

## Environmental Monitoring Report Phase - 2 (Construction Phase)



# **CONTENTS**

1. Executive Summary
2. Summary of Monitoring Activities
3. Construction Progress
4. Monitoring Results
5. Environmental Monitoring Form

## **Appendix**

- A. Water and Waste Water Monitoring Report October, 2015
- B. Air Monitoring Report October, 2015
- C. Noise and Vibration Monitoring Report November, 2015
- D. Monthly Progress Report for July, 2015
- E. Monthly Progress Report for August, 2015
- F. Monthly Progress Report for September, 2015
- G. Monthly Progress Report for October, 2015

## **1. Executive Summary**

The environmental inspection and compliance monitoring program will be implemented under the direction of Ministry of Environmental Conservation and Forestry with oversight by Thilawa SEZ Management Committee.

The monitoring record according to the Environment Monitoring Plan is submitted in conformity with the provision of Chapter 9.1, Table 9.1-2 and 9.2, Table 9.2-2 Content of the EIA Report of Thilawa SEZ Development Project (Zone A).

## **2. Summary of Monitoring Activities**

**a) Progress made to date on the implementation of the EMP against the submitted implementation schedule;**

EMP for Phase 2, Construction Phase First Report is submitted this day attached with Construction Phase implementation schedule. Subsequent Construction Phase reports for the Phase 2 will be submitted on a quarterly base.

**b) Difficulties encountered in implementing of the EMP and recommendations for remedying those difficulties and steps proposed to prevent or avoid similar future difficulties;**

None

**c) Number and type of non-compliance with the EMP and proposed remedial measures and timelines for completion of remediation;**

None

**d) Accidents or incidents relating to the occupational and community health and safety, and the environment;**

Neither accidents nor incidents happen during this monitoring period.

**e) Monitoring data on environmental parameters and conditions as committed in the EMP or otherwise required.**

Please refer to the attached Environmental Monitoring Form.

### 3. Construction Progress

Thilawa SEZ Zone A Development Project construction activities is submitted enclosed with monthly progress reports from contractor in Appendix A to D.

- Monthly Progress Report for July, 2015
- Monthly Progress Report for August, 2015
- Monthly Progress Report for September, 2015
- Monthly Progress Report for October,2015

### 4. Monitoring Result

Environmental Monitoring plan report for Construction Phase implemented according to the following table, reference on Table 4.2-2, Chapter 4, EIA report.

**Monitoring Plan ( Construction Phase)**

Category	Item	Location	Frequency	Remark
Air Quality	NO <sub>2</sub> , SO <sub>2</sub> , CO, TSP, PM <sub>10</sub>	Construction site (1point)	Once/ 3month	October 2015, Monitoring Report
Water Quality	Water temperature, pH, SS, DO, BOD, COD, coliform count, oil and grease, chromium	Construction site (6 points) Well in the Monastery (1 point)	Once/2 month	October 2015, Monitoring Report
Waste	Amount of solid waste Management of solid waste of construction	Construction site	Once/3month	Monthly Progress Reports (July, August, September, October) 2015
Noise and Vibration	Noise and vibration level of construction	Preservation area such as residence around the proposed construction site (2 points)	Once/3moth (peak period)	Noise and Vibration Monitoring Report November 2015
		Preservation site such as residence along the route for on-site vehicles (2points)	Once ( peak period)	
Ground Subsidence	Ground elevation Consumption of ground water amount	Representative (1 point)	Every week	Monthly Progress Reports (July, August, September, October) 2015
Hydrology				
Risk for infectious disease such as AIDS/HIV	Status of measures of infectious disease	Construction site	Once/month	Monthly Progress Reports (July, August, September, October)2015
Working conditions (including occupational safety)	Prehension of condition of occupational safety and health Prehension of infectious disease	Construction site	Once/ month	
Accident	Existence of accident	Construction site	As occasion arise	



MYANMAR JAPAN THILAWA DEVELOPMENT LIMITED

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**Thilawa Special Economic Zone (Zone A)  
Development Project –Phase 2**

**Environment Monitoring Form**

Environment Monitoring Form

The latest results of the below monitoring items shall be submitted to Authorities on once at Pre-Construction Phase and on quarterly basis at Construction Phase, and on bi-annually base at Operation Phase. The items, standards to be applied, measurement points, and frequency for each monitoring parameter are established based on the EIA Report for Thilawa Special Economic Zone Development Project (Zone A). Should there be any changes to the original plan, such change shall be reviewed and evaluated by environmental expert.

1) General

1) Phase of the Project (TSEZ Zone A, Phase 2)

- Please mark the current phase.

Pre-Construction Phase

Construction Phase

Operation Phase

2) Obtainment of Environmental Permits (Not Applicable)

Name of permits	Expected issuance date	Actual issuance date	Concerned authority	Remarks (Conditions, etc.)

Attached approval letter:

3) Response/Actions to Comments and Guidance from Government Authorities and the Public (Not Applicable)

Monitoring Item	Monitoring Results during Report Period	Duration of Report Period	Frequency
Number and contents of formal comments made by the public		Same timing of submission of Monitoring Report	Upon receipt of comments/complaints
Number and contents of responses from Government agencies			

(2) Monitoring Results

1) Ambient Air Quality - October 2015

NO<sub>2</sub>, SO<sub>2</sub>, CO, TSP, PM10

Location	Item	Unit	Measured Value (Mean)	Measured Value (Min~Max.)	Country's Standard	Target value to be applied	Referred International Standard*	Frequency	Method	Note (Reason of excess of the standard)
Construction Area	NO <sub>2</sub>	ppm	0.02	0.02 - 0.02	N/A	N/A	0.06	Once in three months	HAZSCANNER, EPAS	
	SO <sub>2</sub>	ppm	0.01	0.01 - 0.01	N/A	N/A	0.04	Once in three months	HAZSCANNER, EPAS	
	CO	ppm	0.13	0.11 - 0.16	N/A	N/A	10	Once in three months	HAZSCANNER, EPAS	
	TSP	ppm	0.02	0.01 - 0.03	N/A	N/A	0.33	Once in three months	HAZSCANNER, EPAS	
	PM10	ppm	0.01	0.01 - 0.02	N/A	N/A	0.12	Once in three months	HAZSCANNER, EPAS	

\*Remark: Referred to the Japan and Thailand Standard (EIA Report, Table 6.4-1).

Complains from Residents

- Are there any complains from residents regarding air quality in this monitoring period?  Yes,  No

If yes, please describe the contents of complains and its countermeasures to fill in below the table.

Contents of Complains from Residents	Countermeasures

**2) Water Quality - October 2015**
**Measurement Point: Effluent of Wastewater**

 - Are there any effluents to water body in this monitoring period?  Yes,  No

If yes, please attach "Analysis Record" and fill in the items not to comply with Referred International Standard.

Location *2	Item	Unit	Measured Value	Country's Standard	Target value to be applied	Referred International Standard*1	Frequency	Method	Note (Reason of excess of the standard)
SW-2	pH	mg/l	7.02	None (Available Guideline Value determined by MOI)	5.0-9.0	>=4	Once in two month	pH meter, HI7609829-1 pH Sensor	
	SS *3	mg/l	300		Max. 30			Gravimetric method	
	DO	mg/l	7.54		-			HI7609829-2, (D.O) sensor	
	COD	mg/l	18		Max. 35			Dichromate method	
	BOD	mg/l	5		Max. 20			Direct inoculation method	
	Oil and Grease	mg/l	-		Max. 5			APHA-AWWA-WEF Method	
	Cr	mg/l	-		Max. 0.5			APHA-AWWA-WEF Method	
	Total coliforms *3	cfu/100ml	1700		Max 400			7.5×10 <sup>3</sup>	
SW-3	pH	mg/l	6.66	None (Available Guideline Value determined by MOI)	5.0-9.0	>=4	Once in two month	pH meter, HI7609829-1 pH Sensor	
	SS *3	mg/l	413		Max 30			Gravimetric method	
	DO	mg/l	5.36		-			HI7609829-2, (D.O) sensor	
	COD	mg/l	23		Max. 35			Dichromate method	
	BOD	mg/l	6		Max. 20			Direct inoculation method	
	Oil and Grease	mg/l	-		Max. 5			APHA-AWWA-WEF Method	



Location *2	Item	Unit	Measured Value	Country's Standard	Target value to be applied	Referred International Standard*1	Frequency	Method	Note (Reason of excess of the standard)	
	Cr	mg/l	-		Max. 0.5			APHA-AWWA-WEF Method		
	Total coliforms *3	cfu/100ml	240		Max 400	7.5×10 <sup>3</sup>		AOAC Petrifilm Method		
SW-4	pH	mg/l	6.53	None (Available Guideline Value determined by MOI)	5.0-9.0	>=4	Once in two month	pH meter, HI7609829-1 pH Sensor		
	SS *3	mg/l	511		Max.30			Gravimetric method		
	DO	mg/l	5.46		-			HI7609829-2,(D.O)sensor		
	COD	mg/l	24		Max. 35			Dichromate method		
	BOD	mg/l	9		Max. 20			Direct inoculation method		
	Oil and Grease	mg/l	-		Max. 5			APHA-AWWA-WEF Method		
	Cr	mg/l	-		Max. 0.5			APHA-AWWA-WEF Method		
	Total coliforms *3	cfu/100ml	490		Max 400			7.5×10 <sup>3</sup>		AOAC Petrifilm Method
GW-1	pH	mg/l	7.18	N/A	5.5~9.0	>=4	Once in two month	pH meter, HI7609829-1 pH Sensor		
	SS	mg/l	44		None			50		Gravimetric method
	DO	mg/l	6.93		(Available			30		HI7609829-2,(D.O)sensor
	COD*4	mg/l	62		Guideline			15		Dichromate method
	BOD	mg/l	6		Value			0.1		Direct inoculation method
	Oil and Grease	mg/l	-		determine			0.04		APHA-AWWA-WEF Method
	Cr	mg/l	-		d by MOI)			0.04		APHA-AWWA-WEF Method
	Total coliforms	cfu/100ml	>23					7.5×10 <sup>3</sup>		AOAC Petrifilm Method

\*1Remark: Referred to the Vietnam Standard (EIA report), Reference to the Monitoring Report, October 2015.

\*2Remark: Same points with Phase (1) Operations Phase Water Quality Monitoring.

\*3Remark: Water quality of suspended solid (SS) at SW-2, SW-3 and SW-4 are high comparing with standard but these values are almost same as the value at upstream (SW-2). Thus these values are judged to be cause as natural event by rainfall.

Total coliform has exceeded the reference standard in SW-2 and SW-4. In December 2015, Thilawa SEZ is not any discharging to the water body. Thus may be because contamination from human or animal waste near by the creek outside of Thilawa SEZ.

\*4Remark: COD level is high at (GW-1) point. COD value can be increase when the presences of natural elements increase in the groundwater of that particular area. And there is no industrial wastewater discharge in Thilawa SEZ Zone A at this moment. So the value of COD high was not because of industrial wastewater sink into the aquifer.

3) Soil Contamination (only operation phase)

Situations environmental report from tenants

- Are there any serious issues regarding soil contamination in this monitoring period?  Yes,  No

If yes, please describe the contents of complains and its countermeasures to fill in below the table.

Contents of Issues on Soil Contamination	Countermeasures

4) Noise –November 2015

Noise Level (Living Environment)

Location	Item	Unit	Measured Value (Mean)	Measured Value (Min~Max)	Country's Standard	Target value to be applied	Referred International Standard*	Frequency	Method	Note (Reason of excess of the standard)
NV-1	Leq (day)	dB(A)	52.49	34.63-61.04	N/A	N/A	75	Once (peak period)	Sound Level Meter	
	Leq(eve)	dB(A)	48.08	42.67-53.68			70			

\*Remark: Referred to the Japan Standard (EIA Report), Reference to the Noise and Vibration Report November 2015.

**Noise Level (Along the Thilawa Development Road)**

Location	Item	Unit	Measured Value (Mean)	Measured Value (Min~Max)	Country's Standard	Target value to be applied	Referred International Standard*	Frequency	Method	Note (Reason of excess of the standard)
NV-2	Leq (day)	dB(A)	58.96	55.03-65.49	N/A	75	Singapore	Once in 3 months	Sound Level Meter	
	Leq(eve)	dB(A)	56.58	56.48-56.71		60				
	Leq(night)	dB(A)	52.27	46.28-65.79		55				

\*Remark: Referred to the Singapore Target Noise Standard (EIA Report), Reference to the Noise and Vibration Report November 2015.

**Complains from Residents**

- Are there any complains from residents regarding noise in this monitoring period?  Yes,  No

If yes, please describe the contents of complains and its countermeasures to fill in below the table.

Contents of Complains from Residents	Countermeasures

**5) Solid Waste**

**Measurement Point:** Construction Site (Construction Phase), Storage for Sludge (Operation Phase)

- Are there any wastes of sludge in this monitoring period?  Yes,  No

If yes, please report the amount of sludge and fill in the results of solid waste management Activities.

No.	Date	Description	No. of Loads	Remarks
1.	1-Aug-15	Waste Disposal	06	YCDC
2.	22-Sep-15	Waste Disposal	05	YCDC

\*Remark: Reference to the Monthly Progress Report July 2015, August 2015 and September 2015, October 2015.

**6) (a) Ground Subsidence and Hydrology-July 2015**

Duration (Week)	Water Consumption		Ground Level		Frequency	Note
	Quantity	Unit	Quantity	Unit		
2-Jul-15	170	m3/week	+6.990	m	Once a week	
9-Jul-15	130	m3/week	+6.989	m		
16-Jul-15	150	m3/week	+6.989	m		
23-Jul-15	170	m3/week	+6.988	m		
30-Jul-15	110	m3/week	+6.986	m		

\*Reference to the Monthly Progress Report July 2015.

**(b) Ground Subsidence and Hydrology- August 2015**

Duration (Week)	Water Consumption		Ground Level		Frequency	Note
	Quantity	Unit	Quantity	Unit		
6-Aug-15	250	m3/week	+6.985	m	Once a week	
13-Aug-15	200	m3/week	+6.984	m		
20-Aug-15	228	m3/week	+6.988	m		
27-Aug-15	280	m3/week	+6.987	m		

\*Reference to the Monthly Progress Report August 2015.

**(c) Ground Subsidence and Hydrology-September 2015**

Duration (Week)	Water Consumption		Ground Level		Frequency	Note
	Quantity	Unit	Quantity	Unit		
3-Sep-15	202	m3/week	+6.986	m	Once a week	
10-Sep-15	250	m3/week	+6.987	m		
17-Sep-15	197	m3/week	+6.986	m		
24-Sep-15	203	m3/week	+6.991	m		

\*Reference to the Monthly Progress Report September 2015.

(d) Ground Subsidence and Hydrology-October 2015

Duration (Week)	Water Consumption		Ground Level		Frequency	Note
	Quantity	Unit	Quantity	Unit		
1-Oct-15	200	m3/week	+6.995	m	Once a week	
8-Oct-15	240	m3/week	+6.989	m		
15-Oct-15	130	m3/week	+6.992	m		
22-Oct-15	250	m3/week	+6.989	m		
29-Oct-15	120	m3/week	+6.990	m		

\*Reference to the Monthly Progress Report October 2015.

7) Offensive Odor (only operation phase) Not Applicable at Construction Phase Report

Complains from Residents

- Are there any complains from residents regarding offensive odor in this monitoring period?  Yes,  No

If yes, please describe the contents of complains and its countermeasures to fill in below the table.

Contents of Complains from Residents	Countermeasures

Situations environmental report from tenants Not Applicable at Construction Phase Report

- Are there any serious issues regarding offensive odor in this monitoring period?  Yes,  No

If yes, please describe the contents of complains and its countermeasures to fill in below the table.

Contents of Issues on Soil Contamination	Countermeasures

## 8) Infectious disease, Working Environment, Accident

Information from contractor (construction phase) or tenants (operation phase)

- Are there any incidents regarding Infectious disease, Working Environment, Accident in this monitoring period?  Yes,  No

If yes, please describe the contents of complains and its countermeasures to fill in below the table.

Contents of Incidents	Countermeasures

Note: If emergency incidents are occurred, the information shall be reported to the relevant organizations and authorities immediately.

End of Document

**Thilawa Special Economic Zone (Zone A)  
Development Project –Phase 2**

**Appendix**

**Water and Waste Water Monitoring Report**

**October, 2015**



MYANMAR JAPAN THILAWA DEVELOPMENT LIMITED

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# WATER QUALITY MONITORING IN THILAWA SEZ ZONE A (PHASE 2, CONSTRUCTION PHASE)

**(Bi-Monthly Monitoring)**

**October 2015**



**Resource & Environment Myanmar Ltd.** B-702/401 Delta Plaza Building, Shwegondaing Rd., Bahan, Yangon. MYANMAR

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## 1. INTRODUCTION

The water quality sampling points are in the Thilawa SEZ area, which is located in the Thanlyin and Kyauktan townships, about 20 km southeast of Yangon city (Figure 1). Thilawa SEZ is surrounded by ring road and accompanied with the container ports along the Yangon River.

There are two ways to access to Thilawa SEZ from Yangon city, which are the route passing through Thanlyin Bridge and also through Dagon River.

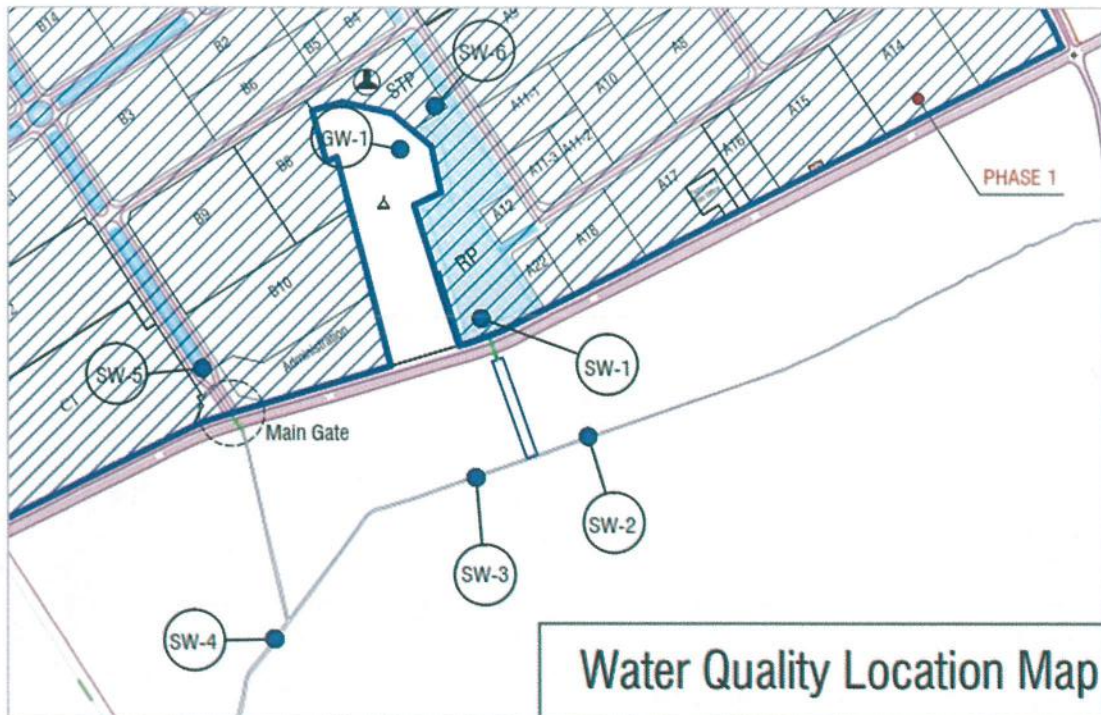


Figure 1. Location map of Thilawa SEZ area and water quality sampling locations

## 2. FIELD SURVEY

Water quality sampling for October 2015 was conducted in 4 locations (SW-2, SW-3, SW-4, GW-1) among proposed 7 locations (SW-2, SW-3, SW-4, SW-5, SW-6, GW-1).

### *Survey Item*

Parameters for water quality survey are determined so as to cover the parameters of existing environmental standards. There were four locations for water quality survey as W-2, W-3, W-5 and W-6.

### *Summary of sampling points*

The details of the locations of monitoring points are shown below.

Table 1. Locations of water quality sampling points

No.	Station	Type	Coordinate	Location
1.	SW-2	Surface Water	16° 40' 06.0" N 96° 16' 43.1" E	Upstream of Shwe Byauk Creek, Thilawa SEZ
2.	SW-3	Surface Water	16° 40' 05.5" N 96° 16' 41.6" E	Upstream of Shwe Byauk Creek, Thilawa SEZ
3.	SW-4	Surface Water	16° 39' 54.6" N 96° 16' 26.4" E	Downstream of Shwe Byauk Creek, Thilawa SEZ
4.	GW-1	Ground Water	16° 40' 25.1" N 96° 16' 31.7" E	In Moegyoe Swan Monastery, Thilawa SEZ

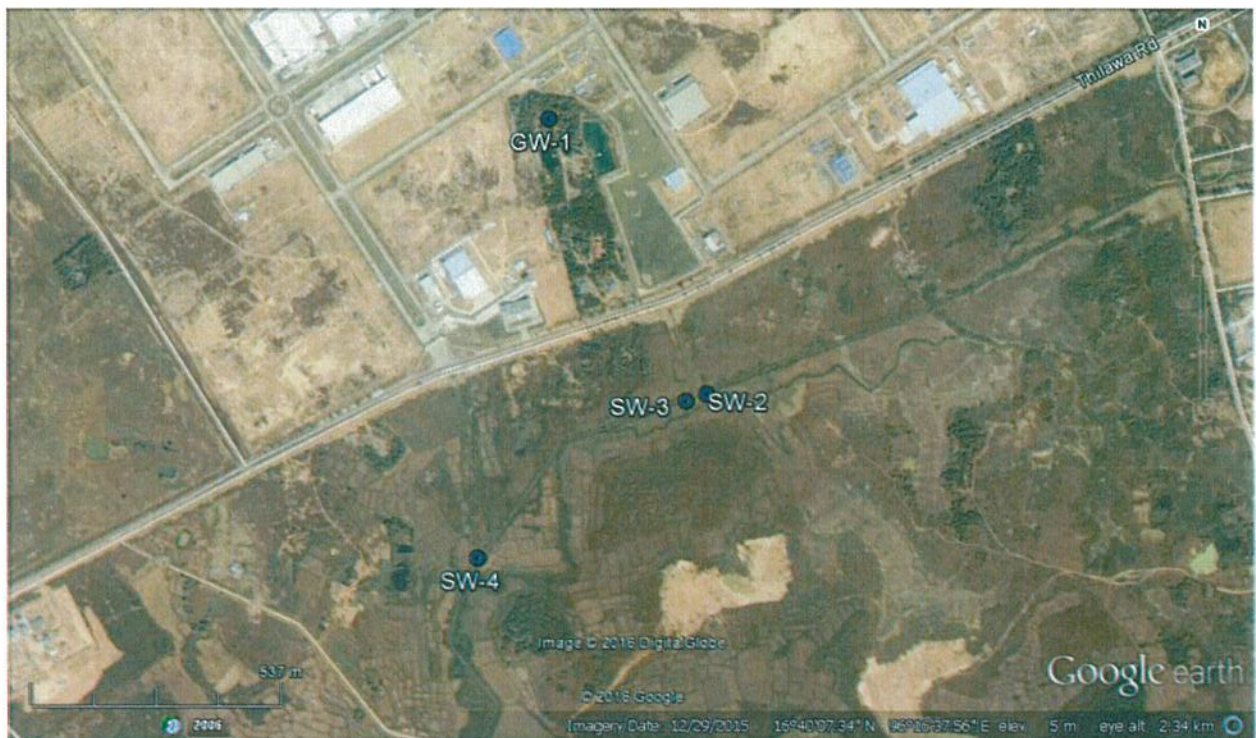


Figure 2. Location map of water quality sampling points

#### SW-2

SW-2 was collected at the upstream of Shwe Byauk Creek, where the creek is represented as the northern boundary of sub-area "2a" within the Zone B development area. This sampling point is also located at south of Zone A area and Dagon-Thilawa car road. The surrounding area are Class A in the north, industrial compound in the east and paddy field in the south and west respectively.



Figure 3. Surface water sampling at SW-2

### SW-3

SW-3 was collected at the upstream of Shwe Byauk Creek, where the creek is represented as the northern boundary of sub-area "2a" within the Zone B development area. It is distanced about 60 m downstream of SW-2. This sampling point is also located at south of Zone A area and Dagon-Thilawa car road. The surrounding area are Zone A in the north, industrial compound in the east and paddy field in the south and west respectively.



Figure 4. Surface water sampling at SW-3

### SW-4

SW-4 was collected at the downstream of Shwe Byauk Creek, where the creek is represented as the northern boundary of sub-area "2a" within the Zone B development area. It is distanced about 500 m downstream of SW-3. This sampling point is also located at south of Zone A area and Dagon-Thilawa car road. The surrounding area are Zone A in the north, industrial compound in the east and paddy field in the south and west respectively.



Figure 5. Surface water sampling at SW-4

#### *GW-1*

GW-1 was collected from tube well as ground water sample. It is located in the compound of Moegyoe Swan Monastery as well as in the Zone A area. The transparency of the ground water is high.



Figure 6. Ground water sampling at GW-1

#### *Survey Period*

Water quality survey was conducted on 19<sup>th</sup> October, 2015.

#### *Survey Method*

Water samples were taken by Alpha horizontal water sampler and collected in sterilized sample containers. All sampling was in strict accordance with recognized standard procedures. The parameters as pH, temperature, velocity, dissolved oxygen (DO), electrical conductivity (EC), and turbidity were measured at each site concurrently with sample collection. All samples were kept in iced boxes and were transported to the laboratory and stored at 2-4 °C refrigerators.

Table 2. Field Equipment for river flow measurement and water quality survey

No.	Equipment	Manufacturer	Originate Country	Model
1	Multi-parameter (Temp., pH, EC, ORP, DO, TDS, Turbidity)	HANNA	USA	HI7609829 (with 3 sensors)
2	SmarTROLL multi-parameter	In-situ Inc.	USA	-
3	Alpha Bottle (Water Sampler)	Wildlife Supply Company®	Indonesia	-

Table 3. Container and preservation method of water samples for laboratory analysis

No.	Parameter	Container	Preservation
1	BOD, COD	1000 ml glass bottle	Refrigerate
2	Suspended solid	1000 ml plastic bottle	Refrigerate
3	Coliform	1000 ml glass bottle	Refrigerate
4	Other	2000 ml plastic bottle	Refrigerate

The following table provides the test method for water quality.

Table 4. Analytical method for water quality

No.	Item	Analysis method	Sampling point
			W-2, W-3, W-5, W-6
1	Water Temperature	HI7609829-1 Sensor	✓
2	pH	HI7609829-1 Sensor	✓
3	Dissolved Oxygen (DO)	HI7609829-2 Sensor	✓
4	Suspended Solid	APHA-AWWA-WEF Method	✓
5	BOD	APHA-AWWA-WEF Method	✓
6	COD	APHA-AWWA-WEF Method	✓
7	Color	APHA-AWWA-WEF Method	✓
8	Odor	APHA-AWWA-WEF Method	✓
9	Total Nitrogen	APHA-AWWA-WEF Method	✓
10	Total Phosphorus	Photometric Method	✓
11	Total Coliform	APHA-AWWA-WEF Method	✓

### Survey Result

Water samples were sent to SGS Myanmar and SGS Thailand laboratories. Water quality results are shown in following table.

This table reveals that all of the monitoring results are under the limit (lower than the standard) except suspended solid content in all sampling points which are higher than the standard as previous times. Total coliforms of SW-2 and SW-4 were high. Location of SW-2 is upstream area of the creek and any discharge from Thilawa SEZ is not included in the water quality. Thus, case of high total coliform level is not due to any discharge from Thilawa SEZ. . Since October 2015, Operation Phase of Thilawa SEZ Zone A project, there is no discharge of industrial wastewater. This revealed that high COD level at GW-1 is judged not because of the industrial wastewater sink into the aquifer. High COD level may be caused by the presence of natural elements in that particular area, which can increase the COD in the groundwater. Certified analytical results from each laboratory are described in appendix.

Table 5. In-Situ Measurement and laboratory analysis of water quality

No	Parameter	SW-2	SW-3	SW-4	GW-1	Standard
1	Water Temperature (C)	33.56	33.90	31.38	34.05	40
2	pH	7.02	6.66	6.53	7.18	5 - 9
3	Suspended solid (mg/l)	300	413	511	44	30
4	DO (mg/l)	7.54	5.36	5.46	6.93	-
5	BOD (mg/l)	5	6	9	6	20
6	COD (mg/l)	18	23	24	62	35
7	Color (Pt.Co)	4	6	10	1	-
8	Odor	Natural	Natural	Natural	Natural	-
9	Total nitrogen (mg/l)	0.6	0.6	0.7	ND	-
10	Total phosphorus (mg/l)	0.016	ND	0.01	ND	-
11	Total Coliform (MPN/100ml)	1700	240	490	>23	400

**APPENDIX**

**LAB RESULTS**

## ANALYSIS REPORT

Job Ref: 6375/2015

Date : 02.11.2015

Page 1 of 2

Client Name : **RESOURCE AND ENVIRONMENT MYANMAR CO., LTD**  
 B-702 Delta Plaza, Shwegondaing Rd, Bahan Township,  
 Yangon, Myanmar

Project Name : Environmental Monitoring in Thilawa SEZ, Zone A (Phase I)

Sample Brought By : Client

Sample Location : Thilawa

Sample Received Date : 21.10.2015

Analysed Date : 21.10.2015

Results (mg/l)	Methods	Stations				Detection Limit
		W-2 (19.10.15)	W-3 (19.10.15)	W-5 (19.10.15)	W-6 (19.10.15)	
Lab Code	-	212/15	213/15	214/15	215/15	-
Commodity Name	-	Surface Water	Surface Water	Surface Water	Ground Water	-
BOD	In-house method based on Standard methods for the examination of water & waste water, APHA, AWWA & WEF, 22nd ed, 2012 ; 5210 D (Respirometric) and manual of BOD System Ox direct (Lovibond)	5	6	9	6	-
COD	In-house method based on Standard methods for the examination of water & waste water APHA, AWWA & WEF, 22nd ed, 2012; 5220 D (Closed Reflux, Colorimetric) and manual of Photometer-system MD 100 and RD 125 Reactor (Lovibond)	18	23	24	62	-
Oil & Grease	Based on Standard methods for the examination of water & waste water APHA, AWWA & WEF, 22nd ed, 2012 ; 5520 B	ND	ND	ND	ND	0.2
Total Nitrogen (organic)	Based on Standard methods for the examination of water & waste water APHA, AWWA & WEF, 22nd ed, 2012; 4500-N <sub>org</sub> C	0.6	0.6	0.7	ND	0.6



**WARNING:** The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted. This document is issued by the Company under its General Conditions of Service printed overleaf or available on request and accessible at [http://www.sgs.com/terms\\_and\\_conditions.htm](http://www.sgs.com/terms_and_conditions.htm). Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample (s) tested and such sample (s) are retained for 7 days (in case of perishable items) and 30 days for all other samples. The samples from regulatory bodies are to be retained as specified. This document cannot be reproduced except in full, without prior written approval of the company.



Results (mg/l)	Methods	Stations				Detection Limit
		W-2 (19.10.15)	W-3 (19.10.15)	W-5 (19.10.15)	W-6 (19.10.15)	
Lab Code	-	212/15	213/15	214/15	215/15	-
Commodity Name	-	Surface Water	Surface Water	Surface Water	Ground Water	-
Total Suspended Solid	Based on Standard methods for the examination of water & waste water APHA , AWWA & WEF,22nd ed, 2012; 2540 D	300	413	511	44	2
Phosphorus	Laboratory Manual For the Physico-Chemical Analysis of Soil, Water and Plant ; Photometric (Ascorbic ) Method	0.016	ND	0.01	ND	0.01
Sulfide	Based on Standard methods for the examination of water & waste water APHA , AWWA & WEF,22nd ed, 2012; 4500-S <sup>2-</sup> F	ND	ND	ND	ND	1
Zinc	Based on Standard methods for the examination of water & waste water APHA , AWWA & WEF,22nd ed, 2012 ; 3111B (Direct Air- Acetylene Flame method)	ND	ND	ND	ND	0.1
Copper	Based on Standard methods for the examination of water & waste water APHA , AWWA & WEF,22nd ed, 2012 ; 3111B (Direct Air- Acetylene Flame method)	ND	ND	0.186	0.266	0.1

\*\*\*\*\*End of report\*\*\*\*\*

SGS (Myanmar) Limited

*Nu Nu Yi*  
(Nu Nu Yi)  
Manager

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**Report No. : 2015-01417 / 001 (Page 1 of 1)**

Issued date : November 13, 2015

**CLIENT :** RESOURCE AND ENVIRONMENT MYANMAR CO., LTD.  
**CONTACT :** Ms. Toe Toe Hlaing  
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 Tel. +959-73013448 Fax. +951-552901  
 E-mail : toetoehlainggeo@gmail.com

## Analysis Report

**PROJECT NAME :** Environmental Monitoring in Thilawa SEZ, Zone A (Phase I)  
**SAMPLE DESIGNATED AS :** Surface Water Quality **SAMPLING DATE :** October 19, 2015  
**SAMPLING LOCATION :** Thilawa, Myanmar **SAMPLING BY :** Client

Parameters	Units	LOQ	Results		
			W-2	W-3	W-5
Color	Pt.Co	1	4	6	10
Odor	-	-	Natural	Natural	Natural
Phenol	mg/l	0.001	0.027	0.029	0.029
Formaldehyde	mg/l	0.01	<0.01	0.05	0.02
Free Chlorine (Cl <sub>2</sub> )	mg/l	0.01	0.13	0.06	0.01
Arsenic (As)	mg/l	0.002	<0.002	<0.002	<0.002
Barium (Ba)	mg/l	0.1	<0.1	<0.1	<0.1
Total Chromium (Cr)	mg/l	0.02	<0.02	<0.02	<0.02
Cadmium (Cd)	mg/l	0.0020	<0.0020	<0.0020	<0.0020
Lead (Pb)	mg/l	0.010	<0.010	<0.010	<0.010
Nickel (Ni)	mg/l	0.010	<0.010	0.010	<0.010
Mercury (Hg)	mg/l	0.0005	<0.0005	<0.0005	<0.0005
Selenium (Se)	mg/l	0.01	<0.01	<0.01	<0.01
Total Coliform Bacteria	MPN/100mL	-	1,700	240	490

**Remarks :**

- Analysis Methods followed the Standard Methods for the Examination of Water and Wastewater endorsed by American Public Health Association (APHA), American Water Works Association (AWWA) and Water Environment Federation (WEF) except ;
  - Odor followed ISO 8588-1987.
  - Formaldehyde followed Water and Wastewater Analysis endorsed by Environmental Engineering Association of Thailand (EEAT).
  - Mercury (Hg) followed U.S. EPA method 245.1.
- LOQ = Limit of Quantitation

*Siripom Z*  
 (Siripom Imwilaiwan)

Environmental Monitoring Manager

*Thepson Y.*  
 (Thepson Yommana)

Technical Manager

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TY/Client/PPT/CJ

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**Report No. : 2015-01417 / 002 (Page 1 of 1)** Issued date : November 13, 2015

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## Analysis Report

**PROJECT NAME :** Environmental Monitoring in Thilawa SEZ, Zone A (Phase I)  
**SAMPLE DESIGNATED AS :** Groundwater Quality **SAMPLING DATE :** October 19, 2015  
**SAMPLING LOCATION :** Thilawa, Myanmar **SAMPLING BY :** Client

Parameters	Units	LOQ	W-6
Color	Pt.Co	1	1
Odor	-	-	None
Phenol	mg/l	0.001	0.026
Formaldehyde	mg/l	0.01	<0.01
Free Chlorine (Cl <sub>2</sub> )	mg/l	0.01	<0.01
Arsenic (As)	mg/l	0.001	<0.001
Barium (Ba)	mg/l	0.1	<0.1
Total Chromium (Cr)	mg/l	0.02	<0.02
Cadmium (Cd)	mg/l	0.001	<0.001
Lead (Pb)	mg/l	0.006	<0.006
Nickel (Ni)	mg/l	0.002	<0.002
Mercury (Hg)	mg/l	0.0005	<0.0005
Selenium (Se)	mg/l	0.01	<0.01
Total Coliform Bacteria	MPN/100mL	-	>23

**Remarks :**

- Analysis Methods followed the Standard Methods for the Examination of Water and Wastewater endorsed by American Public Health Association (APHA), American Water Works Association (AWWA) and Water Environment Federation (WEF) except ;
  - Formaldehyde followed Water and Wastewater Analysis endorsed by Environmental Engineering Association of Thailand (EEAT).
  - Mercury (Hg) followed U.S. EPA method 245.1.
- LOQ = Limit of Quantitation

*Siriporn L.*  
 (Siriporn Imwilaiwan)

Environmental Monitoring Manager

*Thepsan Y.*  
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**Thilawa Special Economic Zone (Zone A)  
Development Project –Phase 2**

**Appendix**

**Air Quality Monitoring Report**

**October, 2015**

## AIR QUALITY MONITORING IN THILAWA SEZ ZONE A (PHASE 2, CONSTRUCTION PHASE)

October 2015



**Resource & Environment Myanmar Ltd.** B-702/401 Delta Plaza Building, Shwegondaing Rd., Bahan, Yangon. MYANMAR

Tel: (959) 7301 3448; Fax: (951) 552901

[www.enviromyanmar.net](http://www.enviromyanmar.net)

### **Survey Item**

Parameters for air quality survey were determined by referring environmental quality standard for air in Thailand and Japan as shown in following table.

As there is no environmental standard for ambient air quality in Republic of Myanmar, the survey result was evaluated by comparing with Japan and Thailand standards.

Table-1. Survey parameters and target levels for air quality

Parameters	Averaging Period	Value
SO <sub>2</sub>	24 hours	0.12 ppm <sup>1</sup>
CO	24 hours	9 ppm <sup>1</sup>
NO <sub>2</sub>	24 hours	0.04 – 0.06 ppm <sup>2</sup>
TSP	24 hours	0.33 mg/m <sup>3</sup> <sup>1</sup>
PM10	24 hours	0.12 g/m <sup>3</sup> <sup>1</sup>

1 Thailand Standard

2 Japan Standard

### **Summary of sampling points**

The detail of the location of air quality monitoring point is shown below.

Table-2. Location of air quality monitoring station.

Sampling Point	Coordinates	Location
AQ-1	16°41'13.4"N, 96°15'51.9"E	In the Zone A area, Thilawa SEZ

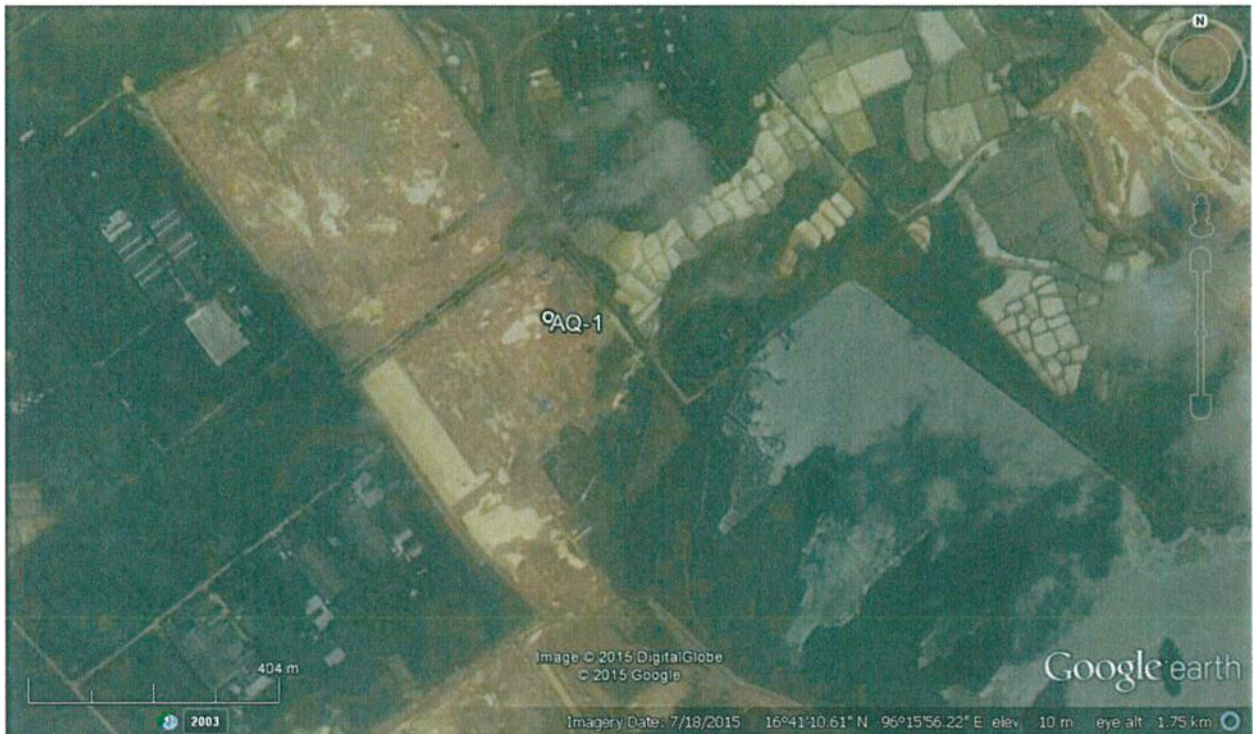


Figure-1. Location map of air quality monitoring point

#### AQ-1

This station was installed in the flat area, in the northern part of Thilawa SEZ Zone A. AQ-1 is bounded by Thilawa dam in southeast, agricultural land and residential houses of Alwan sok village in north and garment factory in the west respectively. Possible emission source is from daily human activities in Alwan sok village far about 400 m from this monitoring location.



Figure-2. Air quality monitoring at AQ-1

### **Survey Period**

Air quality monitoring was conducted seven consecutive days during October 2015. The measurement duration is shown in the following table.

Table-3. Sampling duration for air quality survey

Sampling Point	Period
AQ-1	7 <sup>th</sup> - 14 <sup>th</sup> October, 2015

Source: Resource & Environment Myanmar Co., Ltd.

### **Survey Method**

Sampling and analysis of ambient air pollutants was conducted by referring to the recommendation of United States Environmental Protection Agency (U.S. EPA). The Haz-Scanner Environmental Perimeter Air Station (EPAS) was used to collect ambient air monitoring data. The characteristics of the instrument are:

- Portable direct reading
- Configure up to 14 simultaneous air measurements including U.S. EPA criteria air pollutants
- Standard configuration measures PM2.5, PM10 or TSP particulates, CO, NO, NO<sub>2</sub>, SO<sub>2</sub>, temperature, and relative humidity
- Wind parameters are also measured by Haz-scanner EPAS and the required data are analyzed by using the WRPLOT View of AERMOD View (ver. 7.0) in which calm wind is defined below 0.5 m/s.

Table-4. Sampling and analysis method for air quality

No.	Parameter	Analysis Method
1	Sulfur dioxide (SO <sub>2</sub> )	On site reading
2	Carbon monoxide (CO)	On site reading
3	Nitrogen dioxides (NO <sub>2</sub> )	On site reading
4	Total Particle matter (TSP)	On site reading
5	Particle matter 10 (PM10)	On site reading

Source: Resource & Environment Myanmar Co., Ltd.

### **Survey Result**

Daily average of ambient gases levels at AQ-1 for 7 consecutive are presented in following tables. All ambient gases levels and particulate matters in each day are lower than the environmental standard (1-day) in Japan and Thailand Standards. Generally, it indicated the area had few emission sources and it was certainly to say the measured data were baseline level in the area.



Table-5. Ambient air quality at AQ-1

	Date	Time	Co	NO2	TSP	PM (10)	SO2
	D.M.Y	Hours	ppm	ppm	mg/m3	mg/m3	ppm
1	7-8 October, 2015	24	0.12	0.02	0.03	0.02	0.01
2	8-9 October 2015	24	0.12	0.02	0.01	0.01	0.00
3	9-10 October 2015	24	0.10	0.02	0.01	0.01	0.00
4	10-11 October 2015	24	0.11	0.02	0.01	0.02	0.01
5	11-12 October 2015	24	0.13	0.02	0.01	0.01	0.00
6	12-13 October 2015	24	0.14	0.02	0.01	0.01	0.00
7	13-14 October 2015	24	0.16	0.02	0.02	0.01	0.01
Maximum		24	0.16	0.02	0.03	0.02	0.01
Average		24	0.13	0.02	0.02	0.01	0.01
Minimum		24	0.11	0.02	0.01	0.01	0.01
Target value		24	10	<0.06	<0.33	<0.12	<0.04

Source: Resource & Environment Myanmar Co., Ltd

## **Appendix**

### **Hourly Air Results**

Date	Time	CO	NO2	TSP	PM10	SO2
D.M.Y	H.M.S	ppb	ppb	µg/m3	µg/m3	ppb
7.10.2015	13:00-14:00	0.0000	11.5172	150.8103	81.1724	1.0000
7.10.2015	14:00-15:00	62.5667	47.1667	18.6333	30.9667	22.4333
7.10.2015	15:00-16:00	124.2333	30.1000	2.8500	11.3000	4.2167
7.10.2015	16:00-17:00	158.5667	22.9833	3.6833	6.7000	3.5333
7.10.2015	17:00-18:00	168.6167	19.1000	2.3833	2.6000	1.1500
7.10.2015	18:00-19:00	184.1833	13.2833	6.7667	8.1000	2.5167
7.10.2015	19:00-20:00	143.8605	23.1628	4.9535	16.7674	1.0000
7.10.2015	20:00-21:00	113.4375	27.1875	17.3750	9.1250	1.0000
7.10.2015	21:00-22:00	134.1154	8.1346	39.4038	78.0577	1.0000
7.10.2015	22:00-23:00	132.1333	5.1167	40.9167	58.5833	1.1500
7.10.2015	23:00-00:00	127.9333	9.9333	35.0667	16.8000	2.5833
8.10.2015	00:00-01:00	128.7333	19.3833	8.1667	10.7667	6.0667
8.10.2015	01:00-02:00	139.8833	16.4000	6.5000	9.3000	1.0000
8.10.2015	02:00-03:00	148.3077	22.3077	8.6923	11.6923	2.2308
8.10.2015	03:00-04:00	94.3750	25.9583	12.9167	18.4167	1.0000
8.10.2015	04:00-05:00	96.9394	15.8485	23.0303	36.8182	2.0000
8.10.2015	05:00-06:00	99.5833	20.1167	19.2833	20.1667	3.2333
8.10.2015	06:00-07:00	156.0667	19.1500	22.9833	16.8500	6.7167
8.10.2015	07:00-08:00	142.1667	12.1500	36.7333	19.8167	13.8333
8.10.2015	08:00-09:00	157.7167	11.4167	37.9333	19.5500	11.9500
8.10.2015	09:00-10:00	153.6500	71.6667	2.8500	14.1333	1.1500
8.10.2015	10:00-11:00	121.0000	32.8000	37.6667	21.2500	45.0833
8.10.2015	11:00-12:00	52.8000	4.7000	51.8000	14.4500	66.8500
8.10.2015	12:00-13:00	41.3333	3.2333	28.2833	4.4000	26.7500
MAX	24hours	184.1833	71.6667	150.8103	81.1724	66.8500
MIN	24hours	0.0000	3.2333	2.3833	2.6000	1.0000
Average	24hours	120.0918	20.5340	25.8201	22.4076	9.5603

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.184	0.071	0.15	0.081	0.066
MIN	24hours	0.000	0.003	0.002	0.002	0.001
Average	24hours	0.120	0.020	0.025	0.022	0.009

Date	Time	CO	NO2	TSP	PM10	SO2
D.M.Y	H.M.S	ppb	ppb	µg/m3	µg/m3	ppb
8.10.2015	13:00-14:00	64.7000	5.3667	2.1000	7.4833	6.3000
8.10.2015	14:00-15:00	105.0833	16.9000	2.0000	6.3667	1.2833
8.10.2015	15:00-16:00	91.9167	5.0333	14.7500	14.6333	3.1333
8.10.2015	16:00-17:00	125.0000	34.1667	2.6667	21.0167	1.3000
8.10.2015	17:00-18:00	159.6333	18.3333	3.7000	3.2833	1.0833
8.10.2015	18:00-19:00	189.4833	8.2000	6.7500	2.4833	5.2333
8.10.2015	19:00-20:00	163.3833	15.2167	17.5667	6.1333	1.6500
8.10.2015	20:00-21:00	146.5000	21.2167	15.5333	8.8667	1.0000
8.10.2015	21:00-22:00	113.1667	20.6000	15.9500	15.1500	1.0000
8.10.2015	22:00-23:00	122.0000	11.7167	18.2333	14.0167	1.0000
8.10.2015	23:00-00:00	116.7500	9.0333	14.4333	12.1833	4.1500
9.10.2015	00:00-01:00	121.6333	13.3167	14.2333	11.9167	2.9000
9.10.2015	01:00-02:00	111.2000	15.5333	6.5667	19.6000	1.8667
9.10.2015	02:00-03:00	112.5667	19.1333	6.3833	14.0833	1.0000
9.10.2015	03:00-04:00	112.6333	21.9000	11.4500	20.4667	1.1167
9.10.2015	04:00-05:00	118.1000	15.7167	11.5667	12.8000	1.0000
9.10.2015	05:00-06:00	123.2000	21.6667	14.4000	13.2500	1.0000
9.10.2015	06:00-07:00	162.5167	19.6333	21.3500	20.3500	3.0333
9.10.2015	07:00-08:00	163.9667	17.6500	29.6500	25.2167	11.2167
9.10.2015	08:00-09:00	129.6333	37.5333	28.7167	19.5500	3.9667
9.10.2015	09:00-10:00	124.4667	24.2667	17.4333	8.7000	4.5167
9.10.2015	10:00-11:00	50.1500	12.0833	23.7000	14.9000	19.0667
9.10.2015	11:00-12:00	82.0667	29.0833	7.4000	7.8667	2.2333
9.10.2015	12:00-13:00	93.7333	9.7667	36.2833	18.9833	37.8500
MAX	24hours	189.4833	37.5333	36.2833	25.2167	37.8500
MIN	24hours	50.1500	5.0333	2.0000	2.4833	1.0000
Average	24hours	120.98	17.63	14.28	13.30	4.91

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.189	0.037	0.036	0.025	0.038
MIN	24hours	0.050	0.005	0.002	0.002	0.001
Average	24hours	0.120	0.020	0.010	0.010	0.000

Date	Time	CO	NO2	TSP	PM10	SO2
D.M.Y	H.M.S	ppb	ppb	µg/m3	µg/m3	ppb
9.10.2015	13:00-14:00	40.3167	10.3000	10.0500	17.4333	2.9333
9.10.2015	14:00-15:00	127.8833	24.1000	6.6167	2.3000	1.0000
9.10.2015	15:00-16:00	143.6667	21.1833	4.6667	13.5167	1.0167
9.10.2015	16:00-17:00	141.7833	45.0000	4.8667	3.5000	1.6500
9.10.2015	17:00-18:00	122.5000	37.5667	7.4833	5.1500	1.0000
9.10.2015	18:00-19:00	108.2167	30.0667	14.4167	11.0333	1.0000
9.10.2015	19:00-20:00	84.9667	24.0500	13.5833	10.7000	1.0000
9.10.2015	20:00-21:00	87.4000	21.2833	18.4000	12.9667	1.5667
9.10.2015	21:00-22:00	91.4667	19.5833	9.7000	12.2667	2.7167
9.10.2015	22:00-23:00	24.6500	30.1167	12.7333	16.5833	3.0167
9.10.2015	23:00-00:00	72.5833	29.3833	9.5833	14.8167	7.0000
10.10.2015	00:00-01:00	86.7833	32.9000	9.3667	14.1833	1.4833
10.10.2015	01:00-02:00	92.1833	29.9000	10.8167	12.6000	1.4500
10.10.2015	02:00-03:00	85.9833	23.3667	13.7333	13.6667	1.0000
10.10.2015	03:00-04:00	86.3500	19.6167	18.7500	14.9167	1.0000
10.10.2015	04:00-05:00	104.7167	22.4833	16.6833	14.4000	1.0000
10.10.2015	05:00-06:00	101.6833	27.9333	8.4167	8.2667	1.1667
10.10.2015	06:00-07:00	156.6667	26.4667	16.8167	24.1167	2.4500
10.10.2015	07:00-08:00	98.1167	27.1333	29.8667	22.9333	1.4333
10.10.2015	08:00-09:00	52.6833	23.4833	4.6833	9.2000	1.0000
10.10.2015	09:00-10:00	83.4500	8.4333	37.4833	20.9333	4.5500
10.10.2015	10:00-11:00	83.4167	10.9667	33.7667	19.7167	41.1500
10.10.2015	11:00-12:00	100.1167	12.4333	21.4333	12.2500	7.9667
10.10.2015	12:00-13:00	115.0833	11.6500	2.1667	3.2333	1.2833
MAX	24hours	156.6667	45.0000	37.4833	24.1167	41.1500
MIN	24hours	24.6500	8.4333	2.1667	2.3000	1.0000
Average	24hours	95.53	23.73	14.00	12.95	3.78

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.160	0.045	0.040	0.020	0.040
MIN	24hours	0.020	0.010	0.000	0.000	0.000
Average	24hours	0.100	0.020	0.010	0.010	0.000

Date	Time	CO	NO2	TSP	PM10	SO2
D.M.Y	H.M.S	ppb	ppb	µg/m3	µg/m3	ppb
10.10.2015	13:00-14:00	140.0000	6.0167	26.1833	8.0833	4.2500
10.10.2015	14:00-15:00	133.0000	14.3167	25.1000	15.6333	9.3833
10.10.2015	15:00-16:00	132.7333	45.8667	4.0167	24.1833	5.9333
10.10.2015	16:00-17:00	124.9500	7.4500	4.1500	19.0500	1.7833
10.10.2015	17:00-18:00	138.4167	24.8667	2.4000	25.8167	1.0000
10.10.2015	18:00-19:00	112.7167	22.3500	3.2333	16.6000	1.0000
10.10.2015	19:00-20:00	103.5667	23.4167	5.3833	8.8833	1.0000
10.10.2015	20:00-21:00	74.4000	30.0500	10.8000	10.2500	1.0000
10.10.2015	21:00-22:00	128.2833	34.8833	13.1167	14.4000	1.0833
10.10.2015	22:00-23:00	68.3167	31.7000	9.2833	3.6333	1.0000
10.10.2015	23:00-00:00	101.9833	26.9500	17.5833	11.2167	1.2500
11.10.2015	00:00-01:00	92.9000	27.0000	9.0333	21.8833	1.0000
11.10.2015	01:00-02:00	83.2500	35.9667	12.7667	15.1500	1.0000
11.10.2015	02:00-03:00	101.2667	38.5667	15.1333	12.6833	1.1000
11.10.2015	03:00-04:00	95.4167	31.7667	12.8500	13.3667	1.0000
11.10.2015	04:00-05:00	104.4500	21.6833	11.2667	15.8333	1.7333
11.10.2015	05:00-06:00	123.7167	24.0833	9.5167	15.1167	3.2167
11.10.2015	06:00-07:00	156.5333	27.2667	8.0333	14.6500	3.9167
11.10.2015	07:00-08:00	178.9167	20.3667	29.8000	24.1167	16.1833
11.10.2015	08:00-09:00	113.1500	7.0167	36.7500	22.9333	4.0500
11.10.2015	09:00-10:00	75.3167	4.7167	30.9667	14.3333	21.9167
11.10.2015	10:00-11:00	21.5000	10.4333	20.2667	19.2167	18.9333
11.10.2015	11:00-12:00	52.1500	9.5833	15.3167	9.8167	32.9833
11.10.2015	12:00-13:00	75.0167	16.1333	2.4167	11.5500	1.1333
MAX	24hours	178.9167	45.8667	36.7500	25.8167	32.9833
MIN	24hours	21.5000	4.7167	2.4000	3.6333	1.0000
Average	24hours	105.4979	22.6021	13.9736	15.3500	5.7021

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.178	0.045	0.036	0.025	0.032
MIN	24hours	0.021	0.004	0.002	0.003	0.001
Average	24hours	0.105	0.022	0.013	0.015	0.005

Date	Time	CO	NO2	TSP	PM10	SO2
D.M.Y	H.M.S	ppb	ppb	µg/m3	µg/m3	ppb
11.10.2015	13:00-14:00	101.1333	9.4167	2.1000	1.3000	1.0000
11.10.2015	14:00-15:00	122.2500	28.5000	2.5667	7.9333	1.0000
11.10.2015	15:00-16:00	146.7833	15.5667	9.1333	10.3333	1.0000
11.10.2015	16:00-17:00	158.1167	9.6167	12.7667	8.7167	3.3667
11.10.2015	17:00-18:00	124.1000	8.3833	14.6333	6.5000	1.0000
11.10.2015	18:00-19:00	157.0833	15.1833	14.5167	15.4333	3.5500
11.10.2015	19:00-20:00	199.4000	12.9833	10.9500	19.7500	10.4000
11.10.2015	20:00-21:00	130.8500	27.6333	15.3667	15.1667	1.0000
11.10.2015	21:00-22:00	115.9333	19.4500	11.7167	16.2167	1.7833
11.10.2015	22:00-23:00	116.3333	19.7500	9.9667	17.7833	1.2667
11.10.2015	23:00-00:00	109.5000	15.7167	4.3667	19.3833	2.1167
12.10.2015	00:00-01:00	112.6000	16.5000	11.1000	9.8000	1.0000
12.10.2015	01:00-02:00	116.5833	19.3167	11.6000	10.5000	1.7833
12.10.2015	02:00-03:00	113.1000	15.5333	7.5667	12.8500	1.0000
12.10.2015	03:00-04:00	113.0833	10.2167	7.9167	10.8833	1.0000
12.10.2015	04:00-05:00	114.3167	21.1000	10.3000	10.7833	1.0000
12.10.2015	05:00-06:00	116.7833	16.8000	11.8333	10.8333	2.4000
12.10.2015	06:00-07:00	120.4000	18.5000	15.6500	11.9333	1.1667
12.10.2015	07:00-08:00	124.1500	20.4833	7.5333	11.8833	1.0000
12.10.2015	08:00-09:00	123.1667	18.1833	14.7333	7.3667	1.6167
12.10.2015	09:00-10:00	171.0833	22.6333	8.1833	10.1000	1.5333
12.10.2015	10:00-11:00	184.0833	19.2333	5.6667	5.1833	1.5500
12.10.2015	11:00-12:00	165.1833	11.6167	24.7333	9.4500	4.5500
12.10.2015	12:00-13:00	141.2000	19.2000	23.7667	20.3500	10.4167
MAX	24hours	199.4000	28.5000	24.7333	20.3500	10.4167
MIN	24hours	101.1333	8.3833	2.1000	1.3000	1.0000
Average	24hours	133.2174	17.1465	11.1944	11.6847	2.3958

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.199	0.028	0.024	0.020	0.010
MIN	24hours	0.101	0.008	0.002	0.001	0.001
Average	24hours	0.133	0.017	0.011	0.011	0.002

Date	Time	CO	NO2	TSP	PM10	SO2
D.M.Y	H.M.S	ppb	ppb	µg/m3	µg/m3	ppb
12.10.2015	13:00-14:00	153.1833	24.2333	3.5667	11.6500	2.3333
12.10.2015	14:00-15:00	169.0000	16.3167	2.1833	5.1167	5.0667
12.10.2015	15:00-16:00	111.0167	22.6167	5.8000	5.8833	1.4333
12.10.2015	16:00-17:00	143.1333	11.5167	12.0333	5.4167	1.2500
12.10.2015	17:00-18:00	280.4833	18.5167	16.1000	16.4000	1.6667
12.10.2015	18:00-19:00	194.4833	20.4000	10.4833	14.5667	1.8667
12.10.2015	19:00-20:00	160.0333	22.3000	11.1500	11.1833	2.6500
12.10.2015	20:00-21:00	163.4667	19.2833	10.4333	11.5833	2.2167
12.10.2015	21:00-22:00	91.0167	25.1333	5.3000	18.3000	1.0000
12.10.2015	22:00-23:00	115.8167	24.6000	8.0333	10.6167	1.0000
12.10.2015	23:00-00:00	115.1667	20.2000	5.7167	11.1000	1.1000
13.10.2015	00:00-01:00	108.6667	14.3833	13.5167	9.0000	1.0000
13.10.2015	01:00-02:00	115.1167	16.6333	16.2000	7.9000	1.0000
13.10.2015	02:00-03:00	130.0167	22.3833	12.4500	8.2000	1.5500
13.10.2015	03:00-04:00	145.1000	20.5667	7.5333	7.7000	2.3667
13.10.2015	04:00-05:00	104.9667	18.4833	11.2167	10.1667	2.0833
13.10.2015	05:00-06:00	106.6667	18.7167	11.9333	12.0833	1.2000
13.10.2015	06:00-07:00	148.8000	18.0500	11.2667	8.6833	2.9500
13.10.2015	07:00-08:00	179.1833	16.2667	19.9667	8.0000	4.5833
13.10.2015	08:00-09:00	156.7833	19.8167	31.8500	13.2667	4.8000
13.10.2015	09:00-10:00	143.9833	26.9167	17.3500	18.8000	4.9500
13.10.2015	10:00-11:00	136.0833	33.2833	3.3833	8.1833	1.0500
13.10.2015	11:00-12:00	131.4667	20.4000	9.2167	5.7000	3.5000
13.10.2015	12:00-13:00	166.6667	19.9500	6.6000	8.1667	4.6333
MAX	24hours	280.4833	33.2833	31.8500	18.8000	5.0667
MIN	24hours	91.0167	11.5167	2.1833	5.1167	1.0000
Average	24hours	144.60	20.46	10.97	10.32	2.39

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.280	0.033	0.310	0.018	0.005
MIN	24hours	0.091	0.011	0.002	0.005	0.001
Average	24hours	0.144	0.020	0.010	0.010	0.002



Date	Time	CO	NO2	TSP	PM10	SO2
D.M.Y	H.M.S	ppb	ppb	µg/m3	µg/m3	ppb
13.10.2015	13:00-14:00	152.7000	9.4000	12.0167	8.5500	1.0000
13.10.2015	14:00-15:00	154.0333	21.0167	23.3167	9.1667	1.0500
13.10.2015	15:00-16:00	160.4500	7.8500	32.1667	28.0000	5.4833
13.10.2015	16:00-17:00	155.0000	10.7833	21.7833	19.4667	15.2000
13.10.2015	17:00-18:00	105.2000	25.7333	4.5167	9.2167	1.0833
13.10.2015	18:00-19:00	160.0000	23.8500	4.0500	3.2167	1.0000
13.10.2015	19:00-20:00	192.1833	17.0667	10.6833	10.4000	3.9333
13.10.2015	20:00-21:00	201.5167	23.8167	10.5667	13.0167	1.5833
13.10.2015	21:00-22:00	183.0833	10.4667	13.1500	14.4000	2.1333
13.10.2015	22:00-23:00	169.8000	16.9333	8.7667	14.2667	14.0833
13.10.2015	23:00-00:00	190.1333	21.3833	10.9333	15.2000	9.5167
14.10.2015	00:00-01:00	171.1500	14.2500	8.7500	10.0000	1.7000
14.10.2015	01:00-02:00	205.1333	17.7167	11.9500	16.6000	4.6167
14.10.2015	02:00-03:00	188.6167	14.9333	10.2667	15.6833	9.1833
14.10.2015	03:00-04:00	203.8833	29.9167	7.1333	12.4333	1.0000
14.10.2015	04:00-05:00	132.2333	41.6667	6.2833	13.9333	1.0667
14.10.2015	05:00-06:00	153.4833	16.6667	9.6667	14.6667	8.0000
14.10.2015	06:00-07:00	217.7333	27.0000	12.6167	23.2333	19.3667
14.10.2015	07:00-08:00	177.3500	7.2500	33.5500	28.4667	9.4500
14.10.2015	08:00-09:00	98.2333	6.2667	39.4167	19.6000	10.5833
14.10.2015	09:00-10:00	89.9833	5.0333	31.7667	11.5000	23.6833
14.10.2015	10:00-11:00	95.1333	4.1333	26.4333	5.9333	30.7333
14.10.2015	11:00-12:00	86.4667	6.8167	11.7333	6.4333	42.1333
14.10.2015	12:00-13:00	105.8511	15.6809	23.2553	1.5532	50.8936
MAX	24hours	217.7333	41.6667	39.4167	28.4667	50.8936
MIN	24hours	86.4667	4.1333	4.0500	1.5532	1.0000
Average	24hours	156.22	16.48	16.03	13.54	11.19

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.217	0.041	0.039	0.028	0.050
MIN	24hours	0.086	0.004	0.004	0.001	0.001
Average	24hours	0.156	0.016	0.016	0.013	0.011

**Thilawa Special Economic Zone (Zone A)  
Development Project –Phase 2**

**Appendix**

**Noise and Vibration Monitoring Report**

**November, 2015**

## **NOISE AND VIBRATION MONITORING IN THILAWA SEZ ZONE A (PHASE 2, CONSTRUCTION PHASE)**

**November 2015**



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## 1. INTRODUCTION

The monitoring points are sited in the Thilawa SEZ area, which is located in the Thanlyin and Kyauktan townships, about 20 km southeast of Yangon city (Figure 1). Thilawa SEZ is surrounded by ring road and accompanied with the container ports along the Yangon River.

There are two ways to access to Thilawa SEZ from Yangon city, which are the route passing through Thanlyin Bridge and also through Dagon River.

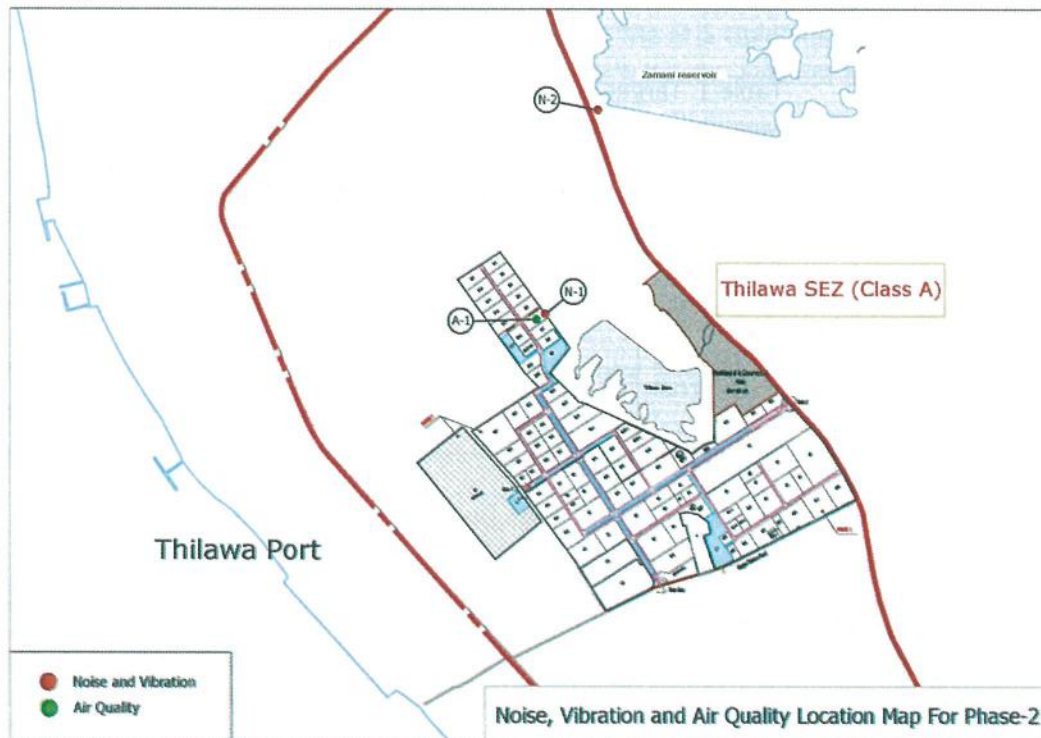


Figure 1. Location map of Thilawa SEZ area and monitoring locations

## 2. ENVIRONMENTAL STANDARD

### (A) Noise

#### *Construction Phase*

There is no noise standard of construction activities to receptors in Myanmar and International Organization's standards such as WHO and Environmental, Health, and Safety (EHS) Guidelines prepared by International Fiancé Cooperation (IFC) in a group member of World Bank, therefore the target noise level at construction stage is set based on the standard in the other foreign countries.

In the south-east Asia countries, only Singapore has the noise standard of construction activities to receptors categorized area to be quiet, residential area, and the other areas. On the basis of the above information, target noise level is set as following concept.

Items		Day time (Leq)	Night time (Leq)
	Commercial and Business	70 dB (7am – 10pm, 15hrs)	60 dB (10pm – 7am, 9hrs)
Singapore	Sensitive Areas	60 dB (7am – 7pm, 12hrs)	55 dB (7pm – 10pm, 3hr) 50 dB (10pm – 7am, 9hr)
	Residential Areas	65 dB (7am – 7pm, 12hrs)	60 dB (7pm – 10pm, 3hr) 55 dB (10pm – 7am, 9hr)
	Commercial Areas	70 dB (7am – 7pm, 12hrs)	65 dB (7pm – 10pm, 3hr) 60 dB (10pm – 7am, 9hr)
Thailand	Noise standard	70 dB (24hrs)	
Japan	Sensitive Area (Class AA)	50 dB (6am – 10pm, 16hrs)	40 dB (10pm – 6pm, 8hrs)
	Residential Area (Class A and Class B)	55 dB (6am – 10pm, 16hrs)	45 dB (10pm – 6pm, 8hrs)
	Commercial and Industrial Area (Class C)	60 dB (6am – 10pm, 16hrs)	50 dB (10pm – 6pm, 8hrs)
IFC	Residential; institutional, educational	55 dB (7am – 10pm, 15hrs)	45 dB (10pm – 7am, 9hrs)
	Industrial; commercial	70 dB (7am – 10pm, 15hrs)	70 dB (10pm – 7am, 9hrs)

Source: Noise Standard in Indonesia (KEP-48/MENLH/11/1996)

Effect of Traffic Noise on Sleep: A Case Study in Serdang Raya, Selangor, Malaysia, Environment Asia, 2010

Environmental Protection and Management Act in Singapore (Chap.94A, Section 77, revised in 2008)

Notification of Environmental Board No. 15 B.E.2540(1997) under the Conservation and Enhancement of National Environmental Quality Act B.E.2535 (1992) dated March 12, B.E.2540 (1997) and Notification of Pollution Control Department ; Subject: Calculation of Noise Level Dated August 11, B.E. 2540 (1997) in Thailand

## (B) Vibration

As there is no vibration standard to receptors in Myanmar, the target vibration level at construction phase shall be set based on the standards in some foreign countries. Accordingly the target level of vibration is set based on the following policies.

- Monastery and residential house where are necessary to keep quiet and sleep shall comply with the Japanese standard for residential area,
- Office, commercial facilities, and factories areas shall comply with the Japanese standard for mixed areas including residential and commercial and industrial areas, and
- The category of times divided into three types in a manner consistency with target noise level for construction.

### 3. FIELD SURVEY

The survey included noise and vibration monitoring for three locations in Thilawa SEZ area.

#### Survey Item

##### (A) Noise

Parameter for noise level survey was determined by referring the environmental quality standards in Japan and other countries for operation stage as shown in Table 5.

Table 5. Survey parameters for noise level

No.	Parameter	Category	Day Time (Leq) (7am-7pm)	Evening Time (Leq) (7pm-10pm)	Night Time (Leq) (10pm-7am)
1	A-weighted loudness equivalent (LAeq)	Residential houses and monastery located more than 150m from the construction site, office, commercial facilities, and factories	75 dB	65 dB	65 dB

##### (B) Vibration

Vibration can be defined as regularly repeated movement of a physical object about a fixed point. The parameter normally used to assess the ground vibration is the Peak Particle Velocity (PPV) expressed in millimeters per second (mm/s).

Vibration can cause varying degrees of damage in buildings and affect vibration-sensitive machinery or equipment. Its effect on people may be to cause disturbance or annoyance or, at higher levels, to affect a person's ability to work.

Typical levels measured during construction activities are shown below:

Construction Activity	Typical Ground Vibration Level
Vibratory roller	Up to 1.5mms @ 25m
Hydraulic rock breakers	4.5 mm/s @ 5m, 0.4 @ 20m, 0.1 @ 50m
Compactor	20mm/s @ 5m, <0.3mm/s @30m
Pile driving	1-3mm/s @ 50m depending on soil conditions and piling technique
Bulldozer	1-2mm/s @ 5m, 0.1 @ 50m
Truck traffic (smooth surface)	<0.2mm/s @ 20m
Truck traffic (rough surface)	<2mm/s @ 20m

### Summary of sampling points

The detail of the locations of monitoring points are shown below.

Table 6. Locations of noise and vibration monitoring stations

Sampling Point	Coordinates	Description of Sampling Point
NV-1	16° 41' 14.3" N 96° 15' 50.6" E	Inside of the Thilawa class A expansion compound.
NV-2	16° 42' 16.2" N 96° 16' 00.8" E	In front of Myanmar Maritime University.

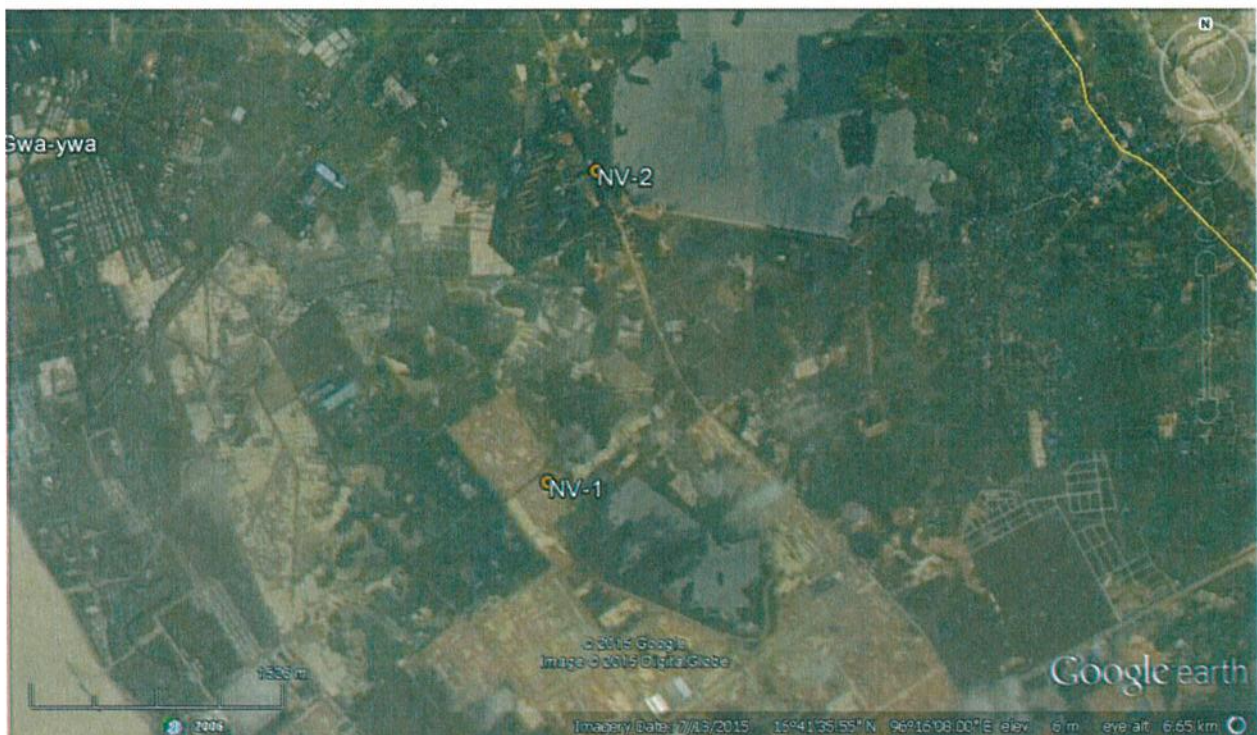


Figure 2. Location map of noise and vibration monitoring locations

#### NV-1

NV-1 was an open area located within the Class A expansion area, north of Class A. It is surrounded by Thilawa dam in the south, residential area in the northeast and garment factory in the west respectively. There is an access road situated north of NV-1 and which is paved with moderately traffic volume. Dominant source of noise was vehicular traffic activity nearby the site. Noise and vibration monitoring at NV-1 is shown in figure 3.



Figure 3. Noise and vibration monitoring at NV-1.

#### NV-2

NV-2 was sited at the north of Class A in Thilawa SEZ and which is surrounded by Zarmani dam in the east and Myanmar Maritime University in the west. The location was an open area and distanced about 14m from the car road. The road was paved with moderately traffic volume especially during the day time. Dominant sources of noise were vehicle traffic during the day time. Noise and vibration monitoring at NV-2 is shown in figure 4.



Figure 4. Noise and vibration monitoring at NV-2.

#### **Survey Period**

Sampling and monitoring of surrounding sound and vibration level at NV-1 and NV-2 were conducted during 12<sup>th</sup> - 14<sup>nd</sup> November 2015.

Sampling Point	Survey Period
NV-1	13 <sup>th</sup> - 14 <sup>th</sup> November, 2015 (24 hours)
NV-2	12 <sup>th</sup> -13 <sup>th</sup> November, 2015 (24 hours)



Table 8. A-weighted Loudness Equivalent ( $L_{Aeq}$ ) Level  
Unit: dB(A)

Date	NV-1 13 <sup>th</sup> - 14 <sup>th</sup> November 2015			NV-2 12 <sup>th</sup> - 13 <sup>th</sup> November 2015		
	Day Time	Evening Time	Night Time	Day Time	Evening Time	Night Time
	52.49	48.08	40.63	58.96	56.58	52.27
Target Noise Level	75	65	65	75	65	65

**(B) Vibration**

Vibration results were presented in Figure 6 to 8. Table of observed vibration level is presented in Appendix.

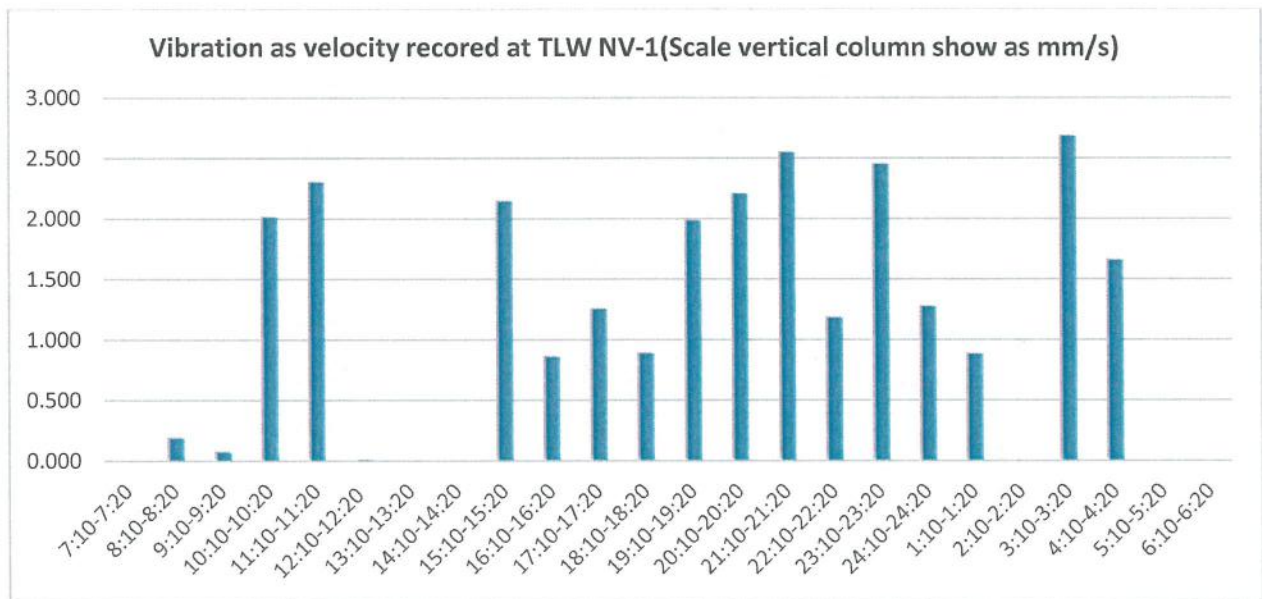


Figure 5. Vibration result of NV-1.

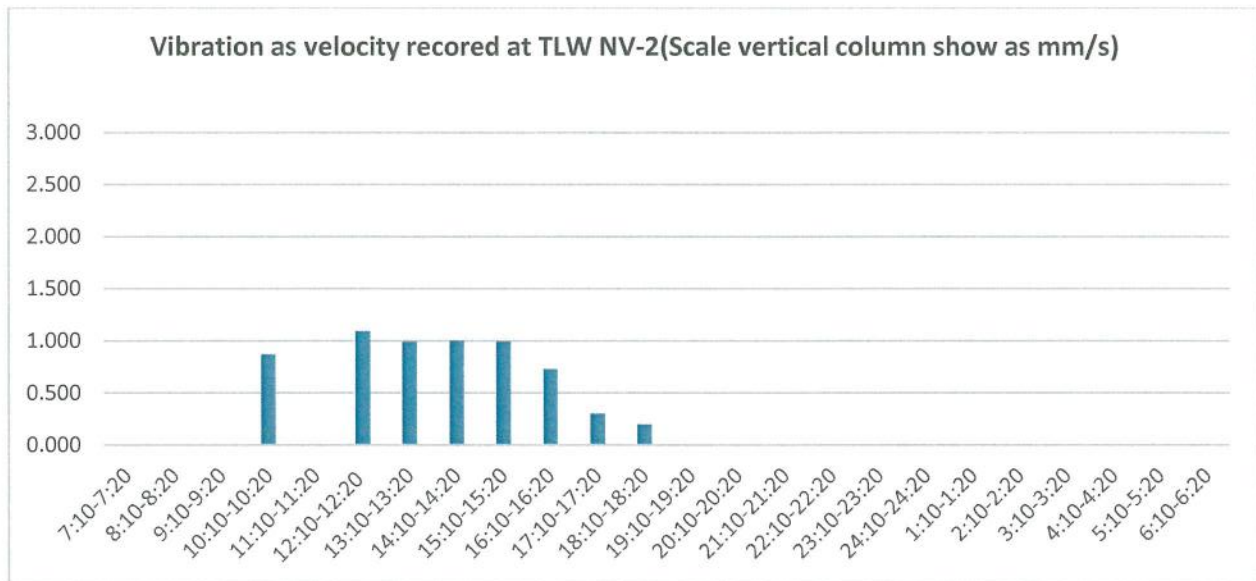


Figure 6. Vibration result of NV-2.

#### 4. CONCLUSION

The noise level monitoring results are compared with target noise level proposed in this report (See Table 3). Two noise receptors were designated in construction phase based on the baseline noise data.

The noise level monitoring at two sites are lower than the target noise level (See Table 8).

There is no standard relating to vibration during construction activities. Common practice in Myanmar has been to use guidance from internationally recognized standards. Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. In both instances, the magnitude of vibration is expressed in terms of Peak Particle Velocity (PPV) in millimeters per second (mm/s).

In the case of nominally continuous sources of vibration such as traffic, vibration is perceptible at around 0.5mm/s and may become disturbing or annoying at higher magnitudes. However, higher levels of vibration are typically tolerated for single events or events of short duration.

During the monitoring time, there were site cleaning activities near NV-1 like loading and unloading materials by small vehicles. The main noise and vibration source are largely road traffic noise and vibration. The observed noise and vibration in all monitoring points are lower than the target level.

## APPENDIX

Observed vibration level in 2 monitoring stations

Vibration as Velocity (mm/s)

Time	NV 1 (13-14 November)	NV 2 (12-13 November)
7:10-7:20	0.000	0.000
8:10-8:20	0.191	0.000
9:10-9:20	0.076	0.000
10:10-10:20	2.016	0.872
11:10-11:20	2.304	0.000
12:10-12:20	0.014	1.092
13:10-13:20	0.000	0.990
14:10-14:20	0.000	1.000
15:10-15:20	2.145	0.994
16:10-16:20	0.861	0.729
17:10-17:20	1.257	0.302
18:10-18:20	0.890	0.198
19:10-19:20	1.986	0.000
20:10-20:20	2.208	0.000
21:10-21:20	2.551	0.000
22:10-22:20	1.184	0.000
23:10-23:20	2.453	0.000
24:10-24:20	1.278	0.000
1:10-1:20	0.886	0.000
2:10-2:20	0.000	0.000
3:10-3:20	2.686	0.000
4:10-4:20	1.658	0.000
5:10-5:20	0.000	0.000
6:10-6:20	0.000	0.000