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

$$\begin{aligned} &Fuel\ Consumption\ (TJ) \\ &\quad = Diesel\ Use\ (l) \times NetCalorific\ Value\ (TJ/Gg) \times Diesel\ Density\ (kg/m^3) \\ &\quad \times 10^{-6}(Gg/kg) \times 10^{-3}(m^3/l) \end{aligned}$$

Equation 3: Fuel Energy Consumption

$$\begin{aligned} &Fuel\ Consumption\ (TJ) \\ &\quad = Gasoline\ Use\ (l) \times NetCalorific\ Value\ (TJ/Gg) \times Gasoline\ Density\ (kg/m^3) \\ &\quad \times 10^{-6}(Gg/kg) \times 10^{-3}(m^3/l) \end{aligned}$$

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	1,293.49	1.31	3.12	1,297,921.84	1,297.92
Gasoline	5,292	0.17	12.03	0.013	0.031	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

$$Emissions = \sum \left(Fuel_j \cdot EF_j \right)$$

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	6.22419×10^{-6}	7.2998×10^{-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.[99]

[99] 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	2.30×10^{10}	1.15×10^{7}	11.73	6.58×10^{5}	293	349	6.59×10^{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.			

<table>
<tr><th colspan="6">Significance of Impact</th></tr>
<tr><td>Impact Scale</td><td colspan="5">The emissions from LNG Terminal are calculated to be 11,028.14 tonnes of CO_2eq or 0.011 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%.</td></tr>
<tr><td>Frequency</td><td colspan="5">Emissions will be released continuously throughout the operation period.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td>Positive</td><td>Negligible</td><td>Small</td><td>Medium</td><td>Large</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td rowspan="2">Receptor Sensitivity</td><td>Low</td><td colspan="2">Medium</td><td colspan="2">High</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Negligible</td><td>Minor</td><td>Moderate</td><td colspan="2">Major</td></tr>
<tr><td colspan="5">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.</td></tr>
</table>

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[100]

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

100 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[101] 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
  - Operation of LNG Receiving Terminal components.

[101] ISO 9613-2 refers to the standard for acoustic attenuation of sound during propagation outdoors – general method of calculation (2017).

- 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 construction phase.			

Significance of Impact					
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.

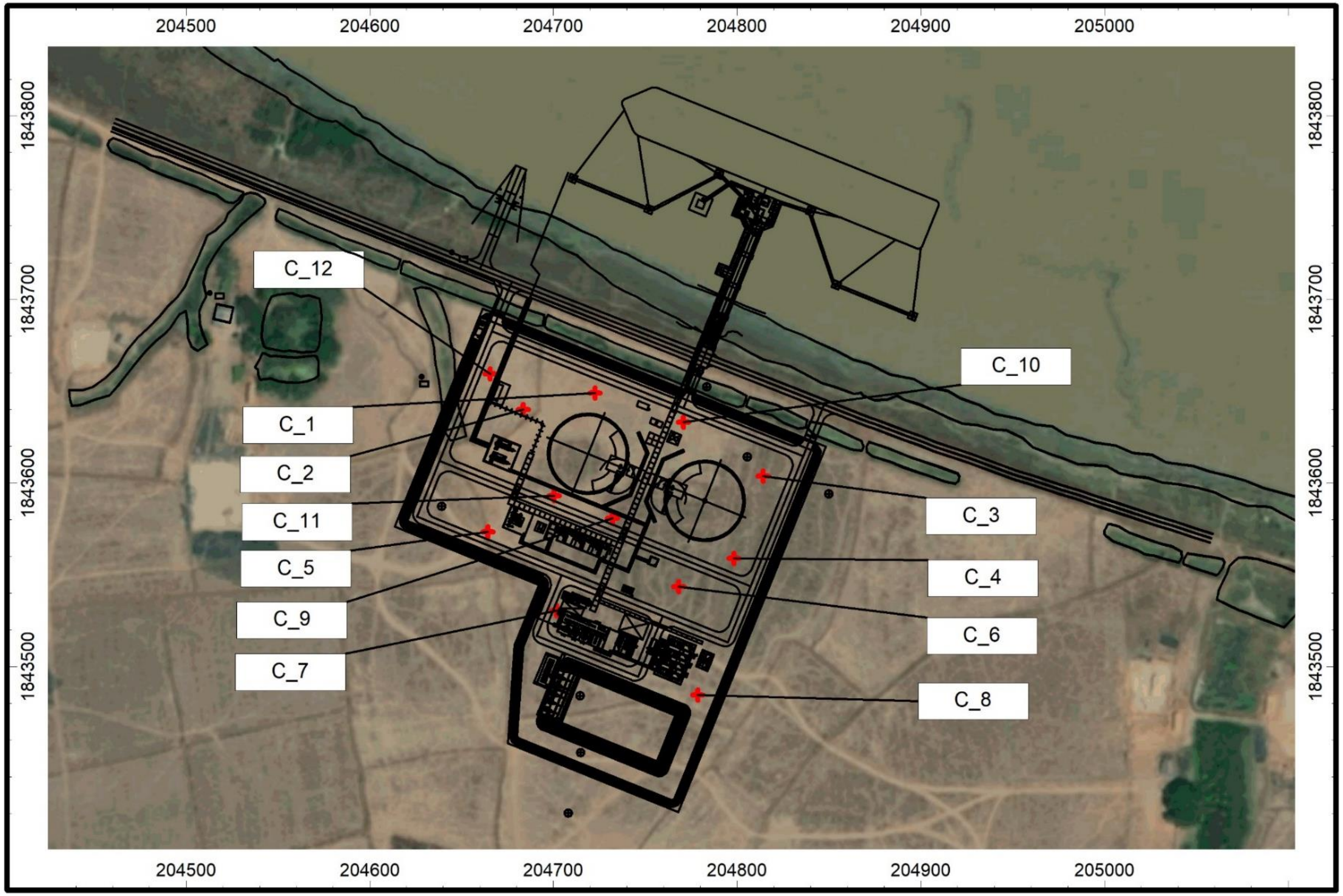
Table 7.29: Amount of Earthwork Machinery

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[102], 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)[102]. 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.

102 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

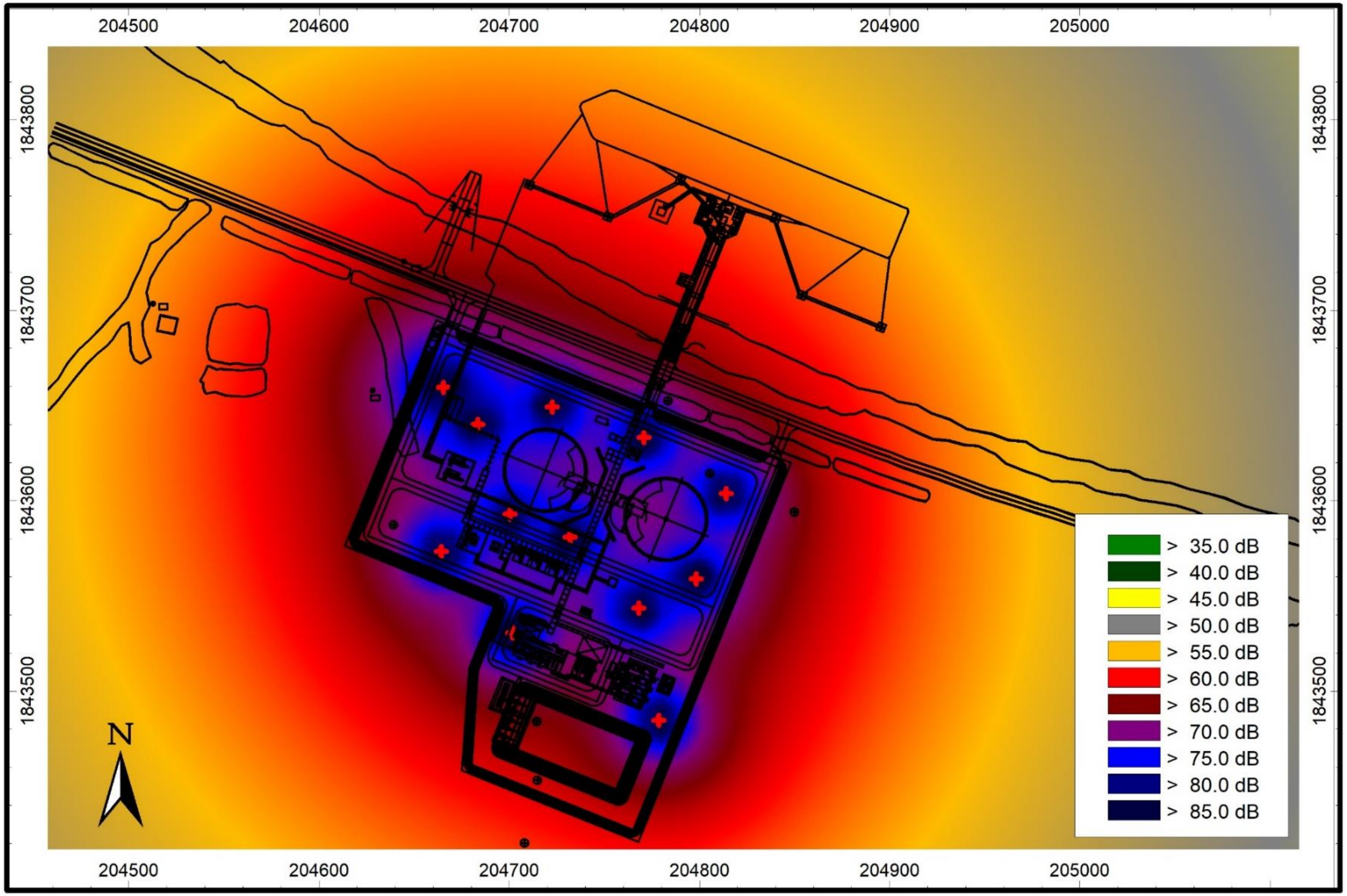
Time of Day	Baseline (dBA)[a]	Contribution from Construction Equipment (dBA)	Total Noise Level (dBA)
Day Time	63	39	63.01726
Night time	51	39	51.26572

Source: SEM, 2018

Note: [a] Baseline data for noise station N3, survey period 10-11 May 2018.

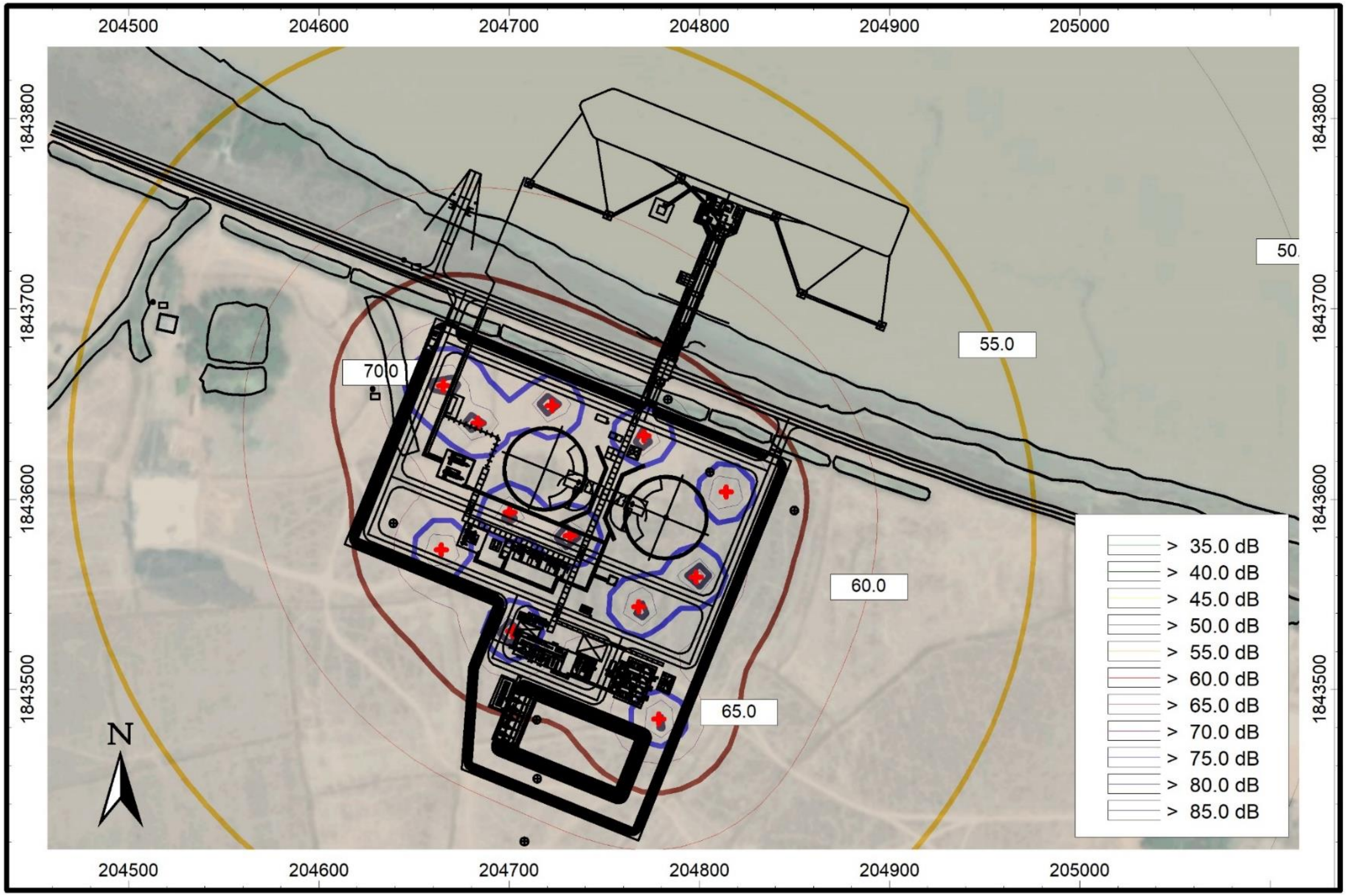
Type A map (noise gradient map which shows the dissipating of noise over distance) and type B (noise contour map which shows the noise level at certain distance) demonstrate is modelled based on the same noise level results; but with different graphical representation.

Figure 7.4: Noise Contour during Construction Phase (Type A)



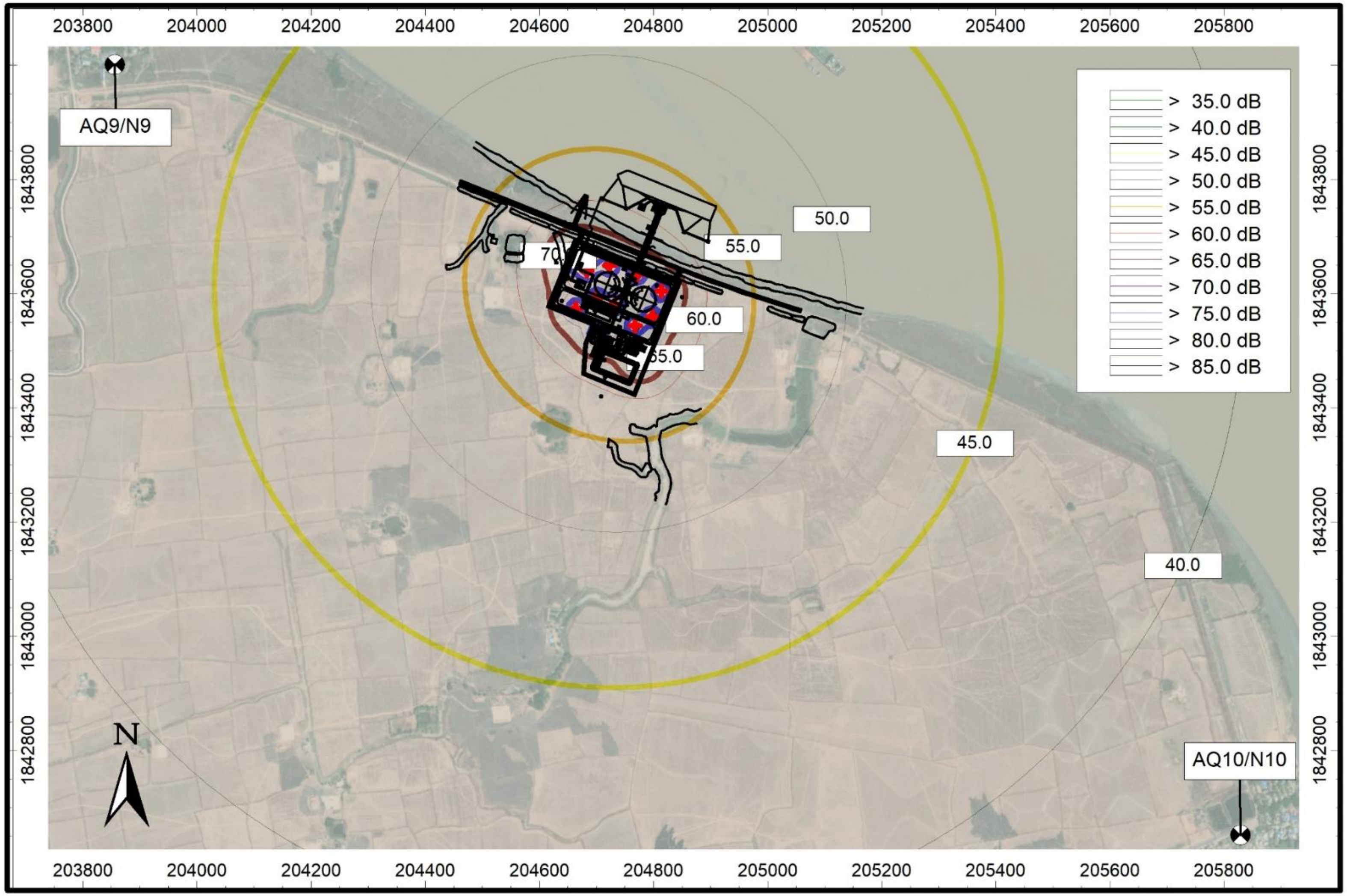
Source: AMacoustic, 2019.

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	Description of Sampling Point	Lday dB(A)	Lnight dB(A)	Leq dB(A)	NEQG Daytime (residential)	NEQG Daytime (industrial)
		WGS84						
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[103]. 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.

[103] https://www.fhwa.dot.gov/Environment/noise/noise_barriers/design_construction/keepdown.cfm

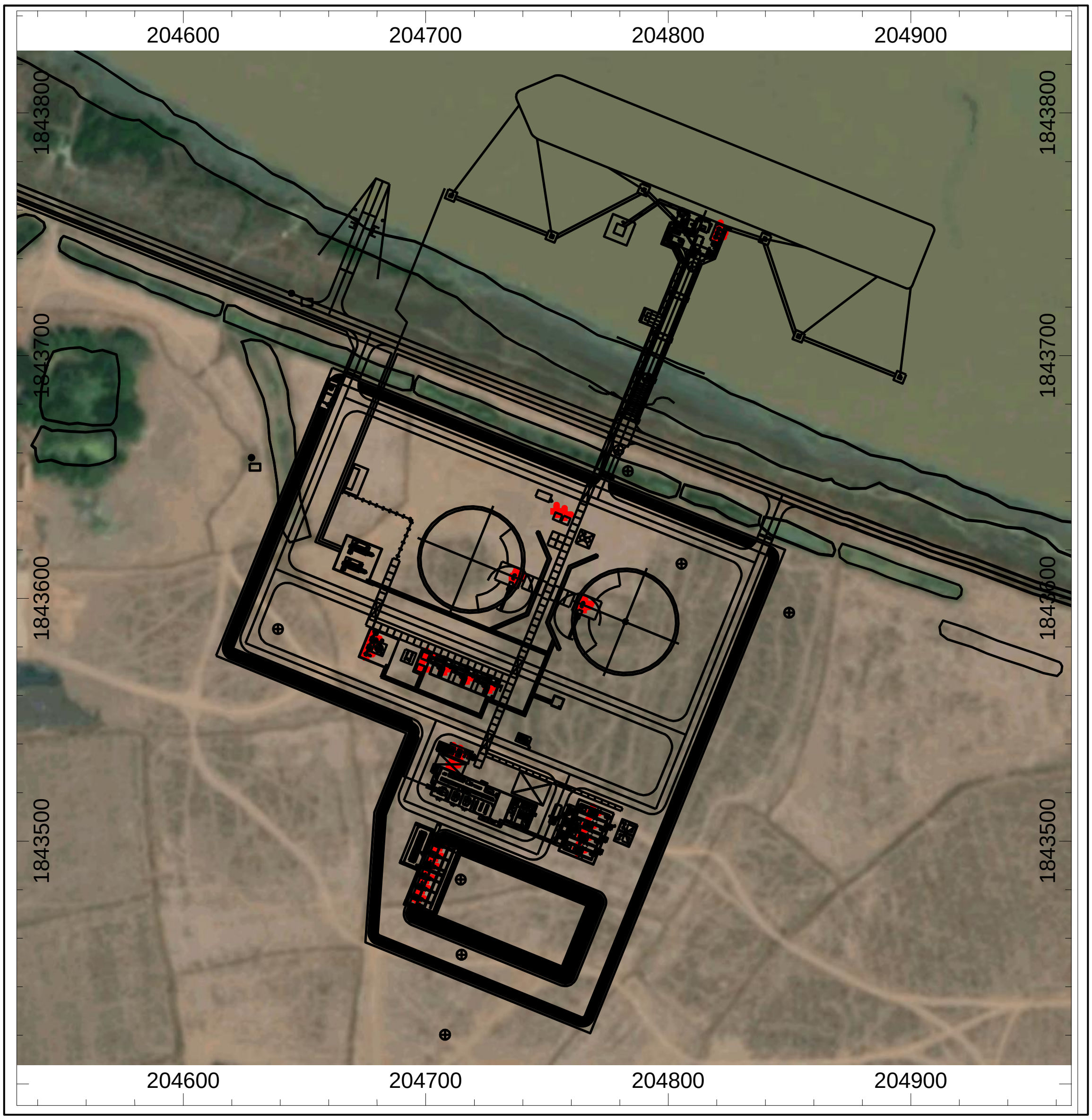
Table 7.34: Operation Equipment Noise Level

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



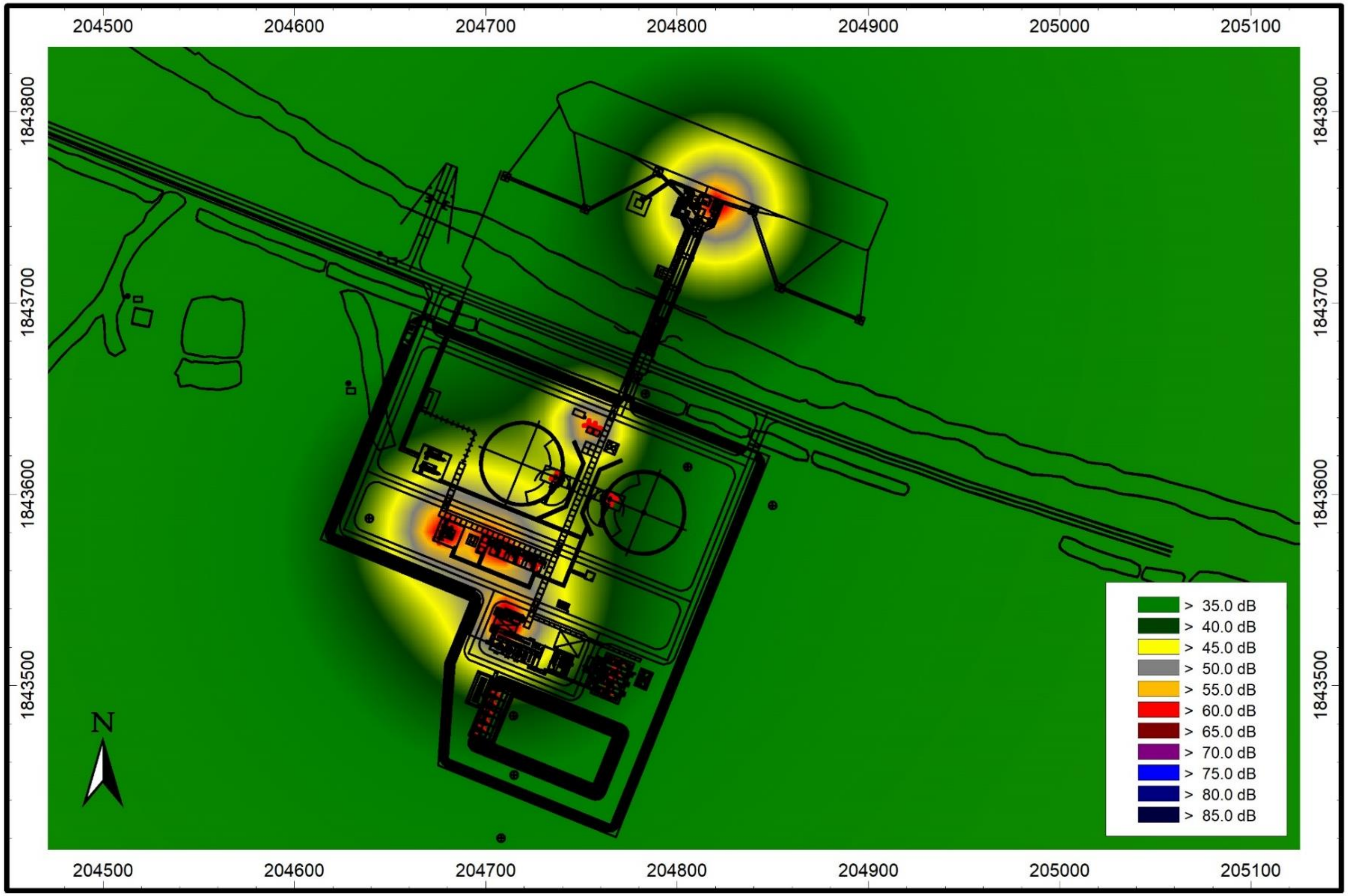
Source: TPMC, 2019. (Modified by AMacoustic)

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.

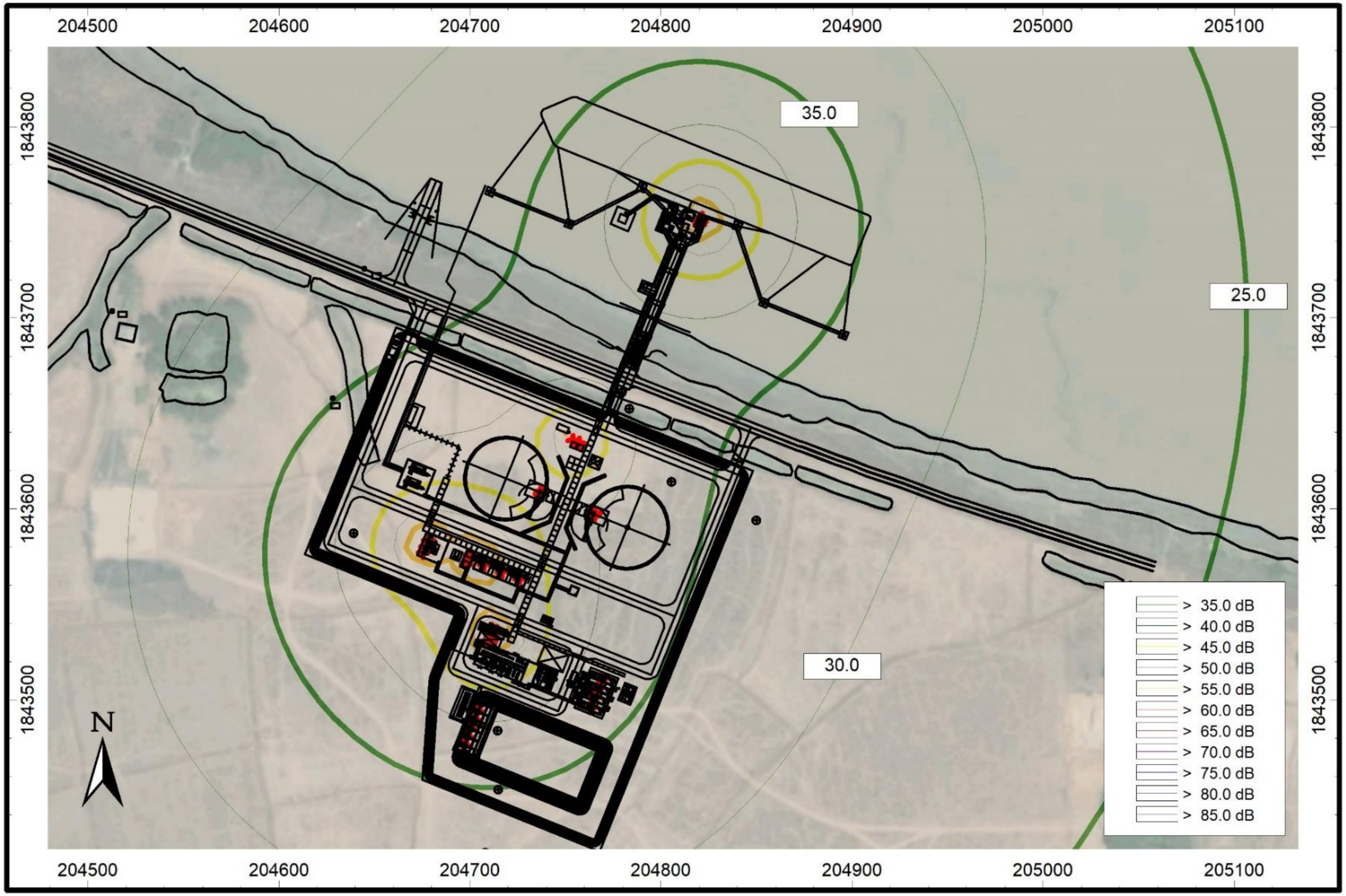
Based on the worst-case scenario (as shown in ***Figure 7.11***, ***Figure 7.12*** and ***Figure 7.13)***, the results suggest that noise levels rapidly dissipate over distance; with the majority of noise emission levels that extend beyond the LNG Receiving Terminal boundary being <40.0 dBA, which then 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)



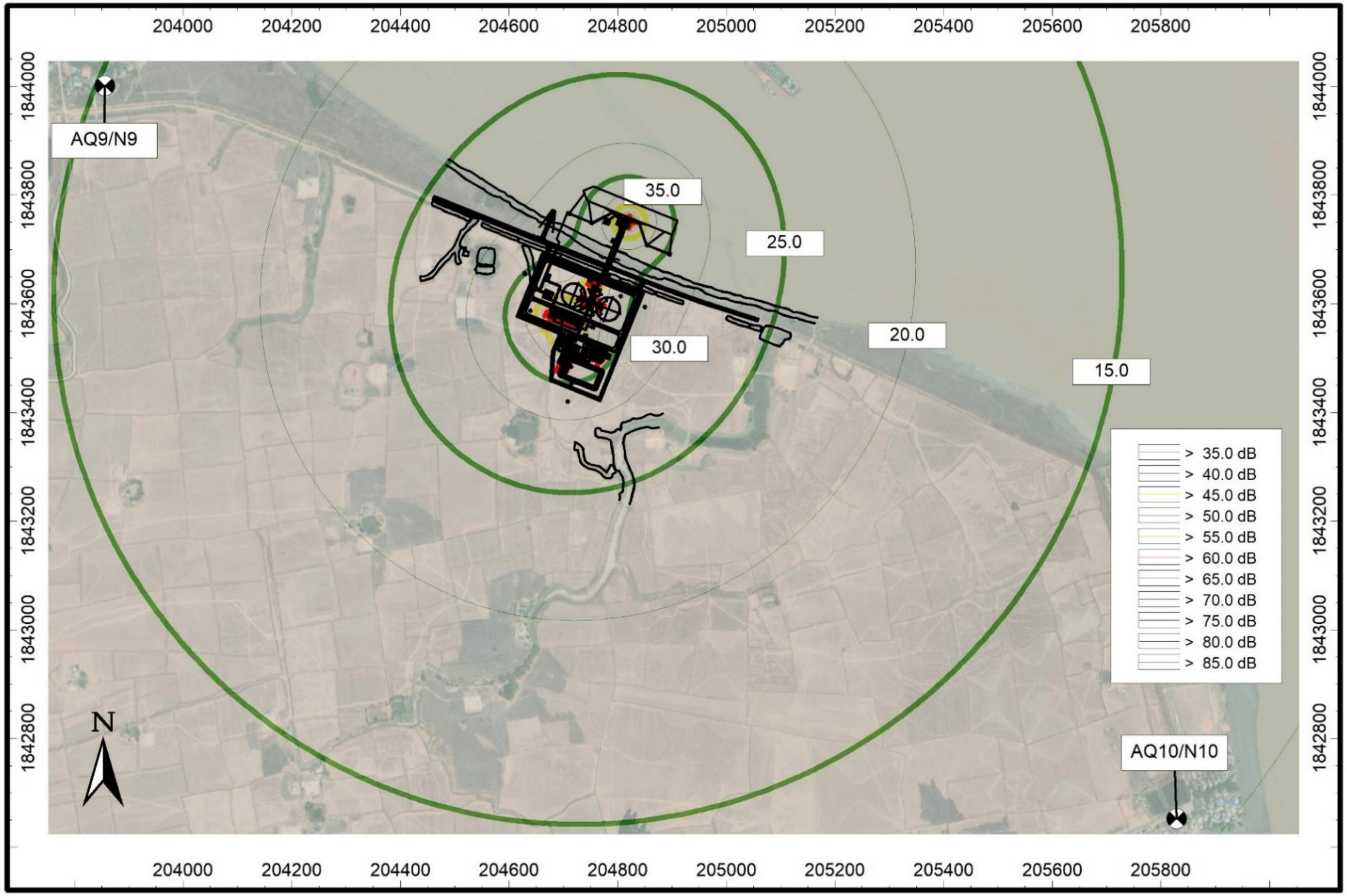
Source: AMacoustic, 2019.

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



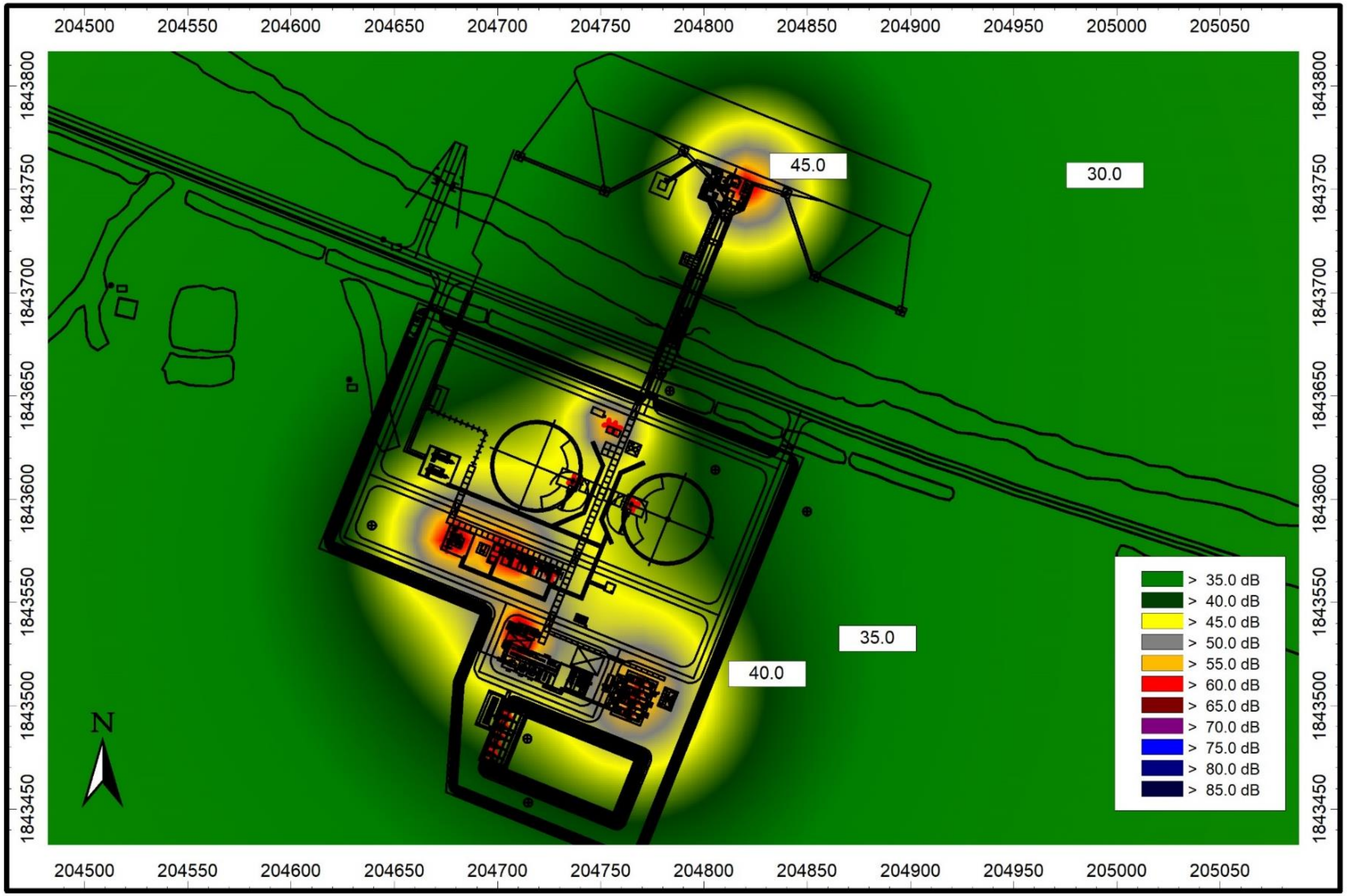
Source: AMacoustic, 2019.

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

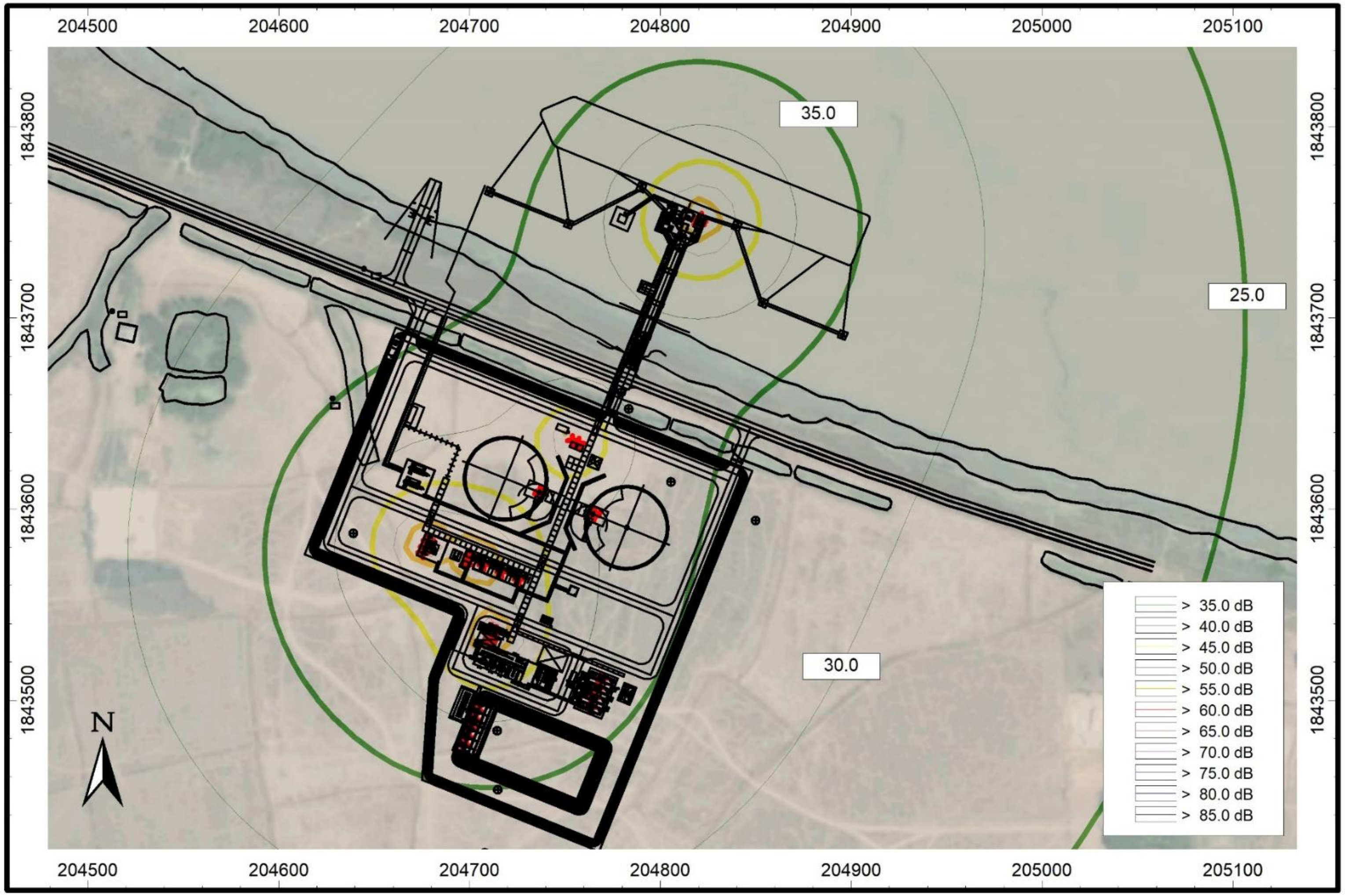
Source: TPMC, 2019.

Figure 7.11: Noise Contour during Operation Phase (Worst-case Scenario) (Type A)



Source: AMacoustic, 2019.

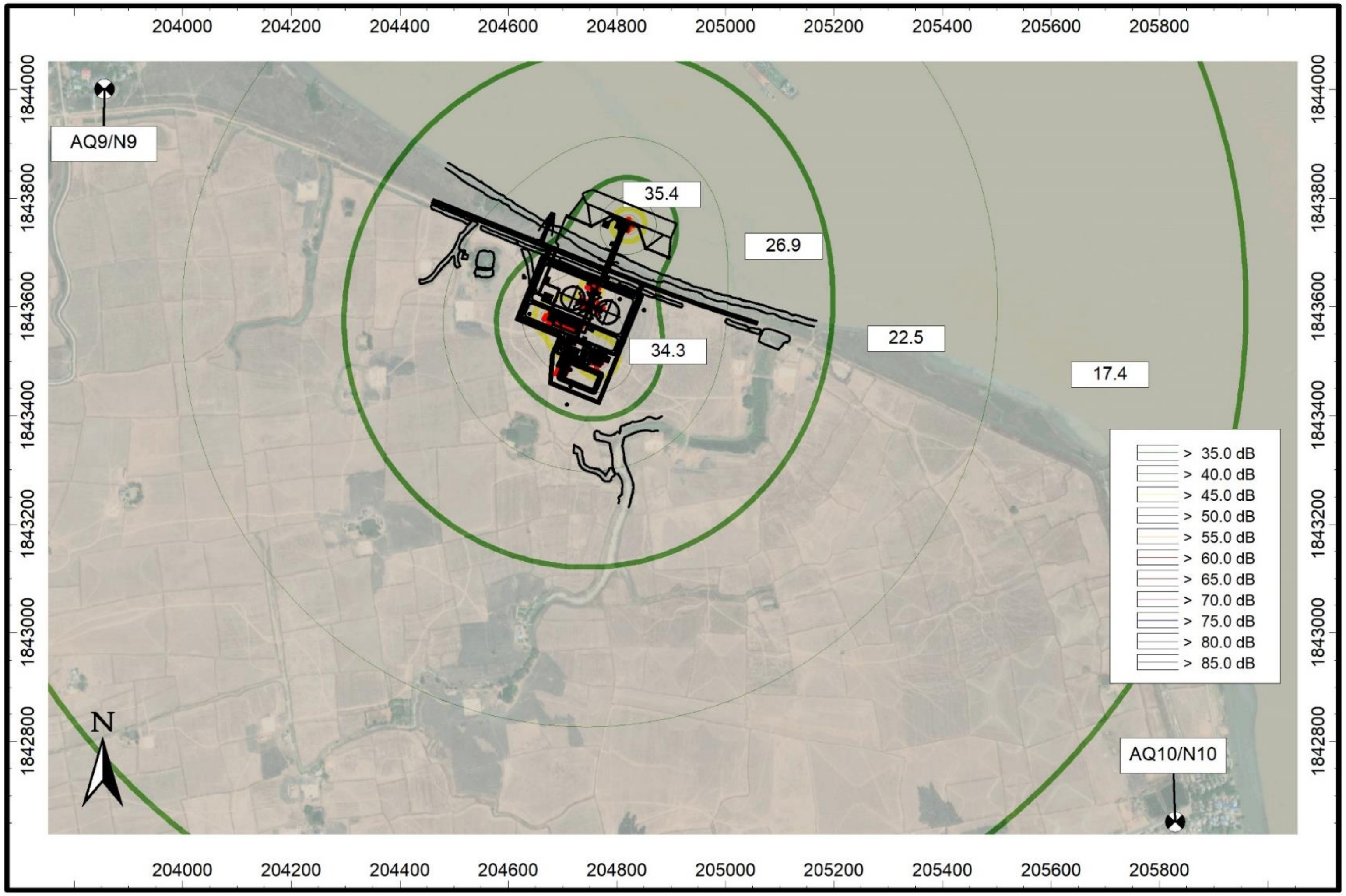
Figure 7.12: Noise Contour during Operation Phase (Worst-case Scenario) (Type B) – Zoomed In



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 considered long-term.			

Significance of Impact					
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)[104].

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.

[104] 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[105], 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[106] 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).		

105 Metcalf& Eddy Inc. Wastewater Engineering: Treatment, Disposal, Reuse. 3rd Edition McGraw Hill, Network, 1979

106 http://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/WHO/WHO5%20-%20Minimum%20water%20quantity%20needed%20for%20domestic%20use.pdf

<table>
<tr><th colspan="61">Significance of Impact</th></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="20">Direct</td><td colspan="20">Indirect</td><td colspan="20">Induced</td></tr>
<tr><td colspan="60">Impacts to surface water would be direct impacts through water intake from the Yangon River.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="15">Temporary</td><td colspan="15">Short-term</td><td colspan="15">Long-term</td><td colspan="15">Permanent</td></tr>
<tr><td colspan="60">Construction will take approximately 23 months, which would be considered short-term.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="20">Local</td><td colspan="20">Regional</td><td colspan="20">International</td></tr>
<tr><td colspan="60">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.</td></tr>
<tr><td>Impact Scale</td><td colspan="60">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.
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.</td></tr>
<tr><td>Frequency</td><td colspan="60">Impacts to surface water from water use could occur intermittently but repeatedly throughout the day for the duration of the construction phase.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">Small</td><td colspan="12">Medium</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">Based on the characteristics above, the impact magnitude is likely to be Negligible.</td></tr>
<tr><td rowspan="2">Receptor Sensitivity</td><td colspan="20">Low</td><td colspan="20">Medium</td><td colspan="20">High</td></tr>
<tr><td colspan="60">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.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td colspan="15">Negligible</td><td colspan="15">Minor</td><td colspan="15">Moderate</td><td colspan="15">Major</td></tr>
<tr><td colspan="60">The combination of a Low Resource Sensitivity and Negligible Impact Magnitude will result in an overall Negligible impact.</td></tr>
</table>

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, impacts to the Yangon River water supply is expected to have a relatively small impact.

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, 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:

- 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.

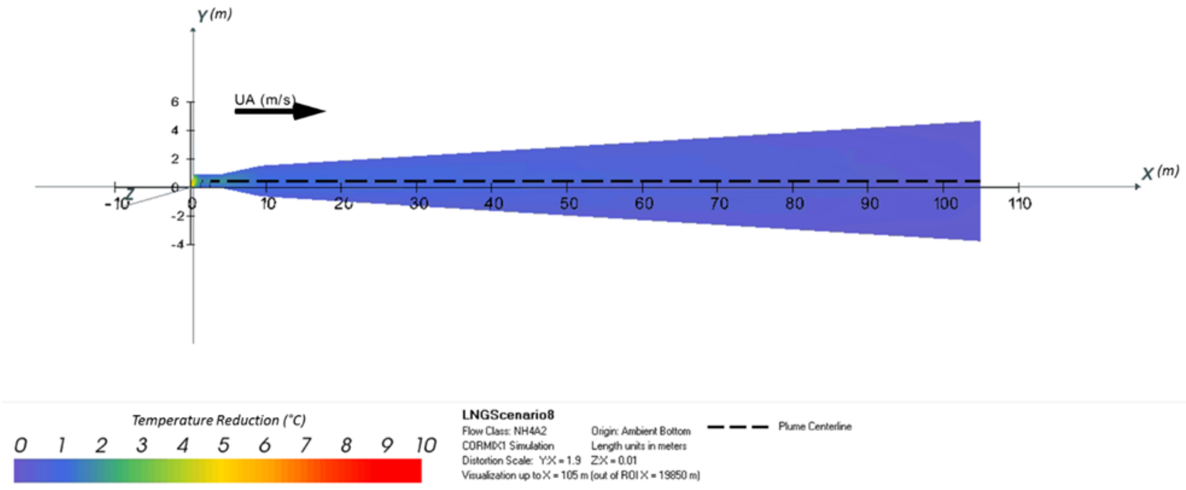
Various scenarios including critical conditions were modelled using CORMIX and evaluated for compliance with IFC standards. All modelling scenarios indicated the most critical scenario (worst case scenario) for the LNG Receiving Terminal involves high ambient velocity, high ambient temperature, and large 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.

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***.

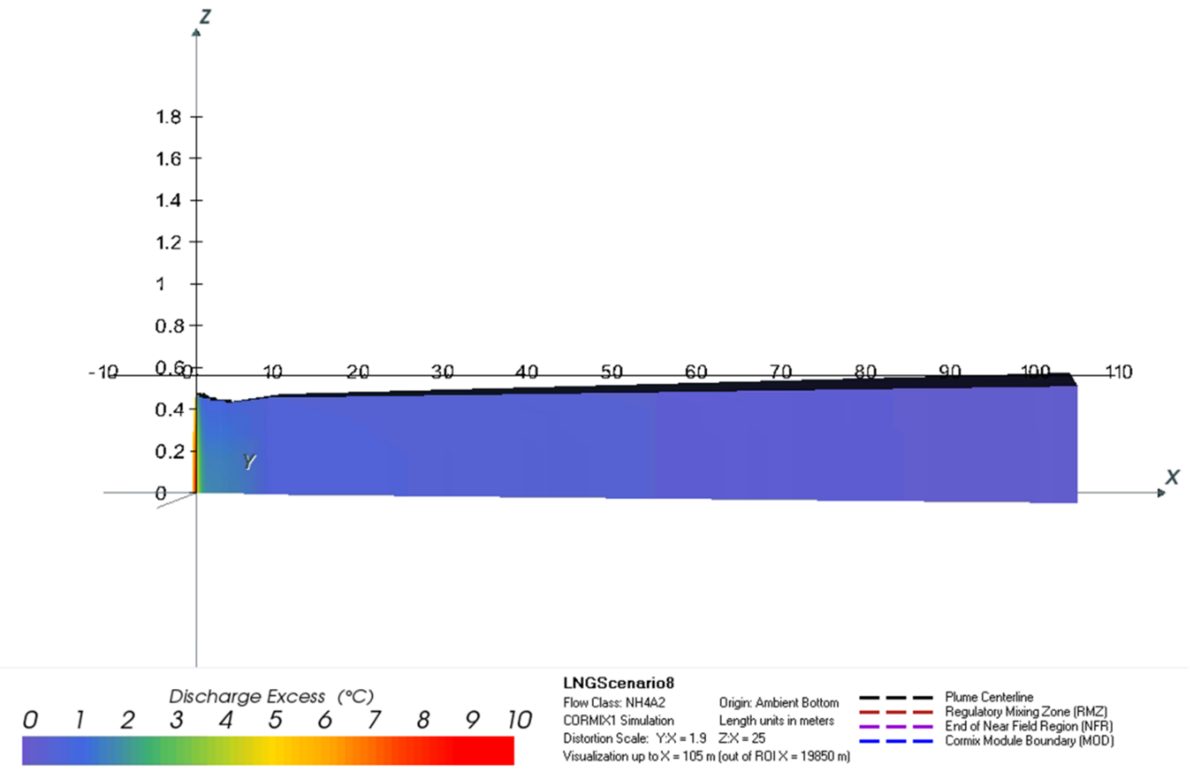
The full CORMIX modelling results are shown in ***Appendix R***.

Figure 7.14: Lateral (X-Y) View of the Thermal Plume Resulting from LNG Scenario 8 Critical Conditions



Source: ERM, 2019. (***Appendix R***)

Figure 7.15: Vertical (X-Y) View of the Thermal Plume Resulting from LNG Scenario 8 Critical Conditions



Source: ERM, 2019. (***Appendix R***)

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
	Potential impacts to surface water would be considered to be adverse (negative).		

Significance of Impact					
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.			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	Construction will take approximately 23 months, which would be considered short-term.			

<table>
<tr><th colspan="6">Significance of Impact</th></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="2">Local</td><td colspan="2">Regional</td><td>International</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Impact Scale</td><td colspan="5">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.</td></tr>
<tr><td>Frequency</td><td colspan="5">Impacts to surface water from piling activities could occur intermittently but repeatedly throughout the day for the duration of the construction phase.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td>Positive</td><td>Negligible</td><td>Small</td><td>Medium</td><td>Large</td></tr>
<tr><td colspan="5">Based on the characteristics above, the impact magnitude is likely to be Negligible.</td></tr>
<tr><td rowspan="2">Receptor Sensitivity</td><td colspan="2">Low</td><td colspan="2">Medium</td><td>High</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Negligible</td><td>Minor</td><td colspan="2">Moderate</td><td>Major</td></tr>
<tr><td colspan="5">The combination of a Low Resource Sensitivity and Negligible Impact Magnitude will result in an overall Negligible impact.</td></tr>
</table>

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.				
	Low	**Medium**	High		

Receptor Sensitivity	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.			

Significance of Impact						
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.					
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 4.14*** 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.			

Significance of Impact					
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 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.			

<table>
<tr><th colspan="2">Significance of Impact</th></tr>
<tr><td>Impact Scale</td><td>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).</td></tr>
<tr><td>Impact Frequency</td><td>Impacts would occur intermittently but repeatedly throughout the operation and maintenance activity.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td>Positive | Negligible | Small | Medium | Large</td></tr>
<tr><td>Based on the combination of the above impact characteristics the impact magnitude is considered to be small.</td></tr>
<tr><td rowspan="2">Receptor Sensitivity</td><td>Low | Medium | High</td></tr>
<tr><td>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.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Negligible | Minor | Moderate | Major</td></tr>
<tr><td>The combination of a medium resource sensitivity and small impact magnitude will result in minor level of impact significance.</td></tr>
</table>

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.			
	Temporary	**Short-term**	**Long-term**	Permanent

Significance of Impact					
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[107]	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.

[107] 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.

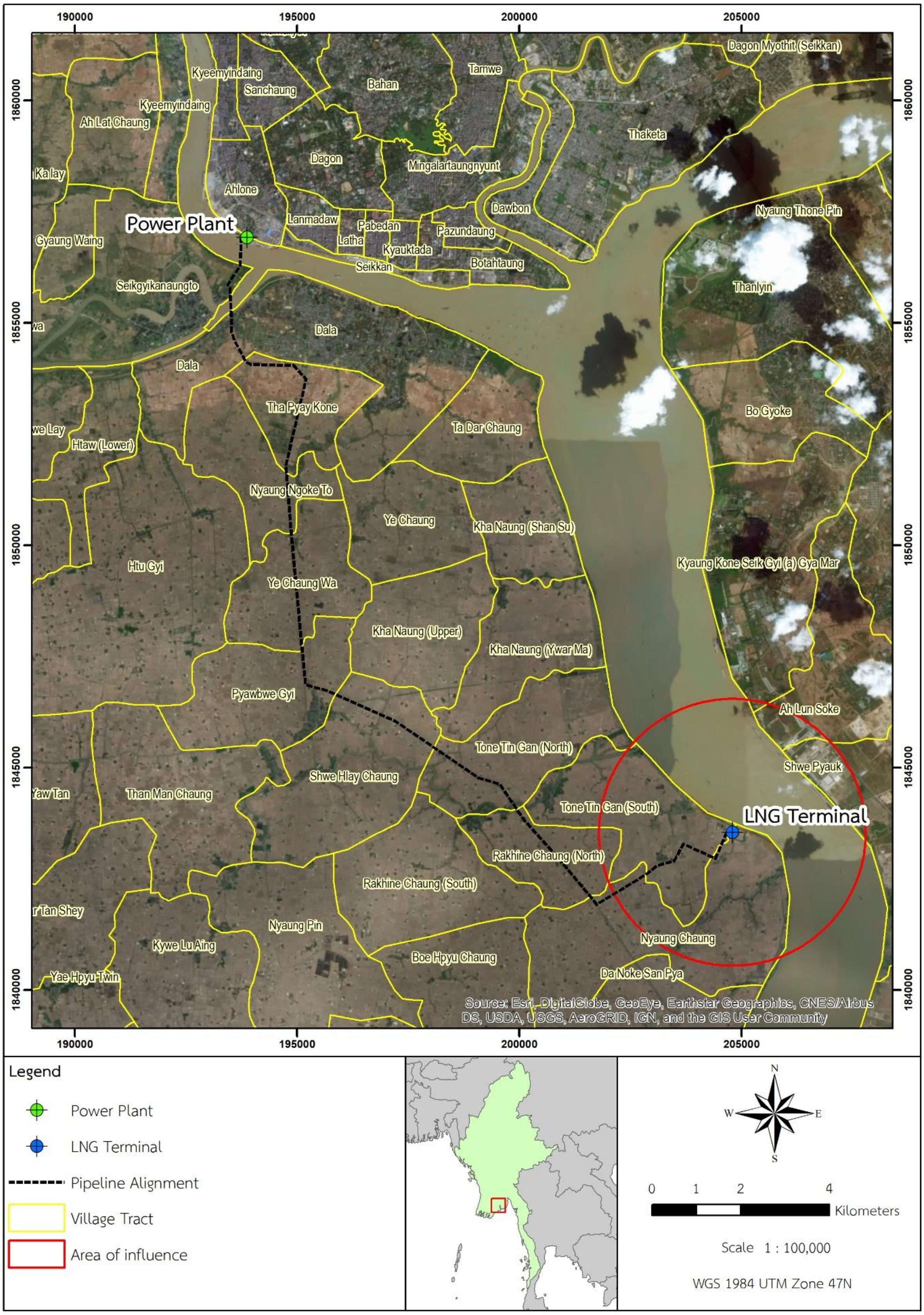
Box 7.1: IFC Definition of Area of Influence

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.

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 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.

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 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. About 20% of the people interviewed said they engage in farming or that they 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		
	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 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 need to 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 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.

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 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 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 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 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).		

<table>
<tr><th colspan="6">Significance of Impact</th></tr>
<tr><td rowspan="2">Impact Type</td><td>Direct</td><td colspan="2">Indirect</td><td colspan="2">Induced</td></tr>
<tr><td colspan="5">Potential impacts would likely be direct impacts.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td>Temporary</td><td>Short-term</td><td>Long-term</td><td colspan="2">Permanent</td></tr>
<tr><td colspan="5">Impact has the potential to have a long lasting effect as the operation will last for 25 years.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td>Local</td><td colspan="2">Regional</td><td colspan="2">International</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Impact Scale</td><td colspan="5">The number of Households that could be impacted is small as only the people living directly next to the terminal will experience the impacts.</td></tr>
<tr><td>Frequency</td><td colspan="5">Impact will be experienced daily</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td>Positive</td><td>Negligible</td><td>Small</td><td>Medium</td><td>Large</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td rowspan="2">Receptor Sensitivity</td><td>Low</td><td colspan="2">Medium</td><td colspan="2">High</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Negligible</td><td>Minor</td><td>Moderate</td><td colspan="2">Major</td></tr>
<tr><td colspan="5">The significance is Negligible</td></tr>
</table>

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 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 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.				
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.				

Significance of Impact				
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 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 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

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.

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 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.[108] 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.[109] 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.

[108] 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

[109] 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.

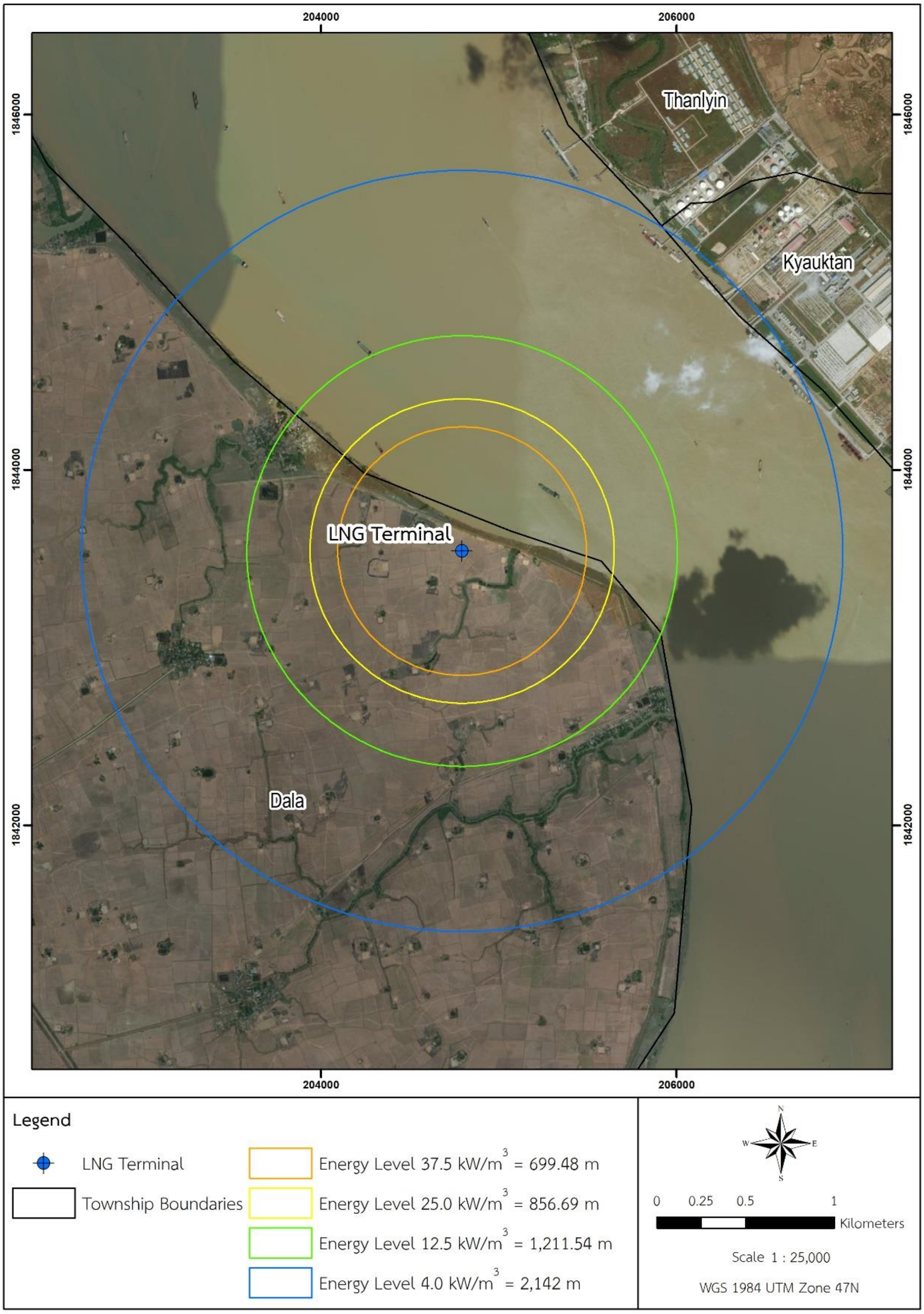
Source: World Bank technical paper number 55, Techniques for Assessing Industrial Hazards a Manual (1998)

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]

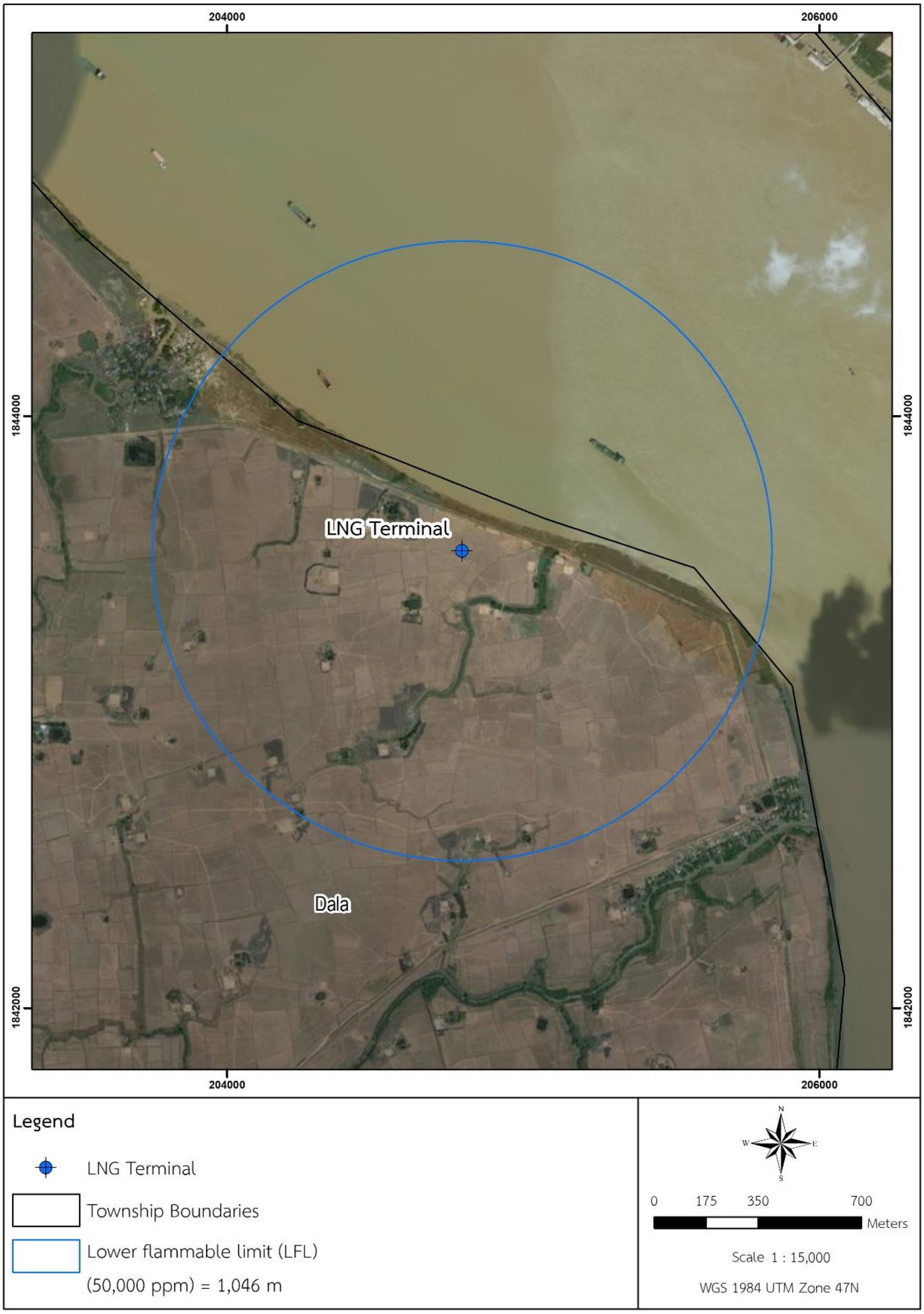
Source: [a] Breeze Incident Analyst User Guide Version 1.4, Trinity Consultants (2018)
[b] Lees, Frank P., Loss Prevention in the Process Industries, Vol.1, London and Boston (1980)
[c] Planning Guidance for Response to a Nuclear Detonation, Federal Emergency Management Agency (FEMA) (2010)

Figure 7.17: Heat radiation radius in of fire ball scenario



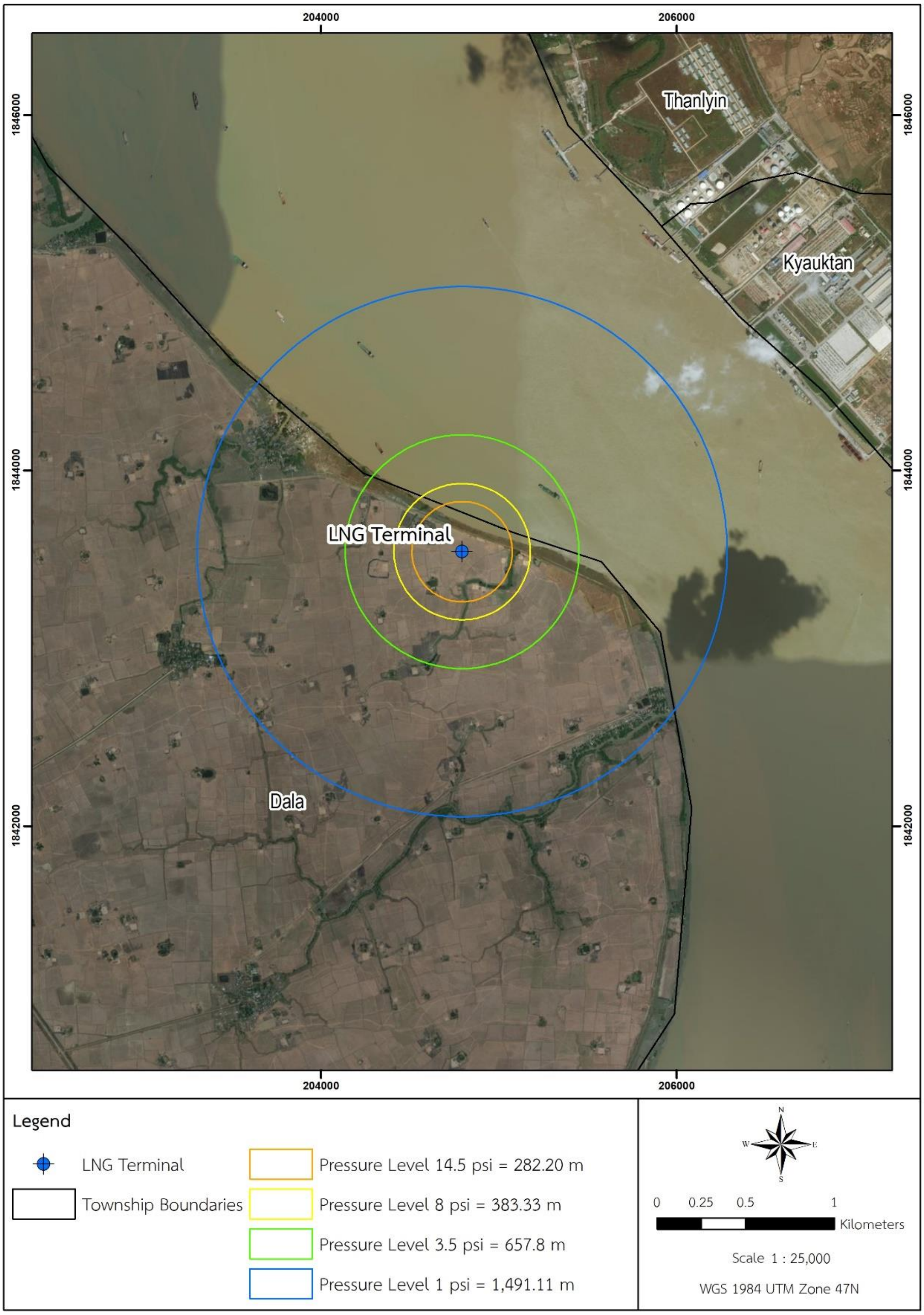
Source: BREEZE Incident Analyst. (Modified by ERM)

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 more in life of the Project.				

Significance of Impact				
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).		
Impact Type	**Direct**	Indirect	Induced

Significance of Impact					
	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.			
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).			

<table>
<tr><th colspan="6">Significance of Impact</th></tr>
<tr><td>Impact Scale</td><td colspan="5">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.</td></tr>
<tr><td>Impact Frequency</td><td colspan="5">If construction and operation activities are carried out appropriately, the frequency is anticipated to be in-frequent</td></tr>
<tr><td rowspan="2">Impact Consequence</td><td>Incidental</td><td>Minor</td><td>Moderate</td><td>Major</td><td>Severe</td></tr>
<tr><td colspan="5">Based on the combination of the above impact characteristics, the impact magnitude is considered to be Minor to Moderate.</td></tr>
<tr><td rowspan="2">Impact Likelihood</td><td>Very Unlikely</td><td>Unlikely</td><td>Likely to occur once or more in life of the Project</td><td>Likely to occur once or twice per year</td><td>Will likely occurs more than twice per year, or is continuous or certain to occur</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Negligible</td><td>Minor</td><td>Moderate</td><td colspan="2">Major</td></tr>
<tr><td colspan="5">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.</td></tr>
</table>

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	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

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

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
	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 Q*** 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 Q*** 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 Q***. 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 Q***).

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)[110] 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 Q***). 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***.

[110] 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 moderate.				

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[111] 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 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.

[111] Official greenhouse gas inventory reporting includes Sustainability Reporting, CDP, DJSI or other nationally relevant greenhouse reporting schemes.

- **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.[112]

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[113] GHG emissions in 2013, accounting for 51.0% of the country's total emissions.[114] Within the LUCF sector, changes in forest land contributed 73% of emissions.[115] Agriculture was the second most significant source (32.1%)

112 https://www.climatelinks.org/resources/greenhouse-gas-emissions-factsheet-burma

113 Burma ratified the UNFCCC as Myanmar. UNFCCC Status of Ratification, viewed on March 20, 2017.

114 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).

115 Food and Agriculture Organization of the United Nations Statistics Division (FAOSTAT). Myanmar, Emissions – Land use total, viewed on March 18, 2017.

with rice cultivation and enteric fermentation from livestock contributing 67% of agriculture emissions.[116] 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.[117] 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.

[116] FAOSTAT. Myanmar, Emissions – Agriculture total, viewed on March 18, 2017.

[117] 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)
LNG Terminal	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
LNG Terminal	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.[118] 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***.

[118] 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.			

Significance of Impact							
	Car ferry to be used for transporting trucks containing construction material has a reference sound level per unit of 87 dBA.[119] 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

[119] 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

produce a certain level of noise impact towards NSRs. Given that the pipeline will be constructed in 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.			

Significance of 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 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[120]. 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.

120 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[121];
- 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.

[121] 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[122]. 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[123] 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)

<table>
<tr><th colspan="5">Significance of Impact</th></tr>
<tr><td>Impact</td><td colspan="4">Potential impacts on surface water due to water intake requirements during construction phase.</td></tr>
<tr><td rowspan="2">Impact Nature</td><td>Negative</td><td colspan="2">Positive</td><td>Neutral</td></tr>
<tr><td colspan="4">Potential impacts to surface water would be considered to be adverse (negative).</td></tr>
<tr><td rowspan="2">Impact Type</td><td>Direct</td><td colspan="2">Indirect</td><td>Induced</td></tr>
<tr><td colspan="4">Impacts to surface water would be direct impacts through water intake from the Yangon River and adjoining streams and tributaries.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td>Temporary</td><td>Short-term</td><td>Long-term</td><td>Permanent</td></tr>
<tr><td colspan="4">Construction is expected to be completed in 18 months, which would be considered short-term.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td>Local</td><td colspan="2">Regional</td><td>International</td></tr>
<tr><td colspan="4">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.</td></tr>
</table>

[122] Metcalf& Eddy Inc. Wastewater Engineering: Treatment, Disposal, Reuse. 3rd Edition McGraw Hill, Network, 1979
[123] 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 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. Although the Yangon River and adjoining streams and tributaries 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.						
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)

<table>
<tr><th colspan="6">Significance of Impact</th></tr>
<tr><td>Impact</td><td colspan="5">Potential impacts on surface water due to water discharge from hydrostatic testing during construction phase.</td></tr>
<tr><td rowspan="2">Impact Nature</td><td colspan="2">Negative</td><td colspan="2">Positive</td><td>Neutral</td></tr>
<tr><td colspan="5">Potential impacts to surface water would be considered to be adverse (negative).</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="2">Direct</td><td colspan="2">Indirect</td><td>Induced</td></tr>
<tr><td colspan="5">Impacts to surface water would be direct impacts through discharge of hydrostatic testing fluid to the Yangon River and adjoining streams and tributaries.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td>Temporary</td><td colspan="2">Short-term</td><td>Long-term</td><td>Permanent</td></tr>
<tr><td colspan="5">Construction is expected to be complete in 18 months, which would be considered short-term.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="2">Local</td><td colspan="2">Regional</td><td>International</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Impact Scale</td><td colspan="5">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.
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.</td></tr>
<tr><td>Frequency</td><td colspan="5">Impacts to surface water from the discharge of degraded hydrostatic testing fluid is only expected to occur once per hydrostatic test.</td></tr>
<tr><td></td><td>Positive</td><td>Negligible</td><td>Small</td><td>Medium</td><td>Large</td></tr>
</table>

Significance of Impact				
Impact Magnitude	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)

<table>
<tr><th colspan="5">Significance of Impact</th></tr>
<tr><td>Impact</td><td colspan="4">Potential impacts on surface water due to erosion of all construction activities during construction phase.</td></tr>
<tr><td rowspan="2">Impact Nature</td><td>Negative</td><td>Positive</td><td colspan="2">Neutral</td></tr>
<tr><td colspan="4">Potential impacts to surface water would be considered to be adverse (negative).</td></tr>
<tr><td rowspan="2">Impact Type</td><td>Direct</td><td>Indirect</td><td colspan="2">Induced</td></tr>
<tr><td colspan="4">Impacts to surface water would be direct impacts through sedimentation from soil erosion.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td>Temporary</td><td>Short-term</td><td>Long-term</td><td>Permanent</td></tr>
<tr><td colspan="4">Construction is expected to be completed in 18 months, which would be considered short-term.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td>Local</td><td>Regional</td><td colspan="2">International</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td>Impact Scale</td><td colspan="4">The amount of soil that will be removed due to excavation activities for the pipeline and then backfilled is approximately 75,000 m^3.</td></tr>
</table>

Significance of Impact					
	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[124], 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.			

[124] 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[125], 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.			

[125] 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

<table>
<tr><th colspan="7">Significance of Impact</th></tr>
<tr><td>Impact Scale</td><td colspan="6">It is expected that the amount of bentonite produced from HDD activities is approximately 1,000 m³.
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.</td></tr>
<tr><td>Frequency</td><td colspan="6">The impacts is not expected to occur.</td></tr>
<tr><td rowspan="2">Likelihood</td><td>Very Unlikely</td><td>Unlikely</td><td>Likely to occur once or more in life of the Project</td><td colspan="2">Likely to occur once or twice per year</td><td>Will likely occurs more than twice per year, or is continuous or certain to occur</td></tr>
<tr><td colspan="6">The likelihood of an accidental leak to occur is unlikely.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td>Positive</td><td>Negligible</td><td>Small</td><td colspan="2">Medium</td><td>Large</td></tr>
<tr><td colspan="6">The impact magnitude is likely to be Small.</td></tr>
<tr><td rowspan="2">Receptor Sensitivity</td><td colspan="2">Low</td><td colspan="2">Medium</td><td colspan="2">High</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Negligible</td><td colspan="2">Minor</td><td colspan="2">Moderate</td><td>Major</td></tr>
<tr><td colspan="6">The combination of a Low Resource Sensitivity and Small Impact Magnitude will result in an overall Negligible impact.</td></tr>
</table>

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 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.

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 4.33*** 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[126]	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

<table>
<tr><th colspan="6">Significance of Impact</th></tr>
<tr><td>Impact</td><td colspan="5">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.</td></tr>
<tr><td rowspan="2">Impact Nature</td><td>Negative</td><td colspan="2">Positive</td><td colspan="2">Neutral</td></tr>
<tr><td colspan="5">Potential impacts is considered to be adverse (negative).</td></tr>
<tr><td rowspan="2">Impact Type</td><td>Direct</td><td colspan="2">Indirect</td><td colspan="2">Induced</td></tr>
<tr><td colspan="5">Impacts would be direct.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td>Temporary</td><td>Short-term</td><td>Long-term</td><td colspan="2">Permanent</td></tr>
<tr><td colspan="5">Construction will take approximately 18 months for the Pipeline. Duration is considered as short-term.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td>Local</td><td colspan="2">Regional</td><td colspan="2">International</td></tr>
<tr><td colspan="5">The extent of potential impacts may travel outside of the Project footprint but will still remain within local extent.</td></tr>
<tr><td>Impact Scale</td><td colspan="5">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).</td></tr>
<tr><td>Impact Frequency</td><td colspan="5">Impacts would occur intermittently but repeatedly throughout the day for the duration of the construction phase which is anticipated to be 18 months.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td>Positive</td><td>Negligible</td><td>Small</td><td>Medium</td><td>Large</td></tr>
<tr><td colspan="5">Based on the combination of the above impact characteristics the impact magnitude is considered to be medium.</td></tr>
</table>

[126] Metcalf& Eddy Inc. Wastewater Engineering: Treatment, Disposal, Reuse. 3rd Edition McGraw Hill, Network, 1979

Significance of Impact					
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 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.

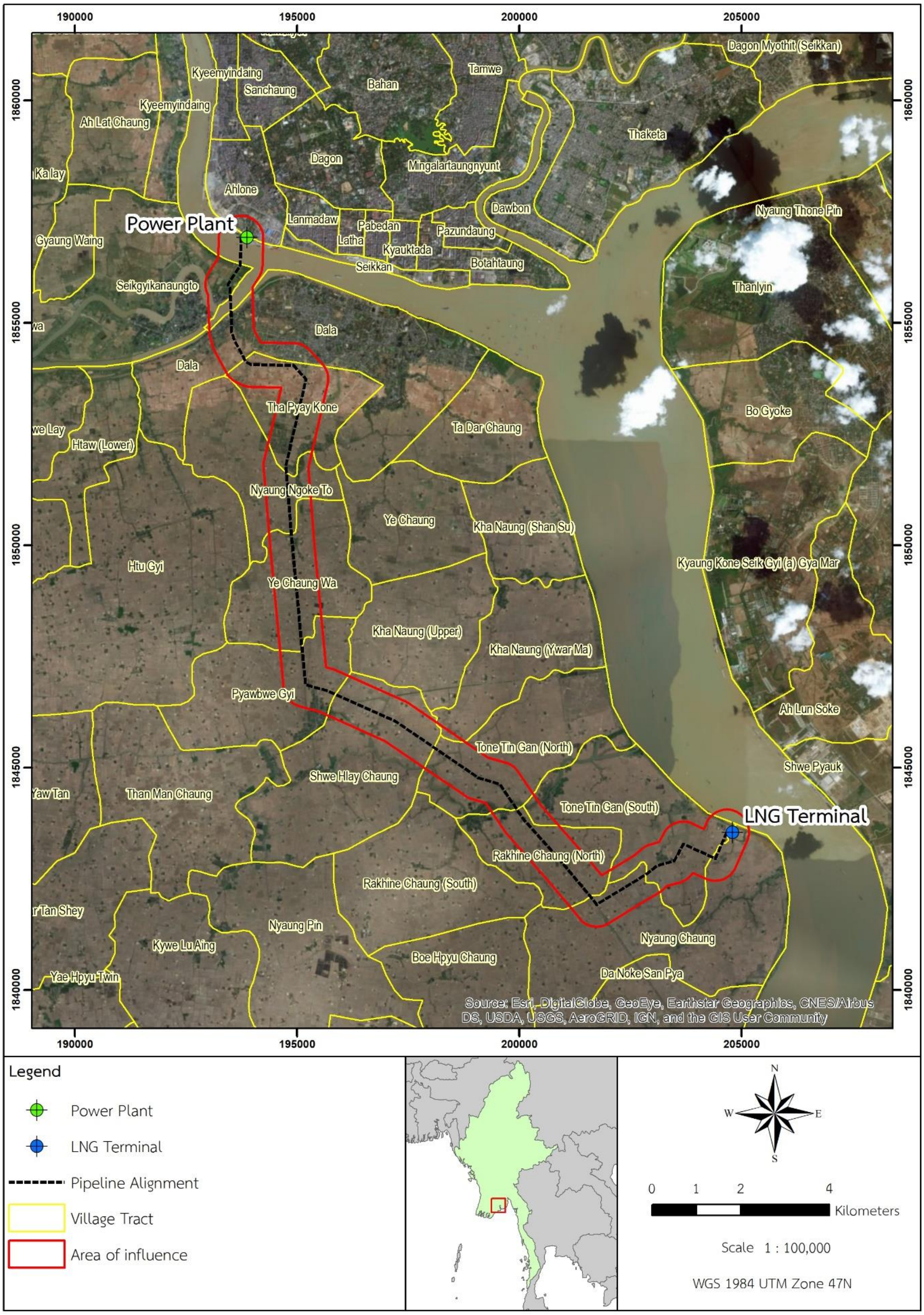
Box 8.1: IFC Definition of Area of Influence

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 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 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 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 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 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 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	
	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 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 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.

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

Althoug the impact is negligible, the following mitigation measures should be implemented:

- 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 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.[127] 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
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;

[127] 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

- 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

Scenarios	Heat Radiation Radius (m)	Affected Area
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
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***.

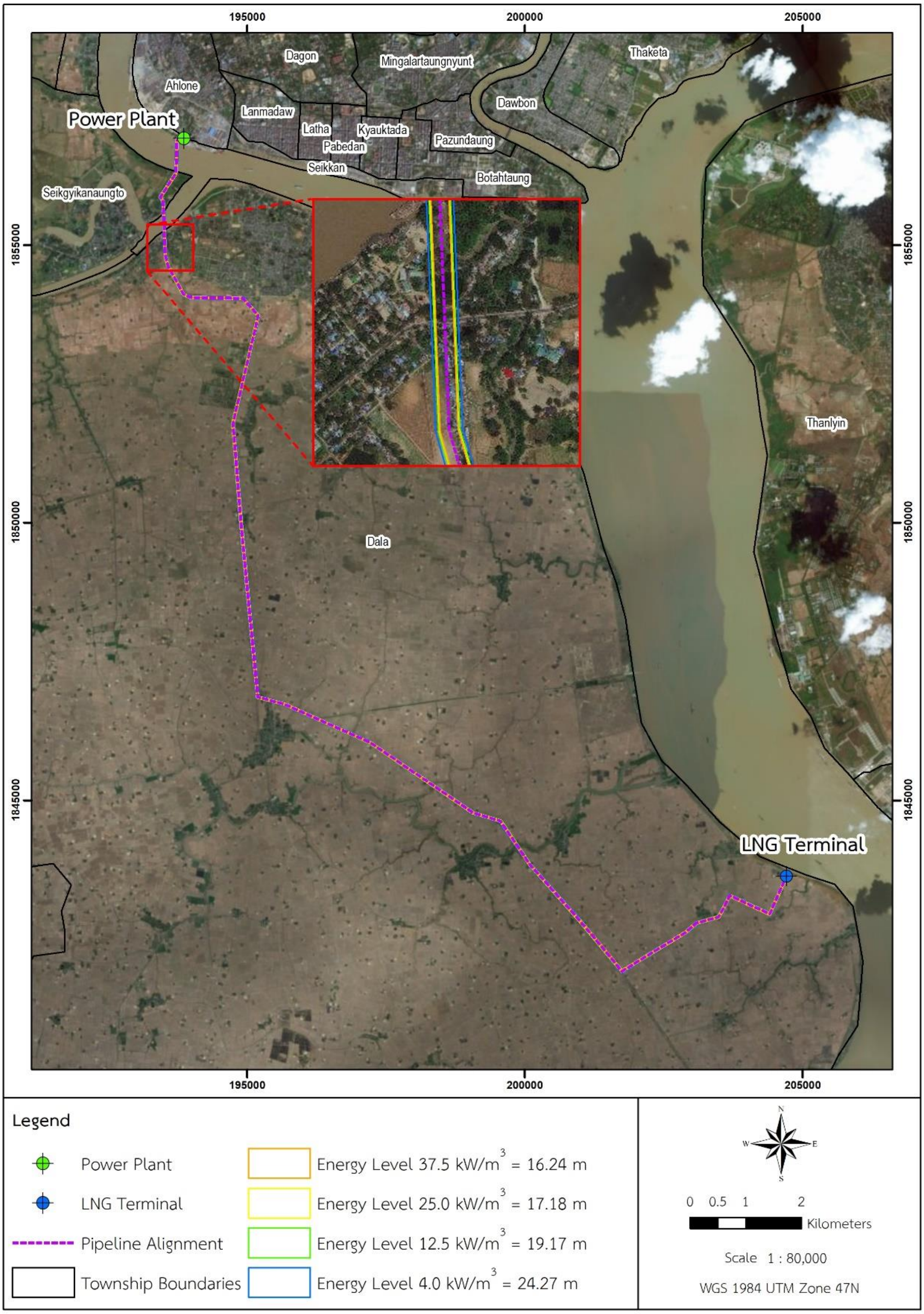
Heat radiation radius assessment of fireball in rupture scenario has the radius of severe impacts from 692 m to 847 m, where the energy level are 37.5 kW/m^2 and 25.0 kW/m^2 respectively as shown in

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***.

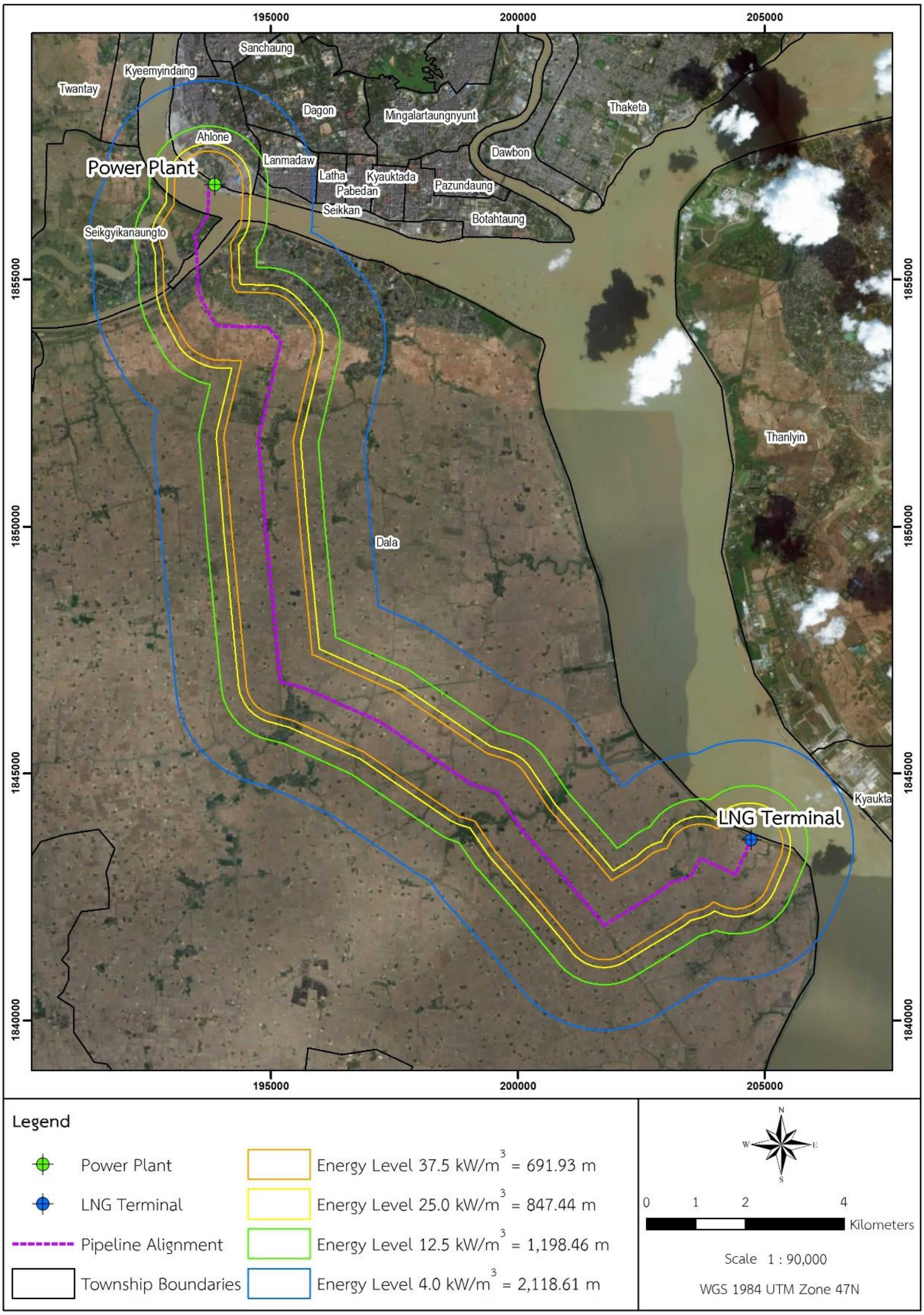
Heat radiation radius assessment of VCE in rupture scenario has the radius of severe impacts from 279 m to 379 m, where the pressure level are 14.5 psi and 8 psi respectively as shown in ***Figure 8.5***. The impact area covers local residence, project area, power plant, and receiving terminal, cropland, 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



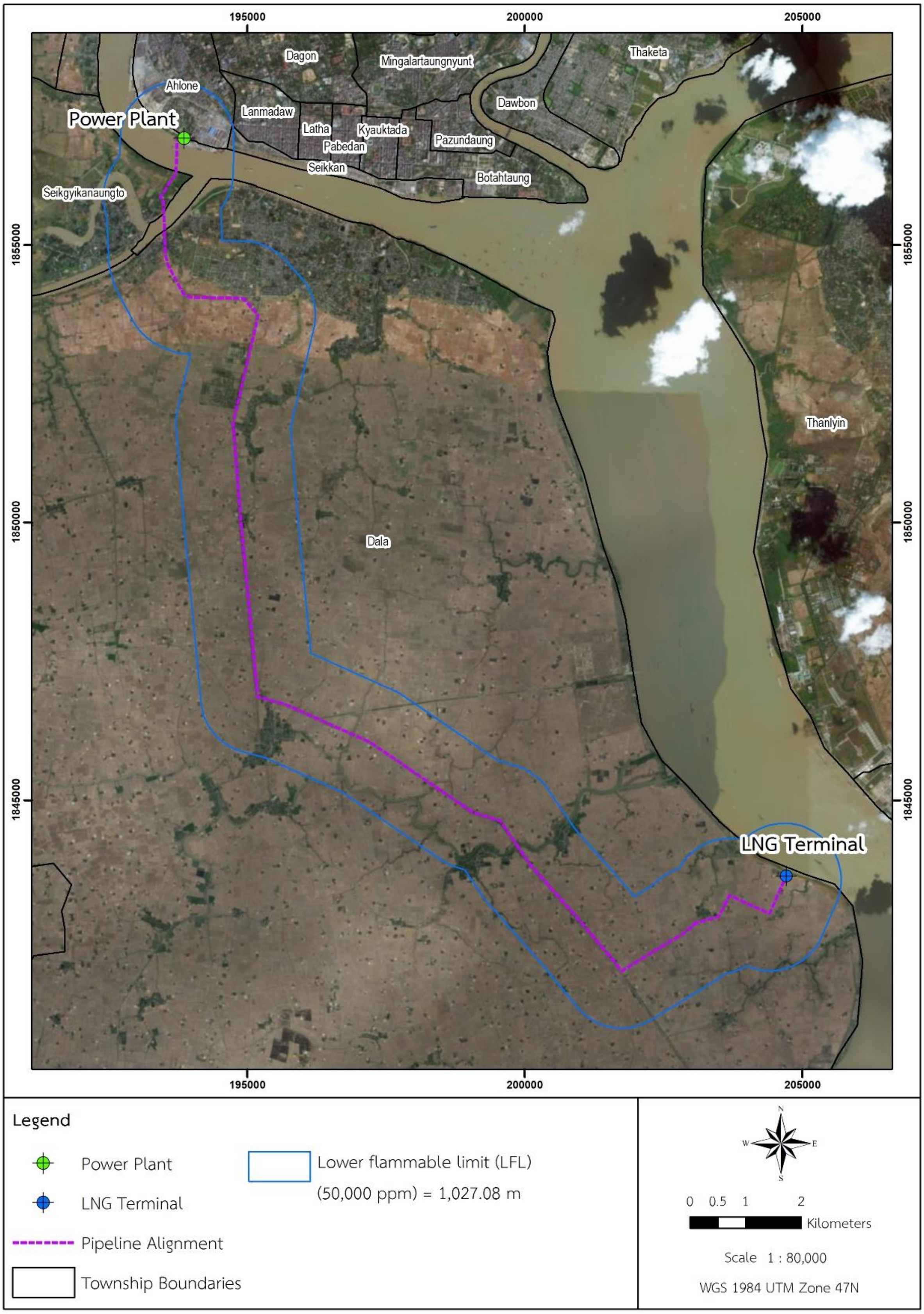
Source: BREEZE Incident Analyst. (Modified by ERM)

Figure 8.3: Heat Radiation Radius in of Fire Ball Scenario



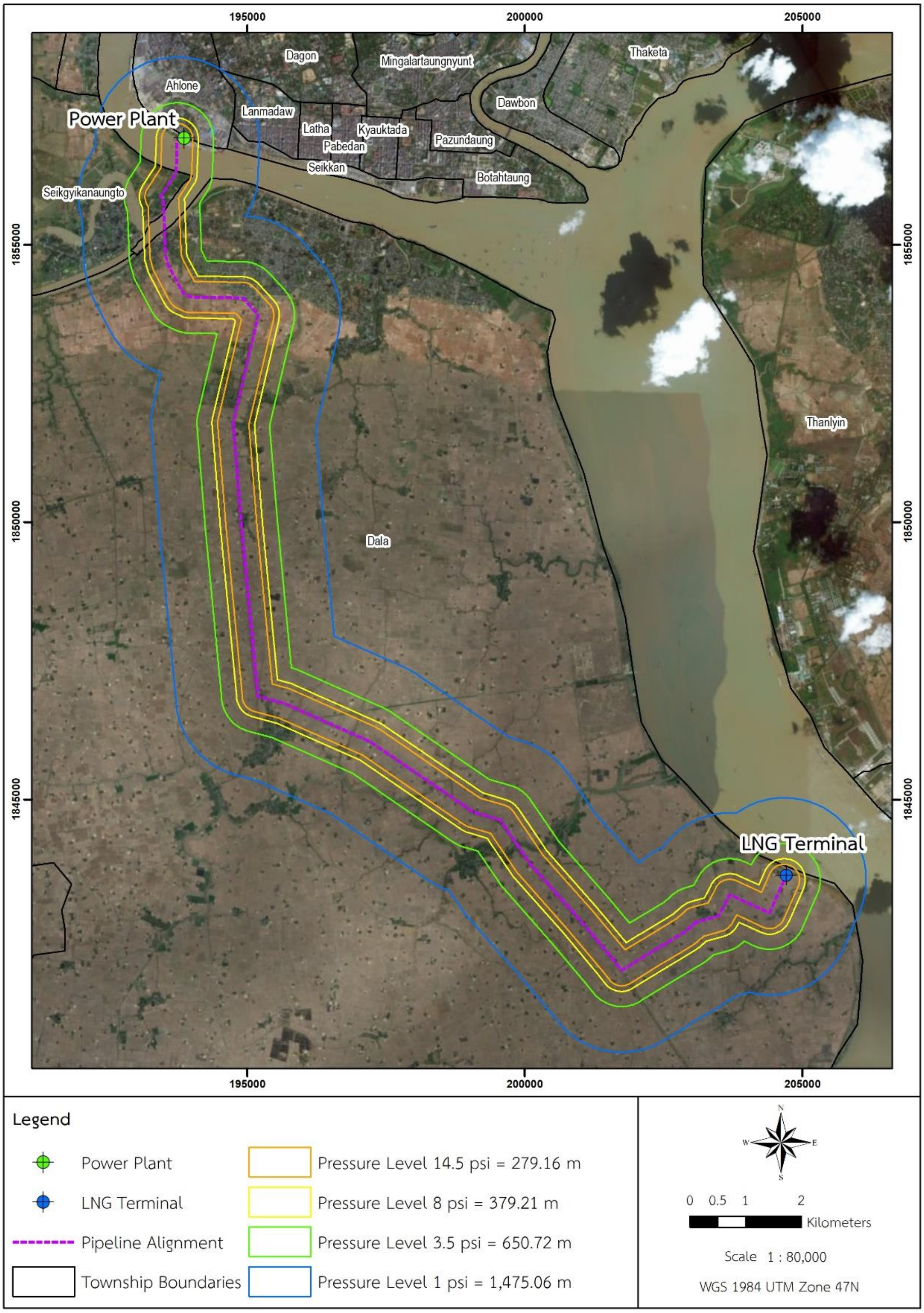
Source: BREEZE Incident Analyst. (Modified by ERM)

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/m²)	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			

Significance of Impact					
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 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.			

Significance of Impact						
Impact Consequence	Incidental	Minor	Moderate		**Major**	Severe
	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 moderate.					

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 **Minor** 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.				
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

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
	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
	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	Moderate	Minor
	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 Q*** 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 Q***, 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)[128] 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 Q***). 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***.

[128] 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[129] 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 Q***.

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.

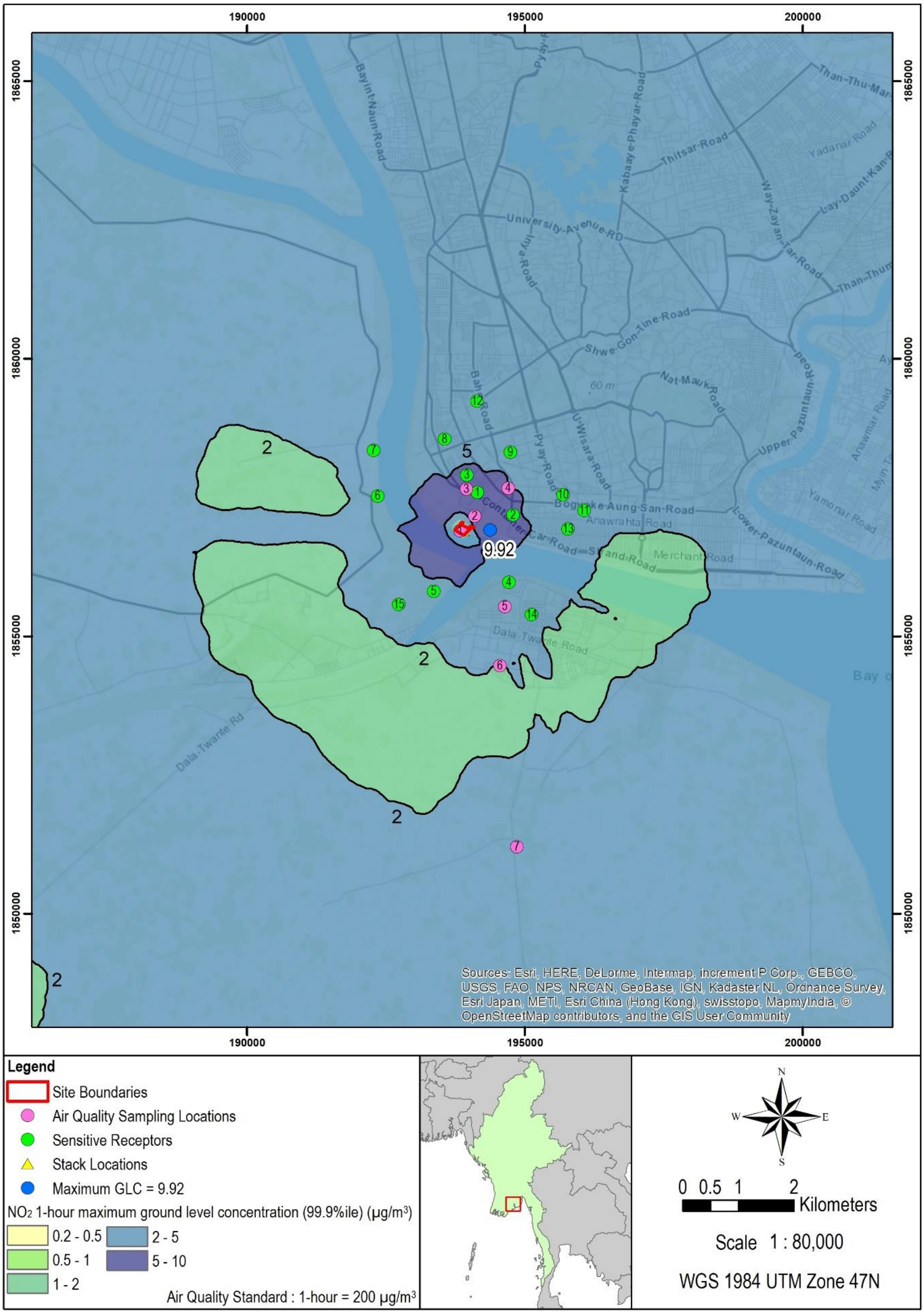
[129] Expected output during operation and is not representative of the maximum steam turbine's capacity.

Table 9.4: Summary of Power Plant Modelling Results

Substance	Averaging Period	Baseline[a] ($\mu g/m^3$)	Max. PC[b] ($\mu g/m^3$)	Max. PEC[c] ($\mu g/m^3$)	AQS[d]	Significance of Impact
NO_2	1-hour	170	9.92	180	200	Negligible
	Annual	24.6	0.0446	25.0	40	Negligible

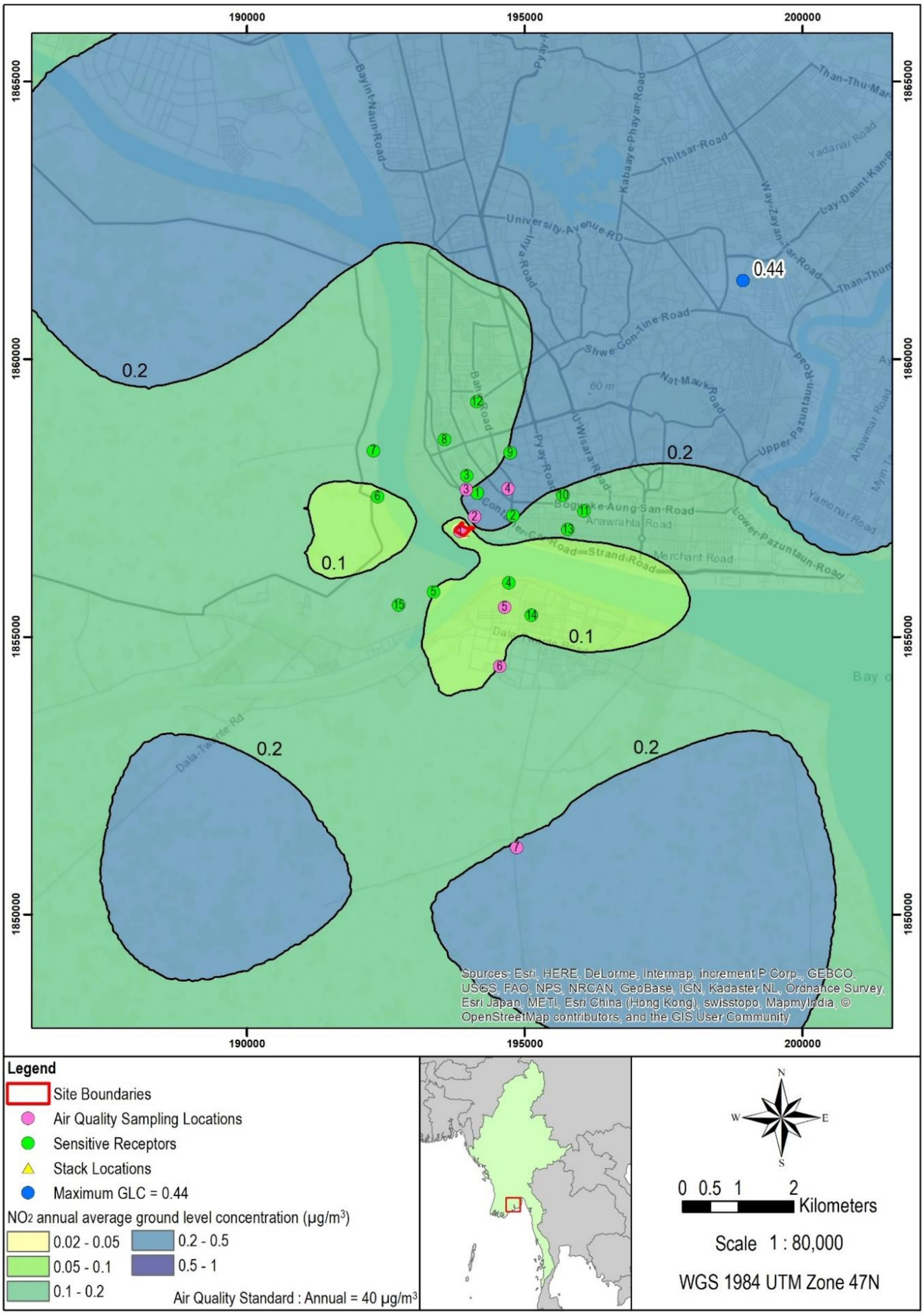
[a] Refer to the baseline assessment in the air quality impact assessment presented in Appendix Q.
[b] Process Contribution is the impact arising solely from project related emissions
[c] Predicted Environmental Concentration is the PC added to the existing baseline
[d] Air Quality Standard as prescribed in the National Environmental Quality (Emission) Guidelines (NEQEG) (2015)

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[130] 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 process

[130] Official greenhouse gas inventory reporting includes Sustainability Reporting, CDP, DJSI or other nationally relevant greenhouse reporting schemes.

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.[131]

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[132] GHG emissions in 2013, accounting for 51.0% of the country's total emissions.[133] Within the LUCF sector, changes in forest land contributed 73% of emissions.[134] Agriculture was the second most significant source (32.1%) with rice cultivation and enteric fermentation from livestock contributing 67% of agriculture emissions.[135] 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.[136] 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 for

[131] https://www.climatelinks.org/resources/greenhouse-gas-emissions-factsheet-burma

[132] Burma ratified the UNFCCC as Myanmar. UNFCCC Status of Ratification, viewed on March 20, 2017.

[133] 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).

[134] Food and Agriculture Organization of the United Nations Statistics Division (FAOSTAT). Myanmar, Emissions – Land use total, viewed on March 18, 2017.

[135] FAOSTAT. Myanmar, Emissions – Agriculture total, viewed on March 18, 2017.

[136] https://www.ncdc.noaa.gov/sotc/global/201813

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)

$$\begin{aligned} Fuel\ Consumption\ (TJ) &= Diesel\ Use\ (I) \times NetCalorific\ Value\ (TJ/Gg) \times Diesel\ Density\ (kg/m^3) \\ &\times 10^{-6}(Gg/kg) \times 10^{-3}(m^3/I) \end{aligned}$$

Equation 16: Fuel Energy Consumption (Gasoline)

$$\begin{aligned} Fuel\ Consumption\ (TJ) &= Gasoline\ Use\ (I) \times NetCalorific\ Value\ (TJ/Gg) \times Gasoline\ Density\ (kg/m^3) \\ &\times 10^{-6}(Gg/kg) \times 10^{-3}(m^3/I) \end{aligned}$$

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.[137]

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.

[137] 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).[138] 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.[139]

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[140] 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[141], 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***

[138] IEA, 2006a: Energy Technology Perspectives 2006: Scenarios and strategies to 2050. International Energy Agency, Paris, 484 pp.

[139] European Commission Joint Research Centre (EUR 19754 EN), Greenhouse Gas Emissions from Fossil Fuel Fired Power Generation Systems.

[140] http://www.csostat.gov.mm/S09MA02.asp cited in UNEP RISØ CENTRE, June 2013, Emission Reduction Profile Myanmar

[141] 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 1.25×10^6 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[142]

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

[142] 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[143] 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

[143] 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.				
	Low	**Medium**	High		

Significance of Impact				
Receptor 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[144], 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 21***:

[144] 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

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)

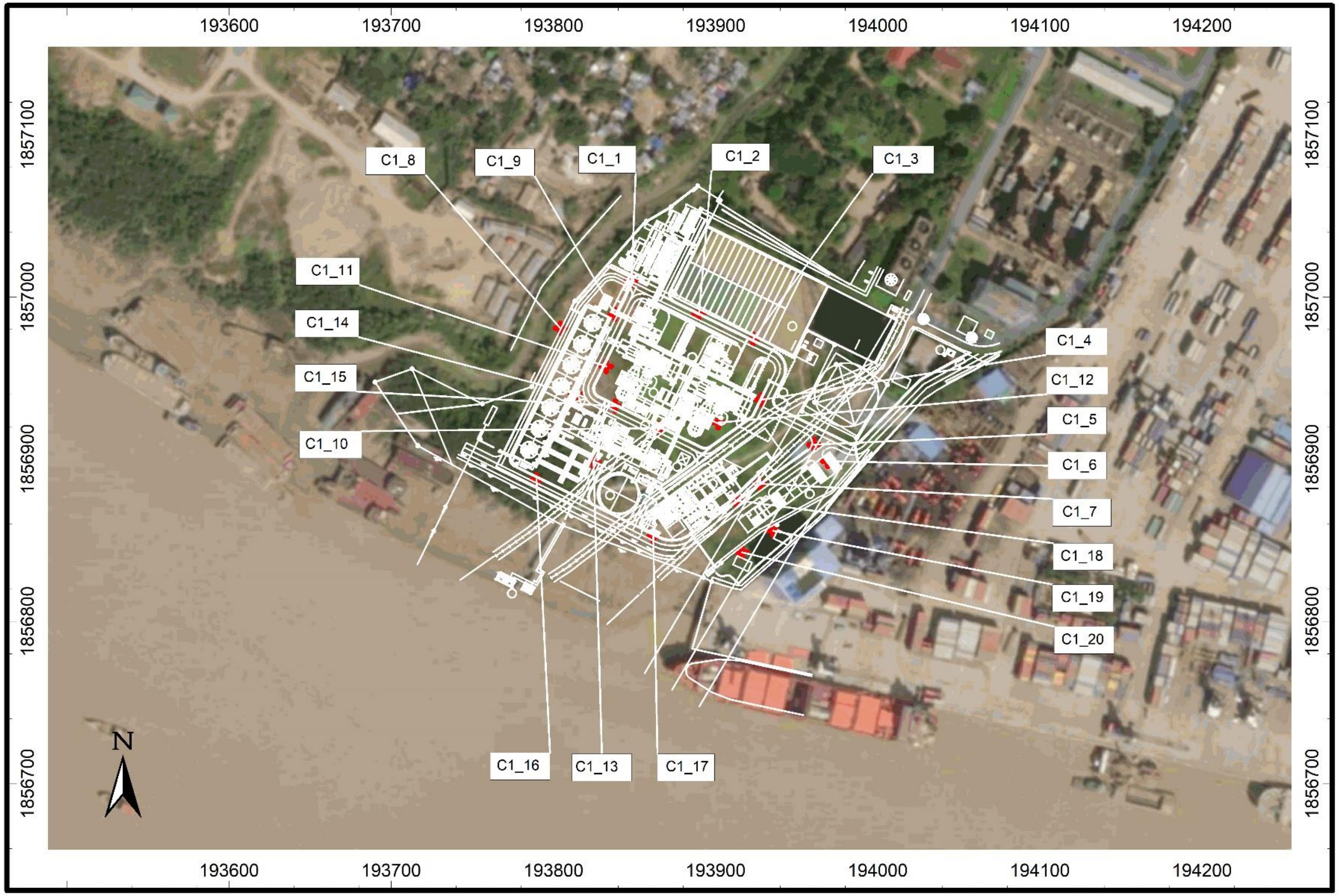
Time of Day	Baseline (dBA)[a]	Noise Level Contribution from Construction Equipment (dBA)	Total Noise Level (dBA)	NEQG Daytime (residential)	NEQG Daytime (industrial)
Day Time	71	54.0	71.08580	55	70
Night time	66	0	66	45	70

Source: SEM, 2018.

Note: [a] Baseline data for noise station N3, survey period 2-4 May 2018.

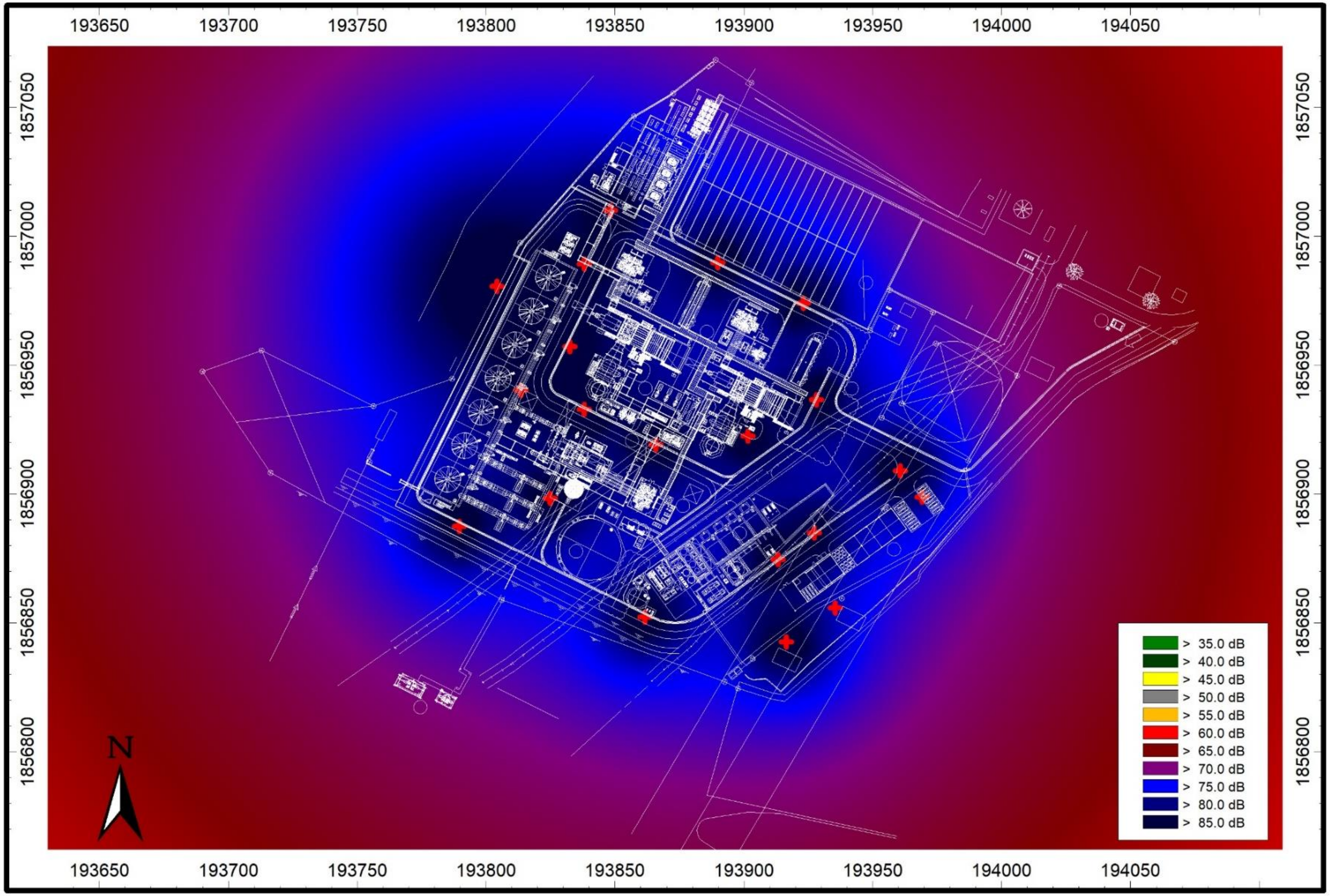
Type A map (noise gradient map which shows the dissipating of noise over distance) and type B (noise contour map which shows the noise level at certain distance) demonstrate is modelled based on the same noise level results; but with different graphical representation.

Figure 9.3: Construction Equipment Location



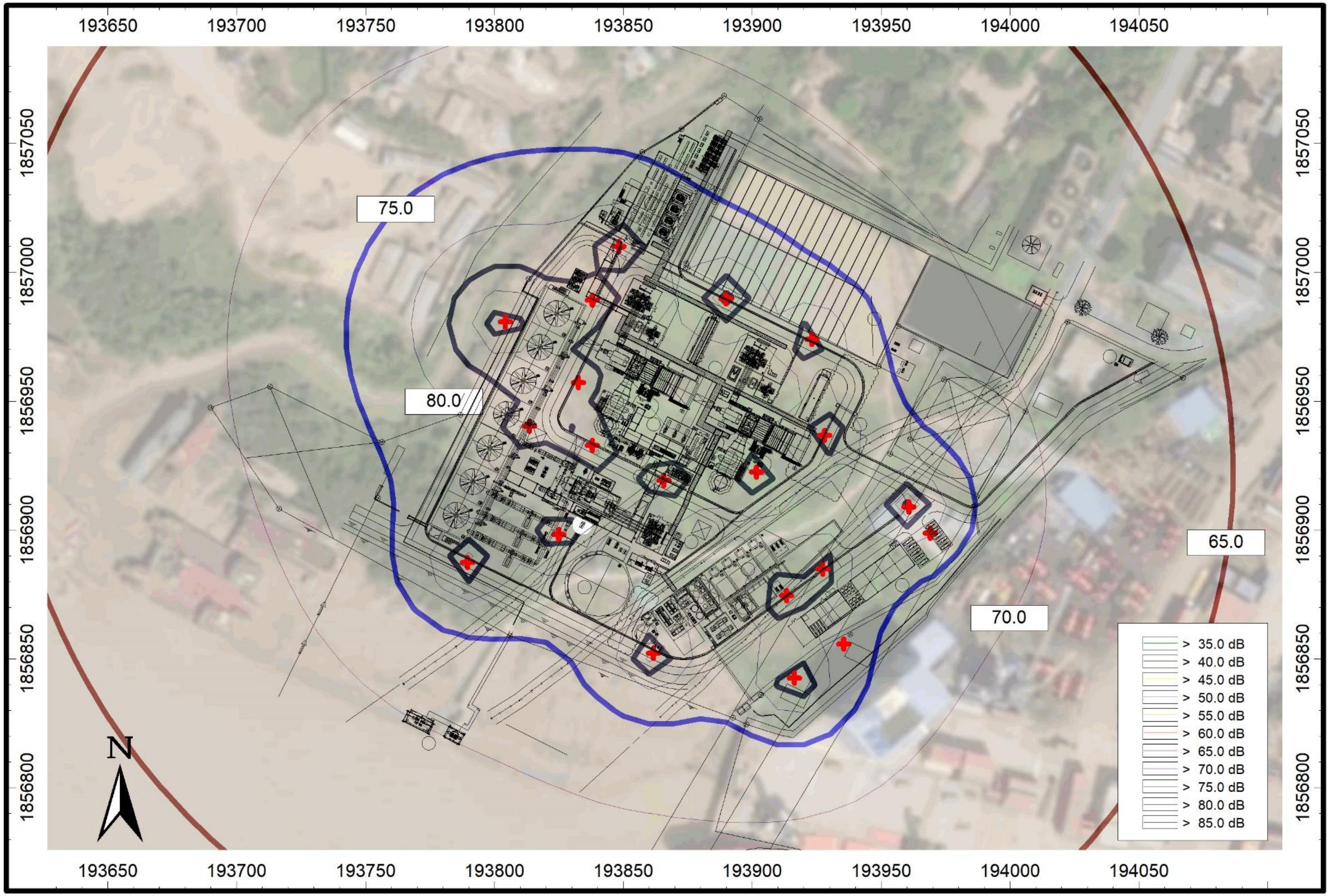
Source: TPMC, 2019. (Modified by AMacoustic)

Figure 9.4: Noise Contour during Construction Phase (Type A)



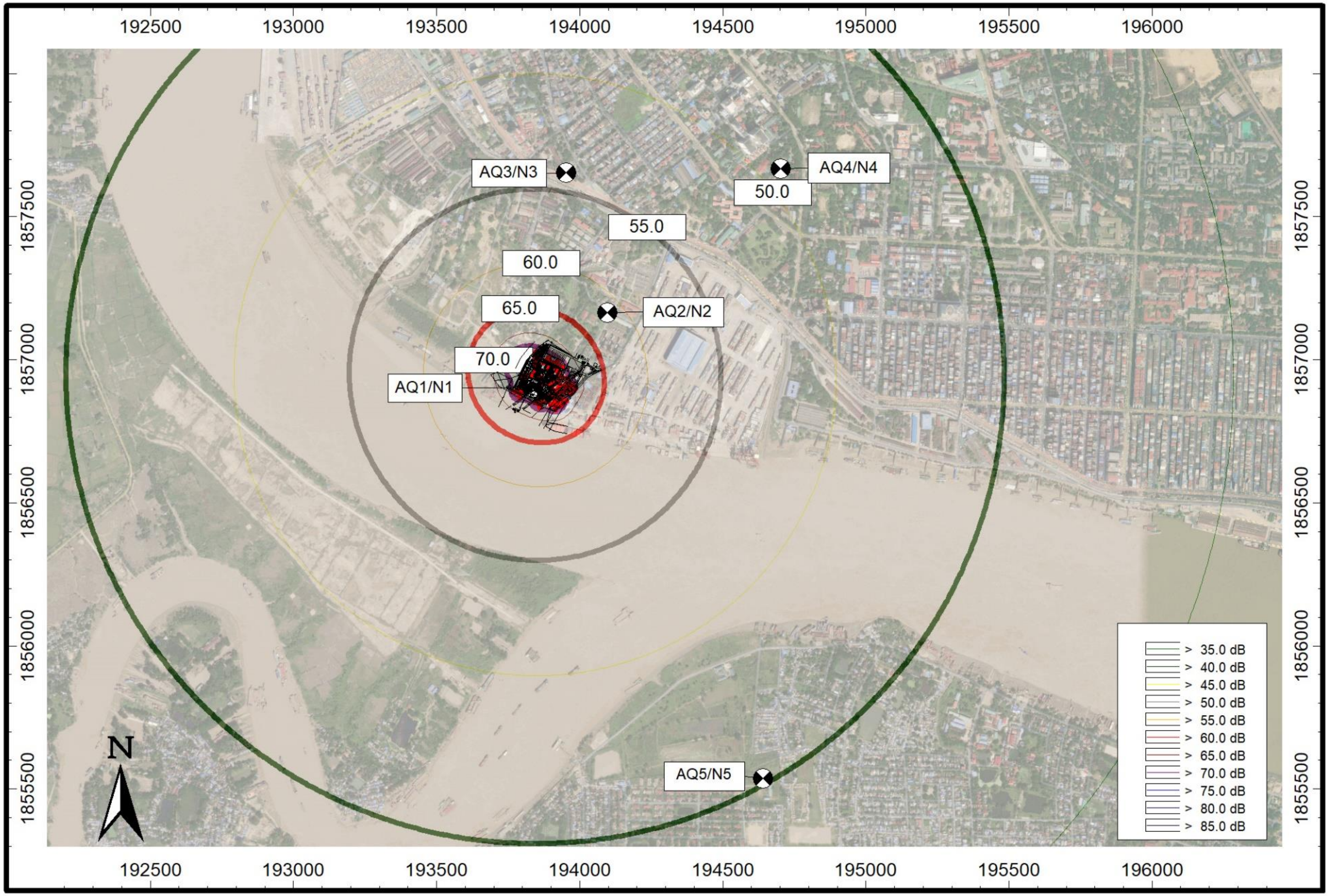
Source: AMacoustic, 2019.

Figure 9.5: Noise Contour during Construction Phase (Type B) – Zoomed In



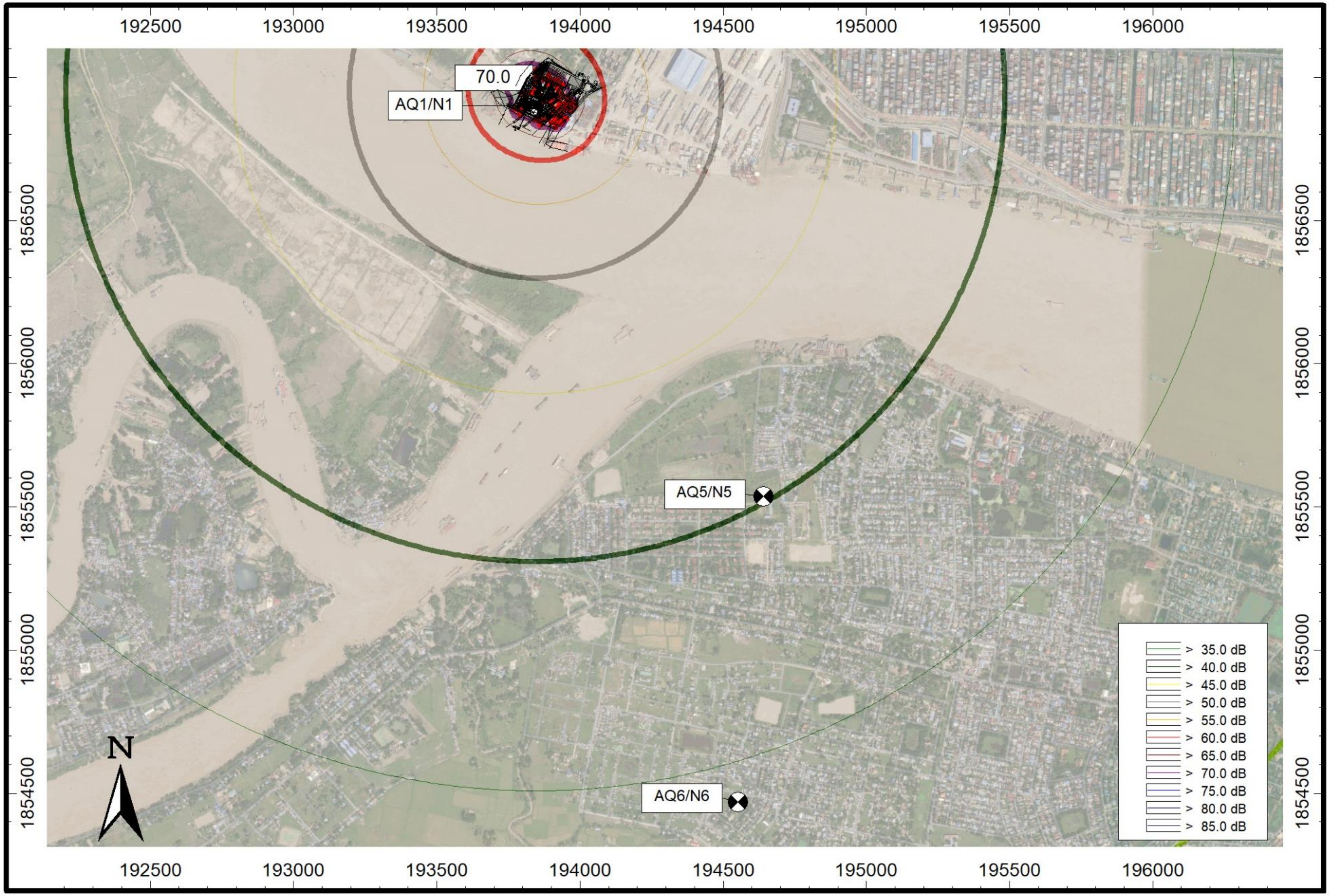
Source: AMacoustic, 2019.

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

<table>
<tr><th colspan="6">Significance of Impact</th></tr>
<tr><td>Impact</td><td colspan="5">Potential impacts to NSRs due to noise emissions Foundation Work and Civil Construction during the construction phase.</td></tr>
<tr><td rowspan="2">Impact Nature</td><td colspan="2">Negative</td><td colspan="2">Positive</td><td>Neutral</td></tr>
<tr><td colspan="5">Potential impacts to NSRs would be considered to be adverse (negative).</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="2">Direct</td><td colspan="2">Indirect</td><td>Induced</td></tr>
<tr><td colspan="5">Potential impacts would likely be direct impacts.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td>Temporary</td><td>Short-term</td><td colspan="2">Long-term</td><td>Permanent</td></tr>
<tr><td colspan="5">Construction is expected to start mid 2019 and be complete in 28 months, which would be considered short-term.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="2">Local</td><td colspan="2">Regional</td><td>International</td></tr>
<tr><td colspan="5">Noise impact from construction equipment will have localised impact.</td></tr>
<tr><td>Impact Scale</td><td colspan="5">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.</td></tr>
<tr><td>Impact Frequency</td><td colspan="5">Equipment is also expected to operate intermittently but repeatedly throughout the day.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td>Positive</td><td>Negligible</td><td>Small</td><td>Medium</td><td>Large</td></tr>
<tr><td colspan="5">Based on the impact characteristics above, the impact magnitude is considered to be medium.</td></tr>
<tr><td rowspan="2">Receptor Sensitivity</td><td colspan="2">Low</td><td colspan="2">Medium</td><td>High</td></tr>
<tr><td colspan="5">The identified NSRs are residential, the sensitivity of the receptor is considered as medium.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Negligible</td><td>Minor</td><td colspan="2">Moderate</td><td>Major</td></tr>
<tr><td colspan="5">The combination of a Medium Receptor Sensitivity and Medium Impact Magnitude will result in an overall Moderate impact.</td></tr>
</table>

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[145]. 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.

[145] 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.				

Significance of Impact				
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 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[146]. 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***.

[146] https://www.fhwa.dot.gov/Environment/noise/noise_barriers/design_construction/keepdown.cfm

Table 9.34: Operation Equipment Noise Level

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

Code	Equipment List	Lw, dBA	Hours	Operation	Working	Standby
P1_34	No.1 & No.2 & No.3 Condensate Extraction Pump	85	24 hr.	Constant	2	1
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.

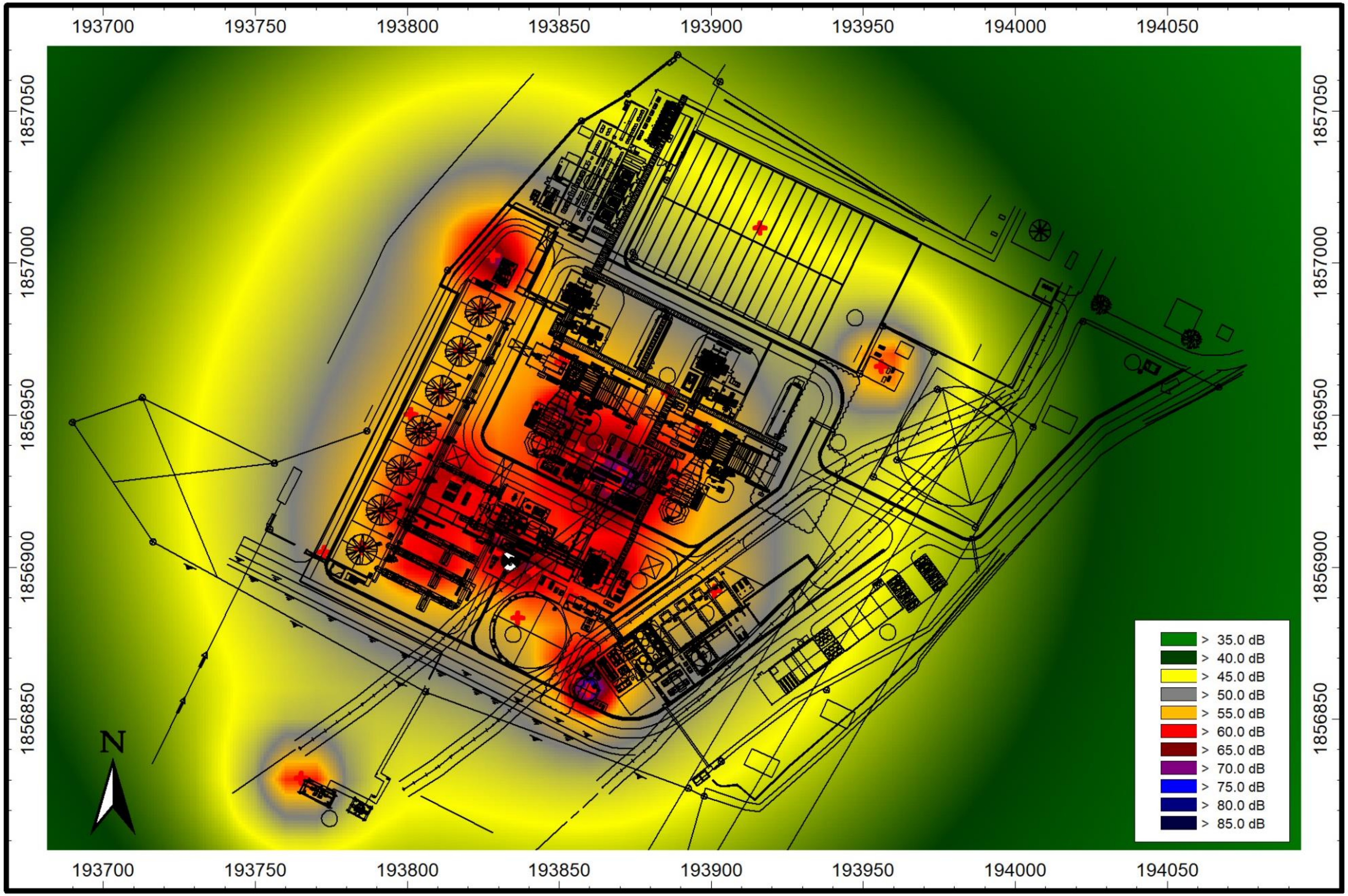
The results suggest that noise levels rapidly dissipate over distance; with the majority of noise emission levels that extend beyond the Power Plant boundary being <45 dBA, which then dissipates down to <40 dBA.

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

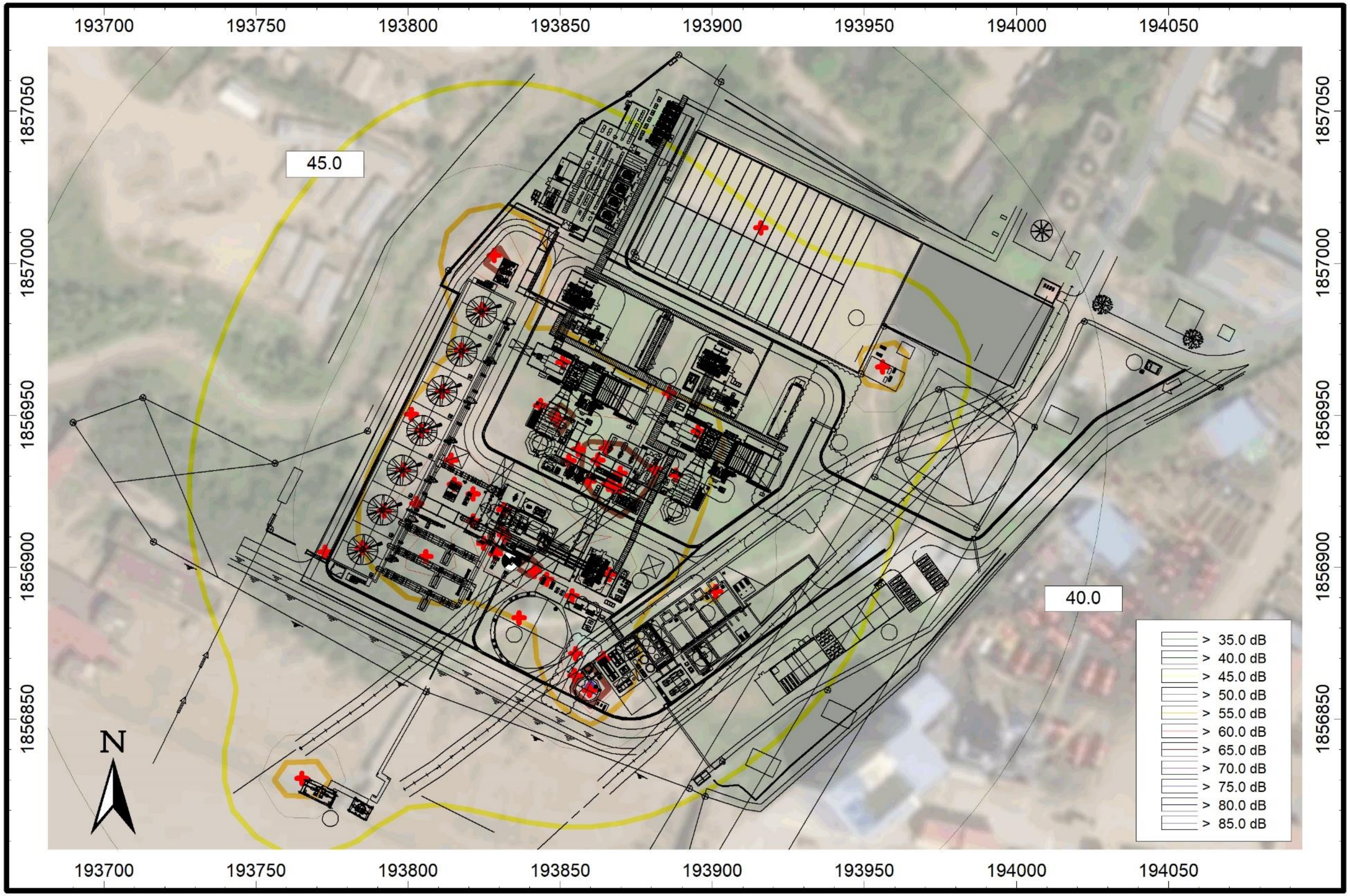
Source: TPMC, 2019. (Modified by AMacoustic)

Figure 9.10: Noise Contour during Operation Phase (Type A)



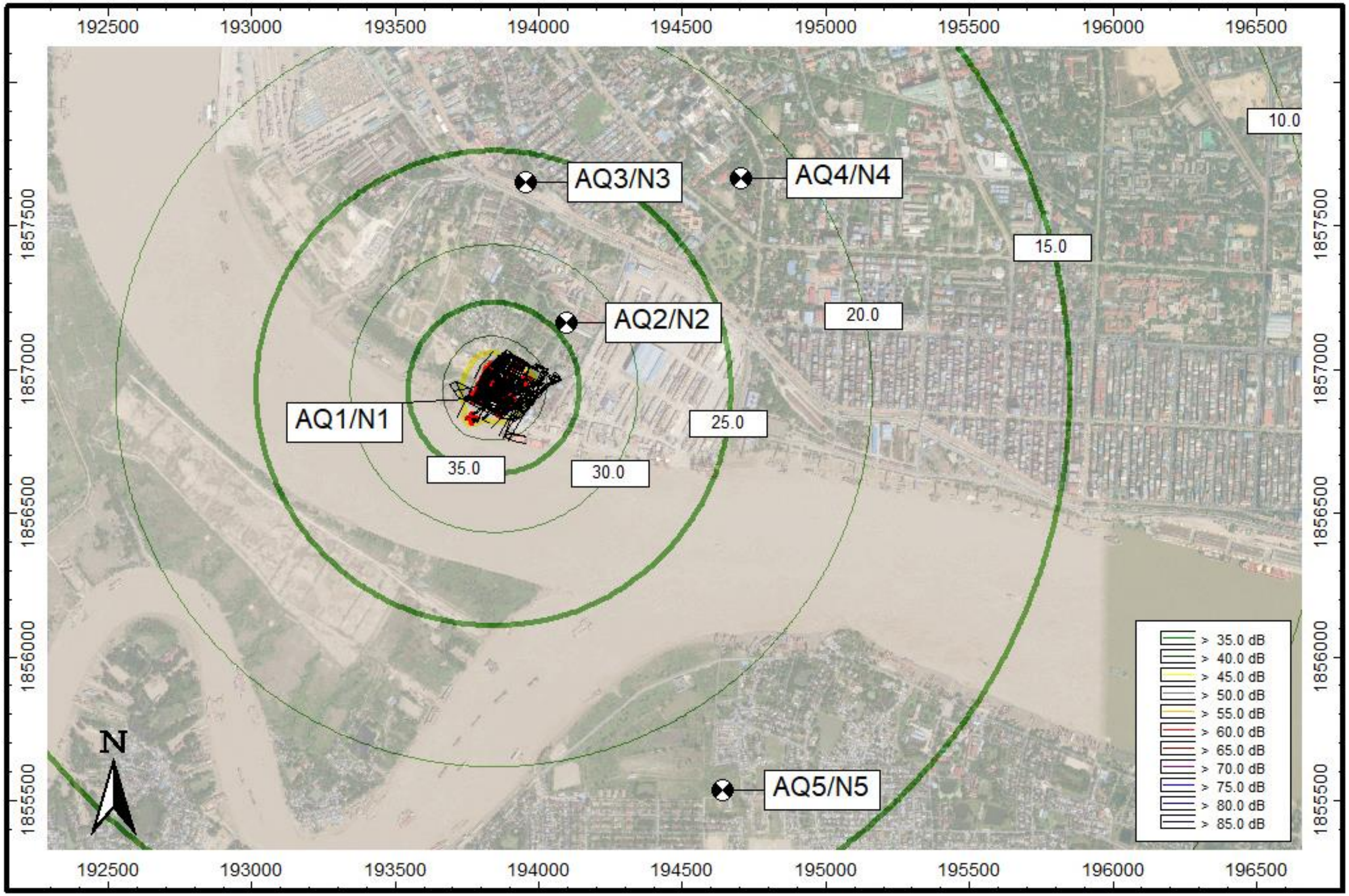
Source: AMacoustic, 2019.

Figure 9.11: Noise Contour during Operation Phase (Type B1)



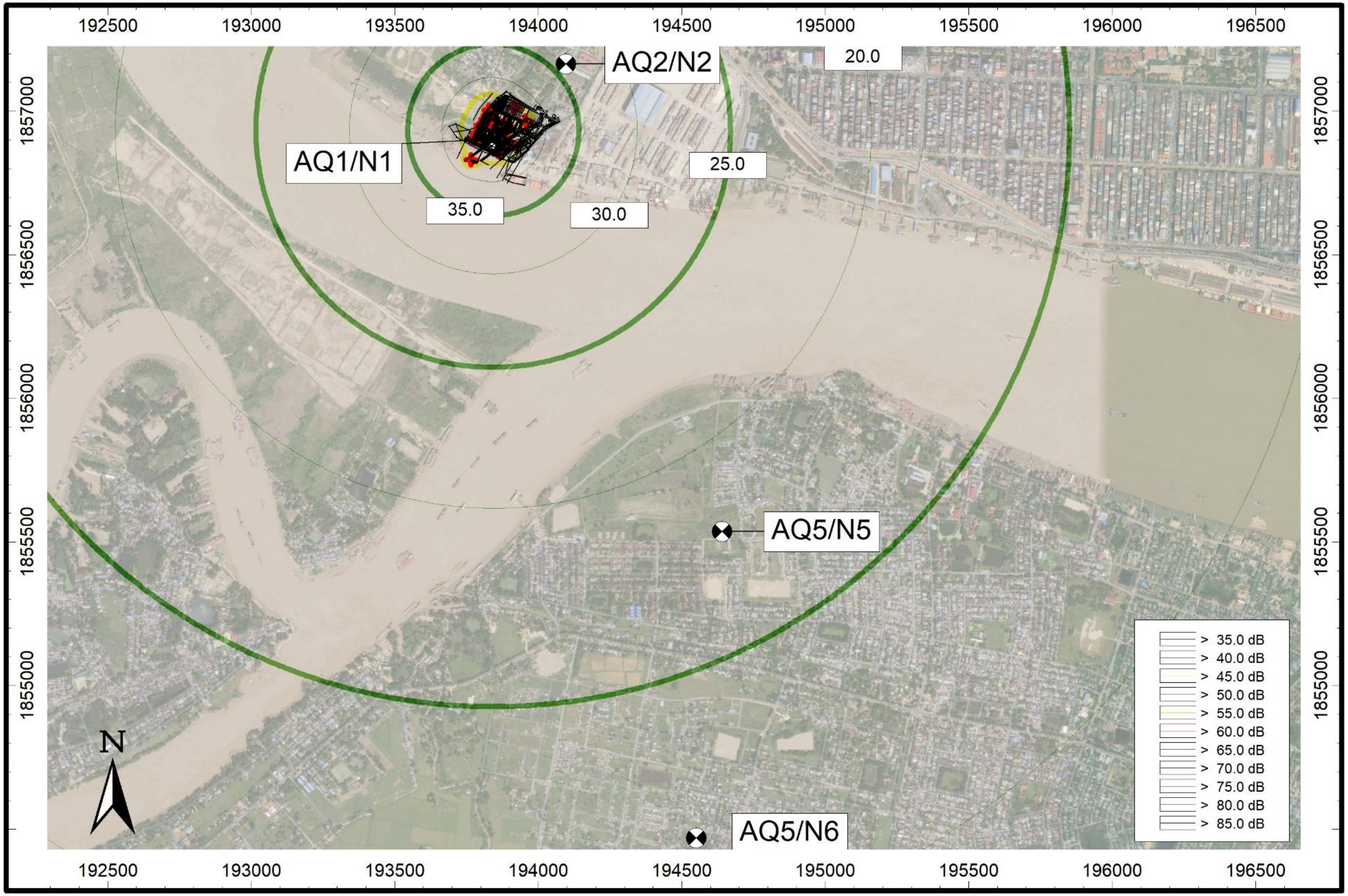
Source: AMacoustic, 2019.

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[147]. The noise barrier material should have a superficial surface density of at least 7 kg/m^2 and have no openings or gaps;

[147] 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[148]. 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[149] 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.

[148] Metcalf& Eddy Inc. Wastewater Engineering: Treatment, Disposal, Reuse. 3rd Edition McGraw Hill, Network, 1979

[149] 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. 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	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 4.48 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)

<table>
<tr><th colspan="6">Significance of Impact</th></tr>
<tr><td>Impact</td><td colspan="5">Potential impacts on surface water due to water intake requirements during operation phase.</td></tr>
<tr><td rowspan="2">Impact Nature</td><td>Negative</td><td>Positive</td><td colspan="3">Neutral</td></tr>
<tr><td colspan="5">Potential impacts to surface water would be considered to be adverse (negative).</td></tr>
<tr><td rowspan="2">Impact Type</td><td>Direct</td><td>Indirect</td><td colspan="3">Induced</td></tr>
<tr><td colspan="5">Potential impacts would likely be direct impacts.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td>Temporary</td><td>Short-term</td><td>Long-term</td><td colspan="2">Permanent</td></tr>
<tr><td colspan="5">The operation phase is expected to continue for approximately 25 years, which would be considered long-term.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td>Local</td><td>Regional</td><td colspan="3">International</td></tr>
<tr><td colspan="5">Potential impacts would be limited to the Power Plant area and downstream of the Yangon River, and hence would be considered to be local.</td></tr>
<tr><td>Impact Scale</td><td colspan="5">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.</td></tr>
<tr><td>Frequency</td><td colspan="5">Water intake for the Power Plant would be near-continuous for the Power Plant’s operational duration.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td>Positive</td><td>Negligible</td><td>Small</td><td>Medium</td><td>Large</td></tr>
<tr><td colspan="5">Based on the characteristics above, the impact magnitude is likely to be Negligible.</td></tr>
<tr><td rowspan="2">Receptor Sensitivity</td><td>Low</td><td>Medium</td><td colspan="3">High</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Negligible</td><td>Minor</td><td>Moderate</td><td colspan="2">Major</td></tr>
<tr><td colspan="5">The combination of a Low Resource Sensitivity and Negligible Impact Magnitude will result in an overall Negligible Impact.</td></tr>
</table>

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:

- 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

Wastewater from the plant process 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 small water channel.

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 considered long-term.			

Significance of Impact					
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 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

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.

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.

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.

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 R***.

Impact Assessment Table

Table 9.44: 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 9.45: 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		
	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 9.46: 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 9.47: 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 9.48: Impact Assessment Table for Accidental Leaks of Cooling Water (Operation Phase)

<table>
<tr><th colspan="6">Significance of Impact</th></tr>
<tr><td>Impact</td><td colspan="5">Potential impacts on soil due to accidental leaks of cooling water the operation phase.</td></tr>
<tr><td rowspan="2">Impact Nature</td><td colspan="2">Negative</td><td colspan="2">Positive</td><td>Neutral</td></tr>
<tr><td colspan="5">Potential impacts to soil would be considered to be adverse (negative).</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="2">Direct</td><td colspan="2">Indirect</td><td>Induced</td></tr>
<tr><td colspan="5">Impacts to soil would be direct impacts through accidental leaks of cooling water.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td>Temporary</td><td colspan="2">Short-term</td><td>Long-term</td><td>Permanent</td></tr>
<tr><td colspan="5">Cooling water is expected to only have short-term impacts on soil and groundwater.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="2">Local</td><td colspan="2">Regional</td><td>International</td></tr>
<tr><td colspan="5">Impacts would be limited to the Power Plant footprint; hence would be considered to be local.</td></tr>
<tr><td>Impact Scale</td><td colspan="5">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.</td></tr>
<tr><td>Frequency</td><td colspan="5">The impacts is not expected to occur.</td></tr>
<tr><td rowspan="2">Likelihood</td><td>Very Unlikely</td><td>Unlikely</td><td>Likely to occur once or more in life of the Project</td><td>Likely to occur once or twice per year</td><td>Will likely occurs more than twice per year, or is continuous or certain to occur</td></tr>
<tr><td colspan="5">The likelihood of an accidental leak to occur is unlikely.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td>Positive</td><td>Negligible</td><td>Small</td><td>Medium</td><td>Large</td></tr>
<tr><td colspan="5">The impact magnitude is likely to be Negligible.</td></tr>
<tr><td rowspan="2">Receptor Sensitivity</td><td colspan="2">Low</td><td colspan="2">Medium</td><td>High</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Negligible</td><td colspan="2">Minor</td><td>Moderate</td><td>Major</td></tr>
<tr><td colspan="5">The combination of a Low Resource Sensitivity and Negligible Impact Magnitude will result in an overall Negligible impact.</td></tr>
</table>

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 9.49: 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 9.50*** and mitigation measures are presented thereafter.

Table 9.50: 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 4.47***. These waste will be stored on-site and transported off-site to a licensed waste disposal contractor.

Table 9.51: 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 9.52***, and mitigation measures are presented thereafter.

Table 9.52: 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 9.53***. 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 9.53: 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. 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 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 9.54***, and mitigation measures are presented thereafter.

Table 9.54: 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 4.14*** presents details of the total non-hazardous construction waste during construction phase.

Table 9.55: 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 9.56***, and mitigation measures are presented thereafter.

Table 9.56: 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 9.57***, and mitigation measures are presented thereafter.

Table 9.57: 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 9.58***.

Table 9.58: 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 9.59***, and mitigation measures are presented thereafter.

Table 9.59: Significance of Impacts from Generation and Management of Domestic Solid Waste during Construction and Operation Phase of Power Plant

<table>
<tr><th colspan="6">Significance of Impact</th></tr>
<tr><td>Impact</td><td colspan="5">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.</td></tr>
<tr><td rowspan="2">Impact Nature</td><td>Negative</td><td colspan="2">Positive</td><td colspan="2">Neutral</td></tr>
<tr><td colspan="5">Potential impacts is considered to be adverse (negative).</td></tr>
<tr><td rowspan="2">Impact Type</td><td>Direct</td><td colspan="2">Indirect</td><td colspan="2">Induced</td></tr>
<tr><td colspan="5">Impacts would be direct.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td>Temporary</td><td>Short-term</td><td>Long-term</td><td colspan="2">Permanent</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td>Local</td><td colspan="2">Regional</td><td colspan="2">International</td></tr>
<tr><td colspan="5">Potential impacts would likely be restricted to the local area.</td></tr>
<tr><td>Impact Scale</td><td colspan="5">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.</td></tr>
<tr><td>Impact Frequency</td><td colspan="5">Impacts would occur intermittently but repeatedly throughout the day for the duration of the construction and operation phase (and during maintenance activity).</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td>Positive</td><td>Negligible</td><td>Small</td><td>Medium</td><td>Large</td></tr>
<tr><td colspan="5">Based on the combination of the above impact characteristics the impact magnitude is considered to be small (operation phase) to medium (construction phase).</td></tr>
<tr><td rowspan="2">Receptor Sensitivity</td><td>Low</td><td colspan="2">Medium</td><td colspan="2">High</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Negligible</td><td>Minor</td><td>Moderate</td><td colspan="2">Major</td></tr>
<tr><td colspan="5">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.</td></tr>
</table>

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 9.60***.

Table 9.60: 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[150]	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 9.61***, and mitigation measures are presented.

Table 9.61: 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.			

[150] Metcalf& Eddy Inc. Wastewater Engineering: Treatment, Disposal, Reuse. 3rd Edition McGraw Hill, Network, 1979

Significance of Impact					
	During maintenance activity, the domestic liquid waste is anticipated to be 135,000 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
	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 9.62: 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, 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 9.63: 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.			
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.			

Significance of Impact					
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 9.64***). Ad-hoc and informal discussion were also conducted with community members, fishermen, hotel owners as well as other project developer in the area.

Table 9.64: 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.

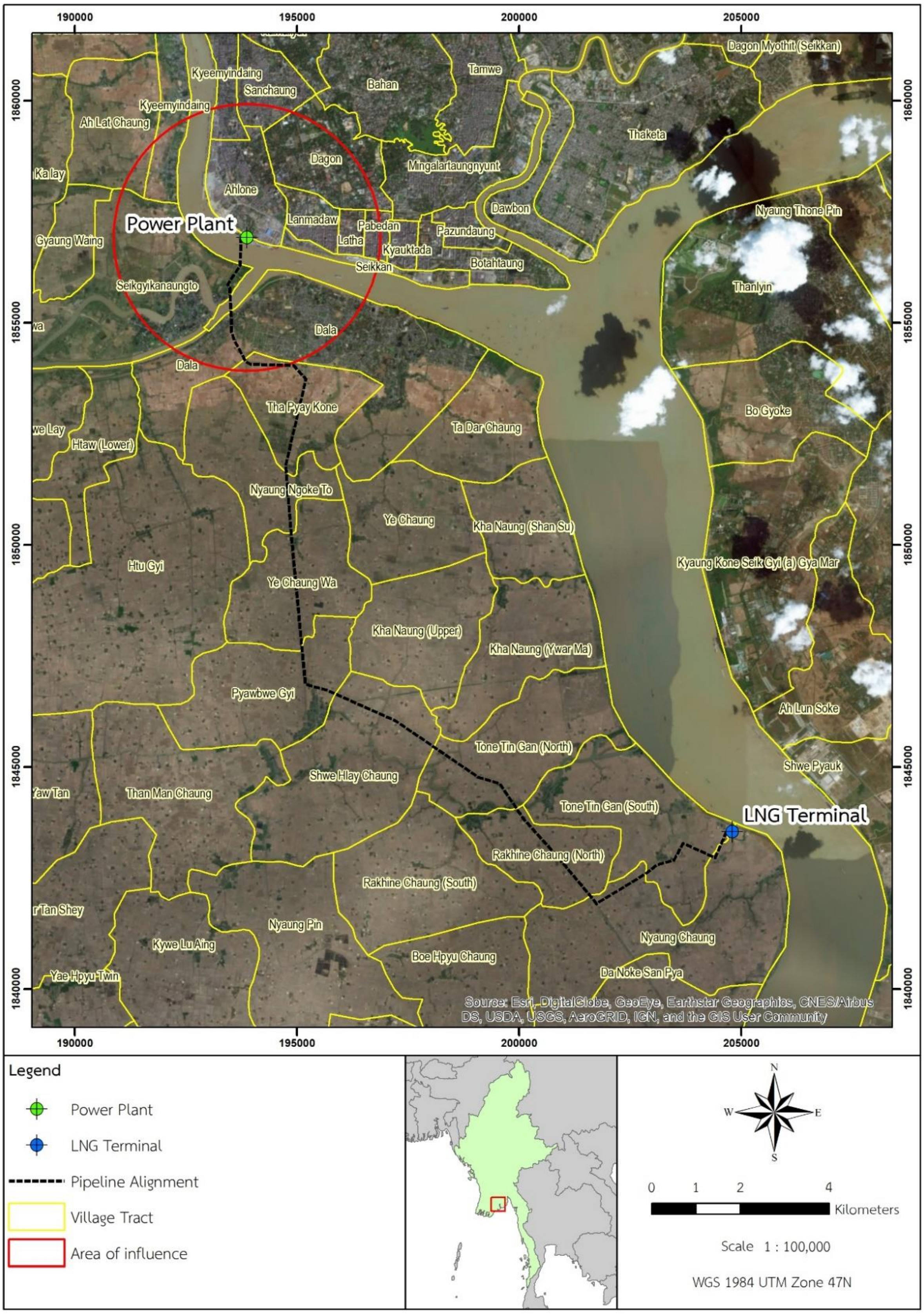
Box 9.1: IFC Definition of Area of Influence

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 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.
- 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.

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 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 transport route.			
Impact Scale	The number of Households that could be impacted is large due to the concentration of people leaving in the SAoI.			

Significance of Impact					
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 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.				
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.				
	Low	**Medium**	High		

Significance of Impact				
Receptor Sensitivity	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 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.				
	Low	Medium	High		

Significance of Impact				
Receptor 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.[151] 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 9.65*** below.

Table 9.65: 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

[151] 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 9.66: 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 9.67: 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

<table>
<tr><th colspan="7">Significance of Impact</th></tr>
<tr><td>Impact</td><td colspan="6">Potential impacts from accidental releases of hazardous substances could be contamination to environments and cause the health effect to human.</td></tr>
<tr><td rowspan="2">Impact Nature</td><td colspan="2">Negative</td><td colspan="2">Positive</td><td colspan="2">Neutral</td></tr>
<tr><td colspan="6">Potential impacts from accidental releases of hazardous substances would be considered adverse (negative).</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="2">Direct</td><td colspan="2">Indirect</td><td colspan="2">Induced</td></tr>
<tr><td colspan="6">Potential impacts from accidental releases of hazardous substances would likely be direct impacts from Project activities.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td>Temporary</td><td colspan="2">Short-term</td><td colspan="2">Long-term</td><td>Permanent</td></tr>
<tr><td colspan="6">The duration of potential impacts is long-term as it can have long lasting impacts on health or the environment.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="2">Local</td><td colspan="2">Regional</td><td colspan="2">International</td></tr>
<tr><td colspan="6">Potential impacts would be limited to the Project footprint and vicinity area in the worst case hence would be considered to be Local.</td></tr>
<tr><td>Impact Scale</td><td colspan="6">The impact is limited within the local villages. The impact scale is medium.</td></tr>
<tr><td>Impact Frequency</td><td colspan="6">N/A, the impact is not expected to occur.</td></tr>
<tr><td rowspan="2">Impact Consequence</td><td>Incidental</td><td colspan="2">Minor</td><td>Moderate</td><td>Major</td><td>Severe</td></tr>
<tr><td colspan="6">Based on the above impact characteristics, the magnitude of impact from accidental releases in the Project Area is anticipated to be moderate.</td></tr>
<tr><td rowspan="2">Impact Likelihood</td><td>Very Unlikely</td><td>Unlikely</td><td colspan="2">Likely to occur once or more in life of the Project</td><td>Likely to occur once or twice per year</td><td>Will likely occurs more than twice per year, or is continuous or certain to occur</td></tr>
<tr><td colspan="6">The likelihood of chemical spill or leaks is anticipated to be unlikely.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Negligible</td><td colspan="2">Minor</td><td colspan="2">Moderate</td><td>Major</td></tr>
<tr><td colspan="6">Considering the level of magnitude and likelihood, the significance of the impact from chemical spill or leak is expected to be minor.</td></tr>
</table>

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					
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.			

<table>
<tr><th colspan="7">Significance of Impact</th></tr>
<tr><td rowspan="2">Impact Consequence</td><td>Incidental</td><td>Minor</td><td>Moderate</td><td>Major</td><td colspan="2">Severe</td></tr>
<tr><td colspan="6">The magnitude of impact from tropical storm and severe weather condition is anticipated to be moderate</td></tr>
<tr><td rowspan="2">Impact Likelihood</td><td>Very Unlikely</td><td>Unlikely</td><td>Likely to occur once or more in life of the Project</td><td>Likely to occur once or twice per year</td><td colspan="2">Will likely occurs more than twice per year, or is continuous or certain to occur</td></tr>
<tr><td colspan="6">The likelihood of the seismic and earthquake is anticipated to be likely to occur once or more in life of the Project.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Negligible</td><td>Minor</td><td colspan="2">Moderate</td><td colspan="2">Major</td></tr>
<tr><td colspan="6">Considering the level of magnitude and likelihood, the significance of the impact from severe weather condition is expected to be moderate</td></tr>
</table>

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

<table>
<tr><th colspan="6">Significance of Impact</th></tr>
<tr><td>Impact</td><td colspan="5">Potential impacts from loss of containment of waste storage facilities on-site may cause contamination to environments and cause the health effect to human.</td></tr>
<tr><td rowspan="2">Impact Nature</td><td colspan="2">Negative</td><td colspan="2">Positive</td><td>Neutral</td></tr>
<tr><td colspan="5">Potential impacts from loss of containment of waste storage facilities on-site would be considered adverse (negative).</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="2">Direct</td><td colspan="2">Indirect</td><td>Induced</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td>Temporary</td><td>Short-term</td><td colspan="2">Long-term</td><td>Permanent</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="2">Local</td><td colspan="2">Regional</td><td>International</td></tr>
<tr><td colspan="5">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).</td></tr>
<tr><td>Impact Scale</td><td colspan="5">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.</td></tr>
<tr><td>Impact Frequency</td><td colspan="5">If construction and operation activities are carried out appropriately, the frequency is anticipated to be in-frequent</td></tr>
<tr><td rowspan="2">Impact Consequence</td><td>Incidental</td><td>Minor</td><td>Moderate</td><td>Major</td><td>Severe</td></tr>
<tr><td colspan="5">Based on the combination of the above impact characteristics, the impact magnitude is considered to be Minor to Moderate.</td></tr>
<tr><td rowspan="2">Impact Likelihood</td><td>Very Unlikely</td><td>Unlikely</td><td>Likely to occur once or more in life of the Project</td><td>Likely to occur once or twice per year</td><td>Will likely occurs more than twice per year, or is continuous or certain to occur</td></tr>
<tr><td colspan="5">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.</td></tr>
</table>

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 9.68***.

Table 9.68: 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

Receptors	Impact Name	Phase	Impact Significance	
			Pre-mitigation	Post-mitigation
	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
	Generation and Management of Domestic Solid Waste	Operation	Minor to Moderate	Negligible

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	
	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 Duration	**Temporary**	Short-term	Long-term	**Permanent**
	The clearing of habitats will be both temporary and permanent.			

Significance of Impact					
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. An area of 200 square metres will be impacted that is considered to be natural habitat.				
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

<table>
<tr><th colspan="6">Significance of Impact</th></tr>
<tr><td>Impact</td><td colspan="5">Potential impacts on disturbance and displacement of fauna and flora.</td></tr>
<tr><td rowspan="2">Impact Nature</td><td colspan="2">Negative</td><td colspan="2">Positive</td><td>Neutral</td></tr>
<tr><td colspan="5">Potential impacts to habitat loss would be considered to be adverse (negative).</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="2">Direct</td><td colspan="2">Indirect</td><td>Induced</td></tr>
<tr><td colspan="5">Potential impacts would likely be indirect impacts.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td>Temporary</td><td colspan="2">Short-term</td><td>Long-term</td><td>Permanent</td></tr>
<tr><td colspan="5">Only occurs during the construction and operation period.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="2">Local</td><td colspan="2">Regional</td><td>International</td></tr>
<tr><td colspan="5">Impact extent will be within the Project Area and adjacent habitats within the AoI.</td></tr>
<tr><td>Impact Scale</td><td colspan="5">Disturbance and displacement will be small in scale and limited to areas within the Project Area and adjacent habitats within the AoI</td></tr>
<tr><td>Frequency</td><td colspan="5">Occurs only once.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td>Positive</td><td>Negligible</td><td>Small</td><td>Medium</td><td>Large</td></tr>
<tr><td colspan="5">The impact magnitude is likely to be Negligible.</td></tr>
<tr><td rowspan="2">Receptor Sensitivity</td><td colspan="2">Low</td><td colspan="2">Medium</td><td>High</td></tr>
<tr><td colspan="5">The receptors are Least Concern species so the sensitivity is considered to be Low.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Negligible</td><td colspan="2">Minor</td><td>Moderate</td><td>Major</td></tr>
<tr><td colspan="5">The significance is likely to be Negligible.</td></tr>
</table>

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:

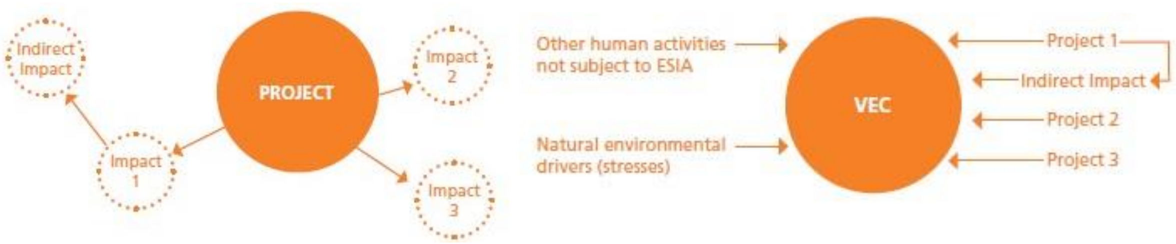
- Physical features, habitats, wildlife populations (e.g., biodiversity, water supply);
- Ecosystem services (e.g., protection from natural hazards, provision of food);
- Natural processes (e.g., water and nutrient cycles, microclimate);
- Social conditions (e.g., community health, economic conditions); 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



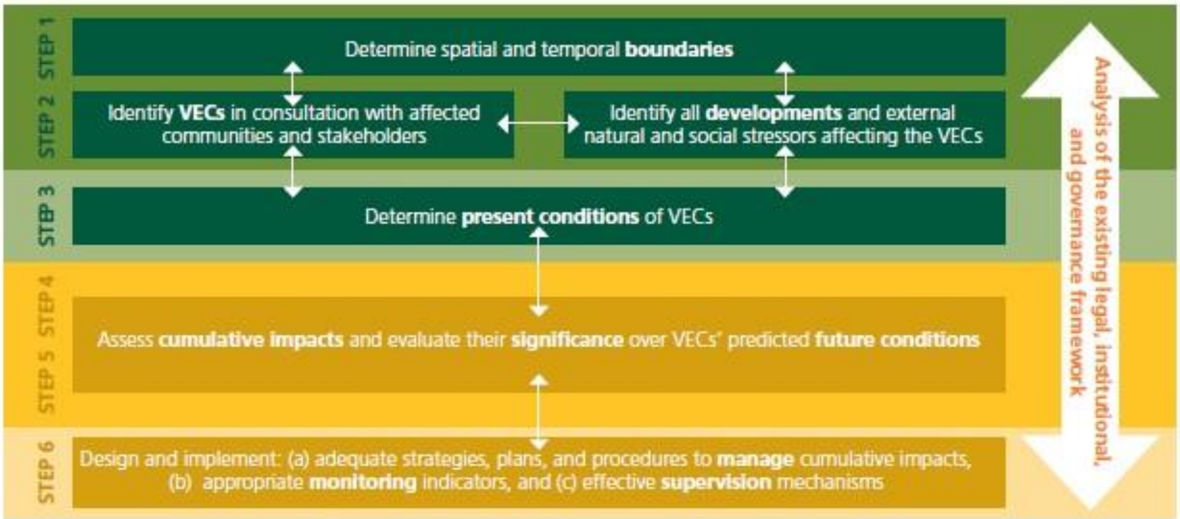
ESIA: Project-Centered Perspective **CIA: VEC-Centered Perspective**

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:

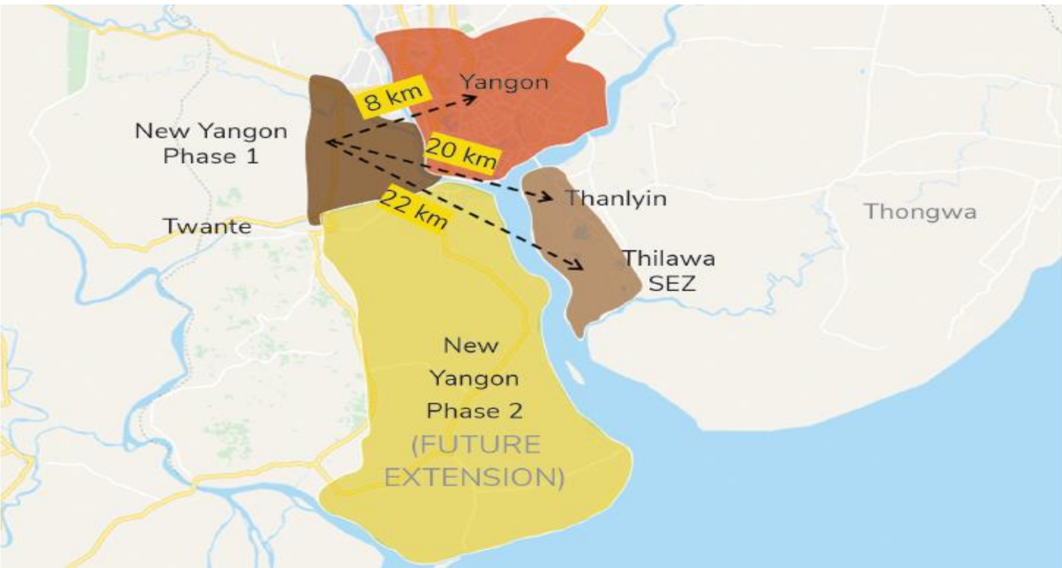
- Infrastructure projects: two bridges 26 km of artery roads, power (a 1x230 kV transformer substation and transformer and distribution lines), water and wastewater systems, and a 13 km^2 industrial zone.

- 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.

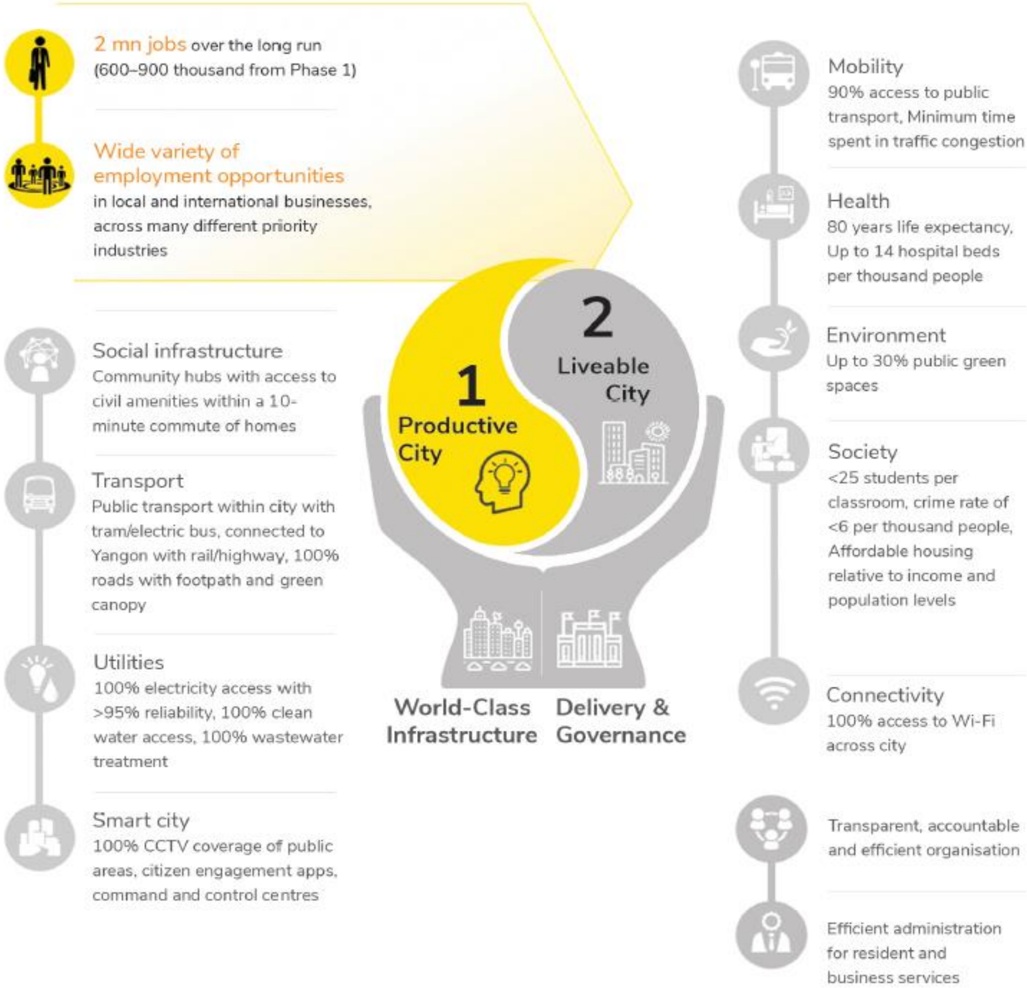
Phase 2: will cover a land area of approximately 600 km^2. Infrastructure improvements to enhance trading connectivity and boost economic opportunities for the Ayeyawady Region. Phase 2 of the New Yangon City project expects to generate 1-1.2 million jobs.

Figure 11.3: New Yangon City Layout



Source: NYDC, 2018.

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 Q*** 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 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***.

11.5.2.3 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.	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**
Socioeconomic conditions	**Construction Phase**: During construction, the workforce will 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	**New Yangon City Project** *Construction Phase:* relocation 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.	Any risks that climate change poses to critical infrastructure 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.	Increased employment and increased demand for goods 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	**Low**

VEC	Potential Impacts from the Project	Potential Impacts from Other Projects	Potential Impacts from External Drivers	Cumulative Impact	Significance
	171 staff will work on the operational phase of the Project.				
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 health and wellbeing: noise and vibration	**Construction and Operation 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).	New Yangon City Project *Construction Phase*: noise from mechanical equipment (excavators, bulldozers, generators, trucks, etc). *Operation Phase*: increased noise from use of the bridges and roads	Increased urbanization, vehicle use and industrial expansion are likely to result in increased noise pollution in the study area.	Noise can lead to hearing 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).	**Medium**

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 12.1*** for the LNG Terminal ***Table 12.2*** for the Natural Gas Pipeline and ***Table 12.3*** 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 following detailed management plans are considered necessary to effectively implement the outcomes of the ESIA throughout the life of the Project:

- Air Quality Management Plan;
- Dust Management Plan
- Plant and Vehicle Management and Maintenance Plan;
- Preventive Maintenance Plan;
- Traffic Management Plan;
- Marine Safety Management Plan;
- Noise and Vibration Management Plan;
- Surface Water Management Plan;
- Soil and Groundwater Management Plan;
- Biodiversity Action Plan;
- Waste Management Plan (Hazardous Waste);
- Waste Management Plan (Non Hazardous Waste);
- Recycling Plan;
- Oil and Chemical Spill Contingency Management Plan;
- Emergency Response Plan (including Community Emergency Response Plan);
- Fire Prevention Plan;
- Evacuation Plan;
- Typhoon Response Plan, and Typhoon Evacuation Plan;
- Occupational Occupational Health and Safety Management Plan;
- Stakeholder Engagement Plan (including Grievance Management Plan);
- Community Development Plan (CDP);
- Land acquisition and Compensation Plan;
- Community Health Management Plan;
- Procurement and Recruitment Management Plan
- Workers' Accommodation Management Plan;
- Local Recruitment and Procurement Plan;
- Influx Management Plan;
- Worker Training Plan(including Induction Training Program);

- Cultural Heritage Chance Find Procedure;
- Security Plan; and
- Decommissioning Management Plan Framework.

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), 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 12.4*** for the LNG Terminal, ***Table 12.5*** for the Natural Gas Pipeline and ***Table 12.6*** 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 12.1: 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

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
	Noise level	Foundation work and civil constructions	Impacts to noise sensitive receivers (NSRs) due to noise emission	■ 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[152]. 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.	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
1.4	Surface Water	Water Intake Requirements during construction phase	Impact to surface water	■ Not required	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:	Appointed EPC Contractor	On site Project Management team and designated EHS team	Conduct monthly site audit	EPC Contractor Cost

[152] 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
				– 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.				
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	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
				■ 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.				
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

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
	Social	Construction of LNG Receiving Terminal	Impacts to fishing activities	■ 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 river ways/ areas. ■ 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 HSE team	Weekly monitoring of the grievance log during construction period	EPC 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 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 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 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.	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
				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 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.			Monthly inspection of infrastructures (e.g. road).	
	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 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;	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
				■ 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 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;	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
				■ 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.				
	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 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 CO_2) 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

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
	Surface Water	Cold water discharge (regasification process)	Impact to surface water	■ Not require	Designated HSE team	HSE Department Manager	Continuous temperature monitoring at discharge point; by installing a continuous monitoring system at discharge point.	TPMC 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;	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
				■ 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.				
	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

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
	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	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 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 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 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

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
	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 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.	Designated HSE team	HSE Department Manager	Bi-yearly engagement with local authorities and service provider. Monthly review of grievance log. Yearly inspection of infrastructures.	TPMC Operation Cost
	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 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;	Designated HSE team	HSE Department Manager	Six monthly review of training log. Daily and monthly monitoring and review of accidents and incidents.	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
				– 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 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.			Developed an occupational health and safety monitoring and surveillance programme. 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	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
				■ 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 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

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
	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). ■ 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	Not required	TPMC Operation Cost

12.5.2.2 Mitigation Measures for the Pipeline

Table 12.2 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

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
	Noise Level	Excavation work and civil construction	Impacts to noise sensitive receivers (NSRs) due to noise emission	■ 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; ■ 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.	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
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;	Appointed EPC Contractor	On site Project Management team and	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
				■ 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.		designated EHS team		
	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;	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	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
				■ 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.			COC documentation.	
	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	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
							at discharge location.	
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	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 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.	Appointed EPC Contractor	On site Project Management team and	Monitor the grievance log weekly.	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
				■ 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 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.		designated EHS team	Monitor the employment of stakeholders whose land are impacted.	
	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 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 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 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

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
	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 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 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;	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 (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.	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
				■ 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.				
	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);	Appointed EPC Contractor	On site Project Management team and	Monitoring and review of accidents and incidents.	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
				■ 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 as part of the Project. The Project will also include a Grievance Mechanism to collect grievances from local stakeholder affected by the Project activities.		designated EHS team	Weekly review of grievance log.	
1.10	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 ■ 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.	Appointed EPC Contractor	On site Project Management team and designated EHS team	Not required	EPC Contractor Cost
	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;	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
				– 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.				
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.	Designated HSE team	HSE Department Manager	Monitor the grievance log weekly	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
				■ TPMC will need to continue implementing the Stakeholder Engagement Plan 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.				
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 ■ 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 HSE team	HSE Department Manager	Not required	TPMC Operation Cost
	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 12.3 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 civil construction	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)	Appointed EPC Contractor	On site Project Management	Monthly noise monitoring conducted	EPC Contractor Cost

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				noise reduction can be provided[153]. 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.		team and designated EHS team	at the representative NSRs	
	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	■ Not required	Appointed EPC Contractor	On site Project Management team and	Monthly monitoring of water intake quantities	EPC Contractor Cost

[153] 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

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						designated EHS team	and flow rates in the 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

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	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-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 pf waste segregation, transportation and disposal practices. Monitoring of appointed waste contractors using COC documentation.	EPC Contractor 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

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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	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.	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	EPC Contractor Cost

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				■ 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 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.			of permit and safety equipment. Review engagement and communication log with local authorities.	
	Social	Transportation during construction	Impact to traffic and transport	■ 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.	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 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;	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.	EPC Contractor Cost

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				■ 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 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 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.			Regular unplanned 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.	

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	Social	Construction activities	Impact to the 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, 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; 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 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.	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
	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 take place during special religious activities; and ■ The EPC contractor will monitor the grievance log weekly.	Appointed EPC Contractor	On site Project Management team and designated HSE team	Monitoring and review of accidents and incidents. Weekly review of grievance log.	EPC Contractor Cost
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;	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
				■ 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 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	■ Not required	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

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
	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 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; ■ 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

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
	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
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

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
	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 potential	■ 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 ■ 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. Yearly monitoring during operation.	TPMC Operation Cost
	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;	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	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
				– 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 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.			safety monitoring program. Weekly review of worker grievance log.	
	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;	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 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.				
	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.	Designated HSE team	HSE Department Manager	Not required.	TPMC Operation Cost
	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 12.4: 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	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	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	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	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	pH, Electrical Conductivity, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD),	Yangon River (upstream and downstream of the LNG Receiving Terminal)	Standard analytical methods	Every 6 month	3rd Party Environmental Consultant	EPC Contractor Cost (Approx ~2500 USD / time)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for implementation	Cost
		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).					
Ground Water	Contamination of ground water	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),	At nearest ground water extraction pump	Standard analytical methods	Every 6 month or upon complaint from local stakeholders	3rd Party Environmental Consultant	EPC Contractor Cost (Approx ~2500 USD / time)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for implementation	Cost
		Total Chromium (Cr), Copper (Cu), Iron (Fe), Zinc (Zn), Lead (Pb), Cadmium (Cd), Mercury (Hg); Arsenic (As).					
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, 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)
	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	Records of training, Fauna Shepherding	NA	Compliance against protocols.	3 monthly basis	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
	species) due to vegetation clearing (Habitat loss) and mortality (vehicle strike, hunting and poaching) at the work site	protocol and accidents					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 engagement	NA	Compliance against the Stakeholder Engagement Plan	Monthly	EHS Team of EPC Contractor	EPC Contractor 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	Every 4 month	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
				international regulation for operating vessels			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. Daily monitoring of construction area, worker camp and surrounding; Regular unplanned audit on worker code conduct; Monthly visual inspection of first	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
					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 discharge	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),	Discharge point	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
		Total Chromium (Cr), Copper (Cu), Iron (Fe), Zinc (Zn), Lead (Pb), Cadmium (Cd), Mercury (Hg); Arsenic (As).					
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 and disposal areas	Compliance to the WMP	Unplanned audit yearly	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 Management Plan	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	Responsible Party for implementation	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 monitoring and surveillance programme. Conduct regular unplanned audit of	TPMC EHS team	TPMC Opex cost

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for implementation	Cost
					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

12.5.2.5 Monitoring Programme for the Natural Gas Pipeline

Table 12.5 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	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	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	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	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	pH, Electrical Conductivity, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Nitrogen,	Yangon River and water bodies (upstream and downstream of the pipeline alignment)	Standard analytical methods	Every 6 month	3rd Party Environmental Consultant	EPC Contractor Cost (Approx ~2500 USD / time)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for Implementation	Cost
		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).					
Ground Water	Contamination of ground water	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),	At nearest ground water extraction pump from pipeline construction area	Standard analytical methods	Every 6 month or upon complaint from local stakeholders	3rd Party Environmental Consultant	EPC Contractor Cost (Approx ~2500 USD / time)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for Implementation	Cost
		Iron (Fe), Zinc (Zn), Lead (Pb), Cadmium (Cd), Mercury (Hg); Arsenic (As).					
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, 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)
	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	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)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for Implementation	Cost
	(Habitat loss) and mortality (vehicle strike, hunting and poaching) at the work site						
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 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)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for Implementation	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. 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.	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
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 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)
	Impact to occupational health and safety	Accidents or incidents due to operation activities, workers' health	Near-misses, incidents, occupational diseases,	Project activity areas	As defined in operation phase Health & Safety Plan to be	TPMC EHS team	TPMC Opex cost

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsible Party for Implementation	Cost
			dangerous occurrences		prepared by EPC contractor		

12.5.2.6 Monitoring Programme for the Power Plant

Table 12.6 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	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	As per MMRP requirements	As per MMRP requirements (Minimum every 6 month)	EPC Contractor	EPC Contractor Cost (included in Capex cost)