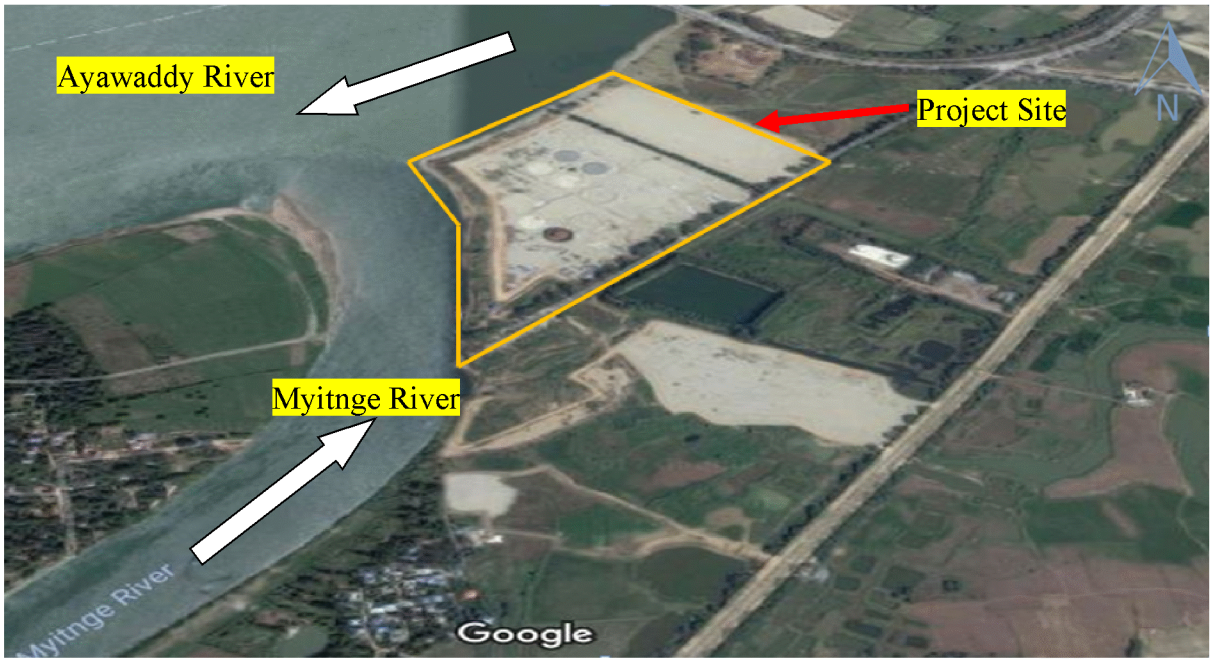
1. EXECUTIVE SUMMARY

1.1. Introduction

Myanma Energy Sector Development Public Company Limited (MESDP) established in 1st January, 2013, Yangon. There are 51 companies who are members of Myanmar Petroleum Trade Association (MPTA) will put together as MESDP. MESDP would like to start fuel oil storage facilities in Mandalay Region, Myanmar. The proposed project will support to develop of energy sector in Upper Myanmar. The name of Project is MESDP Jetty & Depot (Mandalay). So, it is necessary to conduct Environmental Impact Assessment (EIA) for the proposed project according to the Environmental Conservation Law, 2012 and Environmental Impact Assessment Procedure, 2015. Ever Green Tech Environmental Services and Training Co., Ltd. was appointed to conduct Environmental Impact Assessment (EIA) for the proposed project.

1.2. Project Location

The proposed project is located near the intersection of Ayawaddy River and Myitnge River (Dokehtawady River) in Amrapura Township, Mandalay Region. The central coordinate point of the project site is at 21°51'50.30" N and 95°59'41.63" E. The depot will be first business depot in lower Myanmar and specializes in the handling of fuel oil.



Project Location

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1.3. Brief of the Project Proponent

The followings are the brief of project proponent.

Project Developer	
Project Developer	Myanma Energy Sector Development Public Company Limited (MESDP)
Type of Project	Fuel Oil Storage Facilities
Project Version	To distribute fuel oil with reasonable price in upper Myanmar
Project Location	Near the confluence of the Ayeyawady River and Dottawady (Myitnge) River, Oh Htoke Tan Village, Amarapura Township, Mandalay Region. 21°51'50.30" N and 95°59'41.63" E
Contact Person	U Soe Min Oo (Executive Director, MESDP) No. (29), Min Ye Kyaw Swar Road, UMFCCI 10th Floor, Lan Ma Daw Township, Yangon. 09-975909945, Email: mesdp.myanmar@gmail.com

1.4. Project at a Glance

The following table shows the brief descriptions of the proposed project.

Aspects	**Descriptions**
Storage capacity	32 No. of (2 million gallons) storage tank = Total 64 million gallons
Type of oil	Diesel (AGO) 26 storage tanks and Petro 6 storage tanks
Total Project Area	Approximately 38 acres
Type of land	Farmland (having permission to use the farmland by other means) under Section 30, the Farmland Law, 2012
Domestic Water Demand	Approx.: 30,000 liters/day
Source of Process and Domestic Water	Tube well inside the project compound

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Source of Electrical Power	MEPE
Fuel Oil Shipping and Distribution	Ship vessels (oil tankers) will be used along water way (in the Irrawaddy River) to carry fuel oil to the project site (storage tank). Oil Barge will be used for distribution of distribution by waterway and oil bowser will be used for distribution of fuel oil by road way. Especially, water way will be used for places that can be transported by water way. Road way (Oe Htoke Tan Road) will be used where for region that water way cannot be used.
Solid and Liquid Wastes and Control Program	1) Process waste water (oil water) will be disposed after treatment with oil separator. 2) Sewage treatment facilities will be provided for all sewage generated on site. 3) Recyclable domestic waste will be recycled. Other domestic waste will be disposed of in a domestic waste disposal site as directed by Mandalay City Development Committee (or) City Development Committee (Amrapura). 4) Industrial wastes will be stored in concrete building and all of these industrial wastes can be recycled and will be reused.

1.5. The Aim of the Project

The developer statements publicly that the proposed project will essential for Upper Myanmar due to the following reasons:

(a) To provide good quality fuel oil for upper Myanmar at a cheap price.
(b) To store more fuel oil more safety with modern oil storage facilities, and
(c) To get benefits for both customers and supplier together with increasing employment opportunities for local people as well as resulting in government revenues.

1.6. Construction, Operaation Period and Employment

The construction, operation period and employment condition are show below;

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Construction Period	It is estimated that the construction phase will last for approximately 18 to 22 months. The estimated construction time for each task of the development is listed below: • Site Preparation : two weeks; • Piling : 40 weeks; • Tank foundation : 60 weeks; • Bund walls : 35 weeks; • Bund floor sealing : 35 weeks; • Fire protection systems : 53 weeks; • Product pumps and piping : 63 weeks; • Filling points : 20 weeks; • Offices : 20 weeks; • Electrical works : 35 weeks; and • Commissioning : 12 weeks.
Operation Period	30 years
Employment	**1. Pre-construction Phase** The project will be used a total of 10 people at pre-construction phase and most of people will be local workers from nearest villages. **2. Construction Phase** The project will employ a total of 30 people at construction of which approximately 20 people will be sourced from the local area. **3. Operation Phase** The operation of the facility will create employment opportunities for more than 200 staff members in total.

Current Status of Project

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Current status of the project is described below.

Myanma Energy Sector Development Public Co.,ltd.

Project Frame

No	Project	Description	Quantity	Finished	Remarks
A	**Operational System**				
1	2 Million Tank with wing wall	32Nos	23	43%	
2	Dike	Wall		100%	
		Floor(inner)		66%	
		Firewall(2ft Height)		66%	
3	Jetty	Jetty	3	100%	
		Sponson			
		Steel Bridge			
		Pontoon			
4	Pipe Line & Pipe Rack	From Ship to Jetty		36%	
		From Jetty to Tank			
		From Tank to Pump House			
		From Pump House to Filling Point			
		Over Head Bridge			
		In Filling Station			
5	Pump	Pump House(12nos)	9	75%	
		Loading Pump on Pontoon			
		Suction Pump of Tank			
6	Filling Shed	Structure	3	95%	
		Pipe Line			
		Flow Meter			
7	Fire Fighting System	Fire Fighting Pipe Line		95%	
		Monitor			
		Fire Tank and Box			
		Fire Station and Truck			
		Foam System			
8	Electrical	Transformer 1&2 with Panels	1	40%	
		Generator			
		Cabling for Each Electrical House			
9	Oil Water Separator System	Separator & Pump			
		Underground Drain Pipeline			
		Lift Station			
		Drain Valve & Pit			
		Slop Tank			
10	Terminal Automation System	Control Room	4	100%	
		Control System	5	40%	
		Machine/Pump			
11	Gate with Digital Weighting Scale	Gate 1 & Gate 4	2	50%	
B	**Other Infrastructure**				
12	Drain and Apron	Internal Drain		100%	
		External Drain		100%	
13	Internal Road	40ft Road- 3300ft		100%	
14	Extension Road	Ohtoketan Road	1	22%	
15	Office for Individual		14	6%	
16	Canteen	Gate 1 & Gate 4	2	50%	
17	Bath & WC	Gate 1 & Gate 4	2	50%	
18	Lodge		1		
19	Retaining Wall	Ayeyarwaddy Side	1	100%	
		Duttawaddy Side	1		
20	Fencing	1500 ft (side Oaktiketen Road)	1	100%	
21	Landscaping		1		
22	Underway Concrete Pipe (3'O)		1		
C	**Additional Works**				
23	2-1/2 Office	Pile Foundation	1	70%	
24	Switch Bay		1		
25	Carparking		1	50%	
26	Water Tank for Fire Protection System		1		
27	Foam Station	Steel Structure with RC Foundation	2		

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1.7. Brief of the Environmental Assessment Practitioner

Below is the background information on Ever Green Tech Environmental Services and Training Co., Ltd., (Third party) who will conduct the EIA.

Ever Green Tech Environmental Services & Training Co., Ltd.			
ESIA Team Members	1.	Dr. Kyaw Swar Tint	Ph.D. (Mining)
	2.	Dr. Thein Tun	Ph.D. (Metallurgy)
	3.	Dr. Myo Min Nyunt	Ph.D. (Mining)
	4.	Dr. Kyaw Zay Moe	Ph.D. (Botany)
	5.	Dr. Ko Myint	Ph.D. (Zoology)
	6.	Dr. Ni Ni Aye	M.B.B.S (Ygn)
	7.	Dr. Pyae Phyo Kyaw	Ph.D. (Archeology)
	8.	Daw Tin Tin Ohm	M.Sc. (Forest Soil Science)
	9.	Dr. Myint Thein	Ph.D. (Geology)
	10.	Dr. Win Swe	Ph.D. (Geography)
	11.	Mr. Moe Pyi Kyaw	B.Sc. (Forestry)
	12.	U Min Aung	M.Sc. (Chemistry)
	13.	Ms. Thazin Htwe	BE (IT), Dip. in EIA/EMS, M.S. in EIA/EMS
	14.	Ma Nandar Nwe	BE (IT), Dip. in EIA/EMS, M.S. in EIA/EMS
	15.	Ms. May Thet Zaw	B.Sc. (Botany)
	16.	U Aung Naing Tun	L.L.B, M.B.A
Company Name	Ever Green Tech Environmental Services and Training Co., Ltd.		
Company Registration Number	3344/2015-2016 (Ygn)		
Contact Address	No.14, Thiri Mying (8th) Street, 13th Quarter, Hlaing Township, Yangon		
Telephone Number	09-43106929, 09-91019166, 09-799700171		
E-mail	green.evergreentech@gmail.com,		

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Contact person	Dr. Kyaw Swar Tint Key Consultant 09-5099232 11kyawswar@gmail.com

1.8. Scope of the EIA Study

All of the environmental and social impact assessment will be conducted within the 3 kilometer radius around the proposed project. The reasons for conduction 3 km around the proposed project are to cover (1) the impacts zone during emergency case (fire and exploration), (2) the impact zone due to increase in traffic congestion and road accident, (3) the impact zone for visual impact and cultural heritage.

1.8.1. Summary of Alternative Analysis

According to the altenative analysis, the following alternative will be considered as suitable alternative for the proposed project.

(a) "No-Project Alternative"

Proposed project enhances energy security, economic stability, and regional development, making the no-project alternative unacceptable from a socio-economic perspective. So, the project may be acceptable with intense and precise mitigation measures especially for fire and exploration hazard according to the impact assessment.

(b) Process, Design, and Technologies

Tank Roof Design: Internal floating-roof tanks (IFRT) are chosen to minimize evaporation, reduce emissions, and enhance fire safety.

Technologies for Oil Tanks: API Standard 650 is selected for large welded steel tanks due to its durability, safety, and industry compliance.

Storage Tank Placement: Above-ground tanks are preferred over underground ones due to feasibility, maintenance, and environmental factors.

Shipping and Distribution: Waterway transport is the most cost-effective, efficient, and environmentally sustainable option.

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Water Sources: A mix of groundwater, rainwater harvesting, and treated river water ensures a reliable and sustainable supply.

1.9. Vicinities around the Proposed Project

The nearest local residents are Oe Htoke Tan Village and Lat Yway Village. The nearest environmentally sensitive areas and their distances of the proposed project are shown in the following table.

No.	Vicinity	Description	Distance (km)
1.	Nearest Public Residents	Latt Yway Village	0.8 km
2.	Nearest Water Body	Ayeyarwady River, Duthavati River (Myit Nge River)	0.1km, 0.1km
3.	Nearest Densely Populated Area	Shwe Kyet Yat Village	0.9 km
4.	Nearest Cultural and Hesitate Site	Queen Me Nu Brick Monastery Tha Bye Dan Fortress	1.2 km 0.4 km
5.	Nearest Bridge	Innwa Bridge	0.78 km
6.	Nearest Road	Ore Htoke Tan Road	0.0 km

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Vicinity around the Proposed Project

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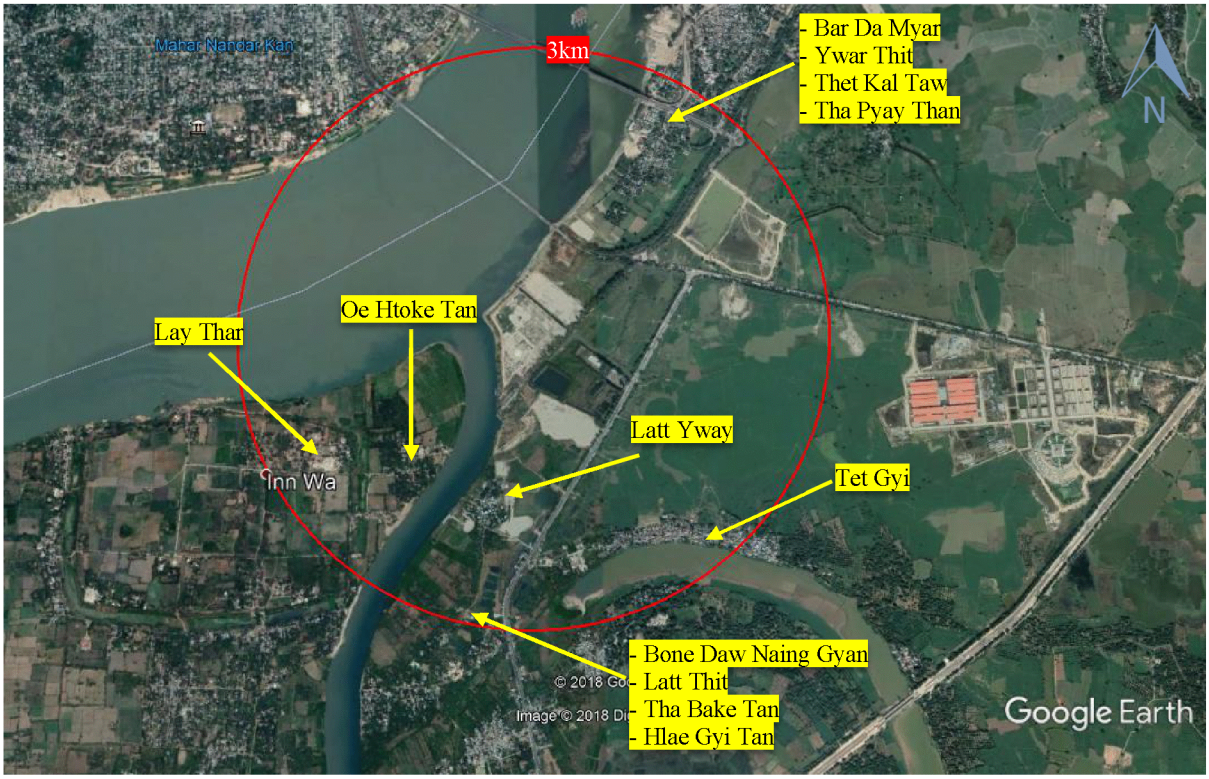
1.10. Nearest Environmentally Sensitive Areas

(a) Nearest Local Residents

The impact assessment will be conducted within the 3 kilometer diameter (1.5 kilometer diameter), as shown in the following figure.



Name of local residents and their concerns by socio-economic survey (household survey) within 3km diameter of the proposed project are as follow:

Village Tract	Villages	Impacts
Shwe Kyat Yat	*Shwe Kyat Yat* *Padamyar,* *Ywa Thit,* *That Ke Taw* *Ta Pyan Ten*	-Traffic congestion - Traffic Accidents -Fire risk
PhoneTawNainKan	*Phone Taw Nain Kan* *Ta Bait Tann,* *Lat Yway* *Latt Thit* *Hlay Gyi Tan*	-Traffic congestion - Traffic Accidents -Fire risk

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That Gyi	*That Gyi*	-Traffic congestion - Traffic Accidents -Fire risk
Oh Htoke Tan	*Oh Htoke Tan* *Lay Thar*	- Fire risk - River bank erosion

(b) Nearest Surface Water Bodies

Nearest surface water bodies (Ayarwady and Myit Nga Rivers) will impact due to the containing of oil in effluent water from project site and direct entering of fuel oil from oil tanker and fuel oil from storage facilities during emergency cases.

(c) Nearest Flora Diversity (Farm Lands)

As there will be farm lands beside the project area and there will have impact on these farm lands due to the soil erosion caused by the releasing of oily effluent water from the project site and direct entering of fuel into the farm lands during accidential cases.

(d) Aquatic Lives in Nearest Rivers

Nearest sensitive flora diversity is aquaitic lives in Myit-Nga and Arrawady Rivers. There will have impact on these aquatic lives if oily water enters the river directly and unsystematically disposal of domestic wastes.

(e) Nearest Cultural and Heritage Sites

The nearest cultural and heritage sites are Queen Me Nu brick monastery, Tha Bye Dan fortress, Innwa-Sagaing bridge. As tourists often come to this area, there will be visual impact on their vision. There will also impact on these cultural and heritage sited during emergency case (fire and exploration).

(f) Seismic Zone

The nearest source for natural disaster (earthquake) is Sagine Fault. So, the proposed project can have high risks (fire and explosion and pollution) due to earthquake.

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1.11. Legal and Other Requirements

Myanmar has promulgated several laws and regulations concerning protection of the environment. The following table describes laws and regulations complied by the proposed project.

Table - Environmental Laws and Regulations in Myanmar

Laws and Regulations	Year
The Labour Organization Law, 2011 (Amended 2012) (Section 18, 19, 20, 21, 22)	2011
The Settlement of Labour Dispute Law, 2012 (Amended 2014, 2019) (Section 38, 38-A, 39, 40, 51)	2012
Employment and Skill Development Law, 2013 (Section 5, 14, 30 (a,b))	2013
The Leave and Holiday Act, 1951 (Law Amended July, 2014) (Section 3, 4, 5, 7A)	1951
Minimum Wages Law, 2013 (Section 12, 13)	2013
The Payment of Wages Law, 2016 (3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14)	2016
The Social Security Law, 2012 (Amended 2014) (Section 11 (a), 15 (a,b), 18 (b), 48 (b), 75)	2012
The Workmen's Compensation Act, 1923 (Amended 1955,1957,2005) (Section 3)	1923
The Prevention of Hazard from Chemical and Related Substances Law, 2013 (Section 15, 16 (b,c, d, e, f, g, h, i, j), 17, 22, 27)	2013
The Prevention of Hazard from Chemical and Related Substances Rules, 2016 (Rule 17, 20, 24, 28)	2016
The Occupational Safety and Health Law, 2019 (Section 12 (a,b), 14, 16, 17, 18, 26, 27, 34 (a, b), 36 (a, b, c, d)	2019
The Industrial Explosive Materials Law, 2018 (Section 6 (c), 7 (c), 11 (b), 13, 14 (b), 15, 16, 18, 19, 20, 21)	2018
The Explosives Substances Act, 1908 (Section 3, 4, 5)	1908
The Ethnic Rights Protection Law, 2015 (Section 5)	2015
The Ethnic Rights Protection Rules, 2020 (Rule 20,21)	2020
The Protection and Preservation of Cultural Heritage Regions Law, 2019 (Section 21 (b))	2019
The Protection and Preservation of Antique Objects Law, 2015 (Section 12)	2015
The Protection and Preservation of Ancient Monuments Law, 2015 (Section 12, 15, 20(f))	2015
The Environmental Conservation Law, 2012 (Section.7(o), 14,15,24,29)	2012
The Environmental Conservation Rules, 2014 (Rule 54, 69 (a,b))	2014
Environmental Impact Assessment (EIA) Procedure, 2015 (Article 102 to 110, 113, 115, 117)	2015
National Environmental Quality (Emission) Guidelines, 2015 (Section 1.1, 1.3, 2.1.9)	2015
The Conservation of Water Resources and River Law, 2006 (Amended 2017) (Section 8(a), 11(a, b, c), 19, 21(b), 22, 24(b), 30)	2006

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The Conservation of Water Resources and Rivers Rules, 2013 (Amended 2020) (Rule 47, 49)	2013
The Forest Law, 2018 (Section 12(a))	2018
The Conservation of Biodiversity and Protected Areas Law, 2018 (Section 35 (a, c, d), 39 (d))	2018
The Underground Water Act , 1930 (Section 3,5)	1930
The Law relating to Aquaculture (1989) (Section 29 (b))	1989
Mandalay Region Freshwater Fisheries Law, 2012 (Section 38)	2012
The Highways Law, 2000 (Section 8)	2000
The Vehicle Safety and Motor Vehicle Management Law, 2020 (Section 9 (a), 12 (c), 14 (r), 18 (a), 81 (g))	2020
The Vehicle Safety and Motor Vehicle Management Rules, 2022 (Rule 252, 253, 254, 256, 261, 262, 263, 269, 271)	2022
Public Health Law, 1972 (Section 3, 5)	1972
The Prevention and Control of Communicable Diseases Law ,1995 (Amended 2011) (Law No. 3(a)9, 4, 11)	1995
The Control of Smoking and Consumption of Tobacco Product Law, 2006 (Amended 2017) (Section 9)	2006
Farm Land Law, 2012 (Amended 2020) (Section 30)	2012
Natural Disaster Management Law, 2013 (Section 14, 15, 16, 17, 18)	2013
Constitution of the Republic of the Union of Myanmar (Articles 45, 349, 359)	2008
The Myanmar Investment Law (Section 50(a, d), 51 (b,d,e,f), 65, 73) (2016) (2019 Amended)	2016
The Myanmar Investment Rules, 2017 (Amended 2018) (Rule 202, 203, 206, 212)	2017
The Export and Import Law, 2012 (Section 7)	2012
The Myanmar Fire Brigade Law, 2015 (Section 25)	2015
The Myanma Insurance Law, 1993 (Section 15, 16)	1993
Private Industrial Enterprise Law, 1990 (Section 13 (a), 27)	1990
The Myanmar Engineering Council Law, 2013 (2019 Amended) (Section 34, 37)	2013
The Petroleum and Petroleum Product Law, 2017 (Section 8(a,c), 9 (a,e), 10 (a, b, d, e), 11)	2017
The Petroleum Rules, 1937 (Rule 24, 25, 26, 63, 64(1), 65, 66, 72, 74, 75, 76, 80 90, 91, 93, 94, 95, 99, 100, 106)	1937
The Electricity Law, 2014 (Section 20, 21 (a), 24, 27, 29, 33, 40, 68)	2014
The Myanma Port Authority Law, 2015 (Section 72, 73)	2015
Mandalay City Development Law (2014) (Amended 2016, 2021) (Section 67, 69 (h,I,m), 88 (a, b,c), 101 (a,b,j, k), 103 (g,h), 104 (a), 105 (f,l,m,n), 106 (h,j,l)	2014
The Administration of Vacant, Fallow and Virgin Lands Law (2012) (Amended 2018) (Section 5, 9, 10 (a), 16 e, f, g), 19 (a,d), 25 (c,d)	2012
The Bridges Law, 2019 (Section 11 (f), 12 (c))	2019
The Myanmar Coastal and Inland Water Transport Service License Law (2015) (Section 14, 22, 23 (a, b)	2015

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The Myanmar Companies Law 2017 (Amended 2018) (Section 4 (a,b), 6 (b), 7, 25 (a, c), 27, 28 (b,c), 58 (a,b), 141 (b, c, d, e), 142, 143, 228 (a), 228 (b), 298 (b)	2017

1.12. Project Descriptions

(a) Infrastructure Components for Oil Storage

The infrastructure components (facilities) for oil storage are jetty, oil storage tanks, pipeline, loading /discharging pump, office block; guard house; 2.4-meter-high security fence complete with truck entrance/exit gates and emergency exits, canteen, car parking, etc.

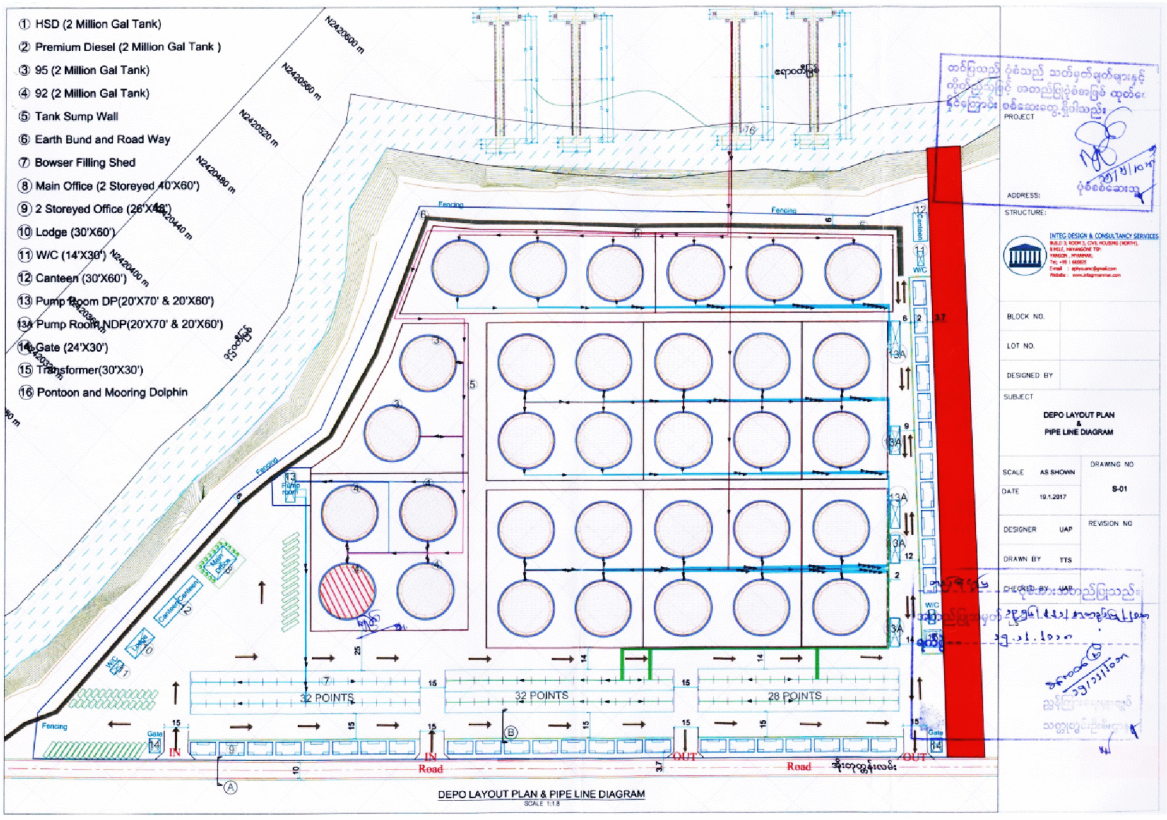

Figure- Layout Plan for Infrastructure Components

(b) Jetty

While the jetty (length 18m and width 6m) will be operated, all fire protection for the jetty will be the responsibility of MESDP.

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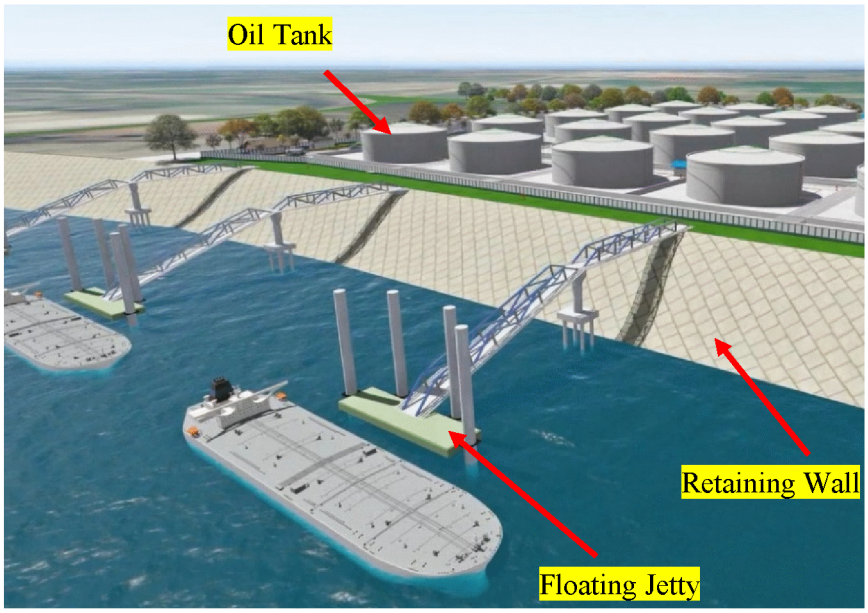

Figure- 3D Model of Jetty

The facility of jetty will have the following components: four sub terminals protection: foam monitor (350 gpm) 2 No. for each jetty approximately two oil tankers per day will be conveyed in jetty and the dimension of oil tankers are (length 150-200 ft), (width 30-50ft) and (height 9-10ft). There will be about 20 barge per day will deliver fuel oil during operation phase.

(c) Oil Pipeline

The terminal will be supplied by an above ground 10 inch pipeline, approximately 900 m in length, operating at about 6 bar pressure (the pipeline is designed for a pressure of 15 bar) connect to the main depot.

(d) Oil Storage Tanks

The storage tanks will be founded on ground type foundation reinforced by concrete piles (8×8 inch, 20 meter deep). This will be required due to the poor ground conditions as the area is on reclaimed ground. The working volume of oil capacity in a storage tank is approximately 9690m^3 (2 millions gallons). The dimension of storage tanks are height (32 ft) and diameter (105ft). The distance between two storage tanks are (50-75ft). There are 32 storage tanks (Diesel (AGO) 26 storage tanks, Petro 6 storage tanks) of the proposed project.

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Bund has been designed to contain 110 percent of nominal capacity of the largest tank contained within the bund. To achieve this bund walls are required to be 2.5m high for all type product. All storage tanks will be designed and build to meet the API 650 standard. API 650, Welded Tanks for Oil Storage, is a standard developed and published by the American Petroleum Institute (API) that establishes minimum requirements for the design, fabrication, erection, and inspection of welded storage tanks.

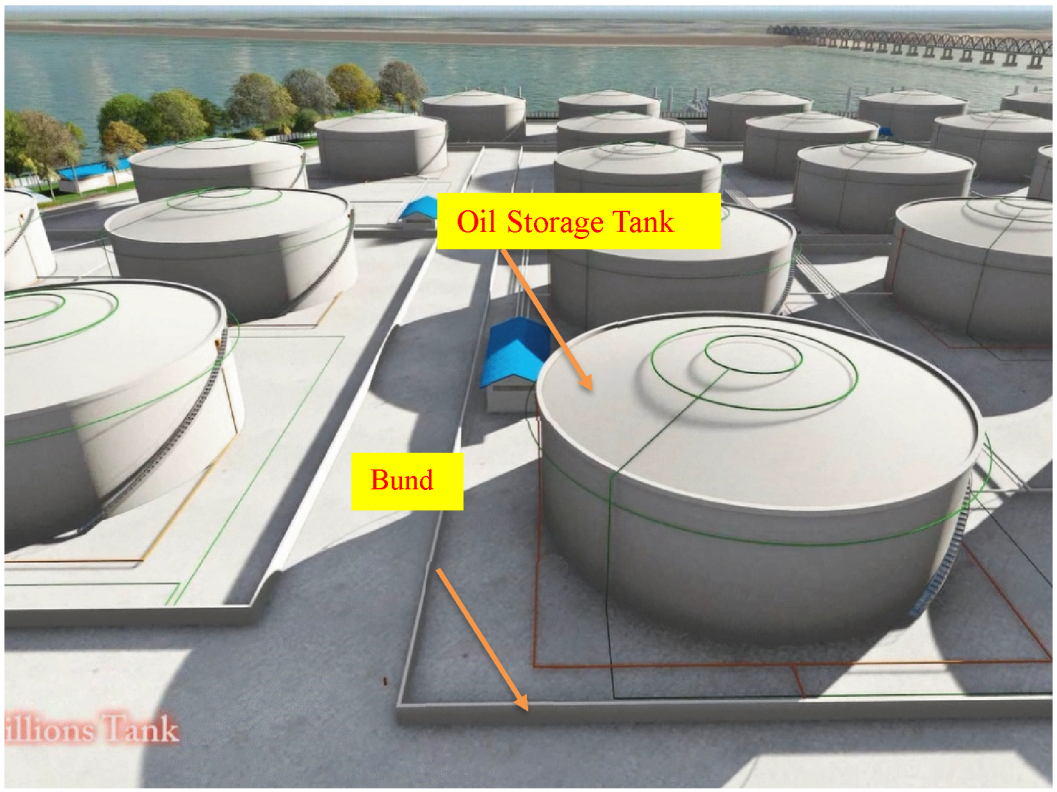

Figure- Oil Storage Tank and Bund

(e) Internal Floating Roof

The storage tanks will be an internal floating roof (IFR) tank, increasing the safety of storage tank. The objective of the internal floating roof is to have minimal or eliminate completely the potential gaseous zone above the stored liquid. This is a safety feature required within many industrial storage tank systems. Other benefits of a storage tank internal floating roof is, that by removing the gaseous region above the stored liquid, the tank is subjected to less corrosion or oxidizing elements.

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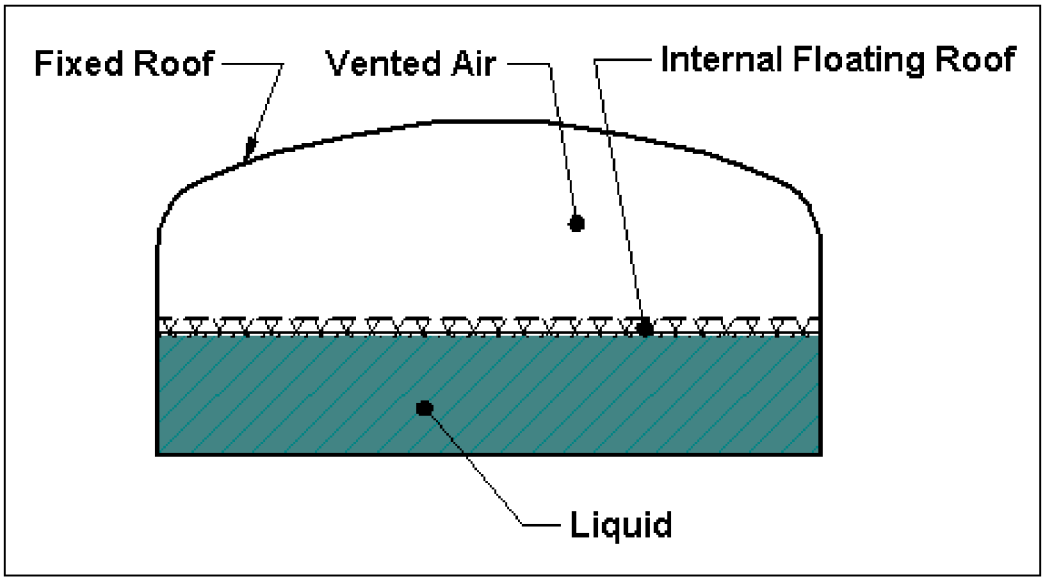

Figure- Internal Floating Roof Storage Tanks (Engineers Edge, 2007)

(f) Fire Protection

Approximately 10000m³ will be required to fire fight the worst case scenario fire for one hour. River water will be used for this purpose. Firefighting system will have the following features:

- Fire Pump Station;
- Tank Foam Facilities;
- Tank Cooling;
- Pump Manifold;
- Bung Foam

(i) Fire Pump Station

Three fire water pumps: two duty pumps with a pressure of 12,250 litres/minutes and one standby.

Two foam pumps: one duty pump with a pressure of 470 litres/minutes and one standby.

Additionally, a tie in from the port firefighting foam system has been incorporated into the firefighting in an event of an emergency.

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Figure- Fire Hydrant

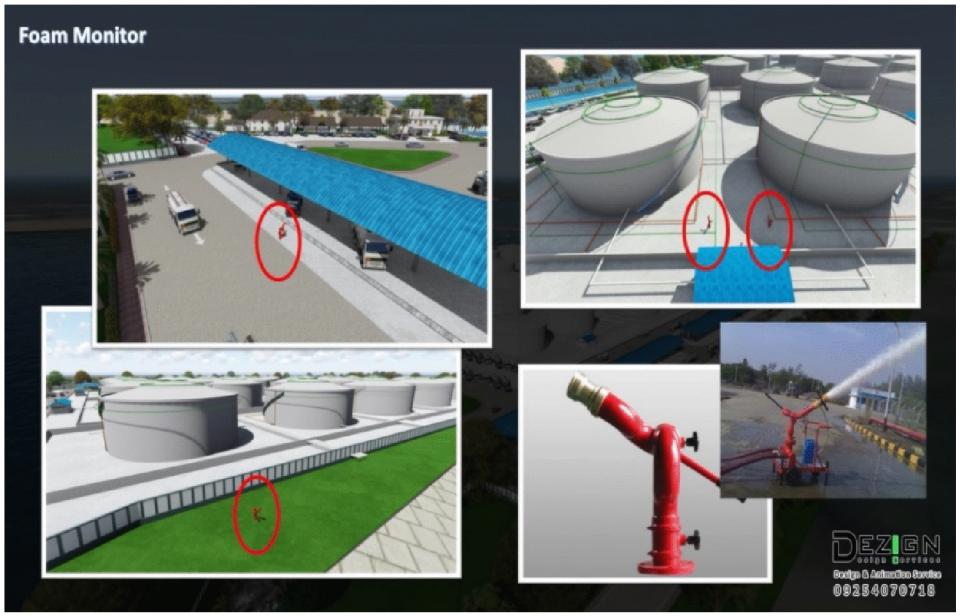

Figure- Foam Monitor and Foam Hydrant

(ii) Tank Foam Facilities

- All tanks will be fitted with foam top pouring systems;
- Manifolds will be located at a safe distance away from the tanks and these valves will be manually operated; and
- Testing facilities will be incorporated into the system.

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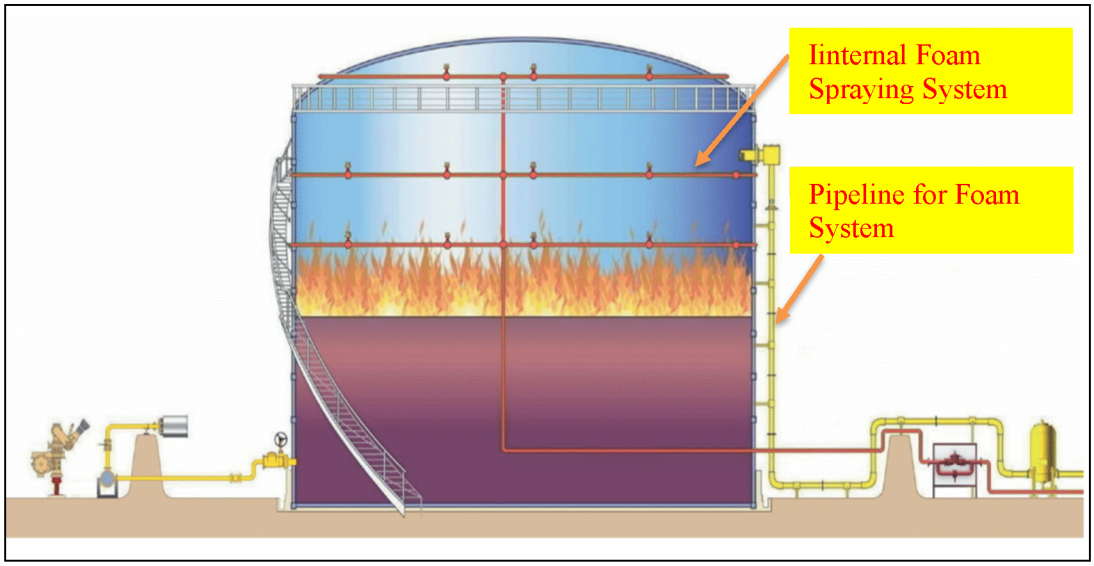

Figure- Tank Foam Facilities

Foam spray valves are checked daily and locations of the foam spray valves are expressed with the following figure.

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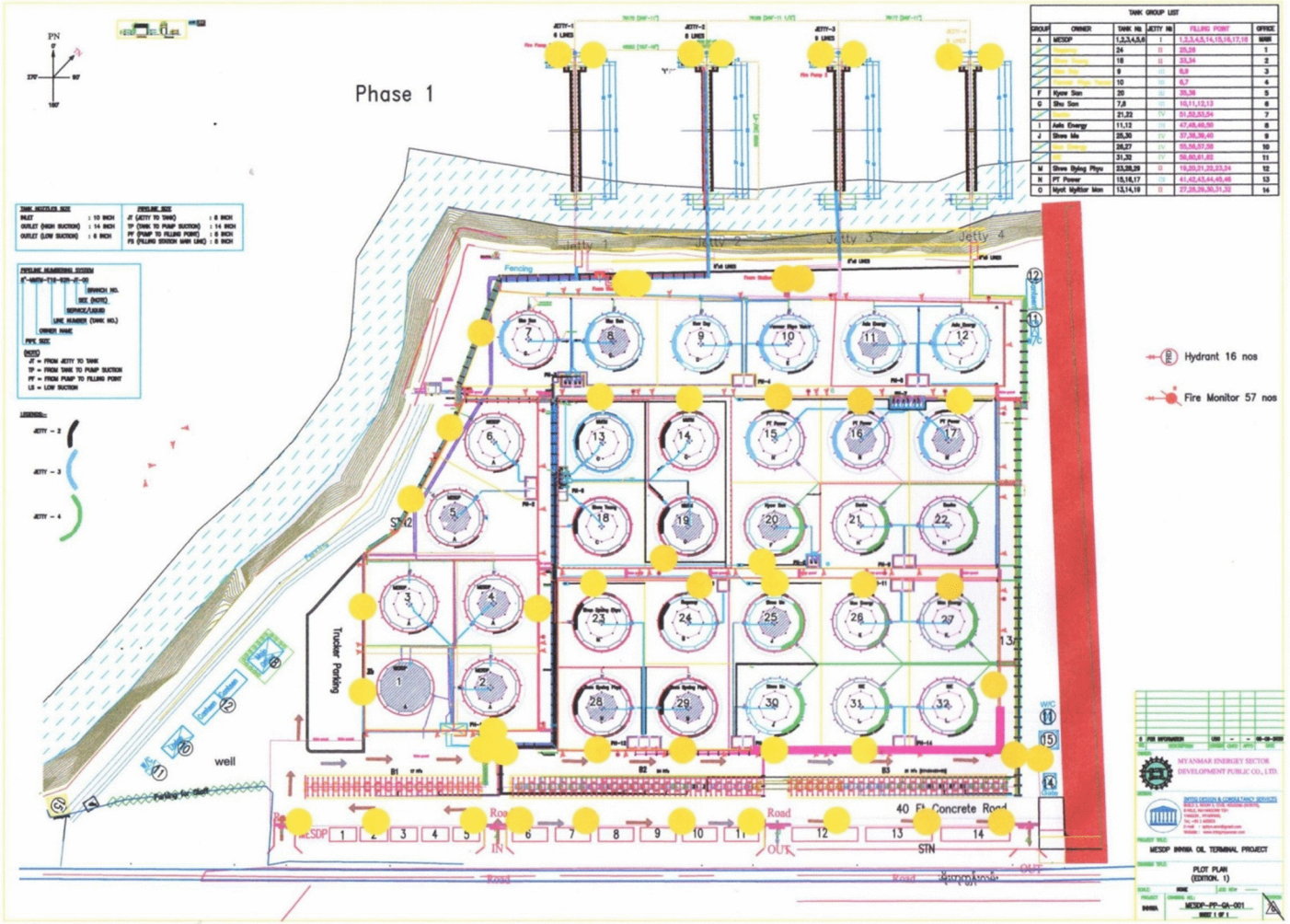

Figure- Location of Foam Spray Valves

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(iii) Fire Alarm System

A zoned fire alarm system will be installed at the located in the following areas.

- Filling points entrance and exit;
- Pump skid;
- Bund entrance / exits;
- Office building;
- Workshop;
- Site exit; and
- MCC / switch room.

Activation of the fire alarm system will create a site emergency shutdown.

(iv) Emergency Shut Down

An emergency shutdown (ESD) system will be installed that will be active from either the fire alarm system or any ESD push button that are located in the following areas:

- Filling point entrance and exit;
- Pump area;
- Bund entrance / exits
- Control room;
- MCC/ switch room; and
- Site exit.

The ESD panel will be located within the switch room and consist of relay logic, local lamps for system status and reset functionality.

(g) Drainage Systems

The flow chart of drainage systems is shown in the following figure.

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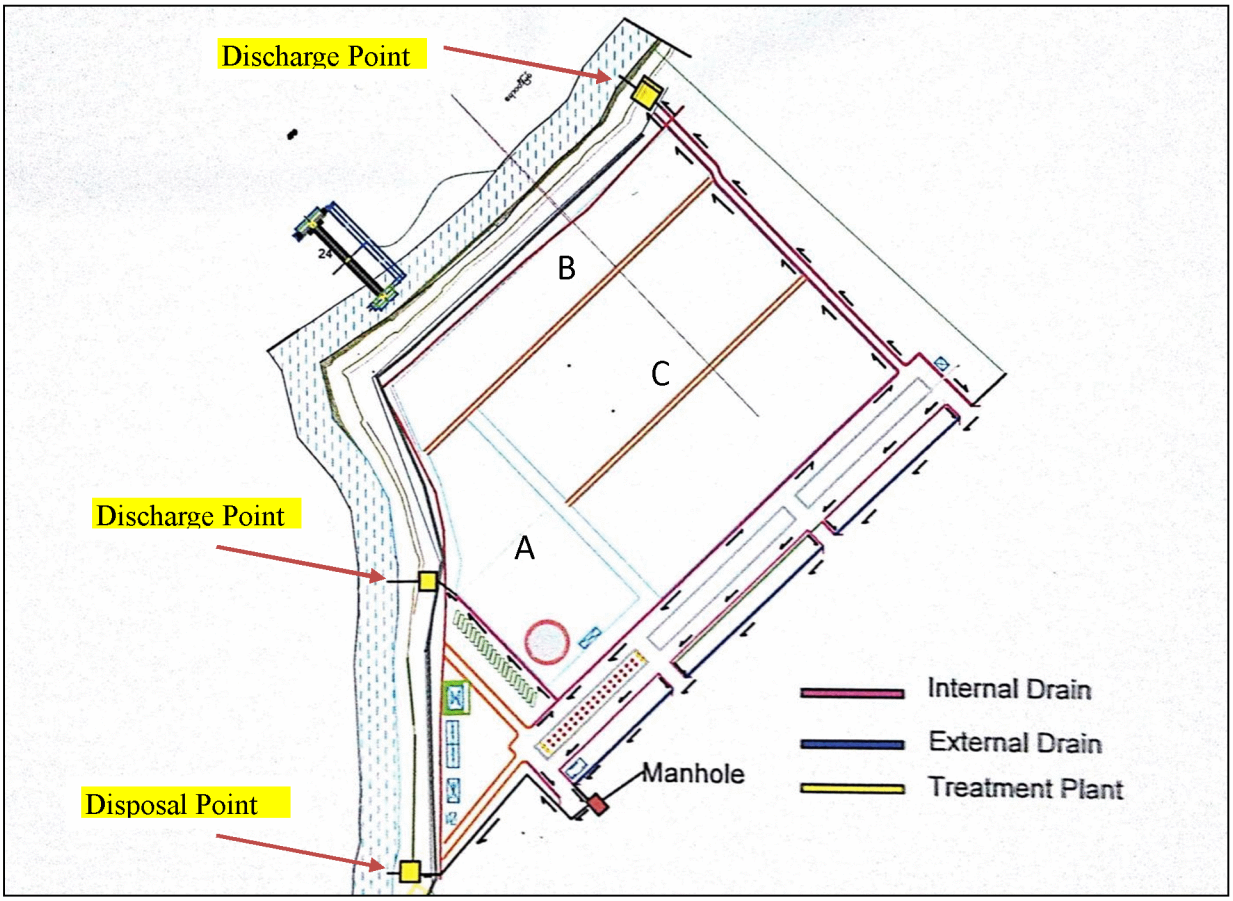

Figur- Internal Drainage System of Project Area

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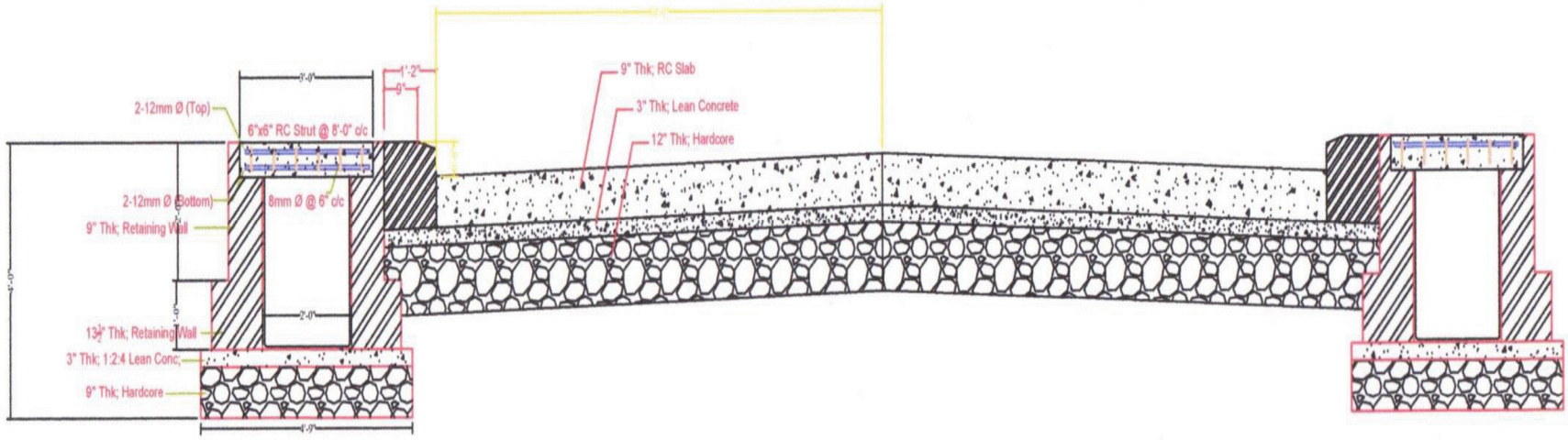

Figur- Cross Section of Drainage

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(h) Waste Management System

Three oily water separators will be installed. Two of the oily water separators will be located at the main storage area, and the third separator will be located within the road gantry area as shown in the above figure. Contaminated and potentially contaminated water will flow into the system. The separator is designed as a one in ten year intensity rainfall separator with three chambers.

(i) Fuel Oil Transportation Plan

As transportation of fuel oil by water way will carry a lot of fuel, cheap amount of costs per barrel, water way will be used as first priority. Transportation of road way (Trucks and oil boxer) will only use to carry smaller capacities of oil short distances as these trucks can cause traffic congestion. Fuel oil will be transported from Yangon to Mandalay by using water way passing through Ayeyarwaddy River and travel time is approximately 7 days. Oil transportation plan is shown in the following table.

Carry From	Yangon to Mandalay (Storage Tanks)	Water Way (Ship Vessels)
Sent To	Mandalay (Storage Tanks) to - upper Myanmar cities - Southern/Northern of Shan State - Sagaing Region and Chin State - Central Region of Myanmar	Both water and road ways

1.13. Phases for the EIA Report

The following phases are considered in conducting of EIA for the proposed project.

(i) Pre-construction Phase

Pre-construction will involve site clearing, land clearing and earth filling activities. Pre-construction period is approximately one month. The project area is not situated in forest area and most of the lands use are sand filling and so no trees are needed to cut down. The following table shows the number of vehicles will use in the pre-construction phase.

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No.	Pre-construction activities	vehicles	workers	Duration
1	Site/ land clearing	Dozer (1)	(10)	15 days
2	earth working	Track (3)	(15)	30 days




Project Site Land

(ii) Construction Phase

The construction phase will include the construction of the temporary camp for construction workers and construction of oil storage tanks and other facilities for fuel oil distribution. The activities and tiem during of construction phase are as follow:

No.	construction activities	Duration
1	Piling	40 weeks
2	Tank foundation	60 weeks
3	Bund walls	35 weeks
4	Bund floor sealing	35 weeks
5	Fire protection systems	53 weeks
6	Product pumps and piping	63 weeks
7	Filling points	20 weeks
8	Offices	20 weeks
9	Electrical works	35 weeks
10	Commissioning	12 weeks

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Pilling Activities



Oil Tank Construction

(iii) Operation Phase

The main operation processes are transportation of fuel oil by oil tanker, storage of fuel oil, and distribution of fuel oil. The main operation processes are as follow:

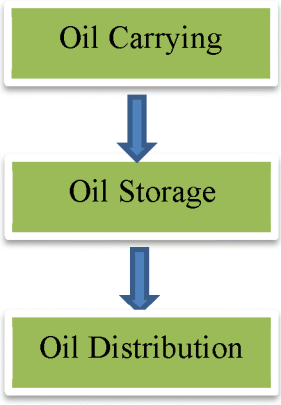

Figure- Operation Diagram

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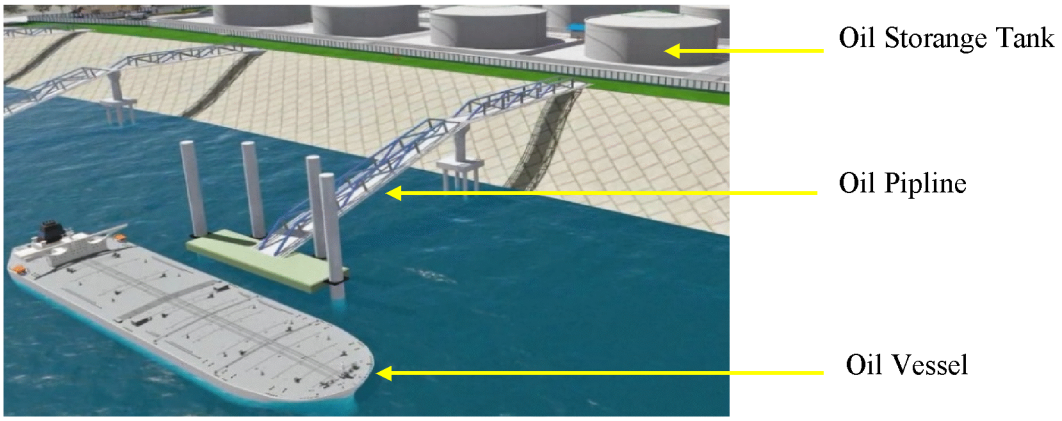
Oil Carrying

The fuel oil (diesel and petro) will be delivered to the storage tanks by oil tankers (ship vessels) from Yangon port. The oil tankers will be deported at the jetty and the fuel oil are conveyed through the pipeline to the storage tanks. The pipeline will be located within a culvert. In-out product balances will be monitored, and flow rate meters installed. The pipeline will be inspected regularly.



Oil Transportation

Oil Storage

Fuel oil storage will be divided into diesel and petro in storage of diesel (AGO) 26 storage tanks and petro 6 storage tanks.

Oil Distribution

The fuel oil are distributed to oil barge or oil bower through the filling stations. The filling of trucks will be controlled by land controllers and metering equipment designated to each filling arm. The fill controllers will be located on the filling point and connected to the site automation system.

(iv) Decommissioning

Although the proposed project is long-term project, decommissioning of the project will occur at the end of its lifespan. The goal of project decommissioning will be to remove the concrete and steel structures or as a whole and return the site to a condition as close to a pre-construction state as feasible. The physical removal of the structures and equipment will be the reversal of the construction process. All areas disturbed by the proposed project will be restored to pre-project conditions and/or to conditions acceptable to the MCDC rule and regulations. During decommissioning phase, all concrete and steel structures and equipment will be dismantled and removed.

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1.14. Key Anticipated Environmental Impacts and Mitigation Measures

The key environmental impact will be blockage of drainage system during construction phase. Visual impact, traffic congestion, oil spillage, fire and exploration during operation phase. Other impacts will be fire and exploration during accidental and disasters cases as shown in the following table.

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Summary of Anticipated Impacts and Mitigation Measures

No.	Phase	Anticipated Impacts	Mitigation Measures
1.	Construction Phase	- Blockage of drainage system	- Alternative water ways to reduce the blockage of drainage system will be prepared as part of compensation program. The alternative water ways will have the enough capacity to control water volume at least equal volume of natural drainage system.
		- Traffic congestion and accidents	- the movement of heavy machinery during the construction phase will be limited to off-peak hours and construction materials carry to nigh time
		- Visual Impacts	- Enclose the construction camp sites with non-transparent fencing (temporary fencing) to minimize the visual impacts on nearby areas especially for travelers along the Oh Htoke Tan Road
2.	Operation Phase	- Soil and water pollution (oil spillage)	- Oily process waste water (effluent water) will be disposed as effluent watr after treatment with oil separator. - The drainage from these areas will be collected via a separate drainage system and discharged to three chamber oily water separate. Liquid waste in the form of domestic waste water will be collected and contained in septic tanks and then removed for disposal as necessary by an MCDC licensed contractor. Effective spill prevention and control will decrease the risk of oil-contaminated wastewater entering the surrounding environment, including the implementation of secondary containment to avoid accidental releases. A drainage channel network will connect all the fuel storage and work areas to an oil/water separator and fuel recovery tank which have to be regularly maintained.

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	Operation Phase	- Fire and Explosion	- The Fire Prevention Plan and Emergency Preparedness and Response Plan (EPRP) will assist project staff in effectively responding to emergencies associated with project hazards event such as fires and explosion.
		- Traffic congestion and accidents	- The construction materials will be transported at night during construction phase. - The new extension road will contruct parallel with the Oh Htoke Tan road to reduce traffic during construction phase.
		Impact on Cultural and Heritage	- To reduce the indirect impact, the boundary will be demarcated 40 m away from the edge of ancient monument zone (especially from Tha Bye Dan Fortress) - The height of any project buildings will be limited as the maximum height allowed by the Heritage Authority as Department of Archaeology and National Museum (DoANM). - To reduce the visual impacts on the cultural landscape, tall green trees and some fence-bushes will be grown along the fence of the project area for covering the visual pollutants e.g. the geometric design of oil storage tanks and standard colours (White or some brilliant colours). The area of green space will be placed outside the fence of project area and it will be 40 m wide in minimum. To consider the water way and jetty importantly associated to the project area, the northern and eastern river bank of Innwa City Wall will be carefully preserved to make retaining walls with the collaboration of DoANM and some associated authorities of government sectors and rules of laws.
3.	Natural Disaster	- Earth quake	- Oil storage tanks in order to build at least one earthquake Richard scale (7.7).
		- Fire and Explosion	- According to the international standard (NFPA) standards will be built in storage tank. All tanks will be fitted with foam top pouring Fire Fighting System.

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1.14.1. Summary of Cumulative Impacts and Mitigation Measures

Anticipated cumulative impacts due to proposed project are alternation in land used pattern, traffic congestion, erosion of river bank, fire and explosion hazard, and visual Impact. To minimize changes in land use patterns and economic disruptions, MESDP will prioritize hiring local people, especially those who sold their farmland, and will allow small businesses like food court and tea shops near the project. To reduce traffic congestion, MESDP will upgrade roads and restrict vehicle parking outside the project area. For riverbank erosion, retaining walls will be constructed if necessary to mitigate potential soil erosion from fuel oil transportation. Fire and explosion risks will be managed as per operational safety plans, with MESDP also sharing firefighting knowledge with other. To reduce visual impacts, natural barriers such as vegetation and landscape management plans will be implemented, while storage tank locations and colors will be chosen to blend with the surroundings.

1.15. Data Collections

The project related data, project layout plans and design parameter are provided by MESDP. Secondary data on demographic distribution in the area are sourced from General Administrative Department (Amayapura) and data on public health are sourced from Public Health Department (Amayapura). Primary data for public concerns, socio-economic and health profiles are conducted by household survey.

1.16. Public Consultation and Participation Process

In this study, effective public consultation and participation approaches in the form of stakeholder identification, focus group discussions, public meetings and public disclosure will be conducted. Public participation will be conducted by the following procedures:

(a) Household survey;
(b) Public meetings; and
(c) Public disclosure process.

(a) Most Public Needs and Concerns during Household Survey and Public Meeting

During household survey and public meeting for scoping proposal, the most important positive outcomes from the project expected by the local people and most of their concerns about proposed project are as follow:

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Village Name	Most Pubic Concerns
Shwe Kyat Yat village tract (*Padamyar Ward, Ywa Thit, That Ke Taw, Ka War, Ta Pyan Ten*)	• Fire and Exploration • Flood • Pollution by oil leakage
PhoneTawNainKan village tract (*PhoneTawNainKan, TaBaitTann, LatYway, LatTitYat, HlayGyiTan*)	• Flood • Fire and Exploration • Damages to Tha Pya Tan Fort, Shwe Kyat Yat Pagoda
That Gyi	• Fire • Flood risk • Environmental impact
Oh Htoke Tan village tract (*OeHtokeTan, LayThar*)	• Damages to Shwe Kyat Yat Pagoda • Pollution by oil leakage
Other participants (INGOs and CBOs)	• Traffic • Location of the project • Visual impact • Impact on aquatic lives

(b) Public Meetings

The following communities, authorities and NGOs will be considered as key stakeholders who are directly or indirectly related to the proposed project.

(a) Members of Myanmar Energy Sector Development Public Co., Ltd.
(b) Local People (around the proposed project area)
(c) Village Administrative Offices (around the proposed project area)
(d) Environmental Conservation Department (Mandaly)
(e) Head of Local Administration Office (Amarapura);
(f) City Development Committee (Amarapura);
(g) Department of Public Health (Amarapura);
(h) Planning and Statistics Department (Amarapura);
(i) Department of Settlement and Land Record (Amarapura);
(j) Department of Water Resources Utilization Department (Amarapura);
(k) Department of Labour (Amarapura);
(l) Myanmar Police Force (Amarapura)
(m) Local Media, and
(n) NGOs and CBOs (Sein Yaung Sone, Tha Ba Wa Sein etc.)

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The public participation process were made three times and the followings are the key discussions during the meetings.

1.16.1. Key Discussions of Public Meetings

Public meetings were made as (i) public meeting for scoping proposal, (ii) first public meeting, and (iii) second public meeting. The followings are the key findings from these meetings.

(a)Public Meeting for Scoping Proposal

Public meeting of scoping process was held in (22.10.2017) and the key findings during meeting are as follow;

- Impacts on Thapyatharn Fortress and Innwa Bridge due to fire and explosion;
- Blockage of existing drainage system;
- Erosion of river bank;
- Impacts on culture and heritage site;

The main discussion of the meeting is to mitigate the impact emerge from construction and operation of the proposed project. MESDP commits to mitigate all of the impact of the proposed project. The key findings during scoping of impact assessment are as follow;

(1) Most local people worried about the fire risk, impacts on culture and heritage, increased in river bank erosion, traffic jam and waterway or natural drainage blockage.
(2) One of CSOs attending this meeting suggest to change hotel project instead of oil storage facilities because the area is located near culture and heritage site and Sagaing earthquake prone areas.
(3) The project proponent commits to implement the project by minimizing as least as possible for the impacts on environment, socio economic and cultural and heritage etc. If the project affected to local communities, the company will take responsibility and accountability for those impacts.
(4) The project proponent also commits to use the CSR fund regularly.

Suggestion Letters during Public Meeting for Scoping Proposal

Key findings from suggestion letters of local people are as follow;

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(1) Blockage of water way during earth filling activities of the proposed project;
(2) Make sure not to blockage of natural drainage system system in the related four fields;
(3) The blockage of oil bowser on village road;
(4) The use of CSR fund regularly;
(5) The implementation of commitments during the meeting;
(6) Erosion of river bank at Oh Htoke Tan village;
(7) Damage of the plants that are planting on Innwa Road;

(b) First Public Meeting

The first public meeting was completed in (20.1.2018) during the EIA study and the main discussions are as follow:

(i) Implementation of mitigation measues for accidentally fire and explosion; the project proponent must control to avoid these accidents and have to pay compensation of these accidents.
(ii) Blockage of drainage system during earth filling in construction activities. MESDP will prepare to flow the water volume more than natural drainage system.
(iii) Building of retaining wall at the Inwa side cause by transportation of oil tankers.
(iv) Upgrading of Oh Htoke Tan Road to reduce traffic congestion,
(v) Fish breeding rate in nearest rivers.

Suggestion Letters during first Public Meeting

Key findings from suggestion letters of local people are as follow;

(1) To give priority to local job opportunities;
(2) Impacts on culture and heritage site;
(3) To safe of fire risk;
(4) To responsible for accidents (fire and explosions);
(5) Sustainable prosperity of Tha Bye Dan Fortress; and
(6) To implement water flow/drainage system.

(c) Second Public Meeting

The second public meeting was held in (27.3.2018) and mainly discuss the following points:

(1) Upgrade and maintenance of Latt Yway entrance road before raining seasons;

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(2) Blockage of drainage system due to the sand filling of the proposed project;
(3) River bank erosion;
(4) Oil spill from oil tanker during emergency case;
(5) Blockage of underground water cause by piling activities;
(6) Impact on Nga Late kyaut in Arawady River; and
(7) Limited space for construction of 32 fuel oil storage tanks in current place.

Suggestion Letters during Second Public Meeting

Key suggestions from suggestion letters of local people are as follow;

(1) Regular inspection with foreign expert to check the quality of the storage tank;
(2) Job opportunities and CSR program;
(3) Wrong location for the oil storage facilities and more suitable for other projects;
(4) To respect the recommendations of Geological and Geographical experts;
(5) To prevent the erosion of river bank on Aye Yar Waddy and Tha Bye Dan Fortress;
(6) To draw management plan for traffic, fire risk and emergency response plan for this project; and
(7) To prevent the impact on the environment and human resources.

1.17. Environmental Management Plan (EMP)

EMP is a site specific plan developed to ensure that the project is implemented in an environmental sustainable manner where all contractors and subcontractors, including consultants, understand the potential environmental impacts arising from the proposed project and take appropriate actions to properly manage that risk. EMP also ensures the project implementation is carried out in accordance with the design by taking appropriate mitigation actions to reduce adverse environmental impacts during its life cycle. EMP will include mitigation and management measures for all of the anticipated impacts of the prposped project. The complete EMP for the proposed project is presented in Chapter 8 of this EIA Report.

1.17.1. Summary of EMP, Budget of EMP and monitoring Plan

The Environmental Management Plan (EMP) outlines all of the management and mitigation measures in pre-construction phase, construction phase, operation phase and decommissioning phase. Morover, EMP also describe estimated costs and responsibilities for environmental management measures, monitoring measures and responsibility for each

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management and monitoring measures. The followings are the estimated cost and budget for environmental management and monitoring measures.

Estimated Cost for Environmental Management: US $ US $ 10/ daily for air quality and US $ 50 for water quality during pre-construction phase. US $ 10/ daily for air pollution, US $ 50 for water pollution and US $ 5 for socio-ecomomic during construction phase. US $ 10/ daily for air quality, US$ 1000 for water quality, US$ 200 for biodiversity, US $ 150,000 for risk management during operation phase. US $ 10/ daily for air quality during decommissing phase.

Estimated Cost for Environmental Monitoring: US $ 10/ weekly for air quality, during pre-construction phase. US$ 50/weekly for air quality during construction phase. US$ 550/biannually for air quality, S $ 100/biannually for water quality and US $ 500 for greenbelt development during operation phase.

Environmental Management Team of MESDP is primarily responsible environmental management and mitigation measures in all phases.

1.18. Emergency Response Plan (ERP)

Emergency incident response plan for proposed project is proposed to mitigate harms on humans and environment in the project area and its vicinity in case of incident. This plan provides the management structure, key responsibilities, emergency assignments and general procedures to follow during and immediately after an emergency. The emergency conditions for proposed project are following:

(a) Fire and explosion
(b) Oil leakage; and
(c) Sinking of oil tanker.

Oil storage facilities will be designed and operated according to international standards for the prevention and control of fire (API 650 standards) and explosion hazards including provisions for distances between tanks in the facility, and between the facility site boundary and adjacent buildings.

Implementing safety procedures for loading and unloading of product to transport systems (e.g. tanker trucks, and vessels), including use of fail safe control valves and emergency shutdown equipment;

The Fire Prevention Plan and Emergency Preparedness and Response Plan (EPRP) will assist Project staff in effectively responding to emergencies associated with project hazards event such as fires and explosion.

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1.19. Natural Disaster Management Plan

The natural disasters for proposed project are following:

(a) Fire risk;

(b) Earth quake; and

(c) Flood.

The complete natural disaster management plan for the proposed project is presented in Chapter 8 of this EIA Report.

1.20. Project Benefits

The available benefits of proposed project are employment opportunities, direct and indirect taxes, low-priced of fuel oil in the upper Myanmar and decrease unsystematic oil distribution system on near Shwe Kyet Yat village with diangerous fire condition.

1.21. Conclusion

The proposed project is located near the culture and heritage areas and some residential areas. These areas can cause ard during fire and explosion because oil storage facilities are high risk for fire and exploration. Moreover, the project site is situated in prone of earthquake (seismic zone). So, the project developer (MESDP) will make construction and operation of storage tanks (i) to minimize fire risk, and (ii) to withstand highest earthquake in the region with messive retaining wall at river bank. The Fire Prevention Plan and Emergency Preparedness and Response Plan (EPRP) will assist project staff in effectively responding to emergencies associated with project hazards event such as fires and explosion. Moreover, to be responsible for the preservation of cultural heritage and landscapes including Innwa Old City, Ava Bridge and Tha Bye Dan, MESDP will participate with the heritage authority and negotiate with DoANM; to reduce the visual impacts between the boundaries of project area and the ancient monument zones, such as the buffer area (40m) will be left as the particular landscape; prepare signage for cultural heritage at the project site, and monitoring to do stewardship for the cultural landscape. Crude oil and petroleum product transport and storage facilities will be designed and operated according to international standards for the prevention and control of fire and explosion hazards including provisions for distances between tanks in the facility, and between the facility site boundary and adjacent buildings. If the above points do sensibly, the proposed project can be able to operate with low environmental impacts and the continuous improvement of the economic and social development of local communities.

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2. INTRODUCTION

2.1. Project Background

Myanma Energy Sector Development Public Company Limited (MESDP) will operate oil storage facilities and jetty for storage and distribution fuel oil in upper Myanmar. The name of project is MESDP Jetty & Depot (Mandalay). MESDP was established in 1st January, 2013 and 100 % public. There are 51 companies who are members of Myanmar Petroleum Trade Association (MPTA) will put together as MESDP. The proposed project will support to develop energy sector in upper Myanmar.

2.2. The Aim of the Project

The developer statements publicly that the proposed project will need in upper Myanmar due to the following reasons:

(a) To provide quality fuel oil for upper Myanmar with a reasonable price.
(b) To store large quantity of fuel oil with safety, and
(c) To get benefits for both customers and supplier together with increasing employment opportunities for local people as well as resulting in government revenues.

2.3. Brief of the Project Proponent

The followings are the brief of project proponent.

Project Developer	
Project Developer	Myanma Energy Sector Development Public Company Limited (MESDP)
Type of Project	Fuel Oil Storage Facilities and Jetty
Contact Person	U Soe Min Oo (Executive Director) MESDP No. (29), MinYe Kyaw Swa Road, UMFCCI 10th Floor, Lan Ma Daw Township, Yangon. Ph- (09-975909445) Email- mesdp.myanmar@gmail.com

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2.4. Brief of the Environmental Assessment Practitioner

Below is the background information on Ever Green Tech Environmental Services and Training Co., Ltd., (Third party) who conducted the EIA.

Ever Green Tech Environmental Services & Training Co., Ltd.	
Company Name	Ever Green Tech Environmental Services and Training Co., Ltd.
Company Registration Number	3344/2015-2016 (Ygn)
Contact Address	No.14, Thiri Mying (8th)Street, 13th Quarter, Hlaing Township, Yangon
Telephone Number	09-43106929, 09-91019166, 09-799700171
E-mail	green.evergreentech@gmail.com
Contact person	Dr. Kyaw Swar Tint Principal Environmental and Social Consultant 09-5099232

2.5. Selected Consultants for Conducting EIA

The following table shows the environmental and social consultants who drawn up the respective portion of the EIA.

	Name	Degree	Responsibility	Area of Expertise
Our Consultants	Dr. Kyaw Swar Tint	Ph.D. (Mining)	Principal Consultant	(a) Air Pollution Control (b) Noise and Vibration (c) Socio-Economy (d) Environmental Management and Monitoring
	Dr. Thein Tun	Ph.D. (Metallurgy)	Senior Consultant	(a) Risk Assessment and Hazard Management (b) Facilitation of Meeting

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				(c) Legal Analysis (d) Occupational Safety and Health
	Dr. Myo Min Nyunt	Ph.D. (Mining)	Senior Consultant	(a) General Geology (b) Noise (c) Meteorology, Modeling for Air Quality
	Dr. Kyaw Zay Moe	Ph.D. (Botany)	Consultant	Flora Diversity
	Dr. Ko Myint	Ph.D. (Zoology)	Consultant	Aquatic Lives and Plankton Analysis
	Dr. Ni Ni Aye	M.B.B.S. (Ygn)	Consultant	(a) Health Impact Assessment (b) Water Pollution Control
	Dr. Pyae Phyo Kyaw	Ph.D. (Archeology)	Consultant	Cultural and Hesitate Impact Assessment
	Daw Tin Tin Ohm	M.Sc. (Forest Soil Science)	Consultant	Soil Quality
	Dr. Myint Thein	Ph.D. (Geology)	Consultant	Liquification and Risk Assessment
	Dr. Win Swe	Ph.D. (Geography)	Consultant	Hydrology and Risk Assessment
	Mr. Moe Pyi Kyaw	B.Sc. (Forestry)	Consultant	Environmental Baseline Study (Air & Water Quality Analysis)
	Mr. Min Aung	M.Sc. (Chemistry)	Key Consultant	(a) Modelling of Water Quality
	Ms. Nandar Nwe	M.S. in EIA/EMS (YTU)	Consultant	Solid and Hazardous Waste Management
	Ms. Thazin Htwe	M.S. in EIA/EMS (YTU)	Consultant	Social Impact Assessment (Public Consultation and Stakeholder Engagement)
	Ms. May Thet Zaw	B.Sc. (Zoology)	Consultant	Air Quality Monitoring
	Mr. Aung Naing Tun	L.L.B; MBA	Consultant	(a) Laws and Regulations (b) Economic Analysis

2.6. The Need of EIA

EIA for the proposed project is required according to the Environmental Conservation Law (2012) and Environmental Impact Assessment Precedure (2015). The Environmental Conservation Department under Ministry of Natural Resources and Environmental Conservation is the lead authority for this EIA process and the development needs to be

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authorized by this Department in accordance with this Environmental Conservation Law (2012).

2.7. Objectives of the EIA Study

This EIA will be conducted according to Environmental Impact Assessment Procedures, 2015. The main objectives of an EIA is to provide the relevant authorities with sufficient information on the proposed activities to allow them to make an informed decision on whether or not the EIA should be authorised. The objectives of an EIA are:

- To inform decision-makers and result in appropriate levels of environmental protection and community well-being;
- To provide timely information and outputs which assist with design and engineering modifications that reduce negative impacts;
- To identify any significant environmental effects and key issues (i.e. the matters that must be taken into account when making decisions) and apply the necessary mitigation measures;
- To provide opportunities to inform and involve Interested and Affected Parties (I&APs), incorporating their inputs and concerns explicitly into the documentation and decision-making;
- To allow opportunities for participation by the authorities involved;
- To ensure that the EIA team has implemented appropriate methodologies and experts from the relevant disciplines, and to ensure the team has assessed potential interrelationships between the biophysical, social and economic issues; and
- To provide, as far as possible, an objective, rigorous and balanced assessment of the issues.

2.8. About the EIA and EMP Report

EIA is a formal process used to predict how the proposed project will affect natural resources such as water, air, land, socio-economic and wildlife. It is desirable to ensure that the development options under consideration are sustainable. It also aims to make recommendations for the mitigation of the potential negative impacts and enhancement of the positive ones.

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EMP is a site specific plan developed to ensure that the project is implemented in an environmental sustainable manner where all contractors and subcontractors, including consultants, understand the potential environmental impacts arising from the proposed project and take appropriate actions to properly manage that risk. EMP also ensures the project implementation is carried out in accordance with the design by taking appropriate mitigation actions to reduce adverse environmental impacts during its life cycle. So, the EIA will contain:

(a) the present status of air, noise, water, land, biological, socio-economic and health components of the environment;
(b) identification and evaluation of positive and negative impacts due to the development of the project;
(c) proposed pollution control measures, environmental management plan (EMP) to be adopted for mitigation of adverse impacts;
(d) measures for the improvement of the community around the area, and
(e) post-project environmental quality monitoring programme.

In making impact assessment, Green Tech ESIA Team mostly referred to the pollution limits set by Myanmar National Emission Guidelines, Occupational Safety and Health Administration (OSHA) and International Finance Cooperation (IFC).

2.9. Scope of the EIA Report

Firstly, executive summary in both Myanmar and English languages are described. Then, the need of the project, the need of the EIA report, objectives and scope of the EIA are described. Then, laws and regulations related to the project are described. Then all of the factors relating to the proposed project are described. Then, alternative analysis, methodologies for EIA study, anticipated environmental, social and health impacts and mitigation / enhancement measures in all phases (construction, operation, and decommissioning phases) are described. Then, environmental management system, environmental monitoring program are described. Finally, CSR program, conclusion and recommendation are described in the last section.

2.10. Phases for the EIA Study

The following phases were considered in conducting of EIA for the proposed project.

(i) Pre-construction Phase

Pre-construction activities will involve site clearing, and sand filling activities.

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(ii) Construction Phase

The construction activities will include the construction of project development (including oil storage tanks, offices, internal roads, drainage system, water treatment plant, and other facilities for fuel oil distribution).

(iii) Operation Phase

The main operation processes will be carryingg of fuel oil, storing of fuel oil, handling and distribution of fuel oil (oil by oil tankers by road way and oil vessels in water way).

(iv) Decommissioning Phase

Although the proposed project is long-term project, decommissioning of the project would occur at the end of its lifespan. The goal of project decommissioning will be to remove the concrete and steel structures or as a whole and return the site to a condition as close to a pre-construction state (during the pre-construction period, the project area, being a riverbank and including filled lands, not including large trees at project site) . as feasible. The physical removal of the structures and equipments will be the reversal of the construction process. All areas disturbed by the proposed project would be restored to pre-project conditions and/or to conditions acceptable to the MCDC's rule and regulations. During decommissioning phase, all concrete and steel structures and equipments would be dismantled and removed. The major activities that will be required for the decommissioning of the proposed project are:

(a) Concrete structures removal,
(b) Storage tank removal,
(c) Treatment plant and drainage system removal, and
(d) Equipments and electrical supply system removal.

2.11. Scope of EIA Study

Consideration of AOI

An environmental and social impact assessment will be conducted within a 3-kilometer diameter of the proposed project site to ensure a comprehensive evaluation of potential impacts. This distance has been selected for several reasons. Firstly, it encompasses areas that could be affected in the event of emergencies, such as fires or explosions, allowing for a

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thorough assessment of potential risks to surrounding communities. Secondly, the assessment will address the effects of increased traffic congestion and the associated potential for road accidents, ensuring the safety of residents and travelers in the vicinity. Additionally, this radius will include areas that may experience visual disturbances and impacts on cultural heritage, providing insight into how the project might affect the local landscape and community values. By focusing on this 3-kilometer area, the assessment aims to capture a holistic view of the environmental and social impacts associated with the project.

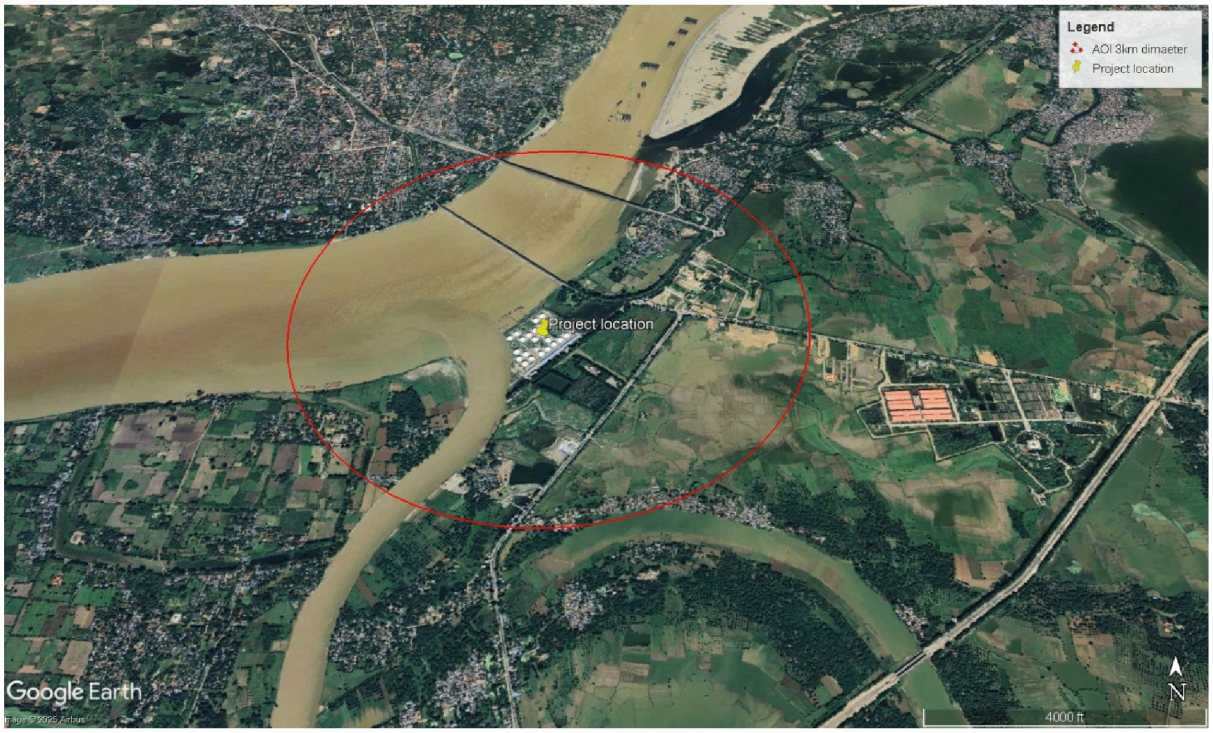

Figure: 3km AOI of the Project

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		Project Actions/Activities	Air Quality	Noise	Vibration	Soil Quality	Surface Water Quality	Groundwater quality	Groundwater quantity	Flora	Fauna	Cultural Heritage	Community Health and Safety	Community tensions	Economy	Employment	Visual Impact
Pre-Construction & Construction Phase	1	Site clearing and ground leveling	√	√	-	√	√	-	-	√	√	-	-	√	-	-	-
	2	Vehicular Movement	√	√	-	√	-	-	-	√	√	-	-	√	-	-	-
	3	Blockage of drainage due to solid wastes	-	-	-	√	√	-	-	-	-	-	√	-	-	-	-
	4	Piling	-	-	√	-	-	√	-	-	√	√	-	-	-	-	-
	5	Above ground construction, earthworks, cut and fill or excavations	√	√	√	√	√	√	-	√	√	-	-	-	-	-	√
	6	Rise in the number of migrant workers	-	-	-	-	-	-	-	-	-	-	√	√	√	√	-
Operational Phase	1	Release of VOC's from Stored Petroleum Products	√	-	-	-	-	-	-	√	√	-	√	√	-	-	-
	2	Vehicular Movement	√	√	-	√	-	-	-	√	√	-	-	√	-	-	-
	3	Accidental spill	-	-	-	√	√	√	-	√	√	-	-	-	-	-	-
	4	Improper disposal of solid waste	-	-	-	√	√	-	-	√	√	-	-	-	-	-	√
	5	Discharge of effluent water	-	-	-	√	√	-	-	√	√	-	√	-	-	-	-
	6	Rise in the number of migrant workers	-	-	-	-	-	-	-	-	√	-	√	√	√	√	-
	7	Increased in Traffic	-	-	-	-	-	-	-	-	-	-	√	√	√	-	-

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	8	Benefit to local and national economy	-	-	-	-	-	-	-	-	-	-	-	-	√	√	-
Decommission Phase	1	Removal of Infrastructures	√	√	-	√	√	-	-	-	-	-	-	-	-	-	√
	2	Improper disposal of waste	-	-	-	√	√	-	-	√	√	-	√	-	-	-	√
	3	Vehicular Movement	√	√	-	√	-	-	-	√	√	-	-	√	-	-	-
	4	Job Losses	-	-	-	-	-	-	-	-	-	-	-	-	√	√	-
	5	Site Rehabilitation	-	-	-	-	-	-	-	√	√	-	-	-	-	-	-

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According to the above considerations for AOI, the summary tables for considerations are as follow:

Phase	Potential Impacts	Affected Receptors	Baseline Study	Considerations of AOI for
Pre-Construction and Construction Phase	Air Quality (Fugitive Dust Generation)	- Nearest Local Residents - Fauna and Flora diversity	Baseline study of air quality is moderate. Baseline air quality were compared with National Environmental Quality Guidelines (NEQEG) and all the concentration values from the measured parameters were lower than NEQEG guideline values except PM10 at 67µg/m3 which slightly exceed the guideline values as the area is close to the busy road; Oh Htoke Tan Road.	PM 10, PM 2.5 concentration decreases with distances and due to the direction of the air, the emissions may reach the nearest residences. Therefore, AOI for 3km diameter is suitable.
	Air Quality (Gaseous Emission)	-Nearest Local Residents	Baseline study of the gaseous emission is within the range of national and international standards.	The gaseous emission is within the guideline values, so AOI of 3km diameter is a suitable choice to assess the impact.
	Noise	- Nearest Local Residents - Fauna diversity	Baseline study of noise quality is moderate, most of the samples lies within the range for Guideline Values (dBA) Residential, Institutional, educational except AN-1 (Day time) at 55.8 dBA was slightly exceed the Myanmar Emission Guidelines of 55 dBA as the area is close to the busy road; Oh Htoke Tan Road.	In order to cover all the sensitive areas, AOI of 3km diameter centered is suitable to be used.
	Vibration	- Nearest Local Residents - Fauna diversity -Nearest infra-structures		A 3 km diameter cover the potential vibration impacts from construction as significant vibrations typically affect areas within 100-200 meters for heavy construction (including jetty work) and smaller for

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				operational activities.
	Water Quality	- Nearest Local Residents - Fauna diversity	Baseline study of the water quality is within the range of national standards.	The water quality is within the guideline values, so AOI of 3km diameter is a suitable choice to assess the impact.
	Blockage of natural drainage system	- Potential to flood, Impact on agricultural land and changes in hydrology regeme,	There is Ayeyarwaddy and Myitnge (Dokehtawady River) Rivers near project area.	Blockage of drainage system will occur due to the improper disposal of construction derbies and so AOI of 3km diameter is a suitable choice to assess the impact.
	Socio-economic	- Traffic - Pressure on local services due to migrant workers - Impact on agricultural land - Impact on utilities (such as water and firewood)	Most of the local residents near the project are villagers	Most of the construction sites are quite far from dense populated area; nearest Densely Populated Area is Shwe Kyet Yat Village which is 0.9m far from the project and so AOI of 3km diameter is a suitable choice to assess the impact.
	Vibration	- Nearest Local Residents - Fauna diversity -Nearest infra-structures		A 3 km diameter cover the potential vibration impacts from construction as significant vibrations typically affect areas within 100-200 meters for heavy construction (including jetty work) and smaller for operational activities.
Operation Phase	Air Quality	- Nearest Local Residents - Fauna and Flora diversity	Baseline study of air quality is moderate. All the air quality values were lower than NEQEG guideline	Release of VOC's from Stored Petroleum Products and dispersion of particulate matters

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			values except PM10 at 67µg/m3 which slightly exceed the guideline values as the area is close to the busy road; Oh Htoke Tan Road.	(PM10, PM 2.5) mainly impacts the air quality but the concentration of these pollutants decreases with distances and due to the direction of the air, the emissions may reach the nearest residences. Therefore, AOI for 3km diameter is suitable.
	Noise	- Nearest Local Residents - Fauna diversity	Baseline study of noise quality is moderate, most of the samples lies within the range for Guideline Values (dBA) Residential, Institutional, educational except the point near busy road	In order to cover all the sensitive areas, AOI of 3km diameter is suitable to be used.
	Surface Water	- Nearest Local Residents - Fauna diversity	Baseline study of the water quality is within the range of national standards.	The water quality is within the guideline values, so AOI of 3km diameter is a suitable choice to assess the impact.
	Soil and Ground Water	- Nearest Local Residents - Fauna diversity -Groundwater quality and quantity	Baseline study of the soil and ground water quality is good.	Accidental spills and leakage of oil and improper waste disposal can impact on soil and groundwater quality moreover over extraction of groundwater can impact on ground water quantity. AOI of 3km diameter will cover for impact on soil and water during operation phase.
	Biodiversity	Impact on Fauna diversity especially aquatics while vessels passes	During Operation phase Ayeyarwaddy River is used for water transport.	Air, soil and water pollution due to project activities can directly or indirectly impacts on nearby fauna diversities and AOI of 3km diameter will cover for impact on flora and fauna diversities during operation phase.
	Socio-	- Traffic	Local residents near	AOI of 3km diameter

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	economic	- Pressure on local services - Impact on utilities -Job opportunities -Economy -Visual impacts	the project are mostly villagers	will cover for impacts on Socio-economic for both direct and indirect impacts during operation phase as densely populated area is 0.9m from project.
	Cultural Heritage	Cultural heritage sites near project area	The project area is closed to ancient cultural heritages of Innwa Old City and Tha Bye Dan Fortress	AOI of 3km diameter will cover for impacts on Cultural Heritage for both direct and indirect impacts during operation phase.
	Occupational Health and Safety	Workers	Accidents at works, ergonomic injuries, exposure to petroleum hydrocarbons can impact on occupational health and safety.	AOI of 3km diameter is enough for impacts on occupational health and safety during operation phase.
Decommission Phase	Air Quality	- Nearest Local Residents - Fauna and Flora diversity	Baseline study of air quality is moderately good compared with National Environmental Quality Guidelines (NEQEG).	The main air pollutants during decommission phase is particulate matters but these pollutants decreases with distances and AOI for 3km diameter is suitable.
	Noise	- Nearest Local Residents - Fauna diversity	Baseline study of noise quality is moderate, most of the samples lies within the range for Guideline Values (dBA) (Residential, Institutional, educational)	In order to cover all the sensitive areas, AOI of 3km diameter is suitable.
	Water Quality	- Nearest Local Residents - Fauna diversity	Baseline study of the water quality is within the range of national standards.	The project area is close to water body and AOI of 3km diameter covers impacts on water quality during decommission phase.
	Blockage of natural drainage system	- Potential to flood and changes in hydrology regeme,	There is Ayeyarwaddy and Myitnge (Dokehtawady River) Rivers near project area.	Blockage of drainage system will occur due to the improper disposal of decommission derbies and to cover this impacts so AOI of

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				3km diameter will be considered.
	Socio-economic	- Traffic -loss of job opportunities	Most of the local residents near the project are villagers	Densely populated area is 0.9m far from project and AOI of 3km diameter is a suitable choice to assess the impact on socio-economic during decommission phase.

2.12. Data Collections

The project related data, project layout plans and design parameter are provided by MESDP. Secondary data on demographic distribution in the area are sourced from General Administrative Department (Amayapura) and data on public health are sourced from Public Health Department (Amayapura). Primary data for public concerns, socio-economic and health profiles are conducted by household survey.

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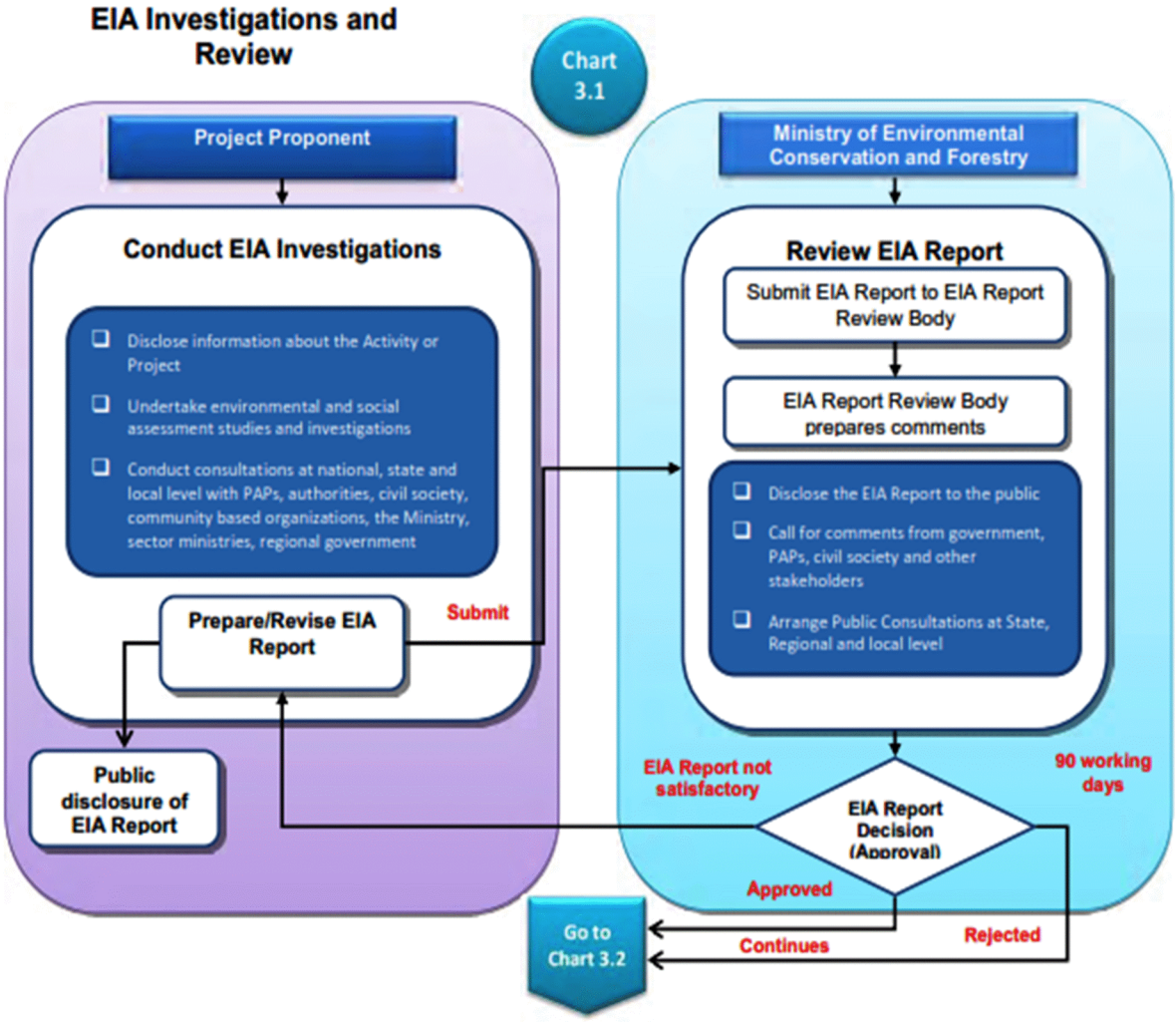
3.0. POLICY, LEGAL AND OTHER REQUIREMENTS

This chapter sets out the relevant legal and policy context in Myanmar and documents the environmental and social standards with which the proposed project has to comply with, as well as the international standards that the project will follow.

3.1. National Requirements

The EIA has been undertaken in accordance with the Myanmar Environmental Impact Assessment Procedure which was promulgated on December 29th, 2015, and provides legislation for environmental and social governance of economic development in Myanmar, under the Environmental Conservation Law 2012 and Environmental Conservation Rules 2014 of the National Environmental Policy for Myanmar 1994. An overview of the process (from the Myanmar EIA Procedure, 2015) is shown in Figure 3.1.



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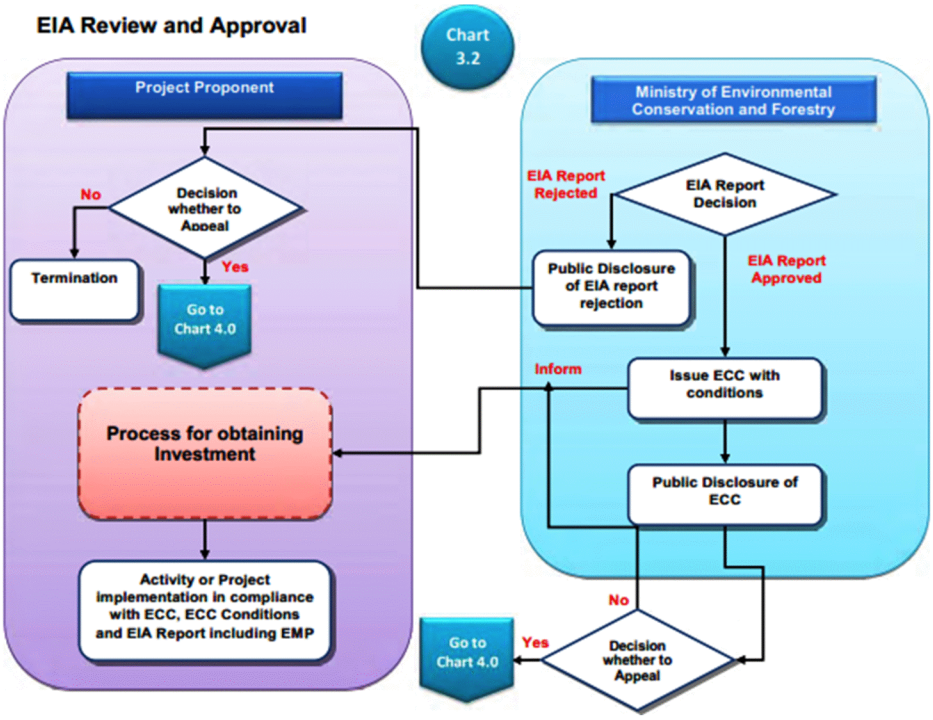

Figure 3.1 EIA Review and Approval Process

3.2.1 National Guidelines

(a) National Environmental Quality (Emissions) Guidelines for Crude Oil and Petroleum Product Terminals

This national guideline is applicable to land and shore-based petroleum storage terminals receiving and dispatching bulk shipments of crude oil, gasoline, middle distillates, aviation gas, lube oil, residual fuel oil, compressed natural gas, liquid petroleum gas, and specialty products from pipelines, tankers, railcars, and trucks for subsequent commercial distribution. Process effluent discharge quality guideline values will be established on a site-specific basis, taking into account effluent characteristics and receiving water use. Storm water runoff from terminals will be treated as required to achieve the following effluent levels. General air emissions guidelines shall apply and volatile organic compound emissions from all sources will be controlled such that ambient air quality levels do not exceed health-based standards.

Table 3.1. Effluent Levels for Crude Oil and Petroleum Product Terminals NEQ(E)G (2.1.9)

Parameter	Unit	Maximum Concentration
Biological oxygen demand	mg/l	30
Chemical oxygen demand	mg/l	125
Oil and grease	mg/l	10
pH	S.U.[a]	6-9

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Total coliform bacteria	100 ml	400
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Total suspended solids	mg/l	50

[a] Standard unit

(b) Air Emission (NEQ(E)G - 1.1)

Projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that: (i) emissions do not result in concentrations that reach or exceed national ambient quality guidelines and standards, or in their absence current World Health Organization (WHO) Air QualityGuidelines1 for the most common pollutants as summarized below; and (ii) emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards (i.e. not exceeding 25 percent of the applicable air quality standards) to allow additional, future sustainable development in the same air shed. Industry-specific guidelines summarized hereinafter shall be applied by all projects to ensure that air emissions conform to good industry practice. Reference should be made to WHO's Air Quality Guidelines for Europe2 for air pollutants not included in the following table.

1 Air quality guidelines global update. 2005. World Health Organization.
2 Air quality guidelines for Europe. 1997. WHO regional publications, European series No. 23. World Health Organization.

Pollutants	Averaging Period	Guideline Values µg/m^3
Nitrogen dioxide (NO_2)	1-year	40
	1-hr	20
Ozone (O_3)	8-hour daily maximum	100
Particulate matter PM_{10}[a]	1-year	20
	24-hr	50
Particulate matter $PM_{2.5}$[b]	1-year	10
	24-hr	25
Sulfur dioxideSO_2	24-hr	20
	10-minute	500

[a] Particulate matter 10 micrometers or less in diameter
[b] Particulate matter 2.5 micrometers or less in diameter

(c) Noise Emission (NEQ(E)G - 1.3)

Noise prevention and mitigation measures should be taken by all projects where predicted or measured noise impacts from a project facility or operation exceed the applicable noise level guideline at the most sensitive point of reception. Noise impacts should not exceed the levels

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shown below, or result in a maximum increase in background levels of three decibels at the nearest receptor location off-site.

Receptor	One Hour LAeq (dBA)a	
	Daytime 07:00 - 22:00 (10:00 - 22:00 for Public holidays)	**Nighttime 22:00 - 07:00 (22:00 - 10:00 for Public holidays)**
Residential, institutional, educational	55	45
Industrial, commercial	70	70

(d) National Surface Water Quality Standard (NSWQSD)

Water use Classification

Water bodies shall be classified from Class I to Class V based on its intended water use. Table - sets out the corresponding water use in the respective water class. Different standards shall apply to different water classes.

Table - Classification and Use of Surface Water

Water Class	Water use
Class I	(1) Conservation of the natural environment (2) Water supply Grade 1 (conventional treatment) (3) Water uses listed in Class II to V
Class II	(1) Water supply Grade 2 (pre-treatment and conventional treatment) (2) Fisheries Grade 1 (3) Bathing & Swimming (4) Water uses listed in Class III to V
Class III	(1) Water supply Grade 3 (advanced treatment) (2) Fisheries Grade 2 (3) Industrial water Grade 1 (4) Agricultural water Grade 1 (5) Water uses listed in Class IV to V
Class IV	(1) Industrial water Grade 2 (2) Agricultural water Grade 2 (3) Water uses listed in Class V
Class V	(1) Navigation/Transportation (2) Environmental conservation

Water supply Grade 1	applicable for water supply with sedimentation, filtration and other comparable means
Water supply Grade 2	applicable for water supply with pre-treatment, sedimentation, filtration and other comparable means
Water supply Grade 3	applicable for water supply with pre-treatment and other advanced means
Fisheries Grade 1	applicable for fisheries of oligotrophic species
Fisheries Grade 2	applicable for fisheries of semi-eutrophic species
Industrial water Grade 1	applicable for industrial use with sedimentation and other

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	comparable means
Industrial water Grade 2	applicable for industrial use with chemical additives and other advanced means
Agricultural water Grade 1	applicable for agricultural use with ordinary means
Agricultural water Grade 2	applicable for agricultural use with advanced means
Environmental Conservation	maintained to the extent of not causing discomfort to citizens

Parameters for Environmental Conservation

Parameters mainly important for the conservation of the aquatic ecosystem and the living environment are grouped as parameters for environmental conservation. Different standard values are applied to respective water classes, taking into account desirable levels of surface water quality according to the intended use of the waterbodies. The standard values of respective parameters are given in Table.

Table - Standard Values of Parameters for Environmental Conservation

Parameter	Unit	Class I	Class II	Class III	Class IV	Class V
Physical Parameter						
Total Suspended Solids	mg/L	25	50	75	100	150
Chemical Parameter						
BOD	mg/L	2	3	8	25	30
COD	mg/L	5	8	13	50	100
DO	mg/L	>6	>5	>4	>3	>2
pH	S.U	6.5 – 8.5	6.5 – 8.5	6 – 9	5 – 9	-
Ammonium nitrogen	mg/L	0.2	0.3	0.5	0.8	0.9
Organics						
Oil & Grease		No noticeably seen				
Biological Parameter						
Escherichia coli (E.coli)	MPN/ 100 mL (or) CFU/1 00 mL	20	300	1000	1000	-
Heavy Metals						
Copper	mg/L	0.1	0.3	0.5	-	-

Monitoring Parameters

The monitoring parameters are those that are recommended for monitoring and data accumulation. Continuous efforts shall be made to conduct their monitoring and raise their analytical capacity in the country.

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Some parameters are listed not because of their direct harmful effect to the water environment but because of easy to monitor and function for human health and environmental conservation. Other parameters, including pesticides, require advanced analytical equipment such as Gas Chromatography. Although their monitoring data in the country are quite limited, efforts should be made to accumulate monitoring data of those parameters based on their toxicity and potential usage in the country. Monitoring parameters are subject to future review to consider their inclusion to priority parameters, as domestic analytical capacity advances and more data accumulates.

The standard values of respective parameters are given in Table.

Table - Standard Values of Monitoring Parameters

Parameter	Unit	Class I	Class II	Class III	Class IV	Class V
Physical Parameter						
Colour	TCU (or) mg Pt/L	15	25	50	100	150
Conductivity	dS/m	1	1.5	1.5	3	6
Total Dissolved Solids	mg/L	500	1000	1000	1500	2000
Turbidity	NTU	5	25	25	50	100
Chemical Parameter						
Chloride	mg/L	250	250	250	350	400
Pesticides						
Atrazine	µg/L	100				
Carbofuran	µg/L	7				
Chlorpyrifos	µg/L	30				
Fenitrothion	µg/L	3				
Glyphosate	µg/L	370				
Permethrin	µg/L	300				
Thiram	µg/L	6				

(e) Myanmar Drinking Water Quality Standard (2019)

According to Myanmar Drinking Water Quality Standard (2019), the following water parameters should be tested as priority form the point of health and people acceptance.

No	Parameter	Unit	Standard Value
1	Total coliform	MPN/ 100 ml	0 (piped water)
			0 (water within water distribution system)
			3 (non-piped water)
			10 (Emergency Water distribution)

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2	Fecal coliform	MPN/ 100 ml	0 (piped water)
			0 (water within water distribution system)
			0 (non-piped water)
			3 (Emergency Water distribution)
3	Taste	Acceptable/ No objectionable taste	-
4	Smell	Acceptable/ No objectionable taste	-
5	Color	TCU (true Color Unit)	15
6	Turbidity	NTU Nephelometric Turbidity Units	5
7	Arsenic	mg/l	0.05
8	Lead	mg/l	0.01
9	Nitrate	mg/l	50
10	Manganese	mg/l	0.4
11	Chloride	mg/l	250
12	Hardness	mg/l (as CaCO3)	500
13	Iron	mg/l	1
14	pH	mg/l	6.5 – 8.5
15	Sulphate	mg/l	250
16	TDS	mg/l	1000

3.3. International Guidelines

DIN 4150 – 3 – Structural Vibration – Part 3: Effects of vibration on structures

This standard specifies a method of measuring and evaluating the effects of vibration on structure designed primarily for static loading. It applies to structures which do not need to be designed to specific standards or codes of practice as regards dynamic loading.

This standard gives guidelines values which, when complied with, will not result in damage that will have an adverse effect on the structure's serviceability. In some cases, guideline values for a simplified evaluation are also given.

Effect on structure as a whole due to short-term vibration

The vibration measured in the plane of the highest floor resting on external walls also provides significant information for this evaluation, taking the maxima of the two horizontal components as a basis.

Table A and Figure A give guideline values for *vi* at the foundation and in the plane of the highest floor of various types of building. Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur. If damage nevertheless occurs, it is to be assumed that other causes are responsible. Exceeding the values in table 1 does not necessarily lead to damage; should they be significantly exceeded, however, further investigations are necessary.

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Table A: Guideline values for vibration velocity to be used when evaluating the effects of short-term vibration on structures

Line	**Type of structure**	**Guideline values for velocity, *vi'* in mm/s Vibration at the foundation at a frequency of**			**Vibration at Horizontal plane of highest floor at all frequencies**
		1 Hz to 10Hz	**10Hz to 50 Hz**	**50 Hz to 100 Hz*)**	
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10	8
*) At frequencies above 100 Hz, the values given in this column may be used as minimum values.					

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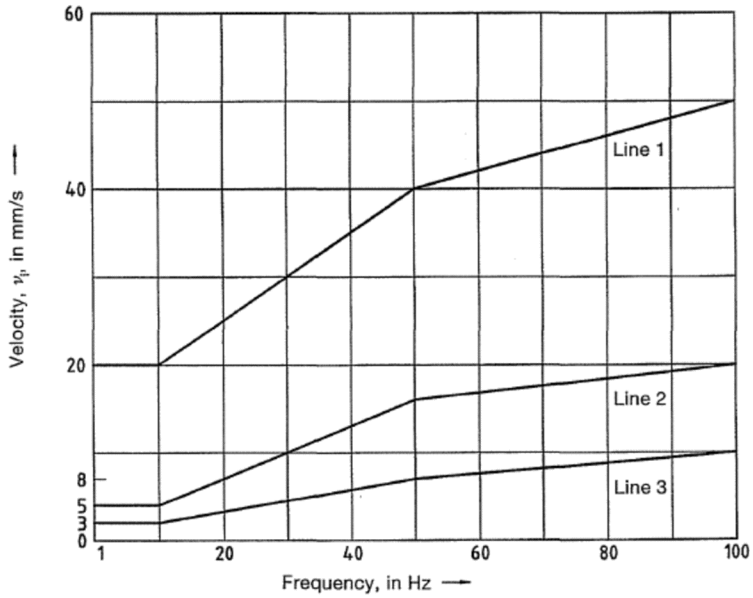

Figure A: Curves for guideline values specified in table 1 for velocities measured at the foundation

Effect on structure as a whole due to long-term vibration

Table B gives guideline values for the highest value of the two horizontal components measured in the top floor, for different types of building. Experience has shown that if these values are complied with, damage will not occur. Exceeding the values in table 3 slightly does not necessarily lead to damage. In the case of multi-storey frame structures, the dynamic stress component can also be determined from the relative displacement of the ends of the vertical members.

If a building is subjected to harmonic vibration, then the maximum values can also occur in floors other than the top floor, or in the foundation. The values given in table B also apply in these cases. When other points of reference are used, separate analysis is required.

Table B: Guideline values for vibration velocity to be used when evaluating the effects of long-term vibration on structures

Line	Type of structure	Guideline values for velocity, *vi,* in mm/s, of vibration in horizontal plane of highest floor, at all frequencies
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	10
2	Dwellings and buildings of similar design and/or occupancy	5
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic	2,5

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	value (e.g. listed buildings under preservation order)	

Measurement

To measure vibration in foundations, the pick-ups for the three directions of measurement shall be placed close together on the ground floor of the building to be investigated, either at the foundation of the outer wall, on the outer wall itself, or in a recess in that wall. In buildings without a basement, the point ·of measurement shall be no more than 0,5 m above the ground.

Measurement points shall preferably be on the side of the structure that faces the source of excitation. The time history of the vertical vibration (z-axis) and horizontal vibration *(x-* and y-axes, at right angles to each other) shall be recorded, with one of the directions of measurement running parallel to a side wall of the building.

For structures with a large ground floor area, simultaneous measurements shall be made at several locations. In addition to the measurements made on the foundation and the highest floor, a measurement in the vertical direction may also have to be made on the floors on which the strongest vibration is expected; in this case, the point of measurement should be in the centre of the floor.

Pick-ups for measurements in the highest floor shall be placed on or immediately next to structural masonry so that the two horizontal directions of measurement, *x* and *y,* are at right angles to each other, with one direction running parallel to a side wall.

API (American Petroleum Institute) Standards

API 620 for Oil Storage Tanks

API 620 is a standard developed by the American Petroleum Institute (API) that governs the design, construction, and inspection of large, low-pressure aboveground storage tanks used for storing oil, liquefied gases, and other petroleum products. This standard applies specifically to tanks operating at pressures up to 15 psig and at temperatures as low as -325°F (-198°C), making it suitable for refrigerated or cryogenic storage tanks. Unlike API 650, which covers atmospheric tanks, API 620 focuses on tanks with higher internal pressures and special structural requirements.

The design considerations under API 620 include material selection, welding procedures, structural integrity, and seismic design to ensure tanks can safely withstand internal and external forces. The standard also provides inspection and testing guidelines, such as

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radiographic testing (RT) for welds and hydrostatic testing for structural verification. For oil storage applications, compliance with API 620 ensures safe handling of volatile or pressurized hydrocarbons, preventing leaks, overpressure failures, and environmental risks.

In summary, API 620 is essential for low-pressure oil storage tank projects where higher containment integrity is required, particularly in pressurized or temperature-sensitive applications. By following API 620, oil storage facilities can achieve enhanced safety, reliability, and regulatory compliance, ensuring their tanks are designed, constructed, and maintained to withstand demanding operational conditions.

API 653

API 653 provides essential guidelines for the inspection, repair, alteration, and reconstruction of aboveground oil storage tanks (ASTs), ensuring their safety, reliability, and compliance with industry standards. This standard applies to tanks originally built according to API 650 or similar construction standards and helps assess their continued suitability for service.

The inspection frequency of a tank depends on multiple factors, including the stored product type, corrosion rates, past inspection results, leak detection systems, and environmental risks. The inspection requirements under API 653 are structured to ensure early detection of potential failures. Routine in-service inspections must be conducted monthly, focusing on visible leaks, corrosion, foundation settlement, and proper functioning of floating roofs and vents.

Regular external inspections should occur every five years, while internal inspections depend on the corrosion rate and must be conducted at intervals not exceeding 20 years. If corrosion rates are unknown, internal inspections should occur at least every 10 years.

Routine in-service inspections involve monthly visual checks for leaks, structural issues, and settlement, while more detailed external inspections assess wall thickness, corrosion, and grounding systems using ultrasonic thickness testing (UTT) and other methods. Internal inspections, required to ensure tank bottom integrity, can be performed using robotic ultrasonic systems or traditional out-of-service methods. These inspections ensure compliance with jurisdictional regulations, which often mandate vapor loss controls, seal integrity, spill containment, and leak prevention.

For a risk-based inspection (RBI) approach, factors such as tank material, past maintenance quality, environmental risks, and failure consequences are analyzed to adjust inspection intervals. Proper corrosion prevention measures, like coatings, liners, cathodic protection, and

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secondary containment, help extend the tank's service life and prevent environmental contamination.

More detailed internal inspections must be performed every 10 years (or as determined by corrosion rates), involving Magnetic Flux Leakage (MFL) scanning or vacuum box testing to check for bottom plate integrity, pitting, and leaks. Hydrostatic testing is necessary after major repairs to confirm structural integrity.

The minimum allowable thickness of tank components is a critical factor in determining whether a tank can continue operating safely. The inspection intervals depend on the measured corrosion rate, with tanks showing a rate of ≤1.0 mils per year requiring internal inspections every 20 years, while those with rates above 2.0 mils per year must be inspected every 10 years. If corrosion rates are unknown, the first internal inspection should be conducted within 10 years of service. Repairs to tank shells, nozzles, and bottom plates must follow API 650 welding standards and ASME Section IX requirements, ensuring structural integrity and leak prevention. In cases where significant corrosion is found, patch plates, double-bottom installations, or cathodic protection systems may be required to extend the tank's service life.

API Safety and Fire Protection

RP 2001

Fire Protection in Refineries Provides a better understanding of refinery fire protection and the steps needed to promote the safe storage, handling, and processing of petroleum and petroleum products in refineries. A basic premise of this standard is that fire prevention provides the fundamental foundation for fire protection. This publication covers basic concepts of refinery fire protection. It reviews the chemistry and physics of refinery fires; discusses how the design of refinery systems and infrastructure impact the probability and consequences of potential fires; describes fire control and extinguishing systems typically used in refineries; examines fire protection concepts that should be covered in operating and maintenance practices and procedures; and provides information on organization and training for refinery emergency responders. Many of the concepts, systems, and equipment discussed in this document are covered in detail in referenced publications, standards, or governmental requirements.

RP 2021 Management of Atmospheric Storage Tank Fires

Provides experience-based information to enhance the understanding of fires in atmospheric storage tanks containing flammable and combustible materials. It presents a systematic management approach that can assist tank fire prevention. If fires do occur, this information

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can help responders optimize fire suppression techniques to reduce the severity of an incident and reduce the potential for escalation.

Std 2350 Overfill Protection for Storage Tanks in Petroleum Facilities (includes Errata 1 dated April 2021) (ANSI/API Std 2350)

Applies to storage tanks associated with marketing, refining, pipeline, and terminals operations and with tanks containing Class I or Class II petroleum liquids and use is recommended for Class III petroleum liquids. This standard addresses overfill protection for petroleum storage tanks. It recognizes that prevention provides the most basic level of protection, thus while using both terms "protection" and "prevention," the document emphasizes prevention. The standard's scope covers overfill (and damage) prevention practices for aboveground storage tanks in petroleum facilities, including refineries, marketing terminals, bulk plants, and pipeline terminals that receive flammable and combustible liquids. The fourth edition continues to build on experience and new technology through the use of management systems. Since operations are the primary overfill prevention safeguard, new definitions and requirements are established for alarms. Risk reduction is also addressed by current and generally accepted industry practices. The essential elements of this document are based on current industry safe operating practices and existing consensus standards. Federal, state, and local regulations or laws may contain additional requirements for tank overfill protection programs. For existing facilities, the results of a risk-based analysis of aboveground atmospheric petroleum storage tanks may indicate the need for more protection against overfilling. In such cases, some provisions from this standard may be suitable. The purpose of this standard is to assist owner/operators and operating personnel in the prevention of tank overfills by implementation of a comprehensive overfill prevention process (OPP). The goal is to receive product into the intended storage tank without overfill or loss of containment. This standard does not apply to: underground storage tanks; aboveground tanks of 1320 U.S. gallons (5000 liters) or less; aboveground tanks which comply with PEI 600; pressure vessels; tanks containing non-petroleum liquids; tanks storing LPG and LNG; tanks at service stations; tanks filled exclusively from wheeled vehicles (i.e. tank trucks or railroad tank cars); and tanks covered by OSHA 29 *CFR* 1910.119 and EPA 40 *CFR* 68, or similar regulations.

RP 2003 Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents

Presents the current state of knowledge and technology in the fields of static electricity, and stray currents applicable to the prevention of hydrocarbon ignition in the petroleum industry and is based on both scientific research and practical experience. The principles discussed in this recommended practice are applicable to other operations where ignitable liquids and

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gases are handled. Their use should lead to improved safety practices and evaluations of existing installations and procedures.

Electricity & Lightning API provides a framework for managing electrical systems, ensuring safe power distribution, and mitigating lightning-related risks in industrial settings. It covers aspects such as voltage regulation, surge protection, grounding systems, and emergency shutdown mechanisms. This API is particularly crucial for projects involving high-power machinery, oil storage facilities, and manufacturing plants, where electrical safety is paramount. Compliance with electrical codes and standards ensures reliability and reduces fire hazards caused by electrical faults or lightning strikes.

Cleaning & Storage API focuses on the maintenance, cleanliness, and proper storage of equipment, raw materials, and hazardous substances. It defines protocols for waste disposal, contamination control, and safe storage practices to prevent environmental pollution and workplace hazards. This API is essential in industries like pulp and paper production, chemical processing, and wastewater treatment, where efficient storage and cleaning procedures enhance operational efficiency and regulatory compliance. Proper implementation minimizes risks related to chemical spills, microbial growth, and material degradation, ensuring a safe and sustainable working environment.

3.4. Sustainability Policy of MESDP

MESDP's sustainability model is "To operate in a sustainable manner means to create value for stakeholders, and to use resources so that the needs of future generations will not be compromised, respecting people, the environment and the society as a whole." MESDP adheres to a sustainability policy, which is composed of the following principles:

- *Stakeholder relations* – "Engaging stakeholders and involving them in company's business are both prerequisites for sustainability and for the construction of reciprocal value."
- *Human Rights* – "The respect of Human Rights represents the basis for an inclusive growth of societies, of the territories and, consequently, of the companies that work there."
- *Relations with communities and contribution to local development* – "Dialogue, the respect of local communities, the evaluation of impacts are all preconditions for an effective cooperation, targeted at creating territorial value."

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- *Climate strategy* – "To satisfy the world's energy demand, by containing, at the same time, emissions of gases that have an impact on climatic change, is one of the greatest challenges of modern society."

The main policy and commitment of MESDP can be identified in the following points:

- the protection of public safety, the health and safety of the workforce and the local communities
- the protection and promotion of human rights, the economic and social development of local communities;
- the protection of the environment and the conservation of biodiversity and ecosystems;
- the compliance with Myanmar laws, regulations and industrial standards regarding the environment, health, safety and hygiene at work in all of our operations
- visible and active leadership that promotes HSE excellence, which engages and motivates employees and contractors alike to succeed
- manage HSE in order to achieve our objective of incident free operations
- implementing sustainable development principles in our activities
- seek and achieve continuous improvement in our processes, consistent with our strategic objectives and priorities, by adopting the most advanced systems for environmental protection and energy efficiency
- creating a culture in which MESDP employees, contractors and visitors share these commitments and understand that working safely is a condition of employment.

3.5. Developer's Policies for Socio-economic Development of Local People

MESDP's policies for local socio-economic development are shown in the following table.

No.	Description	Company's Policy
1.	Local Community Development Policy	Appoint local people with relevant skills as much as possible (At least 50% of Local People)
2.	Corporate Social Responsibility (CSR)	Fund at least 3 percent of the annual net profit after taxes as CSR fund or at least 500 lakhs per year. They

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	Policy	also promise environmental mitigation and monitoring costs will not take account as CSR fund.

3.6. Legal Requirements of the Proposed Project (Laws and Regulations in Myanmar)

Myanmar has promulgated several laws and regulations concerning protection of the environment. The following table describes laws and regulations that will be complied bythe proposed project.

Table 3.2. Environmental Laws and Regulations in Myanmar

Laws and Regulations	Year	Purposes
The Labour Organization Law (2012 Amended)	2011	The Pyidaungsu Hluttaw enacts this Law, in accord with section 24 of the Constitution of the Republic of the Union of Myanmar, to protect the rights of the workers, to have good relations among the workers or between the employer and the worker, and to enable to form and carry out the labour organizations systematically and independently.
The Settlement of Labour Dispute Law	2012	The Pyidaungsu Hluttaw enacts this Law for safeguarding the right of workers or having good relationship between employer and workers and making peaceful workplace or obtaining the rights fairly, rightfully and quickly by settling the dispute of employer and worker justly.
The Employment and Skill Development Law,	2013	To facilitate employment which is appropriate to the age and ability of the job seeker To help workers obtain employment and to provide stability of employment and skills development for employees To help employers obtain appropriate employees
The Leave and Holiday Act	2014	-
The Minimum Wages Law	2013	the Pyidaungsu Hluttaw enacts this Law to meet with the essentials of the workers and their family, who are working at the commercial business, production business and service, agricultural and livestock breeding business and to increase capacity of the workers and to develop the competitiveness,
The Payment of Wages Law	2016	-
The Social	2012	(a) Causing to support the development of the State's

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Security Law (Amended 2014)		economy through the increase of production to enjoy more security in social life and health care of workers who are major productive force of the Union by the collective guaranty of the employer, worker and the Union for enabling to fulfill health and social needs of the workers; (b) Causing to enjoy more security in social life and health care by the public by their voluntary insurance; (c) Causing to raise public reliance upon the social security system by providing benefits which are commensurate with the realities; (d) Causing to have the right to draw back some of the contributions paid by the employers and the workers as savings, in accord with the stipulations; (e) Causing to obtain the right to continued medical treatment, family assistance benefit, invalidity benefit, superannuation benefit, survivors' benefit, unemployment benefit, the right to residency and ownership of housing after retirement in addition to health care and pecuniary benefit for sickness, maternity, decease and employment injury of the workers.
The Workmen's Compensation Act 1923(Amended 1955,1957,2005)	2005	-
The Prevention of Hazard from Chemical and Related Substances Law	2013	(a) to protect from being damaged the natural environment resources and being hazardous any living beings by chemical and related substances; (b) to supervise systematically in performing the chemical and related substances business with permission for being safety; (c) to perform the system of obtaining informations and to perform widely educative and research for using the chemical and related substance systematically; (d) to perform the sustainable development for the occupational safety, health and environmental conservation.
The Prevention of Hazard from Chemical and Related Substances Rules	2016	-
The Occupational Safety and Health	2019	(a) to effectively implement occupational safety and health matters at each sector;

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Law (Pyidangsu Hluttaw Law: No.8)		(b) to designate duties to the stakeholders under this Law including employers and workers in order to reduce and eliminate occupational accidents and occupational diseases; (c) to prevent and protect the occupational risks and occupational diseases by employers, workers and stakeholders under this Law; (d) to ensure the occupational safety and health of workers and increase productivity for the prevention of occupational injuries and diseases; (e) to create safe and healthy workplaces by standardizing properly with national context in line with the international and regional standards on occupational safety and health; (f) to support research work for the development of occupational safety and health.
The Industrial Explosive Materials Law	2018	(a) to manufacture, import, transfer, store and use industrial explosive materials systematically; (b) to be safe and secure at work places where dynamite and related substances are used; (c) to supervise manufacture and use of industrial explosive materials systematically.
The Explosives Substances Act	1908	-
The Ethnic Rights Protection Law	2015	(a) to obtain equal citizen's rights for all ethnic groups; (b) to live eternally together with amicable relations among ethnic groups on the basic of genuine Union Spirit; (c) to preserve and develop language, literature, fine art, culture, custom, national character and historical heritage of ethnic groups; (d) to promote solidarity, mutual amity and respect, and mutual assistance among ethnic groups; (e) to promote socio-economic development including education, health, economy, transport and communication, so forth, of less-developed ethnic groups; (f) to fully obtain the rights prescribed in the Constitution by ethnic groups.
The Ethnic Rights Protection Rules (Rule 20,21) 2019 (2020 Amended)	2020	-
The Protection and Preservation of Cultural	2019	(a) to promote and implement the policy of protection and preservation for the sustainable of cultural heritage that has existed for many years in the past;

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Heritage Regions Law		(b) to protect and preserve cultural heritage regions and cultural heritages within these regions against deterioration caused by man-made or natural disasters or by vegetation, pests, birds and animals; (c) to uplift hereditary pride, and to motivate dynamism of the Union spirit of the citizens by protecting and preserving the cultural heritage regions; (d) to promote public awareness and perception on the high value of the protection and preservation of cultural heritage regions; (e) to protect the cultural heritage regions from destruction; (f) to carry out the protection and preservation of the cultural heritage regions in conformity with the international convention ratified by the State. (g) to cooperate with the national and international world heritage organizations; (h) to carry out the protection and preservation tasks of the cultural heritage within the cultural heritage region in harmonies balance with those of the social and economic development of the local people.
The Protection and Preservation of Antique Objects Law	2015	(a) to implement the policy of protection and preservation for the perpetuation of antique objects; (b) to protect and preserve antique objects so as not to deteriorate due to natural disaster or man-made destruction; (c) to uplift hereditary pride and to cause dynamism of patriotic spirit by protection and preservation of antique objects; (d) to have public awareness of the high value of antique objects; (e) to carry out in respect of protection and preservation of antique objects in conformity with the International Convention and Regional Agreement ratified by the State.
The Environmental Conservation Law	2012	(a) to enable to implement the Myanmar National Environmental Policy; (b) to enable to lay down the basic principles and give guidance for systematic integration of the matters of environmental conservation in the sustainable development process; (c) to enable to emerge a healthy and clean environment and to enable to conserve natural and cultural heritage for the benefit of present and future generations; (d) to reclaim ecosystems as may be possible which are

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		starting to degenerate and disappear; (e) to enable to manage and implement for decrease and loss of natural resources and for enabling the sustainable use beneficially; (f) to enable to implement for promoting public awareness and cooperation in educational programmes for dissemination of environmental perception; (g) to enable to promote international, regional and bilateral cooperation in the matters of environmental conservation; (h) to enable to cooperate with Government departments, Government organizations, international organizations, non-government organizations and individuals in matters of environmental conservation.
The Environmental Conservation Rules	2014	-
Environmental Impact Assessment (EIA) Procedure	2015	-
National Environmental Quality (Emission) Guidelines (Articles 1.1, 1.2,1.3)	2015	These national Environmental Quality (Emission) Guidelines (hereafter referred to as Guidelines) provide the basis for regulation and control of noise and vibration, air emissions, and wastewater from various sources in order to prevent pollution for purposes of protection of human and ecosystem health.
The Conservation of Water Resources and River Law, 2006 (Amended 2017)	2017	(a) to conserve and protect the water resources and rivers system for beneficial utilization by the public; (b) to smooth and safety waterways navigation along rivers and creeks; (c) to contribute to the development of State economy through improving water resources and river system; (d) to protect environmental impact.
The Conservation of Water Resources and Rivers Rules 2013 (Amended 2020)	2013	To implement the aims of The Conservation of Water Resources and River Law.
The Forest Law	2018	(a) to implement the forest policy of the Government; (b) to implement the policy of the Government related to

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		natural resources and environmental conservation; (c) to promote public cooperation in implementing the forest policy and the natural resources and environmental conservation policy of the Government; (d) to support economic development of the State, to contribute towards food, clothing and shelter needs of the public and to enjoy benefits perpetually through conservation and protection of forests; (e) to comply with the international agreements relating to conservation of forests, conservation of natural resources and environment, climate change and natural disaster risk reduction; (f) to prevent deforestation, biodiversity decline, outbreak of fires, insect infestation and plant disease incidence; (g) to conserve natural forests and establish forest plantations simultaneously; (h) to contribute towards fuel requirement of the State; (i) to implement sustainable forest management in order to support sustainable development.
The Conservation of Biodiversity and Protected Areas Law	2018	(a) to implement biodiversity strategy and policy of the State; (b) to implement the Government policy on conservation of protected areas; (c) to carry out protection and conservation of wild fauna, wild flora, ecosystems and migratory animals in accordance with International Conventions ratified by the State; (d) to regulate trade of wild fauna and wild flora or their parts, derivatives or products; (e) to protect geo-physically unique areas, endangered wild fauna and wild flora and their natural habitats; (f) to contribute to natural scientific research and environmental education activities; (g) to protect wild fauna and wild flora by establishing zoological and botanical gardens.
The Underground Water Act	1930	-
The Law relating to Aquaculture (1989)	1989	-
Mandalay Region Freshwater Fisheries Law, 2012	2012	The purpose of this law are as follows: (a) To develop fisheries sector (b) To prevent fish species depletion (c) To prevent and conserve water bodies for freshwater fisheries.

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		(d) To achieve relevant revenue for State. (e) To manage and take actions for fisheries sector in accordance with existing laws.
The Highways Law	2000	(a) to cause easier communication and transportation among states and divisions by constructing the highways and to strengthen national solidarity and friendship and to cause all-round development in all regions and areas in economic and social sectors, (b) to give support in implementing the duty for security and convenience in road and communication and quickness in flow of commodities; (c) to give support in the modernization and development of the State by constructing highways within the State or by constructing highways which connect with neighbouring countries; (d) to carry out systematically the works of extension, repair and maintenance for durability of highways; (e) to supervise systematically in respect of traffic and use of highways.
The Vehicle Safety and Motor Vehicle Management Law	2022	(a) ensure that motor vehicles are registered after inspecting them in accordance with law; (b) issue driving licences to drivers after examining them whether they meet the prescribed qualifications according to the classes of motor vehicles; (c) reduce air, water and land pollution and noise pollution from motor vehicles; (d) reduce motor vehicle accident through the systematic traffic management; (e) ensure vehicle safety by conducting vehicle inspection and supervision in accordance with the stipulations; (f) reduce traffic congestion and use effective intelligent transport system for vehicle safety; (g) reduce loss of lives, socio-economic losses and risk of injury due to vehicle accidents, and to ensure convenience and safety of road users; (h) transport dangerous goods safely.
The Vehicle Safety and Motor Vehicle Management Rules	2022	-
Union of	1972	Systematic management of public health.

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Myanmar Public Health Law		
Prevention and Control of Communicable Diseases Law 1995 (Amended 2011)	1995	To prevent the outbreak of Communicable Diseases, by implementing following project activities: (i) immunization of children by injection or orally; (ii) immunization of those who have attained eligible target group including adult by injection or orally, when necessary; (iii) carrying out health education activities relating to communicable disease; (iv) carrying out the activities of surveillance, prevention and control concerning communicable disease; . (v) carrying out the activities of medical examination for prevention of communicable disease in cross-border entrance and exit of the country, international airport, seaport, other necessary airport, seaport and bus terminal; (vi) prohibition or restriction of movements at home, hotel, motel and guest house; (vii) isolation of infected person of communicable disease or suspect of being infected therewith; (viii) carrying out the activities of spraying, immunization by injection or orally and environmental sanitation necessary for prevention and control according to communicable diseases; (ix) giving advice to and coordinating with relevant Government departments, organizations and non-governmental organizations for construction of healthy housing, obtaining safe drinking water and fresh water for use, proper waste disposal in order to prevent occurrence of communicable disease for workers who are carrying out activities of social and economic development; (x) carrying out other functions prescribed by the Ministry of Health, from time to time.
The Control of Smoking and Consumption of Tobacco Product Law 2006 (Amended 2007)	2006	(a) to convince the public that health can be adversely affected due to smoking and consumption of tobacco product and to cause refraining from the use of the same; (b) to protect from the danger which affects public health adversely by creating tobacco smoke-free environment; (c) to obtain a healthy living style of the public including child and youth by preventing the habit of smoking and consumption of tobacco product; (d) to uplift the health, economy and social standard of the public through control of smoking and consumption of

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		tobacco product; (e) to implement measures in conformity with the international convention ratified by Myanmar to control smoking and consumption of tobacco product;
Farm Land Law (2012)	2012	-
Natural Disaster Management Law	2013	(a) to implement natural disaster management programmes systematically and expeditiously in order to reduce disaster risks; (b) to form the National Committee and Local Bodies in order to implement natural disaster management programmes systematically and expeditiously; (c) to coordinate with domestic and foreign government departments and organizations, social organizations, other non-government organizations or international organizations and foreign regional organizations in carrying out natural disaster management activities; (d) to conserve and restore the environment affected by natural disasters; (e) to provide health, education, social and livelihood programmes in order to bring about better living conditions for victims.
Constitution of the Republic of the Union of Myanmar	2008	To conserve the natural environment, To prevent and upgrade the rights and lives of the workers
The Myanmar Investment Law	2016	(a) to develop responsible investment businesses which do not cause harm to the natural environment and the social environment in the interest of the Union and its citizens; (b) to protect the investors and their investment businesses in accordance with the Law; (c) to create job opportunities for the people; (d) to develop human resources; (e) to develop highly functioning production, service, and trading sectors; (f) to develop the technology, the agriculture, livestock and industrial sectors; (g) to develop various professional fields, including infrastructures around the Union; (h) to enable the citizens to be able to work alongside with the international community; (i) to develop businesses and investment businesses that meet international standards.

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The Myanmar Investment Rules, 2017 (Amended 2018)	2017	-
The Export and Import Law	2012	(a) to enable to implement the economic principles of the State successfully; (b) to enable to lay down the policies relating to export and import that support the development of the State: (c) to cause the policies relating to export and import of the State and activities are to be in conformity with the international trade standards: (d) to cause to be streamlined and speedy in carrying out the matters relating to export and import.
The Myanmar Fire Brigade Law	2015	(a) to prevent destruction of State-owned property, private property, cultural heritage and the lives and property of the public by fire and other natural disaster; (b) to organize the Fire brigade systematically and to train members of the fire brigade; (c) to carry out extinguishing fire, prevention and search and rescue when fire, other natural disaster, epidemic disease or any kind of sudden disaster occurs; (d) to educate, organize and incite extensively so as to achieve public cooperation when any disaster occurs; (e) to participate and help, if necessary, for the State safety, peace of the public and the rule of law.
The Myanma Insurance Law	1993	(a) to overcome financial difficulties by effecting mutual agreement of insurance against social and economic losses which the people may encounter, due to common perils; (b) to promote the habit of savings individually by effecting life assurance, thus contributing to the accumulation of resources of the State; (c) to win the trust and confidence of the people in the insurance system by providing effective insurance safeguards which may become necessary in view of the social and economic developments.
The Private Industrial Enterprise Law	1990	(a) to protect the rights and interests of the owner of industrial design and creator in accordance with this Law; (b) to contribute the development of industry by promoting the protection of creation of industrial designs; (c) to contribute to the development and dissemination of industrial design technology; (d) to contribute to the mutual advantage of creators and industrial design-users of technological knowledge and in a

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		manner conducive to social and economic welfare; (e) to contribute to a balance of rights and obligations of creators and industrial design-users.
The Myanmar Engineering Council Law	2013	(a) to uphold and upgrade the dignity, ethics and quality of the Myanmar citizen engineers, graduate technicians and technicians who are practising engineering works; (b) to explore using engineering technology and information technology combined the good methods, research and development activities by which the natural resources and human resources of the State may be beneficially applied with least impact on environment; (c) to carry out guidance and supervision, and to take necessary actions for fulfillment of the requirements of stipulated technical standard, proper method, free from danger, keeping ethic and being dutiful in the fields of engineering and technology education, researches and services; (d) to service engineering and technology related functions and duties beneficial for the State assigned by the relevant Ministry and relevant organizations.
The Petroleum and Petroleum Product Law	2017	(a) to carry out the petroleum and petroleum product business activities systematically in accordance with the provisions of the law, stipulated standards, procedures and conditions; (b) to enable the petroleum and petroleum product business activities to carry out safely without environmental impact; (c) to establish free and fair competition in carrying out petroleum and petroleum product business activities; (d) to secure energy requirement and energy security of the Union; (e) to obtain tax revenue of the Union.
The Petroleum Rules,	1937	-
The Electricity Law	2014	(a) to achieve further development in the electric power sector, to meet the State electric power demand and to supervise the electrical businesses by managing the electrical matters systematically in line with the Union Government policies; (b) to encourage the production and distribution of large scale electric power that has the right to be managed by the Union in addition the production and distribution of both small and medium scale electric power in Regions and States;

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		(c) to enable to use electric power safely and broadly; (d) to carry out the electrical business in accordance with the specified standards; (e) to encourage the local and foreign investment in the electrical business; (f) to enact fair, transparent and appropriate rules and regulations in order to prescribe the rates of electric power fee which are consistent with current times; (g) to have the right to use the electric power which has the standardized voltage, current, and frequency by the users of electric power and to protect from causing damages to the electrical equipment of users due to the electric power which is not consistent with standardization; (h) to adhere in accord with the international environmental protection treaties which Myanmar has ratified.
The Myanma Port Authority Law (2015)	2015	The objectives of this Law are as follows: (a) to cause develop the ports of the State more and to cause develop the economy more; (b) to cause the port works free from danger and safe; (c) to enable to transform the works relating to port as an independent Myanma Port Authority institution; (d) to enable to allow to operate by the local and foreign investors by prescribing the conditions systematically in accord with the State's market economy system; (e) to enable to cooperate with the foreign countries, regional organizations or international organizations for the further development of port port operation.
Mandalay City Development Law (2014) (Amended 2016, 2021)	2014	-
The Administration of Vacant, Fallow and Virgin Lands Law (2012) (Amended 2018)	2012	-
The Bridges Law, 2019	2019	The objectives of this Law are: (a) to construct a new bridge, upgrade, expand the bridge, inspect the strength of the bridge, maintain, repair and demolish the bridge, manage and monitor for the use of the bridge by the person, motor vehicle and train, and collect the toll systematically; (b) to be safe and secure for the users of the bridge, and to carry out the matters relating to maintenance and durability

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		of the bridge; (c) to save the transportation charge, and to develop the socio-economic status and living standard of citizens by making passengers safety and by facilitating the flow of goods in using the bridge; (d) to accelerate the development works of the State by constructing a new bridge, upgrading, expanding the bridge, inspecting the strength of the bridge, repairing and maintaining the bridge for long-term use.
The Myanmar Coastal and Inland Water Transport Service License Law	2015	The objectives of this Law are as follows: (a) to implement the agreements which is relevant to water transport service concluded by regional countries or neighbouring countries or regional organizations; (b) enable to lay down the policies relating to water transport service; (c) causing to systematically perform the service of transportation passenger and goods in the Myanmar coastal and inland water in accord with the stipulations.

The following table shows more detailed about rules and regulations associated with the proposed project.

Table 3.3 – Laws and Regulations Related to Workmen's Right, Occupational Safety and Health

Law name and section	Legal Commitments
The Labour Organization Law, 2011 (Amended 2012)	
Section 18	The project proponent commits to the labour organization' right to demand the relevant employer to re-appoint a worker if such worker is dismissed by the employer and if there is cause to believe that the reasons of such dismissal were based on labour organization membership or activities, or were not in conformity with the labour laws in accordance with section 18 of the Labour Organization Law.
Section 19	The project proponent commits to the labour organizations' right to send representatives to the Conciliation Body in settling a dispute between the employer and the worker and the right to send representatives to the Conciliation Tribunals formed with the representatives from the various levels of labour organizations in accordance with section 19 of the Labour Organization Law.
Section 20	The project proponent commits to the labour organizations' right to participate and discuss while discussing with the Government, the employer and the complaining workers in respect of worker's rights or interests contained in the

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	labour laws in accordance with section 20 of the Labour Organization Law.
Section 21	The project proponent commits to the labour organizations' right to participate in solving the collective bargains of the workers for dispute between employer and worker with section 21 of the Labour Organization Law.
Section 22	The project proponent commits to follow procedures, regulations, by-laws and any directives prescribed by the relevant Labour Federation while the labour organizations carrying out holding of meetings, going on strike and carrying out other collective activities in accordance with section 22 of the Labour Organization Law.
The Settlement of Labour Dispute Law, 2012 (Amended 2014, 2019)	
Section 38	The project proponent commits not to fail to negotiate and coordinate in respect of the complaint within the prescribed period without sufficient cause in accordance with section 38 of The Settlement of Labour Dispute Law, 2012 (Amended 2014, 2019).
Section 38-A	The project proponent has to comply not to fail to form the Coordinating Committee in accordance with the provision contained in section 3 and will not fail to reform the Coordinating Committee within 60 days from the date of conviction by the court due to failure to form it in accordance with section 38-A of The Settlement of Labour Dispute Law, 2012 (Amended 2014, 2019).
Section 39	The project proponent commits not to alter the conditions of service relating to workers concerned in such dispute at the consecutive period before commencing the dispute within the period under investigation of the dispute before the Arbitration Body or Council, to affect the interest of such workers immediately in accordance with section 39 of The Settlement of Labour Dispute Law, 2012 (Amended 2014, 2019).
Section 40	The project proponent commits not to lock-out or strike without accepting negotiation, conciliation and arbitration by Arbitration Body in accord with this law in respect of a dispute in accordance with section 40 of The Settlement of Labour Dispute Law, 2012 (Amended 2014, 2019).
Section 51	The project proponent commits to pay full compensation in the amount determined by the Arbitration Council or the Arbitration Body if the project proponent, in the course of settlement of dispute, commits any act or omission, without sufficient cause, which by causing a reduction in production resulting so as to reduce the workers' benefits in accordance with section 51 of The Settlement of Labour Dispute Law, 2012 (Amended 2014, 2019).
Employment and Skill Development Law, 2013	
Section 5	The employer commits to employ according to Section 5 of Employment and Skill Development Law, 2013 :(a) (1) If the employer has appointed the employee to work for an employment, the employment agreement shall be made within 30 days. But it shall not be related with government department and organization for a permanent employment. (2) If pre training period and

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	probation period are stipulated before the appointment the said trainee shall not be related with the stipulation of sub-section (1). (b) The following particulars shall be included in the employment agreement: (1) the type of employment; (2) the probation period; (3) wage, salary; (4) location of the employment; (5) the term of the agreement; (6) working hour; (7) day off, holiday and leave; (8) overtime; (9) meal arrangement during the work hour; (10) accommodation; (11) medical treatment; (12) ferry arrangement to worksite and travelling; (13) regulations to be followed by the employees; (14) if the employee is sent to attend the training, the limited time agreed by the employee to continue to work after attending the training; (15) resigning and termination of service; (16) termination of agreement;(17) the obligations in accord with the stipulation of the agreement; (18) the cancellation of employment agreement mutually made between employer and employee; (19) other matters; (20) specifying the regulation of the agreement, amending and supplementing; (21) miscellaneous. (c) The worksite regulations contained in the employment agreement shall be in compliance with any existing law and the benefits of the employee shall not be less than those of the any existing law. (d) According to the employment agreement, the Ministry shall issue the notification for paying the stipulated compensation to the employee by the employer, if the work is completed earlier than the stipulated period or the whole work or any part of it have to be terminated due to unexpected condition or the work has to be terminated due to various conditions. (e) The employment agreement made under sub-section (a) shall be related with daily wage workers, piece rate workers who are appointed temporarily in the government department and organization. (f) The worksite regulations and benefits contained in the employment agreement mutually made between the employer and employee or among the employees shall be amended as necessary, in accord with the existing law. (g) The employer shall send a copy of the employment agreement made between the employer and employee, to the relevant employment and labour exchange office within the stipulated period and shall get the approval of it. (h) The employment agreement made before the enforcement of this law shall be confirmed up to the end of the term of the original agreement.
Section 14	The employer commits to carry out training program in accord with the work requirement in line with the policy of the skill development team to develop the skill relating to the employment for the workers who are proposed to appoint and working at present in accordance with Section 14 of Employment and Skill Development Law, 2013
Section 30 (a & b)	The employer commits to the following in accordance with section 30 of Employment and Skill Development Law, 2013: (a) The employer of the industry and service business shall put in to the fund monthly as put in fees without fail for the total wages of the subordinates and the supervisors' salary for not less than 0.5%; (b) Put in money paid under sub-section (a) shall not be deducted from the wage and salary of the employees.

The Leave and Holiday Act, 1951 (Law Amended July, 2014)

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Section 3 (1)	The project proponent commits to grant the public holidays mentioned in section 3 (1) of The Leave and Holiday Act 1951 (Law Amended July, 2014) to every employees with full wages or pay.
Section 3 (2)	The project proponent commits in accordance with section 3 (2) of The Leave and Holiday Act 1951 (Law Amended July, 2014): if any public holiday falls on any weekly day of rest or on any other holiday, an alternative holiday shall not be allowed, which the public holiday incidentally falls shall be granted as a public holiday. If however, an employee is required to work on a public holiday, he shall be paid basic wages or pay (as the case may be) at double the usual rate, as well as the cost of living allowance, if admissible, at the ordinary single rate.
Section 3 (4)	The project proponent commits to determine and allow at least a day in a week as the holiday on full wage or pay in accordance with section 3 (4) of The Leave and Holiday Act 1951 (Law Amended July, 2014)
Section 5	The project proponent commits to allow leave in accordance with section 5of The Leave and Holiday Act 1951 (Law Amended July, 2014): (1) An employee shall be admissible to casual leave with wages or pay (as the case may be) aggregating six days in a year: Provided that he shall only be admissible to a maximum casual leave of three days at any one time. (2) Casual leave shall not be combined with any other kind of leave. (3) If the employee does not take the casual leave which he is entitiled to within the year, it shall lapse.
Section 7 A	The project proponent commits to allow the pregnant woman workers six weeks before and eight weeks after the delivery as maternity leave with the relevant wage or pay. The maternity leave may be allowed joining with medical leave in accordance with section 7 A of The Leave and Holiday Act 1951 (Law Amended July, 2014)
Minimum Wages Law, 2013	
Section 12	The employer commits in accordance with section 12 of Minimum Wages Law, 2013: the employer (a) shall not pay wage to the worker less than the minimum wage stipulated under this Law; (b) may pay more than the minimum wage stipulated under this Law; (c) shall not have the right to deduct any other wage except the wage for which it has the right to deduct as stipulated in the notification issued under this Law; (d) shall pay the minimum wage to the workers working in the commercial, production and service business in cash. Moreover, if the specific benefits, interests or opportunities are to be paid, it may be paid in cash or partly in cash and partly in property, with prevailing regional price, jointly according to the desire of the worker; (e) in paying minimum wage to the workers working in the agricultural and livestock business, some cash and some property at prevailing regional price may be paid jointly according to local custom or desire of the majority of workers or collective agreement. Such payment shall be for any personal use and benefit of

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	the worker and his family and the value shall also be considerable and fair.
Section 13	The employer commits in accordance with section 13 of Minimum Wages Law, 2013:the employer (a) shall inform the workers the rates of minimum wage relating to the business among the rates of minimum wage stipulated under this Law and advertise it at the workplace to enable to be seen by the relevant workers; (b) shall prepare and maintain the lists, schedules, documents and wages of the workers correctly; (c) shall report the lists, schedules and documents prepared and maintained under sub-section(b) to the relevant department in accord with the stipulations; (d) shall accept the inspection when summoned by the inspection officer. Moreover, he shall produce the said lists and documents upon asking to submit; (e) shall allow the entry and inspection of the inspection officer to the commercial, production and service businesses, agricultural and livestock breeding workplaces and give necessary assistances; (f) if the workers cannot work due to sickness, shall give them holiday for medical treatment in accord with the stipulations; (g) if the funeral matter of the member of the family of worker or his parent occurs, shall give holiday without deducting from the minimum wage, in accord with the stipulations
The Payment of Wages Law, 2016	
Section 3 (a)	The project proponent commits to pay wages to the workers employing in his business in local currency or foreign currencies stipulated by the Central Bank of Myanmar. Such payment may be paid in cash or cheque or deposit into the bank account of the worker with the agreement between the employer and the worker in accordance with section 3 (a) of The Payment of Wages Law, 2016.
Section 3 (b)	The project proponent commits in accordance with section 3 (a) of The Payment of Wages Law, 2016 in pay such wages: (i) if it is necessary to pay particular benefit, profits and opportunities for workers working in commerce, production and service businesses, it may be paid in cash or some in cash and some in things set up by local price on own volition of workers in accordance with the stipulations; (ii) for workers employing in agriculture and livestock breeding business, it may be paid some wage in cash and something set up by local price according to custom, or on the volition of majority of worker or by collective agreement. In paying so, it shall be for personal use and the interest of his family, and shall be appropriate and equitable.
Section 3(c)	The project proponent commits in accordance with section 3 (c) of The Payment of Wages Law, 2016: if any worker is conscripted under the Public Military Service Law, the (60) days of wages shall be paid as a special right.
Section 4 (a)	The project proponent commits to pay wages at the end of the work or at the time agreed to pay to the worker for hourly, daily, weekly or other part time work, or temporary or piece work in accordance with section 4 (a) of The Payment of Wages Law, 2016.
Section 4 (b)	The project proponent commits not to exceed one month than the period agreed with the worker under sub-section (a) to pay wages in accordance with section 4

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(b) of The Payment of Wages Law, 2016.

Section 4 (c) The project proponent commits to pay the wages for the permanent work monthly. In making such payment: (i) if workers are not more than 100, wages shall be paid at the end of the period for payment of wage; (ii) if workers are more than 100, it shall be paid no later than five days after the end of the period for payment of wage in accordance with section 4 (c) of The Payment of Wages Law, 2016.

Section 4 (d) The project proponent commits to pay the due wages within two working days from the date of termination, if a worker is terminated in accordance with section 4 (d) of The Payment of Wages Law, 2016.

Section 4 (e) The project proponent commits to pay the wages at the end of the period for payment of wages, if a worker resigns on his own volition by sending prior written notice of resignation in accordance with section 4 (e) of The Payment of Wages Law, 2016.

Section 4 (f) The project proponent commits to pay the due wages to a legal heir within two working days after the decease, if a worker is deceased in accordance with section 4 (f) of The Payment of Wages Law, 2016.

Section 4 (g) The project proponent commits to pay all wages on a working day in accordance with section 4 (g) of The Payment of Wages Law, 2016..

Section 5 The project proponent commits in accordance with section 5 of The Payment of Wages Law, 2016.; if an employer encounters difficulties to make payment under sub-section (c) of the Section 4 due to any unexpected condition, including natural disaster, the employer shall submit that which date has been altered for the payment of wages with the consent of the workers to the Department on reasonable ground.

Section 7 The project proponent commits to deduct from wages in accordance with section 7 of The Payment of Wages Law, 2016.: the employer (a) may deduct from wages, except leaves which are entitled wages under the relevant law and public holidays, for the absent period from work; (b) may deduct expenses which are allowance for accommodation and ferry service arranged by the employer, meal allowance, electricity charges, water service charges and income taxes liable to be paid by worker and cash paid in excess under a mistake, which are not included in the expression of wages under this Law; (c) may deduct advance payment or reimburse or savings for the worker or any contribution under any law demanded by a worker from wages; (d) may deduct from the wages of the worker under a decision of a Court or Arbitration Council or Arbitration Body.

Section 8 The project proponent commits not to deduct from the wages of the worker except deduction from wages in accordance with provisions of Section 7 and Section 11 in accordance with section 8 of The Payment of Wages Law, 2016..

Section 9 The project proponent commits to deduct from wages in accordance with

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section 9 of The Payment of Wages Law, 2016: in deducting from wages under Section 7, all deductions made by the employer shall not exceed 50 percent of the wages of a worker except deduction from wages for the failure of a worker to perform his duty.

Section 10 (a) The project proponent commits to obtain prior approval of the Department for what deduction can be made from wage and how much can be deducted before deducting anything stipulated as a fine under section 11 in accordance with section 10 (a) of The Payment of Wages Law, 2016.

Section 10 (b) The project proponent commits to post the approval contained in sub-section (a) in conspicuous places at relevant factory and work in accordance with section 10 (b) of The Payment of Wages Law, 2016.

Section 10 (c) The project proponent commits not to exceed fine deducted for compensation than the value of damage or loss by action or omission of a worker in accordance with section 10 (c) of The Payment of Wages Law, 2016.

Section 10 (d) The project proponent commits in accordance with section 10 (d) of The Payment of Wages Law, 2016.: in deducting from wages under Section 11: (i) will not deduct from wages without giving right to defence of the worker; (ii) will not deduct more than 5 percent of the monthly wages of the worker;

Section 10 (e) The project proponent commits absolutely deduct as the fine from a worker under 16 years of age in accordance with section 10 (e) of The Payment of Wages Law, 2016.

Section 10 (f) The project proponent will carry out the date of payment of passing fine in accordance with the agreement between the employer and the worker in accordance with section 10 (f) of The Payment of Wages Law, 2016.

Section 10 (g) The project proponent commits to deduct from wages for compensation due to loss of property within a limited period by an agreement of the relevant Township Conciliation Body in accordance with section 10 (g) of The Payment of Wages Law, 2016.

Section 10 (h) The project proponent commits to enter the deducting cash from wages into the register and systematically maintain it in accordance with section 10 (h) of The Payment of Wages Law, 2016.

Section 10 (i) The project proponent commits to submit a report of the deduction from wages to the Department in accordance with section 10 (i) of The Payment of Wages Law, 2016.

Section 10 (j) The project proponent commits to use fines of deduction from wages under sub-section (b) of Section 11 for the worker benefit in coordination with legally registered Labour Organization in the factory in accordance with section 10 (j) of The Payment of Wages Law, 2016.

Section 11 The project proponent commits to deduct from wages in accordance with section 11 of The Payment of Wages Law, 2016: The employer may designate

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	as fine to compensate for the following acts and omissions of a worker and deduct from his wages: (a) any loss of property and cash expressly entrusted to the worker by the employer due to intentional negligence and carelessness or dishonest acts or omissions of the worker, which is caused directly by the carelessness and mistake of such worker; (b) violation of any terms or conditions stipulated as fines in the employment agreement.
Section 12	The project proponent commits in accordance with section 12 of The Payment of Wages Law, 2016: The worker: (a) may request to the employer to be settled by himself or legally registered labour organization or the Workplace Coordination Committee in the factory if the following conditions occur: (i) deduction from wages obtainable without credible reason; (ii) failure to pay overdue payment of wages. (b) may submit to the inspector to solve the problem, if the employer fails to solve the problem asked under sub-section (a), within six months from the date of deduction or failure to pay.
Section 13	The project proponent understands and commits in accordance with section 13 of The Payment of Wages Law, 2016: (a) The inspector may scrutinize such submission under sub-section (b) of the Section 12 and, if necessary, interrogate the relevant persons and make an appropriate order. (b) The worker or employer may file an appeal to the chief inspector, if he does not satisfy the order made under sub-Section (a), within 30 days from the date of such order. (c) The chief inspector may make an appropriate order after scrutinizing the appeal under sub-section (b) and hearing the employer and the worker. (d) The order of the Chief Inspector is final.
Section 14	The project commits to pay overtime wages stipulated by the law to the workers if he works over time in accordance with section 14 of The Payment of Wages Law, 2016.
The Social Security Law, 2012 (Amended 2014)	
Section 11 (a)	The project proponent commits to the following provisions in accordance with section 11(a) of The Social Security Law, 2012 (Amended 2014): (a) The following establishments shall be applied with the provisions for compulsory registration for social security system and benefits contained in this Law if they employ minimum number of workers and above determined by the Ministry of Labour in co-ordination with the Social Security Board: (i) production industries doing business whether or not they utilize mechanical power or a certain kind of power, works of production, repairing or services, or engineering works, mills, warehouses, establishments; (ii) Government departments, Government organizations and regional administrative organizations doing business; (iii) development organizations; (iv) financial organizations, (v) companies, associations, organizations and their subordinate departments and branch offices doing business; (vi) shops, commercial establishments, public entertaining establishments; (vii) Government departments and Government organizations doing business or transport businesses owned by regional administrative body, and transport businesses carried out with the permission of such department, body or in joint venture with such department or body; (viii)

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construction works carried out for a period of one year and above under employment agreement; (ix) works carried out with foreign investment or citizen investment or joint ventured businesses; (x) works relating to mining and gemstone contained in any existing law; (xi) works relating to petroleum and natural gas contained in any existing law; (xii) ports and out-ports contained in any existing law; (xiii) works and organizations carried out with freight handling workers; (xiv) Ministry of Labour and its subordinate departments and organizations; (xv) establishments determined by the Ministry of Labour from time to time, in co-ordination with the Social Security Board and with the approval of the Union Government; that they shall be applied with the provisions of compulsory registration for Social Security System and benefits contained in this Law.

Section 15(a, b) The project proponent is obligated to contribute to the Social Security Fund as outlined in: (a) The following funds are included in the Social Security Fund: (i) health and social care fund; (ii) family assistance fund; (iii) invalidity benefit, superannuation pension benefit, and survivors' benefit fund; (iv) unemployment benefit fund; (v) other social security fund for social security system of compulsory registration and contribution specified by the Ministry of Labour, in co-ordination with the Social Security Board, according to clause (2) of sub-section (e) of section 13; (vi) other social security fund specified as to which contribution may be paid after voluntary according to clause (2) of sub-section (e) of section 13; (vii) fund for Social Security Housing Plan

Section 18 (b) The project proponent commits to deduct contributions to be paid by worker from his wages together with contribution to be paid by him and pay to the social security fund in accordance with section 18(b) of The Social Security Law, 2012 (Amended 2014):.

Section 48 (b) The project proponent commits to the provision stating that the employers may effect insurance by registering voluntarily for insurance of the workers who are not applied to provisions of compulsory registration for employment injury benefit insurance system, by paying stipulated contribution to employment injury benefit insurance fund in accordance with section 48(b) of The Social Security Law, 2012 (Amended 2014):

Section 75 The project proponent commits to maintain and retain the following records, as specified by this Law in accordance with section 75 of The Social Security Law, 2012 (Amended 2014):: The employers of establishments applied by this Law (a) shall prepare and keep the following records and lists correctly and submit to the relevant township social security office in accord with the stipulations: (i) records and lists of workers' daily attendance; (ii) records on appointment of new workers, employing worker by changing of work, termination, dismissal and resignation; (iii) records on promotion and paying remuneration; (iv) records and lists of employer, manager, and administrator and records on change of them; (b) shall inform the relevant township social security office if the following matters arise: (i) changes in number of workers and address of establishment; (ii) change of employer, change of business, suspension of work, and close-down of work; (iii) employment injury, decease

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and contracting diseases; (c) shall submit records of work and lists if requested by inspectorate or official assigned by the Social Security Head Office and various levels of Regional Social Security Office under this Law.

The Workmen's Compensation Act, 1923 (Amended 1955,1957,2005)

Section 3 (1)	The project proponent complies in accordance with section 3(1) of The Workmen's Compensation Act, 1923 (Amended 1955,1957,2005) and pay compensation in accordance with the provisions if personal injury is caused to a workman by accident arising out of and in the course of his employment. The employer shall not be so liable in respect of any injury, not resulting in death, caused by an accident which is directly attributable to- (i) the workman having been at the time thereof under the influence of drink or drugs, or (ii) the wilful disobedience of the workman to an order expressly given, or to a rule expressly framed, for the purpose of securing the safety of workmen, or (iii) the wilful removal or disregard by the workman of any safety guard or other device which he knew to have been provided for the purpose of securing the safety of workmen.
Section 3 (2)	The project proponent complies in accordance with section 3 (2) of The Workmen's Compensation Act, 1923 (Amended 1955,1957,2005):if a workman, whilst in the service of an employer in whose service he has been employed for a continuous period of not less than six months in any employment specified in [List A of] Schedule III, contracts any disease specified therein as an occupational disease peculiar to that employment, the contracting of the disease shall be deemed to be an injury by accident within the meaning of this section and, unless the employer proves the contrary, the accident shall be deemed to have arisen out of and in the course of the employment. Explanation.-For the purposes of this sub-section a period of service shall be deemed to be continuous which has not included a period of service under any other employer.
Section 3 (3)	The project proponent will comply in accordance with section 3 (3) of The Workmen's Compensation Act, 1923 (Amended 1955,1957,2005):if a workman contracts any disease specified in List B of Schedule III, and it is certified by a qualified medical practitioner that the disease is directly due to the nature of any employment in which the workman was employed at any time within the twelve months previous to the date of disablement, the contracting of the disease shall be deemed to be an injury by accident within the meaning of this section, and unless the employer proves the contrary the accident shall be deemed to have arisen out of and in the course of the employment aforesaid: Provided that the compensation shall be recoverable from the employer who last employed the workman during the said twelve months in the employment to the nature of which the disease was due.

The Prevention of Hazard from Chemical and Related Substances Law, 2013

Section 15 (a)	The project proponent commits to be inspected for the safety and the power of resistance of the machinery and equipments by the respective Supervisory

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Board and Board of Inspection before starting the respective chemical and related substances business in accordance with section 15 (a) of The Prevention of Hazard from Chemical and Related Substances Law, 2013.

Section 15 (b) The project proponent commits to be attended the person who serve in the work to the respective foreign trainings or the trainings and the expert trainings on prevention of hazard from the chemical and related substances opened by the government department and the government organizations before starting the respective chemical and related substances business in accordance with section 15 (b) of The Prevention of Hazard from Chemical and Related Substances Law, 2013.

Section 16 (b) The project proponent commits to abide strictly the instructions for being safety in using the chemical and related substances by himself and also the persons who serve the work in accordance with section 16 (b) of The Prevention of Hazard from Chemical and Related Substances Law, 2013.

Section 16 (c) The project proponent commits to keep the required safety equipments enough in the chemical and related substances businesses, furthermore shall grant the personal protection equipment and dresses free of charge to the working persons in accordance with section 16 (c) of The Prevention of Hazard from Chemical and Related Substances Law, 2013.

Section 16 (d) The project proponent commits to make the course of training and study and instruction if necessary to the working persons for using the occupational safety equipment, the personal protection equipment and the dresses systematically in the chemical and related substances business in accordance with section 16 (d) of The Prevention of Hazard from Chemical and Related Substances Law, 2013.

Section 16 (e) The project proponent commits to be inspected by the respective Supervisory Board and Boards of Inspection in respect of whether or not the hazard may impact on the Human Being and Animals' health and the environment in accordance with section 16 (e) of The Prevention of Hazard from Chemical and Related Substances Law, 2013.

Section 16 (f) The project proponent commits to make medical checkup the working persons who will work in the chemical and related substances business and shall permit to serve in that work after obtaining the recommendation that his health is suitable for that work. This medical checkup records shall be kept systematically in accordance with section 16 (f) of The Prevention of Hazard from Chemical and Related Substances Law, 2013.

Section 16 (g) The project proponent commits to send the copy of informative letter of the permission to the respective Department of Township Administration, if the hazardous chemical or related substances are permitted to store in accordance with section 16 (g) of The Prevention of Hazard from Chemical and Related Substances Law, 2013.

Section 16 (h) The project proponent commits to acquire in advance the guidance and agreement of the respective Department of Fire Brigade, if the business that is

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worried to fire hazard is operated by using the fire hazard substances or the explosive substances in accordance with section 16 (h) of The Prevention of Hazard from Chemical and Related Substances Law, 2013.

Section 16 (i) The project proponent will transport only the permitted amount of the chemical and related substances in accordance with the prescriptive stipulations, if they are transported in local in accordance with section 16 (i) of The Prevention of Hazard from Chemical and Related Substances Law, 2013.

Section 16 (j) The project proponent commits to take the permission from the Central Supervisory Board if the chemical and related substance is altered and transferred from one place to any other place which contained in the license in accordance with section 16 (j) of The Prevention of Hazard from Chemical and Related Substances Law, 2013.

Section 17 The project proponent commits to put the insurance in accordance with the prescriptive stipulations to be able to pay the compensation, if the impact and damage is occurred on the Human Being and Animals or the environment in respect of the chemical and related substances businesses in accordance with section 16 (k) of The Prevention of Hazard from Chemical and Related Substances Law, 2013.

Section 22 The project proponent commits to the regulations consisted in the registration certificate furthermore shall also abide the order and instructions issued occasionally by the Central Supervisory Board in accordance with section 22 of The Prevention of Hazard from Chemical and Related Substances Law, 2013.

Section 27 The project proponent commits to the following matters to control and decrease the hazard of the chemical and related substances in accordance with section 27 of The Prevention of Hazard from Chemical and Related Substances Law, 2013.:-(a) classifying the hazard level to protect in advance the hazard according to the properties of the chemical and related substances; (b) expressing the Material Safety Data Sheet and Pictogram; (c) providing the safety equipments, the personal protection equipments to protect and decrease the accident and attending to the training to be used systematically; (d) performing in accordance with the stipulations in respect of transporting, possessing, storing, using, discharging the chemical and related substances; (e) not being imported or exported the chemical and related substances banned by the Central Supervisory Board and the machinery and equipment which are used them.

The Prevention of Hazard from Chemical and Related Substances Rules, 2016

Rule 17 The project complies in accord with Rule 17: The Project proponent who wants to apply the licence for the business of chemical and related substances will apply to the Central Supervisory Board after filling up in Form (1) with necessary facts and documents completely

Rule 20 The project proponent commits to apply to the Central Supervisory Board to get the recommendation for export and import of the chemical and related

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substances after filling in Form (3) and Form (4) completely.

Rule 24

The project proponent complies in accordance with Rule 24 and will comply to; (a) operate only chemical and related substances business which is permitted in licence; (b) operate it in accordance with the licence duration of registered substances; (c) pay the prescriptive fees for renewal of licence; (d) not make the incorrect advertising and selling the chemical and related substances in respect of their potency, quality and standard; (e) hang the licence at a conspicuous place in the occupational area; (f) hang the certificates and recommendation letters that the employees in chemical and related substances business have attended the training on prevention of hazard from chemical and related substances and systematic use of them at a conspicuous place; (g) hang distinctly the caution letter or pictogram which shows the hazard information at the storehouse where the chemical and related substances are stored and at the relevant occupational area; (h) store the chemical and related substances only at the place and types of building that are prescribed and allowed by the Central Supervisory Board; (i) carry out the required safety measures at the occupational area and building where the chemical and related substances are stored in accordance with the stipulations of the Central Supervisory Board; (j) pack the chemical and related substances safely and carry out the sticking of pictogram on the package in accordance with the stipulations; (k) carry out the safety measure for the chemical and related substances, equipment and machineries which are used in the occupational area; (l) instruct the name of hazardous chemical and related substances, maximum contact amount and other required information to the persons who contact and use chemical and related substances and practise for emergency situations; (m) do regular medical check up for working people according to the timetable which is prescribed by the respective doctor, and keep these medical check up records; (n) make the special treatment after being medical check up by the respective doctor if the working people happen the suffering of hazard and the bad health by contacting the chemical and related substances; (o) allow the respective doctor to inspect at any place and any record in the occupational area in respect of health condition. The suitable health care shall be made according to the doctor's suggestions (p) abide by and perform in accordance with provisions in existing laws in respect of working people's health in operating the chemical and related substances business; (q) allow the Boards of Inspection to enter and inspect at any place concerning with the chemical and related substances business and assist for requirements; (r) abide by systematically and carry out the prescriptive provisions related to fire safety of the Department of Fire Brigade in storing the chemical and related substances; (s) abide by the orders, notifications and directives issued by the Central Supervisory Board from time to time.

Rule 28

The project proponent commits to apply again the registration certificate to the Central Supervisory Board if the registration certificate holder needs to use the chemical and related substances which are not included in the registered list, or occur any of following facts: (a) changing the trade mark or identity of the registered chemical and related substances; (b) changing the amount of content of the registered chemical and related substances; (c) changing the registered quality assurances and standards; (d) using the new kinds of chemicals which

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are not included in the national chemical and related substances profile.

The Occupational Safety and Health Law, 2019

Section 12 (a)	The project proponent complies to appoint a person in-charge for occupational safety and health according to the type of industries to closely supervise the safety and health of the workers in accordance with the specifications of the Ministry under section 12 (a) of The Occupational Safety and Health Law, 2019.
Section 12 (b)	The project proponent complies to establish each Occupational Safety and Health Committee comprising equal number of employers and workers' representatives according to the types of industry without lessening the number of workers prescribed by the Ministry to be safe and healthy workplace, in accordance with the specifications of the Ministry under section 12 (b) of The Occupational Safety and Health Law, 2019.. In establishing the Committee, occupational safety and health matters for female workers shall be considered according to the nature of work.
Section 14	The project proponent complies to follow Law, and rules, orders, directives and, procedures issued under this Law to be safe and healthy workplace in accordance with section 14 of The Occupational Safety and Health Law, 2019.
Section 16	The project proponent will comply to allow inspector's inspections to workplace and follow the instructions in accordance with section 16 of The Occupational Safety and Health Law, 2019.
Section 17	The project proponent complies to allow inspectors for conducting the actions described in section 17 of Occupational Safety and Health Law: (a) enter, inspect and examine any workplace applicable to this Law without a warrant by showing their identity cards at any time; (b) inspect and copy all records, books, and documents relating to the workplace and process, and seize any of them as exhibits, if necessary; (c) take photographs and video records of the workplace situations and processes which may be harmful to the occupational safety and health; (d) assess and record the amount of impact and time on the workplace environment, due to noise, illumination, temperature, dust, fume and hazardous materials, with the assistance of an expert on the respective subjects, if necessary; (e) inquire any person working at the workplace during working hours about contracting occupational diseases or potential situations with the assistance of a certified doctor; (f) ask the responsible person from hospitals and medical clinics to confidentially send the medical report of a worker who is receiving medical treatment for injuring in a workplace accident or suffering from an occupational disease or information about death or the autopsy report requested with the form prescribed by the Department.
Section 18	The project proponent will comply to follow the inspector's temporary order to the employer for work stoppage partially or wholly in accordance with section 18 of The Occupational Safety and Health Law, 2019.if any occupational accident, disease, dangerous occurrence or major accident happens or is likely

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to happen due to any of the following facts: (a) impropriety to work continuously due to the unsafe workplace conditions, unsafe acts of workers, the existence of hazardous material and machinery at the workplace, or parts of machinery or laying out of machinery at the workplace, and working practices; (b) impropriety to work continuously due to violation of or failure to comply with any provision of this Law; (c) assumption to be harmful to workers at the workplace due to any act of negligence and carelessness or omission by any person; (d) necessity to evacuate workers for safety due to the imminent danger situation of the occupational injury;

Section 26 (a) The project proponent complies to arrange to assess the risk severity of material and machinery used in the workplace and process, if necessary in accordance with section 26 (a) of The Occupational Safety and Health Law, 2019.

Section 26 (b) The project proponent complies to arrange to assess the risk of occupational factors, if necessary in accordance with section 26 (b) of The Occupational Safety and Health Law, 2019.

Section 26 (c) The project proponent complies to arrange to conduct medical examination for workers by the certified doctor in accordance with the specifications whether occupational diseases are contracted in accordance with section 26 (c) of The Occupational Safety and Health Law, 2019.

Section 26 (d) The project proponent complies to arrange to be safe and healthy workplace based on the findings of subsections (a), (b) and (c) in accordance with section 26 (d) of The Occupational Safety and Health Law, 2019.

Section 26 (e) The project proponent complies to provide the suitable personal protective equipment, things and facilities adequately prescribed and allowed by the Department to the workers with free of charge, and make sure them to wear at the workplace in accordance with section 26 (e) of The Occupational Safety and Health Law, 2019.

Section 26 (f) The project proponent complies to take the preventive measures and emergency response preparedness in accordance with section 26 (f) of The Occupational Safety and Health Law, 2019.

Section 26 (g) The project proponent complies to establish dispensary, appoint registered doctors and nurses, and provide necessary medicines and facilities at the workplace where the workers are not less than the number of workers prescribed by the Ministry in accordance with section 26 (g) of The Occupational Safety and Health Law, 2019.

Section 26 (h) The project proponent complies to cause to attend the training on occupational safety and health prescribed by the Ministry to the managers and workers from the respective type of work or branch including himself and members of the Occupational Safety and Health Committee in accordance with section 26 (h) of The Occupational Safety and Health Law, 2019.

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Section 26 (i)	The project proponent complies to arrange to give information immediately to the person in-charge for occupational safety and health or managers if any worker faces the situation which is likely to happen occupational injury or harm his life and health in accordance with section 26 (i) of The Occupational Safety and Health Law, 2019.
Section 26 (j)	The project proponent complies to arrange to be safe and healthy for persons at the work place due to material and machinery used in the workplace or process, or wastes in accordance with section 26 (j) of The Occupational Safety and Health Law, 2019.
Section 26 (k)	The project proponent complies in accordance with section 26 (k) of The Occupational Safety and Health Law, 2019 to arrange to stop the process immediately, remove the workers from the workplace, and perform necessary evacuation and rescue procedures in case of imminent danger. If possible, workers are transferred to and worked at other suitable safety workplaces.
Section 26 (l)	The project proponent complies to have instructions, warning signs, notices, posters and signage regarding occupational safety and health in accordance with the specifications in accordance with section 26 (l) of The Occupational Safety and Health Law, 2019.
Section 26 (m)	The project proponent complies to arrange to follow the precautions in accessing to the restricted workplaces where may be harmful in accordance with section 26 (m) of The Occupational Safety and Health Law, 2019.
Section 26 (n)	The project proponent complies to arrange to distribute or disseminate the manual and guidance regarding the occupational safety and health issued by respective Ministries to workers and persons related to the workplace for acquiring knowledge, technology and skills. in accordance with section 26 (n) of The Occupational Safety and Health Law, 2019.
Section 26 (o)	The project proponent complies to design the fire security plan and organize the fire-drills, and train to use systematically fire extinguishers and devices in accordance with section 26 (o) of The Occupational Safety and Health Law, 2019.
Section 26 (p)	The project proponent complies to allow the chief inspector and inspectors to inspect the workplace, inquire, ask for documents or seize exhibits in accordance with section 26 (p) of The Occupational Safety and Health Law, 2019.
Section 26 (q)	The project proponent complies to employ workers within the prescribed working hours at hazardous work and workplaces in accordance with section 26 (q) of The Occupational Safety and Health Law, 2019.
Section 26 (r)	The project proponent complies to bear any expenditure regarding occupational safety and health measures in accordance with section 26 (r) of The Occupational Safety and Health Law, 2019.

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Section 27	The project proponent complies not to dismiss suspend any worker due to one of the following reasons in accordance with section 27 of The Occupational Safety and Health Law, 2019.:(a) before obtaining the medical report of a registered doctor for being injury in the workplace or the medical report of a certified doctor for contracting occupational disease; (b) complaint about a matter of unsafe or health risk; (c) undertaking the functions and duties of the Occupational Safety and Health Committee; (d) no longer working at the imminent danger situation or situation to be contracted the occupational disease.
Section 34 (a)	The project proponent complies to inform the Department in case of an occupational accident, dangerous occurrence and major accident in accordance with section 34 (a) of The Occupational Safety and Health Law, 2019.
Section 34 (b)	The project proponent complies to submit a report with the medical report of the certified doctor to the Department, in case of any worker contracted any of the prescribed occupational diseases or being or likely to be occupational poisoning due to any material or process in accordance with section 34 (b) of The Occupational Safety and Health Law, 2019.
Section 36 (a)	The project proponent complies to allow inspectors' investigation for the occupational accident, dangerous occurrence, occupational disease, and occupational poisoning if they become aware of in accordance with section 36 (a) of The Occupational Safety and Health Law, 2019.
Section 36 (b) (c)	The project proponent complies to make sure not to remove, destroy, add or alter the whole or part of material, machinery, equipment, layouts, and documents related to the occupational accidents, dangerous occurrences, occupational diseases and occupational poisoning without the permission of the chief inspector except the activities necessarily for the safety of life and property, and rescue operations in accordance with section 36 (b,c) of The Occupational Safety and Health Law, 2019.
Section 36 (d)	The project proponent complies to remove, detach, add and alter the material, machinery, equipment and layouts in case of causing adverse consequences due to the prohibition under subsection (b) with chief inspector's permission in accordance with section 36 (d) of The Occupational Safety and Health Law, 2019.

The Industrial Explosive Materials Law, 2018

Section 6 (c)	The project proponent commits to apply to the Ministry in accordance with the stipulations if he/she wishes to obtain approval for a plot to construct a magazine for storage of industrial explosive materials or any person who wishes to carry out any one or more of import, transport, storage, manufacture, use, possession, transfer or destruction of industrial explosive materials in accordance with Section 6 (c) of The Industrial Explosive Materials Law, 2018.
Section 7 (c)	The project proponent understand and commits to comply in accord with section 7 (c) of The Industrial Explosive Materials Law, 2018: if the Office of the Commander-in-Chief (Army) found that the finding and remark of the sub-

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committee for procurement, provision, storage and distribution of explosives is in conformity with the specifications, the office shall grant permission to the applicant to carry out any one or more of import, transport, store, manufacture, use, process or transfer of industrial explosive materials. A copy of permission shall be sent to the Ministry.

Section 11 (b) The project proponent understand and commits to comply in accord with section 11 (b) of The Industrial Explosive Materials Law, 2018: when the application for a licence under section 10 is received, the Chief Inspector shall inspect whether the magazine is constructed in specified features and grant a licence to the applicant with the approval of the Ministry if the magazine is constructed in specified features.

Section 13 The project proponent commits to comply in accordance with section 13 of The Industrial Explosive Materials Law, 2018 and apply to renew the licence, 30 days before expiration to the Chief Inspector in accordance with the stipulations if he wishes to continue to store industrial explosive materials.

Section 14 (b) The project proponent understand and commits to comply in accord with section 14 (b) of The Industrial Explosive Materials Law, 2018: when the application for renewal of the licence under section 13 is received, the Chief Inspector shall inspect the magazine of the applicant and may renew the licence with the approval of the Ministry if the magazine is constructed in specified features.

Section 15 (a) The project developer commits to agree section 15(a) of The Industrial Explosive Materials Law, 2018 that systematically store industrial explosive materials without excessing the permitted amount in accordance with the specifications.

Section 15 (b) The project developer commits to accept the inspection of the Chief Inspector or an inspector from time to time in accordance with section 15 (b) of The Industrial Explosive Materials Law, 2018

Section 15 (c) The project developer commits to inform about if damage to property, injury to or death of people occurs due to loss, burning or explosion of industrial explosive materials and it to the nearest police station immediately, and report it to the Chief Inspector timely in accordance with section 15 (c) of The Industrial Explosive Materials Law, 2018

Section 15 (d) The project developer commits to pay licence fees stipulated by the Ministry to the Department in accordance with section 15 (d) of The Industrial Explosive Materials Law, 2018

Section 16 (a) The project developer commits to store industrial explosive materials only in the licensed magazine in accordance with section 16 (a) of The Industrial Explosive Materials Law, 2018

Section 16 (b) The project developer commits to take necessary preventive measures in accordance with the specifications to avoid harm in transport, manufacture, use

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	or possession of industrial explosive materials in accordance with section 16 (b) of The Industrial Explosive Materials Law, 2018
Section 18	The project developer commits not to refuse inspection of the Chief Inspector or an inspector in accordance with section 18 of The Industrial Explosive Materials Law, 2018
Section 19 (a)	The project developer commits to complies that important, transport, store, manufacture, use, possess or transfer explosive materials without permission in accordance with section 19 (a) of The Industrial Explosive Materials Law, 2018.
Section 19 (b)	The project developer commits not to destroy industrial explosive materials without approval of the Executive Committee of Defense Service Council in accordance with section 19 (b) of The Industrial Explosive Materials Law, 2018
Section 19 (c)	The project proponent commits not to fail to act in accordance with the rules, regulations, by-laws, notifications, orders and directives issued under the industrial explosive Law in accordance with section 19 (c) of The Industrial Explosive Materials Law, 2018
Section 20 (a)	The project proponent commits not to accept to store industrial explosive materials in an unlicensed magazine in accordance with section 20 (a) of The Industrial Explosive Materials Law, 2018.
Section 20 (b)	The project proponent commits not to deliver to store industrial explosive materials in an unlicensed magazine in accordance with section 20 (b) of The Industrial Explosive Materials Law, 2018.
Section 21 (a)	The project proponent commits not to accept to store industrial explosive material more than the limited amount mentioned in the licence issued by the Ministry in accordance with section 21 (a) of The Industrial Explosive Materials Law, 2018.
Section 21 (c)	The project proponent commits not to continue to store industrial explosive material without renewal after expiration of the licence in accordance with section 21 (c) of The Industrial Explosive Materials Law, 2018.
The Explosives Substances Act, 1908	
Section 3	The project proponent commits in accordance with section 3 of The Explosives Substances Act, 1908 to accept punishment of transportation for life or any shorter term, to which fine may be added, or with imprisonment for a term which may extend to ten years, to which fine may be added if he/she unlawfully and maliciously causes by any explosive substance an explosion of a nature likely to endanger life or to cause serious injury to property whether any injury to person or property has been actually caused or not.
Section 4 (a)	The project proponent commits in accordance with section 4 (a) of The Explosives Substances Act, 1908 to accept the punishment with transportation for a term which may extend to twenty years, to which fine may be added, or

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with imprisonment for a term which may extend to seven years, to which fine may be added if he intent to cause by an explosive substance, or conspires to cause by an explosive substance, an explosion in the Union of Burma of a nature likely to endanger life or to cause serious injury to property whether any explosion does or does not take place and whether any injury to person or property has been actually caused or not.

Section 4 (b) The project proponent commits in accordance with section 4 (b) of The Explosives Substances Act, 1908 to accept the punishment with transportation for a term which may extend to twenty years, to which fine may be added, or with imprisonment for a term which may extend to seven years, to which fine may be added if he makes or has in his possession or under his control any explosive substance with intent by means thereof to endanger life, or cause serious injury to property in the Union of Burma, or to enable any other person by means thereof to endanger life or cause serious injury to property in the Union of Burma whether any explosion does or does not take place and whether any injury to person or property has been actually caused or not.

Section 5 The project proponent commits in accordance with section 5 of The Explosives Substances Act, 1908 to accept the punishment with transportation for a term which may extend to fourteen years, to which fine may be added, or with imprisonment for a term which may extend to five years, to which fine may be added if he makes or knowingly has in his possession or under his control any explosive substance, under such circumstances as to give rise to a reasonable suspicion that he is not making it or does not have it in his possession or under his control for a lawful object, shall, unless he can show that he made it or had it in his possession or under his control for a lawful object.

Table 3.4 – Law and Regulations Related to Cultural and Heritage

Law name and section	Legal Commitments
The Ethnic Rights Protection Law, 2015	
Section 5	The project proponent commits to completely be informed, coordinated and performed with the relevant local ethnic groups in the case of development works, major projects, businesses and extraction of natural resources will be implemented within the area of ethnic groups in accordance with section 5 of The Ethnic Rights Protection Law, 2015
The Ethnic Rights Protection Rules, 2019 (2020 Amended)	
Rule 20(a)	The project proponent commits to explain the possible impacts of the project to the local communities and ethnic groups with their understandable languages before implementing the project in accordance with Rule 20(a) of The Ethnic Rights Protection Rules, 2019 (2020 Amended).
Rule 20(b)	The project proponent commits to implement and operate the project according to Myanmar Sustainable Development Plan – MSDP in accordance with Rule 20(b) of The Ethnic Rights Protection Rules, 2019 (2020 Amended).
Rule 20(c)	The project proponent commits to do Environmental and social impact assessment with the guidance of respective departments in accordance with Rule 20(c) of The Ethnic Rights Protection Rules, 2019 (2020 Amended).
Rule 20(d)	The project proponent commits to consult with local ethnic groups in all stages

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	of Environmental and social impact assessment in accordance with Rule 20(d) of The Ethnic Rights Protection Rules, 2019 (2020 Amended).
Rule 21(a)	The project proponent commits to submit report about activities mentioned in rule 20 to the ministry in accordance with Rule 21(a) of The Ethnic Rights Protection Rules, 2019 (2020 Amended).
Rule 21(b)	The project proponent commits to inform pre-planned activities and the status of the implementation to the ministry after implementing the project in accordance with Rule 21(b) of The Ethnic Rights Protection Rules, 2019 (2020 Amended).
The Protection and Preservation of Cultural Heritage Regions Law, 2019	
Section 21 (b)	The project proponent commits to complies the provisions of the existing laws and apply to the Region or State Preservation Committee for obtaining the prior permission that there is no impact on cultural heritages in accordance with the stipulations under section 21 (b) of The Protection and Preservation of Cultural Heritage Regions Law, 2019: : in the buffer area: (i) constructing roads, renovating and extending wharfs, parking lots, rail tracks, railway station, stadium, sports grounds, buildings and bridges; (ii) conducting and erecting pylons, underground works, underground electric power lines, high voltage power lines, transformer stations, lamp posts and gas pipelines; (iii) arranging the flights of helicopter, hot air balloons and gliders; (iv) constructing theatres such as the entertainment building, accommodation facilities, recreation centers, riding and race camps and infrastructures.
The Protection and Preservation of Antique Objects Law, 2015	
Section 12	The project proponent who finds the object which has no owner or custodian commits to inform the relevant Ward or Village-Tract Administrator if he knows or it seems reasonable to assume that the said object is an antique object in accordance with Section 12 of The Protection and Preservation of Antique Objects Law, 2015.
The Protection and Preservation of Ancient Monuments Law, 2015	
Section 12	The project proponent commits to promptly inform the relevant Ward or Village-Tract Administrative Office when he finds an ancient monument of over one hundred years old and above or under the ground or above or under the water which has no owner or custodian knows or it seems reasonable to assume that the said monument is an ancient monument, in accordance with Section 12 of The Protection and Preservation of Ancient Monuments Law, 2015.
Section 15	The project proponent commits to apply to get prior permission to the Department when the project is within the specified area of an ancient monument in accordance with Section 15 of The Protection and Preservation of Ancient Monuments Law, 2015.
Section 20 (f)	The project proponent commits not to carry out discarding chemical substance and rubbish which can affect an ancient monument and the environment within the specified area of an ancient monument or of a listed ancient monument without a written prior permission in accordance with Section 20 (f) of The Protection and Preservation of Ancient Monuments Law, 2015.

Table 3.5 – Laws and Regulations Related to Natural Environment

Law name and section	Legal Commitments
The Environmental Conservation Law, 2012	
Section 7 (o)	The project proponent commits to manage to cause the polluter to compensate for environmental impact, cause to contribute fund by the organizations which obtain benefit from the natural environmental service system, cause to

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	contribute a part of the benefit from the businesses which explore, trade and use the natural resources in environmental conservation works in accordance with Section 7(o) of The Environmental Conservation Law, 2012.
Section 14	The project proponent commits to carry out treating of emitting substances which cause pollution in the environment in accord with stipulated environmental quality standards in accordance with Section 14 of The Environmental Conservation Law, 2012.
Section 15	The project proponent commits to install or use an on-site facility or controlling equipment in order to monitor, control, manage, reduce or eliminate environmental pollution in accordance with Section 15 of The Environmental Conservation Law, 2012.
Section 24	The project proponent commits to follow the Ministry terms and condition relating to environmental conservation in accordance with Section 24 of The Environmental Conservation Law, 2012.
Section 29	The project proponent commits to follow the rules, notifications, orders, directives and procedures issued under this Law in accordance with Section 29 of The Environmental Conservation Law, 2012.
The Environmental Conservation Rules, 2014	
Rule 69 (a)	The project proponent commits not to emit, cause to emit, dispose, cause to dispose, pile and cause to pile, by any means, the pollutants to environment and the hazardous waste or hazardous material stipulated by notification under the Law and any of these rules at any place which may affect the public directly or indirectly Law in accordance with Rule 69 (a) of The Environmental Conservation Rules, 2014.
Rule 69 (b)	The project proponent commits not to carry out the actions which can be damaged to natural environment which is changing due to ecosystem and such system, except the permission of the relevant Ministry in order to the interest of the public in accordance with Rule 69 (b) of The Environmental Conservation Rules, 2014.
Environmental Impact Assessment (EIA) Procedure, 2015	
Article 102 (a)	The project proponent commits to take full legal and financial responsibilities for all of the Project Proponent's actions and omissions and those of its contractors, subcontractors, officers, employees, agents, representatives, and consultants employed, hired, or authorized by the Project acting for or on behalf of the Project, in carrying out work on the Project in accordance with article 102 (a) of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 102 (b)	The project proponent commits to take full legal and financial responsibilities for PAPs until they have achieved socio-economic stability at a level not lower than that in effect prior to the commencement of the Project, and shall support programs for livelihood restoration and resettlement in consultation with the PAPs, related government agencies, and organizations and other concerned persons for all Adverse Impacts in accordance with article 102 (b) of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 103	The Project Proponent commits to fully implement the EMP, all Project commitments, and conditions, and is liable to ensure that all contractors and subcontractors of the Project comply fully with all applicable Laws, the Rules, this Procedure, the EMP, Project commitments and conditions when providing services to the Project in accordance with article 103 of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 104	The project proponent commits to take responsibilities to fully and effectively implement, all requirements set forth in the ECC, applicable Laws, the Rules, this Procedure and standards in accordance with article104 of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 105	The Project Proponent commits to timely notify and identify in writing to the

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	Ministry, providing detailed information as to the proposed Project's potential Adverse Impact in accordance with article 105 of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 106	The Project Proponent commits in accordance with article 106 of Environmental Impact Assessment (EIA) Procedure, 2015.that during all phases of the Project (pre-construction, construction, operation, decommissioning, closure and post-closure), engage in continuous, proactive and comprehensive self-monitoring of the Project and activities related thereto, all Adverse Impacts, and compliance with applicable laws, the Rules, this Procedure, standards, the ECC, and the EMP.
Article 107	The Project Proponent commits to notify and identify in writing to the Ministry any breaches of its obligations or other performance failures or violations of the ECC and the EMP as soon as reasonably possible and in any event, in respect of any breach which would have a serious impact or where the urgent attention of the Ministry is or may be required, within not later than twenty-four (24) hours, and in all other cases within seven (7) days of the Project Proponent becoming aware of such incident in accordance with article 107 of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 108	The Project Proponent commits to submit monitoring reports to the Ministry not less frequently than every six (6) months, as provided in a schedule in the EMP, or periodically as prescribed by the Ministry in accordance with article 108 of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 109	The project proponent commits to make sure that the monitoring reports will include: a) documentation of compliance with all conditions; b) progress made to date on implementation of the EMP against the submitted implementation schedule; c) difficulties encountered in implementing the EMP and recommendations for remedying those difficulties and steps proposed to prevent or avoid similar future difficulties; d) number and type of non-compliance with the EMP and proposed remedial measures and timelines for completion of remediation; e) accidents or incidents relating to the occupational and community health and safety, and the environment; and f) monitoring data of environmental parameters and conditions as committed in the EMP or otherwise required in accordance with article 109 of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 110	The project proponent commits in accordance with article 110 of Environmental Impact Assessment (EIA) Procedure, 2015. that within ten (10) days of completing a monitoring report as contemplated in Article 108 and Article 109 in accordance with the EMP schedule, the Project Proponent will make such report (except as may relate to National Security concerns) publicly available on the Project's website, at public meeting places (e.g. libraries, community halls) and at the Project offices. Any organization or person may request a digital copy of a monitoring report and the Project shall, within ten (10) days of receiving such request, submit a digital copy via email or as may otherwise be agreed upon with the requestor.
Article 113 (a)	The project proponent commits to grant to the Ministry and/or its representatives, at any time during normal working hours, access to the Project's offices and to the Project site and any other location at which the Project activities or activities related to the Project are performed in accordance with article 113 (a) of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 113 (b)	The project proponent commits to grant the Ministry access to the Project's offices and to the Project site and any other location at which the Project activities or activities related to the Project are performed from time to time as and when the Ministry may reasonably require in accordance with article 113

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	(b) of Environmental Impact Assessment (EIA) Procedure, 2015..
Article 115	The project proponent commits to grant full and immediate access to the Ministry at any time as may be required by the Ministry in the event of an emergency, or where, in the opinion of the Ministry, there is or may exist a violation or risk of violation of the compliance by the Project with all applicable environmental and social requirements in accordance with article 115 of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 117	The Project Proponent commits to ensure that the Ministry's rights of access hereunder shall extend to access by the Ministry to the Project's contractors and subcontractors in accordance with article 117 of Environmental Impact Assessment (EIA) Procedure, 2015.
National Environmental Quality (Emission) Guidelines, 2015	
Section 2.1.9, 1.1, 1.3	The project proponent has to comply with the National Environmental Quality (Emission) Guidelines
The Conservation of Water Resources and River Law, 2006 (Amended 2017)	
Section 8 (a)	The project developer commits not to carry out any act or channel shifting with the aim to ruin the water resources and rivers and creeks in accordance with Section 8 (a) of The Conservation of Water Resources and River Law, 2006 (Amended 2017).
Section 11 (a)	The project developer commits not to dispose of engine oil, chemical, poisonous material and other materials which may cause environmental damage, or dispose of explosives from the bank or from a vessel which is plying, vessel which has berthed, anchored, stranded or sunk in accordance with Section 11 (a) of The Conservation of Water Resources and River Law, 2006 (Amended 2017).
Section 11 (b)	The project developer commits not to catch aquatic creatures within river-creek boundary, bank boundary or waterfront boundary with poisonous materials or explosives in accordance with Section 11 (b) of The Conservation of Water Resources and River Law, 2006 (Amended 2017).
Section 11 (c)	The project developer commits not to dispose of disposal soil and other materials from panning for gold, gold mineral dredging or resource production in the river and creek, into the river and creek or into the water outlet gully which can flow into the river and creek in accordance with Section 11 (c) of The Conservation of Water Resources and River Law, 2006 (Amended 2017).
Section 19	The project developer commits not to dump into the river that may cause damage to the waterway or change course in a stranded or sunken vessel in accordance with Section 19of The Conservation of Water Resources and River Law, 2006 (Amended 2017).
Section 21 (b)	The project developer commits to carry out no excavation without the permission of the Department in accordance with Section 21 (b) of The Conservation of Water Resources and River Law, 2006 (Amended 2017).
Section 22	The project developer commits not to pile sand, shingle and other heavy materials for business purposes in the bank area and waterfront area without the permission of the directorate in accordance with Section 22 of The Conservation of Water Resources and River Law, 2006 (Amended 2017).
Section 24 (b)	The project developer has to follow the rules prescribed by the Department in order to prevent water pollution and change of watercourse in rivers and creeks in accordance with Section 24 (b) of The Conservation of Water Resources and River Law, 2006 (Amended 2017).
Section 30	The project proponent commits to request approval from the Ministry of Transport and Communications for constructing drainage, utilizing river water intake, constructing bridges spanning rivers, connecting underground pipe, connecting underground electric power cable, connecting underground telecom cable or digging in rivers and creeks, bank boundary and waterfront boundary,

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	under the requirement of work in order not to adversely affect the water resources and rivers and creeks in accordance with Section 30 of The Conservation of Water Resources and River Law, 2006 (Amended 2017).
The Conservation of Water Resources and Rivers Rules, 2013 (Amended 2020)	
Rule 47	The project proponent commits to request the approval from the Ministry for constructing drainage, hydropower plant, pumping river water within boundaries of rivers and creeks, banks and waterfronts by stating the location of work, scope of work and the period of operation in accordance with Rule 47 of The Conservation of Water Resources and Rivers Rules, 2013 (Amended 2020)
Rule 49 (a)	The project proponent commits to pay prescribed fees for site investigation, survey and mapping in accordance with Rule 49 (a) of The Conservation of Water Resources and Rivers Rules, 2013 (Amended 2020).
Rule 49 (b)	The project proponent commits to pay prescribed fees for river water use and river maintenance in accordance with Rule 49 (b) of The Conservation of Water Resources and Rivers Rules, 2013 (Amended 2020)
The Forest Law, 2018	
Section 12 (a)	The project proponent complies to obtain prior approval of the Ministry to carry out any development work or economic scheme within forest land or forest covered land at the disposal of the Government in accordance with Section 12 (a) of The Forest Law 2018.
The Conservation of Biodiversity and Protected Areas Law, 2018	
Section 35 (a)	The project proponent complies not to enter a prohibited area without permission and pay fine from a minimum kyats 30,000 to a maximum kyats 100,000 if commit the acts a protected area or a zoological garden or botanical garden in accordance with section 35(a) of The Conservation of Biodiversity and Protected Areas Law, 2018.
Section 35 (c)	The project proponent complies not to dig on the land, cultivating or carrying out any activity and pay fine from a minimum kyats 30,000 to a maximum kyats 100,000 if commit the acts within a protected area or a zoological garden or botanical garden in accordance with section 35(c) of The Conservation of Biodiversity and Protected Areas Law, 2018.
Section 35 (d)	The project proponent complies not to extract, collect or destroy in any manner, any kind of wild flora or cultivated plant and pay fine from a minimum kyats 30,000 to a maximum kyats 100,000 if commit the acts within a protected area or a zoological garden or botanical garden in accordance with section 35(d) of The Conservation of Biodiversity and Protected Areas Law, 2018.
Section 39 (d)	The project proponent complies not to intentionally pollute soil, water or air, damaging a water-course or poisoning or electrifying water, or using chemical or explosive materials in the water within the protected area and be punished with imprisonment for a term not exceeding 3 years or with a fine from a minimum of kyats 200,000 to a maximum of kyats 500,000, or with both if commit in accordance with section 39(d) of The Conservation of Biodiversity and Protected Areas Law, 2018.
The Underground Water Act , 1930	
Section 3	The project proponent complies not to sink a tube for the purpose of obtaining underground water except under and in accordance with the terms of a license granted by the water officer. If the project proponent owning a tube which was in existence before the extension of this Act to the local area concerned will apply to the water officer for a license for the said tube, and such license shall be granted free of charge in accordance with Section 3 of The Underground Water Act , 1930.
Section 5	The project developer complies to supply the water officer with the information for obtaining underground water in accordance with Section 5 of The Underground Water Act , 1930.

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The Law relating to Aquaculture (1989)	
Section 29 (b)	The project proponent complies not to obstruct navigation and flowing of water or polluting the water within the fisheries waters or abetting such acts in accordance with Section 29 (b) of the Law Relating to Aquaculture, 1989.
Mandalay Region Freshwater Fisheries Law, 2012	
Section 38	The project proponent complies not to disturb or damage the fish, aquatics lives, and living and non-livings things in any water bodies and not to pollute water in accordance with section 38 of Mandalay Region Freshwater Fisheries Law, 2012.

Table 3.6– Laws and Regulations Related to Transportation and Communication

Law name and section	Legal Commitments
The Highways Law, 2000	
Section 8 (a)	The project proponent complies not to disturb or obstruct the work of constructing, extension, repairing and maintenance of highway and accept the punishment if contravene the law in accordance with Section 8 (a) of The Highways Law, 2000.
Section 8 (b)	The project proponent complies not to drive the prohibited types of vehicles, a vehicle with a laden weight or using an iron rim of cart wheel on highways and accept the punishment if contravene the law in accordance with Section 8 (b) of The Highways Law, 2000.
Section 8 (c)	The project proponent complies not to plant, cut or destroy trees or crops within the boundary of highway without permission of Public Works and accept the punishment if contravene the law in accordance with Section 8 (c) of The Highways Law, 2000.
Section 8 (d)	The project proponent complies not to disturb or obstruct public works in clearing of trees which cause danger and accept the punishment if contravene the law in accordance with Section 8 (d) of The Highways Law, 2000.
The Vehicle Safety and Motor Vehicle Management Law, 2020	
Section 9 (a)	The project proponent complies to follow the Ministry for determining and restricting the areas where motor vehicles used in the country are allowed to travel in accordance with Section 9 (a) of The Vehicle Safety and Motor Vehicle Management Law, 2020.
Section 12 (c)	The project proponent complies to follow the Ministry in relation to the initial registration of motor vehicles in accordance with Section 12 (c) of The Vehicle Safety and Motor Vehicle Management Law, 2020.

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Section 14 (r)	The project proponent complies to set the speed for the safe movement of vehicles traveling on public roads in accordance with Section 14 (r) of The Vehicle Safety and Motor Vehicle Management Law, 2020.
Section 18 (a)	The project proponent complies to maintain the vehicle and repair in accordance with the standards prescribed by the Department in order to drive safely in accordance with Section 18 (a) of The Vehicle Safety and Motor Vehicle Management Law, 2020.
Section 81 (g)	The project proponent complies to carry out the loading or transporting of dangerous goods in the motor vehicle in accordance with the stipulations in accordance with Section 81 (g) of The Vehicle Safety and Motor Vehicle Management Law, 2020.

The Vehicle Safety and Motor Vehicle Management Rules, 2022

Rule 252	The project proponent commits not to use any vehicles as commercial vehicles unless these vehicles are registered and get license as commercial vehicles in accordance with the Road Transport Operations Law under Rule 252 of The Vehicle Safety and Motor Vehicle Management Rules, 2022.
Rule 253	The project proponent commits that the commercial vehicles will not carry more than the maximum number of passengers or loads determined by the Department in accordance with Rule 253 of The Vehicle Safety and Motor Vehicle Management Rules, 2022.
Rule 254	The project proponent commits in accordance with section 254 of The Vehicle Safety and Motor Vehicle Management Rules, 2022 while using commercial vehicles; (a) follow the terms and conditions mentioned in commercial vehicle license by Road Transport Operations Law. (b) use the places specified by Nay Pyi Taw Council, respective State and regional organizations and departments for drop off, parking and temporary stops.(c) Provide route visible destinations signboards at the front and back of tour passenger vehicles. (d) Passenger vehicles stop at the side of the road at designated stops for picking up and dropping off passengers and do not block the other vehicles. (e) If there is another passenger vehicle stopped at the bus stop, the following vehicle must stop at least 4 feet (1.22 meters) apart. (f) Do not stop side-by-side with a passenger vehicle standing at a bus stop.
Rule 256	The project proponent commits in accord with section 256 of The Vehicle Safety and Motor Vehicle Management Rules, 2022 and visibly display the name and license number of driver or both driver and conductor in the driver's compartment for all Truck (reluctance), Passenger vehicles and taxis.
Rule 261 (a)	The project proponent commits to carry the loads within the truck and not hanging at the truck front, back and sides in accordance with section 261 (a) of The Vehicle Safety and Motor Vehicle Management Rules, 2022.
Rule 261 (b)	The project proponent commits not to spill the loads to public road in accordance with section 261 (b) of The Vehicle Safety and Motor Vehicle

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Management Rules, 2022.

Rule 262 (a) The project proponent commits to follow the Prevention of Hazard from Chemical and Related Substances Law if the motor vehicle carries hazardous substances in accordance with section 262 (a) of The Vehicle Safety and Motor Vehicle Management Rules, 2022.

Rule 262 (b) The project proponent commits to provide licenses and certificates from respective departments if the motor vehicle carries hazardous substances in accordance with section 262 (b) of The Vehicle Safety and Motor Vehicle Management Rules, 2022.

Rule 262 (c) The project proponent commits to provide vehicle marking, container marking, tank marking, packaging, labeling, loading and unloading signs at the hazardous substances carrying vehicles according to the guideline of department in accordance with section 262 (c) of The Vehicle Safety and Motor Vehicle Management Rules, 2022.

Rule 262 (d) The project proponent commits to provide safety equipment and emergency response plan at the hazardous substances carrying vehicles in accordance with section 262 (d) of The Vehicle Safety and Motor Vehicle Management Rules, 2022.

Rule 263 The project proponent commits in accordance with department instructions while carrying hazardous substances by road in accordance with section 263 of The Vehicle Safety and Motor Vehicle Management Rules, 2022.

Rule 269 The project proponent commits to provide spare wheel, tool box, emergency fire extinguisher, safety hammer, wheel chock and emergency medical kit for the motor vehicles in accordance with section 269 of The Vehicle Safety and Motor Vehicle Management Rules, 2022.

Rule 271 The project proponent commits to follow rules and regulation of the department if the vehicle owner or address of motor vehicles owner will change in accordance with section 271 of The Vehicle Safety and Motor Vehicle Management Rules, 2022.

Table 3.7 – Laws and Regulations Related to Communities' Development, Health and Safety

Law name and section	Legal Commitments
Public Health Law, 1972	
Section 3	The project proponent commits to allow the government to improve the health of the working population and advising on the health issues described in section 3 of 1972 Union of Myanmar Public Health Law to protect the health of the working population.
Section 5	The project proponent commits to allow the inspection of organizations formed

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	under this law, any government departments and organizations under government to the workshops, factories, departments, shops, premises, places and buildings at any time relating with controlling the quality and cleanliness of food, drugs, environmental sanitation, epidemic diseases and regulation of private clinics in accordance with Section 5 of Public Health Law, 1972.
The Prevention and Control of Communicable Diseases Law, 1995 (Amended 2011)	
Section 3(a)(9)	The project proponent commits to follow the Ministry of Health to prevent the spread of infectious diseases in accordance with Section 3(a)(9) of The Prevention and Control of Communicable Diseases Law, 1995 (Amended 2011).
Section 4	The project proponent commits to comply with the measures undertaken by the Ministry of Health and the Department of Health under section 3 in respect of prevention of the occurrence and spread of communicable disease and control thereof in accordance with Section 4 of The Prevention and Control of Communicable Diseases Law, 1995 (Amended 2011).
Section 11	The project proponent commits to comply the health officer's measures in accordance with Section 11 of The Prevention and Control of Communicable Diseases Law, 1995 (Amended 2011); (a) investigation of a patient or any other person required; (b) medical examination; (c) causing laboratory investigation of stool, urine, sputum and blood samples to be carried out; (d) other necessary investigation; (e) prohibition of the right of movement of the vehicle carrying animal or animal product suspected of having epidemic disease in order to prevent and control the spread of a Epidemic Disease in accordance with section 11 of The Prevention and Control of Communicable Diseases Law, 1995 (Amended 2011).
The Control of Smoking and Consumption of Tobacco Product Law, 2006 (Amended 2017)	
Section 9 (a)	The project proponent complies to keep the caption and mark referring that it is a non-smoking area at the place mentioned in section 6 in accordance with the stipulations under section 9 (a) of The Control of Smoking and Consumption of Tobacco Product Law, 2006 (Amended 2017).
Section 9 (b)	The project proponent complies to arrange the specific place where smoking is allowed as mentioned in section 7 and keep the caption and mark also referring that it is a specific place where smoking is allowed, in accordance with the stipulations under section 9 (b) of The Control of Smoking and Consumption of Tobacco Product Law, 2006 (Amended 2017).
Section 9 (c)	The project proponent complies to supervise and carry out measures so that no one shall smoke at the non-smoking area in accordance with section 9 (a) of The Control of Smoking and Consumption of Tobacco Product Law, 2006 (Amended 2017).
Section 9 (d)	The project proponent complies to accept the inspection when the supervisory body comes to the place for which he is responsible in accordance with section 9 (d) of The Control of Smoking and Consumption of Tobacco Product Law, 2006 (Amended 2017).

Table 3.8 – Other Relative Laws and Regulations for Proposed Project

Law name and section	Legal Commitments
Farm Land Law, 2012 (Amended 2020)	

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Section 30	The project proponent complies to request permission from The Central Farmland Management Body in respect of the application to utilize the farmland for other purposes in the interest of the public in accordance with Farm Land Law, 2012 (amended 2020).
Natural Disaster Management Law, 2013	
Section 14	The project proponent complies to conduct preparatory measures for natural disaster risk reduction before the natural disaster strikes include the followings under Section 14 of Natural Disaster Management Law, 2013: (a) prioritization of the natural disaster risk reduction by the National Committee and each Local Body; (b) carrying out improvement on early warning system of natural disaster; (c) applying education, knowledge and innovation to be a habit of safety and resilience at every level from the national level to the ward or village tract level; (d) incorporating measures of natural disaster risk reduction in development plans of the State; (e) establishing sound preparations to confront the natural disaster at every level from the national level to the ward or village tract level.
Section 15	The project proponent complies to organize preparatory measures before the natural disaster in the area where it is likely to strike include the followings under Section 15 of Natural Disaster Management Law, 2013: (a) identifying the area where the natural disaster is likely to strike and preparing the natural disaster risk assessment and drawing emergency plans; (b) assuring public awareness of knowledge of the natural disaster, keeping the early warning systems, training for search and rescue and holding rehearsal; (c) enhancing the capacity of the public for emergence of a disaster resilient community in compatible with climate change for reduction of damage and losses due to unforeseen disaster risk caused by climate change; (d) guiding, motivating and implementing active participation of the community including youth volunteers in the community-based natural disaster management activities and disaster reduction activities by the National Committee and Local Body; (e) issuing information and early warning to the public to enable timely evacuation of their properties and cattle to a safety area; (f) stockpiling to provide readily the minimum requirement of food and relief items and rehabilitation materials according to the type of natural disaster; (g) taking measures to enable to get assistance of the Defence Services, the Myanmar Police Force, the Fire Brigade, the Red Cross, volunteer organizations, civil societies and other non-government organizations for search, rescue and assistance expeditiously; (h) communications network for providing necessary assistance by foreign countries, international organizations and foreign regional organizations in case of serious damage and heavy losses caused by the natural disaster; (i) taking preparatory measures for rehabilitation and reconstruction of health, education, social and other sectors for improving better living standard after the natural disaster strikes; (j) performing other duties assigned by this Law in respect of the preparatory measures.
Section 16	The project proponent complies to carry out preventive measures in the area where the natural disaster is likely to strike before the natural disaster include

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	the followings under Section 16 of Natural Disaster Management Law, 2013: (a) building cyclone shelters and life-saving hillock-sanctuaries in the area where easy evacuation is impossible; (b) constructing embankments along the coast and in the possible flooded areas; (c) preservation of mangroves along the coast and planting fast-growing trees; (d) taking preventive measures according to the type of natural disaster; (e) performing other duties assigned by this Law in respect of the preventive measures.
Section 17	When the natural disaster strike, the project proponent complies to conduct emergency responses including search and rescue include the following under Section 17 of Natural Disaster Management Law, 2013: (a) emergency search and rescue of missing persons due to the natural disaster; (b) evacuation of the victims to a safety area and providing accommodation in temporary shelters; (c) emergency providing of food and relief items; (d) clearance of damage and collecting preliminary data on losses and making examinations for necessaries to provide; (e) opening an emergency natural disaster management centre and supervising closely; (f) providing emergency health care to the local people and prevention of the outbreak of contagious diseases by forming mobile healthcare teams; (g) providing medical treatment to the injured and the sick by opening temporary clinics and hospitals; (h) conducting emergency responses including search and rescue according to the type of natural disaster; (i) performing other duties assigned by this Law in respect of emergency responses including search and rescue.
Section 18	After the disaster, the project proponent complies to carry out Rehabilitation and reconstruction activities include the following under Section 18 of Natural Disaster Management Law, 2013: (a) collecting data and confirming damage and losses due to natural disaster;(b) providing the continuation of sufficient food, relief items and rehabilitation items and appropriate financial assistance from the allotted funds to the victims; (c) laying down the plan for rehabilitation and reconstruction on the situation of damage and losses; (d) reconstructing buildings and houses damaged by the natural disaster in an appropriate place as disaster-resilient buildings; (e) rehabilitating to restore agriculture, livestock breedings and other vocations required for victims; (f) establishing reintegration into society by uplifting the mental affected person due to the natural disaster; (g) providing medical treatment to the victims and taking preventive measures against contagious diseases that is likely to cause as consequences; (h) taking measures for the continuation of students' studies out of the victims and reconstruction of schools; (i) taking measures for the safety of the victims and the rule of law in the disaster affected area; (j) coordination with the relevant body of prevention against human trafficking to the victims; (k) performing other duties assigned by this Law in respect of rehabilitation and reconstruction.
Constitution of the Republic of the Union of Myanmar, 2008	
Section 24	Project proponent commits to section 24 of Constitution of the Republic of the Union of Myanmar in association with the chance of workers.

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Section 45	Project proponent complies to section 45 of Constitution of the Republic of the Union of Myanmar in association with conservation of natural environment.
Section 349	Project proponent complies to section 349 of Constitution of the Republic of the Union of Myanmar in association with development of project.
Section 359	Project proponent complies with section 359 of Constitution of the Republic of the Union of Myanmar in association with forced to work.

The Myanmar Investment Law, 2016 (Amended 2019)

Section 50 (a)	The project proponent commits to comply the rights to use land and invest the land or building in accordance with the existing laws according to the section 50 (a) of Myanmar Investment Law, 2016 (Amended 2019).
Section 50 (d)	The project proponent commits to register the land lease contract at the Office of Registry of Deeds in accordance with the Registration Act according to the section 50 (d) of Myanmar Investment Law, 2016 (Amended 2019).
Section 51 (b)	The project proponent commits to provide capacity building programs and appoint citizens to different level positions of manager, technical and operational experts, and advisors according to the section 51 (b) of Myanmar Investment Law, 2016 (Amended 2019).
Section 51 (d)	The project proponent commits to appoint skilled citizen and foreign workers, technicians, and staffs by signing an employment contract between employer and employee in accordance with the labor laws and rules according to the section 51 (d) of Myanmar Investment Law , 2016 (Amended 2019).
Section 51 (e)	The project proponent commits to ensure to obtain the entitlements and rights in the labor law and rules according to the section 51 (e) of Myanmar Investment Law, 2016 (Amended 2019).
Section 51 (f)	The project proponent commits to settle the dispute in accordance with the existing law according to the section 51 (f) of Myanmar Investment Law, 2016 (Amended 2019).
Section 65 (a)	The project proponent commits to respect and comply with the customs, traditions and traditional culture of the ethnic groups in the Union in accordance with section 65 (a) of Myanmar Investment Law, 2016 (Amended 2019).
Section 65 (b)	The project proponent commits to establish and register a company or sole proprietorship or legal entities or branches of such entities under the Laws in order to invest in accordance with section 65 (b) of Myanmar Investment Law, 2016 (Amended 2019).
Section 65 (c)	The project proponent commits to abide by the terms and conditions, stipulations of a special license, permit, and business operation certificates issued to them, including the rules, notifications, orders and directives and procedures issued by this Law and the existing laws, terms and conditions of contract and tax obligations in accordance with section 65 (c) of Myanmar

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Investment Law, 2016 (Amended 2019).

Section 65 (d) The project proponent commits to carry out in accordance with the stipulations of the relevant department if it is, by the nature of business or by other need, required to obtain any license or permit from the relevant Union Ministries, government departments and government organizations, or to carry out registration in accordance with section 65 (d) of Myanmar Investment Law, 2016 (Amended 2019).

Section 65 (e) The project proponent commits to immediately inform to the Commission in accordance with section 65 (e) of Myanmar Investment Law, 2016 (Amended 2019).if it is found that natural mineral resources or antique objects and treasure trove are not related to the investment permitted above and under the land on which the investor is entitled to lease or use and not included in the original contracts. If the Commission allows, the investor shall continue to carry out the investment in such land, and if not allowed, the investor shall transfer and carry out, by obtaining the permission, at the substituted place which is selected and submitted by him;

Section 65 (f) The project proponent commits not to make any significant alteration of topography or elevation of the land on which he is entitled to lease or to use, without the approval of the Commission in accordance with section 65 (f) of Myanmar Investment Law, 2016 (Amended 2019).

Section 65 (g) The project proponent commits to abide by the existing laws, rules, procedures and best standards practiced internationally for the investment so as not to cause damage, pollution, and loss to the natural and social environment and not to cause damage to cultural heritage in accordance with section 65 (g) of Myanmar Investment Law, 2016 (Amended 2019).

Section 65 (h) The project proponent commits to list and keep proper records of books of account and annual financial statements, and necessary financial matters relating to the investments performed by permit or endorsement in accordance with internationally and locally recognized accounting under section 65 (h) of Myanmar Investment Law, 2016 (Amended 2019).

Section 65 (i) The project proponent commits to close and discontinue the investment only after payment of compensation to employees in accordance with the existing laws under section 65 (i) of Myanmar Investment Law, 2016 (Amended 2019).

Section 65 (j) The project proponent commits to pay wages and salaries to employees in accordance with the existing laws, rules, procedures, directives and so forth during the period of suspension of investment for a credible reason according to the section 65 (j) of Myanmar Investment Law.

Section 65 (k) The project proponent commits to pay compensation and indemnification in accordance with the existing laws to the relevant employee or his successor for injury, disability, disease and death due to the work in accordance with section 65 (k) of Myanmar Investment Law, 2016 (Amended 2019).

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Section 65 (l) The project proponent commits to supervise foreign experts, supervisors and their families, who employ in his investment, to abide by the existing laws, rules, orders and directives, and the culture and traditions of Myanmar in accordance with section 65 (l) of Myanmar Investment Law, 2016 (Amended 2019).

Section 65 (m) The project proponent commits to respect and comply with the labor laws in accordance with section 65 (m) of Myanmar Investment Law, 2016 (Amended 2019).

Section 65 (n) The project proponent commits to have the right to sue and to be sued in accordance with the laws under section 65 (n) of Myanmar Investment Law, 2016 (Amended 2019).

Section 65 (o) The project proponent will pay effective compensation for loss incurred to the victim in accordance with section 65 (o) of Myanmar Investment Law, 2016 (Amended 2019).

Section 65 (p) The project proponent commits to allow the Commission to inspect in any places, when the Commission informs the prior notice to inspect the investment in accordance with section 65 (p) of Myanmar Investment Law, 2016 (Amended 2019).

Section 65 (q) The project proponent commits to take in advance permit or endorsement of the Commission for the investments which need to obtain prior approval under the Environmental Conservation Law and the procedures of environmental impact assessment in accordance with section 65 (q) of Myanmar Investment Law, 2016 (Amended 2019).

Section 73 The project proponent commits to insure the types of insurance stipulated in the provision of the rules at any insurance enterprise which is entitled to carry out insurance businesses within the Union in accordance with section 73 of Myanmar Investment Law, 2016 (Amended 2019).

The Myanmar Investment Rules, 2017 (Amended 2018)

Rule 202 The project proponent commits to abide by all the terms and conditions set forth in the permit and other applicable laws when conducting the investment business in accordance with Rule 202 of The Myanmar Investment Rules, 2017 (Amended 2018).

Rule 203 The project proponent commits to contact the relevant government department in accordance with Rule 203 of The Myanmar Investment Rules, 2017 (Amended 2018).

Rule 206 The project proponent commits to submit the application attached with passport, expertise evidence or degree certificate and summary of biography of expert foreigner to the Commission Office for approval in accordance with Rule 206 of The Myanmar Investment Rules, 2017 (Amended 2018) if foreign consultant expert is hired

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Rule 212	The project proponent commits to insure the relevant type of insurance in accordance with Rule 212 of The Myanmar Investment Rules, 2017 (Amended 2018).

The Export and Import Law, 2012

Section 7	The project proponent commits not to violate the conditions contained in the license in accordance with Section 7 of The Export and Import Law, 2012.

The Myanmar Fire Brigade Law, 2015

Section 25	The project proponent commits in accord with the directive of the Department of Fire Services under Section 25 of The Myanmar Fire Brigade Law, 2015: (a) not fail to form the Reserve Fire Brigade; (b) not fail to provide fire safety equipment.

The Myanma Insurance Law, 1993

Section 15	The project proponent commits to ensure compliance with compulsory Third-Party Liability Insurance through Myanmar Insurance, as stipulated by the requirement that owners of motor vehicles shall effect compulsory Third Party Liability Insurance with the Myanmar Insurance in accordance with Section 15 of The Myanma Insurance Law, 1993.
Section 16	The project proponent commits to obtain mandatory General Liability Insurance from Myanmar Insurance if their enterprise could lead to loss of state-owned property, harm to the public or their property, or environmental pollution, as specified in: An entrepreneur or an organization operating an enterprise which may cause loss to State-owned property or which may cause damage to the life and property of the public or which may cause pollution to the environment shall effect compulsory General Liability Insurance with the Myanmar Insurance in accordance with Section 16 of The Myanma Insurance Law, 1993.

Private Industrial Enterprise Law, 1990

Section 27	The project proponent commits to comply in accordance with section 27 of Private Industrial Enterprise Law, 1990; (a) in distributing and selling the goods he has produced shall not sell without a trade mark: (b) shall not violate any provision of section 13: (c) shall not fail to comply with any order or decision passed by the Minister and the Director General.

The Myanmar Engineering Council Law, 2013 (2019 Amended)

Section 34	The project proponent complies according to the section 34 of The Myanmar Engineering Council Law, 2013 (2019 Amended): if any registration certificate holder violates any of the provision of this Law, or any prohibition of the rules, regulations and by-laws, notifications, orders, directives and procedures issued by this Law, or any conditions of the registration certificate, the Executive Committee may impose any of the following administrative order against

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him::(a) warning; (b) causing to pay the stipulated fine; (c) suspending the register certificate for a limited period; (d) cancelling the register certificate.

The Petroleum and Petroleum Product Law, 2017

Section 8 (a)	The project proponent complies in accordance with license by ministry for transporting petroleum and petroleum products in accordance with Section 8 (a) of The Petroleum and Petroleum Product Law, 2017.
Section 8 (c)	The project proponent complies to follow ministry procedures and conditions relating to transportation of petroleum and petroleum products in accordance with Section 8 (c) of The Petroleum and Petroleum Product Law, 2017.
Section 9 (a)	The project proponent complies to use licensed vehicles, vessels and barges by Ministry of Transport and communication for carrying petroleum and petroleum products in accordance with Section 9 (a) of The Petroleum and Petroleum Product Law, 2017.
Section 9 (e)	The project proponent complies to follow the procedures and conditions by Ministry of Transport and communication in carrying out transport business except transport by pipeline in accordance with Section 9 (e) of The Petroleum and Petroleum Product Law, 2017.
Section 10 (a)	The project proponent complies according to license by the Ministry of Natural Resources and Environmental Conservation for the storage tanks and warehouses petroleum and petroleum products in accordance with Section 10 (a) of The Petroleum and Petroleum Product Law, 2017.
Section 10 (b)	The project proponent complies to request permit from the Ministry of Natural Resources and Environmental Conservation for the vehicles, vessels and barges that shall carry any petroleum and petroleum product in accordance with Section 10 (b) of The Petroleum and Petroleum Product Law, 2017.
Section 10 (d)	The project proponent complies according to the Ministry of Natural Resources and Environmental Conservation if environmental impact occurs due to carrying of petroleum and petroleum products.
Section 10 (e)	The project proponent complies to follow procedures and conditions relating to standard and quality of storage tanks and warehouse, and tanks of vehicles, vessels and barges that carry any petroleum and petroleum product in accordance with Section 10 (d) of The Petroleum and Petroleum Product Law, 2017.
Section 11	The project proponent complies to express the warning sign of danger by stamping, embossing, painting, printing or any other means on all receptacles containing any dangerous petroleum and petroleum product in accordance with Section 11 of The Petroleum and Petroleum Product Law, 2017 and If it is impossible to express as such, similar warning signs of the nature of danger of gasoline, spirit or petroleum shall be expressed in writing at the ostensible place in salient words or signs near to the receptacle.

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The Petroleum Rules, 1937

Rule 24	The project proponent complies to follow all due precautions to prevent accident by fire or explosion in accordance with Rule 24 of The Petroleum Rules, 1937.
Rule 25	The project proponent complies to follow all due precautions to prevent any escape of petroleum during transport especially into any drain, sewer, harbour, river or water course in accordance with Rule 25 of The Petroleum Rules, 1937.
Rule 26	The project proponent complies to empty all the tanks or other receptacles before open for cleaning in accordance with Rule 26 of The Petroleum Rules, 1937.
Rule 63	The project proponent complies to follow prohibition of fires and smoking in accordance with Rule 63 of The Petroleum Rules, 1937.
Rule 64 (1)	The project proponent complies to use metal pipes or armoured hose in which the armouring is electrically continuous throughout for filling and discharge of tanks in accordance with Rule 64 (1) of The Petroleum Rules, 1937.
Rule 65	The project proponent complies to adequately supply dry sand or other efficient means of extinguishing fire in an easily accessible position on every vehicles transporting petroleum in bulk by road in accordance with Rule 65 of The Petroleum Rules, 1937.
Rule 66	The project proponent complies that petroleum will not transport on any public vehicles carrying passenger in accordance with Rule 66 of The Petroleum Rules, 1937.
Rule 72	The project proponent complies to inform that the vehicle owner, who employs any person in connection with such transport, shall be responsible that all necessary measures have been taken to ensure that such person is acquainted with and carries out the provisions of the rules in accordance with Rule 72 of The Petroleum Rules, 1937.
Rule 74	The project proponent complies that petroleum will not transport in cans or other receptacles unless the wagon is so constructed as to comply with the conditions applicable to transport on wagons in accordance with Rule 74 of The Petroleum Rules, 1937.
Rule 75	The project proponent complies to be kept securely closed filling and dipping pipes of a tank-wagon except during the operations of filling or emptying in accordance with Rule 75 of The Petroleum Rules, 1937.
Rule 76	The project proponent complies to fill, discharge and empty the tank-wagons between the hours of sunrise and sunset except where approved electric lighting as specified in rule 105 is exclusively used in accordance with Rule 76 of The Petroleum Rules, 1937.
Rule 80	The project proponent complies that speed of vehicle will not exceed 50

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	kilometers per hour if fitted with pneumatic tires and 25 kilometers per hour if fitted with solid tires in accordance with Rule 80 of The Petroleum Rules, 1937.
Rule 90	The project proponent complies to store petroleum under a license granted in accordance with Rule 90 of The Petroleum Rules, 1937.
Rule 91	The project proponent complies to follow precautions against fire in accordance with Rule 91 of The Petroleum Rules, 1937.
Rule 93	The project proponent complies that storage area is clean and free from all inflammable material, waste vegetation and rubbish in accordance with Rule 93of The Petroleum Rules, 1937.
Rule 94	The project proponent complies that no water shall be allowed to accumulate in the enclosure, water pipe shall be fitted with a valve actuated from the outside of the enclosure, all valves and other openings for draining off water shall be kept closed except when water is being drained off in accordance with Rule 94 of The Petroleum Rules, 1937.
Rule 95	The project proponent complies not to employ and allow entering a person under age of 15 in accordance with Rule 95 of The Petroleum Rules, 1937.
Rule 99	The project proponent complies that the capacity of every tank will conspicuously marked on the tank in accordance with Rule 99 of The Petroleum Rules, 1937.
Rule 100	The project proponent complies to construct every tank or other receptacle used for the storage of petroleum in bulk other than well-head tank with iron or steel properly erected and designed according to sound engineering practice and, together with all pipes and fitting shall be so constructed and maintained as to prevent any leakage of petroleum in accordance with Rule 100 of The Petroleum Rules, 1937.
Rule 106	The project proponent complies not to use internal combustion engine or electric motor shall for driving pumps for pumping petroleum save in a pump house in accordance with Rule 106 of The Petroleum Rules, 1937.
The Electricity Law, 2014	
Section 20	The project proponent commits to the rules, regulations, bye-laws, notifications, orders, directives and procedures issued by the Ministry in carrying out the electrical business contained in the permit in accordance with Section 20 of The Electricity Law, 2014.
Section 21 (a)	The project proponent has to be liable according to law if causes damages and losses to any person and entity for failing to abide by this laws, rules, procedures, regulations, bye-laws, order and directives and failing to abide by the prescribed qualities and standardization in accordance with Section 21 (a) of The Electricity Law, 2014.
Section 24	The project proponent commits to pay the calculated compensation in accord

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	with the method prescribed by the Ministry for the value of damage or loss if damages or losses arise to any other electric power user or any electrical business due to negligence of any electric power user in accordance with Section 24 of The Electricity Law, 2014.
Section 27	The project proponent commits to report to the Chief Inspector and in-charge of the relevant department as soon as possible in the event of electricity hazard occurs in respect of generation, transmission, distribution and utilization of electric power in accordance with Section 27 of The Electricity Law, 2014.
Section 29	The project proponent commits in accordance with Section 29 of The Electricity Law, 2014; the Ministry to inspect the specification of quality and standardizations in respect of the factories, equipments installed to them, business buildings, and electrical equipment which are manufactured, imported and sold from the local and foreign country.
Section 33	The Project Proposer commits in accordance with Section 33 of The Electricity Law, 2014 and commits to allow the Chief Inspector, Inspectors and persons conferred duty by them to enter and inspect any place or building to perform their duties in accord with stipulations.
Section 40	The project proponent commits to carry out in accordance with the rules, standards, and procedures issued by the Ministry, and will undergo the necessary inspections of relevant government departments and government organizations in accordance with Section 40 of The Electricity Law, 2014.
Section 68	The project proponent commits in accordance with section 68: respect the right of the aggrieved person to claim for compensation from the permit holder if a person is injured, or disabled or killed by the electric shock or outbreak of fire due to negligence or default of the permit holder or the person designated by him as follow in accordance with Section 68 of The Electricity Law, 2014: (a) if the aggrieved person is applied to the existing Workmen's Compensation Act, the compensation prescribed under such law; (b) if the aggrieved person is not applied to the existing Workmen's Compensation Act, the compensation prescribed by the rules issued under this Law.
The Myanma Port Authority Law, 2015	
Section 72	The project proponent commits in accordance with Section 72 The Myanmar Port Authority Law, 2015: (a) A person desirous to build any kinds of wharf, shipyard, dry dock, slip way shall apply to the Myanma Port Authority in accord with the stipulations to obtain a operation licence. (b) The Myanmar Port Authority may allow or refuse the application under sub-section (a) after scrutiny. If allowed, it shall issue an operation licence., with the approval of the Ministry, by determining the terms and conditions. (c) The person who has obtained an operation licence under sub-section (b) shall pay the prescribed licence fee.
Section 73	The project proponent commits in accordance with Section 73 The Myanma Port Authority Law, 2015: The Myanmar Port Authority may, if the person who has obtained an operation licence under sub-section (b) of section 72 violates

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any prohibition contained in the Rules, Regulations, By-Laws and Orders issued under this law or any terms and conditions contained in the operation licence to be complied which is permitted under this law, such violator shall be fined by administrative means in accord with the stipulations, suspend the operation licence for a limited period or terminate it.

Mandalay City Development Law (2014) (Amended 2016, 2021)

Section (67) (a)	The project proponent commits to follow in accordance with Occupational Safety and Health regulations and rules of the City Development Committee relating to implementation, relocation,, expansion workspace and renovation of hazardous business, factories and workshops under section 67 (a) of Mandalay City Development Law (2014) (Amended 2016, 2021).
Section (67) (b)	The project proponent commits to follow in accordance with Occupational Safety and Health regulations and rules of the City Development Committee for producing, storing, distributing, transporting and selling of hazardous and inflammables materials and fuels under section 67 (b) of Mandalay City Development Law (2014) (Amended 2016, 2021).
Section (67) (c)	The project proponent commits to follow in accordance with Occupational Safety and Health regulations and rules of the City Development Committee if there is a danger to the environment or disturbance to the environment during the operation of hazardous business, the business place will not be used or refurbished under section 67 (c) of Mandalay City Development Law (2014) (Amended 2016, 2021).
Section (69) (h)	The project proponent commits to provide latrine, flash toilet, sewage pipe, septic tank within the factories, workshops, building and land under section 69 (h) of Mandalay City Development Law (2014) (Amended 2016, 2021).
Section (69) (i)	The project proponent commits not to enter the effluents from the factory into residents, creeks, wells, lakes, drainage, pipe lines, animal drinking ponds and drains, and agricultural lands under section 69 (i) of Mandalay City Development Law (2014) (Amended 2016, 2021).
Section (69) (m)	The project proponent commits to follow the standards of WHO or other related ministries for drinking water, effluents and sewage in accordance with section 69 (m) of Mandalay City Development Law (2014) (Amended 2016, 2021).
Section (88) (a)	The project proponent commits to allow the entering of either by the municipal officer assigned by the committee or whether more than two municipal employees to the workshop, building or place within City Development Committee Areas for inspection of municipal activities or land survey during day time (Between sunrise and sunset) with prior notice in accordance with section 88 (a) of Mandalay City Development Law (2014) (Amended 2016, 2021).
Section (88) (b)	The project proponent commits to allow the entering of either by the municipal officer assigned by the committee or whether more than two municipal employees to project sites, undergoing with committee permission or within any building spaces for inspection at any time in case of any emergency situations in accordance with section 88 (b) of Mandalay City Development Law (2014) (Amended 2016, 2021)..
Section (88) (c)	The project proponent commits to allow the entering of either by the municipal

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	officer assigned by the committee or whether more than two municipal employees into any project area, land, building and places that are permitted under this law or any project area, land, building and places that apply committee permission in accordance with section 88 (c) of Mandalay City Development Law (2014) (Amended 2016, 2021).
Section (101) (a)	The project proponents commits not to connect water supply illegally in accordance with section 101 (a) of Mandalay City Development Law (2014) (Amended 2016, 2021).
Section (101) (b)	The project proponents commits not to carry out the follows without permission of city development committee in accordance with section 101 (b) of Mandalay City Development Law (2014) (Amended 2016, 2021): (i) breaking the water pipe belonging to the committee, breaking the water pipe and getting water into his house; (ii) Installed and connected with a secondary pipeline from the water supply pipe approved by the committee; (iii) Using electricity or any kind of energy and hand token to get more water from a pipe approved by the committee: (iv) Changing, altering or adding water and sanitation equipment originally installed with the approval of the committee; (v) extracting and distributing underground water; (vi) accessing water from fire hydrants.
Section (101) (j)	The project proponents commits not to flow, leaks or dispose anything from his compound, land, building and high rise building that is likely to cause danger or nuisance to the public or any dirty and smelly matters into rivers, creeks and drainage in accordance with section 101 (j) of Mandalay City Development Law (2014) (Amended 2016, 2021)
Section (101) (k)	The project proponents commits not to dispose any waste and sewage from his building premises into sewage system of city development committee without permission in accordance with section 101 (k) of Mandalay City Development Law (2014) (Amended 2016, 2021)
Section 103 (g)	The project proponent complies not to carry out activities that will destroy the natural ecosystem such as burning, cutting trees and catching aquatics and animals in accordance with section 103 (g) of Mandalay City Development Law (2014) (Amended 2016, 2021)
Section 103 (h)	The project proponent complies not to dispose any waste water from their business into the lakes within public park in accordance with section 103 (h) of Mandalay City Development Law (2014) (Amended 2016, 2021).
Section 104 (a)	The project proponent complies not to carry out nor encourage constructing building with city development committee area without permission of the committee in accordance with section 104 (a) of Mandalay City Development Law (2014) (Amended 2016, 2021).
Section (105) (f)	The project proponent complies not to dispose any waste water from their business into the drainage, rivers and agricultural land without treating according to the standards set by the committee in accordance with section 105 (f) of Mandalay City Development Law (2014) (Amended 2016, 2021).
Section 105 (l)	The project proponent complies not to store waste without the permission of the Committee nor transport such stored waste to other places except the waste disposal site designated by the committee in accordance with section 105 (l) of Mandalay City Development Law (2014) (Amended 2016, 2021).
Section 105 (m)	The project proponent complies not to dispose any air emission form his

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	factory, workshop and business without treating according to the standards in accordance with section 105 (m) of Mandalay City Development Law (2014) (Amended 2016, 2021).
Section 105 (n)	The project proponent complies not to violate direction of the committee for disposing and reusing wastes in accordance with section 105 (n) of Mandalay City Development Law (2014) (Amended 2016, 2021).
Section (106) (h)	The project proponent complies not to construct new accessed road without the permission of the committee in accordance with section 106 (h) of Mandalay City Development Law (2014) (Amended 2016, 2021).
Section (106) (j)	The project proponent complies not to change water flow, disturb drainage, land fill, change flow direction to any natural rivers, outlets or any parts or drainage and underground drainage of committee or natural existing water flow without permission of the committee in accordance with section 106 (j) of Mandalay City Development Law (2014) (Amended 2016, 2021).
Section (106) (l)	The project proponent complies not to dispose any wastes and waste water into public drainage, ditches, rivers, river outlets and creeks in accordance with section 106 (l) of Mandalay City Development Law (2014) (Amended 2016, 2021).
The Administration of Vacant, Fallow and Virgin Lands Law (2012) (Amended 2018)	
Section 5	The project proponent commits to apply to the Central Committee in accord with the stipulations to obtain the right to carry out or use vacant, fallow and virgin lands in the State for the businesses contained in section 4.
Section 9	The project proponent commits to pay insurance premium when the right to cultivate or utilize vacant, fallow and virgin land is permitted under section 8 and section 8-A by the Central Committee and the Management Committees.
Section 10 (a)	The project proponent commits to section 10 (a); The Central Committee may, when permitting vacant, fallow and virgin lands for agriculture, livestock breeding and businesses relating to them in respect of land area: (a) in the agricultural business: (i) permit not exceeding 5000 acres at a time, if it is the perennial tree. If it has been carried out 75 percent of the permitted acres fully, permit not exceeding 5000 acres for a time and up to the total of 50000 acres time after time. If it is the business which should be permitted for the interest of the State, permit more than 5000 acres at a time of acres that can actually grow with the approval of the Union Government; (ii) if it is the horticultural crops, permit not exceeding 3000 acres; (iii) if it is the industrial seasonal crop, permit not exceeding 5000 acres at a time. If it has been carried out 75 percent of the permitted acres fully, permit not exceeding 5000 acres for a time and up to the total of 50000 acres time after time. If it is the business which should be permitted for the benefit of the State, permit more than 5000 acres at a time with the approval of the Union Government; (iv) administer to enable to permit by the relevant regional organization, not exceeding 50 acres of vacant, fallow and virgin lands for the rural farmers and family capacity who desire to carry out agriculture;
Section 16 (e)	The project proponent commits the terms and conditions stipulated by the Central Committee relating to the right to carry out or use vacant, fallow and virgin lands.
Section 16 (f)	The project proponent commits not to extract other natural resources above and

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	below the ground except the permitted business.
Section 16 (g)	The project proponent commits in accordance with section 16 (g) that when confiscating the required land area from the permitted land area, in finding the natural resources within the permitted land and the Government is desirous to produce commercially, shall return as directed by the Union Government.
Section 19 (a)	The project proponent has to comply the right of the Central Committee has to recover the required minimum land area from the permitted vacant, fallow and virgin lands if finding the ancient cultural heritages in the permitted vacant, fallow and virgin lands;
Section 19 (d)	The project proponent has to comply the right of the Central Committee has to recover the required minimum land area from the permitted vacant, fallow and virgin lands if finding resources in the vacant, fallow and virgin lands permitted to carry out the business contained in sub-sections (a), (b) and (d) of section 4.
Section 25 (c)	The project proponent commits the Central Committee in accordance with Section 25 (c); allow to proceed in accordance with law after obtaining consent of local cultivators who have been cultivating on the permitted vacant, follow and virgin land area
Section 25 (d)	The project proponent commits the Central Committee in accordance with Section 25 (d); amend the permit or pay appropriate compensation or damages depending on mutual agreement or submission in settling the disputes under sub-sections (a), (b) and (c)
The Bridges Law, 2019	
Section 11 (f)	Project proponent commits not to drive the motor vehicle, train, machinery, type of wheel, loaded vehicle, vehicle more than the permitted bridge load capacity which are not allowed to drive on the bridge in accordance with Section 11 (f) of the Bridges Law, 2019.
Section 12 (c)	Project proponent commits not to do the followings with the permission of Ministry in accordance with Section 12 (c) of the Bridges Law, 2019: (a) construct and install any petroleum and gas pipe, water pipe, electric line and communication cable crossing the bridge; (b) construct and install the buildings, towers, underground pipelines and communication cables within the boundary of the bridge; (c) extract sand and gravel within a specified distance from upstream and downstream of the bridge, use as a port, and store and transport hazardous chemicals and fuel.
The Myanmar Coastal and Inland Water Transport Service License Law (2015)	
Section 14 (a)	The project proponent commits to pay the prescribed service license fee to the Central Supervising Body or the relevant Regional Supervising Body in accordance with section (14) (a) of The Myanmar Coastal and Inland Water Transport Service License Law (2015) when obtain the service license.
Section 14 (b)	The project proponent commits with stipulated terms and conditions according to category of service license in accordance with section (14) (b) of The Myanmar Coastal and Inland Water Transport Service License Law (2015) when obtain the service license.
Section 14 (c)	The project proponent commits in accordance with section (14) (c) of The Myanmar Coastal and Inland Water Transport Service License Law (2015) after expiring the term of service license, apply to renew the term of license according to the stipulations, if desirous to continue the water transport service

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	when obtain the service license.
Section 22	The project proponent commits not to operate or cause to operate the service of water transport service without a service license in accordance with section (22) of The Myanmar Coastal and Inland Water Transport Service License Law (2015).
Section 23 (a)	The project proponent commits in accordance with section (23) (a) of The Myanmar Coastal and Inland Water Transport Service License Law (2015): Whoever violates the prohibition contained in section 22 shall, on conviction, be punished with imprisonment for a term not exceeding six months or be liable with a fine not exceeding five hundred thousand kyats or with both.
Section 23 (b)	The project proponent commits in accordance with section (23) (b) of The Myanmar Coastal and Inland Water Transport Service License Law (2015): Whoever violates the prohibition contained in sub-section (a) shall, on conviction, be punished with imprisonment for a term not exceeding six months or a fine not exceeding ten hundred thousand kyats.
The Myanmar Companies Law 2017 (Amended 2018)	
Section 4 (a)	The project proponent commits to register the company with the following facts in accordance with Section 4 (a) of The Myanmar Companies Law 2017 (Amended 2018): (i) a name;(ii) a constitution;(iii) at least one share in issue (provided that a company limited by guarantee need not have a share capital);(iv) at least one member; (v) subject to sub-section (vi), at least one director who shall be ordinarily resident in the Union;(vi) if the company is a public company, at least three directors, one of whom shall be a Myanmar citizen who is ordinarily resident in the Union; and(vii) a registered office address in the Union.
Section 4 (b)	The project proponent commits to appoint a company secretary and have a common seal in accordance with Section 4 (b) of The Myanmar Companies Law 2017 (Amended 2018)
Section 6 (b)	The project proponent commits to state the following facts with prescribed form for company registration in accordance with Section 6 (b) of The Myanmar Companies Law 2017 (Amended 2018): (i) the proposed name of the company; (ii) the proposed type of the company; (iii) the full name and address of each applicant; (iv) the full name, date of birth, gender, nationality and address of every director and any secretary of the proposed company; (v) that each individual named as a director or secretary of the proposed company has given their written consent to act as a director or secretary of the proposed company; (vi) the address of the registered office of the proposed company, which in the absence of any other notice will be taken to be the address for service of documents to the proposed company; (vii) the address of the company's principal place of business if different to the registered office; and
Section (7)	The project proponent commits in accordance with Section 7 of The Myanmar Companies Law 2017 (Amended 2018): understand and accept the penalties

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with fines of 2,500,000 kyats for making a false declaration in an application under section 6.

Section (25) (a) The project proponent commits not to register the company by a name identical with that by which a body corporate in existence is already registered, or so nearly resembling that name as to be calculated to deceive or otherwise likely to mislead or cause confusion, except where the body corporate in existence is in the course of being dissolved and signifies its consent to the registrar in accordance with Section 25 (a) of The Myanmar Companies Law 2017 (Amended 2018):

Section (25) (c) The project proponent commits not to register the company by a name which in accordance with Section 25 (c) of The Myanmar Companies Law 2017 (Amended 2018):
(i) contains any of the following words, namely, "National Government", "State", "Central Bank", "Union Government", "President", "Ministry" or any word which suggests or is calculated to suggest the patronage of the Government of Myanmar or of any ministry, department, office or agency thereof; or
(ii) contains the word "Municipal", or any word which suggests or is calculated to suggest connection with any state, regional, municipality or other local authority or with any society or body incorporated by applicable law.

Section (27) The project proponent commits in accordance with Section 27 of The Myanmar Companies Law 2017 (Amended 2018) to make sure that its name is clearly stated in:
(a) every written communication sent by or on behalf of the company; and
(b) every document issued or signed by or on behalf of the company that evidences or creates a legal obligation of the company.

Section (28) (b) The project proponent commits in accordance with Section 28 (b) of The Myanmar Companies Law 2017 (Amended 2018) that a company may execute a document without using a common seal if the document is signed by:
(i) the director, if the company has only one director;
(ii) two directors of the company; or
(iii) a director and a company secretary of the company.

Section (28) (c) The project proponent commits in accordance with Section 28 (c) of The Myanmar Companies Law 2017 (Amended 2018) that a company with a common seal may execute a document if the seal is fixed to the document and the fixing of the seal is witnessed by:
(i) the director, if the company has only one director;
(ii) two directors of the company; or
(iii) a director and a company secretary of the company.

Section (58) (a) The project proponent commits to file with the registrar an application in the prescribed form to change its company type which includes the following statements in accordance with Section 58 (a) of The Myanmar Companies Law 2017 (Amended 2018):
(i) a statement confirming that the special resolution that resolves to change the type of the company, specifying the new type and the company's new name if a

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	change of name is made has been duly passed; (ii) a statement confirming that the special resolution that resolves to amend the company's constitution (if any) has been duly passed and a copy of the amended constitution where the company proposes to use a constitution which differs in any substantive way from the model constitution; (iii) a statement which updates any other changes arising in connection with the change of company type to the particulars of the company which are maintained on the register by the registrar; and (iv) for a company limited by guarantee changing to a private or a public company: (aa) a statement confirming that in the directors' opinion the company's creditors are not likely to be materially prejudiced by the change of type and that sets out their reasons for that opinion; and (bb) if the company limited by guarantee does not have a share capital, a statement confirming that special resolution approving the issue of shares has been duly passed and a statement containing the information required by sub-section 6(b)(viii).
Section (58) (b)	The project proponent commits to give a notice in the Gazette and by publication in a daily newspaper circulating generally in the Union that it has filed an application with the registrar to alter the details of the company's registration to change the company type in accordance with Section 58 (b) of The Myanmar Companies Law 2017 (Amended 2018).
Section (141) (a)	The project proponent commits to have a registered office to which all communications and notices may be addressed from the date of its cooperation in accordance with Section 141 (a) of The Myanmar Companies Law 2017 (Amended 2018).
Section (141) (b)	The project proponent commits in accordance with Section 141 (b) of The Myanmar Companies Law 2017 (Amended 2018): The company need not carry on businesses in the premises at the address of its registered office. Provided that, the person who occupies such place shall obtain and retain with its records the consent to the use of premises of the company as its registered office. If such consent is withdrawn, the company shall identify a new registered office. The registrar may require the company to produce evidence of the consent required under this subsection.
Section (141) (c)	The project proponent commits in accordance with Section 141 (c) of The Myanmar Companies Law 2017 (Amended 2018): Notice of the registered office setting out a complete address shall be given in the application for incorporation and notice of any subsequent proposed change therein shall be given in the prescribed form prior to the date of the change to the registrar. The registrar shall record such change.
Section (141) (d)	The project proponent commits in accordance with Section 141 (d) of The Myanmar Companies Law 2017 (Amended 2018): The inclusion in the annual return of a company of the statement as to the address of its registered office shall not be taken to satisfy the obligation imposed by this section.
Section (141) (e)	The project proponent commits in accordance with Section 141 (e) of The Myanmar Companies Law 2017 (Amended 2018): If the registrar believes that any of the following matters occurs, the registrar may give notice to any resident director that it intends to change the address of the registered office to

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	the address of the director: (i) if the registered office is at premises in which, the company is no longer carrying on business at those premises the company is carrying on business ;or (ii) If the registered office is not at premises in which the company is carrying on business, the occupier of those premises has not consented or has withdrawn its consent to the use of the company of those premises as its registered office or such occupier themselves no longer occupies such premises; If the company has not notified a new address of the registered office within 28 days of the issue of such notice then the registrar may so change the registered office address.
Section (142)	The project proponent commits to a fine of four million kyats if a company fails to comply with the requirements of section 141 in accordance with Section 142 of The Myanmar Companies Law 2017 (Amended 2018) .
Section (143)	The project proponent commits in accordance with Section 143 of The Myanmar Companies Law 2017 (Amended 2018) ; (a) to display its name at its registered office, at every office or place in which its business is carried on that is open to the public, in a conspicuous position, in legible Myanmar and English character; (b) to have its name engraved in legible characters on its seal if the company has a seal; (c) to have its name mentioned in legible Myanmar or English character in all following matters: (i) written communications sent by or on behalf of the company; and (ii) documents issued or signed by or on behalf the company that create a legal obligation of the company;
Section 228 (a)	The project proponent commits in accordance with Section 228 (a) of The Myanmar Companies Law 2017 (Amended 2018): Subject to the constitution of a company and other applicable laws, and without limiting other powers conferred under this law or any other applicable law, a company shall have the power to create and grant mortgages and charges prescribed in section 229. The registrar shall register such mortgages and charges submitted by the company or mortgagee or chargee or person acting on their behalf in accordance with section 234.
Section 228 (b)	The project proponent commits in accordance with Section 228 (b) of The Myanmar Companies Law 2017 (Amended 2018): The following matters shall not be restricted by the Transfer of Immovable Property Restriction Law, or the provisions of any other applicable law having a similar effect, and such matters shall also not be presumed the breach of such provisions: (i) the grant of a mortgage or charge prescribed in section 229; or (ii) the exercise of rights by or on behalf of the mortgagee or charge under such a mortgage or charge in implementation of realising the value of any property secured for the mortgage or charge.
Section 298 (b)	The project proponent commits in accordance with Section 298 (b) of The Myanmar Companies Law 2017 (Amended 2018): A company may be wound up by the court: (a) if the company has by resolution resolved that the company be wound up by

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the court;
(b) if default is made in filing the statutory report or in holding the statutory meeting;
(c) if the company does not commence its business within a year from its incorporation, or suspends its business for a whole year;
(d) if the number of members is reduced below one;
(e) if the company is unable to pay its debts; or
(f) if the court is of opinion that it is just and equitable that the company should be wound up.

3.7. International Agreements and Conventions

In addition to the domestic laws listed above, Myanmar is also a signatory to the following international conventions, and these may have relevance to the proposed survey activities. Refer to the following Table.

Table 3.3. International Agreements and Conventions Relevant to the Proposed Project

International Agreements and Conventions	Status	Purposes
Vienna Convention for the Protection of the Ozone Layer, 1985	1998	Aims at the protection of the ozone layer, including requirements for limiting the production and use of ozone depleting substances.
Montreal Protocol on Substances that Deplete the Ozone Layer, 1989	1993	Aims at the protection of the ozone layer, including requirements for limiting the production and use of ozone depleting substances.
Basel Convention, 1989	2015	The Convention regulates the transboundary movements of hazardous wastes and provides obligations to its parties to ensure that such wastes are managed and disposed of in an environmentally sound manner.
United Nations Framework Convention on Climate Change (UNFCCC), New York, 1992 and Kyoto Protocol 1997	1995 and 2005	Provide a framework for intergovernmental efforts to tackle climate change. Recognises that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases.
Convention on Biological Diversity, Rio de Janeiro, 1992	1994	Aims to promote national policies for the conservation of wild flora, fauna and habitat that needs to be included in planning policies. The three main goals are: (1) the conservation of the biological diversity; (2) the sustainable use of its components; (3) fair and

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		equitable sharing of the benefits.
Asia Least Cost Greenhouse Gas Abatement Strategy (1998 ALGAS)	1998	Develop national and regional capacity for preparation of GHG inventories. Assist in identifying GHG abatement options and preparation of a portfolio of abatement projects for each country.
United Nations Agenda 21	1997	Building on the National Environment Policy of Myanmar, takes into account principles contained in the Global Agenda 21. Myanmar Agenda 21 also aims at strengthening and promoting systematic environmental management in the country.
Relevant ILO Conventions in force in Myanmar • C1 Hours of Work • C14 Weekly Rest • C17 Workmen's Compensation (Accidents) • C19 Equality of Treatment (Accident Compensation) • C26 Minimum Wage Fixing Machinery • C29 Forced Labour Convention • C42 Workmen's Compensation (Occupational Diseases) Revised 1934 • C52 Holidays with Pay		Sets out legal instruments drawn up by the ILO's constituents (governments, employers and workers) and setting out basic principles and rights for workers.

3.8. Penalties and other Administrative Punishment

The developer must know the penalties and other administrative punishment granted as EIA Procedures in Myanmar as follow:

No	Non-Compliance	Penalties	Specific Administrative Punishment of the Ministry
1.	Failure or delay in timely submission of reports within Period prescribed by Ministry	100 to 500 US$ or equivalent Myanmar Kyat + 10-25 US$/ day unit cured or equivalent Myanmar Kyat	-Issue Enforcement Notice
2.	Obstruction or interference with an official in the course of their duties	250 to 5,000 US$ or equivalent Myanmar Kyat	-Issue Enforcement Notice -Criminal prosecution

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3.	Failure to provide information to the Ministry or any representative	1,000 to 5,000 US$ or equivalent Myanmar Kyat	-Suspension of Approval of EMP, EMP-CP, EMP-OP in whole or in part
4.	Failure to provide information to the Ministry Inspector or any representative when requested in regard to inspection and monitoring	250 to 5,000 US$ or equivalent Myanmar Kyat	- Issue Enforcement Notice
5.	Undertaking or allowing any preparatory or other construction works without the prior approval by the Ministry of a reserved EMP or EMP-CP	1,000 to 5,000 US$ or equivalent Myanmar Kyat +50 to 500 US$/ day until cured or equivalent Myanmar Kyat	-Criminal prosecution
6.	Operating/implementing without a permit, or approval by the Ministry of an EMP or EMP-Op	1,000 to 5,000 US$ or equivalent Myanmar Kyat +50 to 500 US$/ day unit cured or equivalent Myanmar Kyat	- Criminal prosecution
7.	Non-compliance with an Enforcement Notice or Suspension Notice issued by the Ministry	2,000 to 10,000 US$ or equivalent Myanmar Kyat +100-500 US$/day unit cured or equivalent Myanmar Kyat	-Suspension of Approval of EMP, EMP-CP or EMP-OP in whole or in part -Revocation of Approval of EMP, EMP-CP or EMP-OP in whole or in part
8.	Failure to notify to the Ministry of any knowledge of any event of an imminent of Environmental damage	1,000 to 5,000 US$ or equivalent Myanmar Kyat	- Issue Enforcement Notice - Suspension of Approval of EMP, EMP-CP or EMP-OP in whole or in part -Revocation of Approval of EMP, EMP-CP or EMP-OP in whole or in part
9.	Failure to take reasonable steps to prevent an imminent thread of damage to the Environment, social, human health, livelihoods, or property, where application based on the EMP, EMP-CP or EMP-OP	2,500 to 10,000 US$ or equivalent Myanmar Kyat	-Issue Enforcement Notice - Suspension of Approval of EMP, EMP-CP or EMP-OP in whole or in part -Revocation of Approval of EMP, EMP-CP or EMP-OP in whole or in part
10.	Non-compliance with conditions in 'the ECC and allowable Emission Limit Values	1,000 to 10,000 US$ or equivalent Myanmar Kyat	-Issue Enforcement Notice - Suspension of Approval of EMP, EMP-CP or EMP-OP in whole or in part -Revocation of Approval of EMP, EMP-CP or EMP-OP in whole or in

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			part
11.	Failure to take pay compensation amounts required in respected in respect of social impacts	1,000 to 10,000 US$ or equivalent Myanmar Kyat	-Issue Enforcement Notice - Suspension of Approval of EMP, EMP-CP or EMP-OP in whole or in part -Revocation of Approval of EMP, EMP-CP or EMP-OP in whole or in part
12.	Failure to fully restore social conditions upon resettlement	1,000 to 10,000 US$ or equivalent Myanmar Kyat	-Issue Enforcement Notice - Suspension of Approval of EMP, EMP-CP or EMP-OP in whole or in part -Revocation of Approval of EMP, EMP-CP or EMP-OP in whole or in part

Notes:

1. All penalty amounts set forth in this Annex are denominated in United States Dollars (US$) and are subject to annual inflation adjustment.
2. Abbreviations are as follows;

   EMP = Environmental Management Plan

   EMP-CP = Environmental Management Plan – Construction Phase

   EMP-OP = Environmental Management Plan –Operational Phase

3.9. Statement of Commitments

3.9.1 Commitments of Project Developer

We, Myanma Energy Sector Development Public Co. Ltd (MESDP) endorse and commit to comply with the followings:

a) This Environmental Impact Assessment Report is accurate and complete.

b) Environmental Impact Assessment is carried out in accordance with EIA procedure (2014), and other related laws, rules and regulations.

c) Comply with the commitments expressed in this EIA report and fully implement the environmental impacts mitigation measures and environmental management plan in accordance with Article 62 of EIA procedure.

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d) Comply with the commitments of the environmental and socio-economic development revealed in the Environmental Impact Assessment report.

e) Acknowledge and comply the laws, regulations and guidelines associated with the project, included in the report.

f) Comply and proceed the alternative methods, mitigation measures and monitoring plans included in the report for the reduction of the negative environmental impacts; and take responsibility for the environmental impacts due to non-compliance of the commitment.

g) Give priorities for the occupational health and safety of the workers.

h) Utilize the exact amount of fund as stated in proposed expenditure for cooperate social responsibility funds.

i) Take responsibility for all of the works and absence of the contractors, sub-contractors, officers and representatives of the company in operating the processes.

j) Take responsibility to support after discussion for the impacted people to ensure for their stable livelihood not lower than before the project; and resettlement and rehabilitate the impacted local people, government organizations and other related people and organizations.

k) We, (MESDP) commit to follow the environmental commitments, mitigation measures, management plans illustrated in the EIA report. We also commit to follow the Environmental Conservation Laws 2012, and the Environmental Conservation Rules 2015.

Moreover, MESDP will commit the following sections in EIA report.

Summary of Commitments	No.	Clear Statement of Commitment	Chapter Reference
Collection of Data	2.11	Data collection in this EIA study has been conducted and complied in accordance with Chapter 2.11.	Chapter 2
Legal Frameworks	3.3, 3.6	The project developer will undertake to implement the project in compliance with the laws and regulations related to the project which has been mentioned in Chapter 3.3 and 3.6 of the report.	Chapter 3
National and International Standards and Guidelines	3.2, 3.3, 3.7	The project developer will undertake to implement the project in compliance with the National and International guidelines mentioned in Chapter 3 of the report.	Chapter 3
Description of the Project	4.0	The project developer affirms that all the descriptions and activities of the project provided in Chapter 4 are accurate and true.	Chapter 4

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Description of the Surrounding Environment	5.0	All the primary and secondary data described in Chapter 5 of the report are affirmed to be accurate and true and the baseline data in that chapter were indeed conducted and measured.	Chapter 5
Risk Assessment and Mitigation Measures	6.8	The project developer will adhere to implement the mitigation measures outlined in Chapter 6.8 of the report.	Chapter 6
Cumulative Impacts and Mitigation Measures	7.2	The project developer will adhere to implement the mitigation measures for cumulative impacts outlined in Chapter 7.2 of the report.	Chapter 7
Residual Impacts and Mitigation Measures	7.3	The project developer will adhere to implement the mitigation measures for residual impacts outlined in Chapter 7.3 of the report.	Chapter 7
Environmental Impacts and Mitigation Measures	8.1	The project developer acknowledges the environmental impacts and pledge to implement the mitigation measures outlined in the report.	Chapter 8
Environmental Monitoring Plan	8.2	The project developer will adhere to implement the environmental monitoring plans outlined in Chapter 8.2 of the report.	Chapter 8
Management and Monitoring Sub - Plans	8.3	The project developer will adhere to implement the environmental management and monitoring sub plans outlined in Chapter 8.3 of the report.	Chapter 8
Corporate Social Responsibility (CSR) Program	8.8	The community development activities described in the report have been indeed undertaken by the project developer and pledge to allocate at least 2 percent of the annual net profit after tax as CSR fund.	Chapter 8
Household Surveys	9.2.2	The apprehensions and needs of the local people will be addressed and the project will be implemented in alignment with the preferences of the community.	Chapter 9
Conclusion	10.0	The project developer will prioritize and implement with the aspects discussed at the conclusion of the report.	Chapter 10

ကတိကဝတ်အကျဉ်း	မာတိကာ	ကတိကဝတ်အကြောင်းအရာ	ရည်ညွှန်းအခန်း
အချက်အလက်ကောက်ခံခြင်း	၂.၁၁	ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်း အစီရင်ခံစာပါ အချက်အလက်များကို မာတိကာ ၂.၁၁ တွင် ဖော်ပြထားသည့်အတိုင်း	အခန်း (၂)

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		ကောက်ခံစုဆောင်းထားခြင်းဖြစ်ပါသည်။	
ဥပဒေမူဘောင်	၃.၃၊ ၃.၆	စီမံကိန်းအဆိုပြုသူသည် စီမံကိန်းအကောင်အထည်ဖော် ဆောင်ရွက်ရာတွင် မာတိကာ ၃.၃၊၃.၆ တို့တွင်ဖော်ပြထားသည့် ဥပဒေ၊ နည်းဥပဒေ၊ စည်းမျဉ်းစည်းကမ်းများနှင့် အညီ ဆောင်ရွက်သွားပါမည်။	အခန်း (၃)
နိုင်ငံတော်အဆင့်နှင့် နိုင်ငံတကာအဆင့် စံချိန်စံညွှန်းနှင့် လမ်းညွှန်ချက်များ	၃.၂၊ ၃.၃၊ ၃.၇	စီမံကိန်းအဆိုပြုသူသည် စီမံကိန်းအကောင်အထည် ဖော် ဆောင်ရွက်ရာတွင် အခန်း (၃) တွင် ဖော်ပြထားသည့် နိုင်ငံတော်အဆင့်နှင့် နိုင်ငံတကာ အဆင့် စံချိန် စံညွှန်း၊ လမ်းညွှန်ချက်များ နှင့် အညီ ဆောင်ရွက်သွားပါမည်။	အခန်း (၃)
စီမံကိန်း အကြောင်းအရာ ဖော်ပြချက်	၄.၀	အခန်း (၄) တွင်ဖော်ပြထားသည့် စီမံကိန်း အကြောင်းအရာဖော်ပြချက်များ၊ စီမံကိန်း ဆောင်ရွက်ချက်များမှာ မှန်ကန်မှုရှိပါသည်။	အခန်း (၄)
အနီးပတ်ဝန်းကျင် အကြောင်းအရာ ဖော်ပြချက်	၅.၀	အခန်း (၅) တွင် ဖော်ပြထားသည့် Primary and secondary များမှာ မှန်ကန်မှုရှိပါသည်။ baseline data များကို အမှန်တကယ် ကောက်ယူ၊ တိုင်းတာထားခြင်း ဖြစ်ပါသည်။	အခန်း (၅)
ဘေးအန္တရာယ်ရှိမှု ဆန်းစစ်ခြင်းနှင့် လျော့ပါးရေး နည်းလမ်းများ	၆.၈	စီမံကိန်းအဆိုပြုသူသည် မာတိကာ ၆.၈ တွင်ဖော်ပြထားသည့် ထိခိုက်မှုလျော့ပါးရေး နည်းလမ်းများကို အကောင်အထည်ဖော် ဆောင်ရွက်ပါမည်။	အခန်း (၆)
ဆင့်ပွားသက်ရောက်မှု ဆန်းစစ်ခြင်းနှင့် လျော့ပါးရေး နည်းလမ်းများ	၇.၂	စီမံကိန်းအဆိုပြုသူသည် မာတိကာ ၇.၂ တွင်ဖော်ပြထားသည့် ဆင့်ပွားသက်ရောက်မှုများ အတွက် ထိခိုက်မှုလျော့ပါးရေး နည်းလမ်းများကို အကောင်အထည်ဖော် ဆောင်ရွက်ပါမည်။	အခန်း (၇)
ကြွင်းကျန်သက်ရောက်မှု ဆန်းစစ်ခြင်းနှင့် လျော့ပါးရေး နည်းလမ်းများ	၇.၃	စီမံကိန်းအဆိုပြုသူသည် မာတိကာ ၇.၃တွင်ဖော်ပြထားသည့် ကြွင်းကျန်သက်ရောက်မှုများ အတွက် ထိခိုက်မှုလျော့ပါးရေး နည်းလမ်းများကို အကောင်အထည်ဖော် ဆောင်ရွက်ပါမည်။	အခန်း (၇)
ပတ်ဝန်းကျင်ဆိုင်ရာ သက်ရောက်မှု ဆန်းစစ်ခြင်းနှင့် လျော့ပါးရေး နည်းလမ်းများ	၈.၁	စီမံကိန်းအဆိုပြုသူသည် အစီရင်ခံစာတွင် တွင်ဖော်ပြထားသည့် ပတ်ဝန်းကျင်ဆိုင်ရာ သက်ရောက်မှုများကိုသိရှိနားလည်ပြီး၊ ထိခိုက်မှု လျော့ပါးရေး နည်းလမ်းများ အကောင်အထည်ဖော် ဆောင်ရွက်ပါမည်။	အခန်း (၈)

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ပတ်ဝန်းကျင်ဆိုင်ရာ စောင့်ကြပ်ကြည့်ရှုမှု အစီအစဉ်	၈.၂	စီမံကိန်းအဆိုပြုသူသည် မာတိကာ ၈.၂ ပတ်ဝန်းကျင်ဆိုင်ရာ စောင့်ကြပ်ကြည့်ရှုမှု အစီအစဉ်များကို အကောင်အထည်ဖော် ဆောင်ရွက်ပါမည်။	အခန်း (၈)
ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲခြင်းနှင့် စောင့်ကြပ်ကြည့်ရှုမှု အစီအစဉ်ခွဲများ	၈.၃	စီမံကိန်းအဆိုပြုသူသည် မာတိကာ ၈.၃ ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲခြင်းနှင့် စောင့်ကြပ်ကြည့်ရှုမှု အစီအစဉ်ခွဲများကို အကောင်အထည်ဖော် ဆောင်ရွက်ပါမည်။	အခန်း (၈)
ရပ်ရွာအကျိုးပြုလုပ်ငန်း ပရိုဂရန် (CSR) Program	၈.၈	စီမံကိန်းအဆိုပြုသူသည် အစီရင်ခံစာတွင်ဖော်ပြထားသည့် ရပ်ရွာအကျိုးပြုလုပ်ငန်းများကို အကောင်ထည်ဖော်ဆောင်ရွက်ပါမည်။ စီမံကိန်း၏ အခွန်ဆောင်ပြီး တစ်နှစ်အသားတင်အမြတ်ငွေ၏ ၂ ရာခိုင်နှုန်းကို ရပ်ရွာအကျိုးပြုလုပ်ငန်းရန်ပုံငွေ အဖြစ်သုံးစွဲပါမည်။	အခန်း (၈)
အိမ်ထောင်စုစစ်တမ်း ကောက်ယူခြင်း	၉.၂.၂	ဒေသခံပြည်သူများ၏ စိုးရိမ်ပူပန်မှုနှင့် လိုအပ်ချက်များကို ဖြေရှင်းဆောင်ရွက်ပေးမည် ဖြစ်ပြီး စီမံကိန်းကို ရပ်ရွာလူထု၏ လိုလားချက်များနှင့်အညီ အကောင်အထည်ဖော် ဆောင်ရွက်သွားမည်ဖြစ်ပါသည်။	အခန်း (၉)
နိဂုံး	၁၀.၀	စီမံကိန်းအဆိုပြုသူသည် အစီရင်ခံစာ၏နိဂုံးချုပ်တွင် ဆွေးနွေးထားသည့် ကဏ္ဍများကို ဦးစားပေး၍ အကောင်အထည်ဖော်မည်ဖြစ်ပါသည်။	အခန်း (၁၀)

(Signature)

Name -

Position -

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3.9.2. Commitments of the Environmental Assessment Practitioner

The EIA report was written by Ever Green Tech Environmental Services and Training Co., and EIAs in this report were planned by the following criteria;

(a) The drawn the EIA complied with the National Constitution, Environmental Conservation Law, EIA Procedures, and National Environmental Quality Guidelines.

(b) This EIA also complied with the existing or future Labor laws, Occupational Health and Safety Laws, and related Rules and Procedures.

(c) These environmental impact protection procedures are designed of incident avoiding, mitigation and replacing for the project proponent who commits to follow the environmental impact protection procedure.

(d) This environmental management report is systematically planned not only for environmental impact protection procedures and occupational safety and health but also emergency management planning and social welfare programs.

(e) All facts including in this report are systematically surveyed without bias. As a third party, we commit and take full responsibility for all of the factors described in this report.

In addition, the commitments of the environmental assessment practitioner are described below.

Name	Article No.	Commitment	Chapter
Executive Summary	1.1 to 1.10	EGT commits the summaries according to the chapters of the environmental management plan have been selected and presented without omission.	Chapter 1
Description of the Project Background	2.1, 2.3, 2.4, 2.5, 2.9, 2.10	EGT commits the description of the project background and information related to the third-party is correct and accurate.	Chapter 2
Policy, Legal and Other Requirements	3.2, 3.3, 3.6, 3.7	EGT commits laws and regulations related to the proposed project, international agreements and conventions and national and international guidelines have been carefully chosen.	Chapter 3
Project Description	4.1 to 4.18	EGT commit the project description and project activities, operation process and waste management system will be accurately performed during the	Chapter 4

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		operation of the project.	
Description of Surrounding Environment	5.1 to 5.16	EGT commits the air, water and soil monitoring quality, biodiversity conditions, socio-economic conditions, traffic study and cultural heritage near the project area described in chapter 5 of the report are the actual onsite data of the proposed project.	Chapter 5
Environmental Impacts and Mitigation Measures	6.9	EGT commits the anticipated environmental impacts and mitigation measures during the pre-construction, construction, operation and decommissioning phases without bias.	Chapter 6
Anticipated Residual and Cumulative Impacts	7.2, 7.3	EGT commits the systematic analysis of residual and cumulative impacts that may occur due to the operation of the factory.	Chapter 7
Environmental Management Plan	8.1, 8.2, 8.3	EGT commits all of the factors are correct in the environmental management plan, environmental monitoring plan, occupational safety and health plan, risk management plan, monitoring sub-plans and community development plan.	Chapter 8
Public Participation Process	9.1, 9.2, 9.3	EGT commits the public participation processes, households survey within the project affected area, public concerns and socio-economic information was correctly conducted.	Chapter 9
Conclusion	10.0	EGT commits the conclusion of the EIA is the correct consideration about the feasibility of the project.	Chapter 10

ကတိကဝတ် အကျဉ်း	မာတိကာ	ကတိကဝတ်အကြောင်းအရာ	ရည်ညွှန်း အခန်း
အနှစ်ချုပ် အစီရင်ခံစာ	၁.၁ မှ ၁.၁၀	EGTသည် ပတ်ဝန်းကျင် စီမံခန့်ခွဲမှု အစီအစဉ်၏ အခန်းများအလိုက် အကျဉ်းချုပ် အကြောင်းအရာများကို ချန်လှပ်ထားခြင်းမရှိဘဲ တင်ပြထားပါသည်။	အခန်း (၁)
စီမံကိန်းနောက်ခံ အကြောင်းအရာ ဖော်ပြချက်	၂.၁၊ ၂.၃၊ ၂.၄၊ ၂.၅၊ ၂.၆၊ ၂.၁၀	EGT သည် စီမံကိန်းအကြောင်းအရာ ဖော်ပြချက်များ၊ တတိယအဖွဲ့အစည်း အချက်အလက်များကို တိကျမှန်ကန်စွာ ဖော်ပြထားပါသည်။	အခန်း (၂)

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မူဝါဒနှင့် ဥပဒေ ဆိုင်ရာ လိုအပ်ချက်များ	၃.၁၊ ၃.၃၊ ၃.၆၊ ၃.၇	EGTသည် စီမံကိန်းနှင့် သက်ဆိုင်သည့် ဥပဒေ၊ စည်းမျဉ်း စည်းကမ်းများ အပြည်ပြည်ဆိုင်ရာ သဘောတူညီ ချက်များ၊ နိုင်ငံတော်နှင့် နိုင်ငံတကာ လမ်းညွှန်ချက် များကို သေချာစွာ ရွေးချယ်ထားပါသည်။	အခန်း (၃)
စီမံကိန်း အကြောင်းအရာ	၄.၁ မှ ၄.၁၈	EGTသည် က စီမံကိန်း အကြောင်းအရာ ဖော်ပြချက်၊ စီမံကိန်း လုပ်ဆောင်မှုများ၊ လည်ပတ်မှုလုပ်ငန်းစဉ်နှင့် စွန့်ပစ်ပစ္စည်း စီမံခန့်ခွဲရေးစနစ်တို့သည် စီမံကိန်း လည်ပတ်စဉ်ကာလတွင် အမှန်တကယ် လုပ်ဆောင် မည်ဖြစ်ကြောင်း အတည်ပြု ပါသည်။	အခန်း (၄)
စီမံကိန်း အနီးဝန်းကျင် ဖော်ပြချက်	၅.၁ မှ ၅.၁၆	EGT သည် အစီရင်ခံစာ၏ အခန်း ၅ တွင်ဖော်ပြထားသော စီမိကိန်းဇရိယာ အနီးရှိ လေ၊ ရေနှင့် မြေဆီလွှာဆိုင်ရာ အရည်အသွေး၊ ဇီဝမျိုးစုံမျိုးကွဲ အခြေအနေ များ၊ လူမှုစီးပွား အခြေအနေများ၊ ယာဉ် အသွားအလာ လေ့လာရေးနှင့် ယဉ်ကျေးမှု အမွေ အနှစ်များသည် စီမံကိန်း ၏ မြေပြင် အချက်အလက်များ ဖြစ်ကြောင်း ကတိပြု ပါသည်။	အခန်း (၅)
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သက်ရောက်မှုများ		ကတိပြုပါသည်။	
ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအစီအစဉ်	၈.၁၊ ၈.၂၊ ၈.၃	EGT သည် ပတ်ဝန်းကျင် စီမံခန့်ခွဲမှုအစီအစဉ်၊ ပတ်ဝန်းကျင် စောင့်ကြည့်ရေးအစီအစဉ်၊ လုပ်ငန်းခွင် ဘေးအန္တရာယ်ကင်းရေးနှင့် ကျန်းမာရေး အစီအစဉ်၊ ဘေးအန္တရာယ်ဆိုင်ရာ စီမံခန့်ခွဲမှု အစီအစဉ်၊ စောင့်ကြည့်ရေး အစီအစဉ်ခွဲများနှင့် ရပ်ရွာဖွံ့ဖြိုးတိုးတက်ရေး အစီအစဉ်များကို မှန်ကန်သော အချက်များဖြင့် ရေးသားပြုစုထားကြောင်း ကတိပြုပါသည်။	အခန်း (၈)
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နိဂုံး	၁၀.၀	EGT သည် EIA အစီရင်ခံစာ၏ နိဂုံးကို စီမံကိန်း၏ ဖြစ်နိုင်ခြေများနှင့် ဆက်စပ်၍ မှန်ကန်စွာ ထည့်သွင်းစဉ်းစား ထားကြောင်း ကတိပြုပါသည်။	အခန်း (၁၀)

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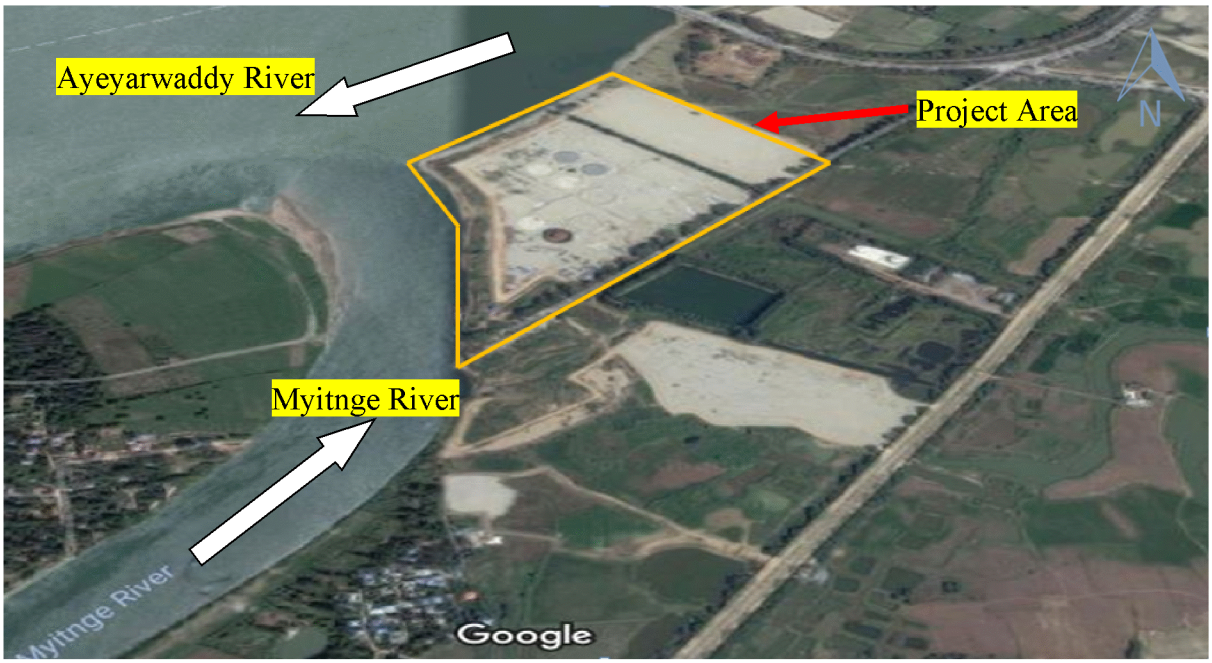
4. PROJECT DESCRIPTION AND ALTERNATIVE SELECTION

MESDP will establish oil storage facilities in Mandalay which meets international standards in loading and unloading of fuel oil. It will be first modernize and international standard fuel oil storage facilities in Upper Myanmar. The followings are the necessary description of the proposed project.

4.1. Project Location, project background, requirement of the project and objectives

Project Location

The project area is located at the confluence of Ayeyarwaddy and Myitnge River (Dokehtawady River) in Amrapura Township, Mandalay Region at the coordinate of 21°51'50.30" N and 95°59'41.63" E. as follow:



Project Location

Project Background, requirement of the project and objectives,

Before this project, fuel oil is distributed directly from tanker to tank track using pipe connection at Shwe Kyat Yat Jetty, which is situated at Amarapura Township, Mandalay Division. This fuel oil distribution system has some weakness such as, fire risk, environmental impacts due to oil leakage, and loss of national tax revenue, in this way, there is a need to implement international standard fuel oil storage and jetty at upper Myanamar.

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Myanma Energy Sector Development Public Company Limited (MESDP) will operate oil storage facilities and jetty for storage and distribution fuel oil in upper Myanmar. The name of project is MESDP Jetty & Depot (Mandalay). MESDP was established in 1st January, 2013 and 100 % public. There are 51 companies who are members of Myanmar Petroleum Trade Association (MPTA) will put together as MESDP. The proposed project will support to develop energy sector in upper Myanmar.

The mission and objectives of the project are as follow:

- To provide quality fuel oil for upper Myanmar with a reasonable price.
- To store large quantity of fuel oil with safety, and
- To provide fuel requirement of upper Myanamr in case of any natural disaster.
- To fully achieve national revenue from fuel oil sector.
- To minimize negative environmental impacts
- To provide employment opportunities for local people.

4.2. Project Authorizations

Authorization and endorsement letters from related ministries such Regional Government, Firefighting Department, Ministry of Religious Affairs and Culture for the proposed project is shown in Appendix IV.

4.3. Vicinity around the Project

The nearest environmentally sensitive areas of the proposed project are shown as follow:

Table 4.1. Environmentally Sensitive Areas near the Proposed Project

No.	Sensitive Areas	Description	Distance (km)
1.	Public Residents	Oh Htoke Tan Village	0.8 km
2.	Water Body	Ayeyarwady River, Duthavati River (Myit Nge River)	0.1km, 0.1km
3.	Biodiversity	Aquatic lives in Myit Nge and Ayarwadi Rivers	0.1km

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4.	Densely Populated Area	Shwe Kyat Yat Village Tract	0.9 km
5.	Cultural and Hesitate Site	Queen Me Nu Brick Monastery Tha Bye Dan Fortress	1.2 km 0.4 km

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Figure 4.1. Vicinity around the Proposed Project

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(a) Cattle Grazing

There is no cattle's grazing land inside or near the proposed project. Most of the cattle grazing lands are inside the Oh Htoke Tan Village and Lat Yway Village.

(b) Nearest Flora Diversity

The nearest flora diversity is paddy fields near the proposed project.

(c) Nearest Fauna Diversity

Nearest fauna diversity is aquatic lives in Myit nge and Arrawady Rivers.

(d) Nearest Surface Water Body

The nearest surface water bodies are Myitnge and Arrawady Rivers which are closed to the proposed project.

(e) Nearest Culturally Sensitive Areas

Innwa Bridge (0.48 mile), Thabyaedan Fortress (0.27 mile) and Innwa Ancient Dynasty (Nan-Ma-Daw Mal-Nu Brick Monastery) are the nearest culturally sensitive sites.

(f) Nearest Source for Natural Disaster

The nearest source for natural disaster is Sagine Fault that can cause medium to high earthquake.

(f) Nearest Public Transportation

The nearest public road is Oh Htoke Tan Road (0.0 km) which is closed to the proposed project.

4.4. Project at a Glance

The following table shows the brief descriptions of the proposed project.

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Aspects	Descriptions
Project Purposes	
Objective	To construct storage tanks and other facilities for distribution of fuel oil in Upper Myanmar
Waste Management	
Solid Wastes	1. Recyclable domestic waste will be recycled. Other domestic waste will be disposed of in a domestic waste disposal site as directed by Mandalay City Development Committee. 2. Industrial wastes will be stored in concrete building and all of these industrial wastes will be recycled or reused.
Liquid Wastes	1. Amount of oil wastes will be 0.0001% of total solid waste and will be treated by oil-water separator 2. Oily water from oil-water separator will be disposed according to the MCDC's Rules.
Domestic Effluent	Sewage treatment facilities will be provided for all sewage generated on site.
Effluent Water	Effluent water from the project site during rainy seasons will be drained with separated drainage system and will be discharge into the rivers after treating with oil-water separator
Treatment System	All of the oily water from project site will be treated with oil-water separator
Other Infrastructures	
Office and other facilities	The office will be provided for administration purpose.
Access and haul roads	A ten meter wide access road exists on one side of the road.
Employment	
Employment	**1. Pre-construction Phase** The project will be used a total of 10 people at pre-construction phase and most of people will be local workers from nearest villages. **2. Construction Phase**

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	The project will employ a total of 30 people at construction of which approximately 20 people will be sourced from the local area. **3. Operation Phase** Once the site is complete and operational it is expected that the facility will have a lifespan of approximately 40 years or more. The operation of the facility will create employment opportunities for more than 200 staff members in total. Wasted resulting from the operation of the facility will include oily water and general office waste. **4. Decommissioning** Once the facility reaches the end of its lifespan, the facility will be decommissioned. After this time, the site will be rehabilitated in accordance with best practice at the time of decommissioning.
Construction Period	
	It is estimated that the construction phase will last for approximately 18 to 22 months. The estimated construction time for each task of the development is listed below: • Site Preparation : two weeks; • Piling : 40 weeks; • Tank foundation : 60 weeks; • Bund walls : 35 weeks; • Bund floor sealing : 35 weeks; • Fire protection systems : 53 weeks; • Product pumps and piping : 63 weeks; • Filling points : 20 weeks; • Offices : 20 weeks; • Electrical works : 35 weeks; and • Commissioning : 12 weeks.
Salient Features	

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Total Project Area	Approximately 38 acres
Domestic Water Demand	Approx.: 30,000 liters/day
Source of Process Water and Domestic Water	There is a 160 mm diameter ring feed around the perimeter of the site supplying fresh water.
Chemical Used	Firefighting Foam (Approx.: 7,500 liters)
Source of Electrical Power	MEPE (11kVA) Power Generator (500 kW) - 2 Nos.
Electrical Power Used	(11 kVA) - 1no. (35 kVA) - 1no.
Vehicles	Backhoe - 1no. Truck - 2 nos. Pick up - 1no. Oil Browser -100 nos.
Investment	First state = 20 billion Kyats Second state = 30 billion Kyats Total = 50 billion Kyats

Current Status of Project

Current status of the project is described below.

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Myanma Energy Sector Development Public Co.,ltd.

Project Frame

No	Project	Description	Quantity	Finished	Remarks
A	**Operational System**				
1	2 Million Tank with wing wall	32Nos	23	43%	
2	Dike	Wall		100%	
		Floor(inner)		66%	
		Firewall(2ft Height)		66%	
3	Jetty	Jetty	3	100%	
		Sponson			
		Steel Bridge			
		Pontoon			
4	Pipe Line & Pipe Rack	From Ship to Jetty		36%	
		From Jetty to Tank			
		From Tank to Pump House			
		From Pump House to Filling Point			
		Over Head Bridge			
		In Filling Station			
5	Pump	Pump House(12nos)	9	75%	
		Loading Pump on Pontoon			
		Suction Pump of Tank			
6	Filling Shed	Structure	3	95%	
		Pipe Line			
		Flow Meter			
7	Fire Fighting System	Fire Fighting Pipe Line		95%	
		Monitor			
		Fire Tank and Box			
		Fire Station and Truck			
		Foam System			
8	Electrical	Transformer 1&2 with Panels	1	40%	
		Generator			
		Cabling for Each Electrical House			
9	Oil Water Separator System	Separator & Pump			
		Underground Drain Pipeline			
		Lift Station			
		Drain Valve & Pit			
		Slop Tank			
10	Terminal Automation System	Control Room	4	100%	
		Control System	5	40%	
		Machine/Pump			
11	Gate with Digital Weighting Scale	Gate 1 & Gate 4	2	50%	
B	**Other Infrastructure**				
12	Drain and Apron	Internal Drain		100%	
		External Drain		100%	
13	Internal Road	40ft Road- 3300ft		100%	
14	Extension Road	Ohtoketan Road	1	22%	
15	Office for Individual		14	6%	
16	Canteen	Gate 1 & Gate 4	2	50%	
17	Bath & WC	Gate 1 & Gate 4	2	50%	
18	Lodge		1		
19	Retaining Wall	Ayeyarwaddy Side	1	100%	
		Duttawaddy Side	1		
20	Fencing	1500 ft (side Oaktiketen Road)	1	100%	
21	Landscaping		1		
22	Underway Concrete Pipe (3'Ø)		1		
C	**Additional Works**				
23	2-1/2 Office	Pile Foundation	1	70%	
24	Switch Bay		1		
25	Carparking		1	50%	
26	Water Tank for Fire Protection System		1		
27	Foam Station	Steel Structure with RC Foundation	2		

Material Requirement for construction and operation

No.	Material	Quantity
1	Alpha Cement	L.S

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2	Rock	L.S
3	Brick	L.S
4	Sand	L.S
5	16mm Steel Rods	L.S
6	12mm Steel Rods	L.S
7	10mm Steel Rods	L.S
8	Binding Wire	L.S
9	16mm Steel Plate	L.S
10	12mm Steel Plate	L.S
11	10mm Steel Plate	L.S
12	8mm Steel Plate	L.S
13	4.5mm Steel Plate	L.S
14	8" MS Pipe	L.S
15	10" MS Pipe	L.S
16	U Beam	L.S
17	H Beam	L.S
18	Premium Diesel	L.S
19	92	L.S
20	95	L.S

One 25 ton cranes, one 7 ton Excavator, two Sino truck and one Suzuki carry are used during construction phase.

4.5. Overall Operating Process

The fuel oil tankers will transport fuel oil from Yangon and the fuel oil will be delivered from the oil tankers through pipe lines to the storage tank. Oil browsers will be filled by automatic filling system from the storage tanks. The operation diagram is shown in the following figure.

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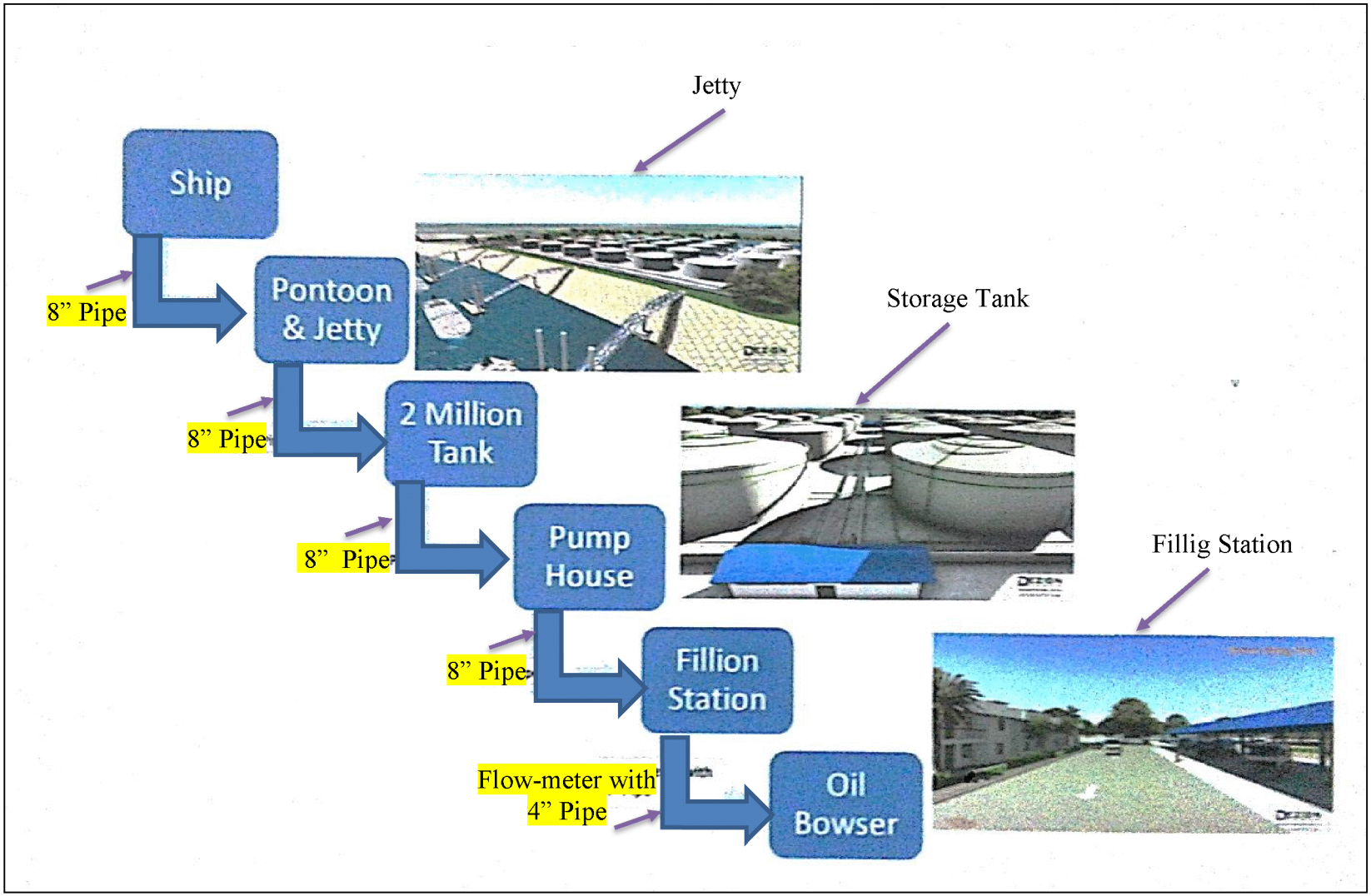

Figure 4.2. Operating Process Flow Chart

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Detailed operation process

(a) Proportional storage rights are determined according to the storage capacity of oil storage tank based on the amount of oil purchase by the companied within a month.

(b) Starting from January of each year, the previous months are also consider in monthly calculation and storage rights is determined by means of average value.

(c) In the past, the stored oil samples were tested in MPTA Lab (Ygn) and the oil that meets the specified quality are allowed to be store. Now the oils are tested with Mobile Fuel Lab form PPRD to reduce time consumption and qualify oil are allowed to store.

(d) Oil storage companies are allowed to unload oil depending on the date of arrival of the oil tanker if it is within the quantity allowed to be stored.

(e) If the oil is allowed to be unloaded but exceeds the available storage allowance, it is allowed to be unloaded depending on the date of arrival of the oil tanker that meets the specifications.

(f) If the available storage capacity is full but there is no oil tanker to unload, the oil tanker will be allowed to unload if it does not interfere with the arrival of oil tanker.

(g) The arrival of the oil tanker and the right of storage in the oil tank must be focused on the oil tanker, but considering the condition of storage in the oil tank, in order to facilitate the extraction (Issue) of the oil tanker, the oil tankers arriving later will also be coordinated to unload the oil.

(h) Inform to PPRD as soon as the oil tanker is arrived and opening/inspection, checking and recording will be carried out with representatives, responsible inspectors, and PPRD officials.

(i) For quality test, three numbers of 1.5 gallon bottles oil samples are taken from oil tanker and these three samples will send to Yangon MPTA Lab, store in the office and PPRD Mobile Fuel Lab respectively.

(j) After berthing the qualified oil tanker to the jetty, checking the presence of water by using a water tester in the tank openings, at oil pump chambers and proceed to loading the oil.

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(k) Inspection of pumps and motors used to load oil, filters in flow meter, cleaning of Y-strainer is carried out daily.

(l) Install the oil suction pipes carefully and install the oil filter in the place that will come into contact with the oil.

(m) Before loading oil, fire extinguishers and emergency fire extinguishing equipment are checked for ready to use.

(n) Avoid smoking or using mobile phones near the fueling area.

(o) Acceptance of the transfer of oil tank is done and recorded by the representative of the oil company and the official of MESDP at Standard Temp.

(p) After accepting the transfer of the oil tank, the pipeline tightening work will be carried out by driving about 50000 Liters of oil, re-measuring the oil tank and carrying out the calibration work, and then continuing the oil loading work.

(q) An operator must always be present when the oil is being loaded and check whether or not the motors are running normally, flow meter flow rate, and the amount of oil loaded is recorded and if there is any difference, report to the Engineer in charge immediately.

(r) Upon completion of all the oil loading operations, the representative of oil tanker/ company and the official of MESDP will sign for approval.

(s) The amount of demand to produce oil will be issued only after the MPTA receives the PO and sign of the responsible person from PPRD.

(t) Oil tankers are checked by the security team at the entrance of the gate to ensure that they do not bring in unnecessary items and dangerous items

(u) Oil tankers are registered and inspected on the MESDP Truck Scale.

(v) In order to facilitate the entry/exit of vehicles to refuel vehicles, supervisors and refueling staff/car attendants will look around and install earth (earth cable), oil filling pipe with oil tanker and measures to prevent oil leakage during refueling so that refueling can be done instantly.

(w) The oil representative/refueling staff/driver and officials check the amount of oil to be extracted, enter the amount on the flow meter and start driving the machine to start dispensing oil from the control room.

(x) After refueling the oil tankers, our staff will measure the fueling rooms and take a record to check if there is less/more.

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(y) After measuring the oil tankers, check and register by using MESDP platform scale, check again at the exit gate, request permission form office to leave, and only allow the vehicle to leave after completing all these procedures and get approval from office.

(z) The deadline for placing demand is 15:00 and after completing the filling of demand vehicle, checks oil filling area, flow meters / Bars and then close main switches.

(aa) In order to prevent the flow meters from being damaged or damaged, the taps are removed once a week for cleaning and the taps are re-taped in cooperation with the officials.

(bb) After all the issue extraction is completed, a third-party calibration team conducts temperature measurements at 20 degrees and performs calibration for Issue Gain-Loss.

(cc) Line losses will be paid by the companies that draw 50,000 liters of oil in tank 1 on the last day before loading the ship. (if only one company extract oil, that company will incur Line Losses).

(dd) Proportionately receiving and paying night gain/night loss from companies storing fuel on days when no fuel is loaded into tank 1.

(ee) When issuing from a tank, the issuing office receives and pays a proportional share of the issue gain/loss incurred. 92-Ron oil loading/unloading in Tank-1 with Standard 20 Degree calculation registration. Google Sheet registrations are also done daily, sharing to companies, checking the inventory before issuing issues when companies post demand, and issuing oil only after mentioning it via Viber as daily routine.

4.6. Project Layout Design

The project is split into two plots: plot 1 and plot 2. Plot 1 is oil filling and office area. Plot 2 is the tank storage area and jetty.

(a) Layout of Plot 1

Plot 1will have the following infrastructure components:

- 50 of two arm bottom filling point complete with additive injection (Automotive gas oil AGO Diesel additive and unleaded petrol additive);

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- Fire/foam pump station;
- Fire water / foam tank;
- Office block;
- Guard house;
- 2.4-meter-high security fence complete with truck entrance/exit gates and emergency exits;
- Vapour Recovery Unit (VRU); and
- Associated lighting and closed circuit television (CCTV)



Figure 4.3. Layout Plan of the Proposed Project

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Office



Road



Canteen

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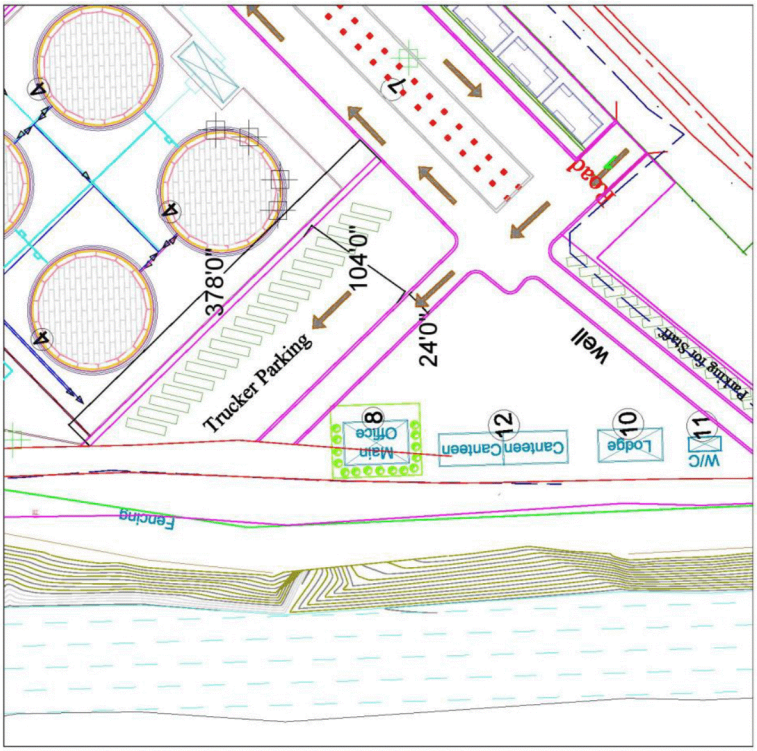
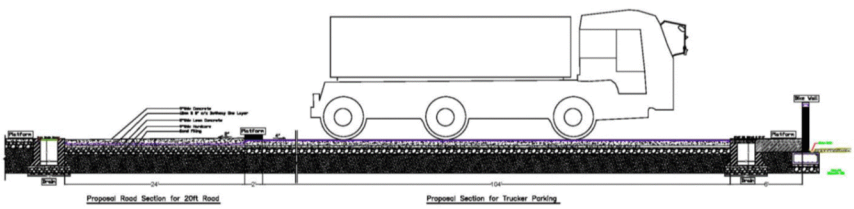
The project also provides 39312 square feet area cars parking for Truckers.







Car Parking

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Bowser Filling Shed

(b) Layout of Plot 2

Layout for plot 2 will comprise of the following components:

- Four off bunded storage areas;
  - Bund A will contain four petro storage tanks and 2 premium AGO storage tanks all 35m ×18.9H- total working capacity of 9690m^3
  - Bund B, C and D will contain 26 AGO storage tanks all 35m×18.9H- total combined working capacity of 9690m^3
- Import/export manifold;
- loading /discharging pump AGO – six of 500 l /m pumps;
- loading / discharging pump PETRO – two of 500 l/m pumps;
- Motor Control Centre (MCC) and generator building;
- 2.4 m high security fence complete with truck entrance / exit gates and emergency exits;
- Associated lighting, closed circuit television (CCTV) and bund access road and;
- An above ground 10 inch 900 m pipeline operating at about 6 bar (designed for 15 bar pressure).
- Press Pile System (8×8 inch, 20 m deep)

Solar panels with power packs will be installed on the lighting fixtures the power for the lights. Solar panels will also be installed on the office building roofs for power output.

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Air-conditioners are installed at Office and control room and the gas used for these air conditioners are R-22, R-440 and R-32. Rainwater will be collected in water tanks for the flush toilet to be installed. The FSS facility is located between plot 1 and 2. The existing road that currently surrounds the site will be extended to match the existing road outside the new boundary area of plot 1 in order to keep access to existing. The facility will also have the following components:

- Fuel system;
- Fire Protection System; and
- Electrical System.

Detailed layout plan of the project is described below.

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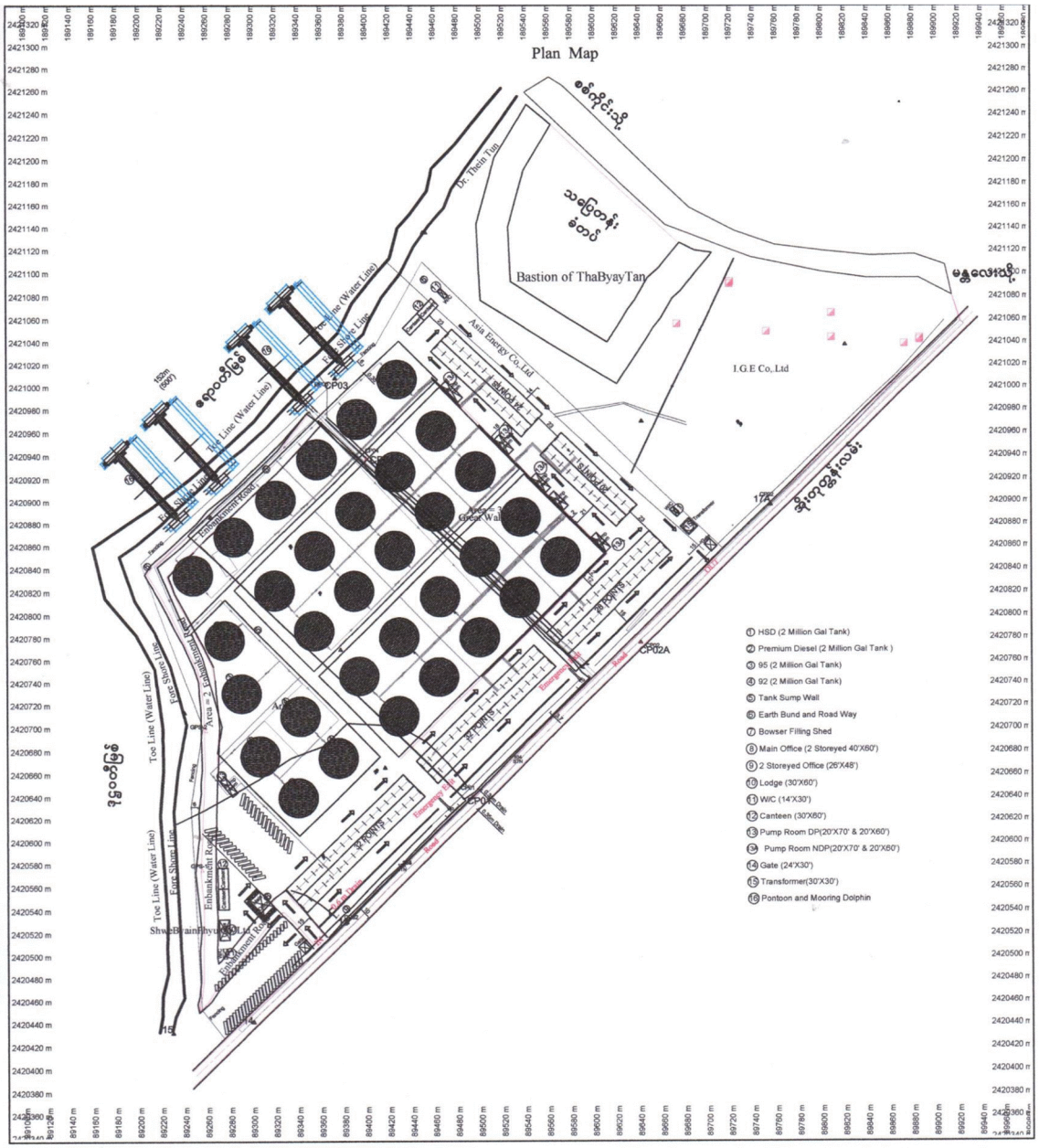

Figure: Detailed Layout Plan

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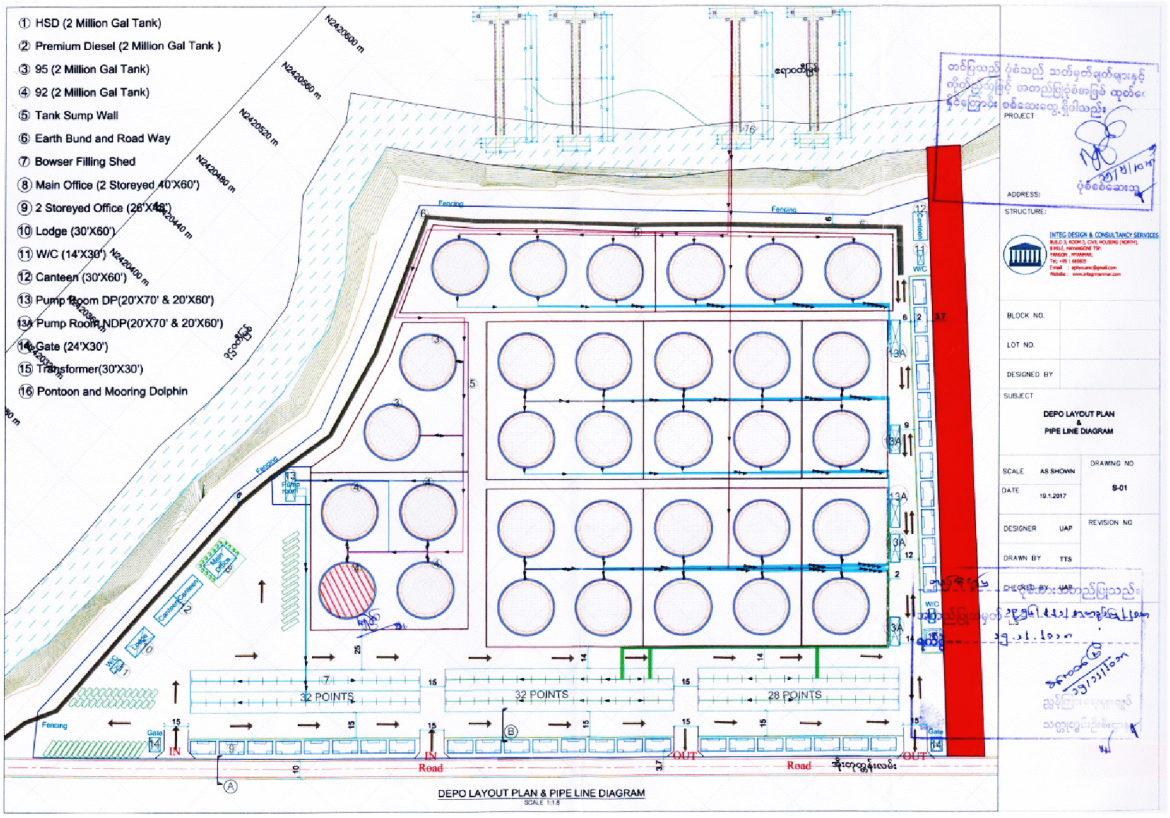

Figure: Detailed Layout Plan and Pipeline

4.7. Design of Storage Facility

API 650, Welded Tanks for Oil Storage, is a standard developed and published by the American Petroleum Institute (API) that establishes minimum requirements for the design, fabrication, erection, and inspection of welded storage tanks.

This standard only applies to tanks with uniformly supported bottoms and to tanks in non-refrigerated service that have a maximum design temperature of 93 degrees Celsius (200 degrees Fahrenheit) or less.

(a) Tank Feed

An above ground about 900 m long and 10 inch diameter section of pipeline is expected to feed the product storage tanks from other facilities. The pipeline will transfer both diesel and petro from berth to tanks. The pipeline will be located within a culvert. In-out product balances will be monitored, and flow rate meters installed. The pipeline will be inspected regularly.

The product storage tanks filled via berth offloading. This system will be comprised of two marine loading arms mounted to the berth structure. These loading arms will supply

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the import manifold where an operator can select the appropriate tank to be filled. It has been assumed that all berth are able to off-load its product within 24 hour and the largest product supply is 2400 m^3. In order to prevent VOC release from Storage tank, Breather Bars are installed at each tank and the operation staffs check the leakage daily.

(b) Tank Allocation/bund Storage

The storage tanks will be founded on ground type foundation reinforced by concrete piles (8×8 inch, 20 meter deep). This will be required due to the poor ground conditions as the area is on reclaimed ground. The working volume of oil capacity in a storage tank is approximately 9690m^3 (2 million gallons). The dimension of storage tanks are height (32 ft) and diameter (105ft). The distance between two storage tanks are (50-75ft). The proposed facility is expected to have a total working volume tank capacity of approximately 310080m^3 with the following tankage capacities;

- Diesel (AGO) 26×9690m^3
- Petro 6× 9690m^3



Petro and Diesel Storage Tank

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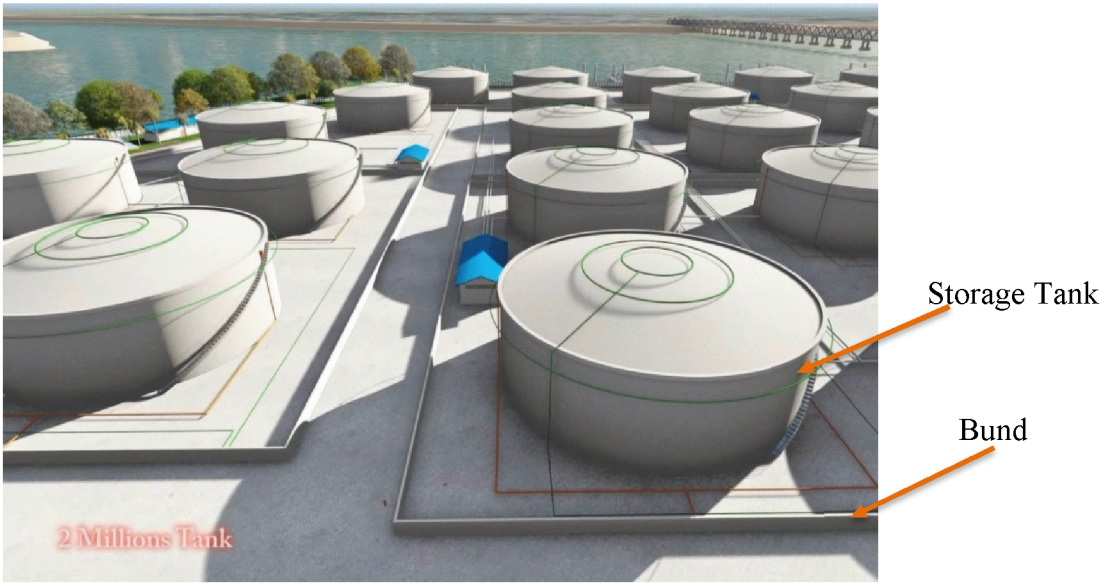
(c) Bund

Bund has been designed to contain 110 percent of nominal capacity of the largest tank contained within the bund. Bund walls will be constructed with a bung capacity of 110 percent of the tank;

- All bund floors will be sealed with concrete;
- Bunds will drain which are controlled via pipes and valves;
- Tanks have been sub-divided into intermediate bund areas; and
- Underflow / overflow weirs are installed to control flow from one sub-division to the next; and
- Additionally, the filling points are will have an automated overflow system.



Oil Storage Tank and Bund

Dyke wall Height and Design (Bund Wall)

- The height of Dyke walls are 5 feet.
- There are total 10 dyke walls and each dyke wall support two to four tanks.
- There are separate dyke walls for Gasoline and Diesel tanks.
- Each dyke walls are 20 feet apart as emergency route
- Dyke walls are designed to load up to 140% capacity of Tank.

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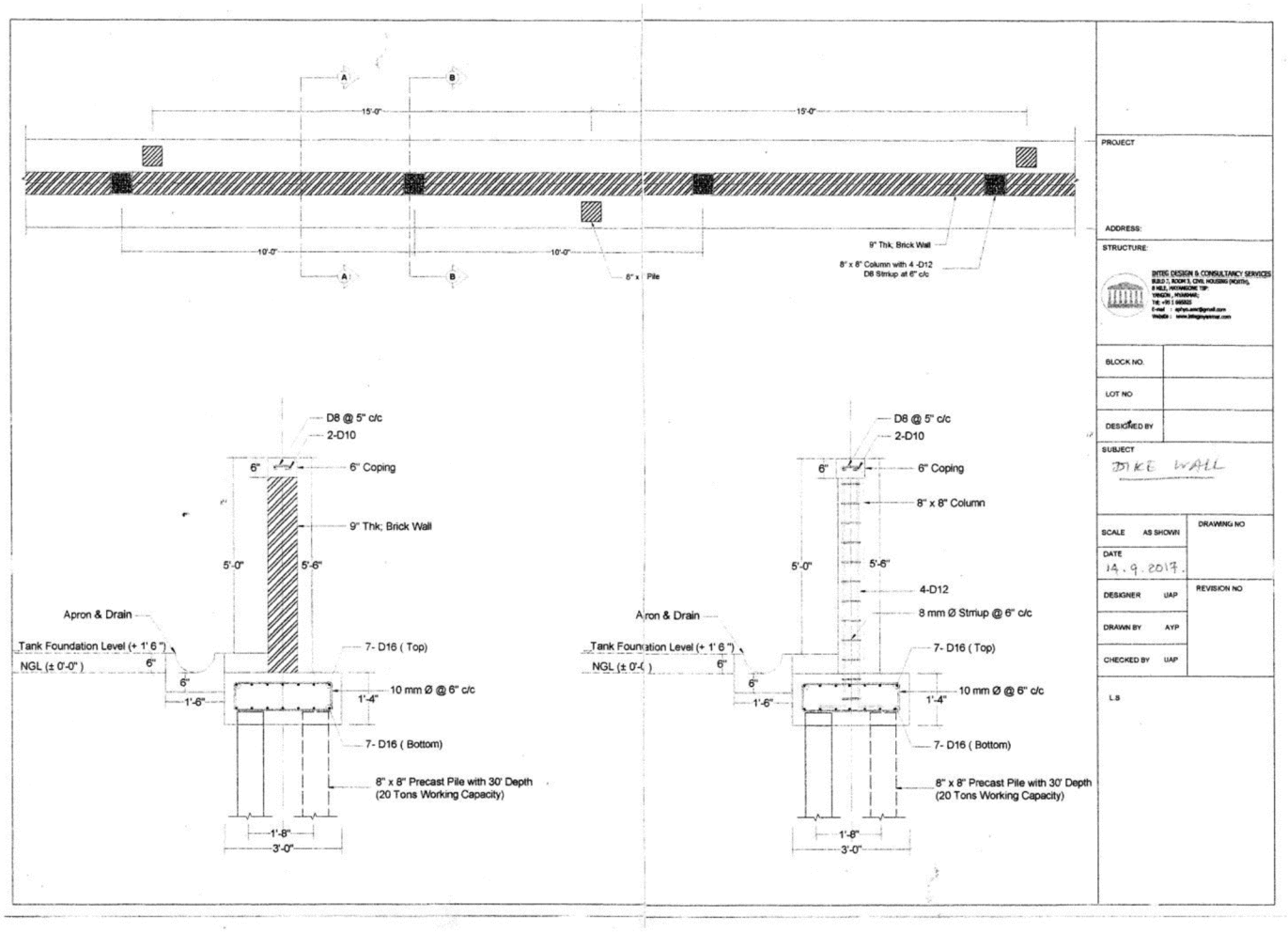

Figure: Design of Dyke wall (Bund Wall)

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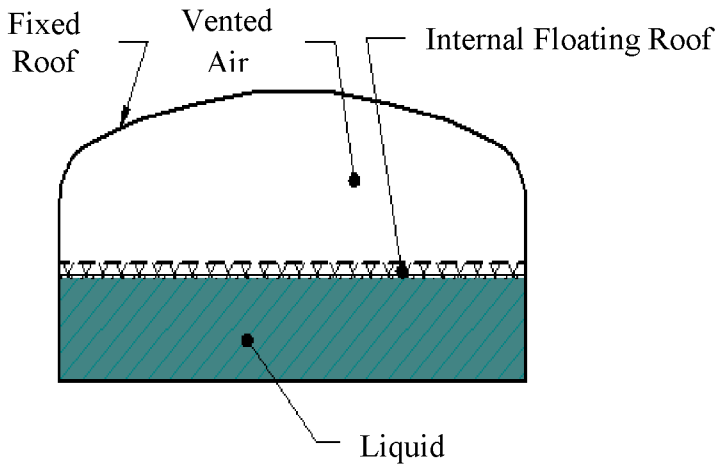
(d) Internal Floating Roof (IFR)

Storage tanks systems may require an internal floating roof and a fixed or permanent roof system. The floating roof is used in the tank structure and is floating on the liquid stored within the tank. The floating roof rises and falls with the liquid level within the tank achieving a no vapor zone. The objective of the internal floating roof is to have minimal or eliminate completely the potential gaseous zone above the stored liquid. This is a safety feature required within many industrial storage tank systems. Other benefits of a storage tank internal floating roof is, that by removing the gaseous region above the stored liquid, the tank is subjected to less corrosion or oxidizing elements.



(IFR) Storage Tanks (Engineers Edge, 2007)

(e) Tank Gauging

An automated tank gauging system will install to cover each product tank, additive tank and the fire water tank. The gauging system will consist of tank instrumentation a communications interface unit and a link into the site digital control system operator computer interface.

Each tank will have a tank gauge and temperature element installed. Information on the tank product level and temperature readings will be transmitted to tank side indicator and the communications interface unit located within the office building.

The communications interface unit takes the communications link from the tank gauges and transmits this to the DCS which then displays information on the computer interface. This unit also provides hard wired relay outputs for the following items:

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- Low level from any product tank;
- High level from any product tank; and
- High level from any product tank.

The low level outputs are interlocked with the associated products pumps to prevent the pumps running dry and the high and high level outputs are covered by the tank overfill protection described below. The site DCS computer interface will provide tank level and temperature information in the control room and will be configured to provide a range of 'soft' alarms for each tank on the interface itself.

(f) Tank Overfill Protection

MESDP has assumed that the overfill prevention system on the product storage tanks will be deemed by the hazard and operability (HAZOP) and layer of protection analysis (LOPA) studies as an instrumented protective function (IPF). This system will meet the requirements of a specified safety instrument level (SIL) established in the LOPA study and will be managed in line with process safety lifecycle requirements. The design of the overfill protection system, the number and type of equipment and hardware required will be confirmed during the detailed design stage. The system will be safety integrity level (SIL) 1 compliant. The overfill prevention philosophy for each product storage tank consists of alarms generated from the tank gauging system with alarms and a trip function generated from the independent tank overfill prevention system. The independent tank overfill prevention system for each tank is composed of a High level switch, logic, fail close remotely operated shutoff valves (ROSOVs) located tank side on the tank inlet and outlet lines and terminal alarms.

The tank gauging generated high level alarm creates an audible and visual alarm in the control room for each tank through the DCS computer interface. The High level alarm from each tank also activates the common tank High level horn and beacon located in the terminal area and the common tank High level short message service (SMS) alarm message sent to the remote alarm device located on the jetty.

The tank gauging generated High alarm from each tank activates the common tank High level horn and beacon located on the jetty. The tank overfill protection system high level switch is a radar type gauge that monitors the tank level and transmits this information to the logic on a 4-20mA signal. The High level trip point is set within the logic and upon

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activation will close the ROSOVs on the tank in question and activate an alarm on the site annunciator panel.

The tank level reading from each High level switch is provided to the DCS, enabling the information to be viewed on the DCS computer interface. A comparison between the High level switch reading and the tank gauge reading can be made. In order to prevent possible damage to the pipework or pumps in operation as a result of increased pressures within the system due to product surging in the pipework, the closing speed of all ROSOVs will be limited.

Storage Tank Design

- Single Size 2 million Gallon (Ø33.2m x H 10.6m)
- Diameter 33.2m (108' 10")
- High 10.7m (35')
- Cone roof tank (with internal floater for Gasoline tank)
- Materials: A36 Carbon Steel
- Foundation: Press pile (400 Nos per tank)
- Total Number of tank: 6 Nos. (Gasoline), 26 Nos. (Diesel)
- Although the tanks are constructed and managed by various companies, Tank design, Bund and Foam Facilities are installed uniformly for the whole project.

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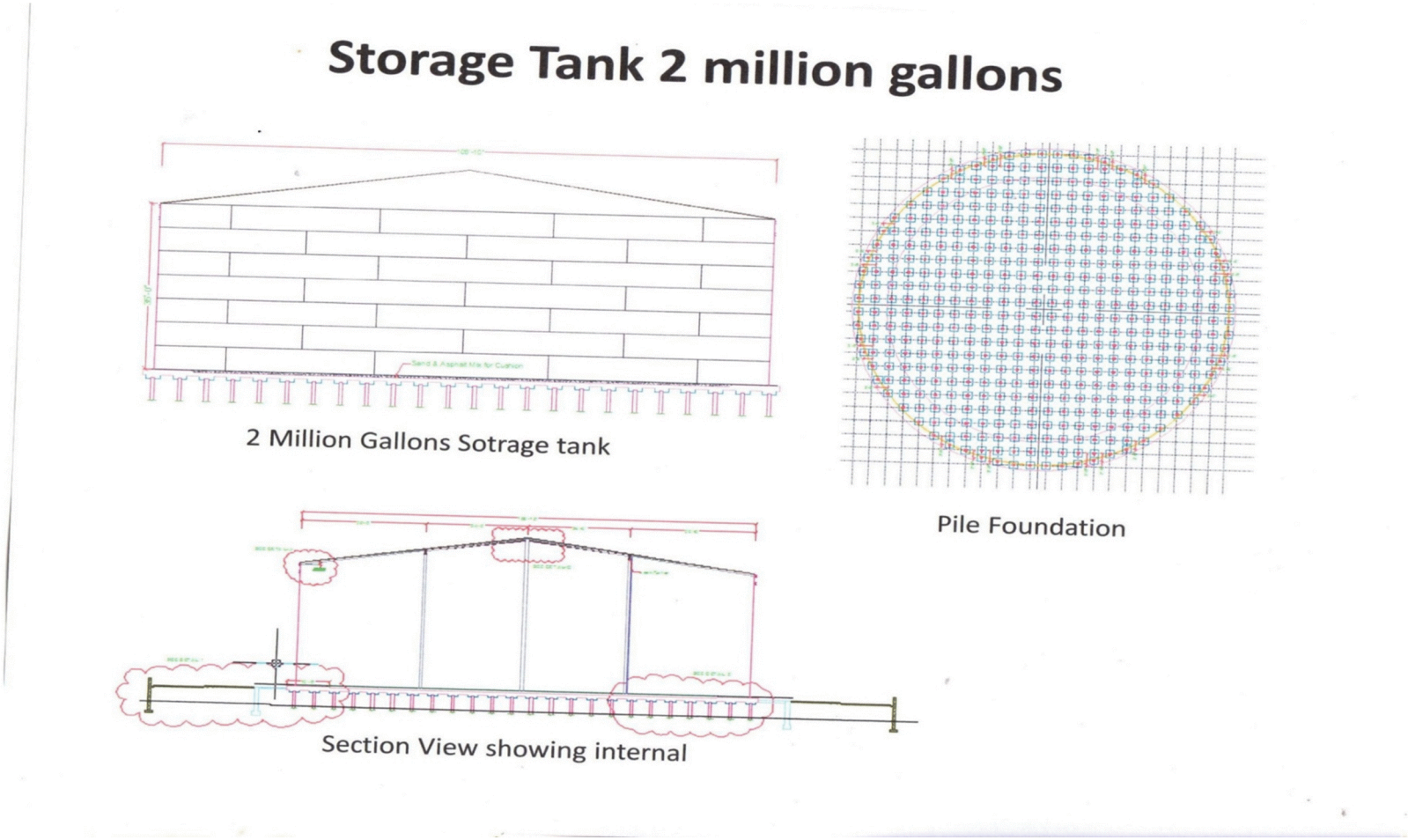

Figure: Design of Storage Tank

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The storage tanks are constructed with pile foundation for flood and earthquake resistance. Wing Walls are also installed to separate the earth bedding between the tanks in case of any failure.



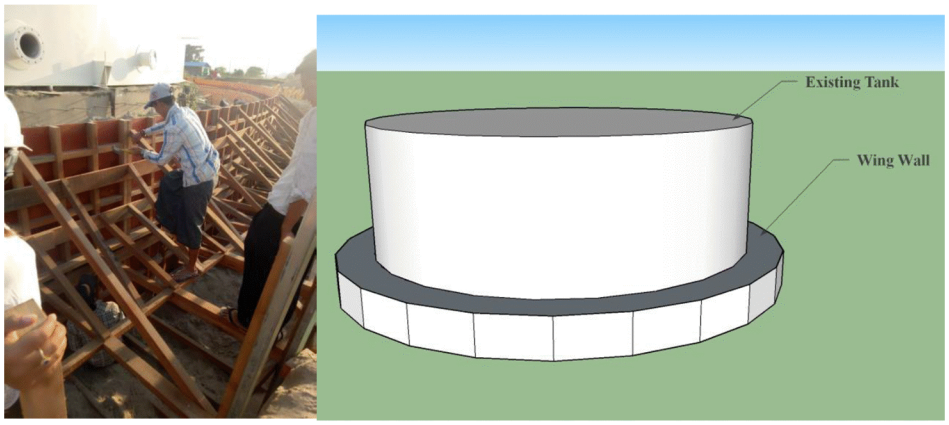

Figure: Storage Tank Construction

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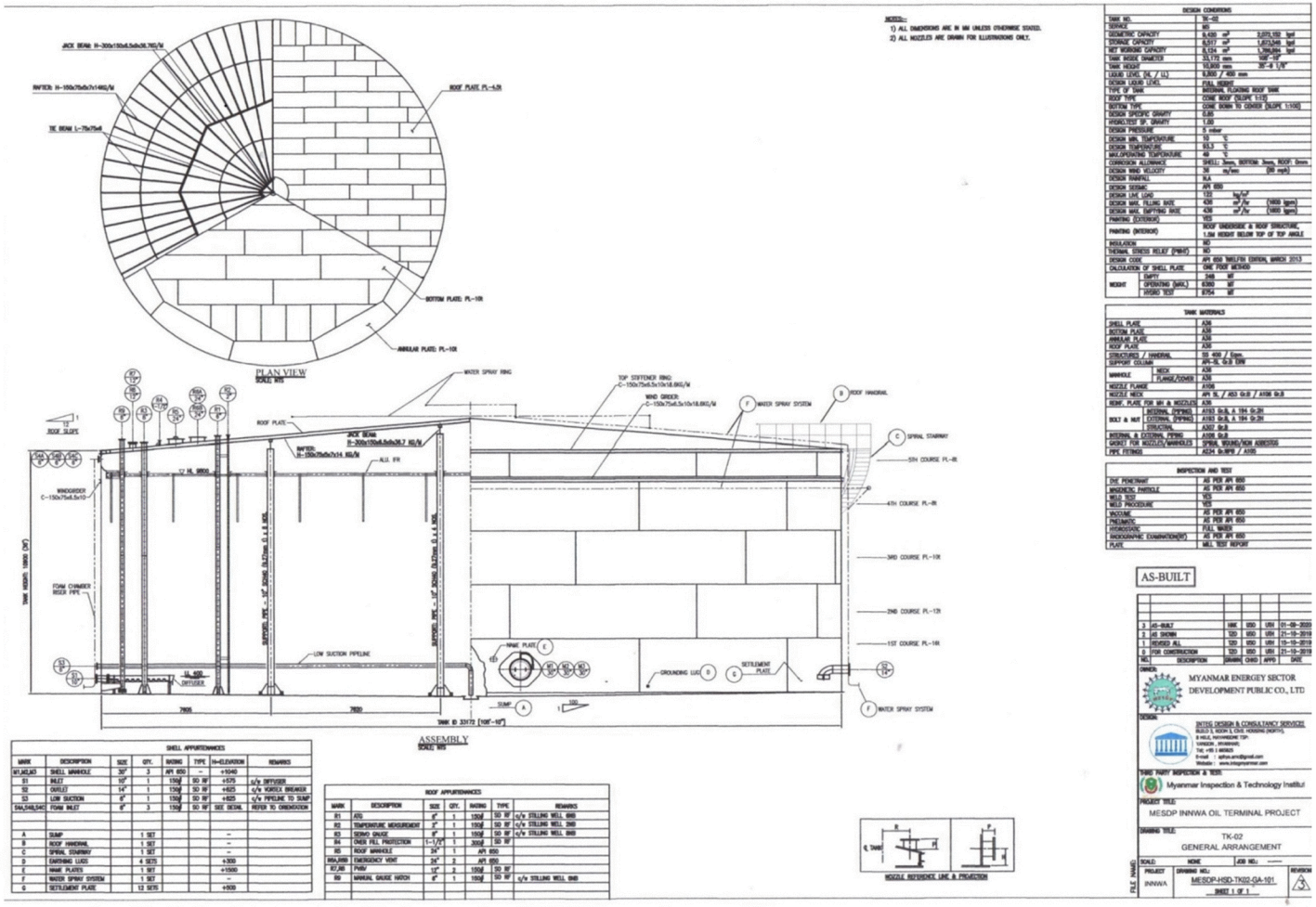

Figure: Engineering Drawing of Ground Tank Design

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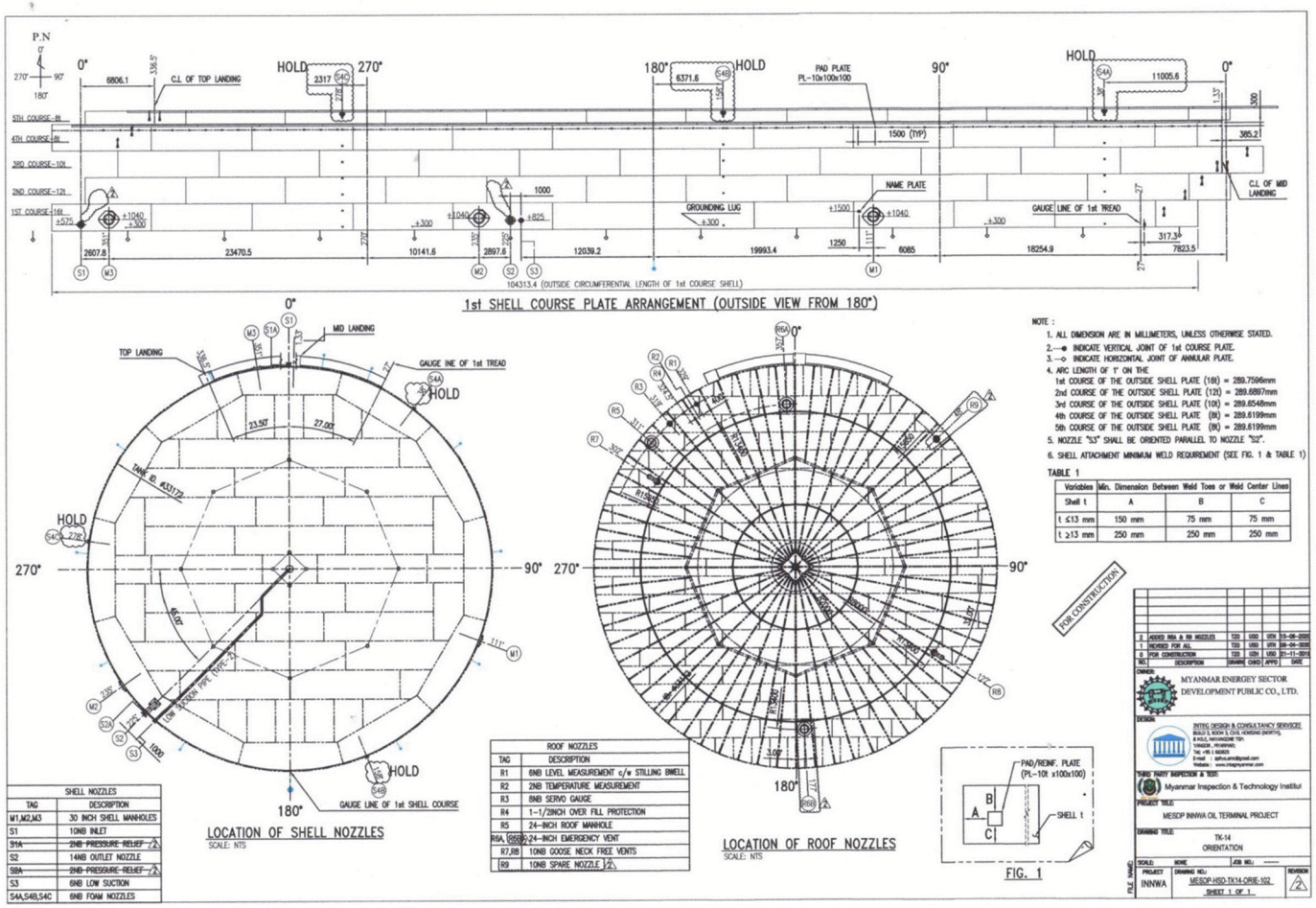

Figure: Shell Course Plate Arrangement

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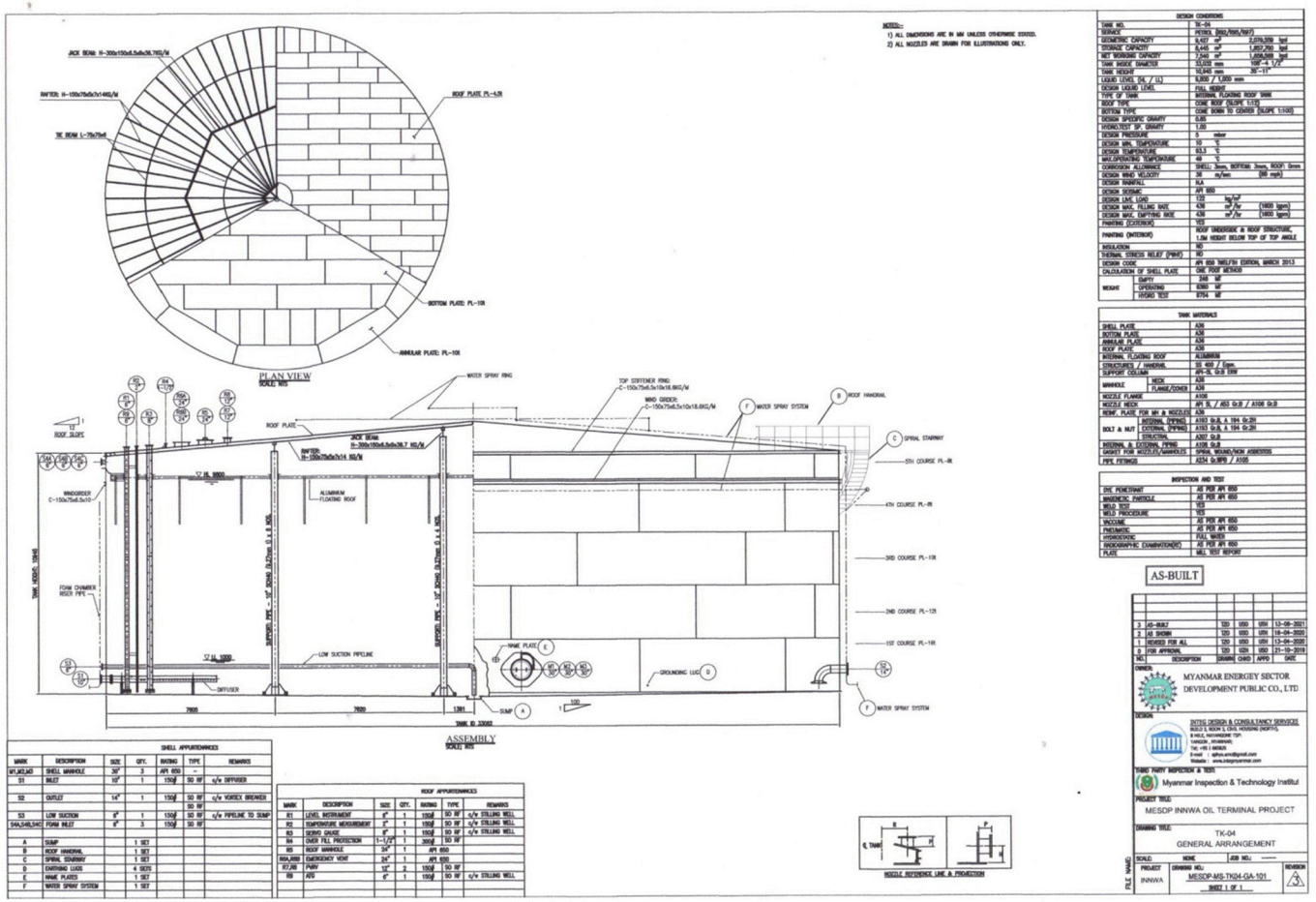

Figure: Engineering Drawing of Ground Tank Design (Section)

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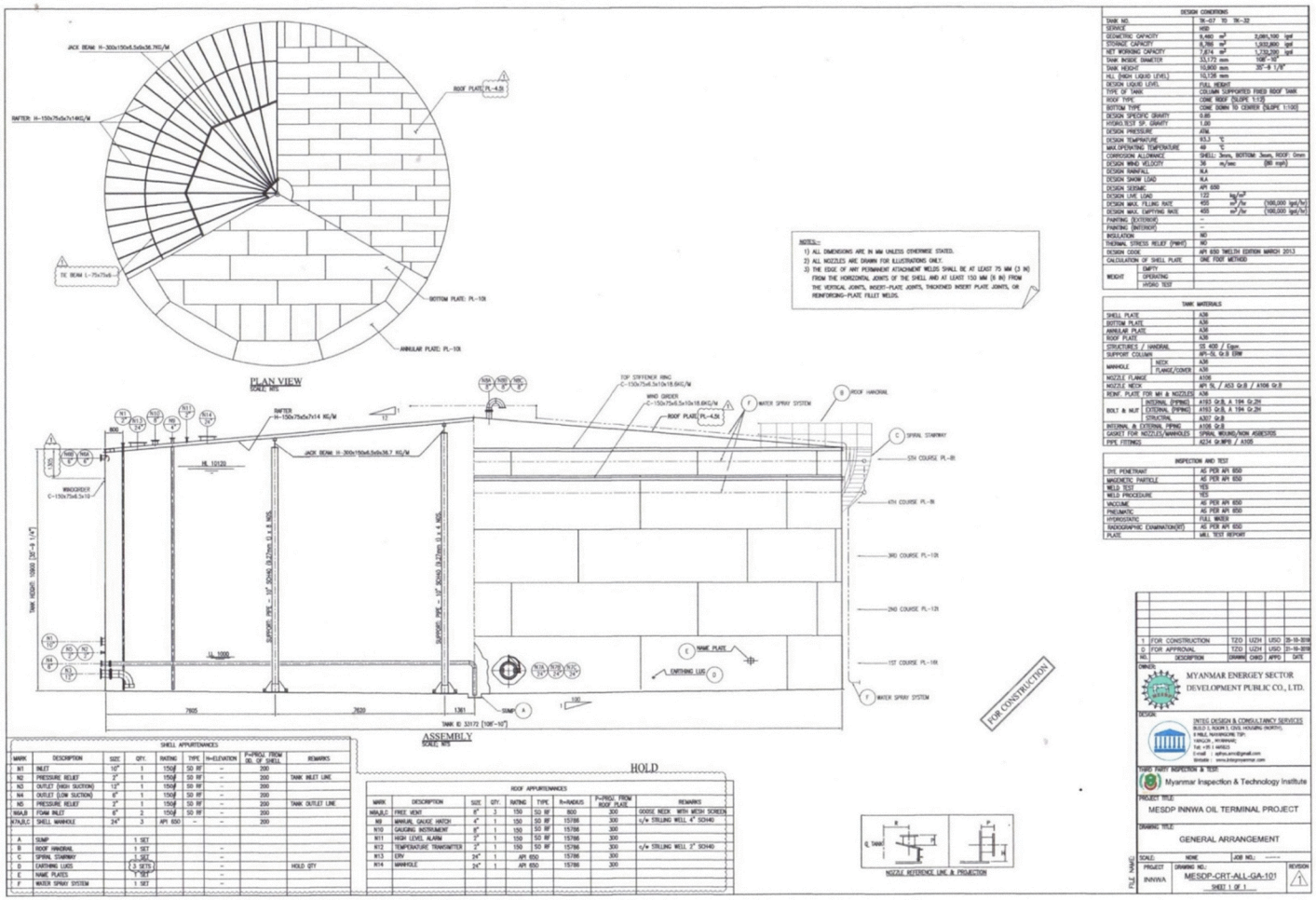

Figure: Engineering Drawing of Ground Tank Design (Section)

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Tank Protection

Foam Protection System

- Design Flow rate : 5lpm /m2
- Foam chamber 2No
- Discharged rate 2200 Lpm x 2

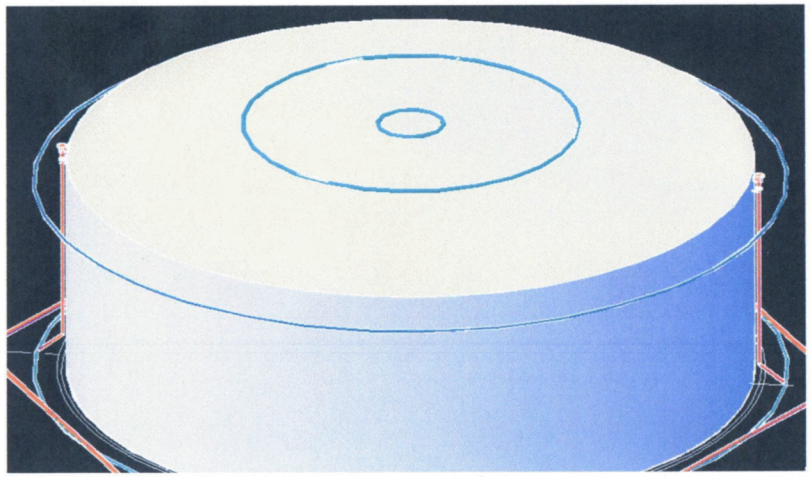

Figure: Foam Protection System

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4.8. Jetty and Retaining Wall

The terminal is now expected to be supplied by berth located adjacent from the FFS site, supplied by an above ground 10 inch pipeline, approximately 900 m in length, operating at about 6 bar pressure (the pipeline is designed for a pressure of 15 bar) connect to the main depot. While the jetty (length 18m and width 6m) will be operated, all fire protection, oil spill and accident of oil shipping for the jetty will be the responsibility of MESDP. The facility of jetty will also have the following components:

- two pontoon for river burge
- Four sub terminals
- protection: Foam Monitor (350 gpm) 2 No. for each jetty

Approximately two oil tankers per day will be conveyed in jetty and the dimension of oil tankers are (length 150-200 ft), (width 30-50ft) and (height 9-10ft). It will take approximately 3 days for a vessel to unload the oil and there is around 40 vehicles access to the project site daily.

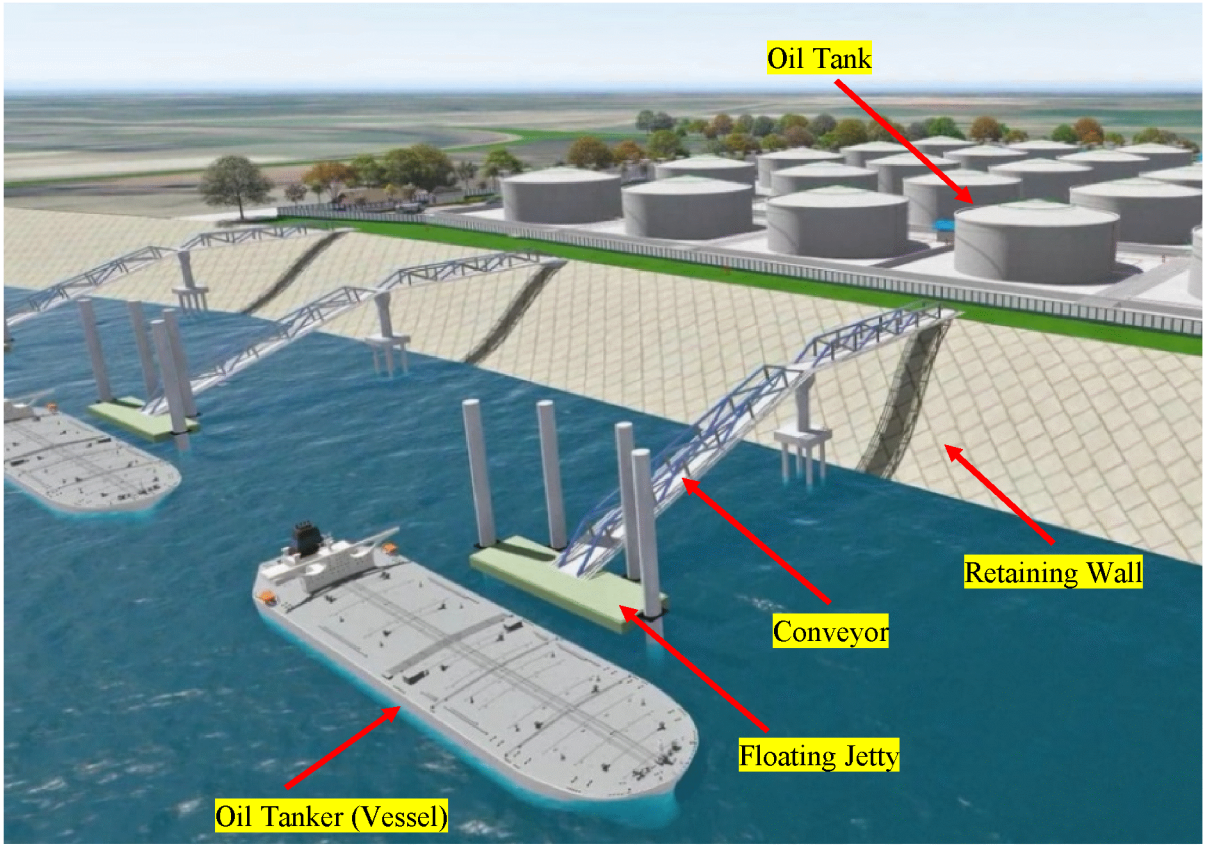

Figure 4.4. 3D Model of Jetty

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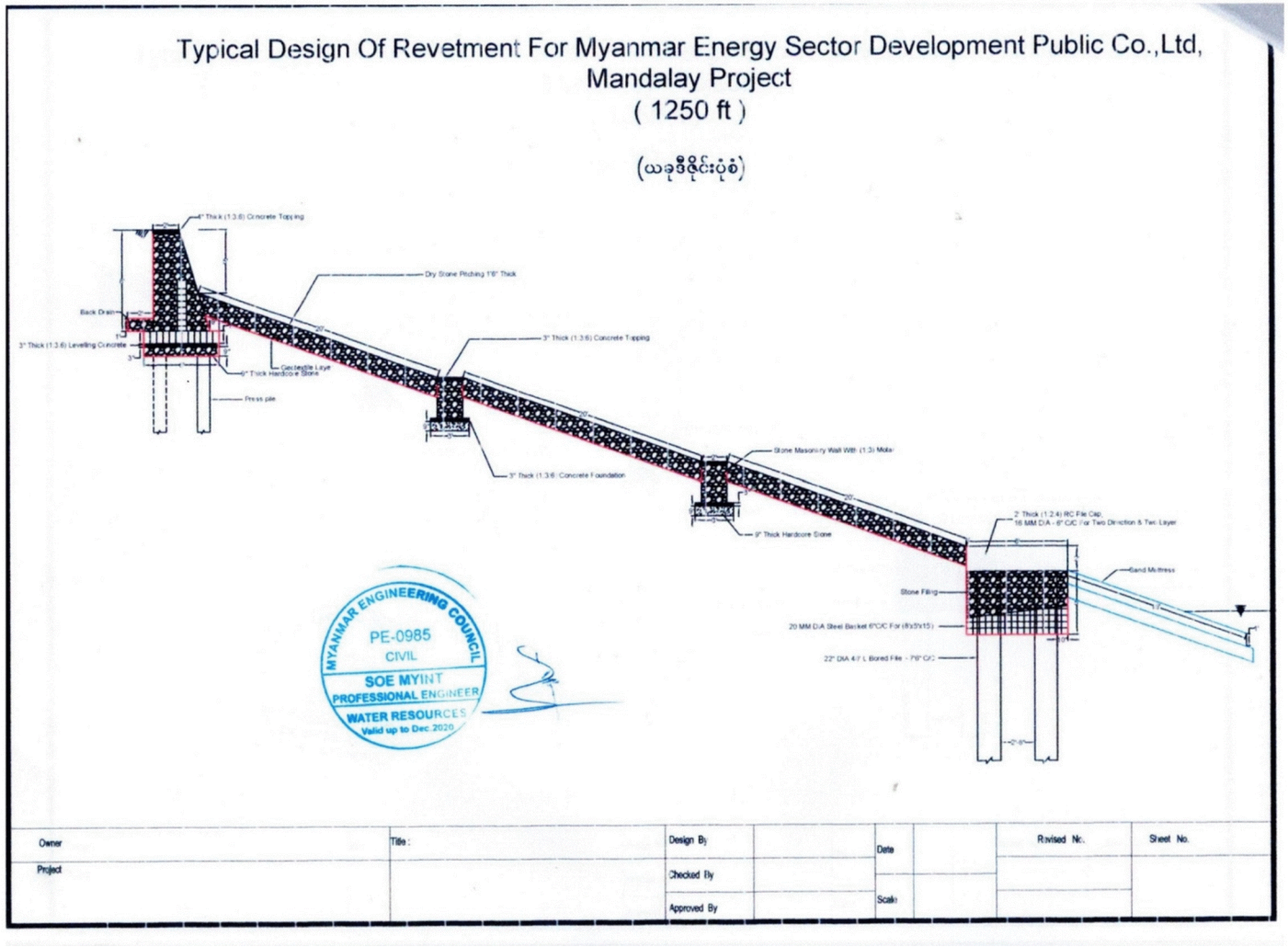
Retaining walls and jetty are designed and constructed based on the flood design. Four jetties are already constructed.



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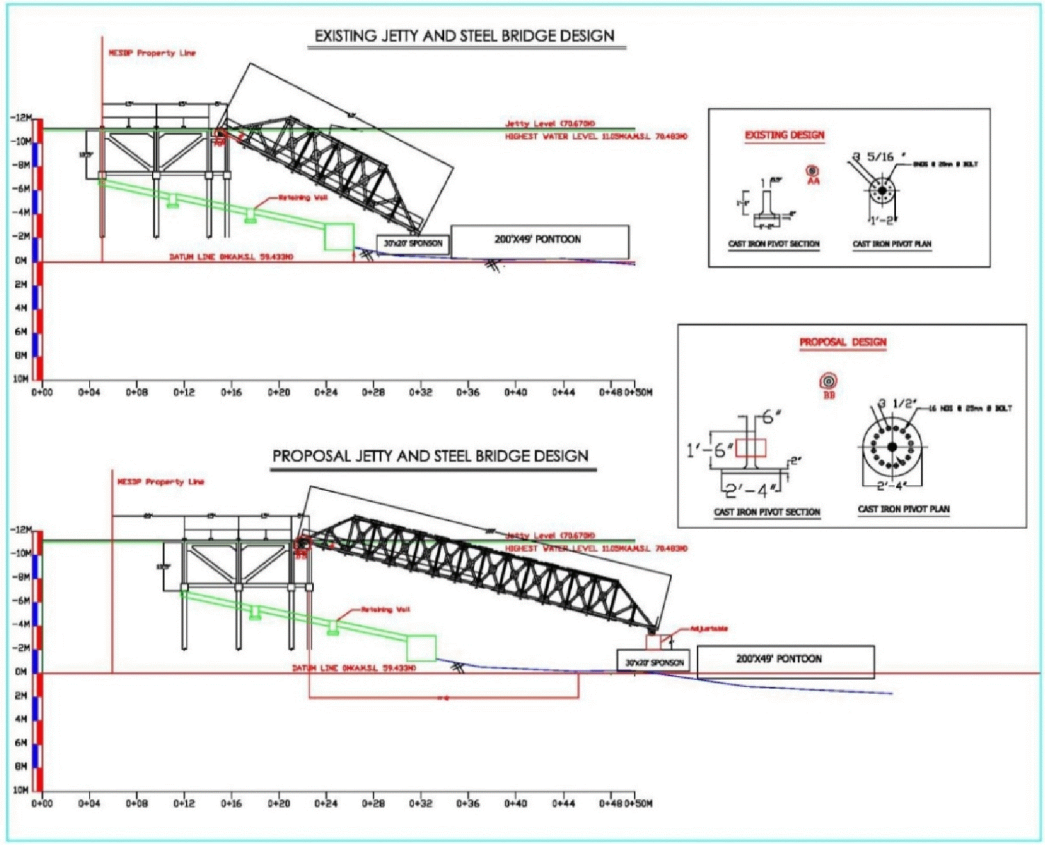

Figure: Jetty and Steel Bridge Design

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Phase of construction retaining wall

DWIR is constructing retaining wall at the opposite side of the project, Innawa City. As the project exist at the confluence of Ayeyarwaddy and Myit Nge River, the project constructed retaining wall at the side of Ayayarwaddy River Bank in 2019 and there is also plan to construct the retaining wall at the Myit Nge River Bank before 2025 rainy season.

As the project situated in confluence of Ayeyarwaddy and Myit Nge Rivers, three numbers of 300 feet long groyne are proposed to construct before rainy season in order to prevent the erosion. Each groyne is 300 feet long with 22" Ø x 50' bored pile. Bored piles will be placed in average depth 20 feet penetrate into ground, water depth 20 feet and 10 feet above summer water line and each bored piles are driven 9 feet apart. Pour lean on the top of river bed (average depth 20 feet penetrate into ground). Install steel basket with 6 inches mesh on top of the lawn with 16 mm Ø steel and then fill the steel basket with large stones and build them up to 10 feet above the Load Waterline Length (L.W.L) to prevent erosion.

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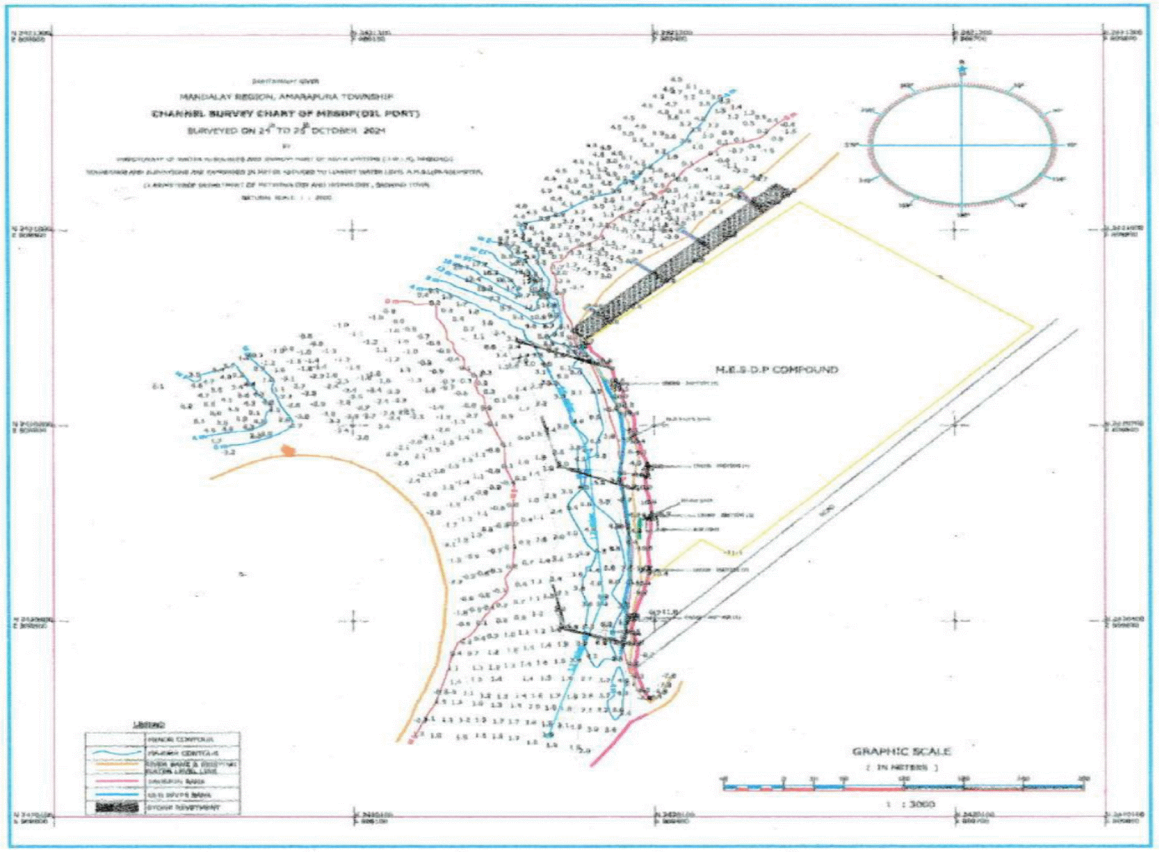

Figure: Survey Map for Water Depth

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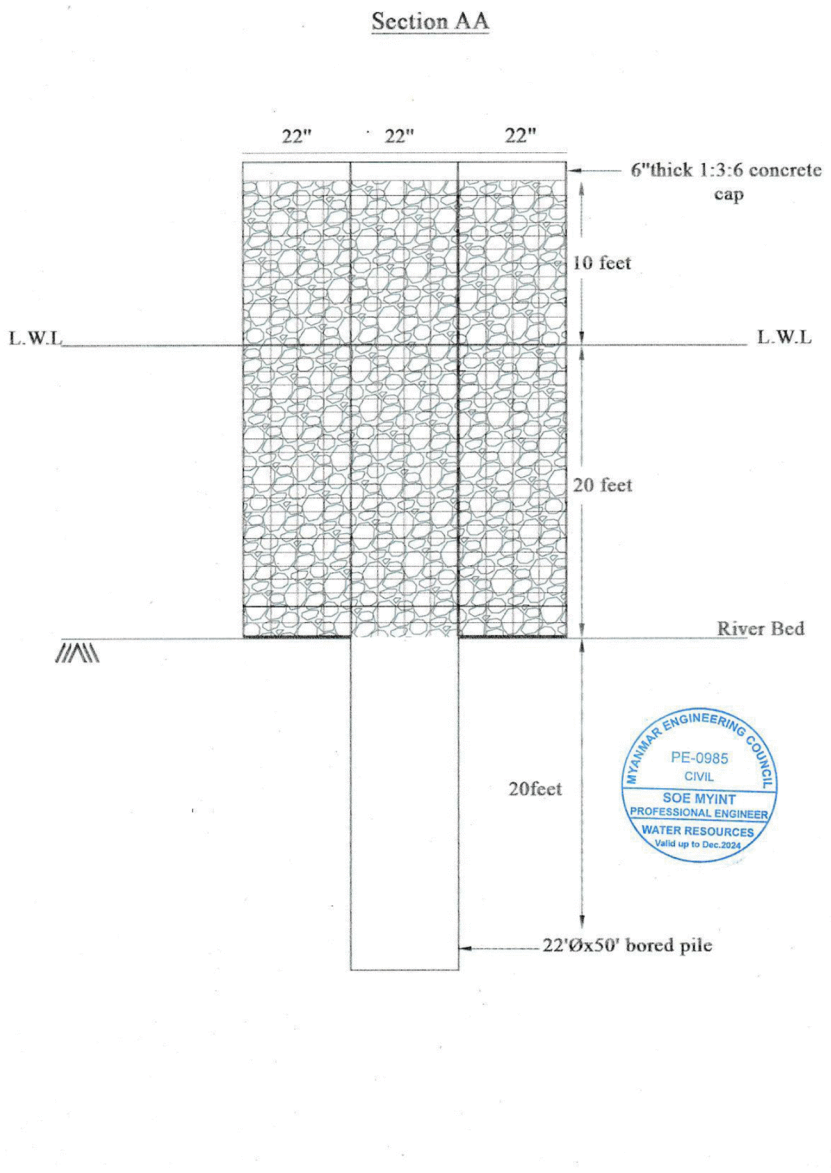

Figure: Cross Section of groyne

4.9. Filling Points

There will be 2 trucks loading point each with two loading arms. The filling point will consist of concrete with packaged unit steelwork gantries consisting of a covered roof, and multiple counterbalanced filling arms. Each filling point will have the following main equipment

- Counter balance filling arms;
- Flow meters;

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- Control valves;
- Flow controller;
- Basket filters;
- Vapour stack;
- Fill controllers; and
- Additive injection

The loading facility will also have overspill prevention and earthing protection, which will directly stop the on-going loading operation if triggered. The filling of trucks will be controlled by land controllers and metering equipment designated to each filling arm. The fill controllers will be located on the filling point and connected to the site automation system, enabling the identity of the driver to be registered and filling permission granted before filling commences. This connection also allows pre-programmed fills from the driver's company system to be entered into the fill controller for individual drivers via the terminal automation system's internet based ERP connection. All fills not pre-programmed will be entered into the fill controller by the driver prior to filling.

Following the filling of a road trucker all volumes are logged in the automation system for bill of lading printing, as well as stocks and accounting purposes. The fill controllers control the flow of product on a batch fill process where the fill is controlled to a preset flow rate. Each fill controller is capable of controlling up to 50 loading arms simultaneously. Control is achieved by a flow control valve and feedback to the fill controller from a flow meter. The flow meter provides accuracy to a fiscal level and is used for throughput accounting and stocks control purposes. The control valve is a digital electro hydraulic set-stop type where the hydraulic medium used is the product line pressure. A temperature element will provide feedback to the load controller allowing temperature compensation calculations to be accurately made. Each loading arm will be suitable for a maximum flow rate of 400 l/min.

Basket filters will be installed on each meter stream to protect the flow meters and control valves. Filling will not be permitted unless the vapour-collection hose has been connected to the vehicle and there is a free passage for the displaced vapours to flow from the vehicle into the vapour-collection system. There is 50 to 70 trucks fill oil at the filling points daily.

4.10. Fire Protection

Tank design

Weak Weather Design is used for storage tank roof as there is a risk of explosion in case of fire. During fire the pressure rises and the roof collapses without causing an explosion

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to sides. There is a cooling system in order to prevent the spreading of fire to the surrounding tanks although there is less explosion risk. Sprinklers are also installed at filling points. These sprinklers contain foaming system and set up for automatic fire extinguishing in case of fire. Moreover, auto cut-out bars are installed in all pipelines although there is no oxygen within pipeline and less chance of fire. However, there is possibility of entering oxygen into the pipelines when burning occurs outside of the pipelines.

For the firefighting system, fresh water will be supplied to the depot from Transnet. Approximately 10000m³ will be required to fire fight the worst case scenario fire for one hour. Additional water supply from Transnet's river water system could also be available. The fresh water firefighting system will have the following features:

- Fire Pump Station;
- Fire Water Distribution;
- Tank Foam Facilities;
- Tank Cooling;
- Pump Manifold;
- Bung Foam; and
- Bunds.

(a) Fire Pump Station

- Three fire water pumps: two duty pumps with a pressure of 12,250 liters/minutes and one standby with a pressure of 12,250 liters /minute;
- Two foam pumps: one duty pump with a pressure of 470 liters/minutes and one standby pump with a pressure 470 liters/minutes;
- 26m³ of foam stocks stored on site;

Additionally, a tie in from the port firefighting foam system has been incorporated into the firefighting in an event of an emergency.

(b) Fire Water Distribution

A 200 cm diameter fire water ring main around all thirty portions of the site has been catered which will be used for the portable firefighting equipment if necessary.

(c) Tank Foam Facilities

- All tanks will be fitted with foam top pouring systems; and
- Manifolds will be located at a safe distance away from the tanks and these valves will be manually operated.

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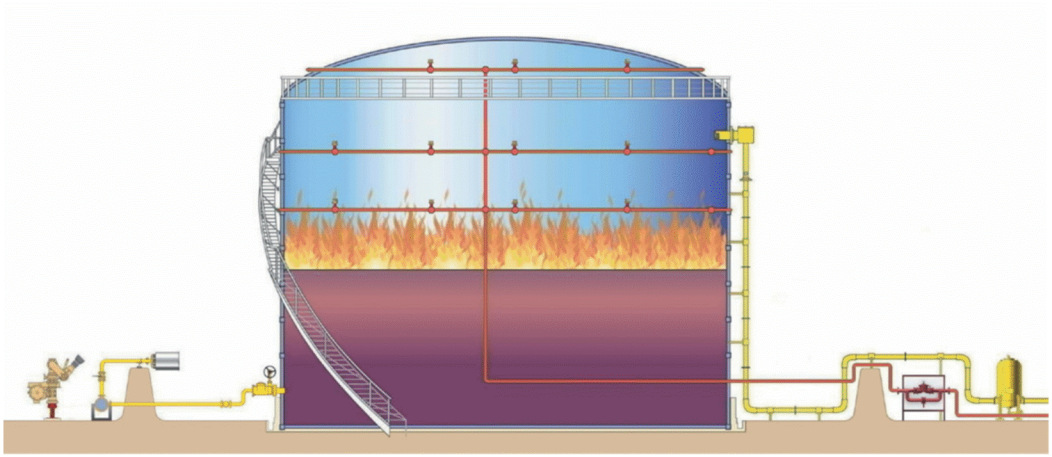

Tank with Foam Top Pouring System

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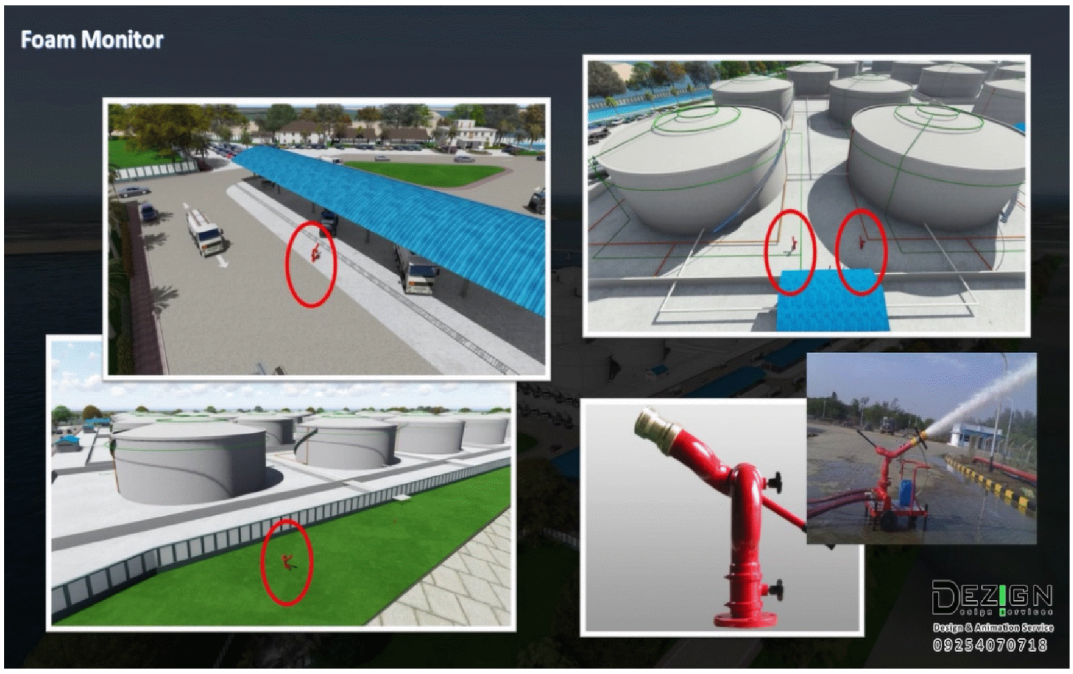

Foam Monitor and Foam Hydrant

The only chemical used in the proposed project is Fluroprotein Foam which will be stored in 3000 gallon storage tank and connecting with two Foam Bladders and foaming stations.



Figure: Fluroprotein Foam Storage Tank

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Tank Protection

Foam Protection System

- Design Flow rate : 5lpm /m2
- Foam chamber 2No
- Discharged rate 2200 Lpm x 2

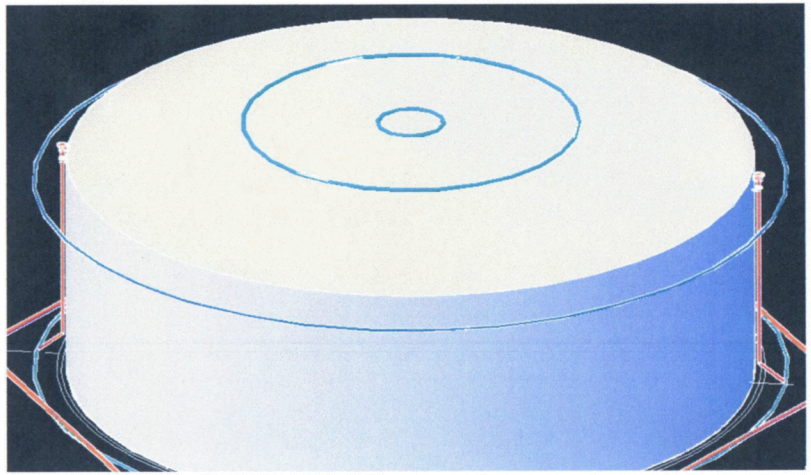

Figure: Foam Protection System

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(d) Tank Cooling

- All tanks will be fitting with tank cooling rings with one mini ring on the roof of the tank and one main ring running around the perimeter of the tank;
- Manifolds will be located at a safe distance away from the tanks and these valves will be manually operated; and
- The valves for the tank cooling will be automated valves that can be controlled from the control room.
- Water is used as tank cooling agent.

(e) Pump Manifold

The pump manifold will be protected against fire by fire detection and monitoring.

(f) Bund Foam

- All bunds will be fitted with fixed bund foam pourers;
- Manifolds will be located at a safe distance away from the tanks and these valves will be manually operated; and
- The valves for bund foam pourers will be automated valves that can be controlled from the control room.

(h) Fire Alarm System

A zoned fire alarm system will be installed will be consisting of the following:

- Break glass units situated throughout the terminal;
- Break glass units and smoke alarms within the office building;
- Fire alarm panel located in the control room;
- An early detection smoke alarm system in the switch room and MCC; and
- Fire alarm sirens within the offices building and site areas.

The break glass units will be separated into 20 detection zones, located in the following areas.

- Filling points entrance and exit;
- Pump skid;
- Bund entrance / exits;
- Office building;

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- Workshop;
- Site exit; and
- MCC / switch room.

In addition to the above early smoke detection systems installed, the MCC / switch room will be linked into the fire alarm system and will have its own zone. The fire alarm sirens will be located on the office building roof; road loading area and tank farm area to inform personnel when a site evacuation is required. The activation of the office building fire alarm zone will also interlock to the air conditioning. Activation of the fire alarm system will create a site emergency shutdown.

Water for Fire Fighting

Currently, Ayeyarwaddy river water will be pumped and used directly for fire fighting. 500,000 gallon water storage reservoir is planned to construct in the future to store water for fire fighting.





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Figure: Pumped water system form Ayeyarwaddy River

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Figure: Proposed location of Lake for Fire Fighting Water

Control Room

Tank cooling and bund foam are controlled from control room witin the project compound. Although the storage tanks are managed by various companines, the control room is supervised and managed by certified Fire Safety Manager (FSM) from MESDP. The assigned people for supervising control room are described below.

No.	Name	Qualification
1	U Han Wint Aung	Certified Fire Safety Manager
2	U Naing Thu Aung	Certified Fire Safety Manager

4.11. Waste Management System

MESDP store and distribute HSD, PD, 92 and 95 and these four products are already final products and ready to distribute so there is no waste for project operations except few domestic wastes from the workers.

(a) Oily Water Separators

Three oily water separators will be installed at the development. Two of the oily water separators will be located at the main storage area, and the third separator will be located within the road gantry area. Contaminated and potentially contaminated water will flow into the system. The sources of the contaminated and potentially contaminated water are from the following areas:

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Bunded area:

- All bund drainage is controlled and flows via channels and piping to main bund separator;

Road loading gantry:

- Drains directly to road loading gantry separator;
- Drainage system designed so to allow a holding capacity of 2min of maximum pumping;
- Separator designed so that excess flow into the separator will be drained and stored in site first flush basin and then pumped through gantry separator at a later stage.

Pump and Manifolds Slabs

- Drains directly to relevant separator;
- Drainage system designed so to allow a maximum holding capacity of 2 minutes of maximum pumping.

Hard standing for truck driveways in depot:

- All hard standing driveways inside depot drains towards first flush basin;
- First 4mm of rain from hard standing driveways is stored in the first flush basin; the remainder will then be diverted to storm water.

For liquid waste, only oil waster separator is used and the mixture of oil and water from internal drains within the dykes are collected in the 4 ft x 4ft x 4ft sedimentation pond. The waste water then enters into oil water separators which have 3 chambers. In the first chamber, the mixture of oil and water enters. In this stage, oil is floating on the top surface and only water sits at the bottom. The water enters into the second chamber though the hole at the bottom of first chamber. Treatment process is carried out at second chamber and then the treated water flow into the third chamber. From the third chamber, the water disposed into river through drain line.

The oil from the first chambers are manually collect with sponge (or) collect with tank and then transport with vehicles to the treatment plant and reuse.

The separators would be installed to treat contaminated surface runoff and unintentionally contaminated water from the fuel storage terminal more specifically the bund area. This is to ensure to that contaminant concentrations are within the limits for disposal to the sewer. It is anticipated that the throughput capacity of the separator would be no more than 15,000m³ per annum and approximately 9m³ per day per separator.

The separator is designed as a one in ten year intensity rainfall separator with three chambers. The oily water separators will have the following capacities: two meters wide

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by one and a half meters in depth. The primary chamber will be three meters in length, the secondary chamber two meters in length and the tertiary chamber one meter in length. If any severe fuel spill occurs within the bunded area, the spill will be pumped out by an appropriate hydrocarbon removal contractor. Additionally, the separator will be constructed in reinforced concrete and will be designed according to SANS 10089.

The Figure below illustrates the process that occurs in an oily water separator. The oily water separators to be installed on site would be used to treat contaminated water. The Ultra spin Technology to be used, is able to remove <10mg/1 of oil and grease, without the use of chemicals.

The Ultra spin separator produces a separation force of more than 1000 times of the force of gravity, thereby separating smaller oil droplets to 15-microns in size from oily water. The oily water is pumped into the large diameter end. This initiates a spinning vortex. This spinning vortex is accelerated as it moves down the tapered separation tube fighting the heavier water to the outside walls while the lighter oil movies to the centre. The separated oil is removed and the treated water is discharged out the other end of the tube. Additionally, all water released from the separator will be tested before discharge. The figure below shows a diagram of the process of oil water separation within the Ultra sin Separator.



Figure: Sedimentation Pond

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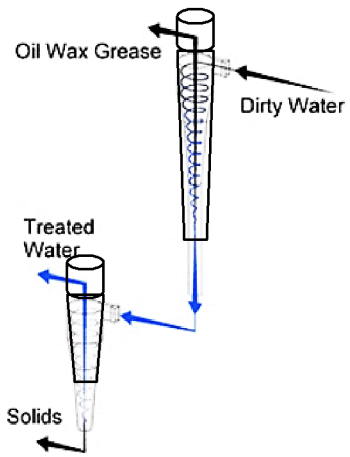
Figure: Oil Water Separator

Hazardous Waste

Chemical used for the project is Fluoroprotein Foam and there is no other chemicals used for this project and so there is no hazardous waste from this project in the normal operation condition. Tank washing was carried out once for a 92 Ron Storage tank in 19th August 2022. Periodic tank maintenance and cleaning generate sludge containing fuel residues and sediments. This should be handled as hazardous waste, with disposal through thermal treatment, incineration, or specialized landfills. Wastewater from tank cleaning should be treated through the Oil Water Separator and additional filtration systems before safe disposal. Discharge water quality should meet NEQEG Standards, with regular testing for oil content, heavy metals, and other pollutants.



Ultra spin Separator

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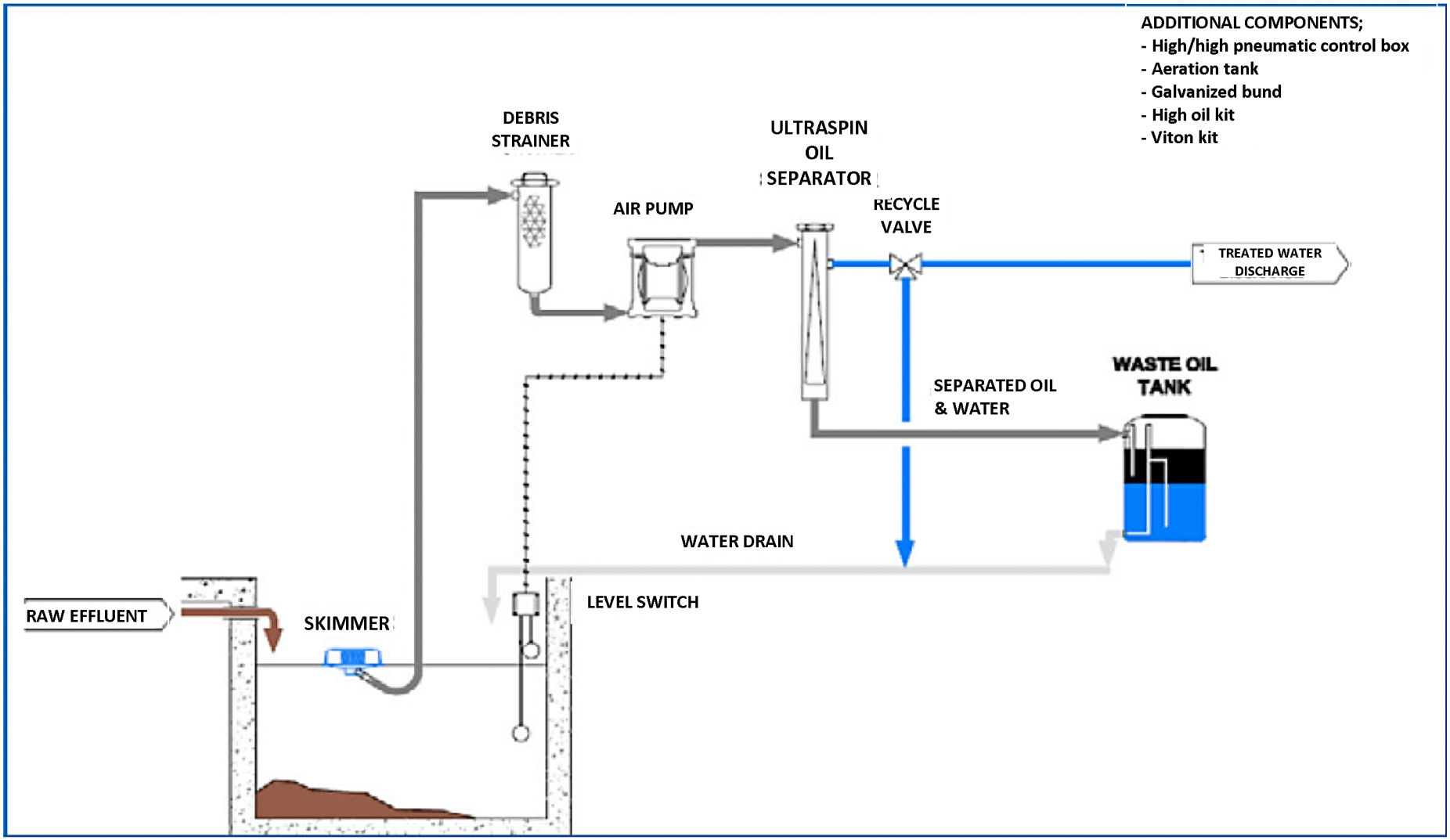

Figure 4.5. Oily Water Separator Process Diagram

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4.12. Drainage Systems

The flow chart of drainage systems is shown in the following figure.

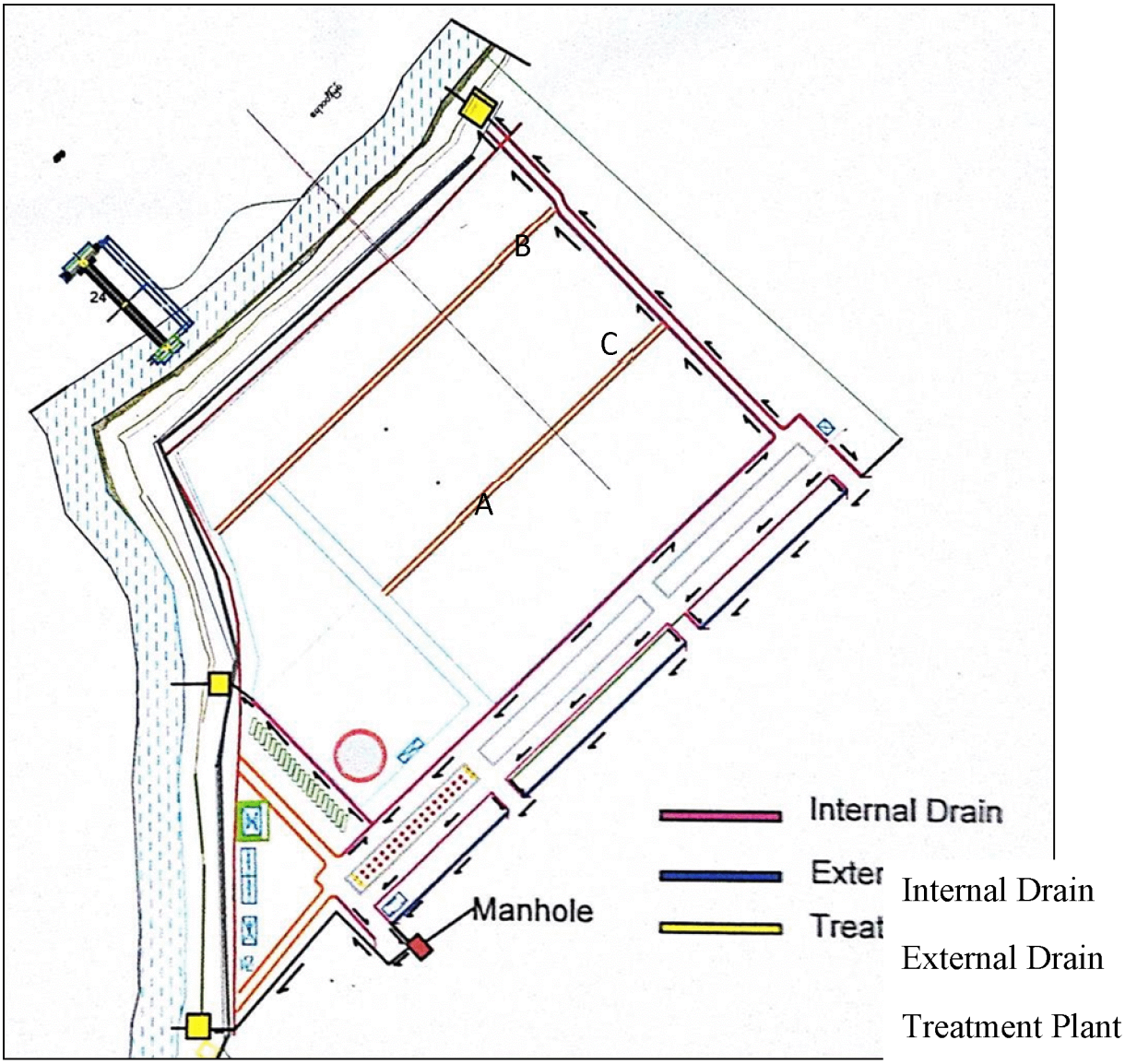

Figure 4.6. Internal Drainage System of Project Area

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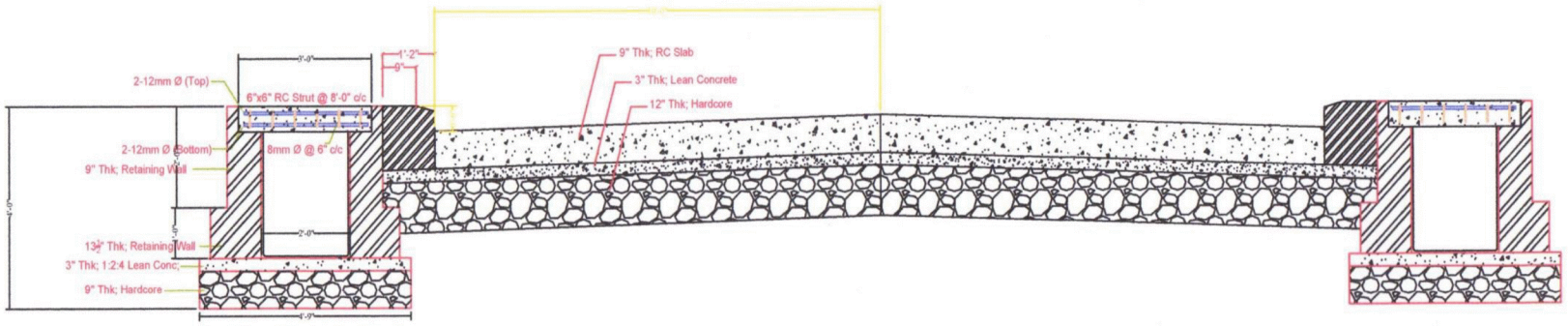

Figur- Cross Section of Drainage

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Drainage streams will be as follows:

(a) Oily Water (OW)

This will be drainage from the 'dirty' areas where accidental spillages could occur. Such areas include the road loading gantry, pump bay and VRU spill slab. The drainage from these areas will be collected via a separate drainage system and discharged to a three chamber oily water separate. The separator outlet will be valved and will discharged into the foul sewer. Oil build up in the separator will be pumped into an Ultra-spin unit, which will separate the oil from the water and collect the oil recovered in a tank for late disposal. Clean water from the Ultra-spin unit will be discharged into the foul sewer system. Any substantial hydrocarbon product spill collected inside the primary chamber of the separator will be pumped out by an approved hydrocarbon removal contractor as required, and will then be discharged off site.

(b)Occasionally Oil Contaminated (OCC)

Water falling on the concrete hard standing area within the fence area, excluding the road receipt loading facility and VRU spill slab, will be deemed 'clean', except for possible minor contamination (such as oil leaks from vehicles). These area will be graded towards central to low areas and all storm water will be piped to the First Flush Basin (FFB), which will be designed to retain a volume equal to [the area of the 'hardstanding' area] x [4mm] = 7.6m³. The remainder of the runoff will be directed straight to the eastern Mole stormwater system. After a storm event, the water in the FFB will be pumped to the site separator.

(c) Clean Stormwater (SW)

Storm water runoff from the undeveloped area is gravel surface areas, car park area and roof drainage will be designed for a 1:10 year storm event. This storm water will be discharged off the site to the closest natural clean storm water system. All sewer water will flow into the existing sewer line. Each land portion has been analysed in the context of the above drainage streams.

Land Portion A

Land Portion A will contain oily water, occasionally oil contaminated and clean storm water drainage streams.

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Oily Water (OW); the drainage from the road loading gantry and VRU spill slab will be drained into the OW drainage stream.

Occasionally Oil Contaminated (OOC); the water falling on the concrete had standing area within the fenced area, excluding the road receipt loading facility and VRU spill slab, will be deemed 'clean', except for possible minor contamination such as oil leaks from vehicles. This stream will be drained into the OOC drainage system.

Clean Stormwater (SW); runoff from undeveloped areas such as the gravel surface areas, car par and roof drainage will be designed for a 1:10 year storm event and will be discharged of site to the nearest natural clean water system (SW), through outlet point at Ayeyarwaddy and Myit Nge River.

Land Portion B

Land Portion B will contain oily water, occasionally oil contaminated and clean storm water drainage streams.

Oily Water(OW); the drainage from the road receipt spill slab will be drained into the OW drainage stream.

Occasionally Oil Contaminated (OCC); drainage from the bunded areas, import manifold, export manifold and pump slabs will be drained into the OCC drainage stream.

Clean Stormwater (SW); runoff from the undeveloped areas such as the gravel surface areas will be designed for a 1:10 year storm event. This water will be discharged off site to the closest natural clean water system(SW), through outlet point at Ayeyarwaddy and Myit Nge River.

Land Portion C

Land Portion C will contain occasionally oil contaminated and clean storm parking area into the OCC drainage system

Clean Stormwater (SW); the storm water runoff from the undeveloped areas such as the gravel surface will be designed for a 1:10 year storm event. This water will discharge off site to the closets natural clean water system (SW), through outlet point at Ayeyarwaddy and Myit Nge River.

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(d) First Flush Basin (FFB)

The purpose of the FFB is to collect the first 4mm of runoff from the OOC areas, excluding the bunded areas. Once the FFB has reached full capacity (such as after a storm event), the excess runoff will bypass the FFB and drain into the nearest natural clean water system. A pump will be installed next to the FFB in order to pump the 'dirty' water if required to the first chamber of the oily water separator.

4.13. Utilities

Electrical Systems

Currently there is no confirmation on the power supply that will feed to the site. This may be of median voltage and consist of a transformer and associated switchgear to provide the low voltage required, or be a low voltage feed.

The main distribution board will be split into two halves and contain a maintained and non maintained side. An air circuit breaker tripped from activation of the site emergency shutdown (ESD) system will feed the non maintained side and enable all power to the non maintained feeds to be removed. This non maintained side on the distribution board will feed all the pumps via the site motor control centre (MMC).

An uninterrupted power supply (UPS) system will be installed to feed all components that have been identified as requiring power in an emergency situation or sensitive to fluctuation in the supply voltage including a selection of local area lighting. The UPS autonomy time will be established during the detailed design stage. The UPS design will take the time period to safety shutdown the site system and evacuate the site into consideration. The UPS will include a bypass switch to allow for maintenance of equipment and in case of failure and the UPS DB will have surge protection included for when it is supplied in this nature.

The proposed project will use 150 KVA Generator and approximately 388 gallon of Premium Diesel is used monthly. The diseal for generator is stored in two 800 gallon oil tanks. Oil storage area is systematically constructed with concrete floor and roof in order to minimize the environmental impacts.

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Figure: Generator and transformer room





Figure: Diesel Storage Tanks for generator

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Water Resources

The project use water from tube well and store in the overhead tank. Domestic water usage is approximately 30,000 liters/day. The tube well water is used without pre treatment as it is relied only for domestic uses. For drinking, purified drinking water is bought from the outside.





Figure: Tube well and overhead tank

Location of tube well

	Latitude	Longitude
Tube well	21°51'40.89"N	95°59'37.01"E

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Figure: Location of Tube well

4.14. Site Alarms

All non-critical control alarms are to be handled by the DCS interface. All site alarms deemed as critical or not control based will alarm on the site annunciator panel. This will be located within the control room and provide a visual and audible alarm through a lamp box type interface. While the alarm will be able to be silenced, the reset of an alarm can only be achieved once the alarm input has been removed. This system will include a data logger which will provide a time and date stamp log of all alarms and resets.

4.15. Emergency Shut Down

An emergency shutdown (ESD) system will be installed that will be active from either the fire alarm system or any ESD push button that are located in the following areas:

- Filling point entrance and exit;
- Pump area;
- Bund entrance / exits
- Control room;
- MCC/ switch room; and

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- Site exit.

The ESD panel will be located within the switch room and consist of relay logic, local lamps for system status and reset functionality. The ESD system will have one level of activation with the following functionality:

- Stopping of all site pumps by tripping the main distribution board ESD circuit breaker feeding the MCC and all non-maintained supplies;
- Stopping of filling point by removing the permissive to fill signal to the filling controllers and closing all filling point shutdown valves;
- Closing of the site separator outlet automated valve ; and
- Alarm activation on the site annunciator panel in the control room.

4.16. Road Plan

The following figure shows the road plan of the project area. The new extension road will be plan in order to parallel with the Oh Htoke Tan road. The new road is 1200 ft long, right of way and 50 ft width and road width 40 ft.

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Figure 4.7 Road Upgrading Plan

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Figure: Proposed Road Plan

4.17. Fuel Oil Shipping/Transportation Plan

Fuel oil will be transported by water way from Yangon through Ayeyarwaddy River.It will take approximately 7 days to transport the fuel oil from Yangon to Mandalay. There will no transit time or delay time in other city along the Ayeyarwaddy River. Oil transportation plan is shown in the following table.

Bring From	Yangon (Thilawa Port) to Mandalay (Storage Tanks)	Water Way
Sent To	Mandalay (Storage Tanks) to - upper Myanmar cities - Southern/Northern of Shan State - Sagaing Region and Chin State - Central Region of Myanmar	Water Way and Road Way

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4.18. Alternative Analysis

Alternative analysis will be considered as an integral part of EIA process, which involves examination of alternative ways of achieving the objectives of the proposed project. The aim of alternative analysis is to arrive at a development option, which maximizes the benefits while minimizing the unwanted impacts. Alternative analysis is also a form of mitigation measures. Alternatives to a proposed activity are meeting the general purpose and requirements of a proposed activity, and may include alternatives to:

- The property on which or location where it is proposed to undertake the activity;
- The type of activity to be undertaken;
- The design or layout of the activity;
- The technology to be used in the activity;
- The operational aspects of the activity; and
- The option of not implementing the activity (the "No-Project" alternative).

Alternatives help identify the most appropriate method of developing a project, and also help identify the activity with the least environmental and social impacts.

4.18.1. The "No Action" Alternative (No Project Alternative)

This alternative avoids the implementation of the proposed project. In no project scenario case, there will be no impact on natural environment and local communities. But there will be positive impacts on residents' life quality in "Project Scenario" case. The "No Action" alternative will be made according to the following perspective:

(a) From an Environmental Perspective

Although the development of the proposed project will have more or less environmental impacts, the levels of acceptability will be decided in conjunction with threshold criteria as shown in the following table.

Table - Threshold Criteria to Determine the Acceptability of Environmental Impacts

Level of Acceptability	*Threshold Criteria for Potential Impacts*
Unacceptable	Exceeds legal or regulatory standard, e.g. water quality standard. Increases level of risk to public health. Extinction of biological species, loss of genetic diversity, rare

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	or endangered species, critical habitat.
Normally Unacceptable	Conflict with policies or land-use plans. Loss of populations of commercial biological species. Large scale loss of productive capacity of renewable resources.
May be Acceptable with Mitigation	Avoidance of spread of biological disease, pests, feral animals or weeds. Some loss of threatened habitat.
Normally Acceptable	Some loss of populations and habitats of non-threatened species. Modification of landscape without downgrading special aesthetic values. Emissions demonstrably less than the carrying capacity of the receiving environment.

Source: Modified from Sippe (1999)

From the consideration of environmental perspective, the key environmental impacts are fire and explosion, water pollution, and traffic. All of the environmental impacts can be mitigated with proper mitigation measures described in this EIA report. So, the proposed project will be class 3 (may be acceptable with mitigation) and no-project option is not applicable for this purpose.

(b) From Socio-economic Perspective

A "No Action or No-project" option will mean that the status quo remains and all the social impacts related to the existence of the projects are not envisaged. This implies that if the project were not to proceed, none of the positive or negative impacts identified in this study will materialize. A no-project option will see all the anticipated project benefits not realized. Although some potential negative social impacts will be avoided by no-go option of the proposed project, the public benefits associated with the project such as industrial development in the region, increased revenue to the government, hundreds of employment opportunities for local people, infrastructure development including roads and electricity in the region, increased business opportunities for local people, skill development, increased income generation for local people and improved services and community development potential among other benefits would not be realized. According

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to the public consultation process (public meetings), most of the local people do not want to stop the project and they just want to operate with minimum environmental impacts especially for fire hazards and river bank erosion. From a socio-economic perspective, the selection of this project site and the decision to develop a 10-million-gallon fuel storage facility bring significant benefits to the local community and the broader economy. One of the primary reasons for choosing this location is to ensure the distribution of high-quality fuel at fair prices across Upper Myanmar. By maintaining a large storage capacity, the project helps stabilize fuel availability, reducing price fluctuations and preventing shortages that could impact businesses, transportation, and daily life.

The 64-million-gallon storage capacity was chosen to meet the growing fuel demand in the region while ensuring strategic fuel reserves for supply stability. This size allows for bulk fuel imports, optimizing logistics and reducing transportation costs, which can translate into lower fuel prices for consumers. Additionally, the larger storage volume enhances emergency preparedness, ensuring fuel availability during market disruptions, seasonal demands, or supply chain delays.

Beyond economic factors, the project will create job opportunities for the local community, supporting both direct employment in construction, operations, and maintenance, as well as indirect benefits for local businesses providing goods and services. This contributes to skill development and long-term economic growth in the area. Furthermore, the project will generate significant tax revenue for the government, funding essential public services such as education, healthcare, and infrastructure development. By establishing a safe and efficient storage facility, the project also minimizes environmental risks associated with smaller, scattered fuel depots, ensuring better compliance with safety regulations.

By integrating these socio-economic and logistical considerations, the 64-million-gallon oil storage project not only supports energy security and economic stability but also fosters regional development, job creation, and long-term sustainability for Upper Myanmar.So, no-project alternative is not acceptable from socio-economic point of view.

4.18.2. Site Location Alternative

Site location alternative cannot be made because the project location has been selected before the starting of the ESIA study. The followings are the reasons for the selection of site location claimed by the developer.

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(1) No commercial site opportunities were available either of the ports of Ayawaddy.
(2) Shortest distance from lower Myanmar to the major demand centre for fuel products.

Alternative site location in upper Myanmar was considered early on by shareholders of MESDP fuel storage and distribution facility. Alternative site location included the ports of Ayawaddy. However, no commercial site opportunities were available at the time at either of these places. However, considering of the distance from lower Myanmar to the major demand centres for fuel products in the region, namely Mandalay, upper Myanmar. This site alternative was excluded from further analysis for economics and transportation logistic reasons. The fuel storage facilities will evaluated in Mandalay (upper Myanmar). There was relative low level of storage capacity at the Mandalay. It was founded that MESDP has existing petroleum handling facilities and this development fit with current Mandalay activities in the vicinity. Furthermore, an advantage of locating a storage and distribution facility at that place is fuel can received from barge .The feasibility of this alternative was further supported by Local Government, ran for a fuel storage and distribution facility in the boundaries. Local Government permit this location to contract oil storage tanks other than other place. MESDP tendered for this opportunity and get to develop a fuel storage and distribution facility at the upper Myanmar. There is no environmentally sensitive areas expect from Cultural and Hesitate Sites. There will be impact of earthquake due to Sagaing Fault although the project is selected in other place because the earthquake influence zone is so wide. By the same way, fire hazards impact zone is also wide and no other place that will free from fire hazard is available at this time. So, location alternative cannot be made although the project is intended to construct in culturally sensitive area (Innwa ancient city and Innwa bridge) and prone to fire hazards for nearest villages.

4.18.3. Alternative Analysis for Process, Design and Technologies

The proposed oil storage facilities will be built with the best in class technology with international standard (API and NFPA Standards) and engineering partners for all their processes. The type of construction selected for a storage tank depends on the size of tank required and might be dependent on the type of product being stored, the location and space available for storage, prevailing weather or site-specific conditions, and local safety or environmental considerations.

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(a) Alternative Analysis for Tank Roof Design

Environmental and safety requirements continue to be a significant factor in the selection and design of the storage tanks used by the petroleum industry. The general types of atmospheric storage tanks (AST) in use may be open top tanks (OTT), fixed-roof tanks (FRT), external floating-roof tanks (EFRT), or internal floating-roof tanks (IFRT). Depending on the product, a closed floating-roof tank (CFRT) may even be selected.

The proposed project will use internal floating-roof tank. The basic reasons to use a floating-roof have not changed in over 75 years. Safety, effectiveness and economy are the reasons floating roof tanks remain the worldwide "standard" for storage of volatile petroleum and chemical products. Although significant advancements have been made since the first successful tests in 1923, the basic principles remain unchanged. Floating roofs should be designed for full liquid contact in order to minimize evaporation and reduce product side corrosion. Another benefit from reduced evaporation is improved fire safety. Each floating roof must include features designed to accept the full range of roof movement, keep product emissions to a minimum, and provide an extended service life with minimal maintenance.

(b) Alternative Analysis for Technologies for Oil Tank

As with the smaller bolted storage tanks, API standards have been developed and improved over the years to ensure the tanks meet the safety and operating needs of the petroleum industry. The tenth edition of API Spec. 12D, Field Welded Tanks for Storage of Production Liquids provides standard sizes with nominal capacities from 500 to 10,000 bbl for the production sector. When larger tanks are required, the industry can refer to the tenth edition of API Standard 650, Welded Steel Tanks for Oil Storage for material, design, fabrication, erection, and testing requirements. The standard covers storage tanks that generally operate at atmospheric pressures. Design pressures above atmospheric and design temperatures exceeding 200°F may be permitted when additional requirements are met. So, API Standard 650, is best suitable for large oil storage tanks.

(c) Alternative Analysis for Storage Tank

No alternative technologies for tank storage facilities have been considered. Fuel storage tank can be stored either above ground or underground and underground storage tanks are not a feasible option given the proposed location and the volume anticipated for the project.

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4.18.4 Alternative Analysis for Shipping and Distribution of Fuel Oil

The alternative analysis for transportation (road way and by waterway) will be made based on the available data of traffic congestion, gaseous emission, safety and job opportunities.

Waterway- Ship Vessels and barges can transport this petroleum all around the country. Because these vessels can carry a lot of fuel, the amount it costs per barrel to move this oil is very cheap.

Road way- is transported via rail cars, trucks and tank tankers (bowsers). Trucks and oil boxer are usually used to carry smaller capacities of oil short distances. Like rail cars, these trucks can carry several different forms of this petroleum, but they do not really carry the petroleum in its crude oil form because operating the trucks would cost more than the crude oil itself would be worth. However, these trucks often deliver this fuel to gas stations, or deliver the fuel straight to the consumer. They also are used in situations where it would be illogical to use rail cars, pipelines and tanker ships.

Pipelines- are used to transport oil from the wells to refineries and storage facilities. Pipelines are viewed as the most cost efficient way to move oil on land. However, pipelines can be used the same way to deliver already refined fuels such as gasoline, diesel and even jet fuel from the refinery to distribution facilities or a consumer. These pipelines are not just a solid line of straight pipe, but have various components on the pipeline. These pipelines will have booster pumps to keep the fuel moving along a long distance, inspection areas to make sure that the fuel is not getting any contaminants, and even other collection and delivery points along the way. Although it costs a lot of money and time to set up these pipelines, the operation cost is significantly less than using any other type of transportation.

According to the above consideration, water way is the most suitable for economically, technically and environmentally reasonable.

4.18.5. Alternative sources of water for project operation and domestic uses

The proposed project will use groundwater from tube well for cleaning and domestic uses. The estimated water demand is 30,000 liters/day. As over extraction of ground water can cause groundwater depletion, the alternative way for water consumption is taken into account.

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The project area is located at the confluence of Ayeyarwaddy and Myitnge River (Dokehtawady River) river water source is an option for source of water uses. But river water at a jetty area is generally unsuitable for direct domestic use due to the high likelihood of contamination from boats, industrial runoff, and biological pathogens. Extensive treatment is required to make it safe such as Filtration, Chemical Treatment. It may require advanced Treatment in cases of industrial pollution or heavy metals. Moreover, River water is not ideal for cleaning oil tanks unless it is first treated to remove sediments, contaminants, and corrosive substances. Treated or filtered water is recommended for better cleaning efficiency and to avoid long-term damage to the tanks, as well as to meet environmental safety standards. River water can be used for firefighting, but it requires adequate filtration, reliable pumping infrastructure, and regular maintenance to ensure it does not damage equipment or reduce firefighting effectiveness.

Rainwater harvesting at an oil storage tank facility can provide a sustainable, cost-effective, and environmentally friendly water source for various non-potable uses such as firefighting, cooling, cleaning, and dust control. Proper filtration, storage, and treatment ensure that the harvested rainwater is suitable for these applications while reducing the facility's environmental impact. Rainwater can be collected from the roof of storage tanks or nearby structures and stored in dedicated reservoirs for firefighting or cooling purposes. It reduces dependence on the Ayeyarwaddy River or groundwater resources and lowers the risk of runoff-related pollution by collecting rainwater in controlled storage. It needs regular maintenance to keep storage tanks clean and operational and requires significant storage capacity. As the project area located in the dry zone, with tropical wet and dry/savanna climate and rain from May to October, it may require large area of storage facility to store rainwater to cover whole year water uses so relying on rainwater only is not suitable.

Groundwater as source of water is another option. Groundwater typically provides a consistent and reliable supply of water year-round, unaffected by surface water fluctuations like seasonal rainfall or droughts. Groundwater is reliable, cost-effective, and environmentally sustainable water source for various operational needs. Groundwater, especially from deeper aquifers, is often less susceptible to contamination from surface runoff, making it a safer water source for domestic uses compared with untreated river water. Groundwater is naturally filtered as it percolates through soil and rock layers, which helps remove sediments, pathogens, and other impurities. This often results in higher

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water quality compared to surface water sources. Due to its generally higher quality, groundwater may require less treatment before use in oil storage operations, leading to cost savings in water treatment processes. Moreover, it can reduce the need for extensive infrastructure to transport water from external sources, resulting in cost savings also reduced treatment requirements and transportation costs contribute to overall operational efficiency, leading to long-term savings.

In conclusion, a comprehensive water resource management strategy for an oil storage project can effectively integrate groundwater, river water, and rainwater harvesting to ensure a sustainable and reliable water supply throughout the year. Groundwater serves as a consistent and dependable source of high-quality water that is naturally filtered and less susceptible to contamination, making it ideal for various non-potable applications such as cleaning, cooling, and general operations. Its use minimizes treatment needs, thereby reducing operational costs while providing an adequate supply of water. In addition, utilizing groundwater helps mitigate surface water pollution, safeguarding local ecosystems while ensuring a stable supply for the facility.

River water can serve as an essential backup supply for firefighting purposes. Although it may require some treatment to ensure it is free of sediments and contaminants, it can be quickly accessed during emergencies when large volumes of water are needed urgently. Having access to river water during fire emergencies can help minimize response times and operational costs associated with obtaining water from other sources. Furthermore, rainwater harvesting provides an additional water source for various uses during rainy seasons. This method supports sustainable practices by utilizing natural rainfall, reducing dependence on traditional water sources, and promoting efficient water management.

By combining these three water sources-groundwater for year-round operational needs, river water for emergency situations, and rainwater harvesting as a supplemental resource-the oil storage project can achieve a balanced, sustainable approach to water management. This strategy not only ensures operational efficiency and cost savings but also promotes environmental stewardship and resilience against potential water scarcity issues. Implementing this diversified approach allows the facility to adapt to varying environmental conditions while safeguarding local water resources and ecosystems, with proper management and monitoring of each source being crucial to ensure sustainability and compliance with environmental regulations.

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5. DESCRIPTION OF THE SURROUNDING ENVIRONMENT

Some important environmental settings around the proposed project are as follow:

5.1. Location

The Location of fuel oil (Diesel & Petrol) tanks site is east bank of Ayeyarwady river and north bank of Myit Nge River whose upstream, is called Namt, or corner point on confluence of Ayeyarwady-Myitnge River (Dokehtawady River). The outstanding relative location is the southern half kilometers from Innwa bridge on east bank of Ayeyarwady river. The distance from Mandalay is about (12) miles to east gate of AVA bridge. After the time of 1988, the newly transportation motor road to AVA (Innwa) old ancient city from that the east gate of AVA bridge was constructed. This transportation road has been attracting to this choice of the fuel oil (Diesel & Petrol) tanks site.

This location is face to face or side by side of Myitnge River with the AVA (Innwa) old ancient city and close up to the jetty gate of Myitnge River and also in the same with the Sagaing Town on northern bank of Ayeyarwady River. The straight line distance from the tourism heritage site of *Taungthaman In* to this location is about only in (6.5) kilometers and the same level of elevation. The most outstanding on the aerial view or satellite viewing is center location of AVA, Sagaing, Amapura and Mandalay old ancient cities and Buddhist Pagodas and religious buildings.

5.2. Socioeconomic Baseline

The population of Amarapura was estimated to be 0.185 million in 2017 with an annual population growth of approximately three percent. The high population numbers can be attributed to the constant in-migration of people from the Amarapura to the Mandalay in search of employment and other opportunities. It covers an area approximately 207 km² and it has a population density of 895/person km².

The age profile for the Amarapura illustrates a developing population dominated by youth and middle aged people (69 percent between 15 and 64 years); this is followed by the children (26 percent between zero and 14 years) and the elderly population (above 65 years of age) comprise the remaining five percent.

5.3. Topographic Setting

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The Myitnge river originates at a height of about 5000 feet (1617m) above sea-level in Kutkai and Thenni (Hsenwi) township, northern Shan state. Many small streams of Namtu source on Mt. Loi-Sawng, Loi Hkan, Mt. Loi-San and Mt. Loi Yang. It has a length of 328 Miles with a drainage basin area of about (17500) square miles (Dr. Nyi Nyi, 1967). The general topographic elevation of lower reach of Myitnge river from Shwesayan to Ayeyarwady is about (200 – 250ft) (61 – 75m). The upstream area or northern Shan state suffer the (Cwa) with an average annual rainfall of (57.77) inches(11467.36mm) where the lower reach or downstream enjoys tropical steppe climate (BShw) with (29.8) inches.

This location is present river bank of Ayeyarwady and Myitnge rivers and the soil is recent alluvial soil only and is about 100 year old age. The elevation is about (69m) or (226) feet. This surrounding location is Ayeyarwady-Myitnge (Dokehtawady River) rivers confluence alluvial plain and flooded in rainy season. The straight line distance from Shwesayan to this location is about (17) miles and the elevation of Shwesayan is about (250) feet. And thus the gradient is about 0.002785 and level slope according to A. Young (1975).

5.4. Fluvial Perspective

The most distinctive fluvial perspective is Ayeyarwady – Myitnge River (Dokehtawady River) confluence and alluvial flooded plain. The surrounding area is old alluvial soils and meandering structures, oxbow lakes, meander scars. These fluvial characters are flooded and wetland characters in rainy season from August to November. The swamps or Inns are about (15) from Shwesayan to Ayeyarwady river. Meandering channel and back swamps (back swamps refer to Inn in Myanmar) are common features in this area. Most of them are dried up in the dry seasons except Lettauk, Myittu and WunbeInns.

In 1991-92, Mg Thet Khaing have done the research work on The River Morphology of The Lower Reach of Myitnge River for M.A Geography. The (17) cross-sections have been made between Shwesayan and river mouth. His fundamental measures are channel size such as channel capacity (Cc) or cross sectional area (A), channel width (W), mean depth (D), and wetted perimeter (Wp) and width-depth ratio (F) and channel asymmetry are all variables of channel shape. According to these above measuring data and formularized calculating, there is no abrupt change in channel form, and that is more exact in present time because of the lower discharge by the construction of Yeywa Reservoir Dam.

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Thet Khaing mentioned in his "Analysis on Cross-sectional morphology" that "The variables of a channel are usually related to another rivers' variables over different time scale (Schumm and Litchy, 1965). On the short term, channel variables are controlled by bankfull or dominant discharge imposed on them. Leopold and Meddock (1953) suggested that as discharge of a river increase downstream, channel width, channel depth, and current velocity also increase with simple power function of discharge:

$$W = aQ^b \; ; D = cQ^f, \; \nabla = kQ^m$$

Where a,c and k are constant and b, f and "m" are the numerical values of exponents. The constants are not significant, but the values of exponents are very important. Since Q = WD∇ thus the equation can be written as

$$Q = (aQ^b)\,(cQ)^f\,(kQ^m)$$
$$Q = ackQ^{b+f+m}$$

It follows that

$$ack = 1 \text{ and } b + f + m + 1$$

Channel cross section morphology adjusts to accommodate the downstream changes of discharge and sediment load (Keith Richard, 1982, p.155).

In the study reach, downstream changes of cross sectional variables are not significant, but they adjust to correspond with discharge variation; $W = 25.88Q^{.273}$; r = .54; and $D = 4.83Q^{.061}$; r = .177. These relations Indicate that the rate of change of width depending on discharge is more faster than that of depth. In other word, it can be assumed that the discharge is doing the work of lateral erosion." This finding of research is not important because of the lower discharge by the construction of Yeywa Reservoir Dam. And thus, the serious problem of this tank may be effect on this historical site of *Taungthaman Inn and U pain Bridge of Wooded Structure* built up on the crisscross on *Taungthaman Inn.* When the flash flood in flooded season of Ayeyarwady and Myitnge (Dokehtawady River) Rivers may be the same water level of Taungthaman Inn and Ayeyarwady – Myitnge confluence and incidentally fuel tanks destructions will be effect on U pain Bridge of Wooded Structure.

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5.5. Human Settlements Setting

Historical ancient cities environ and geographic agricultural favorable characters of soils, agricultural available and agricultural products marketing accessible of populous Mandalay cities, Amarapura and transportation linking to other settlement areas of Myanmar are creating the dense population. Million populous Mandalay city and median populous towns of Amarapura, Myitnge, Tada-U and Ava or Innwa and then the small settlement villages are close up to this area. These settlement areas, especially the southwestern areas of Mandalay city, western areas of Amarapura Town, and downstream areas of ancient city of AVA, southwestern areas of Sagaing Town and riverbank villages of Ayeyarwady are the same in water level of flooding period and the danger will be the same in suffering.

5.6. Hydrological Perspectives

Hydrological perspectives are mostly important for this project because of the fuel oils transportation is mainly from downstream to upstream of Ayeyarwady water way and some of redistribution from this storage tanks site to other upper Myanmar are small amount of water way. The effects of the giant vessel of fuel oil tankers along the Ayeyarwady water way are more than normal water wave eroded action on the surrounding Ayeyarwady and Myitnge rivers banks. Fortunately, the Oh Htoke Tan bank of Myitnge river mouth is gentle slope of sand bar and thus lowers than erosion action but in contradict condition of navigable water way in Ayeyarwady river close up to the eastern bank from downstream to upstream Synkyun village to the mouth of Myitnge River. The depth of water in Ayeyarwady River at the mouth of Myitnge river mouth is about 8.8 m to 11.4 m in the winter season of January (channel survey map of DWIR).

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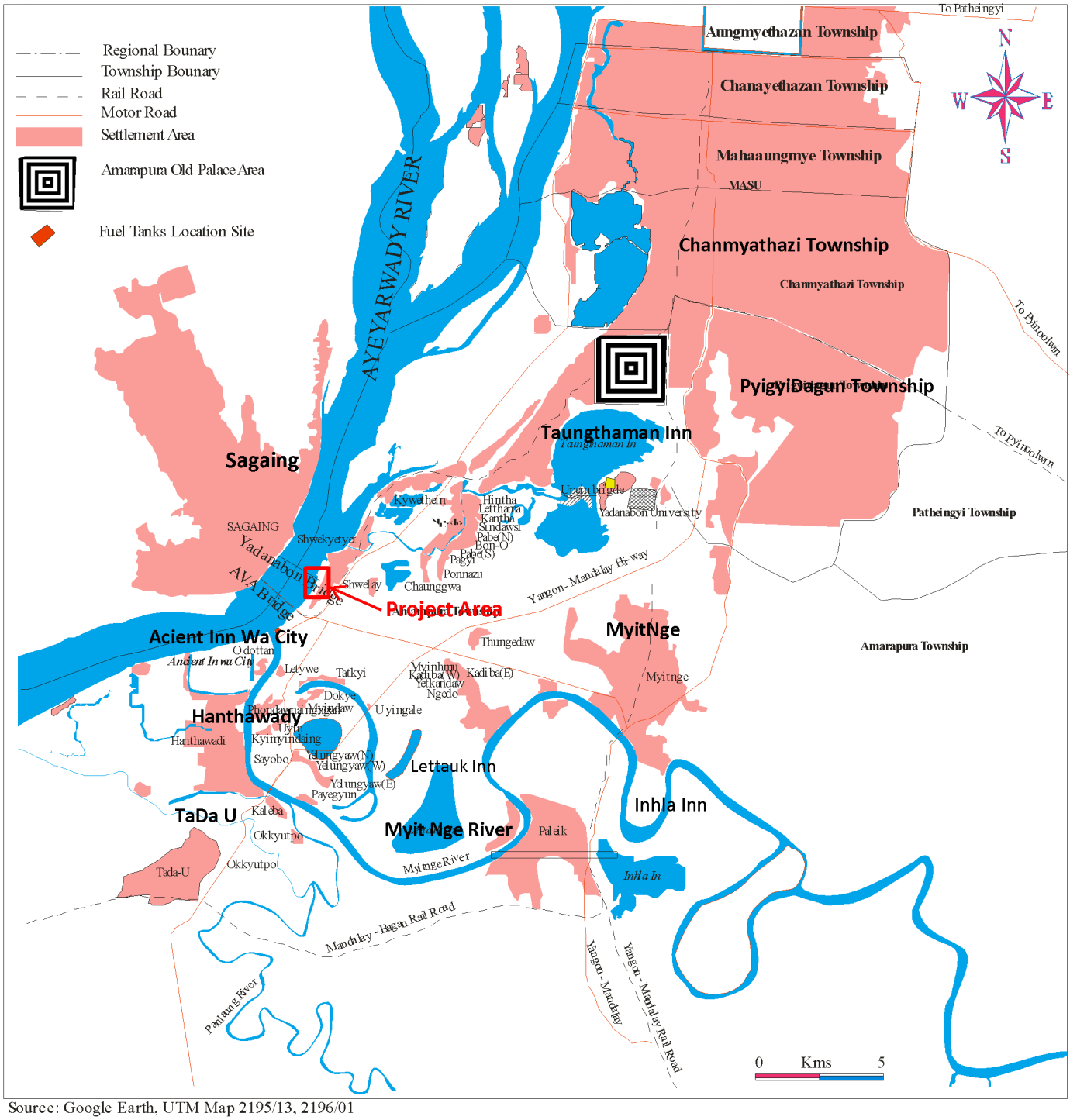
Environmental Location of MESDP Fuel Tanks Site



Source: Google Earth, UTM Map 2195/13, 2196/01

Myitnge river hydrological data are the same in dry season except from heavy thunder shower along the river basin area because of the Yeywa Hydroelectric Purpose Reservoir Dam. After the construction of this dam, hydrological and fluvial functions are not naturally active and controlled by the human activities.

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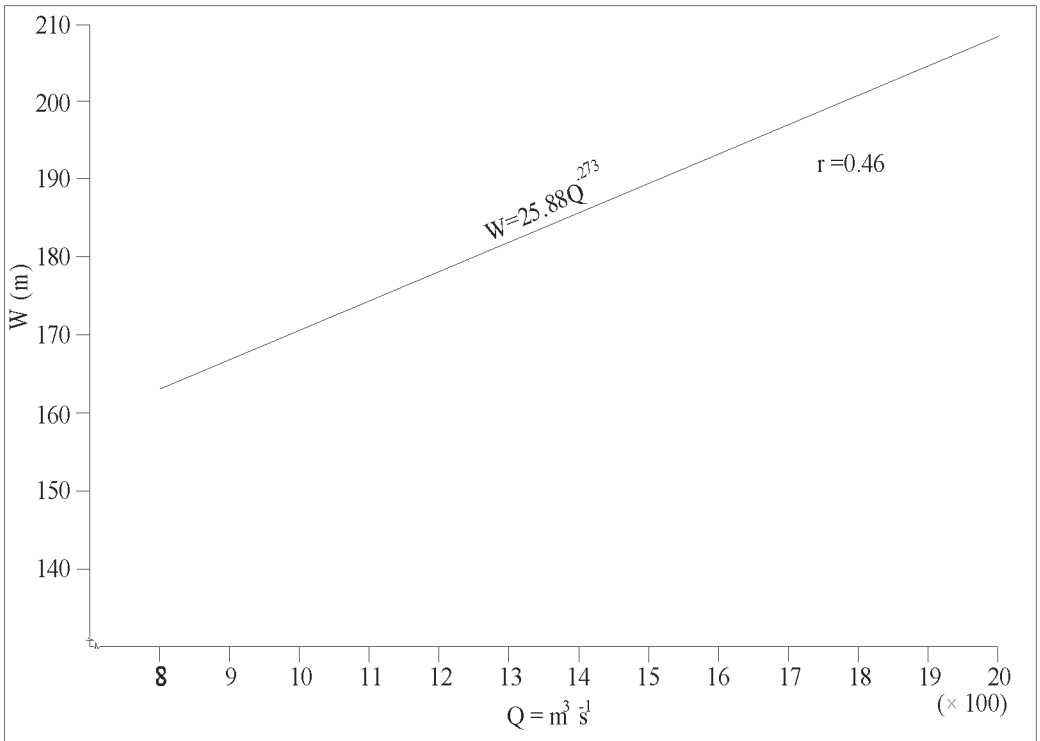
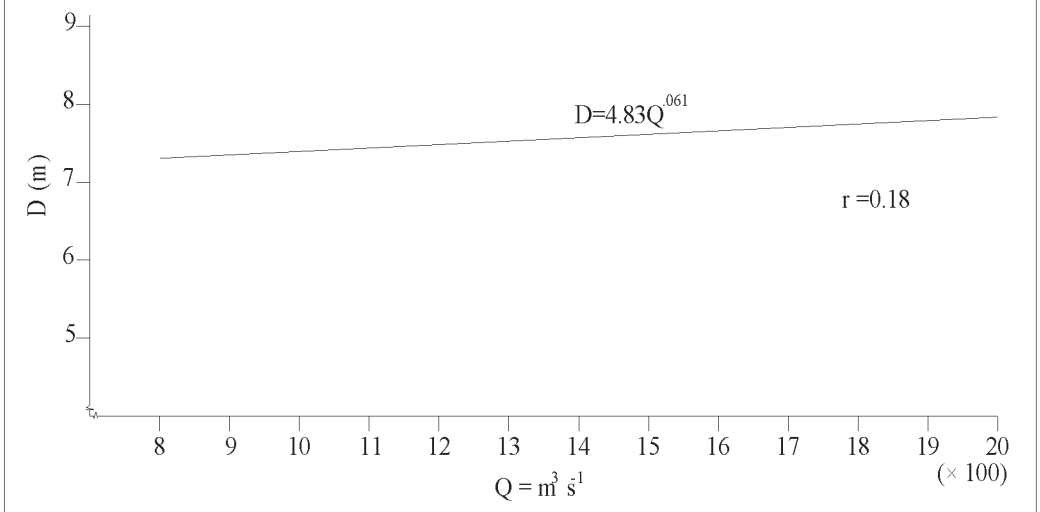


140Fig:(5.18) Relationship between channel width (W) and discharge (Q)



140Fig:(5.19) Relationship between mean depth (D) and discharge (Q)

Source: THE RIVER MORPHOLOGY OF THE LOWER REACH OF MYITNGE RIVER MAUNG THET KHAING (G- 8), 1991 - 92, UNIVERSITY OF MANDALAY

5.7. Heritage and Cultural Value

In this proposed project area, cultural heritage sites and resources are identified according to the Protection and Preservation of Cultural Heritage Region Laws. As a result, no cultural heritage sites and resources are discovered in the proposed project area.

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Heritage Resource Type	Observation
Places, Buildings, Structures and equipment	Inn wa, Sin kyone, Tha Pya Tan, Shwe Kyat Yat Pagoda
Places associated with oral traditions or living heritage	None were identified within the proposed project area
Landscapes	None were identified within the proposed project area
Natural features	None were identified within the proposed project area
Traditional burial places	None were identified within the proposed project area
Geological sites of scientific or cultural importance	None were identified within the proposed project area
Archaeological Sites	None were identified within the proposed project area
Historical settlements and townscapes	None were identified within the proposed project area
Public monuments and memorials	None were identified within the proposed project area
Battlefields	None were identified within the proposed project area

The situation of this ancient urban landscape is risky with the water erosion along the bank of the rivers. This alignment is 2.4 km long from the southeastern corner to northwestern corner passed through the northeastern corner. Innwa is a major site including a lot of archaeological monuments and sites. In assessment project, these sites must be explored to identify how significant features of archaeological evidences will be come out in making assessment of impacts as well as the appropriate plan for mitigation process.

The existing risk especially disaster risk management is not efficient to protect and preserve the cultural environment of Innwa area. The topographic feature of the site is distinctively risky with the river confluence and erosion as well as the transportation and heavy loading of shipping. The elevation and features of Innwa is facing with the very crowded development plan recently.

The significant feature found nearby the project area is the concrete structure concerning with the ancient warfare and brick monastery concerned with the ancient religious dedication. Furthermore, it is closely related to the area of city walls and moats, which challenged by the river erosion due to the heavy loading of shipping and some other river formation. The earthquake is also the most important risk for this area.

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(a) Queen Me Nu Brick Monastery - Maha Aungmye Bonzan Monastery (1822)

It is popularly known as Me Nu Ok Kyaung "Me Nu's Brick Monastery" that was built in 1818 by Nanmadaw Me Nu, the famous Chief Queen of Bagyidaw. For the residence of her religious Preceptor, the Nyaunggan Sayadaw, the Queen Me Nu donated this monastery. The earthquake of 1838, damaged it, and in 1873, it was restored by Sinbyumashin, Queen of Mindon, and a daughter of Nanmadaw Me Nu. The building is markedly different from traditional Burmese monasteries, which are constructed with wood, not masonry.



Figure 5.1. Queen Me Nu Brick Monastery

(b) Tha Bye Dan Fortress (1878)

The remain of Thabyedan (Thapyaytan) fortress was built by King Mindon between 1874 and 1878 to defend against the British during the third Anglo-Burmese War. It is near the Innwa Bridge. It could be related to the risk of deterioration such as human threats and development plans. But, the appropriate mitigation plan can provide the preservation of cultural significance of this site and the cultural landscape should also be emphasized in every stages of the development plans in many ways.

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Figure 5.2. Tha Bye Dan Fortress



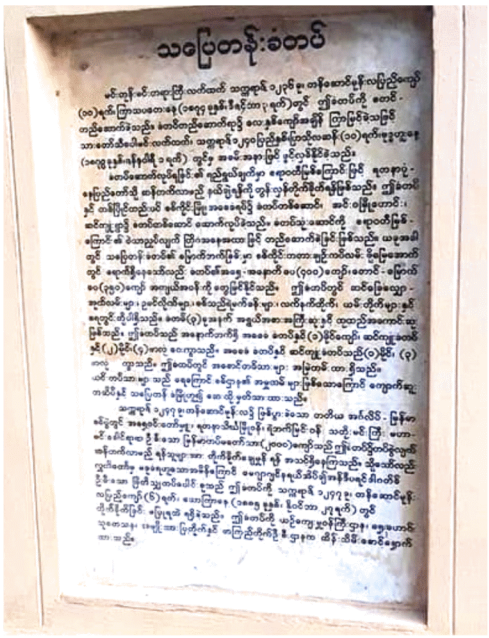

Figure 5.3. Description Pillar of Tha Bye Dan Fortress

(c) Innwa Bridge (1934)

Innwa bridge was built by British Colonial Government and it has 16 span cantilever bridge was the only structure to span the Ayeyarwady River until recently. Although now superseded by a parallel 2005 road bridge, it is still in use for railway and local road traffic.

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Figure 5.4. Innwa Bridge

(d) Innwa City Wall (East and North) (14th -19th Century AD)

The northern part of Innwa is nearby the bank of Ayeyarwady River and the Eastern partis on the bank of Duthavati (Myitnge) River. These two areas are usually eroded by rivers in every rainy season. Because of the water transportation and tourism development, the challenges of this ancient urban landscape are often impacting on the landscape. The most risky impact is wasting sewage and garbage around the cultural heritage monuments.

In both of north and east, there are the places of jetty that the local and tourist can enter into the ancient cultural area by waterway. These jetties should be measured to get the loading of using the waterway to be accessible. In the time of heavy rain, these parts were usually flooded not to be accessible by car or some vehicles. Therefore, the flash flood is also the major risk for cultural heritage. The development plan can frighten the cultural landscape by their preparedness of construction and operation processes. But, it is depending on their respective types of plan. As for oil storage tanks project, even though it may be considered the various types of risks for the cultural heritage, there can be drawn out these possible impacts of visual and cumulative aspect.



Figure 5.5. Outside View of Innwa Northern City Wall nearby the Jetty

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Figure 5.6. The Small Gateway to Reach the Jetty - Photo Taken from the Jetty



Figure 5.7. Inside View of Innwa Northern City Wall nearby the Jetty



Figure 5.8. In the Time of Flooding at the Southeast Corner of City Wall

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Assessment Items (On Ground and Underground)

1. Exploration to the area including the ancient cultural landscapes and remains
2. Surveying to the associated feature of ancient cultural features
3. Relationship between the previous researches and literature reviews
4. Cultural mapping

To scope the project area for the cultural assessment, the visual pollution can be challenged to the cultural landscape. Additionally, the operation process e.g. heavy equipment and traffic of trucks can also be assessed to make mitigation not easily to destroy the landscape of cultural environment.

The areas in danger can distinctively be demarcated as city walls and monuments and associations of Innwa Old City, the ancient urban landscape concerned with the bank of the rivers, the Innwa Bridge and Tha Bye Dan fortress. To measure the possible impacts, it could be associated with the visual challenges to the cultural landscape as well as the cumulative impacts on the monuments and its surrounding areas of the heritage.

Cultural and Hesitate Impact Assessment (CHIA)

This project area is situated on the southern bank of Ayeyarwady River at the confluence of Ayeyarwady and Myitnge (Dokehtawady River) Rivers. Generally, the locality is very risky among the cultural landscapes and touristic areas. The cultural significances of this area are Innwa Old City and three serial heritage sites of fortresses viz. Sinkyone, Asekhan and Thabyetan. The nearest site is the buffer area of Thabyetan Fortress at the northeast of the project area. It can be risky for the heritage landscapes and must be measured the potential impacts on them. Possible impacts have been come out after dusk studies and aerial analyses on this area. Normally the development project should not be founded in this area due to the challenges of cultural heritage landscape. But the actual plan of this project had already been started in planning and construction stages. Therefore, the assessment plan must be measured for the construction, operation and decommissioning stages. The systematic measurement for the cultural resource management must be carried out to have the strong mitigation plan.

The Oil Tanks project must be measured by the spatial archaeological approach to have correlation with the public attraction on ancient cultural heritage as well as touristic area. The significant site of Yadanabon Period is TBD Tha Bye Dan fortress, Innwa City Wall and Me Nu brick monastery concerning this project area. In this area, since British Colonial Period, the Innwa-Sagaing Bridge was built through the area of TBD. Therefore, it can be listed as 1. Tha Bye Dan fortress 2. Innwa-Sagaing Bridge 3. Queen Me Nu brick monastery 4. East and North of Innwa Old City.

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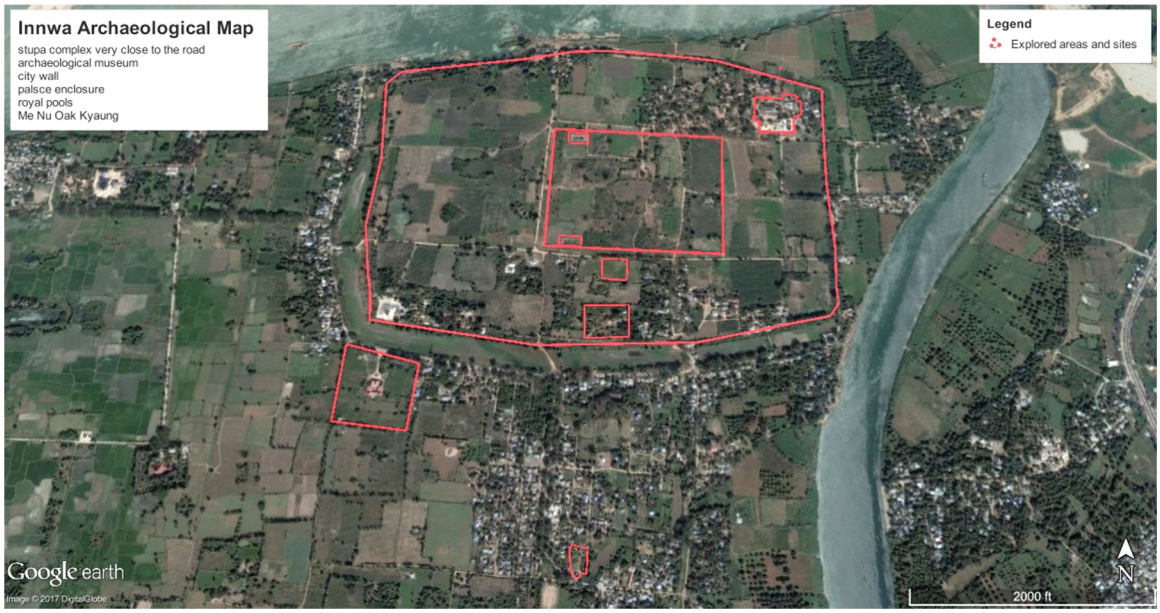
For the preliminary assessment of impacts, though it may not directly be impacted on the cultural property, some types of indirect impacts such as visual pollution or impacts, cumulative and residual impacts will be risky on this area due to the important value of cultural environment and landscape.

This assessment project was organized by Ever Green Tech Environmental Services and Training Co., Ltd. (EGT) for the Project area of Oil Storage Tanks (Myanmar Energy Sector Development Public Co., Ltd). The local authorities are essential to collaborate in this project according to the existed law of cultural heritage regions enacted in 1998 and antique objects law in 2015 as well as the rules of 2011 and 2016. Then, the local community will be informed and invited to collaborate in this assessment project. Some local people who are living in the cultural heritage area will involve in the part of exploration in the assessment. Funding will be provided by EGT Co. Ltd.

Historical Background within the Project Area

The ancient urban landscapes, since 14th century AD, are very important for studying and associating with Myanmar cityscape and national consolidation as well as those of the Mainland Southeast Asia, India and China. Internationally the evidences of ancient urban management found in this area can be well known as Ava recently known as Innwa. Innwa or Ava means "mouth of the Lake" entrance gateway at the confluence of two rivers and it was the ancient trade port between lower and upper Myanmar as well as other foreign relationships. Innwa was the capital of Burma over three hundred years ago from 1365 to 1842. In Innwa city, it can be divided as Ava (Innwa) period (14th to 16th centuries) Toungoo and Konbaung periods (16th to 19th centuries).



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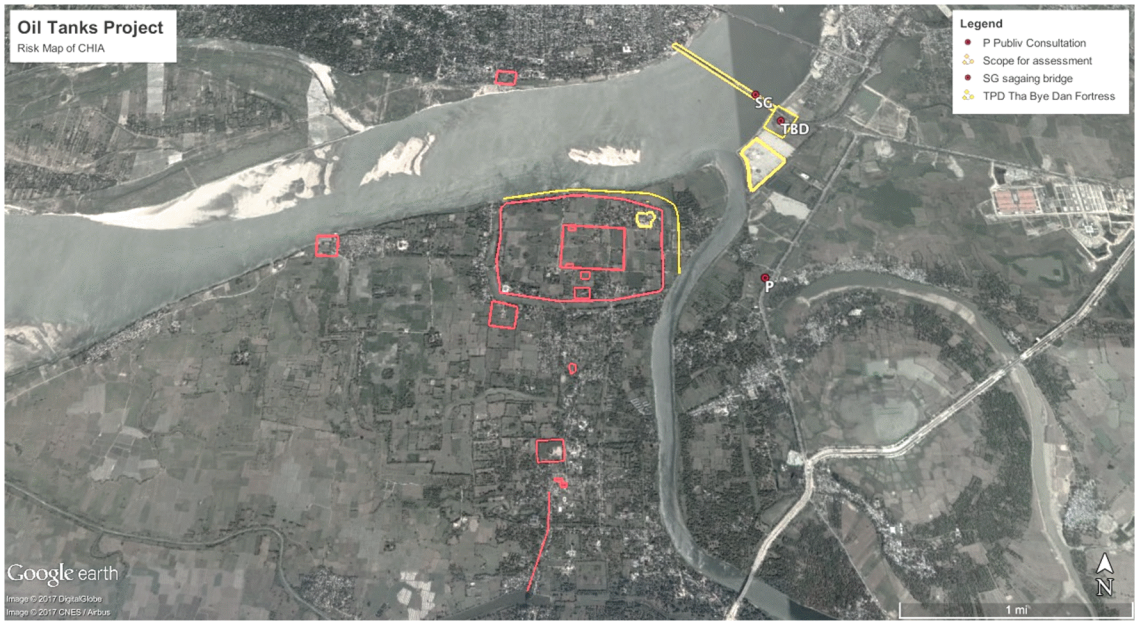
Significance of Cultural Heritage Associating the Project Area

In this Map, the red lines show the significance of cultural heritage sites and monuments; the yellow lines show the area concerning the Project Area; in mitigation plans, yellow lines must be considered to protect and preserve the heritage sites, monuments and landscape.



Threat Matrix of Heritage Impact Assessment Accordance with ICOMOS Guidance 2011

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In CHIA process, the cultural significances are essential to make a cultural map concerning the project area. The assessment area is around the area of Myanmar Energy Sector Development Public Co., Ltd belonging to the boundary of archaeological zone Innwa and Tha Bye Dan Fortress.

To deliver the threat matrix for CHIA value in this project area, there are three portions of matrix such as Matrix I is CHIA ***Threat*** Matrix; Matrix II is ***Severity*** Matrix; and Matrix III is ***Acceptability*** of Impact Assessment. Then, each matrix measurement will be described as *Planning, Construction, Operation* and *Decommissioning.*

Matrix I CHIA Threat Matrix

In Matrix I, the planning stage was not including because CHIA work was invited after planning stage was over. The construction stage was also partially done before inviting to CHIA. The recent situation of the project area can still be seen as the waiting for the construction process. Here, the significance of archaeological and cultural attributes is in very high value with the references of literature and field information. The indirect impact can reversely be measured as the deterioration of cultural environment related to Tha Bye Dan and Innwa City Wall. The operation stage concerning the oil spilling and heavy tankers impacts on the ancient cultural heritage landscape of Innwa Period (14th century AD) and Konbaung Period (18th -19th century AD). In fact, the threat of mine site is ***Very High*** and time duration and extent are measured as ***Moderate.***

Matrix II Severity Impact

In this Matrix II, the severity impact was measured with the degree of these following items; type of impact, duration of impact and range of impact. Measuring these three situations measured in mine site, the severity impact is ***moderate severity*** and depending on the very high degree of cultural significance in this area. Matrix II shows the ***moderate severity*** and ***very high value*** of the significance of cultural heritage value units.

Matrix III Acceptability of Impact Assessment

In this Matrix III, project area can be ***acceptable with mitigation*** with the references of the following information; the degree of cultural significance is *very high value*; the type of impact is direct and the severity is *moderate*. According to the Matrix III, the moderate impact can be acceptable but **mitigation** must be needed.

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Conclusion

The Oil Storage Tanks Project was seriously included in the ancient cultural heritages of Innwa Old City and Tha Bye Dan Fortress. According to the field assessment data, it was already started by construction process but recently the project was stopped by the necessary of EIA process including CHIA. It must be continued to save the 14th century cultural heritage.

According to the ICOMOS HIA guideline 2011, the severity impact is moderate and type of impact is indirectly and visually on the heritage area. The acceptability is challenged with the some threats and the monitoring process for this acceptable condition must be prepared. Archaeologically, the project area is very important to take care for cultural resource management. The boundary of project area must be associated with the authenticity of ancient cultural landscape. Here, the meaning of cultural landscape is concerned with the vegetation, land use, ancient monuments and its associated community.

Summing up, the common result of cultural assessment in the project area is severer with the references of field surveying data. Acceptable condition of CHIA result clearly found in this project area must be taken with the mitigation plan.

Heritage Authorities

If some traces of archaeological and cultural heritage will be come out in the project area, Department of Archaeology and National Museum, Ministry of Religious Affairs and Culture, will be reported as *Heritage Authorities*. This CHIA programmee will comply with *2012 Rule & 1998 Protection and Preservation of Cultural Regions Law, 2015 Protection and Preservation of Antique Objects Law* and *Ancient Monuments Law* approved by a heritage authority, DOANM of MoRC.

5.8. Biophysical Environment

(a) Climate and Meteorology

Amarapura, Mandalay Region is at 21°54'N, 96°3'E, 15 m (249 ft). Amarapura has a tropical wet and dry/savanna climate under the Köppen climate classification system. The city features a lengthy wet season from May through October where a substantial amount of rainfall is received. The rainfall for Amarapura is lowest in May (120mm) and highest

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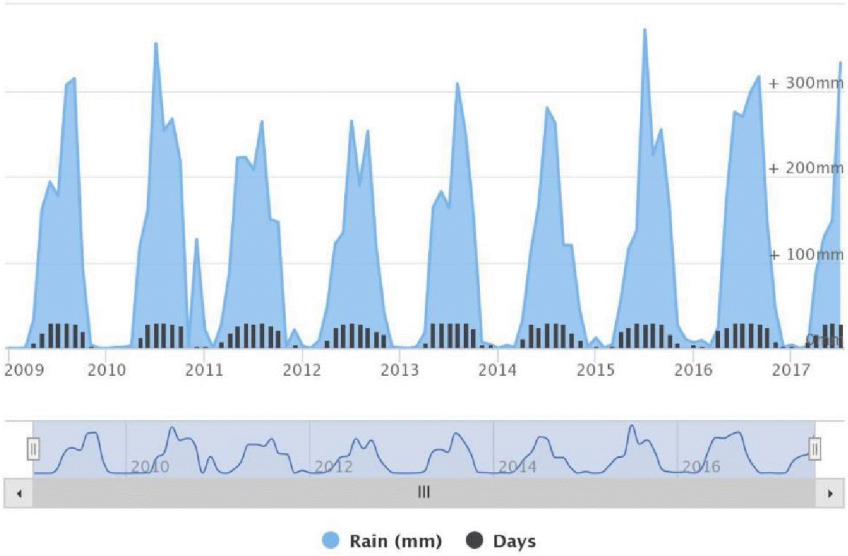
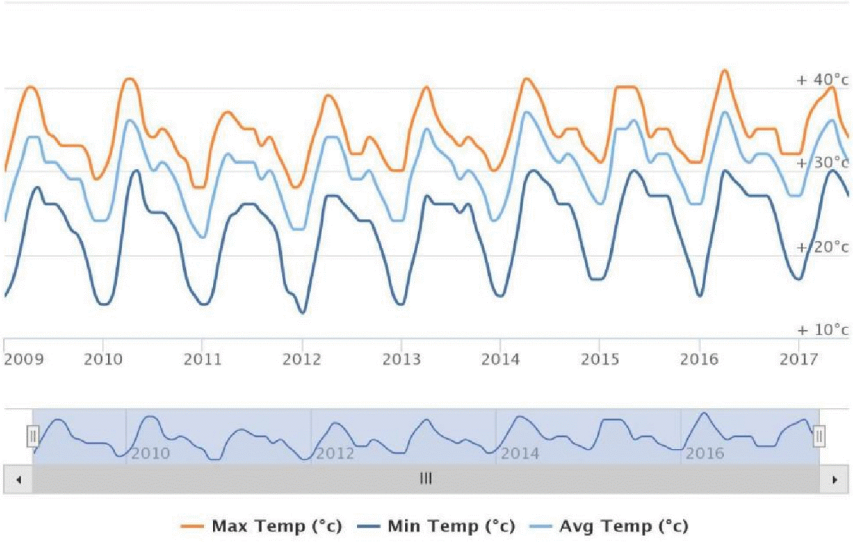
in Juiy (330mm). It is primarily due to the heavy rainfall received during the rainy season and a dry season from November through April, where little rainfall is seen. Amarapura is situated in or near the tropical very dry forest biome according to the Holdridge life zones system of bioclimatic classification. The total annual precipitation averages 915mm (36 inches) which is equivalent to 915 Litres/m^3 (22.44 Gallons/$ft^{2)}$.



Average Rainfall and Rainy days of Project Area



Average Maximum and Minimum Temperature of Project Area

The mean annual temperature in Amarapura is hot at 27.3 °C (81.1 °F). The range of mean monthly temperatures is 10.3°C (18.5°F) which is a low range. The warmest month (April) is very hot having an average temperature of 31.3°C (88.34°F). The coldest month (January) with a mean temperature of 21°C (69.8°F).

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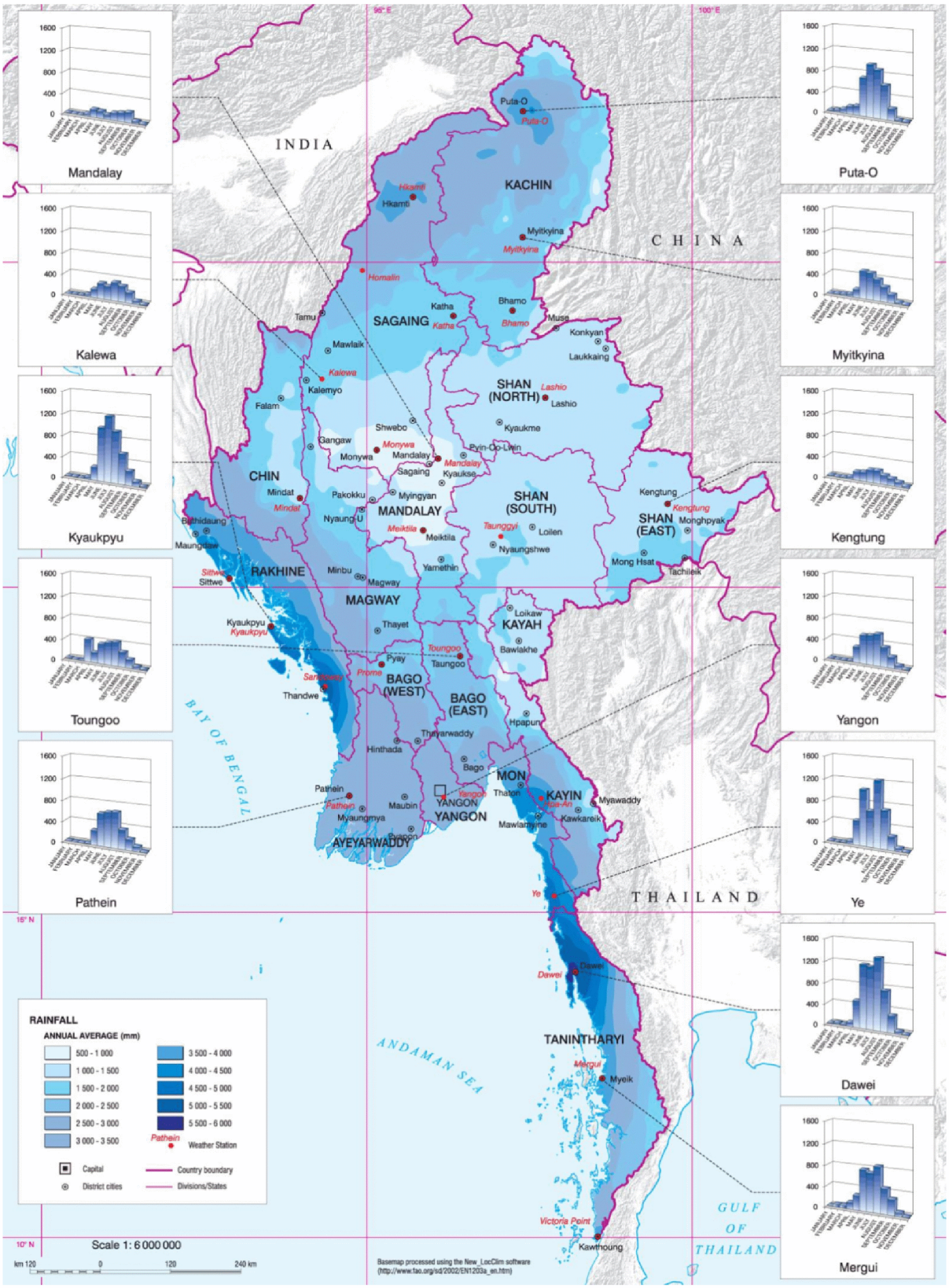

[Source: http://dwms.fao.org/atlases/myanmar/atlas_en.htm]

Figure 5.9. Rainfall Map of Myanmar with Monthly Distribution Patterns

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(b) Wind

Winds approach the project area primarily from the east and northeast. Long-term wind data obtained from the station of Mandalaay (Department of Meteorology and Hydrology Myanmar) located 7 miles east of the site.

During the pre-monsoon months of onset date to June, the wind blew South, Southeast and Southwest direction over the project area. In the Southwest monsoon months of July and August, the wind blew South and Southwest direction and in the post monsoon months of September to withdrawal date, the wind blew from South, Southeast and North direction over the project area. Figures 5.10 to 5.13 show the results for the wind direction and speed representing the regions of Mandalay during the study period 2001-2010. The data indicates that greater than 4 mph of the wind speed are more frequently from the south and Southeast in pre-monsoon season and monsoon season. In post monsoon season south, southeast and north sectors are greater than 4 mph of wind speed.

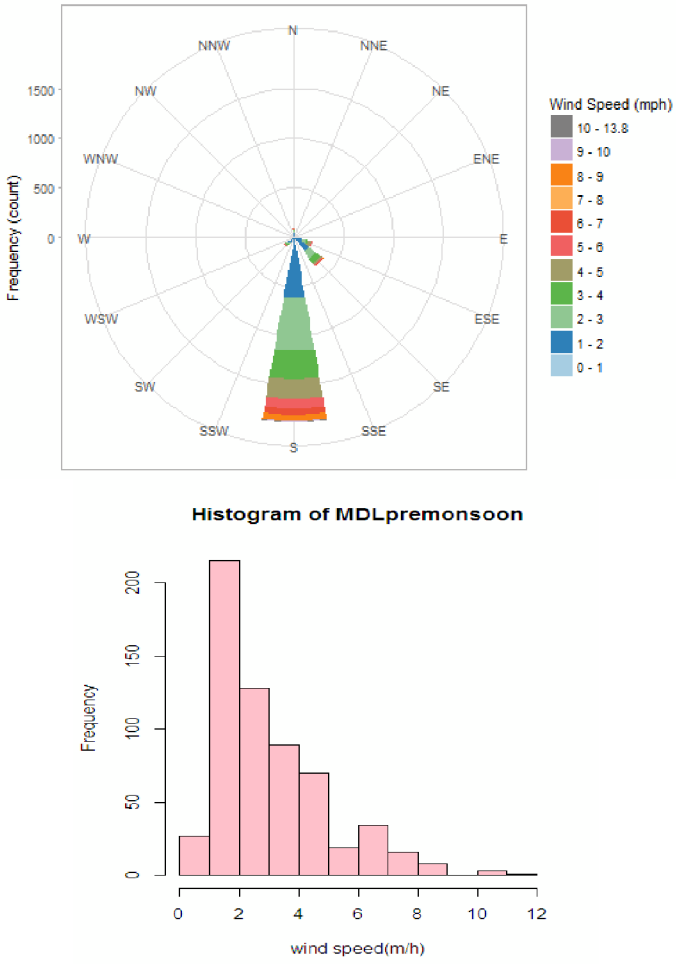

Figure 5.10. Wind Rose and Frequency of Wind Speed for Pre-monsoon Season

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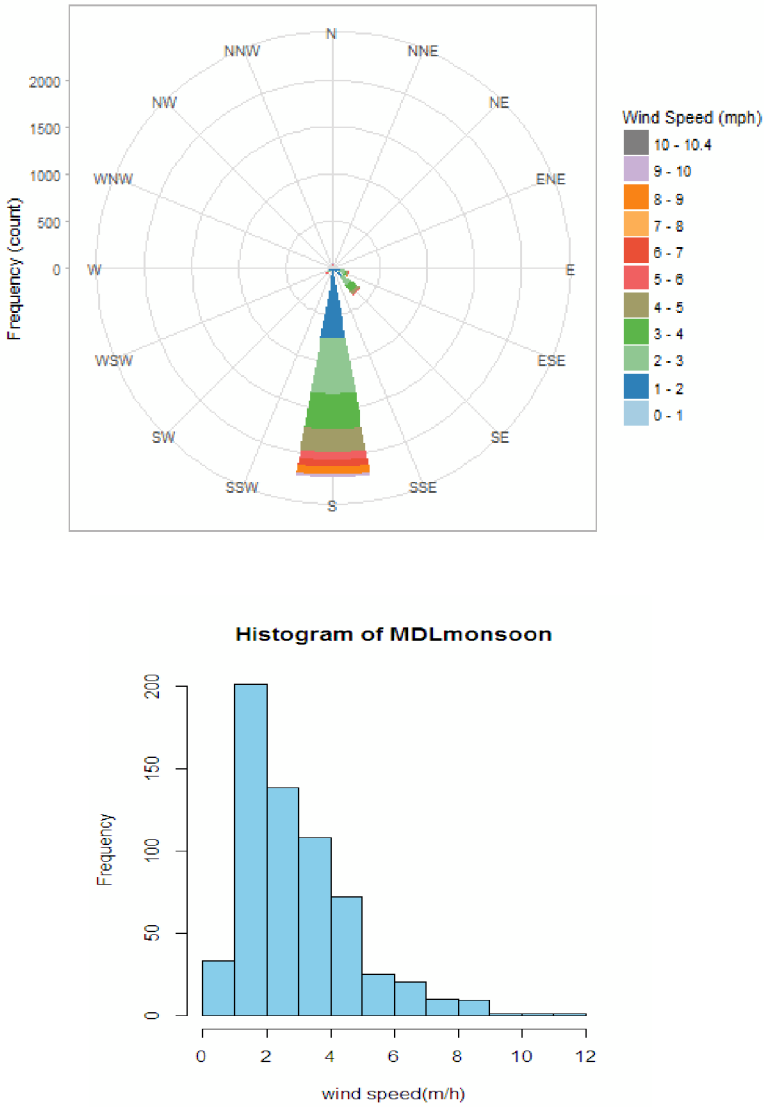
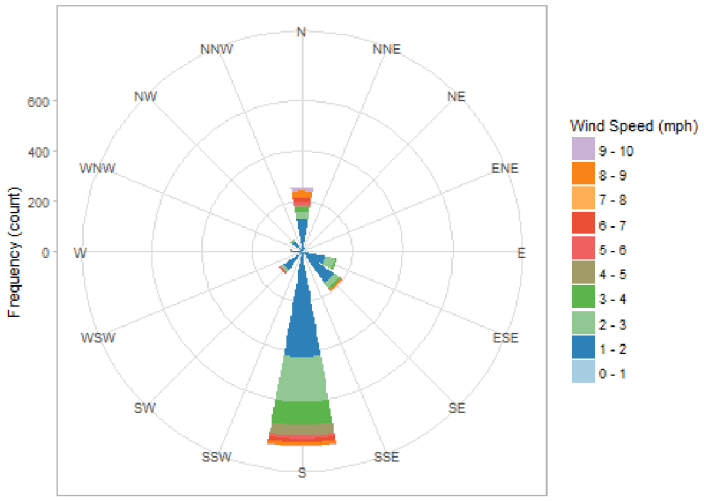


Figure 5.11. Wind Rose and Frequency of Wind Speed for Monsoon Season



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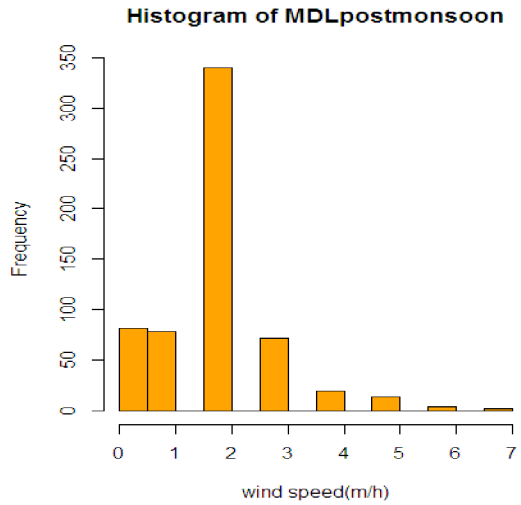

Figure 5.12. Wind Rose and Frequency of Wind Speed for Post Monsoon Season

5.9. Geology, Seismicity and Earthquake Conditions in Innwa-Sagaing-Madalay area

The fuel-storage-tanks construction site in the Innwa-Amarapura-Mandalay area, a well-known cultural hub in central Myanmar, is blessed with natural surroundings. The area stretches north-south across a vast, fertile, low-lying plain with metamorphic rock-islands peeping through the Recent alluvium.

The metamorphic rocks of isolated hills on the east side of the Ayeyarwady River and those of the Sagaing Ridge belong to the Mogok Metamorphic Belt and form basement of the Innwa-Amarapura-Mandalay area. Above these crystalline rocks are siliciclastic sediments that fill the hollows and deep valleys cut into the basement rocks. The surficial deposits have been classified into six soil zones which trend north-south, roughly parallel to the Ayeyarwady River. The western-most sand-rich soil zone which is susceptible to liquefaction, appears to extend southwards into the Innwa area, passing through the construction site.

The construction site at the confluence of Ayeyarwady and Myitnge Myitnge (Dokehtawady River) rivers is located in a seismotectonically active region. The construction site is very close to (1 km away from) the Sagaing Fault, a potential seismic source, that has been responsible for the significant earthquake events, including the Ava Earthquake (1839) and the Sagaing Earthquake (1956). A future major earthquake in the region could have devastating consequences. As the area indeed is earthquake prone, possible adverse consequences (earthquake-induced natural hazards) of the construction site were identified and highlighted, based on the bedrock geology, soil characteristics, tectonic geomorphology, macroseismic zone map and microseismic zone map, liquefaction susceptibility map and past seismic events of the area.

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The Earthquake Hazard and Risk Assessment of the construction site was made to provide the project personnel and general public with a realistic knowledge of the severity and consequences of possible earthquake events. This report will also allow project leaders to make proper plans to prepare for the earthquake and take necessary measures. The report concludes with recommendations to mitigate earthquake hazards and risks of the area, including the construction site.

5.9.1. Introduction

The area, with which the present report is concerned, lies between the old royal captitals: Ava (Innwa); Zayyarpura (Sagaing), Yadanapura (Amarapura) and Yadanarpon (Mandalay), which are well-known for their rich cultural heritage.



Figure 5.13. Airphotograph, Showing Location of Construction Site

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Geotectonically, this area falls within the north-south trending margin between the West Burma (Myanmar) Block and the Shan-Thai Block, which are shearing past each other along the Sagaing Fault, a major continental transform fault, bisecting Myanmar into subequal halves. The basement in the area is an assemblage of low- to high-grade metamorphic rocks of the Mogok Metamorphic Belt. These rocks are cropping out at the Sagaing Ridge, Mandalay Hill, Shwe Kyet Yet-Shwe-Kyet Kya Hills in the form of rock islands, peeping through the Recent alluvium built by the Ayeyarwady and Myitnge rivers. The location of the construction site is shown in Fig. 5.13.

The Innwa-Sagaing-Amarapura-Mandalay area indeed is earthquake prone with a long history of earthquakes dating back to several centuries. This is due to the fact that the Sagaing Fault, which is seismically very active, passes through the western fringe of the area. Recent works on seismic zoning of Myanmar appear to indicate that the Innwa-Amarapura-Mandalay area lies in the destructive zone with greater earthquake hazards.

5.9.2. Physiography

In a broad sense, physiography concerns with the description and origin of landforms. Topographically, the area on the west side of the Ayeyarwady River and north of Sagaing consists of two parallel north-south ridges: the Minwun Ridge in the west and the Sagaing Ridge in the east; the latter studded with venerable religious edifices is much longer, broader, and higher than the former; and the highest point is 406 m above sea level (see Fig. 5.14). The two ridges, often considered as the transpressive features, are separated by a wide fault valley (Kyaukta-Yega valley).

Along this valley are fault-related features, such as fault furrow; stream offsets, springs, sag ponds, alluvial fans (bajada) which run into the 7-mile–long Yemyet Inn-- a place of refuge for migratory birds. Southwards the Sagaing Ridge disappears, but the Minwun Ridge plunges below and occasionally pokes out of the undulating alluvium as low linear ridges (pressure ridges).

To the east of the braided Ayeyarwady River is a vast fertile plain with metamorphic rock islands (Mandalay Hill, Yankin Hill, Shwe Kyet Yet and Shwe Kyet Kya Twin-Hills, etc.). Through this low-lying belt in front of the W-facing towering Shan scarps, the Myitnge River flows westwards sluggishly as a highly sinuous (meandering), sediment-laden river with its oxbow lakes and back swamps, and finally joins the Ayeyarwady River near north of Innwa. On the Satellite image, the areas close to the Ayeyarwady River and the Myitnge River appear to be water logged as indicated by tonal characteristics (red tone) of the satellite image.

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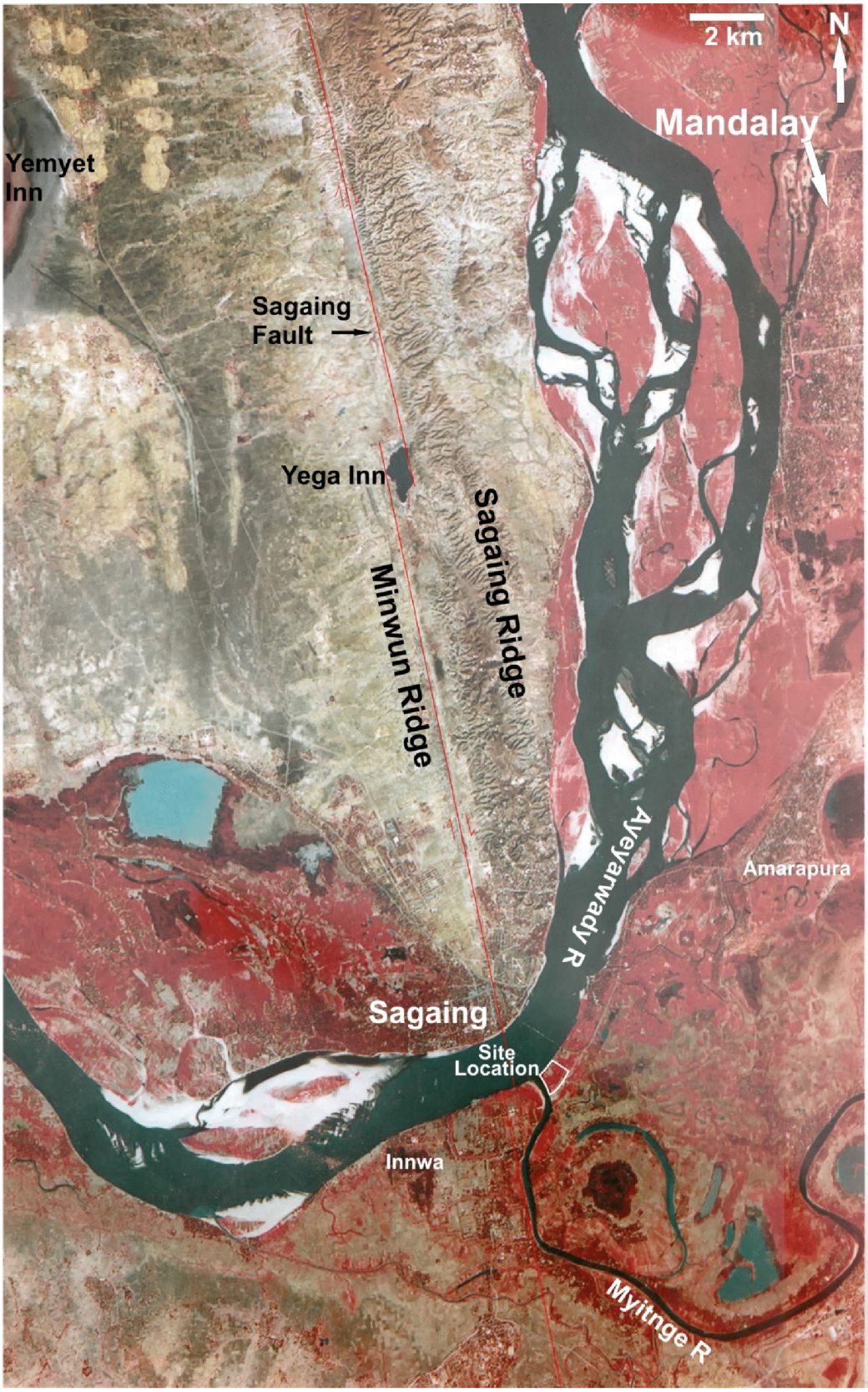

Figure 5.14. A Satellite Image, Showing Physiographic Features of the Innwa-Sagaing-Mandalay Area

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5.9.3. Geology of the Area

(a) Tectonic Setting

The Innwa-Sagaing-Mandalay area falls within the north-south trending margin between the Myanmar Plate and the Sundaland, which are shearing past each other along the Sagaing Fault (Win Swe, 1972), a major dextral strike-slip structure, 1500 km long, which is also thought to represent the present plate boundary between the Indian and Eurasian plates (Le Dain et al.1984). The Sagaing Fault joins a seafloor spreading-centre of the Andaman Sea in the south, and merges with the East Himalayan Syntaxis in the north. It is exceptionally straight in the middle (Vigny et al. 2003). Due to oblique subduction of the Indian Plate underneath the West Myanmar Block and subsequent seafloor spreading in the Andaman Sea, the West Myanmar Block has been moving northwards at an average rate of 20 mm/yr (Myint Thein et al., 1991).

(b) Geology of the Innwa–Sagaing-Mandalay Area

As shown in the geological map (Fig. 5.15), rocks of the Sagaing Ridge and those of the isolated hills (Mandalay Hill, ShweKyet yet Hill and Shwe Kyet Kya Hill), east of the Ayeyarwady River, are metamorphic rocks of the Mogok Metamorphic Belt, including gneiss, calcsilicate, marble, locally intruded by granite at Mandalay Hill. Metamorphic grade ranges from amphibolites to granulite facies; and locally white marble bands are conspicuous. However, the metamorphic rocks of the Minwun Ridge are lower in metamorphic grade and consist of amphibolite, schists and some limestone mylonite. Generally the metamorphic units trend north-south and their compositional layering are mostly subvertical. Radiometric dating of a phlogopite sample indicates that the metamorphism took place 20.7 million years ago (Myint Thein, 2017).

In the area Late Cenozoic sedimentary rocks overlie the metamorphic rocks and underlie the alluvium (Myint Thein, 2002). The sedimentary rocks belong to the Upper Pegu Group and the Irrawaddy Formation, and were formed in non-marine environments, such as delta, fluvial, alluvial fan and lacustrine. Older Alluvium consists of older Ayeyarwady terrace deposits, fanglomerates, silt and clay layers, and some gravel interbeds. Younger Alluvium generally covers low-ground areas traversed by the Ayeyarwady and Myitnge rivers, and mainly consists of loose-sand layers, some clay and gravel layers. A generalized succession of units (in order of chronology) is shown in Fig. 5.16, and it is supported by a table (Table 5.1) which briefly describes units of the area (see also Myint Thein, 2013, 2016).

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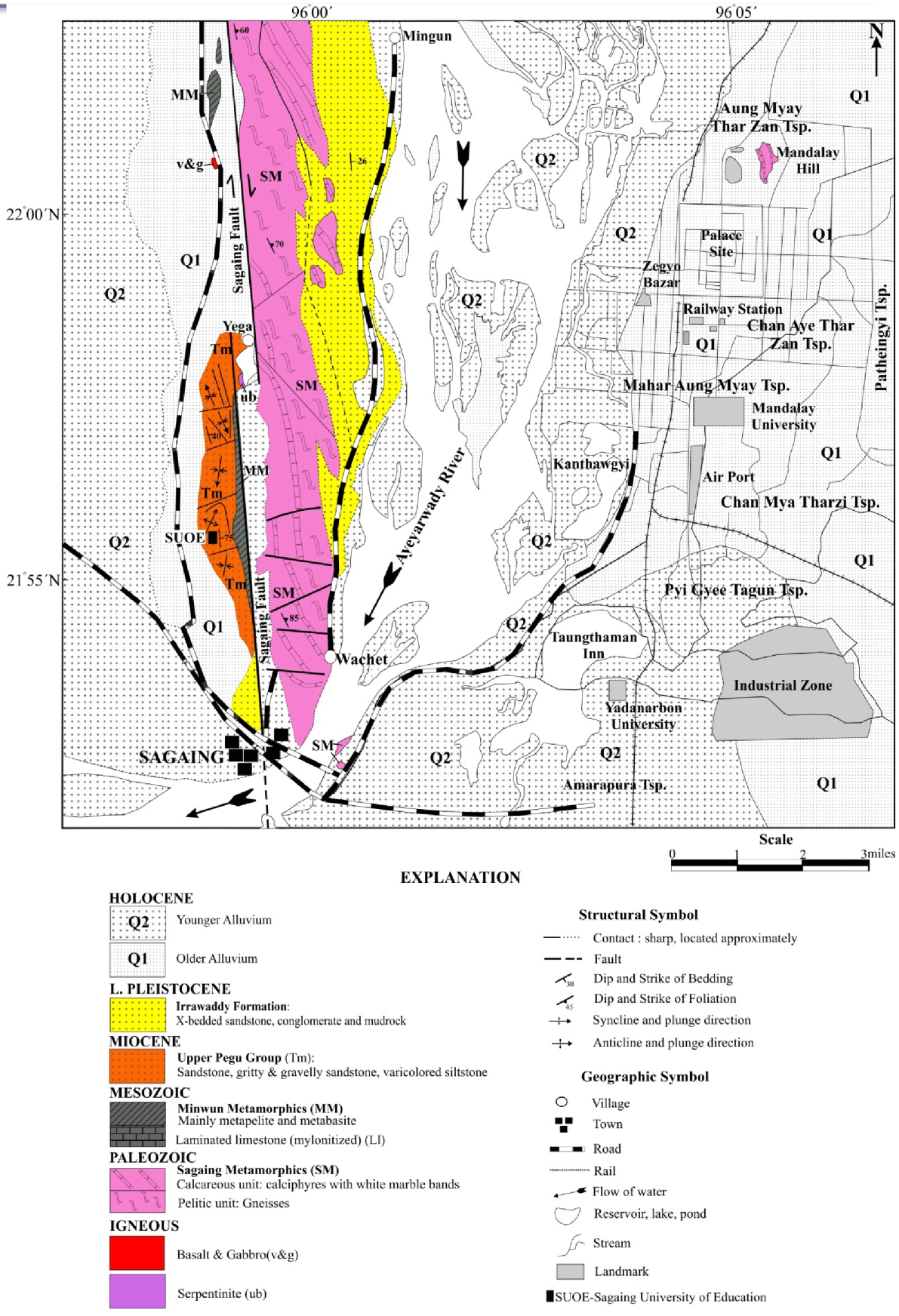

Figure 5.15 Geological Map of the Innwa-Sagaing-Mandalay Area

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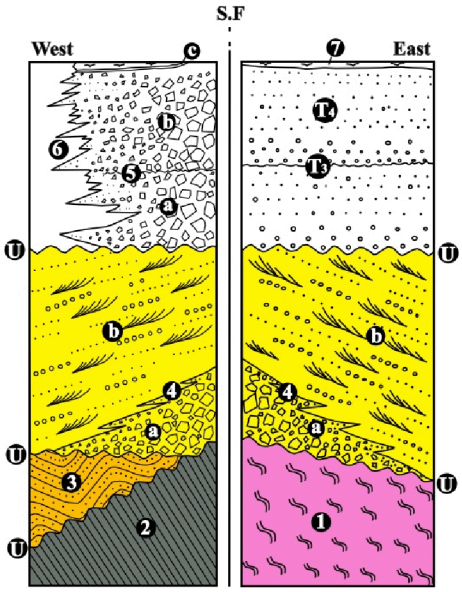

1: **Sagaing Metamorphics** (Paleozoic); **2**: **Minwun Metamorphics** (Mesozoic); **3**: **Upper Pegu Group** (Miocene); **4**: **Upper Irrawaddy Series**(Lower Pleistocene) (**a**. Lower fan division, **b**. Upper fluvial division); **5**:**Younger fans** (Upper Pleistocene-Holocene) (**a**. Lower red division, **b**. Upper grey division, **c**. Calcrete); **6**: **Lake deposit** (Upper Pleistocene-Holocene); **T3** & **T4**: Third & fourth river terraces (Upper Pleistocene); **7**: Modern alluvium; **U**: Unconformity, and **S.F**: Sagaing Fault

Figure 5.16. Stratigraphic Columns of the Sagaing-Mandalay Area (not to scale)

Table 5.1. Stratigraphic Succession of the Sagaing- Manadalay Area

Unit	Description
6. Younger Alluvium	River, stream & lake sediments
5. Older Alluvium	Alluvial fan, river terrace & lacustrine deposits; red earth
4. Upper Irrawaddy Fm. (L. Pleistocene)	Sandrock, conglomerate & clay with freshwater fossils; locally with bone fossils of mammals
3. Upper Pegu Group (Miocence)	Sandstone, shale and grit; locally rich in floral remains
2. Minwun Metamorphics (Upper Mesozoic)	Metapelites (garnet muscovite schist, kyanite schist, chlorite schist) & metabasites (talc chlorite schist, chlorite schist, actinolite schist, amphibolites & quart zo-fedspatic rocks); greatly isolated lentils of mylonitized limestone and some ultrabasics
1. Sagaing Metamorphics (L. Paleozoic?)	b. Calcareous Unit: Interbedded marble (phlogopite marble, forsterite marble, diopside marble & white marble) & calcsilicate; some gnesses a. Pelitic Unit: Biotite gneiss, hornblende gneiss, leuco-genesis, garnet biotite schist & some calcsilicates

(c) Soil Zones

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Sedimentary materials that are generally unconsolidated and overlying the basement rock of the area belong to Quaternary age. These, treated as soils, occupy the low-lying area between the Ayeyarwady River in the west and the Shan scarps in the east. The soils have been formed either directly from the weathering material of the underlying (basement) rock or on sediment that was transported to and deposited at the site; and their colour, texture and composition vary depending on many factors, including topography, vegetation, climate and parent rock. It is important to note that local soil conditions play an important role in the ground motions on soil surface due to amplification of ground motions propagating through soils.

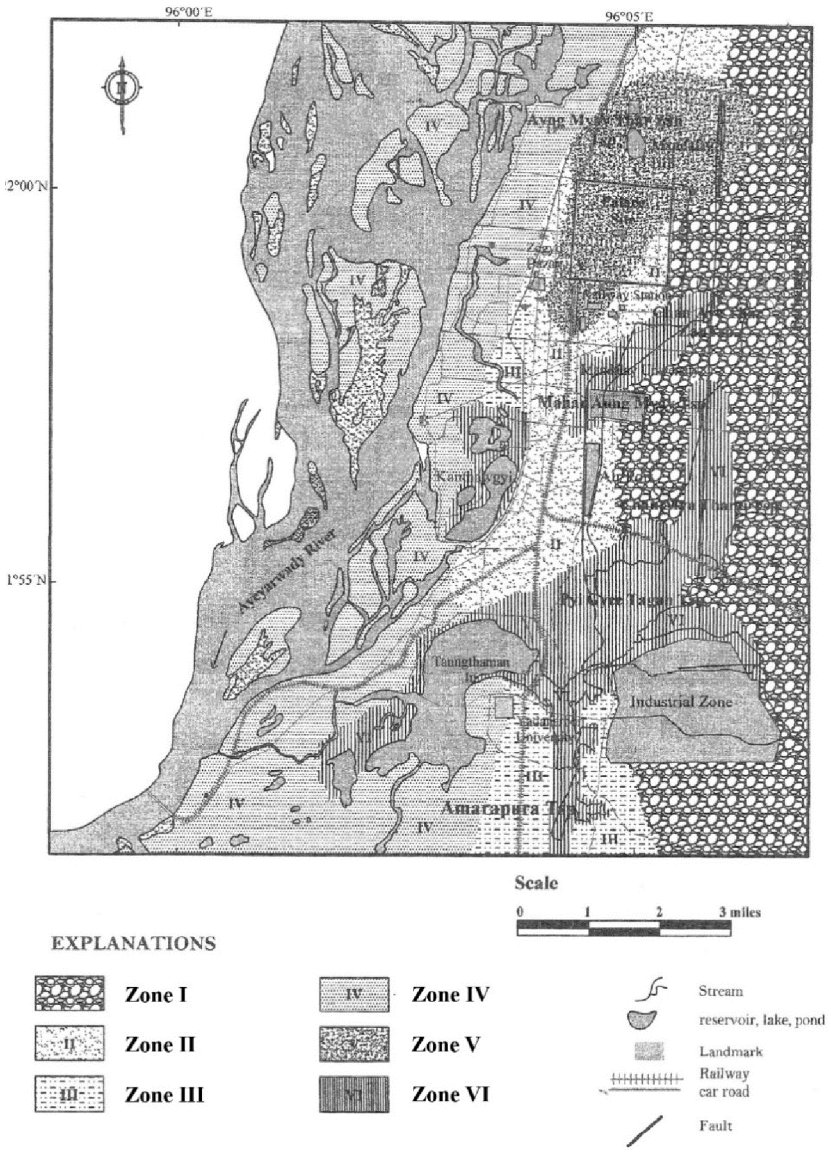

Figure 5.17. Soil Zones of Mandalay-Amarapura Area (Source: Eyn Keey and MaungThein, 2007)

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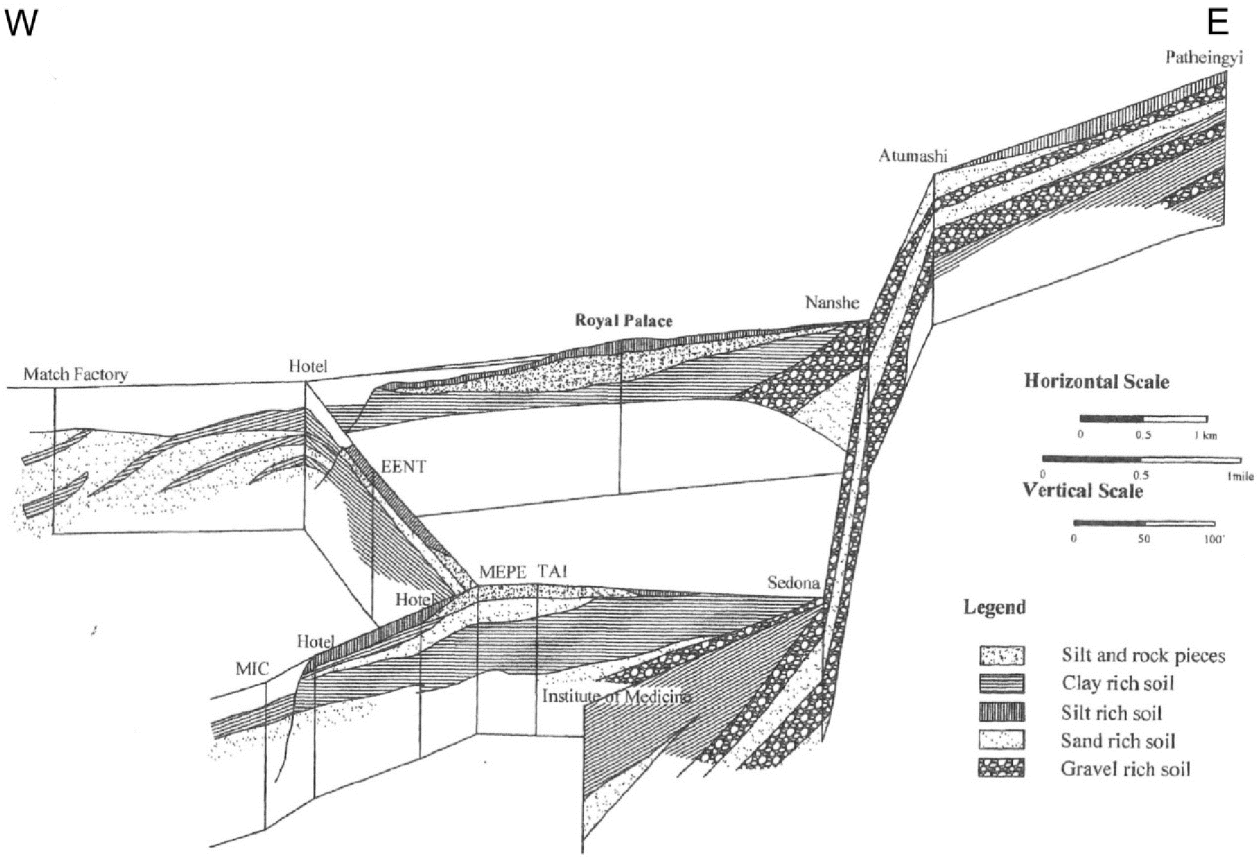

Figure 5.18. Fence Diagram of Soil Zones in Mandalay-Amarapura Area (Source: Eyn Keey and Maung Thein, 2007)

U Eyn Keey and Maung Thein (2007) subdivided the soils of the Mandalay-Amarapura area into six soil zones (see Fig. 5.17). These zones run north-south and roughly parallel to the Ayeyarwady River. Their position in space, based upon borehole data, has been reconstructed in the form of a fence diagram (Fig. 5.18). Two- to eight-feet thick topmost layer which consists of dark-grey soil and filled materials was not taken into consideration in the classification of soil zones. Brief descriptions of each zone are as follows:

Zone I: Mainly consists of silty fine sand with interculations of gravel and clay. This soil zone is more or less stiff.

Zone II: Mainly composed of clay with at least two ferruginous layers. This soil zone is moderately stiff.

Zone III: It is divided into two subzones: An upper 15' to 20' layers of clayey sand-silt, and a lower sand which becomes soft (loose) in the upper part.

Zone IV: Chiefly constituted of sand layers; upper sands are loose, while lower sands are stiff.

Zone V: Dominantly slope-wash deposit around the Mandalay Hill; soil material is stiff.

Zone VI: Mainly dark clays (black cotton soil), and they become moderately hard when dry. (Zone I is the lower, and the Zone VI is the upper)

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The soil map and fence diagram show that sand-rich soil zone IV(with some clay-rich layers) is close to the Ayeyarwady River, occupying the western most part of the Mandalay-Amarapura area , and it also appears to extend southwards into the Innwa area, passing through the construction site.

(d) Seismicity

Geographically, Myanmar is a land located at the southern part of major earthquake belt, known as the Alpide Belt (Richter, 1958) which is a young orogenic belt formed by the collision of Australian-Indian Plate and Eurasian Plate. Due to this seismotectonic situation, the country is exposed to hazard of large earthquakes. A seismic zone map of Myanmar (see Fig. 5.19) shows that the Innwa-Mandalay-Sagaing area lies very close to the Sagaing Fault, the main source of earthquakes in Myanmar and it is the largest, and perhaps the youngest and presumably the most active fault in Myanmar (see also Win Swe & Win Naing, 2004).

Seismicity along the course of the Sagaing Fault is quite well known since the days of the Myanmar kings, because many of ancient royal capitals of Myanmar, such as Hanthawady (Bago), Kaetumade (Taunggoo), Ava (Innwa), Zayyarpura (Sagaing), Yadanapura (Amarapura), and Yadanapon (Mandalay), and Tagaung were incidently located on or close to the Sagaing fault zone. The intermittent slips along the fault have caused earthquakes at (from north to south) Putao (1908), Tagaung (1946), Thabeikkyin (2012), Sagaing (1956), Innwa (1839), Swa (1929), Phyu (1930) and Yangon (1927).

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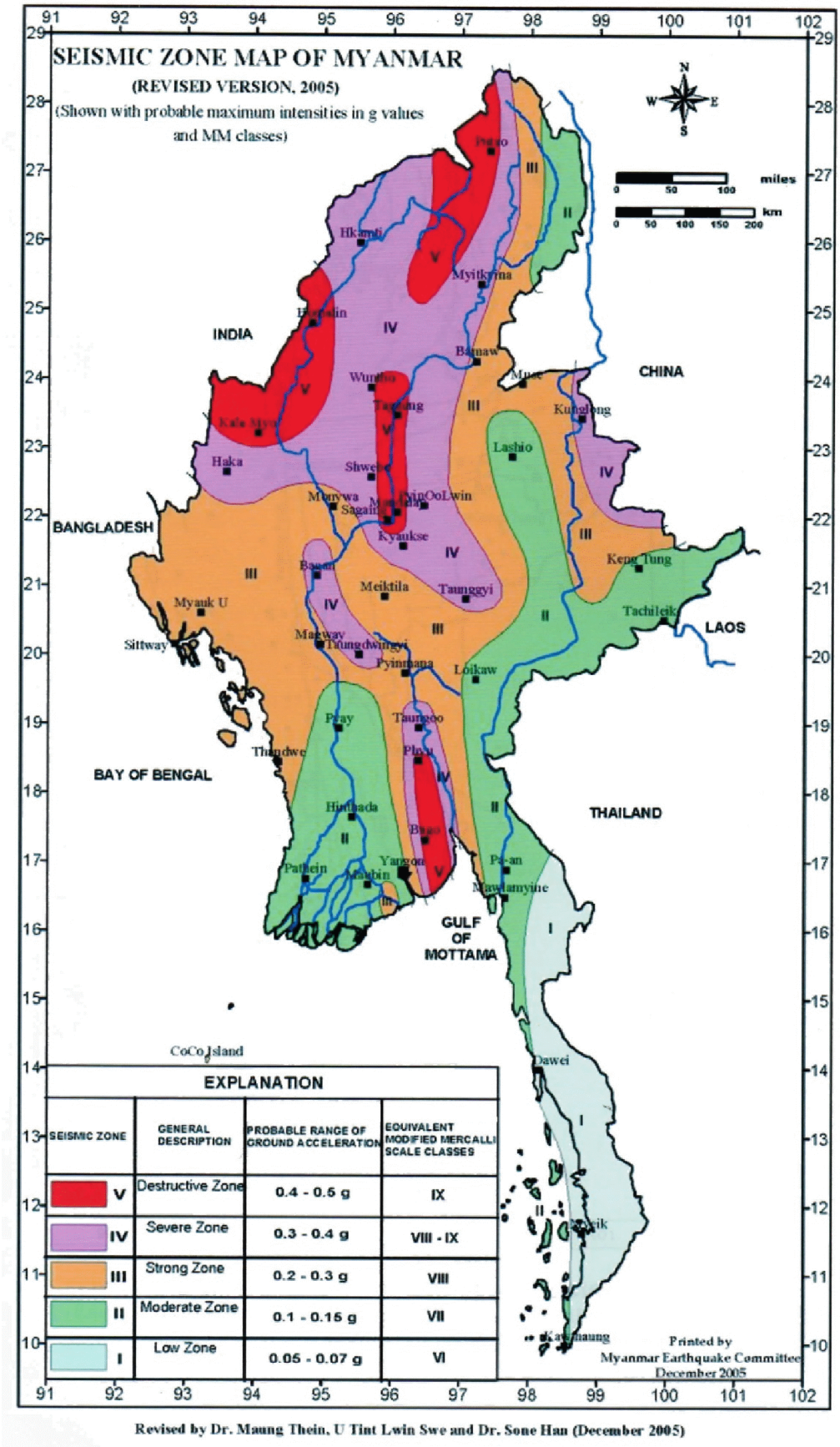

Figure 5.19. Seismic Zone Map of Myanmar

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5.10. Physical Hydrogeology of the Amarapura-Madalay Area

Mandalay is a major city in central Myanmar with a population of 1,225,000 people that lacks a wastewater management system, a solid waste disposal procedure, and access to treated drinking water. Myanmar only treats about 10% of its wastewater, and there is effectively no treatment in the city of Mandalay (United Nations World Water Assessment Programme 2017). In the urban areas of the country of Myanmar, 76.38% have access to basic sanitation services, and in 2015 around 75% of the population were using lined latrines with water, 12% were using septic systems, and the remainder using sewers (JMP2018).

The Amarapura Township is an urban area on the south side of Mandalay surrounding Taung Tha Man Lake (TTML). No one in the Amarapura Township has access to piped water, so the people depend on tube wells, dug wells, or purchased purified bottled water (ADB 2013). The majority of these wells are within 50 m of untreated wastewater canals that are in direct contact with the ground surface. It is important to investigate the physical and chemical properties of this groundwater system to identify indicators of wastewater contamination that pose a potential risk to the groundwater supply in the Amarapura Township.

In developing areas such as the Amarapura Township, costs of computer software and licenses are major limiting factors when conducting this type of study. Programs such as QGIS (Quantum Geographic Information System 2016) and MODFLOW (Haitjema 2016) were used because they are open-source programs that are easy to obtain in developing countries such as Myanmar. QGIS provides the ability to project data spatially and MODFLOW is used to assess groundwater flow throughout the study area. Digital elevation models (DEM) were chosen because of limitations on being able to conduct survey work with the proper equipment and in the time period allocated for the project (Michael Grzybowski & Melissa E. Lenczewski et al. 2018).

The purpose of this study was to gain a preliminary understanding of the physical hydrogeology of the aquifer serving Amarapura Township in Mandalay and compare and identify seasonal variations in groundwater flow, and to yield quantitative data on the hydrogeologic properties of the Amarapura Aquifer using an analytic element model.

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Study Area

Mandalay is in central Myanmar on the west side of Southeast Asia. The city is about 70–80 m above mean sea level (m amsl) in a flood plain for the Irrawaddy River between the Shan Plateau and the Sagaing Mountains. The Irrawaddy River starts in the Himalayas, running north to south and cuts west on the south side of Mandalay. The Irrawaddy River is approximately 2,100 km long, and its drainage basin is about 414,400 km^2 (Kravtsova et al. 2008).

The Amarapura Township contains about 235,000 people and is located on the south side of Mandalay (UNDP 2014). Taung Tha Man Lake (TTML) is an oxbow lake in the middle of the Amarapura Township on the south side of Mandalay (Kyi 2005;). Smaller streams from the Shan Plateau flow into TTML, and the Me-O Chaung is the outlet stream connecting TTML with the Irrawaddy River. The Myitnge River starts in the Shan Plateau, running east to west on the south side of the Amarapura Township, while the Shwe-TaChaung canal runs from Mandalay through the Amarapura region between TTML and the Irrawaddy River. The Shwe-Ta-Chaung canal is one of the larger discharges of wastewater from the city of Mandalay into the Irrawaddy River.

Outline of the Model

Aquifer unit classification, model structure, boundary conditions and some aquifer constants were specified as follows:

1) Aquifer Classification

Judging from the available existing data, the Mandalay aquifer system consists of three aquifers and two aquitards. The 1st Aquifer is phreatic, or unconfined, and is composed of the Holocene sediments underlain by clayey formation. Although the detail data is not available about this clayey formation, the layer could be an aquitard overlying the 2nd Aquifer.

The 2nd and 3rd Aquifers are main aquifers in Mandalay Area, and consist of the Pleistocene sediments. Most of the 2nd Aquifer and all of the 3rd Aquifer are under confined conditions. These confined aquifers are separated by a confining layer of hard clay (In the existing reports, the clay is sometimes expressed as “shale”). Clayey sediments, Neogene sediments and Pre-Cretaceous rocks, which form hydrogeologically impermeable basements for the Mandalay aquifer system, underlie the 3rd Aquifer.

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2) Model Structure

Taking the hydrogeological information of Mandalay area into account, the structure of the simulation model was determined to be three-dimensional (3-D) model having 4 layers. Each model grid is 1km square in size. The modeled domain has 26 km in E-W direction and 35 km in N-S direction. The total number of active cells and river cells are (601 meshes) × (4 layers) = 2404 cells.

Because much information about the 1st Aq uifer is not obtained, and for the simplicity of the model, the phreatic aquifer and the first aquitard were compiled to one layer taking the anisotropy into account. The classification of the hydrogeology is as follows:

Ist Layer: (1st Aquifer Aq1 + 1st Aquitard Co1)	:	Phreatic (Unconfined)/1st Aquitard
IInd Layer: (Shallow Confined Aquifer: Aq2)	:	Confined (partially unconfined)
IIIrd Layer: (2nd Aquitard: Co2)	:	Confined
IVth Layer: (Deep Confined Aquifer: Aq3)	:	Confined

3) Boundary Conditions

Based on the hydrogeological structures of Mandalay Area, boundary conditions for Ist Layer were assigned as follows:

- Western and southern boundaries: Constant head boundaries were assigned at the Ayeyarwaddy and the Dotehtawaddy Rivers. For the constant head, the water level data at the river gauging stations were utilized.
- Eastern boundary: Where impermeable old rocks crop out, no flow boundary was given. While constant head boundaries were set at the apexes of alluvial fans.
- Northern boundary: Generally, groundwater flows from mountainside to the lowest place (in most cases, the largest river) in a groundwater flow system depending on the topography. Therefore, in natural conditions, east-to-west groundwater flow dominates in Mandalay Area. Since no flow crosses flow lines, a flow line can be treated as no flow boundary (Rushton and Redshaw) 1979)). In addition, several monadnocks composed of impermeable rocks exist some 10km northeast of Mandalay urban area. Therefore, no flow boundary was set at the northern boundary.
- Additionally, the effect of the Kandawghi Lake and the Thaung Tha Man Pond was taken into account.

For IInd and IIIrd Layers, no flow boundaries were assigned based on the following reasons:

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- Northern boundary is located on the flow lines. Further, the existence of several monadnocks suggests that the impermeable basement is shallow around the monadnocks.
- Western and southern boundaries are located under the Ayeyarwaddy and the Dotehtawaddy Rivers, respectively, which is thought to be the discharge area of the Mandalay groundwater flow system.
- Eastern boundary abuts on impermeable old rocks.

4) Input Parameters

The calculation parameters for the MODFLOW program mentioned earlier were prepared based on the hydrogeological data. Followings are the initial input data obtained so far. Table 2 indicates the summary.

(a) Top and bottom elevations of each layer

Top and bottom elevations of each layer are compiled from the existing geological columns and electrical prospecting data conducted by the JICA Study Team. Geologic logs of newly drilled wells (PTW-28, JICA No.1 to 6, see 1.2.) are also utilized.

(b) Aquifer Constants

Table 5.2 shows the aquifer constants. Most of the constants were mainly analyzed in this Study. Some of the constants, however, were compiled from pumping test results obtained by Ministry of Home & Religious Affairs (1984) and MCDC (1989) for the high resistivity zone of the electrical prospecting. In the model calculation, the aquifer constants in Table 5.2 were applied using following assumptions:

i. For effective porosity, 0.25 and 0.06 were given to sand and gravel, and silt and clay, respectively, based on Todd (1980, pp.38).
ii. Specific storage is given as (storage coefficient)/(aquifer thickness).
iii. Ist Layer is mainly composed of fine sand (K=2.5m/d, S=0.1), and silt and clay (K=0.08m/d, S=0.06). [Values in the parenthesis are based on Todd (1980, pp.71).] In the initial model, the horizontal and vertical averages were used, and the aquifer constants were changed depending on the results of the simulation.
iv. The vertical hydraulic conductivities were analyzed using Hantush's method for leaky aquifer (see e.g. Walton) (1970).). The results are as follows. For confined aquifers Aq2 and Aq3, anisotropy was thought to be negligible: Lower part of Ist Layer (Co1): 0.0058m/day, IIIrd Layer(Confining Layer): 0.0018 m/day

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Table 5.2. Aquifer Constants

Well No.	Year & Month	Depth Bored(m)	Screen Depth(m)	Aquifer	Calculation Method**	T(m^2/d)	*K* (m/d)*	S	*K*'(m/d)*	Notes
PW-1	Mar. 1988	104.0	33.5-49.5	Shallow Confined (Aq2)	Jacob	2272	142.0	3.10×10^{-4}		Observation Well: PZ-1(r=20m)
					Theis	2117	132.3	4.85×10^{-4}		
					Recovery	2065	129.1			
PW-2	Mar. 1988	114.3	55.0-67.0	ditto	Jacob	1961	163.4	7.66×10^{-4}		Observation Well: PZ-2(r=20m)
					Theis	1788	149.0	1.24×10^{-3}		
					Recovery	1848	154.0			
					Recovery	1702	141.8			
					Hantush	1366	113.8	1.37×10^{-3}*	5.77×10^{-3}	
Aq2 Average						1870	139.9	7.21×10^{-4}	5.77×10^{-3}	Geometric Mean
Test Well	Feb. 1987			Deep Confined (Aq3)	Jacob	4227	211.4)			Aquifer thickness was assumed to be 20m.
					Recovery	4564	228.2)			
PTW-4	Feb. 1989	137.2	98.9-117.2	ditto	Jacob	4111	145.3	1.11×10^{-3}*		Observation Well: Test Well (r=110m)
					Hantush	3132	110.7	1.44×10^{-3}*	1.82×10^{-3}	
PTW-12	Dec. 1987	160.0	123.3-129.4	ditto	Jacob	5994	245.7			
			135.3-153.6		Recovery	6663	273.1			
PTW-16	Feb. 1987	115.8	90.9-109.2	ditto	Jacob	4536	247.9			
					Recovery	5186	283.4			
PTW-17	Mar. 1988	175.3	115.2-117.6 123.5-135.7 141.6-153.8	ditto	Jacob	4201	184.3			
					Recovery	6098	267.5			
PTW-18	Feb. 1987	109.2	86.0-104.3	ditto	Jacob	4510	246.4			
					Recovery	5003	273.4			
Aq3 Average						4759	219.0	1.26×10^{-3}	1.82×10^{-3}	Geometric Mean for high resistivity zone
PTW-28	Aug. 2001	150	63.0-68.8 92.6-98.4 101.5-107.3	ditto	Theis	651.2	34.5	(0.306)		Observation Well: Test Well (r=4.21m)
					Jacob	736.5	39.0	(0.331)		
					Recovery	711.6	37.7			
					Recovery	723.9	38.3			PTW-28
PTW-28 Average						705.0	37.3 (Aq2:26.6, Aq3:42.6)			Geometric Mean for intermediate resistivity zone
JICA-No.1	Oct. 2002	182	94.7-106.5 123.1-134.9 157.1-165.9	ditto	Theis	26.6	0.821	(2.46)		
					Jacob	29.2	0.899	(2.84)		
					Recovery	34.0	1.05			
Average						29.9	0.916	(2.63)		
JICA-No.2	Nov. 2001	108	100.0-105.5	ditto	Theis	29.9	0.916	8.20×10^{-4}		
					Jacob	25.3	0.786	5.38×10^{-4}		
					Recovery	33.4	1.03			
Average						29.4	0.907	6.64×10^{-4}		
JICA-No.3	Nov. 2001	120.4	114.6-120.1	ditto	Theis	69.1	2.01	1.41×10^{-2}		
					Jacob	97.6	2.98	1.79×10^{-2}		
					Recovery	127.0	3.92			
Average						95.0	2.87	1.59×10^{-2}		
JICA-1 to 3 Average						43.7	1.34	2.33×10^{-3}		Geometric Mean for low resistivity zone (all Aq3)

* Aquifer constants from PTW-1 to PTW-18are mainly compiled from Ministry of Home & Religious Affairs (1984) and MCDC(1989). However, K,some data of S, and *K*' are analysed in this Study.

** For details of the calculation methods, refer groundwater textbooks, e.g. *Groundwater Hydrology* by Todd (1980).

Symbols) T: transmissivity, *K*: hydraulic conductivity(Screen length was used as the aquifer thickness.), S: storage coefficient,

K': hydraulic coefficient of confining layer, r: distance between a pumping well and the observation well

Table - Input Parameters for the Groundwater Simulation Model (Initial Model)

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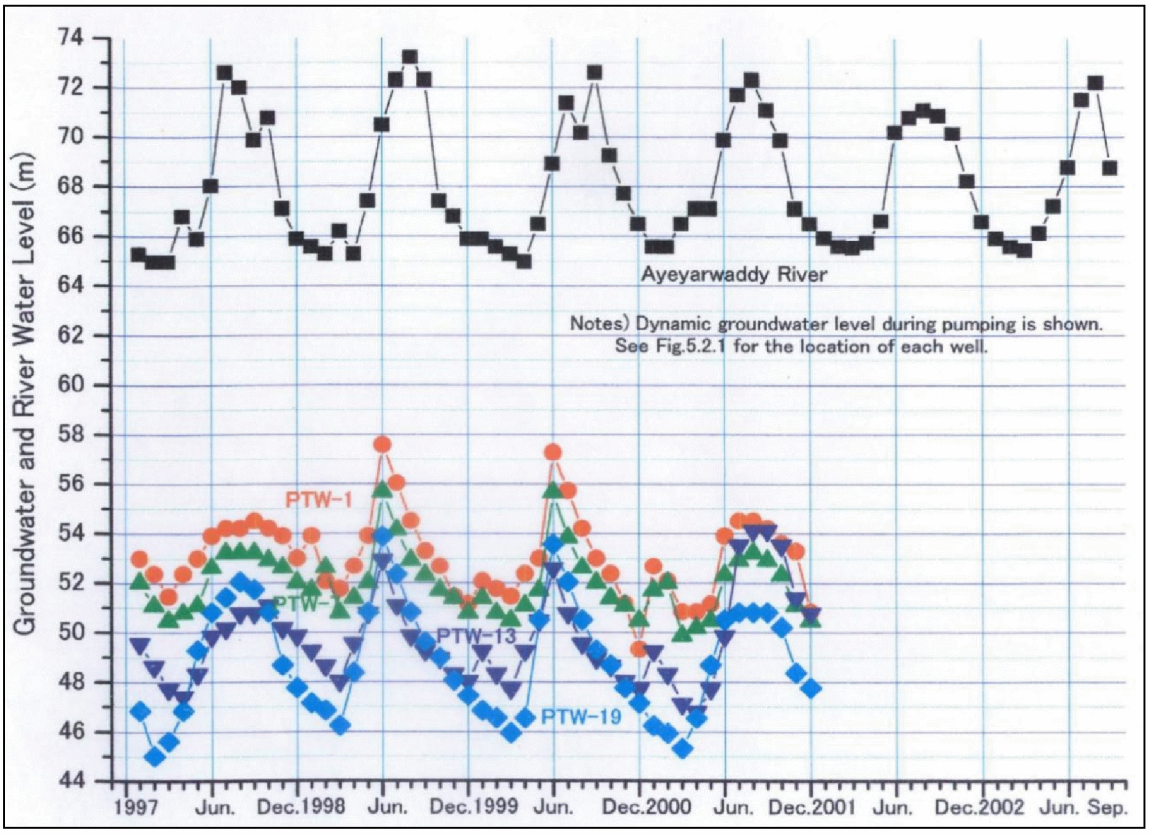
Model Layer	Aquifer Unit	Aquifer type	Top and Bottom Elevation (masl)	Effec-tive Poro-sity	*Ss* (l/m)	*Kh* (m/day)	*Kv* (m/day)	Initial Heads (masl)	Recharge Rate (mm/day)	Pumping Rate (2002) (m^3/day)
1st Layer (Aq1/ Co1)	1st Aquifer/ 1st Aquitard	Unconfined / Confined	Top: 65to 96 Btm: 45 to 72	0.12	2.4E -03	0.89	0.0087	60-88	0.84(Mdy) to 1.05(other area)	5867
IInd Layer (Aq2)	Shallow Confined Aquifer	Confined (partially unconfind)	Top: 45 to 72 Btm: -29 to 47	0.25	5.4E -05	140 (114-163) to 26.6	140 (114 - 163) to 26.6	68-85	0	5779
IIIrd Layer (Co2)	2nd Aquitard	Confined	Top:-29to 47 Btm: -70 to +1	0.06	6.1E -05	0.08	0.0018	67-82	0	0
IVth Layer (Aq3)	Deep Confined Aquifer	Confined	Top:-70to +1 Btm: -95 to -18	0.25	6.9 to 7.2E -05	220 (111-273) to 42.6 to 1.34	220 (111 - 273) to 1.34	65-76	0	158083

*masl meter above sea level, *Ss* specific storage, *Kh* and *Kv* horizontal and vertical hydraulic conductivity respectively



Source; The Study on Water Supply Systems in Mandalay City and in the Central Dry Zone

Figure 5.20. Change in Groundwater and River Water Level

(c) Initial Groundwater Levels and Changes in Groundwater and Surface Water Level

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As the initial groundwater levels for time-dependent simulation, calculated groundwater levels were estimated using steady-state simulation. For the calculated values, the continuous groundwater level measurement for 15 wells, and the simultaneous groundwater level measurement for 100 wells including river and pond water level were referred.

Changes in groundwater level data of the deep confined aquifer have been observed only at 4 wells close to the Ayeyarwaddy River. The problem is that the data are dynamic groundwater level. Groundwater level data for other aquifers are not observed. Surface water levels corresponding to these well data are observed at Mandalay gauging station of the Ayeyarwaddy River. Close relationships between groundwater level of the deep confined aquifer and the river level are obtained (Fig. 5.20).

(d) Recharge Rate

As discussed in above (Groundwater Balance), average groundwater recharge rate in and around Mandalay City is estimated to be less than or equal to 1 mm/d (365mm/y). Further, as the recharge rate of the groundwater simulation, 0.84 mm/d (306mm/y) and 1.05 mm/d (383mm/y) were adopted for Mandalay urban area and the surrounding area, respectively.

5.11. Extisting Hydrological Condition of the Project Area

This report is the environmental impact of the proposed oil storage tanks development on the hydrological regime at the proposed project site in Amarapura area of Mandalay region. It aims at assessing sensitivity of the baseline hydrological environment and the potential impacts of the proposed development upon it and proposes mitigation measures in order to ensure that the potential adverse impacts of the proposed oil storage tanks development on the hydrological environment will be slight and neutral.

The description of the baseline hydrological environment at the subject site and in the surrounding area was by means of a desktop study. This was supplemented by a site walkover by the hydrologist to site.

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Relevant desktop studies were undertaken to aid in understanding the underlying hydrology of project area. Supporting information relating to the proposed development was collected for purposes of understanding the oil storage project.

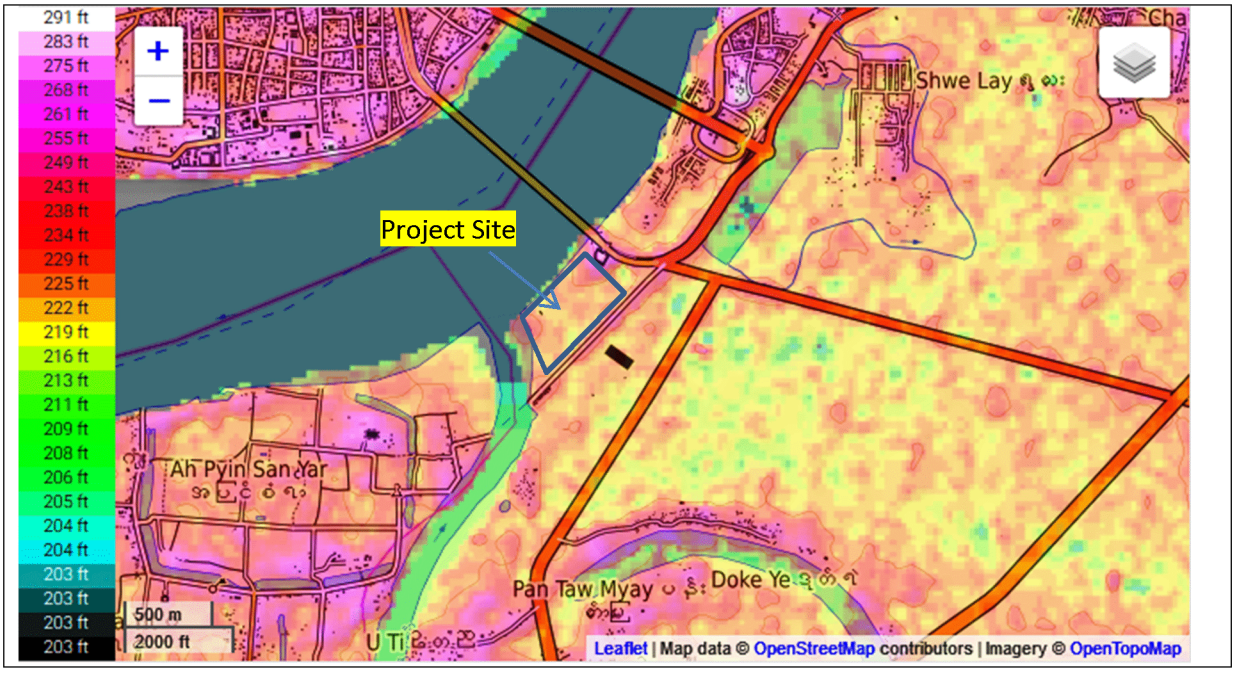
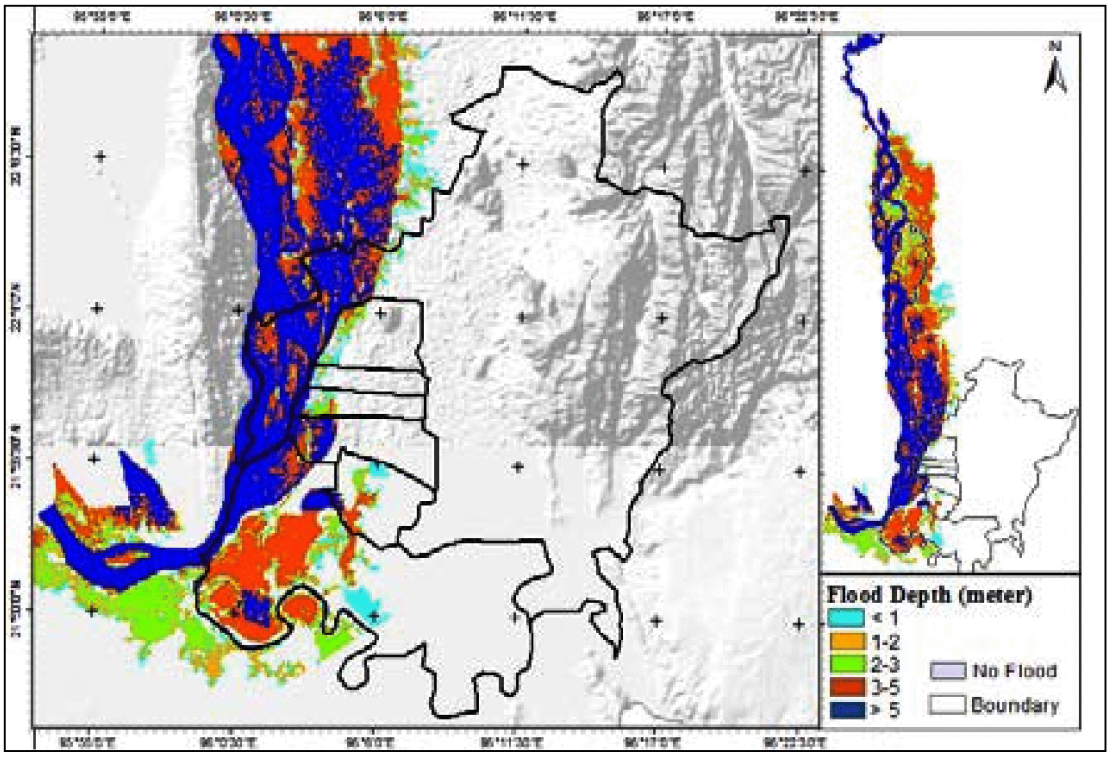


Figure 5.21. Digital Elevation Map of Project Area



Source: Flood Hazard Mapping using Hydraulic Model and GIS, [Kyu Kyu Sein, Thida Myint]

Figure 5.22. Flood Hazard Map of 100 years return period in Mandalay District

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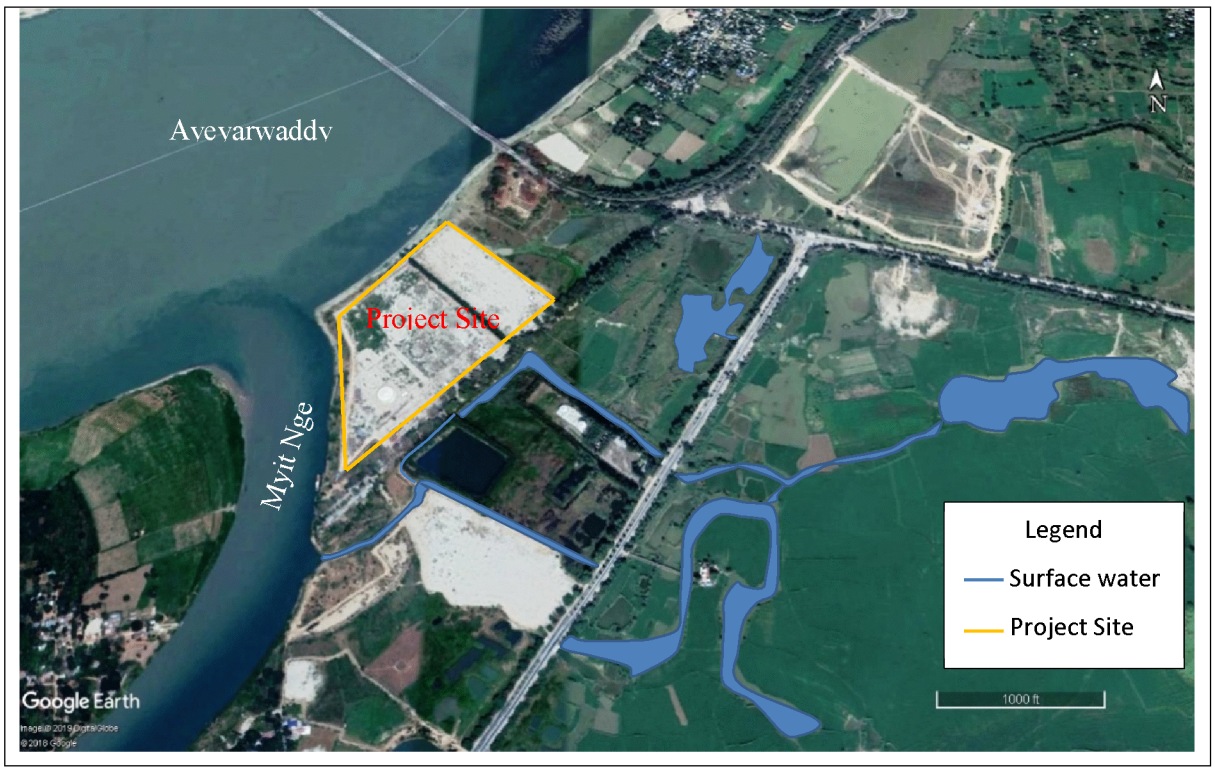

Figure 5.23. Surface Water Condition around Project Area

The proposed project area is located at the confluence of Ayeyarwaddy and Dokehtawady River (Myit Nge River). Southern part of the project area has two creeks, they flows south to north direction and join to the southern part of the project area before flow into the Myit Nge River. Many of paddy fields are situate in the eastern part of the project area. End of the pass creek place is slightly high within the project area. In the rainy season and tidal wave period, if rain water is peak it will be affect few flood situations. Digital elevation model map of the proposed project area is illustrated in figure 5.21.

The project site is at elevated location and no natural steams in the area. During construction period, loose soil and gravel is likely to be washed out. Potential impacts on surface water quality during construction could arise from dust emissions due to vehicular movement and disturbance of soil cover. It causes high suspended solids in storm water run off. Bund and embankments will be provided avoid wash out of loose soil and gravel. Dust emissions will be controlled by periodic spraying with water. Suspended solids will be controlled by using the construction pits to allow the particles to settle down prior to discharge. Further, construction work during rainy period will be curtailed. These measures will reduce surface water quality impacts during construction to insignificant levels.

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According to the data available, the study region shows all the features of semi-arid erosion, the drainage channels are short and discontinuous and remain dry except during short period of rainfall. The amount of rainfall in the study area is the main factor causing changes in water level of the streams, which will affect their water quality. During rainy days water in streams is turbid. Off rainy days the water is of good quality.

5.12. Subsurface Soil Investigation of Proposed Project Area

(a) Scope of Work

Location of the project site

The Project Site is located at the confluence of Ayeyarwaddy and Dokehtawady River (Myit Nge River), some 9 miles of south – west of Mandalay, Amarapura Township, and Mandalay Region. It is closely bounded by Ayeyarwaddy River running NE to SW direction and Dokehtawady River running south to north direction; Mandalay – Sagaing Highway on the north. Thapyaytan defence fortification can be seen beside that highway.

Field Investigation

Field investigations works involve in this investigation include the following:-

1. To explore the subsurface condition of the proposed project area and to provide general information relating to the project.
2. To carry out Standard Penetration Test, to determine bearing capacity of the soil for the purpose of designing.
3. To obtain disturbed and undisturbed samples for laboratory tests to examine the natural and relevant physical properties of subsoil.
4. To measure the water – Level at each drill hole to study the groundwater condition of the project area.
5. To study Geology, Tectonism, Liquefaction and other general information of the project area to consider the safety of structures during the designed stage.

Equipment Record and Report Members

(1) Boring Equipment -------- GX- 300, XY 2PC
(2) Boring diameter --------- BX
(3) Casing diameter --------- 4 inches (NX)
(4) Boring Method --------- Rotary Drilling
(5) Nominal Dia. of hole ------- 4 inches (NX)

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(6) Date commenced ------- 15.3.2015

(7) Type of Sample collection ---- Disturbed / Undisturbed.

(8) Laboratory Test - (1) Myayarpin Laboratory.

(9) Consultant (Engineering Geology): U Tin Tun (Engineering Geologist).

(10) Consultant : Dr. Banyar Aung (BE (Civil)., ME, PhD (Japan) Geotechnical Engineer)

(11) Supervisor : U Aung Ko Ko, U Kyaw Soe Oo (B.,Sc,) Engg - Geol.

(12) Operator : U Naung Naung Oo (Drilling Head) U Mya Maung (Drilling Head)

Standard Penetration Test

This test is done in accordance with BS 1377: 1990, Part 9 and covers the determination of the resistance of the penetration of a split-barrel sampler and obtaining disturbed samples of the soil for identification purpose.

It was performed using a split-barrel sampler connected to the lower end of boring rods. The sampler was driven into soil by means of a 63.5kg hammer falling freely through a height of 76 cm on to an anvil attached to the top of the rods. A trip-release mechanism and guiding assembly were used to control the falling hammer and the driving energy was thus transmitted through the rods to the SPT sampler. The sampler was driven 45 cm into soil with the number of blows required for each 15cm of penetration recorded. The resistance, N-value, was taken as the number of blows for the last 30cm of penetration.

When 50 blows were reached before the full penetration of 30cm, no further blows were applied and the final penetration was recorded. At the end of the test, the sampler was withdrawn and some extracted soil was placed into a plastic container and then labeled. These samples were used to describe the type of soil existing in the boring points. In this project, total 20 numbers of SPT were taken in order to get the information and technical data on the strength and type of soil.

Undisturbed Sampling

Undisturbed sampling was carried out by using a thin-wall tube sampler with outer diameter of 75mm. prior to sampling; the borehole was flushed with water to remove the remnants left at the bottom of the borehole. The bottom was measured to confirm the depth at which the soil sample was taken. The sample tube was lowered down to the bottom of the hole and jacked into soil. After the sample tube was jacked to the required depth, the sample tube was taken out to the surface. Wax was then applied to form a seal on both sides of the UD tube and labeled properly before transporting to the laboratory for

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testing. In this project, total 20 numbers of undisturbed samples were collected by taking UD samples at every change of strata depth from each borehole, whenever the conditions are favorable.

Disturbed

Disturbed samples were taken from a split tube sampler for identification purpose, and were stored in sealed plastic containers. In this project, disturbed samples were taken out at every 1.5 m of each borehole.

Laboratory Tests

The following Laboratory tests are carried out on the undisturbed samples obtained from the boreholes.

- Grain Size Destibution Test.
- Atterberg's Limit Test.
- Specific Gravity Test.
- Bulk and Dry Density Determination Test
- Unconsolidated Undrained Triaxial Compression Test.
- Moisture Content.

The purpose of laboratory tests is for the evaluation of shear strength, compressibility characteristics and classification of soil properties. All tests were carried out in accordance with BS1377. Classification of soil type is based on the Unified Soil Classification System (USCS).

Moisture Content

To determine the moisture of soils, a soil sample is dried at a temperature of 105°C to 100°C for about 24 hours. The loss in weight of the soil sample represents the weight of moisture in the soil. The moisture content of the soil to the dry weight of soil in percentage is the moisture content of the testing soil. This test is performed in accordance with BS 1377: Part 2 : 1990 # 3

Bulk and Dry Density Determination Test

The bulk density of a soil is the mass per unit volume of the soil deposit including any water it contains. The dry density is the mass of dry soil contained in a unit volume. Both are expressed in Mg/m3, which is numerically the same as g/cm3. It was determined at the

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laboratory by using the linear measurement method approached by B.S. 1377: 1900 Part 2: Test 7:2

Unconsolidated Undrained Triaxial Compression Test (UU)

Unconsolidated Undrained Triaxial Compression Tests were conducted to determine the undrained shear strength of the soil. This test performed with the drain valve closed for all phases of the test and before the sample has a chance to consolidate. That is, the undisturbed samples (on 38mm diameter x 76mm length) are sheared under undrained condition. It is based on the test method approached by B.S 1377: 1990 Part 7: Test 9.

(b) Geomorphology and Geology

The project area is located on the flood plain of Ayeyarwaddy and Dokehtawady Rivers. It is mainly composed of sand and silt and it extends down to the depth of 100 ft, bottom of the holes. However, thin layers of clayey soil are observed in some drill holes occasionally. Generally the topography of the site is rather flat and its altitude is about 70 m eter above sea level. At the project area, the alluvium thickness is too great and none of drill holes reach the bedrock till the depth of 100 ft below the ground level. Generally the upper layer of the sand is loose and give fine to medium grained whereas the lower portion is dense to very dense and medium to coarse grained. Besides, inclusions of some gravel are notice at some drill holes. Two numbers of pounds are found at the project area and four numbers of creaks flowing into the Dokehtawady River at the southernmost part of the area.

(c) Tectonism

The project area is very near to Sagaing Fault, which run north – south direction along the west of Ayeyarwaddy River. It is the most prominent active fault in Myanmar. Moreover, the Sagaing Fault is infamous and dangerous because it has been an originator of a larger proportion of the destructive earthquake in Myanmar.

According to the seismic zone map of Myanmar, it lies in Destructive Zone with 9 Modified Marcalli intensity. Probable range of ground acceleration is in the range of 0.4 to 0.5 g. Hence, it is recommended to pay a special attention on seismicity in designing the structure, Regarding the Modified Marcalli Scale class, the level of probable damage and destruction may be summarized.

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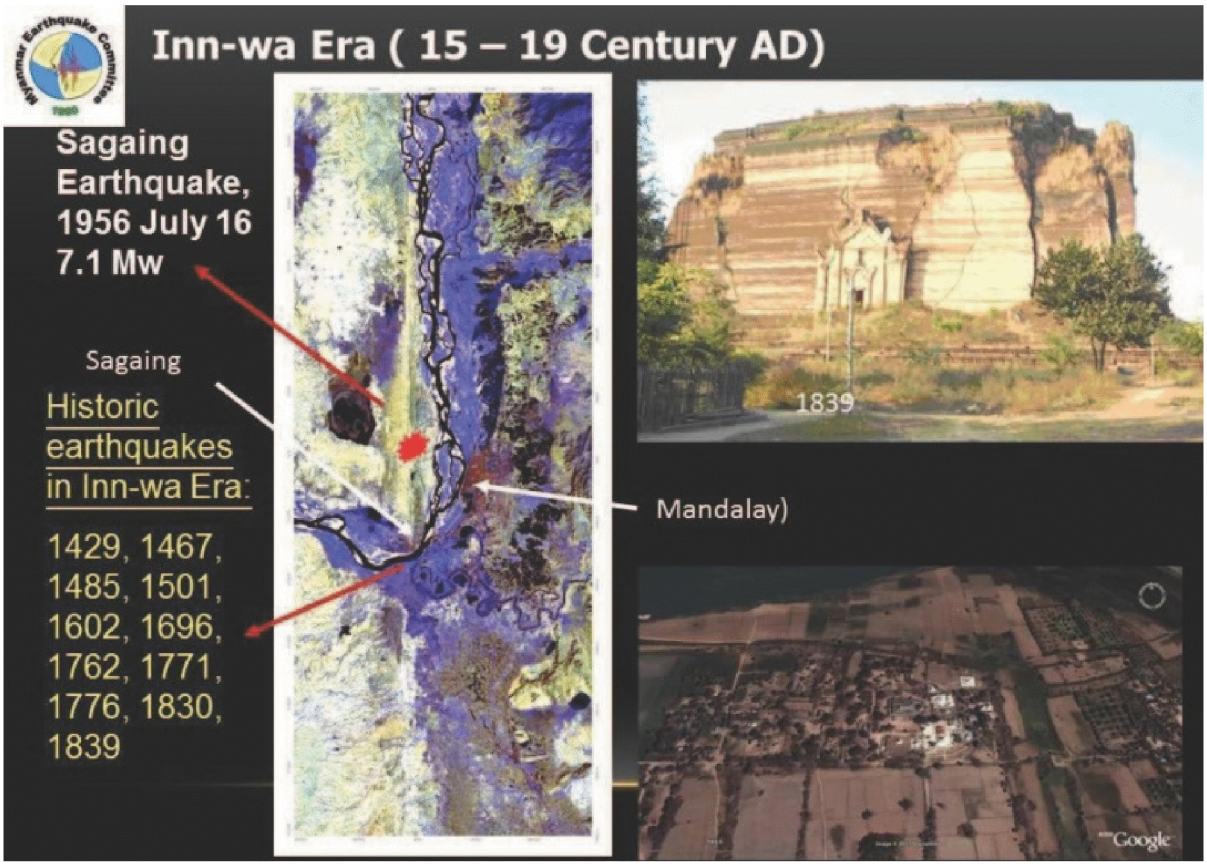
Modified Marcalli Scale Class

Zone	MM Class	Probable Damage	Example of damage
V	IX	Major damage	-Considerable damage in specially designed structures. -Major damage in good RC buildings
IV	VIII- IX	Considerable damage	-Considerable damage in good RC buildings. -Major damage in ordinary brick buildings
III	VIII	Moderate damage	-Moderate damage in good RC buildings. -Considerable damage in ordinary brick buildings
II	VII	Minor damage	-Minor damage in good RC buildings. -Moderate damage in ordinary brick buildings
I	VI	Slight damage	-Minor damage in ordinary brick buildings



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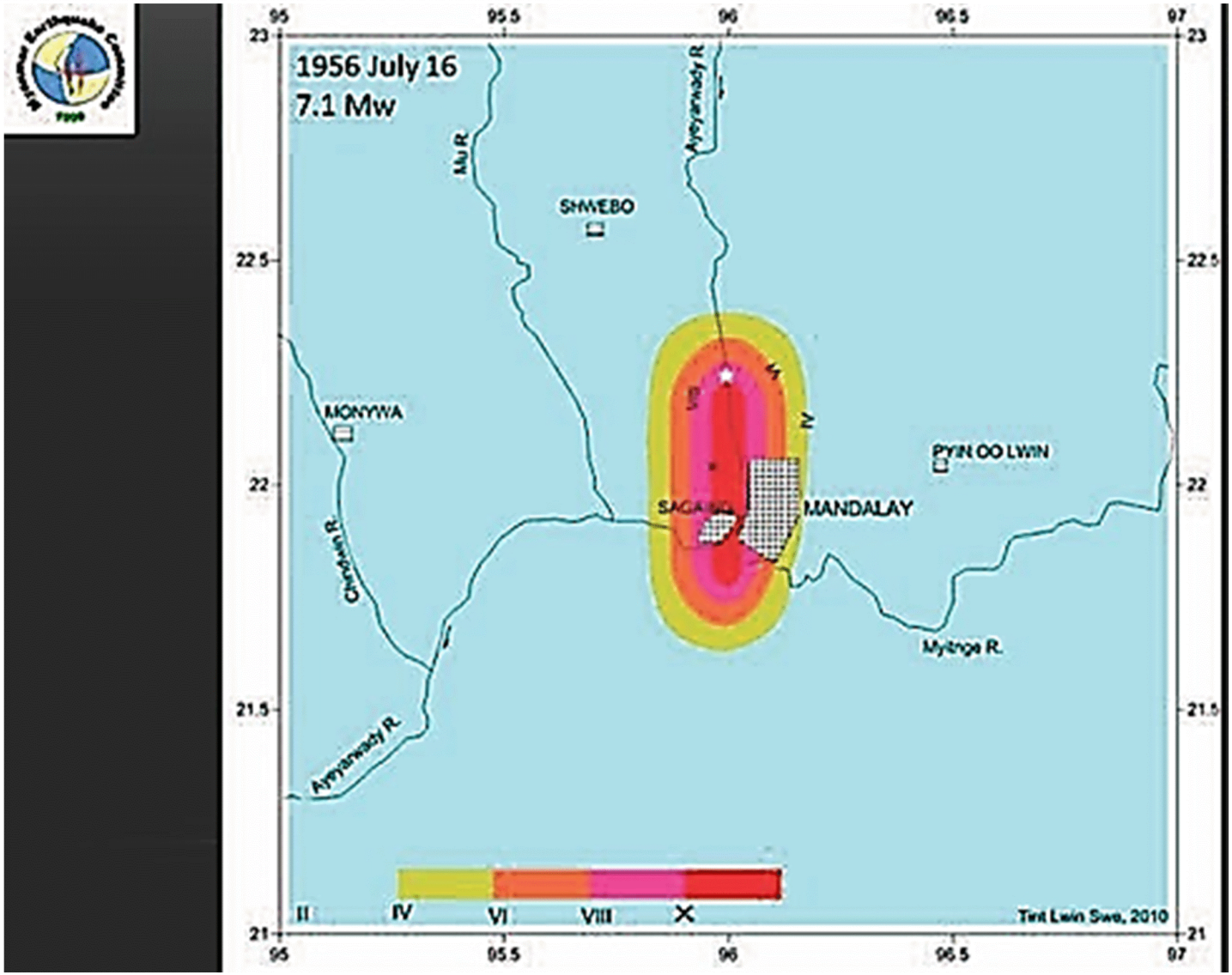

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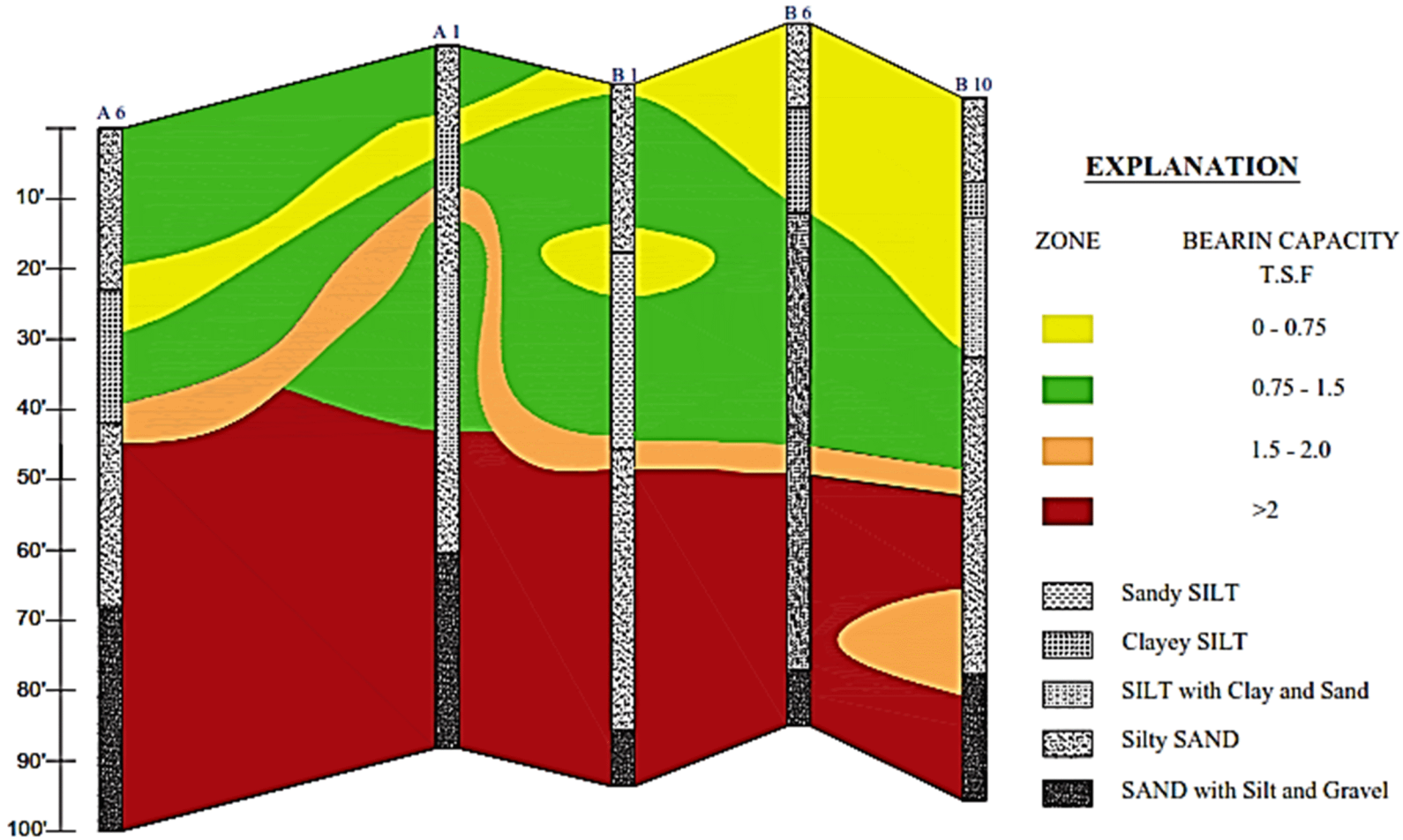

Bearing Capacity of Subsoil in Project Area

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GEOLOGICAL MAP OF PROJECT AREA

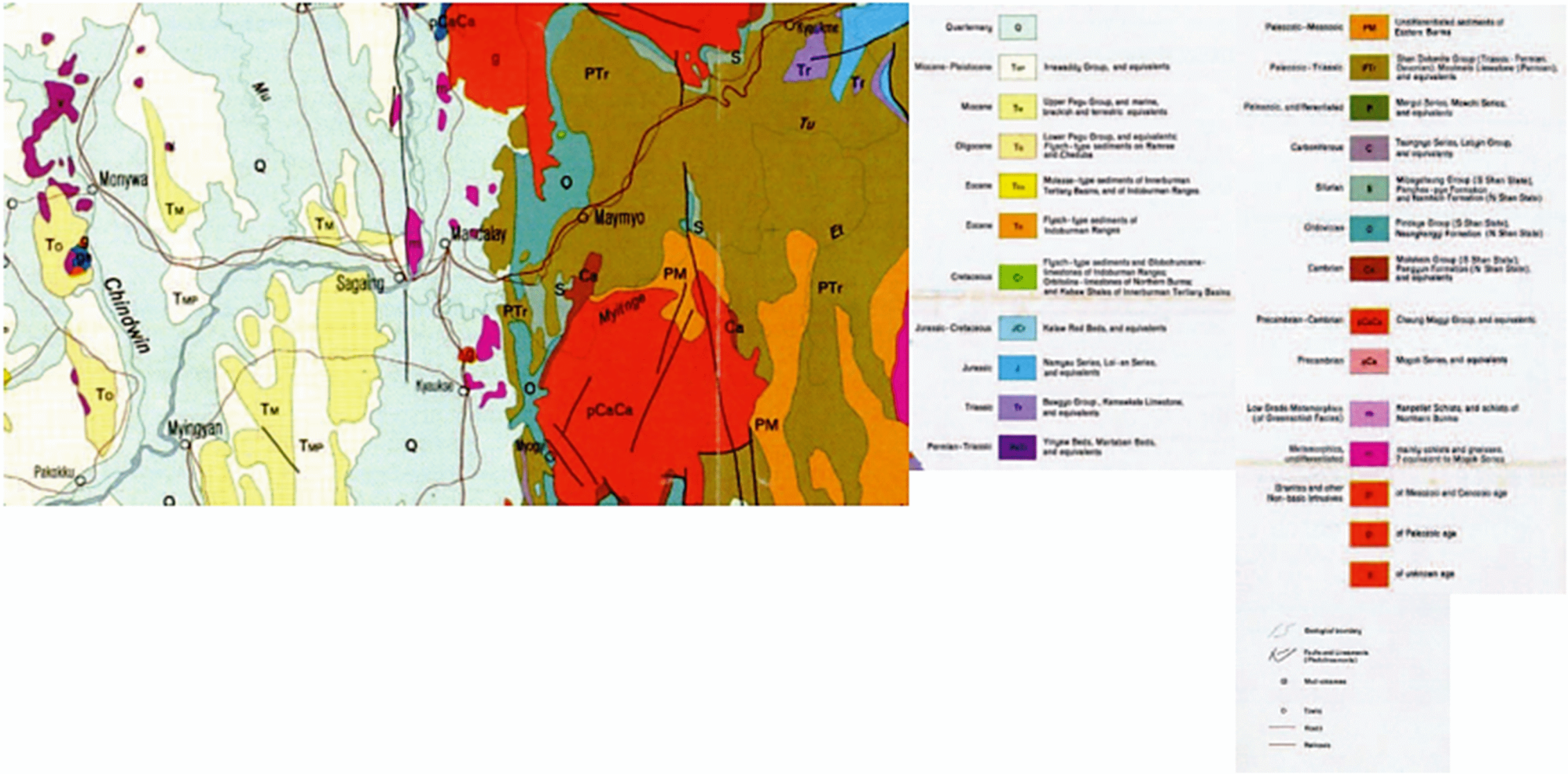

Figure 5.24. Geology Map of Project Area

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Figure 5.25. Topographic Map of Project Area

(d) Engineering Geology of the Project Area

In order to find out the foundation condition 20 numbers of Standard Penetration Test were carried out during the investigation period. The project area is situated at the confluence of Ayeyarwaddy and Myitnge (Dokehtawady River) Rivers and the whole area is covered entirely by sand and silt of alluvial deposit. Moreover, clayey sand or silt layers are encountered occasionally at some horizons. No trace of bedrock is found till to the depth of 100 ft, bottom of the holes.

According to the Standard Penetration Test results, two layers of bearing strata are observed. The upper layer of bearing strata is found at some drill holes at the depth of about 25' to 40' (e.g. A1, A2, A8, A9, B4, B6), but the bearing thickness is thin and liquefaction due to earthquake shaking or other rapid loading is expected. The lower

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layer of bearing strata is rather thick. It is found in all drill holes at th e depth of about 52 ft to 100 ft.

This section is composed of dense to very dense sand with silt, sometimes including gravels, light grey to grey and medium to coarse grained. It is recommended that, this layer is suitable for foundation, due to its bearing thickness and liquefaction may not be occurred.

(e) Ground Water Condition

The type of water is mostly seepage water which can come from pervious, semi pervious soil layers and surface run off. The investigation team was measured the ground water level below the ground from SPT Investigation Bore Holes at March 2015 of summer season. Following data are Ground Water Level of each Building site.

Date	Bore Hole No.	G.W.L (ft)
17.3.15	A 1	23'
17.3.15	B 1	23'
19.3.15	B 2	21'
20.3.15	A 2	25'
21.3.15	B 3	17'
23.3.15	A 3	21'
23.3.15	A 4	20'
23.3.15	B 4	16'
25.3.15	B 5	20'
26.3.15	A 5	18'

Date	Bore Hole No.	G.W.L (ft)
28.3.15	A 6	23'
30.3.15	A 9	10'
31.3.15	B 8	18'
1.4.15	A 7	20'
3.4.15	B 7	20'
4.4.15	A 8	19'
5.4.15	B 6	20'
7.4.15	B 9	18'
27.4.15	B 10	21'
29.4.15	B 11	9'

Conclusion

- The project area is located at the confluence of Ayeyarwaddy and Myitnge (Dokehtawady River) Rivers, some 9 miles south – west of Mandalay, Amarapura Township, Mandalay Region.
- 20 no's of Standard Penetration Test were done covering 2000 running feet.
- The whole area is covered entirely by sand and silt of alluvial deposits and none of penetration test reaches the bedrock.

Suggession

- Two layers of bearing strata are observed. Bearing thickness of the upper layer is thin and found at some drill holes only (e.g. A1, A2, A8, A9, B4, B6) on the other hand, liquefaction due to earthquake shaking or other rapid loading is expected.
- The lower layer of bearing strata is rather thick and made up of dense to very dense sand, medium to coarse grained, sometime including gravel. It is recommended

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that pile foundation scheme can be adopted at that layer and pile end shell be placed into certain depth. Numbers, sizes, spacing and length of piles required will depend on the weight of structures.

- Bank protection is taken into consideration, because the project area is closely bounded by two main rivers.
- According to the Seismic Zone Map of Myanmar it lies in Destructive Zone with 9 Modified Marcilli intensity. Probable range of ground acceleration is in the range of 0.4 to 0.5. Hence, it is recommended to pay a special attention on seismicity in design stage.
- According to the liquefaction potential of project area, soil depth, 0 to 50 ft can be occurred liquefaction due to earthquake shaking and other rapid loading. This result is calculation base on ground acceleration factor – 0.45 g.

5.13. Living Environment

The overall conditions of air quality, water quality, soil quality, and noise levels are quoted from the scoping report for oil storage Project. The location of the environmental survey for overall conditions is shown in the following figure.

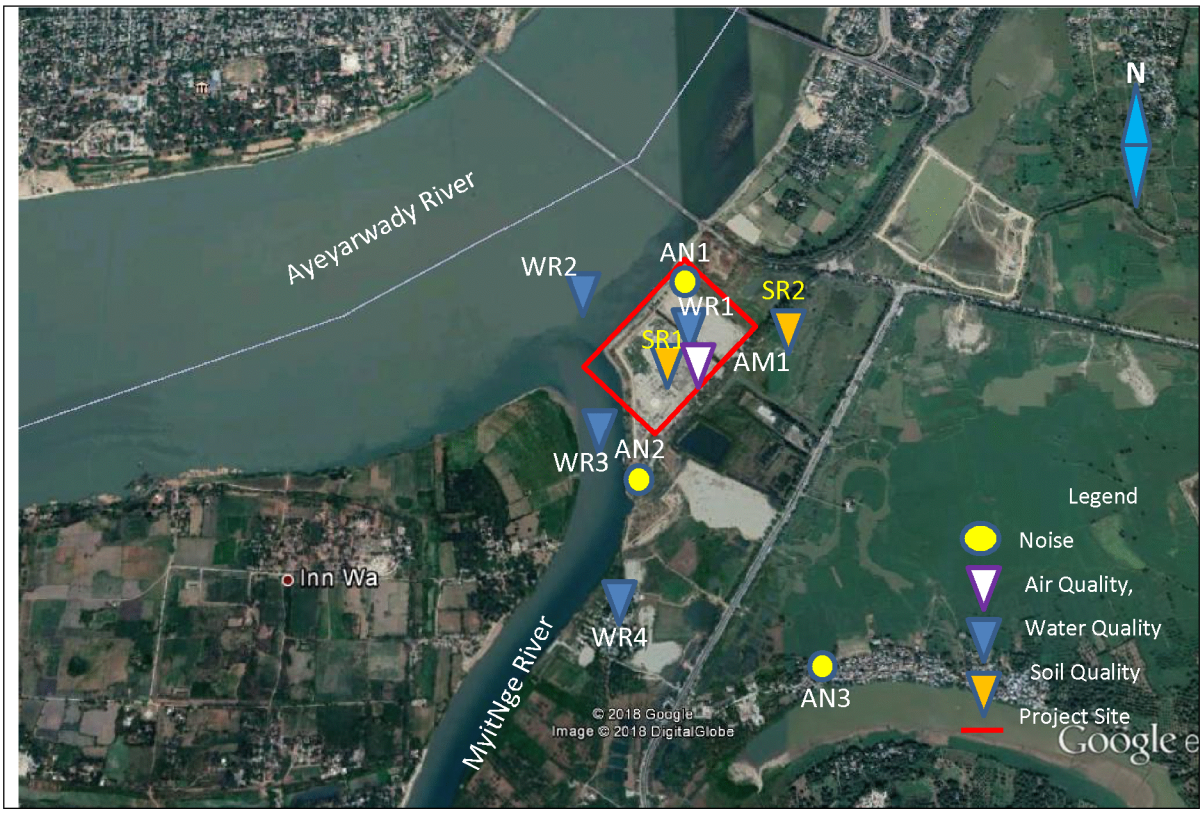

Figure 5.26. Locations of Environmental Baseline Study

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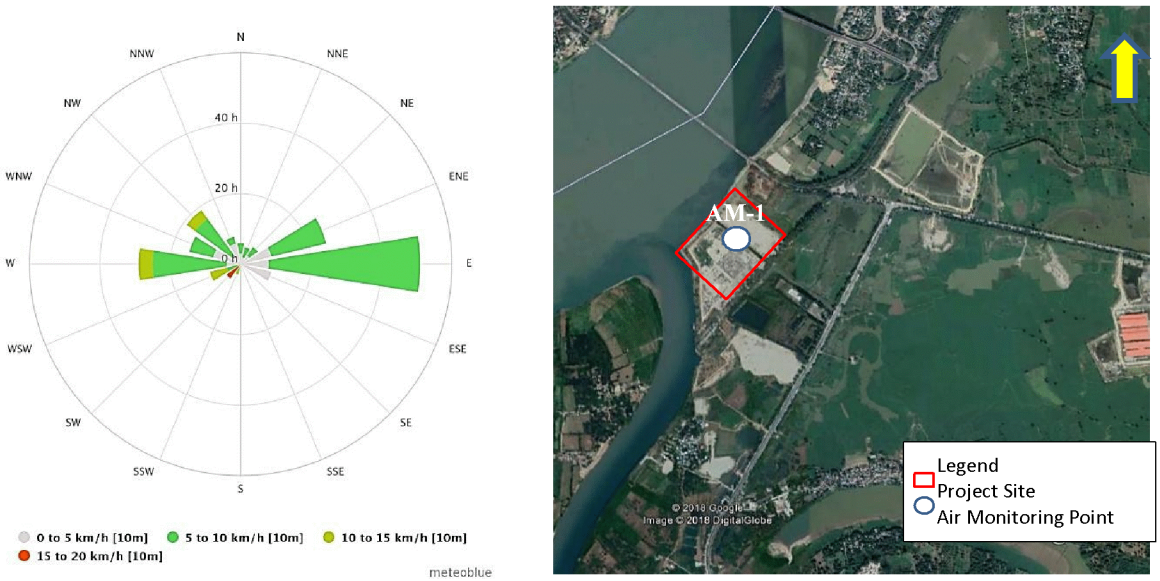
Location	GPS Coordinate	
AM-1	95°59'39.35"E	21°51'49.29"N
AN-1	95°59'42.07"E	21°51'49.00"N
AN-2	95°59'36.23"E	21°51'35.61"N
AN-3	95°59'51.85"E	21°51'12.88"N
WR-1	95°59'42.41"E	21°51'48.89"N
WR-2	95°59'34.83"E	21°51'58.36"N
WR-3	95°59'32.56"E	21°51'41.54"N
WR-4	95°59'32.53"E	21°51'21.14"N

5.13.1 Air Quality

(a) Sample Points Selection

Locations for ambient air quality monitoring were determined based on the wind speed and direction of the project area. According to the wind-rose plot of Mandalay station at meteoblue website, the wind is significantly blowing from east-west and from west-east direction during the survey period. The monitoring was conducted at the project site as shown in the following figure.



Weekly Windrose Plot Vew and Air Quality Monitoring Locations

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Recorded Photo for Air Quality Monitoring

Air Monitoring Point Locations

Monitoring ID	Coordinate	Remarks
AM-1	21°51'49.29"N 95°59'39.35"E	at the center of the project site

(b) Methodology

The Environmental Perimeter Air Station (EPAS) was used to detect ambient air quality for 24-hour averaging periods. The following table presented the methods and parameters covered in the 24-hour monitoring period.

Pollutants and Methodologies Covered in 24-hr Monitoring Period

No.	*Parameters*	*Analysis Methods*
1.	Sulfur dioxide (SO_2)	Electrochemical sensors
2.	Nitrogen dioxide (NO_2)	Electrochemical sensors
3.	Carbon Dioxide (CO_2)	NDIR (optional sensor)
4.	Carbon monoxide (CO)	Electrochemical sensors
5.	Hydrogen Sulfide (H_2S)	Electrochemical sensors
6.	Particulate Matter 2.5 ($PM_{2.5}$)	Infrared Light Scattering
7.	Particulate Matter 10 (PM_{10})	Infrared Light Scattering
8.	Ozone (O_3)	Gas Sensing Semiconductor-GSS technology (optional sensor)

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(c) Results and Discussion

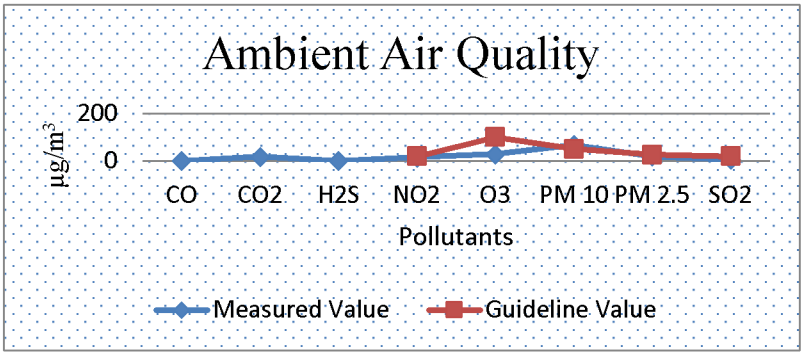
Ambient air quality monitoring analysis results were compared with National Environmental Quality Guidelines (NEQ), Myanmar. It was found that all the concentration values from the measured parameters were lower than the NEQ guideline values except PM_{10} at 67µg/m^3 which slightly exceed the guideline values. The possible source of PM will be from the travelling vehicles in Oh Htoke Tan Road because the air quality monitoring point is not too far from the road. There are no identified guideline values for CO and CO_2 either in NEQ or WHO, however, according to the US EPA (8-hr averaging period of CO at 35 ppm (40E-4 µg/m^3) and 8-hr CO_2 at 5000 ppm (89.9E-6 µg/m^3), the concentration values from the in-situ measurement were lower than human threshold limits. The mean concentration values compared with guideline values were expressed in the following table and graph.

Comparison of Pollutants Concentrations between Measured and Guideline Values

Pollutants	Averaging Period	Unit	Guideline Values*	Measured Values
CO [a]	1-hr	µg/m^3	-	0.4E-4
CO_2 [b]	24-hr	µg/m^3	-	18E-6
H_2S	24-hr	µg/m^3	-	0.00
NO_2	1-year	µg/m^3	40	-
	1-hr	µg/m^3	20	15
O_3	8-hr	µg/m^3	100	28
PM 10	1-year	µg/m^3	20	-
	24-hr	µg/m^3	50	67
PM 2.5	1-year	µg/m^3	10	-
	24-hr	µg/m^3	25	19
SO_2	24-hr	µg/m^3	20	5.3
	10-minute	µg/m^3	500	-

* National Environmental Quality (Emission) Guidelines, Myanmar

[a and b] the original values were multiplied with 10^{-4} and 10^{-6} in order to make the graphical presentation clear



Comparison of Concentration Values from In-situ Measurement and NEQ Guideline

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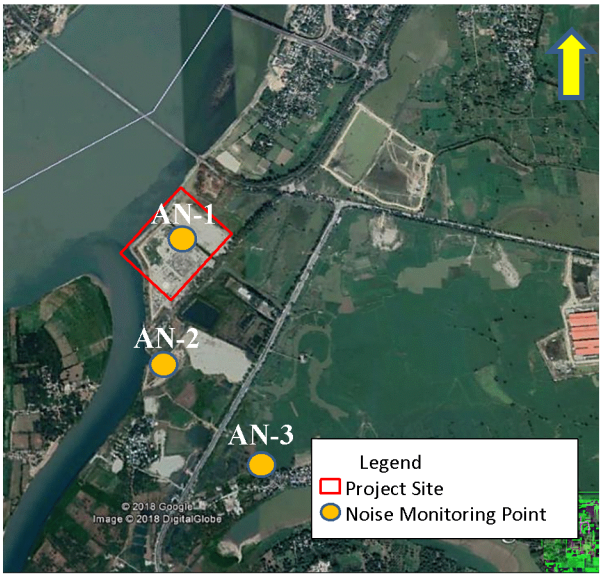
(a) Sample Points Selection

The locations for the monitoring of ambient noise level were presented in the following figure. The monitoring was conducted around the project site. It was observed that the nearest receptors were located about 5 meters NE and SW of the project site. However, the other villages are also considered to carry out noise monitoring.





TES-1353H Integrating Sound Level Meter and Noise Monitoring Locations

(b) Methodology

Two units of TES-1353H Integrating Sound Level Meter were used for day and night times noise levels monitoring. The detailed monitoring points and analysis method are presented in the following table and figure.

Noise Monitoring Locations and Methods

Receptor Location	Date	Description	GPS Coordinates	Unit	Methodology
AN-1		Inside the project site	21°51'49.00"N 95°59'42.07"E	dBA	Measured continuous Sound Pressure Level (SPL) with 0.5-inch Electret condenser
AN-2		Near the shop house in Oh Htoke	21°51'35.61"N 95°59'36.23"E		

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		Tan			microphone
AN-3		Near the Tet Gyo Village	21°51'12.88"N 95°59'51.85"E		

Results and Discussion

Noise level from the measured values at receptor locations were compared with NEQ guideline values. It was observed that day time noise level measurement in all receptor locations AN-1 at 55.8 dBa was slightly exceed the Myanmar Emission Guidelines at 55 dBA whereas the values of AN-2 at 52.7 dBA and AN-3 at 532.6 dBA were lower than the guidelines. The possible source for higher noise level in AN-1 will be noise from travelling of motocycle in Oh Hotke Tan Road and noise from travelling of motorboat inside the Myit Nge River. The night time monitoring of (AN-1 at 42.5 dBa, AN-2 at 43.4 dBA and AN-3 44.1dBa) were lower than the guidelines. The summary of measurement results and guideline values were described in the following table.

Noise Level Measurement Results and Guideline Values

Noise Level	Time Period	Receptor Locations		
		AN-1	AN-2	AN-3
Measured Values (dBA)	Day Time	55.8	52.7	53.6
	Night Time	42.5	43.4	44.1
Guideline Values (dBA) Residential, Institutional, educational	Day Time (07:00-22:00) (10:00-22:00 for Public holidays)	55		
	Night Time (22:00-07:00) (2200-10:00 for Public holidays)	45		

5.13.3 Water Quality

(a) Sample Points Selection

Since the project site is located at the confluence of Myit Nge Myitnge (Dokehtawady River) and Ayeyarwaddy river, the sampling points were selected upstream and downstream area of the project site. The locations of sample points were presented in the following figure.

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Location of Water Quality Sampling Points

(b) Sampling and Analysis Methods

Sampling Method

Water samples was collected in terms of grab sampling method (especially for the river with regular flow rate) with the following approaches;

- Rinsing the water bottle with river water;
- Water sample was taken by water sampler;
- Tip bottle upright and allow water to fill bottle; and
- Remove bottle from water and screw on cap.



Recorded Photo during Surface Water Sampling

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Sample Handling and Preservation

- use water resistant label for each sample bottle with the date, time, and site number/name
- documentation is done in field logbook
- store the samples in ice box immediately after sampling and transport for laboratory analysis

Analysis Method

In-situ measurement of water quality will be conducted for the parameter such as pH, conductivity and total dissolved solid with pH and Conductivity handheld meter. The remaining parameters described in the following table will be sent to laboratory for laboratory analysis.

Parameters and Methods were used in Water Quality Analysis

Parameter	In-situ	Laboratory Analysis
	Equipment/ Method Used	
pH	pH meter	Ion selected electrode method
Conductivity	EC Meter	Ion selected electrode method
Total Dissolved Solid		Ion selected electrode method
Turbidity	-	Absorption Method
Color	-	Platinum Cobalt Method
5-day Biochemical oxygen demand	-	-
Chemical oxygen demand	-	-
Absorbable organic halogen	-	-
Total nitrogen	-	-
Total phosphorus	-	-
Total suspended solids	-	-
Total suspended solids	-	-

Note: Laboratory analysis methods are referred to Occupational Health and Environmental Safety Laboratory under the Ministry of Health

Water qualities are tested in Occupational Health Department, Ministry of Health and Sports. Detailed results for water qualities are shown in Appendix V.

Results and Discussion

The analysis results were compared with National Surface Water Quality Standard and the method and equipment used in analysis and results are presented in the following table.

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Table: Water Quality Analysis Results

Analyses	Ref; Value	Unit	Result				Method/Equipment Used
			Ayeyarwady River Water	Tube Well Water	Myit Nge River Water	Water to be used at Project Site	
pH	6-9	-	7.7	7.4	8.3	8.2	Ion Selected Electrode Method
Total Dissolved Solid	2000	Mg/L	50	90	260	40	Ion Selected Electrode Method
Arsenic	0.1	Mg/L	0	0	0	0	Arsenator
Sulphate	1000	Mg/L	41	9	9	7	Barium Chloride Method
Chloride	1000	Mg/L	0.1	0.3	18.2	2.5	Argentomeric Method
Electro Conductivity	1500	µmhos/cm	700	140	200	370	Ion Selected Electrode Method
Turbidity	5-15	NTU	0.05	0.05	0.05	0.05	Absorption Method
Iron	3.5	Mg/L	0.2	0.4	0.5	0.3	Bipyridyl Method
Zinc	2	Mg/L	0	0	0	0	Zincon Method
Hardness	500	Mg/L as aCO3	87	116	402	161	Unit Dose Vials Method
Color	15	TCU	1	0	0	0	Platinum Cobalt Method
Magnesium	150	Mg/L	16	23	41	26	APHA Method (ICP)

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Impacts Assessment on groundwater

Groundwater in Hydrologic cycle

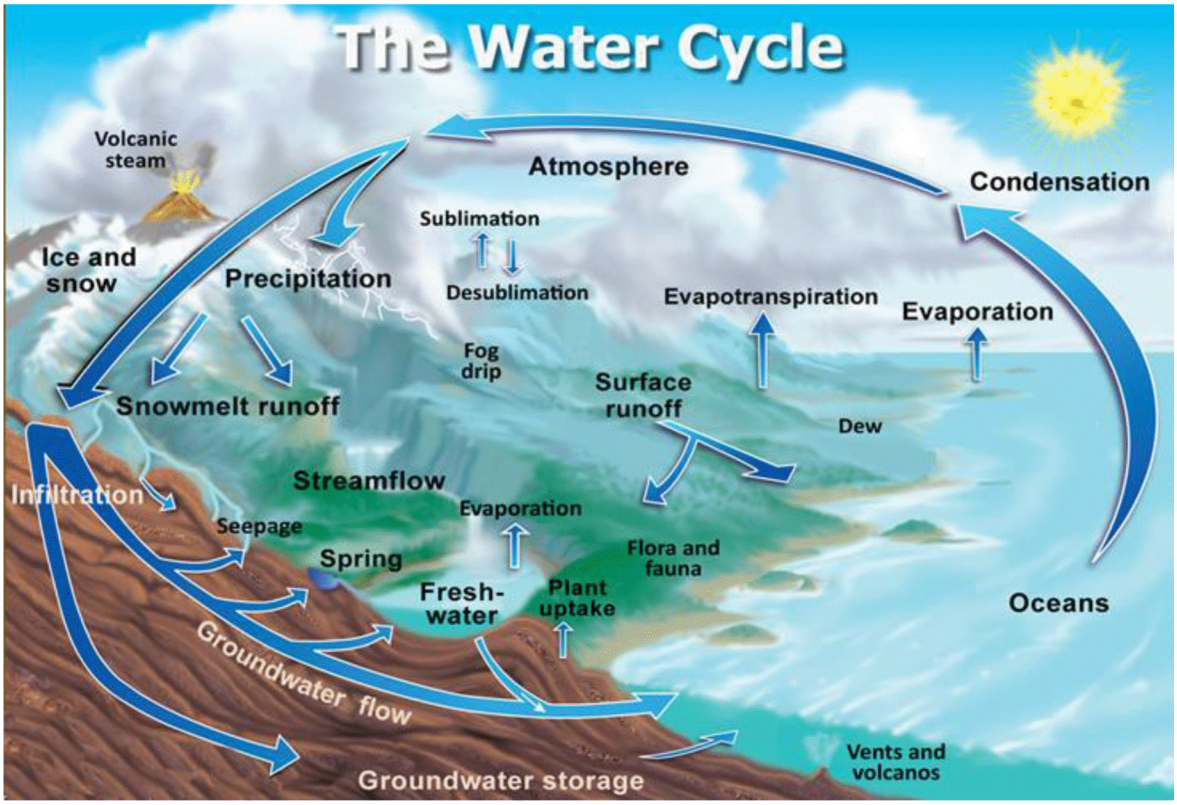

Figure: Hydrologic Cycle

Ref: www.usgs.org

Groundwater plays a vital role in the water cycle, or hydrologic cycle, which describes the ongoing movement of water on, above, and below Earth's surface. It begins with precipitation—rain, snow, sleet, or hail—falling onto the Earth's surface, where it can either run off or infiltrate the soil. The water that infiltrates percolates through the ground, becoming groundwater. This process, known as recharge, recharge occurs when the rate of water entering the aquifer exceeds the rate of water leaving it. This replenishment of groundwater resources is critical for sustaining aquifers and supporting ecosystems, as well as supplying drinking water and irrigation for human activities.

Groundwater is stored in aquifers, which can vary from shallow unconfined aquifers to deep confined aquifers, depending on geological conditions. It moves through the subsurface, influenced by gravity, flowing from areas of higher to lower elevation. This flow is determined by factors like the permeability of the surrounding material and the slope of the water table. Groundwater naturally discharges into surface water bodies such

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as rivers, lakes, and wetlands, contributing to base flow during dry periods. Some of it also returns to the atmosphere through evapotranspiration, where plants absorb water from the soil and release it into the air, and some may evaporate directly from the soil.

Additionally, groundwater can discharge into oceans through coastal outflows, playing an important role in the global water budget and affecting coastal ecosystems. Human activities, such as groundwater pumping for irrigation or water supply, can significantly alter groundwater flow patterns, leading to depletion, reduced stream base flow, land subsidence, and other environmental impacts.

Groundwater is an integral part of the hydrologic cycle, intricately connected to the overall water cycle, regulating water distribution and movement within the Earth's system. Proper management of groundwater is crucial for maintaining healthy ecosystems, supporting human needs, and addressing the impacts of climate variability and human activity on water availability.

Soil Conditions

The project area is close to the water bodies and having compact soil. Compact soil is characterized by its tightly packed structure, resulting in reduced porosity and low permeability. Heavily compacted soils contain few large pores, less total pore volume and, consequently, a greater density. A compacted soil has a reduced rate of both water infiltration and drainage. This type of soil often forms through natural processes such as sediment deposition or human such as using heavy machinery or frequent traffic. Due to its compact nature, compact soil has limited spaces for air and water to move through, which makes it difficult for water to infiltrate. As a result, compact soil tends to have high bulk density and resists root penetration, making it challenging for vegetation to thrive. Additionally, water tends to run off the surface rather than percolate into the ground, which can lead to increased surface runoff and erosion.

When located near rivers, compact soil generally has a low capacity for groundwater recharge. Since water infiltration is slow, the ability of compact soil to contribute to groundwater reserves is significantly reduced. Water may temporarily accumulate in surface depressions during periods of river overflow or flooding, but this water typically infiltrates very slowly. The recharge process is especially limited in compact soil because of the minimal pore space that restricts water movement. Seasonal flooding may provide temporary opportunities for recharge, but overall, compact soil does not efficiently support the percolation of water into deeper layers.

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The groundwater storage capacity of compact soil near rivers is also limited. Due to its dense structure, compact soil cannot hold significant amounts of water. Surface water may collect during high river stages, but deep groundwater storage is restricted unless there are less compacted, permeable layers beneath the compact soil, such as sand or gravel. In such cases, some water may eventually reach deeper layers, though the recharge process remains slow. Ultimately, compact soil near rivers has poor groundwater recharge and storage potential, which impacts the sustainability of groundwater resources in those areas.

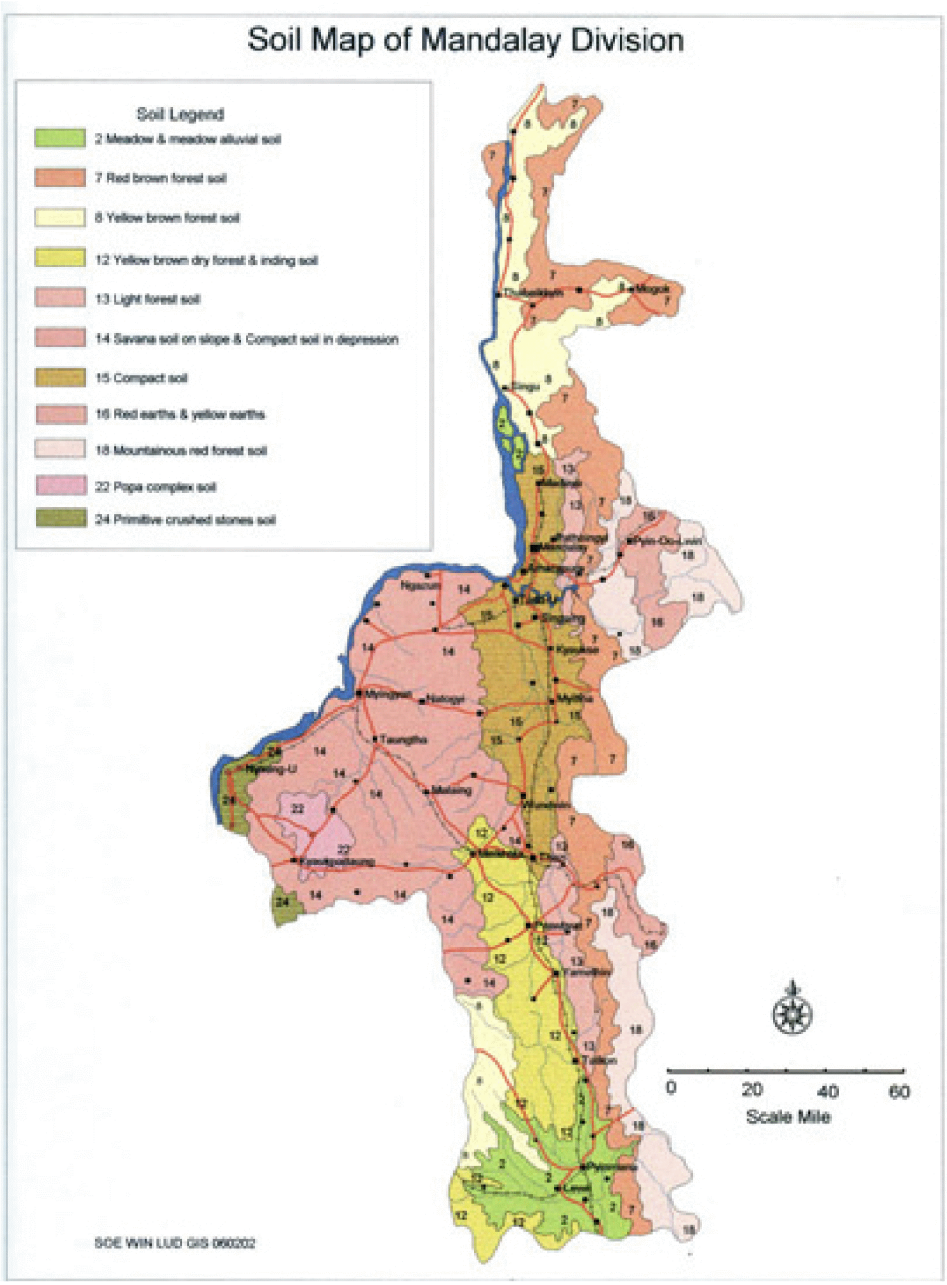

Figure: Soil Map of Mandalay Division

Ref: landusedivision.doa.gov.mm

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Land use

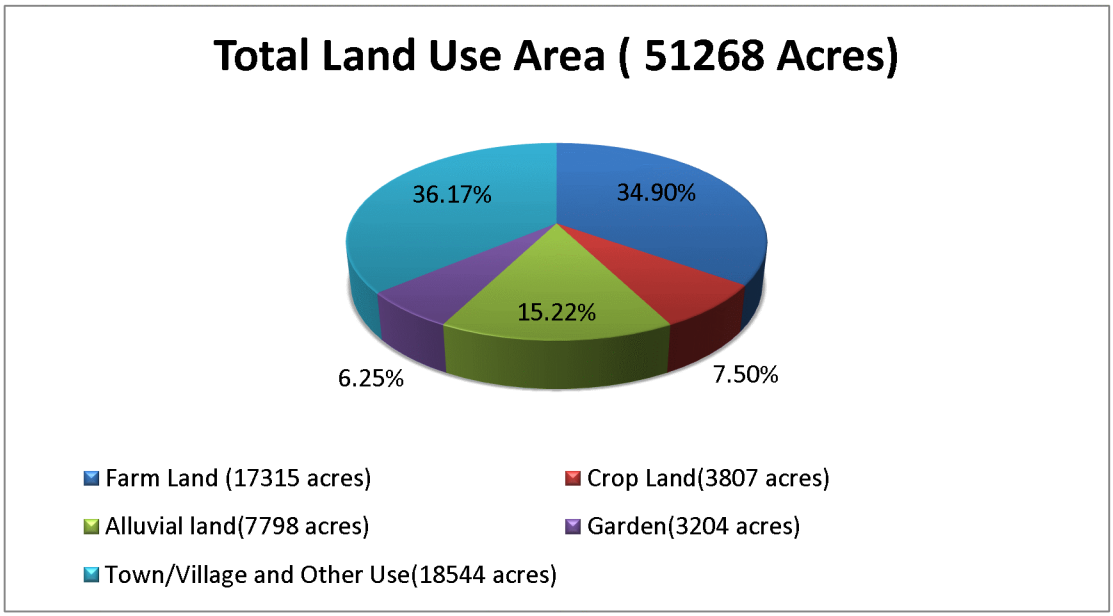

Figure: Land use of Amarapura Region

Based on the land use distribution in the chart, groundwater recharge potential varies significantly across different land types. **Farm land**, which makes up 34.9% of the total area (17,315 acres), has moderate to good potential for groundwater recharge, depending on agricultural practices. Sustainable methods like efficient irrigation and conservation tillage can help water infiltrate the soil and replenish groundwater. However, if the land is over-farmed or compacted, recharge potential decreases. **Alluvial land** accounts for 15.22% (7,798 acres) and typically offers the highest recharge potential. These areas, made up of loose, porous sediments deposited by rivers, allow water to easily percolate through the soil, making them excellent for groundwater recharge, especially in areas close to water bodies.

In contrast, **towns, villages, and other developed areas**, which cover 36.17% (18,544 acres), have poor groundwater recharge potential. Urbanization and the presence of impermeable surfaces like roads and buildings limit water infiltration, leading to increased surface runoff. These areas are unlikely to significantly contribute to groundwater replenishment unless specific measures like rainwater harvesting systems or permeable pavements are implemented. **Crop land**, covering 7.50% (3,807 acres), has a variable recharge potential depending on soil conditions and water management practices. If handled well, crop lands can contribute to groundwater recharge, especially during the

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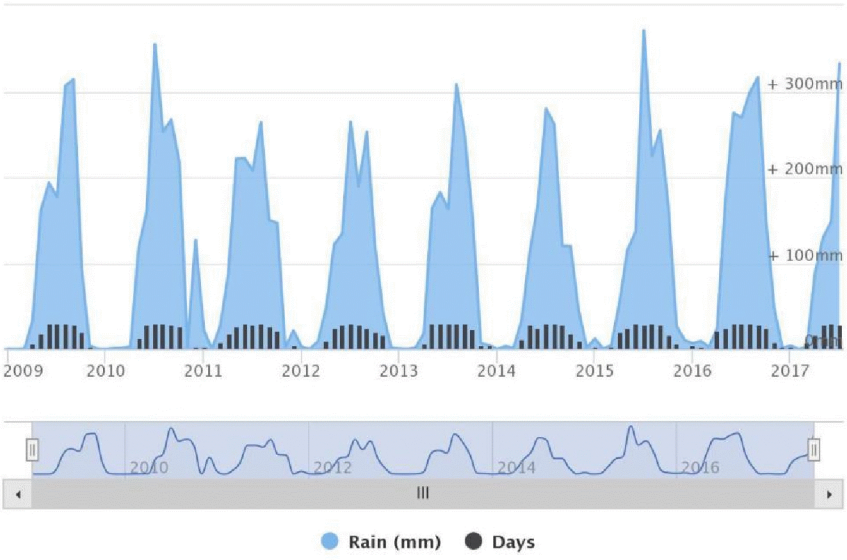
rainy season, but excessive irrigation without recharge strategies could reduce their effectiveness.

Lastly, **gardens**, which make up 6.25% (3,204 acres), offer some localized recharge benefits, particularly when permeable surfaces and vegetation that promotes water retention are present. However, their overall impact on groundwater recharge is relatively small. In summary, the best opportunities for groundwater recharge lie in alluvial lands and farm lands, while urbanized and developed areas offer minimal recharge potential. Effective water and land management in agricultural zones could enhance overall groundwater replenishment in this region.

Rainfall

Amarapura, Mandalay Region is at 21°54'N, 96°3'E, 15 m (249 ft). Amarapura has a tropical wet and dry/savanna climate under the Köppen climate classification system. The city features a lengthy wet season from May through October where a substantial amount of rainfall is received. The rainfall for Amarapura is lowest in May (120mm) and highest in Juiy (330mm). It is primarily due to the heavy rainfall received during the rainy season and a dry season from November through April, where little rainfall is seen. Amarapura is situated in or near the tropical very dry forest biome according to the Holdridge life zones system of bioclimatic classification. The total annual precipitation averages 915mm (36 inches) which is equivalent to 915 Litres/m^3 (22.44 Gallons/$ft^{2)}$.



Average Rainfall and Rainy days of Project Area

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Impact of Ground Water depletion due to over extraction of groundwater

Groundwater over extraction leads to ground water table falls and groundwater depletion. Moreover, the ground water table fall during no and less rain period (from November to April) so ground water extraction should be carried out with sustainable water management practice, monitoring wells to track water levels and withdrawals, maintain pervious layers for groundwater recharge, and use alternative water resources such as rainwater harvesting, use surface water, recycle the process water and reuse.

Impact of Ground Subsidence due to over extraction of groundwater

Mandalay is in an alluvial setting (Holocene Age) containing predominantly sands and gravels in a shallow aquifer, called the Amarapura Aquifer (Htay et al.2014; Moe 2013). Compact soil in Alluvial setting may be primarily composed of fine-grained materials like clay and silt, which hold a lot of water as the project area is quite close to river. These soils have small pore spaces that compress when groundwater is extracted, making them more prone to subsidence. Moreover, over extraction of Groundwater in such areas not only lowers the water table but can also disturb the river's water flow dynamics.

Groundwater in the alluvial sediments, especially fine-grained compact soils like clay, helps maintain the structure of the soil by supporting the weight of overlying layers. Near a river, soils are typically more saturated due to proximity to the water source. When groundwater is extracted, the withdrawal of water from saturated compact soils can cause considerable settling or subsidence because the soils rely on the presence of water to maintain their structure. When water is pumped out, the pressure in the pores drops and compress the soil particles more tightly together, leading to subsidence. In areas with high water demand for agriculture, industry, or urban use, groundwater extraction often exceeds the natural recharge rate.

Uneven sinking or differential subsidence damages infrastructure like roads, bridges, and buildings. Moreover, the slow compaction of fine-grained soils, characteristic of alluvial settings, can lead to long-term, often irreversible, subsidence. Over-extraction can exceed the natural recharge rate of the aquifer, particularly in regions where groundwater is heavily relied upon for agriculture or urban use. This reduces the capacity of the aquifer to store water in the future, contributing to water scarcity. Additionally, subsidence can increase flood risks by lowering the elevation of land near the river, making it more vulnerable to overflow during high-water events. The loss of agricultural productivity is

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another concern, as subsidence can disrupt irrigation systems and alter drainage patterns, leading to decreased crop yields or land becoming unsuitable for farming.

To mitigate these risks, regulating groundwater extraction is crucial. Managed aquifer recharge by providing pervious layer within project area can help restore groundwater levels by directing surface water back into the aquifer. Monitoring groundwater levels and track the water use by installing water meter is also important steps in reducing the long-term impacts. Stabilizing riverbanks through engineering measures can further protect against erosion and collapse. Moreover, try other alternative use of ground water such as using river water, harvesting rain water, recycling the reusing the waste water will also reduce the over extraction of ground water which can cause ground subsidence.

5.13.4. Soil Sample

Sample Point Selection

To determine the chemical composition of soil around the project site, the sample points are selected at the project site, rivers' bank and inside the farm land. The sampling points described in the following figure are considered for the in-situ sampling.



Location of Soil Quality Monitoring

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Methodology for Soil Sampling

The simple sampling method was used in soil sampling. Hand augur was used to sample the surface soil. Samples were taken at the bare soil at the depth between 0 to 6 inches as it is common surface sampling depth. The samples were put in the plastic bag, labeled properly and sent to laboratory for analysis.



Recorded Photos for Soil Sampling

Results and Discussion

The laboratory analysis of two samples are expressed in the following table.

Soil Analysis Results (SR1 and SR2)

Parameter	Unit	SR1	SR2
pH	-	6.8	7.1
Conductivity	ds/m	0.15	0.14
Moisture	%	21.94	30.63
Total Nitrogen	%	0.2	0.2
Magnesium	cmol(+)/kg	13	9.2
Sodium	cmol(+)/kg	8	0.32
Chlorine	mg/kg	54	73.9

Soil Analysis Results (SR3 and SR4)

Parameter	Unit	SR3	SR4
pH	-	7.0	6.9
Conductivity	ds/m	0.15	0.17
Moisture	%	24.51	27.08
Total Nitrogen	%	0.2	0.2
Magnesium	cmol(+)/kg	12	10.2
Sodium	cmol(+)/kg	9	0.32
Chlorine	mg/kg	56	70

Detatiled results for laboratory soil quality testing are shown in Appendix VI

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5.14. Traffic Study

(a) Purposes of Traffic Study

Since the project is near located in the relatively populated municipal area and the nature of the project is highly interrelated with the traffic conditions especially in public holidays due to the visiting of travelers to Innwa old city in Oh Htoke Tan Road (the road closed to the project), EIA team took a traffic study and prepared vehicle movements summaries at the vicinity of the project. The purpose of the traffic study is to study the counts of vehicle movements through Oh Hoke Tan road and to know the peak period hours. This peak hour will help to reduce the cumulative traffic impacts due to the more vehicles during construction and operation phases of the proposed project.



Study Point for Traffic in Google Map

(b) Materials and Methods

EIA team uses both of the video record and self-counted by surveyors to the vehicles entering the Oh Htoke Tan Road. The reason to choose this point for traffic study is to analyse the vehicles entering the Oh Htoke Tan road during working and weekend days.

Summary of Vehicle Movements in Working Day

	SUMMARY OF VEHICLE MOVEMENTS
	LOCATION: OhHokeTan Rd

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TOWNSHIP: Amarapura				CITY: Amarapura	
OBSERVER: EIA Team				DATE: 20.1.2018 (Sat)	
WEATHER: Clear				Weekend Day	
REMARK:					
	VEHICLE MOVEMENTS				
TIME		**Types of Vehicles**			**Total**
BEGIN	Motorcycle	Car	Truck	Tricycle	
7:00(Am) – 10:00 (Am)	850	157	49	47	1103
11:00(Am) – 2:00 (Pm)	561	96	34	27	718
4:00(Pm) – 7:00 (Pm)	986	184	56	51	1277
7:30(Pm) – 9:30 (Pm)	752	129	37	24	942
	Traffic Volume				**4040**
4:00(Pm) – 7:00 (Pm)	Peak Period Hours		**1277**		
	Peak Period Traffic Volume				
4:00(Pm) – 7:00 (Pm)	986	184	56	51	

According to the traffic count result in weekend day, morning peak hour occurs at 7:00-10:00 am, midday peak at 11:00 am-2:00 pm, evening peak at 4:00-7:00 pm and night peak at 7:30-9:30 pm. At morning peak hour, peak volume is 1103 vehicles. In this period, vehicles coming from Oh Hoke Tan road as the time is inbound hours at the beginning of weekend day. At midday peak hour, peak volume is 718 vehicles. In this period, vehicles moving in all inbound and outbound directions were about the same amount. At evening peak hour, peak volume is 1277 vehicles. At night peak hour, peak volume is 942 vehicles. Comparing to morning peak volume, the peak volume recorded between 4:00-7:00 pm is significantly high. And weekend day peak volume is 4040 vehicles.

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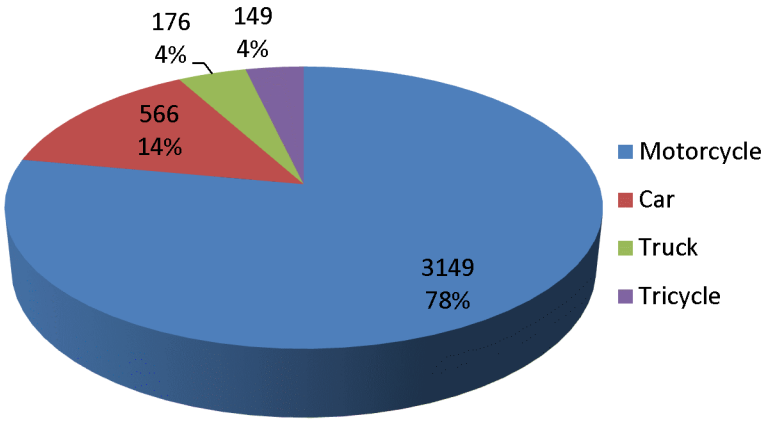

Types of Vehicles Counted in Oh HokeTan Road (Working Day)

Summary of Vehicle Movements in Weekend Day

	SUMMARY OF VEHICLE MOVEMENTS				
	LOCATION: OhHokeTan Rd				
TOWNSHIP: Amarapura		CITY: Amarapura			
OBSERVER: EIA Team		DATE: 19.1.2018 (Fri)			
WEATHER: Clear		Work Day			
REMARK:					
	VEHICLE MOVEMENTS				
TIME		**Types of Vehicles**			**Total**
BEGIN	Motorcycle	Car	Truck	Tricycle	
7:00(Am) – 10:00 (Am)	971	163	62	51	1247
11:00(Am) – 2:00 (Pm)	657	108	39	28	832
4:00(Pm) – 7:00 (Pm)	1205	207	67	59	1538
7:30(Pm) – 9:30 (Pm)	893	142	42	32	1109
	Traffic Volume				**4726**
7:00(Am) – 10:00 (Am)	Peak Period Hours	**1538**			
	Peak Period Traffic Volume				
7:00(Am) – 10:00 (Am)	1205	207	67	59	

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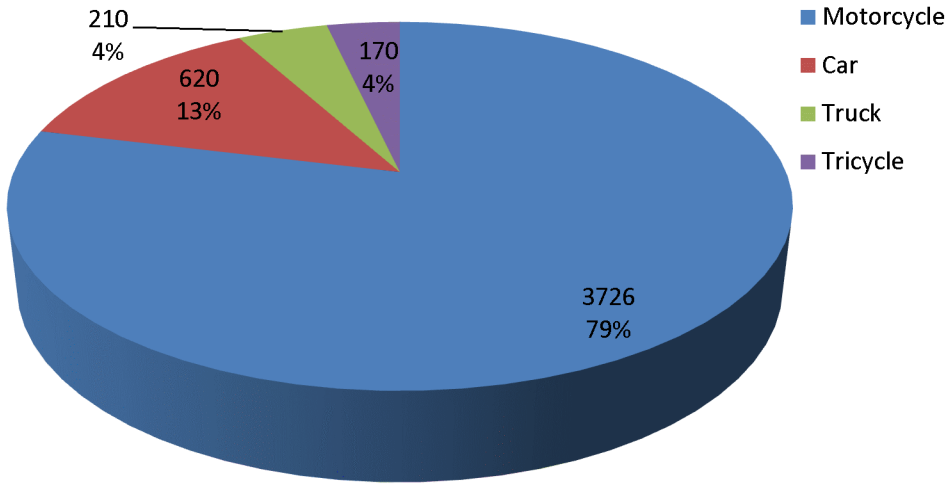
According to the traffic count result in weekend day, morning peak hour occurs at 7:00-10:00 am, midday peak at 11:00 am-2:00 pm, evening peak at 4:00-7:00 pm and night peak at 7:30-9:30 pm. At morning peak hour, peak volume is 1247 vehicles. In this period, vehicles coming from OhHokeTan road as the time is inbound hours at the beginning of work day. At midday peak hour, peak volume is 832 vehicles. In this period, vehicles moving in all inbound and outbound directions were about the same amount. At evening peak hour, peak volume is 1538 vehicles. At night peak hour, peak volume is 1109 vehicles. Comparing to morning peak volume, the peak volume recorded between 7:00-10:00 am is significantly high.



Types of Vehicles Counted in Oh Hoke Tan Road (Weekend Day)

Conclusion for Traffic Study

According to the study, the vehicle movements in weekend day is greater 14.5% generation rate of in working day vehicles volume as many visitors coming to Inwwa Old City during weekend days.

5.15. Existing Ecological Condition

Flora and fauna in terrestrial environment are low population in and around the project area. Aquatic animals are relatively abundant. A total of (50) flora species are observed in and surrounding area. In fauna (55) species comprises of (17) amphibian and reptile, (8) species of birds, (19) species of fish, one species of dragonfly and two species of benthos and 8 species of zooplankton are recorded during the scoping survey. The proposed project is

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considered may be affected directly or indirectly on terrestrial and aquatic environment due to the contamination of those environments. According to the scope data analysis, there will be a small impact (no significant) on aquatic fauna and land vegetation. The extent of the impact on fauna and flora is investigated as only in the site specific. Developer should be implemented the mitigation and recommendation to become low or negligible risk to the surrounding environment. Zooplankton is used as an indicator species of water quality of the environment, the present study is investigated the water quality of the study sites as favorable condition for aquatic animals in accordance of their occurrence.

(a) Biodiversity Impact Assessment

Biodiversity impact assessment is meant to predict the biodiversity impacts and to find out the mitigation measures. The project of Depot, oil and petroleum storage tank construction and its operation will have impact on both terrestrial and aquatic biodiversity. However, the mitigation measures will help to minimize the impact of the project.

(b) National law for Protection of Biodiversity

Regards on biodiversity conservation, Myanmar's Environmental laws relating to biological conservation and management issued by the Ministry of Natural Resources and Environment Conservation (MONREC) are listed in the following table.

Environmental Law Related to Biological Matters

1. The Territorial Sea and Maritime Zones Law, 1977	Measures for the protection of marine and coastal zone environments and for the conservation of marine biological diversity
2. The Forest Law, 1992	Provisions to conserve water, soil, biological diversity and the environment; sustain forest produce yields; protect forest cover; establish forest and village firewood plantations; sustainably extract and transport forest products
3. The Protection of Wild Life and Wild Plants and Conservation of Natural Areas Law, 1994	Provisions on the protection of fauna and flora and their habitat (including living and non-living organisms, migratory and endangered species); the conservation of natural areas; guidelines for scientific research; and the establishment of the national protected area.

(c) Impact Levels

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Impact level classified into three categories such as low, moderate and high followed by the standard guidelines.

Impact Level Associated with Proposed Project

Sr. No.	Impact level	Caused Events
1	small	This is an impact that is limited to the immediate project area, affects a relatively small proportion of the local population (less than 10%), and does not result in a measurable change in carrying capacity or population size in the affected area.
2	moderate	This is an impact that extends beyond the immediate project area, affects an intermediate proportion of the local population (10 to 30%), and results in a measurable but moderate (not destabilizing) change in carrying capacity or population size in the affected area.
3	large	This is an impact that extends beyond the immediate project area, could affect more than 30% of a local population, and could result in a large, measurable, and destabilizing change in carrying capacity or population size in the affected area.

(d) Biological Environment of the Project Area

The project site is located at the junction and bank of the Ayeyarwady and Myit Nge River in Mandalay region. Vegetation and terrestrial animals are very low abundant in the project area. Small population of flora and fauna in surrounding area of land are found. Aquatic fauna including fish and birds are fairly abundant according to the scoping survey. Small fisheries practiced by local fishermen are observed during in the survey period. No red list species of flora and fauna in both terrestrial and aquatic environments are recognized during the scoping survey. There is also no any wildlife protected area, wetland and reserved forests nearby the project area.

(e) Ecology of Irrawaddy River

No complete and precise list of all the fish in the Irrawaddy river basin currently exists, but in 1996 it was estimated that there are about 200 species. In 2008, it was estimated that the Irrawaddy ecoregion is home to 119–195 species of fish found nowhere else in the world (endemic). Several new species of fish have been described from the Irrawaddy river basin

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in recent years (for example, the cyprinid *Danio htamanthinus* in 2016 and the stone loach *Malihkaia aligera* in 2017), and it is likely that undescribed species remain.

Among the most well-known species in the river is the Irrawaddy dolphin (*Orcaella brevirostris*), a euryhaline species of oceanic dolphin with a high and rounded forehead, lacking a beak. It is found in discontinuous sub-populations near sea coasts and in estuaries and rivers in parts of the Bay of Bengal and South-East Asia. Along the North-South course of the Irrawaddy River, a number of notably different ecoregions can be distinguished (*https://www.nationalgeographic.com*).

(f) Field Work

Based on the characterizations of the biological environment, the faunal and floral groups that might be impacted by the proposed project activities are investigated under field work. The groups of species are as follow:

- Vegetation;
- Arthropoda;
- Avifauna;
- Mammals;
- Herpetofauna (Reptiles and Amphibia)
- Fish
- Benthos and Zooplankton

(g) Data Collection of Plant Species

A total of (15) sampling point was randomly selected in which a number of five sampling points from the bank of Irrawaddy River and a number of ten sampling points was inside the project area (Figure 5.27). Moreover, roadside plants and fence plants are observed and listed. Plant survey was carried out in the river bank, fence area and roadside area of the project site (Figure 5.28). For each sampling points, 3m x 3m quadrates were set up to observed the plant species. In this survey, plant collection, taken photographs, interviewing with local people, etc. were conducted. After field trip, plant identification was conducted based on available literatures such as key to the families of the flowering plants, issued by Department of Botany, Yangon University (1994), Backer *et. al.*(1963), Kress *et. al.* (2003), Gardner *et al.* (2000) etc., and verification was conducted by recorded field photographs and

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some useful internet websites. In this report, most scientific names and family names of flora was based on the literature of "A checklist of the trees, shrubs, herbs and climbers of Myanmar" (2003). A Google map from iTouchMap.com (https:// itouchmap. com/ latlong. html) was used to show the sampling points and different zones of the project area where plant species were observed. Different line colors are used by Adobe Photoshop (7.0) to prominent the different zones of the flora observation. The spatial location (latitude and longitude) of each quadrate was also recorded by using a GPS (Global Positioning System). The threatened levels of plant species of the project area were checked and described their present conservation status in accordance with "The IUCN Red List of Threatened Species, 2016" (http://www.iucnredlist.org/ details/199856/0).

(h) Data Collection of Animal Species

Appropriate biological survey methods for each kind of animal are used to collect the data and information. Specimen collection was taken in and surrounding area of the project area. Identification and list of animal species inhabiting in the surrounding area are undertaken. Observed frequency and abundance of individual species of animals are also recorded. Interview survey is taken with fisherman to investigate fish species richness and abundance. Benthos fauna sampling including zooplankton species along the river at different zones are collected by using plankton net and hand net (Figure 5.28). The most common method is used to pull a fine mesh net through the water horizontally, and then collect the animals that have been retained by the net Collected sample of zooplankton is identified at the zoological laboratory of Yangon University. Consultation and open discussion are taken.

(i) Data and Impact Analysis

Data analysis is made by descriptive statistical analysis through Microsoft excel. Impact analysis is conducted followed by the standard guideline. Identification of the potential impacts such as impact level: extent and duration on biodiversity caused by the proposed project is made. Impact levels are identified into three categories such as low, moderate and high. The factors are used in determining impact significance and magnitude, these factors are 1. area of influence, 2. percentage of resource affected, 3. persistence of impacts, 4. sensitivity of resources, 5. status of resources, 6. regulatory status, and 7. social values.

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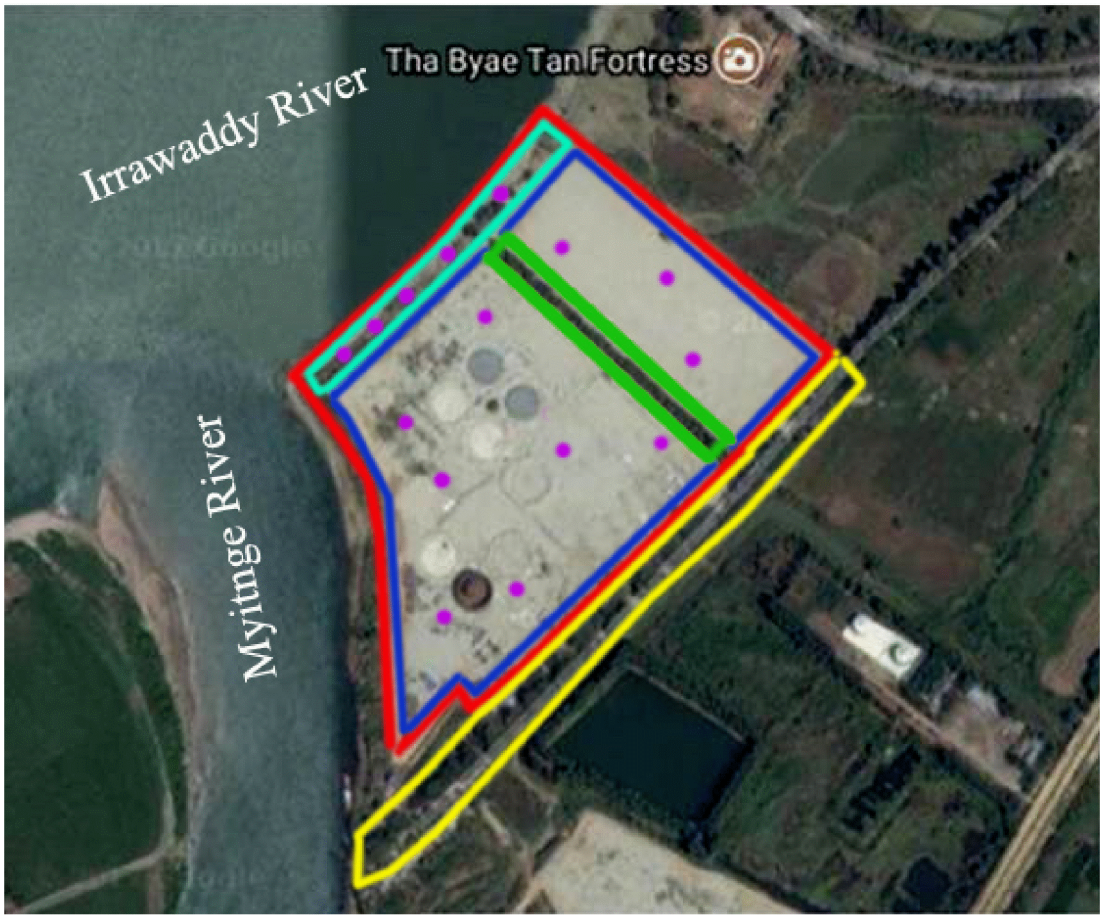

Map source: https://itouchmap.com/latlong.html

Figure 5.27. A Map Showing that Observed Flora and Fauna Species of the Project Area

Legends:

- Boundary of the project area
- Boundary of inner core area (or inside area)
- Boundary of located fence plants
- Boundary of located roadside plants
- Sampling points

Table- Representative GPS Points

Numbers of sample plot in cropland and scrubland vegetation	Representative GPS Points	
	Longitude	Latitude
Site 1(River Bank)	95° 59' 35.083"E	21° 51' 52.369"N
Site 2(River Bank)	95° 59' 36.685"E	21° 51' 53.790"N
Site 3(River Bank)	95° 59' 37.981"E	21° 51' 54.867"N

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Site 4(River Bank)	95° 59' 38.907"E	21° 51' 55.872"N
Site 5(River Bank)	95° 59' 40.261"E	21° 51' 57.322"N
Site 6(Core Area)	95° 59' 38.155"E	21° 51' 44.377"N
Site 7(Core Area)	95° 59' 40.393"E	21° 51' 45.021"N
Site 8(Core Area)	95° 59' 37.902"E	21° 51' 48.714"N
Site 9(Core Area)	95° 59' 36.938"E	21° 51' 50.49"N
Site 10(Core Area)	95° 59' 42.442"E	21° 51' 49.359"N
Site 11(Core Area)	95° 59' 45.628"E	21° 51' 49.539"N
Site 12(Core Area)	95° 59' 40.066"E	21° 51' 53.607"N
Site 13(Core Area)	95° 59' 42.266"E	21° 51' 55.526"N
Site 14(Core Area)	95° 59' 45.243"E	21° 51' 54.968"N
Site 15(Core Area)	95° 59' 46.404"E	21° 51' 52.228"N



River bank vegetation



Core area vegetation



Fence plants



Roadside plants



Quadrate set up



Benthos sample collection

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Fish sample collection



Zooplankton sample collection

Figure 5.28. Vegetation of the Project Area and Field Activities

Flora

In this survey, a total of (50) plant species from (22) families of the project area was observed in which both shrubs and tree species was each (15) species (30%), followed by herbs with (6) species (12%), climber and grass (5) species with (10%) in each, and finally small trees (4) species (8%) respectively (Figure 5.29).

In family level, the highly contributed families were Fabaceae and Mimosaceae in which a total of each (7) species included. The second significant family was Caesalpinaceae and Poaceae in which each (5) species included. The rest families were included in (1) or (2) species only. According to species occurrence from different zones, a total of (15) plant species from the vegetation of river bank, (27) species from core area vegetation, and (19) species from the roadside and fence areas were observed and listed. Plant habits of the herbs, shrubs, climbers and grasses were mostly found in the river bank and core area vegetations. And, most of small trees and trees were from roadside and fence areas (Table 5.3). According to IUCN red list (2016), all plant species were not included in any threatened categories. All plant species were common.

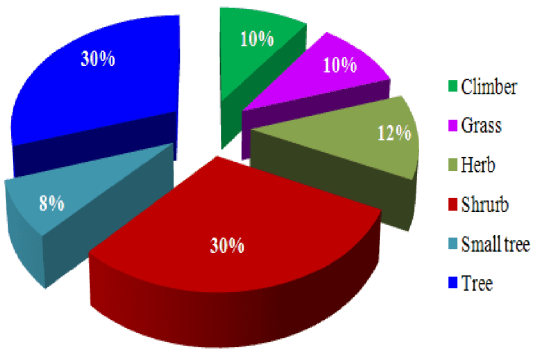

Figure 5.29. Plant Species Composition of the Project Area

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Table 5.3 List of plant species together with their family, scientific name, Myanmar name, habit, different habitats, and IUCN status

No.	Family	Scientific Name	Myanmar Name	Habit	Different habitats			IUCN status
					RB	CA	Rd-Fe	
1	Asclepiadaceae *[1]	*Calotropis procera* (Ait.) R.Br.	Mayo	Shrub=15	ì	ì		NL
2	Asteraceae	*Eupatorium odoratum* L.	Bizat	Shrub		ì		NL
3	Asteraceae	*Centipeda minima* (L.) A. Br. & Asch.	Chay-sat	Herb=6		ì		NL
4	Asteraceae*[3]	*Microglossa volubilis* DC.	Bizat	Climber=5	ì	ì		NL
5	Bombacaceae *[1]	*Bombax ceiba* L.	Letpan	Tree=15	ì		ì	NL
6	Boraginaceae	*Cordia dichotoma* Forst.	Thanat	Tree			ì	NL
7	Boraginaceae *[2]	*Heliotropium indicum* L.	Sin-hna-maung	Herb		ì		NL
8	Caesalpinaceae	*Cassia obtusa* Roxb.	Kathaw-pok	Shrub		ì		NL
9	Caesalpinaceae	*Cassia senna* L.	Pwegain	Shrub	ì			NL
10	Caesalpinaceae*[5]	*Cassia tora* L.	Dangywe	Shrub		ì		NL
11	Caesalpiniaceae	*Delonix regia*(Boj. ex Hook.) Raf.	Seinban	Tree			ì	NL
12	Caesalpiniaceae	*Tamarindus indica* L.	Magyi	Tree			ì	NL
13	Combretaceae *[1]	*Terminalia catappa* L.	Banda	Tree			ì	NL

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Table- Contd.

No.	Family	Scientific Name	Myanmar Name	Habit	Different habitats			IUCN status
					RB	CA	Rd-Fe	
14	Cucurbitaceae	*Melothria maderaspatana* (L.) Cogn.	Sa-thakwa	Climber		ì		NL
15	Cucurbitaceae*[2]	*Cephalandra indica* Naud.	Kinmon	Climber		ì		NL
16	Dioscoreaceae *[1]	*Dioscorea spinosa* Roxb.	Thadut-ni	Climber	ì		ì	NL
	Fabaceae	*Sesbania aegyptiaca* Poir.	Ye-tha-gyi	Small tree=4		ì	ì	NL
18	Fabaceae	*Crotalaria striata* DC.	Taw-pike-san	Shrub		ì		NL
19	Fabaceae	*Desmodium pulchellum* Benth.	Tabyetse	Shrub		ì		NL
20	Fabaceae	*Sesbania cannabina* (Retz.) Pers.	Nyan	Herb	ì			NL
21	Fabaceae	*Butea frondosa* Roxb.	Pauk	Tree			ì	NL
22	Fabaceae	*Pterocarpus macrocarpus* Kurz.	Padauk	Tree			ì	NL
23	Fabaceae*[7]	*Indigofera atropurpurea* Buch.-Ham.	Meyaing	Shrub		ì		NL
24	Lamiaceae	*Hyptis suaveolens* (L.) Poit.	Taw-pin-sein	Herb		ì		NL
25	Lamiaceae*[2]	*Leucas cephalotes* Spreng.	Pin-gu-hteik-peik	Shrub		ì		NL
26	Lecythidaceae *[1]	*Barringtonia acutangula* (L.) Gaertn.	Kyi-ni	Tree		ì	ì	NL
27	Malvaceae	*Abutilon bidentatum* Hochst. ex A. Rich.	Bauk-nwe	Shrub		ì		NL
28	Malvaceae*[2]	*Urena lobata* L.	Kat-sine	Shrub		ì		NL
29	Mimosaceae	*Acacia farnesiana* (L.) Willd.	Nan-lon-kyaing	Small tree	ì			NL
30	Mimosaceae	*Acacia nilotica* (L.) Delile	Subyu	Small tree	ì			NL
31	Mimosaceae	*Mimosas pudica* L.	Tikayon	Herb	ì	ì		NL

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No.	Family	Scientific Name	Myanmar Name	Habit	Different habitats			IUCN status
					RB	CA	Rd-Fe	
32	Mimosaceae	*Samanea saman* (Jacq.) Merr.	Thinbaw-kokko	Tree			ì	NL
33	Mimosaceae	*Acacia pruinescens* Kurz.	Kinmon-gyin	Climber			ì	NL
34	Mimosaceae	*Leucaena glauca* (L.) Benth.	Bawsagaing	Small tree			ì	NL
35	Mimosaceae *[7]	*Albizia lebbekoides* (DC.) Benth.	Anya-koko	Tree			ì	NL
36	Moraceae	*Ficus rumphii* Bl.	Nyaung-phyu	Tree			ì	NL
37	Moraceae*[2]	*Ficus obtusifolia* Roxb.	Nyaung-gyat	Tree			ì	NL
38	Myrtaceae *[1]	*Eucalyptus ovata* Labill.	Eu-ca-lit	Tree			ì	NL
39	Phyllanthaceae *[1]	*Securinega leucopyrus* (Willd.) Mull. Arg	Kone-chin-yar	Shrub	ì	ì		NL
40	Poaceae	*Cynodon dactylon* (L.) Pers.	Myin-sar-myet	Grass		ì		NL
41	Poaceae	*Eleusine indica* (L.) Gaertn.	Sinngo-myet	Grass		ì		NL
42	Poaceae	*Leersia hexandra* Sw.	Thaman-myet	Grass	ì			NL
43	Poaceae	*Phramites vallatoria* (L.)Veldkamp	Kyu	Grass	ì	ì		NL
44	Poaceae *[5]	*Saccharum spontaneum* L.	Kaing	Grass=5	ì			NL
45	Rhamnaceae *[1]	*Zizipus jujube* (L.) Mill & Lam.	Zi	Tree			ì	NL
46	Sapotaceae *[1]	*Mimusop elengi* L.	Khayay	Tree			ì	NL
47	Solanaceae *[1]	*Physalis minima* L.	Bauk-pin	Herb		ì		NL
48	Tiliaceae *[1]	*Triumfetta rotundifolia* Lam.	Katsine-galay	Shrub		ì		NL
49	Verbenaceae	*Lantana indica* Roxb.	Se-hnit-yathi	Shrub	ì	ì		NL
50	Verbenaceae *[2]	*Lantana aculeata* L.	Nadaung-ban	Shrub	ì	ì		NL
22 families		Number of recorded plant species from different zones=			**15**	**27**	**19**	

RB: River bank; CA: Core area of the project **site**; Rd-Fe: Roadside and Fence areas; IUCN: International Union of Conservation for Nature; NL: Not listed

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Fauna

The following six fauna groups are classified to investigate their abundance and possible impacts caused by the project activities. According to scoping survey result, the abundance of individual recorded species in terrestrial habitat in and around the project area is low. But in aquatic environment, there was found the fish species and benthos are relatively abundant. No threatened species are recorded during the survey period.

-Herpetofauna (Reptiles and Amphibians)
-Avifauna;
-Mammals;
-Fish
-Arthropoda (dragonfly)
-Benthos and Zooplankton

Herpetofauna (Amphibian and reptiles)

Low population and diversity are classified in and around the project area. A total of 17 species belong to 9 families were recorded during the scoping survey (Table 5.4). The abundance status of individual species based on observed frequency was recorded as small. All recorded amphibians and reptiles are common species and none are classified as Red Data species. Regard ecology of amphibians and reptiles, they are widely distributed animals and they may occupy similar habitats around the region. Amphibians and reptiles are one of the important members of aquatic and terrestrial ecosystems as they serve as both predators and prey. They inhabit both ecosystems serve to transfer energy between the two systems.

Table 5.4. Recorded Amphibian and Reptile Species (17 species) in the Buffer Zone and the Project Area

Sr. No	Family	Common name	Scientific name	Conservation status IUCN 2016	Habitats	Abundance status
Frog and Toad						
1	Dicroglossidae	Indian cricket frog	*Fejervarya limnocharis*	LC	Stream side	S
2	Dicroglossidae	Chinese edible	*Hoplobatrachus*	LC	Stream side	S

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		frog	*rugulosa*			
4	Microhylidae	Dark-sided frog	*Microhyla ornata*	LC	Leave letter	S
5	Microhylidae	Painted bull frog	*Kaloula pulchra*	LC	Road side	S
6	Rhacophoridae	Common tree frog	*Polypedates leucomystax*	LC	Shrub	S
7	Bufonidae	Asian common toad	*Duttaphrynus melanostatus*	LC	Under log	S
Snake						
1	Colubridae	Water snake	*Xenochrophis flavipunctatus*	LC	Stream	S
2	Colubridae	Long-nosed whip snake	*Ahaetulla nasuta*	LC	Shrub/Tree	S
3	Colubridae	Copper head racer	*Elaphis radiatus*	LC	Shrub/grass	S
4	Colubridae	Indo-Chinese Rat Snake	*Ptyas korros*	LC	Woodland	S
5	Viperidae	Russell's viper	*Daboia russelli*	LC	Shrub/woodland	S
6	Elapidae	Banded krait	*Bungarus fasciatus*	LC	Woodland/ water edge	S
7	Elapidae	Common krait	*Bungarus caeruleus*	LC	Woodland/ grass/shrub	S
8	Elapidae	Monocellate cobra	*Naja kaouthia*	LC	Woodland/ grass/shrub	S
Lizard						
1	Agamidae	Garden fence lizard	*Calotes versicolor*	LC	Shrub	S
2	Gekkonidae	Tockay	*Gekko gecko*	LC	Tree	S

Notes: S= small number <50, M= moderate number >50, L= larger number >100

Birds

During the scoping period, birds' species around the project area is recognized as small number and its abundance status is also observed as low. A total of 8 species of bird belongs to 6 families are recorded around the project area (Table 5.5). Among them egrets include Cattle egret *Bubulcus ibis,* Great egret *Ardea alba* and Indian pond heron *Ardeola grayii* are commonly found in different habitats around the aquatic environment of the project area. House sparrow *Passer domesticus* are relatively abundant found as moderate number. All observed species are common and widely distributed animals recognized their distribution in

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various habitats around the region. No migratory and threatened species are observed during the survey period. Birds are taking play in ecological important role as they serve as in food-chain and food web, seed dispersal and propagation, pollination, pest control and rodent control.

Table 5.5. Recorded Bird Species (8 species) around the Project Area

Sr. No	Family	Common name	Scientific name	Conservation status (IUCN 2016)	Habitats	Abundance Status
1	Columbidae	Spotted dove	*Streptopelia chinensis*	LC	Terrestrial	S
2	Dicruridae	Black drongo	*Dicrurus macrocercus*	LC	Terrestrial	S
3	Sturnidae	Common myna	*Acridotheres tristis*	LC	Terrestrial	S
4	Pycnonotidae	Red whiskered bulbul	*Pycnonotus jocosus*	LC	Terrestrial	S
5	Passeridae	House sparrow	*Passer domesticus*	LC	Terrestrial	M
6	Ardeidae	Cattle egret	*Bubulcus ibis*	LC	Aquatic	S
7	Ardeidae	Great egret	*Ardea alba*	LC	Aquatic	S
8	Ardeidae	Indian pond heron	*Ardeola grayii*	LC	Aquatic	S

Notes: S= small number <50, M= moderate number >50, L= larger number >100

Mammals

Mammal species are not observed around the project area. Aquatic mammal, Irrawaddy dolphin, *Orcaella brevirostris*, had been observed in over ten years ago along the river, nearby the project area, reported by the local people in their interview. But at the present, they have never seen this animal which inhabit around the area. Irrawaddy dolphin is threatened species listed in IUCN Red Data Book and protected by Myanmar Wildlife Law 1994.

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Fish

Fish samples were collected with the help of fishermen when they are fishing or when they return from fishing along the Ayeyarwady and Myit Nge river nearby the project area. Fish availability is relatively large in Myit Nge rather than Ayeyawady river. Both economic fish and small fish are recorded during the survey period. A total of 19 species under 14 families were recorded (Table 5.6). Indian carp *Catala*, Tilapia *Oreochromis mossambicus* and Burmese river shad *Gudusia variggata* are larg recorded in Myit Nge and Wallago *attu*, Flatheaded cafish *Pseudotropius garua* and Flatmouthed cat fish *Mystus aor* are recorded in Ayeyawady river nearby the project area which species are economically important. All are common species and widely distributed in the region. There is no present as an important rare fish species around the project area. About 10 or 15 small fishing boats are seen their fishing nearby the project area of Ayeyawady river. They are largely relying on fishing for their livelihood in this river. Large bamboo-fishing trap is set up in Myit Nge river (nearby of the project area) which can be caught a large amount of verity of fish in each day observed during study period. There is no recorded any threatened species in the survey period.

Table 5.6. Recorded Fish Species (19 Species) Ayeyawady and Myit Nge River nearby the Project Area

Sr. No	Family	Common name & local name	Scientific name	Conservation status (IUCN 2016)	Habitats	Abundance status
1	Siluridae	Wallago/Nga-bat	*Wallago attu*	LC	AR	S
2	Siluridae	Pabo catfish/Nga Nu Than	*Ompok pabo*	LC	AR	M
3	Sahilbeidae	Flat-headed cat fish/Nga Myin	*Pseudotropius garua*	LC	AR	S
4	Cichidae	Mozambique tilapia	*Oreochromis mossambicus*	LC	AR & MN	L
5	Clupeidae	Burese river shad	*Gudusia variggata*	LC	MN	L
6	Anabantidae	Climbing perch/	*Anabas*	LC	AR & MN	S

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		Nga Byay Ma	*testudineus*			
7	Osphornemidae	Snakeskin /Nga Phyin Tha Let	*Trichgester pectoralis*	LC	AR & MN	M
8	Notoptridae	Bronze feather fish/Nga Phae	*Notopterous notopterus*	LC	AR & MN	S
9	Cyprinidae	Ray-fin fish/Nga Pe Ohaung	*Osteobrama belangri*	LC	AR & MN	L
10	Cyprinidae	Swamp barb/Nga khone Ma	*Puntius chola*	LC	AR & MN	L
11	Cyprinidae	Mrigal carp	*Cirrhinus mrigala*	LC	AR & MN	L
12	Cyprinidae	Indian carp	*Catla*	LC	AR & MN	L
13	Synbranchidae	Asian swamp eel/Nga Chint	*Monopterus albus*	LC	AR & MN	S
14	Claridae	Walking Catfish/Nga khu	*Clarias batrachus*	LC	AR & MN	S
15	Bagridae	Flat-mouth catfish/Nga gyaung	*Mystus aor*	LC	AR	S
16	Bagridae	Dwarf Catfish/Nga Zin Yaing	*Mystus pulcher*	LC	AR & MN	L
17	Channidae	Striped Snake head/Nga Yant	*Channa striata*	LC	AR & MN	S
18	Channidae	Snake head/Nga Yant Gaungto	*Channa punctata*	LC	AR & MN	M
19	Ambassidae	Bald glassy/Ngazinzat	*Ambassis gymnocephalus*	LC	AR & MN	L

Notes: S= small number <50, M= moderate number >50, L= larger number >100
AY=Ayewady River, MN= Myit Nge

Irrawaddy Dolphins

The number of Irrawaddy dolphins in the Ayeyarwady river in Myanmar has been estimated to be between 59 and 72 individuals (www.wcs.org). The population trend is not known, but 42 deaths were recorded between 2002 and 2016.

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Figure – Past Distribution of Irrawaddy Dolphins (Source: WWF)



Figure – Current Distribution of Irrawaddy Dolphins (Source: WWF)

Dragonfly

One species of dragonfly is commonly called as Coastal glider with scientific name of *Macrodiplax cora* in the Family Libellulidae was recorded in the project area which

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observed mostly in near shallow water and also on the land. Large number estimates that several thousands are observed at day time in flying. Dragonfly is used as indicator species of Environmental Health. Their presence indicates pure unpolluted waters and good habitat quality in general. They play crucial role in ecosystem functioning and serve to keep other insects including those harmful to humans like mosquitoes, blood-sucking flies, etc. and also play a valuable role in the biological control of agricultural pests. Apart from functioning as predators in the ecosystem, their value as indicators of habitat quality has also been widely appreciated in recent times.

Macrobenthic Fauna

Macrobenthos comprises the larger, more visible, benthic organisms that are greater than 1 mm in size. Some examples are polychaete worms, bivalves, echinoderms, sea anemones, corals, sponges, sea squirts, turbellarians and larger crustaceans such as crabs, lobsters and cumaceans.

During the survey, Macrobenthic fauna in shallow water zone and mudflat was collected for sample as because the fauna is important to indicate water quality and aquatic environment. The survey recorded large number of larvae of dragonfly (*Macrodiplax cora*) and copepods (freshwater snail). Benthic macrofauna have been used for decades as indicators of environmental status and trends in estuaries and coastal areas because they are important components of aquatic food webs and they affect transport and cycling of nutrients and toxicants.

Zooplankton

Zooplankton are heterotrophic plankton. Plankton are organisms drifting in oceans, seas, and bodies of fresh water. These organisms serve as an intermediary species in the food chain, transferring energy from planktonic algae (primary producers) to the larger invertebrate predators and fish who in turn feed on them. Zooplankton are highly sensitive to changes in aquatic ecosystems. Zooplankton are also sensitive to their environment and like phytoplankton—a change in zooplankton concentration can indicate a subtle environmental change. Zooplankton are highly responsive to nutrient levels, temperatures, pollution, food that is not nutritious, levels of light, and increases in predation. As well as providing an essential link in the food chain, the diversity of species, amount of biomass and abundance of zooplankton communities can be used to determine the health of an ecosystem. Zooplankton are also affected by levels of pH, heavy metals, calcium, and

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aluminum. Nutrients like nitrogen and phosphorus will affect the prey of zooplankton (like algae, protozoa and bacteria), indirectly affecting zooplankton survival.

Zooplankton sample collection result shows that population and density is not abundant. A total of 8 species of zooplankton were sampled from sampling sites in Ayewady and Myit Nge rivers. Which was represented by Rotifera (3 species), Cladocera (2 species) and Copepoda (3 species) (Figure 5.30). Rotifera was represented by the species *Branchionus quadridentata, Cephalodella auriculata* and *Notholca* sp. The representative Cladocera species are *Diaphamosona brachyurum* and *Bosmina coregoni* and Copepoda was represented by the species *Cyclopoid* sp, *Calanoid* sp and *Harpaticoid* sp. The density of collected species in Ayeyarwady River is relatively larger than in the Myit Nge River. Average 6 individuals of recorded species in 25 liters in Ayeyarwady River are recorded while 4 individual numbers in Myit Nge River at the same water volume is recorded.

Red Data Faunal Species and Important Area

There are no species of special concern (rare, endemic, threatened, or with unique functionalities). There are no recognized important areas such as Wildlife Sanctuary and Reserved forest in surrounding place of 3 km radius of the project area.



Catla



Channa striata



Oreochromis mossambicus



Gudusia variggata

Some Recorded Fish Species in the Study Area during the Scoping Survey

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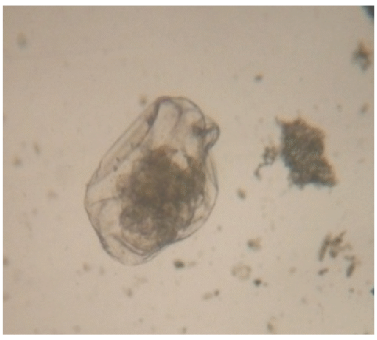

Rotifer:
Cephalodella auriculata



Cladocera
Diaphamosona brachyurum



Copepoda
Cyclopoid sp

Some Recorded Zooplankton Species

Figure 5.30. Recorded Fauna Species in the Study Area

Potential Impacts on Biodiversity

The proposed developmental project is considered may be affected directly or indirectly on terrestrial and aquatic environment due to the contamination of those environments caused by the project activities.

Construction Phase

- Loss of vegetation,
- Contamination of land and water will disturb on animal behavior and movement,

Operational Phase

- Land contamination by the vehicles and incidental oil spill will affect on plant photosynthesis process existing nearby the project area and animal behavior and movement,
- Water contamination by the vessels and incidental oil spill will affect on animal community and composition (fishes, birds, benthos and zooplankton)
- Reduction and loss of biodiversity
- Loss of fishing ground for local fishermen

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Impact Levels

Impact levels are categorized into three classes caused by the proposed project development to biological diversity. According to the scope data analysis, there will be a small impact (no significant) on aquatic fauna and land vegetation. The extent of the impact on fauna and flora is investigated as only in the site specific and the duration of the impact is assumed may be permanent.

Mitigation Measures

Mitigation measures should be carried out during constructional and operational phase as below:

- Remain the plants and vegetation as possible as which existing in and around the project area,
- Plan for green area development around the project site will be provide in accordance with aesthetic, atmospheric pollution control, carbon storage, and against from the erosions.
- Reduce the land and water contamination which might be disturb the animals and plants
- Provide possible facility to fishermen to be sustainable of their fishing

Monitoring

Monitoring plan will conduct by the project developer. Monitoring survey data can help to support the proper management plan on biodiversity sustainability. Data compilation and analysis on aquatic animals and plants should be recorded. Reporting system will be provided once or twice a year or annually.

Conclusion

Terrestrial plants and animals are very low density in and around the project area. Aquatic animals are relatively abundant especially found in fish population. A total of (50) flora species including tree and vegetation, trees are observed in surrounding area. In fauna (54) species comprises of (17) amphibian and reptile, (8) species of birds, (19) species of fish, one species of dragonfly and two species of benthos and 6 species of zooplankton are recorded during the scoping survey. According to the density of zooplankton and population status, the water quality of study sites is investigated as favorable condition for aquatic animals.

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The proposed developmental project is considered may be affected directly or indirectly on terrestrial and aquatic environment due to the contamination of those environments caused by the project activities. According to the scope data analysis, there will be a small impact (no significant) on aquatic fauna and land vegetation. The extent of the impact on fauna and flora is investigated as only in the site specific. MESDP will be implemented the mitigation and recommendation to become low or negligible risk to the surrounding environment.

Impacts on Ayeyarwaddy dolphin due to vessel traffic

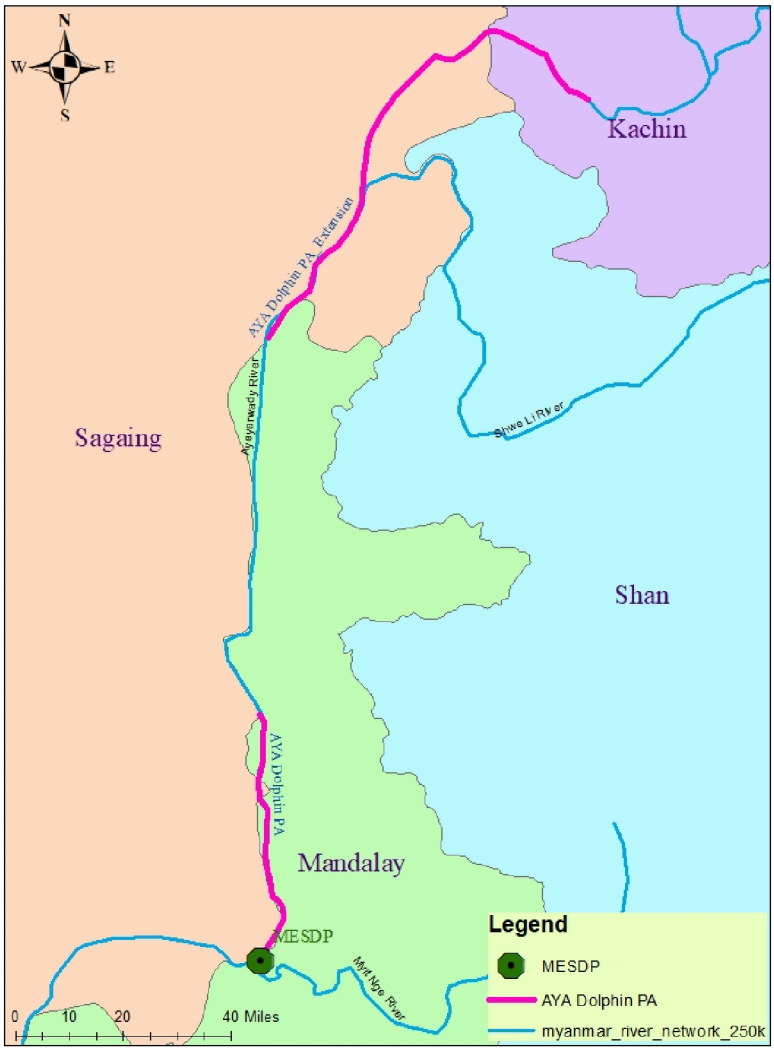

Figure: Ayeyarwaddy Dolphin Protected Area

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A 74 km stretch of the river was set up by the Department of Fisheries (DoF) in 2005 as the Ayeyarwady Dolphin Protected Area (ADPA), where it is strictly forbidden to catch, kill or trade dolphins, to practice electrocution fishing, or to use certain types of nets. Gold mining was banned along the whole Ayeyarwady River in 2005.

In 2018, the Ayeyarwady Dolphin Protected Area (ADPA) in Myanmar was expanded to include a 100-kilometer stretch of the Ayeyarwady River, extending the protected area from Male to Shwegu. The expansion also included a 100-kilometer buffer zone with milder restrictions.

The project area is closed to the Ayeyarwaddy dolphin protected area. The vessels traffic makes several impacts on Ayeyarwaddy dolphin. Vessel traffic, particularly in high-density areas or narrow river systems like those the Ayeyarwaddy dolphins inhabit, significantly disturbs their behavior, causes stress, disrupts communication, and poses physical dangers. [Daniëlle Kreb and Karen D. Rahadi]

Behavioral Disturbances: River dolphins, such as the Ayeyarwaddy dolphins, significantly reduced surfacing behaviors in the presence of boats. This was more pronounced for river dolphins compared to coastal dolphins. Specifically, they reacted more strongly to motorized canoes, speedboats, and container tugboats. The response include longer dive times and fewer surfacings.

Avoidance and Stress: Dolphins showed avoidance behavior when boats approached, particularly within 250-300 meters of a speedboat. They actively avoided tugboats and other large vessels. The presence of boats not only disrupted their surfacing patterns but also potentially caused stress, which could lead to long-term physiological effects.

Noise Pollution: The noise from vessels especially speedboats and container ships, interfered with dolphin communication, making it difficult for them to echolocate and maintain social cohesion. Sudden vessel noise in narrow areas could startle dolphins, leading to rapid dives or increased swimming speed to avoid collisions.

Physical Harm: Fast-moving vessels in shallow or narrow river bends posed a heightened risk for collisions.

[Daniëlle Kreb and Karen D. Rahadi]

Mitigation Measures

To mitigate the impacts of vessel traffic on Ayeyarwaddy dolphins, several targeted strategies can be implemented to reduce disturbances and promote safer habitats for the

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species. One of the most effective measures is the establishment of speed reduction zones in areas of high dolphin activity, such as confluences, narrow river tributaries, and known feeding or resting areas. By imposing speed limits, especially for motorized canoes, speedboats, and larger vessels like container tugboats, the risk of collisions can be minimized, and noise pollution significantly reduced. Slower-moving boats generate less underwater noise, allowing dolphins to maintain communication and echolocation abilities while also reducing the likelihood of startle responses or injury.

Another key measure is the creation of traffic-free zones or times, particularly in critical dolphin habitats. Restricting boat traffic during periods of high dolphin activity, such as feeding or breeding times, or diverting boats to specific lanes away from dolphin core areas, can help prevent disturbances. In addition, quieter engine technologies, such as electric motors or soundproofed propulsion systems, should be encouraged to reduce underwater noise pollution. Boats equipped with noise-reducing devices can significantly lessen the impact on dolphins, who rely heavily on acoustic signals for navigation, hunting, and social interaction.

Raising awareness among local boat operators and fishermen is crucial for the success of these measures. Training programs and awareness rising activities can help educate boaters on the importance of adhering to speed limits, maintaining safe distances from dolphins (at least 300 meters), and avoiding sudden changes in course. Community involvement, particularly in regions where fishing and riverine transport are integral to local livelihoods, can foster cooperation in promoting dolphin-friendly boating practices.

Enforcement is essential for ensuring compliance with these regulations. Regular patrols in dolphin-sensitive areas can monitor traffic and ensure that boat operators follow speed limits and respect restricted zones.

5.16. Socio-Economic Profile

5.16.1 Socio-economic Profile Resulting from Primary Data Collection

According to the data analysis, the following are the main socio-economic data resulting from primary data collection (household survey).

(a) Major Ethnic Groups and Religious Groups in Percentage

Within the project affected villages, Burma is the major ethnic group. According to the survey result, most of the people are Myanmar and Buddhism.

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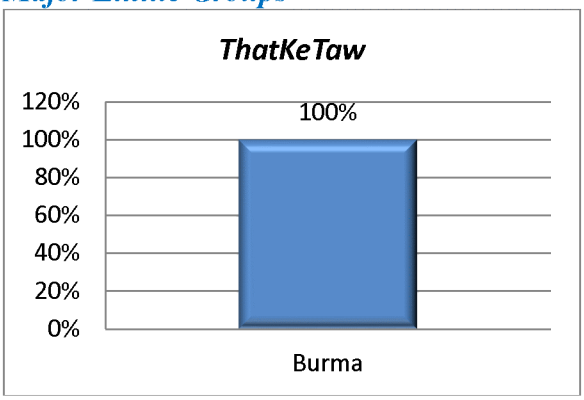
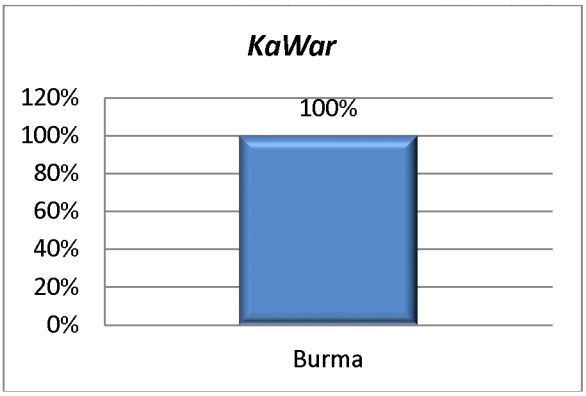
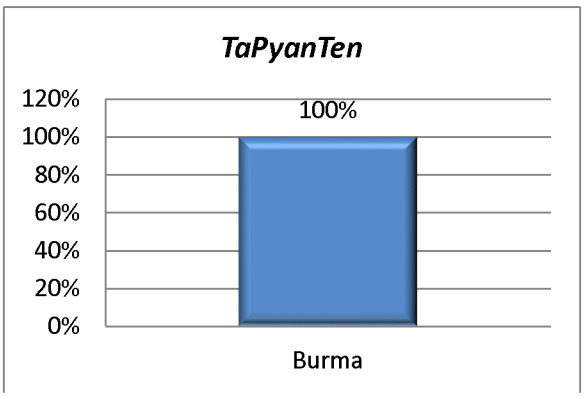
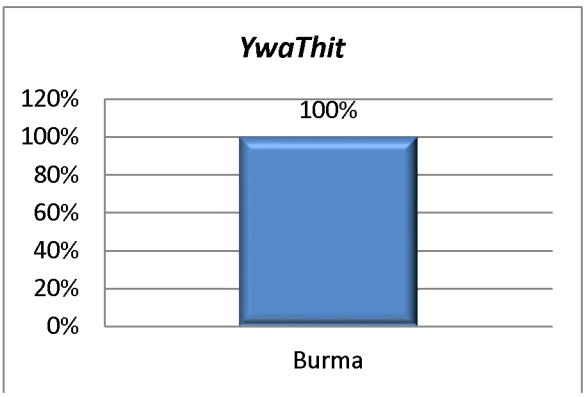
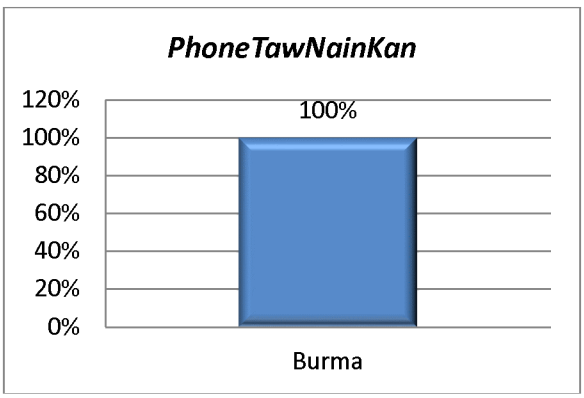
Major Ethnic Groups

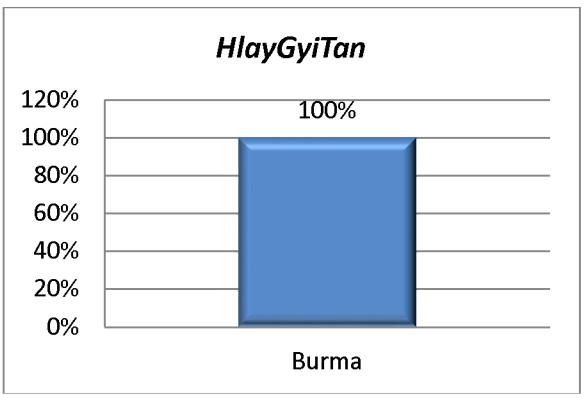


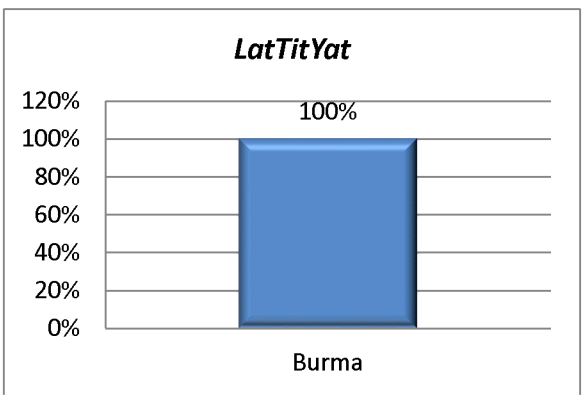


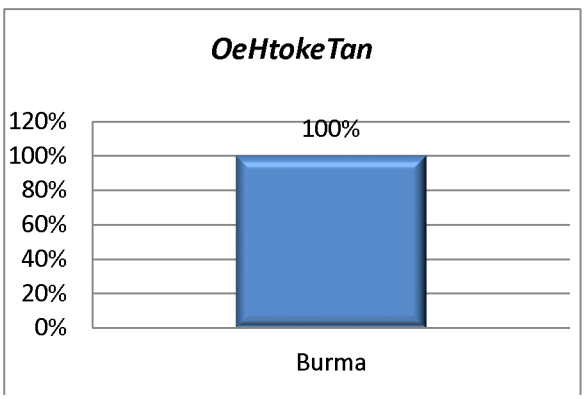












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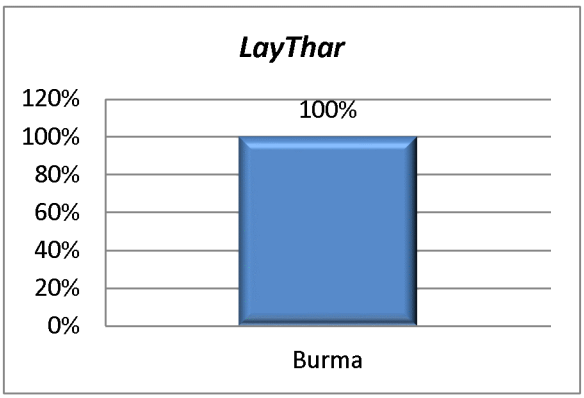
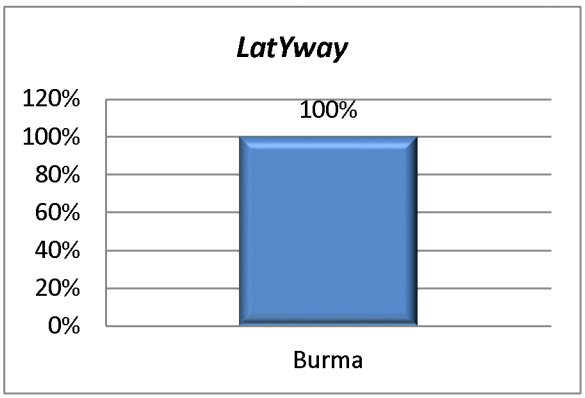
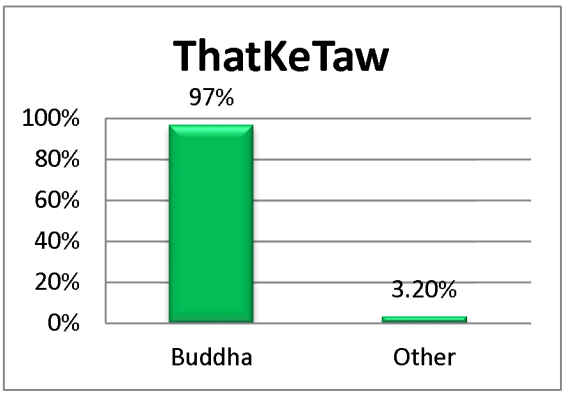


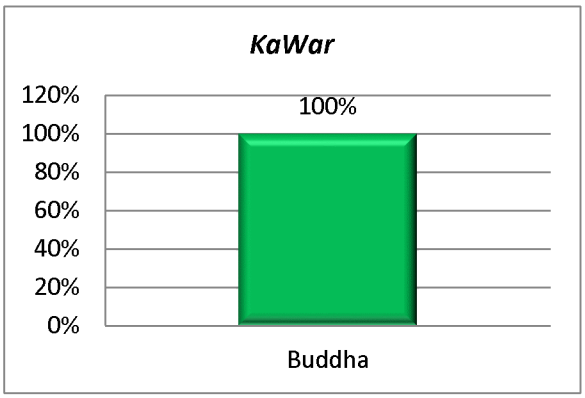


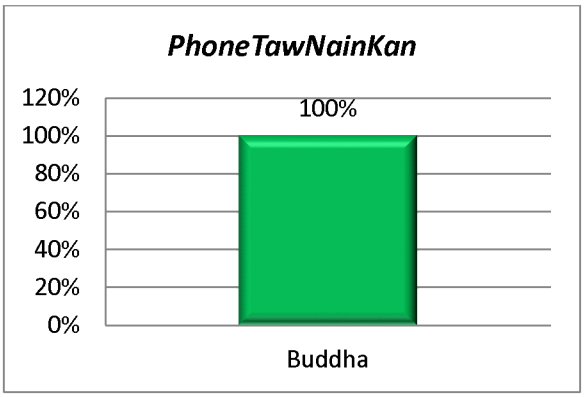
Figures: Major Ethnic Groups in Percentage

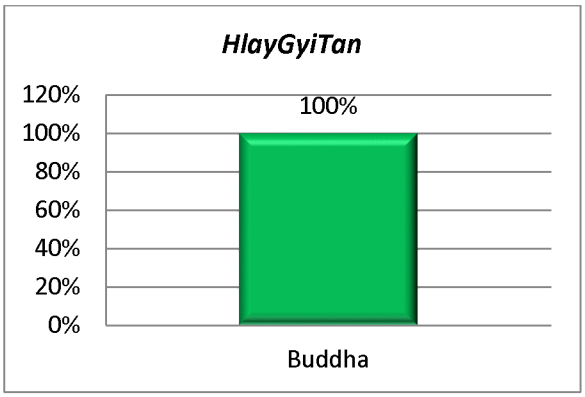
Religious Groups

The only one dominant religion of the people in the project area is Buddhism nearly 99% and other such as Christian; Hindu; Muslim are nearly 1% .









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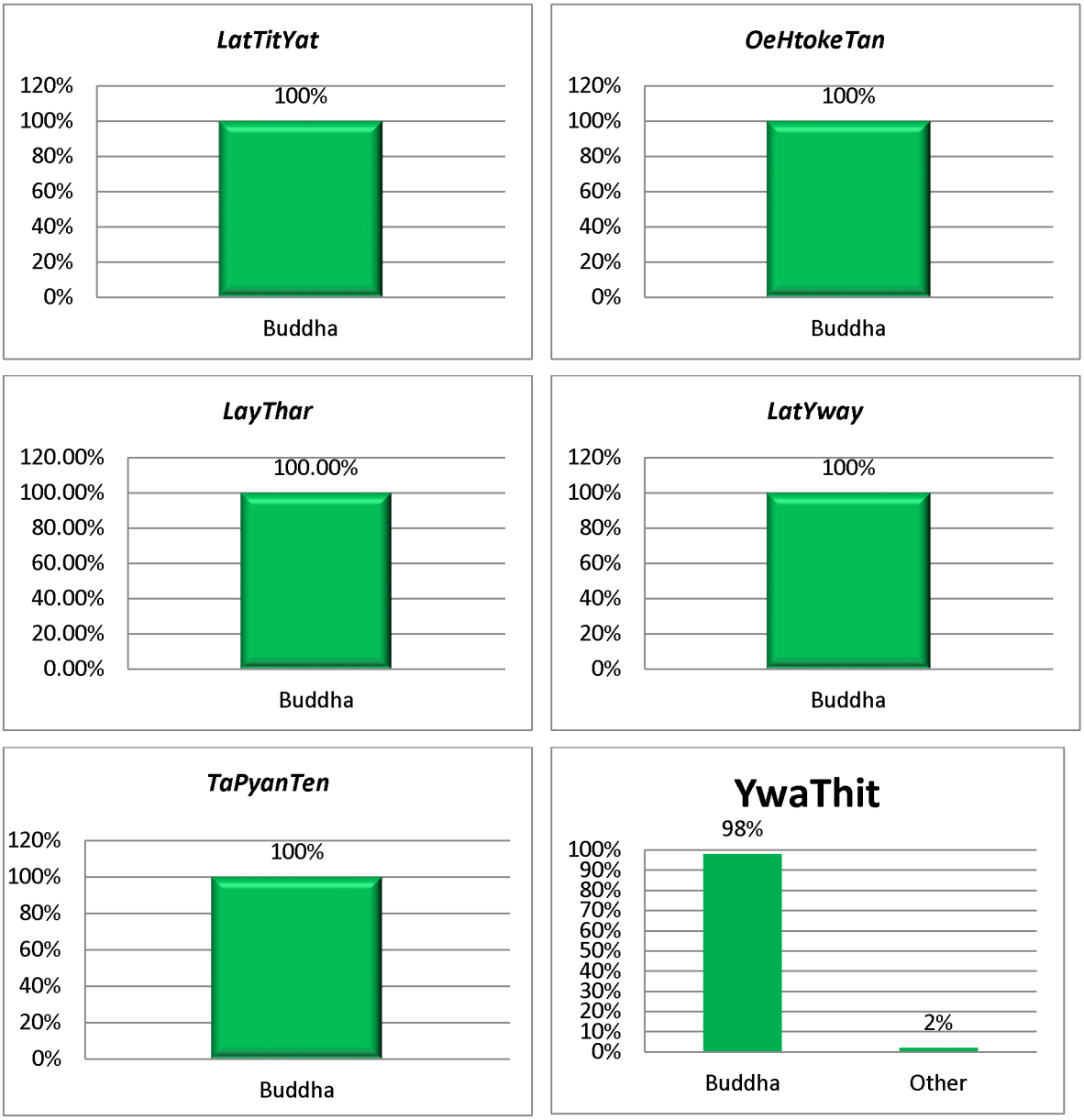

Figures - Major Religious Groups in Percentage

(b) Domestic Use of Water

The survey results on domestic water sources used by communities in the project area are provided in the following figures. Majority of households in the project area obtained their domestic water from hand held pump (Tonkin) and near river.

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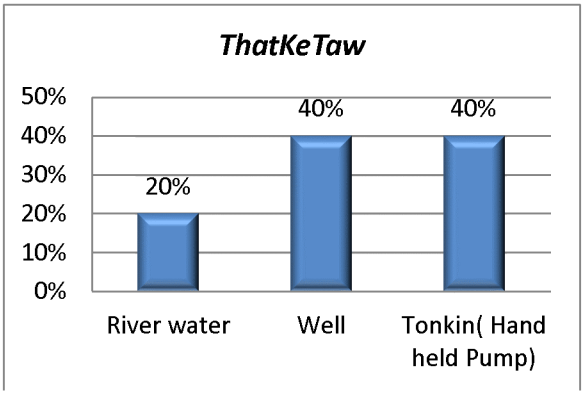

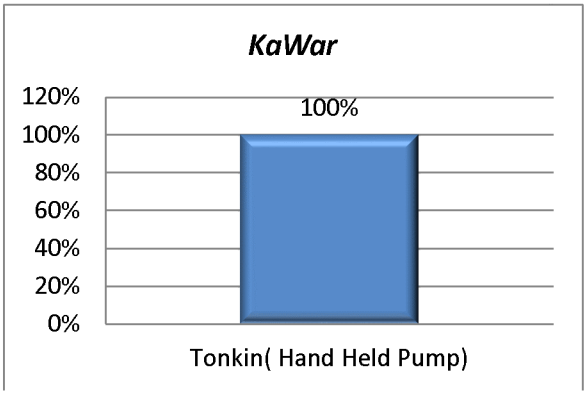

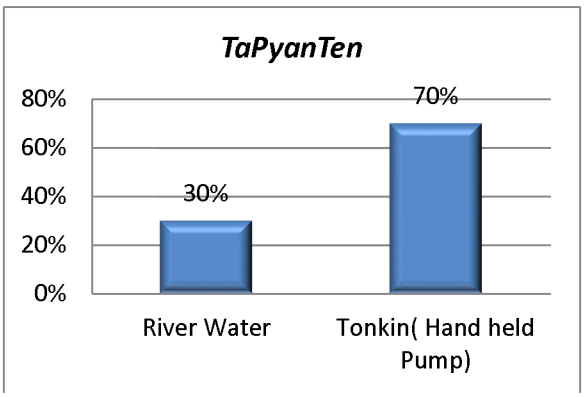

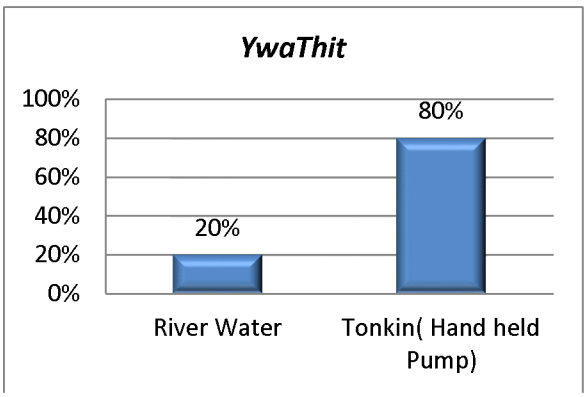

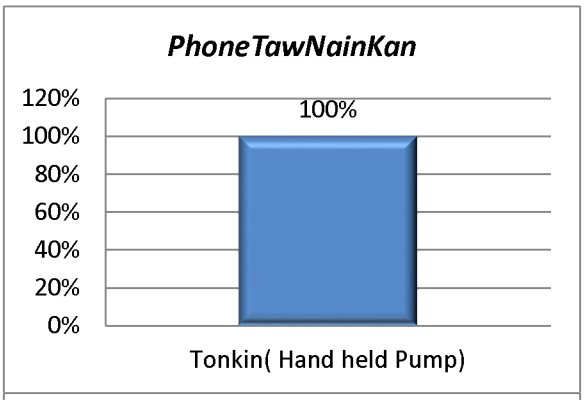

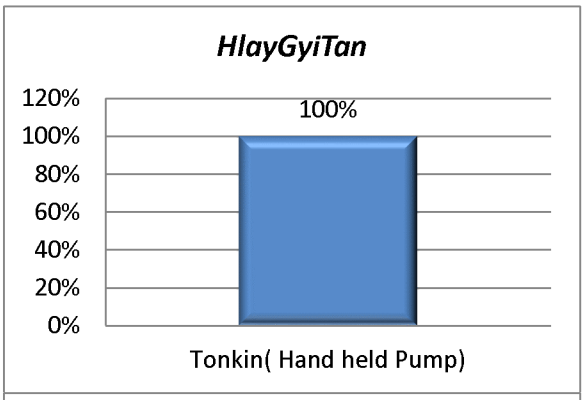

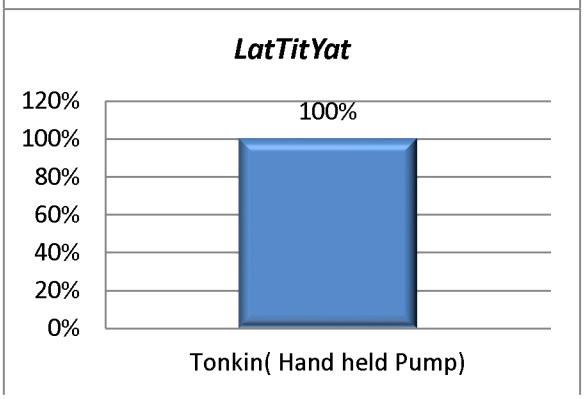

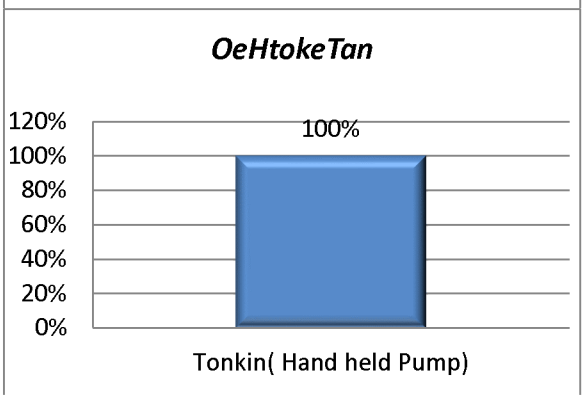

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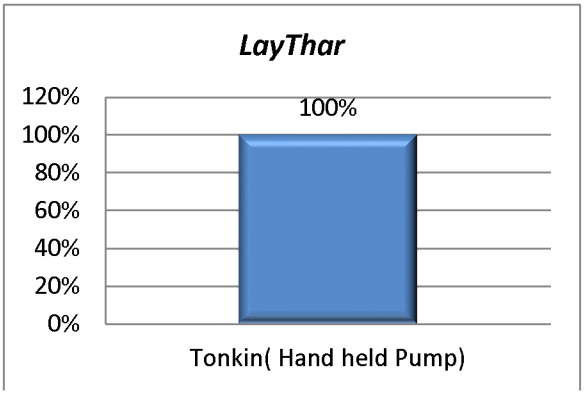
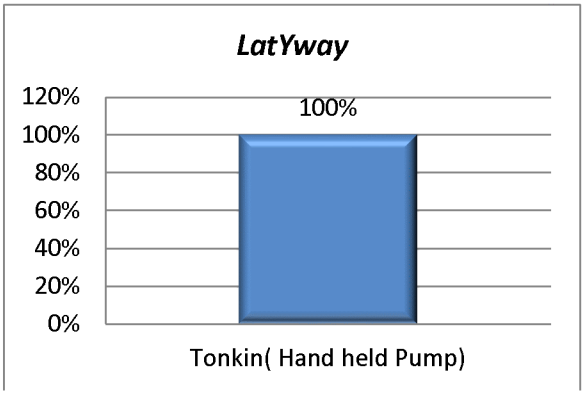
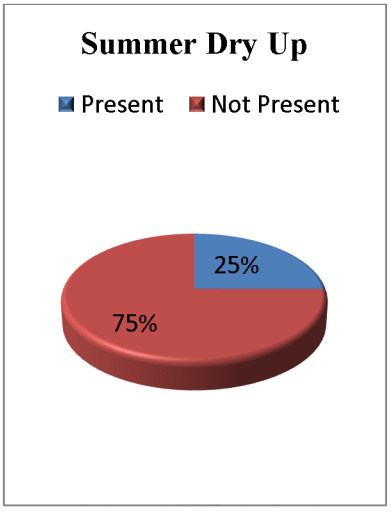
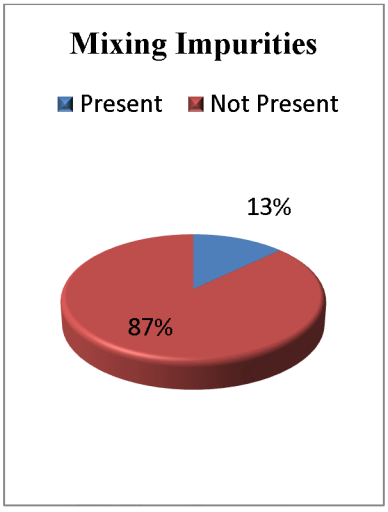


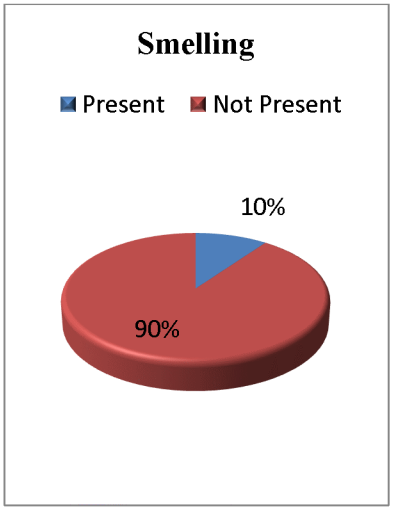


(c) Quality of Domestic Water

Access to clean and safe water is crucial to the health population and thus have a direct impact on the quality of life of local community. According to the primary data collection, there have less potential to dry up during summer, low in mixing impurities and smelling of domestic water used. The following figures shown the answers in percentage of the local people during household survey on the existing quality of domestic water.







(d) Drinking Water Source

Most of the villagers drink purified drinking water (bottled water). Some drink the well and Tonkin water after boiling and filtering, but there are also people who drink well water in natural form only through filtering.

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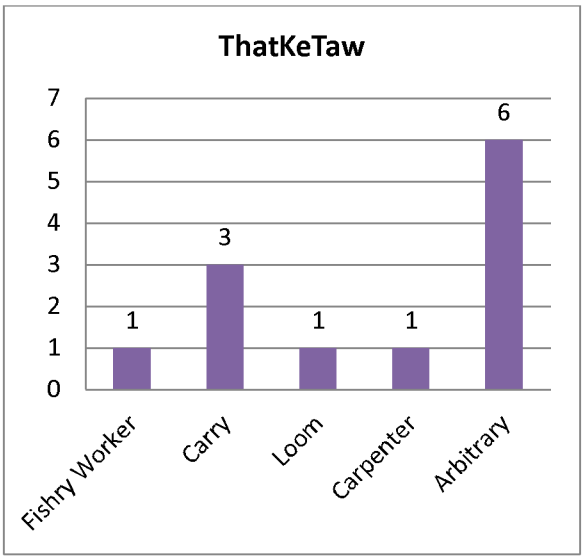
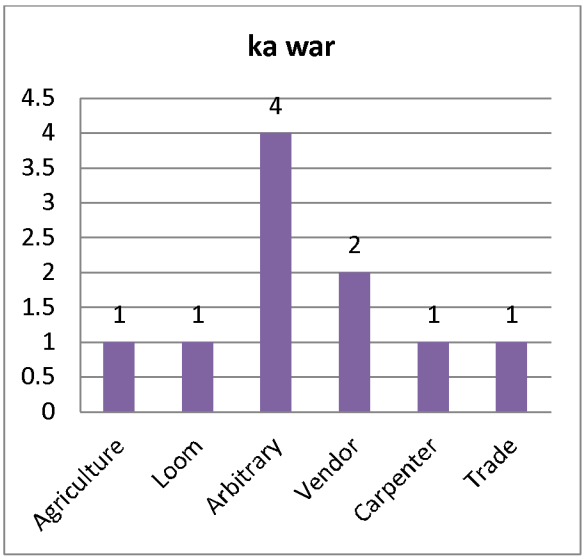
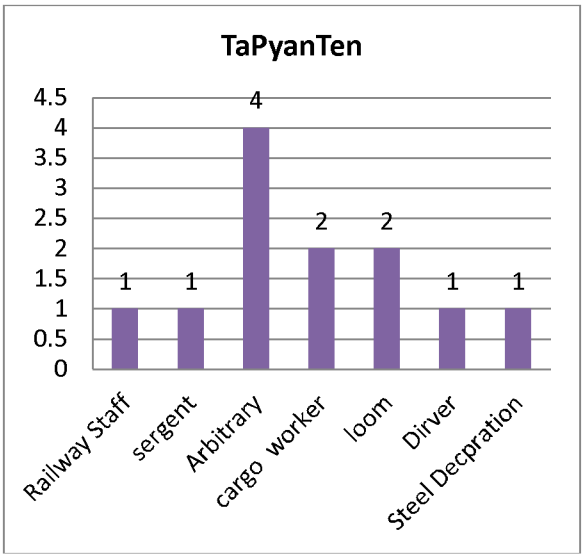
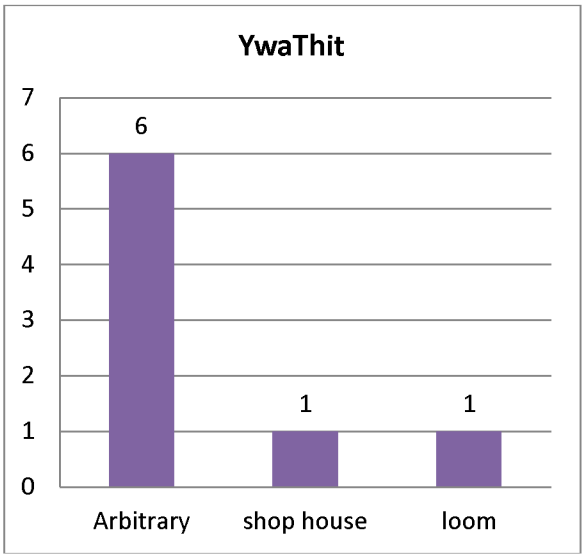
(e) Livelihood and Occupational Pattern

In the project area most of the household population enumerated in the household survey reported that their main occupation was loom industry. The largest proportion of households in the area is rural based and the major sources of household income are from loom, trade, staff (company/government), arbitrary and other.









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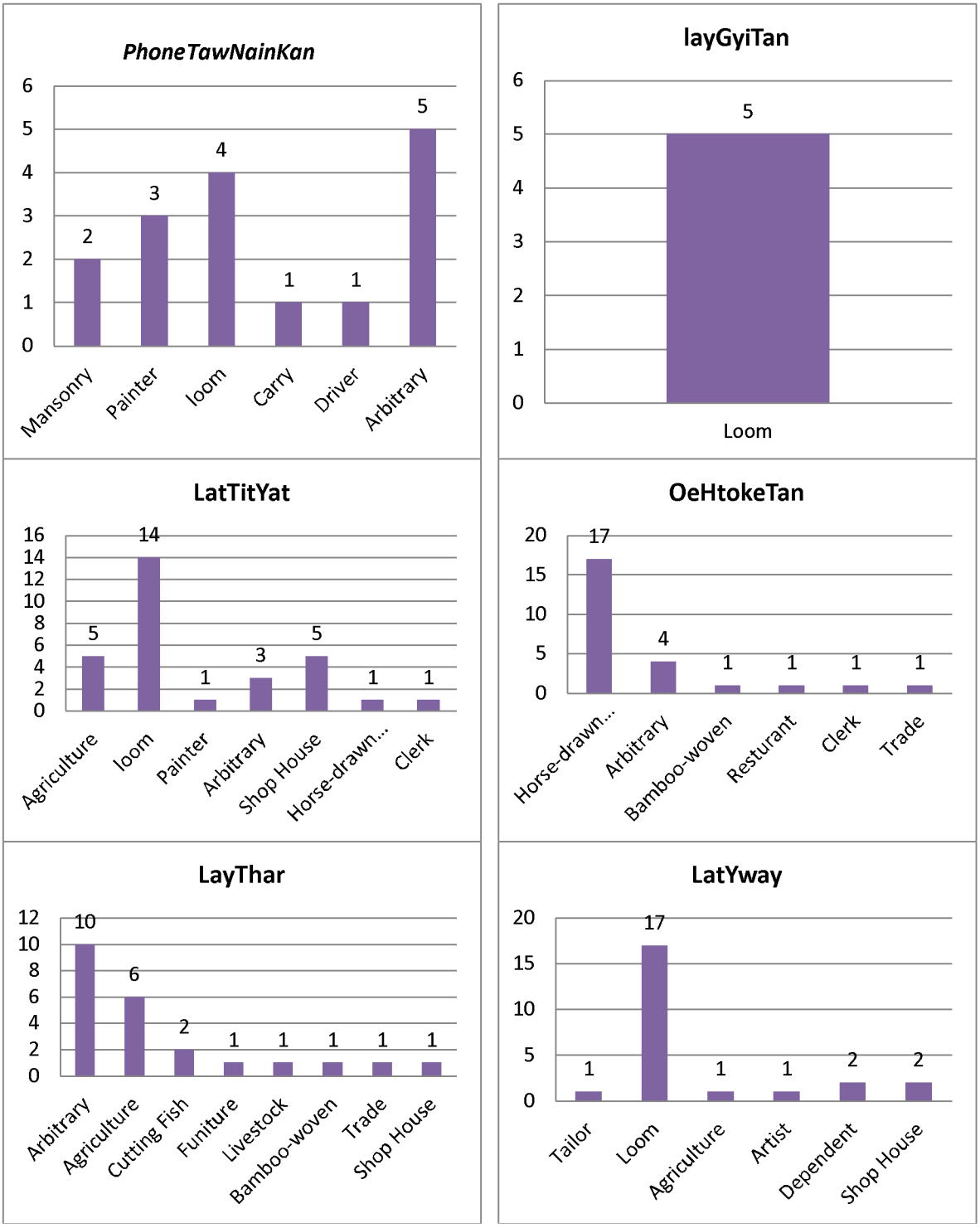

According to the above figure resulted from household survey, the land used for the proposed projects does not have potential to impact on livelihood and occupation pattern of local people in nearest villages.

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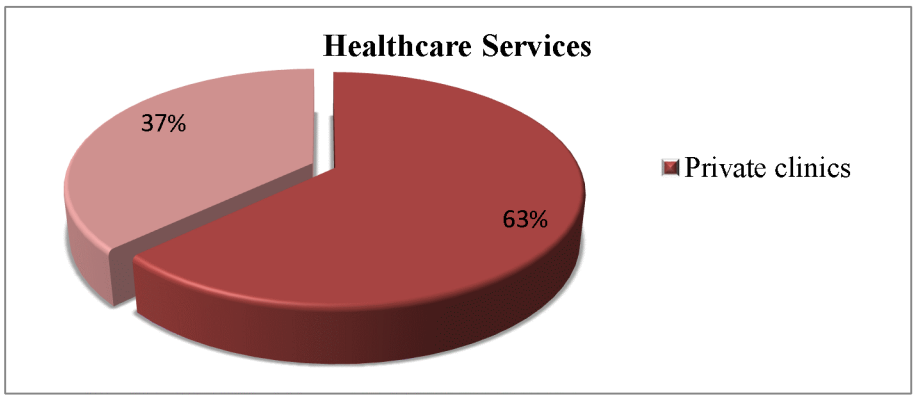
(f) Healthcare Services

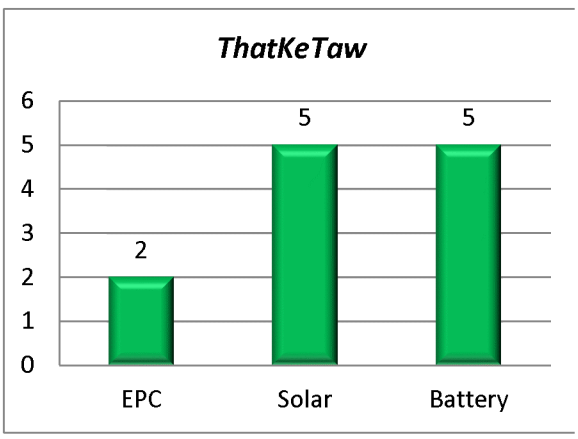
In the survey, healthcare services available in the project area were also investigated. There were three types of healthcare centers people in the project area usually go for their illness and disease. As shown in the following figure, private clinics in Amarapura Township were the most common centers people attended (54%), followed by private hospitals (14%), and government hospitals (32%).

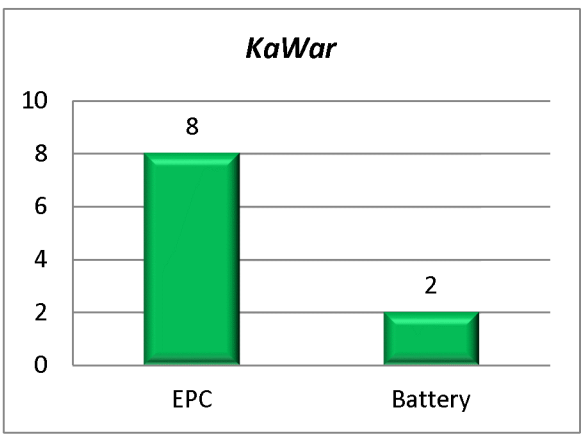


According to the household questionnaires, some local people answered that it is a little difficult to go to clinic and hospital in Amarapura.. So, they want to have health care facilities near the village.

(g) Energy Sources for Lighting

Primary data from household survey revealed that the sources of energy for lighting in many of the villages are mainly the electricity from Government (EPC) and other is from solar energy and battery. Some of the villages are not accessible to electricity and use candle for lighting.





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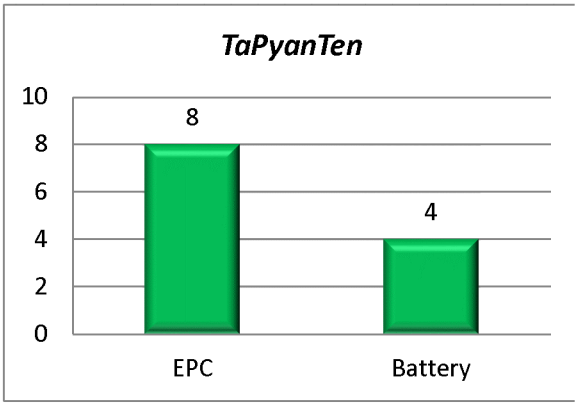

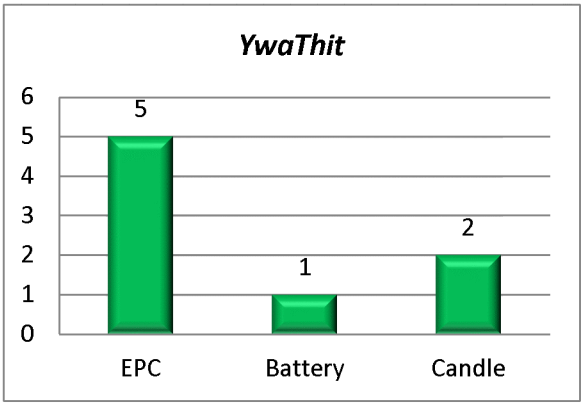

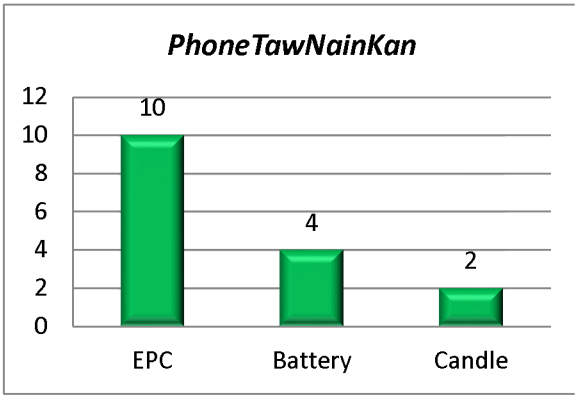

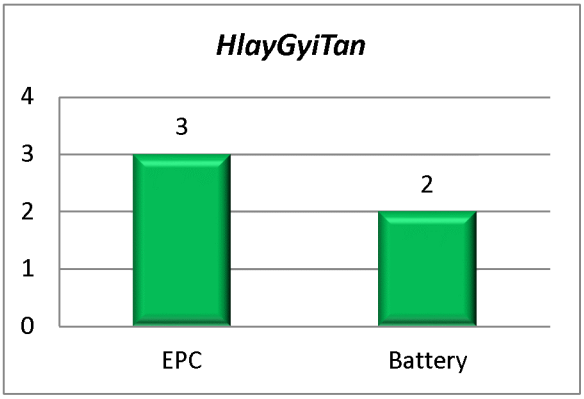

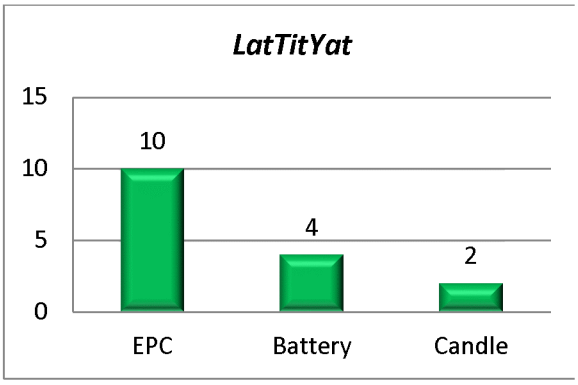

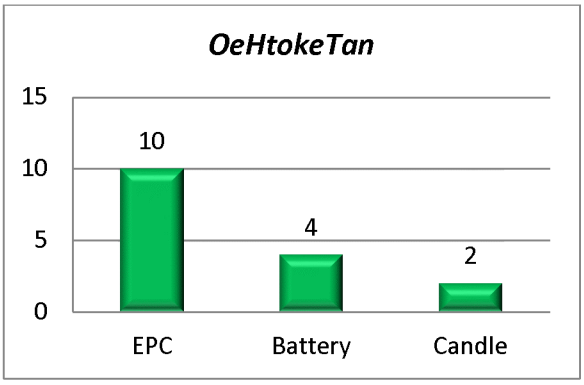

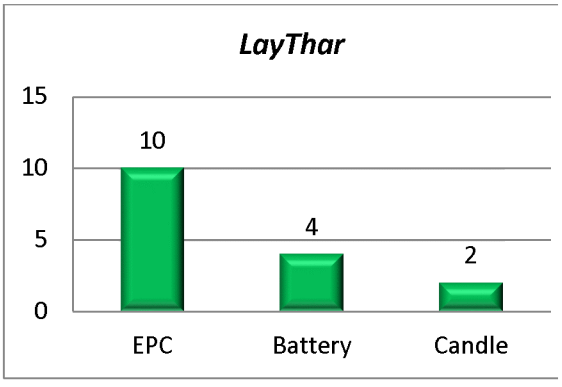

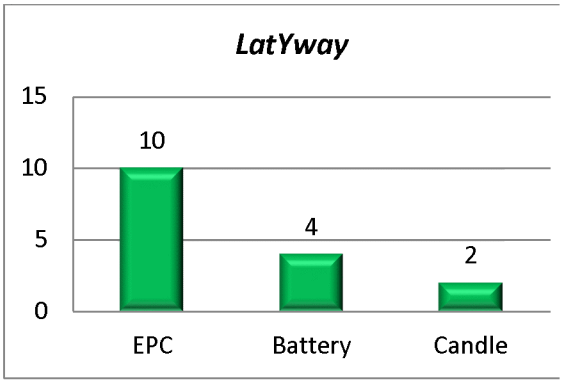

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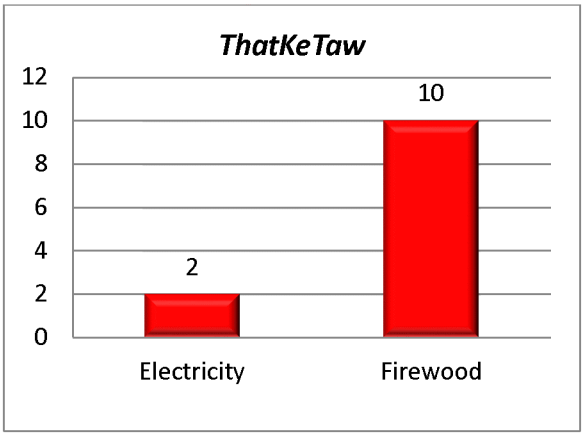
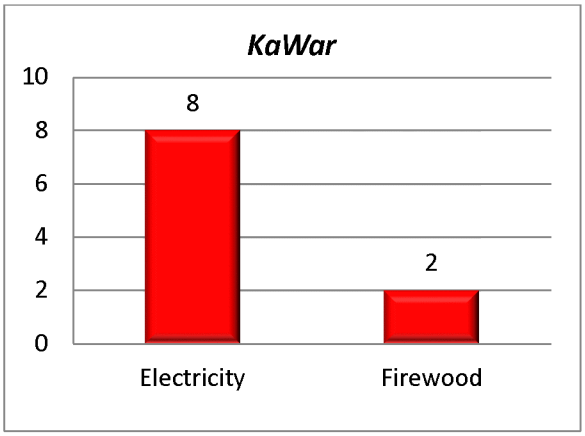
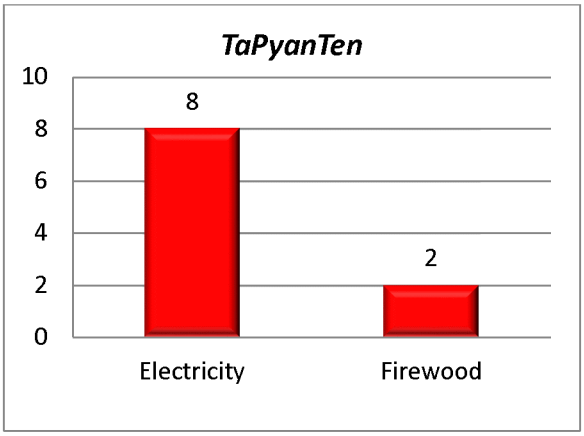
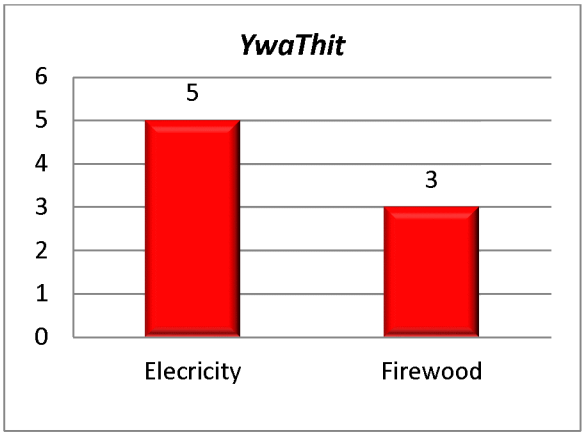
(h) Energy Sources for Cooking

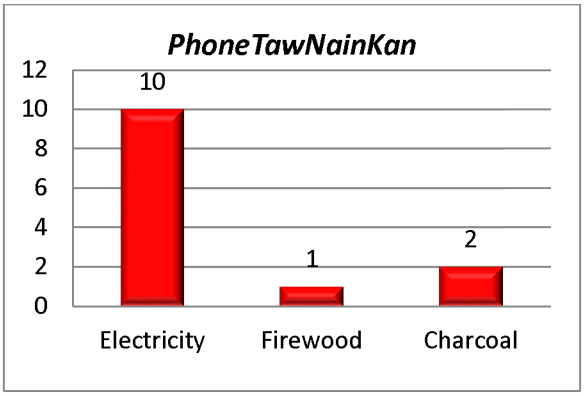
Primary data from field survey show that Electricity and firewood were the main source for cooking fuel in the entire project area, followed by use of charcoal.

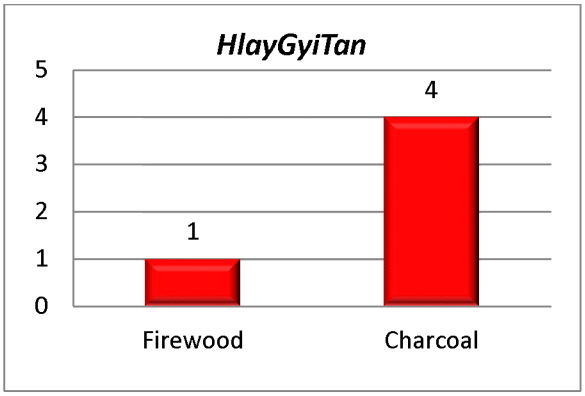












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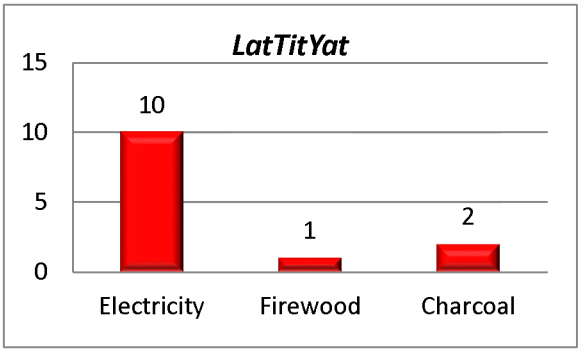

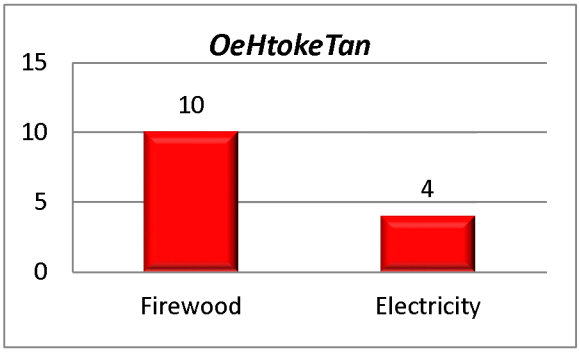

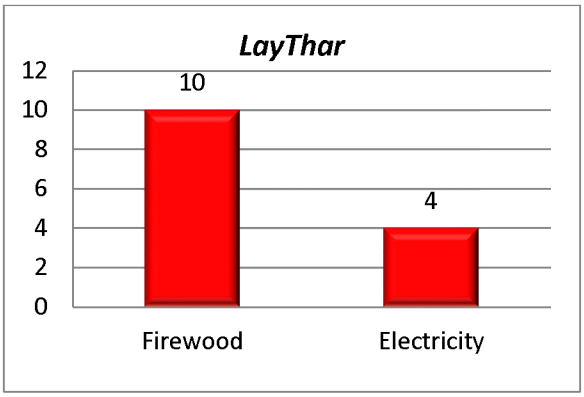

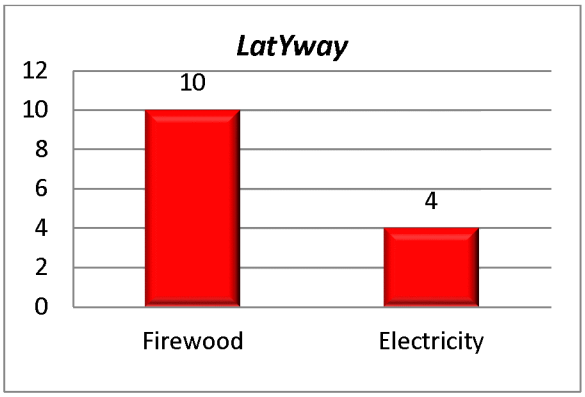

(i) Types of Transportation

According to household survey, motorcycle is the mainly used vehicle for transportation.

(j) Most Public Needs and Concerns during Household Survey

During social survey, immediate community needs and concerns about the proposed project were assessed. The most important positive outcomes from the project expected by the local people and most of their concerns about proposed project are as follow:

Village Name	Most Public Needs	Most Pubic Concerns
Shwe Kyat Yat village tract (*Padamyar Ward, Ywa Thit, That Ke Taw, Ka War, Ta Pyan Ten*)	• Expanding and upgrading of village road • Upgrading of education services • Getting electricity • Supporting Fire-engine	• Fire and explosion • Flood • Pollutions by oil leakage
Phone Taw Nain Kan	• Upgrading of education	• Flood

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village tract (*Phone Taw Nain Kan, Ta Bait Tann, Lat Yway, Lat Tit, Hlay Gyi Tan*)	services • Supporting to sub rural health center • Supporting of river retaining wall • Getting of electricity • Supporting Fire-engine	• Fire and explosion • Damages to Tha Pya Tan Fort, Shwe Kyat Yat Pagoda • Blockage of natural drainage system
That Gyi	• Job opportunity • Getting of electricity • Upgrading of road • Supporting of retaining wall	• Fire risk • Flood risk • Water pollution • Blockage of drainage system
Oe Htoke Tan village tract (*Oh Htoke Tan, Lay Thar*)	• Getting of electricity • Upgrading of road • Upgrading of Primary School to High School • Supporting of river retaining wall • Upgrading of Health Care	• Damages to Shwe Kyat Yat Pagoda • Pollution by oil leakage • Potential to flood

All of these data are local people hopes on the proposed project according to their wishes and concerns that were got from household survey in their surroundings on surveying within the limited border (3km).

5.16.2. Secondary Data Collection for Socio-economic Profile for Amarapura Township

For qualitative approach, data on demographic distribution of Amarapura Township are sourced from local government offices. The project data are provided by the developer. The accuracy of secondary data of this report is mainly based on these regional data and data from developer. The following are the regional socio-economic profile resulting from secondary data collection.

Overall Township Profile

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The overall township profile is mentioned in Table below.

Table - Township Profile

Location	
Coordinates	Latitude 21˚ 46′ to 14˚36′N, Longitude 96˚00′ to 96˚3′E
Adjacent Territory N/E/S/W	Chanmyatharsi/ Pathingyi and Pyigyithakhon/ Sintgaing/ Tada-U
Areas	80.11mile^2
Above sea level	250 feet
Township profile	
Administrative division	9 wards, 42village tracts and 170 villages
Ethnicity	Kachin 0.006%; Kayin 0.006%; Bamar 99.97%; Shan 0.011%; Rakhine 0.007% ; Chin .017%
Religion	Buddhists 92.95%; Christian 0.187 %; Hindu 0.189 %; Islam 4.45%
Household information	
Dwellings	32,886
Households	40,406
Ratio of urban and rural household	1:2.4 [urban 11,648 rural 28,758]
Average household size [persons]	Urban4.7 rural4.5

Population Details

As shown in the following table, the total population of the region is .18 million (185305 persons) of which .086 million (86849 persons) are males and .098 million (98456 persons) females. In 2014, this region has population increase rate of 2% and average population density of 1,145persons/Km^2. The male-female ratio is 1:1.2. The ratio of under 18 year and above 18 year is 1:0.55.

There are 32,886 dwellings and 40,406 households in the township. The ratio of rural and urban household is 1:2.4.

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Table - Population and Gender

Residence	Older than 18			Younger than 18			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Urban	17680	20622	39302	8063	8436	16499	25743	30058	55801
Rural	36826	42836	79662	24280	25562	49842	61106	68398	129504
Total	54506	64458	118964	32343	33998	66341	86849	98456	185305

Ethnicity and Religion

According to official statistics, the major ethnic in the township are Bamar (99.97%). Other ethnic minority groups include Shan (0.011%); Rakhine (0.007%); Chin (0.017%). Below Table reveals that the majority of local people are Buddhists (92.95%) followed by Christian 0.187 %; Hindu 0.189 %; Muslim 4.45%. Thus, only one religious group is dominating there. There are many religious places in the region including three historic site, twelve well-known pagodas and monasteries for Buddhists. There are also 3 churches, 2 Hindu temples and 18 Mosques.

Table - Religious Groups

Buddhism	Christian	Hindu	Islam	Total
172243 (92.95%)	347 (0.187%)	352 (0.189%)	12363 (4.45%)	185305

Occupational Patterns

Data shows (Tables below) that agriculture and loom industry are the common livelihood means of households in Amarapura Township. The other main economic activities in the area are livestock, trade, arbitrary and industry. According to official statistics, Amarapura has a total of 68.9% (127,675.14 people) as the township workforce and 125,451.5 people (67.7%) are employed with an unemployment rate of 1.8%.

Table - Occupational patterns

Government	Agriculture	Livestock	Trade	Industry	Arbitrary	Others

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Employee						
123	20038	20396	39351	20961	10800	7363

Table - Employment

Workforce	Employed	Unemployed	Unemployment rate
127,676.14	125,451.5	2224.64	1.8%

Economic Infrastructure

The Economic infrastructures of Amarapura Township are as follow;

Table - Markets

No.	Name	Location
1	Thaingyi Market	Owtaw Ward
2	Nan Yadanar Market	Nandawyar Ward
3	Myitnge Market	Myitnge

Table - Banks

No.	Name	Government	Private
1	Myanmar Economic Bank	1	-
2	Myanmar Agricultural Development Bank	1	-
3	KBZ Bank		2
4	Myanmar Orient Bank		1
5	UAB Bank		1
6	AGD Bank		1
7	Global Treasure Bank		1
8	AYA Bank		1

NGOs

Several NGOs work in Amarapura Township. The following Table provides NGOs and their force.

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Table - NGOs

Myanmar Women Affair Federation	Maternal and Child Care	Veteran	Red Cross	Auxiliary Fire Brigade	Total
69368	52002	815	556	564	123305

Education

For education sector, although primary school education is compulsory and fee-free, school enrollment rate of 5-year-olds is relatively high (100%) in the overall township. Percentage of students passing the matriculation is 33.04% for 2015-16 academic year and 91.37% for 2016-17 academic year. The teacher-student ratios are 1:39 in pre-BEPS, 1:30 in BEPS, 1:23 in BEMS, and 1:31 in BEHS. Data on education and literacy report that literacy rate in Amarapura Township was 100%.

Table - Educational Infrastructure

School	No. of Schools	No. of Teachers	No. of Students	Teacher/ Student Ratio
BEHS	6	397	1291	1:31
BEHS (Extension)/BEMS	5	150	3411	1:23
BEPS	4	81	2501	1:30
Preschool	6	83	3205	1:39

Table - Scholl Enrollment

No. of 5 yrs-old children			Enrollment			Enrollment Rate
Male	Female	Total	Male	Female	Total	
1713	1604	3317	1713	1604	3317	100%

Table - Matriculation Pass Rate

2015-16			2016-2017		
Sit	Pass	Pass Rate	Sit	Pass	Pass Rate

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2415	798	33.04%	2466	2234	91.37%

Table - Literacy Rate

Population above 15 years of age	Literate	Literacy Rate
105546	105546	100%

Healthcare Profile of Amarapura Township

In public health sector, the ratios of medical service personnel and local population indicate the existing conditions of the insufficient health care facilities, especially for rural people. According to secondary data available, the most common diseases include Diarrhea, Hepatitis, malaria, dysentery, and tuberculosis. It was also found out that there were substantial amount of incidence of diarrhea, TB and dysentery in the township.

Table - Healthcare Facilities

Population	No. of Doctors	Ratio	No. of Nurses	Ratio	No. of Healthcare Assistant	Ratio
185305	9	1:22	19	1:10	5	1:41

Table - Hospitals

Sr. No.	Hospital	Govt./Private	Bed
1.	Township hospital (**Amarapura**)	Govt.	25
2.	Ye Lun Kyaw	Govt.	16
3.	Ta Lin Gyi	Govt.	16
4.	Ta Mote Hsoe	Govt.	16

Table -- Healthcare Centers

Sr. No.	Type of Healthcare Center	No. of Healthcare Center
1.	Rural Healthcare Center	5

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2.	Rural Sub-Healthcare Center	22

Table - Common Diseases

Sr. No.	Disease	Incidence	Dead
1.	Malaria	37	-
2.	Diarrhoea	996	1
3.	TB	337	21
4.	Dysentery	418	-
5.	Hepatitis	5	-

Table - HIV/AIDS

2015-16		2016-17	
Infected	Dead	Infected	Dead
488	-	488	-

Table - Health Indices

No.of Maternal	No.of Infant	Per 1000			
		Birth Rate	Maternal Mortality Rate	Infant Mortality Rate	Abortion Rate
4155	3821	18.50%	1.04%	2.1%	0.7%

6. IMPACT AND RISK ASSESSMENT AND MITIGATION MEASURES

6.1. Phases for the EIA Study

The following phases will be considered in conducting of EIA for the proposed project.

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(i) Pre-construction Phase

Pre-construction activities will involve site clearing, land clearing and earth working activities.

(ii) Construction Phase

The construction activities will include the construction of the temporary camp for construction workers and construction of project development (including storage tanks, pipeline, jetty, filling point, pump house, office etc.).

(iii) Operation Phase

The main operation plan is the storage and distribution facility of loading and unloading of fuel oil.

(iv) Decommissioning Phase

Although the proposed project is long-term project, decommissioning of the project would occur at the end of its lifespan. The goal of project decommissioning will be to remove the concrete and steel structures, and storage tank equipments or as a whole and return the site to a condition as close to a pre-construction state as feasible. The physical removal of the structures and equipments will be the reversal of the construction process. All areas disturbed by the proposed project would be restored to pre-project conditions and/or to conditions acceptable to the MCDC rule and regulations. During decommissioning phase, all concrete and steel structures and equipments would be dismantled and removed. The major activities that will be required for the decommissioning of the proposed project are:

(a) Concrete structures removal,
(b) Steel structures removal,
(c) Pipeline removal,
(d) Jetty removal, and
(e) Equipments and electrical supply system removal.

6.2. Environmental Impact Assessment Methodology

The methodology and approach to be followed during this EIA is described below. Each specialist will undertake an impact assessment, and prepare an impact assessment report as supporting documentation to the EIA. These will include:

- Executive Summary;

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- Introduction;
- Brief project description;
- Methodology including guidelines and standards used in the study;
- Baseline description of the Environment;
- Assessment of the potential significance of impacts of the project; and
- Recommendations for mitigation/management of impacts.

Impacts will be assessed using information gathered during the baseline assessment in combination with previously collected data and the detailed project plan. The significance of the identified impacts will be determined using the approach outlined in Table 6.1. This incorporates two aspects for assessing the potential significance i.e. occurrence and severity, which are further sub-divided as indicated. The impact ranking will be described for both pre and post implementation of mitigation/management measures conditions.

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic Environmental system that can be attributed to human activities. The significance of the aspects/impacts of the process was rated by using a Matrix Method modified by Green Tech ESIA Team. The significances of the impacts were determined through a synthesis of the criteria below:

1. Scale

No.	Description	Rating	Score
1.	Impact will be affected (Distance = 100 m or Area =1000 m^2)	Site	1
2.	Impact will be affected (Distance = 1000 m or Area = 10 km^2)	Limited	2
3.	Impact will be affected (Distance = 1000 m to 10 km or Area = 10 km^2 to 100 km^2)	Local	3
4.	Impact will be affected (Distance = 10 km to 100 km or Area = 100 km^2 to 1000 km^2)	District	4
5.	Impact will be affected (to the distance exceeding 100 km or Area = 1000 km^2)	Regional	5

Note: For linear objects areal gradations are used. If the area cannot be evaluated, the linear distance is used.

2. Duration

No.	Description	Rating	Score
1.	One day to one month	Very short term	1

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2.	One month to two years	Short term	2
3.	Two years to ten years	Medium term	3
4.	Ten years to the whole life of operation	Long term	4
5.	Permanent and irreversible impact on nature	Permanent	5

3. Severity for the Environment

No.	Description	Rating	Score
1.	Isolated parts will be damaged and easy to mitigate/restore	Very low	1
2.	Isolated parts will be damaged and hard to mitigate/restore	Low	2
3.	Large parts will be damaged and easy to mitigate/restore	Low to Medium	3
4.	Large parts will be damaged and hard to mitigate/restore	Medium	4
5.	Large parts will be permanently destroyed	High	5

4. Frequency

No.	Description	Rating	Score
1.	Less than twice a year	Rare	1
2.	3 to 4 times per year	Intermittent	2
3.	Once a month	Regular	3
4.	1-3 times per week	Very Often	4
5.	More than 3 times per week	Continuous	5

5. Probability

No.	Description	Rating	Score
1.	Impact is very unlikely to occur under normal conditions but may occur in exceptional circumstances	Very Seldom	1
2.	Impact is unlikely to but may occur at some time under normal operating conditions	Seldom	2

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3.	Impact is likely to occur at some time under normal conditions	Probable	3
4.	Impact is very likely to occur at some time under normal conditions	Highly probable	4
5.	Impact will occur under normal operating conditions	Certain	5

Calculation of Impact Rating

Impact Significant = (Scale + Duration + Severity) × (Frequency + Probability)

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Table- Impact Rating Table

Likelihood \ Consequence	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
3	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
4	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
5	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
6	6	12	18	24	30	36	42	48	64	60	66	72	78	84	90
7	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
8	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
9	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
10	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

- Very Low (0- 25)
- Low (26- 50)
- Low to Moderate (51-75)
- Moderate (76-100)
- Moderate to High (101-125)
- High (126 to 150)

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Mitigation Requirement for Impact Significance

No.	Impact Significance	Mitigation Requirement
1	Very Low (Negligible)	No mitigation required
2	Low	Required a small number of additional mitigations
3	Low to Moderate	Require more or less additional mitigations
4	Moderate	Require a number of additional mitigations
5	Moderate to High	Require a number of additional mitigation or modification of the project design
6	High	Require additional mitigations plus modification of the project design or alternative action may be required

Prediction Confidence

Although not explicitly included in the criteria tables, there is uncertainty associated with the information and methods used in an ESIA because of its predictive nature. The certainty with which an impact analysis can be completed depends on a number of factors including:

- Understanding of natural/ecological and socio-economic processes at work now and in the future; and
- Understanding of present and future properties of the affected resource.

The level of prediction confidence for an impact analysis will be discussed when there are questions about the factors reviewed above. Where the level of prediction confidence makes a prediction of the impact problematic, a subjective assessment is made based on the available information, the applicability of information on surrogates and on professional opinion.
The level of prediction confidence is sufficiently low in some cases that an estimate of Environmental consequence cannot be made with a sufficient degree of confidence. Undetermined ratings are accompanied by recommendations for research or monitoring to provide more data in the future.

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Development of Mitigation Measures

A common approach to describing mitigation measures for critical impacts is to specify a range of targets a predetermined acceptable range and an associated monitoring and evaluation plan. To ensure successful implementation, mitigation measures should be unambiguous statements of actions and requirements that are practical to execute. The following summarize the different approaches that may be used in prescribing and designing mitigation measures:

- Avoidance: e.g. mitigation by not carrying out the proposed action on the specific site, but rather on a more suitable site;
- Minimization: mitigation by scaling down the magnitude of a development, reorienting the layout of the project or employing technology to limit the undesirable Environmental impact;
- Rectification: mitigation through the restoration of Environments affected by the action;
- Reduction: mitigation by taking maintenance steps during the course of the action; and Compensation: mitigation through the creation, enhancement or acquisition of similar Environments to those affected by the action.

6.3. Social Impact Assessment (SIA) Methodology

SIA is a formal process used to predict how the proposed project will affect existing socio-economic conditions of nearest local communities. It is desirable to ensure that the development options under consideration are sustainable. It also aims to make recommendations for the mitigation of the potential negative impacts and enhancement of the positive ones.

SIA will also contain Social Management and Monitoring Plan (SMMP). SMMP is a site specific plan developed to ensure that the project is implemented in a socially sustainable manner where all contractors and subcontractors, including consultants, understand the potential socio-economic impacts arising from the proposed project and take appropriate actions to properly manage that risk.

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Objectives of the SIA Study

The objectives of the SIA report are to:

(i) describe the process undertaken during project design to engage stakeholders, and the planned information disclosure measures and the process for carrying out consultation with affected people and facilitating their participation during project implementation;
(ii) assess the project's likely positive and negative, direct and indirect impacts to existing socio-economic conditions in the project's area of influence;
(iii) identify and evaluate the potential positive and negative socio-economic impacts resulting from the development of the proposed project;
(iv) present a set of mitigation measures to avoid, reduce, mitigate, or compensate for adverse socio-economic impacts;
(v) describe the monitoring measures and reporting procedures to ensure early detection of conditions that necessitate particular mitigation measures; and
(vi) identify who is responsible for carrying out the mitigation and monitoring measures.

Scope of the SIA Study

SIA will report will also cover the following:

(a) the present status of socio-economic components of the environment;
(b) The primary data collection of socio-economic conditions of the villages around the 4 km radius of the proposed project,
(c) The secondary data collection for the whole Amayapura Township,
(d) Identification and evaluation of socio-economic impacts for construction, operation and decommissioning phases of proposed project,
(e) Mitigation and enhancement measures for anticipated social impacts in all phases,
(f) Social management plan (SMP) to manage the necessary mitigation and enhancement measures, and
(g) Social monitoring program to measure the improvement of the community around the area.

In making impact assessment, the SIA team will mostly referred to the Guidelines and Methodologies from Asia Development Bank (ADB), International Finance Organization (IFC) and Work Bank.

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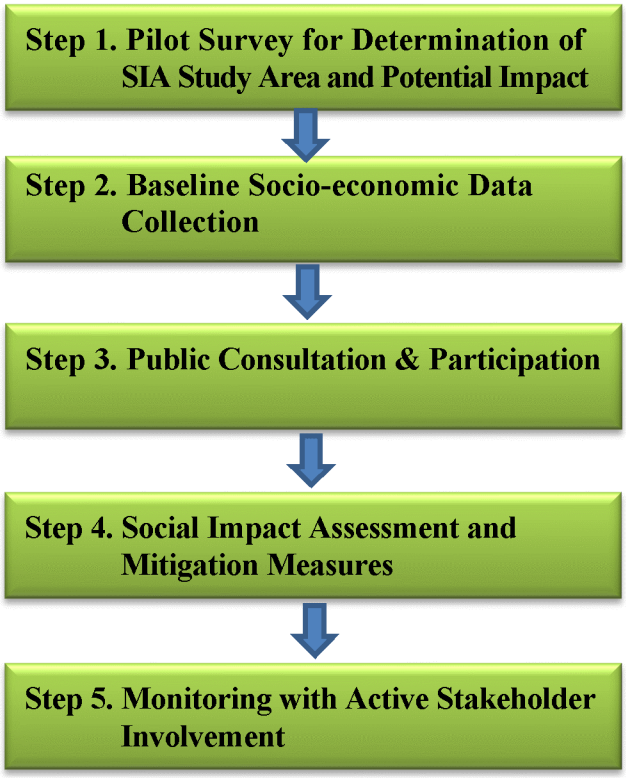
Details of the Social Assessment Practitioner

SIA will be conduct by Socially Responsible Partner (SPR) SIA Team. Below is the background information of SIA Team.

Socially Responsible Partner, SPR		
Specialists including written the SIA report	Dr. Kyaw Swar Tint	Ph.D. (Mining)
	Dr. Thein Tun	Ph.D. (Metallurgy)
	Ma Nandar Nwe	Dip. and M.S. in EIA/EMS; Dip in Applied Psychology
	Ma Thazin Htwe	Dip. and M.S. in EIA/EMS; Dip in Applied Psychology

Methodology for SIA Study

Socioeconomic impact assessment for proposed project was conducted by the following procedures.



Main Steps in SIA Study used by SRP Group

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Step I: Pilot Social Survey for Determination of SIA Study Area and Potential Socio-economic Impacts

Pilot survey was done for determination of SIA study area and study area was considered after the discussions with key informers project managers from MESDP and the heads of Village General Administrative Offices of nearest villages. Google Map and census are also used for the determination of SIA study area during pilot survey.

Step 2: Baseline Socio-economic Data Collection

To assess the baseline socio-economic conditions that may result from the development of the proposed project, the SIA team employed both quantitative and qualitative approaches as follow:

Primary Data Collection by Household Survey

The collection of primary data consisted of focus group discussions and household surveys in the target study areas. Household sample survey was conducted to evaluate primary socio-economic conditions of the project area and to understand the mood, perceptions and extent of preparedness of the people towards the proposed project. The household survey was carried out to tap the baseline socio-economic conditions of project area and to assess project perceptions and attitudes of the local people over a period of five days. The accuracy of primary data collection was based on the accuracy, number of surveyed household and experiences of surveyors. To get the accurate data, primary data collection was conducted by social specialist, social consultants, local authorities and local people.



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(a) Survey Team

The team was formed with researchers from social, medical, and engineering sciences having research experiences in the field of social impact assessment and social management planning.

(b) Development of Survey Questionnaire

Socioeconomic aspects to be included in questionnaire were based on site visits and issues identified by interviews with local people and village heads during pilot survey. Items were formulated by the consultants and reviewed by social assessment team members as to clarity of item wordings and relevance to the socioeconomic domains measured. The survey questionnaire was designed to collect information as to the following household characteristics:

- household composition (age, gender, educational status, religion, ethnicity, language used and marital status);
- occupations;
- ownership of agricultural fields and livestock;
- energy sources and facilities;
- agricultural and other economic activities;
- daily movement patterns;
- income and expenditure patterns;
- access to and use of community services/facilities and natural resources;
- health and nutrition; and
- views/concerns/suggestions on the proposed project.

(c) Recruitment and Training

The enumerators were received a training program prior to commencing with the fieldwork. The training program included a briefing on the objectives of the survey, socioeconomic aspects to be measured, interview techniques as well as a detailed explanation of each question and its relevance to the survey objectives, how to pose the question and how to code the answer. Discussions were also held among participants about the socioeconomic conditions and initial questionnaire items were revised based on the discussion results. A set of guidelines were given to each enumerator for administration of survey questionnaire. In the field data collection activities, the enumerators were supervised by experienced supervisors with household survey.

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(d) Data Collections

The project related data, project layout plans and design parameter are will be provided by Myanma Energy Sector Development Public Co., Ltd. Secondary data on demographic distribution in the area will be collected from Head of Local Administration Office (Amarapura) and data on public health will be collected from Public Health Department (Amarapura). Primary data for public concerns, socio-economic and health profiles will be conducted by household survey.

(e) Data Analysis

In household survey data collection period, field supervisors checked and ensured the control of data quality. During field surveys, information obtained through household survey and interviews was corroborated through direct observation by the study team aiming at assessing social and cultural infrastructure existed in the project area, physical assets of people, and living conditions. Observations were backed up by photographic records. Quantitative data were coded and processed using SPSS statistical package. Qualitative data were coded using standard methods.

Socio-economic Impact Study

The EIA team will make the impact assessment for socio-economic both positive and negative impacts such as job opportunities, impacts associated with population influx, impacts on social services etc.

6.4. Health Impact Assessment Methodology

(a) Introduction

HIA provides a systematic analysis of the potential community health impacts as well as developing options for maximizing the positive health impacts, minimizing the negative impacts and enhancing health equity/reducing health inequalities. This HIA report was conducted by Socially Responsible Partner (SRP) Social and Health Impact Assessment Group, and the potential health impact of the proposed project on local communities and the wider society were assessed.

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(b) Methodology for HIA Study

HIA for proposed mine site was conducted by the following procedures.

(a) Scoping process;
(b) Identification and evaluation of potential health impacts;
(c) Mitigation measures for potential health impacts; and
(d) Management and monitoring process HIA as follow:

No.	Stage of Health Impact Assessment	Purposes	Outcomes
1.	Scoping Process	To determine the scope of the HIA to be undertaken.	Outlines of how the HIA will be conducted including the time, resources and activities required.
2.	Identification and assessment of potential health impacts	To identify and assess the potential health outcomes.	Document that describes the potential health outcomes of the proposed sugar mill.
3.	Mitigation	To minimize and remedy for potential health impacts.	Set of mitigation measures to prevent, reduce and minimize for potential impacts of proposed project.
4.	Management and Monitoring	To manage the effectiveness of the HIA and monitor health outcomes.	Document that manage and monitor the HIA process and other outcomes.

(c) Scope of the Study

Initially, a detailed understanding of the project, its aims and objectives is developed. This is followed by a desk-based community health and wellbeing profile using existing local health information from Public Health Department (Amrapura). Based on secondary data collection, HIA for local people in nearest villages follows by a more detailed community health impact based on the ground fieldwork, social surveys, focus groups and discussions with key informants such as community health and development workers and local health/public health officials. This study also involves developing a baseline assessment and community profile with a particular focus on existing health and wellbeing problems and assets.

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(d) Methods of Data Collection

The typical methods of data collection of existing health conditions consist of the following:

(a) ***Interaction with Government Departments***: Interaction with key government departments such as general administrative office, department of health etc. are conducted to identify constraints and additional information specific to the individual departments and ministries;

(b) **Household Surveys**: Questionnaires and surveys about health are employed to obtain public needs and concerns from a representative sample household.

Primary and secondary data for obtainable health conditions of local communities were collected from the following data sources.

(a) Regional health data from department of health;
(b) Group discussions with key informers,
(c) Community feedback from household surveys,
(d) Feedback from government and non-government stakeholders, and
(e) Public meetings.

(e) Law and Regulations Related to HIA

The relevant laws and legislations that safeguard about the health and wellbeing of public in Myanmar are shown in **Error! Reference source not found.**

Table - Health Related Laws and Regulations in Myanmar

Laws and Regulations	Year	Purpose
Town Act and Village Act	1907, 1908	To protect the people and animals of Myanmar from infection diseases.
Essential Supplies and Services Act	1947	To maintain supplies and services essential to the life of the community providing or regulating water supply and environmental sanitation in rural areas.
Public Health Law	1972	To promote and safeguard public health and to take necessary measures in respect of environmental health.

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Animal Health and Development Law	1993	To prevent of dangers to animal feeds, prevention of infectious diseases, and prevention of cruelty to animals.

(f) Methodology Used in Health Impact Assessment

HIA for proposed mine site was conducted by the following methodology.

(a) Scoping process for determination of HIA study area and project affected persons (PAPs);

(b) Data collection for anticipated health impacts;

Scoping Process for HIA Study

Scoping for HIA study was done to determine SIA study area and PAPs.

Determination of HIA Study Area

HIA study area was also conducted within 4 km radius around the proposed project.

HIA Survey Team

The HIA team organized 7 people (1 health consultant, 2 social consultant, 2 local people and 2 health surveyors). Two local people are members of quarter administrative offices and 3 surveyors are from qualified survey team. Roles and responsibilities of key consultants are as follow:

No.	Consultants	Role	Responsibility
1.	**Dr. Khon Aung** M.B.B.S (Ygn)	Health Consultant	Health Impact Evaluation and Health Management Plan
2.	**U Aung Naing Htun** B.E (Mech:), L.L.B, M.B.A, M.P.A, M. Dev.s, M.A (BL) M.A (TEFL)	Law Consultant	Related Rules and Regulation of HIA

Data Collection

To assess potential health impacts, HIA team made sure of both primary and secondary data collections as follow:

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Public Consultation Process for HIA

Public meetings for active public participation are accomplished three times by the combination of EIA and SIA. People from local authorities, communities, NGOs and INGOs, and those who are directly or indirectly affected by the proposed project are attended in these meetings.

Impact Rating Method for HIA Study

There is no universally agreed formula for assessing public health significance, although assessments are mostly based on a subjective judgment about the magnitude of the potential health impacts (size of the affected population and scale of the positive or negative health impact); its likelihood of occurrence; and the degree of confidence in the impact actually occurring (based on scientific and other evidence of the health impact occurring in similar circumstances elsewhere). The following table shows Methodology for consideration of health impact significance.

Table - Considerations for Health Impact Significance used by SPR Group

	Likelihood of Occurrence of Health Impact			**Health Impact Rating**
	Low	Medium	High	
Magnitude of Health Impact	Unlikely to occur	Likely to occur sometimes	Likely to occur often	
None	No significance	No significance	No significance	0
Low	Very Low	Low	Medium	1
Medium	Low	Medium	High	2
High	Medium	High	Very High	3

Analysis of health impacts involves systematically determining the range of potential impacts, their relative importance and where, when and how likely they are to occur. The information for the HIA was obtained from the primary data collection (household survey), literature review, community profile and Health Data from Pubic Health Department (Amrapura) as well as knowledge and expertise of the HIA Consultant.

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When analyzing health impacts, it is important to consider the magnitude, likelihood and public health significance of the potential impacts. This analysis involves expert judgment based on a consideration of the evidence gathered and its applicability to the local context and the specific project.

Distributional, health equity and inequality impacts are analyzed by examining how particular sub-groups within a population, particularly vulnerable groups, are likely to be affected by the project. The scoping and community profiling steps are likely to have already identified potentially vulnerable groups through existing local information on these individuals/groups or through community surveys and meetings with key informants e.g. community leader, community health worker or local NGO.

Health equity/inequality impacts occur when the projects benefits and harms are unevenly distributed. This includes where the risk is equally distributed, such as air pollution, but the impact is disproportionate – affecting particularly children, older people and those with existing ill health.

Types of Health Impacts for HIA Study

The following health related impacts are considered during HIA study.

(a) Infectious Diseases (Malaria, HIV and influenza);
(b) Chronic diseases (Heart disease, cancer, bronchitis, and asthma);
(c) Nutritional disorders (Malnutrition, vitamin deficiencies and obesity); and
(d) Mental health and wellbeing (Depression, stress and anxiety).

6.5. Methodology for Biodiversity Impact Assessment

The objectives of the Ecology Impact Assessment include:

- Undertaking the collection of baseline Environmental data;
- Characterization of the baseline Environment;
- Identification, and assessment of key adverse impacts that may result from the activities of the project;
- Identification, assessment and recommendations of appropriate and practical mitigation measures to remove or minimize the adverse impacts identified; and
- Providing specialist ecological input into the Environmental and Social Management Plan (ESMP).

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Scope of Work

Flora

- Conduct initial desktop review of vegetation likely to occur within the study area;
- Develop a species list of red data and protected plants;
- Conduct a detailed survey (using standard scientific methodology) in order to:
- Identify general vegetation types and communities on site;
- Identify dominant plant species;
- Record red data and protected species;
- Identify invader or exotic species;
- Identify floral species with any medicinal, cultural or commercial importance;
- Identify sensitive landscapes and habitats including wetland and riparian habitats;
- Identify possible impacts of the proposed project on flora species and communities; and
- Recommend mitigation measures for these identified impacts.

Fauna

- Conduct initial desktop review of faunal species likely to occur within the study area;
- Develop a species list of red data and protected animals;
- Conduct a detailed survey (using standard scientific methodology) in order to identify terrestrial fauna linked to veldt types and vegetation communities on site, including:
- Visual observations;
- Live capture and release, including small mammal trapping;
- Identify the dominant faunal species on site;
- Record observed red data and protected faunal species;
- Identify observed exotic species;
- Identify possible impacts of the proposed project;
- Identify possible impacts of the proposed project on flora species, habitats and communities; and
- Recommend mitigation measures for these identified impacts.

Current Biological Environment

Vegetation and terrestrial animals are very low abundant in the project area. Small population of flora and fauna in surrounding area of land are found. Aquatic fauna including fish and birds are fairly abundant. Small fisheries practiced by local fishermen are observed during in

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the survey period. No red list species of flora and fauna in both terrestrial and aquatic environments are recognized during the scoping survey. There is also no any wildlife protected area, wetland and reserved forests nearby the project area.

Methodology

(a) Field Survey and Data Collection

Data collection will be taken by field observation. List of the terrestrial plant and habitats will be classified. Terrestrial and aquatic fauna survey will be carried out one time in cold season. The collected data will be analysis to investigate the plant and animal population and distribution by using the appropriate methods: Relative Frequency (R.F), Relative Abundance (RA) and Importance Value Index (I.V.I) for plants and habitat utilization for fauna species will be identified. The threatened species on both flora and fauna described in IUCN Red List will be included if possible found for the concern of conservation. Benthos and zooplankton will be collected and analysis for their abundance and distribution.

(b) Impact Analysis

Impact analysis will be done based on available survey data and information. Analysis method will be used in accordance with the standard of biodiversity and wildlife international.

(c) Anticipate the Potential Impacts

Impact analysis will be carried out to investigate the specific impacts on biodiversity during the constructional and operational.

- Impact on terrestrial and aquatic animals
- Impact on plant community

(d) Survey Work

Detail study for fauna and flora to be included are as follow:

- Baseline data of flora and fauna on both terrestrial and aquatic environment
- General type and dominant species of plants and animals
- Species richness, abundance and distribution of plants and animals
- Benthos and zooplankton species and their abundance
- Rare and Endangered species if possible found
- Further investigation on the potential impacts

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6.6. Surface Water (Hydrology) Impact Assessment

The surface water study was focus on the characterisation of the baseline hydrology at the project site and assess the potential impacts on surface water due to project development. The following tasks were conducted:

- Compilation of a baseline report to characterise the existing hydrology and water quality of the area;
- Development of flood lines for the area;
- Development of a storm water management plan for the site; and
- Development of management plan for erosion of river bank.

There were important interactions between groundwater and surface water in this type of environment. There were therefore be strong collaboration between the groundwater and surface water specialist teams.

Scope of Work

The scope of work for the surface water assessment is provided below.

Site Visits

Two site visits are conducted. The first visit was a reconnaissance visit to understand the situation in site. The further visit was to set up the baseline monitoring program and take field measurements.

Hydrology Impact Assessment Team

No.	Name	Qualification	Responsibility
1.	Ma May Thet Zaw	M.E. (Civil)	Team Leader
2.	Mg Yaw Ma Nar	B.Sc. (Forestry); Dip in EIA/EMS	Team Member

Hydrology Study

This report is the environmental impact of the proposed oil storage tanks development on the hydrological regime at the proposed project site in Amarapura area of Mandalay region. It aims at assessing sensitivity of the baseline hydrological environment and the potential

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impacts of the proposed development upon it and proposes mitigation measures in order to ensure that the potential adverse impacts of the proposed oil storage tanks development on the hydrological environment will be slight and neutral.

The proposed project will consist of oil storage tanks, jetty, pump houses, main office, retaining wall and access tracks. The area is mainly covered by grass and shrubs with occasional sandy outcrops projecting onto the surface cover. The soils cover is thin and comprises of sandy surfaces in some places. The potential impacts on the surface water environment from the proposed project development, in the absence of suitable mitigation measures, are considered to be as follows:

- Direct impacts of the project construction on the hydrological environment for example contamination of surface water (if encountered in excavations) from the spillage/leakage of fuels from vehicles and fuel/ waste storage areas.
- Direct impacts from excavated areas (overburden) where vegetation has been removed through release of silt laden surface water runoff into local watercourses due to soil erosion and increased volumes of surface water runoff.
- Direct impacts of project operation on the hydrology for example, surface water contamination from minor leakage of oil from vehicles or filling point used on the site and oil storage at the switch room.

Baseline Hydrological Environment

The description of the baseline hydrological environment at the subject site and in the surrounding area was by means of a desktop study. This was supplemented by a site walkover by the hydrologist to site.

Relevant desktop studies were undertaken to aid in understanding the underlying hydrology of project area. Supporting information relating to the proposed development was collected for purposes of understanding the oil storage project and to relate development to hydrological characteristics inherent in the area in order to:-

- Assess the sensitivity of the baseline hydrological environment at the subject site and in the surrounding area with respect to the proposed oil storage project development.
- Identify any potential impacts on the hydrological environment associated with the proposed development.

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- Identify any constraints posed by the existing hydrological environment to the proposed development and to;
- Recommend appropriate mitigation measures in order to ensure that the potential impact of the proposed project is slight and neutral.

Field Survey Methodology

In order to inform the hydrological impact assessment, a site walkover was carried out by the hydrologist to record observations and features of significance in the project area.

Significance Criteria

Relevant documentation gathered from diverse sources categorize impact into five (5) categories to aid in assessing the potential impacts of the proposed development on the hydrological environment in terms of how significant an impact may be on the overall environment as follows:

***Imperceptible Impact*:** An impact capable of measurement but without noticeable consequences.

Slight Impact: An impact which causes noticeable changes in the character of the environment without affecting its sensitivities.

***Moderate*:** An impact that alters the character of the environment in a manner that is consistent with existing and emerging trends.

Significant Impact: An impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.

***Profound Impact*:** An impact which obliterates sensitive characteristics.

Erosion of Riverbanks

The EIA team was studied the erosion of river bank in the other side of the nearest rivers due to the travelling of fuel oil loading vessels as part of the hydrology study.

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Potential to Erosion of Riverbank at Innwa

Blockage of Natural Drainage System

The hydrologist studied on potential to blockage of natural drainage system due to earth filling of proposed project.

Existing Water Quality Monitoring

Existing water qualities were monitored for both surface and ground water qualities as follow:

Monitoring of Surface Water Quality: The locations that take the surface water samples were in the Myit Nga River, Ayawaddy River and project site.

Monitoring of Ground Water Quality: The locations that take the ground water samples were in project site and at nearest villages.

Water Quality Testing

All of the surface and ground water quality were tested in Water Quality Testing Laboratory under the Department of Occupational Health.

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6.7. Cultural and Heritage Impact Assessment

This project area is situated on the southern bank of Ayeyarwady River at the confluence of Ayeyarwady and Myite Nge Rivers. Generally, the locality is very risky among the cultural landscapes and touristic areas. The cultural significances of this area are Innwa Old City and three serial heritage sites of fortresses viz. Sinkyone, Asekhan and Thabyetan. The nearest site is the buffer area of Thabyetan Fortress at the northeast of the project area. It can be risky for the heritage landscapes and must be measured the potential impacts on them. Possible impacts have been come out after dusk studies and aerial analyses on this area. Normally the development project should not be founded in this area due to the challenges of cultural heritage landscape. But the actual plan of this project had already been started in planning and construction stages. Therefore, the assessment plan must be measured for the construction, operation and decommissioning stages. The systematic measurement for the cultural resource management must be carried out to have the strong mitigation plan.

Terms of Reference

TOR contains the following 3-steps_

1. The study area concerning the east and north of Innwa city wall, measured as 2.38 km long in extent of East alignment from (21°51'29.77" N and 95°59'13.90" E) to (21° 51' 35. 60" N and 96°59' 11.12" E) and North alignment from (21° 51' 35. 60" N and 96°59' 11.12" E) to (21° 51' 35. 03" N and 96°58' 23.65" E). Then, it will be focused on these coordinates (21°52'1.14"N and 95°59'47.58"E) for TBD and (21°52'10.47"N and 95°59'40.71"E) for Innwa bridge.
2. Data requirements and sources were collected from the references of Archaeological reports, previous studies of Mandalay Region and the existed laws authorized by Department of Archaeology and National Museum, Ministry of Religious and Cultural Affairs.
3. Expertise needed on the impact assessment team is that the cultural resource management, field archaeologists or archaeological excavators, liaison officers, GIS and visual pollution on the cultural heritages.

Cultural and Heritage Impact Assessment Methodology

In fact, there are possible necessaries to do cultural heritage assessment as follows;

1. Baseline data for the existing cultural heritage sites

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2. The potential impacts on the cultural heritage sites and landscape
3. Making cultural map
4. Writing the strong mitigation and monitoring plans to reduce the negative impacts

To make assessment plan, the following challenges must be considered to preserve the cultural landscape;

1. Heritage authorities and laws
2. Visual Pollution
3. Cumulative and Residual Impacts
4. Disaster Risk management

Introduction

The Oil Tanks project must be measured by the spatial archaeological approach to have correlation with the public attraction on ancient cultural heritage as well as touristic area. The significant site of Yadanabon Period is TBD Tha Bye Dan fortress, Innwa City Wall and Me Nu brick monastery concerning this project area. In this area, since British Colonial Period, the Innwa-Sagaing

Bridge was built through the area of TBD. Therefore, it can be listed as 1. Tha Bye Dan fortress 2. Innwa-Sagaing Bridge 3. Queen Me Nu brick monastery 4. East and North of Innwa Old City. For the preliminary assessment of impacts, though it may not directly be impacted on the cultural property, some types of indirect impacts such as visual pollution or impacts, cumulative an`d residual impacts will be risky on this area due to the important value of cultural environment and landscape.

Stakeholder and Partnership

This assessment project was requested by Ever Green Tech Environmental Services and Training Co., Ltd. (EGT) for the Project area of Oil Storage Tanks (Myanmar Energy Sector Development Public Co., Ltd). The local authorities are essential to collaborate in this project according to the existed law of cultural heritage regions enacted in 1998 and antique objects law in 2015 as well as the rules of 2011 and 2016. Then, the local community will be informed and invited to collaborate in this assessment project. Some local people who are living in the cultural heritage area will involve in the part of exploration in the assessment. Funding was be provided by EGT.

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Resources and Date Analysis

To make dataset and analysis on collected information, the members of Myanmar Archaeology Association and the archaeologists from the universities' campuses will participate in the exploration and assessment of archaeological resources. In this project area, the important site of ancient urban landscapes located near the Innwa Old City will be explored and assessed by the following persons -

1. Dr Pyiet Phyo Kyaw, Lecturer,
   Department of Archaeology, Mandalay University,
   Advisor of Myanmar Archaeology Association

2. Mr. Soe Win Naing, MA (Archaeology),
   President of Myanmar Archaeology Association

3. Mr. Saw Tun Lin, Assistant Lecturer,
   Department of Archaeology, University of Yangon,
   Founding member of Myanmar Archaeology Association

To make data analysis on the findings extracted from this site, archaeologists and staffs from the universities' campuses will collaborate and make a particular dataset of archaeological findings.

Cultural Mapping

There is a very important site concerning the Innwa Old City and the ancient urban landscapes from 14th to 19th century AD. To say the chronology of ancient urban evidences, it must be totally depended on the cultural environment of this area.

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Map1. Cultural Map around the Oil Storage Tanks Project

For example, there is TBD, Innwa bridge, Innwa cityscape, ancient monastic buildings as well as the area along the bank of Ayeyarwady and Duthavati or Myitnge Rivers. A stupa in the Oat Pho Roe monastery was totally changed to be new one. The original stupa might be associated with the 15th century Hamsavati Period. But now, monks and villagers have already reconstructed it.

Historical Resources and Previous Studies

The ancient urban landscapes, since 14th century AD, are very important for studying and associating with Myanmar cityscape and national consolidation as well as those of the Mainland Southeast Asia, India and China. Internationally the evidences of ancient urban management found in this area can be well known as Ava recently known as Innwa. Innwa or Ava means "mouth of the Lake" entrance gateway at the confluence of two rivers and it was the ancient trade port between lower and upper Myanmar as well as other foreign relationships. Inwa was the capital of Burma over three hundred years ago from 1365 to 1842. In Innwa city, it can be divided as Ava period (14th to 16th centuries) Toungoo and Konbaung periods (16th to 19th centuries).

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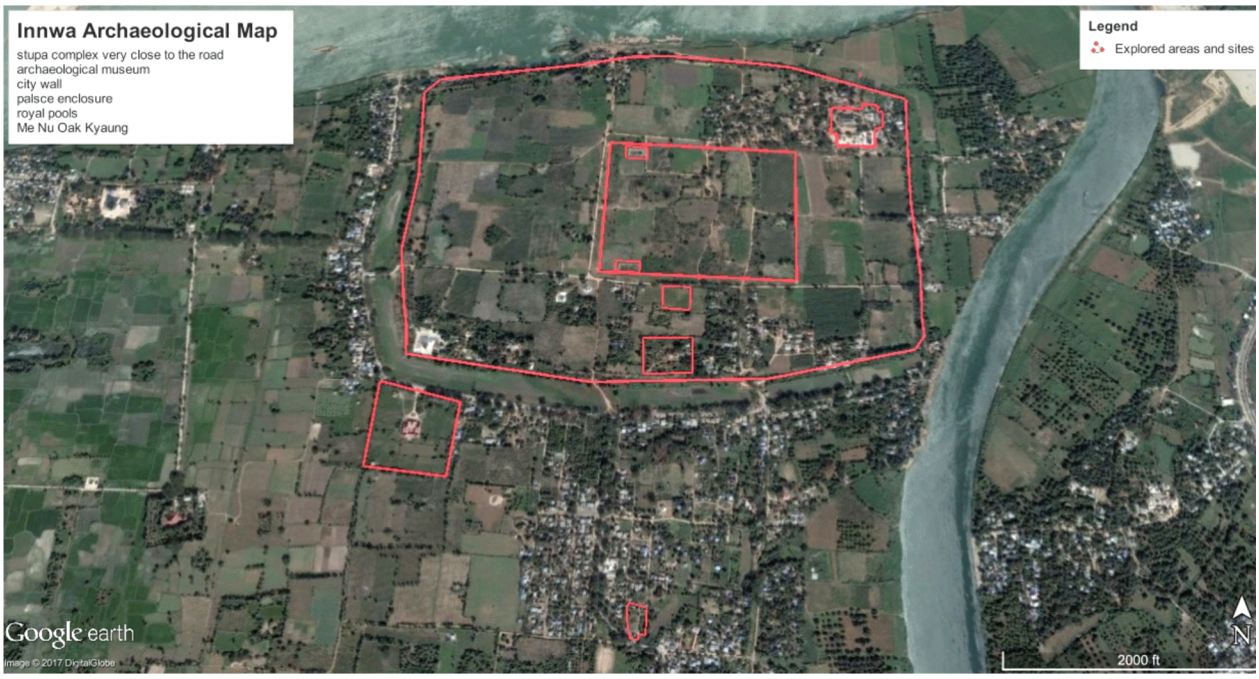

Map2. Innwa Archaeological Map

Significant of Impacts on Human Environment

Threat Matrix of Heritage Impact Assessment Accordance with ICOMOS Guidance 2011 is as follow:

In CHIA process, the cultural significances are essential to make a cultural map concerning the project area. The assessment area is around the area of MESDP belonging to the boundary of archaeological zone Innwa and Tha Bye Dan Fortress.

To deliver the threat matrix for CHIA value in this project area, there are three portions of matrix such as Matrix I is CHIA ***Threat*** Matrix; Matrix II is ***Severity*** Matrix; and Matrix III is ***Acceptability*** of Impact Assessment. Then, each matrix measurement will be described as *Planning, Construction, Operation* and *Decommissioning.*

Matrix I CHIA Threat Matrix

In Matrix I, the planning stage was not including because CHIA work was invited after planning stage was over. The construction stage was also partially done before inviting to CHIA. The recent situation of the project area can still be seen as the waiting for the construction process. Here, the significance of archaeological and cultural attributes is in very high value with the references of literature and field information. The indirect impact can

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reversely be measured as the deterioration of cultural environment related to Tha Bye Dan and Innwa City Wall. The operation stage concerning the oil spilling and heavy tankers impacts on the ancient cultural heritage landscape of Innwa Period (14th century AD) and Konbaung Period (18th -19th century AD). In fact, the threat of mine site is ***Very High*** and time duration and extent are measured as ***Moderate.***

Matrix 1	HIA Threat Matrix				
Work/Esisting Vulnerabilities	Attribute (s) affected	Contribution to significance	Type of Impact	Duration of Impact	Spatial Extent of Impact
Planning Stage					
Construction Stage Oil Storage Tanks, RC buildings Complex, Concrete poles, Retaining Wall and Jetty, Public Toilets, Septic Tank, Fence, Car Park, Power cables	Archaeological Sites, monuments and cultural landscape	Very High	visual indirect cumulative residual	irreversible	Limited
Operational Stage Transportation, Discharging Waste, Jetty	Archaeological Sites, monuments and cultural landscape	Very High	visual indirect cumulative residual	irreversible	Limited
Decommissioning Stage Maintenance, Pollutants, Extension,	Archaeological Sites, monuments and cultural landscape	Very High	residual	irreversible	Limited

Significance of Cultural Heritage Value	Very High
Type of Impact+ Duration of Impact +Range	moderate
Degree of Impact	moderate
Acceptablity of Impact Assessment	Acceptable with Mitigation

Matrix II Severity Impact

In this Matrix II, the severity impact was measured with the degree of these following items; type of impact, duration of impact and range of impact. Measuring these three situations measured in mine site, the severity impact is ***moderate severity*** and depending on the very high degree of cultural significance in this area. Matrix II shows the ***moderate severity*** and ***very high value*** of the significance of cultural heritage value units.

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Matrix 2	Severity Impact					
Value of Heritage Asset	Severity of Impact (Type+Duration+Range)					
		Neutral	Minimal	Moderate (Severity Impact)	Large	Very Large
	Very High (Cultural Heritage Value) (OST Project)	Minimal	Moderate	Moderate (OST Project)	High	Very High
	High	Minimal	Moderate	Moderate	High	High
	Medium	Minimal	Minimal	Moderate	Moderate	Moderate
	Low	Minimal	Minimal	Minimal	Moderate	Moderate

Matrix III Acceptability of Impact Assessment

In this Matrix III, project area can be ***acceptable with mitigation*** with the references of the following information; the degree of cultural significance is *very high value*; the type of impact is direct and the severity is *moderate*. According to the Matrix III, the moderate impact can be acceptable but **mitigation** must be needed.

Matrix 3	Acceptability of Impact Assessment					
Value of Heritage Asset	Degree of Impacts					
		Neutral Impact	Minimal Impact	Moderate (Severity Impact)	High Impact	Very High Impact
	Very High (Cultural Heritage Value) (OST Project)	Acceptable	Acceptable with Mitigation	Acceptable with Mitigation (OST Project)	Unacceptable	Unacceptable
	High Value	Acceptable	Acceptable with Mitigation	Acceptable with Mitigation	Unacceptable	Unacceptable
	Medium Value	Acceptable	Acceptable	Acceptable with Mitigation	Acceptable with Mitigation	Acceptable with Mitigation
	Low Value	Acceptable	Acceptable	Acceptable	Acceptable with Mitigation	Acceptable with Mitigation

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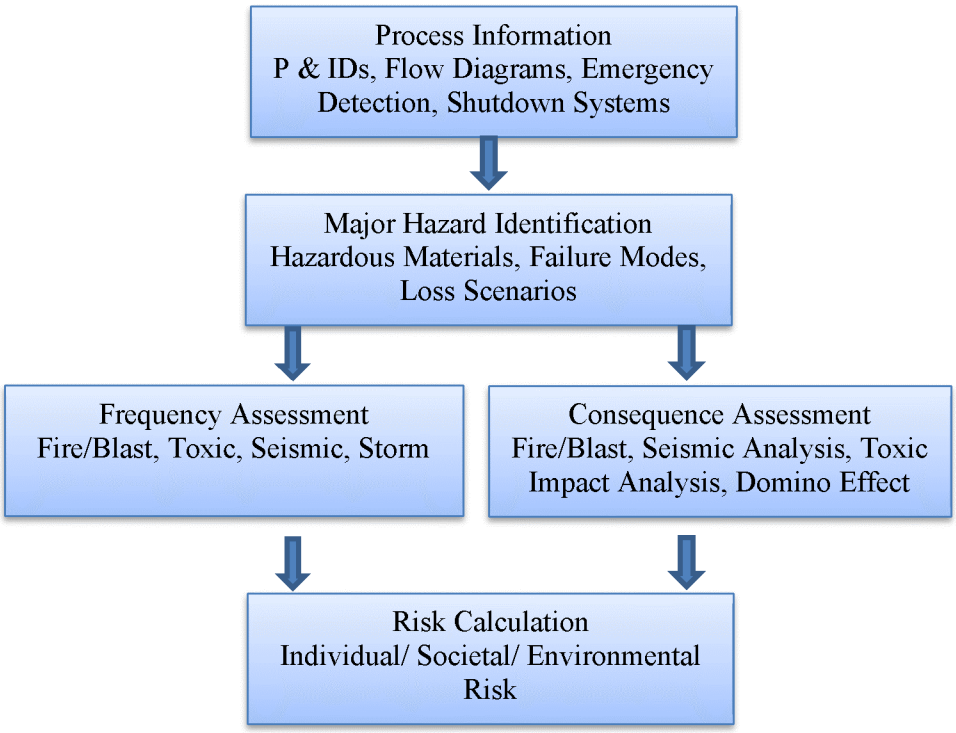
6.8. Methodology for Risk Assessment

Risk assessment for a hydrocarbon storage tank terminal were required due consideration of process and non-process hazards.

Risk Assessment Flow Diagram

The following is the flow chart for risk assessment procedure.



Risk Calculation

Risk due to hazards at a storage tank terminal and its surroundings is composed of summation of all risks given no escalation (i.e. no domino effects) of undesired events and all risks given an escalation (i.e. domino effects) of undesired events:

$$Risk = \Sigma\ Risk\ |No\ Escalation + \Sigma Risk\ |Escalation$$

Tolerability of Environmental Risk (Category Definitions) – Loss of Containment

Category	Definitions	
6	Catastrophic	- Major airborne release with serious off-site effects - Site shutdown - Serious contamination of ground water or water course with extensive loss of aquatic life

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5	Major	- Serious toxic effect on beneficial or protected species - Widespread but not persistent damage to land - Evacuation of local populace - Temporary disabling and hospitalization - Serious toxic effect on beneficial or protected species - Widespread but not persistent damage to land - Significant fish kill over 5-mile range
4	Serve	- Hospital treatment required - Public warning and off-site emergency plan invoked - Hazardous substance releases into water course with 1/2-mile effect
3	Significant	- Severe and sustained nuisance, e.g. strong offensive odors or noise disturbance - Major breach of permitted emissions limits with possibility of prosecution - Numerous public complaint
2	Noticeable	- Noticeable nuisance off-site, e.g. discernible odors - Minor breach of permitted emission limits, but no environmental harm - One or two complaints from the public
1	Minor	- Nuisance on site only (no off-site effects) - No outside complaint.

UK HSE, "Safety and environmental standards for fuel storage sites", Process Safety Leadership Group, 2009. Environment Agency for England and Wales, "Integrated Pollution Prevention and Control (IPPC) Environmental Assessment and Appraisal of BAT", July 2003

Tolerability Criteria of Environmental Risk

Category	Definition	Acceptable if frequency less than	Acceptable if reduced as low as is reasonably practical and frequency between	Unacceptable if frequency above
6	Catastrophic	1.0E-06 per year	1.0E-04 to 1.0E-06 per year	1.0E-04 per year
5	Major	1.0E-06 per year	1.0E-04 to 1.0E-06 per year	1.0E-04 per year
4	Serve	1.0E-06 per year	1.0E-04 to 1.0E-06 per year	1.0E-02 per year
3	Significant	1.0E-04 per year	1.0E-04 to 1.0E-06 per year	1.0E-01 per year
2	Noticeable	1.0E-02 per year	~1.0E+01 to 1.0E-02 per year	~1.0E+01 per year
1	Minor	All shown as acceptable	-	-

A comprehensive, holistic approach will be done for determining risk in and around the hydrocarbon storage tank terminal accounting for domino effects.

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6.9. Anticipated Impacts and Mitigation Measures

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic environmental system that can be attributed to human activities. Environmental impacts for the proposed oil storage facilities will include in all different phases of the project. To cover the environmental impacts in the entire life of the project, it is necessary to conduct impact assessment for four major phases as follow:

(a) Phase I: Pre-construction Phase (during the pre-construction period),
(b) Phase II: Construction Phase (during the construction period),
(c) Phase III: Operation Phase (during the operation period), and
(d) Phase IV: Decommissioning Phase (after the operation period).

The impact assessment will identify all of the potential positive and negative impacts (both biophysical and social) associated with the proposed project.

6.9.1. Anticipated Impacts during Pre-construction Phase

Pre-construction activities will involve site clearing and ground leveling. Site clearing will include some tree cutting and minor earth working activities. Ground leveling will include sand filling activity. The duration of pre-construction period will be about 2 months. The following table shows the number of vehicles used in the pre-construction phase.

No.	Pre-construction Activities	Types of Vehicles	Quantity	Duration
1	Site/ land clearing	Dozer (1)	1	15 days
		Workers	10	15 days
2	earth working	Truck (3)	3	45 days
		Workers	20	45 days
Total				60 days

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Site before Pre-construction State

As there will have no big trees to cut down within the project site, small area for site clearing and short time, the anticipated impacts during pre-construction phase will be not significant. Some of the impacts related to the above pre-construction activities will be as follow:

(a) Impacts on Air Environment;
(b) Impacts on Water Environment;
(c) Impacts on Soil and Ground Water Environment;
(d) Impacts on Biodiversity Environment;
(e) Impacts on Socio-economic;
(f) Impacts on Cultural and Heritage; and
(g) Impacts on Community Health.

6.9.1.1. Anticipated Impacts on Air Environment during Pre-construction Phase

The major impacts on air quality during the pre-construction phase will be fugitive dust generation, vehicular emissions and increased in noise level due to the site clearing and sand filling activities.

(a) Fugitive Dust Generation (Particulate Matter Emission)

During pre-construction phase, the main source of air pollution will be dust generation (PM) due to the movement of dozer and trucks for site clearing and ground levelling activities. The nearest receptor was located about 250 m south of the project site and found no significant impacts on the receptor as the minor operations will carry out in this phase. However, short-term impacts will be experienced by the workers, pedestrians passing along the Oh Htoke Tan Road near the project site.

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(b) Vehicular Emissions

The gaseous emissions such as CO_2, CO, NO_x and SO_2 were emitted during the operation of vehicles and machineries during the pre-construction phase including both on-site and the public.

(c) Increased in Noise Level

Site clearing and earth working vehicle (1 dozer) and delivery vehicles (3 trucks) traveling to and from the site produced noise which will increase existing noise level in pre-construction phase. All of the calculation of predicted noise level during pre-construction phase will be based on Patrick Breysse, and Peter S.J. Lees., School of Public Health, Johns Hopkins University, Bloomberg, 2006. The required data for calculation of the noise levels will be used typical construction equipments prepared by "Handbook of Noise Control" as follow:

Typical Construction Equipment Noise Emission Levels

Equipment Type	Noise Level (dBA at 50 Feet)
Dozer	87
Truck (Medium and Heavy)	84

Source: Harris, C.M. "Handbook of Noise Control," McGraw Hill, New York, 1979

The predicted noise level at nearest residents can be calculated by the addition of existing noise level and additional noise from pre-construction phase. Based upon a 6-dBA drop-off rate per doubling of distance, the existing noise level from the project and predicted noise level at nearest receptors are as follow:

Predicted Noise Levels during Pre-construction Phase

Receptors and distances from project	Existing noise levels monitored by integrated noise level meter (dBA)		Calculated noise level at site (dBA)		Reduced noise level at receptors due to Distance (dBA)	Predicted cumulative noise level at receptors (dBA)		Allowable noised level (existing noised level + 3dBA) (dBA)	
	Day Time	Night Time	Day Time	Night Time		Day Time	Night Time	Day Time	Night Time
Latt Yway (20.8 km)	50.7	43.4	85.2	-	50.4	53.5	43.4	53.7	46.4
Tet Gyi (31.15 km)	51.6	44.1			47.3	52.9	44.1	54.6	47.1

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According to the above table, there is no impacts of noise on nearest residents (Latt Yway and Tet Gyi Villages) and all of the predicted noise levels during day time and night time are lower than the allowable limit (existing noise level plus 3dB). Although all of the predicted noise levels are based on calculations and the actual noise level may a little change due to the affect of other factors (seasonal wind direction and wind speed), these changes will not affect local residents.

Significant of Impacts on Air Environment during Pre-construction Phase

The nature of impact on air quality during pre-construction phase will not be significance due to minor earth working activities and pre-construction period as follow:

Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Fugitive dust generation	Site clearing and ground levelling	Negative (-)	Limited (-2)	Very Short term (-1)	Very Low (-1)	Very Often (-4)	Highly Probable (-4)	Low (-32)
Vehicular emission	Site clearing and ground levelling	Negative (-)	Local (-3)	Very Short term (-1)	Very Low (-1)	Very Often (-4)	Highly Probable (-4)	Low (-40)
Noise	Noise from dozer and trucks	Negative (-)	Limited (-2)	Very Short term (-1)	Very Low (-1)	Very Often (-4)	Highly Probable (-4)	Low (-32)

Consideration of Mitigation Requirement for Air Environment

The intensity of mitigation required for air environment according to the consideration of impact evaluation and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation required considered by EIA team	Intensity of Mitigation Required	Responsibility
1.	Fugitive Dust Generation	Low (-32)	No	Yes	Minor	MESDP (or) Pre-construction service provider(s)
2.	Vehicular Emission	Low (-40)	No	Yes	Minor	MESDP (or) Pre-construction service provider(s)
3.	Noise	Low (-32)	No	Yes	Minor	MESDP (or) Pre-construction service provider(s)

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Mitigation Measures for Impacts on Air Environment

MESDP will do (or) will make sure pre-construction service provider(s) to reduce impacts on air quality during pre-construction phase as follow:

(a) Mitigation Measures for Dust Generation

Due to the minor mitigation requirement, dust will be countered by sprinkling of water during pre-construction phase. It is also the most cost-effective dust suppressant. Water will be used from Myit Nge River beside the site. Ground water will not use for this purpose. Water will be sprayed by using handheld spray as for small workplace.

(b) Mitigation Measures for Vehicular Emission

Due to the minor mitigation requirement on vehicular emission, there will require a plan to reduce in loading and unloading time and plan to reduce in idle time during working hours. Vehicles used during pre-construction phase will avoid local traffic time. Moreover, MESDP will put pressure to pre-construction services provider(s) to use good engines and low sulphur content fuel oil to reduce gaseous emission.

(c) Mitigation Measures for Noise

According to the requirement of minor mitigation measures for noise during pre-construction phase and the nature noisy environment (near the public road), the following mitigation measures will do:

- Avoid the operation of noisy equipment and machineries unless they are necessary and the use at the same time, and
- Avoid working at night.

Residual Impacts on Air Envrionment during Pre-construction Phase

After proper mitigation measures, there will no residual impacts on air environment during pre-construction phase due to low impact rating.

6.9.1.2. Impacts on Surface Water Environment during Pre-construction Phase

During pre-construction phase, impacts on surface water environment will be temporary water pollution in Myit Nga River due to earth working activities (soil erosion and sedimentation). The mobilization and transport of soil particles may, in turn, result in

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sedimentation of surface drainage networks, which may result in impacts to the water quality. In addition, improper handling of fuel oil and lubricants may constitute a risk for pollution of surface water. Site clearing activity for construction of jetty will also cause temporary water pollution in Ayarwadi River.

Significant of Surface Water Pollution during Pre-construction Phase

Impact on nearby surface water bodies, Ayarwadi and Myit Nge Rivers will be low probability and not significant due to the amount of work in pre-construction phase as follow:

Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Increase in turbidity, oil and grease in Myite Nga and Ayarwaddy Rivers	Site preparation activities (including Jetty)	Negative (-)	Limited (-2)	Very Short term (-1)	Medium (-4)	Rare (-1)	Seldom (-2)	Very Low (-21)

6.9.2.2. Consideration of Mitigation Requirement for Surface Water Environment

The intensity of mitigation measures for surface water environment according to the consideration of impact evaluation and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern during Public Consultation	Mitigation Requirement by Impact Evaluation	Intensity of Mitigation	Responsibility
1.	Increase in turbidity, oil and grease in Myite Nga and Ayarwaddy	Very Low (-21)	No	Yes	Minor	MESDP (or) Pre-construction service provider(s)

Mitigation Measures for Impacts on Surface Water Quality

MESDP will do or will ensure pre-construction service provider(s) to do the following mitigation measures to protect the surface water quality during the pre-construction phases of the proposed project.

No	**Construction Activities**	**Mitigation Measures**
1.	Earth Working	- Avoid/limit earth working and excavation during monsoon season.
2.	Stacking and	- All stacking and loading areas will be provided with proper drains to

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	Loading Areas	prevent run off from the site to enter any water body.
3.	Waste Water from the Site	- Waste water channels from the site will be connected to septic tank during pre-construction to prevent wastewater from entering the nearest water bodies.
4.	Leakage of Oil and Lubricants	- Avoid any leakage of oil and lubricant from vehicles and machineries used in pre-construction phase

Moreover, the following prevention measures will also do to reduce surface water pollution during pre-construction phase.

(a) Limit unnecessary earthworks;
(b) Prevent over-excavation;
(c) Working in a small area at a point of time (phase wise construction);
(d) Temporary sedimentation pond on the waterway to Myit Nga River at site; and
(e) Vegetation of bare areas after the pre-construction state.

Residual Impacts on Water Envrionment during Pre-construction Phase

After proper mitigation measures, there will no residual impacts on water environment during pre-construction phase due to low impact rating.

6.9.1.3. Impacts on Soil and Ground Water Environment

Impacts on soil and ground water environment during pre-construction phase will include the followings:

(a) Impacts of Soil Quality

A small amount of domestic wastes will be produced from pre-construction workers. Moreover, some biomass- unsuitable soil materials-were generated from site clearing and tree cutting (bushes and small trees) activities during pre-construction phase. All of these solid wastes will have more or less impact on soil and ground water quality.

(b) Impacts on Ground Water Quality

Impact on ground water was very little or negligible because of the nature and duration of pre-construction activities and if pre-construction will not conduct in rainy season. Therefore, no specific mitigation measure is required for ground water pollution during pre-construction phase.

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Significant of Impacts on Soil and Ground Water Environments

Domestic wastes from pre-construction workers will be minimal due to the small number of workforce (about 30 people). Amount of scrub produced will also be negligible because the site small are to clear and there will very small number of trees to fell down (small trees). Moreover, according to the soil quality monitoring and geological investigation, soil type within the project are is not contained toxic mineral composition and not environmentally sensitive soil type (sandy soil). So, impacts on soil and ground water environment during pre-construction phase will be very low as shown in the following table.

Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Soil contamination	Domestic wastes and unusable materials in soil	Negative (-)	Site (-1)	Short term (-2)	Low (-2)	Rare (-1)	Seldom (-2)	Very Low (-15)
Ground water pollution	Domestic wastes and unusable materials in soil	Negative (-)	Local (-3)	Short term (-2)	Low (-2)	Rare (-1)	Very Seldom (-1)	Very Low (-14)

Consideration of Mitigation Requirement for Soil and Ground Water Environment during Pre-construction Phase

The intensity requirement of mitigation measures for soil and ground water environment according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern during Public Consultation	Mitigation Requirement by Impact Evaluation	Mitigation Scale	Responsibility
1.	Soil contamination	Very Low (-15)	No	Yes	Minor	MESDP (or) Pre-construction service provider(s)
2.	Ground water pollution	Very Low (-14)	No	Yes	Minor	MESDP (or) Pre-construction service provider(s)

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Mitigation Measures for Impact on Soil and Ground Water Environments during Pre-construction Phase

According to the need of the minor mitigation measures, all of the solid wastes produced from pre-construction phase will systematically dispose according to the rules and regulations of MCDC. Accordingly, MESDP (or) pre-construction services provider(s) will follow MCDC rules and regulations for solid waste management during the preconstruction phase. Moreover, MESDP will take special care on handling of diesel and lubricants to avoid leakage.

Residual Impacts on Soil and Ground Water Envrionment during Pre-construction Phase

After proper mitigation measures, there will no residual impacts on soil and ground water environment during pre-construction phase due to low impact rating and short time.

6.9.1.4. Anticipated Impacts on Biodiversity Environment during pre-construction phase

Anticipated Impacts on biodiversity environment during pre-construction phase will be as follows:

(a) Impacts on Flora Diversity

There will not too much tree cutting inside the project site because the project site is located in the river banks and no big tree was found.

(b) Impacts on Fauna Diversity

Increase in noise during pre-construction phase may affect the feeding, breeding and movement of wildlife in near area.

Significant of Impacts on Biodiversity Environment during Pre-construction Phase

It can considered that pre-construction phase of proposed project will not have significant negative impact on biodiversity environment as follow:

(a) Impact Significance on Flora Diversity

A total of (50) flora species including tree and vegetation, trees are observed in surrounding area. Most flora species around the project site are herbs, shrubs, grass and climbers. Tree

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species are mosly fecence plants and rode side plants. Among them, Delonix regia (Bojere ex Hook)Raf., Caesalpiniaceae, (Sein-ban in Myanmar) is formely assessed as VU (Vulnearble), high risk of endangerment in the wild, in the IUCN Red List (2013). But, in (2014) it was changed to LC (Least concern- lowest risk) and reason for change is (N), non genious status change, (i.e status change due to new information, improved knowledge of criteria, incorrect data used previously, taxonomic revision, etc). Red List version was (2014.1). So, no endangered species from IUCN red list were identified in the direct impact zone and impact significance will be very low due to short period of pre-construcion phase.

(b) Impact Significance on Fauna Diversity

In fauna (54) species comprises of (17) amphibian and reptile, (8) species of birds, (19) species of fish, one species of dragonfly and two species of benthos and 6 species of zooplankton are recorded during the survey. According to the impact assessment on fauna diversity, no endangered species were determined on the project site. So, pre-construction activities will not siginificant or very low impact on fauna diversity.

Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Impacts on Flora Diversity	Nosie and tree cutting	Negative (-)	Site (-1)	Long term (-4)	Very Low (-1)	Rare (-1)	Seldom (-2)	Very Low (-18)
Impacts on Fauna Diversity	Nosie, muddy water and tree cutting	Negative (-)	Limited (-2)	Very Short term (-1)	Very Low (-1)	Very Often (-4)	Seldom (-2)	Very Low (-24)

Consideration of Mitigation Requirement for Biodiversity Environment during Pre-construction Phase

The requirement of mitigation measures for biodiversity environment according to the consideration of impact evaluation and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern during Public Consultation	Mitigation Requirement by Impact Evaluation	Intensity of Mitigation	Responsibility
1.	Impacts on Flora Diversity	Very Low (-18)	No	Yes	Minor	MESDP (or) Pre-construction service provider(s)
2.	Impacts on Fauna Diversity	Very Low (-24)	No	Yes	Minor	MESDP (or) Pre-construction service provider(s)

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Mitigation Measures for Impacts on Biodiversity Environment

According to the consideration of intensity of mitigation measures (minor scale), it is just necessary to avoid tree cutting of road side plants and fence plants and avoid working at night for fauna species. So, MESDP will do or will force pre-construction service provider(s) to avoid tree cutting as much as possible at project site and no tree cutting beside the road. MESDP also avoid working at night during pre-construction phase

Residual Impacts on Biodiversity Envrionment during Pre-construction Phase

After proper mitigation measures, there will have residual impact due to tree cutting because replantation will need some time to grow up. Replantation more trees will compensate this residual impact.

6.9.1.5. Impacts on Socio-economic during Pre-construction Phase

Impacts on socio-economic during pre-construciton phase will be both positive and negative as follow:

(a) Positive Socio-economic Impacts

The positive socio-economic impact during pre-construction will be job creation. The proposed project will provide temporary employment opportunities (30 workers) for local people during pre-construction period (about 2 months).

(b) Negative Socio-economic Impacts

The negative socio-economic impacts during pre-construction phase will be blockage of drainage system due to the land filling at project site. The blockage of natural drainage system will increase potential to flood in nearest villages (Latt Yway and Tatt Gyi Villages). There will no relocation or resettlement of local people because the project site is close to river bank and no local people lived in there.

Significant of Impacts on Socio-economic Enivronment during Pre-construction Phase

(a) Job Creation without Enhancement Measures

Job creation during pre-construction phase can be considered as very low without enhamcement measures due to the small number of workforce (about 30 people) and operators for dozar and truck will mainly outsourced from other places.

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Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Potential to Increase in household income	Jobs opportunities in pre-construction site	Positive (+)	Limited (+2)	Very Short term (+1)	Low (+2)	Regular (+3)	Seldom (+2)	Very Low (+25)

Enhancement Measures for Job Creation

Although this kind of positive impact will not benefit to local people in nearest villages, MESDP will make agreement with pre-construction contractor and sub-contractor to use local labor force as part of tender requirement.

Impact Significance of Job Creation after Enhancement Measures

The impact will rise into very low to low after enhancement actions as follow:

Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Reduce jobless people	Job creation	Positive (+)	Local (+2)	Very Short term (+1)	Low (+2)	Regular (+3)	Probable (+3)	Low (+30)

(b) Blockage of Drainage System without Mitigation Measures

According to the site survey, there will potential to blockage of two drainage system during earth filling in pre-construction phase as shown in the following figure.

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Drainage System before the Earth Filling Activities

Southern part of the project area has two creeks, and these creeks flows south to north direction and join to the southern part of the project area before flow into the Myit Nge River. End of the pass creek place is slightly high within the project area. In the rainy season and tidal wave period, if rain water is peak it will be affect few flood situations.

Historical imagery analytical results and outcomes from interview with local senior residences indicated that two creeks of surface water was passed through inside the project site and flowed to the Myint Nge River at points of 1, 2 and 3 in Fugure 6.1 and 6. 2. In existing condition the surface water of two creeks was cobine and joined to the Myint Nge River at points of 3 in Figure 6-3. Any moderate to minor changes of existing components of water balance (inflows and outflows of the system) by pre-construction activities will have negatively influence especially on function and characteristic of waterways, drainage and sub watershed as proposed project is being located in low lying flat plain. Construction of road

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access will somehow interfere with flow pattern of creeks and thereof it has high potential to have waterways blockage.

Potential changes in hydrological regimes of creeks due to waterways blockages by proposed project activities will have negative impact not only on flowing characteristic along the longitudinal profile of creeks but also on surface water volume area of creeks. The monsoon period when agricultural work starts, degree of negative effect on drainage system of paddy field is expected to be low in terms of physical environment. Nevertheless significance of negative impact will turn from low to high; if waterways blockage persists till the agricultural activities in nearest paddy fields has begun. Review on outcomes of public stake holder meetings and focus group discussion reveal that Latt Yway village area is likely to have flooding effect resulting from existing creek is essential to be utilized as drainage facilities to discharge the harvested rain water from neighboring paddy fields in the rainy season and tidal wave period.



Flood in Farm Lands in Rainy Seasons

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Figure 6.1. Surface Water Drainage Condition of Project Area in 2002

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Figure 6.2. Surface Water Drainage Condition of Project Area in 2010

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Figure 6.3. Current Surface Water Drainage Condition of Project Area

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This kind of impact can be considered as medium to high due to the possibility of flash flood in nearest farm lands as shown in the following figure.

Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Potential to Blockage of drainage system	Earth filling	Negative (-)	Limited (-2)	Permanent (-5)	High (-5)	Regular (-3)	Highly Probable (-4)	Medium to High (-84)

Potential cumulative effects can be considered as the enlargement of water catchment area from the southern part of the proposed project area is shown in Figure 6.3. The landfill area and Great Wall Co. Ltd, near the southern part of the proposed project, there is large area of land functioning as storage of inundated water and runoff water during period of inundation and raining. If both rainfall and high tide happen in the same period, flow that enters from southern part of landfill area will probably meet inundated water flow, though the man-made channel, near the Tada-U Road boundary and formation of larger and wider mouth of the enlargement water can be flood situations. Interview with the local people reveals that flood situations area is characterized by the inundation and flood height is approximately 4 feet from ground surface of the Latt Yway village in raining season.

Mitigation Measures for Impacts of Blockage of Drainage

MESDP will use alternative waterway (manmade drainage system that can drain the large water volume to the Myit Nge River) to avoid potential to flood due to the blockage of natural drainage system during pre-construction phase. The alternative water way will prepare to flow the water volume more than natural drainage system to reduce potential to flood.

Residual Impacts on Socio-economic Environment during Pre-construction Phase

After proper mitigation measures, there will no residual impacts on socio-economic environment during pre-construction phase.

6.9.2. Anticipated Impacts and Mitigation Measures during Construction Phase

Construction of proposed project will include (1) foundation works for steel structures and concrete buildings, (2) construcitons of storage tanks and concrete buildings, and (3)

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constructions of intrnal road and drainage system. The construction phase is expected to be about two year. The major activities during construction phase will include:

(a) Vehicular movement,
(b) Loading and unloading construction materials and plant machineries,
(c) On site storage of construciton materials and plant machineries,
(d) Erection of storage tanks and steel structures,
(e) Connection of power supply system,
(f) Maintenance of construction machinery, and
(g) Disposal of solid wastes from both construction site and workers etc.

According to the above activities, construction of proposed project can potentially affect the natural environment and local communities. Moreover, construction activities will be disturbed to wildlife. The following construction operations and considerations, which could have a particularly significant impact, have been included in the assessment of disruption due to construction:

(a) The scale of earth movements;
(b) The storage and treatment of surplus material before removal;
(c) The likelihood of night-time working;
(d) Number, type and routes of vehicle movements;
(e) Storage and re-use of materials;
(f) Duration and nature of construction activities;
(g) Advance works by utilities if required;
(h) Materials logistics such as origin of materials and routes to site;
(i) Quantities of materials required and an estimate on quantities to be discarded;
(j) Identification of wastes that will be generated including sources; and
(k) The likelihood of contaminants being encountered.

Some of the impacts related to construction of the proposed project are as follow:

(a) Impacts on Air Environment;
(b) Impacts on Water Environment;
(c) Impacts on Soil and Ground Water Environment;
(d) Impacts on Biodiversity Environment; and
(e) Impacts on Socio-economic Environment.

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Construction related impacts (noise, fugitive dust emission and traffic) were not significantly affect people in places of nearest residents. However, these impacts will affect on people in workplace, cyclists, pedestrians and vehicle travelers along the access road because the construction site is close to public road.

6.9.2.1. Impacts on Air Environment during Construction Phase

Impacts on air quality during construction phase will be as follow:

(a) Fugitive dust generation from transportation of construction materials and construction activities,
(b) Vehicular emissions related to the transportation of personnel and construction materials,
(c) PMs and gaseours emission from cutting and welding of steel structure, and
(d) Noise from construction activities

(a) Fugitive Dust Generation

Particulate matter (PMs) were released from transportation of construction materials and construction activities such as during excavation, movement of earth materials, unloading and mixing of construction materials, contact of construction machinery with bare soil, traffic movement on unpaved roads, transport of demolition waste, and exposure of bare soil and soil piles to wind. The construction emissions associated with the site were intermittent and temporary. Although construction is not a long time, construction activities could affect particularly in dry season.

(b) Vehicular Emissions

Some gases such as carbon monoxide (CO), nitrogen oxides (NOx), sulfur oxides (SOx), particulate matter (PM) and volatile organic compounds (VOCs) were emitted from the operation of generator, concrete mixer, vehicles and construction machineries into the atmosphere during the construction phase (including both on-site and the public roads). Air emissions are expected to be limited due to the short duration and scope of construction operations. The impact is negative, direct, temporary, intermittent, reversible, localized and short-term.

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(c) PMs and Gaseours Emission from Cutting and Welding of Steel Structures

Particulate matter, nitrogen oxides and carbon dioxide will be generated from cutting and welding of higher volume of steel structure. Gases are generated due to the high temperature and ultraviolet (UV) radiation from the arc. The main components of welding emissions are oxides of metals due to contact between the oxygen in the air and the vaporized metals. Common chemical hazards include particulates (lead, nickel, zinc, iron oxide, copper, cadmium, fluorides, manganese, and chromium) and gases (carbon monoxide, oxides of nitrogen, and ozone).

(d) Increased in Noise Level

For the proposed project, the major noise generating sources during the construction phase will be caused by the operation of pile drivers, earth moving and excavation equipments, generators, concrete mixers, as well as welding and grinding. The increased noise level can impact construction workers and should correct mitigation measures not be implemented, and can become a nuisance to the public and sensitive receptors in the area.

If most of the construction machineries (concrete mixer, generator, truck etc.) are running at the same time, this cumulative noise level can increase to 99.7 dB(A) at 15 m (about 50 feet) distance as follow:

$$Leq = SPL_{site} = 10\log\left(\frac{10^{8.4} + 10^{8.5} + 10^{9.6} + 10^{7.4} + 10^{9.9} + 10^{8.5}}{6}\right)$$

$$= 99.7\text{dBA}$$

Typical Construction Equipment Noise Emission Levels

Equipment Type	Noise Level (dBA at 50 Feet)
Concrete Mixer	<85
Truck (Medium and Heavy)	84
Pile drivers (hydraulic press piling)	96
Welding	74
Grinding	98
Generator	81

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Source: EPA, 1 971; "Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances". NTID 300.1

The predicted noise level at nearest villages during construction phase can be predicted as follow:

Predicted Noise Levels during Construction Phase

Receptors and distances from project	Existing noise levels monitored by integrated noise level meter (dBA)		Calculated noise level at site (dBA)		Reduced noise level at receptors due to Distance (dBA)	Predicted cumulative noise level at receptors (dBA)		Allowable noised level (existing noised level + 3dBA) (dBA)	
	Day Time	Night Time	Day Time	Night Time		Day Time	Night Time	Day Time	Night Time
Latt Yway AN2 0.8 km	50.7	43.4	99.7	-	64.4	64.6	43.4	53.7	46.4
TetGyi AN3 1.15 km	51.6	44.1			61.3	61.7	44.1	54.6	47.1

According to the above table, there will be impacts of noise on nearest residents (Residents in Latt Yway and Tet Gyi Vilages) and all of the predicted noise levels during day time are relatively higher than the allowable limit (existing noise level plus 3dB). Moreover, nosie will also impact on travelers who travel along the Oh Htoke Tan Road. Although all of the predicted noise levels are based on calculations and the actual noise level may a little change due to the other factors (seasonal wind direction and wind speed), these changes will not affect local residents.

Significant of Impacts on Air Environment during Construction Phase

Impacts on air environment during construction phase will be little significant because of the use of heavy construction machineries (pilling machine, crane, backhoe etc.). Most of the brickwork and steel structure work will be carried out by human activities.

Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Fugitive dust emission	Construction activities	Negative (-)	Site (-1)	Very Short term (-1)	Low (-2)	Very Often (-4)	Probable (-3)	Very Low (-28)
Vehicular emission	Construction activities	Negative (-)	Site (-1)	Very Short term (-1)	Very Low (-1)	Very Often (-4)	Highly Probable (-4)	Very Low (-24)

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Noise	Noise from construction equipment	Negative (-)	Limited (-2)	Very Short term (-1)	Medium (-4)	Very Often (-4)	Highly Probable (-4)	Low to Medium (-56)
PMs and Welding fumes	Cutting and welding of steel structure	Negative (-)	Limited (-2)	Very Short term (-1)	Low (-2)	Very Often (-4)	Highly Probable (-4)	Low (-45)

Consideration of Mitigation Requirement for Air Environment during Construction Phase

The intensity of mitigation measures for air environment according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by Impact Evaluation	Mitigation Scale	Responsibility
1.	Dust generation	Very Low (-28)	No	Yes	Minor	MESDP (or) Construction service providers
2.	Gaseous emissions	Very Low (-24)	No	Yes	Minor	MESDP (or) Construction service providers
3.	Noise	Low to Medium (-56)	Yes	Yes	Minor to Moderate	MESDP (or) Construction service providers
4.	PM and welding fumes	Low (-45)	No	Yes	Minor	MESDP (or) Construction service providers

Mitigation Measures for Air Environment

MESDP will conduct or ensure construction service provider(s) the following mitigation measures for air environment during construction phase.

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(a) Mitigation Measures for Dust Generation

Like pre-construction phase, dust will be efficiently countered by sprinkling of water during construction phase for minor mitigation measures. Water can be sprayed by using handheld spray. The Safeguards during construction related to dust control will include:

- Minimizing dust from material handling sources by using covers or control equipment;
- Minimizing dust from open area sources, including storage piles by using enclosures or covers, or increasing moisture content;
- Use of dust suppression techniques such as applying water or non-toxic chemicals to minimize dust from vehicle movements Other mitigation measures include maintaining good housekeeping practices throughout the construction phase. These low cost measures include:
- Properly enclosing the site through use of appropriate hoarding and screening.
- Perform mixing and unloading operations of solid materials on-site (to minimize off-site impacts).
- Proper handling of cement material.
- Requiring and monitoring for minimal traffic speed on-site
- Covering the loads of all vehicles hauling materials likely to give off dust emissions.
- Ensuring adequate maintenance and repair of demolition and construction machinery and vehicles.
- Prohibiting burning of material for and resulting from site clearance.
- Covering excavated soils and demolition wastes with impervious sheeting.
- Ensuring the timely removal of demolition waste to an MCDC approved site for landfilling or reclamation and reuse.
- Applying water as a dust suppressant as needed.
- Identifying periods where site activities may create higher levels of dust (e.g. at times of demolition, heavy traffic or excavation) and planning accordingly to have adequate water supply available and implement dust suppression techniques to decrease emissions into the atmosphere and to ensure maximum efficiency, facility trucks and equipment will be inspected on a regular basis and have a regular maintenance schedule. Trucks and machinery will be turned off when not in use to reduce power consumption as well as the emission of pollutants.

Moreover, MESDP will do the following activities to control dust during construction phase are shown in the following table.

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Recommended Actions for Dust Control during Pre-construction Phase

Fugitive Dust Source Category	Dust Control Actions
Earth-moving	▪ For any earth moving which is more than 30 m from all property lines, conduct watering as necessary to prevent visible dust emissions from exceeding 100 cm in length in any direction. ▪ Physical barrier is required to install to prevent dust moving to the surrounding. ▪ Fascial mask need to be provided to the constricution workers during potentially dusty operations
Disturbed surface areas (except completed grading areas)	▪ Apply dust suppression in a sufficient quantity and frequency to maintain a stabilized surface; ▪ Areas, which cannot be stabilized, as evidenced by wind driven dust, must have an application of water at least twice per day to at least 80 percent of the unstabilized area. Damping down shall take place on a continual basis.
Disturbed surface areas (completed grading areas)	▪ Apply water to at least 80 percent of all inactive accessible disturbed surface areas on a daily basis when there is evidence of wind driven fugitive dust.
Inactive disturbed surface areas	▪ Apply dust suppressants in sufficient quantity and frequency to maintain a stabilized surface.
Unpaved roads	▪ Water all roads used for any vehicular traffic at least twice per day of active operation; or ▪ Water all roads used for any vehicular traffic once daily and restrict vehicle speed to 15 mph.
Track-out control	▪ Downwash of trucks (especially tyres) prior to departure from site.

(b) Minimizing of Gaseous Emissions

For minor mitigation requirement, certain mitigation measures will be adopted to limit atmospheric impacts to as great an extent as possible during construction phase. For instance, the transportation of personnel and materials will be scheduled such as to avoid periods of peak flow where congested conditions are more likely, and to reduce the overall number of vehicular movements. In addition to careful traffic management, close adherence to the recommended maintenance regime will be applied to both on-site and off-site vehicles.

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Improved Maintenance: Recognizing that significant emission reduction will be achieved through regular equipment maintenance.

Reduction of On-site Construction Time: Rapid on-site construction will reduce the duration of traffic interference and therefore, reduce emissions from traffic delay. Off-site fabrication of structural components can also enhance the quality of work, as the production takes place in controlled settings and external factors such as weather and traffic do not interfere.

Reduction and mitigation measures of emission from cutting and welding of steel structures: Using personal protective equipment is the least recommended control way. Improvement of working practices is of crucial importance to reduce the worker exposure. Proper training programs, housekeeping, maintenance, and doing task on time are the safe welding habits to reduce exposure. In addition, dilutin of emission by fresh air either in terms of natural or machenical ways can also reduce the exposure to contaminnats. However, dilution approach will not be useful if the worker is downstream of contaminant.

(c) Mitigation Measures for Noise

To reduce noise level during construction phase, MESDP will conduct or will ensure construction service provider(s) to the following:

- running construction machineries at the same time;
- using pressure pilling instead of percussion pilling;
- avoiding working at night.
- use of hearing protection actively when noise levels exceed 70dB(A).
- installing warning signs in areas of high noise levels.
- considering the use of acoustic insulating materials, isolation of the noise source, and other engineering controls to minimize noise impact.
- effectively utilizing material stockpiles and other structures, where feasible; to reduce noise from on-site construction activities.
- choosing inherently quiet equipment with mufflers.
- operating only well maintained mechanical equipment on-site and only operated it according to manufacturer's gratification.
- keeping equipment speed as low as possible.
- shutting down or throttling down to minimum equipment that may be intermittent in use, between work periods.

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- Restricting access to the site for truck traffic outside of normal working hours.
- Routing trucks away from noise sensitive areas where feasible
- Utilizing proper site logistics and planning.
- Scheduling noisy activities during the morning hours.
- Consulting with local communities prior to beginning work and inform the communities when especially noisy activities are planned.
- Developing grievance mechanism for communities to voice concerns over noise.
- Developing and implementing noise monitoring program.

Residual Impacts on Air Envrionment during Construction Phase

After proper mitigation measures, there will no residual impact on air environment during construction phase due to low impact rating.

6.9.2.2. Impacts on Surface Water Environment during Construction Phase

Potential construction-induced impacts to surface water quality will be soil erosion and sedimentation resulting from excavation and grading activities necessary for the construction of infrastructure during rainy seasons. Drainage and seepage from construction waste dumping site will have potential to surface water pollution. Mobilization and transport of soil particles due to construction activities may result in sedimentation of surface drainage networks, which may result in impacts to the water quality in Myit Nge River and Arrawadi River via drains. In addition, handling of fuel oil, other oil products, chemicals and lubricants may constitute a risk for pollution of surface water. It will be more evidence in rainy seasons (June to September). Waste generated from construction activity will also have potential to surface water pollution and will include construction debris and waste from construction workers.

(a) Construction Debris

Waste materials (pallets, packing crates, steel structure off-cuts, and waste concrete) will be generated during construction period. The unsuitable soil material from foundation preparation will also produce. All of the construction wastes will have potential to soil and water pollutions if they are not properly managed. Drainage and seepage from construction waste dumping site will have potential to surface water pollution.

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(b) Oil and Grease

Trucks and cars can leak fuel oil during transportation of construction materials and workers during construction phase. Moreover, lubricants and grease from construction machineries can also leak during construction phase. All of the fuel oil and lubricants can cause surface water pollution (increase in oil and grease content in Ayarwadi River) for a while.

(c) Domestic Wastes from Construction Workers

A few small amount of domestic waste will be generated from construction workforce (about 20 workers). The establishment of labour camps will also effect on environment through improper waste (solid & garbage /sewage) disposal.

Significant of Impacts on Surface Water Environment during Construction Phase

Impact on water environment during construction phase will not be significant due to the amount of wastewater produced during construction phase (the volume of nearest water bodies is very much greater than the volume of wastewater disposed by construction site) and the time of construction phase.

Anticipated Impacts	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Surface Water Pollution	Construction Debris	Negative (-)	Limited (-2)	Very Short term (-1)	Very Low (-1)	Very Often (-4)	Seldom (-2)	Very Low (-24)
	Oil and Lubricants	Negative (-)	Limited (-2)	Very Short term (-1)	Very Low (-1)	Very Often (-4)	Seldom (-2)	Very Low (-24)
	Domestic Wastes	Negative (-)	Limited (-2)	Very Short term (-1)	Very Low (-1)	Very Often (-4)	Very Seldom (-1)	Very Low (-20)

Consideration of Mitigation Requirement for Surface Water Environment during Construction Phase

The intensity of mitigation measures for surface water environment according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by Impact Evaluation	Required Mitigation Scale	Responsibility
1.	Construction Debris	Very Low (-24)	No	Yes	Minor	MESDP (or) Construction Service Providers

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2.	Oil and Grease	Very Low (-24)	No	Yes	Minor	MESDP (or) Construction Service Providers
3.	Domestic Wastes	Very Low (-20)	No	Yes	Minor	MESDP (or) Construction Service Providers

Mitigation Measures for Impacts on Surface Water Environment

According to the above impact identification and evaluation, there will need minor mitigation measures for impact on water environment during construction phase. Construction period should not start in rainy seasons. If construction will have to start in rainy seasons, it is necessary to contruct temporary settling pond inside the project compound. The following are the required mitigation measures for surface water quality during construction phase.

Mitigation Measures for Surface Water Pollution

No.	Construction Activities	Mitigation Measures
1.	Stacking and Loading Areas	- All stacking and loading areas should be provided with proper drains to prevent run off from the site to enter any water body.
2.	Waste Water from the Site	- Waste water channels from the site should be connected to septic tank during construction to prevent wastewater from entering the nearest water bodies.
3.	Leakage of Oil and Lubricants	- Avoid any leakage of oil and lubricant from vehicles and machineries used in construction phase.

Moreover, MESDP will do the following mitigation measures to reduce soil erosion and water pollution as follow.

(a) Working in a small area at a point of time (phase wise construction),
(b) Temporary sedimentation pond on the waterway to nearest river at construction site, and
(c) Vegetation of bare areas after the construction state.
(d) Using sediment controls, with special care taken during the rainy season. The erosion and sediment control measures to be implemented include:
(e) Minimize the time of exposure of any waste and erodible land exposed to stormwater runoff.

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(f) Use sediment controls when pumping rainwater from trenches or foundation excavations into storm drains and not directly to the aquatic environment.
(g) Minimize land clearing activities to those of required work areas.
(h) Cover open stockpiles of construction materials with tarpaulin or similar fabric during rainstorm events to prevent erosion and resultant sedimentation of receiving waters.
(i) Compact soil as soon as building foundations are formed to prevent erosion, especially during the wet season.
(j) Restore work areas as soon as possible once any construction is complete.
(k) Avoid construction works during the rainy season.
(l) Paving roads wherever possible.

Residual Impacts on Water Envrionment during Pre-construction Phase

After proper mitigation measures, there will no residual impacts on water environment during construction phase due to low impact rating.

6.9.2.3. Impacts on Soil and Ground Water Environment during Construction Phase

Impact of soil and groundwater environment during construction phase will be leakage of fuel oil, leakage of lubricants and disposal of wastes.

(a) Impact on Ground Water Quantity

The large numbers of piles (465 piles for one storage tank and total 14592 piles will be required for 32 tanks) during pilling process in construction activities will cause the reduction of groundwater flow and will impact the availability of groundwater at the nearest villages (Tite Kyi, Latt Yway and Bone Daw Naing Gan Village Tracts). Acoording to the calculation based on piling area, the total possible bloakage area for groundwater flow of the propesd project is 18 acres or 802125 square feet and also 47% of the whole project areas (38 acres).

(b) Impact on Soil and Ground Water Quality

Accidental Spills of Fuel Oil and Lubricants: Potential contamination of soil and groundwater during construction phase could possibly occur as a result of aaccidental spills of lubricants, oils, solvents and degreasers during construction can infiltrate and contaminate the soil. This can occur from poorly maintained or improperly operated on-site vehicles and construction equipment, as well as due to improper storage or handling of equipment or hazardous materials. Wastewater from repair shops and washing places contaminated with hydrocarbons (oil, lubricants and solvents) can enter the soil

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if spilled. Liquid contaminants that enter the soil can then percolate further and result in soil contamination and groundwater pollution.

Construction Debris and Domestic Wastes: During construction phase, construction debris such as packing materials and domestic wastes from construction workers will produce. There will have potential to soil contamination and ground water pollution if these solid wastes are not properly disposed. Moreover, seepage from construction waste dump site will also impact on soil and ground water qualities.

Impacts Significance on Soil and Ground Water Environment during Construciton Phase

Construction related impacts to soil and groundwater in project site will be as follow:

Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Soil and Ground Water Pollution	Piling	Negative (-)	Local (-3)	Long term (-4)	Medium (-3)	Regular (-3)	Possible (-3)	Low to Medium (-60)
	Leakage of fuel oil and lubricants	Negative (-)	Site (-1)	Short term (-2)	Very Low (-1)	Regular (-3)	Very Seldom (-1)	Very Low (-16)
	Construction debris and Domestic Wastes	Negative (-)	Limited (-2)	Short term (-2)	Very Low (-1)	Very Often (-4)	Very Seldom (-1)	Very Low (-25)

Consideration of Mitigation Requirement for Soil and Ground Water Quality

The requirement of mitigation measures for soil and ground water environment according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Pilling	Low to Medium (-60)	Yes	Yes	Sensible	MESDP (or) Construction Service Provider(s)
2.	Leakage of fuel oil and lubricants	Very Low (-16)	No	Yes	Minor	MESDP (or) Construction Service Provider(s)
2.	Construction debris and domestic wastes	Very Low (-25)	No	Yes	Minor	MESDP (or) Construction Service Provider(s)

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Mitigation Measures for Impacts on Soil and Ground Water Environment during Construction Phase

(a) Mitigation Measures for Ground Water Quantity

MEDPS will take resposibilty for the shortage of groundwater to the affected area (the nearest villages) by digging the new deep wells, tube well and supporting water requirement to those areas if they suffer the shortage of groundwater.

(b) The Mitigation Measure for Soil and Groundwater Quality

According to the above consideration for required mitigation measures, there will be minor mitigation measures such as disposed of solid wastes according to the rules and regulations of MCDC to reduce impacts of solid wastes during construction phase. Care should be taken not to leak during the handling of fuel oil and lubricants. All of the fuel tank and lubricants container have to store over concrete floor or impermeable pad. Machineries used in construction phase have to good conditions.

Construction wastes need to be transported in an orderly manner that ensures that no material escapes from the trucks during transport, and that the waste is then deposited in MCDC approved landfill locations to ensure that the surrounding environment does not become contaminated with the waste materials generated. Wherever possible, steel scraps, metals, and other construction wastes should be recovered for re-use, recycling and reclamation after the adequacy of the physical and chemical properties of such material is ascertained and the absence of contamination is ensured.

Domestic effluent will be collected and contained in septic tanks on site. The contents will be removed for disposal as and when necessary by an MCDC licensed contractor.

During the construction phase, there will be generation of debris as a result of various construction activities. An agreement will be drafted with solid waste collectors and schedule set for demolition and construction wastes to be delivered to an MCDC approved site appropriate for landfilling for:

- Contaminated and hazardous material,
- Non-hazardous material,
- Where feasible, for reclamation and reuse.

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The generated materials will also be used for reclamation purposes whenever applicable on site in the project. Sorting of construction wastes will be encouraged, as well as, adoption of a re-use/recycle program on site whenever deemed feasible.

Construction wastes will also be minimized through careful planning during the design stage, whereby reducing or eliminating over-ordering of construction materials to decrease waste generation and reduce project costs (cost of surplus materials).

Chemical wastes have to be generated including containers that were used for storage of chemical wastes on site, the chemical residue as well as contaminated material. These materials have to be segregated as hazardous and non-hazardous and properly labeled, stored and disposed of. Storage be located in a separate area that has an impermeable floor, adequate ventilation and a roof to prevent rainfall from entering.

In addition all chemical wastes must be clearly labeled in Myanmar, stored in corrosion resistant containers and arranged so that incompatible materials are adequately separated. There will be a prior agreement with the MCDC for the disposal of any hazardous waste generated.

General refuse generated during project activities will be stored in enclosed bins or compaction units separate from construction and chemical wastes. An agreement will be drafted with a solid waste collector certified by the MCDC to identify collection sites and schedule the removal to minimize odor, pest infestation and litter buildup. The burning of refuse on the construction site will be strictly prohibited and penalized. General refuse is generated largely by food service activities on site, so reusable rather than disposable dishware will be promoted if feasible. Aluminum cans will be recovered from the waste stream by individual collectors if they are segregated and made easily accessible, so separate, labeled bins for their storage should be provided if feasible.

Residual Impacts on Soil and Ground Water Envrionment during Construction Phase

After proper mitigation measures, there will no residual impacts on water environment during construction phase due to low impact rating.

6.9.2.4. Impacts on Biodiversity Environment during Construction Phase

The anticipated impacts on biodiversity during construction phase of proposed project will be as follow:

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(a) Impact on Flora Diversity

Clearing away trees and natural vegetation during construction phase can cause impacts on flora diversity.

(b) Impact on Fauna Diversity

Clearing away trees and natural vegetation can cause hazards to the habitats of birds and butterflies. Noise due to construction activities at the site involving human and vehicular movement will disturb aril and wild animals in the area. If waste disposal during construction are not properly done, there will be increased in the habitat loss of native species. Terrestrial micro flora and fauna at the site are also affected. Although the project is adjacent to Ayarwadi River, there will be no impact on aquatic lives in Ayarwadi River because waste water produced from construction site will be little amount from small area (about two acres).

Significant of Impacts on Biodiversity Environment during Construction Phase

(a) Significant of Impacts on Flora Diversity

Unmanaged grassland is a frequent habitat in the area and is not of any particular conservation importance. The project site is near the settlement area; therefore, there will be no concerns for wild life disturbance as there is no suitable habitat in terms of suitable natural flora cover and related fauna. The various areas of improved grassland do not have any conservation value. The total carbon sequestration of herbs and grass communities in proposed factory will be very little. So that loss of carbon stock by proposed project is very low.

(b) Significant of Impacts on Fauna Diversity

The impact on fauna diversity will be minimal due to the site had already cleared by human activities and very little fauna species are found within the project site (direct impact zone). However, there will be a little impact on surrounding fauna diversity (indirect impact zone), due to the construction noise.

Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Impacts on flora and fauna diversities	Cutting of trees	Negative (-)	Site (-1)	Long term (-4)	Very Low (-1)	Rare (-1)	Very Seldom (-1)	Very Low (-12)
	Cutting of trees, wastes and noise	Negative (-)	Limited (-2)	Short term (-2)	Very Low (-1)	Very Often (-4)	Very Seldom (-1)	Very Low (-25)

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Consideration of Mitigation Requirement for Biodiversity Environment

The intensity of mitigation requirement for biodiversity environment according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public Consultation Processes	Mitigation Requirement by impact evaluation	Required Mitigation Scale	Responsibility
1.	Cutting of trees	Very Low (-12)	No	Yes	Minor	Construction Service Provider(s)
2.	Cutting of trees, wastes and noise	Very Low (-25)	No	Yes	Minor	Construction Service Provider(s)

Mitigation Measures for Impacts on Biodiversity Environment during Construction Phase

According to the minor mitigation requirement, it is necessary to avoid tree cutting, dispose wastes properly and avoid working at night to reduce impacts on flora and fauna diversities during construction phase.

Residual Impacts on Soil and Ground Water Envrionment during Construction Phase

After proper mitigation measures, there will no residual impacts on soil and ground water environment during construction phase due to low impact rating.

6.9.2.5. Impact on Socio-economic Environment during Construction Phase

The anticipated socio-economic and health impacts on human environment during construction phase are as follow:

6.9.2.5.1. Potential Socio-economic Impacts during Construction Phase

During construction phase, the following positive and negative socio-economic impacts will occur.

(a) Positive Socio-economic Impacts during Construction Phase

The potential positive social impacts during construction phase are as follow:

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Job Creation

The proposed project will provide about 100 temporary employment opportunities for local people during construction phase.

Impact Significance of Job Creation without Enhancement Measures

According to the primary data collection by household survey, almost all of the local people in Amarapura Region are not practiced to construction of steel tanks and all of the welder will be sourced from Mandalay and Sagine Regions. So, most of the construction workers (welders) will be in-migrant workers from Mandalay and Sagine Regions. Nevertheless, there has jobless persons in nearest villages and job creation during construction phase can be considered as low without enhancement measures as follow:

Anticipated Impact	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Potential to Increase in household income	Positive (+)	Limited (+2)	Short term (+2)	Medium (+3)	Intermittent (+2)	Seldom (+2)	Low (+28)

Enhancement Measures for Job Creation during Construciton Phase

MESDP will do the following mitigation measures for ensuring job opportunities for local people.

(a) Training program for welding will be opened before the construction phase.

(b) Unskilled and semi-skilled job opportunities will be offered to the local communities as much as possible.

(c) As the population of females is slightly higher than that of males in the township, employment opportunities for construction works will be created to ensure that the local female population also has equal chance for these opportunities (Gender Equality).

(d) MESDP will encourage construction sub-contractor to use local labor force as part of tender requirement.

Impact Significance of Job Creation after Enhancement Measures

If job creating is provided to local people, the impact will become low after enhancement actions as follow:

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Anticipated Impact	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Potential to Increase in household income	Positive (+)	Limited (+2)	Short term (+2)	Medium (+3)	Very often (+4)	Highly probable (+4)	Low to Medium (+56)

Job opportunities for local people is one of the most public needs according to the primary data collection and through public meeting. So, MESDP will intensely consider to creat job opportunity for local people during construction phase.

Skill Development for Local People

Local people hired by the proposed project would remain in communities with skills acquired during project construction including concrete work for offices and other facilities, steel work for oil tanks and stone work for retaining wall. Communication skills for local people will also improve in office works during construction period.

Impact Significance of Skill Development without Enhancement Measures

According to the primary data collection, most of the sub-contractors for minor construction works in nearest villages are not too familiar with modern construction technique. So, the impact significance of local skill development during construction phase without enhancement measures can be considered very low as follow:

Components	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Local skill development	Positive (+)	Local (+3)	Long term (+4)	Low to Moderate (+3)	Intermittent (+2)	Very Seldom (+1)	Low (+30)

Enhancement Measures for Skill Development for Local People

MESDP will do the following enhancement measures for local skill development.

(a) Training programs (e.g. maintaining of vehicles, welding, wiring, masonry building etc.) will be implemented prior to and during the construction phase because majority

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of the local people may not be adequately skilled to qualify for positions requiring skilled labor, if required.

(b) Local construction sub-contractors will be chose as first priority during tender process.

(c) MESDP will encourage construction contractors and sub-contractors to stimulate local skill development as part of tender requirement.

Impact Significance of Skill Development after Enhancement Measure

Skill development for local people will be great benefit for local engineers at Amarapura Region. However, local skill development is not the public needs according to the public consultation and most of the young people are willing to work in Mandalay City. So, the impact significance of local skill development during construction phase can be considered as low to moderate after enhancement measures as follow:

Components	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Local skill development	Positive (+)	Local (+3)	Long term (+4)	Low to Moderate (+3)	Intermittent (+2)	Highly Probable (+4)	Low to Moderate (+60)

Residual Impacts on Positive Socio-economic Impacts during Construction Phase

After proper enhancement measures, there will no residual impacts on socio-economic environment during construction phase.

(b) Potential Negative Socio-economic Impacts during Construction Phase

The potential negative socio-economic impacts during construction phase are as follow:

Impacts Associated with Population Influx

The increase of population during construction phase will increase temporary pressure on existing infrastructure and services including health care, food, shelter, water, transport and recreational facilities.

Significant of Impacts Associated with Population Influx without Mitigation Measures

As proposed project is very close to urban area and little number of workers (about 100 people), there will have little impact on local health care facilities and local food consumption. Moreover, the requirements for housing and water for construction workers

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will be provided by MESDP inside the project site and no more facilities are required. Impact significances related to population influx during construction period will be considered as follow:

Anticipated Impact	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Increase pressure on housing, recreational facilities, and water	Negative (-)	Site (-1)	Short term (-2)	Very low (-1)	Continuous (-5)	Very seldom (-1)	Very low (-24)
Increase pressure on health care facility	Negative (-)	Site (-1)	Short term (-2)	Low to Moderate (-3)	Regular (-3)	Highly Probable (-4)	Low (-42)
Increase pressure on adequate amount of local food	Negative (-)	Limited (-2)	Short term (-2)	Very Low (-1)	Continuous (-5)	Very seldom (-1)	Very low (-30)

Mitigation Measures for Impacts Associated with Population Influx

All of the impacts due to increase in population can be mitigated by appointing local construction workers and it will also reduce pressure on health care facilities for construction workers. Own health care facilities will be supported to workers during construction period.

Impacts Associated with Population Influx

Infrastructure and facilities to be impacted due to the increase of population during construction phase will increase temporary pressure on existing infrastructure and services including health, food, shelter, water, transport and recreational facilities.

Significant of Impacts Associated with Population Influx without Mitigation Measures

There will be a little impact existing public health care facility in Amarapura Township because there were few public health care facilities in nearest villages and most of the construction workers cannot afford for private health care facilities in nearest villages. As Amarapura Township is very close to Mandalay and there will have no impact on local food

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consumption. Moreover, proposed projects are situated in the existing facility of project and the requirements for housing, recreational facilities and water for additional people will be provided by the existing facilities. All of the impact significance related to population influx during construction period.

Mitigation Measures for Impacts Associated with Population Influx

No mitigation measures is required for pressure on housing, recreational facilities and water for additional workers because the impact rating is very low. Similarly, impact significant of pressure on local food consumption is very low and no mitigation measure is required. All of the impacts associated with population influx can be minimized by the use of local labor force. Own health care facilities should be supported to additional workers during construction period.

Significant of Impacts Associated with Population Influx after Mitigation Measures

All of the impacts due to increase in population can be mitigated by appointing local construction workers and it will also reduce pressure on health care facilities for construction workers. Own health care facilities should be provided for workers during construction phase. So, impact on health care facility due to population influx will be very low after mitigation measures as follow:

Components	Anticipated Impact	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Increase pressure on health care facility	Anxiety of existing workers	Negative (-)	Site (-1)	Short term (-2)	Low to Moderate (-3)	Intermittent (-2)	Seldom (-2)	Very Low (-24)

Residual Impacts on Negative Socio-economic Impacts during Construction Phase

After proper enhancement measures, there will no residual impacts on socio-economic environment during construction phase.

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6.9.2.6. Potential Health Impact and Mitigation Measures for Construction Phase

During construction phase, the anticipated health related impacts are as follow:

(a) Increase Infection of Air-borne Diseases

An influx of construction workers from other places can lead to overcrowded conditions where air-borne diseases such as tuberculosis, influenza and meningitis can spread easily.

Impact Significance for Increase Infection of Air-borne Diseases

According to the secondary data collection, infections of TB is one of the common disease in Amarapura Region. So, impact rating for air-borne diseases will be considered as follow:

Who will affected?	Magnitude/Consequence of impact			Likelihood/Probability of impact			Health Impact Significance Rating		
	Low	Medium	High	Unlikely to occur	Likely to occur sometimes	Likely to occur often	Low	Medium	High
People in nearest residents	√	-	-	-	√	-	√ (HIR 1)	-	-
Construction workers	-	√	-	-	√	-	-	√ (HIR 2)	-

Mitigation Measures for Infection of Air Borne Diseases

This potential impact will be minimized by providing medical check for workers who are susceptible infection of air-borne diseases.

(b) Fugitive Dust Emissions

During construction phase, the main source of air pollution will be dust generation due to site clearing, ground levelling activities, construction activities and transportation of construction materials. Dust will expose the construction workers and the some local people in nearest villages to bronchial and other respiratory tract diseases.

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Impact Significance for Fugitive Dust Emissions

The impact will be mainly on construction workers within the project and little on local people in nearest villages.

Who will affected?	Magnitude/Consequence of impact			Likelihood/Probability of impact			Health Impact Significance Rating		
	Low	Medium	High	Unlikely to occur	Likely to occur sometimes	Likely to occur often	Low	Medium	High
People in nearest residents	√	-	-	-	√	-	√ (HIR 1)	-	-
Construction workers	-	√	-	-	√	-	-	√ (HIR 2)	-

Mitigation Measures for Fugitive Dust Emission

Dust can be controlled by:

(a) Wetting of roads by water spraying;
(b) Seeding storage mound surfaces as soon as is practicable;
(c) Spraying exposed surfaces of mounds regularly;
(d) Restricting vehicle speeds;
(e) Watering roadways; and
(f) Wheel or body washing.

(c) Increase Infection of Water Borne Diseases

Project activities could become sources of pollution, as a result of infiltration into the surface stream. The incidence rate of water borne diseases such as cholera and diarrhea will increase if there will be no proper sanitation practices at the construction site. Improper waste disposal of construction debris will also have potential to increase water borne diseases because the project site is very close to surface water resources (Ayarwady and Nyit Nge Rivers). The possible negative impacts considered significant are:

- Loose soil from earthworks may be washed into river.
- Irresponsible dumping of domestic solid waste can lead to underground water contamination, due to contaminants emanating from various products into the groundwater and filtering through to the aquifers. This will be a particular problem during the rainy season.
- Potential surface water pollution can emanate from waste products generated by construction activities entering the surface drainage.

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Impact Significance for Increase Infection of Water Borne Diseases

According to the secondary data collection, infections of water borne diseases such as diarrhea are still the public healthcare problems in Amarapura Region and so the impact will be considered as follow:

Who will affected?	Magnitude/Consequence of impact			Likelihood/Probability of impact			Health Impact Significance Rating		
	Low	Medium	High	Unlikely to occur	Likely to occur sometimes	Likely to occur often	Low	Medium	High
People in nearest residents	√	-	-	√	-	-	√ (HIR 1)	-	-
Construction workers	-	√	-	-	√	-	-	√ (HIR 2)	

Mitigation Measures for Increase Infection of Water Borne Diseases

Avoid construction time during rainy seasons. If it is not possible to avoid rainy seasons, proper sanitation system will be provided for construction workers during construction period. Construction debris will be disposed at suitable location that does not impact on local nearest rivers. Construction activities will ensure that no loose soil is permitted into watercourses and stockpiles are located away from surface water. All mixing of cement will be carried out in a designated area away from surface water and areas of potential runoff. All areas of fuel storage will be banned to prevent hydrocarbon pollution of surface water.

(d) Potential to Increase Infections from Mosquito

Stagnant pools of water during the construction phase will cause cause bleeding zone for mosquitoes and can cause potential to cause infections from mosquitoes especially in rainy season.

Impact Significance of Infections from Mosquito

The impact can be rated as medium because malaria is still a health problem in Amarapura Region.

Who will affected?	Magnitude/Consequence of impact			Likelihood/Probability of impact			Health Impact Significance Rating		
	Low	Medium	High	Unlikely to occur	Likely to occur sometimes	Likely to occur often	Low	Medium	High
People in nearest residents	√	-	-	√	-	-	√ (HIR 1)	-	-

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Construction workers	-	√	-	-	√	-	-	√ (HIR 2)	

Mitigation Measures for Infections from Mosquito

Avoid construction time in rainy seasons as much as possible. Ensure that there are no stagnant pools of water during the construction phase. Proper temporary or permanent drainage system will be compensated if there will be the blocked of natural drainage system during construction phase.

(e) Increase Risk of Sexually Transmitted Infections

During construction phase, the improved economic status of the area and the influx of new migrant workers, living away from their families, can also lead to an increased risk of sexually transmitted infections such as HIV/AIDS, gonorrhoea and chlamydia. Major outbreaks of infectious diseases can have a devastating effect not only on or near the project site but also on local communities.

Impact Significance of Increase Risk of Sexually Transmitted Infections

Impact rating for sexually transmitted infection (448 people in Amarapura Region in 2017) can be considered as moderate in Amarapura Region.

Who will affected?	Magnitude/Consequence of impact			Likelihood/Probability of impact			Health Impact Significance Rating		
	Low	Medium	High	Unlikely to occur	Likely to occur sometimes	Likely to occur often	Low	Medium	High
Local people in Dawei Region	-	√	-	-	√	-	-	√ (HIR 2)	-

Mitigation Measures for Increased Risk of Sexually Transmitted Infections

MESDP will provide information and education about safe sex and implement HIV control program for migrant construction workers.

(f) Health Impact Related to Increase in Noise Level

Construction activities normally generate a lot of noise. Noises will also arise from various construction machinery at site. Pilling operation will also produce high noise level. Both acute loud noise and chronic lower level noise have been associated with a variety of negative health effects. Hearing loss and impairment are known to occur as a result of exposure to

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acute, high decibel noise (greater than 85 dB). Noise annoyance can lead to stress related impacts on health such as feelings of displeasure, interference with thoughts, feelings, and activities and disturbed sleep and can have impacts on mood, performance, fatigue, and cognition.

Impact Significance of Increase in Noise Level

The impact will be considered as low for local people due to the distance of nearest villages and medium to construction workers inside the construction site as follow:

Who will affected?	Magnitude/Consequence of impact			Likelihood/Probability of impact			Health Impact Significance Rating		
	Low	Medium	High	Unlikely to occur	Likely to occur sometimes	Likely to occur often	Low	Medium	High
People in nearest residents	√	-	-	-	√	-	√ (HIR 1)		-
Workers at site	-	√	-	-	-	√	-	-	√ (HIR 2)

Mitigation Measures Health Impact Related to Increase in Noise Level

1. Reduce speed limits for trucks in the project area to reduce noise level.
2. Alert residents of anticipated noise, including time, duration, decibel levels, and machinery to be used to protect public health.
3. Avoid working at night.

Residual Impacts on Health during Construction Phase

After proper mitigation measures, there will no residual impacts on public health during construction phase.

6.9.2.7. Visual Impacts during Construction Phase

Since the proposed project site is very close to the popular tourist attraction places: Tha Byae Tan fortress, Innwa City Wall, Me Nu brick monastery, some local community depends on the tourism business, the visual pollutants like construction materials and equipment impact

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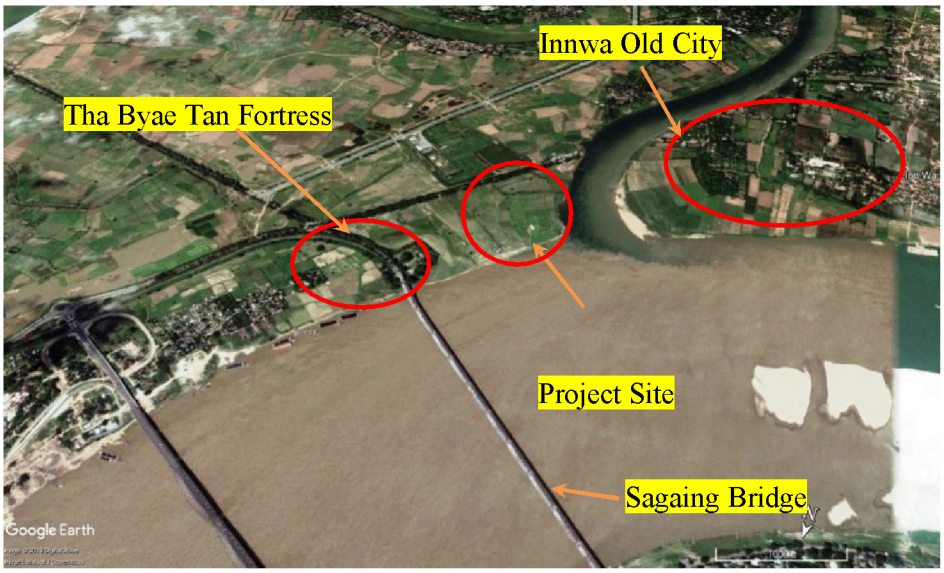
on their visualization. Visual intrusions arise from the inevitable presence of construction equipment, materials, transport vehicles, and piles of soil and debris during construction activities. If the storage, transportation and disposal of these waste materials are not managed properly, the waste will decreasing visual amenity.



View of Project Area before Construction (in 2009)



View of Project Area during construction state (in 2019)

Mitigation Measures for Visual Impacts

To decrease the project impacts on landscape and visual amenity, MESDP will be undertaken several steps as follows:

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- Enclose the construction camp sites with non-transparent fencing to minimize the visual impacts on nearby areas especially for travelers along the Oh Htoke Tan Road.
- Prohibiting the parking of construction equipment, construction materials, and transport vehicles along Oh Htoke Tan Road.
- Site housekeeping to keep project area clean and limit visual intrusion.
- Efficient and timely removal of all demolition and construction wastes as per MCDC requirements.

Residual Impacts on Visual during Construction Phase

After proper mitigation measures, there will no residual impacts on visual during construction phase.

6.9.2.8. Impacts on Cultural Heritage during Construction Phase

The project site and infrastructure are located near the Innwa ancient city and there can be indirect negative impact of incorrect sourcing of construction material (sand and gravel), in or near the cultural heritate zone.

Mitigation Measures for Impacts on Cultural and Heritage

MESDP will have a plan to source construction materials such as sand and gravel that will not in or near the archeological sites or will not input these construction materials from these sites. Moreover, there are (11) mitigation plans depending the measurement impacts in and around the project area as follows;

1. To reduce the indirect impact, MESDP will arrange that the boundary will be demarcated 40 m away from the edge of ancient monument zone (especially from Tha Bye Dan Fortress).
2. The height of any project buildings will be limited as 10 m or the maximum height allowed by the Heritage Authority as Department of Archaeology and National Museum (DoANM).
3. To be responsible for the preservation of cultural heritage and landscapes including Innwa Old City, Ava Bridge and Tha Bye Dan, the project developers will participate with the heritage authority and negotiate with DoANM; to reduce the visual impacts between the boundaries of project area and the ancient monument zones, the buffer

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area (40m) will be accepted with the particular landscape; signage for cultural heritage, and monitoring to do stewardship for the cultural landscape; e.g. the signage composed with the full information about cultural significance related to the Oil Storage Tanks project area will be founded to know the peoples and observers.

4. To reduce the visual impacts on the cultural landscape, tall green trees and some fence-bushes must be grown along the fence of the project area for covering the visual pollutants e.g. the geometric design of oil storage tanks and standard colours (White or some brilliant colours). The area of green space must be placed outside the fence of project area and it must be 40 m wide in minimum.
5. Entrance of the oil storage tank will be constructed with the ancient architecture design of Innwa Era.
6. To reduce the visual impacts on the ancient architectural features, the colour will be green and red-brown on the taller structures like tower, overhead water tanks etc. If the colour cannot be changed to green or red-brown, the covering system must be arranged not to see the inappropriate vision inside the cultural landscape. For example, growing tall green trees along the fences is more suitable for covering the visual impacts in four directions.
7. To consider the water way and jetty importantly associated to the project area, the northern and eastern river bank of Innwa City Wall will be carefully preserved to make retaining walls with the collaboration of DoANM and some associated authorities of government sectors and rules of laws.
8. The developers must provide to make Archaeological Risk Management Plan (ARMP) to attach the Disaster Risk Management Plan (DRMP) for project operation and local community.
9. Archaeological Risk Management means the management for the potential risks of cultural heritage and its dangers. Additionally, the causes of deterioration will be measured and collected to make database system. Then, it can be available when the surprise risks may come out, e.g. earthquake, flash flood, vandalism, and encroachment problems.
10. Because the project area is including and associated to the ancient cultural heritage landscape, the MESDP will be responsible to make monitoring and preservation for the cultural landscape more than other peoples. In this way, MESDP will do the collaborative works for the preservation of cultural heritage process, e.g. monitoring system, rescue alarm system, public awareness system.

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11. In monitoring system, local peoples, developers' staffs, government staffs, scholars from third party organization will be involved. According to the monitoring process, the report or new letters will be delivered monthly *or* yearly. In this monitoring report, the condition of cultural heritage will be described whether or not the deterioration may be come out depending on the project operational workload.
12. To make awareness about the safety of Oil Storage Tanks and the technical point of view, MESDP will attempt to announce what the techniques are safe appropriately for constructing oil storage tanks and the threat of fire case. For example, the signage with the safety information and profiles of construction techniques about oil storage tanks will be founded in the public area. In this way, the tourists and the peoples can easily know what the safety arrangement of oil storage tanks were already planned and constructed.

Residual Impacts on Visual during Construction Phase

After proper mitigation measures, there will no residual impacts on visual during construction phase.

6.9.2.9. Impacts to Occupational Health and Safety

(a) Potential Impacts on Employees from Accidents and Fall

During the construction phase, an increased risk of accidents may occur due to operation of heavy construction equipment. In addition, employees risk electrocution during the operation of equipment if it is not correctly handled, or has not been regularly maintained. There is an increased risk of falls from elevated positions during construction activities, as well as falls from ground level into unsecured open trenches. In addition should construction debris not be removed in a timely manner, it might lead to risk of trips, falls and injury.

Mitigation Measures

Appropriate working gear (such as nose, ear mask and clothing) and good construction site management shall be provided. Safety signal devices should be installed to ensure safety during construction. The contractor shall ensure that the construction site is fenced and hygienically kept with adequate provision of facilities including waste disposal receptacles, sewage, fire-fighting and clean and safe water supply. A well-stocked First Aid kit shall be maintained at each construction site. The medical personnel shall also be responsible for

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primary treatment of ailments and other minor medical cases as well as providing some health education to the workforce.

If the storage, transportation and disposal of these waste materials are not managed properly, the waste will contaminate the surrounding environment, contaminating soils and decreasing visual amenity.

Residual Impacts on Occupational Health and Safety during Construction Phase

After proper mitigation measures, there will no residual impacts on occupational health and safety during construction phase.

6.9.2.10. Increased in Traffic

As the construction operations will last about 2 years, traffic flows can be increased by the activities such as construction of new extension road parallel to the Oh Toke Tan village road where the existing road can be congested due to delivary of heavy machineries, transportation of construction workers and construction materials will lead to increasing in traffic volumes to and from the site. This will lead to an increase the risk of accidents to the employees and in the local community as well as present the potential for nuisance from the increase or if the traffic presents delays to the public. Additionally, equipment, material and construction debris in and out of the site not be secured correctly, there is a risk that this transported material could become a hazard and further increase the rates of accident and injury.

Mitigation Measures for Increased in Traffic during Construction Phase

Impact of increased traffic on local populations will be mitigated by instituting a traffic control plan which is to be prepared by the contractor, and ensuring that traffic into and out of the site will occur mainly during the daytime, especially for heavy machinery, and will do so in an ordered manner. In addition, the movement of heavy machinery during the construction phase will be limited to off-peak hours and prior notification will be provided to minimize the potential negative impacts of traffic on local communities.Affected communities will be notified regarding the construction schedule during the construction and rehabilitation phase. In addition, a traffic re-routing plan will be provided for the construction phase, with alternative routes delineated where feasible. Any road damage sustained by transportation of heavy equipment will be repaired.

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Residual Impacts on Increased in Traffic during Construction Phase

After proper mitigation measures, there will no residual impacts on increased in traffic during construction phase.

6.9.3. Anticipated Impacts and Mitigation Measures in Operation Phase

The main operation processes are transportation of fuel oil by oil tanker, storage of fuel oil, handling and distribution of fuel oil. The fuel oil (diesel and petro) will be delivered to the storage tanks by oil tankers (ship vessels). The oil tankers will be deported at the jetty and the fuel oil are conveyed through the pipeline to the storage tanks. The fuel oil are distributed to oil barge or oil bower through the filling stations.

The anticipated environmental impacts during operation phase will be as follows:

(a)Impacts on air environment;

(b) Impacts on surface water environment;

(c)Impacts on soil and ground water environment;

(d) Impacts of high utilities consumption;

(e)Impacts on biodiversity environment; and

(f) Impacts on human environment.

6.9.3.1. Impacts on Air Environment during Operation Phase

The pollutants considered for the operational impacts are:

- Nitrogen Dioxide (NOx);
- Particulates with aerodynamic diameters less than 10 μm (PM_{10});
- Volatile Organic Compounds (VOCs);
- Hydrocarbons (HC);
- Sulphur Dioxide (SO_2);
- Carbon Monoxide (CO);

Table : Pollutants – Sources and Effects

Pollutant	Main Sources	Impacts	Assess	Comments
HC and VOCs	storage, leakage and spills of fuels between storage tanks and vehicle tanks/marine vessels	Carcinogenic (Benzene)	YES	Fuel tank emissions and combustion are potential sources

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CO	Incomplete combustion of fuel (especially from vehicular movements)	Reduces capacity of blood to carry oxygen	YES	Combustion/transport sources at fuel farm
Oxides of Nitrogen	NO formed during combustion in air. NO2 formed by oxidation of NO (especially from vehicular movements)	Impaired lung function; acidification and eutrophication of soils	YES	Combustion / transport sources present at fuel farm
Ozone (O_3)	No man-made sources. Formed through chemical reactions in presence of sunlight (especially from vehicular movements)	Eye, nose and throat irritation, chest infection; affects crop growth	NO	No assessment required in relation to local air quality due to lack of sources
PM_{10}	Industrial processes, especially mineral and ferrous metals. Combustion processes. Chemical reaction in air (especially from vehicular	Affects the respiratory and cardiovascular systems, asthma and mortality	YES	Combustion/transport sources present at fuel farm
SO_2	Predominant source is combustion of sulphur-containing fossil fuels, principally coal and heavy oils.Some industrial processes (especially from vehicular movements)	Constriction of airways by stimulating nerves in the lining of the nose, throat and lungs	YES	Diesel engines are potential source
Lead	Road traffic was main contributor before general sale of leaded petrol was banned on 1 January 2000. Industry contributes to lead emissions but to a lesser extent	Affects the synthesis of haemoglobin, kidneys, joints and the reproductive system. Can cause damage to the nervous system	NO	No significant sources of lead associated with this project

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Dust	Natural sources, industrial processes, construction activities (especially from vehicular movements)	Nuisance dust soiling of surface. Corrosion of artifacts leading to faults or abrasion or contamination. Can affect growth of vegetation	YES	Construction activities are a potential source

According to the above table, there will only emission of VOCs from oil storage facilities. Other gases are emitted especially from machines,vehicles and generators. VOCs are included to assess the contribution made by the fuel tanks to the regional emissions of ozone precursors and also as a measure of the odour creation potential of the storage facility. The following are the anticipated impacts on air environment during operation phase of the proposed project.

(a) Impacts to Air Quality due to Release of VOC's from Stored Petroleum Products

Unstable tank pressures and incorrect maintenance of vapor spaces in the oil terminal storage tanks can allow the escape of VOC's into the surrounding atmosphere. In addition fugitive emissions can occur at pipes, valves, seals, and tanks. Escaped vapor emissions can result in ambient air quality levels in excess of health-based standards. Acute exposure to petroleum hydrocarbons can be detrimental to those with breathing disorders and can lead to an exacerbation of symptoms of asthma and chronic bronchitis. Fatigue, headache, nausea and drowsiness can occur from inhalation of some petroleum constituents at high concentrations. Skin irritations can also occur. Chronic exposure to certain components of petroleum products can lead to increased incidences of cancer in exposed employees or nervous system damage.

(b) Fugitive Dust Emission

In the proposed project, dust will mainly be generated from the travelling of oil tankers on the public road.

(c) Impact from Noise

During the operation stage, noise may be generated from power station area due to the operating engine rooms, back up generators, pump house and higer volume of bowser trucks at the filling stations. If most of the operation machineries (pump, generator,bowser truck etc.) are running at the same time, this cumulative noise level can increase to 86.2 dB(A) at 15 m (about 50 feet) distance as follow:

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Typical Construction Equipment Noise Emission Levels

Equipment Type	Noise Level (dBA at 50 Feet)
pump	76
Oil Truck (Bowser)	84
Generator	81

Source: EPA, 1 971; "Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances". NTID 300.1

The predicted noise level at nearest villages during construction phase can be predicted as follow:

Predicted Noise Levels during Operation Phase

Receptors and distances from project	Existing noise levels monitored by integrated noise level meter (dBA)		Calculated noise level at site (dBA)		Reduced noise level at receptors due to Distance (dBA)	Predicted cumulative noise level at receptors (dBA)		Allowable noised level (existing noised level + 3dBA) (dBA)	
	Day Time	Night Time	Day Time	Night Time		Day Time	Night Time	Day Time	Night Time
Latt Yway AN2 0.8 km	50.7	43.4	86.2	86.2	51.6	53.6	52.0	53.7	46.4
TetGyi AN3 1.15 km	51.6	44.1			48.5	53.3	49.8	54.6	47.1

According to the above table, there is significant impacts of noise on nearest residents (Residents in Latt Yway and TetGyi Vilages) and all of the predicted noise levels during day time are lower than the allowable limit (existing noise level plus 3dB) whereas the values of noise levels during night time are relatively higher than the allowable limit. Although all of the predicted noise levels are based on calculations and the actual noise level may a little change due to the other factors (seasonal wind direction and wind speed), these changes will not affect local residents.

Significant of Impacts on Air Environment during Operation Phase

Significant of impact on air environment can be considered as follow:

Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Air pollution	Fugitive dust	Negative (-)	Limited (-2)	Long term	Low (-2)	Continuous (-5)	Highly Probable	Low to Moderate

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	emissions			(-4)			(-4)	(-72)
	Release of VOCs	Negative (-)	Local (-3)	Long term (-4)	Low (-2)	Continuous (-5)	Highly Probable (-4)	Moderate (-81)
	Noise	Negative (-)	Local (-3)	Long term (-4)	Low (-2)	Continuous (-5)	Highly Probable (-4)	Moderate (-81)

Consideration of Mitigation Requirements for Air Environment

The intensity of mitigation measures for air environment according to the consideration of impact evaluation and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public consultation Processes	Mitigation requirement by impact evaluation	Mitigation Intensity	Responsibility
1.	Fugitive dust emissions	Low to Moderate (-72)	No	Yes	Minor	MESDP
2.	Release of VOCs	Moderate (-81)	Yes	Yes	Moderate	MESDP
3.	Noise	Moderate (-81)	Yes	Yes	Moderate	MESDP

Mitigation Measures for Impacts on Air Environment

MESDP will do the following mitigation measures to reduce impacts on air quality during the operation phase.

(a) Mitigation Measures for Release of VOC's from Petroleum Storage Tanks

Recommendations to prevent and control the emission of VOCs from storage and working losses which apply to most bulk fuel storage tanks, as well as aboveground piping and pump systems, include the following:

- Standard operating procedures and control techniques for minimizing release of VOC's from tank storage area include maintaining stable tank pressures and vapor space by:
  - Installing vapor collection systems such as vapor condensing units, catalytic oxidizers, vapor combustion units, or gas adsorption media to control vapor emissions during gasoline loading. However, aviation gas and diesel fuel loading systems are not required to use a vapor collection system.

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- Appropiate loading and unloading practices have influence on reducing vapour emission. If feasible, it is recommended to practice submerged loading practice that introduces the fuel into the bottom of the tank below the liquid level. This reduces liquid turbulence and vapor-liquid contact.
- Regular inspection and maintenance program is recommended to conduct to reduce the emission from equipment leakage.
- Implementation of vapor balancing between tanks whereby vapor displaced during filling activities is transferred to the vapor space of the tank being emptied or to other containment in preparation for vapor recovery;
- Reducing breathing losses by using white or other reflective color paints with low heat absorption properties on exteriors of storage tanks for lighter distillates, or by insulating the tanks.
- Tanks cleaning and degassing can release VOCs and become a source of low level ozone pollution. Tank degassing vapors will therefore be routed to an appropriate emission control device.
- Establishing a procedure for periodic monitoring of fugitive emissions from pipes, valves, seals, tanks and other infrastructure components with vapor detection equipment, and with subsequent maintenance or replacement of components as needed.

Standards for Floating Roof Tanks

- Installing decks, fittings, and rim seals according to design specifications of international standards to minimize evaporative losses.
- Protecting rim seals from wind and weather damage and conducting regular maintenance;
- Consider the use of double seal systems for floating roof tanks where appropriate based on the nature of the material being stored, the size of the tank(s) in question, throughputs, location considerations, and meteorology.
- Using sleeves to eliminate emissions from slotted guide poles;
- Minimize losses from tank roof landing events by limiting the number and durations of such events. Use practices that minimize the impact of tank roof landing events, such as keeping legs on a low setting or restricting activities to evenings when

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temperatures are cooler and the potential for ozone formation is lower. Consider cone bottom drain dry floor designs which reduce potential emissions when a tank roof is landed.

Residual Impacts on Air Environment during Operation Phase

After proper mitigation measures, there will no residual impacts on air environment during operation phase.

6.9.3.2. Impacts on Surface Water Environment during Operation Phase

The followings are the potential impacts on surface water quality during the operation of the proposed project.

Potential Impact to Surface Water Quality due to Spills

Accidential leakage and spill from pump house, pipelines, filling stations, and fuel boxers are likely to have impact on nearby surface water quality as it can enter to the nearby water bodies with runoff water through the drainage channels. Besides, seawage from office's toilets are also likely to be spilled if poorly maintained as the proposed project is adjacent to the rivers, care must be taken into account.

Significant of Impact on Surface Water Environment

Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Surface water pollution	Contaminated water from oil storage area	Negative (-)	Limited (-2)	Long term (-4)	Medium (-4)	Seldom (-2)	Highly Probable (-4)	Low to Moderate (-60)

Consideration of Mitigation Requirement for Surface Water Environment

The intensity of mitigation measures for surface water environment according to the consideration of impact evaluation and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern through Public consultation Processes	Mitigation requirement by impact evaluation	Mitigation Intensity	Responsibility
1.	Contaminated water from oil storage area	Low to Moderate (-60)	Yes	Yes	Moderate	MESDP

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Mitigation Measures for Impact on Surface Water Quality

Mitigation measures such as correct maintenance of onsite structures and monitoring for early spill detection will help decrease the impact from any potential leaks and spills to surface waters. An Oil Spill Contingency Plan in place and will ensure all staff are trained how to respond in the event of an oil spill emergency. Spill control measures to prevent surface-water body contamination have to include the following:

- Oil leakage or spillage have to be contained and cleaned up immediately.
- Spent oil and lubricants have to be collected and stored for recycling or proper disposal.

In addition, all chemical storage areas have to be provided with locks and located within secondary containment structures. Storage tanks and components must meet international standards for structural design integrity and operational performance to avoid catastrophic failures. Storage tanks must have appropriate secondary containment and undergo periodic inspection for structural integrity.

Liquid waste in the form of domestic effluent must be collected and contained in septic tanks and then removed for disposal as necessary by an MCDC licensed contractor. Effective spill prevention and control must decrease the risk of oil-contaminated wastewater entering the surrounding environment, including the implementation of secondary containment to avoid accidental releases. A drainage channel network must connect all the fuel storage and work areas to an oil/water separator and fuel recovery tank which have to be regularly maintained.

Tank roofs, seals and other sources of potential water infiltration have to be regularly inspected, and maintained. Water content inside tanks must be determined using meters (sight glasses), and vortex eliminators/barriers have to be used to minimize product release during draw off.

Water which separates out from condensation inside the fuel storage tanks must be periodically drained and the resulting effluent have to be passed through an oil/water separator prior to disposal in a manner approved by MCDC.

Any chemical additives required for testing (such as dyes) must be carefully selected in terms of concentration, toxicity, biodegradability, and bioaccumulation potential. Lab analysis of water used in the hydrostatic test have to include testing for pH, BOD, COD, TSS, Phenols, Sulfides, Chlorides, conductivity, RCRA metals, BTEX compounds and Total Petroleum Hydrocarbon content. Waste water from hydrostatic testing must not be discharged into the nearest riverrs, and will be treated as

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required to achieve Myanmar Emission Guidelines limits prior to discharge into the sewage network. Treatment system will be Separate Drainage system and discharged to a three chamber oil- water separator. (detail process are showed in section 4.11 and 4.12)

Residual Impacts on Surface Water Environment during Operation Phase

After proper mitigation measures, there will no residual impacts on surface water environment during operation phase.

6.9.3.3. Impacts on Soil and Groundwater Quality during Operation Phase

There was a significant decrease in the Ca ,K, P Cations-ecxchange Capacity (CEC)as well as a significant increase in the sand fraction and Na content of the oil-spill affected soils when compared with the non-affected soil . The ecological problems observed as a result of **oil spill** include a brownish vegetation and soil erosion, diminishing resources of the natural ecosystem, fertile land turned barren and adverse effect on the life, health and economy of the people (Roberts, 1997). High drainage of oil into the lower horizon of the soil causing aeration problem as the air pores will be blocked with oil and prevent the easy flow of nutrients to the soil (Chinda and Braide, 2000). The fertility status of the soils is reduced as the oil makes most of the essential nutrient unavailable for plant and crop utilization.

(a) Leaks and Accidental Spills

During operations there are a number of potential sources of leaks and accidental spills:

- Large quantities fuel stored in tanks and transported in pipelines, especially if not correctly maintained. Leaks such as these that aren't visible may go undetected for some time, causing further impact to soil and groundwater.
- Hazardous materials used on the site include heavy duty cleaners, degreasers, corrosion inhibitors, lubricating oil and coolants.
- Wastes that will be generated include waste oil, lead acid batteries, transformer oil, and waste cooling system additives.
- Wastewater from repair shops may contain hydrocarbons or other hazardous substances

Accidental spills can contaminate the soil and then proceed to percolate into groundwater if spill prevention measures are not applied.

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(b) Solid Wastes Generated

Solid materials such as domestic waste and packaging from raw materials can enter and contaminate the soil if strict hygienic practices and correct disposal of garbage waste is not adhered to by employees. If the storage, transportation and disposal of these waste materials are not managed properly, the waste will contaminate the surrounding environment, contaminating soils and decreasing visual amenity. Solid wastes will be produced from wokers' dormitories during operation phase of proposed project.

(c) Liquid Wastes and Effluent

Liquid waste from operations may also pose risks if improperly handled and /or disposed of, and become a health and safety hazard.

Oil contaminated waste water may be generated in several areas of the facility including inside the fuel storage tanks (due to condensation inside the tanks or rainwater penetration if tanks have not been adequately maintained), from hydrostatic water testing for the integrity of the pipeline, and from spills and leaks that flow into stormwater channels.

Significant of Impact on Soil and Ground Water Quality during Operation Phase

Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Soil and Ground Water Pollution	Accidental spill	Negative (-)	Limited (-2)	Long term (-4)	High (-5)	Regular (-3)	Certain (-5)	Moderate (-88)
	Solid waste	Negative (-)	Limited (-2)	Long term (-4)	Low (-2)	Regular (-3)	Highly Probable (-4)	Low to Moderate (-56)
	Liquid waste	Negative (-)	Site (-1)	Long term (-4)	Very Low (-1)	Regular (-3)	Certain (-5)	Low (-48)

Intensity of Mitigation Measures for Soil and Ground Water Quality during Operation Phase

Intensity of mitigation measures for soil and ground water environment during operation phase according to the public concerns and impact evaluation are as follow:

Parameters	Impact Rating	Public Concern through Public consultation Processes	Mitigation requirement by impact evaluation	Mitigation Intensity	Responsibility
Accidental spill	Moderate (-88)	Yes	Yes	Major	MESDP

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Solid waste	Low to Moderate (-56)	No	Yes	Moderate	MESDP
Liquid waste	Low (-48)	No	Yes	Minor	MESDP

Mitigation Measures for Impacts on Soil and Groundwater Environment

Mitigation measures for impacts on soil and groundwater qualities will be as follow:

An Oil Spill Contingency Plan in place and will ensure all staff are trained how to respond in the event of an emergency. As a "good practice", contractors must collect and dispose of these wastes at designated MCDC approved facilities. Domestic effluent will be collected and contained in septic tanks on site. The contents will be removed for disposal as and when necessary by the licensed contractor.

Mitigation Measures for Solid and Liquid Wastes

The philosophy of solid waste management will be to encourage the four R (4R) of waste i.e. waste reduction, reuse, recycling, and recovery (materials & energy). Impacts on domestic solid waste can be reduced by the segregation, storage at source and collection of the waste management system.

Segregation and Storage at Source: Segregation or sorting waste at its source should be practiced in order to encourage reuse/recycling. With segregation at source, recyclables do not lose their commercial value due to cross contamination. Waste generated at the proposed project should be segregated as inert cum mixed waste, recyclables and waste from changing lubricant oil. The entire waste stream from the complex should be stored and collected separately.

Collection: The recyclables from proposed project would be given to the waste itinerant buyers or rag pickers, whereas segregated bio-degradable waste and inert cum mixed waste shall be sent to the nearest landfill site for processing and final disposal.

To prevent accidental release of contaminants into the soil and groundwater below, spill control measures will include the following:

- Chemicals on site will be stored in closed containers at designated areas with secondary containment, and will have natural or synthetic liners beneath.
- Spills and releases will be cleaned up immediately including excavation of contaminated soils as needed.
- Contaminated soils will be stored on plastic sheeting and kept covered until disposed of properly into an MCDC approve site.
- Non-toxic and biodegradable chemicals will be used on site whenever possible.

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- Drip pans or plastic sheeting will be used when performing vehicle and equipment maintenance.
- Storage tanks and components will meet international standards for structural design integrity and operational performance to avoid catastrophic failures. Storage tanks will have appropriate secondary containment and undergo periodic inspection for structural integrity. To mitigate risk of spills from the tank farm, the fuel storage tanks will have concrete flooring, and a secondary containment retaining wall which will be designed to hold 110% capacity of the largest tank. In addition the tanks will be fitted with filling alarms to prevent over filling and spillage. Loading and unloading activities will be conducted according to formal procedures. A spill prevention and control plan will be developed.

Residual Impacts on Soil and Ground Water Environment during Operation Phase

After proper mitigation measures, there will no residual impacts on soil and ground water environment during operation phase.

6.9.3.4. Impacts on Biodiversity Environment during Operation Phase

The proposed developmental project is considered may be affected directly or indirectly on terrestrial and aquatic environment due to the contamination of those environments caused by the project activities.

- Land contamination by the vehicles and incidental oil spill will affect on animal behavior and movement,
- Water contamination by the vessels and incidental oil spill will affect on aquatic animal community and composition (fishes, birds, and zooplankton)
- Reduction of biodiversity in surrounding water of the project area (fishes, birds, and zooplankton) by the project activities

(a) Impacts on Flora Diversity

Impacts on flora diversity will be gaseous emissions and improper disposal of solid waste during operation phase. At present condition, there are tall trees in it for the roosting for nesting for the birds. However in the indirect zone, there is an area of ecologically sensitive mangrove and its associates. Mangrove habitat is a key to the aquatic animals. Although the impacts from proposed project is not directly affected to mangrove area, the prevention firewood collection in this area is especially important issue in conservation point of view.

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(b) Impacts on Fauna Diversity

There are several causes for the impacts for fauna diversity, one is noise pollution produced by the motor and pumps from fuel oil distribution process. Noise pollution is one of the factors that affect on the breeding performance. Some animals are not breed properly in the natural habitats if the noise is made. There is relatively effect on the bird species due to their mobility behaviour. They have to change a small part of their foraging ground.

(c) Impacts on Aquatic Lives

There will have impacts on aquatic lives in Myit Nga and Ayarwadi Rivers due to the discharge of effluent water (oily water) especially in rainy season the oil storage facilities.

Significant of Impact on Biodiversity Environment

The status of flora and fauna which might be affected by the factors caused by the proposed project activities in and surrounding area of the project site were tabulated in the following table. This assumption was made which based on analysis of collected data in the field. These factors are to be considered in determining impact significance and magnitude. These factors are area of influence, percentage of resource affected, sensitivity of resources, status of resources, regulatory status, and societal value. Impact analysis showed that fishes and zooplankton are most affected (<45%) by the project activities in moderate level, then other species are in lower status of impact. Impact levels are categorized into three classes caused by the proposed project development to biological diversity in the following table. According to the survey data analysis, there will be an secondary impact with moderate level on fish and zooplankton (non-significant) while other species on terrestrial and aquatic fauna and flora with small impact are assumed. The extent of the impact on fauna and flora is investigated as only in the site specific and the duration of the impact for fish is assumed may be permanent.The following will be the impacts on biodiversity environment during operation phase of the proposed project.

Factors affected on biodiversity	Land vegetation	Fishes	Birds	Dragonfly	Zooplankton
Area of influence	<30%	<30%	<30%	<45%	<30%
percentage of resource affected	<30%	<45%	<30%	<45%	<45%
sensitivity of resources	<30%	<45%	<30%	<45%	<45%
status of resources	normal	normal	normal	normal	normal
regulatory status	normal	normal	normal	normal	normal
social value	normal	normal	normal	normal	normal

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Status of impact

< 15% = very low, <30% low, <45% = moderate, 60% = large, >75% very large

Table (13) Investigated impact levels, extent and duration on biological diversity in the proposed project area

No	Biological groups	Impact Levels			Extent			Duration		
		Sm	Mo	La	R	L	Sp	Lt	Mt	St
1	Herpetofauna	✓	-	-	-	-	✓	-	-	✓
2	Birds	✓	-	-	-	-	✓	-	-	✓
3	Fishes	-	✓	-	-	-	✓	✓	-	-
4	Dragonfly	✓	-	-	-	-	✓	-	-	✓
5	Zooplankton	-	✓	-	-	-	✓	✓	-	-
7	Land vegetations	✓	-	-	-	-	✓	-	-	✓

Status
Sm=small, Mo=moderate, La= large, R=regional, L=local, Sp=site specific, Lt=long term, Mt=mid-term, St= short term

(a) Significant of Impacts on Flora Diversity

A total of 204 plant species representing 180 genera and 62 families were analyzed in the buffer area. Among them Delonix regia (Bojer ex Hook.) Raf. is assessing in IUCN Red list as vulnerable. In Myanmar it is grown in road side as an ornamental or shade tree and its name is Seinban. Although the species is endanger in the wild, it is widely cultivated elsewhere in Myanmar. So, the impact will be considered as very low.

(b) Significant of Impacts on Fauna Diversity

There are many bushes of insect habitats at the present (raining season). Insect fauna co-existing with bushes in the direct zone will be locally cleaned up while those in the indirect zone will be affected by the changing of ecosystem. There is no large mammal in the small area, but for the small mammals such as house rats and mice recorded in the zone are pests and better for the human kinds. There is no IUCN Red List fauna in the project area.

(c) Significant of Impacts on Aquatic Lives

The impact on aquatic lives due to the discharge of oily water will be medium due to the present of endanger species in Ayarwadi River. So, the impact on fauna diversity will also be as follow:

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Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Impacts on fauna diversity	Improper disposal of solid waste	Negative (-)	Limited (-2)	Long term (-4)	Low (-2)	Continuous (-5)	Seldom (-2)	Low to Moderate (-56)
Impacts on flora diversity	Noise	Negative (-)	Limited (-2)	Long term (-4)	Low (-2)	Continuous (-5)	Seldom (-2)	Low to Moderate (-56)
Impacts on aquatic lives	Discharge of effluent water	Negative (-)	Limited (-2)	Long term (-4)	Moderate (-3)	Continuous (-5)	Seldom (-2)	Moderate (-63)

Consideration of Mitigation Requirements for Biodiversity Environment

According to the impact rating and public concern, intensity of mitigation measures for impacts on biodiversity environment will be as follow:

) Parameters	Impact Rating	Public Concern through Public consultation Processes	Mitigation requirement by impact evaluation	Mitigation Intensity	Responsibility
Impacts on fauna diversity	Low to Moderate (-56)	No	Yes	Minor	MESDP
Impacts on flora diversity	Low to Moderate (-56)	No	Yes	Minor	MESDP
Impact or Aquatic Lives	Moderate (-63)	Yes	Yes	Moderate	MESDP

Mitigation Measures for Impacts on Biodiversity Environment

Mitigation measures should be carried out by the developer during operational phase as below:

- Maintain the plants and vegetation as possible as which existing in and around the project area,
- Plan for green area development around the project site should be provide in accordance with aesthetic, atmospheric pollution control, carbon storage, and against from the erosions.
- Reduce the land and water contamination which might be disturb the animals and plants

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- Provide possible facility to fishermen who have been fishing around the project area to be sustainable of their fishing as the project activities might be affected on fish population reduction around the water (their fishing ground) of project area.

The following mitigation measures are proposed for minor and moderate mitigation scales.

(a) Waste materials produced from the plant must be kept inside the project and disposed systematically.

(b) Greenbelt development have to develop around the project corrider and should be plant quick growing tree species as a wind-break behind the wall of the compound to reduce gaseous emissions and noise. Suggested wind-break tree species are listed in the following table.

Wind-break Species

No.	Vernacular Name	Scientific Name	Family Name
1.	Ban-da	*Terminalia catappa* L.	Combretaceae
2.	Eu-ca-lit	*Eucalyptus ovate* Labill.	Myrtaceae
3.	Kha-yae	*Mimusops elengi* L.	Sapotaceae
4.	Korea-ban-da	*Bucida* sp.	Combretaceae
5.	Lan-ta-ma	*Polyalthia longifolia* (Lam.)Benth. & Hook.f.	Annonaceae
6.	Ma-lay-sha-padauk	*Acacia auriculiformis* A.Cunn	Mimosaceae
7.	Pinle-kabwe	*Casuarina equisetifolia* Forst.	Casuarinaceae

Remark: All of the wind-break tree species are available in local market.

(c) Any water released from the proposed project must be free of oil and it is necessary to treated before released to the surrounding water bodies.

Residual Impacts on Soil and Ground Water Environment during Operation Phase

After proper mitigation measures, there will no residual impacts on soil and ground water environment during operation phase.

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6.9.3.5. Impacts of High Utilities Consumption

The following materials will be used during the operation of the proposed project.

(a) Electrical Power

Some portion of fuel oil distribution process will use high electrical power. Electrical power will use in motors, pumps, conveyor and air blower. Although electrical consumption is not directly concerned with impact on nature environmental, the resource utilization is an issue which should be seen from a sustainable development perspective, scarcity of water resources, combustion of fossil fuels, utilization of raw materials, emission of ozone depletion gases, CO_2, SO_2,etc.

Impact Significance of Utilities Consumption

(a) Electrical Power

There will be impact on local electricity consumption because electricity consumption and distribution in Amarapura region is still a problem (required electricity = 208,76,3400 kW and distributed electricity = 204,67,0000 kW) according to the secondary data collection.

Anticipated Impact	Parameters	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
High Utilities Consumption	Electricity	Negative (-)	Local (-3)	Long term (-4)	High (-5)	Very Often (-4)	Certain (-5)	Moderate to High (-108)

Consideration of Mitigation Measures for Utilities Consumption

Intensity of mitigation measures for high utilities consumption during operation phase according to the public concerns and impact evaluation are as follow:

Parameters	Impact Rating	Public Concern through Public consultation Processes	Mitigation requirement by impact evaluation	Mitigation Intensity	Responsibility
Electricity	Moderate to High (-108)	Yes	Yes	Major	MESDP

Mitigation Measures for Utilities Consumption

There will need mitigation measures for electricity power consumption as follow:

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A reduction in energy consumption is also an important consideration in a pollution prevention program and in lowering the operational cost. There are several methods that can be employed to help conserve electricity, which include:

(a) Install energy and water meters to measure and control consumption throughout the facility;
(b) Implementing good housekeeping measures such as turning off equipment and lights when not in use;
(c) Use LED lights and/or lower wattage lamps;
(d) Using more efficient equipment when replacing old equipment (such as motors and transformer units);
(e) Installation of timers and thermostats to control heating and cooling; and
(f) Preventative maintenance of operational processes and pipes so as to improve efficiency and minimize losses.

(b) Minimizing Water Consumption

As the proposed project uses ground water for, cleaning and domestic uses, water conservation measures are needed to be taken. The reduction in the amount of water consumed in a project will have several environmental and economic benefits, including conservation of water resources, and consequently, lower wastewater discharge volumes. Water conservation during operation phase can be conducted as follows:

(a) Reducing process water use
(b) Minimizing domestic water consumption

Reducing Process Water Use: All of the cleaning water should be recycled and reused as the cooling purpose. Limewater from treatment plant must be recycled. This potentially allows less costly and less water consumption.

Minimizing Domestic Water Consumption: Domestic water consumption will be minimized by implementing water efficient fixtures such as 3 liters WC flushing cistern, sensor operated urinals and taps to minimize the wastage of water together with other water conservation measures if feasible. Furthermore, to ensure ongoing water conservation, an employee education and awareness programmed will be introduced for the employee of the proposed project. Dry type urinals will also be used selectively. The following are specific measures:

(a) Awareness campaign to disseminate knowledge on strategies and technologies that can be used for water conservation;

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(b) New employees will be issued standard water information packed. The information should include water conservation plans, water conservation methods being adopted in the complex and a list of essential and nonessential water uses;

(c) Manager of proposed project shall periodically remind the staff for water conservation efforts.

(d) Proper methods of water use will be placed in the toilets and other areas of water consumption.

6.9.3.6. Impacts on Socio-economic Impacts during Operation Phase

The anticipated socio-economic impacts during operation phase will be both positive and negative impacts as follow:

Positive Socio-economic Impacts during Operation Phase

The anticipated positive socio-economic impacts during operation phase are as follow:

(a) Employment Opportunities

The proposed project will create about 200 permanent jobs including managers, supervisors, housekeeping, technicians, general workers and security during operation phase.

Impact Significance of Employment Opportunities before Enhancement Measures

Increased employment will improve household income levels and increase livelihood of local people. According to the secondary data collections, there is significant number of unemployment in Amarapura Region as follow:

Workable People	Working People	Jobless People	Jobless Percentage
128417	126008	2409	1.8%

The study area features strong stereotypical gender roles, with the male partner the most likely to be receiving the primary income and the female partner either working part time or not at all. So, secured long term job opportunities for nearest villages are very important not only for elder household (male partner) but also for female partner. Job opportunities will provide an alternative livelihood to people in the project area other than going to Mandalay and Sagine for works. After attention of all factors, the impact rating can be considered as moderate without enhancement measures as follow:

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Components	Anticipated Impact	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Employment opportunities	Potential to increase in household income	Positive (+)	Local (+3)	Long term (+4)	High (+4)	Continuous (+5)	Probable (+3)	Moderate (+88)

Enhancement Measures for Employment Opportunities

Local people who have potential for office works will be afforded training opportunities and apprenticeship in project operational activities to ensure to support local community in obtaining employment opportunities. According to the secondary data, the literate rate of Amarapura Township is as follow:

Township Population	Population 15 Years and Older	Literate Population	Literacy Rate
0.185 million	0.138 million	0.177 million	95.6%

The above table means that there will have sufficient graduates for required jobs for proposed project. So, a large portion of these personnel can be sourced from local communities with sufficient training. So, MESDP will carry out advertising and disseminating information about employment opportunities that will be offered for local community in project operation in advance since the time of project construction period. By doing so, local people will acquire necessary skills and make preparation for the alternative livelihood that will contribute their substantial household income.

Impact Significance of Employment Opportunities after Enhancement Measures

Being a rural area, secure long-term job opportunities are important to sustain local economic development for nearest villages and the impact will be moderate to high after enhancement measures as follow:

Components	Anticipated Impact	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Employment opportunities	Potential to increase in household income	Positive (+)	Local (+3)	Long term (+4)	Moderate (+4)	Continuous (+5)	Certain (+5)	Moderate to High (+110)

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(b) Local Community Development Potential and Increased Living Standard

The project may provide opportunities for continued improvements in basic infrastructure, roads, supply of electrical power, provision of health care services and education and local skill development as part of CSR program. Moreover, CSR fund will also help to improve local community development in addition to the Government Supports. All of these can also potential for local community development and increased living standard for long run.

Impact Significance of Local Community Development Potential and Increased Living Standard without Enhancement Measures

According to the primary data collection by household survey improvement in roads & bridge, health care services, electricity, retaining wall for preventation of river bank, fire fighting facilities, education and skill development will be the essential things and basic needs for local community development as follow:

Village Name	Most Public Needs
Shwe Kyat Yat **village tract** (***Padamyar Ward, YwaThit, ThatKeTaw, KaWar, TaPyanTen***)	• Expanding and upgrading of village road • Upgrading of education services • Getting of electricity • Supporting Fire-engine
PhoneTawNainKan village tract (***PhoneTawNainKan, TaBaitTann, LatYway, LatTitYat, HlayGyiTan***)	• Upgrading of education services • Supporting to sub rural health center • Supporting of river retaining Wall • Getting of electricity • Supporting Fire-engine
That Gyi	• Job opportunity • Getting of electricity • Upgrading of road • Supporting of retaining wall
Oe Htoke Tan village tract (***OeHtokeTan, LayThar***)	• Getting of electricity • Upgrading of road • Upgrading of Primary School to High School • Supporting of river retaining wall • Upgrading of Health Care

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Being a developing area, increased in social services will be great benefit to the development of local community in short term. So, the impact will be rated as low to medium as follow:

Components	Anticipated Impact	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Local community development potential	Social services development	Positive (+)	Local (+3)	Long term (+4)	Medium (+4)	Intermittent (+2)	Probable (+3)	Low to Moderate (+55)

Enhancement Measures for Local Community Development Potential and Increased Living Standard

This positive impact of the project can be enhanced by adjusting allocation of CSR budget and giving priority for CSR activities relevant to community immediate needs each year. According to the social survey, it would be better to support the road up within the villages, health care facilities and educational supports for local people are the most of the public needs and it will also support community development. MESDP will use at least 2% of annual net benefit after tax for every year in CSR activities. MESDP also has well-established policies and plans for CSR budject allocation (skill-building, providing healthcare services, assisting education, and social-welfare activities) after discussion with representatives from local authorities and CBOs. So, with enhancement measures, CSR program will be the basic and essential needs for local community development every year.

Impact Significance of Local Community Development Potential and Increased Living Standard after Enhancement Measures

The significant of impact will be considered as moderate after enhancement measures as follow:

Components	Anticipated Impact	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Local community development potential	Social services development	Positive (+)	Local (+3)	Long term (+4)	Medium (+4)	Regular (+3)	Highly Probable (+4)	Moderate (+77)

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(c) Benefits to National Economy

The project operation will pay revenues in terms of taxes paid to the government and multiplier effect arising from its linkages to other sectors (low cost for fuel oil will directly benefit to low price for transportation).

Impact Significance of Benefits to National Economy before Enhancement Measures

Being a developing country, taxes from proposed project are important for national economy. Moreover, the decrease in transportation cost will also help to improve national economy. So, this positive impact will be considered as moderate before enhancement measures as follow:

Components	Anticipated Impact	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Income in government revenue	Benefit to national economy	Positive (+)	Regional (+5)	Long term (+4)	Moderate (+4)	Rare (+1)	Highly Probable (+4)	Low to Moderate (+65)

Enhancement Measures for Benefits to National Economy

MESDP will creat responsible taxes paying system to local or national government. MESDP will work in hand in hand with local taxes office and external audit will be carried out regularly for transparency.

Impact Significance of Benefits to National Economy after Enhancement Measures

After enhancing efficient and responsible tax paying system, this positive impact will be moderate to high after enhancement measures as follow:

Components	Anticipated Impact	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Income in government revenue	Benefit to national economy	Positive (+)	Regional (+5)	Long term (+4)	Moderate (+4)	Rare (+1)	Certain (+5)	Moderate (+78)

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(d) Benefits to Local Economy

The project will help to improve in local economy by creating related services for transportation, food supply and vehicles repair during operation phase. Private health care facility will also need for proposed project and this will be benefit for local doctor. All of these things will help to improve local economy in short term.

Impact Significance of Benefits to Local Economy before Enhancement Measures

The impact rating for benefit to local economy will be considered as follow:

Components	Anticipated Impact	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Income in local revenue	Benefit to local economy	Positive (+)	Local (+4)	Long term (+4)	Moderate (+4)	Regular (+3)	Probable (+3)	Low to Moderate (+72)

Enhancement Measures for Benefits to Local Economy

MESDP will give pressure to construction services provider to buy consumable goods and foods for workers from local market as first priority if feasible. This agreement will prepare to include in agreement contract with construction services providre(s).

Impact Significance of Benefit to Local Economy after Enhancement Measures

After enhancement measures, impact can be rated as moderate as follow:

Components	Anticipated Impact	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Income in local revenue	Benefit to local economy	Positive (+)	Local (+4)	Long term (+4)	Moderate (+4)	Regular (+3)	Highly Probable (+4)	Moderate (+84)

Negative Socio-Economic Impacts during Operation Phase

The anticipated negative socio-economic impacts during operation phase are as follow:

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(a) Increase in Crime and Conflict with Local People

An inflow of migrant workers to the proposed project during operation phase will increase in social pathologies and crime including drug and alcohol abuse, assault, theft and violence. There will also have potential to conflict with workers and local people during the operation phase. This will intend to increase demand on education, health, emergency and police services due to population influx.

Impact Significance of Increased in Crime and Conflict with Local People before Mitigation Measures

The impact will be considered as medium without mitigation measures as follow:

Components	Anticipated Impact	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Increase crime and security	Public security	Negative (-)	Limited (-2)	Long term (-4)	Medium (-4)	Intermittent (-2)	Probable (-3)	Low (-50)

Mitigation Measures for Increased in Crime and Conflict with Local People

The use of local people will greatly reduce the probability of increased in crime and conflict with local people. Unskilled job opportunities like security and housekeeping will be offered to the local communities as much as possible. MESDP will prepare the basic salary as high as to attrack local people to work in project site. MESDP will continue to work with the local and regional police personnel and local administrative members in the resolution of potential increase in crime and violence. Project area will be fenced to avoid the conflict on resources use with local people.

Impact Significance of Crime and Security after Mitigation Measures

After systematically control of migrant workers and continuous cooperation with local administrative office and police force, the impact will be low as follow.

Components	Anticipated Impact	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Increase crime and security	Public security	Negative (-)	Limited (-2)	Long term (-4)	Medium (-4)	Rare (-1)	Seldom (-2)	Low (-30)

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(e) Impacts Associated with Population Influx

A possible population influx due to the migrant workers during operation phase will increase pressure on existing infrastructure and social services including health care, food, water, and recreational facilities. Services (transportation, sight seeing, ferryboat for Innwa Old City, food supply etc.) for local and foreign visitors to Innwa Old City will also be provided by migrant workers and will be conflict with local people.

Significant of Impacts Associated with Population Influx without Mitigation Measures

According to the secondary data collection from local administrative office, the ratio of teacher to pupil is between 1:25 to 1:30 and this is good condition for educational services because the matriculation examination pass percent of BEHS (Shwe Kyat Yat) is 100% in year of 2016- 2017. Moreover, there is not enough service for health care (1:5615) in Amarapura Region and municipal services (not enough sanitation and domestic wastes services by MCDC). So, impact related with population influx will be moderate as follow:

Components	Anticipated Impact	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Increase pressure on housing, recreational facilities, health care, water and food	Public anxiety	Negative (-)	Limited (-2)	Long term (-4)	Medium (-4)	Very often (-4)	Probable (-3)	Moderate (-70)

Mitigation Measures for Impacts Associated with Population Influx

All of the impacts associated with population influx will be minimized by the use of local labor force. Self health care facilities and dormitory for migrant workers will be supported to additional workers during operation period. MESDP will dispose solid and liquid wastes with no pressure on local municipal services. Being a developing rural area, people in nearest villages are not ready for extra food and facilities for additional people. So, MESDP will have to ensure the use of local people as much as possible.

Significant of Impacts Associated with Population Influx after Mitigation Measures

Impacts due to population influx will be low after mitigation measures as follow:

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Components	Anticipated Impact	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Increase pressure on housing, recreational facilities, health care, water and food	Public anxiety	Negative (-)	Limited (-2)	Long term (-4)	Medium (-4)	Intermittent (-2)	Seldom (-2)	Low (-40)

(e) Fire Outbreak Risk

Although fire outbreak risk in Amarapura Region is Category C (ARI 100) according to the disaster risk assessment based on secondary data collection, there will have potential to fire outbreak risk due to the population increase and nature of oil storage facilities.

Type of Disaster	Frequency	Building Losses	Value
Fire	7	37	193.2 Million Kyats

Impact Significance of Fire Outbreak Risk without Mitigation Measures

According to the survey, the project site is a little far from local fire fighting force and had limited fire-fighting capacity. So, the impact can be rated as medium although Amarapura Region is Category C (ARI 100) of fire disaster.

Components	Anticipated Impact	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Fire outbreak risk	Project and public security	Negative (-)	Local (-3)	Long term (-4)	High (-5)	Rare (-1)	Probable (-3)	Low (-44)

Mitigation Measures for Fire Outbreak Risk

MESDP will set up their own fire fighting force and fire fighting system. Fire service personnel should be assigned and well trained on how to prevent fire, how to use fire-fighting equipment, and emergency response actions. MESDP will adhere both of the fire fighting rules and regulations of NFPA and local fire fighting rules of the Ministry of Home Affairs and will collaborate with regional fire brigade in the prevention of fire outbreak and training section.

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Impact Significance of Fire Outbreak Risk after Mitigation Measures

After consideration of all of the mitigation measures for fire outbreak risk and systematically composed of fire fighting team, impact rating can be reduced as low as follow:

Components	Anticipated Impact	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Fire outbreak risk	Project and public security	Negative (-)	Local (-3)	Long term (-4)	High (-5)	Rare (-1)	Very Seldom (-1)	Very Low (-24)

6.9.3.7. Anticipated Health Impact and Mitigation Measures during Operation Phase

Although there are not many factories along the rivers, water can be polluted due to the spills and leakage of fuel oil and soil, ground water and surface water can be polluted within the miles of its radius. The following will be the anticipated positive and negative health impacts of the operation of proposed project.

(a) Increase Risk of Sexually Transmitted Infections

Increased risk of sexually transmitted infections such as HIV/AIDS, gonorrhoea and chlamydia will be continued during operation phase because there will be KTV and massage related to the increased in population due. Major outbreaks of infectious diseases can have a devastating effect not only on or near the proposed plant site but also on local communities. Moreover, the influx of large groups of, generally, male workers can sometimes lead to social unrest which may include violence and sexual assault in Amarapura region. Similarly, an increase in commercial sex workers (CSW) can have significant, long term, negative individual and community health and wellbeing impacts. It will also impact on custom of local people who were lived in Ancient City.

Impact Significance of Risk of Sexually Transmitted Infections

Increased transmission of sexually transmitted infections and other social harms can cause serious health problem for local people. According to the secondary data collection, there are 488 persons who suffer HIV/AIDS in the Amarapura Region (in 2016-2017). So, impact rating for sexually transmitted infection can be considered as high.

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Who will affected?	Magnitude/Consequence of impact			Likelihood/Probability of impact			Health Impact Significance Rating		
	Low	Medium	High	Unlikely to occur	Likely to occur sometimes	Likely to occur often	Low	Medium	High
Local people in nearest residents	-	-	√	-	√	-	-	-	√ (HIR 3)

Mitigation Measures for Risk of Sexually Transmitted Infections

To protect local communities in case of disease outbreaks among the workforce, a premedical examination for workers will be conducted, followed by routine medical examination during the works and a final post medical examination. MESDP will review sexually transmitted infection clinic access and education to reduce spread of sexually transmitted infections within the community. MESDP will also provide information and education to workers about safe sex and implement HIV control program for migrant workers per year or accordingly.

(b) Impact on Community Wellness

The commencement of proposed project may stimulate some forms of social pathologies and crime including increased substance abuse, drugs, thief, crime, human trafficking and decreased social cohesion. It will impact on mental health of people in nearest villages.

Impact Significance of Impact on Community Wellness

Impact significance of impact on community wellness will be as follow:

Who will affected?	Magnitude/Consequence of impact			Likelihood/Probability of impact			Health Impact Significance Rating		
	Low	Medium	High	Unlikely to occur	Likely to occur sometimes	Likely to occur often	Low	Medium	High
People in nearest residents	√	-	-	-	√	-	√ (HIR 1)	-	-

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Mitigation Measures for Impact on Community Wellness

MESDP will do the following ways to reduce the potential impact to community wellness.

1. Establish a mechanism to facilitate on-going community engagement between the local authorities and local residents for early identification of impacts on community wellness.
2. Implement smoking and drug free zone.

6.9.3.8. Impacts of Increased in Traffic

Operation activities will lead to increased traffic to and from the site (office use vehicles, oil tanker and oil bowser). This will lead to an increase the risk of accidents to employees and in the local community as well as present the potential for nuisance from the increase or if the traffic presents delays to the public. Additionally, any transported material in and out of the site will be secured correctly, to avoid a hazard and further increase the rates of accident and injury. According to the traffic study, the public road outside the project compound already have traffic congestion due to the travelling of visitors to Innwa ancient dynasty especially in holidays.

Mitigation Measures for Increased in Traffic

Alternative road will be used to reduce traffic. If it is not feasible to use alternative road (not permission by the related local authorities), existing road will be upgraded. Traffic in and out of the project will proceed in a clearly designated route and according to specified speed limits, to decrease congestion and increase safety of operations. A traffic control plan will be developed and will take into account the reservations and inputs of local communities.

To decrease the risk of vehicular road traffic accidents, all drivers will be adequately trained, licensed and all vehicles will be well maintained with regular maintenance checks and up to date records. All drivers will be instructed to fully abide by driving laws and speed limits.

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6.9.3.9. Impacts on Cultural and Heritage

The proposed project is seriously included in the ancient cultural heritages of Innwa Old City and Tha Bye Dan Fortress. According to the field assessment data, it was already started by construction process but recently the project was stopped by the necessary of EIA process including CHIA. It must be continued to save the 14th century cultural heritage.

Impact Significance for Cultural and Heritage

According to the ICOMOS HIA guideline 2011, the severity impact is moderate and type of impact is indirectly and visually on the heritage area. The acceptability is challenged with the some threats and the monitoring process for this acceptable condition must be prepared. Archaeologically, the project area is very important to take care for cultural resource management. The boundary of project area must be associated with the authenticity of ancient cultural landscape. Here, the meaning of cultural landscape is concerned with the vegetation, land use, ancient monuments and its associated community.

Summing up, the common result of cultural assessment in the project area is severer with the references of field surveying data. Acceptable condition of CHIA result clearly found in this project area must be taken with the mitigation plan. The developers must follow the mitigation plans to be continued their construction project and some further phases of operation and decommissioning.

Mitigation Measures for Impact of Cultural and Heritage

The possible impacts on the cultural heritage and its landscape are indirectly and visually impacts on the ancient landscape including the cultural features of architecture and landscapes. There are (11) mitigation plans depending the measurement impacts in and around the project area as follows;

1. To reduce the indirect impact, the boundary will be demarcated 40 m away from the edge of ancient monument zone (especially from Tha Bye Dan Fortress).
2. The height of any project buildings will be limited as 10 m *or* the maximum height allowed by the Heritage Authority as Department of Archaeology and National Museum (DoANM).

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3. To be responsible for the preservation of cultural heritage and landscapes including Innwa Old City, Ava Bridge and Tha Bye Dan, the project developers will participate with the heritage authority and negotiate with DoANM; to reduce the visual impacts between the boundaries of project area and the ancient monument zones, the buffer area (40m) must be accepted with the particular landscape; signage for cultural heritage, and monitoring to do stewardship for the cultural landscape; e.g. the signage composed with the full information about cultural significance related to the Oil Storage Tanks project area must be founded to know the peoples and observers.
4. To reduce the visual impacts on the cultural landscape, tall green trees and some fence-bushes must be grown along the fence of the project area for covering the visual pollutants e.g. the geometric design of oil storage tanks and standard colours (White or some brilliant colours). The area of green space must be placed outside the fence of project area and it must be 40 m wide in minimum.
5. To reduce the visual impacts on the ancient architectural features, the colour must be green and red-brown on the taller structures like tower, overhead water tanks etc. If the colour cannot be changed to green or red-brown, the covering system must be arranged not to see the inappropriate vision inside the cultural landscape. For example, growing tall green trees along the fences is more suitable for covering the visual impacts in four directions.
6. To consider the water way and jetty importantly associated to the project area, the northern and eastern river bank of Innwa City Wall must be carefully preserved to make retaining walls with the collaboration of DoANM and some associated authorities of government sectors and rules of laws.
7. The developers must provide to make Archaeological Risk Management Plan (ARMP) to attach the Disaster Risk Management Plan (DRMP) for project operation and local community.
8. Archaeological Risk Management means the management for the potential risks of cultural heritage and its dangers. Additionally, the causes of deterioration will be measured and collected to make database system. Then, it can be available when the surprise risks may come out, e.g. earthquake, flash flood, vandalism, and encroachment problems.

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9. Because the project area is including and associated to the ancient cultural heritage landscape, the developers must be responsible to make monitoring and preservation for the cultural landscape more than other peoples. In this way, the developers must consider the collaborative works for the preservation of cultural heritage process, e.g. monitoring system, rescue alarm system, public awareness system.
10. In monitoring system, local peoples, developers' staffs, government staffs, scholars from third party organization must be involved. According to the monitoring process, the report or new letters must be delivered monthly *or* yearly. In this monitoring report, the condition of cultural heritage must be described whether or not the deterioration may be come out depending on the project operational workload.
11. To make awareness about the safety of Oil Storage Tanks and the technical point of view, the developers must attempt to announce what the techniques are safe appropriately for constructing oil storage tanks and the threat of fire case. For example, the signage with the safety information and profiles of construction techniques about oil storage tanks must be founded in the public area. In this way, the tourists and the peoples can easily know what the safety arrangement of oil storage tanks were already planned and constructed.
12. To reduce vibration impact due to the travelling of oil bowser, slow down will make in front and near the heritage sites.

6.9.3.10. Impacts on Employee Health and Safety

Potential Impacts on Workers during Construction Phase

Occupational health and safety issues associated with oil storage facilities primarily include the following:

(a) Over-exertion

Over-exertion, and ergonomic injuries and illnesses, such as repetitive motion, over-exertion, and manual handling, are among the most common causes of injuries in construction site.

Mitigation Measure

- Training of workers in lifting and materials handling techniques in construction and decommissioning, including the placement of weight limits above which mechanical assists or two-person lifts are necessary;
- Planning work site layout to minimize the need for manual transfer of heavy loads;

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- Selecting tools and designing work stations that reduce force requirements and holding times, and which promote improved postures, including, where applicable, user adjustable work stations; and
- Implementing administrative controls into work processes, such as job rotations and rest or stretch breaks.

(b) Slips and Falls

Slips and falls on the same elevation associated with poor housekeeping, such as excessive waste debris, loose construction materials, liquid spills, and uncontrolled use of electrical cords and ropes on the ground, are also among the most frequent cause of lost time accidents at construction site.

Mitigation Measure

- Implementing good house-keeping practices, such as the sorting and placing loose construction materials or demolition debris in established areas away from foot paths;
- Cleaning up excessive waste debris and liquid spills regularly;
- Locating electrical cords and ropes in common areas and marked corridors; and
- Use of slip retardant footwear.

(c) Work in Heights

Falls from elevation associated with working with ladders, scaffolding, and partially built or demolished structures are among the most common cause of fatal or permanent disabling injury at construction site.

Mitigation Measure

- Training and use of temporary fall prevention devices, such as rails or other barriers able to support a weight of 200 pounds, when working at heights equal or greater than two meters or at any height if the risk includes falling into operating machinery, into water or other liquid, into hazardous substances, or through an opening in a work surface
- Training and use of personal fall arrest systems, such as full body harnesses and energy absorbing lanyards able to support 5000 pounds (also described in this section in Working at Heights above), as well as fall rescue procedures to deal with workers

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whose fall has been successfully arrested. The tie in point of the fall arresting system should also be able to support 5000 pounds.

- Use of control zones and safety monitoring systems to warn workers of their proximity to fall hazard zones, as well as securing, marking, and labeling covers for openings in floors, roofs, or walking surfaces.

(d) Struck by Objects

Construction and decommissioning activities may pose significant hazards related to the potential fall of materials or tools, as well as ejection of solid particles from abrasive or other types of power tools which can result in injury to the head, eyes, and extremities.

Mitigation Measure

Techniques for the prevention and control of these hazards include:

- Using a designated and restricted waste drop or discharge zones, and/or a chute for safe movement of wastes from upper to lower levels
- Conducting sawing, cutting, grinding, sanding, chipping or chiseling with proper guards and anchoring as applicable
- Maintaining clear traffic ways to avoid driving of heavy equipment over loose scrap
- Use of temporary fall protection measures in scaffolds and out edges of elevated work surfaces, such as hand rails and toe boards to prevent materials from being dislodged
- Evacuating work areas during blasting operations, and using blast mats or other means of deflection to minimize fly rock or ejection of demolition debris if work is conducted in proximity to people or structures
- Wearing appropriate PPE, such as safety glasses with side shields, face shields, hard hats, and safety shoes

(e) Moving Machinery

Vehicle traffic and use of lifting equipment in the movement of machinery and materials on a construction site may pose temporary hazards, such as physical contact, spills, dust, emissions, and noise. Heavy equipment operators have limited fields of view close to their equipment and may not see pedestrians close to the vehicle. Center-articulated vehicles create

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a significant impact or crush hazard zone on the outboard side of a turn while moving.

Mitigation Measure

Techniques for the prevention and control of these impacts include:

- Planning and segregating the location of vehicle traffic, machine operation, and walking areas, and controlling vehicle traffic through the use of one-way traffic routes, establishment of speed limits, and on-site trained flag-people wearing high-visibility vests or outer clothing covering to direct traffic
- Ensuring the visibility of personnel through their use of high visibility vests when working in or walking through heavy equipment operating areas, and training of workers to verify eye contact with equipment operators before approaching the operating vehicle
- Ensuring moving equipment is outfitted with audible back-up alarms
- Using inspected and well-maintained lifting devices that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job-site elevations.

(f) Dust

Dust will be emerged from vehicle movement, construction operation.

Mitigation Measure

- Dust suppression techniques will be implemented, such as applying water or non-toxic chemicals to minimize dust from vehicle movements; and
- PPE, such as dusk masks, will be used where dust levels are excessive.

(g) Confined Spaces and Excavations

Examples of confined spaces that may be present in construction site include: silos, vats, hoppers, utility vaults, tanks, sewers, pipes, and access shafts. Ditches and trenches may also be considered a confined space when access or egress is limited.

Mitigation Measure

The occupational hazards associated with confined spaces and excavations in construction site will be prevented according to the following ations:

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- Controlling site-specific factors which may contribute to excavation slope instability including, for example, the use of excavation dewatering, side-walls support, and slope gradient adjustments that eliminate or minimize the risk of collapse, entrapment, or drowning.
- Providing safe means of access and egress from excavations, such as graded slopes, graded access route, or stairs and ladders
- Avoiding the operation of combustion equipment for prolonged periods inside excavations areas where other workers are required to enter unless the area is actively ventilated

Potential Impacts on Workers during Operation Phases

Occupational health and safety issues associated with oil storage facilities primarily include the following:

(a) Exposure to HFO

Acute exposure to petroleum hydrocarbons can occur as well as by any accidental spills or leaks. This exposure may be detrimental to those with breathing disorders and can lead to an exacerbation of symptoms of asthma and chronic bronchitis. Fatigue, headache, nausea and drowsiness can occur from inhalation of some petroleum constituents at high concentrations. Skin irritation can also occur. Chronic exposure to certain components of petroleum products can lead to increased incidences of cancer in exposed employees or nervous system damage.

Mitigation Measures

All activities and operations of the oil storage depot will be discontinued followed by immediate clean up measure (using tools such as shovel, rake, scraper, etc.) of the oil spillage by the personnel and proper equipment. In addition, the workers involved in the clean-up measures are provided with proper personal protective equipment (PPE). Moreover, the following personal protection will be arranged for workers' safety and health.

- Provision for emergency decontamination showers and an eye wash;
- Employees engaged in product transfer operation including sampling, tank cleaning, pipeline connection/ disconnection, will wear adequate PPEs as identified during the pre-transfer safety briefing;

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- Emergency Reporting requirements and Emergency procedures will be discussed and displayed at relevant locations prior commencing transfer operation; and
- First aid kits will be kept available in the control room.

(b) Fire and Explosions

Fires and or explosions resulting from ignition of flammable materials or gases can lead to loss of property as well as possible injury or fatalities to project workers.

Mitigation Measure

Prevention and control strategies include:

- Storing flammables away from ignition sources and oxidizing materials. Further, flammables storage area will be:
  - Remote from entry and exit points into buildings
  - Away from facility ventilation intakes or vents
  - Have natural or passive floor and ceiling level ventilation and explosion venting o Use spark-proof fixtures
  - Be equipped with fire extinguishing devices and selfclosing doors, and constructed of materials made to withstand flame impingement for a moderate period of time
- Providing bonding and grounding of, and between, containers and additional mechanical floor level ventilation if materials are being, or could be, dispensed in the storage area · Where the flammable material is mainly comprised of dust, providing electrical grounding, spark detection, and, if needed, quenching systems
- Defining and labeling fire hazards areas to warn of special rules (e.g. prohibition in use of smoking materials, cellular phones, or other potential spark generating equipment)
- Providing specific worker training in handling of flammable materials, and in fire prevention or suppression

(c) Confined Space

A confined space is defined as a wholly or partially enclosed space not designed or intended for human occupancy and in which a hazardous atmosphere could develop as a result of the contents, location or construction of the confined space or due to work done in or around the confined space. A “permit-required” confined space is one that also contains physical or

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atmospheric hazards that could trap or engulf the person. Confined spaces can occur in enclosed or open structures or locations. Serious injury or fatality can result from inadequate preparation to enter a confined space or in attempting a rescue from a confined space.

Mitigation Measure

- Engineering measures will be implemented to eliminate, to the degree feasible, the existence and adverse character of confined spaces
- Permit-required confined spaces will be provided with permanent safety measures for venting, monitoring, and rescue operations, to the extent possible. The area adjoining an access to a confined space will provide ample room for emergency and rescue operations.
- Access hatches will accommodate 90% of the worker population with adjustments for tools and protective clothing.
- Prior to entry into a permit-required confined space:
  - Process or feed lines into the space will be disconnected or drained, and blanked and locked-out.
  - Mechanical equipment in the space will be disconnected, de-energized, locked-out, and braced, as appropriate.
  - The atmosphere within the confined space will be tested to assure the oxygen content is between 19.5 percent and 23 percent, and that the presence of any flammable gas or vapor does not exceed 25 percent of its respective Lower Explosive Limit (LEL).
  - If the atmospheric conditions are not met, the confined space will be ventilated until the target safe atmosphere is achieved, or entry is only to be undertaken with appropriate and additional PPE.
- Safety precautions will include Self Contained Breathing Apparatus (SCBA), life lines, and safety watch workers stationed outside the confined space, with rescue and first aid equipment readily available.
- Before workers are required to enter a permit-required confined space, adequate and appropriate training in confined space hazard control, atmospheric testing, use of the necessary PPE, as well as the serviceability and integrity of the PPE will be verified. Further, adequate and appropriate rescue and / or recovery plans and equipment should be in place before the worker enters the confined space.

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(d) Handling of Hazardous Material and Oils

By virtue of the nature of the project, employees will need to handle fuel oil. In addition, risk of exposure to petroleum products will be increased should spill and leak, and emission prevention procedures not be correctly applied. Acute exposure to petroleum hydrocarbons can be detrimental to those with breathing disorders and can lead to an exacerbation of symptoms of asthma and chronic bronchitis. Fatigue, headache, nausea and drowsiness can occur from inhalation of some petroleum constituents at high concentrations. Skin irritations can also occur. Chronic exposure to certain components of petroleum products can lead to increased incidences of cancer in exposed employees or nervous system damage. The consequence of short-term exposure will potentially be limited, where an employee that notices effects may require medical attention and miss several days of work, or notice recurring symptoms as the work continues.

Mitigation Measures for Hazardous Material

To decrease risks from handling hazardous materials and oils during operation activities, the mitigation measures will include the following:

- Oil Storage tanks and components will meet international standards for structural design integrity and operational performance to avoid catastrophic failures during normal operations, and during exposure to natural hazards and to prevent fires and explosions. Applicable international standards typically include:
- Provisions for overfill protection (level gauges, alarms, and automatic cutoff systems)
- Metering and flow control
- Grounding to prevent electrostatic charge buildup
- Oil Storage tanks will have appropriate secondary containment, including procedures for the management of containment systems. Secondary containment design needs depend on the type of tank, the nature and volume of the material(s) being stored.
- Installation of impervious asphalt or concrete surfaces with polyethylene sheeting underneath in areas of potential petroleum leaks and spills, including below gauges, pipes, and pumps.
- Oil Storage tanks and components (e.g. roofs and seals) will undergo periodic inspection for corrosion and structural integrity and be subject to regular maintenance and replacement of equipment (e.g. pipes, seals, connectors, and valves).

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- The facility have to develop a spill prevention and control plan that addresses significant scenarios and magnitudes of releases. The plan have to be supported by the necessary resources and employee training. Adequate spill response equipment must be conveniently available to address the most likely types of spills. Where appropriate, spill control and response plans will be developed in coordination with the relevant local regulatory agencies.
- The replacement fuel storage tanks will be built on the secure area, protected from potential collisions by vehicles, vandalism, and other hazards.
- Tank sludge and spill cleanup materials will be managed via re-processing for product recovery or at an MCDC approved waste facility licensed to handle this type of material in an environmentally sound manner.
- All containers of hazardous chemical substances will be stored in a suitable, safe and locked area, and will be clearly labeled with Material Safety Data Sheets made available.
- All workers dealing with hazard substances will be adequately trained in using the correct PPE when handling these materials.
- Hazardous waste will be stored in a secure area, and disposed of according to environmental guidelines.

6.3.9.11. Risk Assessment and Management

The possible risks in proposrd project will be fire and explosion, earthquake and flood as follow:

(a) Fire and Explosion Hazard

Onsite transport and storage of fuel oils lead to an increased risk of fire at the project site. Fire can also occur due to failure of hole to be equipment at the project location, and due to accidents.

Mitigation Measures for Fire and Exploration Hazards

Oil storage facilities will be designed and operated according to international standards for the prevention and control of fire (API 650 standards) and explosion hazards including provisions for distances between tanks in the facility, and between the facility site boundary and adjacent buildings.

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Implementing safety procedures for loading and unloading of product to transport systems (e.g. tanker trucks, and vessels), including use of fail safe control valves and emergency shutdown equipment;

The Fire Prevention Plan and Emergency Preparedness and Response Plan (EPRP) will assist Project staff in effectively responding to emergencies associated with project hazards event such as fires and explosion.

(b) Earthquakes Risk

The proposed project site at the confluence of Ayeyarwady and Myitnge rivers is located in a seismotectonically active region. The site is very close to (1 km away from) the Sagaing Fault, a potential seismic source, that has been responsible for the significant earthquake events. A future major earthquake in the region could have devastating consequences. As the area indeed is earthquake prone, possible adverse consequences (earthquake-induced natural hazards) of the construction site were identified and highlighted, based on the bedrock geology, soil characteristics, tectonic geomorphology, macroseismic zone map and microseismic zone map, liquefaction susceptibility map and past seismic events of the area.

(i) Prehistoric Events

Very recently Myint Thein (2016) described the paleoseismicity of the Sagaing area on the basis of earthquake-induced soft-sediment-deformation-structures (seismites) preserved in the Early Pleistocene fluvial deposits exposed at north of Sagaing. The field evidences indicate that at least 4 strong earthquake events with magnitude > 5.0 occurred in the Sagaing area during a time span of 1 million years.

(ii) Historic Events

Besides instrumentally recorded earthquake data, the historic earthquake events have also been preserved in the form of religious inscriptions which record damage and renovation through about the 2000 years (Win Swe in Wang et al., 2011). The historic records indicate that the Innwa-Sagaing-Mandalay area had been struck several times by strong and major earthquakes in the past (see Table 6.1).

The Innwa area was repeatedly hit (eg. 1469, 1485, 1619, 1688, 1704,1776, 1830,and 1839) by disastrous earthquakes. The new capital Amarapura and the old capital Ava were severely devastated by a large earthquake of Ava. The Ava Earthquake, occurred at about 4 a.m on 23 March 1839 was a very severe and destructive one, but its magnitude was not recorded, because it occurred before the modern seismographs were not yet in use.

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Table 6.1. List of Historic Earthquakes

No.	Date of Earthquake	Remarks
1	1429 AD	Some pagodas in the area damaged or collapsed
2	1469 AD	Pagodas both solid and hollow, and brick monasteries destroyed
3	1485, July 24	Yadana, Kannartawya and Sinmyashin pagodas collapsed
4	1501	Pagodas and other masonry works in the area destroyed
5	1588	Many pagodas collapsed
6	1590	Ponnyashin and Htuparyon pagodas collapsed
7	1619,Jun 08	Some pagodas in Sagaing damaged, ground surface broken
8	1644	Damage mostly in Sagaing
9	1660	It was said that there was a quake in the area
10	1688	Some pagodas heavily damaged; ground cracked
11	1696, Sept 15	Some pagodas, including Shwesaryan and Thihadaw damaged
12	1704, Aug 08	Pagodas fell, water from the river rushed into the city of Innwa
13	1768	Local and even pagodas in Bagan were destroyed
14	1771, July 15	Earthquake hit Innwa, probably not severe
15	1776, June 09	Shwesaryan pagoda as well as many in Innwa collapsed
16	1830, April 26	A strong shock at Innwa
17	1839, March 23	Old palace and many buildings in Innwa demolished
18	1858	Some damage in the area
19	1956, July 16	Sinmyashin and several orther pagodas severely damaged
		(From various Myanmar sources)

The shock was accompanied by a tremendous roar and lasted about 30 seconds. During this earthquake, the banks of Myitnge River between Amarapura and Ava rent in many places, forming chasms, 5 to 20 feet in width, and large quantities of water and sand of black appearance (sand blows) were ejected (Chhibber, 1934). The 27 m high Palace Watch Tower in Ava was tilted, due to soil liquefaction. The estimated deaths were about 400, including a large number of monks buried under collapsed brick monastries. The unfinished colossal Mingun Pagoda (the world's biggest brick pile) was severely damaged and shattered. The shaking was felt in Bahmo, Yangon and 620 km away in Mawlamyaing. Numerous after-shocks, some of which were fairly strong, followed a short intervals of 4 to 5 days, immediately after the main shock and six months thereafter scarcely a day passed without an after-shock (see Chhibber, 1934). During August 8, 1704 Earthquake, the city of Ava, located at the confluence of Ayeyarwady and Myitnge, was unexpectedly inundated due to failure of an embankment (Thawbita, 1976).

(iii) Recent Events

The Sagaing Earthquake, occurred at 15: 07 hours GMT on 16 July 1956, had a magnitude of 7.0 on the Richter scale. Its epicenter was located near Sagaing with a depth between 8 and 10 km. The earthquake was destructive causing property damage at Mandalay and damaging 80% of the buildings, including Sinmyashin and Htupayon pagodas in Sagaing as well as

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causing 50 casualities. The Ava Bridge was reported to have been displaced about 10 cm on the Innwa side. Recently several light to moderate earthquakes, up to Richter Magnitude 5.0, occurred just north of Sagaing. Rupture along the Kyaukkyan Fault, 50 km to the east of Mandalay, caused Maymyo (Pyin Oo Lwin) Earthquake on 23 May 1912, and damage was severe in Maymyo with a moment magnitudeof 8.0, but resulted in minimum damage in Mandalay.

(iv) Recurrence Intervals

Based on analysis of historical seismicities and tectonic geomorphology, Wang et al.(2014) and Soe Thura Tun & Watkinson (2017) suggest that whole segment failures resulting in C. Mw 7.7 earthquakes should occur every 300-400 years, and that partial failures expressed by Mw 6.8-7.0 earthquakes decadal recurrence intervals. Examples of the latter include the partial failure of the Sagaing Segment at Thabeikkyin in 2012 just 66 years after 1946 Mw 7.7 failure, and the failure of Indaw Segment in both 1946 and 1991.

Earthquake Hazard Assessment

Seismic Zone Maps

The Seismic Zone Map of Myanmar consists of five seismic zones: Zone I (Low Zone), Zone II (Moderate Zone), Zone III (Strong Zone), Zone IV (Severe Zone), and Zone V (Destructive Zone). These zones have been named following the nomenclature of the European Macroseismic Scale 1992. The map shows that the construction site lies in the Sagaing-Tagaung Segment with greater earthquake hazard, and possible maximum intensity may be MM IX (i.e. major damage).

The Innwa–Amarapura-Mandalay area indeed is earthquake prone with a long history of earthquakes. This is due to the fact that the Sagaing Fault, which is seismically very active, passes through the western margin of the area with a velocity of 11.1-25.6 mm a-1 (Myint Thein, 2017). The Sagaing Fault is located about 1 km west of the construction site.The Seismic data of the Sagaing Earthquake of 16 July 1956 together with shear wave velocity conditions and soil conditions were used for line sources calculation of peak ground acceleration (PGA) values in upper 30 m using the formula Boore et al. (1993, in Eyn Keey and Maung Thein , 2007). The resulting microseismic zone map (Fig. 8) shows that PGA (Peak Ground Acceleration) values range from 0.25g in the east to 0.45g in the west. The PGA contours are subparallel to the nearly N-S trend of the major rock and soil units of the area. Three microseismic zones have been demarcated and named, following the nomenclature and PGA ranges used in the Seismic Zone Map of Myanmar (2005). These are Strong Zone (0.2-1.3g), Severe Zone (0.3-0.4g), and Destructive Zone (0.4-0.55g). The construction site lies in the Destructive Zone with greater earthquake hazard.

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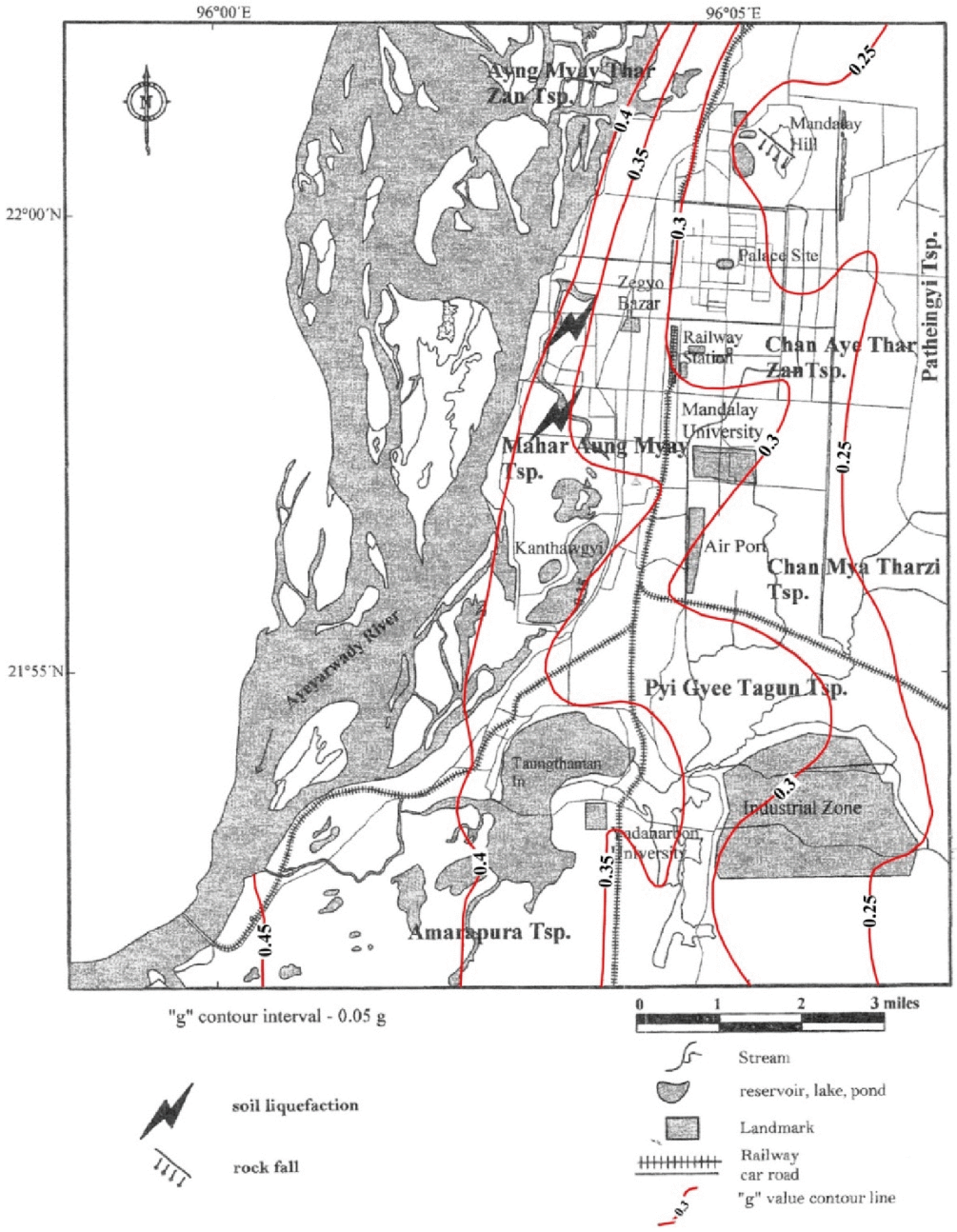

Figure 6.1 PGA contours and possible hazard from potential earthquake-induced ground failure in the Mandalay-Amarapura area. (Source: Eyn Keey 2006)

Possible Earthquake-Induced Hazards and Risks

It is rather important to note that the construction site is unfortunately situated on the sand-rich soil–zone (Soil Zone IV) at the confluence of the Ayeyarwady and Myitnge rivers.

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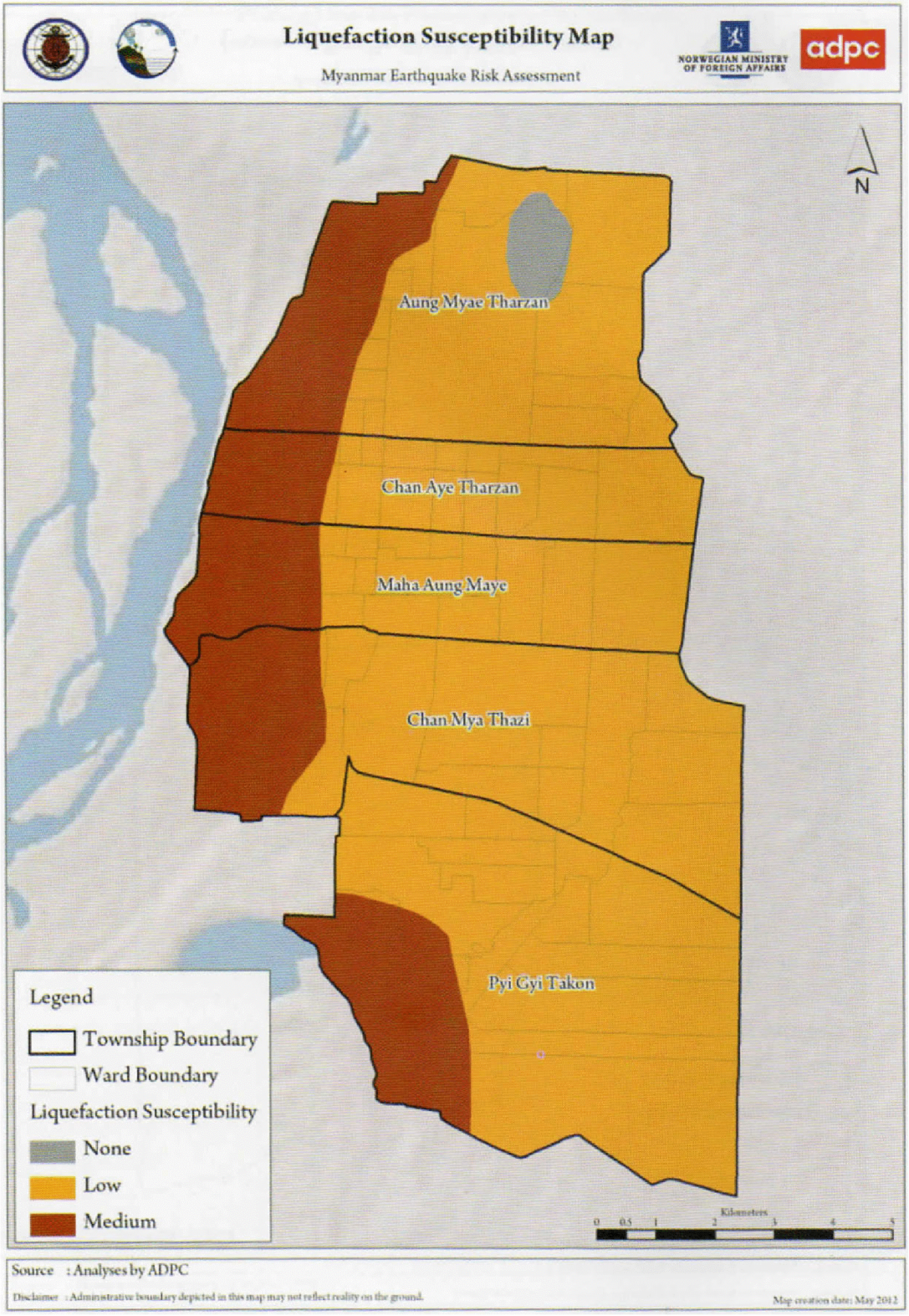

Figure 6.2. Liquefaction Susceptibility of Mandalay – Amarapura

This soil zone could also be water logged/saturated during the wet season. Besides, the PGA contour 0.45g of the Destructive Zone passes through the construction site (Fig 6.1). Consequently, the project area is susceptible to destruction (liquefaction) during severe

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earthquakes (see also Fig.6.2). This is because strong vibrations, created by severe earthquakes, tend to transform water–saturated sediments/soil materials into liquid–like state, due to increase in pore fluid pressure. As a result of this liquefaction phenomenon plus ground fracturing, even solid (RC) structures (including fuel storage tanks) could fell into the soil, leading to adverse effect (as an example see Fig. 6.3). It could have been even worse if the tanks were full of fuel. In a situation like the location of construction site at the confluence of Ayeyarwady and Myitnge rivers, fuel spillage could occur from the tilted and fallen tanks and the spilled fuel could be moved downstream and polluted the river environment. It could have been even worse if the earthquakes were to strike in July, August and September, the wet season, when the Ayeyarwady and Myitnge rivers were brim-full or flooding its banks and floodplain. Other consequences should also be taken into consideration, such as fire, earthquake-induced surging waves (river) and inundation.



Figure 6.3 Tilting and falling of R.C. buildings due to earthquake-induced

The Innwa-Amarapura-Mandalay area, in which lies the construction site, is a well known cultural hub located in a tectonically active region. The construction site is situated near the Sagaing Fault, a potential seismic source that has been responsible for significant earthquakes

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including the Ava (Innwa) Earthquake (1839) and the Sagaing Earthquake (1956). A future major earthquake in the region could have devastating consequences.

The earthquake hazard assessment of the construction site was made to provide the project personnel and general public with a realistic knowledge of severity and consequences of possible earthquake events. The main purpose of this report was to identify seismic hazard and consequences (potential damage) from possible earthquakes. Understanding consequences of severe earthquakes in the Innwa-Amarapura-Mandalay area in general and the construction site in particular, must allow project leaders to make proper plans.

In order to understand the underlying geo-facts of the region, which are products of the past and ongoing Earth's processes, tectonic setting, and both bedrock geology and surficial geology (soil zones) have been described, on the basis of author's own work and published materials. As the area indeed is earthquake prone, possible adverse consequences were highlighted. Use of seismic zone maps, liquefaction susceptibily map of the Mandalay-Amarapuran area and consideration of the physiography and the past seismic events of the area, have been made in an essential step to predicting seismic hazard and risk of the construction site.

The Sagaing Fault, like other major strike-slip faults of the world, is formed by Plate Tectonic processes and it is therefore the major source of great earthquakes. There is a strong possibility that a destructive earthquake could strike the region at any time, and unfortunately, there is still no way to predict an earthquake. In this context a good preparation in advance, before an earthquake strikes would reduce the effect of earthquakes, both injuries, financial losses and environmental deterioration.

Mitigation of Earthquakes Hazards for Environment

Although the oil storage tank cannot make site selection for low seismic activity, , the following factors need to be considered:

1. Site Survey
   - Conduct thorough studies on ground stability, soil type, and groundwater conditions.

2. Design and Construction
   - Use earthquake-resistant designs, such as reinforced concrete walls and materials capable of withstanding seismic forces.

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- Ensure the base and walls of the tank are properly sealed to prevent leaks.

3. Material Selection
   - Use earthquake-resistant materials like high-strength concrete, steel, and other durable materials.
   - Choose materials specifically designed for oil storage tanks.

4. Seismic Response Technologies
   - Incorporate seismic isolators to absorb earthquake shocks.
   - Design the tank to evenly distribute its weight and minimize stress during seismic events.
5. Safety and Maintenance
   - Regularly inspect and maintain the tank after construction.
   - Install emergency shut-off systems to prevent oil spills in case of an earthquake.
6. Compliance with Standards
   - Ensure the construction adheres to international and local seismic resistance standards.

Moreover, by following these guidelines, an oil storage tank can be built to withstand earthquakes effectively.

The Earthquake Hazard and Risk Assessment of the construction site was made to provide the project personnel and general public with a realistic knowledge of the severity and consequences of possible earthquake events.

(1) Given the future earthquake-induced hazards, it is recommended that necessary measures are to be taken, following earthquake-resistant building code, by using concrete piles and constructing earthquake-resistant dykes at the construction site, to reduce hazards and risks.

(2) Initially, the soil is tested for vulnerability to liquefaction. Geological studies identify the landfill sediments, and water table in a seismic region. Soil composed of a mix of small and big grains, can safely endure liquefaction, since the smaller grains fill the pores between the larger grains. Thus, the soil strength is maintained. Furthermore, oil storage tanks are designed to be liquefaction resistant. In a shallow foundation, the foundation constituents are joined to ensure uniform settlement of the foundation. Thus, the induced shear forces are decreased. The soil characteristics may also be

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enhanced by improving the soil density, strength, and drainage characteristics. Mitigation methods to reduce effects of soil liquefaction are:

- Mitigation by deep soil mixing method
- Compaction, Permeation, and Jet Grouting
- Drain Pile technique
- Dynamic compaction and construction of stone columns

Mitigation of Earthquakes Hazards for Worker Safety and Health

(1) Pick "safe places". A safe place could be under a sturdy table or desk or against an interior wall away from windows, bookcases or tall furniture that could fall on you. The shorter the distance to move to safety, the less likely that you will be injured. Injury statistics show that people moving as little as ten feet during an earthquake's shaking are most likely to be injured.

(2) Practice drop, cover, and hold-on in each safe place. Drop under a sturdy desk or table and hold on to one leg of the table or desk. Protect your eyes by keeping your head down. Practice these actions so that they become an automatic response.

(3) Practice these safe earthquake procedures (i.e., drop, cover, and hold-on) at least twice a year. Frequent practice will help reinforce safe behavior. When an earthquake or other disaster occurs, many people hesitate, trying to remember what they are supposed to do. Responding quickly and automatically may help protect you from injury.

(4) Make a plan for workers to follow in the event of an earthquake and be sure that it includes the following precautions:

(5) Wait in your safe place until the shaking stops, then check to see if you are hurt. You will be better able to help others if you take care of yourself first, and then check the people around you. Move carefully and watch out for things that have fallen or broken, creating hazards. Be ready for aftershocks.

(6) Be on the lookout for fires. Fire is the most common earthquake-related hazard, due to broken gas lines, damaged electrical lines or appliances, and previously contained fires or sparks being released.

(7) If you must leave a building after the shaking stops, use the stairs, not the elevator, and look for falling debris. Earthquakes can cause fire alarms and fire sprinklers to

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go off. You will not be able to rule out whether there is a real threat of fire, and the elevators may have been compromised. Always use the stairs.

(8) If you're outside in an earthquake, stay outside. Move away from buildings, trees, streetlights and overhead lines. Crouch down and cover your head. Many injuries occur within ten feet of the entrance to buildings. Bricks, roofing and other materials can fall from buildings, injuring persons nearby. Trees, streetlights and overhead lines may also fall, causing damage or injury.

(9) Inform workers of the plan and discuss earthquakes with workers. Everyone in your workplace should know what to do if an earthquake occurs. Discussing earthquakes ahead of time helps reduce fear and anxiety and lets everyone know how to respond.

(10) Get training. Take a first-aid class from an organization such as the National Red Cross, National Safety Council chapter. Get training on how to use a fire extinguisher. Keep your training current. Training will help you to keep focused and know what to do when an earthquake occurs.

(11) Perform a workplace survey, especially if you are in an area with a high risk of earthquakes, to identify potential hazards to workers if an earthquake occurs. Look for furniture or materials that could fall and strike workers or block means of egress, or cause a release of hazardous materials, or otherwise affect the health and safety of workers as a result of utility loss or system/structural failure.

(b) Flood Hazard

The proposed project is situated at the river banks of the Ayawaddy and Myitnge, both of the floods can potential affect on for the worse case.

Mitigation Measures for Flood Hazards for Project Site

Defenses of flood hazard such as detention basins, levees, bunds, reservoirs, and weirs are used to prevent waterways from overflowing their banks.

- A levee dike, dyke, embankment, floodbank or stopbank is an elongated naturally occurring ridge or artificially constructed fill or wall, which regulates water levels. It is usually earthen and often parallel to the course of a river in its floodplain or along low-lying coastlines.
- Bunding, also called a bund wall, is a constructed retaining wall around storage "where potentially polluting substances are handled, processed or stored, for the

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purposes of containing any unintended escape of material from that area until such time as a remedial action can be taken.

When these defenses fail, emergency measures such as sandbags or portable inflatable tubes are often used to try to stem flooding.

Mitigation Measures for Flood Hazards for Workers

(i) Before a flood

Prepare project site for a flood. Call local building department or office of emergency management for information.

- Purchase flood insurance.
- Keep all insurance policies and a list of valuable items in a safe place.
- Take photos or a videotape of the valuables you keep in your home.
- Listen to your radio or television for reports of flood danger.
- Keep your car filled with gas.

(ii) During a flood

- Do not try to walk or drive through flooded areas. Water can be deeper than it appears and water levels rise quickly. Follow official emergency evacuation routes. If your car stalls in floodwater, get out quickly and move to higher ground.
- Stay away from moving water; moving water six inches deep can sweep you off your feet. Cars are easily swept away in just two feet of water.
- Stay away from disaster areas unless authorities ask for volunteers.
- Stay away from downed power lines.
- If your home is flooded, turn the utilities off until emergency officials tell you it
- is safe to turn them on. Do not pump the basement out until floodwater recedes. Avoid weakened floors, walls and rooftops.
- Wash your hands frequently with soap and clean water if you come in con-tact with floodwaters.

(iii) After a flood

- Wear gloves and boots when cleaning up.
- Open all doors and windows. Use fans if possible to air out the building.
- Wash all clothes and linens in hot water.
- Discard mattresses and stuffed furniture that they can't be adequately cleaned.

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- Wash dirt and mud from walls, counters and hard surfaced floors with soap and water. Then disinfect by wiping surfaces with a solution of one cup bleach per gallon of water.
- Discard all food that has come into contact with floodwater. Canned food is alright, but thoroughly wash the can before opening.
- If your well is flooded, your tap water is probably unsafe. If you have public water, the health department will let you know—through radio and television— if your water is not safe to drink. Until your water is safe, use clean bottled water.
- Learn how to purify water. If you have a well, learn how to decontaminate it.
- When floodwaters have receded watch out for weakened road surfaces.

Workers' Safety during Flood

The following factors should aware to all of the workers to safe during flood.

(a) Do not walk through flowing water. Six inches of moving water can knock you off your feet. Use a pole to test the depth of standing water before you proceed.

(b) Do not drive through a flooded area. Two feet of water will carry away most automobiles.

(c) Stay away from power lines and electrical wires.

(d) Turn off your all electricity if your building is flooded.

(e) Watch out for hiding animals.

(f) Look before you step. Mud can be very slippery to walk on. Broken glass, nails and other debris may be deposited by receding floodwaters.

(g) Be alert for gas leaks. Leave the area immediately if you smell gas fumes.

6.9.4. Anticipated Impacts and Mitigation measures for Decommissioning Phase

Although, the proposed project is expected to have an operational life of at least 30 years, decommissioning of the project would occur at the end of its lifespan. The goal of project decommissioning will be to remove the concrete and steel structures and equipment for proposed project as a whole and return the site to a condition as close to a pre-construction state as feasible. The physical removal of the structures and equipment will be the reversal of the construction process. All areas disturbed by the proposed project would be restored to pre-project conditions and/or to conditions acceptable to the MCDC. During

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decommissioning phase, all concrete and steel structures and equipment would be dismantled and removed. The major activities that will be required for the decommissioning of proposed project are:

(a) Concrete structures removal,
(b) Steel structures removal,
(c) Storage tanks removal,
(d) Concrete foundation removal, and
(e) Equipment and electrical system removal.

Impacts during decommissioning are expected to be limited to workers on site. No impacts are anticipated to nearest residences or businesses because all decommissioning activities will be expected to take place during daytime and will only use small number of machineries. Potential environmental impacts due to the decommissioning activities will include the following:

(a) Impacts on air environment;
(b) Impacts on surface water environment;
(c) Impacts on soil and ground water environment;
(d) Impacts on biodiversity environment; and
(e) Impacts on socio-economic environment.

6.9.4.1. Impacts on Air Environment during Decommissioning Phase

The following will be the anticipated impacts on air quality during decommissioning phase.

(a) Fugitive Dust Generation

During decommissioning some localized increase in dust levels will be unavoidable. The impact of dust generation during decommissioning phase will be less than that of pre-construction and construction phase due to the lack of site clearing, ground leveling and earth filling. The sources of dust generation will be vehicle movement and demolishing of buildings.

(b) Gaseous Emissions

Gases (CO_2, CO, SO_2) will emit during the operation of dozer, trucks and generator used during decommissioning period.

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(c) Increased in Noise Level

Existing local noise levels will increase temporarily by the operation of heavy machineries (dozer and trucks) used for demolition of concrete and steel structures.

Significant of Impacts on Air Quality

As the project area is merely six acres and there will use about two trucks and one dozer for decommissioning purpose, the impact significance of dust generation, gaseous emissions, and noise level during decommissioning phase will be very low as follow:

Components	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Fugitive Dust Generation	Use of dozer and truck	Negative (-)	Limited (-2)	Very Short term (-1)	Low (-2)	Very Often (-4)	Probable (-3)	Low (-35)
Gaseous Emissions	Use of dozer and truck	Negative (-)	Local (-3)	Very Short term (-1)	Very Low (-1)	Intermittent (-2)	Highly Probable (-4)	Low (-36)
Increase in Noise Level	Demolishing activities	Negative (-)	Limited (-2)	Very Short term (-1)	Low (-2)	Very Often (-4)	Probable (-3)	Low (-35)

Consideration of Mitigation Requirements for Air Environment

The requirement of mitigation measures for air environment according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern	Mitigation Requirement	Mitigation Scale	Responsibility
1.	Fugitive Dust Generation	Low (-35)	No	Yes	Minor	MESDP
2.	Gaseous Emissions	Low (-36)	No	No	-	MESDP
3.	Increase in Noise Level	Low (-35)	No	Yes	Minor	MESDP

Mitigation Measure for Impacts on Air Environment

According to the above table, minor mitigation measures are required for air quality during decommissioning phase as follow:

(a) Spray water for dust control;

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(b) Use machineries with good engine with low sulphur content fuel for gaseous emission; and

(c) Avoid working at night for noise control.

6.9.4.2 Impacts on Surface Water Environment during Decommissioning Phase

Improper disposal of decommissioning debris such as concrete blocks, steel pieces and drainage from solid waste dump will cause surface water pollution in nearest rivers, if decommissioning debris is disposed to the river directly.

Impact Significance on Surface Water Environment

The impact on surface water during decommissioning phase will be not be significant because the solid and liquid waste produced during decommissioning phase will be small amount.

Components	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Surface water pollution	Solid Wastes	Negative (-)	Limited (-2)	Very Short term (-1)	Low (-2)	Intermittent (-2)	Highly Probable (-4)	Low (-30)

Intensity of Mitigation Measures for Surface Water Environment

The requirement of mitigation measures for surface water environment according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern	Mitigation Requirement	Mitigation Scale	Responsibility
1.	Solid Wastes	Low (-30)	No	Yes	Minor	MESDP

Mitigation Measure for Surface Water Environment

According to the above impact evaluation process, there will need minor mitigation measures for impact on surface water environment during decommission phase. So, MESDP will do the following mitigation measures for surface water quality during decommission phase.

(a) Pump all of the remaining fuel oil inside the tanks and pipe lines. Care have to be taken the remaining oil are not disposed to nearest water bodies directly.

(b) Waste water channels from the site should be connected to oil and grease separator during decommissioning to prevent wastewater from entering the nearest water bodies.

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(c) Avoid any leakage of oil and lubricant from vehicles and machineries used in decommission phase.

(d) All the solid waste produced during decommissioning phase have to disposed according to the rule and regulations of MCDC.

(e) Vegetation of bare areas after the decommission activities.

6.9.4.3. Impacts on Soil and Ground Water Environment during Decommissioning Phase

Decommissioning debris such as concrete, steel structures, cabling, scrap metal, etc. will produce during decommissioning of the proposed project. Improper dispose of these solid wastes can have potential to soil and ground water pollutions.

Significant of Impact on Soil and Ground Water Environment

The impact on soil and ground water quality during decommissioning phase will not be significant because the solid and liquid waste produced during decommissioning phase will be little amount. The impact on ground water quality will be minimal, short term and low probability. So, the impact will be considered as very low as follow:

Components	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Soil contamination	Solid Wastes and fuel oil	Negative (-)	Limited (-2)	Very Short term (-1)	Low (-2)	Intermittent (-2)	Seldom (-2)	Very Low (-20)
Ground water pollution	Solid Wastes and fuel oil	Negative (-)	Limited (-2)	Very Short term (-1)	Very Low (-1)	Rare (-1)	Very Seldom (-1)	Very Low (-8)

Consideration of Mitigation Requirements for Soil and Ground Water Environment

The requirement of mitigation measures for soil and ground water environment according to the consideration of impact rating and public concerns are as follow:

No.	Parameters	Impact Rating	Public Concern	Mitigation Requirement	Mitigation Scale	Responsibility
1.	Soil contamination	Very Low (-20)	No	Yes	Minor	MESDP
2.	Ground water pollution	Very Low (-8)	No	No	-	MESDP

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Mitigation Measures for Soil and Ground Water Pollution

All the solid and liquid waste produced during decommissioning phase have to disposed according to the rule and regulations of MCDC. Vegetation of bare areas after the decommission activities.

6.9.4.4. Impacts on Socio-economic Environment during Decommissioning Phase

Generally, it tends to reverse the benefits that are got from the operation of the proposed project on closing the project. As an example, it would have to face the cases like giving up job opportunity and losing taxes for National Government.

Loss of Jobs for Local People and Revenues for the Government

In the event of the project closure, there will be potential negative impacts resulting in loss of jobs and indirect employment depending on the operation of proposed and of associated services for tourism as well as loss of revenues for the government.

Significant of Impacts on Socio-economic Environment

Being a developing country, loss of job opportunities and revenues for regional government will be greatly effect on GDP. So, impact significant will be considered as low to moderate for loss of jobs due to insignificant number of workers appointed during operation phase and moderate for loss of revenues due to important of income from industrial section in Amarapura Region.

Components	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Loss of jobs	Negative (-)	Local (-3)	Permanent (-5)	Low (-2)	Regular (-3)	Highly probable (-4)	Low to Moderate (-70)
Loss of revenues	Negative (-)	Regional (-5)	Permanent (-5)	Moderate (-4)	Rare (-1)	Certain (-5)	Moderate (-84)

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Consideration of Mitigation Measures for Socio-economic Environment

The requirement of mitigation measures for socio-economic environment are as follow:

No.	Parameters	Impact Rating	Public Concern	Mitigation Requirement	Mitigation Scale	Responsibility
1.	Loss of job	Low to Moderate (-70)	No	Yes	Sensible	MESDP
2.	Loss of revenue	Moderate (-84)	No	Yes	Sensible	MESDP

Mitigation Measures for Loss of Jobs and Revenues for the Government

Extensive and comprehensive warning to employees to allow them to source alternative livelihood will be taken early. MESDP will prepare their employees for forced retirement by providing applicable jobs at other oil stations under the same developer, if feasible. Moreover, MESDP will prepare a plan to reuse the proposed project to other partner company to retain the revenue for the government.

Components	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
Loss of jobs	Negative (-)	Local (-3)	Permanent (-5)	Low (-2)	Regular (-3)	Seldom (-2)	Low (-50)
Loss of revenues	Negative (-)	Regional (-5)	Permanent (-5)	Moderate (-4)	Rare (-1)	Probable (-3)	Low to Moderate (-56)

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Summary of Anticipated Impacts

All of the anticipated impacts in pre-construciton, construction, operation and decommissioning phases are summarized in the following Tables.

Summary Anticipated Impacts in Pre-construction Phase

No.	Components	Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
I. Impacts on Air Environment										
1.	Fugitive dust generation	Public nuisance	Site clearing and ground levelling	Negative (-)	Limited (-2)	Very Short term (-1)	Very Low (-1)	Very Often (-4)	Highly Probable (-4)	Low (-32)
2.	Vehicular emissions (CO_2, CO, SO_2, NO_x)	Air pollution	Site clearing and ground levelling	Negative (-)	Local (-3)	Very Short term (-1)	Very Low (-1)	Very Often (-4)	Highly Probable (-4)	Low (-40)
3.	Noise	Public nuisance	Noise from dozar and trucks	Negative (-)	Limited (-2)	Very Short term (-1)	Very Low (-1)	Very Often (-4)	Highly Probable (-4)	Low (-32)
II. Impacts on Surface Water Environment										
1.	Surface Water Quality	Increase turbidity, oil and grease in Attran River	Erosion and sedimentation	Negative (-)	Limited (-2)	Very Short term (-1)	Medium (-4)	Rare (-1)	Seldom (-2)	Very Low (-21)

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III. Impacts on Soil and Ground Water Environment										
1.	Soil Quality	Potential to soil contamination	Domestic wastes and unusuable materials in soil	Negative (-)	Site (-1)	Short term (-2)	Low (-2)	Rare (-1)	Seldom (-2)	Very Low (-15)
2.	Ground water Quality	Potential to Ground water pollution	Domestic wastes and unusuable materials in soil	Negative (-)	Local (-3)	Short term (-2)	Low (-2)	Rare (-1)	Very Seldom (-1)	Very Low (-14)
IV. Impacts on Biodiversity Environment										
1.	Flora Diversity	Impacts on flora diversity	Site clearing and trees cutting	Negative (-)	Site (-1)	Long term (-4)	Very Low (-1)	Rare (-1)	Seldom (-2)	Very Low (-18)
2.	Fauna Diversity	Impacts on fauna diversity	Noise from pre-construction activities	Negative (-)	Limited (-2)	Very Short term (-1)	Very Low (-1)	Very Often (-4)	Seldom (-2)	Very Low (-24)
V. Impacts on Human Environment										
1.	House Income before Enhancement Measures	Potential to increase in household income	Jobs in pre-construction site	Positive (+)	Limited (+2)	Very Short term (+1)	Low (+2)	Regular (+3)	Seldom (+2)	Very Low (+25)
2.	House Income after Enhancement Measures	Potential to increase in household income	Jobs in pre-construction site	Positive (+)	Limited (+2)	Very Short term (+1)	Low (+2)	Regular (+3)	Probable (+2)	Very Low (+30)
3.	Potential to Blockage of drainage system	Blockage of drainage system	Earth filling	Negative (-)	Limited (-2)	Permanent (-5)	High (-5)	Regular (-3)	Highly Probable (-4)	Medium to High (-84)

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Summary Table of Anticipated Impacts in Construction Phase

No.	Components	Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
I. Impacts on Air Environment										
1.	Fugitive Dust generation	Public nuisance	Construction activities	Negative (-)	Site (-1)	Very Short term (-1)	Low (-2)	Very Often (-4)	Probable (-3)	Very Low (-28)
2.	Vehicular emissions	Air pollution	Construction activities	Negative (-)	Site (-1)	Very Short term (-1)	Very Low (-1)	Very Often (-4)	Highly Probable (-4)	Very Low (-24)
3.	Noise	Public nuisance	Noise from construction equipments	Negative (-)	Limited (-2)	Very Short term (-1)	Medium (-4)	Very Often (-4)	Highly Probable (-4)	Low to Medium (-56)
4.	PMs and Gaseous Emission	Air pollution	Cutting and welding of steel structure	Negative (-)	Limited (-2)	Very Short term (-1)	Low (-2)	Very Often (-4)	Highly Probable (-4)	Low (-45)
II. Impacts on Surface Water Environment										
1.	Surface Water Quality	Surface water pollution	Construction Debris	Negative (-)	Limited (-2)	Very Short term (-1)	Very low (-1)	Very Often (-4)	Seldom (-2)	Very Low (-24)

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2.	Surface Water Quality	Surface water pollution	Oil and Lubricants from construction machineries	Negative (-)	Limited (-2)	Very Short term (-1)	Very low (-1)	Very Often (-4)	Seldom (-2)	Very Low (-24)
3.	Surface Water Quality	Surface water pollution	Domestic Wastes	Negative (-)	Limited (-2)	Very Short term (-1)	Very low (-1)	Very Often (-4)	Very Seldom (-1)	Very Low (-20)
III. Impacts on Soil and Ground Water Environment										
1.	Soil and Ground Water Quality	Soil and Ground Water Pollution	Piling	Negative (-)	Local (-3)	Long term (-4)	Medium (-3)	Regular (-3)	Possible (-3)	Low to Medium (-60)
2.	Soil and Ground Water Quality	Soil and Ground Water Pollution	Leakage of fuel oil and lubricants	Negative (-)	Site (-1)	Short term (-2)	Very Low (-1)	Regular (-3)	Very Seldom (-1)	Very Low (-16)
3.	Soil and Ground Water Quality	Soil and Ground Water Pollution	Construction debris and Domestic Wastes	Negative (-)	Limited (-2)	Short term (-2)	Very Low (-1)	Very Often (-4)	Very Seldom (-1)	Very Low (-25)
IV. Impacts on Biodiversity Environment										
1.	Impact on flora	Birds/Butterflies/ Terrestrial fauna	Cutting of trees	Negative (-)	Site (-1)	Long term (-4)	Very Low (-1)	Rare (-1)	Very Seldom (-1)	Very Low (-12)
2.	Impacts on fauna	Birds/Butterflies/ Terrestrial fauna	Cutting of trees, wastes and nois	Negative (-)	Limited (-2)	Short term (-2)	Very Low (-1)	Very Often (-4)	Very Seldom (-1)	Very Low (-25)
V. Impacts of Human Environment										
1.	House Income before Enhancement Measures	Potential to increase in household income	Jobs in construction site	Positive (+)	Limited (+2)	Short term (+2)	Medium (+3)	Intermittent (+2)	Seldom (+2)	Low (+28)

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2.	House Income after Enhancement Measures	Potential to increase in household income	Jobs in construction site	Positive (+)	Limited (+2)	Short term (+2)	Medium (+3)	Very often (+4)	Highly probable (+4)	Low to Medium (+56)
3.	Skill Development before Enhancement Measure	Local skill development	Construction works	Positive (+)	Local (+3)	Long term (+4)	Low to Moderate (+3)	Intermittent (+2)	Very Seldom (+1)	Low (+30)
4.	Skill Development after Enhancement Measure	Local skill development	Construction works	Positive (+)	Local (+3)	Long term (+4)	Low to Moderate (+3)	Intermittent (+2)	Highly Probable (+4)	Low to Moderate (+60)
5.	Increase pressure on housing, recreational facilities, and water	Public anxiety	Influx of construction workers	Negative (-)	Site (-1)	Short term (-2)	Very low (-1)	Continuous (-5)	Very seldom (-1)	Very low (-24)
6.	Increase pressure on health care facility	Anxiety of existing workers	Influx of construction workers	Negative (-)	Site (-1)	Short term (-2)	Low to Moderate (-3)	Regular (-3)	Highly Probable (-4)	Low (-42)
7.	Increase pressure on adequate amount of local food	Public and existing workers' anxiety	Influx of construction workers	Negative (-)	Limited (-2)	Short term (-2)	Very Low (-1)	Continuous (-5)	Very seldom (-1)	Very low (-30)
8.	Increase pressure on health care facility	Anxiety of existing workers	Influx of construction workers	Negative (-)	Site (-1)	Short term (-2)	Low to Moderate (-3)	Intermittent (-2)	Seldom (-2)	Very Low (-24)

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Summary Table of Anticipated Impacts in Operation Phase

No.	Components	Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
I. Impacts on Air Environment										
1.	Fugitive Dust	Air pollution	Fugitive dust emissions	Negative (-)	Limited (-2)	Long term (-4)	Low (-2)	Continuous (-5)	Highly Probable (-4)	Low to Moderate (-72)
2.	Release of VOCs	Air pollution	Release of VOCs	Negative (-)	Local (-3)	Long term (-4)	Low (-2)	Continuous (-5)	Highly Probable (-4)	Moderate (-81)
3.	Noise	Workers' Health	Noise emission	Negative (-)	Local (-3)	Long term (-4)	Low (-2)	Continuous (-5)	Highly Probable (-4)	Moderate (-81)
II. Impacts on Surface Water Environment										
1.	Surface water quality	Surface water pollution	Contaminated water from oil storage area	Negative (-)	Limited (-2)	Long term (-4)	Medium (-4)	Seldom (-2)	Highly Probable (-4)	Low to Moderate (-60)
III. Impacts on Soil and Ground Environment										
1.	Soil and Ground Water Quality	Soil and Ground Water Pollution	Accidental spill	Negative (-)	Limited (-2)	Long term (-4)	High (-5)	Regular (-3)	Certain (-5)	Moderate (-88)
2.	Soil and Ground Water Quality	Soil and Ground Water Pollution	Solid waste	Negative (-)	Limited (-2)	Long term (-4)	Low (-2)	Regular (-3)	Highly Probable (-4)	Low to Moderate (-56)
3.	Soil and Ground Water Quality	Soil and Ground Water Pollution	Liquid waste	Negative (-)	Site (-1)	Long term (-4)	Very Low (-1)	Regular (-3)	Certain (-5)	Low (-48)

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IV. Impacts on Biodiversity Environment										
1.	Fauna	Impacts on fauna diversity	Improper disposal of solid waste	Negative (-)	Limited (-2)	Long term (-4)	Low (-2)	Continuous (-5)	Seldom (-2)	Low to Moderate (-56)
2.	Flora	Impact on flora diversity	Noise	Negative (-)	Limited (-2)	Long term (-4)	Low (-2)	Continuous (-5)	Seldom (-2)	Low to Moderate (-56)
3.	Aquatic lives	Impacts on aquatic lives	Discharge of effluent water	Negative (-)	Limited (-2)	Long term (-4)	Moderate (-3)	Continuous (-5)	Seldom (-2)	Moderate (-63)
V. Impacts of High Utilities Consumption										
1.	Significance of Utilities Consumption	High Utilities Consumption	Electricity	Negative (-)	Local (-3)	Long term (-4)	High (-5)	Very Often (-4)	Certain (-5)	Moderate to High (-108)
V. Impacts of Human Environment										
1.	Opportunities before Enhancement Measures	Employment opportunities	Jobs in proposed project	Positive (+)	Local (+3)	Long term (+4)	High (+4)	Continuous (+5)	Probable (+3)	Moderate (+88)
2.	Opportunities after Enhancement Measures	Employment opportunities	Jobs in proposed project	Positive (+)	Local (+3)	Long term (+4)	Moderate (+4)	Continuous (+5)	Certain (+5)	Moderate to High (+110)
3.	Increased Living Standard before Enhancement Measures	Local community development potential	Social services development	Positive (+)	Local (+3)	Long term (+4)	Medium (+4)	Intermittent (+2)	Probable (+3)	Low to Moderate (+55)
4.	Increased Living Standard after Enhancement Measures	Local community development potential	Social services development	Positive (+)	Local (+3)	Long term (+4)	Medium (+4)	Regular (+3)	Highly Probable (+4)	Moderate (+77)

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5.	National Economy before Enhancement Measures	Benefit to national economy	Taxes	Positive (+)	Regional (+5)	Long term (+4)	Moderate (+4)	Rare (+1)	Highly Probable (+4)	Low to Moderate (+65)
6.	National Economy after Enhancement Measures	Benefit to national economy	Taxes	Positive (+)	Regional (+5)	Long term (+4)	Moderate (+4)	Rare (+1)	Certain (+5)	Moderate (+78)
7.	Local Economy before Enhancement Measures	Benefit to local economy	Income in local revenue	Positive (+)	Local (+4)	Long term (+4)	Moderate (+4)	Regular (+3)	Probable (+3)	Low to Moderate (+72)
8.	Local Economy before Enhancement Measures	Benefit to local economy	Income in local revenue	Positive (+)	Local (+4)	Long term (+4)	Moderate (+4)	Regular (+3)	Highly Probable (+4)	Moderate (+84)
9.	Crime and Security before Mitigation Measures	Public security	Increase crime and security	Negative (-)	Limited (-2)	Long term (-4)	Low (-2)	Rare (-1)	Probable (-3)	Low (-50)
10.	Crime and Security after Mitigation Measures	Public security	Increase crime and security	Negative (-)	Limited (-2)	Long term (-4)	Medium (-4)	Rare (-1)	Seldom (-2)	Low (-30)
11.	Population Influx without Mitigation Measures	Public anxiety	Increase pressure on housing, recreational facilities, health care, water and food	Negative (-)	Limited (-2)	Long term (-4)	Medium (-4)	Very often (-4)	Probable (-3)	Moderate (-70)
12.	Population Influx after Mitigation Measures	Public anxiety	Increase pressure on housing, recreational facilities, health care, water and food	Negative (-)	Limited (-2)	Long term (-4)	Medium (-4)	Intermittent (-2)	Seldom (-2)	Low (-40)
13.	Fire Outbreak Risk without Mitigation Measures	Project and public security	Fire outbreak risk	Negative (-)	Local (-3)	Long term (-4)	High (-5)	Rare (-1)	Probable (-3)	Low (-44)
14.	Fire Outbreak Risk after Mitigation Measures	Project and public security	Fire outbreak risk	Negative (-)	Local (-3)	Long (-4)	High (-5)	Rare (-1)	Very Seldom (-1)	Very Low (-24)

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Summary of Anticipated Impacts in Decommissioning Phase

No.	Components	Anticipated Impact	Sources	Impact Type	Scale	Duration	Severity	Frequency	Probability	Impact Rating
I. Impacts on Air Environment										
1.	Fugitive Dust Generation	Air Pollution	Use of dozer and truck	Negative (-)	Limited (-2)	Very Short term (-1)	Low (-2)	Very Often (-4)	Probable (-3)	Low (-35)
2.	Gaseous Emissions	Air Pollution	Use of dozer and truck	Negative (-)	Local (-3)	Very Short term (-1)	Very Low (-1)	Intermittent (-2)	Highly Probable (-4)	Low (-36)
3.	Increase in Noise Level	Public Anxiety	Decommissioning Activities	Negative (-)	Limited (-2)	Very Short term (-1)	Low (-2)	Very Often (-4)	Probable (-3)	Low (-35)
II. Impacts on Surface Water Environment										
1.	Surface water	Surface Water Pollution	Solid Wastes	Negative (-)	Limited (-2)	Very Short term (-1)	Low (-2)	Intermittent (-2)	Highly Probable (-4)	Low (-30)
III. Impacts on Soil and Ground Water Environment										
1.	Soil	Soil contamination	Solid Wastes and fuel oil	Negative (-)	Limited (-2)	Very Short term (-1)	Low (-2)	Intermittent (-2)	Seldom (-2)	Very Low (-20)
2.	Ground water	Ground water pollution	Solid Wastes and fuel oil	Negative (-)	Limited (-2)	Very Short term (-1)	Very Low (-1)	Rare (-1)	Very Seldom (-1)	Very Low (-8)

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IV. Impacts of Human Environment										
1.	Loss of jobs	Decline in local economy	Decommissioning of proposed project	Negative (-)	Local (-3)	Permanent (-5)	Low (-2)	Regular (-3)	Highly probable (-4)	Low to Moderate (-70)
2.	Loss of revenues	Decline in regional economy	Decommis-sioning of proposed project	Negative (-)	Regional (-5)	Permanent (-5)	Moderate (-4)	Rare (-1)	Certain (-5)	Moderate (-84)
3.	Loss of jobs After Mitigation Measures	Decline in local economy	Decommissioning of proposed project	Negative (-)	Local (-3)	Permanent (-5)	Low (-2)	Regular (-3)	Seldom (-2)	Low (-50)
4.	Loss of revenues After Mitigation Measures	Decline in regional economy	Decommissioning of proposed project	Negative (-)	Regional (-5)	Permanent (-5)	Moderate (-4)	Rare (-1)	Probable (-3)	Low to Moderate (-56)

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7. CUMMULATIVE IMPACTS ASSESSMENT

Cumulative Impact Assessment is the process of assessing potential effects on receptors from environmental and social impacts caused by the combined influence of more than one project. Evaluation of potential cumulative impacts is an integral element of an impact assessment.

7.1. Methodology and Approach

The analysis of cumulative impacts in this section follows the processes recommended by EIA procedure (2015) and the regulations at Section 42 of the Environmental Conservation Law. Cumulative impacts in relation to an activity are defined in the EIA Regulations (Government Notice R543) as meaning "*the impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area*". Cumulative impacts were assessed by taking into consideration of potential environmental impacts of the proposed project and other related activities that had happened in the past, currently is happening at present and likely to happen in the future. In general, the proposed project cumulative impact oil storage facilities depending on the resource considered. The potential cumulative impact for the proposed project encompasses the area of physical disturbance along the proposed project construction ROW and adjacent areas that could have localized impacts associated with temporary access roads and aboveground facilities. The actions considered in the cumulative impact analysis may vary from the proposed project in nature, magnitude, and duration. These actions are included based on their likelihood of occurrence, and only projects with either ongoing or reasonably foreseeable impacts are identified.

7.2. Anticipated Cumulative Impacts

Cumulative impacts will be alteration of land use pattern, increased in road traffic, erosion to river banks and increased in fire hazards as follow:

(a) Alternation in Land Used Pattern

Although the project will merely use 38 acres, there will have alternation of land use (alternation of farm lands to other industrial purposes) as cumulative impact.

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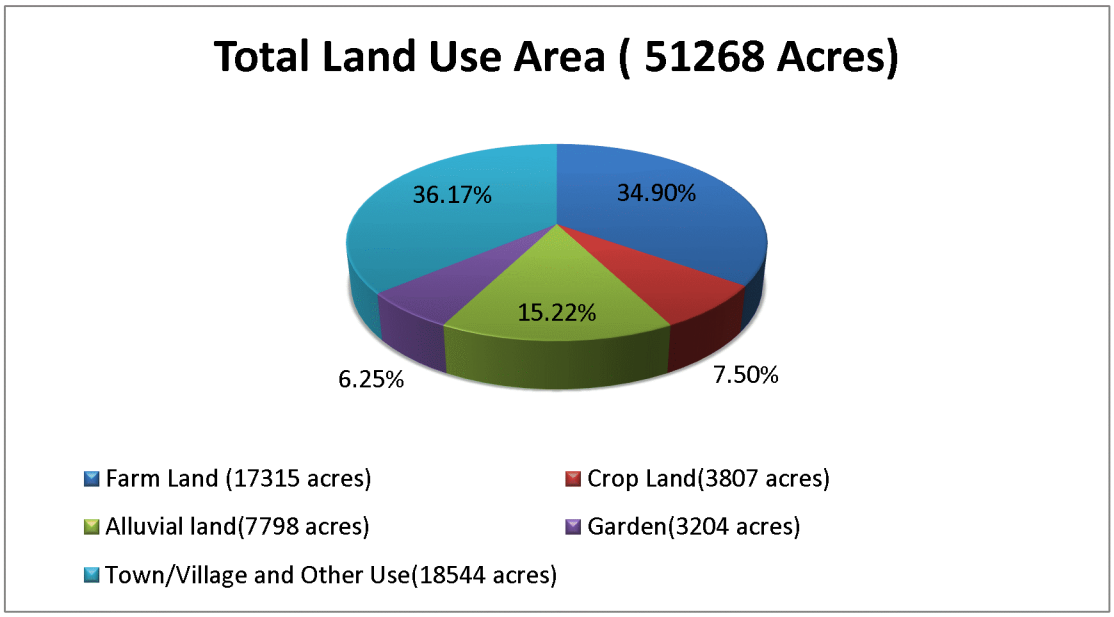

According to the figure, the land use for farm land in Amarapura Region is 34.9%, 7.42% for crop land, 15.22% for alluvial land, 6.25% for garden and town/village and other land is 36.17%. Although the proposed will only use 0.22% of agricultural land (0.074% of the whole land), gradually changes of land use near the proposed project will cause cumulative impacts on land use pattern due to the gradually increased in land use for industrial purpose within 10yrs as shown in the following figures.



Farm Lands in 2008 (No Land Use for Industrial Purprose)

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Farm Lands in 2019 (25% of Farm Lands as Industrial Purprose)

(b) Traffic as Cumulative Impact

According to the traffic study, there already had parking problem in front of the project side (on Oh-Htoke-Tan Road) due to the visiting of travelers to Innwa Ancient City in public holidays. Oil tankers (bowser) which will take fuel oil and will increase traffic and parking problem as cumulative impact.



Existing Parking Condition in Oh-Htoke-Tan Road in Holidays

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Most Potential Area to Taffic and Car Parking Problem in Oh Htoke Tan Road

(c) Erosion of River Banks as Cumulative Impact

According to the study, there already have potential to erosion of river bank due to the travelling of vessels and boats inside the Arrawadi and Myit Nga Rivers.



Potential to Erosion of River Bank

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The oil vessels which will treansport of fuel oil to and from the proposed project will increase potential to erosion of river banks along the rivers especially to the adjacent side of the Myit Nga River where Innwa Old City (archeologically important site) is existed as shown in the above figure.

(d) Fire and Explosion Hazard as Cummulative Impact

As there will be another oil storage facility (Great Wall Oil Storage Facility Project) and highly potential to increase in other industrial projects, there will increase in potential to fire and exploration hazard as cumulative impact.

(e) Visual Impact as Cummulative Impact

Like fire and exploration hazard there will have potential to visual impact as cumulative impact due to the potential to increase in oil storage facility or other industrial projects.

7.2.1. Mitigation Measures for Cumulative Impacts

(a) Mitigation Measures for Alternation in Land Used Pattern

According to the primary data collection by household survey, most of the farmers want to ll their farm lands are willing to handover their lands with reasonable price and want to employ with the higher salary in the proposed project. So, to reduce alternation in appen pattern and reduce income for local economy, MESDP will appoint local people especially people who sold their farm lands to MESDP. Moreover, MESDP will allow to open eating place and tea shop near the project to creat job opportunities for local people and upgrading of existing shop houses at the Oh Htoke Tan marina to high class shops.

(b) Mitigation Measures for Increase in Traffic

MESDP will upgrade existing road to reduce traffic congestion in Oh-Htoke-Tan Road and no vehicles and oil bowser will not be allowed to parking outside the project and along the Oh Htoke Tan Road.

(c) Mitigation Measures for Erosion of River Bank

There will little impact on soil erosion of river bank on adjacent side (Oh-Htoke-Tan Side) due to the flow speed of river and condition of river bank smooth slope. Nevertheless,

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MESDP will prepare retaining wall at other side of the Myit Nga River (Oh-Htoke Tan side) if there have any potential condition for soil erosion due to fuel oil transportation.

(d) Mitigation Measures for Fire and Explosion Hazard

Mitigation measures for fire and explosion hazard are the same as mitigation measures for fire and exploration in operation phase (See in Section 6). Moreover, MESDP will share their knowledge of fire fighting and response plan to other industires in future.

(e) Mitigation Measures for Visual Impacts

Visual impacts will be prevented through the installation of natural visual barriers such as vegetation. Landscape management and site restoration plans will be in place with recommended mitigation measures such as replacement planting, and vegetation barriers. The location and color of storage tanks will be selected with consideration of architecture view.

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8.0. ENVIRONMENTAL MANAGEMENT PLAN (EMP)

In order to manage the physical, biological and sociological impacts identified in the impact assessment, MESDP has committed to implement an environmental management plan of the project (EMP). This management plan will form the basis for the development of an integrated management system for environmental and community issues. EMP is a site specific plan developed to ensure that the project is implemented in an environmental sustainable manner where all contractors and subcontractors, including consultants, understand the potential environmental impacts arising from the proposed project and take appropriate actions to properly manage that risk. EMP also ensures the project implementation is carried out in accordance with the design by taking appropriate mitigation actions to reduce adverse environmental impacts during its life cycle. EMP for proposed project will include the following essential parts.

(a) Potential Environmental Impacts and Mitigation Measures,
(b) Environmental Monitoring Plan,
(c) Occupational Safety and Health Management Plan,
(d) Emergency Response Plan,
(e) Fire and Explosion Response Plan,
(f) Oil Spill Management and Response Plan,
(g) Disaster Management Plan, and
(h) Corporate Social Responsibility (CSR) Program.

8.1. Potential Environmental Imapcts and Mitigation Measures

The following tables show summary of potential environmental impacts and mitigation measures for pre-construction, construction, operation and decommissioning phases.

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Summary of Impacts and Mitigation Measures

Source	Phase	Parameter	Mitigation Measures	Intensity of Mitigation
Air Pollution	Pre-construction	Fugitive Dust Generation	Water Spraying	Minor
		Vehicular Emission	Use machineries with good engine with low sulphur content fuel	Minor
	Construction	Dust generation	Water spraying	Minor
		Gaseous emissions	Regular equipment maintenance and reduce idel construction time	Minor
	Operation	Fugitive Dust generation	Water Spraying	Minor
		Gaseous emissions	Installation of secondary emissions controls such as vapor condensing and recovery units, catalytic oxidizers, vapor combustion units, or gas adsorption media Establishing a procedure for periodic monitoring of fugitive emissions from pipes, valves, seals, tanks and other infrastructure components with vapor detection equipment, and with subsequent maintenance or replacement of components as needed. Use machineries with good engine with low sulphur content fuel	Moderate
	Decommissioning	Fugitive Dust generation	Spraying water	Minor
		Gaseous emissions	Use machineries with good engine with low sulphur content fuel	Minor

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Noise	Pre-construction	Noise level in dB(A)	Avoid working at night	Minor
	Construction	Noise level in dB(A)	Use soundproof machineries Avoid running construction machineries at the same time Avoid working at night	Minor
	Operation	Noise level in dB(A)	Avoid working at night Use high efficiency motors and pumps	Minor
	Decommissioning	Noise level in dB(A)	Avoid working at night	Minor
Surface Water	Pre-construction	Increase turbidity, oil and grease in Ayarwadi River	Avoid earth working and excavation during rainy seasons, Use waste water channels, Avoid leakage of oil & lubricant, Vegetation of bare areas.	Minor
	Construction	Construction Debris	Temporary settling pond	Minor
		Oil and Grease	Avoid any leakage of oil and lubricant	Minor
		Domestic Wastes	Use proper waste management system	Minor
	Operation	Oil and Grease	Avoid any leakage of oil and lubricant Installation of stormwater channels and collection ponds with subsequent treatment through oil / water separators Oil spill management system	Moderate
		Domestic Wastes	Use proper waste management system	Minor
	Decommissioning	Solid Wastes	Avoid any leakage of oil and lubricant, Vegetation of bare areas	Minor

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Soil and Ground Water	Pre-construction	Potential to soil contamination	Proper waste management system	Minor
		Potential to ground water pollution	Proper waste management system	Minor
	Construction	Leakage of fuel oil and lubricants	Store over concrete floor or impermeable pad	Minor
		Construction debris and domestic Wastes	Solid wastes according to the rules and regulations of CDC (Amarapura)	Minor
	Operation	Oil and Grease	Avoid any leakage of oil and lubricant Oil spill management system	Moderate
		Domestic solid waste	Segregation, storage at source and collection of the waste management system	Minor
	Decommissioning	Soil contamination	Waste disposal according to the rule and regulations of CDC (Amarapura),	Minor
		Ground water pollution	-	-
Biodiversity	Pre-construction	Impacts on flora diversity	Avoid tree cutting as much as possible	Minor
		Impacts on fauna diversity	Avoid working at night	Minor
	Construction	Cutting of trees	Avoid tree cutting	Minor
		Cutting of trees, wastes and noise	Avoide dispose wastes properly avoid working at night	Minor

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	Operation	Impacts on flora diversity	Proper waste management system, wind-break tree species	Minor
		Impacts on fauna diversity	Proper waste management system, wind-break tree species	Minor
Socio-Economic	Pre-consruction	Potential to Increase in household income	Job creation	Minor
	Construction	Increase pressure on health care facility	Use own health care facilities or not to pressure on local facilities	Moderate
	Operation	Impacts Associated with Population Influx	Use of local labor force, Provide short and long terms health care services for workers	Minor
		Fire and explosion	-Prevention and control of fire and explosion hazards -Proper grounding to avoid static electricity buildup and lightning hazards (including formal procedures for the use and maintenance of grounding connections) -Use of safe electrical installations and nonsparking tools. -Implementation of permit systems and formal procedures for conducting any hot work during maintenance activities, including proper tank cleaning and venting. -Preparation of a fire response plan supported by install own fire fighting force and fire fighting system.	Major
		Increased in Traffic	Prevention of traffic related injuries Consider alternative access to the project site.	

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		Visual impacts	Install natural barriers Replant, and vegetation barriers The location and color of bulk storage facilities should be selected with consideration of visual impacts.	
		Impacts on Cultural and Heritage	Participate with the heritage authority and negotiate with DoANM Left buffer area (40m) Signage for cultural heritage Reduce speed near heritage sites	
	Decommissioning	Loss of Jobs and Revenues	Employees to alternative livelihood	
Utilities Consumption	Operation	Electricity	Use high efficiency motor and pumps Close uncessary lighting Use LED lights	Minor
		Water	Implementing water efficient fixtures Awareness campaign for workers Proper methods of water use	Minor

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8.2. Environmental Monitoring Program

The purpose of environmental monitoring is to evaluate the effectiveness of implementation of Environmental Management Plan (EMP) by periodically monitoring the important environmental parameters within the impact area, so that any adverse affects are detected and timely action can be taken. Main objectives of environment monitoring plan include:

(a) Identify all environment changes which may cause adverse effects on environment by the project implementation;
(b) Monitor discharge sources (gas emission, waste water and solid waste) and operation of environmental protection equipments in order to ensure that these activities will comply with legislative requirements;
(c) Check monitoring process and inspect installation system and equipments in respect of pollution prevention and control;
(d) Prevent potential incidents;
(e) Propose appropriate environment protection measures based on results of environmental monitoring;
(f) Overcome and repair all weak-points based on results of environment monitoring program.

8.2.1. Environmental Monitoring Team for Regular Monitoring

The environmental monitoring team will accomplish regular environmental monitoring. The environmental officer or environmental coordinator will be fully responsibility for environmental affair and environmental monitoring. The following table will be the organization plan for the environmental monitoring team of the proposed project.

No.	Group Member	Quantity
1.	Environmental Officer (or) Coordinator	1
2.	Occupational Health and Safety Officer (or) Coordinator	1
3.	Site Manager	1
4.	Supervisor	1
5.	Helpers	1

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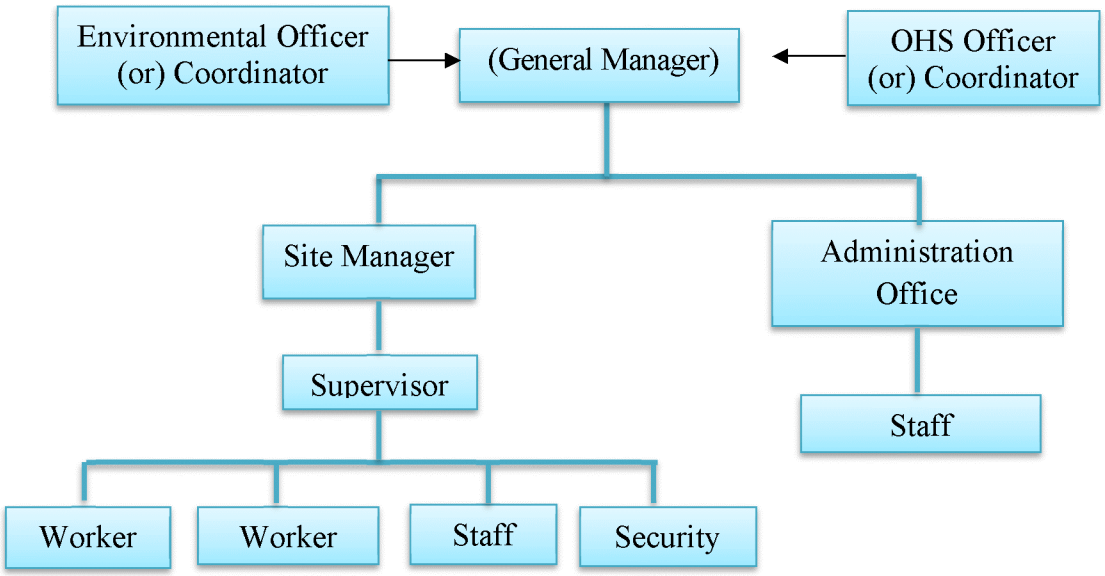
The following will be the organization structure of environmental monitoring team.



Organization Structure for Environmental Monitoring Team

Apart from having an Environmental Management Plan, it is necessary to have a permanent staff charged with the task of ensuring its effective implementation of mitigation measures and to conduct environmental monitoring. Environmental monitoring can also be done by registered third party monitoring agency. Detailed function of the environmental officer but not limited are as follow:

Environmental Officer

The major duties and responsibilities of the environmental officer or person-in-charge for environmental monitoring of proposed project will be as given below:

(a) To implement the environmental management plan,

(b) To assure regulatory compliance with all relevant rules and regulations,

(c) To ensure regular operation and maintenance of pollution control devices,

(d) To minimize environmental impacts of operations by strict adherence to the EMP.

(e) To initiate environmental monitoring as per approved schedule.

(f) Review and interpretation of monitored results and corrective measures in case monitored results are above the specified limit,

(g) Maintain documentation of good environmental practices and applicable environmental laws as ready reference,

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(h) Maintain environmental related records,

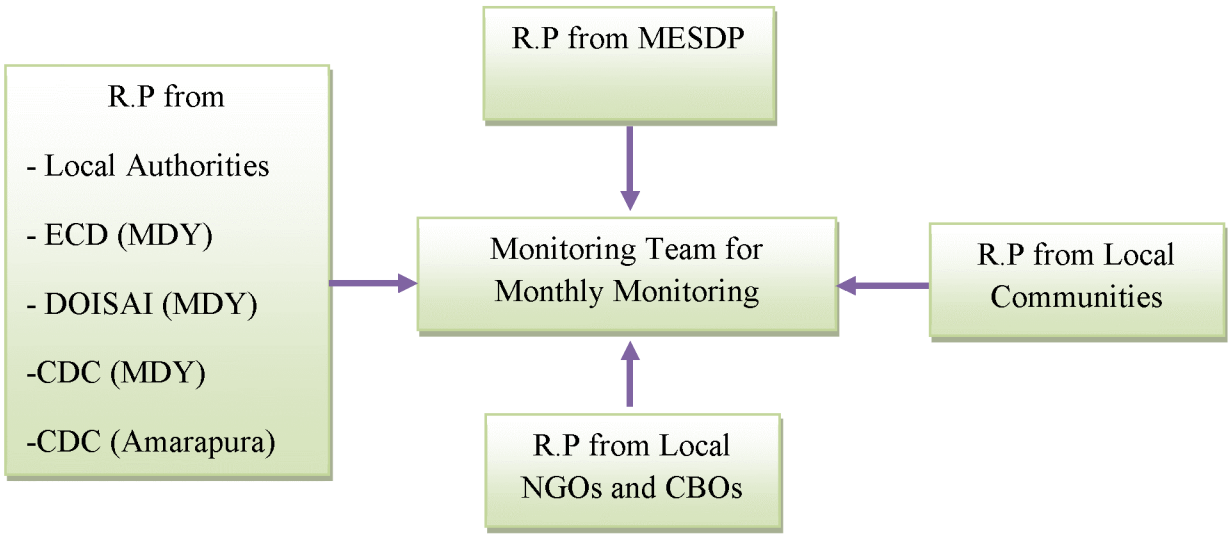
(i) Coordination with regulatory agencies, external consultants, monitoring laboratories,

(j) Maintain of log of public inconvenience and the action taken,

(k) Ready to solve any complaints from local people about environmental and social issues especially in waste water and traffic.

8.2.2. Environmental Monitoring Team for Monthly Monitoring

Environmental monitoring team for monthly monitoring has to organize representatives from environmental monitoring team for regular monitoring, representative persons from General Administrative Office (GAO, Amarapura), Department of Industrial Supervision and Inspection (DOISAI, Mandalay), Environmental Conservation Department (ECD, Mandalay),MCDC, City Development Committee (CDC, Amarapura), local communities and local NGOs & CBOs as follow:



Note: should participate , R.P = Representative Persons

Proposed Environmental Monitoring Team for Monthly Monitoring

8.2.3. Parameters, Responsibilities, and Estimated Cost for Mitigation and Monitoring

Monitoring should be conducted daily by the environmental monitoring group of proposed project and monthly by proposed monitoring team or by the registered monitoring agency. Monitoring frequency should be sufficient to provide representative data for the parameter

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being monitored. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Monitoring should be carried out throughout all project implementation phases and the responsibilities for monitoring for construction and operation phases. The parameters to be monitored; location of the monitoring sites; frequency and duration of monitoring, responsibilities and estimated cost for each of the monitoring parameters are presented in the following tables.

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Estimated Cost for Environmental Monitoring

Discharge Source	Phase	Parameter	Monitoring Frequency	Proposed Monitoring Locations	Responsibility	Estimated Cost/Frequency	Available Third Party Agency
Air Pollution	Pre-construction	Particulate Matter ($PM_{2.5}$, PM_{10})	Weekly	1. At workplace 2. At nearest residents	MESDP (or) Pre-construction services provider(s)	US $ 50	Third Party Monitoring Agency
	Construction	Particulate Matter ($PM_{2.5}$, PM_{10})	Weekly	1. At workplace 2. At nearest residents	MESDP (or) Construction contractor(s)	US$ 50	Third Party Monitoring Agency
	Operation	VOCs, NO_x, SO_2, CO_2, CO	Monthly	1. At workplace 2. At nearest residents	MESDP	US$ 500	Real time monitoring equipment
Noise	Construction	Noise level in dB(A)	Weekly	1. at workplace 2. at nearest residents 3. at downwind residents	Construction contractor(s) by their own digital sound level meter	-	-
	Operation	Noise level in dB(A)	Monthly	1. at workplace 2. at nearest residents 3. at downwind residents	MESDP by their own digital sound level meter or through registered third party monitoring agency	US$ 50	Third Party Monitoring Agency

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Solid Waste	Construction	Construction debris	Weekly	1. at workplace	Construction contractor	-	-
	Operation	Domestic solid waste	Monthly	Around the project area	MESDP	-	-
Surface Water	Operation	Oily water	Monthly	Effluent water disposal points	MESDP	US$ 500 for all cost	Every Third Party Monitoring Agency
Energy Consumption	Operation	Electricial power used	Monthly	monthly power consumption record book	MESDP through external consultants and internal audit	-	-
Greenbelt Development	Operation	Plantation, Fencing, watering, keeping watch	Weekly for three years	Around the greenbelt area	MESDP with the suggestions from DOF (Amarapura)	US$ 500 for all cost	-
Failure of oil storage facility	Operation	Condition of storage tanks, pipe line, valves etc.	Daily	at workplace	MESDP	-	-

Note: Construction service provider (contractor) will have the responsibility for monitoring during construction phase. MESDP will ensure that the construction company has the responsibility of monitoring during construction periods and this monitoring responsibility will be included in the agreements of the construction contract. MESDP is the most responsible agency for environmental monitoring during operation phase.

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Estimated Cost for Mitigation Measures

The following table shows estimated cost for mitigation measures for anticipated impacts in all phases.

Source	Phase	Parameter	Mitigation Measures	Intensity of Mitigation	Responsibility	Estimated Cost/ Frequency
Air Pollution	Pre-construction	Fugitive Dust Generation	Water Spraying	Minor	Pre-construction services provider	US $ 10/ daily during pre-construction period
		Vehicular Emission	Use machineries with good engine with low sulphur content fuel	Minor	Pre-construction services provider	-
	Construction	Dust generation	Water spraying	Minor	Construction services provider	US $ 10/ daily during pre-construction period
		Gaseous emissions	Regular equipment maintenance, reduce construction time	Minor	Construction services provider	-
	Operation	Fugitive Dust generation	Water Spraying	Minor	MESDP	US $ 10/ daily during operation period
		Gaseous emissions	Install vapor condensing and recovery units, catalytic oxidizers, vapor combustion units, or gas adsorption media Fugitive emissions from pipes, valves, seals, tanks and other infrastructure components with vapor detection equipment Use machineries with good engine with low sulphur content fuel	Major	MESDP	-

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	Decommissioning	Fugitive Dust generation	Spraying water	Minor	MESDP	US $ 10/ daily during decommissioning period
		Gaseous emissions	Use machineries with good engine with low sulphur content fuel	Minor	MESDP	-
Noise	Pre-construction	Noise level in dB(A)	Use sound proof machines	Minor	Pre-construction services provider	-
	Construction	Noise level in dB(A)	Avoid running construction machineries at the same time Avoid working at night.	Minor	Construction services provider	-
	Operation	Noise level in dB(A)	Avoid working at night.	Minor	MESDP	-
	Decommissioning	Noise level in dB(A)	Avoid working at night	Minor	MESDP	-
Surface Water	Pre-construction	Increase turbidity, oil and grease in Ayarwadi River	Avoid earth working and excavation during rainy seasons, waste water channels, avoid leakage of oil & lubricant, Vegetation of bare areas.	Minor	Pre-construction services provider	US $ 50 for all cost
	Construction	Construction Debris	Temporary settling pond	Minor	Construction Services Provider	US$ 50 for all cost
		Oil and Grease	Avoid any leakage of oil and lubricant	Minor	Construction Services Provider	-
		Domestic Wastes	Use proper waste management system	Minor	Construction Services Provider	-
	Operation	Oil and Grease	Avoid any leakage of oil and lubricant Installation of stormwater channels and	Moderate	MESDP	US$ 1000 for all cost

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			collection ponds with subsequent treatment through oil / water separators Oil spill management system			
		Domestic Wastes	Use proper waste management system	Minor	MESDP	-
	Decommissioning	Solid Wastes	Avoid any leakage of oil and lubricant, Vegetation of bare areas	Minor	MESDP	-
Soil and Ground Water	Pre-construction	Potential to soil contamination	Proper waste management system	Minor	Pre-construction services provider	-
		Potential to ground water pollution	Proper waste management system	Minor	Pre-construction services provider	-
	Construction	Leakage of fuel oil and lubricants	Store over concrete floor or impermeable pad	Minor	Construction Services Provider	-
		Construction debris and domestic Wastes	Solid wastes according to the rules and regulations of CDC (Amarapura)	Minor	Construction Services Provider	-
	Operation	Oil and Grease	Avoid any leakage of oil and lubricant Oil spill management system	Moderate	MESDP	US$ 1000 for all cost
		Domestic solid waste	Segregation, storage at source and collection of the waste management system	Minor	MESDP	-
	Decommissioning	Soil contamination	Waste disposal according to the rule and regulations of CDC (Amarapura),	Minor	MESDP	-
		Ground water pollution	-	-	MESDP	-
Biodiversity	Pre-construction	Impacts on flora diversity	Avoid tree cutting as much as possible	Minor	Pre-construction services provider	-
		Impacts on fauna diversity	Avoid working at night	Minor	Pre-construction services provider	-

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	Construction	Cutting of trees	Avoid tree cutting	Minor	Construction Service Providers	-
		Cutting of trees, wastes and noise	Avoide dispose wastes properly avoid working at night	Minor	Construction Service Providers	US $ 50
	Operation	Impacts on flora diversity	Proper waste management system, wind-break tree species	Minor	MESDP	US$100
		Impacts on fauna diversity	Proper waste management system, wind-break tree species	Minor	MESDP	US $ 100
Socio-Economic	Pre-consruction	Potential to Increase in household income	Job creation	Minor	MESDP	
	Construction	Increase pressure on health care facility	Use health care facilities of Amarapura	Moderate	MESDP	US $ 5/ for one time
	Operation	Impacts Associated with Population Influx	Use of local labor force, provide short and long terms health care services for workers	Minor	MESDP	-
		Fire Outbreak Risk	Install own fire fighting force and fire fighting system.	Major	MESDP	US $ 15000 for all cost
	Decommissioning	Loss of Jobs and Revenues	Employees to allow them to source alternative livelihood		MESDP	-
Utilities Consumption	Operation	Electricity	Install energy and water meters, Use LED lights, ,	Minor	MESDP	-
		Water	Implementing water efficient fixtures, Awareness campaign, Proper methods of water use	Minor	MESDP	-

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8.2.4. Important Factors for Environmental Monitoring

The following factors will be considered during the environmental monitoring.

(a) Monitoring will be done by registered third party monitoring agency or proposed environmental monitoring team of the proposed team. and at least three representatives from proposed monitoring team will be participated in every monitoring process.

(b) If monitoring results show constantly (3 consecutive years) and significantly (e.g. less than 75 percent) better than the required levels, frequency of monitoring can be reduced (IFC, World Bank, 2007).

(c) By studying the wind rose, the most dominant wind direction and wind speed for every season can be predicted and monitoring station for dust, noise and gas emissions will be carried out at that wind direction.

8.2.5. Environmental Management Training Program

Environmental management training program is an important part in EMP. Training and human resource development is an important link to achieve sustainable operation of the facility and environmental management.

Training Program for Construction Phase

During construction phase, construction contractor must ensure that project staffs are trained on labor safety and environment protection during construction phase.

Training Program for Operation Phase

In operation phase, all staff of proposed plant will be trained on environment safety throughout training courses to be familiar with operation processes and guidelines, fire fighting exercises and practices, etc. Project Management Board will be established and maintain training programs that are regularly updated to help staff at all levels and related functional departments are aware of their responsibility on environment protection. For successful functioning of the project, relevant EMP's will be communicated to the following groups of people:

Employees

Employees must be made aware of the importance of safety, waste segregation and storage, and energy conservation. This awareness will be provided through leaflets and

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periodic in-house meetings. They will be informed about their responsibilities for successful operation of various environmental management schemes inside the premises.

Site Staff

Relevant personnel at site will be trained for:

(a) Collection, segregation and storage of the solid and waste generated during operation,
(b) Operation and maintenance of sewage treatment plant and reclamation system,
(c) Requirements of the emergency response plan in case of an emergency,
(d) Techniques for waste minimization, water conservation and energy conservation,
(e) Applicable environmental, health and safety regulations and compliance requirements,
(f) Functioning of the environmental management system including environmental monitoring, reporting and documentation needs.

8.2.6. Record Keeping

Record keeping and reporting of performance is an important management tool for ensuring sustainable operation. Records will be maintained for regulatory, monitoring and operational issues. Typical record keeping requirements for the site is summarized in following table.

Record Keeping Requirements

Parameter	Particulars
Resources Use	- Daily quantity of electrical power consumption through power meter - Daily quantity of water use for cooling system and domestic use through water meter
Solid Waste Handling and Disposal	- Daily quantity and management of domestic solid waste from workers' dormitory
Monitoring and Survey	-Records of all monitoring carried out as per the finalized monitoring protocol.

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Complaints from Nearest Residents	- Records of all complaints about the traffic from the nearest villages
Employee Health and Safety Record	- Daily record for accidents at the workplace
Others	- Equipment inspection and calibration records, where applicable - Vehicle maintenance and inspection records

8.2.7. Environmental Audits and Corrective Action Plans

To assess whether the implemented EMP is adequate, MESDP will conduct periodic environmental audits. Environmental audit is an independent and objective oriented examination of whether the practice complies with expected standards. Broadly, environmental audit means a check on some aspects of environmental management, and implies some kind of testing and verification.

There are two levels of Environmental Audits, i.e. Environmental Impact Audit and Environmental Management Audit. Environmental Impact Audit involves comparing the impacts predicted in an EIA with those that actually occur after implementation of the project while Environmental Management Audit involves checks against adherence to plans, mitigation measures and general compliance of terms and conditions. These audits will be followed by Corrective Action Plans (CAP) to correct various issues identified during the audits.

8.2.8. Reporting Monitoring Results

Results of recorded in files to monitor and audit monitoring will be carried out strictly as required by the related national regulations and the monitoring results of required parameters should be reported to local authorities monthly and copies to MOl (Mandalay), ECC (Mandalay), MCDC and Quarter Administrative Offices.

8.3. Management and Monitoring Sub - Plans

8.3.1Occupational Safety and Health Management Plan

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Occupational safety and health management plan for the proposed project will include the following:

(a) Emergency and First-aid Procedures
(b) Medical Precautionary Measures
(c) Maintenance and Troubleshooting Precautions
(d) House Keeping
(e) Safety awareness
(f) Safety training

8.3.1. Emergency and First-aid Procedures

First aid is immediate, temporary treatment given in the event of accident or illness.

Eye: Contact lenses, if worn, will be removed. Irrigate the eyes immediately with large amounts of water for 15 minutes. Occasionally hold the eyelids apart to insure complete irrigation. Apply a dry protective dressing. Call for emergency medical assistance.

For "flash burns" cover the eye with cold (preferably iced) compresses for 5 to 10 minutes; then repeat. Apply a dry protective dressing. Call a physician. Don't rub the eye. Don't use ointments or drops unless prescribed by a physician.

Skin: For skin contact with irritants, flush the areas with large amounts of water, and then wash with soap and water. Remove contaminated clothing. If mucous membranes are irritated, flush with water. Wash cuts and scrapes with mild soap and water. Avoid contamination. Apply a dry sterile dressing.

For thermal bums, cold water is an effective first aid measure. If skin is not broken, immerse bum part in clean cold water or apply clean ice to relieve pain. Do not disturb or open blisters. Prevent contamination. Bandage loosely with a clean dry dressing. Call for emergency medical assistance.

Electrical Shock and Electrical Burns: Disconnect and turn off power. Remove victim from contact. Use no conducting materials if the rescuer must resort to pulling the victim from the live contact. The rescuer must first protect himself by use of insulated materials such as gloves. If not breathing, administer CPR as soon as electrical contact is broken. Call for emergency medical assistance. Continue CPR until spontaneous breathing has been restored or until a physician arrives. Administer oxygen. Keep comfortably warm.

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Keep horizontal until there is no further evidence of shock. Treat electrical bums as thermal bums. For electrical bums apply clean, cold (iced) compresses. Prevent contamination. Cover with a clean, dry dressing. Call for emergency medical assistance.

8.3.2. Medical Precautionary Measures

The following medical precautionary measures will be conducted by MESDP.

(a) Periodic health examinations will do with the cooperation with Public Health Office (Amarapura). The potential health effects of nonwork related factors, such as smoking, must be considered.

(b) An effective educational, training, and industrial hygiene program will be instituted. The program will cover the following: (a) the nature and potential hazards of welding, cutting and gouging; (b) proper and safe use of equipment; and (c) emergency and first aid procedures.

(c) Medical personnel will be available on-site or by phone for advice and consultation. Emergency phone numbers will be posted near the telephones. At leastone person on each shift will be trained in first aid, as well as qualified to administer oxygen and cardiopulmonary resuscitation (CPR).

(d) The following will be readily available: (a) first aid supplies approved by a physician; (b) stretchers and blankets for transportation; (c) oxygen inhalation equipment; and (d) approved instant acting eye washes and showers.

(e) Good personal hygiene practices are very important. Employees will wash their face and hands before eating, and it is recommended they not be permitted to eat, drink, or smoke in the work area. Food and beverages will not be stored in the work area. Contaminated clothing will be changed.

(f) Protection against skin conditions, such as chemical burns, rashes, and dermatitis can be provided by appropriate protective clothing and equipment, as well as the use of protective creams or lotions.

8.3.3. Maintenance and Troubleshooting Precautions

Faulty or improperly maintained equipment can cause property damage, physical injury, or possibly death by fire or electrical shock. Here is a list of some important items to check when troubleshooting or maintaining equipment.

(a) Stop operating immediately if equipment is malfunctioning.

(b) Do not perform any maintenance unless you are qualified to perform such work.

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(c) Make test readings carefully.

(d) Protect the equipment from heat, excessive wet conditions, oil or grease, corrosive atmospheres, and inclement weather.

(e) Replace parts only with manufacturer's recommended replacement parts.

(f) Keep all protective devices and covers in position.

8.3.4 House Keeping

The following measures will be practiced at the proposed plant.

(a) Regular cleaning of the floors with service water.

(b) Avoid dumping of wastes, damaged equipment and items anywhere inside the plant affecting aesthetics and increasing risk of fire and other hazards.

(c) Maintaining hygienic conditions in areas like canteens, near drinking water sources and toilets.

(d) Maintaining green belt along the project boundaries to suppress noise, fugitive dust and to improve the aesthetics.

(e) Developing a positive outlook in the employees for improving the working place, both in oil storage area and office clean and well maintained.

8.3.5 Safety Awareness

Safety awareness must be promoted among project managers and employees by:

(a) Imparting regular training.

(b) Installing/displaying safety caution boards and safety posters mentioning Do's & Don'ts at different vulnerable locations.

(c) Arranging safety & housekeeping competition etc.

(d) To procure and maintain personal protective equipment in good working condition.

8.3.6 Safety Training

Training programmes in safety and aeccident prevention will be organized at all levels of employees with a view to familiarize them with the general safety rules, safety procedures in various operational activities and to update their knowledge in safety and accident prevention, industrial hygiene and emergency equipment. These training programmes will be conducted periodically in a planned manner to refresh their knowledge. Training shall be imparted for:

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(a) Safe working and maintenance practices.

(b) Use of proper tools and tackles.

(c) Use of personal protective equipment.

(d) Handling emergency situation.

8.3.7.. Development of an Environmental Health and Safety Plan

An Environmental Health and Safety Plan will be prepared for the demolition, construction, operation and decommissioning phases of the Project to ensure compliance with the Ministry of Health's Guideline for Occupational Health and Safety and the IFC guidelines.

To ensure its employees' health and safety, the Health and Safety plan will address the following topics:

- Safety devices to protect employees from injuries or hazardous conditions;
- Safe drinking water;
- Immunizations, as applicable;
- Clean eating area;
- First aid facilities;
- Sanitary conditions;
- Waste management, including bathrooms, and proper disposal procedures;
- Appropriate signage;
- Fire prevention facilities, training, and awareness; and
- Personal Protective Equipment (PPE).

A safety committee will be formed by LEC and regular safety meetings will be organized. General mitigation measures aimed at employees and contractors include the following:

- Provision of training about the fundamentals of occupational health and safety procedures.
- Provision of appropriate PPE (for example: latex gloves, working overalls, safety boots, safety helmets, safety glasses, hearing protection).
- Ensuring that especially sensitive or dangerous areas (like areas exposed to high noise levels, areas for especially hazardous work, etc.) are clearly marked, and barricaded if appropriate.

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- Ensuring that all maintenance work necessary for keeping machines and other equipment in a good state is regularly carried out.
- Ensuring that the workers (and especially those doing hazardous work or otherwise exposed to risks) are qualified, well-trained and instructed in handling their equipment, including health protection equipment.
- Provision of adequate loading and off-loading space.
- Development of an emergency response plan.
- Provision of appropriate lighting during night-time works (if any)
- Enforcement of speed limits for vehicles entering and exiting the site.

A basic first aid program will be extended to all employees and will ensure that in the event of an accident or injury, someone with first aid knowledge will be present to render initial assistance until further medical attention can be made available. Qualified personnel will provide instruction on the necessary theoretical as well as practical skills required. The advanced first aid program will be an extension of the basic first aid program attended by selected employees, including supervisors and the Health and Safety Officer, and will train participants in the recognition and initial management of serious injuries and illnesses. Employee health and safety orientation will train all employees on the basic rules of work, safety procedures, site-specific hazards, and emergency procedures. A visitor orientation and control program will be implemented if visitors will be entering areas of the site where hazardous conditions or substances are present. Supervisory personnel and safety representatives will attend training on accident investigation and reporting procedures.

Employees and contractor personnel will be provided health and safety training prior to commencing work or a new assignment on this project. The training will consist of basic hazard awareness, identification of site-specific hazards and how they are controlled, safe work practices, potential risks to health and precautions to prevent exposure, hygiene requirements, PPE requirements and proper use, equipment labeling, accident prevention and reporting, and emergency procedures for fire, evacuation, or natural disaster.

All employees, contractors and visitors will be informed of their responsibility to participate in the creation of a healthy and safe environment by reporting unsafe and hazardous conditions when detected and performing work in a safe manner by following the correct work procedure.

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Hazardous areas will be marked with appropriate signs, which identify the hazard and associated safety measures. All signs will conform to international standards and will be designed to be understood by all employees and visitors. Signs may contain both text and pictures, as necessary, to ensure that any illiterate employees or visitors would be made aware of the hazard.

Containers of hazardous materials will be labeled with the contents and associated hazards. A color coding system will be implemented to allow immediate visual identification of containers or equipment which contains hazardous substances.

Emergency personnel will be made aware of the types of fuel and of other hazardous materials and typical amounts stored onsite, and storage locations to expedite emergency response. Local emergency response personnel will be invited to inspect the site periodically to ensure familiarity with potential hazards present

8.4. Emergency Response Plan (ERP)

An emergency is an unplanned event when a project operation loses control, or could lose control, of a situation that may result in risks to human health, property, or the environment, either within the facility or in the local community. Emergency incident response plan for proposed project is proposed to mitigate harms on humans and environment in the project area and its vicinity in case of incident. This plan provides the management structure, key responsibilities, emergency assignments and general procedures to follow during and immediately after an emergency. Moreover, it is necessary to establish ERP to address the immediate requirements for a major disaster or emergency in which normal operations are interrupted and special measures must be taken to:

(a) Save and protect the lives of employees;
(b) Manage immediate communications and information regarding emergency operations and work site safety;
(c) Provide essential services and operations;
(d) Provide and analyze information to support decision-making and action plans; and
(e) Manage resources effectively in an emergency operation.

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8.4.1. Development of an Emergency Response Plan

The EPRP must comply with the IFC Occupational Safety Guidelines and Performance Standards. The EPRP must include:

- Roles and responsibilities of emergency personnel;
- Emergency contacts and communications systems/protocols, including procedures for interaction with local and regional emergency authorities;
- Specific emergency response procedures;
- Design and implementation of an emergency alarm system audible across the entire site;
- An evacuation plan which must be read and practiced by all employees and contractors. The evacuation plan will include emergency escape routes, procedures for accounting for employees after an evacuation, and roles and responsibilities of personnel during an evacuation;
- Identification of supplies and resources to be utilized during an emergency event, including emergency equipment, facilities, and designated areas; and
- A training plan, which includes specific training and drill schedules for personnel who are responsible for rescue operations, medical duties, spill response, and fire response.

If an emergency develops, all persons on the project site must be notified immediately and efforts must be coordinated with others in the vicinity surrounding the project area in order to reduce impacts, if applicable. If an emergency is imminent, but has not yet begun, steps must be initiated to immediately advise persons in the vicinity of the emergency to evacuate and notifications will be made to the local ECD, the County Superintendent, local police, and all other authorities which have responsibility regarding the emergency.

If there is a slowly developing emergency or unusual situation where an emergency is not imminent, but could occur if no action is taken, project personnel will notify the ECD, the County Superintendent, local police, and all other authorities of the potential problem and keep them advised of the situation. These agencies will be requested to indicate if there are any immediate actions that will be taken to reduce the risk or severity of the emergency and if necessary, what preventative actions have to be implemented. In an emergency situation, equipment and supplies have to be

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needed on short notice. Therefore, the LEC must maintain an accurate inventory of emergency response equipment and supplies.

The EPRP will include an evacuation plan which will be read and practiced by all employees and contractors. The evacuation plan will include emergency escape routes, procedures for accounting for employees after an evacuation, and roles and responsibilities of personnel during an evacuation. In general, the following evacuation procedures will be followed:

- Alert the Emergency Response Team to assist in the evacuation.
- Use communications tools that are appropriate for the type of incident and the time of occurrence, such as alarms or loud speakers.
- When communicating an evacuation, speak clearly and succinctly: "We have a [state the type of emergency]. Evacuate to [state the assembly point]".
- Turn equipment off, if possible.
- Take emergency supplies and staff rosters, if possible.
- Account for personnel.
- Wait at the assembly point for further instructions.

The EPRP will have specific information on fire safety and explosion response, which will provide additional details specific to these emergencies.

8.4.2. Elements of ERP

Emergency Preparedness and Response Plan that is commensurate with the risks of the facility and that includes the following basic elements:

(a) Communication systems
(b) Emergency resources
(c) Training and updating
(d) Business Continuity and Contingency

Additional information is provided for key components of the emergency plan, as follows:

(1) Worker Notification and Communication

Alarm bells, visual alarms, or other forms of communication will be used to reliably alert workers to an emergency. Related measures according to IFC Guidelines include:

(a) Testing warning systems at least annually (fire alarms monthly), and more frequently if required by local regulations, equipment, or other considerations; and

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(b) Installing a back-up system for communications on-site with off-site resources, such as fire departments, in the event that normal communication methods may be inoperable during an emergency.

Community Notification

If a local community may be at risk from a potential emergency arising at the facility, the company will implement communication measures to alert the community, such as:

(a) Audible alarms, such as fire bells or sirens;
(b) Fan out telephone call lists;
(c) Vehicle mounted speakers;
(d) Communicating details of the nature of the emergency;
(e) Communicating protection options (evacuation, quarantine); and
(f) Providing advise on selecting an appropriate protection option.

Media and Agency Relations

Emergency information will be communicated to the media through:

(a) A trained, local spokesperson able to interact with relevant stakeholders, and offer guidance to the company for speaking to the media, government, and other agencies.
(b) Written press releases with accurate information, appropriate level of detail for the emergency, and for which accuracy can be guaranteed.

(2) Emergency Resources

(a) Fire Services

MESDP will consider the level of local fire fighting capacity in the event of a major emergency or natural disaster. If insufficient capacity is available, fire fighting capacity will be acquired that may include personal fire engine, pumps, water supplies, trucks, and training for personnel.

(b) Medical Services

MESDP will provide first aid attendants for the facility as well as medical equipment suitable for the personnel, type of operation, and the degree of treatment likely to be required prior to transportation to hospital during emergency case.

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(c) Availability of Resources

Appropriate measures for managing the availability of resources in case of an emergency in Amarapura region include:

(i) Maintaining a list of external equipment, personnel, facilities, funding, expert knowledge, and materials that may be required to respond to emergencies. The list will include personnel with specialized expertise for spill clean-up, flood control, engineering, water treatment, safety, environmental science, etc., or any of the functions required to adequately respond to the identified emergency.

(ii) Providing personnel who can readily call up resources, as required.

(iii) Tracking and managing the costs associated with emergency resources.

(iv) Considering the quantity, response time, capability, limitations, and cost of these resources, for both site-specific emergencies, and community or regional emergencies.

(v) Considering if external resources are unable to provide sufficient capacity during a regional emergency and whether additional resources may need to be maintained on-site.

Note: All of these resources will have alternate facilities.

(d) Mutual Aid

Mutual aid agreements decrease administrative confusion and provide a clear basis for response by mutual aid providers. Where appropriate, mutual aid agreements will be maintained with other organizations to allow for sharing of personnel and specialized equipment.

(e) Contact List

The company will develop a list of contact information for all internal and external resources and personnel in Amarapura region. The list will include the name, description, location, and contact details (telephone, email) for each of the resources, and be maintained quarterly. The contact list will include General Administrative Office (Amarapura), Myanmar Police Force (Amarapura), Public Health and Medical Services (Amarapura), Fire Services Department (Amarapura), Fire Services Department (Amarapura), Department of Relief & Resettlement (Mandalay) and Department of Relief & Resettlement (Mandalay) etc.

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(3) Training and Updating

The emergency preparedness facilities and emergency response plans require maintenance, review, and updating to account for changes in equipment, personnel, and facilities. Training programs and practice exercises provide for testing systems to ensure an adequate level of emergency preparedness. Programs will:

(i) Identify training needs based on the roles and responsibilities, capabilities and requirements of personnel in an emergency

(ii) Develop a training plan to address needs, particularly for flood control, fire fighting, spill response, and evacuation. Conduct annual training, at least, and perhaps more frequent training when the response includes specialized equipment, procedures, or hazards, or when otherwise mandated

(iii) Provide training exercises to allow personnel the opportunity to test emergency preparedness, including:

- Desktop exercises with only a few personnel, where the contact lists are tested and the facilities and communication assessed.
- Response exercises, typically involving drills that allow for testing of equipment and logistics.
- and what aspects require improvement.
- Update the plan, as required, after each exercise. Elements of the plan subject to significant change (such as contact lists) will be replaced.`
- Record training activities and the outcomes of the training.

(4) Business Continuity and Contingency

Measures to address business continuity and contingency include:

(i) Identifying replacement supplies or facilities to allow business continuity following an emergency. For example, alternate sources of water, electricity, and fuel are commonly sought.

(ii) Using redundant or duplicate supply systems as part of facility operations to increase the likelihood of business continuity.

(iii) Maintaining back-ups of critical information in a secure location to expedite the return to normal operations following an emergency.

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8.4.3 Proposed Organization for ERP Team

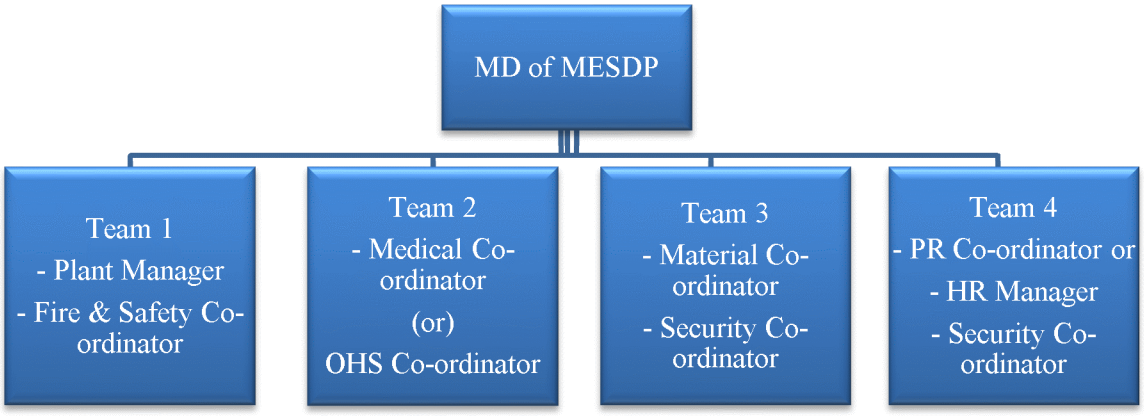

Figure - Organization for ERP Team

Proposed Duty Allocation for EPR Team

The followings are the duty allocation for EPR team.

(a)Chief Emergency Controller (General Manager)

- Take control and declare emergency.
- Focal person for all team.
- Contact Authorities.

(b) Plant Manager

- Take steps. Make Emergency shut-down of activities. Put everything in Safe condition.
- Evacuate.
- Commence initial emergency case, till Fire Department or other agencies comes to take up.
- Identify materials requirements and call Material Manager.

(c)Medical Coordinator

- Establish Emergency Center, Treat affected persons,
- Transfer/Remove Patients.
- Assign and Deploy staff.
- Contact Authorities.

Material Coordinator

- Dispatch necessary Supplies.

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- Arrange Purchases.
- Providing equipment perform shutdown procedures, damage assessments, emergency repairs and equipment protection.

(d) Fire & Safety Coordinator

- Be Overall in-charge for Fire and Safety.
- Coordinate with Area Coordinator and Direct the Operations.
- Coordinate with City and Other Fire-tenderers.

(f) Public Relationship Coordinator & Security Coordinator

- Remove Crowd
- Arrange Gate security
- Contact Police
- Arrange evacuation
- Contact outside Agencies if asked.
- Handle news media
- Mobilise vehicles
- Arrange Food, clothings to Officers inside.

(g) Emergency Control Center

- Adequate Internal phones
- Adequate external phones
- Workers Tally
- Map showing hazardous storages, Fire horns, Safety equipments, Gates and side gates, Assembly points, List of persons.

Emergency Response for Fire

Typically, oil storage facilities can be considered as one of the fire hazard industry and proposed plant must have fire control plan. In order to achieve this target, fire fighting system have to be designed in compliance with requirements of local fire fighting station or the American National Fire Fighting Association (NFPA) standards as shown in table below.

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Table - American National Fire Fighting Association (NFPA) Standards

No.	Parameters	Proposed Capacity
1.	Maximum water pressure	14 bar
2.	Fire water flow	12.0 liters/m^2/min

Fire Fighting Equipment

The proposed project will be equipped with the following fire fighting systems:

(a) Firewater system and posts; and

(b) Firefighting foam and

(c) Portable Fire extinguishers.

All of the fire fighting facilities will be equipped according to the rules and regulations of local fire fighting station (Amarapura).

(a) Firewater System and Posts

Firewater posts will be equipped with the interval of 80m or according to the local fire fighting station's rules and regulations. Tools and accessories will be provided in box at each post.

(b) Firefighting Foam

Firefighting foam is a foam used for fire suppression. Its role is to cool the fire and to coat the fuel, preventing its contact with oxygen, resulting in suppression of the combustion. Types of foam are aqueous film forming foams (AFFF), film-forming fluoroprotein (FFFP), alcohol-resistant fluoroprotein foam (AR-FP), and alcohol-resistant film-forming fluoroprotein (AR-FFFP). Every type of foam has its application. High-expansion foams are used when an enclosed space, such as a basement or hangar, must be quickly filled. Low-expansion foams are used on burning spills. AFFF is best for spills of jet fuels, FFFP is better for cases where the burning fuel can form deeper pools, and AR-AFFF is suitable for burning alcohols. The most flexibility is achieved by AR-AFFF or AR-FFFP. AR-

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AFFF must be used in areas where gasolines are blended with oxygenates, since the alcohols prevent the formation of the film between the FFFP foam and the gasoline, breaking down the foam, rendering the FFFP foam virtually useless.

General Guidelines for the Storage and Handling of Foam Concentrates

The effective life of foam concentrates can be maximized through optimal storage conditions and proper handling. Foam concentrates have demonstrated effective firefighting performance with contents stored in the original package under proper conditions for more than 10 years. To optimize the effective life and performance of firefighting foams they will be stored in the following ways:

Do not expose to direct sunlight or any heat source. The product will be maintained within the recommended temperature range - refer to specific foam concentrate product data sheet for recommended storage temperatures. The storage area will not be susceptible to flooding.

Fire Protection Products recommends tracking of inventory batch numbers and rotating inventory to ensure older batches are used first. Foam color may differ from batch to batch, and foam color can also change during aging. Mixing firefighting foam concentrates (different types, brands, products) for long-term storage is not recommended. However, it is appropriate to use in conjunction with comparable firefighting foam type for immediate incident response. Contact the manufacturer prior to topping off existing stock with any new foam other than the original product.

Inspection

The foam concentrate will be inspected periodically in accordance with any of the following standards: NFPA 11, EN 13565 -2, or other relevant standard. A representative concentrate sample will be sent to qualified laboratory for quality analysis per the applicable standard. An annual inspection and sample analysis is typically sufficient. In case of any doubts, please contact the manufacturer.

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Specific guidelines on the storage of foam concentrates

Totes/Original Packing (Optimum Storage)

The following guidelines are recommended when storing foam concentrates in totes**:**

- Totes are best stored in an environmentally controlled, indoor warehouse
- The storage area around the tote will be clean
- The tote will be stored on the floor and on a rack system rated for the volume of foam concentrate being stored
- Tote will be kept closed and sealed during storage

Disposing foam from Foam Top System

Checking the foaming System

Upon installation of a foam system, several pre-commissioning tests must be conducted to ensure functionality and safety. The pipework must be pressure tested to confirm the integrity of the joints, and isolation and deluge valves need to undergo functional testing. Foam chamber vapor seals should be inspected for any damage, while nozzles must be correctly positioned, free from obstructions, and properly aligned. Foam storage tanks should be filled and ready for use, and pump systems must be tested to verify that their performance meets the required specifications. This testing is facilitated through discharge pipework, typically recirculating into storage tanks to reduce water waste, and includes monitoring with pressure gauges and flow meters. Additionally, foam proportioning systems need to be verified for their foam-to-water ratio under maximum system demand, ensuring proper operation. This can be achieved by sampling discharged foam or using an environmentally friendly test liquid where possible. Moreover, where applicable, the quality of the expanded foam must be quantitatively assessed to confirm its effectiveness in fire suppression, while also minimizing environmental impact during testing.

Environmental Impacts due to using AR-AFFF and AR-AFFFP

Firefighting foam concentrates are simply a mixture of chemicals and all chemicals, whether man made or natural, have an impact on our environment, some of which are positive but many others can do harm. It can therefore be assumed that all firefighting foams will have an adverse impact on our environment.

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There are three ways whereby foams may pollute the aquatic environment and lower water quality. Namely by their persistence, their propensity to bio-accumulate and their toxicity. Of the latter, toxic effects may result from the inherent toxicity of the foam product being released, or indirectly due to oxygen depletion, as the foam subsequently biodegrades.

Fluoroprotein foam (FP foam) has been widely used for firefighting, especially in fuel-based fires, but its environmental impact and safe disposal require careful attention. One major concern is that older formulations contain per- and polyfluoroalkyl substances (PFAS), which are persistent in the environment and can contaminate soil and water. Even newer, supposedly lower-impact versions may still introduce harmful chemicals into ecosystems if not managed properly. When FP foam is used, runoff can seep into groundwater, affecting drinking water sources and aquatic life. Improper disposal, such as dumping it into regular wastewater systems, can lead to contamination that is difficult and costly to remove.

When fluoroprotein foam (FP foam) enters waterways, it can have serious consequences for aquatic life. The chemicals in the foam, especially if it contains PFAS, don't break down easily and can accumulate in fish, shellfish, and other organisms, disrupting their growth, reproduction, and overall health. Even short-term exposure can reduce oxygen levels in water, making it harder for aquatic species to survive. Some components of the foam are toxic to fish and amphibians, leading to population declines and disruptions in the food chain. Over time, these pollutants can move up the food web, potentially affecting humans who consume contaminated seafood.

To minimize harm, it's crucial to prevent foam runoff from reaching rivers, lakes, and groundwater in the first place. Containment measures, such as bunded areas and proper drainage systems at firefighting sites, can help capture foam before it spreads. Using absorbent materials and specialized filtration systems can remove harmful compounds from water before discharge. When disposal is necessary, treating foam waste at certified hazardous waste facilities ensures that toxic elements don't enter the environment

Safe Disposal of fluoroprotein foam (FP) residue after extinguishing a fire

Proper disposal of fluoroprotein foam (FP) residue after firefighting is crucial to protect the environment, especially water sources and soil. If not manage properly, the foam's

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chemical components, including fluorosurfactants in older formulations, can seep into groundwater or be flowed into rivers, harming aquatic life and ecosystems. To prevent this, the first step is containment—ensuring that foam runoff doesn't enter drains or natural water bodies. This can be done using barriers, bunded areas, or absorbent materials to collect the contaminated liquid.

Once collected, the foam residue should be treated before disposal. If it contains PFAS or other hazardous chemicals, it must be transported to a certified hazardous waste facility for high-temperature incineration or advanced filtration. For newer, fluorine-free foams, the wastewater may be treated at an industrial treatment plant using chemical and biological filtration. If the foam has soaked into the ground, soil remediation—such as excavation, containment, or bioremediation—may be needed to prevent long-term contamination.

Following environmental regulations is essential, as many countries have strict guidelines on handling firefighting foam waste. Fire departments and industries using FP foam should also consider switching to fluorine-free alternatives (F3 foam) to reduce future risks.

(c) Portable Fire Extinguishers

Fire Extinguishers of suitable type e.g. CO_2 and DCP extinguishers shall be provided in the proposed project and shall be distributed in vulnerable areas. The extinguishers shall be checked/inspected at regular intervals for replenishment according to the rules and regulations of fire fighting station (Amarpura).

Safety Equipment and Personal Protective Appliances for Fire Fighting

Safety and personal protective appliances shall be provided in adequate numbers and shall be distributed in different sections according to requirement. A list of such appliances that must be available in the plant is given in the Table below.

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Table - List of Safety Equipment for Fire Fighting

No.	Safety Equipment
1.	Gas Mask
2.	Compressed air breathing apparatus
3.	PVC hand gloves
4.	Electrical hand gloves
5.	PVC apron
6.	Face shield of different colour
7.	Goggles of different types
8.	Safety belt
9.	Safety helmet
10.	Leather hand gloves
11.	Chargeable hand set
12.	Ear muffs and ear plugs
13.	Smoke exhauster cum blower

Organization for Fire Fighting Team

Fire fighting organization is proposed for MESDP as follow:

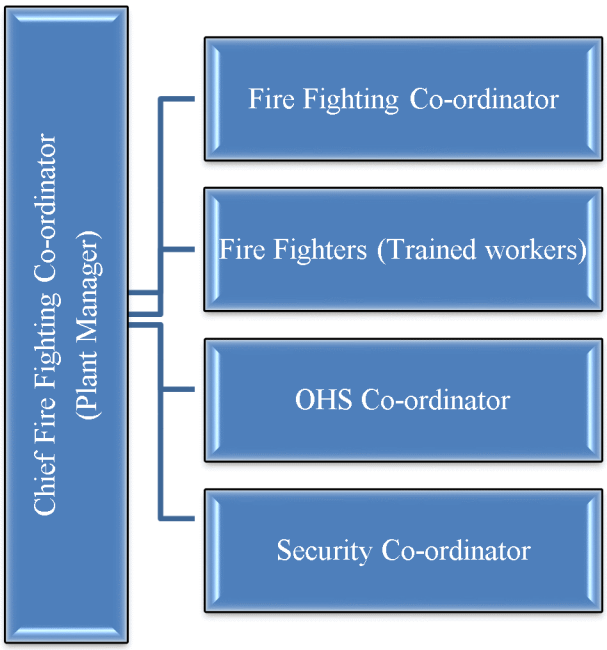

Figure - Organization for Fire Fighting Team

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Role and Responsibilities of Fire Fighting Team

The following role and responsibilities for fire fighting team but not limited are recommended to MESDP.

Team Members	Role	Responsibilities
Plant Manager	Chief co-ordinator	• Make Emergency shut-down of activities. Put everything in Safe condition. • Commence initial emergency case, till fire fighting department (Amarapura) comes to take up.
Fire fighting leader	Fire fighting co-ordinator	• Be Overall in-charge for Fire and Safety. • Coordinate with Local fire fighting station.
Trained workers and securities	Fire fighters	• Put off fire by using available equipments.
Safety officer	OHS co-ordinator	• Establish Emergency Center, Treat affected persons, Transfer/Remove Patients. • Workers Tally • Map showing hazardous storages, Fire horns, Safety equipments, Gates and side gates, Assembly points, List of persons.
Security leader	Security co-ordinator	• Remove Crowd • Arrange Gate security • Contact Police if necessary • Handle news media • Mobilise vehicles

8.5. Fire and Explosion Response Plan

The MESDP will operate under local Fire Fighting Service and will assisted by fire fighting teams which operates on a 8 hour shift round the clock. The location of the Main Fire Station will be at Main Gate.

Methods of Dealing with Different Types of Fire and Leakages

Fires from minor oil spillage on deck or jetty	Use dry chemical or foam extinguishers or water fog or water spray

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Fire from large spillage of oil or burst hose on deck or jetty	Use large dry chemical appliance and follow up with foam or water fog/spray. Cool surrounding area/risks with water spray
Fires from spillage of oil on surrounding waters	Emulsification of oil with water jets or apply foam coverage as appropriate
Ammonia Gas	Use dry chemical, carbon dioxide, water spray or alcohol- resistant foam from upwind position
Phosphoric/Sulphuric Acid	Dry powder, carbon dioxide (CO_2), water fog or
Electrical fires and/or fire in buildings-canteen	Switch off power-use CO_2 or dry chemical extinguishers
Fire in office involving combustible material	Use dry powder fire extinguishers-water spray, use breathing apparatus
LPG and LNG Fires	Will not be extinguished until source of leakage is under control. Dry chemical is the most effective. Cover affected area with water spray to reduce
Fire in cargo tanks	Use foam or steam smothering

Action Plan for Fire at the Jetty

MESDP will do the following actions for fire at Jetty.

(a) Signal station informs plant manager, fire fighting team and ERP team

(b) Master of the vessel ceases all cargo or bunker operations close the manifold valves

(c) Disconnect hoses and consults with Conservator for un berthing & also ensures the immediate action of the vessels Fire fighting squad.

(d) Reconfirms stoppage of cargo operations.

(e) Ensures area cordons off.

(f) Ensures isolation of the electric power on berth.

(g) Inform conservator and need for additional resources.

(h) Informs Crisis Management Group the status and Crisis level.

Action Plan for Fire at Bulk Material Handling Area

MESDP will do the following actions for fire at bulkl material handling area

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ACTION
1. BMH In charge raises alarm by informing signal station & Fire Station simultaneously uses Fire extinguishers to extinguish fire. 2. Switch off power supply and all cargo operation ceases. 3. Informs on-site action Group, Plant Manager and security officer (SO) 4. Shed I/c Mobilises all manpower in the area surrounding the site to bring the fire fighting appliances in the area, to extinguish the fire. 5. The senior most Traffic official on site will mobilize all the work force, labour and cargo handling appliances available in the area. 6. TM ensures the removal of all the unaffected cargo from the shed to a safe place. 7. TM ensures that the details of types of cargo and quantity of cargo in the shed will be kept ready and given to of Port Fire Service who comes first to the scene of the fire. 8. TM shall ensure that the labour working inside the shed is assembled for a head count. 9. Keeps all tugs & craft on stand by. 10. Recall Pilots for movement of vessels. 11. Inform all vessels to be standby.
1. Arrives with fire tenders and resources and takes over Fire Fighting. 2. Conducts search and rescue and evacuation of affected person. 3. Cordon Off the affected area. 4. Apprise Conservator and resources required.
1. Survey & assess the cost to rectify the damage portion of the Cargo storage shed.
2. Ensures isolation of the electric power to cargo storage shed.
3. Keeps ambulance standby by off Administration Building. 4. Provides First Aid to the injured.

Sinking of Vessel in Port

MESDP will do the following actions for sinking of vessin in port.

(a) Ensures vessel is cleared of the channel / turning basin or berths to suitable area for normal traffic.

(b) Informs emergency management team and plant manager;

(c) Proceeds to the area with Tugs and conducts rescue operations;

(d) Initiates the rescue operation of the person on board.

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8.6. Oil Spill Management and Response Plan

(1) Objectives

Objectives of oil spill management and response plan are as follows

- To prevent oil spills ensuring safe fuel oil handling and transport operations.
- To minimize environmental impacts due to project activities
- To protect ecosystem and habitats form any project activities
- To develop rapid response to oil spills to limit its spread quickly
- To enhance preparedness activities to maintain a robust response plan with regular drills and training.
- To protect public health and safety and minimize exposure risks for workers and local communities.

(2) Legal Requirements

Law name and section	Legal Commitments
The Environmental Conservation Law, 2012	
Section 7 (o)	The project proponent commits to manage to cause the polluter to compensate for environmental impact, cause to contribute fund by the organizations which obtain benefit from the natural environmental service system, cause to contribute a part of the benefit from the businesses which explore, trade and use the natural resources in environmental conservation works in accordance with Section 7(o) of The Environmental Conservation Law, 2012.
Section 14	The project proponent commits to carry out treating of emitting substances which cause pollution in the environment in accord with stipulated environmental quality standards in accordance with Section 14 of The Environmental Conservation Law, 2012.
Section 15	The project proponent commits to install or use an on-site facility or controlling equipment in order to monitor, control, manage, reduce or eliminate environmental pollution in accordance with Section 15 of The Environmental Conservation Law, 2012.
Section 24	The project proponent commits to follow the Ministry terms and condition relating to environmental conservation in accordance with Section 24 of The Environmental Conservation Law, 2012.
Section 29	The project proponent commits to follow the rules, notifications, orders, directives and procedures issued under this Law in accordance with Section 29 of The Environmental Conservation Law, 2012.
The Environmental Conservation Rules, 2014	
Rule 69 (a)	The project proponent commits not to emit, cause to emit, dispose, cause to dispose, pile and cause to pile, by any means, the pollutants to environment and the hazardous waste or hazardous material stipulated by notification under the Law and any of these rules at any place which may affect the public directly or indirectly Law in accordance with Rule 69 (a) of The Environmental

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	Conservation Rules, 2014.
Rule 69 (b)	The project proponent commits not to carry out the actions which can be damaged to natural environment which is changing due to ecosystem and such system, except the permission of the relevant Ministry in order to the interest of the public in accordance with Rule 69 (b) of The Environmental Conservation Rules, 2014.
Environmental Impact Assessment (EIA) Procedure, 2015	
Article 102 (a)	The project proponent commits to take full legal and financial responsibilities for all of the Project Proponent's actions and omissions and those of its contractors, subcontractors, officers, employees, agents, representatives, and consultants employed, hired, or authorized by the Project acting for or on behalf of the Project, in carrying out work on the Project in accordance with article 102 (a) of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 102 (b)	The project proponent commits to take full legal and financial responsibilities for PAPs until they have achieved socio-economic stability at a level not lower than that in effect prior to the commencement of the Project, and shall support programs for livelihood restoration and resettlement in consultation with the PAPs, related government agencies, and organizations and other concerned persons for all Adverse Impacts in accordance with article 102 (b) of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 103	The Project Proponent commits to fully implement the EMP, all Project commitments, and conditions, and is liable to ensure that all contractors and subcontractors of the Project comply fully with all applicable Laws, the Rules, this Procedure, the EMP, Project commitments and conditions when providing services to the Project in accordance with article 103 of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 104	The project proponent commits to take responsibilities to fully and effectively implement, all requirements set forth in the ECC, applicable Laws, the Rules, this Procedure and standards in accordance with article104 of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 105	The Project Proponent commits to timely notify and identify in writing to the Ministry, providing detailed information as to the proposed Project's potential Adverse Impact in accordance with article 105 of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 106	The Project Proponent commits in accordance with article 106 of Environmental Impact Assessment (EIA) Procedure, 2015.that during all phases of the Project (pre-construction, construction, operation, decommissioning, closure and post-closure), engage in continuous, proactive and comprehensive self-monitoring of the Project and activities related thereto, all Adverse Impacts, and compliance with applicable laws, the Rules, this Procedure, standards, the ECC, and the EMP.
Article 107	The Project Proponent commits to notify and identify in writing to the Ministry any breaches of its obligations or other performance failures or violations of the ECC and the EMP as soon as reasonably possible and in any event, in respect of any breach which would have a serious impact or where the urgent attention of the Ministry is or may be required, within not later than twenty-four (24)

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	hours, and in all other cases within seven (7) days of the Project Proponent becoming aware of such incident in accordance with article 107 of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 108	The Project Proponent commits to submit monitoring reports to the Ministry not less frequently than every six (6) months, as provided in a schedule in the EMP, or periodically as prescribed by the Ministry in accordance with article 108 of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 109	The project proponent commits to make sure that the monitoring reports will include: a) documentation of compliance with all conditions; b) progress made to date on implementation of the EMP against the submitted implementation schedule; c) difficulties encountered in implementing the EMP and recommendations for remedying those difficulties and steps proposed to prevent or avoid similar future difficulties; d) number and type of non-compliance with the EMP and proposed remedial measures and timelines for completion of remediation; e) accidents or incidents relating to the occupational and community health and safety, and the environment; and f) monitoring data of environmental parameters and conditions as committed in the EMP or otherwise required in accordance with article 109 of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 110	The project proponent commits in accordance with article 110 of Environmental Impact Assessment (EIA) Procedure, 2015. that within ten (10) days of completing a monitoring report as contemplated in Article 108 and Article 109 in accordance with the EMP schedule, the Project Proponent will make such report (except as may relate to National Security concerns) publicly available on the Project's website, at public meeting places (e.g. libraries, community halls) and at the Project offices. Any organization or person may request a digital copy of a monitoring report and the Project shall, within ten (10) days of receiving such request, submit a digital copy via email or as may otherwise be agreed upon with the requestor.
Article 113 (a)	The project proponent commits to grant to the Ministry and/or its representatives, at any time during normal working hours, access to the Project's offices and to the Project site and any other location at which the Project activities or activities related to the Project are performed in accordance with article 113 (a) of Environmental Impact Assessment (EIA) Procedure, 2015.
Article 113 (b)	The project proponent commits to grant the Ministry access to the Project's offices and to the Project site and any other location at which the Project activities or activities related to the Project are performed from time to time as and when the Ministry may reasonably require in accordance with article 113 (b) of Environmental Impact Assessment (EIA) Procedure, 2015..
Article 115	The project proponent commits to grant full and immediate access to the Ministry at any time as may be required by the Ministry in the event of an emergency, or where, in the opinion of the Ministry, there is or may exist a violation or risk of violation of the compliance by the Project with all applicable environmental and social requirements in accordance with article 115 of Environmental Impact Assessment (EIA) Procedure, 2015.

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Article 117	The Project Proponent commits to ensure that the Ministry's rights of access hereunder shall extend to access by the Ministry to the Project's contractors and subcontractors in accordance with article 117 of Environmental Impact Assessment (EIA) Procedure, 2015.
National Environmental Quality (Emission) Guidelines, 2015	
Section 2.1.9, 1.1, 1.3	The project proponent has to comply with the National Environmental Quality (Emission) Guidelines
The Conservation of Water Resources and River Law, 2006 (Amended 2017)	
Section 8 (a)	The project developer commits not to carry out any act or channel shifting with the aim to ruin the water resources and rivers and creeks in accordance with Section 8 (a) of The Conservation of Water Resources and River Law, 2006 (Amended 2017).
Section 11 (a)	The project developer commits not to dispose of engine oil, chemical, poisonous material and other materials which may cause environmental damage, or dispose of explosives from the bank or from a vessel which is plying, vessel which has berthed, anchored, stranded or sunk in accordance with Section 11 (a) of The Conservation of Water Resources and River Law, 2006 (Amended 2017).
Section 11 (b)	The project developer commits not to catch aquatic creatures within river-creek boundary, bank boundary or waterfront boundary with poisonous materials or explosives in accordance with Section 11 (b) of The Conservation of Water Resources and River Law, 2006 (Amended 2017).
Section 11 (c)	The project developer commits not to dispose of disposal soil and other materials from panning for gold, gold mineral dredging or resource production in the river and creek, into the river and creek or into the water outlet gully which can flow into the river and creek in accordance with Section 11 (c) of The Conservation of Water Resources and River Law, 2006 (Amended 2017).
Section 19	The project developer commits not to dump into the river that may cause damage to the waterway or change course in a stranded or sunken vessel in accordance with Section 19of The Conservation of Water Resources and River Law, 2006 (Amended 2017).
Section 21 (b)	The project developer commits to carry out no excavation without the permission of the Department in accordance with Section 21 (b) of The Conservation of Water Resources and River Law, 2006 (Amended 2017).
Section 22	The project developer commits not to pile sand, shingle and other heavy materials for business purposes in the bank area and waterfront area without the permission of the directorate in accordance with Section 22 of The Conservation of Water Resources and River Law, 2006 (Amended 2017).
Section 24 (b)	The project developer has to follow the rules prescribed by the Department in order to prevent water pollution and change of watercourse in rivers and creeks in accordance with Section 24 (b) of The Conservation of Water Resources and River Law, 2006 (Amended 2017).
Section 30	The project proponent commits to request approval from the Ministry of Transport and Communications for constructing drainage, utilizing river water intake, constructing bridges spanning rivers, connecting underground pipe, connecting underground electric power cable, connecting underground telecom

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	cable or digging in rivers and creeks, bank boundary and waterfront boundary, under the requirement of work in order not to adversely affect the water resources and rivers and creeks in accordance with Section 30 of The Conservation of Water Resources and River Law, 2006 (Amended 2017).
The Conservation of Water Resources and Rivers Rules, 2013 (Amended 2020)	
Rule 47	The project proponent commits to request the approval from the Ministry for constructing drainage, hydropower plant, pumping river water within boundaries of rivers and creeks, banks and waterfronts by stating the location of work, scope of work and the period of operation in accordance with Rule 47 of The Conservation of Water Resources and Rivers Rules, 2013 (Amended 2020)
Rule 49 (a)	The project proponent commits to pay prescribed fees for site investigation, survey and mapping in accordance with Rule 49 (a) of The Conservation of Water Resources and Rivers Rules, 2013 (Amended 2020).
Rule 49 (b)	The project proponent commits to pay prescribed fees for river water use and river maintenance in accordance with Rule 49 (b) of The Conservation of Water Resources and Rivers Rules, 2013 (Amended 2020)
The Law relating to Aquaculture (1989)	
Section 29 (b)	The project proponent complies not to obstruct navigation and flowing of water or polluting the water within the fisheries waters or abetting such acts in accordance with Section 29 (b) of the Law Relating to Aquaculture, 1989.
Mandalay Region Freshwater Fisheries Law, 2012	
Section 38	The project proponent complies not to disturb or damage the fish, aquatics lives, and living and non-livings things in any water bodies and not to pollute water in accordance with section 38 of Mandalay Region Freshwater Fisheries Law, 2012.

(3) Overview Map



Figure: Project Location and Jetty

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(4) Implementation Schedule

The Implementation Schedule for the Oil Spill Management and Response Plan includes a phased approach: (1) Planning and Preparation Phase involves developing the plan, risk assessments, procuring response equipment, and establishing response teams. (2) Training and Drills Phase ensures regular training for personnel and stakeholders, along with periodic spill response simulations. (3) Operational Phase includes continuous monitoring, spill prevention measures, and routine equipment maintenance. (4) Emergency Response Phase outlines actions for real-time spill management, containment, and reporting. (5) Post-Spill Phase includes impact assessments, restoration efforts, and updates to the plan based on lessons learned. This schedule ensures proactive preparedness, effective response, and compliance with regulatory requirements.

(5) Management Actions

The Management Actions for the Oil Spill Management and Response Plan focus on prevention, preparedness, and response. Preventive actions include implementing strict safety protocols for fuel handling, vessel inspections, and spill containment system, regular inspections and maintenance of storage tanks, pipelines, and transport vessels to reduce the risk of spills. It also involves installing robust secondary containment systems, such as bund walls and floating booms, to quickly contain spills before they spread. Staff training is an essential component, ensuring that all personnel are familiar with spill response protocols, the use of safety equipment, and environmental protection techniques. Preparedness actions involve maintaining response equipment, training personnel, and conducting regular drills. Response actions include immediate spill containment using booms and skimmers, notifying relevant authorities, and deploying trained response teams to manage cleanup. Post-response actions focus on environmental monitoring, impact assessments, and plan revisions to prevent recurrence. These actions ensure environmental protection, compliance, and effective spill mitigation.

The following activities should be carried out in case of oil spill:

Control room will receives call on fuel spill from staff or public. Initial actions to be taken after fuel spill are as follow:

- identification of the source of oil spill and related information:
- the location of the oil spill
- nature and extent of the oil spill

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- if fuel loss is continuing or has been stopped
- if any persons have been killed or injured
- if fire has broken out or if there is a danger of a fire
- any persons, installations or property that could be in immediate danger
- any dolphin sightings in the vicinity
- the quickest and safest way for emergency services to approach the spill site
- any other information that will assist to quickly contain the spill and minimize or prevent loss of fuel and environmental damage

Reporting to relevant Authorities:

- Fire Service Department (if there is a danger of fire or to persons and property)
- Police (if there is danger to persons and property)
- Agriculture and Fisheries Department (if spill is on the river)
- Environmental Conservation Department

Immediate response:

- Shut down pumps and close valves as required
- Maritime Oil Spill Response Plan to be implemented (if spill is on river)

After taking the initial actions, a Emergency Management Team (EMT) and Emergency Response Plan Team (ERP) will be activated to carry out subsequent response actions to better assess the situation, organize the fuel spill clean-up / fire-fighting operations, and co- ordinate the response with involved parties.

Actions to be taken by EMT

Containment of leaking fuel:

- Assess the size/volume of the spill
- Determine whether the spill can be contained within the tank farm
- Determine if the spill can be contained and what measures are necessary to ensure maximum containment on the rivers below if overflow is occurring (if spill is on river)
- Use soil, sand or absorbent material, if possible, to contain as much fuel as possible and prevent spreading

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- Commence deployment of booms to contain the spill (if spill is on river)

Recovery and processing of free fuel

- If possible, place drip trays, containers etc to collect leaking fuel
- Use air driven diaphragm pumps to recover fuel and transfer it into containers, fuellers or empty tanks
- Recover fuel into containers by use of skimmers, the recovery vessel & fuller trucker, etc (if spill is on river)

Clean up methodology

- Use absorbent pads to soak up the remaining fuel
- Recovery any fuel contaminated soil for treatment or use bio- remediation methods for in-situ de-contamination of affected soil
- Clean the affected wharf area. Allow any remaining moist areas of fuel to evaporate (if spill is on river)

Handling and disposal protocols

- Disposal of absorbent material and residuals of the cleanup processes as chemical waste
- Under close supervision, release the liquid through the control valve on the drainage outlet through the oil-water separators
- Remove any excess fuel from the oil-water separator and place in suitable containers for immediate removal of off-site by a licenced chemical waste collector

➢ Communications with the media and public

- Prepare initial incident report, and a written list of fact concerning the incident
- Arrange to have the incident and the response activities videotaped and photographed several times a day
- Brief the news media and answer the questions at least once a day
- Update information and submit daily reports to relevant authorities

➢ Post-incident review and investigation

- Investigate the cause of spill

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- Identify any problems in the spill response plan or actions
- Identify any environmental damage including damage to the marine environment
- Determine any action to prevent spill recurrence
- Complete an incident report and submit to all relevant authorities

Response actions to be taken if fire incidents have been detected

- Activate Fire Protection System and Emergency Shut-Down Devices
- Use tank base foam injection system only on authorization
- Notify neighboring facilities and others that may be affected
- Evacuate non-essential personnel from scene of incident
- Clear access to scene for emergency fire fighting vehicles and assign a person to direct fire fighters to the scene and prevent entry by unauthorized persons
- Conduct a head count at the emergency assembly point to ensure no one is missing
- Establish communications. Ensure portable radios, phones, and other means of communication are provided to speak to field personnel and emergency responders
- Assemble available fire-fighting materials / pollution control equipment and stand-by to advise and / or assist Fire Services Department
- Deploy oil pollution control equipment and initiate removing oil from affected areas. If required, mobilize other fuel spill clean-up services
- To prevent tank rupture, ensure that the tank cooling systems are activated
- Make sure emergency exit routes are kept open/unobstructed at all times
- Cover fuel spill with foam to prevent fumes from traveling to an ignition source

(6) Monitoring Plans

Oil Spill Management and Response Plan should be checked at the regular basis. Monitoring plan for Oil Spill Management and Response Plan is mentioned in the following table.

Project Activities	Parameter	Guidelines	Locations	Measurements (Methods	Frequency of measuremen	Responsibility

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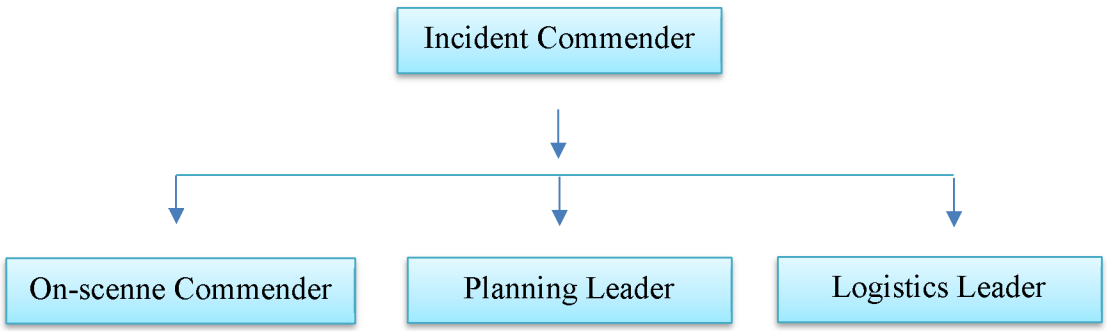
				and Equipment)	t	
Regular inspections and maintenance of storage tanks, pipelines, and transport vessels	Oil spill and leakage	-	Jetty Area (21°51'53.50"N, 95°59'34.87"E)	By vision	Daily	EO of EMMT
Water Quality	Total Suspended solid, BOD, COD, DO, pH, Ammonium nitrogen, Oil & Grease, Ecoli, Copper	National Surface Water Quality Standard (NSWQSD)	Ayeyarwaddy River (21°51'58.36"N, 95°59'34.83"E) Myit Nge River (21°51'41.54"N, 95°59'32.56"E)	Take water sample and test at the laboratory	Twice a year	EO of EMMT

(7) **Projected Budgets and Responsibilities**

The budget for vessel management plan includes in cost for environmental monitoring activities, and project operation cost.

Responsibilities

Emergency Management Team Organization Diagram and Responsibilities



Incident Commander Responsibilities:

- Assess the initial situation

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- Co-ordinate EMT activities
- Ensure the Initial Incident Report is completed and used to make initial notifications
- Hold planning meeting with EMT and relevant Government departments
- Develop and implement the overall response action plan in consultation with appropriate parties
- Authorize the release of information concerning the incident
- Act as liaison with the media and government departments
- Ensure the safety and health of employees, contractors and other people responding to the emergency
- Assign or request an incident investigation team
- Approve termination of crisis response activities
- Co-ordinate the post-emergency review

On-Scene Commander responsibilities:

- • Assess the situation at the scene and report to the incident commander
- Develop and supervise the on-scene response actions
- Use available response equipment and personnel to contain and control situation
- Report special activities, events and occurrences to the incident commander

Planning Leader Responsibilities:

- Compile and display the incident status summary information
- Establish the information requirements and reporting schedules for the EMT
- Supervise and prepare the specific response action plan for the next 24 and 48 hours and longer periods
- Maintain up-to-date information on the status of the incident and resources
- Prepare 'updates' and daily incident summaries for the Incident Commander
- Ensure that communications, medical health and safety, and security needs for the emergency response are being met by employees, contractors, and local response personnel
- Evaluate the environmental effects of the incident and recommend actions to minimize

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Logistics Leader Responsibilities:

- Identify service and support requirements for planned and expected operations
- Provide input and review communication, medical, health and safety, and security needs with planning leader
- Prepare a communication plan
- Arrange video or photographic documentation of the incident
- Arrange for food, temporary housing, water, protective clothing, response equipment and any other materials required to meet the needs of those responding to the crisis
- Establish receiving and distribution systems for incoming equipment, supplies and personnel

8.7. Disaster Management Plan

Disaster means a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man-made cause, or by accident or negligence which result in substantial loss of life or human suffering or damage to, or degradation of, environment, and is of such nature or magnitude as to be beyond the coping capacity of the community of the affected area. Disaster Management implies continuous and integrated process of planning, organising, coordinating and implementing measures which are necessary as expedient for

- Prevention of danger or threat to any disaster.
- Mitigation or reduction of risk of any disaster or its severity or consequences.
- Capacity building.
- Preparedness to deal with any disaster.
- Prompt response to any threatening disaster situation or disaster.
- Assessing the severity of magnitude of effect of every disaster.
- Evacuation rescue & relief.
- Rehabilitation and reconstruction.

Types of Disasters

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1. Fire
2. Escape, intentional release or threat to release due to – oil, gas, chemicals or radioactive, biological or flammable materials
3. Accidents – Collision, grounding and sinking of ships, transport or work place accidents.
4. Natural calamities – Flood and Earth quake

Internal Department

The primary focus of MESDP disaster management system is to mitigate the effects of disaster on port community wherever possible or practical, while preparing to respond when disaster occur. The role and responsibilities specifically for each phase.

Specific responsibilities – Response Phase

- Activate the disaster management response team and also crisis response team.
- Activate the relevant / workplace emergency team for the first strike response including traffic and pollution
- Thereafter assist emergency services to respond to the event.
- Assist with providing relief for persons affected by disaster.

Specific responsibilities – Recovery Phase

- Satisfy immediate, essential personal and port community needs to extent of port capability.
- Maintain liaison and timely communication with district disaster coordinator.
- Contribute to the recovery function coordinated by District Disaster coordinating authority.
- Coordinate the recovery of physical infrastructure.
- Coordinate activities with relevant Disaster district initiatives and plans.
- Participate in long term recovery, reconstruction and rehabilitation
- Communicating regarding restoration of Plant activities.

Flood (Similar to Cyclone)

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DEPT	ACTION
EMT	• Signal Station passes weather message to On-scenne Commender and Planning Leader • HM places on-site action group alert • Conservator apprises Chairman of weather developments who places
Civil Dept.	• Drainage system of the port i.e inside harbour area & out side harbour area will made cleared. • Trailer mounted portable Diesel pump sets to be made standby with sufficient length of hose pipes. • Sand bags to be used around sensitive areas including water supply • Pump stations electric sub stations
E & M Dept.	• All the outside installations and equipment shall be properly secured. • Cyclone field units to be made alert
Administration	• To make standby arrangements for transportation to evacuate population to cyclone centres and relief centres.

Relife Work after an Earthquake

ACTION
To contact the District Collector, Relief Commissioner, Army, fire force and seek assistance for project site.
To assist the Chairman to assess relief requirements. Arrange Food, shelter & transportation
To provide and hire if necessary, earthmoving equipments, cranes, forklifts, bull dozers etc.
Deploy engineers to direct or guide earth moving equipment and cranes to remove the debris
Ensure safety of cargo in cargo sheds and at project site. Ensure the safety of Port Marine craft and vessels alongside
To organise Search and Rescue of persons trapped under debris.
Medical officer to ensure provide of proper Medical Aid to the injured

- If outdoors, find a clear spot away from buildings, trees, streetlights, and power lines. Keep lying on the ground and stay there until the shaking stops. Injuries can occur from falling trees, street-lights and power lines, or building debris.
- If on vehicle, pull over to a clear location, stop and stay with your seatbelt fastened until the shaking has stopped. Trees, power lines, poles, street signs, and

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other overhead items may fall during earthquakes. Stopping will help reduce your risk. Once the shaking has stopped, proceed with caution. Avoid bridges or ramps that might have been damaged by the quake.

- If indoor – Go below bed / table until the shaking stops. Avoid lift and Staircase.

Spillage of Hazardous Substances

1. Port Signal Station reports spillage of hazardous Substances on Port properties to Plant manager / EMT / SO.
2. Plant manager inform CEO.

Immediate Action

1. Determine the nature of the substance and approximate quantities involved. Verify from Master of the vessel, ship agent.
2. If details of substance are unknown and spill gives toxic or noxious fumes
    - Inform local Hospital.
    - Initiate evacuation measures.
    - Notify Duty Pilot.
    - Where applicable turn off Air Conditioning – ventilate to open air if possible
    - Evacuation procedure to be upwind.
    - Remove any ignition sources if the spill is suspected to be combustible.
    - Cut Off Electric supply.
    - Seal off water approaches with launches and crafts.
    - Seal off entry points and clearing the area of all personnel / Public.
    - Evacuated persons are not to return to the affected area until all clearance given.

Sabotage

- The proposed site will be fully secured all around the periphery and there will be only one entry and one exit to the entire facility.
- The entry and exit points will be manned for 24 hours with specially trained security staff fully equipped with latest security gadgets including closed circuit

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electronic surveillance cameras/CCTVs monitoring all sensitive areas within the site complex. A log book will be maintained to record the identities of all "vehicles/staff/guests/visitors" entering and leaving the site.

All "persons/vehicles" entering the site will be fully checked for explosives and weapons.

8.8. Corporate Social Responsibility (CSR) Program

Contribution at random places with no records will have some social problem due to the lack of transparency. So, A will have CSR program to contribute and manage CSR fund effectively.

(1) CSR Fund

MESDP will set up fixed CSR fund (at least 2% of net profit) for local community development. It is important that CSR activities will be accomplished not only by financial assistance but also by technical assistance and manpower in some donations to retain good relation with local communities. Allocated percent of CSR fund is based on local community needs according to the public survey. Proposed allocated percent of CSR budget in bond with public needs according to the household survey are as follow:

No.	Activities	Proposed allocated per cent of CSR budget	Public Needs according to Public Consultation Processes
1.	Donation to NGOs and CBOs	10%	Yes
2.	Construction of roads	30%	Yes
3.	Donation to schools	20%	Yes
4.	Donation to health care facilities	20%	Yes
5.	Donation to agricultural development	10%	Yes
Total		100%	

(2) CSR Officer (or) Coordinator

MESDP will assign CSR officer (or) CSR coordinator to closely relate with local people in order to manage the contributions of CSR fund effectively. HR manager can also be

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assigned as CSR officer. CSR officer will donate CSR fund after the discussion with representative people from nearest villages.

(3) Proposed CSR Activities

The following are the proposed CSR activities and most of the CSR activities are according to the public needs during social survey and determination of SIA Team for local community development. All of the proposed activities will improve the socio-economic conditions of nearest villages significantly.

(a) Health Care Facilities;
(b) Education;
(c) Village Roads
(d) Participating in Government Schemes; and
(e) Funds for NGOs and INGOs.

Health Care Facilities

According to social survey, there is no public health care facility for nearest residents. So, health care facilities of proposed project will be assessed to nearest local people with lowest or no charge as part of CSR program. Ambulance for emergency case will be provided for local people in nearest villages.

Education

Distribution of education materials and financial aid or scholar grants to the students who are economically deprived in the nearest villages in Amarapura region will have a great benefit for students. Most of the schools in nearest villages are furnished inadequately and upgrade and fulfillment of educational requirements and facilities are recommended to be included in CSR program.

Participating Government Schemes for Social Welfare

MESDP will actively participate in implementation of government schemes for welfare of the society of the Amarapura region.

Cooperation with Local NGOs

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MESDP will cooperate with local NGOs and CBOs in nearest villages in the activities to improve regional, religious, and all round developments in Amarapura region. Some percentage of CSR fund will provide regularly to NGOs and CBOs in nearest villages.

Declare the Contribution of CSR Fund

All of the CSR activities and contribution programs will be declared to public by means of local media, company annual report or company's website on a regular basis. Audit on contribution of CSR fund will be carried out together with environmental and social audits through independent external audit team for transparency.

8.9. Vessel traffic management plan

(1) Objectives

- Prevent vessel collisions, spills, and accidents.
- Improve Streamline vessel movement efficiency to minimize delays.
- Prevent oil spills and mitigate impacts on the river ecosystem.
- Improve compliance with local and international maritime laws.
- Ensure effective communication between vessel operators, harbor authorities, and environmental agencies.

(2) Legal requirements

The Myanma Port Authority Law, 2015	
Section 72	The project proponent commits in accordance with Section 72 The Myanmar Port Authority Law, 2015: (a) A person desirous to build any kinds of wharf, shipyard, dry dock, slip way shall apply to the Myanma Port Authority in accord with the stipulations to obtain a operation licence. (b) The Myanmar Port Authority may allow or refuse the application under sub-section (a) after scrutiny. If allowed, it shall issue an operation licence., with the approval of the Ministry, by determining the terms and conditions. (c) The person who has obtained an operation licence under sub-section (b) shall pay the prescribed licence fee.
Section 73	The project proponent commits in accordance with Section 73 The

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	Myanma Port Authority Law, 2015: The Myanmar Port Authority may, if the person who has obtained an operation licence under sub-section (b) of section 72 violates any prohibition contained in the Rules, Regulations, By-Laws and Orders issued under this law or any terms and conditions contained in the operation licence to be complied which is permitted under this law, such violator shall be fined by administrative means in accord with the stipulations, suspend the operation licence for a limited period or terminate it.
The Myanmar Coastal and Inland Water Transport Service License Law (2015)	
Section 14 (a)	The project proponent commits to pay the prescribed service license fee to the Central Supervising Body or the relevant Regional Supervising Body in accordance with section (14) (a) of The Myanmar Coastal and Inland Water Transport Service License Law (2015) when obtain the service license.
Section 14 (b)	The project proponent commits with stipulated terms and conditions according to category of service license in accordance with section (14) (b) of The Myanmar Coastal and Inland Water Transport Service License Law (2015) when obtain the service license.
Section 14 (c)	The project proponent commits in accordance with section (14) (c) of The Myanmar Coastal and Inland Water Transport Service License Law (2015) after expiring the term of service license, apply to renew the term of license according to the stipulations, if desirous to continue the water transport service when obtain the service license.
Section 22	The project proponent commits not to operate or cause to operate the service of water transport service without a service license in accordance with section (22) of The Myanmar Coastal and Inland Water Transport Service License Law (2015).
Section 23 (a)	The project proponent commits in accordance with section (23) (a) of The Myanmar Coastal and Inland Water Transport Service License Law (2015): Whoever violates the prohibition contained in section 22 shall, on conviction, be punished with imprisonment for a term not exceeding six months or be liable with a fine not exceeding five hundred thousand

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kyats or with both.

Section 23 (b) The project proponent commits in accordance with section (23) (b) of The Myanmar Coastal and Inland Water Transport Service License Law (2015): Whoever violates the prohibition contained in sub-section (a) shall, on conviction, be punished with imprisonment for a term not exceeding six months or a fine not exceeding ten hundred thousand kyats.

(3) Overview Map



Figure: Project Location and Jetty

(4) Implementation Schedule

Pre-Construction and Construction Phase: During this phase, the groundwork for the Vessel Traffic Management Plan (VTMP) is established to ensure a safe and efficient system for the proposed project. Regulatory compliance reviews are conducted to align the project with current regulations and safety standards. Baseline data collection is critical to identify high-risk zones or environmentally sensitive areas. This stage includes preparation and construction of infrastructures such as jetty buoys, lights, and sign boards.

Operation Phase: In this stage, vessel traffic management plan becomes fully active, focusing on real-time vessel monitoring to ensure safe navigation and minimize environmental risks. Traffic separation schemes are implemented, directing vessels along clearly defined routes to avoid collisions (between vehicles and with aquatics) and congestion. Pilots and vessel operators are trained and certified to adhere to the established protocols. Emergency response plans, particularly for oil spills or collisions, are also tested

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and maintained to guarantee swift action if incidents occur. Continuous monitoring and regular evaluations is also necessary.

Decommissioning Phase: During decommissioning, the vessel traffic management plan remains essential to manage the safe removal of infrastructure and avoid disruptions to existing river traffic. Navigation aids are systematically deactivated or removed, and traffic routes are adjusted to reflect the reduced activity. Special attention is given to minimizing environmental impacts, particularly the risk of oil spills or surface water contamination. Once the site is returned to its pre-construction state, final evaluations ensure that no hazards remain, and traffic patterns are normalized. Engagement with stakeholders (government agencies and local community) continues throughout this phase, providing updates on progress and ensuring all parties are informed about the project's safe conclusion.

(5) Management Actions

Effective management actions are essential for ensuring the safe and efficient operation of vessel traffic especially for this project that exists at the confluence of the Ayeyarwaddy and Myit Nge Rivers. The first step involves establishing clear navigation protocols, including designated shipping lanes and traffic separation schemes to prevent congestion, reduce collision risks and the timing of vessel movements is adjusted to minimize disturbance to the Ayeyarwaddy dolphins, especially during their breeding and feeding periods. Advanced navigation aids, such as buoys, lights, sign boards and radar systems, will be deployed and maintained to guide vessels safely through the confluence, particularly in low-visibility conditions.

A centralized vessel traffic monitoring center will oversee real-time operations, tracking vessel movements and ensuring adherence to safety protocols. This center will be staffed by trained personnel who can communicate directly with vessel operators, providing guidance and responding to any emergencies.

Emergency preparedness is a critical component of the plan, with comprehensive response strategies developed for potential incidents such as oil spills, groundings, or collisions. These strategies include rapid deployment of spill containment measures and coordination with local authorities for swift action. Routine drills will ensure that all stakeholders, including vessel operators and emergency response teams, are well-prepared to handle emergencies.

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Environmental protection is also crucial to minimize pollution and disturbance to the surrounding ecosystem. Vessels will be required to adhere to strict waste management and fuel handling practices. Continuous monitoring of water quality and noise levels will help detect any adverse impacts, allowing for prompt mitigation measures.

Community engagement and transparent communication will also play a vital role. Regular meetings with local stakeholders will address concerns and provide updates on traffic management operations. By implementing these management actions, the vessel traffic management plan aims to ensure safe navigation, protect the environment, and foster positive relationships with the local community.

Emergency response plan for vessel collision

Emergency response plan for vessel collisions is critical to ensuring safety, protecting the environment, and minimizing operational disruptions. The plan's primary goal is to safeguard human life, prevent environmental damage especially to sensitive areas like the Ayeyarwaddy dolphin habitat and reduce damage to jetty infrastructure and vessels.

In the event of a collision many of the actions to take will depend upon the seriousness of the damage inflicted to either or both of the vessels involved. For example the collision may only involve a glancing blow where the structural damage is superficial, or it might be more serious and followed by a fire, explosion, and serious pollution, stranding or foundering, with the possibility of crew overboard, seriously injured or even killed.

In the event of a vessel collision, the first step is to activate emergency procedures, including sounding alarms and notifying the Emergency Response Team (ERT). The incident should also be reported immediately to the local authorities, and relevant stakeholders. Ensuring the safety of all personnel is the top priority, which may involve evacuations, administering first aid to the injured, and establishing a safety perimeter around the collision site. A quick assessment of the situation will help determine the extent of the damage, any risks of fire, explosion, oil spills, or hazardous material release, and the required response actions.

To protect the environment, oil spill containment measures such as deploying booms and skimmers will be initiated, while hazardous materials will be safely secured or removed. Water quality should be tested and monitored to address pollution risks. If there is a fire or explosion, onboard fire suppression systems, portable firefighting equipment, and firefighting vessels will be used to control the situation and prevent escalation. Salvage

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teams will work to stabilize damaged vessels, prevent sinking, and clear any debris that could obstruct waterways or damage the jetty.

(6) Monitoring Plans

Vessel Traffic management should be checked at the regular basis. Monitoring plan for Vessel Traffic management plan is mentioned in the following table.

Project Activities	Parameter	Guidelines	Locations	Measurements (Methods and Equipment)	Frequency of measurement	Responsibility
Vessel Traffic	Collision, traffic congestion, oil spill and any emergency conditions	-	Jetty Area (21°51'53.50"N, 95°59'34.87"E)	By vision	Daily	EO of EMMT
Water Quality	Total Suspended solid, BOD, COD, DO, pH, Ammonium nitrogen, Oil & Grease, Ecoli, Copper	National Surface Water Quality Standard (NSWQSD)	Ayeyarwaddy River (21°51'58.36"N, 95°59'34.83"E) Myit Nge River (21°51'41.54"N, 95°59'32.56"E)	Take water sample and test at the laboratory	Twice a year	EO of EMMT
Noise Quality	Equivalent noise level dB(A)	National Environmental Quality (Emission) Guidelines	Project Area (21°51'53.50"N, 95°59'34.87"E)	Monitoring by noise level meter (Third Party)	Twice a year	EO of EMMT

(7) **Projected Budgets and Responsibilities**

The budget for vessel management plan includes in cost for environmental monitoring activities, and project operation cost.

The project management team will oversee the entire vessel traffic management plan, coordinating with local authorities and regulatory bodies. The vessel traffic monitoring center will be staffed by trained operators responsible for real-time tracking, communication with vessels, and responding to emergencies. Environmental officers will

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handle ongoing monitoring, ensuring compliance with environmental standards and implementing mitigation measures when necessary. Vessel operators are responsible for adhering to established navigation protocols and reporting any incidents or deviations. Project representative of Grievance Redress Committee (GRM) will manage stakeholder engagement, addressing any issues raised by local communities and ensuring that the project operates transparently and responsibly.

8.10. Traffic management plan

(1) Objectives

The objectives of traffic management sub plan are

1. To reduce accidents and ensure the safety of workers, transport operators, and local communities.
2. To minimize traffic congestion and delays due to project activities
3. To reduce noise, dust, and emissions impacts on nearby communities and sensitive areas.
4. To improve compliance with local traffic regulations and road safety standards.

(2) Legal Requirements

Law name and section	Legal Commitments
The Highways Law, 2000	
Section 8 (a)	The project proponent complies not to disturb or obstruct the work of constructing, extension, repairing and maintenance of highway and accept the punishment if contravene the law in accordance with Section 8 (a) of The Highways Law, 2000.
Section 8 (b)	The project proponent complies not to drive the prohibited types of vehicles, a vehicle with a laden weight or using an iron rim of cart wheel on highways and accept the punishment if contravene the law in accordance with Section 8 (b) of The Highways Law, 2000.
Section 8 (c)	The project proponent complies not to plant, cut or destroy trees or crops within the boundary of highway without permission of Public Works and accept the punishment if contravene the law in accordance with Section 8 (c) of The Highways Law, 2000.
Section 8 (d)	The project proponent complies not to disturb or obstruct public works in

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	clearing of trees which cause danger and accept the punishment if contravene the law in accordance with Section 8 (d) of The Highways Law, 2000.
The Vehicle Safety and Motor Vehicle Management Law, 2020	
Section 9 (a)	The project proponent complies to follow the Ministry for determining and restricting the areas where motor vehicles used in the country are allowed to travel in accordance with Section 9 (a) of The Vehicle Safety and Motor Vehicle Management Law, 2020.
Section 12 (c)	The project proponent complies to follow the Ministry in relation to the initial registration of motor vehicles in accordance with Section 12 (c) of The Vehicle Safety and Motor Vehicle Management Law, 2020.
Section 14 (r)	The project proponent complies to set the speed for the safe movement of vehicles traveling on public roads in accordance with Section 14 (r) of The Vehicle Safety and Motor Vehicle Management Law, 2020.
Section 18 (a)	The project proponent complies to maintain the vehicle and repair in accordance with the standards prescribed by the Department in order to drive safely in accordance with Section 18 (a) of The Vehicle Safety and Motor Vehicle Management Law, 2020.
Section 81 (g)	The project proponent complies to carry out the loading or transporting of dangerous goods in the motor vehicle in accordance with the stipulations in accordance with Section 81 (g) of The Vehicle Safety and Motor Vehicle Management Law, 2020.
The Vehicle Safety and Motor Vehicle Management Rules, 2022	
Rule 252	The project proponent commits not to use any vehicles as commercial vehicles unless these vehicles are registered and get license as commercial vehicles in accordance with the Road Transport Operations Law under Rule 252 of The Vehicle Safety and Motor Vehicle Management Rules, 2022.
Rule 253	The project proponent commits that the commercial vehicles will not carry more than the maximum number of passengers or loads determined by the Department in accordance with Rule 253 of The Vehicle Safety and Motor Vehicle Management Rules, 2022.
Rule 254	The project proponent commits in accordance with section 254 of The Vehicle Safety and Motor Vehicle Management Rules, 2022 while using commercial vehicles; (a) follow the terms and conditions mentioned in commercial vehicle license by Road Transport Operations Law. (b) use the places specified by Nay Pyi Taw Council, respective State and regional organizations and departments

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	for drop off, parking and temporary stops.(c) Provide route visible destinations signboards at the front and back of tour passenger vehicles. (d) Passenger vehicles stop at the side of the road at designated stops for picking up and dropping off passengers and do not block the other vehicles. (e) If there is another passenger vehicle stopped at the bus stop, the following vehicle must stop at least 4 feet (1.22 meters) apart. (f) Do not stop side-by-side with a passenger vehicle standing at a bus stop.
Rule 256	The project proponent commits in accord with section 256 of The Vehicle Safety and Motor Vehicle Management Rules, 2022 and visibly display the name and license number of driver or both driver and conductor in the driver's compartment for all Truck (reluctance), Passenger vehicles and taxis.
Rule 261 (a)	The project proponent commits to carry the loads within the truck and not hanging at the truck front, back and sides in accordance with section 261 (a) of The Vehicle Safety and Motor Vehicle Management Rules, 2022.
Rule 261 (b)	The project proponent commits not to spill the loads to public road in accordance with section 261 (b) of The Vehicle Safety and Motor Vehicle Management Rules, 2022.
Rule 262 (a)	The project proponent commits to follow the Prevention of Hazard from Chemical and Related Substances Law if the motor vehicle carries hazardous substances in accordance with section 262 (a) of The Vehicle Safety and Motor Vehicle Management Rules, 2022.
Rule 262 (b)	The project proponent commits to provide licenses and certificates from respective departments if the motor vehicle carries hazardous substances in accordance with section 262 (b) of The Vehicle Safety and Motor Vehicle Management Rules, 2022.
Rule 262 (c)	The project proponent commits to provide vehicle marking, container marking, tank marking, packaging, labeling, loading and unloading signs at the hazardous substances carrying vehicles according to the guideline of department in accordance with section 262 (c) of The Vehicle Safety and Motor Vehicle Management Rules, 2022.
Rule 262 (d)	The project proponent commits to provide safety equipment and emergency response plan at the hazardous substances carrying vehicles in accordance with section 262 (d) of The Vehicle Safety and Motor Vehicle Management Rules, 2022.
Rule 263	The project proponent commits in accordance with department instructions

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while carrying hazardous substances by road in accordance with section 263 of The Vehicle Safety and Motor Vehicle Management Rules, 2022.

Rule 269 The project proponent commits to provide spare wheel, tool box, emergency fire extinguisher, safety hammer, wheel chock and emergency medical kit for the motor vehicles in accordance with section 269 of The Vehicle Safety and Motor Vehicle Management Rules, 2022.

Rule 271 The project proponent commits to follow rules and regulation of the department if the vehicle owner or address of motor vehicles owner will change in accordance with section 271 of The Vehicle Safety and Motor Vehicle Management Rules, 2022.

(3) Overview maps and site layout maps, images, aerial photos, satellite images



Figure: Access Road to the project

(4)Implementation Schedule

Traffic management will have to carry out at all phases of project; pre construction phase, construction phase, operation phase and decommission phase.

(5) Management Actions

During the **pre-construction phase**, the focus will be on preparing accessed roads for minimizing impacts on local communities. A detailed route survey will assess the capacity and condition of roads, identifying any sections that need reinforcement to handle heavy

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vehicles. Traffic impact assessments will be conducted in collaboration with local authorities, and key stakeholders, including nearby communities, will be informed about the planned routes and mitigation measures. Necessary road improvements will have to carry out, and clear signage will have to install along all routes to ensure safety and compliance. Drivers will be trained on specific safety protocols, such as adhering to speed limits, avoiding sensitive zones, and respecting community needs.

During **construction phase**, road usage will peak as materials, equipment, and personnel are transported to the site. To minimize the potential impacts due to project activities, traffic will be scheduled during off-peak hours to reduce congestion, and designated routes will be enforced to avoid residential or ecologically sensitive areas. Speed limits, especially in villages and sensitive zones, will be strictly implemented, and measures such as dust suppression using water sprinklers and noise control barriers will be employed to minimize environmental impacts. Emergency response plans will be in place to handle accidents or spills, and frequent road maintenance will address wear and tear caused by heavy vehicles. Regular communication with local communities will continue to resolve concerns and keep them informed of ongoing traffic activities.

During the **operation phase**, road usage will significantly decrease, as the project will rely primarily on waterways for transportation. However, occasional road use for maintenance or auxiliary supplies will still be managed carefully. These trips will be restricted to predefined and previously improved routes to avoid unnecessary disruptions. Periodic inspections will ensure roads remain safe and in good condition, and any repairs will be undertaken promptly. Local authorities and communities will be notified in advance of any significant road activity, and strict compliance with speed limits and safety protocols will continue. By limiting road use to essential activities, the plan ensures minimal impact on both local communities and the environment during this phase. Moreover, the new extension road will be constructed parallel with the Oh Htoke Tan road. The new road is 1200 ft long, right of way and 50 ft width and road width 40 ft.

During the **decommissioning phase**, road traffic will primarily involve the removal of equipment, machinery, and demolition materials from the project site. To manage this increased activity efficiently and responsibly, designated routes used during the construction phase will be re-evaluated to ensure they remain suitable for heavy vehicle use. Roads that may have degraded over time will be inspected and repaired before

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decommissioning begins. Traffic will be scheduled during off-peak hours to minimize disruptions to local communities, and speed limits will be strictly enforced, particularly in residential or sensitive ecological areas.

(6) Monitoring Plans

Traffic conditions should be checked at the regular basis. Monitoring plan for traffic management plan is mentioned in the following table.

Project Activities	Parameter	Guidelines	Locations	Measurements (Methods and Equipment)	Frequency of measurement	Responsibility
Traffic	Traffic volume, accidents and road damage due to project activities	-	Access road to the project	Visual and Report	Daily	EO of EMMT

(7) Projected Budgets and Responsibilities

Estimated Budget

The budget for traffic monitoring include in cost for environmental monitoring activities.

Role and Responsibilities

Role and responsibilities for the successful implementation of traffic management plan are as follows.

The Project Manager will oversee the overall plan, ensuring all phases—pre-construction, construction, operation, and decommissioning—are implemented effectively. This includes coordinating with authorities, allocating budgets, and addressing any significant traffic-related challenges.

Safety Officer will focus on enforcing protocols such as speed limits, accident prevention measures, and driver safety training. The Safety Officer will also investigate any incidents or near misses and maintain emergency response plans. Alongside this, the Maintenance Team will play a critical role in keeping the road infrastructure in good condition. Their tasks include repairing damage caused by project activities such as (driving heavy

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vehicles), maintaining signage and road markings, and implementing dust suppression and noise control measures where necessary.

The Environmental Officer will oversee environmental safeguards, ensuring measures like dust suppression, and emissions control are implemented effectively to minimize negative impacts.

All Personnel (Project Developer and the Employee) will have to comply with requirements of this management plan, report all environmental incidents as they occur and attend environmental inductions or any other training as required.

9. PUBLIC CONSULTATION AND PARTICIPATION PROCESS

Public participation is a process that is designed to enable all interested and affected parties (I&APs) to voice their opinion and/ or concerns which enables the practitioner to evaluate all aspects of the proposed development, with the objective of improving the project by maximising its benefits while minimising its adverse effects. I&APs include all interested stakeholders, technical specialists, and the various relevant organs of state who work together to produce better decisions. Public participation empowers local people so that they regard the development projects as their own. Public participation (community involvement) also reduces the impact of uncertainties and stress caused by the proposed project.

In this study, effective public consultation and participation approaches in the form of stakeholder identification, focus group discussions, public meetings and public disclosure will be conducted.

9.1. Objectives of Public Participation in EIA

Public participation is an essential and regulatory requirement for EIA process according to the EIA Procedure, 2015. The public participation process will be designed to provide sufficient and accessible information to I&APs in an objective manner to assist them to:

During the Scoping Phase:

- Raise issues of concern and suggestions for enhanced benefits;
- Verify that their issues have been recorded;
- Assist in identifying reasonable alternatives; and

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- Contribute relevant local information and traditional knowledge to the environmental assessment.

During the Impact Assessment Phase:

- Contribute relevant information and local and traditional knowledge to the Environmental assessment;
- Verify that their issues have been considered in the Environmental studies; and
- Comment on the findings of the Environmental assessments.

9.2. Methodology for Public Consultation and Participation Process

Public participation was conducted by the following procedures:

(a) Stakeholder Engagement and Identification;

(b) Household survey;

(c) Public meetings; and

(d) Public disclosure process.

The EIA includes the activities undertaken during detailed design stage to engage the stakeholders, and planned information disclosure measures and processes for carrying out consultation with affected people and facilitating their participation during implementation stage. Five rounds of engagements were undertaken as follow:

Table - Public Consultation and Stakeholder Engagement Process

Round	Method	Stakeholders
Round 1: Information sharing and issues identification	Conduct house hold survey	Village leaders and local people in project affected area, local non-government and community based organizations.
Round 2: Public Meetings (First public	(a) Invitation letters, handout, and report for current situation were distributed. (b) Posters and presentations	Key stakeholders in civil society, Government officials, supporting committees for Mandalay Region Government, NGO's, INGO and

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meeting) (20.1.2018)	were used during the meeting.	CBO's, community leaders, and local people
Round 3: (Second public meeting) (27.3.2018)	(a) Invitation letters, handout, and report for current situation were distributed. (b) Posters and presentations were used during the meeting.	Key stakeholders in civil society, Government officials, supporting committees for Mandalay Region Government, NGO's, INGO and CBO's, community leaders, and local people
Round 4: Public disclosure process	Distribution of executive summary and EIA report	Civil society, NGO's and CBO's, Government officials, community leaders

.2.1. Stakeholder Engagement and Identification

EGT was developed a Stakeholder Engagement Plan (SEP) which will follow the framework provided by the International Finance Corporation (IFC) in Guidance Note (GN) 1, Annex B, in terms of Performance Standard 1, Assessment and Management of Environmental and Social Risks and Impacts (www.ifc.org).

The purpose of stakeholder engagement is to:

"Establish and maintain a constructive relationship with a variety of external stakeholders over the life of the project .... An effective engagement process allows the views, interests and concerns of different stakeholders, particularly of the local communities directly affected by the project (Affected Communities), to be heard, understood, and taken into account in project decisions and creation of development benefits (GN6). Stakeholder engagement is the basis for building strong, constructive, and responsive relationships that are essential for the successful management of a project's environmental and social impacts (GN 90)."

The involvement of the following groups or organisations in the stakeholder engagement process will be considered to be particularly important:

- Relevant Government Departments at the National, Provincial and Local level;
- Directly affected communities in the project area;
- Representatives of the local industries;

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- Environmental groups and Non-Governmental Organisations (NGO)s;
- Community Based Organisations;
- Academic/research Organisations;
- International donors/funders active in the project area;
- Local communities; and
- The media.

The following communities, authorities and NGOs will be considered as key stakeholders who are directly or indirectly related to the proposed project according to the above consideration.

(a) Myanmar Energy Sector Development Public Co., Ltd.
(b) Local People (around the proposed project area)
(c) Village Administrative Offices (around the proposed project area)
(d) Environmental Conservation Department (Mandaly)
(e) Head of Local Administration Office (Amarapura);
(f) City Development Committee (Amarapura);
(g) Department of Public Health (Amarapura);
(h) Planning and Statistics Department (Amarapura);
(i) Department of Settlement and Land Record (Amarapura);
(j) Department of Archaeology and National Museum (Mandaly)
(k) Department of Water Resources Utilization Department (Amarapura);
(l) Department of Labour (Amarapura);
(m) Myanmar Police Force (Amarapura)
(n) Local Media, and
(o) NGOs and CBOs (Sein Yaung Sone, Tha Ba Wa Sein etc.)

9.2.2. Household Surveys

Household sample survey was conducted to evaluate primary socio-economic conditions of the project area and to understand the mood, perceptions and extent of preparedness of the people towards the proposed project. The household survey was carried out to tap the baseline socio-economic conditions of project area and to assess project perceptions and attitudes of the local people over a period of five days. To get the accurate data, primary data collection will be conducted by social specialist, social consultants, local authorities and local people.

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Sample Size Determination

i. Sample size

The total numbers of households in 4 villages were 2,312, according to the preliminary survey. The sample size was determined using Yamane's formula. The sampling error was considered as 4 % as the confident level was set at 96%. Thus, total sample size is 491 out of 2,312 households. However, the total of 609 householdswere surveyed to get higher representative results.

$$\mathbf{n} = \frac{N}{1+Ne^2}$$

Where,

n = sample size

N =total number of households in the study area

e = desired margin error

In order to have a clear understanding about the sampling error "e" value, the correlation between sample size and "e" value were presented in the following table.

Table: Correlation between Sample Size and Sampling Error

Size of Population	Sample Size (n) for Precision (e) of:			
	±3%	±5%	±7%	±10%
500	a	222	145	83
600	a	240	152	86
700	a	255	158	88
800	a	267	163	89
900	a	277	166	90
1,000	a	286	169	91
2,000	714	333	185	95
3,000	811	353	191	97
4,000	870	364	194	98
5,000	909	370	196	98
6,000	938	375	197	98
7,000	959	378	198	99
8,000	976	381	199	99
9,000	989	383	200	99
10,000	1,000	385	200	99

Source: Updated from Glenn D. Israel, 2003

This formula is not applicable for small population below 500 sizes of population, so the small size population was calculated 30% of each population's size. Then sample size was distributed according to the number of households in each village. However, the selection

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was done by the number of households located in the project affected part of the village. Thus, the sampled households were more or less differed from village to village. The following presented the sample households distributed in the survey.

ii. Sampling Method

The sampling unit was individual household in the study area. The sampling was carried out by stratified random sampling with the following steps.

- ***Step-1***, Households information were preliminary accessed during the pilot survey. The information includes baseline information of socio-economic activities and their concerns about the proposed projects.
- ***Step-2***, The households in each ward will be geographically classified sub-groups such as
  - households located nearby the proposed project
  - households located along the accessed roads to the proposed project site
  - households located beside the river bank of the proposed project
  - households located near the cultural and heritage site (Innwa Acient City)
- Step-3, The respondent households were randomly selected from each group according to the sample size.

Table - Stratified Systematic Sample for Study Strata

No.	Quarter	No. of Households	Sample Size	Remark
1.	Shwe Kyat Yat Village Tract (*Padamyar Ward, Ywa Thit, That Ke Taw, Ta Pyan Ten*)	1583	470	
2.	Phone Taw Nain Kan Village Ttract (*PhoneTaw Nain Kan, Tha Bake Tann, Lat Yway, Latt Thit, Hlay Gyi Tan*)	297	89	30% of Population
3.	That Gyi	319	95	30% of Population
4.	Oe Htoke Tan village tract *(Oe Htoke Tan, Lay Thar)*	114	35	30% of Population

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Some Recorded Photos during Household Survey

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9.3. Public Meetings

Public meetings will be held three times as follow:

9.3.1. Public Meeting for Scoping Proposal

(a)Findings during Public Meeting Scoping Proposal

Public meeting of scoping process was held in (22.10.2017) and the key findings during meeting are as follow;

- Affected to the Thapyatharn Fortress and Innwa Bridge due to fire exploration
- Situation of the inlet road expansion to the project area
- To build maintenance wall of river bank
- Affected to culture and heritage site
- Can transfer and build or not at the harbor
- Situation for the usage of CSR fund
- Situation of riverbank erosion due to tide and water wave
- Stream blockage due to the project

In conclusion, the main discussion of the meeting is to mitigate the impact emerge from proposed project. The project proponent replies and discusses the questions from the local people and commits to mitigate the impact of the proposed project. The key findings during scoping of impact assessment are as follow;

(1) Most local people concern about the project is to implement this project by avoiding and mitigating the impacts (especially fire risk, impacts on culture and heritage, increasing of riverbank erosion, traffic jam and waterway or stream blockage) as minimum as possible.

(2) One of CSOs attending this meeting suggest to change hotel project instead of this proposed project because the area is located near culture and heritage site and Sagaing earthquake prone areas.

(3) The project proponent commits to implement the project by minimizing as least as possible for the impacts on environment, socio economic and cultural and heritage etc. If the project affected to this, the company will take responsibility and accountability for those impacts.

(4) The project proponent also commits to use the CSR fund regularly.

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(b) Suggestion Letters during Public Meeting for Scoping Proposal

Key findings from suggestion letters of local people are as follow;

(1) Dredging of creek and water way which have been blocked during earth filling process in the project.
(2) To implement water drainage system in the related four field
(3) To manage that oil bowser should not disturb the local people
(4) Is actually used or not CSR fund?
(5) Is actually implement the commitments during the meeting?
(6) To build river bank maintenance wall at Oh Toke Tan village this suffers river bank erosion.
(7) Not to damage the plants that are planting on Innwa Road.









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Some Recorded Photos during Public Meeting for Scoping Proposal

Attendance list and key discussion during the public meeting for scoping proposal are shown in Appendix I.

Most Public Needs and Concerns during Household Survey and Public Meetings

During household survey and public meeting for scoping proposal, the most important positive outcomes from the project expected by the local people and most of their concerns about proposed project are as follow:

Village Name	Most Public Needs	Most Pubic Concerns
Shwe Kyat Yat village tract (*Padamyar Ward, YwaThit, ThatKeTaw, KaWar, TaPyanTen*)	• Expanding and upgrading of village road • Upgrading of education services • Getting ofelectricity • Supporting Fire-engine	• Fire and explosion • Flood • Pollutions by oil leakage
PhoneTawNainKan village tract (*PhoneTawNainKan, TaBaitTann, LatYway, LatTitYat, HlayGyiTan*)	• Upgrading of education services • Supporting to sub rural health center • Supporting of river retaining Wall • Getting of electricity • Supporting Fire-engine	• Flood • Explosion • Damages to Tha Pya Tan Fort, Shwe Kyat Yat Pagoda
That Gyi	• Job opportunity	• Firing risk

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	• Getting of electricity • Upgrading of road • Supporting of retaining wall	• Flood risk • Environmental impacts
Oe Htoke Tan village tract (*OeHtokeTan, LayThar*)	• Getting of electricity • Upgrading of road • Upgrading of Primary School to High School • Supporting of river retaining wall • Upgrading of Health Care	• Damages to Shwe Kyat Yat Pagoda • Pollution by oil leakage
Other participants	• No comment	• Traffic • Visual impact • Impact on aquatic lives

9.3.2. First Public Meeting

(a) Findings during First Public Meeting

The first public meeting was completed in (20.1.2018) during the EIA study and mainly discuss the following points:

(1) Wished to keep the programs of accidentally fire and mitigation measures; the project proponent must control to avoid these accidents and will also pay compensation of these accidents.

(2) There will potential to blockage of drainage system during earth filling in construction activities. MESDP prepare to flow the water volume more than natural drainage system.

(3) To build the retaining wall at the Inn Wa landslide cause by oil transport ships lead to waves of landslide the fact that to permit Directorate of Water Resources and Improvement of River Systems (DWIR) and will be build give DWIR permission.

(4) Also discussed the factors of traffic congestion, fear of the decline in fish breeding rate expressed river confluence, need to follow the policies because the construction site is near the riverbank and third party in accordance with the procedures and need to act without bias.

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(b) Suggestion Letters during first Public Meeting

Key findings from suggestion letters of local people are as follow;

(1) To give priority to local job opportunities
(2) Affected to culture and heritage site
(3) Safty of fire risk
(4) Responsible for accidents (fire and Explosions)
(5) the sustainable prosperity of Tha Bye Dan Fortress
(6) Notwithstanding the construction workers to leave by intruder
(7) To implement water flow/drainage system



Some Recorded Photos during First Public Meeting

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Attendance lists, key discussion during public meeting and suggestion letters are shown in Appendix II.

9.3.3. Second Public Meeting

(a) Findings during Second Public Meeting

The second public meeting was completed in (27.3.2018) during the EIA study and mainly discuss the following points:

(1) The fact require to maintenance of LattYway entrance road before raining period that the project proponent will be follow this request.
(2) The damage caused in emergencies or other project location will be moved to other locations will be affected. These affected have to prevent damage and a responsibility in current project location. the project proponent will follow the international guideline and responsible for damage of environment.
(3) Thanks to the fact that desires the opportunity presented by the local people in public meeting
(4) The request to take responsibility of river bank erosion that the project proponent will be build retaining wall on receiving authorization from DWIR permission
(5) Follow and responsibility of the oil ship accident
(6) Affected on underground water blocking capabilities cause by pile construction activities the fact that the project proponent will examine this impact.
(7) Discussion occurred with the capture of Ngar Late Kyaut is found near the project site that the project proponent will done field stundy and additional measures
(8) opinions expressed the building 32 numbers of oil storage tanks in current place the fact that MESDP will build these storage tanks follow by API standard and NFPA standard and to take permissions from Fire Department, Ministry of Energy has been discussed.

Attendance lists, key discussion during public meeting and suggestion letters are shown in Appendix III.

(b) Suggestion Letters during Second Public Meeting

Key findings from suggestion letters of local people are as follow;

(1) Since initial stage of project, inspection team including foreign experts to check the quality
(2) To provide local employment opportunities, and the development program

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(3) To safty place

(4) To respect the recommendations of Geological and Geographical experts,

(5) To prevent the erosion of river bank on AyeYarWaddy and Tha Bye Dan Fortress

(6) To draw management plan for traffic, fire risk and emergency response plan for this project

(7) To prevent the impact on the environment and human resources



Recorded Photos during Second Public Meeting

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9.3.4. Cosideration of Public Concerns in EIA Study

The primary concerns of the public are fire and explosion hazards. Additionally, local communities are particularly worried about the potential impact on ancient cultural heritage sites, which could also be affected by fire and explosion risks. Therefore, the report emphasizes ensuring fire safety as a key priority. The main objective is to contribute to regional development, and a CSR (Corporate Social Responsibility) fund has been established to support this initiative. Regular utilization of this fund is strongly encouraged.

Allocated percent of CSR fund is based on local community needs according to the public survey. Proposed allocated percent of CSR budget in bond with public needs according to the household survey are as follow:

No.	Activities	Proposed allocated per cent of CSR budget	Public Needs according to Public Consultation Processes
1.	Donation to NGOs and CBOs	10%	Yes
2.	Construction of roads	30%	Yes
3.	Donation to schools	20%	Yes
4.	Donation to health care facilities	20%	Yes
5.	Donation to agricultural development	10%	Yes
Total		100%	

9.3.5. Public Disclosure Process

Summary of EIA report in Myanmar Language was distributed to all key stakeholders as public disclosure process. Meeting minutes and summary were distributed to all participants during second public meeting. Stakeholders were invited to comment on the Draft EIA Report in the following ways:

- By completing a comment sheet made available together with the report at the public places, and by submitting additional written comments, by email or fax, or by telephone, to the public participation office; and

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- The Draft ESIA Report and its accompanying Specialist Studies were distributed for comment to public places in the project area, to everyone who requests a copy, and placed on the MESDP website:

All comments and issues raised during the comment period on the Draft ESIA report were added to the final ESIA report.

10. CONCLUTION

As the proposed project is located close to the seismic zone, it has potential to oil tank falling due to earthquake and will cause water pollution, soil pollution and fire risk. Moreover, the project is closely situated in archeologically sensitive area, surface water body and some residential area and all of these areas can impact if fire and explosion will occour. The project developers must provide construction for seismic design oil storage tanks, building massive retaining walls that will perform in river bank. To be responsible for the preservation of cultural heritage and landscapes including Innwa Old City, Ava Bridge and Tha Bye Dan, the project developers must participate with the heritage authority and negotiate with DoANM; to reduce the visual impacts between the boundaries of project area and the ancient monument zones, the buffer area (40m) must be accepted with the particular landscape; signage for cultural heritage, and monitoring to do stewardship for the cultural landscape; e.g. the signage composed with the full information about cultural significance related to the Oil Storage Tanks project area must be founded to know the peoples and observers. There will be no fuel transporting vehicles that stop at the Oketoketan Street and it needs to plant the trees around the whole project area. Crude oil and petroleum product transport and storage facilities must be designed and operated according to international standards for the prevention and control of fire and explosion hazards including provisions for distances between tanks in the facility, and between the facility site boundary and adjacent buildings. The Fire Prevention Plan and Emergency Preparedness and Response Plan (EPRP) must assist project staff in effectively responding to emergencies associated with project hazards event such as fires and explosion. If the above points must accurately proposed project will be able to operate with low environmental impact and the continuous improvement of the economic and social development of local communities.

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