Engineer	Ministry of Agriculture, Livestock and Irrigation	09-4074751250
146	Mr.Aung Thein Than	Resident	Thar Kya Ta Township	09-250382505
147	Mr.Tun Myint Oo	Government Staff	Thanlyin Township	09-799444840
148	Mr.Khine Lin Oo	General Adminstration Officer	Kyauktan Township	09-441523546
149	Mr.Naing Tun Tun	Adminstration Officer	Thanlyin Township	09-43182243
150	Mr.Aye Win	Government Staff	Thanlyin Township	

151	Mr.Soe Thein	Resident	Aungmingalar Township	09-266464544
152	Mr.Hla Tun Lwin	Resident	Bago Su Township	09-254129939
153	Mr.Kyaw Min Khine	Resident	Thanlyin Township	09-425753553
154	Mr.Maung Than	Resident	Thanlyin Township	
155	Mr.Htain Win	Resident	Thanlyin Township	
156	Mr.Tin Tun	Resident	Thanlyin Township	
157	Mr.Tun Thein	Resident	Thanlyin Township	
158	Mr.Maung Naing	Resident	Thanlyin Township	
159	Ms.Khin Khin San	Government Staff	YCDC (Thanlyin)	09-782752775
160	Mr.Naing Lin Tun	Resident	A Lwan Swut Township	09-791661207

List of Participation (Photo)



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စဉ်	အမည်	နေရပ်လိပ်စာ (မြို့နယ်)	ဖုန်းနံပါတ်	လက်မှတ်	မှတ်ချက်
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ရှင်းလင်းတင်ပြသော အစမ်းအနား (Public Participation Meeting No. 2)

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APPENDIX MM PUBLIC CONSULTATION MINUTES OF MEETING (DRAFT ESIA PRESENTATION)

High Level Flood Likelihood Evaluation (FLE): *Ahlone Township, Myanmar*

Final Report

September 2018

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FINAL REPORT

Toyo Thai Power Myanmar Company Limited

High Level Flood Likelihood Evaluation (FLE): Ahlone Township, Myanmar

September 2018

0439461

Prepared by: ERM-Siam Co Ltd

For and on behalf of ERM-Siam Co Ltd

Approved by: Kamonthip Ma-oon

Signed: 

Position: Partner

Date: 21 September 2018

CONTENTS

1 INTRODUCTION

Toyo Thai Power Myanmar Company Limited **('TPMC' or 'the Project Proponent')** is planning to expand its current operation of Ahlone Combined Cycle Power Plant in Yangon, Myanmar. An additional of 356MW Combined Cycle Power Plant (CCPP) will be added to the existing Ahlone Power Plant to supply the power to the Republic Union of Myanmar.

ERM was commissioned by **TPMC** to conduct a High Level Flood Likelihood Evaluation (FLE) for the expansion of their power plant at their site located next to Myanmar Industrial Port in Ahlone Township (hereinafter referred to as 'subject property' or 'Site' see ***Figure 2.1***). The Site is spread over an area of 8.97 acres (~36,300 m^2). The Site reconnaissance and field survey was conducted between 04th May and 05th May 2018 by ERM professional Adam Stickler and additional field data were collected on 15th June 2018, during a period of heavy rainfall event.

The objective of this FLE is to support TPMC in understanding any likelihood of flooding hazard to the subject property.

1.1 SCOPE OF WORK

The scope of work was as below:

- A visit of the subject property, including a visual survey of the surrounding drainage area as identified from the maps;
-
- Discussions with some key informants in the neighbouring properties to understand the historical flood events and levels in this area;
- Collection of relevant information for the subject property and surrounding area. This included preparation of Site area maps and identification of land-use;
- Collection of historical rainfall data Yangon airport Meteorological data and other available relevant information on the existing natural drainage system in the area;
- A review of readily available records and documents on hydrology of the area, to assist in determining surface water drainage patterns for the subject property and adjacent areas; and
- Broad level recommendations for mitigating the identified flood risks for the Site.

1.2 LIMITATIONS

1.2.1 Scope of Activity

The report is based upon the application of engineering principles and professional judgement to certain facts with resultant subjective interpretations. Professional judgements expressed herein are based on the currently available facts within the limits of the existing data, scope of work, budget and schedule. ERM makes no warranties, express or implied, including, without limitation, warranties as to merchantability or fitness for a particular purpose. In addition, the information provided to the Client in this report is not to be construed as legal advice.

1.2.2 Limitations of Use of This Report

ERM is not engaged in such studies and reporting for the purposes of advertising, sales promotion, or endorsement of any Client's interests, including raising investment capital, recommending investment decisions, or other publicity purposes. Client acknowledges that this report has been prepared for the exclusive use of the Client and agrees that ERM's reports or correspondence will not be used or reproduced in full or in part for such purposes, and may not be used or relied upon in any prospectus or offering circular. Client also agrees that none of its advertising, sales promotion, or other publicity matter containing information obtained from this assessment and report will mention or imply the name of ERM.

Nothing contained in this report shall be construed as a warranty or affirmation by ERM that Site and subject 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 liability.

1.3 STRUCTURE OF REPORT

The remainder of the report is structured as follows:

Section 2: Hydrological and Geomorphological Data;

Section 3: Hydro-meteorological Data;

Section 4: Secondary Data from Local Civic Authorities;

Section 5: Likelihood of a Flooding Event;

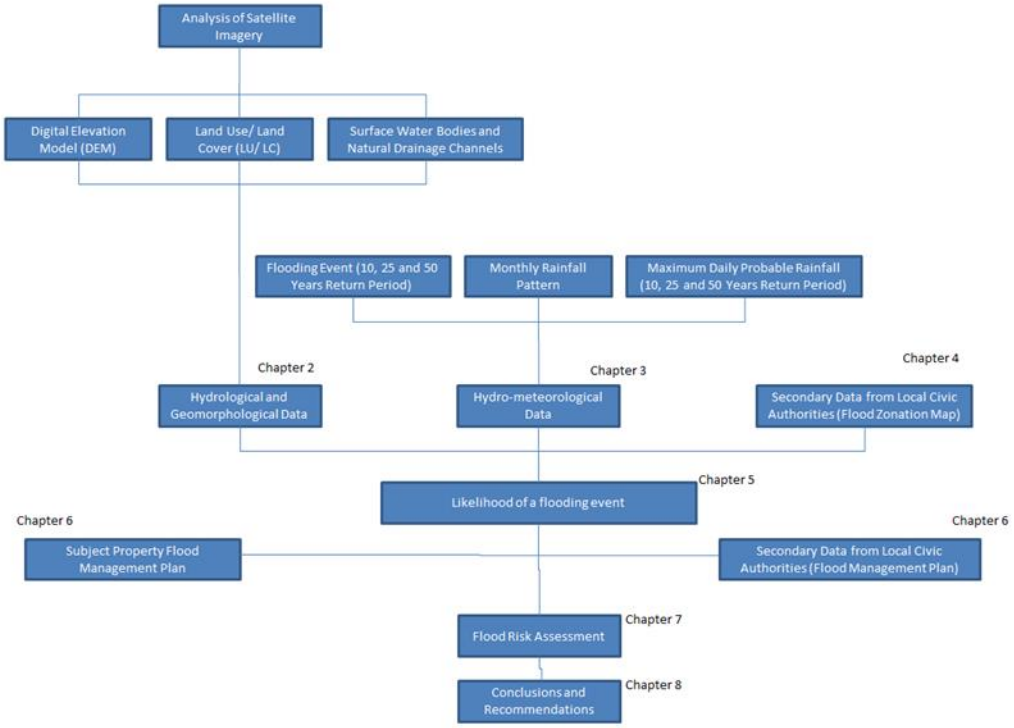
Section 6: Existing Flood Management Plans;

Section 7: Flood Risk Assessment; and

Section 8: Conclusions and Recommendations.

Figure 1.1 shows the detailed structure of the report

Figure 1.1 Detailed Structure of the Report



1.3.1 Risk Categorization

ERM has adopted a qualitative risk based categorization to identify potential risks and vulnerabilities associated with flooding, inundation and waterlogging. The risks are defined considering the likelihood of their occurrence and potential severity of the impact broadly following the risk matrix presented in the table below.

Risk = Likelihood of an impact occurring x Potential severity of the impact.

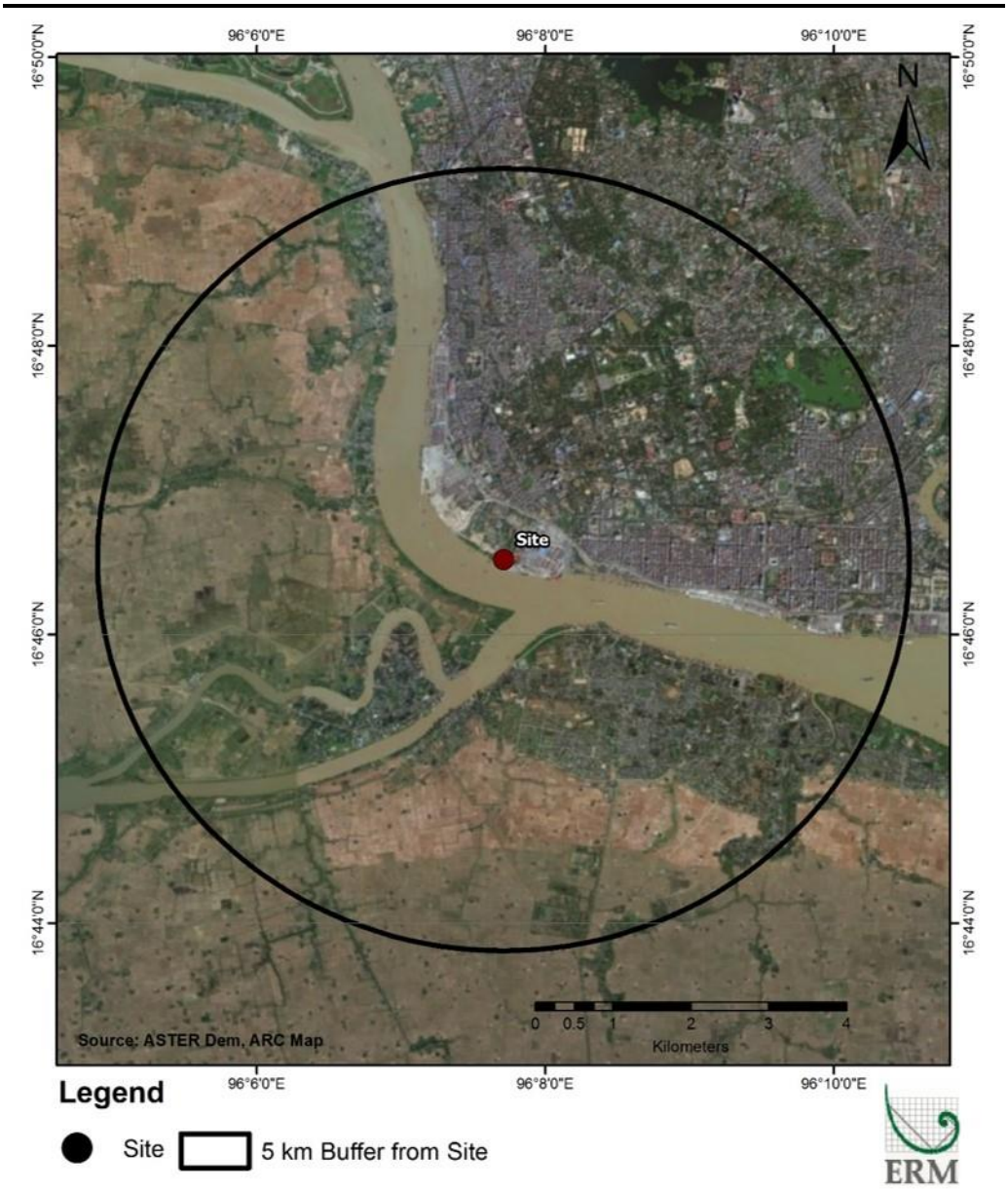
		Probability of Occurrence		
		Low	Medium	High
Potential Impact	Low			
	Medium			
	High			

Note: The study was carried out to evaluate and understand the likelihood of flood impact on the Site only. Risk categorization has been adopted merely for providing broad level perspective on the potential for impact from floods / inundation / water logging on the Site and to emphasize specific areas for further evaluation prior to developing Site specific mitigation measures only.

The Site (96° 7'43.75"E, 16°46'31.58"N) is located in Ahlone Township in Yangon City, in the Southern Yangon Region of Myanmar.

The Site location map is presented in ***Figure 2.1***.

Figure 2.1 Site Location Map



Source: ASTER DEM, ARC Map

2.1 SITE AND SURROUND AREA

The Site occupies an area of 8.97 acres (~36,300 m^2) and is located adjacent to the container yard of Myanmar Industrial Port (MIP). During the Site visit, it was observed that the Site was covered in thick vegetation and was largely undeveloped. Few temporary buildings were observed to be located on the eastern portion of the Site. Southern and southwestern portion of the Site was observed to be part of the inter-tidal zone of the River Yangon which was heavily silted at the time of field visit. Dense mangrove trees occupied the western portion of the Site. A gully / ditch originate in the central portion of the Site and passes along northeast to southwest vector. A pier and a docking station were located at the southwestern portion of the Site extending through the silted inter-tidal zone into River Yangon.

The Site is surrounded by various features as shown in ***Figure 2.2***.

Figure 2.2 Salient Features at Site and Surrounding Area

Source: Google Earth Pro

See ***Table 2.1*** for more details.

Table 2.1 Surrounding Land Features of the Site

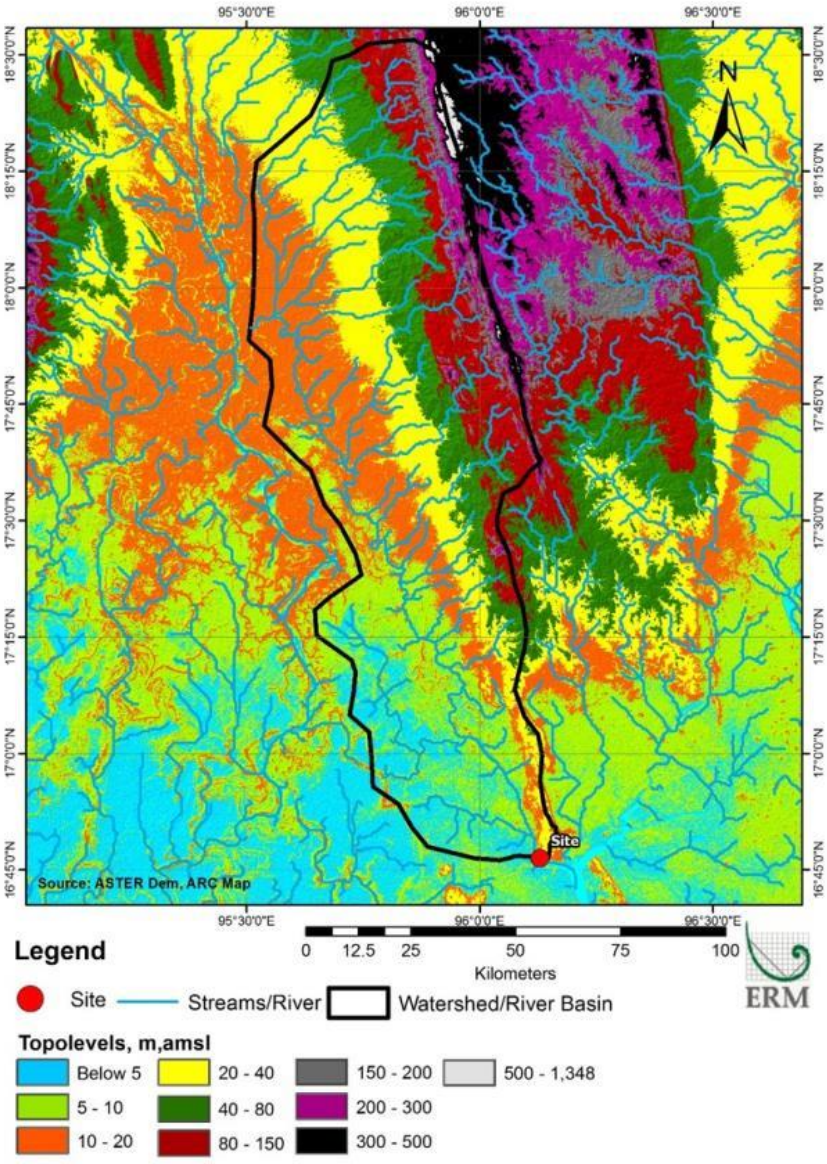
Direction w.r.t. Site	Feature
West	A tidal stream adjoining the western boundary and mangrove trees followed by largely vacant undeveloped land with some temporary buildings
North	A residential settlement is located in the north approximately 50 m from the northern boundary of the Site. Vegetated land and the government owned Ahlone gas power plant are located north-north east of the Site.
East	Myanmar Industrial Port
South	Inter-tidal zone of River Yangon along the south western boundary followed by River Yangon and Myanmar Industrial Port along the south eastern boundary followed by River Yangon.

2.2 *DIGITAL ELEVATION MODEL (DEM)*

Based on the Digital Elevation Model developed for the Site from USGS ASTER GDEM data set, LANDSAT and Google Earth Imagery available and the Site visits undertaken, ERM identified key topographic features in the study area such as topographic highs and lows, natural drainage network and delineated the catchment area of the micro-watershed in which the Site is located. An ASTER GDEM having a 30 m resolution was used for detailed mapping of the micro watershed in which the Site lies.

The ground slope leads the drainage from the area to *River Yangon* which is situated at a distance of ~ 50 m south-west of the Site. The Site is located down-gradient of the catchment[1]. The digital elevation model (DEM) of the watershed and the area around the Site are presented in ***Figure 2.3*** and ***Figure 2.4.***

Figure 2.3 ***Digital Elevation Model of the Watershed in which the Site is Located***



Source: Developed by ERM using data from ASTER GDEM

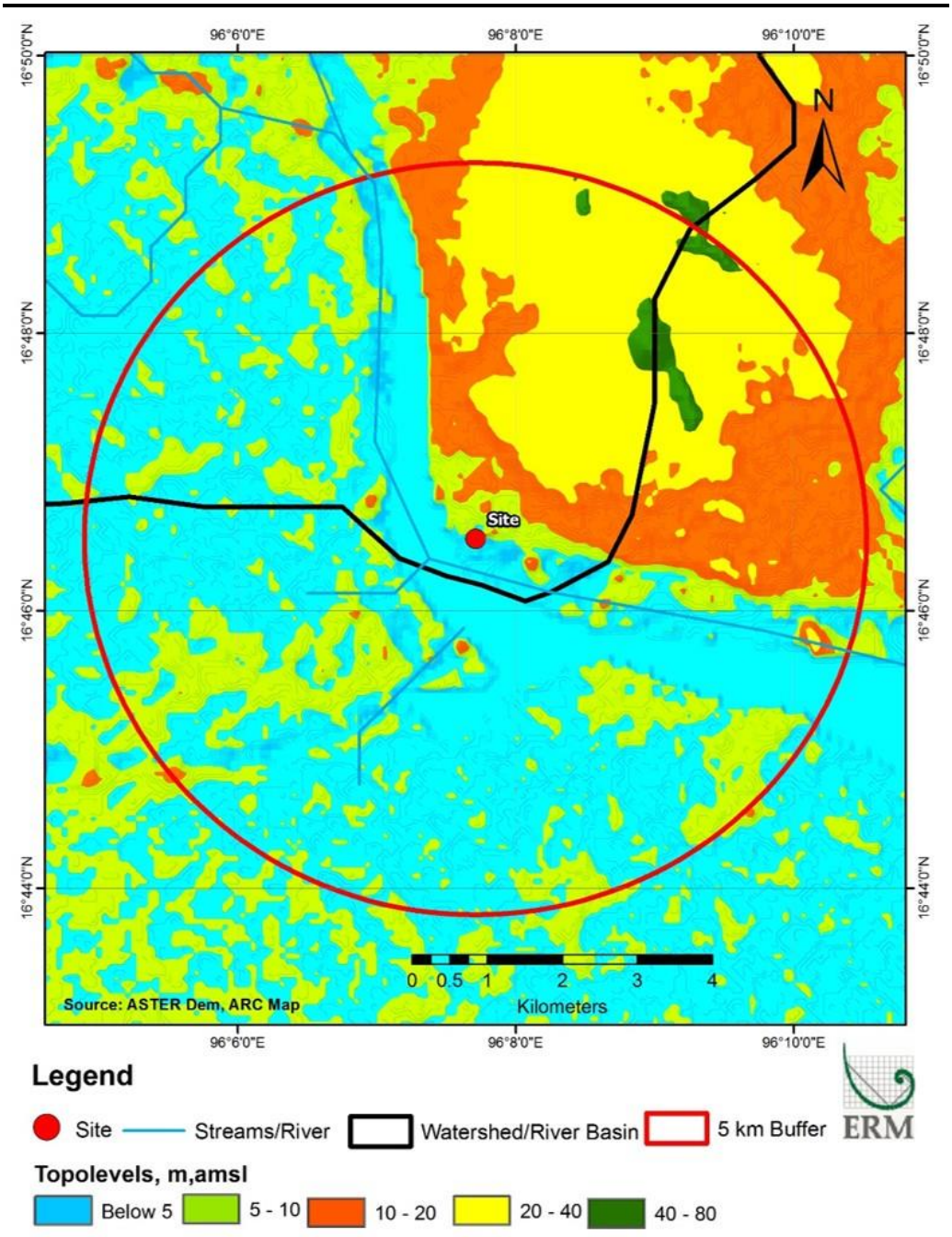
[1] Catchment is a topographically defined area, draining surface water to a single outlet point. It may frequently include an area of tributary streams and flow paths as well as the main stream.

The topography of the watershed within which the Site is located varies from 500 – 1,350 m amsl (above mean sea level) near the upper reaches in the north to < 5 m amsl near the lower reaches of the watershed in the south. The Site is located at the downstream portion of the watershed at the discharge point/outlet. This makes the Site prone to flooding / inundation.

The watershed has physical extent of 8,340 sq.km and extends over north-south vector.

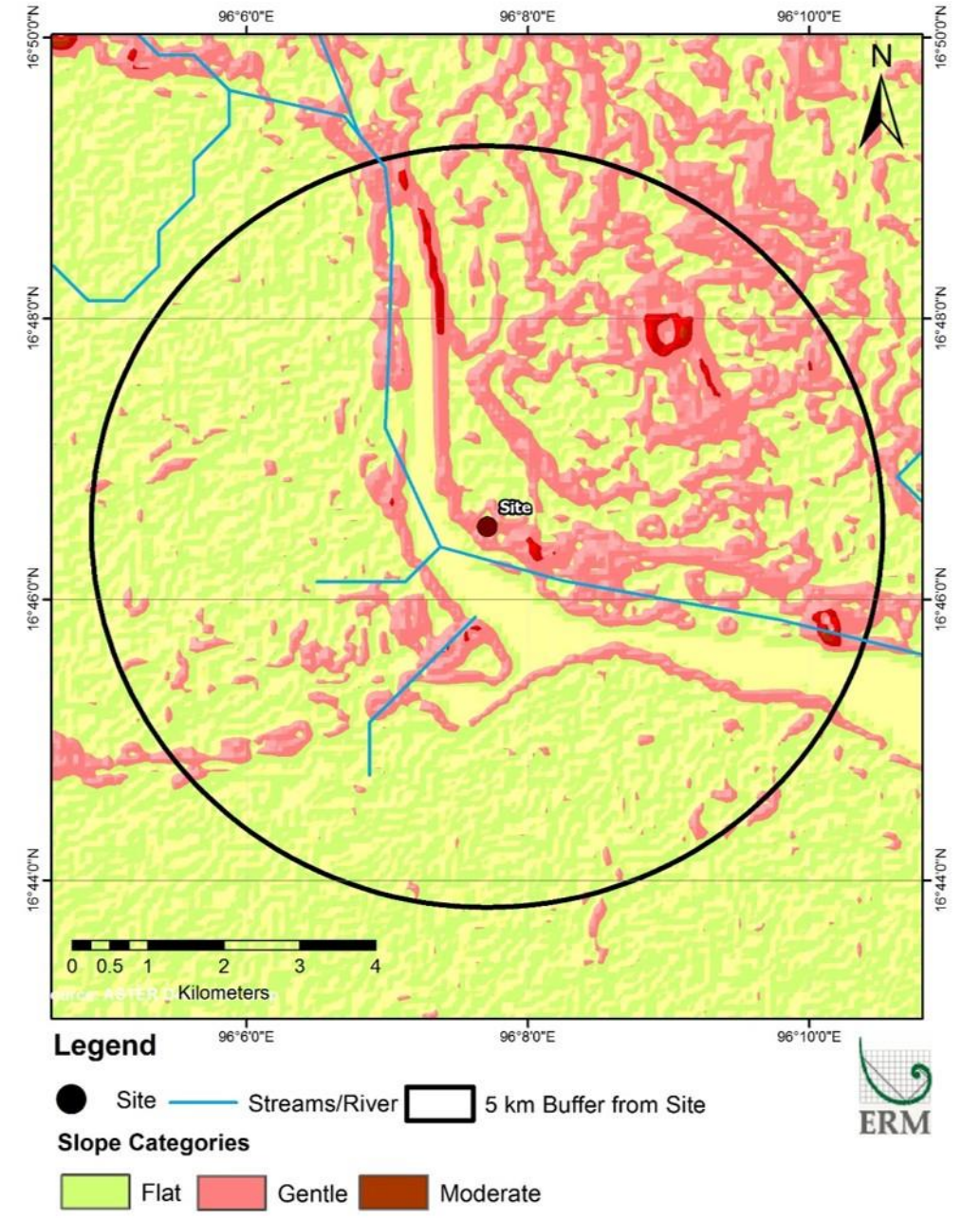
In order to understand the topography of the area surrounding the Site, a DEM and a slope map have been developed for a 5 Km radius buffer area around the Site as presented in ***Figure 2.4*** *and* ***Figure 2.5*** respectively.

Figure 2.4 Digital Elevation Model of the 5 Km Buffer Zone around the Site



Source: Developed by ERM using data from ASTER GDEM

Figure 2.5 Slope Map



Developed by ERM using data from ASTER GDEM

The topography of the 5 Km buffer zone around the Site was observed to be largely flat with gentle slopes in the north eastern quadrant and pockets of moderate slopes in the north and north east. General slope of the catchment area / watershed is from North to South. Topographic elevation within the 5 Km buffer zone varies from 40 – 80 m amsl near the northeast to < 5 m amsl which may be observed in most part of the buffer zone. This may be indicative of large tracts of low lying areas within the buffer zone which may be prone to localized flooding / inundation during rainy season. The Site was observed to be located in an area with elevation of < 5 m amsl. Considering the topographical features of the area surrounding the Site, risk associated with flooding / inundation in the area around the Site may be considered as "*High*".

2.3 *ANALYSIS OF HISTORICAL SATELLITE IMAGERY*

ERM analyzed the historical satellite imagery of the Site and its surrounding area to identify any events of flooding or inundations.

Figure 2.6 Historical Satellite Imagery

Figure 2.7 Historical Satellite Imagery

For assessing potential for impacts from flood, inundation and waterlogging at Site, ERM reviewed satellite imagery of Site and surrounding area as available from GoogleEarth Pro from 2003 till present. Review of historical satellite imagery indicates considerable developmental activity including clearance of vegetation, construction of temporary structures (buildings), piers/jetties, and soil excavation and/or compaction. Further, significant land use change was observed in the surrounding area since the year 2003 particularly in the southeast which is associated with the expansion of container yard of the Myanmar Industrial Port.

Based on review of satellite imagery, high tide period of River Yangon extends between October to April of the year with considerable ebbs and waning over shorter spans within this period possibly associated with the precipitation in the catchment area. Between 2003 and present, Site was observed to be affected due to water ingress from the River Yangon on twelve (12) instances as apparent from available satellite imagery. Maximum water level during this period was observed to extend up to 73 m inside the Site (from southwestern boundary) submerging ~50% of the Site area. During these instances, impact on Site varied from High (some part of the Site was inundated) to Extreme (significant part of the Site was submerged in flood water).

Table 2.2 Historical Floods near the Site as Observed from Satellite Imagery

Satellite Image Date	Spatial Extent of Inundation/Submergence at Site	Observations on Tidal Stream (located adjoining western boundary of the Site)	Observations on Site and Surrounding Area
6th Nov 2004	>30% area of Site flooded	Discharge into the Site area (SW portion)	~50% of Site appears to be intertidal zone
22nd Nov 2005	>30% area of Site flooded	Discharge into the Site area (SW portion)	Levee built across tidal stream adjoining the western boundary of Site is breached
23rd Feb 2007	20 – 30% area of Site flooded		A barge is docked in the intertidal zone within the Site; Container yard of MIP is observed to have been expanded by 60 m into the intertidal zone.
26th Dec 2009	>20% area of Site flooded		Most of the Site is covered in thick mangrove vegetation
25th Jan 2010	>20% of Site flooded		
25th Nov 2010	Some part of Site flooded along the southwestern boundary	Stream course, particularly the discharge point appears to have changed to westerly direction and away from the Site	Vegetation in central and eastern portion of the Site is cleared; 2 jetties have been constructed in the southern boundary of Site.
30th Jan 2012	Some part of Site flooded along the southwestern boundary		Both jetties have disappeared indicating possible damages caused by flood waters; Container yard of MIP under further expansion.
8th Dec 2012	>10% of Site flooded		Vacant site located west of the Site has been cleared of vegetation in preparation for development; New jetty has been constructed at the southern boundary of Site; Container yard expansion appears to have been completed.
5th October 2014	Some part of Site flooded along the southwestern boundary		New jetty has disappeared indicating possible damages caused by flood waters.
1st Jan 2016	Some part of Site flooded along the southwestern boundary		Another new jetty has been constructed in the south western boundary of Site.
15th Mar 2016	Some part of Site flooded along the southwestern boundary	Water course of the tidal stream appears to have breached into the Site	
12th Dec 2017	Some part of Site flooded along the southwestern boundary		

Review of historical satellite imagery indicates considerable changes in flooding pattern in the Site and surrounding area, particularly from the end of 2012 which marks the completion of container port expansion near the Site. Expansion of the container port of MIP has resulted in extension of the port 80 m into the River Yangon. This expansion may have altered the river course near the immediate vicinity of the Site resulting in subsidence of extent of flooding at Site. Considering the apparent historical impacts of flooding at Site and changes in flooding pattern at the Site and surrounding area over time based on historical satellite imagery, risk associated with flooding and inundation at Site may be considered as "*High*".

Note: Extent of flooding and land submergence observed from historical satellite imagery may not be representative of the actual scenario. Impact from flooding during an extreme weather event which coincides with high tide period may be significantly higher than that presented in Satellite Imagery. This is because the satellite images may not have captured the precise moments of peak river flow. Peak river flow may even occur over short time span of few hours during an extreme weather event which may coincide with high tide period.

2.4 NATURAL DRAINAGE AND SURFACE WATER BODIES

The Site is located on the left bank in the lower reaches of the Yangon River basin. The Yangon River (aka Rangoon river), is about 40 km long (25 miles), and flows from southern Myanmar as an outlet of the Irrawaddy (Ayeyarwady) river into the Ayeyarwady delta. It empties into the Gulf of Martaban of the Andaman Sea. Yangon River is linked west to the Irrawaddy River by the Twante Canal which is located ~850 m south and downstream from the Site.

Figure 2.8 Water Bodies and Drainage Channels near the Site

Drainage within the 5 Km study area around the Site is largely defined by the Yangon River. Surface runoff from the Site mostly drains directly into Yangon River. Surface runoff from area immediately upstream of the Site drains into the tidal stream which lies adjoining the western boundary of the Site. This tidal stream extends over north to southwest vector before discharging into Yangon River ~80 m from the western boundary of the Site.

Other surface water bodies within the study area include Kandaygyi Lake which is spread over an area of ~142 acres and located ~3,700 m northeast of Site. No other major water infrastructure such as dams, reservoirs, and levees were observed within 5 Km radius around the Site. Review of satellite imagery did not indicate presence of any significant flood controlling structures constructed across Yangon River upstream of the Site. Drainage network and major water bodies in the area are presented in ***Figure 2.8***.

Figure 2.9 ***Tidal Stream located Adjoining the Western Boundary of Site***

The Study Area (Site and surrounding area) is located 40 Km upstream from the mouth of the Yangon River. Based on secondary information, the average tidal range of the Yangon River is about 5.85 m at spring tide and 2.55 m at neap tide. Further, a modelling based study of the discharge of Yangon River indicates discharges ranging from <500 m^3/s in April to approximately 7,000 m^3/s in August, with tidal water level variations of ~1 m to ~6 m based on water level measurements at Monkey Point downstream of Project Site (confluence point of River Yangon and River Bago ~7.4 Km east-southeast from Site)[1]. In the Irrawaddy Delta which includes the Yangon River, drainage, salt intrusion and flood protection are major concerns (EO Earth Website, 2016).

[1] Theilen-Willige, Barbara & Pararas-Carayannis, George. (2009). Natural hazard assessment of sw myanmar - a contribution of remote sensing and gis methods to the detection of areas vulnerable to earthquakes and tsunami / cyclone flooding. Science of Tsunami Hazards.

Information on historical flooding from the Yangon River in Ahlone area was not available from secondary sources. Information on peak water flow in the tidal stream located adjoining the Site was not available from secondary sources for review.

Considering the close proximity of Yangon River to the Site and the high degree of variation in its tidal range, risk associated with flooding and inundation at Site from Yangon River may be considered as "*High*".

2.5 SITE SETTING AND FLOOD ENTRANCE

A first order natural drainage channel was observed to have been formed within the Site due to erosion from surface runoff, largely generated within the Site and area immediately up-gradient to the Site. The natural drainage of this channel was towards South-Southwest direction predominantly stretching through the central portion of the Site.

Figure 2.10 Water Logged Area and Low Lying Area at Site and immediate Vicinity

Based on observation during field reconnaissance, the waterlogged areas were observed at two (2) locations within the Site in the west central portion. In addition to the waterlogged areas, southwestern portion of the Site was observed to be covered in mangrove vegetation spread over ~0.84 acres of land and extending beyond the Site boundary. Mangrove vegetation may be considered as indicative of intertidal zone in-turn suggesting high potential for frequent inundation and waterlogging.

Figure 2.11 Water Logged Area and Low Lying Area at Site

A follow up field visit was carried out in September 2018 to observe ground conditions post rainfall event. During this field visit, most of the Site area was

observed to be water logged and covered in thick vegetation. Based on field visits, water logging in significant portion of the Site was observed to last throughout the wet/rainy season.

Figure 2.12 Inundation and Waterlogging at Site in the Month of September 2018

Figure 2.13 Intertidal Zone of Yangon River as viewed from Southern Boundary of Site

Further, much of the southern and south eastern portion of the Site was observed to be low lying and covered in vegetation at the time of field visit.

Based on field observations, storm water during rainy season may be anticipated to cause inundation / waterlogging within the Site at the identified areas. Further, rise in water level in Yangon River during high tide may cause flooding/inundation in the southern and south western portion of the Site. Hence, likelihood of inundation and waterlogging at Site during rainy season may be considered as "*High*".

2.6 KEY FINDINGS

- Subject property is located on the left bank in the lower reaches of Yangon River with a tidal stream adjoining the western boundary of the Site;
- The Site is located at the downstream portion of the watershed at the discharge point/outlet;
- The topography of the area around the Site was observed to be largely flat with gentle slopes;
- Waterlogged areas were observed at two (2) locations within the Site in the west central portion;
- Southwestern portion of the Site was observed to be covered in mangrove vegetation which is indicative of intertidal zone with high potential for frequent inundation;
- Much of the southern and south eastern portion of the Site was observed to be low lying and covered in vegetation;
- Yangon River experiences large variation in tidal levels during the couse of the year and during rainy season;
- Tidal stream was observed to change is course due to influx of large stream flow;
- Review of historical satellite imagery indicates significant land use change in the surrounding area since the year 2003 particularly in the southeast which is associated with the expansion of container yard of the Myanmar Industrial Port;
- As per historical satellite images, high tide period of River Yangon extends between October to April of the year with considerable ebbs and waning over shorter spans within this period;
- Between 2003 and present, Site was observed to have been affected due to high tide level in River Yangon on twelve (12) instances as apparent from available satellite imagery;
- Maximum water level during this period was observed to extend up to 73 m inside the Site (from southwestern boundary) submerging ~50% of the Site area;
- Jetties at the Site were observed to have been newly constructed on multiple occasions at different locations which were not visible during lean period after a flooding event indicating possible damage / destruction casued by the floods.
- Levee constructed across the tidal stream was observed to have been overtopped and severly damaged due to flood water on more than one occasion;
- Flooding pattern in the Site and surrounding area changed considerable over time, particularly from the end of 2012 which marks the completion of container port expansion adjacent to the Site;

- Considering the close proximity of Yangon River to the Site and the high degree of variation in its tidal range, risk associated with flooding and inundation at Site from Yangon River may be considered as "*High*";
- Considering the topographical features of the area surrounding the Site, risk associated with flooding / inundation in the area around the Site may be considered as "*High*"; and
- Considering the apparent historical impacts of flooding at Site and changes in flooding pattern at the Site and surrounding area over time based on historical satellite imagery, risk associated with flooding and inundation at Site may be considered as "*High*".

In Yangon, the average annual temperature is 27.3 °C. The warmest month of the year is April with an average temperature of 30.5 °C while the coolest month of the year is January with an average temperature of 24.7 °C.

The area receives an annual average rainfall of 2,790 mm. The contribution from rainfall between the months of May till September accounts to 85% of annual precipitation. The wettest month is June with an average of 582 mm. Much of this is attributed to the South-Western monsoon. In addition to this, post-monsoon showers contribute ~10 - 15% of the total rainfall. The maximum yearly rainfall (3,577.63 mm) was observed in the year 1999 and minimum (2,021.02 mm) in 1986.

According to a study on rainfall variability, the lowest variability in Myanmar is observed at Putao, the Eastern Highlands, and coastal area of deltaic region and coastal strip of Tanintharyi with a value of 10 percent to 15 percent. Yangon region is one of the coastal areas considered to have lowest rainfall variability[1].

3.1 MONTHLY RAINFALL PATTERN

The monthly variation of the rainfall for Yangon region was studied for the period 1979-2013 as available for the nearest weather monitoring station (located ~25 Km from the Site) from the Climate Forecast System Reanalysis (CFSR) of the National Centre for Environmental Prediction (NCEP). Details are provided in ***Table 3.1***. Long term (40-year) average annual rainfall in Yangon is about 2,796 mm.

Table 3.1 Monthly Rainfall Pattern for the Period 1979-2013

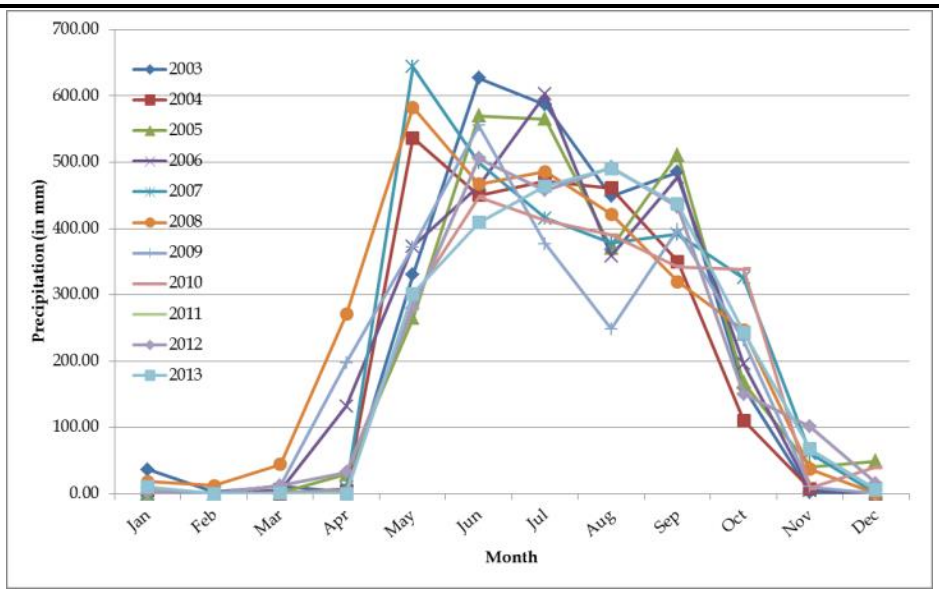
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average	3.29	2.05	12.38	45.02	410.39	582.03	499.58	472.03	424.98	271.64	75.97	9.53	2,796
Maximum	36.59	24.23	120.79	270.79	774.68	1,021.45	686.23	637.33	617.38	507.42	355.92	49.04	3,577
Minimum	0.00	0.00	0.00	0.00	144.35	388.00	284.54	248.53	270.72	110.63	0.03	0.00	2,021

Source: National Centre for Environmental Prediction (NCEP), All values in mm

The monthly rainfall variation observed for the Yangon Region for the period (2003-2013) is shown in ***Figure 3.1***.

[1] http://shodhganga.inflibnet.ac.in/bitstream/10603/25676/9/09_chapter%203.pdf

Figure 3.1 ***Monthly Variation of Rainfall at Yangon Region (2003-2013)***



Source: Climate Forecast System Reanalysis (CFSR) of National Centre for Environmental Prediction (NCEP)

From the ***Figure 3.1*** it is evident that May-September months receive substantial monsoon rains and also the wettest days of some of the years have occurred in the month of June. Smooth drainage of storm water from the Site would be largely dependent on tidal level in the Yangon River and/or the tidal stream located along the western boundary of the Site. Loss of storm water buffer areas / sinks in the lower reaches of the Site, particularly along the southwestern boundary may lead to increase in storm water runoff at the Site. This in conjunction with high tide in Yangon River may result in disruption of flow, which may in-turn lead to flooding / inundation at the Site.

3.2 MAXIMUM DAILY PROBABLE RAINFALL (25, 50 AND 100 YEARS RETURN PERIOD)

Maximum daily probable rainfalls for different return periods for the area as observed from CFSR data are presented in ***Table 3.2***.

Table 3.2 ***Maximum Daily Probable Rainfall at Yangon Region***

Return period in years	Maximum daily probable rainfall in mm
25	181
50	352
100	Not available

Source: CSFR

The heaviest rainfall recorded at Yangon in a 24-hour period from available data was 352 mm recorded on 21st May 2002 which was a ~50 year return period rainfall event (*CSFR*).

3.3 FLOODING EVENT (25, 50 AND 100 YEARS RETURN PERIOD)

Information regarding historical flood events at the Site and surrounding area was not available for review. However, based on secondary sources, flood event in the year 2015 is considered as one of the major flood events in the recent past. No scientific studies were available for review to understand the return periods of those flooding events and hence the actual return period of such events is unknown.

3.3.1 Flash Floods

A flash flood is a rapid flooding of geomorphic low-lying areas due to high-intensity and short duration rainfall events. Based on review of historical daily rainfall data, Yangon area receives high intensity short duration rainfall events occasionally, creating a flooding situation in the Yangon area similar to a flash flood particularly along the banks of Yangon River and low lying areas. A similar situation may be expected for the Site area as well.

Images of the most recent flood at Yangon River caused due to heavy rainfall overnight were available for reference. According to local sources, the high flood level observed during this event was during low tide period. Images of the flood water in Yangon River, its impact on the Site, and reference flood level rise are presented in ***Figure 3.2***, ***Figure 3.3***, and ***Figure 3.4***.

Figure 3.2 shows the rise in Yangon River water level from 15:00 hours on 14th June 2018 to 09:00 hours on 15th June 2018 as observed from the jetty located at the south western boundary of the Site.

Figure 3.2 Flash Flood in Yangon River in June 2018

Left: Water level in Yangon River on 14th June 2018;
Right: Rise in water level due to flash flood in Yangon River as observed on 15th June 2018.

During this flood event, Site was observed to have been partially submerged with significant waterlogging even in the interior parts of the Site (central and eastern portion).

Figure 3.3 ***Site Partially Submerged during Flash Flood in Yangon River in June 2018***

Figure 3.4 ***Water logging near the Internal Access Paths at the Site during Flash Flood in Yangon River in June 2018***

Figure 3.5 ***Water Level Marker located at the Site's Jetty indicating Abrupt Rise in Yangon River Water Level in June 2018***

Note: The numeral marking on the pole circled in Red indicate flood monitoring scale. Scale represents 3 feet (~0.91 m) per unit rise in water level. Flood monitoring scale is located at the end of the jetty constructed at the southwestern boundary of the Site.

A flood level marking pole is located at the end of the jetty located at the Site. Marking on the pole has maximum of 4 units with each unit scaled at 3 feet (0.91 m). From available images of the rise in water level, flash flood resulted in rise of water level from ~1.5 unit to ~3.5 unit (approximately 1.82 m) within a span of 12 hours.

Based on information available from local sources, water level of Yangon River periodically and routinely reaches levels up to 3 units. During this period, water may submerge the Site partially reaching up to the internal access paths located in the interior portion of the Site.

3.3.2 Consultations

Community consultations were not carried out as part of this assessment. Hence incident reports of past flooding events from communities are not available for review.

Based on consultations with the personnel at the existing power plant at Ahlone located ~300 m north of Site, highest water level during peak flood had reached up to the settling pond in the year 1996. This settling pond is located ~30 m north of the northcentral boundary of the Site.

Figure 3.6 Satellite Image showing High Flood Level in 1996

Based on the high flood level (HFL) reference point from the year 1996, Yangon river waters would have flooded/inundated the entire Site area during this event. Due to lack of historical data on high flood levels, intensity of this flooding event could not be confirmed.

Likelihood of recurrence of an event in the future similar to the magnitude of 1996 floods cannot be ruled out. Considering the HFL reference point from 1996 flood event, risk associated with flooding and inundation at Site from Yangon River may be considered as "*High*".

3.4 KEY FINDINGS

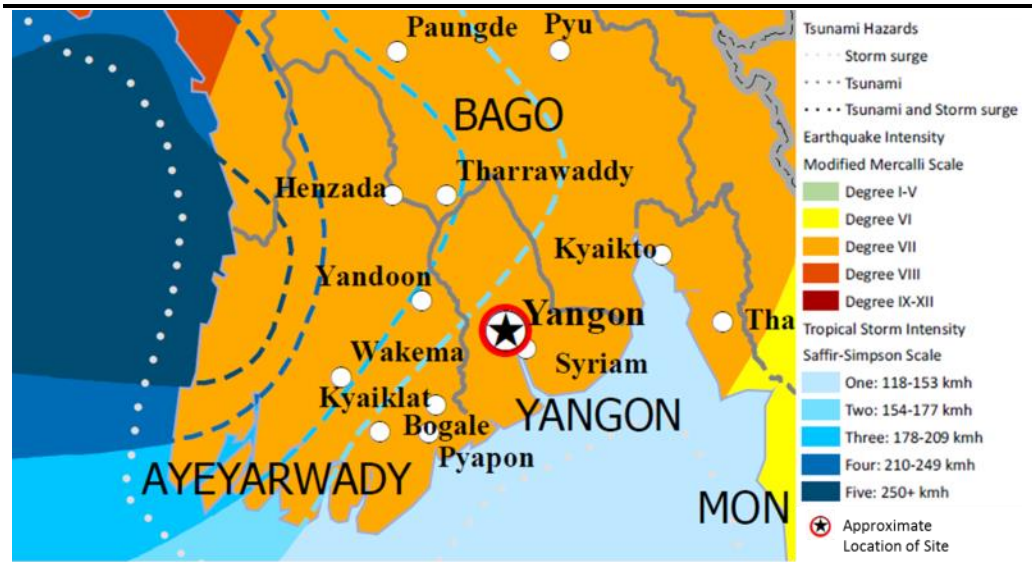
- Area receives high rainfall to the order of 2,796 mm annually with significant high intensity rainfall events;
- The heaviest rainfall recorded at Yangon in a 24-hour period from available data was 352 mm recorded on 21st May 2002 which was a ~50 year return period rainfall event;
- Smooth drainage of storm water from the Site would be largely dependent on tidal level in the Yangon River and/or the tidal stream located along the western boundary of the Site;
- Loss of storm water buffer areas / sinks in the lower reaches of the Site, particularly along the southwestern boundary may lead to increase in storm water runoff at the Site;
- Yangon area receives high intensity short duration rainfall events occasionally, creating a flooding situation in the Yangon area similar to a flash flood particularly along the banks of Yangon River and low lying areas;
- Images from most recent flooding event reported on 14th June 2018 show partially submerged Site with considerable inundation and waterlogging even in interior parts (central and eastern parts) of the Site;
- Water level of Yangon River increased by ~1.82 m within a short span of 12 hours;

4 SECONDARY DATA (FLOOD ZONATION AND HAZARD)

4.1 NATURAL HAZARD RISK

The Office for the Coordination of Humanitarian Affairs (OCHA) at the United Nations (UN) has prepared a natural hazard risks map for Myanmar. This map presents various risk categories for Tsunami, Earthquake, and Tropical storms for Myanmar as presented in ***Figure 4.1***. According to the natural hazard risk map, Yangon region has been categorized as Degree VII zone with respect earthquake intensity. The map does not indicate any hazard associated with Tsunami for Yangon Region. However, tropical storms with intensity ranging between 118 – 153 Km/h may be anticipated in this region.

Figure 4.1 ***Myanmar: Natural Hazard Risks Map showing Yangon Region, March 2011***

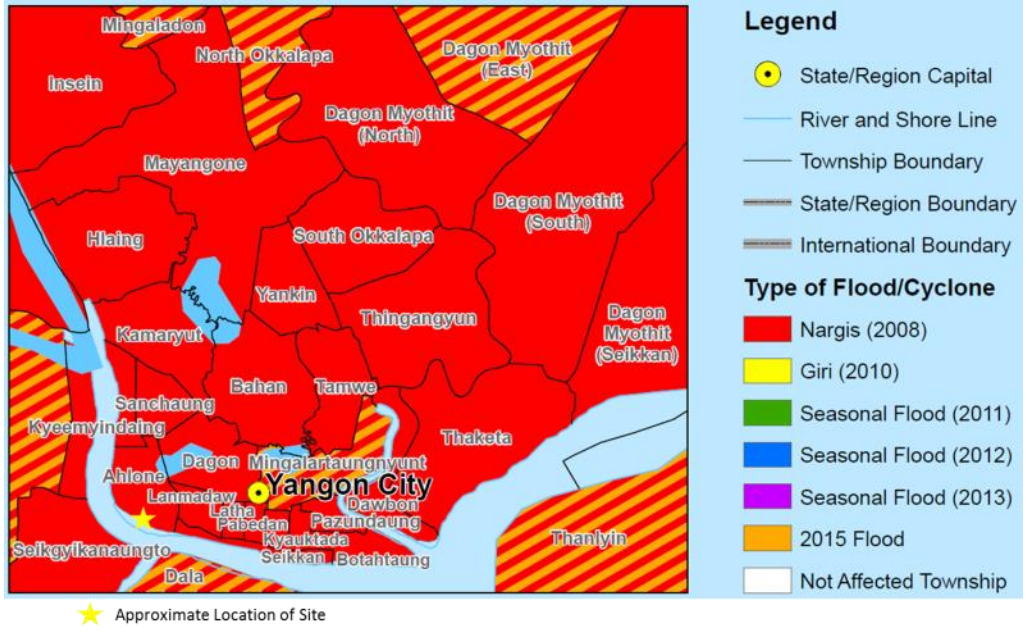


Source: UN Office for the Coordination of Humanitarian Affairs (OCHA).

4.2 AREAS OF POTENTIAL VULNERABILITY TO FLOOD/CYCLONE

Myanmar Information Management Unit (MIMU) has prepared a map of Myanmar indicating the areas of potential vulnerability to flood/cyclone events based on recent floods between the years 2008 and 2015 as presented in ***Figure 4.2***. According to this map, Ahlone area where the Site is located in an area demarcated as "area impacted by floods (Nargis)" in the year 2008.

Figure 4.2 ***Areas of Potential Vulnerability based on Recent Flood / Cyclone Events (2008 – 2015)***



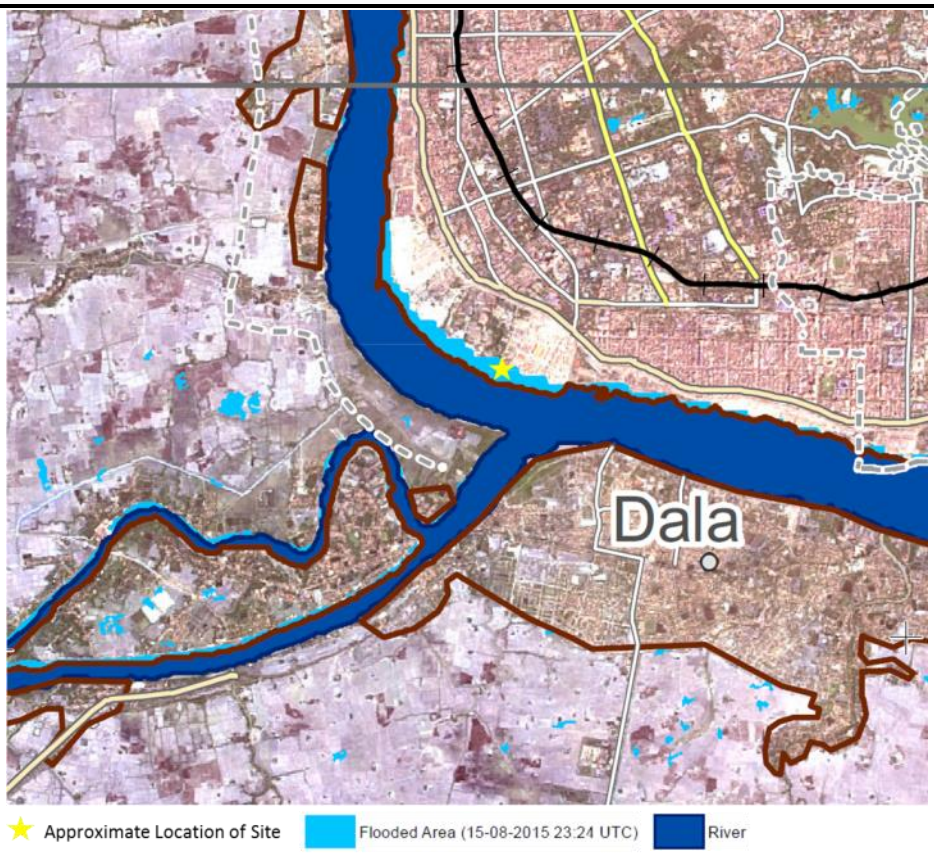
Source: Myanmar Information Management Unit (MIMU).

4.3 *FLOOD DELINEATION IN YANGON WEST*

According to secondary sources, flooding in the year 2015 is considered as one of the major flood events in the recent past. This flooding event was the result of unusual heavy monsoon which had caused river overflows and floods. Widespread damages to farmlands, roads, railway tracks, bridges, among other public infrastructure had been caused due to the torrential rainfall preceding this event. Emergency Management Services of Copernicus – a programme operated by European Commission (EC) in association with European Space Agency (ESA) has delineated the extent of floods from the 2015 torrential rainfall for the Yangon West region as presented in ***Figure 4.3***.

According to this map, Ahlone area where the Site is located has been delineated as flood impacted area.

Figure 4.2 Flood Delineation in the Area of Yangon West (Myanmar)



Source: http://emergency.copemicus.eu/mapping/list-of-components/EMSR130
http://reliefweb.int/sites/reliefweb.int/files/resources/EMSR130_11YANGONWEST_DELINEATION_OVERVIEW-MONIT01_v3_200dpi.pdf

4.4 KEY FINDINGS

- As per Natural Hazard Risks map developed by the UN, likelihood of impact associated with Tsunami on the Site and surrounding area may be considered as "*Low*". Also, likelihood of impact from tropical storms may be considered as "*Low*";
- As per map developed by MIMU, Ahlone area where the Site is located has been demarcated as an area of potential vulnerability to flood / cyclone. According to this map, Site and surrounding areas were impacted during 2008 flooding event (Nargis); and
- As per map developed by Copernicus (European Commission), Ahlone area where the Site is located has been delineated as flood impacted area during the recent major flooding event in the year 2015;

Based on the above-mentioned findings, a likelihood analysis of potential flooding event in and around the facility has been undertaken. The same has been presented in the following table.

Table 5.1 Likelihood of Flood Evaluation

Attributes	Likelihood		
	High	Medium	Low
Digital Elevation Model and Slope Map • No abrupt slope changes were observed at the Site and nearby areas. • The topography of the area around the Site was observed to be largely flat with gentle slopes			
Land use change • Review of historical satellite imagery indicates significant land use change in the surrounding area since the year 2003 particularly in the southeast which is associated with the expansion of container yard of the Myanmar Industrial Port. • Flooding pattern in the Site and surrounding area changed over time, particularly from the end of 2012 which marks the completion of container port expansion adjacent to the Site.			

Attributes	Likelihood		
	High	Medium	Low
<u>Surface water bodies and Natural drainage channels</u> • Site is located on the left bank in the lower reaches of Yangon River • A tidal stream is located adjoining the western boundary of the Site. • Yangon River experiences large variation in tidal levels during the course of the year and during rainy season. • Tidal stream was observed to change its course due to influx of large stream flow. • Per historical satellite images, Site was observed to have been affected due to high tide level in River Yangon on twelve (12) instances as apparent from available satellite imagery between 2003 and present. • Maximum water level of Yangon River during this period was observed to extend up to 73 m inside the Site boundary (from southwestern boundary) submerging ~50% of the Site area. • Jetties at the Site were observed to have been constructed newly on multiple occasions at different locations which were not visible during lean period after a flooding event indicating possible damage / destruction casued by the floods. • Levee constructed across the tidal stream was observed to have been overtopped and severly damaged due to flood water on more than one occasion;			

Attributes	Likelihood		
	High	Medium	Low
<u>Site Setting and Flood Entrance</u> • Waterlogged areas were observed at two (2) locations within the Site in the west central portion. • Southwestern portion of the Site was observed to be covered in mangrove vegetation which is indicative of intertidal zone with high potential for frequent inundation. • Much of the southern and south eastern portion of the Site was observed to be low lying and covered in vegetation • Maximum water level during this period was observed to extend up to 73 m inside the Site (from southwestern boundary) submerging ~50% of the Site area.			
<u>Hydro-meteorological Data</u> • Area receives high rainfall to the order of 2,796 mm annually with significant high intensity rainfall events. • The heaviest rainfall recorded at Yangon in a 24-hour period from available data was 352 mm recorded on 21st May 2002 which was a ~50 year return period rainfall event. • Smooth drainage of storm water from the Site would be largely dependent on tidal level in the Yangon River and/or the tidal stream located along the western boundary of the Site. • Yangon area receives high intensity short duration rainfall events occasionally, creating a flooding situation in the Yangon area similar to a flash flood particularly along the banks of Yangon River and low lying areas. • Most recent flash flood (June 2018) caused from torrential rainfall over a short duration of 12 hours resulted in Yangon River water level to increase by ~1.82 m which submerged the Site partially and caused significant inundation and waterlogging even in central and eastern portion of the Site.			
<u>Natural Hazard Risks as per UN</u> • likelihood of impact associated with Tsunami on the Site and surrounding area may be considered as "*Low*". • Likelihood of impact from tropical storms may be considered as "*Low*".			

Attributes	Likelihood		
	High	Medium	Low
<u>Vulnerability to Floods/Cyclone as per MIMU and European Commission</u> • As per map developed by MIMU, Ahlone area where the Site is located has been demarcated as an area of potential vulnerability to flood / cyclone. • According to map prepared by MIMU, Site and surrounding areas were impacted during 2008 flooding event (Nargis) • As per map developed by Copernicus (European Commission), Ahlone area where the Site is located has been delineated as flood impacted area during the recent major flooding event in the year 2015.			

Based on the observations from the above-mentioned table, it appears that the overall likelihood of flooding event in and around the Site may be considered as "*High*". The main high probability attributes are as follows:

- Site is located on the left bank in the lower reaches of Yangon River. A tidal stream is located adjoining the western boundary of the Site.
- Area receives high rainfall to the order of 2,796 mm annually with significant high intensity rainfall events.
- Yangon area receives high intensity short duration rainfall events occasionally, creating a flooding situation in the Yangon area similar to a flash flood particularly along the banks of Yangon River and low lying areas. Yangon River experiences large variation in tidal levels near the Site during the course of the year and during rainy season.
- Tidal stream was observed to change is course due to influx of large stream flow
- Per historical satellite images, Site was observed to have been affected due to high tide level in River Yangon on twelve (12) instances as apparent from available satellite imagery between 2003 and present.
- The topography of the area around the Site was observed to be largely flat with gentle slopes
- Maximum water level of Yangon River during this period was observed to extend up to 73 m inside the Site boundary (from southwestern boundary) submerging ~50% of the Site area.
- Waterlogged areas were observed at two (2) locations within the Site in the west central portion.
- Southwestern portion of the Site was observed to be covered in mangrove vegetation which is indicative of intertidal zone with high potential for frequent inundation.
- Much of the southern and south eastern portion of the Site was observed to be low lying and covered in vegetation
- Most recent flash flood (June 2018) caused from torrential rainfall over a short duration of 12 hours resulted in Yangon River water level to increase by ~1.82 m which submerged the Site partially and caused significant inundation and waterlogging even in central and eastern portion of the Site.

Peak river flow may even occur over short time span of few hours during an extreme weather event which may coincide with high tide period. Satellite images may not have captured the precise moments of such peak river flow. Hence, extent of flooding and land submergence observed from historical satellite imagery may not be representative of the actual scenario. Potential impact from flooding during an extreme weather event which coincides with high tide period may be significantly higher.

Information presented above is in reference to the Site only. Likelihood of flooding, inundation, and waterlogging and their potential impact beyond the Site boundary (including the area where the existing power plant is located) may vary considerably.

6.1 RECOMMENDATIONS

Based on the analysis, the following measures could be implemented to reduce the likelihood of occurrence of the flooding at the Site.

- Undertake a detailed flood risk assessment (FRA) with modelling of High Flood Level (HFL) to estimate the extent of flood impact on Site under varying scenarios of peak flow and tidal pattern.
- Based on the relative elevation of the Site with respect to the HFL, low lying areas in the south and southwestern portion of the Site may require backfilling to raise the level of the ground above the HFL;
- Construct flood prevention barriers (such as a flood wall, retractable wall, bunds / embankment) along the river bank and boundary neighbouring stream(s);
- Design earth embankment along the northern extent (inland) of mangrove vegetation and along the western boundary of the Site to restrict the flood plains and contain river /tidal stream overflow.
- Design final storm water discharge points (multiple outlets) to prevent backflow during high tide period / high river water level through adoption of sluice valves (one-way valve) and a robust pumping system at each outlet to pump out storm water from internal drainage network into the river manually in case of emergency.
- Locate all key utilities (particularly electrical units such as DG on raised platforms or higher elevations relative to HFL.

In addition to the broad level risk mitigation actions suggested above, development of a robust 'Flood Prevention and Mitigation Plan' and an 'Emergency Action Plan' are recommended for the Site. Flood prevention and mitigation plan must include both active (mitigation measures, short-, medium and long-term) and passive measures (preventive measures, medium and long-term).

Limitations

- *Community consultations were not carried out as part of the field data collection for this assessment;*
- *Information presented are as collected from secondary sources and visual observations made during field reconnaissance only;*
- *The assessment/ evaluation does not include topographical survey, hydrological modelling of catchment, flood plain modelling, and/or estimation of site specific high flood levels (HFLs).*

APPENDIX NN HIGH LEVEL FLOOD LIKELIHOOD EVALUATION (FLE)

10 TERMS OF REFERENCE FOR THE ESIA STUDY

This *Section* serves as the Terms of Reference (TOR) for the ESIA Study and sets out the following:

- Overview of activities to complete the ESIA process;
- Required technical studies to conduct the impact assessments;
- Recommended stakeholder engagement; and
- Outline structure for the ESIA report.

10.1 ESIA OBJECTIVES

The Project Proponent recognizes that comprehensive planning and management of environmental, health and social issues are essential to the execution of any successful project and, therefore, intends to fully integrate environmental and socio-economic considerations into the life cycle of the proposed Project.

To support this, the Project Proponent intends to commission a detailed, integrated ESIA Study to conform to Myanmar Regulatory requirements (refer ***Section 3*** of this report for details).

The purpose of the ESIA Study is to assess the potential impacts of the Project and Project-related activities on the environment (including biophysical and socioeconomic resources), and where applicable, to develop mitigation or enhancement measures to remove, reduce or avoid negative impacts to the environment and enhance positive impacts.

10.2 SCOPE OF WORK FOR ESIA STUDY

After the scoping phase of the Project, the ESIA consultant will:

- Update and finalize the technical Project description as further engineering details become available including conceptual design and work closely with the Project Proponent to confirm details such as the final layout, and construction and operation plans;
- Conduct additional stakeholder consultation and further refine the scope of the ESIA as necessary;
- Identify any gaps and collect additional baseline data through desktop research and field studies to complete a comprehensive description of the existing environmental and social conditions;
- Develop mitigation and enhancement measures and outline an Environmental and Social Management Plan (ESMP) including an approach for monitoring; and
- Report findings in a comprehensive ESIA report.

10.2.1 Baseline Data Collection

An initial site visit was conducted in February 2018. Dry season and wet season baseline surveys has been conducted in May 2018 and in June 2018, respectively. Aspects that has been sampled/monitored include ambient air quality, surface water quality, noise, land use, ecology, and sediment.

Further social baseline surveys, including socio-economic survey, fishermen and other livelihood groups consultations, etc. that would include identification and interviews with relevant local stakeholders and a complete assessment of the likely impacts and issues has been conducted in October 2018, to adequately identify the interactions between the proposed Project, and the surrounding social community and natural environment.

The results from baseline data collection will form the description of the existing environmental conditions, to be used as the basis for the Impact Assessment stage, and will be integrated into the ESIA Report.

Table 10.1 Potential Project Impacts for ESIA Phase

Potential Impacts

• Air Quality impacts during construction and operation phase;
• Noise impacts during construction and operation phase;
• Surface water quality impacts through cooling water discharge;
• Surface water quality impacts from Regasification Unit/ process;
• Soil and ground water impacts through land excavation activities should the soil be contaminated through previous use;
• Soil erosion and land degradation;
• Generation of hazardous and non-hazardous waste and impacts on existing waste infrastructure to handle the waste appropriately;
• Impacts on terrestrial ecology (flora, fauna) through land take, habitat loss and associated construction and operation activities;
• Impacts on aquatic ecology (flora, fauna and fisheries);
• Potential impacts on social and economic resources;
  ○ fisheries resources
  ○ economy and livelihoods
  ○ transportation
  ○ impacts to vulnerable groups
  ○ impacts on existing infrastructure through people influx to the area
  ○ education and skills (through relocation of school)
  ○ demographic patterns (including physical and economic displacement and compensation); and
  ○ community health and safety
• Landscape and Visual Impacts.

10.2.2 *Further Studies recommended for the ESIA Study*

Based on the information identified in this scoping report, the following additional studies are recommended for the ESIA (***Table 10.2***).

Table 10.2 Studies Recommended for the ESIA

Assessment Parameter	Scope and Justification
Air Quality	• Air dispersion modelling for operation phase of the power plant to be conducted based on final Project design; emission rates of key pollutants, final site layout and emission control technologies and included in base and project model scenarios. All receptors within a 5 km radius of the Project site will be included in the air dispersion modelling study and will be extended if deemed to be required; • Qualitative Air Quality impact assessment will be conducted for LNG Receiving Terminal during operation; • Qualitative Air Quality impact assessment will be conducted for construction phase for key Project components.
Surface water quality	• Thermal discharge will be assessed for operation phase to assess cooling water discharge impacts; • Plume modelling will be conducted for cold water discharge from Regasification unit (if required, pending selected technology/ process/ design); • Sedimentation assessments will be conducted for LNG unloading jetty and sub-river bed pipeline during construction if dredging and piling is required; • Qualitative assessments to be conducted for drainage, surface run-off and erosion control.
Noise Levels	• Noise modelling for construction and operation phase to be updated based on final Project layout.
Soil	• Identification of potential sources and contamination pathways from proposed Project layout and natural features;
Terrestrial , Aquatic biodiversity and ecosystem services	• Undertake stakeholder consultation and surveys for aquatic and terrestrial biodiversity values within the Project area and Study area focused on species of conservation significance including major groups: mammals, herpetofauna, birds, fish and flora. • Undertake Natural and Modified Habitat mapping within the Project Area and Area of Influence. • Conduct an invasive species survey within the Project Area and Area of Influence. • Conduct an assessment of ecosystem services utilized by local people through targeted stakeholder interviews
Socio-economic, Health and Safety	• Stakeholder identification shall be updated to include all Project affected people based on final Project layout (and inclusion of stakeholders within areas if applicable); • Socio economic baseline information to be collected including: ○ Demographics ○ Incomes and livelihoods ○ Worker skills ○ Religions ○ Cultural traditions ○ Education ○ Health disease ○ Infrastructure and Services Information to be gathered from household surveys, interviews with key informants, stakeholder meetings and participatory workshops and secondary data sources. • Number of households to be physically/economically displaced to be determined.

Assessment Parameter	Scope and Justification
	Consultation and engagement with the Myanmar authorities will be required throughout this process to ensure that host country laws/practice are followed whilst taking into account all applicable standards. • Development of Stakeholder Engagement Plan.
Land use, River use and River Traffic	• Land use survey will be conducted as well as the stakeholder engagement (including household survey) to understand the current land use and river use (especially Yangon River) • Land use/ River use (including river transportation/ traffic and fishery activities) will be assessed, including required safety zone and safety operation for LNGC.
Waste Management	• Hazardous substance identification and management to be assessed; • Disposal sites and methods to be determined for hazardous and non-hazardous waste. Details of locations of waste disposal facilities for general and hazardous waste and suitable transport companies should be confirmed. This information should be confirmed with local authorities.
Infrastructure and Utilities	• Further details of the use of access roads during construction and operation to be included in assessing impacts to nearby sensitive receivers; • Access to amenities such as hospitals, education facilities to supplement baseline socio-economic surveys.
Health and Safety and Emergency Control	• Review of the Project Proponent Health and Safety Management Plan to assess its adequacy in meeting IFC Performance Standards and applicable guidelines; • Mitigation measures/ monitoring programme/incident response with regard to accidental events/ spills shall be communicated to the EPC Contractor at the early stage; • Emergency Response Plan will be prepared by the Project Proponent and assessed as part of the full ESIA study and shall include all key Project components: Ahlone CCPP , LNG Receiving Terminal and NG pipeline.
Landscape and Visual	• Sensitivity of the landscape and visual system within a visual envelope and their ability to accommodate change will be assessed based on available sources such as land use and development plans if available
Cumulative Impact Assessment	• Evaluation of cumulative impacts taking into account various types of interactions such as: ○ a combination of different types of impact at a particular location; ○ the interaction of different impacts over time; ○ the interaction between impacts from the proposed development and other projects in close proximity to the scheme; and ○ a number of impacts of the same type at different locations, which are not necessarily significant individually, but which collectively, may constitute a significant impact. Prediction and evaluation of cumulative impacts is not straightforward since it is not always possible to directly combine different types of environmental impacts on an objective basis. This is recognised in international good practice guidance; nevertheless it is still important that consideration is given to the issue.

10.2.3 Stakeholder Engagement

Stakeholder engagement is required for the ESIA Study. A first round of stakeholder engagement has been conducted in October 2018 to present the Project and the Scope of the ESIA study to the local communities and stakeholders within the study area. A second round of stakeholder engagement is planned towards February 2019, in which the results and key findings from the ESIA process will be presented to the relevant stakeholders, as well as the proposed mitigation measures and monitoring programme.

It is envisaged that engagement activities carried out in the ESIA Study stage will include consultations designed to further inform local stakeholders about Project design, obtain their key concerns and high level issues and to inform the development of mitigation measures for the Project. This consultation will enable the ESIA team to refine the ESIA analysis by generating additional feedback on the ESIA approach, key issues and analysis of potential impacts (such as assessment of their relative significance).

Consultation is likely to be carried out with the same stakeholders as for the first round of stakeholder consultation, with press release in national newspaper to inform of the consultations details ahead of the meetings.

10.2.4 Structure of the ESIA Report

An outline of the proposed contents of the ESIA Report is provided in ***Table 10.3*** which follows the the ESIA Procedure. It is important to note that the table of contents may be revised based on the requirements of the local Myanmar authorities.

An Environmental and Social Management Plan (ESMP) will be prepared to form part of the ESIA Report. The ESMP will present mitigation and monitoring measures, the content will follow the Administrative Instruction document. A Draft Emergency Response Plan will also form part of the ESIA report.

Table 10.3 Proposed ESIA Report Structure

Chapter Number	Contents Heading	Explanatory Note
	Cover Pages	Title page, acknowledgements, authors and contributors, table of contents (including lists of figures, tables, and maps)
1	Executive Summary	Summary of the entire ESIA report (both English and Myanmar language).
2	Context of the Project	• Presentation of the Project Proponent / Project developer • Presentation of the Environmental and Social Experts • Presentation of Project Background and Project Overview
3	Policy, Legal and Institutional Framework	• Corporate Environmental and Social Policies Policy and Legal Framework, including existing laws and rules, other related environmental law and rules, International Conventions, Treaties and Agreements, and international standards, guidelines • Institutional Framework • Project's Environmental and Social Standards
4	Project Description and Project Alternatives	• Project Background • Project Location, Project Overview including maps and site layout and PFD is available. • Project description during construction, operation and decommissioning of key Project components. • Description of Project Alternatives
5	Description of the Surrounding Environment	• Setting the Study Limits (Study Area) • Methodology and Objectives • Physical Components including topographic maps, water resources map, geology maps, soil maps hydrology / hydrogeology data and maps, environmental quality data and climate data • Biological Components including biodiversity maps, vegetation cover maps • Socio-Economic Components including land use maps, population distribution, maps of other socio-economic indicators • Cultural Components including maps with location of cultural, historical, and religious importance • Visual Components including landscape
6	Impact and Risk Assessment and Mitigation	• Impact Assessment Methodology • Identify potential physical, biological, social, socio-economic, cultural, health and visual impacts; this shall include identification of potential impacts on climate change such as greenhouse gas emissions, and identification of impacts of climate change on the Project based on available climate change predictions from designated national authorities or international scientific research bodies; and develop mitigation measures and assess Residual Impacts • Relevant maps in proper scale clearly indicating the location of sources of Adverse Impacts, images, aerial photos, satellite images, the areas, people, assets or features impacted, sensitive habitats, vulnerable areas or settlements and the nature of the impacts
7	ESMP	• Prepare comprehensive management and monitoring plans for all impacts including role and responsibilities and proposed budget when possible.
8	Cumulative Impact Assessment	• Methodology and Approach • Cumulative Impact Assessment

Chapter Number	Contents Heading	Explanatory Note
9	Public Consultation and Disclosure	• Purpose of consultation undertaken for Project • Methodology and approach • Summary of consultation • Summary of main comments received and how comments taken into account during ESIA process • Minutes of meetings
10	Conclusions and Recommendations	Presents the main conclusions of the ESIA Report and recommendations for future actions as well as commitment of the Project proponent.
Annexes		These will include technical annexes with details of specific technical surveys, and other required information.

APPENDIX OO ESIA STUDY TERMS OF REFERENCE

Findings	Comments	Location in Report	Addressed by
Lack of Project Commitments	According to EIA procedure paragraph (62) - To describe Project Developer Commitment that the project will at all times comply with the commitments, mitigation measures and plans in the EIA report. -To describe the commitment from EIA consultatnt that EIA has been prepared in strict compiance with applicable laws including the procedure and with TOR for the EIA. -Describe signed letter of endorsemet confirming the project commitments from both project proponent and EIA consultant.	Section 3.3.2, Table 3.2 Chapter 15	Added column for commitments in Section 3.3.2 Added Chapter 15 for Statement of Commitment.
Project descriptions	Decribe land ownership status of power plant area 8.97 acres.	Section 4.8.1.1	Inserted "EPGE is the landowner of the Power Plant area (8.97 acres) in Ahlone Township, Yangon. EPGE intends to lease the land to TPMC under a long term land lease agreement."
	To describe the coordinate of Power Plant, LNG receiving Terminal and Pipe Line.	Section 4.4, Table 4.1	Added table with coordinates for the Main Project Facilities

Findings	Comments	Location in Report	Addressed by
	LNG terminal layout (Figure 4.9 , page 114), Power Plant layput (Fig 4.38, page 182), power plant discharge location (Figure 4.41, page 191) shall be indicated by overlaying on satellite image.	Section 4.6.1.1, Figure 4.9: Layout of LNG Receiving Terminal Section 4.8.1, Figure 4.46: Power Plant Layout	Inserted LNG Receiving Terminal and Power Plant layout with map overlay
Water intake in yangon river with pontoon (page 186-7)	-To describe water intake coordinate. - To describe on satellite image	Section 4.8.1, Figure 4.46: Power Plant Layout	Inserted Power Plant layout with map overlay, also contains the coordicates for River Water Intake.
The main freshwater supply source will be taken from Yangon River. However, the use of surface water will be determined and assessed at the later stage to ensure no disruption to the local communities. The maximum intake requirement for the Project is expected to be 916 m3/hr. This is equivalent to approximately 0.83% of the lowest dry season flow in the river at the intake location.	- To describe the water flow yangon river in different season -To describe potential impact from project water intake on other Yangon river water users and mitigatio measures -To describe impact assessment on river transportation and mitigatin measure	Section 7.4.7.3 Section 9.4.7.3 Section 12.5.2.1 Section 12.5.2.3	According to secondary data, under section 5.1.5.1, discharge rates is <500m3/s in April and 7,000 m3/s in August Accoring to primary data, dry season measured highest 0.135 m/s, wet season measured highest 1.5 m/s According to socioeconomic baseline chapter 5 some some households use the Yangon river for domestic use, but very limited. Impact is negligible Mitigation measure added for limiting water intake from the Yangon river

Findings	Comments	Location in Report	Addressed by
Operatoin Phase -25 year 49 workers (page 739) AOI 5km CCPP		No Changes	No Changes
5.2.6 Utilities 5.2.6.1 Electricity (page 366) Power consumption for a regular household in this township is at 7 MW per day. Power consumption for business in this township is at 9.6 MW per day.	Power consumption per household data is relatively high. Please describe the data source.	Section 5.2.6.1	Amended text to "Monthly household energy consumption in Dala is approximately 455 kWh/month"
5.2 Socioeconomic Baseline Chapter 5, page 224,340,33 described AOI is determined 5km radius. However, social receptor are described only the villages in 3km radius of the project.	To describe social receptor within 5 km radius.	Chapter 5 Section 5.2.1	The text is amended to say 3 km, aligned with the study area map. 3km radius was considered for the social receptor because communities within 3km are the ones that will be directly impact from the project activities. Therefore, it is the best representative of the population from the area of impact. Air and noise modelling also indicate that there are no exceedances above the threshold beyond 3km.

Findings	Comments	Location in Report	Addressed by
Summary of Baseline Water Sampling Results(page 268-272)	- To describe reference standard of measured parameters-Water quality measured parameters are indicatd compare with Myanmar EQEG (1.2 waste water, effluent, sanitary discharges and storm water runoff). However, all the parameter of EQEG 1.2 was not compared. Please clarify.	Section 5.1.5.2 - Dry Season Survey; Wet Season Survey	Surface water sampling results were compared to the NEQG standards in the discussion.Parameters that exceeded the standards are further discussed.If any of the parameters are below the standard it is stated that "All other parameters were found to be within the Myanmar NEQG Standards, IFC Standards, and EPA Standards."Added NEQG term within the discussion text to better indicate the comparison is also made to the NEQG standards
5.1.10 Waste Wste generation data in Myanmar and Yangon are described.	To describe waste collection and disposal system in project area , Ahlone township.	Section 5.1.10	No secondary data is available for the waste disposal method in Ahlone Township. Additional secondary data for waste collection and disposal system in Yangon is inserted.
Aquatic ecology assessment (page 337) is based on secondary data (i.e ERM in-house databae)	To describe detail of Acquatic ecology data base (i.e data collected lcoation, time,.etc)	Section 5.1.11.7, Fauna, Fish	Updated Fish baseline

Findings	Comments	Location in Report	Addressed by
Surface water impact assessment Water intake requirements (construction) Prefabricated concrete activities are estimated to consume 40 m3 of water per day. All construction activities are estimated to consume 65 m3 of water per day. The maximum number of workers onsite during construction is anticipated to be 600 persons and each worker is estimated to consume approximately 33.3 litres of water per day148. The average water consumption rate during construction is anticipated to be 624 m3 per month (approximately 30 m3 (30,000 L) per day).The raw water required during construction will be obtained from the local water distribution services, and will be treated and purified before use for construction. Monitoring (p742) Monthly monitoring of water intake quantities and flow rates in the Yangon River. Water intake requirements (Opreation) The maximum intake requirement for the Power Plant is expected to be 605 m3/h (605,000 L/h). Yangon River flow ranges from <500 m3/s in April to 7,000 m3/s in August. Although the Yangon River will be the main source of water for construction activities, the water requirement for the Power Plant is	Page 741 : Although the Yangon River will be the main source of water for construction activities, the water requirement for the Power Plant is not expected to impact the communities' existing water usage; communities mainly use lakes, ponds, or stored rain water as a source of water, with limited intake of the Yangon River Comment : Construction phase water source information are conflict with each sections. To be amended with the impact assessment with actual water soruce. To describe brief about the water usage from other project near by and local communities.	Section 7.4.7.2 Section 8.4.7.2 Section 9.4.7.2	Amended construction water intake to align with Project Description

Findings	Comments	Location in Report	Addressed by
not expected to impact the communities' existing water usage; communities mainly use lakes, ponds, or stored rain water as a source of water, with limited intake of the Yangon River. (page 742)			

Findings	Comments	Location in Report	Addressed by
<u>Water intake requirements (Opreation)</u> The maximum intake requirement for the Power Plant is expected to be 605 m3/h (605,000 L/h). Yangon River flow ranges from <500 m3/s in April to 7,000 m3/s in August. Although the Yangon River will be the main source of water for construction activities, the water requirement for the Power Plant is not expected to impact the communities' existing water usage; communities mainly use lakes, ponds, or stored rain water as a source of water, with limited intake of the Yangon River. (page 742)			No comments

Findings	Comments	Location in Report	Addressed by
Page 189 Water treatment system9.4.7.4 Demineralized Plant Neutralized Water Discharge (Operation Phase)Discharge of neutralized water may elevate the amount of nutrients in the water, which may cause contamination, or secondary impacts such as increased algae growth.The approximate quantity of neutralized water is 20 m3/hr; this amount is considered relatively low, compared to the flow the Yangon River, which is approximately <500 m3/s in April to 7,000 m3/s in August.Mitigation / Management MeasuresThe significance of impacts is rated as Negligible, and no additional mitigation is considered necessaryprovided that existing/in-place controls are appropriately implemented.Monitoring PlanNo monitoring plan is required.	Describe treatment system of Demineralized Plant Neutralized Water before discharging to meet the waste water quality as per EQEG 1.2 Wastwater. Describe monitoring plan.	Section 9.4.7.4	Inserted "Discharge waste water quality will meet with IFC EHS guildline for Thermal Power Plant, pH, Temperature and Conductitiy. Discharge will also follow the NEQG 1.2 Wastewater Standard. Online measurement will be used to measure waste water quality before discharge to the Yangon River."

<table>
<tr><th>Findings</th><th>Comments</th><th>Location in Report</th><th>Addressed by</th></tr>
<tr>
<td>9.4.7.5 Thermal Discharge (Operation Phase) (page 746)

'-the power plant will be utilising a closed cooling water system using cooling towres (page 186)

-The amount of cooling water discharge is approximaterly 210m3/hr (page 745)

-Cooling tower blowdown : 210 m3/hr (intermittent) (page 204)</td>
<td>- Describe deatil of cooling water system,
-Describe if there is treatment of cooling tower blowdown before discharge to Yangon river
-Describe frequency of blow down water discharge
-Describe expected water quality of blowdown water</td>
<td>Section 9.4.7.5</td>
<td>Inserted additional information
<table>
<tr><th colspan="2">Main cooling Water Specification</th><th>Maximum (3 cycle)</th><th>Average (3 cycle)</th></tr>
<tr><td>Turbidity</td><td>NTU</td><td>30</td><td>30</td></tr>
<tr><td>TSS</td><td>mg/l</td><td>45</td><td>30</td></tr>
<tr><td>pH value</td><td>-</td><td>6.0-9.0</td><td>6.0-9.0</td></tr>
<tr><td>Silica</td><td>mg/l as SiO_2</td><td>148</td><td>32</td></tr>
<tr><td>Total hardness</td><td>mg/l as$CaCO_3$</td><td>7633</td><td>1822</td></tr>
<tr><td>hloride</td><td>mg/l as Cl^-</td><td>19790</td><td>4659</td></tr>
<tr><td>Sulfate</td><td>mg/l as SO_4^{2-}</td><td>2323</td><td>705</td></tr>
<tr><td>Total Iron</td><td>mg/l as Fe^-</td><td>0.3</td><td>0.3</td></tr>
<tr><td>Conductivity</td><td>µs/cm</td><td>53498</td><td>13643</td></tr>
<tr><td>M-Alkalinity</td><td>mg/l as $CaCO_3$</td><td>408</td><td>240</td></tr>
<tr><td>Ca-Hardness</td><td>mg/l as $CaCO_3$</td><td>4238</td><td>993</td></tr>
<tr><td>Free Chlorine</td><td>mg/l as Cl_2</td><td>0.2</td><td>0.2</td></tr>
</table>
</td>
</tr>
</table>

Findings	Comments	Location in Report	Addressed by
The amount of cooling water discharge is approximately 210 m3/hr. The most critical scenario for the Power Plant involves high ambient velocity, high ambient temperature, and large depth. The < 3°C excess temperature requirement for the Power Plant is met approximately 4.2 m downstream (in the direction of ambient flow) and 0.6 m across the width of the Yangon River; therefore, the IFC temperature standard for excess temperatures below 3°C within 100 m from the discharge point is met. (page 747) International Finance Corporation (IFC) water quality standards were applied as a basis for evaluating potential environmental impact to the Yangon River. The standard limits thermal discharges by the temperature increase in the receiving waterbody; specifically, temperatures cannot exceed 3°C within a spatial region 100 meters from the discharge point. This standard was modified for analysing the cold water discharge not exceeding a 3°C reduction in background temperature 100 meters from the point of discharge. An estimate of the TPMC Power Plant's maximum thermal loading to the Yangon River results in a 10.7 °C increase above ambient temperatures during the warmer summer months (based on Yangon River temperature of 31.3°C) and a 16.9°C increase above ambient temperatures during the cooler winter months (based on a Yangon River temperature of 25.1°C). (page 746)	According to EQEG 2.11 Thermal Power, disharge water Temperature increase should not exceed +3°C of ambient water temperature. -Describe temperatur control system of dischareg water -Effluent temperature rise : summer 10.7 °C , winter 16.9 °C -Effluent temperature :42 °C	Section 7.4.7.5 Section 9.4.7.5	For LNG Receiving Terminal - inserted "...therefore, the effluent is does not exceed the NEQG 2.1.8 Natural Gas Liquefaction Standard of not more 3°C temperature change beyond 100 meters from point of discharge." For Power Plant - inserted "therefore, the effluent is does not exceed the NEQG 2.1.1 Thermal Power of not more 3°C temperature change, which is achieved 4.2 meters beyond the discharge point. A 4.2 meter mixing zone for the temperature to reduce below 3°C difference is considered insignificant. The Power Plant will also utilize a closed cycle cooling system, to reduce discharge temperatures as best as practicable."

Findings	Comments	Location in Report	Addressed by
Thermal Plume modeling (appendix R)Table 2.2: Power Plant Scenario DefinitionsFigure 3.1: Mixing Zone Resulting from Power Plant Scenario 8 CriticalConditions	Project detail design may not be finalized when EIA assessment prepare . Therefore, thermal plume input data such as outfall lcoation, depth, discharge flowrate) might be assumption. To do the validation of thermal plume modeling after finalization of power final engineering design and opreation.	CORMIX Modelling Report - Appendix R	Amended figure 6 in CORMIX Appendix

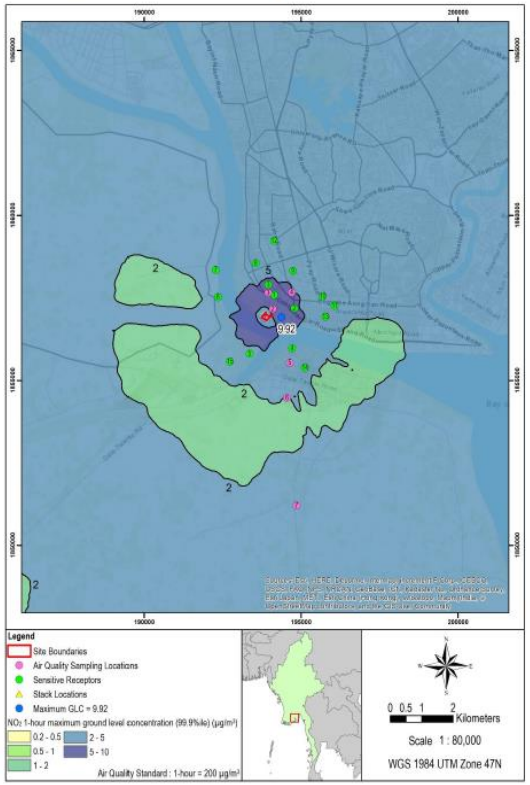
Findings	Comments	Location in Report	Addressed by
<u>Power Plant Construction Waste</u> Opportunities for providing biomass waste to the local community will be explored or biomass waste will be disposed of by an appropriate or a licensed waste contractor. (page197) The hazardous waste from chemical cleaning will be transported off-site to the appropriate or licensed Hazardous Waste Treatment facilities, available in Myanmar. Solid hazardous waste from the construction phase will be properly contained and transported off-site to an appropriate or licensed waste disposal contractor.([page 198) The hazardous wastewater from chemical cleaning will be transported off-site to the appropriate or licensed Hazardous Waste Treatment facilities, available in Myanmar. Solid hazardous waste from the construction phase will be properly contained and transported off-site to an appropriate or licensed waste disposal contractor. (page 199) Sewage will be treated in a package sewage treatment and discharged into the wastewater discharge system to the North West side of the Project site. The sludge will be dewatered and disposed off-site by an appropriate waste contractor. (page 204) Hazardous waste (page 766-769)	- Describe tentative waste/hazardous waste licensed contractor. -Describe detail system of waste collection, storage system at site, transport to final disposal site for both construction and operation phase -Describe waste collection and storage facilities location on site layout. -Describe operation phase hazardous waste management plan. -Describe operation phase estimated sludge volume and final disposal plan.	Section 4.8.2.11 Section 4.8.3.4 Section 12.8.2.2	Inserted "The waste will then be disposed in designated disposal areas provided by the YCDC Pollution Control and Cleansing Department" Cross reference with the section discussing TPMC's Waste Management Plan. Added more information on TPMC's WMP in Section 12.8.2.2

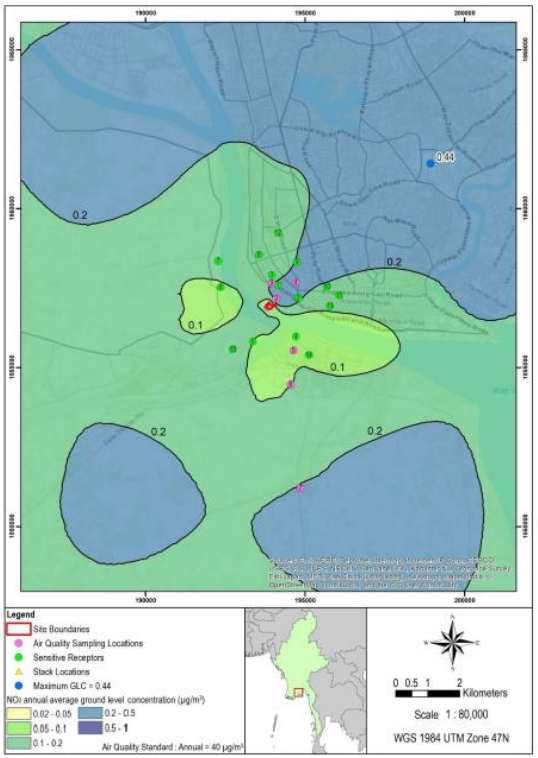
Findings	Comments	Location in Report	Addressed by
during operation phase of the Power Plant, it is anticipated that there will be generation of sludge from operational processes. However, the volume of this sludge waste is unknown at this time. TPMC will assign a local waste contractor to dispose these waste responsibly.(page 769)			

Findings	Comments	Location in Report	Addressed by
<u>Air Quality impact assessment for LNG power plant (Appendix Q)</u> Discharge emission to air will occur continuously from the 2x117MWth power plant. A study area of 10km x 10km is used in this AQIA to ensure the spatial extent of the plume and the resulting worst-case ground level concentrations are suitably considered. (page 20) The dispersion model used in the assessment was the latest USEPA AERMOD dispersion model version 18081 released in April 2018. Meteorological data representative of the study area is crucial for supporting the detailed dispersion modelling assessment. Following IFC recommendations, three to five years of data is necessary in order to capture year on year variability. Hourly sequential meteorological data is required for wind speed; wind direction; precipitation; relative humidity; temperature; and cloud cover. A meteorological station at Yangon Airport, approximately 15 km north-northwest of the power plant location, was identified as having sufficient data availability for all parameters. Three years (2015-2017) of meteorological data was sourced from the site and used to inform the dispersion model. -Stack height =2 * 40m	Page 99 : Project description mentioned that 128.5MW two gar turbine will be used in project. AERMOD model was calculated with 2 x 117MWh gas turbine. To do the air dispersion modelling based on actual gas turbine capacity. -To clarify whether air dispersion modeling is considered the emission from TPMC 120MW and MOEE's 154.2 MW existing power plants.	No changes	Modelling was undertaken based on an emission inventory provided by TTCL. ERM assumes that the data provided was and is representative of the latest Project design. 128.5 MWh is installed capacity; however, 2x117 MWh is calculated based on actual gross gas turbine capacity

Findings	Comments	Location in Report	Addressed by
Cumulative impact assessment11.4 Other projects and External Drivers11.4.1 Other projects11.4.1.1 Existing Power PlantThere is an existing 120MW natural gas power plant located within the project site boundary currently operated and owned by the project proponent. The existing CCPP started its operation in April 2013 and is comprised of 2 Combined Cycle Gas Turbine (CCGT)	- Page 847 CIA for air quality was not mentioned the air quality impact from existing 120MW power plant. To do the assessment and describe.- CIA was not considered the effluent discharge (wastewater) from existing 120MW power plant. To do the assessment and describe.-To describe the water quality impact assessment in Yangon river due to the combined water discharge from existing 120MW and new proposed power plants.	Section 11.6, Table 11.3	Information on the existing 120MW power plant was not available at the time of modelling. The methodology assumes that existing emissions are captured in the baseline, thus a cumulative assessment of existing and proposed emissions has already been conducted.Inserted existing power plant into assessment for air quality and surface water

Findings	Comments	Location in Report	Addressed by
Table 9.4: Summary of Power Plant Modelling Results Substance | Averaging Period | Baseline[a] (µg/m³) | Max. PC[b] (µg/m³) | Max. PEC[c] (µg/m³) | AQS[d] | Significance of Impact NO_2 | 1-hour | 170 | 9.92 | 180 | 200 | Negligible Annual | 24.6 | 0.0446 | 25.0 | 40 | Negligible [a] *Refer to the baseline assessment in the air quality impact assessment presented in Appendix Q.* [b] *Process Contribution is the impact arising solely from project related emissions* [c] *Predicted Environmental Concentration is the PC added to the existing baseline* [d] *Air Quality Standard as prescribed in the National Environmental Quality (Emission) Guidelines (NEQEG) (2015)*	Power plant modeling results on page 680-681 described only for Project Contribution (PC), to describe PC+ baseline (PEC) with image showing spatial distribution for NO2 distribution	No changes	The assessment provides an assessment of the PC against the IFC 25% threshold and the contour maps demonstrate the spatial distribution of the emission from the Project based on worst case met hour/year. The baseline concentration assumes a single worst case value and does not vary in space and time. This approach is taken to estimate a worst case upper limit for comparison the ambient air quality standard. For this reason contour maps to include the baseline are not included. The spatial distribution can be visualized from the current contour maps.

Findings	Comments	Location in Report	Addressed by
Figure 9.1: Power Plant Modelling Results (NO_2 1-hour Average) 	- To clarify and describe whether air quality baseline data collections is cover emission from **existing 120 MW natural gas power plant by Toyo thai power myanmar Co.,Ltd**	No changes	Information on the existing 120MW power plant was not available at the time of modelling. The methodology assumes that existing emissions are captured in the baseline, thus a cumulative assessment of existing and proposed emissions has already been conducted.

Findings	Comments	Location in Report	Addressed by
Figure 9.2: Power Plant Modelling Results (NO_2 Annual Average) 	- As per modeling results described in page 680-681, to describe causes of increasing NO2 concentration at the place far from project	No changes	Areas of relatively higher terrain experience higher ground level concentrations due to plume impaction on the hill. Please refer to updated contour and terrain map and note the correlation between the point of maximum impact and terrain. Also note the wind rose provided in the report (Section 5.1.2.4). The prevailing winds blow from the south west, resulting in maximum annual mean ground level concentration to the northeast of the site.

Findings	Comments	Location in Report	Addressed by
10. BIODIVERSITY IMPACT ASSESSMENT **Table 10.7: Natural Habitat and Modified Habitat within the AoI and Project Area (LNG Terminal, Pipeline, and Power Plant)** A total of 3.02ha will be cleared during construction and operation. The habitat will be agricultural land classes that are considered to be Modified Habitat. An area of 200 square metres will be impacted that is considered to be natural habitat. (page 829)	- To describe position of vegetation cover clear by project with image and describe the clearance location on google earth image - If mangrove forests near project area will clear, to describe reforestation program as mitigation measure	Section 10.3.2.3	Mangrove area located at the edge of the Power plant boundary. It is anticipated not necessary to clear. Amended assessment to "A maximum area of 200 square meters will be impacted that is considered to be natural habitat; however, no mangroves will be cleared."

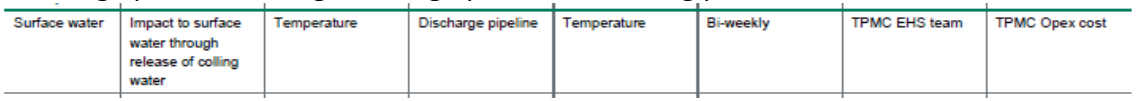
Habitat Type	Project Area (ha)	Habitat Type
Natural Habitat	3.05	1028.16
Modified Habitat	55.73	7457.86

Findings	Comments	Location in Report	Addressed by
9.8.6 Impacts to Traffic and Transportation The following mitigation measures to reduce construction phase traffic impact as per below: Mitigation Measures The following mitigation measures will need to be implemented during the construction phase of the Power Plant: - TPMC will not transport equipment and materials during the local traffic peak time. - TPMC will develop and implement a Stakeholder Engagement Plan as part of the Project. The plan should include measures to notify local stakeholders in advance of any particularly activities on or near local road. This will ensure that stakeholders can anticipate and can appropriately respond to the change and limitation of uses on local roads. The Project should also develop a Grievance Mechanism to collect grievances from local stakeholder whose regular transportation is affected by the Project activities. Monitoring Plan - TPMC will need to monitor the grievance log weekly during construction to identify any specific grievance related to traffic and transport activities.	- To specify and describe prohibited period of transport for construction phase equipment and materials - To describe Stakeholder Engagement Plant and Grievance Mechanism - Traffic congestion situation near project site and along the way of transport caused by construction phase transport equipment and materials, described as monitoring procedure will monitor every 4 months (page 922). To perform daily record for monitoring procedure during construction	Section 9.8.6 Section 12.5.2.3	Inserted peak traffic time. Inserted "Prior to transportation of Construction phase material & equipment to site, TPMC will inform proposed transportation route and schedule to Yangon Regional Government and will transport within permitted date and duration.".

Findings	Comments	Location in Report	Addressed by
7.9 Unplanned Event Impact AssessmentPage 809-823- Mitigation measures were described related with impacts occur from unplanned events such as chemical spill or leak, fire and explosion, tropical storm and extreme weather conditions and loss of containment of chemical storage	- Although Emergency response plan , typhoon response plan and typhoon evacuation plans as of mitigation measures for impacts occur from unplanned events was described but not yet attached, to attach and describe	Section 12.8.2.5Appendix EE	Inserted description and appendix for Typhoon Response Plan
9.8.9 Impacts on Community Health and Safety (page 797-802) Mitigation measures in order to reduce impacts on community health and safety were performed as described: - Emergency Prevention, Preparedness and Response Plans (EPPRPs) - Waste Management Plan - Traffic Management Plan - Stakeholder Engagement Plan - Community health and safety monitoring and surveillance programme	In current EIA report, described as management plans will implement but not yet attach. That's why please describe following plans as below: - Emergency Prevention, Preparedness and Response Plans (EPPRPs) - Waste Management Plan - Traffic Management Plan - Stakeholder Engagement Plan - Community health and safety monitoring and surveillance programme	Section 12.4	Added SEP in the Appendix Added cross-reference

Findings	Comments	Location in Report	Addressed by
Page-885- Construction Noise (Transportation and operation of workers, equipment and machineries Avoid transportation of materials on- and off-site through existing community areas. **<u>Noise Impact Assessment (page 709)</u>** As per baseline study, described as noise level near project area was exceeded EQEG. It is acknowledge that noise level will exceed EQEG during construction phase and operation phase as per modelling results. As of mitigation measures in order to reduce noise impact , Noise barriers should be installed at the site boundary (facing the closest NSRs) and high enough which completely hides the noise sources from the NSR. It is anticipated that at least a 10 dB(A) noise reduction can be provided. The noise barrier material should have a superficial surface density of at least 7 kg/m2 and have no openings or gaps.	To describe transportation route for workers, equipment and machineries during construction (satellite image) As per mitigation measures, Noise barriers will install to reduce noise impact during construction phase and operation phase. To be calculated and described noise level on project nearby houses and power plant compound for construction phase and operation phase	Section 4.8.2.8	Transportation route inserted
Page 894 - It was described that mitigation measures were not necessary to perform for impact to surface water (Operation of demineralized plant neutralized water, Operational Thermal Discharge)	To be disposed water into river after performing treatment and quality analysis in accordance with EQEG 2.1.1 thermal power disposal quality standard for all water from plant into Yangon River	Section 9.4.7.4 Section 12.5.2.3	Inserted mitigation measure "Discharge waste water quality will meet with IFC EHS guildline for Thermal Power Plant, pH, Temperature and Conductitiy, as well as NEQG 1.2 Wastewater Standard, before discharge."
Power Plant Monitoring Plan			

Findings	Comments	Location in Report	Addressed by
- Stack emission monitoring included in air quality monitoring plan but not included for ambient air quality monitoring (monitoring in the surrounding sensitive receptor areas). To describe monitoring locations by choosing sensitive social receptors near project and also describe on satellite image *Operation Phase* Air Quality | Impact to air quality due to operation emissions | Stack emissions | Stack | NOx | Yearly | 3rd Party Environmental Consultant | TPMC Opex cost (Approx ~5000 USD / time)		No changes	IFC recommendation continuous monitoring offsite would be required for large thermal power projects and/or those that result in concentrations that are >25% of the AQ standard. There is therefore no requirement in this instance.The IFC Thermal Power Guideline Table 7 states "If incremental impacts predicted by EA <25% of relevant short term ambient air quality standards and if the facility < 1,200MWth but >/= 100 MWth - Monitor parameters either by passive samplers (monthly average) or by seasonal manual sampling (e.g., 1 weeks/season) for parameters consistent with the relevant air quality standards."
- To describe noise monitoring locations and describe on satellite image Noise | Impact to ambient noise level | Noise from operation activities | Nearest NSR | Decibels | Yearly | 3rd Party Environmental Consultant | TPMC Opex cost (Approx ~2000 USD / time)		Section 12.5.2.6	Revised location text and inserted cross ref to noise samplping location during baseline survey

Findings	Comments	Location in Report	Addressed by
- When performing surface water monitoring, all of the parametersas per EQEG 2.1.1 thermal power have to monitor and monitoring location shall be at upstream and downstream of discarhge point including discharge point. Monitoring plan shall be amended.  Surface water | Impact to surface water through release of colling water | Temperature | Discharge pipeline | Temperature | Bi-weekly | TPMC EHS team | TPMC Opex cost		Section 12.5.2.6	Inserted parameters as per NEQG 2.1.1 standards
<u>Surface Water (Contamination of surface water) Construction phase water quality monitoring parameters Page (911-912)</u> pH, Electrical Conductivity, Biochemical, Oxygen Demand, (BOD), Chemical Oxygen Demand (COD), Total Nitrogen, Total Phosphorus, Oil & Grease, Total Suspended Solids(TSS), Total Coliform Bacteria (TCB), Total Chromium (Cr), Copper (Cu), Iron (Fe), Zinc (Zn), Lead (Pb), Cadmium (Cd), Mercury (Hg); Arsenic (As).	When performing construction phase water quality monitoring, to be measured all the parameters as per EQEG (1.2) wastewater, effluent, sanitary discharges and storm water runoff	Section 12.5.2.4 Section 12.5.2.5 Section 12.5.2.6	Amended to "Parameters as per NEQG 1.2 Wastewater, Effluent, Sanitary Discharges and Storm Water Runoff"

Findings	Comments	Location in Report	Addressed by
<u>Public Consultation (page 955)</u> Question: What kind of CSR activities will contribute to local? Answer: We are going to implement our CSR program with the collaboration from local level. Question: If project affect the paddy field people should receive fair compensation. Answer: Company will be responsible for every impact occurred by project activities during construction and operation phase. Company will compensate fair amount of compensation.	- CSR plan and budget plan to be described - To be describedif if land acquisition is rquried for project. If required , to be attached land acquistion plan	Section 3.3.2 Section 12.8.4	Inserted CSR Activities in section 12.8.4 Inserted "Yangon Regional Government formed a land acquisition committee composed of nominated individuals from relevant government departments. This committee will lead the land acquisition and compensation process for the land required for the Project's pipeline"
General			
As of project, to be described is there any activity to get ISO 14001-complaint and certified Environmental Management System (EMS)		Section 3.5.8	TTCL currently hold the ISO 14001 certificate.
Disclosure EIA Report In EIA Procedure (2015) sub-section 65 **"Not later than fifteen (15) days after submission of the EIA Report to the Departement, the Project Proponent shall disclose the EIA Report to civil society, PAPS, local communities and other concerned stakeholders: (i) by means of national media (i.e. newspapers); (ii) the website(s) of the Project of Project Proponent; (iii) at public meeting places (e.g. libraries, community halls); and (iv) at the offices of the Project Proponent."** So, it is necessary to disclose EIA Report to public.If already disclos, to be described disclosure method, places, etc.		Section 13.5	Add " In addition, since September 19, 2019, the full ESIA report has been available for public access on the Project Proponent website at the following address: https://www.ttcl.com/news/activities/view/113. The report is published in English with executive summary in Myanmar language."

Findings	Comments	Location in Report	Addressed by
In revised EIA Report shall include change log with table- When resubmit this report after revised as per apprisal comments, to be attahed change log table as one appendix. Change log shall includeSection, sub-section, appraisal comment, ammendment (or) clarification, revised report's cover page		Appendix PP	Inserted as appendix
To describe project commitment list by collecting legal commitments, environmental and social impact reduction commitments that will follow by project		Section 3.3.2, Table 3.2	Added column for commitments

Sr. No	Findings	Comments	Location in Report	Addressed by
1	Executive Summary			
(a)	In section 1.5, it is stated that the pipeline will cross the Twante Canal and Yangon River, providing Fig 1.2.	To label the Twante Canal on Fig 1.2.	Section 1.5.3 Section 4.7.1	Inserted new figures Inserted cross reference to figures in Section 1.5.3.1
(b)	While reviewing the pipeline on Google Earth with the aid of kmz file submitted by the proponent, it is observed that the pipeline route cross some buildings in some places	To update the pipeline route.	Section 1.5.3.1 Section 4.7.1	Inserted map with coordinates
(c)	In section 1.5, with regards to Hydrostatic Test, some information was provided just for N.G pipeline but no information for LNG storage tnaks, Pipelines connecting from unloading arm to LNG storage tank, from which to BOG Recondenser, from which to Regasification Unit and Water Discharge Pipelines.	- To specify components where hydrostatic test needs to be carried out. - To update data in Chapter (4) and Impact Assessment Chapters.	Section 1.5.3	Add "There will be no chemical inject in hydrotest water. Fresh Water will be outsource."
(d)	In section 1.5 of Executive Summary (Myanmar Version), sign post with Myanmar Version, which will be installed along the pipeline should be provided.	To provide informations of sign posts of Myanmar verison in this section.	Section 1.5.3.1 Section 4.7.1.6	Inserted translated sign post design
(e)	In sectin 1.5.2, location of LNG Receiving Terminal needs to be decribed in terms of coordinates.	- To provide coordinate points of the location of LNG Receiving Terminal. '- To include map on which LNG Receiving Terminal, its surrounding AOI and distances are described with label/legend.	Section 1.5.1 Section 4.4	Inserted coordinates of LNG Receiving Terminal
(f)	In section 1.5.2.2, **Construction of LNG Receiving Terminal**, the followings are stated: - Earthworks will include clearing of vegetation and grading of the Project site. - The subsoil will be stripped and removed from the	- To provide information of vegetable to be cleared such as type of vegetable and area of vegetation - To provide the volume of subsoil to be stripped and removed from the project	Section 1.5.2.2	Water usage and sourcing added

Sr. No	Findings	Comments	Location in Report	Addressed by
	Project site and it shall be utilised for levelling/ backfilling; the amount of fill material required is 100,000 m3.	site. - To clarify that fill material from the outsides of projects will be used or not and if used, provdie detail informations. - To provide informations of water consumption during construction period.		
(g)	In section 1.5.2.2, **Supporting Facilities**, it is stated that LNG Receiving Terminal Construction Area consists of Laydown Area and Construction Camp.	To include layout plans respectively.	Section 1.5.2.2 Section 4.6.2.8	Added laydown area figure
(h)	In section 1.5.4, **Power Plant**, it needs to provide not only a map on which the proposed power plant and its vicinity can be clearly seen but also coordinate points of the location of the proposed power plant.	To include Fig (4.43) in this section, updating it by inserting distances To provide the coordinate points for the locations of the proposed power plant and existing power plant	Section 1.5.4.1	Power Plant layout inserted in executive summary
(i)	In section 1.5.5, tentative schedule was provided but out of date.	To update tentative schedule not only in this section but also in relevant sections.	Section 1.5.5Section 4.5.1	Project Schedule updated
(j)	In section 1.5.7.1, it is started that there were three (3) LNG Receiving Terminal locations that were considered.	To include map with these locations.	Section 1.5.7	Figure inserted
(k)	In section 1.5.7.2, it is stated that two (2) routes for the piplines were initially considered	To include map representing the two routes for the pipline	Section 1.5.7	Figure inserted
(l)	In section 1.6.1.10, it is stated that three (3) Key Biodiversity Areas are located within 30 km from the Project Site and one (1) protected area lies within 50 km of the Study Area.	To include a map of these areas in this section together with the description of distances on it.	Section 1.6.1.10. Protected Area Section 5.1.11.4	Revised and Inserted figure
(m)	In section 1.6.1.8, the EIA report states as follow; -Potential sensitive visual receivers are located nearby the LNG Receiving Terminal, such as Thet Kei Kwin (1.2 km, northwest), - and Shan Kaw (1.6 km, west) villages.	- To provide amount of agricultural land which is located within the AoI of LNG Receiving Terminal - To include a map of villages within the vicinity of LNG Receiving Terminal,	Section 1.6.1.8 Section 5.1.11.7	Section 1.6.1.8 add size of agricultural land from LAP for LNG and Pipeline (new route); inserted map of nearby villages

Sr. No	Findings	Comments	Location in Report	Addressed by
	- The area along the pipeline alignment will mainly consist of agricultural land and small villages. - Land allocated for the Power Plant currently consists of grasslands and small patches of mangrove, and is currently surrounded by the existing Power Plant and the Ahlone Shipyard.	describing distances respectively. - To provide amount of agricultural land which is located within the AoI of pipeline route - To include a map of villages within the vicinity of the pipeline route - To include a map of villages within the vicinity of the proposed power plant, the existing power plant and the Ahlone Shipyard - Not only to provide the amount of grasslands and patches of mangrove but also to clarify that they will be cleared or not		to the LNG Receiving Terminal and Pipeline. The Power Plant is located in Ahlone Township, which is already surrounded by nearby residential areas that are not classified as villages. Updated Figure 5.33 in section 5.1.11.7 No mangroves will be cleared.
(n)	It is suggested to include the followings in section 1.7: - To provide the estimated amounts of GHG Emission, non-hazardous wate and hazardous waste for each construction phase and each operation phase - To provide the amount of energy consumptions during each construction phase - To summarize the most significant impacts and potential risks and residual impacts		No Changes	GHG emission amount and hazardous/non-haz waste does not fit into section 1.7 Impact significance is already summariazed
(o)	In section 1.88, there is no description of budget allocation for EMP implementation, Environmental Monitoring and CSR Activities	To specify budget allocation	Section 1.8.4 Section 12.8.3	Inserted ESMP Budget
(p)	In section 1.9, no information for Grievance Mechanism	To provide Grievance Mechanism briefly	Section 1.9	Create section 1.9.3 with summary context of Grievance Mechanism and cross ref to section 13.6

	Findings	Comments	Location in Report	Addressed by
2	**Regulation, Law and relevant framework of Organization**			
A	Although there is complete description about some Laws of Myanmar existing Laws related to the Project, the repealed Laws are also mentioned (E.g The Forest Law 1992)	The Project Owner and EIA Consultants are suggested to revise folowing, - Not to mention repealed Law and un-related Law with the Project(To refer General Attorney Officie website https://www.mlis.gov.mm if required in relation with Laws)	Section 3.3.2	Updated laws
B	In Section (3.4.6) Summary of Applicable Standards and Project Commitment, it is analyzed that althought Article 56, 95, 97, 98 of EIA Procedure was mentioned, there is no mention about commitment as per EIA Procedure Article 62.	As per EIA Procedure Article 62, the following is required to confirm - the accuracy and completeness of the EIA - that the EIA has been prepared in strict compliance with applicable Laws including this procedure and with ToR fir the EIA and - that the Project will at all times comply fully with the commitments, mitigation measures and plans in the EIA Report	Section 3.3.2	Inserted Project commitments

	Findings	Comments	Location in Report	Addressed by
C	Some International Standards ans Guidelines related to Project was mentioned in Section (3.5), it is analyzed that others International Standards and Guidelines related to Project as of IFC EHS Guidelines for Shipping (2007) were not mentioned.	The others International Standards and Guidelines as of IFC EHS Guidelines for Shipping (2007) are required to be mentioned.	Section 3.5.5	Inserted IFC EHS Guidelines for Shipping
3	**Project Description and Alternatives**			
A	It is analyzed that although Dala, Thanlyin and Kyauktan was mentioned in Section 4.3.2, Fig.4.4 Location of LNG Receiving Terminal, there is no mention of Villages, Streams near LNG Receiving Terminal.	To mention the map visible the surroundings of LNG Receiving Terminal (including streams/villages) with Label/Legend and distance	Figure 4.4	Update map (Figure 4.4)

	Findings	Comments	Location in Report	Addressed by
B	Although Section (4.6.1.2), LNG Unloading Jetty Description describe the size of Jetty, it is analyzed that the distance between Jetty and LNG Terminal, the depth of Yangon River of Jetty Area, width of Yangon River, the distance between Jetty and the shoreline of Kyauktan are required to be mentioned.	- To mention location of LNG Receiving Terminal and Jetty by Latitude, Longitude. - To mention the depth of Yangon River of Jetty Area, width of Yangon River - To mention Satellite Map including Jetty and Vessel Traffic of Yangon River with proper scale	Section 4.6.1.2	Inserted following information
C	In Section (4.6.3), Detail Site Specific Plan related to Soil erosion management, Traffic Management, Storn Water Pollution Prevention Plan, Dust Prevention Plan, Environmental and Social Management Plan, Waste Management Plan will be distributed to all contractor prior to commencement of work.	It is required to mention site specific plan that will be implemented during construction stage of LNG Receiving Terminal with Appendix	Section 12.4	Inserted management plan index

	Findings	Comments	Location in Report	Addressed by
D	The following description is analyzed in Section (4.6.2.3) Earthwork, "Considering no soil will be excavated, and additional fill soil is required for site elevation, the addition fill soil will be provided by a local supplier in Myanmar."	To mention the location to be taken of Additional Fill Soil (100,000 m3) with Satellite Map.	Section 4.6.2.3	Amended to 80,000 Inserted sand scouring and appendix ref
E	it is analyzed in Section (4.6.2.9) Jetty Construction that LNG Spill Pit will be placed	To mention the location of LNG Spill Pit and other Waste Pit with Map (or) Layout Plan.	Section 4.6.2.9	Inserted spill pit locations

	Findings	Comments	Location in Report	Addressed by
F	it is analyzed in Section (4.6.2.12) Construction Waste that Solid Waste, Wastewater, hazardous Waste will be produced during Construction Phase.	- To mention the produced wastewater amount from Cement wash down, other plant cleaning/rinsing efflucents, vehicle maintenance and the mixing of oils/lubricants in the wastewater and management method. - To mention the storage location of Hazardous Waste produced during Construction Phase and disposal plan	Section 4.6.2.12	Inserted non-hazardous and hazardous waste storage area Added reference to WMP
G	It is analyzed in Section (4.6.3.10) Operational Wastewater and Cold Water Discharge that although the produced amount is mentioned during Operation Period, the disposal location was not mentioned.	To mention the discharge point of produced wastewater and coldwaterduring operation period of LNG Receiving Terminal.	Section 4.6.3.10	Inserted "During maintenance, oils and lubricants will be collected in sump pits and later pumped into small storage drums to be disposed by a licensed waste contractor."

	Findings	Comments	Location in Report	Addressed by
H	The discharged cold water inlet-outlet temperature difference is mentioned 10Deg.C in Section (4.6.3.10) Table 4.21, it is over than guideline value (a temperature change change of no more than 3Deg.C) of IFC EHS Guidelines for LNG Facilities.	To be re-analyze . Parameter exceeds the Guideline Value.	Section 4.6.3.10	Revised text in table to say "1,300 m3/h (Difference in temperature between discharged cooling and river water is 10 °C (only at discharge point))" According to NEQG 2.1.8, it states to use 100m from the point of discharge to as the maximum distance for ≤3 degree C of temp difference. The CORMIX modelling and IA assess this and found that the temperature difference is reduced to ≤3 degree C, 9.06 m from the discharge point
I	The following description is analyzed in Section (4.6.3.11) Storm Water, "uncontaminated storm water will be discharged offsite into the small water channel discharge point to the North West side of the Project Site" Even though The estimated amount of discharge storm water is shown in Table 4.2.1, it is analyzed that ther is no mention in Table 4.2.1.	- To mention discharge point of Storm Watere - To mention the amount of discharged Storm Water	Section 4.6.3.11	Storm water will discharge to Yangon river through overflow pipe installed at final pit.

	Findings	Comments	Location in Report	Addressed by
J	The following description is analyzed in Section (4.6.3.12) Gas Engine Generator, "The four GEGs will operate continuously to generate electricity for in-house operations. The GEGs will use BOG that is generated from storage tanks and other processes as fuel to operate."	To mention GHG emission amount during LNG Receiving Terminal Operation period.	Section 4.6.3.12	Inserted "...this is equivalent to approximately 10,369.59 tCO2eq/year."
K	It is analyzed that land use is not mentioned along the pipeline in Section (4.7) Natural Gas Pipeline	-To mention land use along Natural Gas Pipeline - The map (including land use) that can be seen clearly along gas pipeline with lable.	Section 4.7.1	- amount of Land used added - Crossref to Figure 5.33 & Table 5.52
L	Throughout the pipeline alignment, 5 Types of Sign posts will be installed to protect public health and safety and pipeline integrity and Signpost design nd sign post placement are described.	To describe the pipe line safety training plan in the villages proximity to pipe line. Describe in EMP sub-plan.	Section 8.8.10 and ESMP Section 12.5.2	Inserted "Implement pipeline safety training plan in the villages proximity to pipeline"

	Findings	Comments	Location in Report	Addressed by
M	Although treatment of produced bentonite and that will be stored with container before disposal is mentioned in Section (4.7.2.7) HDD , the location for placement of such containers is not mentioned.	- To mention the location of container storing produced bentonite. - The treatment method of produced bentonite and disposal plan - The disposal method and the amout produced from cutting drilling - The location and design of Drilling Pit - Any other drilling fluid/ chemical addictive usage other than bentonite (if use, the usage amount abd toxicity) - The duration of river crossing pipeline - The start point & end point coordinates of river crossing pipeline	Section 4.7.2.7	Inserted HDD Equipment Layout Inserted Drill cutting No other chemicals used Updated HDD locations with coordinates

	Findings	Comments	Location in Report	Addressed by
N	Section (4.7.2.8) Hydrostatic Testing mentioned that the fluid produced from Hydrostatic Testing will be discharged directly into the Yangon River and will be discharged by opening the pipeline at a point closest to the Yangon River	- To mention clearly whether the water usage for Hydrostatic Testing include/ not-include of Addictive Chemical - To analyze whether pipeline internal corrosion could occue if use Yangon river water (Raw water) - To mention the exact loaction of Hydrstatic Testing Water Discharge Point	Section 4.7.2.8	Revised text as per below comment

	Findings	Comments	Location in Report	Addressed by
O	Appendix E: TPMC' HSE plan Procedure Chapter 4.2.2 Environmental Protection Requirement mention as per following, The hydro test water need to be collected in the lined pond and the water to be tested for any contaminants. If the collected hydrotest water is found not to be contaminated, and further if the water quality conforms to land discharge standards, then the water can be discharged on to the land in small quantities.	Hydrstatic Testing Water Discharge with the statement section (4.7.2.8). To be amended.	Section 4.7.2.8	Revised text according to finding
P	Section(4.7.3.12) Construction Waste (Pipeline) mentioned the amount of Solid Waste, Hazardous Waste and Wastewater during construction phase and related to wastewater, it is analyzed mention as "The EPC contractor will establish a management system for sanitary wstewater before construction.	- To mention the amount of fuel usage for N.G Pipeline construction phase and the GHG emission amount - To mention Management Method about cement wash down, other plant cleaning/rising efflucents, vehicle maintenance and the mixing of oils/lubricants in the wastewater. - To mention Wastewater management system	Section 4.7.2.12	Inserted "All waste will be disposed according to TPMC's Waste Management Plan (Appendix X)."

	Findings	Comments	Location in Report	Addressed by
4	**Description of Environment**			
A	Section (5) Description of Environment mentioned Biophysical Baseline and Socioeconomic Baseline and although Section (7) mentioned Impact Assessment for unplanned event such as Earthquake, Seismicity, Typhons, it is anylazed that the detail description of natural hazard at project located location is required to mention with sub-chapter in Section (5).	To mention the detail description related to Natural hazard at proposed Project located region in Section(5) with sub-chapter.	Section 5.1.12	Inserted Natural Hazards section into baseline

	Findings	Comments	Location in Report	Addressed by
B	Although Section (5.1.1.1) Study Area mentioned "the Study Area (see Figure 5.1) comprises a 5km radius of the Project site (Ahlone CCPP expansion, and LNG Receiving Terminal) as well as a 500m from each side of the Natural Gas Pipeline", the legend of Fig 5.1 mentioned "3 Kilometers from Power Plant", "3 Kilometers from LNG Terminal". Therefore it is analyzed that the study area description of LNG Terminal and Powerplant is not accordigly.	To analyze Study Area description of LNG Receiving Terminal and Power Plant	Section 5.1.1.1	Adjust Project SAoI to 3
C	Although the three location of groundwater sample is mentioned in Section (5.1.7.3) Groundwater Quality, it is analyzed that ther is no ground water sample taken around LNG Receiving Terminal	To take ground water sample around LNG Receiving Terminal	No changes	There are no ground water wells near the LNG Terminal

	Findings	Comments	Location in Report	Addressed by
D	Although Section (5.1.10) Waste mentioned the Waste Generation and Handling around the country, there is no mention for Waste Management Information of Project Region.	To mention Waste Management Information of relevance proposed project located region.	Section 5.1.10	No secondary data is available for the waste disposal method in Ahlone Township. Additional secondary data for waste collection and disposal system in Yangon is inserted.
5	Impact Assessment and Mitigation measure			
A	Section (7.4.7.2) Wate Intake Requirements (Construction Phase) mentioned related to water intake during LNG Receiving Terminal Construction that "the raw water required during construction will be obtained from the local water distribution ", the fifth paragraph such section mentioned that " Although the Yangon River will be the main source of water for construction activities, the water requirement for the LNG Receiving Terminal is not expected to impact the communities" as well. Therefore the descriptions are conflicting .	EIA Consultant - To clarify the source of water usage for LNG receiving Terminal Construction - To mention Intake Amount, location and ,ethod if water will be intaking from Yagon River	Section 7.4.7.2	Inserted "The raw water required during construction will be obtained from YCDC or other local water supplier, and will be transported by water trucks."

	Findings	Comments	Location in Report	Addressed by
B	Section (7.4.7.4) Wastewater from LNGC (Operation Phase) mitigation Measure mentioned the following facts, - Incorporate drainage systems or oil traps into the LNGC design to reduce the amount of potential contaminated water runoff; and - Collect any contaminated water on the LNGC when possible, and send to certified contractor for disposal, to reduce potential contaminated water discharge into the Yangon River.	The Project Owner to clarify the following, - Whether LNG Carrier is under direct control of Project Proponent - Whether the Contract with LNG Supplier/Carrier include such Mitigation Measure	No Changes	LNG carrier is under direct control LNG supplier . Project Proponent will ensure to include the mitigation measure in the contract with LNG supplier.

	Findings	Comments	Location in Report	Addressed by
C	Impact Assessment Table from Section (7.8.6) Impacts from Economical Displacement mentioned that Economical Displacement Impact is "relatively small (minor significance)", Receptor Sensitivity menttioned that "only 20% of the interviewees practice firming" and "the sensitivity of the receptors is considered medium", Mitigation measure of such section mentioned that Stakeholder Engagement Plan will be enacted.	- Whether performing Interviewed/Survey to "all" residents within project area (Shall not mention Rating "medium" of Sensitiity of Receptor if the Interviewed/Survey was not performed to "all" residents in project area) -To mention Livelihood Restoration Plan other than Stakeholder Engagement Plan in Mitigation Measures.	Section 7.8.6	Inserted sample population of people in the area and clearly stated data source as "survey sample"
D	Section (7.8.12) Impacts on Occupational Health and Safety mentioned that "Health and safety standards in the construction sector are relatively low in Myanmar".	To re-check it is appropriate or not to put that sentence.	Section 7.8.12.1	Sentence remove

	Findings	Comments	Location in Report	Addressed by
E	Athough Health and Safety Impact is analysed in Section (7.8.11) and (7.8.12), it is analyzed that assessment is required to perform and input related to Covid-19 as pandemic announced by WHO (World Health Organization)	- To put assessment related to COVID-19 pandemic - To put COVID-19 asssessment and prevention plan	Section 12.8.1.5 Appendix W	Inserted in the Communicable Disease Management Plan for COVID-19

	Findings	Comments	Location in Report	Addressed by
F	Section (8.4.7.2) Water Intake Requirements (Pipeline Construction Phase) described that "During construction, water is required for construction worker activities and prefabricated concrete activities, which may place pressure on the local water supply." In the project description chapter, it is mentioned that construction water requirement will be sourced from local water distribution facilities (see page 141, 175, 197). The only mention of using river water from Yangon River is for the project's operation (LNG Terminal-page 147, power plant-page 200)	EIA Consultant - To clarify the source of water usage for Pipeline Construction - To mention Intake Amount, location and ,method in this Section if water will be intaking from Yagon River	Section 8.4.7.2	Inserted "The raw water required during construction will be obtained from YCDC or other local water supplier, and will be transported by water trucks."

	Findings	Comments	Location in Report	Addressed by
G	It is analyzed to mention that whether or not all Hazardous waste including Additional waste produced from proposed project can be handled by Licensed Waste Facility and the alternaive methods in Section (8.6.7.2) Impacts of Generation and Management of Hazardous Materials and Waste during Construction Phase	To mention that whether or not all Hazardous waste including Additional waste produced from proposed project can be handled by Licensed Waste Facility and the alternaive methods.	Section 8.6.7.2	Inserted "...either DOWA, or YCDC."
6	Cumulative Impact Assessment			
A	It is analyzed in page 847, table 11.3 Cumulative Impact Assessment that only Cumulative Impact Assessment for New Yangon City Project was described but emission (both air and wastewater) for Existing Power Plant (120MW) and Traffic Assessment & Emission Assessment for Thilawa SEZ were not mentioned.	-To do assessment for Cumulative Impacts for emission (both air and wastewater) from Existing Power Plant - To do assessment for Cumulative Impacts for emission (both air and wastewater) from Thilawa SEZ and cumulative impacts for river traffic due to vessels navigation.	Section 11.4.1 Section 11.6	Information on the existing 120MW power plant was not available at the time of modelling. The methodology assumes that existing emissions are captured in the baseline, thus a cumulative assessment of existing and proposed emissions has already been conducted. Inserted existing power plant into assessment for air quality and surface water.

	Findings	Comments	Location in Report	Addressed by
				Inserted Thilawa SEZ
7	Environmental management Plan			
A	Fire Prevention Plan (Appendix G), Emergency Response Plan (Appendix H), Site Security Procedure (Appendix I), Personal Protective Equipment Procedure (Appendix J) among 31 itmes of necessary to effectively implement were mentioned detail in Section (12.4) Detailed Management Plans.	To mention remaining plans and the following plans, - Resettlement Action Plan - Chemical Management Plan - Mooring Management Plan	Section 12.4 Section 12.8.1	According to current Project design and location, there is no requirement for Resettlement Action plan Inserted management plan index

	Findings	Comments	Location in Report	Addressed by
B	It is analyzed in Section (12.8.4), the appropriation budget amount for EMP Implementation, environmental Monitoring and CSR Activities for community developemnt were not mentioned.	To mention the appropriation budget amount for EMP Implementation, environmental Monitoring and CSR Activities for community developemnt.	Section 1.8.4 Section 12.8.3	Inserted ESMP Budget
8	Social Receptor			
A	It is analyzed that 36 Villages can be impacted because of project in Section (5.2.2) Social Receptor and it was mentioned that Public Consultation were performed during Scoping and EIA in Section (13.2) and (13.3)	- To mention how many numbers of villages among the imapcted 36 villages were attended Public Consulataion Meeting done by EIA Consultant. To perform public consultation for all 36 Villages.	Section 5.2.2 Appendix attended list	- Change the total number of village tract according to the list above figure to 29 - The number and list of the villages can be refer to the Appendix attendent list

	Findings	Comments	Location in Report	Addressed by
B	It is analysed that TPMC answered the question of Stakeholder- U Sit Maung in Table 13.4: Key Concerns and Question Raised during Public Consultation 1 as below, We have two types of CSR activities: internal CSR activity and external CSR activity. Internal CSR activities focus on our staff. For external CSR activities, we had supported local people's needs in the project areas such as, educational, religious and health support. We also donated in the areas, affected by floods	To mention the following in Community Development Plan, - The plan of Internal CSR Activities and appropriation budget amount - The plan of External CSR Activities and appropriation budget amount	Section 12.8.4	Inserted CSR Activities in section 12.8.4
C	It is analysed that the address and 24 Hours contacable phone number is required to mention for complaint in Section 913.6) Grievance Mechanism.	To mention the address and 24 Hours phone number for claims and complain.	Section 13.6	Inserted address and 24 hour phone number
9	General			

	Findings	Comments	Location in Report	Addressed by
A	To mention and perform COVID-19 assessment plan and prevention plan due to around 400-600 workers per day for LNG Receiving Terminal Construction, 45-50 workers per day for Jetty Construction, 81-117 workers per day for N.G Pipeline Constrction, 400-600 workers per day for Power Plant Construction will be utilized and there will be migrant workers and also the construction materials and transportation trucks will be assessed.		Section 12.8.1.5 Appendix W	Inserted in the Communicable Disease Management Plan for COVID-19

S. No.	Findings	Comments	Location in Report	Addressed by
1	Lack of 15GOTT,SIGTTO safety guidelines	To describe and comply with 15GOTT, SIGTOO guidelines.	Section 3.6.5-3.6.6	- Add IGC Code and ISGOTT - SIGTTO is an organization
2	To follow Waste matertial mangamenet plan MARPOL 73/78, MPA laws & regulations	To describe waste mangement plan. Port recetron facility service provider. (DOWA, YCDC)	Section 4.8.2.11 Section 4.8.3.4 Section 12.8.2.2	Inserted "The waste will then be disposed in designated disposal areas provided by the YCDC Pollution Control and Cleansing Department" Cross reference with the section discussing TPMC's Waste Management Plan. Added more information on TPMC's WMP in Section 12.8.2.2
3	Under 12.4 Detail Mangement Plan Under 12.4 Detail Mangement Plan (Operation Phase)	To mention TPMC operation cost for each item bbecause it can be related to the tariff of the project.	Section 1.8.4 Section 12.8.3	Inserted ESMP Budget
4	Chapter 13. Grievance Mechanism	To amend GRM. The mentioned GRM under chapter-13 is not fullfilled and prefect	Section 13.6	Add 24hr contact number Update the content according to the ADB version which refer to SEP (have the most update and detail information + live document)
5	Mentioned that constrcution period will use local distributed water	To describe which service will be used. To be disussed with YCDC if company intends to use YCDC distributed water.	Section 7.4.7.2 Section 8.4.7.2 Section 9.4.7.2	Inserted "The raw water required during construction will be obtained from YCDC or other local water supplier, and will be transported by water trucks."

S. No.	Findings	Comments	Location in Report	Addressed by
6	Mentioned that solid waste will manage with waste colelction system in Ahlone	To be discussed with YCDC for collection time and fees, if solid waste are to be collected with exisiting Ahlone waste collection system.	Section 4.8.2.11 Section 4.8.3.4 Section 12.8.2.2	Inserted "The waste will then be disposed in designated disposal areas provided by the YCDC Pollution Control and Cleansing Department" Cross reference with the section discussing TPMC's Waste Management Plan. Added more information on TPMC's WMP in Section 12.8.2.2
7	Mentioned that Harzadous waste will be managed with licensed contractor	It is requried to follow the laws & regulations from YCDC as the project is lcoated in YCDC area. To be discussed with YCDC.	Section 4.8.2.11 Section 4.8.3.4 Section 12.8.2.2	Inserted "The waste will then be disposed in designated disposal areas provided by the YCDC Pollution Control and Cleansing Department" Cross reference with the section discussing TPMC's Waste Management Plan. Added more information on TPMC's WMP in Section 12.8.2.2
8	For LNG terminal safety , to follo safety , to follow -International Code and Law (such as internationl gas carrier code SITTO, ISGOT)		Section 3.6.5-3.6.6	- Add IGC Code and ISGOTT - SIGTTO is an organization
9	To follow the laws & regulations from relevant government departments if there is LNG ship to ship operation.		No Changes	No ship to ship operations

S. No.	Findings	Comments	Location in Report	Addressed by
10	To prepare Fire Control Plan and fire fightig arrangement for LNG vessel.		No Changes	LNG vessel fire control plan , pollution prevention and emergency plan, waste management plan is carried by the LNG carrier under IMO guideline. It will be available after TPMC finalize the LNG supplier and LNG vessel. TPMC will calrify to ECD.
11	Related to marine conservation, to prepare -Marine Pollution prevention emergency plan -Waste management plan from ship and reception facility		No Changes	
12	Related to marine security Terminal requried to obtain Internationl certificate of Statement of Compliance for Port Facility Security .Facility Security. It is suggested to report to Department of Marine Adminstration to comply with above.		No Changes	TPMC will contact with relevant marine authoriy and apply Internationl certificate of Statement of Compliance for Port Facility Security before commericial operation.
13	Policy, legal and institutional framework	To Describe the compliance wth Myanmar Investment Law (2016) section 7.	Section 3.3.2, Table 3.2	Inserted Myanmar Investment Law
14	Construction period is described 23 months.	MIC proposal was mentioned that construction period is 48 months after PPA sign. To be clarified.	No Changes	TTCL will clarify . No changes to report.
15	It is mentioned that CSR contribution is 2% of net income.	MIC proposal was mentioned 1% of net income. MIC proposal shall be amended to 2%.	No Changes	TTCL will clarify . No changes to report.

S. No.	Findings	Comments	Location in Report	Addressed by
16	Constructin & operation period Hazardous Waste management planConstructin & operation period Hazardous Waste management plan	Projct waste mangament plan needs to describe.	Section 12.8.2.2	Added more information on TPMC's WMP in Section 12.8.2.2
17	Discharge water temperature exceeds the EQEG guideline.	To decribe management plan to control temperature to be in line with EQEG guidleine.	Section 9.4.7.5	Inserted "It shall be noted that the Project will utilize a closed cycle cooling system, as described in Section 4.8.1.8; this is considered as an existing measure to limit temperature differences between the Yangon River and the thermal discharge, and will significantly reduce thermal discharge temperatures as compared to a once-through cooling system."
18	Boiler law was not described in policay, legal and institutional framework chapter.	To describe project company will comply with boilwer law and related instructions.	Section 3.3.2, Table 3.2	Inserted The Boiler Law
19	Related to chemcial use, it is required to describe Chemical Substance Law issued by Ministry of Industry.	It is required to copmay with Chemical substnace law (import, storage, handling)	Section 3.3.2, Table 3.2	Inserted: - Prevention from Danger of Hazardous Chemical and Associated Materials Rule (notification No 85/2015-2016) - Prevention from Danger of Hazardous Chemical and Associated Materials Law

S. No.	Findings	Comments	Location in Report	Addressed by
20	To be specified name of chemicals	To be described the chemical used for boiler water.	Section 4.8.1.6	Inserted: - Oxygen Scavenger: for remove dissolved oxygen in the condensate feed water system - Ammonia: for maintain PH of boiler feed water . - Phosphate: for control PH at HP/LP drum.
21	Laws related to cultural heritage are indicated. However, specific law to be complying is not mentioned.	To be described company will comply with The protection and preservation of cultural heritage regions law (2015), section 12 and 13.	Section 3.3.2, Table 3.2	Inserted "Protection and Preservation of Cultural Heritage Regions Law, 2019"
22	Page 544 of EIA report mentioned the main cultural heritage sites located nearest to the proposed Project site is Danot Pagoda, Ah Nar Gan Sayar Thetgyi (meditation station) located roughly 900m from the proposed Project site.	Describe if there is cultural heritage site located in Gas Pipe line right of way If cultural heritage objects are discovered during project construction, it shall hand over to Department as per the section (12) and (13) of law.	Section 8.8.12.1	Add action in the mitigation measures " n If any cultural heritage is identify during the construction period, TPMC will contact the keys governmental department accordingly."

S. No.	Findings	Comments	Location in Report	Addressed by
23	To clearly specify the statement in 1.6.2.3 is SanPya fish market (or) San Pya jetty	It is mentined main landing site for fish in Myanmar is fish market at San Pya in Ahlone Township near the Project Sit. To be inform in advance if thereis impact on fishing boat access.	Section 1.6.2.3 Section 5.2.5.3	Inserted "It shall be noted that the Pipeline construction and operation will not restrict fishing boat access at San Pya Market"
24	It is mentioned that income from fishing is about 20,000 ks/day.	To describe training program prior to construction and opraetion period in order not to impact to small fishing boats and fishingn nets in the river.	Section 7.8.5	TPMC will infrom local communities before commencement of the construction and operation phase in order to avoid the impact on fishing net and fishing activites in the river.

S. No.	Findings	Comments	Location in Report	Addressed by
25	Table 5.50 : Species of Conservation Significance (IBAT species grid)	To describe existing fish species in the riverand origin To describe assessment of imapct on fish species after project lifetime To describe how fishing baseline was carried out To describe if there are fishing farm along the pipe line route (or) not	Section 5.1.11.7, Fauna, Fish	Updated fish baseline Considering the impacts from thermal and cold water discharge is insignificant, impacts to fish will likely be insignificant as well. Impacts to fish after project lifetime will be considered in the decommissioning environmental assessment, and therefore not considered in this assessment. Based on site visit and surveys, there were no fishing farms along the pipeline route.
26	Description of Environment chapter described Climate and Meteorology data. However, data for project specific location was not included.	Climate data shall be amended since there are some flaws. It is necessary to indicate the climate data for project area such as rainfall, temperature, humidity, wind speed and direction.	Section 5.1.3	Inserted additional data; however, data is limited for project areas specifically
27	Chapter (7) described the impact assessment unexpected event such as Earthquake, seismicity, Typhoon. Natural hazard assessment for project location is missing. It is required to add sub-chapter in Chapter (5).	To describe Natural Hazard assessment for project location such as Tropical cyclone, strong wind, strom surge, heavy rain, lighting strike, sesa level rise, urban flood, tsunami, and high tide.	Section 5.1.12	Inserted applicable natural hazards

S. No.	Findings	Comments	Location in Report	Addressed by
28	Whether or not to consider Climate change impact assement since the project is long-term plan.	To describe the statement if cliamte change impact has been studied for the long term opreation of project.	Section 5.1.3.1	Inserted Climate Vulnerability Assessment
29	It is not necessary to mention the purpose of enacted law. Instead, it shall be mentioned that project company's commitment to comply with each related sections, articles of the project relevant laws as follow : (1) The enviromental conservation law 2012 (Chapter 7(a), 14,15,24,29) (2) The environmental conservation rule 2014 (article 69(a), (b) (3) Environmental Impact assessment procedure 2015 (paragrapgh 102 to 110, 113, 115, 117) (4) EQEG ,2015 (5) Myanmar investment law 2016, (chapter 50, 51, 6, 73) (6) Myanmar investment rules 2017 (article 202, 203, 206,212) (7) Electricity law 2014 (article 12, 14, 20, 22(a), 25, 26(b), 27 , 33 + 40, 68 (8) Boiler law 2015 (article 5+6+7+12, 12(a) , 14(a), 15, 18, 19(a), 19(b), 19(c) +14(b), 21 ,		Section 3.3.2, Table 3.2	Inserted

S. No.	Findings	Comments	Location in Report	Addressed by
	24(a), 24(b), 26, 29(b) + 31, 40+38 (9) The Protection and Preservation of Ancient Building Law, 2015 (article 12, 15, 20(f)) (10) The Union of Myanmar Public Health Law, 1972 (article 3,5)			

S. No.	Findings	Comments	Location in Report	Addressed by
30	(11) The Prevention and Control of Communicable Disease Law (1995), (article 3(a), 9, 4, 11) (12) Control of Smoking and Consumption of Tobacco Product Law, 2006 (article 9) (13) The Conservation of Water Resources and Rivers Law, 2006 (article 8(a) / 11/ 19/ 21/ 22/ 24(b) /6(a) +30 / 15(a) / 16+18 / 24 (14) Oil and Petroleum Products Law (2017) (article (d)/ (e)/ 10.(a, d, e)/ (11)/ 7(a, b, c)/ 33/ 31(a)/ 31(c)(d) (15) The petroleum rules 1937 (chapter 3, 4) (16) Engineer Councul law ,2013 (article 37, 34) (17) Myanmar Fire Services Law (2015) (article 25) (18) Import and Export Law, 2015 (article 7) (19) YCDC law (20) Prevention from Danger of Chemical and Associated Material Law (2013) (article 15(a,b) / 16(a) / 5(e) / 17/ 22/ 27) (21) Myanmar Port Authority Law, 2015 (article 19 (a,b) / 23(a,b) / 27(d,e) / 59 / 60 /66(e)/ 72(a,b) / 73		Section 3.3.2, Table 3.2	Inserted

S. No.	Findings	Comments	Location in Report	Addressed by
	(22) Territorial Sea and Maritime Law, 2017 (article 7(a,b) / 8 (f,g)/ 9 / 11(a) +(b)/ 12(c) /25 (d) (23) Farmland Law and Farmland Rules, 2012 (article 30 (a,b))			

S. No.	Findings	Comments	Location in Report	Addressed by
31	3. There are some mistakes about name of labour laws and enacted year in chapter Legal, policies and institutional framework.	Occupational safety and health law (2019)_ Social security law (2012)	Section 3.3.2, Table 3.2	Amended accordingly
32	Ministry of labour, Ministry of health and sports are missing in chapter 3.3.1 Key Ministries, Agencies and State-Owned Enterprises Involved in HSE for this Project.	Department of Factories & General Labour Laws Inspection under Ministry of Labour, Immigration and Population are currently supervised the occupational safety and health of labours in accordance with The Factories Act (1951). In the future, will be supervised in accordance with OSH law. There is another department under Ministry of health and sport concering occupational health. Therefore, MOLIP and MOHS shall be listed in key ministries.	Section 3.3.1	Added MOLIP and MOHS in the table

Findings	ECD comments	Location in Report	Addressed by
4.6.2 Construction Phase / 4.6.2.3 LNG Receiving Terminal/ Site Foundation mentioned that piling work involved and Major Project Works *described the construction of LNG storages tanks.*	Described whether piling for LNG storage tanks required or not. Describe design of Storage tanks, number of piles.	Section 4.6.1.2 Section 4.6.2.3	Design of storage tanks already mention in Ch.4. Number of piles for storage tanks inserted in 4.6.2.3
4.6.2.4 Unloading Jetty/ River Work mentioned that "Dredging of the Yangon River at the location of the Unloading Jetty will not be require as the water depth is suitable for vessels to operate in the area."	Describe Latitude, Longitude of LNG Receiving Terminal & Jetty	Section 4.4	Inserted coordinates
	Describe Jetty Location, depth of Yangon river and width at project area.	Section 4.6.1.2	Inserted Information
	Attach a Map indicating Construction period Safty Zone/ Jetty Location/ and Width of Yangon River at project area.	Section 4.6.2.4	Inserted the unloading Jetty construction safety radius
4.6.3 Operation Phase/ 4.6.3.3 Control of LNGC Berthing Operations and Safety Zone mentioned that **"While an LNG carrier is moored, the waters and waterfront facility located within a defined boundary to be constituted as a safety zone".**	***Describe area of " a safety zone" in this section.***	No Changes	TTCL will clarify that " a safety zone " will subject to discussion with MPA in later stage. No changes in report.
4.6.3 Operation Phase/ 4.6.3.4 LNG Storage Tanks **mentioned that "The secondary liquid container is designed to hold all the liquid contents of primary container in the event of leaks from the primary container"** ***and refer to figure 4.17***	Describe more clear 3D sketch for secondary liquid container.	Section 4.6.3.4	Inserted 3D sketch of LNG Storage Tank

Findings	ECD comments	Location in Report	Addressed by
4.6.3 Operation Phase/ 4.6.3.6 Water Supply *mentioned that* "The raw water will be taken from Yangon River, using the Water Intake Pumping station at the flow rate of approximately 1,300 m3/hr"	Describe whether the operation phase water intake is require treatment or not. If yes, describe the water treatment process.	Section 4.3.6.3	inserted " Intake river water will be used for regasification unit . Regasification Unit is equipped with debris filter. Water treatment process is not required".
4.6.3.11 Storm Water mentioned that "The estimated amount of discharge storm water is shown in Table 4.21." Table 4.21 wasn't mentioned about storm water .	Describe estimated volume of storm water.	Section 4.3.6.10	Inserted 1,000 m3/h Storm Water
4.6.3.11I Table 4.21 mentioned that discharge Cold Water Inlet – Outlet Temperature Difference is 10°C and **APPENDIX R CORMIX MODELLING REPORT** described that "The continuous effluent discharge was modelled based on a temperature reduction value of 10 °C below the ambient, as provided by TPMC" II **3.2 Conclusions** described that "ERM recommends a more detailed modelling study aligned with the local regulatory permitting process be conducted"	Explain the concept of MODELLING **"based on a temperature reduction value of 10 °C below the ambient"**	No Changes	Conducted modelling is based on TTCL's finalized discharge design temperature of regasification unit.

Findings	ECD comments	Location in Report	Addressed by
*4.*7.2.8 Hydrostatic Testing *mentioned that* "Once pipeline installation reaches 3 Once pipeline installation reaches 3 – 5 km completion length, hydrostatic testing will commence" "The amount of hydrostatic testing fluid required for testing is approximately 2,500 m^3."	Describe the hydro test water volume for 3 – 5 km completion length. *-Whether Hydrostatic testing will recycle or not* *-Clarfiy if described 2,500 m3 is for the volume of whole pipe line?*	Section 4.7.2.8	Estimated hydrotest water for 3-5 km pipe line is about 1,000 m3. Hydrotest fluid could be reuse . EPC contractor shall reuse hydrotest liquid as much as possible Corrected to 1,00m3 for 3-5 km pipe line.
4.9 Project Alternatives / 4.9.2.3 LNG Receiving Terminal Location Options 4.9.2.4 Pipeline Route Options *mentioned the project alternatives.*	Describe with comparison table for LNG Receiving Terminal (3) location Location, Pipeline Route (2) routes	Section 4.9.2.3 Section 4.9.2.4	Inserted Comparison Table

Findings	ECD comments	Location in Report	Addressed by
In addition to third party's proposed EMP, other 31 detailed plans are considered necessary and they are to be implemented prior to commencing the constructino and site clearance (page 854). Community compallins are ciommitted to be zero by proponent. what is the voice of proponent? Agree or possible? GHG calculation results by using IPCC are presneted in Table 7.14 , the result figures in Roll5, column 4,5,6 are not presetned correctly. The final input in Roll 5, column 7 is correct, 1000 times the sum of column 4,5,6 . Please check and correct them. The whole report is impresived for the expertise from many foreign exoertise, but most of them use ready made model for many calculation and future prediction of assessment. What are opinion of Myanmar-side third party. e.g the reliability of models , adequacy of fields and site investigation? In the presentation on summary, impact on power plant, GHG emission is found to be stay moderate. What would be the compensation plan for that? Risk assessment such as flood and earthquake should be considered. CSR programm should be added and clearly identified dpensding on the socioeconomic and affected areas. Operation and maintainence system for the proposed LNG, gas pipeline and power plant should be clearly expressed for the security.		Section 7.2.7.1	TTCL will calrify. GHG Calculation Amended

Findings	ECD comments	Location in Report	Addressed by
Table 7.3 Assessment of Impact on Ecology Relating to LNG Receiving Terminal Construction (Pre-Mitigation) "The expected dust emission magnitude during construction phase activities is predicted to be large from earthworks; and medium from construction and track out" mentioned that Impact Magnitude is Large. Although Receptor Sensitivity is determined Medium Impact Significance indicated as Moderate.	To recheck and amend Impact Magnitude and Impact Significance assessment . Also recheck Mitigation Measures, Residual Impacts Monitoring Plan	Section 1.7.1 Section 7.1.7.1 Section 7.10	Amended to medium and major impact magnitude, also resulting in medium to major significance.
Table 7.5 ı Assessment of Impact on Ambient Air Quality Relating to LNG Receiving Terminal Operation (Pre-Mitigation) described that Impact Magnitude is Negligible .	According Appendix Q Table 5.15, please recheck whether it should be Negligible or not.	Section 7.1.7.2	Impact from generators is negligible. No changes
Table 7.43: Impact Assessment Table for Wastewater from LNGC (from regasification process) (Operation Phase) Impact Magnitude mentioned that "Based on the characteristics above, the impact magnitude is likely to be small" . However assessment result is "Negligible"	To recheck and amend Impact Magnitude, Impact Significance assessment . Also recheck Mitigation Measures, Residual Impacts and Monitoring Plan	Section 7.4.7.4	Amended to small magnitude
7.8.9.4 Impact during Operationı page 529 ı Impact Assessment Table mentioned that Impact Magnitude is Small ı Receptor Sensitivity is described as High . However, Impact Significance is shown as "Negligible".	To recheck Impact Significance assessment . Also, recheck Mitigation Measures, Residual Impacts Monitoring Plan	Section 7.8.9.4	Amended to negligible magnitude
8.1.7.1 Table (8.3) described that Impact Magnitude is Large Receptor Sensitivity is Medium. And Impact Significance shown as "Moderate ".	To recheck Impact Significance assessment . Also, recheck Mitigation Measures, Residual Impacts Monitoring Plan	Section 8.1.7.1	Amended to major significance
8.5.7.2 Table (8.22) described that Impact Magnitude Medium ı Receptor Sensitivity is Low . But Impact Significance shown as " Negligible "	To recheck Impact Significance assessment . Also, recheck Mitigation Measures, Residual Impacts Monitoring Plan	Section 8.5.7.2	Amended to small magnitude

Findings	ECD comments	Location in Report	Addressed by
8.9.7.2 Impact Assessment Table described that Impact Consequences is Major I Impact Likelihood is Likely to occur once or more in life of the project . Impact Significance is determined as Moderate	To recheck Impact Significance assessment . Also, recheck Mitigation Measures, Residual Impacts Monitoring Plan	Section 1.7.2 Section 8.9.7.2 Section 8.10	Amended to major significance
Table 8.8: Project Scope and Activity by Emission Source during Construction mentioned that Project Component is LNG Terminal.	Recheck and amend.	Section 8.2.6	Amended to Pipeline
Table 8.10: Expected Stationary Combustion mentioned that Project Component is LNG terminal.	Recheck and amend.	Section 8.2.7.1	Amended to Pipeline

APPENDIX PP COMMITMENT LETTER

TTCL POWER MYANMAR COMPANY LIMITED
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Ministry of Natural Resources and Environmental Conservation
Environmental Conservation Department
Office No.(53),
Nay Pyi Taw, Myanmar

Attn: Director General
Environmental Conservation Department

Subject: **Impact Assessment Report and Environmental Management Plan in respect of the LNG Power Plant (Ahlone) Project (the "ESIA including EMP")**

Dear Sir,

We refer to the captioned ESIA/EMP, which was prepared and finalized by ERM in accordance with the Environmental Conservation Law, Rules and Procedures under the instructions of Ministry of Natural Resources and Environmental Conservation on the 21.Oct.2020.

We endorse and confirm to Ministry of Natural Resources and Environmental Conservation:

a. the accuracy and completeness of the ESIA/EMP;

b. Confirm and undertake to Ministry of Natural Resources and Environmental Conservation that the ESIA/EMP has been prepared in strict compliance with applicable Environmental Conservation Law, Rules and Procedures, and TOR for the ESIA;

c. Confirm and undertake to Ministry of Natural Resources and Environmental Conservation that the established project company (TPMC)in respect of the LNG Power Plant (Ahlone) Project shall at all times comply fully commitments, mititagation measures and plans in the EIA report.

(EIA Consultant)

ERM-Siam Co., Ltd.

By _____
Name: Kamonthip Ma-oon
Title: Partner

(Peoject Proponent)

TTCL Power Myanmar Co., Ltd.

By _____
Name: Suratana Trinratana
Title: Managing Director

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