Tollaust Pty Ltd

Lane Cove Tunnel

CO In Tunnel Air Quality Monitoring

Validated Report

1st January 2015 – 31st January 2015

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Maintenance contract: MC1072

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Lane Cove Tunnel & Military Road E-Ramp

Report No: DAT9116

Tollaust Pty Ltd

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Revision History			
Revision	**Report ID**	**Date**	**Analyst**
0	DAT9116	06/02/2015	David Ding

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Table of Contents

List of Figures

List of Tables

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 by a third party contractor.

This report presents validated data for the month of January 2015.

During the reporting period of January 2015, there were no observed exceedences of CO limits stipulated by the Department of Planning inside the tunnel.

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 January 2015.

- 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

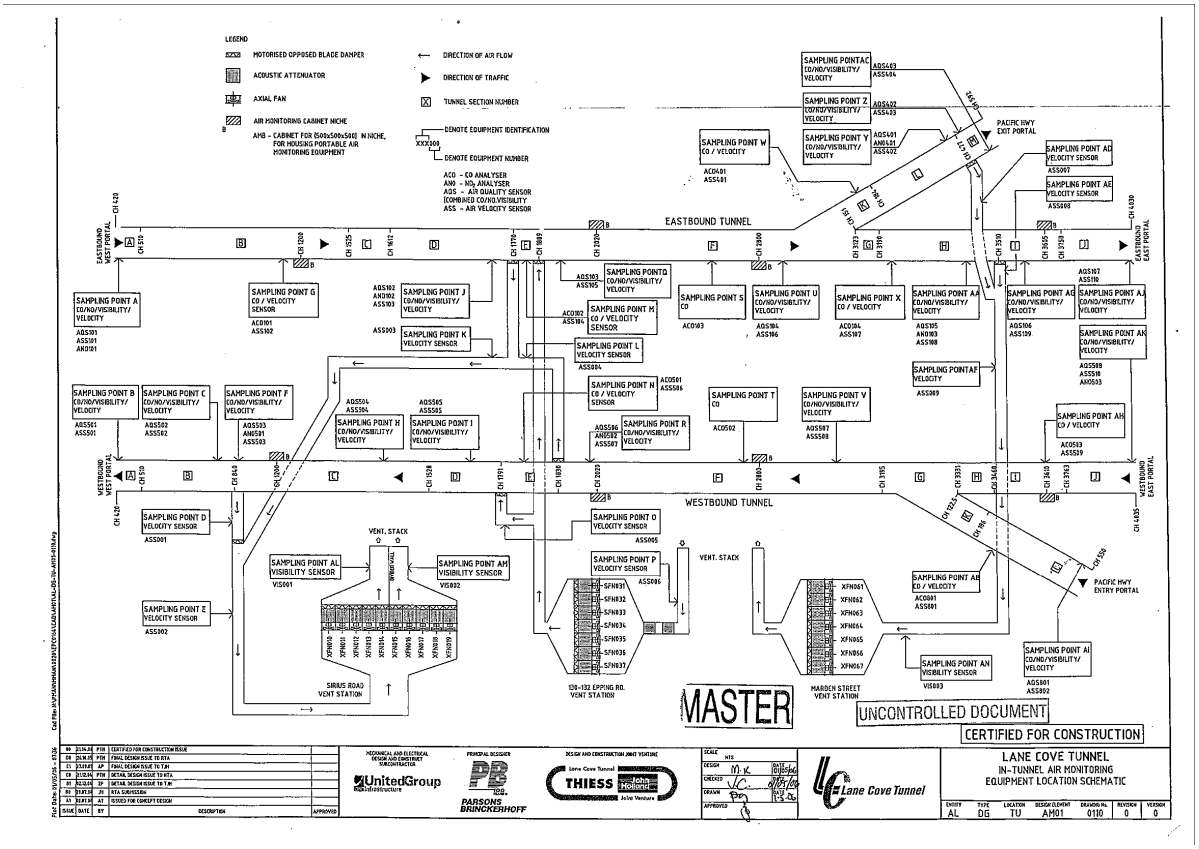

Figure 1: Lane Cove monitoring network

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 2.3.1.

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. Data Validation and Reporting

2.3.3. 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.

2.3.4. Reporting

The reported data is in a Microsoft Excel format file named "Data LCT CO In Tunnel January15_Validated.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 6 below displays data capture statistics for January 2015.

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 January 2015

CO	
Monitoring Location	Data Capture (%)
ACO101	97.5
ACO102	96.2
ACO103	71.5
ACO104	71.9
ACO401	97.5
ACO501	97.5
ACO502	96.8
ACO503	97.5
ACO801	94.0
AQS101	97.5
AQS102	97.5
AQS103	97.5
AQS104	95.9
AQS105	97.5
AQS106	97.5
AQS107	97.5
AQS401	97.5
AQS402	97.5
AQS403	97.5
AQS501	97.5
AQS502	97.5
AQS503	97.5
AQS504	97.5
AQS505	97.5
AQS506	97.5
AQS507	96.7
AQS508	97.5
AQS801	97.5

5.2. Air Quality Summary

Exceedences of the In Tunnel CO levels observed during the reporting period (if any) are recorded in the table below:

Table 7: Exceedences Recorded for January 2015

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

5.3. Graphic Representations

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

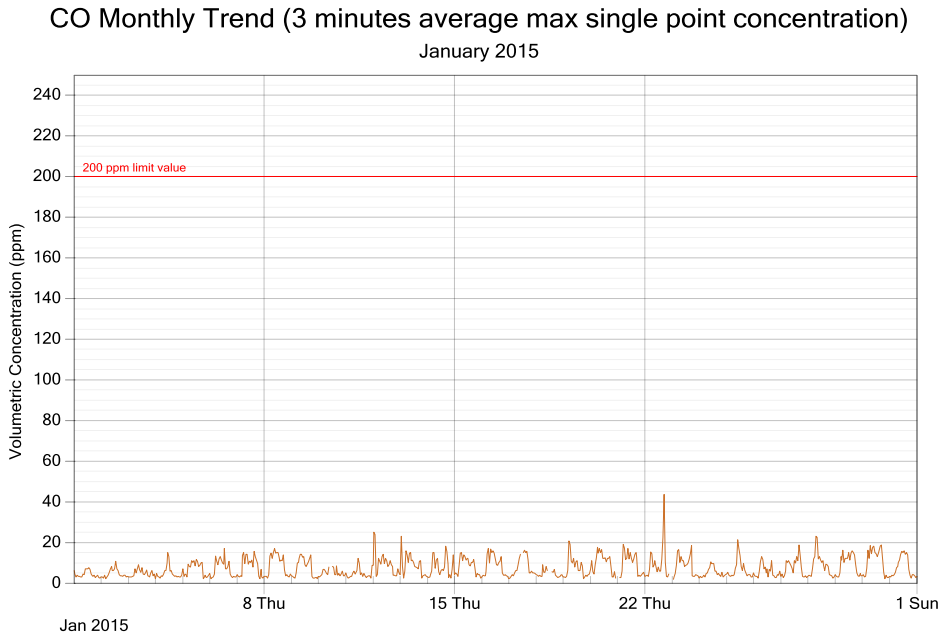

Figure 2: CO exposure and single point 3 minutes rolling averages for January 2015

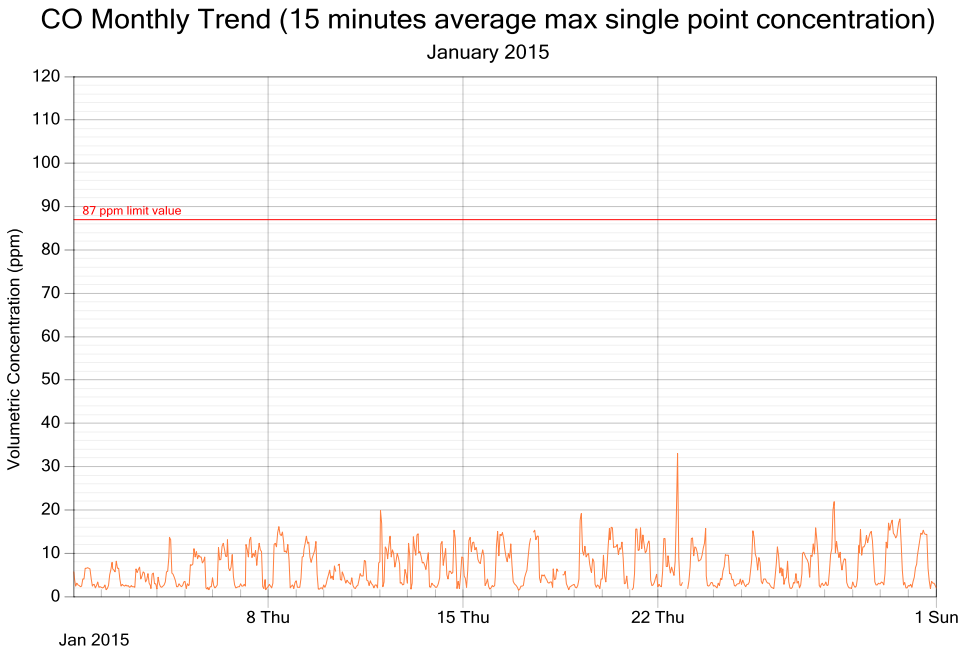

Figure 3: CO exposure and single point 15 minutes rolling averages for January 2015

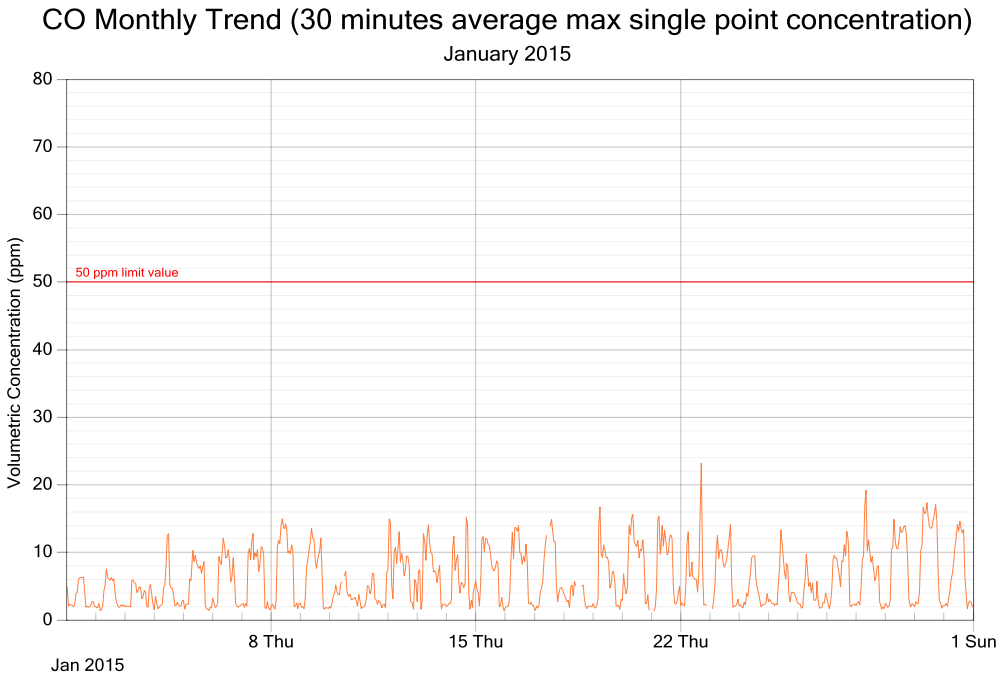

Figure 4: CO exposure and single point 30 minutes rolling averages for January 2015

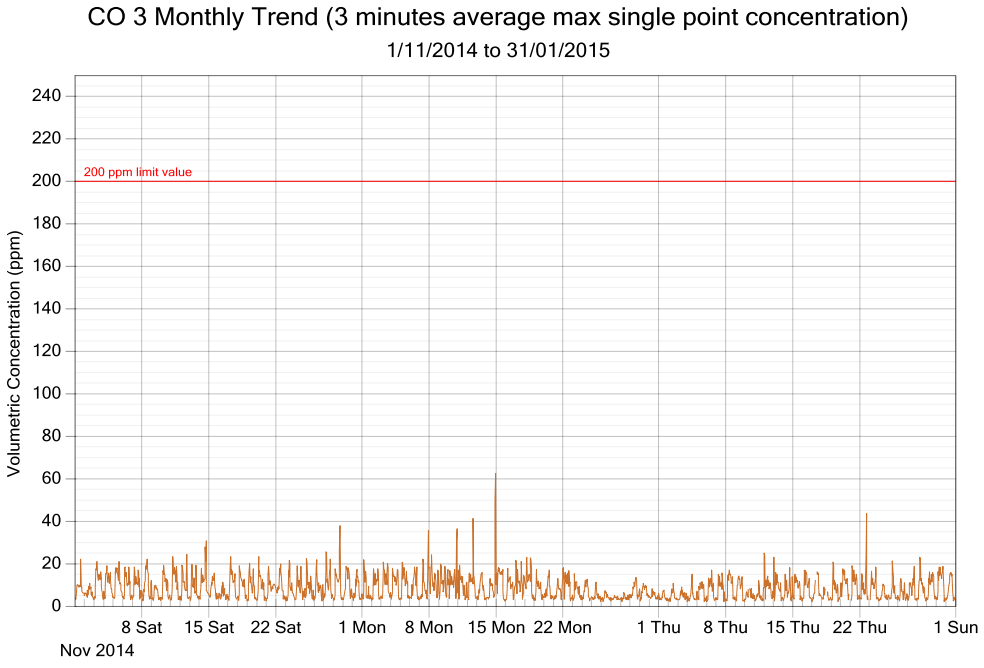

Figure 5: CO exposure and single point 3 minutes rolling averages from November to January 2015 (3 monthly trend)

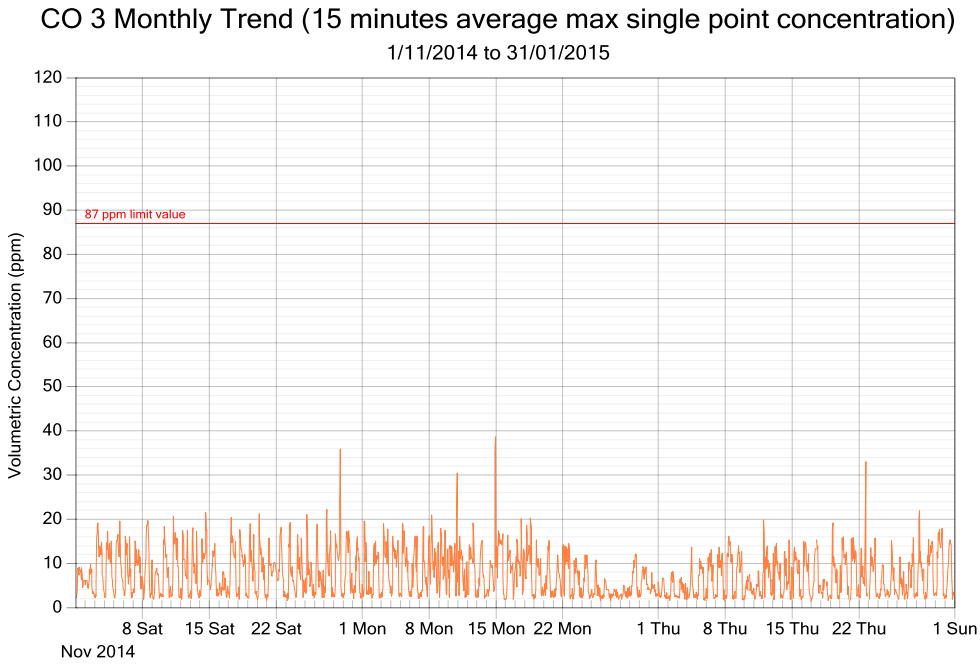

Figure 6: CO exposure and single point 15 minutes rolling averages from November to January 2015 (3 monthly trend)

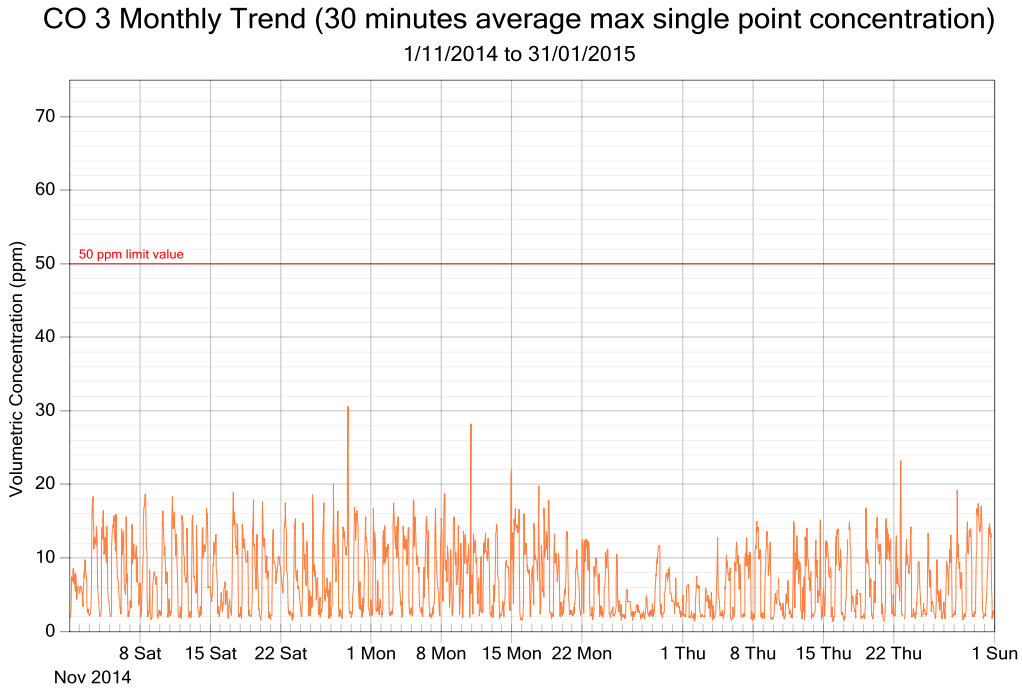

Figure 7: CO exposure and single point 30 minutes rolling averages from November to January 2015 (3 monthly trend)

Report Summary

- During the reporting period of January 2015, there were no observed exceedences of CO limits stipulated by the Department of Planning inside the tunnel.

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

Appendix 1 - Definitions & Abbreviations

CO	Carbon monoxide
ppb	Parts per billion
ppm	Parts per million