Date: 24 March 2015

Ref: MJTD/O/15-03-139

His Excellency Mr.Set Aung

Chairman, Thilawa SEZ Management Committee

Submission of Environmental Monitoring Report for Construction Phase (Report No.3)

Your Excellency,

Referring to the Environmental Impact Assessment (EIA) Report, Appendix 1, Environmental Monitoring Plan (Construction Phase) submitted on October 2013, we would like to submit Thilawa SEZ Zone A Development Project- Phase 1 Environmental Monitoring Report for Construction Phase (3rd time) enclosed herewith this cover letter and six copies of attached documents:

- Environmental Monitoring Report for Construction Phase
- Air, Water and Waste water Monitoring Reports (November 2014)
- Water and Waste water Monitoring Report (December 2014)
- Noise and Vibration Monitoring Report (November 2014)
- Sampling and Laboratory Analysis Inspection for Oil and Grease of Water Quality Analysis, February 2015
- Monthly Progress Reports (October, November, December 2014) Thilawa SEZ (Zones A) Development Project-Phase 1

Yours Truly,

Takashi Yanai

President and CEO

Myanmar Japan Thilawa Development Limited

MJTD

Thilawa Special Economic Zone (ZONE A) Development

Environmental Monitoring Report (Construction Phase)

Myanmar Japan Thilawa Development Limited.

December 2014

CONTENTS

Appendix

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 (Zone A). Development Project.

2. Summary of Monitoring Activities

a) **Progress made to date on the implementation of the EMP against the submitted implementation schedule;**
EMP for Pre-construction Phase was submitted on March 2014. EMP for Construction Phase First Report was submitted at June 2014 and Second Report at September 2014. The Third implementation report during Construction Period is submitted this day. Subsequent reports 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;**
In October 2014 monitoring report, the result of oil and grease monitoring has been exceeding than the standard. For ground water, MJTD inform to Monastery to maintain oil leakage from pump machinery of ground water tube well. For SW points, MJTD also take consider and notice cause of human contamination to the creek outside of the Thilawa SEZ (Zone A). For laboratory sampling, we will remind to environmental consultant to get accurate result by using method APHA 5520B.

c) **Number and type of non-compliance with the EMP and proposed remedial measures and timelines for completion of remediation;**
Only one item, type is Oil and grease. So, re-monitoring has been done at 21 November 2014 and 11 December 2014. The sample water has been sent to SGS Myanmar and SGS Thailand. After investigation and comparing re-monitoring results, the sample water during sampling oil and grease was not visibly present. So, it may be error in the surveying process and testing method. The completion of remediation for oil and grease at 23rd December 2014 and the result is not detected.

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, Phase 1 construction activities is submitted enclosed with monthly progress reports from contractor in Appendix A to C.

- Monthly Progress Report for October, 2014
- Monthly Progress Report for November, 2014
- Monthly Progress Report for December, 2014

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	No2, So2, Co, TSP, PM10	Construction site (1point)	Once/ 3month	November 2014, Monitoring Report
Water Quality	Water temperature, PH, SS, DO, BOD, COD, coliform count, oil and grease, chromium	Construction site (1point) Well in the Monastery (1 point)	Once/2 month	November 2014, December 2014 Monitoring Reports
Waste	Amount of solid waste Management of solid waste of construction	Construction site	Once/3month	Monthly progress reports (October, November, December) 2014
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 2014
		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 (October, November, December)2014
Hydrology				
Risk for infectious disease such as AIDS/HIV	Status of measures of infectious disease	Construction site	Once/month	Monthly progress reports (October, November, December)2014
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	

Thilawa Special Economic Zone (ZONE A)
Development Project –Phase 1

5. 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

- 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 – November 2014

NO_2, SO_2, 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 Near Gate 1	NO_2	ppm	0.04	0.04-0.05	N/A	N/A	0.06	Once in three months	HAZSCANNER, EPAS	
	SO_2	ppm	0.01	0.01-0.02	N/A	N/A	0.04		HAZSCANNER, EPAS	
	CO	ppm	0.33	0.24-0.38	N/A	N/A	10		HAZSCANNER, EPAS	
	TSP	ppm	0.09	0.07-0.12	N/A	N/A	0.33		HAZSCANNER, EPAS	
	PM10	ppm	0.04	0.03-0.06	N/A	N/A	0.12		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) (a) Water Quality – October (17-October 2014)

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	Item	Unit	Measured Value	Country's Standard	Target value to be applied	*Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
SW-2	pH	mg/l	7.40	N/A	6.0-9.0	=<4	Once in two month	pH meter,HI7609829-1 pH Sensor	
	SS	mg/l	121.3*		Max.50			Gravimetric method	
	DO	mg/l	7.6		-			HI7609829-2,DO Sensor	
	COD	mg/l	23.6		Max. 40			Dichromate method	
	BOD	mg/l	4		Max. 20-60			Direct inoculation method	
	Oil and Grease	mg/l	9.3*1		Max. 5			APHA-AWWA-WEF Method	
	Cr	mg/l	0.012000		Max. 0.5			APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	13		-	7.5×10³		AOAC Petrifilm Method	
SW-3	pH	mg/l	8	N/A	6.0-9.0	=<4	Once in two month	pH meter,HI7609829-1 pH Sensor	
	SS	mg/l	150.7*		Max.50			Gravimetric method	
	DO	mg/l	7.39		-			HI7609829-2,DO Sensor	
	COD	mg/l	20.2		Max. 40			Dichromate method	
	BOD	mg/l	8		Max. 20-60			Direct inoculation method	
	Oil and Grease	mg/l	6.2*1		Max. 5			APHA-AWWA-WEF Method	
	Cr	mg/l	0.029		Max. 0.5			APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	46		-	7.5×10³		AOAC Petrifilm Method	

Location	Item	Unit	Measured Value	Country's Standard	Target value to be applied	*Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
SW-4	pH	mg/l	7.46	N/A	6.0-9.0	=<4	Once in two month	pH meter,HI7609829-1 pH Sensor	
	SS	mg/l	150.7*		Max.50			Gravimetric method	
	DO	mg/l	6.30		-			HI7609829-2,DO Sensor	
	COD	mg/l	20.3		Max. 40			Dichromate method	
	BOD	mg/l	7		Max. 20-60			Direct inoculation method	
	Oil and Grease	mg/l	4.4		Max. 5			APHA-AWWA-WEF Method	
	Cr	mg/l	0.012		Max. 0.5			APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	33		-	7.5×10³		AOAC Petrifilm Method	
SW-7	pH	mg/l	7.74	N/A	6.0-9.0	=<4	Once in two month	pH meter,HI7609829-1 pH Sensor	
	SS	mg/l	48.7*		Max.50			Gravimetric method	
	DO	mg/l	8.0		-			HI7609829-2,DO Sensor	
	COD	mg/l	5.7		Max. 40			Dichromate method	
	BOD	mg/l	1.8		Max. 20-60			Direct inoculation method	
	Oil and Grease	mg/l	7.2*1		Max. 5			APHA-AWWA-WEF Method	
	Cr	mg/l	0.01		Max. 0.5			APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	270		-	7.5×10³		AOAC Petrifilm Method	
SW-8	pH	mg/l	7.59	N/A	6.0-9.0	=<4	Once in two month	pH meter,HI7609829-1 pH Sensor	
	SS	mg/l	139*		Max.50			Gravimetric method	
	DO	mg/l	9.5		-			HI7609829-2,DO Sensor	
	COD	mg/l	6.0		Max. 40			Dichromate method	

Location	Item	Unit	Measured Value	Country's Standard	Target value to be applied	*Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
	BOD	mg/l	2		Max: 30-40			Direct inoculation method	
	Oil and Grease	mg/l	7.3**		Max. 5			APHA-AWWA-WEF Method	
	Cr	mg/l	0.10		Max 0.5			APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	490		-	7.5×10³		AOAC Petrifilm Method	
GW-1	pH	mg/l	7.79	N/A	N/A	5.5~9.0	Once in two month	pH meter HI7609829-1 pH Sensor	
	SS	mg/l	22.7			30		Gravimetric method	
	DO	mg/l	8.4			>=4		HI7609829-2/D Clearness	
	COD	mg/l	8.5			30		Dichromate method	
	BOD	mg/l	3.4			15		Direct inoculation method	
	Oil and Grease	mg/l	6.3**			0.1		APHA-AWWA-WEF Method	
	Cr	mg/l	0.032			0.04		APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	52			7.5×10³		AOAC Petrifilm Method	

*Remark: Referred to the Vietnam Standard (EIA Report). Reference to the Monitoring Report, October 2014.

*Remark: Total suspended solid has been exceeding the reference standard since before construction phase as reported in the result of EIA Monitoring report (Sep 2013).

** Reason of exceed: All points of oil and grease parameter except (SW 4) has been exceeding the reference standard. So re-monitored and investigated the situation for oil and grease parameter at all points. The possible reason for oil and grease content for GW 1 may be human contamination or oil leakage from pump machinery of tube well and for other areas may be human or upstream contamination. And according to MKI analysis result, need to check both SGS Myanmar and SGS Thailand about details of analytical methods they are applying. Please kindly refer Sampling and Laboratory Analysis Inspection for Oil and Grease of Water Quality Analysis, February 2015.

a(i) Water Quality Recheck for Oil and Grease Parameter (21 November 2014)

Location	Item	Unit	Measured Value	Country's Standard	Target value to be applied	Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
GW-1	Oil and Grease	mg/l	3.6**	N/A	Max 5				

**Reason of exceed: Water quality of GW 1 may be human contamination or oil leakage from water pump machinery of tube well.

a(ii) Water Quality Recheck for Oil and Grease Parameter (11 December 2014)

Location	Item	Unit	Measured Value	Country's Standard	Target value to be applied	Referred International Standard*	Frequency	Method	Note (Reason of excess of the standard)
SW-2	Oil and Grease	mg/l	1.2	N/A	Max 5			APHA 5520 B	
SW-3	Oil and Grease	mg/l	3.6	N/A	Max 5			APHA 5520 B	
SW-4	Oil and Grease	mg/l	1.2	N/A	Max 5			APHA 5520 B	
GW-1	Oil and Grease	mg/l	ND	N/A	Max 5			APHA 5520 B	

(b) Water Quality – December 2014

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 Refereed International Standard.

Location	Items	Unit	Measured Value	Country's Standard	Target value to be applied	*Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
SW-3	pH	mg/l	7.35	N/A	5.5-9.0		Once in two month	pH meter,HI76409829-1 pH Sensor	SGS Myanmar Lab
	SS	mg/l	3223*		Max.50			Gravimetric method	
	DO	mg/l	7.6		-	>=4		HI76409829-2,ID Opticsen	
	COD	mg/l	40.9		Max. 60			Dichromate method	
	BOD	mg/l	15.0		Max. 20-60			Direct incubation method	
	Oil and Grease	mg/l	3.9		Max. 5			APHA-AWWA-WEF Method	
	Cr	mg/l	0.000		Max. 0.5			APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	23		-	7.5×10³		AOAC Petrifilm Method	
SW-5	pH	mg/l	7.91	N/A	5.5-9.0		Once in two month	pH meter,HI76409829-1 pH Sensor	SGS Myanmar Lab
	SS	mg/l	3558*		Max.50			Gravimetric method	
	DO	mg/l	7.12		-	>=4		HI76409829-2,ID Opticsen	
	COD	mg/l	82.5		Max. 60			Dichromate method	
	BOD	mg/l	21.0		Max. 20-60			Direct incubation method	
	Oil and Grease	mg/l	ND		Max. 5			APHA-AWWA-WEF Method	
	Cr	mg/l	0.000		Max. 0.5			APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	350		-	7.5×10³		AOAC Petrifilm Method	

Location	Items	Unit	Measured Value	Country's Standard	Target value to be applied	*Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
SW-4	pH	mg/l	7.9	N/A	5.5-9.0		Once in two month	pH meter,HI76409829-1 pH Sensor	SGS Myanmar Lab
	SS	mg/l	7017*		Max.50			Gravimetric method	
	DO	mg/l	6.32		-	>=4		HI76409829-2,ID Opticsen	
	COD	mg/l	62.0		Max. 60			Dichromate method	
	BOD	mg/l	25.0		Max. 20-60			Direct incubation method	
	Oil and Grease	mg/l	ND		Max. 5			APHA-AWWA-WEF Method	
	Cr	mg/l	0.000		Max. 0.5			APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	140		-	7.5×10³		AOAC Petrifilm Method	
GW-1	pH	mg/l	7.81	N/A	N/A	5.5-9.0	Once in two month	pH meter,HI76409829-1 pH Sensor	SGS Myanmar Lab
	SS	mg/l	9107*			50		Gravimetric method	
	DO	mg/l	6.32			>=4		HI76409829-2,ID Opticsen	
	COD	mg/l	12.5			30		Dichromate method	
	BOD	mg/l	4.7			15		Direct incubation method	
	Oil and Grease	mg/l	ND			0.1		APHA-AWWA-WEF Method	
	Cr	mg/l	0.000			0.04		APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	2.2			7.5×10³		AOAC Petrifilm Method	

*Remark: Refereed to the Vietnam Standard (EIA Report), Reference to the Monitoring Report, December 2014.

*Remark: Total suspended solid has been exceeding the reference standard since before construction phase as reported in the result of EIA Monitoring report (Sep 2013).

(b)(i) SGS Thailand Laboratory results for oil and grease parameter at all points are as following:

Location	Item	Unit	Measured Value	Country's Standard	Target value to be applied	Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
SW-2	Oil and grease (SGS Thailand)	mg/l	<1	N/A	Max 5			APHA 5520 B	
SW-3	Oil and grease (SGS Thailand)	mg/l	<1	N/A	Max 5			APHA 5520 B	
SW-4	Oil and grease (SGS Thailand)	mg/l	<1	N/A	Max 5			APHA 5520 B	
GW-1	Oil and grease (SGS Thailand)	mg/l	3	N/A	Max 5			APHA 5520 B	

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

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4) Noise –November 2014

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)
TNV-1	Leq (day)	dB(A)	56	54-61	N/A	N/A	70	Once (peak period)	Sound Level Meter	
	Leq(eve)	dB(A)	55	52-58			70			

*Remark: Referred to the Japan Standard (EIA Report), Reference to the Noise and Vibration Report November 2014.

Noise Level (Living Environment-Near Monastery)

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)
TNV-2	Leq (day)	dB(A)	56	49-66	N/A	75	Singapore	Once in 3 months	Sound Level Meter	
	Leq(eve)	dB(A)	59	56-62		60				
	Leq(night)	dB(A)	51	50-58		55				
TNV-3	Leq(day)	dB(A)	54	49-65	N/A	75	Singapore	Once in 3 months	Sound level Meter	
	Leq(eve)	dB(A)	54	51-57		60				
	Leq(night)	dB(A)	47	46-56		55				

*Remark: Referred to the Singapore Target Noise Standard (EIA Report), Reference to the Noise and Vibration Report November 2014.

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	17-Sep-14	Waste Disposal	01	YCDC
2	26-Sep-14	Waste Disposal	01	YCDC
3	29-Sep-14	Waste Disposal	01	YCDC
4	23-Oct-14	Waste Disposal	01	YCDC
5	7-Nov-14	Waste Disposal	01	YCDC
6	21-Nov-14	Waste Disposal	01	YCDC
7	1-Dec-14	Waste Disposal	02	YCDC
8	8-Dec-14	Waste Disposal (Sewage)	01	YCDC

Remark: Referred to Monthly Progress Report (September, October, November and December) 2014

6) (a) Ground Subsidence and Hydrology-September 2014

Duration (Week)	Water Consumption		Ground Level		Frequency	Note
	Quantity	Unit	Quantity	Unit		
4-Sep-2014	188	m3/week	+7.000	m	Once a week	
11-Sep-2014	198	m3/week	+7.000	m		
18-Sep-2014	223	m3/week	+7.000	m		
25-Sep-2014	193	m3/week	+7.000	m		

*Reference to the Monthly Progress Report September 2014.

(b) Ground Subsidence and Hydrology-October 2014

Duration (Week)	Water Consumption		Ground Level		Frequency	Note
	Quantity	Unit	Quantity	Unit		
2-Oct-2014	188	m3/week	+7.012	m	Once a week	
9-Oct-2014	143	m3/week	+7.014	m		
16-Oct-2014	152	m3/week	+7.013	m		
23-Oct-2014	176	m3/week	+7.012	m		
30-Oct-2014	170	m3/week	+7.014	m		

*Reference to the Monthly Progress Report October 2014.

(c) Ground Subsidence and Hydrology-November 2014

Duration (Week)	Water Consumption		Ground Level		Frequency	Note
	Quantity	Unit	Quantity	Unit		
6-Nov-2014	65	m3/week	+7.014	m	Once a week	
13-Nov-2014	162	m3/week	+7.015	m		
20-Nov-2014	160	m3/week	+7.015	m		
27-Nov-2014	150	m3/week	+7.015	m		

*Reference to the Monthly Progress Report November 2014.

(d) Ground Subsidence and Hydrology-December 2014

Duration (Week)	Water Consumption		Ground Level		Frequency	Note
	Quantity	Unit	Quantity	Unit		
4-Dec-2014	123	m3/week	+7.017	m	Once a week	
11-Dec-2014	149	m3/week	+7.019	m		
18-Dec-2014	132	m3/week	+7.013	m		
25-Dec-2014	120	m3/week	+7.015	m		

*Reference to the Monthly Progress Report December 2014.

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 1

Appendix

Air, Water and Waste Water Monitoring Report

November, 2014

MJTD MYANMAR JAPAN THILAWA DEVELOPMENT LIMITED

MONITORING REPORT

FOR

WATER QUALITY (OCTOBER 2014)

AND

AIR QUALITY (NOVEMBER 2014)

THILAWA SPECIAL ECONOMIC ZONE (ZONE A)

Resource & Environment Myanmar Ltd.
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Contents

RESULT OF AIR AND WATER QUALITY MONITORING

1. Introduction

This is the fourth report for Air and water quality monitoring at Thilawa Special Economic Zone (TSEZ). This report sets out the environmental monitoring required throughout the construction of the Thilawa Special Economic Zone. The terms of reference for monitoring are shown in Table 1. The location of air and water monitoring points are shown in Figure 1 and Table 1.

Terms of Reference for Monitoring

Table 1 Terms of reference for air and water quality monitoring at TSEZ.

Description	Items	Frequency	Location
Air Quality	TSP / PM10	1 time / 3months	At construction site (1point)
Waste water quality	pH, SS, DO, BOD, COD, Coliform count, oil and grease, chromium	1time / 2months	At the creek upstream and downstream which is crossed the car road (6points)
Underground water	pH, SS, DO, BOD, COD, Coliform count, oil and grease, chromium	1time /2months	Tube well inside of Moegyoewan Monastery (1 point)

Monitoring Instrument for Air and water

No.	Instrument	Brand & Model	Measurement/ Parameter	
1.	Environmental Perimeter Air Monitoring System	HAZ-SCANNER EPAS	CO, NO_2, NO, SO_2, PM (2.5), PM (10), VOCS, Relative Humidity, Temperature, Wind Speed, Wind Direction	
3	Alpha Bottle (Water Sampler)	Wildlife Supply Company* Indonesia		

So far, there is no environmental standard for ambient air quality in Republic of Myanmar, the survey result was evaluated by comparing with the standards in neighboring country like Thailand, Vietnam, Japan and IFC (Table 2). The consultant will apply the air quality standard in Thailand, Vietnam, Japan and IFC as shown in Table 1.As for TSP and PM10, the standards in Thailand were applied and the others were compared with the standards in Japan.

Table 2 Ambient Air Quality Standard in Southeast Asia

Item	Averaging period	Japan	Thailand	Vietnam	IFC
SO_2	10 min	-	-	-	0.5mg/m^3
	1hour	0.1ppm	0.3ppm	0.35mg/m^3	0.125mg/m^3(InterimTarget-1) 0.05mg/m^3(InterimTarget-2) 0.02mg/m^3(Guideline)
	24hours	0.04ppm	0.12ppm	0.125 mg/m^3	-
	1 year	-		0.05mg/m^3	-
NO_2	1hour	-	0.17ppm	-	0.2mg/m^3
	24hours	0.04-0.06ppm	-	-	-
	1 year	-	0.03ppm	-	0.04mg/m^3
NOx	1hour	-	-	0.2mg/m^3	
	24hours	-	-	0.04mg/m^3	
CO	1hour	--	30ppm	30mg/m^3	-
	8hours	20ppm	-	10mg/m^3	-
	24hours	10ppm	9ppm	-	-
TSP	1hour	-	-	0.3mg/m^3	-
	24hours	-	0.33mg/m^3	0.2mg/m^3	-
	1 year		0.10mg/m^3	0.14mg/m^3	-
PM_{10}	24hours	-	0.12mg/m^3	0.15mg/m^3	0.15mg/m^3(InterimTarget-1) 0.10mg/m^3(InterimTarget-2) 0.07mg/m^3(InterimTarget-3)
	1 year	-	0.05mg/m^3	0.05mg/m^3	0.07mg/m^3(InterimTarget-1) 0.05mg/m^3(InterimTarget-2) 0.03mg/m^3(InterimTarget-3)
SPM	1hour	0.2mg/m^3	-	-	-
	24hours	0.1mg/m^3	-	-	-
$PM_{2.5}$	24hours	0.035mg/m^3	0.05mg/m^3	-	0.075mg/m^3(InterimTarget-1) 0.05mg/m^3(InterimTarget-2) 0.0375mg/m^3(InterimTarget-3)
	1 year	0.015mg/m^3	0.025mg/m^3	-	0.035mg/m^3(InterimTarget-1) 0.025mg/m^3(InterimTarget-2) 0.015mg/m^3(InterimTarget-3)
Ozone	1hour	-	0.10ppm	0.3mg/m^3	-
	8hourdaily maximum	-	0.07ppm	0.2mg/m^3	0.16mg/m^3(InterimTarget-1) 0.1mg/m^3(Guideline)
	1 year	-	0.04ppm	0.14mg/m^3	-
Ox	1hour	0.06ppm	-	-	-
Pb	24hours	-	-	0.0015mg/m^3	
	1 month	-	0.0015mg/m^3	-	
	1 year	-	-	0.0005mg/m^3	

Source: National Air Quality Standard in Japan (CircularNo.25,1973, originally),Ministry of Environment, Japan
NotificationsofNationalEnvironmentalBoardNo.10, 24,28,33, and 36, Ministry of Natural Resources and Environment, Thailand
National Ambient Air Quality Standard (TCVN5973:2005), Ministry of Science and Technology in Vietnam
Environmental, Health, and Safety Guidelines, General EHS Guidelines, IFC, 2007

Figure 1 **Location of air and water monitoring points**

2. Description of the air quality monitoring station

Survey Period

Air quality survey was conducted once per 3 months as per specification provided by the client. The monitoring period was about 7 consecutive days. The sampling duration for each day is as shown in Table 3. Air quality monitoring location is shown in Figure 2.

Table 3 Sampling Duration for Air Quality Survey

Day	Fourth Survey (November 15^{th} _ 22^{nd})
Day 1	Nov. 15^{th} _ 16^{th}
Day 2	Nov. 16^{th} _ 17^{th}
Day 3	Nov. 17^{th} _ 18^{th}
Day 4	Nov. 18^{th} _ 19^{th}
Day 5	Nov. 19^{th} _ 20^{th}
Day 6	Nov. 20^{th} _ 21^{st}
Day 7	Nov. 21^{st} _ 22^{nd}

Source: 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

The basic specifications of the instrument are as follow.

Instrument	Brand	Model	Measurement/ Parameter
Environmental Perimeter Air Monitoring System	HAZ-SCANNER	EPAS	CO, NO_2, NO, SO_2, PM (2.5), PM (10), VOCS, Relative Humidity, Temperature, Wind Speed, Wind Direction

Figure 2 Location and site condition of air quality monitoring station.

Table 4. Sampling and Analysis Method for Air Quality

No.	Parameter	Analysis Method
1	Sulfur dioxide (SO_2)	On site reading
2	Carbon monoxide (CO)	On site reading
3	Nitrogen dioxides (NO_2)	On site reading
4	Total suspended particle (TSP)	On site reading
5	Particle matter 10 (PM10)	On site reading

Source: Resource & Environment Myanmar Co., Ltd.

Target Ambient Air Quality Level

Parameters	Averaging Period	Value
SO_2	24 hours	0.12 ppm[1]
CO	24 hours	9 ppm[1]
NO_2	24 hours	0.04 – 0.06 ppm[2]
TSP	24 hours	0.33 mg/m3[1]
PM10	24 hours	0.12g/m3[1]

1 Thailand Standard
2 Japan Standard

Survey Result

One day average concentration of CO, NO_2, TSP, PM 10 and SO_2 are shown in Table 5. Hourly average data are presented in Appendix -1.

Table 5. one day average concentration of CO, NO_2, TSP, PM10 and SO2

	Date	Time	CO	NO2	TSP	PM10	SO2
	D.M.Y	hours	ppm	ppm	mg/m3	mg/m3	ppm
1	15th-16th Nov, 2014	24	0.24	0.05	0.07	0.03	0.01
2	16th-17th Nov, 2014	24	0.30	0.04	0.09	0.04	0.02
3	17th-18th Nov, 2014	24	0.39	0.04	0.12	0.06	0.02
4	18th-19th Nov, 2014	24	0.39	0.04	0.09	0.04	0.01
5	19th-20th Nov, 2014	24	0.36	0.04	0.08	0.03	0.01
6	20th-21st Nov, 2014	24	0.35	0.04	0.10	0.05	0.01
7	21st-22nd Nov, 2014	24	0.30	0.04	0.09	0.04	0.02
Maximum		24	0.39	0.05	0.12	0.06	0.02
Average		24	0.33	0.04	0.09	0.04	0.01
Minimum		24	0.24	0.04	0.07	0.03	0.01
Target Value		24	10	<0.06	<0.33	<0.12	<0.04
			Japan	Japan	Thailand	Thailand	Japan

Source: Resource & Environment Myanmar Co., Ltd

Concentration levels of all parameters are within the standard in this month.

3. Water Quality Monitoring

Methodology

Sampling and preservation 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 pH, temperature, dissolved oxygen (DO), electrical conductivity (EC), 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 7 Field Equipment for Water Quality Survey

No.	Equipment	Manufacturer	Originate Country	Model
1	pH meter	HANNA	USA	HI7609829-1 pH Sensor
2	DO meter	HANNA	USA	HI7609829-2
3	Digital Water Velocity Meter	Global Water Flow Probe	USA	FP 211
4	Alpha Bottle (Water Sampler)	Wildlife Supply Company®	Indonesia	-

Table 8 Container and Preservation Method for Water Samples

No	Parameter	Container	Preservation
1	Oil and Grease	1000 ml glass bottle	Sulfuric acid, Refrigerate
2	COD	500 ml plastic bottle	Sulfuric acid, Refrigerate
3	BOD_5	1,800 ml plastic bottle	Refrigerate
4	Heavy metals	500 ml plastic bottle	HNO_3 Refrigerate
5	Bacteria	200 ml glass bottle (Sterilize)	Refrigerate
6	Others	1,800 ml polyethylene bottle	Refrigerate

Test method

The following table provides the test method for water quality.

No	Item	Analysis method
1	pH	HI7609829-1 pH Sensor
2	Suspended Solids	Gravimetric method
3	Dissolved Oxygen (DO)	HI7609829-2 Galvanic dissolved oxygen (D.O) sensor
4	Chemical oxygen demand(COD)	Dichromate method
5	Biochemical oxygen demand(BOD_5)	Direct inoculation method
6	Oil & Grease	APHA-AWWA-WEF Method
7	Chromium (Cr) (mg/l)	APHA-AWWA-WEF Method
8	E. coliform, Fecal coliforms, total coliforms	AOAC Petrifilm Method

Monitoring Result (17 October 2014)

No	Item	GW-1	SW-2	SW- 3	SW- 4	SW-7	SW-8	Standard	Unit
1	pH	7.79	7.40	8.0	7.46	7.74	7.59	5-9	
2	Suspended Solids	22.7	321.3	350.7	330.7	48.7	135	Max. 200	mg/l
3	Dissolved Oxygen (DO)	8.40	7.60	7.59	6.20	9.0	9.3	-	mg/l
4	Chemical oxygen demand(COD)	8.5	13.6	20.2	20.3	5.7	6.0	Max. 300	mg/l
5	Biochemical oxygen demand(BOD_5)	3.4	4	8	7	1.9	2	Max. 200	mg/l
6	Oil & Grease	6.3	9.3	6.2	4.4	5.2	7.3	Max. 5	mg/l
7	Chromium (Cr) (mg/l)	0.012000	0.006000	0.025000	0.012000	0.01000	0.01000	Max. 0.5	mg/l
8	E. coliform	<1.8	23	5.1	23	1.1	5.1	-	MPN/100ml
	Fecal coliforms	<1.8	170	31	33	49	170	-	MPN/100ml
	Total coliforms	12	330	46	33	230	490	Max.400	MPN/100ml

Monitoring Result rechecked for oil & grease parameter on 21 November 2014

No	Item	GW-1*	Standard	Unit
1	pH	8.05	5-9	mg/l
2	Dissolved Oxygen (DO)	7.5	-	mg/l
3	Oil & Grease	8.0	Max. 5	mg/l

Monitoring result rechecked for oil & grease on 11 December 2014

No	Item	GW-1*	SW-2*	SW- 3*	SW- 4*	Standard	Unit
1	Oil & Grease	ND	1.2	3.6	1.2	Max. 5	mg/l

Shaded area shows higher than Standard.

* is specially rechecked for oil and grease.

Comparison of Oil and Grease result for GW-1

No	Date/Time	GW-1	Standard	Unit
1	17/10/2014	6.3	Max. 5	mg/l
2	21/11/2014	5.6	Max. 5	mg/l
3	11/12/2014	Not Detected	Max. 5	mg/l

Result of the Water Quality Monitoring (October 2014)

Total of seven water samples from surface and underground water were collected. But 6 samples were analyzed except of SW-6, previous old point was not monitored in this time as there was not enough running water as usual and became like a small pond.

The result of October water quality monitoring, including rechecked location, was shown in above table. The suspended solids of SW-2, SW-3 and SW-4 are high compared to the MOI standard while other locations are lower than the MOI standard and the rest parameters are lower than the standard. Because during the sampling, oil and grease was not visibly present, MJTD decided to recheck the oil and grease content. Firstly MJTD conducted recheck of the GW-1 on 21 November 2014 and secondly all the points which we were able to collect from.

Oil and grease contents are detected in all location including the GW-1 that was collected on 21 November 2014 but GW-1, SW-2, SW-3 and SW-4 collected on 11 December 2014 are lower than the standard. The possible reason for oil and grease content for GW-1 may be high due to human or oil leakage from pump machinery of tube well. The oil and grease content for the other areas may be high due to human or upstream contamination. Also, the testing method for October 2014 may be questionable since all of the rechecked areas for SW on 11 December 2014 are lower than the standard. The sample may be also affected by unexpected contamination from other human activities depend on the analysis method.

Detailed of laboratory result and hourly air quality data are provided in appendix.

Appendix 1

Hourly Air Quality Result

Resource & environment Myanmar Co., Ltd.

Client: Myanmar Japan Thilawa Development Ltd.

Issued Date : 15-11-2014

Analysis Report

Project Name : Thilawa Special Economic Zone (TSEZ)
Sample Designated as : Ambient Air Quality Analysis
Sampling Location : AQM 1 (November _TSEZ)

Date	Time	CO	NO2	TSP	PM (10)	SO2
D.M.Y	H.M.S	ppb	ppb	ug/m3	ug/m3	ppb
15.11.2014	10:00 - 11:00	0.00	244.30	236.67	109.94	1.00
15.11.2014	11:00 -12:00	3.72	51.57	61.95	26.45	7.57
15.11.2014	12:00 -13:00	10.70	63.53	46.52	22.08	7.05
15.11.2014	13:00 -14:00	88.72	18.75	35.63	13.57	1.00
15.11.2014	14:00 -15:00	173.53	23.75	45.32	18.97	3.83
15.11.2014	15:00 -16:00	208.65	17.05	58.57	23.65	1.12
15.11.2014	16:00 -17:00	272.98	27.78	56.83	24.78	7.90
15.11.2014	17:00 -18:00	369.23	49.46	53.05	24.09	7.77
15.11.2014	18:00 -19:00	363.67	46.72	39.07	23.20	5.35
15.11.2014	19:00 -20:00	366.33	49.03	36.25	21.08	2.72
15.11.2014	20:00 -21:00	300.23	47.97	31.67	16.30	3.73
15.11.2014	21:00 -22:00	288.33	46.95	42.05	18.57	2.98
15.11.2014	22:00 -23:00	284.47	45.28	66.75	37.67	3.77
15.11.2014	23:00 -00:00	260.63	44.38	48.95	28.45	1.53
16.11.2014	00:00 -01:00	268.12	48.63	48.20	28.25	1.83
16.11.2014	01:00 -02:00	200.10	42.28	80.28	32.93	7.03
16.11.2014	02:00 -03:00	241.90	45.77	59.43	32.03	33.50
16.11.2014	03:00 -04:00	199.28	42.13	73.92	37.58	4.80
16.11.2014	04:00 -05:00	274.05	46.80	67.00	34.00	1.48
16.11.2014	05:00 -06:00	370.55	45.75	139.50	73.17	5.50
16.11.2014	06:00 -07:00	500.30	34.65	187.68	86.05	16.35
16.11.2014	07:00 -08:00	319.18	12.13	104.02	31.23	41.08
16.11.2014	08:00 - 09:00	253.52	6.77	69.95	21.78	32.03
16.11.2014	09:00 - 10:00	171.63	7.60	37.57	10.07	28.32
MAX	24hours	500.30	244.30	236.67	109.94	41.08
MIN	24hours	0.00	6.77	31.67	10.07	1.00
Average	24hours	241.24	46.21	71.95	33.16	9.55

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.5003	0.2443	0.2367	0.1099	0.0411
MIN	24hours	0.0000	0.0068	0.0317	0.0101	0.0010
Average	24hours	0.2412	0.0462	0.0720	0.0332	0.0096

Resource & environment Myanmar Co., Ltd.

Client: Myanmar Japan Thilawa Development Ltd.

Issued Date : 15-11-2014

Analysis Report

Project Name : Thilawa Special Economic Zone (TSEZ)
Sample Designated as : Ambient Air Quality Analysis
Sampling Location : AQM 1 (November_TSEZ)

Date	Time	CO	NO2	TSP	PM (10)	SO2
D.M.Y	H.M.S	ppb	ppb	ug/m3	ug/m3	ppb
16.11.2014	10:00 - 11:00	100.70	9.22	16.60	3.65	60.75
16.11.2014	11:00 -12:00	89.92	30.42	24.25	8.87	41.93
16.11.2014	12:00 -13:00	201.48	20.77	50.75	20.47	25.73
16.11.2014	13:00 -14:00	262.28	6.88	44.55	18.62	5.20
16.11.2014	14:00 -15:00	238.80	9.72	36.53	13.87	12.57
16.11.2014	15:00 -16:00	279.02	22.40	40.62	16.37	10.23
16.11.2014	16:00 -17:00	282.58	31.77	75.63	34.90	22.27
16.11.2014	17:00 -18:00	419.20	37.97	62.12	27.72	1.48
16.11.2014	18:00 -19:00	404.17	42.00	34.23	15.97	1.00
16.11.2014	19:00 -20:00	441.08	40.88	44.27	23.15	1.00
16.11.2014	20:00 -21:00	482.15	58.27	76.21	42.70	16.64
16.11.2014	21:00 -22:00	656.08	85.92	457.38	75.69	19.38
16.11.2014	22:00 -23:00	360.08	60.07	138.55	56.67	5.78
16.11.2014	23:00 -00:00	316.77	43.42	73.83	43.17	14.92
17.11.2014	00:00 -01:00	233.18	43.90	61.43	30.23	3.03
17.11.2014	01:00 -02:00	243.68	50.30	54.90	27.80	6.63
17.11.2014	02:00 -03:00	214.87	52.78	65.00	29.23	4.78
17.11.2014	03:00 -04:00	222.95	43.33	66.72	30.32	2.13
17.11.2014	04:00 -05:00	335.53	38.43	105.95	60.87	15.43
17.11.2014	05:00 -06:00	380.42	40.79	116.53	68.05	9.11
17.11.2014	06:00 -07:00	354.23	47.21	156.20	82.52	7.32
17.11.2014	07:00 -08:00	343.10	58.15	259.90	119.35	8.65
17.11.2014	08:00 - 09:00	228.80	22.82	141.32	56.42	24.65
17.11.2014	09:00 - 10:00	142.65	8.20	61.88	23.03	44.40
MAX	24hours	656.08	85.92	457.38	119.35	60.75
MIN	24hours	89.92	6.88	16.60	3.65	1.00
Average	24hours	301.41	37.73	94.39	38.73	15.21

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.6561	0.0859	0.4574	0.1194	0.0608
MIN	24hours	0.0899	0.0069	0.0166	0.0037	0.0010
Average	24hours	0.3014	0.0377	0.0944	0.0387	0.0152

Resource & environment Myanmar Co., Ltd.

Client: Myanmar Japan Thilawa Development Ltd.

Issued Date : 15-11-2014

Analysis Report

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Sample Designated as : Ambient Air Quality Analysis
Sampling Location : AQM 1 (November _TSEZ)

Date	Time	CO	NO2	TSP	PM (10)	SO2
D.M.Y	H.M.S	ppb	ppb	ug/m3	ug/m3	ppb
17.11.2014	10:00 - 11:00	68.38	11.65	50.78	14.00	44.07
17.11.2014	11:00 -12:00	123.62	27.20	46.17	18.63	28.33
17.11.2014	12:00 -13:00	176.95	25.10	50.28	20.30	5.78
17.11.2014	13:00 -14:00	150.73	9.09	47.00	17.64	34.73
17.11.2014	14:00 -15:00	180.85	34.30	65.83	29.22	36.60
17.11.2014	15:00 -16:00	270.32	39.95	110.28	48.00	5.02
17.11.2014	16:00 -17:00	330.15	31.78	103.90	41.83	2.98
17.11.2014	17:00 -18:00	696.43	43.68	146.98	77.60	9.98
17.11.2014	18:00 -19:00	687.32	40.98	143.60	77.18	1.07
17.11.2014	19:00 -20:00	775.62	45.33	100.65	55.82	28.78
17.11.2014	20:00 -21:00	554.32	55.67	100.38	59.78	7.97
17.11.2014	21:00 -22:00	610.78	58.70	133.40	70.52	6.17
17.11.2014	22:00 -23:00	436.05	51.95	156.68	91.38	26.20
17.11.2014	23:00 -00:00	554.53	49.00	158.95	86.47	39.77
18.11.2014	00:00 -01:00	572.95	43.70	180.33	94.02	40.15
18.11.2014	01:00 -02:00	660.12	49.90	138.88	65.62	6.57
18.11.2014	02:00 -03:00	459.57	43.52	170.08	79.60	6.03
18.11.2014	03:00 -04:00	275.65	33.18	157.23	68.25	9.63
18.11.2014	04:00 -05:00	332.60	38.45	161.77	76.78	12.23
18.11.2014	05:00 -06:00	345.95	35.82	166.07	77.28	1.68
18.11.2014	06:00 -07:00	490.92	38.90	172.68	70.90	44.52
18.11.2014	07:00 -08:00	259.63	8.30	110.65	32.78	8.52
18.11.2014	08:00 - 09:00	212.53	2.47	76.85	25.88	54.40
18.11.2014	09:00 - 10:00	85.37	23.03	56.52	20.58	66.78
MAX	24hours	775.62	58.70	180.33	94.02	66.78
MIN	24hours	68.38	2.47	46.17	14.00	1.07
Average	24hours	387.97	35.07	116.92	55.00	22.00

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.7756	0.0587	0.1803	0.0940	0.0668
MIN	24hours	0.0684	0.0025	0.0462	0.0140	0.0011
Average	24hours	0.3880	0.0351	0.1169	0.0550	0.0220

Resource & environment Myanmar Co., Ltd.

Client: Myanmar Japan Thilawa Development Ltd.

Issued Date : 15-11-2014

Analysis Report

Project Name : Thilawa Special Economic Zone (TSEZ)
Sample Designated as : Ambient Air Quality Analysis
Sampling Location : AQM 1 (November _TSEZ)

Date	Time	CO	NO2	TSP	PM (10)	SO2
D.M.Y	H.M.S	ppb	ppb	ug/m3	ug/m3	ppb
18.11.2014	10:00 - 11:00	144.75	10.32	37.23	15.58	58.07
18.11.2014	11:00 -12:00	208.33	25.88	41.68	11.80	18.68
18.11.2014	12:00 -13:00	213.58	9.57	33.83	15.83	29.32
18.11.2014	13:00 -14:00	196.58	37.50	33.92	16.60	22.78
18.11.2014	14:00 -15:00	247.53	54.45	56.70	18.87	12.48
18.11.2014	15:00 -16:00	349.53	27.35	61.50	25.70	1.00
18.11.2014	16:00 -17:00	416.87	40.23	79.97	31.37	3.35
18.11.2014	17:00 -18:00	720.47	37.52	147.60	68.15	1.67
18.11.2014	18:00 -19:00	816.77	34.83	157.82	78.23	7.02
18.11.2014	19:00 -20:00	674.70	35.55	91.35	40.60	7.25
18.11.2014	20:00 -21:00	709.28	50.82	137.73	77.02	14.67
18.11.2014	21:00 -22:00	470.73	53.92	79.87	38.02	8.90
18.11.2014	22:00 -23:00	590.57	56.35	138.68	72.00	12.80
18.11.2014	23:00 -00:00	259.67	53.02	88.10	30.05	2.37
19.11.2014	00:00 -01:00	447.72	55.68	103.65	41.52	9.97
19.11.2014	01:00 -02:00	247.62	49.97	71.88	23.32	8.33
19.11.2014	02:00 -03:00	724.35	56.38	111.60	61.48	16.07
19.11.2014	03:00 -04:00	403.87	49.27	175.55	84.27	1.42
19.11.2014	04:00 -05:00	282.07	32.37	114.68	45.50	2.57
19.11.2014	05:00 -06:00	326.18	43.85	130.18	52.75	2.65
19.11.2014	06:00 -07:00	362.17	43.30	117.03	40.55	2.42
19.11.2014	07:00 -08:00	288.05	10.70	95.73	29.38	13.03
19.11.2014	08:00 - 09:00	195.12	5.07	61.53	21.92	25.50
19.11.2014	09:00 - 10:00	117.42	25.93	58.27	18.95	29.25
MAX	24hours	816.77	56.38	175.55	84.27	58.07
MIN	24hours	117.42	5.07	33.83	11.80	1.00
Average	24hours	392.25	37.49	92.75	39.98	12.98

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.8168	0.0564	0.1756	0.0843	0.0581
MIN	24hours	0.1174	0.0051	0.0338	0.0118	0.0010
Average	24hours	0.3922	0.0375	0.0928	0.0400	0.0130

Resource & environment Myanmar Co., Ltd.

Client: Myanmar Japan Thilawa Development Ltd.

Issued Date : 15-11-2014

Analysis Report

Project Name : Thilawa Special Economic Zone (TSEZ)
Sample Designated as : Ambient Air Quality Analysis
Sampling Location : AQM 1 (November _TSEZ)

Date	Time	CO	NO2	TSP	PM (10)	SO2
D.M.Y	H.M.S	ppb	ppb	ug/m3	ug/m3	ppb
19.11.2014	10:00 - 11:00	193.68	24.55	46.30	14.35	24.28
19.11.2014	11:00 -12:00	255.23	27.28	50.70	16.66	17.34
19.11.2014	12:00 -13:00	275.47	28.32	43.60	17.23	25.43
19.11.2014	13:00 -14:00	259.85	40.24	45.07	18.03	36.51
19.11.2014	14:00 -15:00	334.93	54.48	56.37	23.12	38.72
19.11.2014	15:00 -16:00	398.12	42.97	71.75	25.15	1.33
19.11.2014	16:00 -17:00	545.42	45.02	100.85	41.85	1.22
19.11.2014	17:00 -18:00	584.48	39.65	120.30	55.50	1.57
19.11.2014	18:00 -19:00	646.52	39.78	104.65	48.00	1.93
19.11.2014	19:00 -20:00	706.73	44.23	127.40	64.58	2.30
15.11.2014	20:00 -21:00	494.68	51.10	77.37	31.88	1.82
19.11.2014	21:00 -22:00	426.75	49.77	76.77	31.77	3.48
19.11.2014	22:00 -23:00	361.08	44.12	79.68	29.54	1.00
15.11.2014	23:00 -00:00	413.53	63.63	77.95	42.05	1.08
20.11.2014	00:00 -01:00	430.22	38.97	93.90	44.87	1.98
20.11.2014	01:00 -02:00	230.13	50.42	78.15	27.77	27.42
20.11.2014	02:00 -03:00	243.53	43.83	72.42	28.13	7.20
20.11.2014	03:00 -04:00	233.10	37.00	64.48	28.52	11.65
20.11.2014	04:00 -05:00	239.97	34.55	70.38	31.20	3.53
20.11.2014	05:00 -06:00	288.30	42.87	76.12	33.60	1.40
20.11.2014	06:00 -07:00	392.13	50.50	125.03	51.37	25.82
20.11.2014	07:00 -08:00	302.08	26.78	94.75	27.35	2.55
20.11.2014	08:00 - 09:00	228.40	9.33	79.17	26.58	1.85
20.11.2014	09:00 - 10:00	131.02	15.18	69.28	26.80	13.52
MAX	24hours	706.73	63.63	127.40	64.58	38.72
MIN	24hours	131.02	9.33	43.60	14.35	1.00
Average	24hours	358.97	39.36	79.27	32.75	10.62

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.7067	0.0636	0.1274	0.0646	0.0387
MIN	24hours	0.1310	0.0093	0.0436	0.0144	0.0010
Average	24hours	0.3590	0.0394	0.0793	0.0327	0.0106

Resource & environment Myanmar Co., Ltd.

Client: Myanmar Japan Thilawa Development Ltd.

Issued Date : 15-11-2014

Analysis Report

Project Name : Thilawa Special Economic Zone (TSEZ)
Sample Designated as : Ambient Air Quality Analysis
Sampling Location : AQM 1 (November_TSEZ)

Date	Time	CO	NO2	TSP	PM (10)	SO2
D.M.Y	H.M.S	ppb	ppb	ug/m3	ug/m3	ppb
20.11.2014	10:00 - 11:00	179.35	21.53	54.80	21.23	13.58
20.11.2014	11:00 -12:00	198.77	30.12	43.45	16.13	32.60
20.11.2014	12:00 -13:00	236.93	44.65	45.27	18.03	30.87
20.11.2014	13:00 -14:00	321.05	45.93	69.33	27.75	15.53
20.11.2014	14:00 -15:00	390.95	41.60	87.78	34.95	1.00
20.11.2014	15:00 -16:00	412.17	41.15	73.40	28.58	1.10
20.11.2014	16:00 -17:00	413.37	45.22	71.60	28.50	1.40
20.11.2014	17:00 -18:00	443.08	59.43	95.13	47.73	1.00
20.11.2014	18:00 -19:00	500.10	51.57	96.82	49.52	1.80
20.11.2014	19:00 -20:00	442.18	45.53	79.90	41.67	4.48
20.11.2014	20:00 -21:00	360.83	48.63	80.03	37.87	1.37
20.11.2014	21:00 -22:00	338.28	59.23	82.75	39.28	1.22
20.11.2014	22:00 -23:00	302.63	48.53	74.35	34.85	6.35
20.11.2014	23:00 -00:00	275.67	50.88	102.05	44.83	5.95
21.11.2014	00:00 -01:00	381.92	51.98	93.47	49.32	13.43
21.11.2014	01:00 -02:00	339.85	43.72	123.73	70.13	7.50
21.11.2014	02:00 -03:00	286.75	40.72	108.70	65.88	1.00
21.11.2014	03:00 -04:00	300.18	24.98	130.80	76.27	4.57
21.11.2014	04:00 -05:00	236.65	40.38	136.10	80.67	2.57
21.11.2014	05:00 -06:00	264.57	49.92	161.32	85.92	7.13
21.11.2014	06:00 -07:00	476.40	47.42	170.48	83.37	20.07
21.11.2014	07:00 -08:00	665.30	38.83	199.53	77.40	30.20
21.11.2014	08:00 - 09:00	312.75	23.90	132.02	36.87	14.68
21.11.2014	09:00 - 10:00	220.35	5.40	82.67	23.67	9.37
MAX	24hours	665.30	59.43	199.53	85.92	32.60
MIN	24hours	179.35	5.40	43.45	16.13	1.00
Average	24hours	345.84	41.72	99.81	46.68	9.53

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.6653	0.0594	0.1995	0.0859	0.0326
MIN	24hours	0.1794	0.0054	0.0435	0.0161	0.0010
Average	24hours	0.3458	0.0417	0.0998	0.0467	0.0095

Resource & environment Myanmar Co., Ltd.

Client: Myanmar Japan Thilawa Development Ltd.

Issued Date : 15-11-2014

Analysis Report

Project Name : Thilawa Special Economic Zone (TSEZ)
Sample Designated as : Ambient Air Quality Analysis
Sampling Location : AQM 1 (November _TSEZ)

Date	Time	CO	NO2	TSP	PM (10)	SO2
D.M.Y	H.M.S	ppb	ppb	ug/m3	ug/m3	ppb
21.11.2014	10:00 - 11:00	160.30	4.53	58.43	18.35	34.30
21.11.2014	11:00 -12:00	120.20	13.30	41.55	12.73	56.85
21.11.2014	12:00 -13:00	80.68	24.28	39.65	19.97	89.80
21.11.2014	13:00 -14:00	154.88	59.38	80.50	40.17	60.07
21.11.2014	14:00 -15:00	286.33	29.00	68.60	24.03	1.18
21.11.2014	15:00 -16:00	342.05	24.28	69.75	25.65	1.23
21.11.2014	16:00 -17:00	372.08	37.17	71.65	29.50	1.65
21.11.2014	17:00 -18:00	472.35	36.23	83.75	43.92	2.18
21.11.2014	18:00 -19:00	496.62	46.32	77.40	38.22	1.32
21.11.2014	19:00 -20:00	579.30	47.88	90.60	45.00	3.07
21.11.2014	20:00 -21:00	532.85	57.00	122.18	71.52	2.33
21.11.2014	21:00 -22:00	423.63	54.33	83.47	40.72	1.53
21.11.2014	22:00 -23:00	302.17	51.55	70.57	36.42	1.20
21.11.2014	23:00 -00:00	344.37	55.05	90.07	48.52	13.97
22.11.2014	00:00 -01:00	349.95	48.00	106.22	56.57	2.10
22.11.2014	01:00 -02:00	216.22	37.03	79.93	36.70	1.38
22.11.2014	02:00 -03:00	183.25	46.08	65.73	31.18	8.28
22.11.2014	03:00 -04:00	244.48	45.42	109.87	63.33	8.87
22.11.2014	04:00 -05:00	243.23	46.78	125.85	75.23	3.47
22.11.2014	05:00 -06:00	236.23	42.37	196.10	115.68	6.90
22.11.2014	06:00 -07:00	235.90	52.43	164.42	79.37	1.55
22.11.2014	07:00 -08:00	386.67	23.20	137.85	47.00	18.35
22.11.2014	08:00 - 09:00	266.60	3.07	96.13	32.97	60.93
22.11.2014	09:00 - 10:00	127.55	13.37	61.73	21.82	38.95
MAX	24hours	579.30	59.38	196.10	115.68	89.80
MIN	24hours	80.68	3.07	39.65	12.73	1.18
Average	24hours	298.25	37.42	91.33	43.94	17.56

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.5793	0.0594	0.1961	0.1157	0.0898
MIN	24hours	0.0807	0.0031	0.0397	0.0127	0.0012
Average	24hours	0.2982	0.0374	0.0913	0.0439	0.0176

Resource & environment Myanmar Co., Ltd.

Client: Myanmar Japan Thilawa Development Ltd.

Issued Date : 15-11-2014

Analysis Report

Project Name : Thilawa Special Economic Zone (TSEZ)
Sample Designated as : Ambient Air Quality Analysis
Sampling Location : AQM 1 (November _TSEZ)

	Date	Time	CO	NO2	TSP	PM (10)	SO2
	D.M.Y	Hours	ppm	ppm	mg/m3	mg/m3	ppm
1	15th-16th Nov, 2014	24	0.241243	0.04621	0.071951	0.033162	0.009552
2	16th-17th Nov, 2014	24	0.301405	0.037734	0.09439	0.038734	0.01521
3	17th-18th Nov, 2014	24	0.387972	0.035069	0.116915	0.055003	0.021998
4	18th-19th Nov, 2014	24	0.392247	0.037492	0.092754	0.039977	0.012981
5	19th-20th Nov, 2014	24	0.358974	0.039357	0.079268	0.032746	0.010622
6	20th-21st Nov, 2014	24	0.345837	0.041719	0.099812	0.046684	0.009532
7	21st-22nd Nov, 2014	24	0.298246	0.037419	0.091333	0.04394	0.017561

	Date	Time	CO	NO2	TSP	PM (10)	SO2
	D.M.Y	Hours	ppm	ppm	mg/m3	mg/m3	ppm
1	15th-16th Nov, 2014	24	0.24	0.05	0.07	0.03	0.01
2	16th-17th Nov, 2014	24	0.30	0.04	0.09	0.04	0.02
3	17th-18th Nov, 2014	24	0.39	0.04	0.12	0.06	0.02
4	18th-19th Nov, 2014	24	0.39	0.04	0.09	0.04	0.01
5	19th-20th Nov, 2014	24	0.36	0.04	0.08	0.03	0.01
6	20th-21st Nov, 2014	24	0.35	0.04	0.10	0.05	0.01
7	21st-22nd Nov, 2014	24	0.30	0.04	0.09	0.04	0.02
Maximum		24	0.39	0.05	0.12	0.06	0.02
Average		24	0.33	0.04	0.09	0.04	0.01
Minimum		24	0.24	0.04	0.07	0.03	0.01
Target Value		24	10	<0.06	<0.33	<0.12	<0.04

Appendix 2

Laboratory Result

Report No. : 2014-01246 / 001 (Page 1 of 1) **Issued date :** November 11, 2014

CLIENT : **RESOURCE AND ENVIRONMENT MYANMAR CO., LTD.**
CONTACT : Mr. Pwint Pwint
ADDRESS : B702 Delta Plaza, Shwegondaing Rd., Bahan, Yangon, Myanmar
Tel. +959-73013448 Fax. +951-552901
E-mail : pwint@enviromyanmar.net

Analysis Report

PROJECT NAME : Water Quality Monitoring in Thilawa SEZ **SAMPLING DATE :** October 17, 2014
SAMPLE DESIGNATED AS : Water Quality **SAMPLING BY** : Client
SAMPLING LOCATION : Thilawa, Myanmar

Parameters	Units	LOQ	Results					
			GW-1	SW-2	SW-3	SW-4	SW-7	SW-8
Total Coliform Bacteria	MPN/100mL	-	12	330	46	33	230	490
Fecal Coliform Bacteria	MPN/100mL	-	< 1.8	170	31	33	49	170
E.Coli	MPN/100mL	-	< 1.8	23	5.1	23	1.1	5.1

Remark : - Analysis Methods followed to 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).
- LOQ = Limit of Quantitation

(Siripom Imwilaiwan)
Environmental Monitoring Manager

(Thepson Yommana)
Technical Manager

SGS (THAILAND) LIMITED

TY/Client/VR/Ws

ANALYSIS REPORT

ORIGINAL

Job Ref: 6905/2014
Date : 22.10.2014

Client Name	:	**RESOURCE AND ENVIRONMENT CO., LTD** B-702 Delta Plaza, Shwegondaing Rd, Bahan Township, Yangon, Myanmar
Project Name	:	Water Quality Monitoring in Thilawa SEZ (Near Thanlyin & Thilawa)
Sample Brought By	:	Client
Sample Received Date	:	20.10.2014
Analysed Date	:	22.10.2014

Stations	Commodity Name	Lab Code	Results (mg/l)	
			Total Suspended Solid	Oil & Grease
Method	-	-	APHA 2540 D	APHA 5520 B
GW -1	Ground Water	179/14	22.7	6.3
SW-2	Surface Water	180/14	521.3	9.3
SW-3	Surface Water	181/14	550.7	6.2
SW-4	Surface Water	182/14	330.7	4.4
SW-7	Surface Water	183/14	48.7	7.2
SW-8	Surface Water	184/14	135	7.3
Detection Limit			2	0.2

End Of Report

SGS (Myanmar) Limited

(Nu Nu Yi)
Manager

The Government of the Republic of the Union of Myanmar
Ministry of Agriculture and Irrigation
Irrigation Department
Survey and Investigation Branch
Soil Survey Section
Soil and Water Analytical Laboratory

ANALYTICAL DATA FOR WATER SAMPLE

PROJECT NAME; Water Quality Monitoring in Thilawa SEZ
SAMPLE DESIGNATED AS; Water Quality
SAMPLING LOCATION; Near Thanlyin & Thilawa

SAMPLING DATE; 17.10.2014
ISSUED DATE ; 27.10.2014
SAMPLING BY ; Client

Sr No	Station	Results (mg/l)			Remark
		BOD_5	COD	Chromium (Cr)	
1	GW-1	3.4	8.5	0.012	
2	SW-2	4.0	13.6	0.006	
3	SW-3	8.0	20.2	0.025	
4	SW-4	7.0	20.3	0.012	
5	SW-7	1.9	5.7	0.010	
6	SW-8	2.0	6.0	0.010	
Drinking Water Standard (WHO)	Highest desirable level	6 mg/l	10 mg/l	-	
	Maximum permissible level	Concentration at maximum permissible pollution		0.01 mg/l	

Remark: Analytical mentions are ppb unit by AAS. But this unit is changed as mg/L according to the standard of WHO unit.

(May Aye Lwin)
Staff Officer (Laboratory)
Soil and Water Laboratory
Survey and Investigation Branch
Irrigation Department

ANALYSIS REPORT

ORIGINAL

Job Ref: 7599/2014
Date : 28.11.2014

Client Name	:	**RESOURCE AND ENVIRONMENT CO., LTD** B-702 Delta Plaza, Shwegondaing Rd, Bahan Township, Yangon, Myanmar
Project Name	:	Water Quality Monitoring in Thilawa SEZ (Near Thanlyin & Thilawa)
Sample Brought By	:	Client
Sample Received Date	:	24.11.2014
Analysed Date	:	25.11.2014

Stations	Commodity Name	Lab Code	Method	Results (mg/l)
				Oil & Grease
GW -1 (21.11.14)	Ground Water	207/14	APHA 5520 B	5.6
Detection Limit				0.2

End Of Report

SGS (Myanmar) Limited

(Nu Nu Yi)
Manager

ANALYSIS REPORT

ORIGINAL

Job Ref: 7968/2014
Date : 16.12.2014

Client Name	:	**RESOURCE AND ENVIRONMENT MYANMAR CO., LTD** B-702 Delta Plaza, Shwegondaing Rd, Bahan Township, Yangon, Myanmar
Project Name	:	Water Quality Monitoring in Thilawa SEZ
Sample Brought By	:	Client
Sample Received Date	:	11.12.2014
Analysed Date	:	12.12.2014

Stations	Commodity Name	Lab Code	Method	Results (mg/l)
				Oil & Grease
GW-1 (11.12.2014)	Ground Water	228/14	APHA 5520 B	Not Detected
SW-2 (11.12.2014)	Surface Water	229/14	APHA 5520 B	1.2
SW-3 (11.12.2014)	Surface Water	230/14	APHA 5520 B	3.6
SW-4 (11.12.2014)	Surface Water	231/14	APHA 5520 B	1.2
Detection Limit				0.2

End Of Report

SGS (Myanmar) Limited

(Tun Tun)
Manager

Thilawa Special Economic Zone (Zone A) Development Project –Phase 1

Appendix

Sampling and Laboratory Analysis Inspection

For

Oil and Grease of Water Quality Analysis

February 2015

Sampling and Laboratory Analysis Inspection for Oil & Grease of Water Quality Analysis

Final Report

February 2015

MYANMAR KOEI INTERNATIONAL LTD.

Sampling and Laboratory Analysis Inspection for Oil & Grease of Water Quality Analysis Final Report

Table of Contents

1. Overall

1.1. Introduction

During the water sample analysis that was requested by Myanmar Japan Thilawa Development Ltd. (hereinafter referred to as "MJTD"), higher concentration of Oil & Grease (hereinafter referred to as "O&G") in comparison to expected value has been reported. For the above mentioned O&G analysis, the following two Myanmar environmental research/ analysis companies were involved. Resource and Environment Myanmar Ltd. (hereinafter referred to as "REM") performed the sampling and transportation of collected samples, and SGS Myanmar Ltd. (hereinafter referred to as "SGS Myanmar") conducted the laboratory analysis. For these two companies, the inspection for validation of sampling and analysis for O&G (hereinafter referred to as "the O&G Inspection") was carried out by Myanmar Koei International Ltd. (hereinafter referred to as "MKI").

1.2. Inspection Item

The O&G Inspection was performed for the following four items.

1. Preparation of sampling bottle
2. Sampling
3. Operation of analysis
4. Result of analysis

In order to have better validation of the analysis result, the same sample were analyzed in two laboratories, namely, SGS Myanmar and SGS Thailand Ltd. (hereinafter referred to as "SGS Thailand"), and the difference of results between the two laboratories was compared. The laboratory of SGS Thailand is located in Bangkok, Thailand, but adopted for the comparison. This is because SGS Thailand was expected to conduct reliable analysis due to its somewhat geographical closeness for preventing excessive sample quality change during transportation of the sample.

According to American Standard Methods for the Examination of Water and Wastewater 5520 A[1], adopted in United State of America, for O&G analysis, O&G does not mean a specific chemical substance, but defined as a general term for substance that to be extracted in an organic solvent, normal-hexane (hereinafter referred to as "n-hexane"). This definition suggests that the substances soluble in n-hexane, is measured as the O&G. In general, analysis of O&G is targeted at quantification of the less volatile oil.

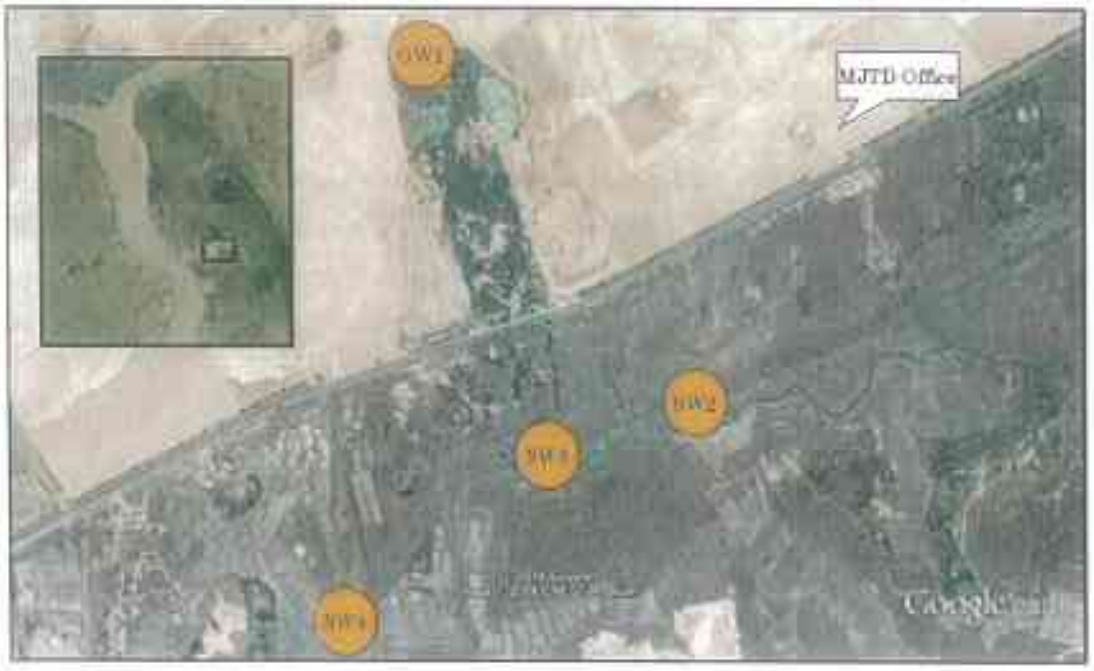
1.3. Inspection Method

Outline of the O&G Inspection is summarized in Table 1.1, and sampling points are shown in Figure 1.1. The conditions of the process from the preparation of sampling bottle to operation of analysis had been observed.

[1] Standard Methods for the Examination of Water and Wastewater 22nd edition, 2012 (issued by American Public Health Association)

Table 1.1 Outline of Inspection about O&G Analysis

No.	Item	Inspection Method	Implementer	Date
1	Preparation of sampling bottle	a) Observation of sample bottle cleaning method b) Confirmation of sampling bottles	REM	12/22
2	Sampling	a) Observation of sample collecting conditions b) Sample points: total 4 points (3 surface water and 1 ground water) Surface water samples were collected from canal (river width about 2m) with flow, from three different points (from upstream SW2, SW3, and SW4). Ground water sample was collected from the pumped well water (GW1). (In order to request the analysis to two laboratories, two bottles of samples are collected at each point.) c) Confirmation of the sample storing d) Confirmation of transportation conditions	REM	12/23
3	Operation of analysis	a) Observation of O&G analysis operation b) Sample: 2 sample (SW4 and GW1) Initially, observation of all 4 samples was planned. However, due to laboratory's physical capacity and available time frame, observation are performed for 2 samples of SW4 (turbidity) and GW1 (clear and colorless) having a different appearances. c) Confirmation of equipment	SGS Myanmar	12/23
4	Result of analysis	Cross-check between the results of two laboratories - SGS Myanmar - SGS Thailand	SGS Myanmar SGS Thailand	Undear (SW4 and GW1 are analyzed at 23th December)



Source: Google earth

Figure 1.1 Sampling Point for O& G Analysis

2. Inspection Result

The serious problem was not observed in the inspected item for the sampling by REM and the analysis by SGS Myanmar. However, the different results were reported in some samples between SGS Myanmar and SGS Thailand. There is possibility that the results of SGS Myanmar and/ or SGS Thailand are not reliable.

Although the probability is low, operations and conditions that may cause significant impacts to the analysis result are summarized in Table 2.1.

Hereinafter, operations and conditions are divided into the positive error and the negative error. The positive error is defined as cases that possibly causing an increase in the result of analysis, when compared with the original concentration of sampled O&G. On the other hand, the negative error is defined as cases that possibly causing a decrease in the result. The detail results of inspection are described in the following section for the respective inspection items.

Table 2.1 Operations and Conditions that may cause Significant Impacts to Analysis Results.

No.	Inspection Item	Operations and Conditions	Positive Error	Negative Error	Relevant Section in this Report
1-1	Preparation of sampling bottle	Insufficient number of rinsing after the sampling bottle washing with powder detergent.	●		2.1.1.
1-2	Preparation of sampling bottle	Sampling bottle washing with insufficient amount of n-hexane.	●		2.1.2.
2	Sampling	Prewashing of sampling bottle with sample.	●		2.2.1.
3-1	Operation of analysis	Handling of samples by using measuring cylinder.		●	2.3.1.
3-2	Operation of analysis	Lack of pH checking for arrived sample.	●	●	2.3.2.
3-3	Operation of analysis	Insufficient shaking time of n-hexane extraction.		●	2.3.3.
3-4	Operation of analysis	Insufficient separation time for n-hexane layer and aqueous layer after extraction.		●	2.3.4.
3-5	Operation of analysis	Evaporation of n-hexane in a condition of opening the mouth of conical flask.	●		2.3.5.
3-6	Operation of analysis	Cooling the conical flask lying horizontally.	●		2.3.6.
3-7	Operation of analysis	Insufficient performance of balance.	●	●	2.3.7.
4	Result of analysis	Different results of both laboratories.	●	●	2.4.1.

2.1. Preparation of Sampling Bottle

In REM brown glass bottles were used for sampling for O&G, and the bottles were washed by the procedure that is shown in Table 2.2. REM adopted some washing methods and bottles depending on the analysis parameter. For O&G analysis, washing step with n-hexane is implemented. This step is intended to remove substances that are not soluble in water but soluble in n-hexane.

Table 2.2 Washing Method of Sampling Bottles for O&G in REM

Step	Operating	Purpose
1	Wash the bottle with detergent	Removal of oil
2	Rinse the bottle with n-hexane	Removal of substances that are not soluble in water but soluble in n-hexane
3	Boil the bottle at 110 to 220°C for 1 hour	Removal of substances that have high-boiling point
4	Dry the bottle	Removal of moisture

Source: Poster of REM laboratory (Purpose column was prepared by MKI)

Washing the bottle with detergent

Rinsing the bottle with n-hexane

Figure 2.1 Washing Condition of Sampling Bottles

According to an operator and Mr Kyaw Zin Win (GIS Consultant/ Director) of REM, new clean sampling bottles are used every time, no reused bottle are used for sampling. Therefore, no affection by the previous collected samples has been confirmed. But, on the some mouth of bottles, precipitates are observed. The precipitate seems to have been deposited upon manufacturing and shipping of bottles.

2.1.1. Insufficient Number of Rinsing after the Sampling Bottle Washing with Powder Detergent

①Result

During the washing of sampling bottle, laundry powder detergent is used, and the tap water is used for all process. According to observations, laundry powder detergent dissolved in water easily.

②Consideration/ Evaluation

There is possibility that the detergent component remains in sampling bottle, when the powder detergent dissolved insufficiently or precipitated again. If the remained detergent components are measured as O&G, an analysis result is predicted to be higher than the original concentration of sampled O&G.

2.1.2. Sampling Bottle Washing with Insufficient Amount of n-hexane

①Result

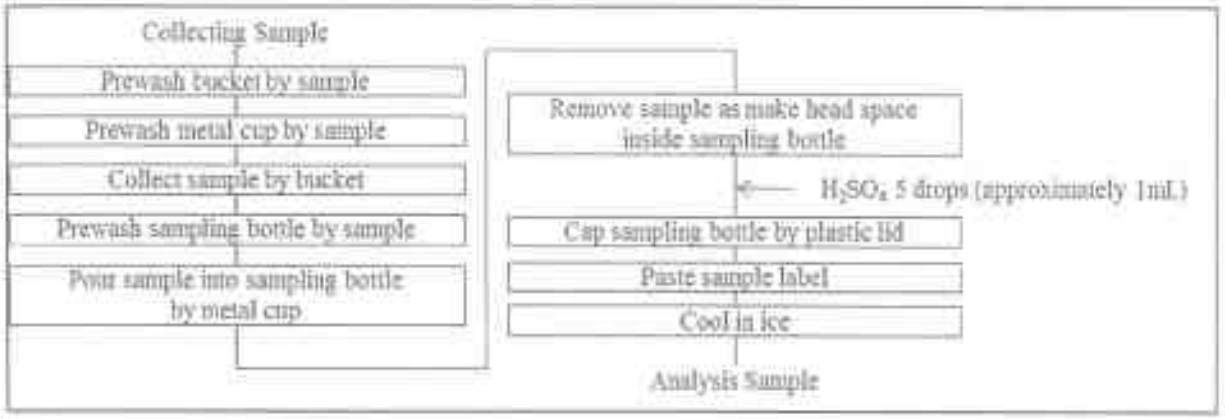
In the process of n-hexane rinsing, 300ml of tap water was poured into sampling bottle, and then 3 drops of n-hexane (total amount is less than 1mL) were added.

②Consideration/ Evaluation

This process is intended to remove substances that are not soluble in water but soluble in n-hexane. It is important that the inside of the sampling bottle is wet enough by n-hexane that has not been diluted. But, the amount of n-hexane seems to be insufficient in this method. If the substances inside the sampling bottle are measured as O&G, an analysis result is predicted to be higher than the original concentration of sampled O&G. In order to prevent the increase in analysis result, the sampling bottle should be washed by using appropriate volume of n-hexane that has not been diluted, depending on the sampling bottle size.

2.2. Sampling

The overall sampling procedure that has been performed by REM is indicated in Figure 2.1. Water samples were collected from i) three different points of a canal (canal width about 2m, from upstream labeled SW2, SW3, and SW4), and ii) a well (GW1). In all sampling points, samples was collected by bucket, and then poured into sampling bottles. Prewashing of bucket and sampling bottle was performed every time (Figure 2.2). At the sampling points, following pretreatments were also done; i) acid (H_2SO_4) was added to collected samples for sample storing, and ii) samples were transported in a styrofoam box filled with ice (Figure 2.3).



Source: Prepared by study team based on the observation in this inspection

Figure 2.1 Sampling Procedure for Oil & Grease in REM

Figure 2.2 Prewashing for Sampling Bottle and Bucket

Figure 2.3 Sample Storing and Transportation Conditions

2.2.1. Prewashing of Sampling Bottle with Sample

①Result

Prewashing of sample bottles with sample was implemented for all sample bottles. Prewashing operation means that a small amount of sample is poured into sampling tools/ bottles, and then discarded after rinsing inside of sampling tools or bottles.

②Consideration/ Evaluation

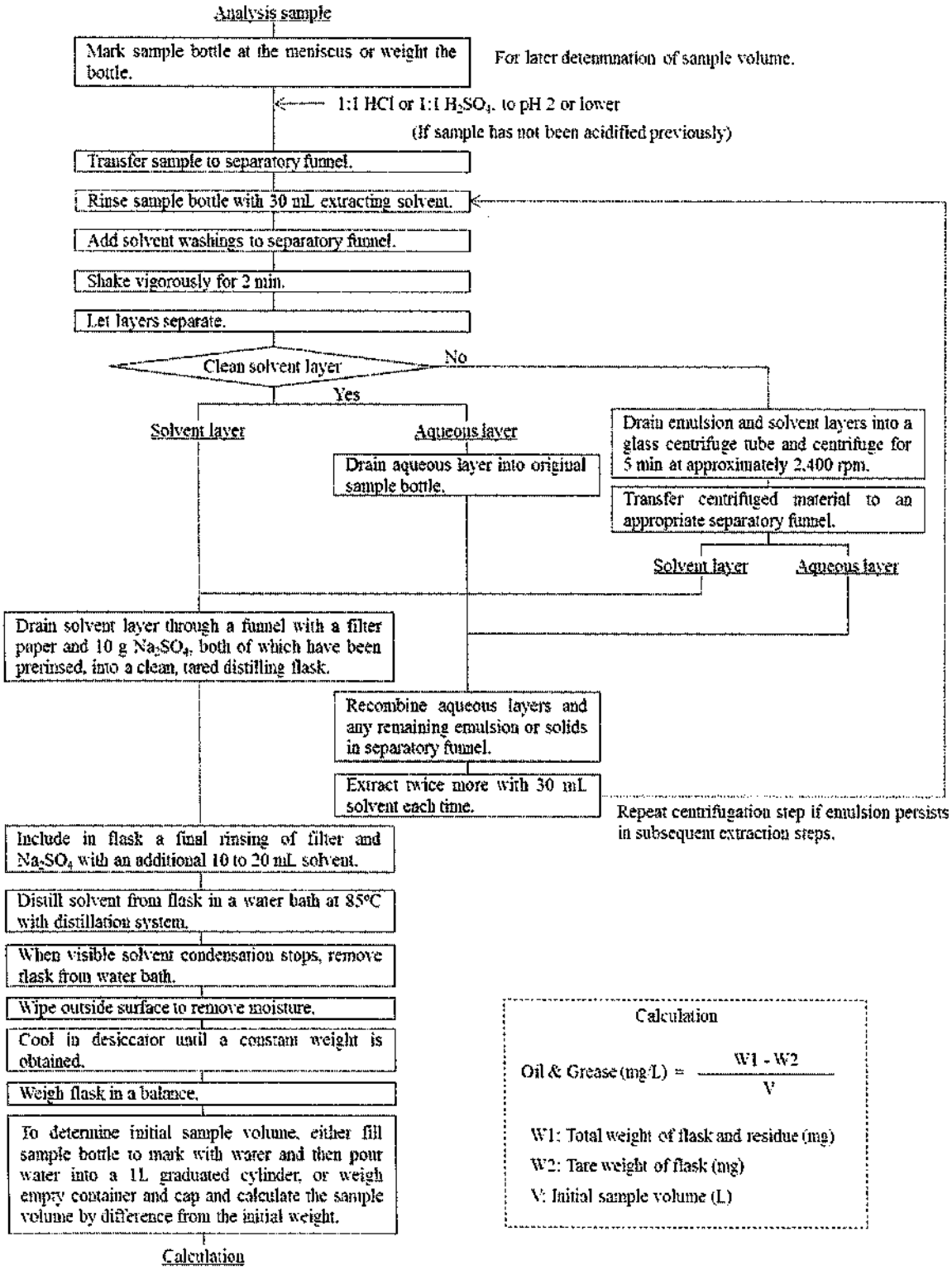
Since target substance of O&G analysis is oil, it has characteristic to remain inside inner surface of the sample bottle as an oil film, after sample was discarded from the bottle. Therefore, prewashing of sampling bottle possibly causes to increase O&G analysis result. In Japanese Industrial Standards (JIS K0102), prewashing is not allowed for analysis of oil. The reason for this is that a part of n-hexane extract substances used for prewashing will remain in the sampling bottle. On the other hand, sample transfers between bottles may cause to decrease O&G analysis result. In consideration of such standard, it is appreciated not to prewash by samples to avoid unnecessary deviation of analysis results.

2.2.2. Other Considerations for Sampling

The sample may be also affected by unexpected contamination from other human activities, depending on timing of sampling. There is a possibility that the O&G analysis result will be affected by contamination of domestic non-fecal wastewater, since flow of canal was very low at the sampling points.

2.3. Operation of Analysis

SGS Myanmar complies with Standard Methods for the Examination of Water and Wastewater 5520 B (hereinafter, referred to as "the Standard"). The method of the Standard is shown in Figure 2.2. In order to extract the target substances to n-hexane, the sample which was made into acidity condition and n-hexane are shake well, then the n-hexane layer is evaporated, and finally the remained substances are measured as O&G by a balance. Photo taking was not allowed in SGS Myanmar laboratory while this inspection.



Source: Standard Methods for the Examination of Water and Wastewater 22nd edition, 2012 (Issued by American Public Health Association)

Figure 2.4 Standard Method 5520 B Adoptedby SGS Myanmar on O&G Analysis

2.3.1. Handling of Samples by Using Measuring Cylinder

①Result

Sample volume was measured by using a measuring cylinder in SGS Myanmar. The inside of measuring cylinder was not rinsed with n-hexane.

②Consideration/ Evaluation

In general, oil tends to be remained on the surface of device/equipment that is in contact with sample. Thus, using the measuring cylinder for the sample measurement is not suggested in the Standard. The Standard describes indirect methods either marking sampling bottle at the water meniscus or weighting the bottle to determine sample volume/ weight.

If analysis is implemented without adding the oil amount remained inside the measuring cylinder, the decreased analysis result may appear. The sample volume should be measured by sample weight according to the Standard. If measuring cylinder is used, the measuring cylinder should be rinsed with n-hexane.

2.3.2. Lack of pH Checking for Arrived Samples

①Result

Though the sample is analyzed under acidity condition as per the Standard, pH value of samples were not checked by SGS Myanmar.

②Consideration/ Evaluation

Basically, arrived samples are expected to be in acidity condition because acid is added by REM when the samples were collected at the field. However, if no acid was added by REM, the sample is analyzed under no acidity condition. If the sample is not analyzed in suitable pH condition for O&G analysis, validity of analyzed results may be lost. Therefore, pH checking shall be done at beginning of this operation analysis stage.

2.3.3. Insufficient Shaking Time of n-hexane Extraction

①Result

When shaking the sample and n-hexane in a separately funnel, the shaking time was less than set time of 2 minutes.

②Consideration/ Evaluation

In the Standard, the shaking time is set as 2 minutes. Insufficient shaking time may reduce the extraction efficiency. In this case, an analysis result is predicted to be lower than the original concentration of the O&G sample. Therefore, shaking time shall follow the requirement in the Standard.

2.3.4. Insufficient Separation Time for n-hexane Layer and Aqueous Layer after Extraction

①Result

The aqueous layer was discharged from the separately funnel immediately after shaking the sample and n-hexane.

②Consideration/ Evaluation

The waiting time after shaking is not described in the Standard. However, if there is no time for waiting, there is a possibility that the small particle of n-hexane is still suspended in the aqueous layer, and separation of two layers is not complete. If analysis is implemented without consideration these remained small particle of n-hexane in aqueous layer, the analysis result may decrease. Therefore reasonable waiting time shall set before discharging the water.

2.3.5. Evaporation of n-hexane in a Condition of Opening the Mouth of Conical Flask

①Result

In SGS Myanmar, water bath and drying oven were used for evaporation of n-hexane that is collected in a conical flask. This evaporation process took over 1 hour. During evaporation process, the mouth of conical flask was opened upward without any covers.

②Consideration/ Evaluation

In such condition, dust suspended in atmosphere or soil samples raised up in the laboratory have possibilities to fall into the conical flask. According to the Standard, the mouth of conical flask is connected with the distillate apparatus and kept closed to recovery evaporated n-hexane. If the weight of fallen substances into the conical flask is measured as O&G, an analysis result is predicted to be higher than the original concentration of the sampled O&G. Therefore, the mouth of the conical flask shall be closed and follow the procedure in the Standard.

2.3.6. Cooling the Conical Flask Lying Horizontally

①Result

In SGS Myanmar, the conical flask was set lying horizontally in desiccator after removed from the drying oven, during the cooling step.

②Consideration/ Evaluation

In such condition, the dew condensation may occur by warm air that can not exhaust from the bottom of conical flask. According to the Standard, the conical flask shall be cooled in desiccator to prevent dew condensation. If the weight of dew condensation is measured as O&G, an analysis result is predicted to be higher than the original concentration of the sampled O&G. Therefore, this step shall also follow the procedure in the Standard

2.3.7. Insufficient Performance of Balance

①Result

Although the electronic balance (A&D INSTRUMENTS Ltd., GR-200) possessed by SGS Myanmar, can indicate up to the digit of 0.0001 g, the precision of product is guaranteed only to digit of 0.01g (10 mg) according to catalogue specification. Calibration of balance is performed weekly in SGS Myanmar. During this inspection on 23 December, 2014, 100.0001 g was displayed when 100 g balance weight was measured.

②Consideration/ Evaluation

For example, if 1L of sample is analyzed for O&G, and then 10 mg of extracted substances is measured by the

balance, the O&G concentration is calculated as 10 mg/L. This implies that SGS Myanmar cannot measure the less than 10 mg/L of O&G when 1 L of sample is used, according to the specification of the balance.

If analysis of low O&G concentration is required, the performance of balance should be improved, or the sample volume should be increased. In the reality, the balance in SGS Myanmar seemed to be able to measured lower than 10 mg. However, to make more reliable measurement, the lower weighing limit of the balance should be confirmed appropriately, and also enough volume of sample should be used in consideration of on the balance performance.

2.4. Result of Analysis

The result of O&G that was analyzed by SGS Myanmar and SGS Thailand is shown in Table2.3. When comparing with MOI guideline value (equivalent to MJTD standard), although GW-1 analyzed by SGS Thailand is equal to the guideline maximum value, the results of all samples were within the guideline value.

Table 2.3 Analysis Result on O&G

SGS	GW-1	SW-2	SW-3	SW-4	LOQ	APHA Method	MOI Guideline*	Unit
Myanmar	<0.2	1.9	<0.2	<0.2	0.2	5520 B	Max. 5	mg/L
Thailand	5	<1	<1	<1	1	5520**		

*Equal to MJTD standard.

**The selected method that is listed in 5520 is unclear.

2.4.1. Different Results of Both Laboratories

①Result

When comparing results between SGS Myanmar and SGS Thailand, the results of GW-1 and SW-2 showed the opposite trend. On the other hand, the results of SW-3 and SW-4 showed the similar trend between two laboratories.

The results of SW-3 and SW-4 in SGS Myanmar and SGS Thailand were less than limit of quantitation (hereafter, LOQ). The lower concentration than LOQ means the low concentration that cannot be analyzed, although it is not zero.

②Consideration/ Evaluation

The different results were reported in 2 samples (GW-1 and SW-2) between SGS Myanmar and SGS Thailand. The following concerns are possible reasons which may have caused different results.

a) Misplacement of samples during analysis
b) Low reliability of results themselves due to discrepancies between the analytical method actually applied and its LOQ (sensitivity).

a) Misplacement of samples during analysis

Although it is a rare case, misplacement of samples may have happened in either SGS Myanmar or SGS Thailand.

If multiple samples were analyzed at the same time, without certain countermeasures to identify each sample, there may be a risk of misplacing samples.

b) Low reliability of results themselves due to discrepancies between the analytical method actually applied and its LOQ (sensitivity).

SGS Myanmar:

This time, SGS Myanmar analyzed O&G according to a method called APHA 5520 B. APHA 5520 has several kinds of analysis methods (B to G). APHA 5520 describes that if O&G concentration is less than 10mg/l, method 5520 C shall be selected instead of APHA 5520 B. If APHA 5520 B is not appropriate for analysis of less than 10mg/l, the analysis result reported by SGS Myanmar may be less reliable.

SGS Thailand:

It is not clear which type of APHA 5520 method, SGS Thailand applied for the analysis. If using APHA 5520 B like in the case of SGS Myanmar, the result of SGS Thailand may be also not reliable. If SGS Thailand was using APHA 5520 C, which has LOQ (sensitivity) of 0.2 mg/l, the result will be more reliable but further confirmation is required.

LOQ setting:

The LOQ was set 0.2 mg/l for SGS Myanmar and 1 mg/l for SGS Thailand. Referring to the sensitivity of APHA 5520 methods, reasons for setting such LOQ is not clear, therefore, the confirmation for LOQ is needed at each laboratory. Especially, there is a possibility that a LOQ calculation procedure has not been well understood in SGS Myanmar.

2.4.2. Calculation Method on SGS Myanmar

①Result

The calculation formula of SGS Myanmar and the calculation formula of standard 5520 B (Figure 2.4) were different. However, both formulas are basically indicating the same thing..

The calculation formula used by SGS Myanmar is indicated as follows.

Calculation: Result [mg/L] = {(w1 - w2) - BL} / V

w1: Total weight of flask and residue before blank correction [mg]

w2: Tare weight of flask [mg]

BL: Blank value [mg]

V: Sample volume [L]

Blank value indicates effect of target substance that is detected from lab devices or reagents. The blank value is obtained as the result of analysis when water is analyzed on same condition with sample.

The calculation formula of the Standard is restated as follows.

Calculation: Result [mg/L] = (W1 - W2) / V

W1: Total weight of flask and residue [mg]

W2: Tare weight of flask [mg]

V: Sample volume [L]

According to the Standard, when the weight of flask "W2" is deducted from "W1", only weight of residue is calculated.

When comparing the calculation formula of SGS Myanmar and the Standard, "W1" in the Standard and "w1 - BL" in SGS Myanmar have equivalent meaning. The "w1" has possibility to contain the residue weight that was contained in reagent. In order to calculate the actual weight of the sampled residue as like in "W1", the blank value should be deducted from "w1". These relations can be expressed formulas follows.

W1 - W2 = (w1 - BL) -w2

②Consideration/ Evaluation

The calculation of SGS Myanmar is essentially the same as the calculation of standard 5520 B. Although the Standard Method does not state that the blank value should be deducted from the difference between W1 and W2, in the reality, deducting the blank value is required to measure O&G with more precision. For example, when a regent that contains O&G is used for analysis, if the blank value is not deducted, an analysis result is predicted to be higher than the original concentration of the sampled O&G. Therefore, it is appropriate to dedcut a blank value from the result, as performed by SGS Myanmar.

3. Predicted Impacts to Analyzed Results

The predicted impact for result of analysis in this inspection and the improving ideas for REM and SGS Myanmar are summarized in Table 3.1.

Table 3.1 Predicted Impacts to Analyzed Results and Possible Countermeasures

No.	Inspection Item	Operations and Conditions	Predicted Impact for Analyzed Result	Possible Countermeasures	Predicted Improvement
1-1	Preparation of sampling bottle	Insufficient number of rinsing after the sampling bottle washing with powder detergent.	The remaining detergent in sampling bottle, are when dissolved insufficiently or precipitated again. These are measured as O&G.	Liquid detergent shall be used and the number of rinsing to be determined	The risk of measuring detergent as O&G will be reduced.
1-2	Preparation of sampling bottle	Sampling bottle washing with insufficient amount of n-hexane.	The substances not soluble in water are remained inside the sampling bottle. These are measured as O&G.	About 20mL of n-hexane shall be used for rinsing without diluting. The frequency for reusing the n-hexane shall be determined	The risk of measuring remained substances on sampling bottle as O&G will be reduced.
2	Sampling	Prewashing of sampling bottle with sample.	Oil remained inside the sampling bottle during prewashing are measured as O&G	No prewashing shall be performed as determined in Japanese Standard (JIS K0102).	The risk measuring higher O&G concentration than the original sample will be reduced.

No.	Inspection Item	Operations and Conditions	Predicted Impact for Analyzed Result	Possible Countermeasures	Predicted Improvement
3-1	Operation of analysis	Handling of samples by using measuring cylinder.	The analysis to be implemented without including the oil remained on the measuring cylinder. These may cause reduced O&G amount.	To follow the Standard and estimate sample volume by measuring sample weight.	The loss of O&G will be decreased. The risk of measuring lower O&G concentration than the original sample will be reduced.
3-2	Operation of analysis	Lack of pH checking for arrived sample.	The sample is analyzed under unsuitable chemical condition for O&G analysis. The validity of analysis may be lost.	The pH value of samples shall be checked with pH test paper before analysis start.	More reliable result can be obtained by performing analysis under suitable pH condition.
3-3	Operation of analysis	Insufficient shaking time of n-hexane extraction.	The extraction efficiency may be reduced. And lower analysis result may be obtained.	The time of shaking shall be set for 2 minutes as per required in the Standard.	The extraction efficiency will be increased. The risk of measuring lower O&G concentration than the original sample will be reduced.
3-4	Operation of analysis	Insufficient separation time for n-hexane layer and aqueous layer after extraction.	The small particle of n-hexane may be suspended in the discarded aqueous layer. This may cause lower analysis result.	Shall discard the aqueous layer long after the n-hexane layer and the aqueous layer are separated, in accordance with the Standard.	The loss of n-hexane layer will be reduced. The risk of measuring lower O&G concentration than the original sample will be reduced.
3-5	Operation of analysis	Evaporation of n-hexane in a condition of opening the mouth of conical flask.	The substances that fall into the conical flask may be measured as O&G.	The cover for the mouth of conical flask shall be set without interfering evaporation. Or shall connect distillate apparatus in accordance with the Standard.	The risk of the fallen substance into conical flask to be measured as O&G will be reduced.
3-6	Operation of analysis	Cooling the conical flask lying horizontally.	The dew condensation may occur by warm air that is not exhaust from the bottom of conical flask. This condensation maybe measured as O&G.	The conical flask shall be set upright.	The risk of the dew condensation on conical flask to be measured as O&G will be reduced.
3-7	Operation of analysis	Insufficient performance of balance.	The validity of analysis for low O&G concentration may be lost.	The actual performance of balance shall be confirmed. Necessary sample volume for analysis shall be determined based on balance performance.	More reliable result can be obtained by performing analysis in consideration of the performance of the balance to be used..
4	Result of analysis	Different results of both laboratories.	The validity of analysis for low O&G concentration may be lost.	The actual method and LOQ shall be confirmed to both laboratories.	The actual precision/ accuracy can be clarified.

4. Conclusion

4.1. Present Status

Though possibility is low, the O&G Inspection revealed that current operation may cause variations in O&G analysis results. Especially, the evaporation of n-hexane without any covers may lead to significant positive errors. The weight of substance that remained in the conical flask after n-hexane removal is measured as O&G. A few mg of remained substance affects seriously to the analyzed result as shown in the calculation formula. Thus, process has the most critical impact than the other process.

In addition, for the weigh measurement, an electronic balance is used, but based on the balance performance, results which are less than 10 mg/L are not fully reliable. This is also regarded as the problem to cause variations in the result.

Since necessary information is still lacking, it is not safe to make any conclusions at this moment. However, there is a possibility that the results of both SGS Myanmar and SGS Thailand are not reliable. Especially, according to adopted method, the analysis results which are less than 10 mg/L are not reliable.

4.2. Recommendations

4.2.1. Analysis Operation and Condition

① The O&G Inspection revealed that analyzed results of SGS Myanmar may have possibilities of unreliable results. The unreliable result seems to be caused more of the suspending dust in laboratory and the performance of balance, rather than the operation of analysis itself. From the viewpoint of Japanese Measurement Sufficient Law, the current condition of SGS Myanmar is not appropriate for O& G analysis.

② If countermeasures suggested in Table 3.1 are adopted, it is possible to decrease the variation in analyzed results. Although these countermeasures do not reach to the analytical precision/ accuracy applied in Japan, much more reliable results than the current practice can be obtained steadily.

③ If REM and/or SGS Myanmar do not adopt countermeasure proposed in this report or any equivalent countermeasures, requesting analysis to other laboratories should also be considered.

4.2.2. Analysis Result

① Need to check with both SGS Myanmar and SGS Thailand, about the details of analytical methods they are applying, how they are setting LOQs and feasibility of such LOQ, and analysis sensitivity.

② If the evidences for applied method and its sensitivity are not clear or insufficient, shall request respective SGS to make necessary corrections in the method they are applying. If either SGS Myanmar or Thailand cannot provide necessary evidences or make necessary corrections, shall consider to use different laboratories for O & G analysis.

③ If evidences provided and corrections made by SGS Myanmar/ Thailand are adequate, performing the accuracy check by using the known concentration of O&G samples is preferable. Ask SGS Myanmar/ Thailand to analyze samples with known concentration and then check whether concentration set will be reported or not.

④ If there is large difference between the concentration set and analyzed result, there is high possibility of analytical operation problems. In such case, shall ask SGS Myanmar/ Thailand to find out reasons and impose countermeasure. In case reasons are not clear or imposing countermeasures are not possible, it is safe to judge that reliable analysis is not possible in SGS Myanmar / Thailand, and shall secure other laboratories for further O&G analysis.

Thilawa Special Economic Zone (ZONE A) Development Project –Phase 1

Appendix

Water and Waste Water Monitoring Report

December 2014

MJTD MYANMAR JAPAN THILAWA DEVELOPMENT LIMITED

MONITORING REPORT

FOR

WATER QUALITY

THILAWA SPECIAL ECONOMIC ZONE (ZONE A)

(DECEMBER 2014)

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RESULT OF AIR AND WATER QUALITY MONITORING

1. Introduction

Water samples were collected on 17th and 23rd December 2014 at Thilawa Special Economic Zone (TSEZ). This report sets out the environmental monitoring required throughout the construction of the Thilawa Special Economic Zone. The terms of reference for monitoring are shown in Table 1. The location of air and water monitoring points are shown in Figure 1 and Table 1.

Terms of Reference for Monitoring

Table 1 Terms of reference for air and water quality monitoring at TSEZ.

Description	Items	Frequency	Location
Air Quality	TSP / PM10	1 time / 3months	At construction site (1point)
Waste water quality	pH, SS, DO, BOD, COD, Coliform count, oil and grease, chromium	1time / 2months	At the creek upstream and downstream which is crossed the car road (3points)
Underground water	pH, SS, DO, BOD, COD, Coliform count, oil and grease, chromium	1time /2months	Tube well inside of Moegyoswan Monastery (1 point)

Monitoring Instrument for Air and water

No.	Instrument	Brand & Model	Measurement/ Parameter	
1.	Environmental Perimeter Air Monitoring System	HAZ-SCANNER EPAS	CO, NO_2, NO, SO_2, PM (2.5), PM (10), VOCS, Relative Humidity, Temperature, Wind Speed, Wind Direction	
3	Alpha Bottle (Water Sampler)	Wildlife Supply Company* Indonesia		

So far, there is no environmental standard for ambient air quality in Republic of Myanmar, the survey result was evaluated by comparing with the standards in neighboring country like Thailand, Vietnam, Japan and IFC (Table 2). The consultant will apply the air quality standard in Thailand, Vietnam, Japan and IFC as shown in Table 1.As for TSP and PM10, the standards in Thailand were applied and the others were compared with the standards in Japan.

Table 2 Ambient Air Quality Standard in Southeast Asia

Item	Averaging period	Japan	Thailand	Vietnam	IFC
SO_2	10 min	-	-	-	0.5mg/m^3
	1hour	0.1ppm	0.3ppm	0.35mg/m^3	0.125mg/m^3(InterimTarget-1) 0.05mg/m^3(InterimTarget-2) 0.02mg/m^3(Guideline)
	24hours	0.04ppm	0.12ppm	0.125 mg/m^3	-
	1 year	-		0.05mg/m^3	-
NO_2	1hour	-	0.17ppm	-	0.2mg/m^3
	24hours	0.04-0.06ppm	-	-	-
	1 year	-	0.03ppm	-	0.04mg/m^3
NOx	1hour	-	-	0.2mg/m^3	
	24hours	-	-	0.04mg/m^3	
CO	1hour	--	30ppm	30mg/m^3	-
	8hours	20ppm	-	10mg/m^3	-
	24hours	10ppm	9ppm	-	-
TSP	1hour	-	-	0.3mg/m^3	-
	24hours	-	0.33mg/m^3	0.2mg/m^3	-
	1 year		0.10mg/m^3	0.14mg/m^3	-
PM_{10}	24hours	-	0.12mg/m^3	0.15mg/m^3	0.15mg/m^3(InterimTarget-1) 0.10mg/m^3(InterimTarget-2) 0.07mg/m^3(InterimTarget-3)
	1 year	-	0.05mg/m^3	0.05mg/m^3	0.07mg/m^3(InterimTarget-1) 0.05mg/m^3(InterimTarget-2) 0.03mg/m^3(InterimTarget-3)
SPM	1hour	0.2mg/m^3	-	-	-
	24hours	0.1mg/m^3	-	-	-
$PM_{2.5}$	24hours	0.035mg/m^3	0.05mg/m^3	-	0.075mg/m^3(InterimTarget-1) 0.05mg/m^3(InterimTarget-2) 0.0375mg/m^3(InterimTarget-3)
	1 year	0.015mg/m^3	0.025mg/m^3	-	0.035mg/m^3(InterimTarget-1) 0.025mg/m^3(InterimTarget-2) 0.015mg/m^3(InterimTarget-3)
Ozone	1hour	-	0.10ppm	0.3mg/m^3	-
	8hourdaily maximum	-	0.07ppm	0.2mg/m^3	0.16mg/m^3(InterimTarget-1) 0.1mg/m^3(Guideline)
	1 year	-	0.04ppm	0.14mg/m^3	-
Ox	1hour	0.06ppm	-	-	-
Pb	24hours	-	-	0.0015mg/m^3	
	1 month	-	0.0015mg/m^3	-	
	1 year	-	-	0.0005mg/m^3	

Source: National Air Quality Standard in Japan (CircularNo.25,1973, originally),Ministry of Environment, Japan
NotificationsofNationalEnvironmentalBoardNo.10, 24,28,33, and 36, Ministry of Natural Resources and Environment, Thailand
National Ambient Air Quality Standard (TCVN5973:2005), Ministry of Science and Technology in Vietnam
Environmental, Health, and Safety Guidelines, General EHS Guidelines, IFC, 2007

Figure 1 **Location of air and water monitoring points**

2. Water Quality Monitoring

Methodology

Sampling and preservation 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 pH, temperature, dissolved oxygen (DO), electrical conductivity (EC), 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 7 Field Equipment for Water Quality Survey

No.	Equipment	Manufacturer	Originate Country	Model
1	pH meter	HANNA	USA	HI7609829-1 pH Sensor
2	DO meter	HANNA	USA	HI7609829-2
3	Digital Water Velocity Meter	Global Water Flow Probe	USA	FP 211
4	Alpha Bottle (Water Sampler)	Wildlife Supply Company®	Indonesia	-

Table 8 Container and Preservation Method for Water Samples

No	Parameter	Container	Preservation
1	Oil and Grease	1000 ml glass bottle	Sulfuric acid, Refrigerate
2	COD	500 ml plastic bottle	Sulfuric acid, Refrigerate
3	BOD_5	1,800 ml plastic bottle	Refrigerate
4	Heavy metals	500 ml plastic bottle	HNO_3 Refrigerate
5	Bacteria	200 ml glass bottle (Sterilize)	Refrigerate
6	Others	1,800 ml polyethylene bottle	Refrigerate

Test method

The following table provides the test method for water quality.

No	Item	Analysis method
1	pH	HI7609829-1 pH Sensor
2	Suspended Solids	Gravimetric method
3	Dissolved Oxygen (DO)	HI7609829-2 Galvanic dissolved oxygen (D.O) sensor
4	Chemical oxygen demand(COD)	Dichromate method
5	Biochemical oxygen demand(BOD_5)	Direct inoculation method
6	Oil & Grease	APHA-AWWA-WEF Method
7	Chromium (Cr) (mg/l)	APHA-AWWA-WEF Method
8	E. coliform, Fecal coliforms, total coliforms	AOAC Petrifilm Method

Monitoring Result (December)

No	Item	GW-1	SW-2	SW- 3	SW- 4	Standard	Unit
1	pH	7.81	7.35	7.91	7.50		
2	Suspended Solids	90	2221	1958	781	Max. 200	mg/l
3	Dissolved Oxygen (DO)	8.32	7.60	7.12	6.32	-	mg/l
4	Chemical oxygen demand(COD)	12.0	40.9	52.5	62.0	Max. 300	mg/l
5	Biochemical oxygen demand(BOD_{5}	4.7	15.0	21.0	25.0	Max. 200	mg/l
6	Oil & Grease (SGS Lab Thailand)	5	<1	<1	<1	Max. 5	mg/l
7	Oil & Grease (SGS Lab Myanmar)	ND	1.9	ND	ND	Max. 5	mg/l
8	Chromium (Cr) (mg/l)	0.000	0.000	0.000	0.000	Max. 0.5	mg/l
9	E. coliform	<1.1	12	23	16	-	MPN/100ml
10	Fecal coliforms	2.2	23	46	70	-	MPN/100ml
11	Total coliforms	2.2	23	350	140	Max.400	MPN/100ml

Remark : ND is Not Detected.

Result of the Water Quality Monitoring (December 2014)

Total of four water samples from surface and underground water were collected on December 2014. According to the Lab results, the rest parameters are not higher than the MOI standard while suspended solid in SW-2 and SW-3 points are higher than the MOI standard.

For oil and grease contents parameter, all of locations in same time were specially checked for two times in both SGS Laboratories in Myanmar and Thailand. The oil and grease content of SW-2, SW-3 and SW-4 were lower than the MOI standard while GW-1 was slightly noticeable in SGS laboratory of Thailand. But oil and grease content of locations in SGS Laboratory of Myanmar were lower than the standard. For GW-1, the oil and grease content is still slightly presented in SGS laboratory of Thailand. The reason may be due to human contamination or oil leakage from pump machinery of tube well.

Detailed of laboratory result data are provided in appendix.

Laboratory Result

SGS

ANALYSIS REPORT

ORIGINAL

Job Ref: 8056/2014
Date : 22.12.2014

Client Name	:	**RESOURCE AND ENVIRONMENT MYANMAR CO., LTD** B-702 Delta Plaza, Shwegondaing Rd, Bahan Township, Yangon, Myanmar
Project Name	:	Water Quality Monitoring in Thilawa SEZ
Sample Brought By	:	Client
Sample Received Date	:	17.12.2014
Analysed Date	:	18.12.2014

Stations	Commodity Name	Lab Code	Method	Results (mg/l)
				Total Suspended Solid
GW-1 (17.12.2014)	Ground Water	234/14	APHA 2540 D	90
SW-2 (17.12.2014)	Surface Water	235/14	APHA 2540 D	2223
SW-3 (17.12.2014)	Surface Water	236/14	APHA 2540 D	1958
SW-4 (17.12.2014)	Surface Water	237/14	APHA 2540 D	781
Detection Limit				2

End Of Report

SGS (Myanmar) Limited

(Nu Nu Yi)
Manager

The Government of the Republic of the Union of Myanmar
Ministry of Agriculture and Irrigation
Irrigation Department
Survey and Investigation Branch
Soil Survey Section
Soil and Water Analytical Laboratory

ANALYTICAL DATA FOR WATER SAMPLE

PROJECT NAME; Monitoring in Thilawa SEZ
SAMPLE DESIGNATED AS; Water Quality
SAMPLING LOCATION; Near Thanlyin & Thilawa
17.12.2014

SAMPLING DATE; 19.12.2014
ISSUED DATE ; 26.12.2014
SAMPLING BY ; Client

Sr No	Station	Results (mg/l)		
		BOD_5	COD	Remark
1	GW-1	4.7	12.0	
2	SW-2	15.0	40.9	
3	SW-3	21.0	52.5	
4	SW-4	25.0	62.0	
Drinking Water Standard (WHO)	Highest desirable level	6 mg/l	10 mg/l	
	Maximum permissible level	Concentration at maximum permissible pollution		

(May Aye Ewin)
Staff Officer (Lab)
Soil Survey Section
Survey and Investigation Branch
Irrigation Department
Yangon

Report No. : 2015-00017 / 002 (Page 1 of 1) Issued date : January 20, 2015

CLIENT : **RESOURCE AND ENVIRONMENT MYANMAR CO., LTD.**
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E-mail : toetoehlainggeo@gmail.com

Analysis Report

PROJECT NAME : Water Quality Monitoring in Thilawa SEZ **SAMPLING DATE** : December 23, 2014
SAMPLE DESIGNATED AS : Groundwater Quality **SAMPLING BY** : Client
SAMPLING LOCATION : Near Thanlyin and Thilawa, Myanmar

Parameter	Units	LOQ	GW-1
Oil and Grease	mg/l	1	5

Remarks : - Analysis Methods followed to 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).
- LOQ = Limit of Quantitation

(Siripom Imwilaiwan)
Environmental Monitoring Manager

(Thepson Yommana)
Technical Manager

SGS (THAILAND) LIMITED

TY/Client/PPT/Ws

Report No. : 2015-00017 / 001 (Page 1 of 1) Issued date : January 20, 2015

CLIENT : **RESOURCE AND ENVIRONMENT MYANMAR CO., LTD.**
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E-mail : toetoehlainggeo@gmail.com

Analysis Report

PROJECT NAME : Water Quality Monitoring in Thilawa SEZ **SAMPLING DATE** : December 23, 2014
SAMPLE DESIGNATED AS : Surface Water Quality **SAMPLING BY** : Client
SAMPLING LOCATION : Near Thanlyin and Thilawa, Myanmar

Parameter	Units	LOQ	Results		
			SW-2	SW-3	SW-4
Oil and Grease	mg/l	1	<1	<1	<1

Remarks : - Analysis Methods followed to 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).
- LOQ = Limit of Quantitation

(Siripom Imwilaiwan)
Environmental Monitoring Manager

(Thepson Yommana)
Technical Manager

SGS (THAILAND) LIMITED

TY/Client/PPT/Ws

ANALYSIS REPORT

ORIGINAL

Job Ref: 8180/2014
Date : 27.12.2014

Client Name	:	**RESOURCE AND ENVIRONMENT MYANMAR CO., LTD** B-702 Delta Plaza, Shwegondaing Rd, Bahan Township, Yangon, Myanmar
Project Name	:	Water Quality Monitoring in Thilawa SEZ
Sample Brought By	:	Client
Sample Received Date	:	23.12.2014
Analysed Date	:	23.12.2014

Stations	Commodity Name	Lab Code	Method	Results (mg/l)
				Oil & Grease
GW-1 (23.12.2014)	Ground Water	242/14	APHA 5520 B	Not Detected
SW-2 (23.12.2014)	Surface Water	243/14	APHA 5520 B	1.9
SW-3 (23.12.2014)	Surface Water	244/14	APHA 5520 B	Not Detected
SW-4 (23.12.2014)	Surface Water	245/14	APHA 5520 B	Not Detected
Detection Limit				0.2

End Of Report

SGS (Myanmar) Limited

(Nu Nu Yi)
Manager

The Government of the Republic of the Union of Myanmar
Ministry of Agriculture and Irrigation
Irrigation Department
Survey and Investigation Branch
Soil Survey Section
Soil and Water Analytical Laboratory

ANALYTICAL DATA FOR WATER SAMPLE

PROJECT NAME;Water Quality Monitoring in Thilawa SEZ
SAMPLE DESIGNATED AS; Water Quality
SAMPLING LOCATION; Near Thanlyin & Thilawa
17.12.2014

SAMPLING DATE; 19.12.2014
ISSUED DATE ; 22.12.2014
SAMPLING BY ; Client

Sr No	Station	Results (mg/l) Chromium (Cr)	Remark
1	GW-1	0.000	
2	SW-2	0.000	
3	SW-3	0.000	
4	SW-4	0.000	
Drinking Water Standard (WHO)	Highest desirable level	-	
	Maximum permissible level	0.01 mg/l	

Remark: Analytical mentions are ppb unit by AAS. But this unit is changed as mg/L according to the standard of WHO unit.

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Staff Officer (Lab)
Soil Survey Section
Survey and Investigation Branch
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Report No. : 2015-00018 / 002 (Page 1 of 1) Issued date : January 29, 2015

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Analysis Report

PROJECT NAME : Water Quality Monitoring in Thilawa SEZ **SAMPLING DATE** : December 17, 2014
SAMPLE DESIGNATED AS : Groundwater Quality **SAMPLING BY** : Client
SAMPLING LOCATION : Near Thanlyin and Thilawa, Myanmar

Parameters	Units	LOQ	GW-1
Total Coliform Bacteria	MPN/100mL	-	2.2
Fecal Coliform Bacteria	MPN/100mL	-	2.2
Escherichia Coli (*E.Coli*)	MPN/100mL	-	<1.1

Remarks : - Analysis Methods followed to 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).
- LOQ = Limit of Quantitation

(Siripom Imwilaiwan)
Environmental Monitoring Manager

(Thepson Yommana)
Technical Manager

SGS (THAILAND) LIMITED

TY/Client/PPT/Ws

Report No. : 2015-00018 / 001 (Page 1 of 1) Issued date : January 29, 2015

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Analysis Report

PROJECT NAME : Water Quality Monitoring in Thilawa SEZ **SAMPLING DATE** : December 17, 2014
SAMPLE DESIGNATED AS : Surface Water Quality **SAMPLING BY** : Client
SAMPLING LOCATION : Near Thanlyin and Thilawa, Myanmar

Parameters	Units	LOQ	SW-2	SW-3	SW-4
Total Coliform Bacteria	MPN/100mL	-	23	350	140
Fecal Coliform Bacteria	MPN/100mL	-	23	46	70
Escherichia Coli (*E.Coli*)	MPN/100mL	-	12	23	16

Remarks : - Analysis Methods followed to 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).
- LOQ = Limit of Quantitation

(Siriporn Imwilaiwan)
Environmental Monitoring Manager

(Thepson Yommana)
Technical Manager

SGS (THAILAND) LIMITED

TY/Client/PPT/Ws

Thilawa Special Economic Zone (Zone A) Development Project –Phase 1

Appendix

Noise and Vibration Monitoring Report

November, 2014

NOISE AND VIBRTION MONITORING

IN

THILAWA SEZ CLASS A DEVELOPMENT

(November 2014)

Resource & Environment Myanmar Ltd., B-702 Delta Plaza Building, Shwegondaing Rd., Bahan, Yangon. MYANMAR Tel: (959) 7301 3448; Fax: (951) 552901 mailto: admin@enviromyanmar.net

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Noise and Vibration Monitoring Report

1. Introduction

The monitoring points are located in the Thilawa SEZ class A area. The site location is shown in Figure 1. Thilawa SEZ is located beside the Thanlyin and Kyauktan towns, about 20 km southeast side of Yangon city as shown in Figure 3.1-1. Project area with 400ha is center of Thilawa SEZ with an area of about 2,400 ha. Thilawa SEZ is surrounded by ring road and accompanied with the container ports along the Yangon River.

There are 2 ways to access to Thilawa SEZ from Yangon city, which are the route passing through Thanlyin Bridge and the route passing through Dagon Bridge.

Figure 1 Location map of the Thilawa Special Economic Zone.

2. Environmental Standard

2.1 Noise

(1) 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.

- Residential houses and monastery located less than 150m from the construction site comply with the middle range of the Singapore standard (categorized as "Residential buildings located less than 150m"), or
- Residential houses and monastery located more than 150m from the construction site, office, commercial facilities, and factories shall comply with the moderate range of standard Singapore standard (categorized as "Other buildings") or

This target noise level is shown in Table 1 and is not so much difference comparing with noise standard at construction stage in the other countries as shown in Table 2.

Table 1 Target Noise Level in Construction Phase

Category	Day time (Leq) (7am-7pm)	Evening Time (Leq) (7pm-10pm)	Night time (Leq) (10pm-7am)
Residential houses and monastery located less than 150m	75 dB	60 dB	55 dB
Residential houses and monastery located more than 150m from the construction site, office, commercial facilities, and factories	75 dB	65 dB	65 dB

Note) Evaluation point is at boundary of building

Table 2 Noise Standard at Construction Stage in the Various Countries

Items		Day time (Leq)	Night time (Leq)
Japan	Using heavy equipments with high noise level (piling, excavating etc.)	85 dB (Maximum)	-
Singapore	Hospitals, schools, institutions of higher learning, homes for the aged sick, etc.	60 dB (7am – 7pm, 12hrs)	50 dB (7pm – 7am, 12hrs)
	Residential buildings located less than 150m from the construction site where the noise is being emitted	75 dB (7am – 7pm, 12hrs)	60 dB (7pm – 10pm, 3hr) 55 dB (10pm – 7am, 9hr)
	Other Buildings	75 dB (7am – 7pm, 12hrs)	65 dB (7pm – 7am, 12hrs)
UK	In rural, suburban and urban areas away from main road traffic and industrial noise.	70 dB (8:00-18:00)	-
	Urban areas near main roads	72 dB (8:00-18:00)	-
USA	Residential	80 dB (8hrs)	70 dB (8hrs)
	Commercial	85 dB (8hrs)	85 dB (8hrs)
	Urban Area with high ambient noise level (>65 dB)	Ambient Noise Level +10dB	

Source: Noise Regulation Act, Japan (Law No.98, 1968, Amended No.33, 2006)
Environmental Protection and Management Act in Singapore (Chap.94A, Section 77, revised in 2008)
British Standard 5228: 1997 "Noise and vibration control on open and construction sites"
Transit Noise and Vibration Impact Assessment, U.S. Department of Transportation in USA, 1995

(2) Operation Phase

There is no ambient noise standard to receptors in Myanmar. However, most of the countries in south-east Asia have the ambient noise standard to receptors categorized land use or requirement of quiet as well as in Japan. International standard is also available in the EHS Guidelines prepared by IFC. On

the basis of the above information, target noise level is set as following concept and target ambient noise level.

- According to baseline survey in the Project, ambient noise levels in the monastery in Thilawa SEZ (Class A) are 53-60 dB in the daytime (6:00-22:00) and 44-58 dB in the nighttime (22:00-6:00).
- Ambient noise standard for sensitive areas of Japan and International Organization, relatively high in comparison with the results of baseline survey especially during nighttime.
- Thus, the target ambient noise level for sensitive and residential area is set in accordance with the noise standard in Singapore which is similar to the ambient noise level of the baseline survey.

The target noise level is shown in Table 3 and the target noise level is not so much difference comparing with ambient noise standard as shown in Table 4.

Table 3 Target Ambient Noise Level in Operation Phase

Category	Day Time (Leq) (7am-7pm)	Evening Time (Leq) (7pm-10pm)	Night Time (Leq) (10pm-7am)
Sensitive area such as Monastery	60 dB	55 dB	50 dB
Residential houses	65 dB	60 dB	55 dB
Commercial and Industrial Areas	70 dB	65 dB	60 dB

Note) Evaluation point is at boundary of building

Table 4 Ambient Noise Standard at Operation Stage in South-East Countries

Items		Day time (Leq)	Night time (Leq)
Indonesia	Noise standard for sensitive areas such as residences, hospitals, schools, places of religious worships	55 dB	
	Noise standard for office and commercial	65 dB	
	Noise standard for commercial and service	70 dB	
Malaysia	Sensitive Areas/ Low Density Residential Areas	55 dB (7am – 10pm, 15hrs)	50 dB (10pm – 7am, 9hrs)
	Sub Urban Residential	60 dB (7am – 10pm, 15hrs)	55 dB (10pm – 7am, 9hrs)
	Urban Residential	65 dB (7am – 10pm, 15hrs)	60 dB (10pm – 7am, 9hrs)
	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: Nose 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

2.2 Vibration

(3) Construction Phase

There is no vibration standard of construction activity to receptors in Myanmar as well as south-east Asia and International Organizations such as WHO and IFC. Thus, the target vibration level at

construction phase shall be set based on the standards in some foreign countries. Accordingly the target level of vibration in construction phase 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. Monitoring Result

Noise Level

Survey Item

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

As there are no environmental standards for noise level in Republic of Myanmar, the survey result was evaluated by comparing with the environmental standards and request limit for road noise in Japan.

Table 5 Survey Parameters for Noise Level

No.	Parameter	Unit		Environmental Standard	Request limit for road noise
				Japan	
				Living Environment	Along Road
1	A-weighted loudness equivalent (LAeq)	dB	Daytime (6:00-22:00)	55	75
			Nighttime (22:00-6:00)	45	70

Note) Environmental Quality Standard for Noise (Category B, Residential Area) in Japan

Survey Location

Third Time Monitoring (20th – 23rd November, 2014)

Summary of sampling points

The locations of noise level points and vibration monitoring points are shown in Table 6. The detail of each sampling points are described below.

Table 6 Location of Noise and Vibration Monitoring Station

Sampling Point	Coordinates	Description of Sampling Point
TNV-1	16°42'15.8"N, 96°16'00.5"E	In front of Myanmar Maritime University; about 2 m east of car road
TNV-2	16°40'15.5"N, 96°16'34.0"E	In the Moekyoswan Monastery Compound; about 140 m away from main car road
TNV-3	16°40'20.2"N, 96°16'35.5"E	In the Moekyoswan Monastery Compound; about 250 m away from main car road

TNV-1

The TNV-1 location was an open area in front of Myanmar Maritime University with about 2m from car road. The road was paved with low traffic volume and moderate speed. The nearest house is 20 meter away and no obstruction from trees. Dominant source of noise was vehicular traffic nearby the site. There was not any other noise source around the house. The location of TNV-1 is shown in Figure 2.

Figure 2 Location of TNV-1.

TNV-2

TNV-2 was sited at Moegyoswun Monastery Compound. The location was an open area beside monk houses with about 250m from the car road. The road was paved with low traffic. Dominant sources of noise were alarm song in the compound that ring thrice a day. There was not any other noise source around the monastery compound. The location of TNV-2 is shown in Figure 3.

Figure 3 Location of TNV-2.

TNV-3

TNV-3 was sited in front of Moegyoswun Monastery. The location was an open area beside the road with about 260 m from the car road. The road was paved with low traffic. Dominant sources of noise were alarm song in the compound that ring thrice a day and vehicular traffic. The location of TNV-3 is shown in Figure 4.

Figure 4 Location of TNV-3.

Survey Period

Sampling and monitoring of surrounding sound and vibration level at TNV-1, TNV-2 and TNV-3 were conducted during 20th – 23rd November, 2014.

Sampling Point	Survey Period
TNV-1	22nd – 23rd November, 2014 (24 hours)
TNV-2	20th – 21st November, 2014 (24 hours)
TNV-3	20th – 21st November, 2014 (24 hours)

Survey Method

Sampling and monitoring of surrounding sound and vibration level were conducted by using following instrument for 24 hours/1 day measurement.

Instrument	Brand	Model	Measurement unit
Sound Level Meter	Lutron	SL-0423SD	dB
Vibration Meter	Lutron	VB-8206SD	mm/s, cm/s

a) Noise Survey

Frequency

- One time (24 hours monitoring in weekday)

Total Sample

- Three samples

Record Interval

- One record for 10 minute interval

b) Vibration Survey

Frequency

- One time (24 hours monitoring in weekday)

Total Sample

- Three samples

Record Interval

- One record for 5 seconds interval for 10 minutes during an hour

Survey Result

Noise levels (L_{Aeq}) of the monitoring points were presented in Table 7. One day L_{Aeq} was calculated by using the following array formula in the excel sheet. This formula is firstly used for hourly L_{Aeq} and then for the 24 hours L_{Aeq}.

10*LOG10(AVERGAE(10^((RANGE)/10)))

By means of the calculated results, all of the noise levels found lower than the environmental standard (1-day) in Thailand. Noise level (LAeq) in present monitoring period was presented in Table 7 and Table 8. Table of observed hourly noise level in three monitoring stations is shown in Appendix 1.

Table 7 Hourly LAeq value in noise monitoring stations.

Unit: dBA

Time	TNV-1	TNV-2	TNV-3
	22nd-23rd November	20th - 21st November	20th - 21st November
6:00-7:00	58	60	56
7:00-8:00	65	66	52
8:00:9:00	55	55	50
9:00-10:00	61	55	56
10:00-11:00	55	48	52
11:00-12:00	55	52	63
12:00-13:00	54	57	49
13:00-14:00	63	59	52
14:00-15:00	59	50	53
15:00-16:00	55	54	53
16:00-17:00	56	54	58
17:00-18:00	56	56	54
18:00-19:00	58	58	60
Day L_{Aeq}	58	56	54
19:00-20:00	55	62	54
20:00-21:00	58	58	57
21:00-22:00	52	56	52
Evening L_{Aeq}	55	59	54
22:00-23:00	47	54	56
23:00-24:00	46	53	51
24:00-1:00	50	50	44
1:00-2:00	46	50	44
2:00-3:00	49	50	45
3:00-4:00	55	50	45
4:00-5:00	47	50	45
5:00-6:00	55	51	44
Night L_{Aeq}	49	51	47

Table 8 A-weighted Loudness Equivalent (LAeq) Level

Unit: dB(A)

Date	TNV-1 22nd – 23rd November 2014			TNV-2 20th – 21st November 2014			TNV-3 20th – 21st November 2014		
	Day Time	Evening Time	Night Time	Day Time	Evening Time	Night Time	Day Time	Evening Time	Night Time
	58	55	49	56	59	51	54	54	47
Target Noise Level	75	65	65	75	60	55	75	60	55

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) Truck traffic (rough surface)	<0.2mm/s @ 20m <2mm/s @ 20m

Survey location

- Three points (same location as noise survey)

Frequency

- One time (24 hours)

Methodology

- Vibration level (dB), Frequency, Velocity, Measurement of vibration level is conducted by International standard method.

Result

Vibration results were presented in Figure 5 to 7. Table of observed vibration level is presented in Appendix 2.

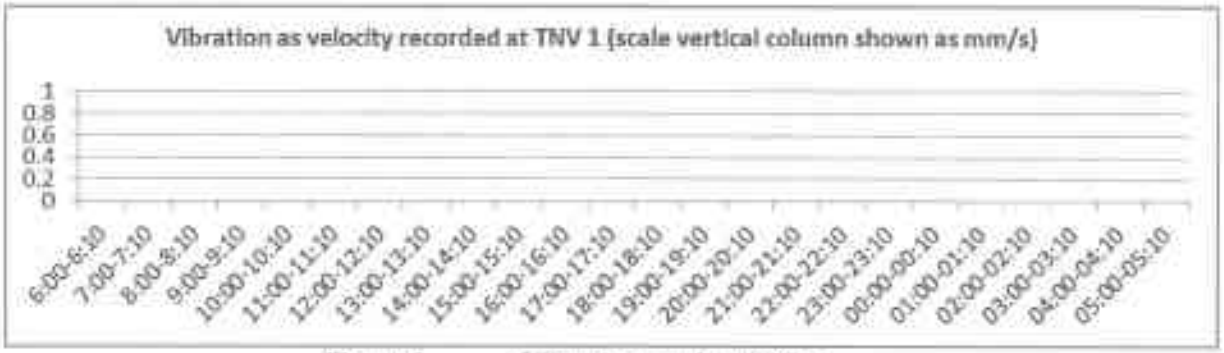

Figure 5 Vibration result of TNV 1.

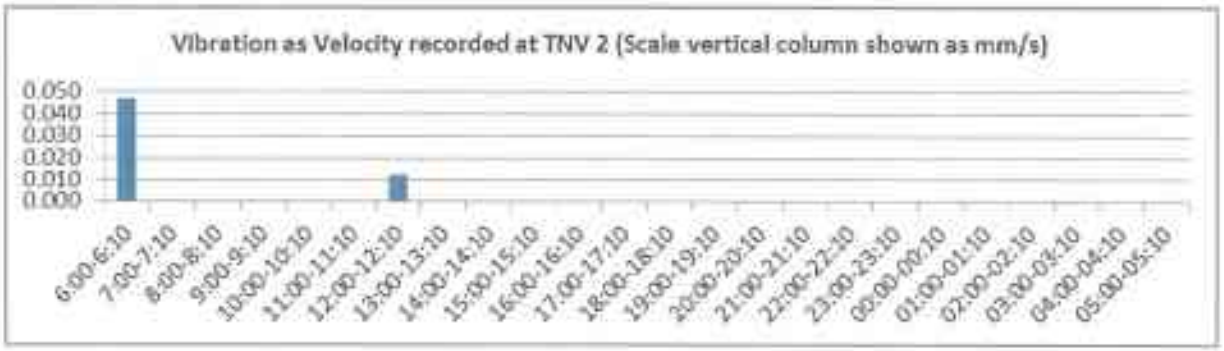

Figure 6 Vibration result of TNV 2.

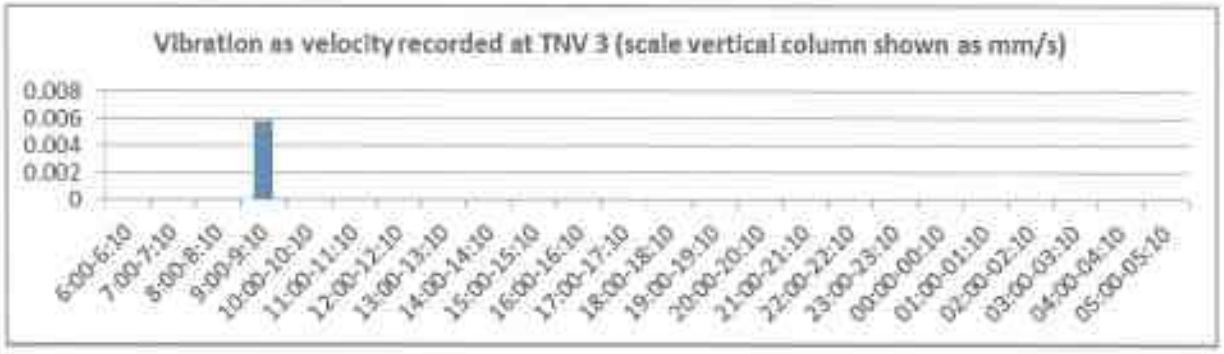

Figure 7 Vibration result of TNV 3.

4. Conclusion

The noise level monitoring results are compared with target noise level proposed in EIA report (See Table 1). Two noise receptors were designated in construction phase based on the baseline noise data.

There are :

1. Residential houses and monastery located less than 150m from the construction site comply with the middle range of the Singapore standard (categorized as "Residential buildings located less than 150m"), or
2. Residential houses and monastery located more than 150m from the construction site, office, commercial facilities, and factories shall comply with the moderate range of standard Singapore standard (categorized as "Other buildings")

The noise level monitoring at three sites in and near the project site 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 millimetres 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 are no activity inside the Class A compound and only the loading and unloading raw 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 in pre – construction phase.

Appendix 1 Observed Noise level in 3 Monitoring Stations

	Date		
	22-23 November	20-21 November	20-21 November
Time	**TNV-1**	**TNV-2**	**TNV-3**
6:00-7:00	58	60	56
7:00-8:00	65	66	52
8:00:9:00	55	55	50
9:00-10:00	61	55	56
10:00-11:00	55	48	52
11:00-12:00	55	52	63
12:00-13:00	54	57	49
13:00-14:00	63	59	52
14:00-15:00	59	50	53
15:00-16:00	55	54	53
16:00-17:00	56	54	58
17:00-18:00	56	56	54
18:00-19:00	58	58	60
Day L_{Aeq}	58	56	54
19:00-20:00	55	62	54
20:00-21:00	58	58	57
21:00-22:00	52	56	52
Evening L_{Aeq}	55	59	54
22:00-23:00	47	54	56
23:00-24:00	46	53	51
24:00-1:00	50	50	44
1:00-2:00	46	50	44
2:00-3:00	49	50	45
3:00-4:00	55	50	45
4:00-5:00	47	50	45
5:00-6:00	55	51	44
Night L_{Aeq}	49	51	47

Appendix-2 Observed vibration level in 3 monitoring stations

Vibration as Velocity (mm/s)

	TNV-1 (22-23 Nov)	TNV-2 (20-21 Nov)	TNV-3 (20-221 Nov)
Time	mm/s	mm/s	mm/s
6:00-6:10	0.00	0.05	0.00
7:00-7:10	0.00	0.00	0.00
8:00-8:10	0.00	0.00	0.00
9:00-9:10	0.00	0.00	0.01
10:00-10:10	0.00	0.00	0.00
11:00-11:10	0.00	0.00	0.00
12:00-12:10	0.00	0.01	0.00
13:00-13:10	0.00	0.00	0.00
14:00-14:10	0.00	0.00	0.00
15:00-15:10	0.00	0.00	0.00
16:00-16:10	0.00	0.00	0.00
17:00-17:10	0.00	0.00	0.00
18:00-18:10	0.00	0.00	0.00
19:00-19:10	0.00	0.00	0.00
20:00-20:10	0.00	0.00	0.00
21:00-21:10	0.00	0.00	0.00
22:00-22:10	0.00	0.00	0.00
23:00-23:10	0.00	0.00	0.00
00:00-00:10	0.00	0.00	0.00
01:00-01:10	0.00	0.00	0.00
02:00-02:10	0.00	0.00	0.00
03:00-03:10	0.00	0.00	0.00
04:00-04:10	0.00	0.00	0.00
05:00-05:10	0.00	0.00	0.00