Tollaust Pty Ltd

Lane Cove Tunnel

CO In Tunnel Air Quality Monitoring

Validated Report

1st April 2014 – 30th April 2014

Report No.: DAT8239

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Maintenance contract: MC1072

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Lane Cove Tunnel & Military Road E-Ramp

Report No: DAT8239

Tollaust Pty Ltd

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Revision History			
Revision	**Report ID**	**Date**	**Analyst**
0	DAT8239	08/05/2014	Pedro Cascão

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Executive Summary

The Lane Cove Tunnel is located in Sydney, Australia and is a 3.6 km twin tunnel motorway under Epping Road that links the M2 Motorway at North Ryde with the Gore Hill Freeway at Artarmon. Ecotech Pty Ltd is contracted by Tollaust Pty Ltd to undertake reporting services for the air quality monitoring system inside the tunnel which ensures that the carbon monoxide (CO) levels inside the Tunnel are always kept to within levels and limits stipulated by the Ministers Conditions of Approval (MCoA) for the Lane Cove Tunnel.

Continuous measurements of CO inside the tunnel are recorded, validated and reported to Tollaust Pty Ltd on a monthly basis.

Maintenance and calibrations are performed a third party contractor.

This report presents validated data for the month of April 2014.

During the period 1st April 2014 to 30th April 2014, CO levels inside the tunnel were within the limits stipulated by the Department of Planning.

1.0 Introduction

Ecotech is an independent company contracted by Tollaust Pty Ltd to undertake in tunnel air quality reporting at the Lane Cove Tunnel.

This report presents the validated data for April 2014.

- Describes air quality measurements;
- Reports any readings above the LCT limits;
- Compares monitoring results;
- Has been quality assured;

2.0 Monitoring and Data Collection

2.1. Siting Details

The CO In tunnel monitoring network consists of

- Twenty eight separate CO monitors attached to the walls and portals of both eastbound and westbound tunnels

Table 1: Locations and parameters for In-tunnel open path type air quality monitoring

Monitoring Location	Parameters Measured
	CO
A	x
B	x
C	x
F	x
G	x
H	x
I	x
J	x
M	x
N	x
Q	x
R	x
S	x
T	x
U	x
V	x
W	x
X	x
Y	x
Z	x
AA	x
AB	x
AC	x
AG	x
AH	x
AI	x
AJ	x
AK	x
AL	
AM	
AN	
TOTAL	28

Non-highlighted rows – tunnel wall monitors; light grey highlighted rows – portal located monitors; dark grey highlighted rows –in ventilation stack monitors

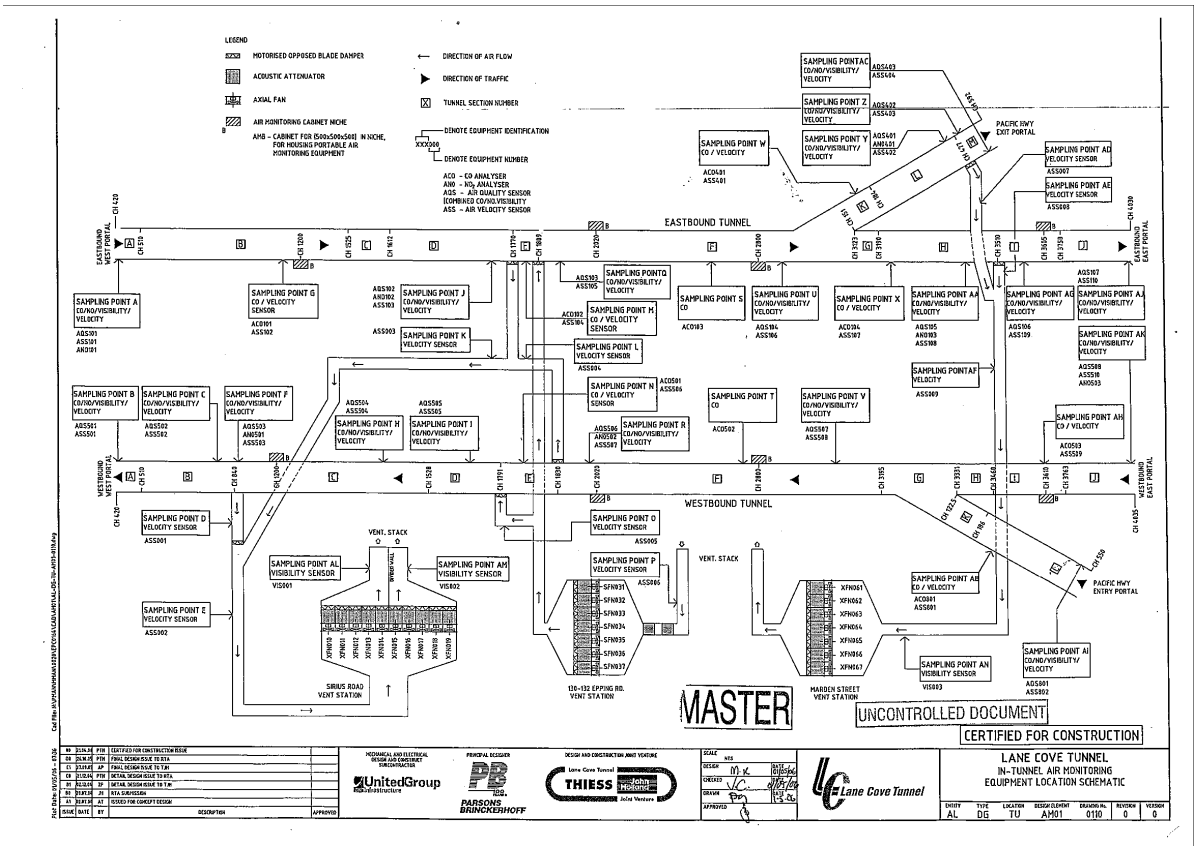

Figure 1: Lane Cove monitoring network

2.2. Monitored Parameters

Table 1 below details the parameters monitored and the instruments used at the monitoring network. Appendix 1 defines any abbreviated parameter names used throughout the report.

Table 2: Parameters measured at the Lane Cove monitoring network

Parameter Measured	Instrument and Measurement Technique
CO	CODEL TunnelCraft III AQM – Infrared Gas Cell Correlation.

2.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 0.

Table 3: Methods

Parameter Measured	Data Collection Methods Used	Description of Method
CO	Codel Tunnel Master Open Path - infrared	This method involves projecting an infrared beam across a 3 meter section of the tunnel into a reflector and the reflected light is received by a transceiver which measures the specific absorption

Carbon monoxide (CO) levels are measured inside the tunnel using a network of 28 separate CO monitors attached to the walls of both eastbound and westbound tunnels. The monitors measure CO using an analytical method known as non-dispersive infra-red absorption with gas filter correlation. Basically this involves projecting an infra-red beam across a 3 meter section of the tunnel and measuring the amount of infra-red light absorbed by CO molecules in the path of the beam. The quantity of infra-red light absorbed is proportional to the concentration of CO in the path of the beam. The monitors used were specially designed for use in road tunnels where access for routine essential maintenance is restricted by the need to minimise traffic disruption. Similar monitors are widely used in other road tunnels in Australia and worldwide.

The CO method of analysis is similar to the standard method AM-6 outlined in "NSW EPA 2001, Approved Methods for Sampling and Analysis of Pollutants in New South Wales." However the method differs from the standard principally by the use of the open beam type instrument as described above in place of a closed analytical cell and sample delivery pump as typically used in ambient air monitoring stations. This deviation from the standard method has been approved by the Department of Planning on the advice of an independent consultant with specialist expertise in the field of air quality monitoring.

2.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Lane Cove Tunnel & Military Road E-Ramp stations according to the methods detailed in Table 3 above.

2.3.2. Data Acquisition

Data acquisition is performed using the LCT-MRE Pty Ltd hardware and software on a weekly basis. The recorded data is remotely collected from the remote PC on a daily basis (using Airodis™ version 5.0) and stored at Ecotech's Environmental Reporting Services (ERS) department in Melbourne, Australia. Data samples are logged in 1 minute intervals.

2.4. Data Validation and Reporting

2.4.1. Validation

Ecotech ERS maintains two distinct databases containing non-validated and validated data respectively.

The validated database is created by duplicating the non-validated database and then flagging data affected by instrument faults, calibrations and other maintenance activities. The data validation software requires the analyst to supply a valid reason (e.g. backed by maintenance notes, calibration sheets etc) in the database for flagging any data as invalid.

Details of all invalid or missing data are recorded in the Valid Data Exception Tables.

Validation is performed by the analyst, and the validation is reviewed. Graphs and tables are generated based on the validated one minute data.

Validation is limited by the information provided by Tollaust.

2.4.2. Reporting

The reported data is in a Microsoft Excel format file named “Lane Cove CO In tunnel Data Report_April14.xls” included as an appendix to this report.

The Excel file(s) consists of 3 Excel worksheets:

1. Cover
2. Max Single Point 3, 15 and 30 m
3. Valid Data Exception Table

The data contained in this report is based on Australian Eastern Standard Time.

All averages are calculated from the one minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00am is for the data collected from 1:00am to 2:00am. One hour averages are calculated based on a clock hour.

3.0 Air Quality Goals

The air quality goals for pollutants monitored at the Lane Cove Tunnel & Military Road E-Ramp monitors are based on the Ministers Conditions of Approval (MCoA) for the Lane Cove Tunnel. The air quality goals are shown in Table 4 below.

Table 4: Station/Network Air Quality Goals

Parameter	Time Period	Exceedence Level	Units	Applicable MCoA
CO	30 minutes rolling averages	50	ppm	MCoA 160
	15 minutes rolling averages	87	ppm	MCoA 160
	3 minutes rolling averages	200	ppm	MCoA 161

4.0 Calibrations and Maintenance

4.1. Units and Uncertainties

The uncertainties for each parameter have been determined by the manufacturer's tolerance limits of the equipment's parameters, and by the data collection standard method.

The reported uncertainties are expanded uncertainties, calculated using coverage factors which give a level of confidence of approximately 95%.

Table 5: Units and Uncertainties

Parameter	Units	Resolution	Uncertainty	Measurement Range
CO	ppm	0.1 ppm	± 1.0 ppm or 2% of span	0 ppm to 100 ppm

5.0 Results

5.1. Data Capture

Data capture is based on 1 minute data, and refers to the amount of available data collected during the report period.

The percentage of data captured is calculated using the following equation:

Data capture = (Reported air quality data / Total data) x 100%

Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 7 below displays data capture statistics for April 2014.

Details of all invalid or missing data affecting data capture are included in the Valid Data Exception Table, see attached Excel file.

Table 6: Monthly Data Capture for Lane Cove Tunnel & Military Road E-Ramp monitors for April 2014

CO	
Monitoring Location	Data Capture (%)
ACO101	98.3
ACO102	99.5
ACO103	83.2
ACO104	96.9
ACO401	99.3
ACO501	68.0
ACO502	96.5
ACO503	98.6
ACO801	98.9
AQS101	49.5
AQS102	99.5
AQS103	99.5
AQS104	96.7
AQS105	98.6
AQS106	49.9
AQS107	98.0
AQS401	99.3
AQS402	99.3
AQS403	99.3
AQS501	97.8
AQS502	60.6
AQS503	97.9
AQS504	97.8
AQS505	98.5
AQS506	98.5
AQS507	98.4
AQS508	98.6
AQS801	98.9

5.2. Air Quality Summary

During the period 1st April 2014 to 30th April 2014, CO levels inside the tunnel were within the limits stipulated by the Department of Planning.

Table 7: Exceedences Recorded for March 2014

Parameter	Time Period	Value of Exceedence	Date of Exceedence	Station
CO	3 minutes rolling averages	-	-	-
	15 minutes rolling averages	-	-	-
	30 minutes rolling averages	-	-	-

5.4. Graphic Representations

Validated 1 minute data for CO were used to construct the following monthly graphic representations.

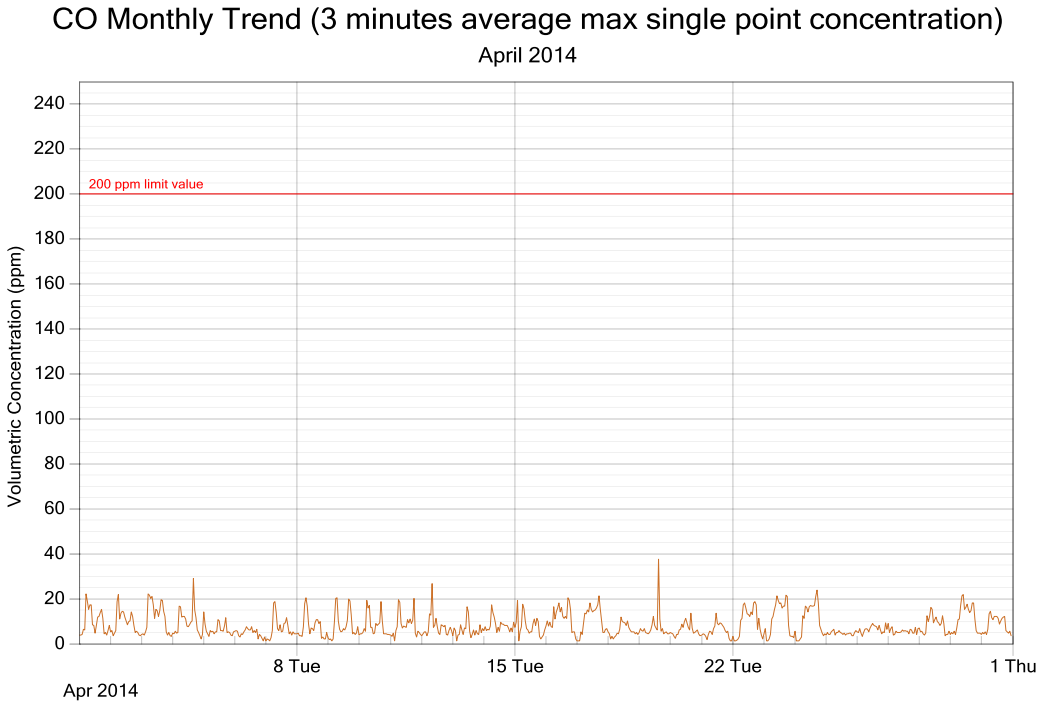

Figure 2: CO exposure and single point 3 minutes rolling averages for April 2014

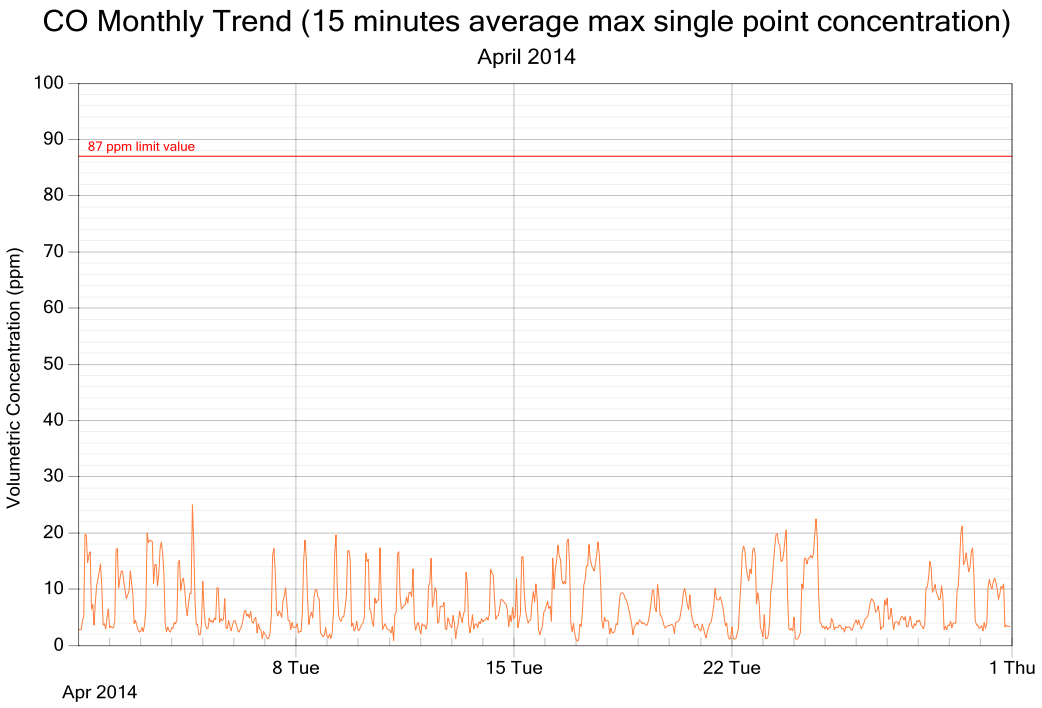

Figure 3: CO exposure and single point 15 minutes rolling averages for April 2014

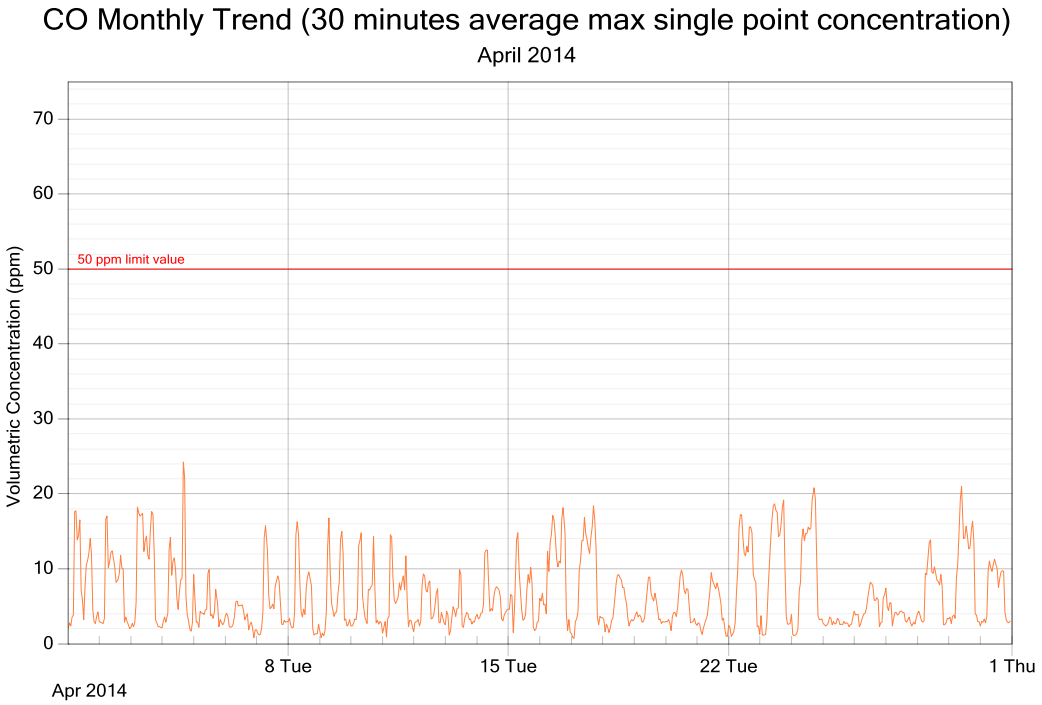

Figure 4: CO exposure and single point 30 minutes rolling averages for April 2014

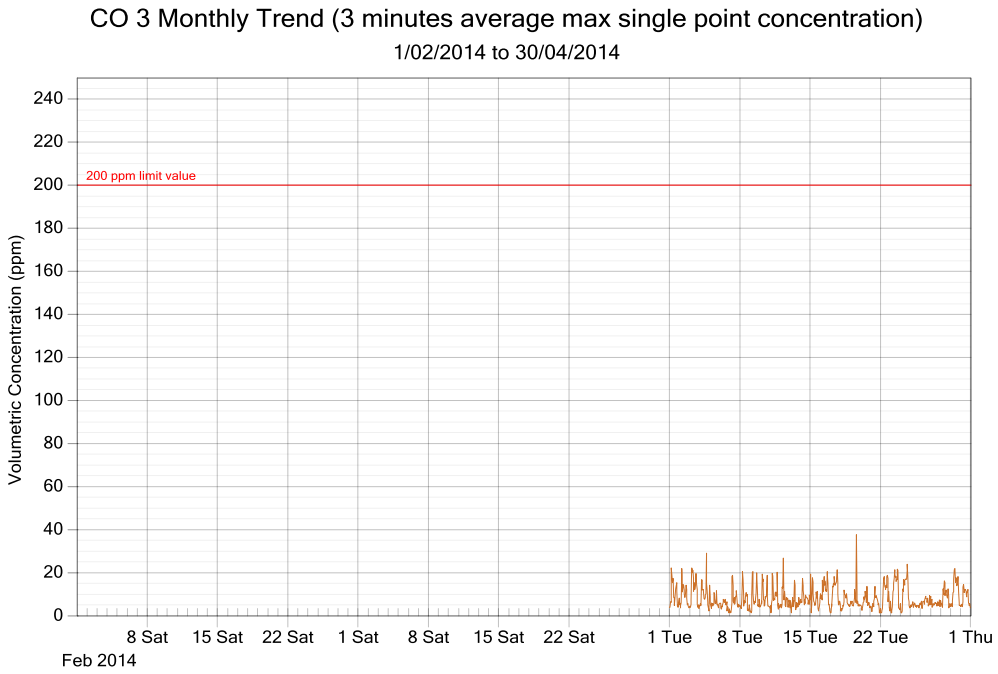

Figure 5: CO exposure and single point 3 minutes rolling averages from February to April 2014 (3 monthly trend)

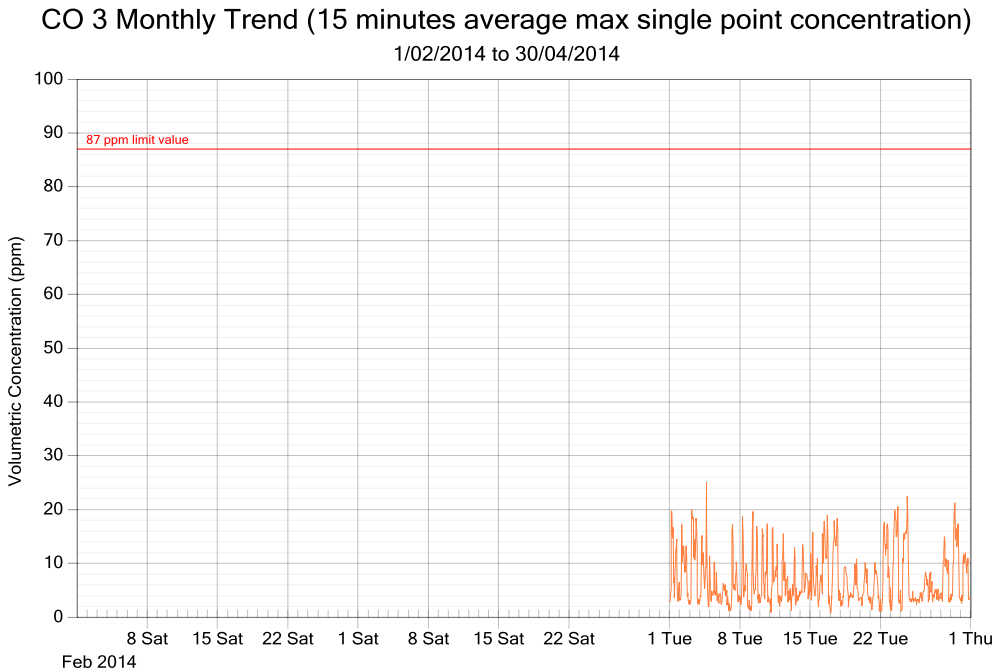

Figure 6: CO exposure and single point 15 minutes rolling averages from February to April 2014 (3 monthly trend)

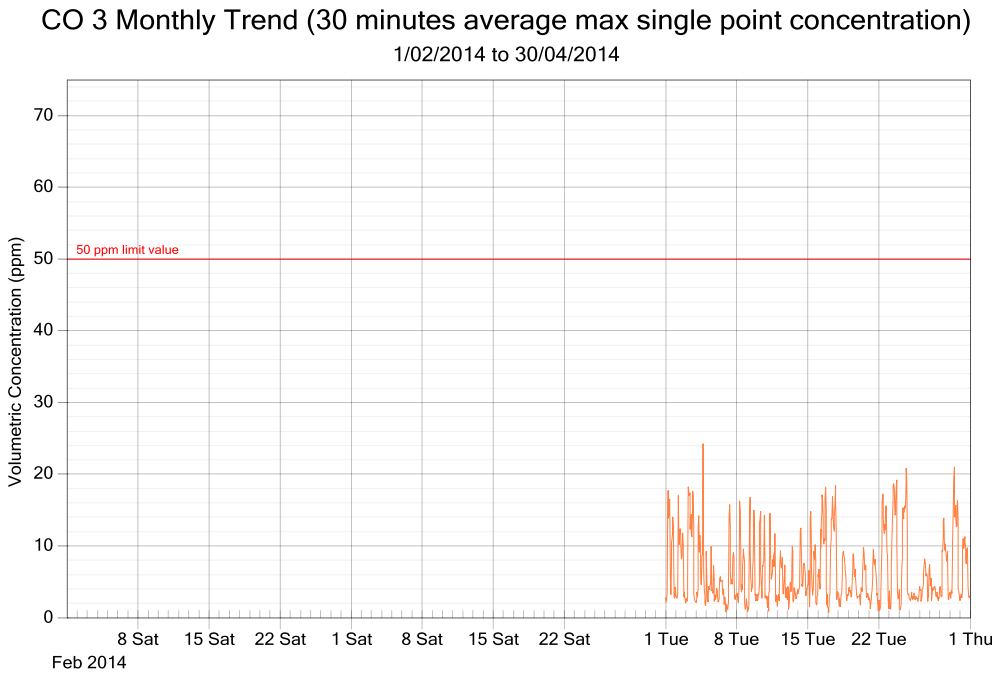

Figure 7: CO exposure and single point 30 minutes rolling averages from February to April 2014 (3 monthly trend)

Report Summary

- During the period 1st April 2014 to 30th April 2014, CO levels inside the tunnel were within the limits stipulated by the Department of Planning.

----------END OF REPORT----------

Appendix 1 - Definitions & Abbreviations

CO	Carbon monoxide
ppb	Parts per billion
ppm	Parts per million

Appendix 2 - Explanation of Exception Table

Calibration check outside tolerance refers to when the calibration values are outside the tolerance limits set for the precision check.

Calibration correction factor applied to data refers to an offset or multiplier applied to the data. This operation may be performed for a number of reasons including: (a) when a clear trend / drift outside the tolerance limit can be demonstrated by repeated operation precision checks, (b) when a correction is required on previously logged data due to a calibration check being outside the allowable tolerance

Commissioning refers to the initial setup and calibration of the instrument when it is first installed. For some instruments there may be a stabilisation period before normal operation commences.

Data transmission error refers to a period of time when the instrument could not transmit data. This may be due to interference, or a problem with the phone line or modem.

Equipment malfunction/instrument fault refers to a period of time when the instrument was not in the normal operating mode and did not measure a representative value of the existing conditions.

Gap in data/data not available refers to a period of time when either data has been lost or could not be collected.

Instrument Alarm refers to an alarm produced by the instrument. A range of alarms can be produced depending on how operation of the instrument is being affected.

Instrument out of service refers to a lack of data due to an instrument being shut down for repair, maintenance, or factory calibration.

Logger error refers to when an error occurs and instrument readings are not correctly recorded by the logger.

Maintenance refers to a period of time when the logger / instrument was switched off due to maintenance.

Overnight span/zero out of tolerance refers to when the span/zero reading measured by the analyser during an automatic precision check falls outside of the expected concentration limits.

Overnight zero out of tolerance refers to when the automatic zero reading measured by the analyser falls outside the expected limits.

Power Interruption refers to no power to the station therefore no data was collected at this time.

Remote Calibration refers to when a technician remotely connects to the station and manually performs a span check.

Static offset or multiplier refers to when a single offset or multiplier has been applied to the data between two points either to increase or decrease the measured value.

Warm up after power interruption refers to the start up period of an instrument after power has been restored.

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