REPORT ON

AMBIENT AIR QUALITY

FOR

WIRANDA (M) SDN. BHD.

PROJECT:

PROPOSED PAN ISLAND LINK 1 HIGHWAY, PENANG

PROJECT REFERENCE	: 1251-1259/2016-03
REPORTING DATE	: 01/08/2016
SAMPLING DATE	: 21-30/03/2016

Performed by:
UiTM – A & A Laboratory
We Make the Future Greener

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1.0 INTRODUCTION

Wiranda (M) Sdn. Bhd., an environmental management consultation firm had commissioned UiTM – A&A Laboratory (SAMM 084) of A&A Scientific Resources Sdn. Bhd. to conduct an Ambient Air Quality Monitoring exercise for Project of 'Proposed Pan Island Link 1 Highway, Penang'. Pan Island Link Highway (PIL) is a proposed motorway for Penang Island. It is one of the two components of the Penang Transport Master Plan which are targeted at addressing the critical traffic congestion on the island. Upon completion, the proposed Pan Island Link (PIL) highway will be able to share the heavy traffic load of the Tun Dr Lim Chong Eu Expressway (LCE), while the proposed Bayan Lepas LRT will be the rail backbone of Penang's future public transport system.

Traffic movement across the island is to be relieved by the PIL and the proposed Bayan Lepas Light Rail Transit, which will be an elevated railway line connecting Teluk Kumbar and Batu Maung with Gurney Drive, with interchanges at Paya Terubong, Relau, Jalan Tun Dr Awang and LCE. Land reclamation off the coast of Gurney Drive will enable the construction of a new coastal highway, tentatively known as the Gurney Expressway. It will be connected to the PIL which will run from Bagan Jermal to Bayan Lepas, to connect with the LCE at the Second Penang Bridge exit. This enables cross-island traffic to bypass the densely populated and congested roads of the central and northeastern portions of the island.

The Ambient Air Quality Monitoring was performed from 21th March 2016 – 30th March 2016 at 9 selected points. Four parameters are measured in this monitoring exercise namely Particulate Matter less than 10 micron (PM_{10}), Particulate Matter less than 2.5 micron ($PM_{2.5}$), Carbon Monoxide (CO) and Nitrogen Dioxide (NO_2). All monitored parameters are then compared against Malaysia Ambient Air Quality Standards

(MAAQS). Below are the sampling duration for the parameters for the ambient air quality monitoring:

Parameter	Sampling Duration
Particulate Matter (PM_{10})	24 hours
Particulate Matter ($PM_{2.5}$)	24 hours
Carbon Monoxide (CO)	Grab Sample
Nitrogen Oxide (NO_2)	1 hour

2.0 OBJECTIVE

The objective of the ambient air quality monitoring is to determine the ambient air quality level at 9 selected locations for Project of 'Proposed Pan Island Link 1 Highway, Penang'.

3.0 SCOPE OF WORK

Scope of work and responsibilities of UiTM – A&A Laboratory are as follows:

- To perform Ambient Air Quality Monitoring at 9 selected sampling locations.
- To prepare and submit an ***"Ambient Air Quality Monitoring Report"*** to Wiranda (M) SDN BHD.

4.0 TERMINOLOGY

- Particulate Matter (PM)
  - Particulate matter is the term for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets, and can be large and dark enough to be seen with the naked eye or so small that they can only be detected with an electron microscope. The size of the particulate has important health considerations.
  - PM_{10} is Particulate matter less than 10 microns in diameter. It poses a health concern because it can be inhaled into and accumulates in the respiratory system.
  - $PM_{2.5}$ is Particulate matter less than 2.5 microns in diameter. It is believed to pose the greatest health risks as it can lodge deeply into the lungs.

- Carbon monoxide (CO)
  - Carbon monoxide is colorless, odorless, and tasteless, but highly toxic. It combines with hemoglobin to produce carboxyhemoglobin, which usurps the space in hemoglobin that normally carries oxygen, but is ineffective for delivering oxygen to bodily tissues. Concentrations as low as 667 ppm may cause up to 50% of the body's hemoglobin to convert to carboxyhemoglobin. A level of 50% carboxyhemoglobin may result in seizure, coma, and fatality.

- Nitrogen dioxide (NO_2)
  - NO_2 is a reddish brown gas with a pungent odor, which upon reaction with other atmospheric compounds, becomes a major contributor to smog, acid rain, inhalable particulates and reduced visibility. At significant levels and exposure, inhalation may result in irritation and burning to the skin and eyes, nose and throat. Prolonged exposure may result in permanent lung damage.

5.0 LEGISLATION AND GUIDELINE

The Malaysian Government has established the necessary legal, institutional arrangements and guidelines to promote of environmentally sound and sustainable development including Ambient Air Quality Monitoring. The monitoring is one way to protect and assess air quality and it is important due to significantly increase in air pollutants emissions. It is a necessary monitoring for all industry players who wish to comply with ISO 14000 by investigating air quality within their industry premises.

The Ambient Air Quality Standard adopts 6 air pollutants criteria which are particulate matter with the size of less than 10 micron (PM_{10}), particulate matter with the size of less than 2.5 micron ($PM_{2.5}$), sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), and ground level ozone (O_3). The air pollutants concentration limit will be strengthened in stages until 2020. There are 3 interim targets set which include interim target 1 (IT-1) in 2015, interim target 2 (IT-2) in 2018 and the full implementation of the standard in 2020.

Pollutants	Averaging Time	Malaysian Ambient Air Quality Standard		
		IT-1 (2015)	IT-2 (2018)	Standard (2020)
		µg/m^3	µg/m^3	µg/m^3
Particulate Matter with the size of less than 10 micron (PM_{10})	1 year	50	45	40
	24 hours	150	120	100
Particulate Matter with the size of less than 2.5 micron ($PM_{2.5}$)	1 year	35	25	15
	24 hours	75	50	35
Sulfur Dioxide (SO_2)	1 year	350	300	250
	24 hours	105	90	80
Nitrogen Dioxide (NO_2)	1 hour	320	300	280
	24 hours	75	75	70
Ground Level Ozone (O_3)	1 hour	200	200	180
	8 hours	120	120	100
Carbon Monoxide (CO) (in mg/m^3)	1 hour	35	35	30
	8 hours	10	10	10

6.0 SAMPLING PLAN AND METHODOLOGY

6.1 Sampling Personnel

- Mr Wan Iqmal Hakimi Bin Nan
- Mr Norkhairi Mustapa

6.2 Monitoring Parameters, Methodology & Instrumentation

The environmental air samples were collected from the fixed point by drawing the air from the surrounding area through the absorbing media via a pre-calibrated portable pump stationed at the fixed points. .

1) Parameter : Particulate Matter less than 10 micron (PM_{10}) and 2.5 micron ($PM_{2.5}$)

Instrument : MiniVol Portable Air Sampler

Sampling Duration : 24 hours

Method

The pump draws air at 5 litres /minute through a particle size separator (impactor) and then through a 47 mm filter. The samples can be collected by using the 10 and 2.5 impactor for PM_{10} and $PM_{2.5}$ measurements, respectively. The particulate sample is caught on the filter, which must be weighed pre- and post-exposure with a microbalance accurate to one microgram.

2) Parameter : Carbon Monoxide as CO

Monitoring Device : KITAGAWA Gas Detector Tube System

Detector Tube : 106SC Carbon Monoxide
(Measuring range: 1– 50 ppm)

Sampling Duration : Grab Sample

Description

Carbon Monoxide, CO is pump into the detector tube for 4 minutes' duration or until the completion of sampling is confirmed with the flow indicator of the pump. The CO concentration is determined by reading the scale at the maximum point of stained layer.

3) Parameter : Nitrogen Dioxide as NO_2

Method Specification : APHA 42602-03-73T

Sampling Duration : 1 hour

Monitoring Device : Sampling pump

Method Description

Nitrogen Dioxide is absorbed from the air by aqueous triethanolamine solution; subsequent analysis is done using an azo-dye forming agent. The color produced by the reagent is measured in a spectrophotometer at 540 nm.

Quality assurance procedure:

Blank sample is prepared by measuring 10 ml of triethanolamine in volumetric flask. Blank sample only contain solute without the analytic and is analyzed along with the sample.

Duplicate sample (10 ml) is selected among the sample and analyzed along with the sample. Percent recovery of the duplicate sample is 80% to 120%.

Quality Control procedure:

Quality check sample is prepared with concentration of 6 µg/L by mixing 3 ml sodium nitrate and 7 ml triethanolamine. The quality control sample is analyzed along with other sample. Accepted percent recovery is within the range of 80% to 120%.

6.3 Sampling Description

Sampling Point	Sampling Point Description	Coordinate	Pollutants	Sampling Time	Sampling Date
A1	Near Snake Temple	N 05° 18'50" E 100°16'56"	PM_{10} & $PM_{2.5}$	11:40 pm to 11:40 pm	21th – 22th March 2016
			NO_2	11:40 pm to 12:40 pm	21th March 2016
			CO	11:45am 14.40pm 22:45 pm	
A2	Pintasan Mayang 7	N 5° 19'19" E 100°16'18"	PM_{10} & $PM_{2.5}$	11:55 pm to 11:55 pm	22th – 23th March 2016
			NO_2	11:55 pm to 12:55 pm	22th March 2016
			CO	11:45 am 14:45 pm 22:40 pm	

Sampling Point	Sampling Point Description	Coordinate	Pollutants	Sampling Time	Sampling Date
A3	Nearby Apartment Sg. Ara	N 5° 19'33" E 100°16'8"	PM_{10} & $PM_{2.5}$	12:20 pm to 12:20 pm	23th – 24th March 2016
			NO_2	12:20 pm to 13:20 pm	23th March 2016
			CO	11:35 am 14:50 pm 22:40 pm	
A4	Near Relau	N 5° 20'36" E 100°15'56"	PM_{10} & $PM_{2.5}$	13:00 pm to 13:00 pm	24th – 25th March 2016
			NO_2	13:00 pm to 14:00 pm	24th March 2016
			CO	11:45 am 14:45 pm 22:45 pm	
A5	Jalan Buah Jambu, Air Hitam	N 5° 22'43" E 100°16'28"	PM_{10} & $PM_{2.5}$	14:20 pm to 14:20 pm	27th – 28th March 2016
			NO_2	14:20 pm to 15:20 pm	27th March 2016
			CO	11:10 am 14:30 pm 22:40 pm	
A6	Near Emerald Height	N 5°23'13" E 100°16'23"	PM_{10} & $PM_{2.5}$	14:50 pm to 14:50 pm	29th – 30th March 2016
			NO_2	14:50 pm to 15.50 pm	29th March 2016
			CO	11:50 am 14:40 pm 22:40 pm	

Sampling Point	Sampling Point Description	Coordinate	Pollutants	Sampling Time	Sampling Date
A7	Taman Cantik	N 5°24'22" E 100°16'58"	PM_{10} & $PM_{2.5}$	14:45 pm to 14:45 pm	28th – 29th March 2016
			NO_2	14:45 pm to 15:45 pm	28th March 2016
			CO	12:00 pm 14:40 pm 22:45 pm	
A8	Penang Chinese Girls High School	N 5°26'1" E 100°18'10"	PM_{10} & $PM_{2.5}$	13:40 pm to 13:40 pm	25th – 26th March 2016
			NO_2	13:40 pm to 14:40 pm	25th March 2016
			CO	11:15 am 14:45 pm 22:40 pm	
A9	SJK Tamil Azad	N 5°26'11" E 100°18'16"	PM_{10} & $PM_{2.5}$	13:55 pm to 13:55 pm	26th – 27th March 2016
			NO_2	13:55 pm to 14:55 pm	26th March 2016
			CO	11:00 am 14:40 pm 22:45 pm	

7.0 RESULT OF ANALYSIS

Parameter	Unit	Sampling Duration	A1	A2	A3	Specification MAAQS (IT-1 [2015])
Particulate Matter (PM_{10})	µg/m^3	24 hours	52	65	65	150
Particulate Matter ($PM_{2.5}$)	µg/m^3	24 hours	26	39	26	75
Carbon Monoxide (CO)	ppm	Grab Sample	1	ND<1	ND<1	35(mg/m^3)
Nitrogen Dioxide (NO_2)	µg/m^3	1 hour	ND<2	ND<2	ND<2	320

**MAAQS: Malaysian Ambient Air Quality Standard*

Parameter	Unit	Sampling Duration	A4	A5	A6	Specification MAAQS (IT-1 [2015])
Particulate Matter (PM_{10})	µg/m^3	24 hours	52	52	39	150
Particulate Matter ($PM_{2.5}$)	µg/m^3	24 hours	26	26	26	75
Carbon Monoxide (CO)	ppm	Grab Sample	ND<1	ND<1	ND<1	35 (mg/m^3)
Nitrogen Dioxide (NO_2)	µg/m^3	1 hour	ND<2	ND<2	ND<2	320

**MAAQS: Malaysian Ambient Air Quality Standard*

Parameter	Unit	Sampling Duration	A7	A8	A9	Specification MAAQS (IT-1 [2015])
Particulate Matter (PM_{10})	µg/m^3	24 hours	52	65	65	150
Particulate Matter ($PM_{2.5}$)	µg/m^3	24 hours	26	26	26	75
Carbon Monoxide (CO)	ppm	Grab Sample	ND<1	ND<1	ND<1	35 (mg/m^3)
Nitrogen Dioxide (NO_2)	µg/m^3	1 hour	ND<2	ND<2	ND<2	320

**MAAQS: Malaysian Ambient Air Quality Standard*

Please refer to Certificate of Analysis: **CN 03183/2016/03**

8.0 CONCLUSION

The Ambient Air Quality Monitoring exercise conducted for Wiranda (M) Sdn. Bhd. for Proposed of Pan Island Link 1 Highway, Penang Project had been completed from 21th March 2016 until 25th March 2016.

Results of the ambient air qualities are compared against the Malaysian Ambient Air Quality Standard. According to Malaysian Ambient Air Quality Standard (IT-1[2015]), the PM_{10}, $PM_{2.5}$, CO and NO_2 level shall not be greater than 150 µg/m^3, 75 µg/m^3, 35 mg/m^3 and 320 µg/m^3, respectively. All parameters at all sampling point were found to be **below** the stipulated limit. No detection of CO and NO_2 level for this monitoring for all sampling point.

Report Prepared By;

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Mawar Hazwani Bt Jasimin
Environmental Officer
UiTM – A&A Laboratory

Report Verified By;

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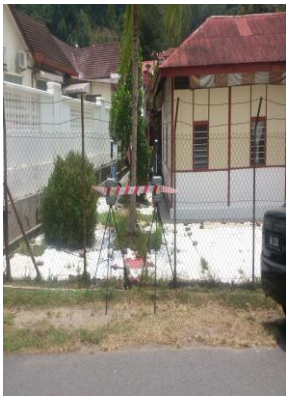
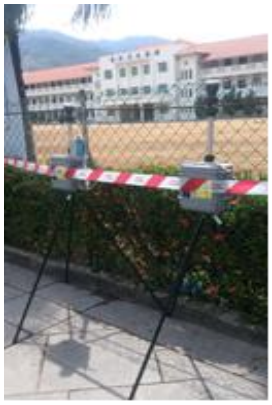
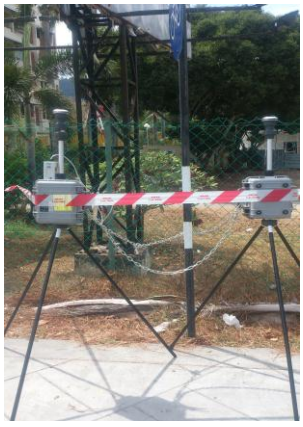
Azita Ayu Abdul Halim,
BSc. (App. Chem.), MSc. (Mar. Sc.), AMIC
IKM No. A/2448/5081/2007
Laboratory Manager, UiTM – A&A Lab

9.0 APPENDICES

- Photos of Sampling Points
- Certificate of Analysis
- Certificate of Calibration

Appendix I: Photos of Sampling Points

A1: Near Snake Temple	A2: Pintasan Mayang 7
	
A3: Near Apartment Sg. Ara	**A4: Near Relau**
	
A5: Jalan Buah Jambu, Air Hitam	**A6: Near Emerald Height**
	

A7: Taman Cantik	A8: Penang Chinese Girls High School
	
A9: SJK Tamil Azad	
	

Appendix ll: Certificate of Analysis

Appendix lll: Certificate of Calibration

MiniVol Portable Sampler
Flow Calibration
Sampler SN: 6345

Calibration Date:	02/18/2016	Transfer Standard SN:	MF1731
Ambient Temp, deg C:	25.0	Transfer Standard Cal Date:	06/01/2015
Atmos Press, mmHg:	760.0	Transfer Standard slope: m(flo) =	5.6984
		Transfer Standard intercept: b(flo) =	-0.0720

Qind (lpm)	Qact (alpm)	Q@std (slpm)	Qcalc (slpm)	Diff (%)
6.50	7.430	7.430	7.364	-0.88
6.00	6.847	6.847	6.838	-0.13
5.50	6.271	6.271	6.312	0.66
5.00	5.693	5.693	5.786	1.64
4.50	5.209	5.209	5.260	0.99
4.00	4.846	4.846	4.734	-2.32

Linear Regression Results:
m(vol) = 1.0520
b(vol) = 0.5261
r2(vol) = 0.9938

The MiniVol calibration should be performed with an NIST-traceable standard. Each unit has a unique pair of calibration constants derived from the calibration which are used to calculate the sampler's actual flow rate at all ambient conditions. The sampler's calibration should be recertified annually.

For an indicated rotameter flow rate (Qind), the flow rate at actual sampling conditions (Qact) is given by the following equation (Eq.1):

$$Q_{act} = \left(m_{vol} Q_{ind} + b_{vol}\right) \times \sqrt{\frac{P_{std}}{P_{act}} \times \frac{T_{act}}{T_{std}}} \qquad \text{Eq.1}$$

The sampler is designed to operate at 5.0 lpm at actual conditions. The rotameter setting for this nominal flow rate (Isp) can be calculated by using the following equation (Eq.2):

$$I_{sp} = \frac{5.0 \times \sqrt{\frac{P_{act}}{P_{std}} \times \frac{T_{std}}{T_{act}}} - b_{vol}}{m_{vol}} \qquad \text{Eq.2}$$

Where:

Isp = Calculated Rotameter Setpoint, liters/min.
Pstd = Standard Atmospheric Pressure (760 mmHg)
Tstd = Standard Temperature (298 deg K)
Pact = Actual Ambient Pressure, mmHg
Tact = Actual Ambient Temperature, deg K
Qact = Actual Flow Rate, liters/min.
Qind = Rotameter Indicated Flow Rate, liters/min.

BIOCLEAR SDN BHD (157369-D)
No 4, Jalan Industri PBP9
Taman Industri Pusat Bandar Puchong
47100 Puchong, Selangor, Malaysia
Tel: 03-58825525 Fax: 03-58824889
E-mail: bioclear@bioclear.com.my
Website: www.bioclear.com.my

AirMetrics
2121 Franklin Blvd #9
Eugene, OR 97403
(541) 683-5420

MULTITECH CALIBRATION SERVICES SDN BHD
(Company No: 929584-D) (GST No: 0009 6447 6928)
No. 48B, Jalan BRP 6/11, Section U20, Bukit Rahman Putra,
47000 Sungai Buloh, Selangor Darul Ehsan, Malaysia.
Tel: 603-6157 3033 / 6157 3055 Fax: 603-6157 3044
Email: multitech06@gmail.com Website: www.multitechcalibration.com

MS ISO/IEC 17025
CALIBRATION
SAMM NO.308

CERTIFICATE OF CALIBRATION

Date of Issue : 10 March 2016

Loke Poo Seng
Approved Signatory

Issue To : **A & A SCIENTIFIC RESOURCES SDN BHD**
BANGUNAN PENYELIDIKAN ALAM SEKITAR,
KOLEJ KENANGA 2, JALAN BERNAS 1/10D,
UNIVERSITI TEKNOLOGI MARA-UITM SHAH ALAM,
40450 SHAH ALAM, SELANGOR.

Certificate Number : YFG0248
Calibration Sticker No. : B 95873
Date of Calibration : 09 March 2016
Requested Cal. Due Date : 08 March 2017
* Recalibration date requested by customer.
* The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

Equipment Details

Instrument : Analytical Balance
Manufacturer : Ohaus
Model : PA214
Serial Number : 1280351291
Related Number : L97
Capacity : 210 g
Resolution : 0.0001 g
Upon Receiving : Good Physical Condition
Upon Returning : Calibrated

Environmental Condition		Min.		Max.	
Temperature	:	26	°C	26	°C
Relative Humidity	:	54	%R.H.	55	%R.H.

This Instrument has been calibrated at A & A SCIENTIFIC RESOURCES SDN BHD

Work Instruction : In House Procedure WI200D

Reference Standard(s) Used

Equipment Used	Certificate Number	Calibration Due Date	Traceable To
Standard Weight	YEE0643	06 September 2016	NML - SIRIM