

TRANSFIELD SERVICES

Lane Cove Tunnel & Military Road E-Ramp

Monthly Air Quality Report

DOCUMENT No: TMF-2035-EV-0017



IN TUNNEL AIR QUALITY MONITORING VALIDATED DATA FOR DECEMBER 2011

FOR THE

LANE COVE TUNNEL



&

MILITARY ROAD E-RAMP



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Issue Date:

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Approved by:

Name: Fabien Baguenard

Position: Contract Manager

Name: Chris Bryett (Approved QA signatory)

Position: HSE Manager

Signature 

Knowledge Mgrs: Jason Ng

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1. INTRODUCTION

The Lane Cove Tunnel commenced operation on 25 March 2007. Transfield Services (Australia) Pty Ltd are contracted by Connector Motorways to undertake the day to day operation and maintenance of the Tunnel. As a core part of this contract, Transfield are responsible for the maintenance of the air quality monitoring system inside the tunnel which ensures that the carbon monoxide (CO) levels inside the Tunnel are always kept to within acceptable levels and limits stipulated by the Department of Planning. Continual measurements of CO inside the tunnel are recorded, validated and reported publicly by Transfield on a monthly basis.

This report presents the results of these measurements for the period 1 December 2011 – 31 December 2011.

1.1. Facility Address

The Lane Cove Tunnel is a 3.5km underground road tunnel running between portals at the Gore Hill Freeway in Artarmon NSW just east of the Pacific Highway and Epping Road near its junction with Mowbray Road. It also has access ramps onto and off the Pacific Highway at Artarmon.

The air quality data from the in-tunnel sensors is stored and processed at the Motorway Control Centre located at 5 Sirius Road, Lane Cove West, NSW, 2066.

2. SUMMMARY

2.1. Compliance with Limits

During the period 1 December 2011 to 31 December 2011, CO levels inside the tunnel were within the limits stipulated by the Department of Planning. The results are presented in full in section 5 of the report.

2.2. Data Availability

The percentage of time the instruments were online was estimated to be 90%. This data capture rate should be sufficient to provide representative reporting of CO levels experienced in the tunnel.

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3. DEFINITIONS & ABBREVIATIONS

| Term | Definition |
|---------|---|
| AM-6 | A method standard recommended by the NSW EPA (OEH) for the sampling and analysis of carbon monoxide in ambient air. The method conforms to AS 3580.7.1 1992. |
| CO | carbon monoxide – a toxic gas present in motor vehicle exhausts |
| NSW EPA | New South Wales Environment Protection Authority which was incorporated into the Department of Environment and Climate Change and Water (DECCW). Most functions of DECCW have now been incorporated into the Office of Environment and Heritage (OEH) |

4. EXPLANATION OF MONITORING

4.1. Method of Analysis

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 metre 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.

This 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.

The number and locations of the CO monitors has been selected using computer generated modelling to provide a representative profile of CO levels inside the tunnel.

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4.2. Presentation of Measurement Results

The monitors provide continual measurements of CO at the point location in the tunnel where they are installed. These measurements are termed **single point concentrations**.

The monitoring system has also been configured using continuous measurements of traffic flow from speed sensors in the tunnel to calculate the exposure to CO of a theoretical motorist travelling through the tunnel every minute using every possible entry/exit portal combination. These measurements are termed **exposure concentrations**.

4.3. Limits

The Department of Planning have stipulated Limits which air quality inside the tunnel must meet. These limits relate to the maximum concentration of carbon monoxide (CO) in air inside the tunnel and are presented in table 1 below:

Table 1: Department of Planning stipulated limits for CO inside tunnel

| Single Point Concentration Limit (as 3 Minute Rolling Average) | Exposure Concentration Limit (as 15 Minute Rolling Average) | Exposure Concentration Limit (as 30 Minute Rolling Average) |
|--|---|---|
| 200 ppm CO | 87 ppm CO | 50 ppm CO |

4.4. Calibration and Maintenance

All instruments were calibrated following installation and will continue to be routinely calibrated on a schedule not exceeding 12 months between re-calibrations. The sensors are maintained according to a schedule recommended by the manufacturer. To minimise traffic disruption to motorists and provide a safe working environment for instrument technicians, maintenance and calibration is usually only performed during scheduled night time maintenance closures of the tunnel.

4.5. Data Validation

The monitoring data is subjected to a validation procedure prior to reporting where it is inspected to ensure that it is representative of CO levels experienced inside the tunnel at the time of measurement.

5. RESULTS

The results of the monitoring are presented in Table 2:

The figures presented are the maximum values recorded for all sections of the tunnel for each hourly period starting from the times tabulated.

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5.1. Factors Affecting Results

Nil.

Table 2: Results of In Tunnel Air Quality Monitoring from 1 December 2011 – 31 December 2011.

| | | Max Single Point CO Concentration (3 Minute Rolling Average) ppm | Max CO Exposure Concentration (15 Minute Rolling Average) ppm | Max CO Exposure Concentration (30 Minute Rolling Average) ppm |
|----------|--------|---|--|--|
| | | Limits | | |
| Date | Time | 200 | 87 | 50 |
| 1-Dec-11 | +00:00 | 2.1 | 1.1 | 1.0 |
| 1-Dec-11 | +01:00 | 2.1 | 1.0 | 1.0 |
| 1-Dec-11 | +02:00 | 2.0 | 0.9 | 0.9 |
| 1-Dec-11 | +03:00 | 2.0 | 0.9 | 0.9 |
| 1-Dec-11 | +04:00 | 1.6 | 0.2 | 0.1 |
| 1-Dec-11 | +05:00 | 6.5 | 0.7 | 0.3 |
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| 1-Dec-11 | +12:00 | 15.8 | 0.8 | 0.4 |
| 1-Dec-11 | +13:00 | 18.0 | 0.9 | 0.4 |
| 1-Dec-11 | +14:00 | 16.2 | 1.3 | 0.7 |
| 1-Dec-11 | +15:00 | 13.8 | 0.8 | 0.4 |
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| 1-Dec-11 | +17:00 | 19.5 | 1.5 | 0.7 |
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| 1-Dec-11 | +19:00 | 18.2 | 0.7 | 0.3 |
| 1-Dec-11 | +20:00 | 4.0 | 1.1 | 0.9 |
| 1-Dec-11 | +21:00 | 3.9 | 1.3 | 1.1 |
| 1-Dec-11 | +22:00 | 5.4 | 1.3 | 1.1 |
| 1-Dec-11 | +23:00 | 2.5 | 1.4 | 0.8 |
| 2-Dec-11 | +00:00 | 2.0 | 0.8 | 0.7 |
| 2-Dec-11 | +01:00 | 1.8 | 0.8 | 0.7 |
| 2-Dec-11 | +02:00 | 2.0 | 0.7 | 0.7 |
| 2-Dec-11 | +03:00 | 1.6 | 0.7 | 0.7 |
| 2-Dec-11 | +04:00 | 2.2 | 0.2 | 0.1 |
| 2-Dec-11 | +05:00 | 7.7 | 0.9 | 0.4 |
| 2-Dec-11 | +06:00 | 10.5 | 0.9 | 0.5 |
| 2-Dec-11 | +07:00 | 14.4 | 0.7 | 0.4 |
| 2-Dec-11 | +08:00 | 20.4 | 0.9 | 0.5 |
| 2-Dec-11 | +09:00 | 4.0 | 0.5 | 0.3 |
| 2-Dec-11 | +10:00 | 5.9 | 0.5 | 0.2 |
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| 2-Dec-11 | +13:00 | 10.2 | 1.1 | 0.6 |
| 2-Dec-11 | +14:00 | 12.0 | 0.6 | 0.3 |
| 2-Dec-11 | +15:00 | 14.3 | 0.8 | 0.4 |

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| 7-Dec-11 | +03:00 | 1.3 | 1.8 | 1.7 |
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| 7-Dec-11 | +08:00 | 26.2 | 0.8 | 0.4 |
| 7-Dec-11 | +09:00 | 32.5 | 0.7 | 0.4 |
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| 7-Dec-11 | +14:00 | 23.7 | 3.6 | 1.8 |
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| 7-Dec-11 | +20:00 | 8.2 | 0.4 | 0.2 |
| 7-Dec-11 | +21:00 | 3.2 | 0.4 | 0.2 |
| 7-Dec-11 | +22:00 | 4.9 | 0.3 | 0.1 |
| 7-Dec-11 | +23:00 | 4.2 | 0.4 | 0.2 |
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| 8-Dec-11 | +19:00 | 33.4 | 23.5 | 20.7 |
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| 9-Dec-11 | +00:00 | 16.7 | 0.4 | 0.2 |

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| 10-Dec-11 | +09:00 | 7.2 | 0.3 | 0.2 |
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| 10-Dec-11 | +11:00 | 11.1 | 1.1 | 0.6 |
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| 10-Dec-11 | +14:00 | 8.9 | 4.4 | 3.9 |
| 10-Dec-11 | +15:00 | 7.2 | 4.2 | 4.3 |
| 10-Dec-11 | +16:00 | 8.2 | 3.5 | 3.3 |
| 10-Dec-11 | +17:00 | 8.6 | 0.7 | 0.4 |
| 10-Dec-11 | +18:00 | 8.9 | 0.9 | 0.4 |
| 10-Dec-11 | +19:00 | 4.2 | 0.6 | 0.3 |
| 10-Dec-11 | +20:00 | 2.1 | 0.3 | 0.1 |
| 10-Dec-11 | +21:00 | 3.4 | 0.4 | 0.2 |
| 10-Dec-11 | +22:00 | 4.4 | 0.5 | 0.2 |
| 10-Dec-11 | +23:00 | 4.2 | 1.4 | 0.8 |
| 11-Dec-11 | +00:00 | 3.2 | 0.4 | 0.2 |
| 11-Dec-11 | +01:00 | 2.7 | 0.3 | 0.2 |
| 11-Dec-11 | +02:00 | 2.0 | 0.2 | 0.1 |
| 11-Dec-11 | +03:00 | 2.1 | 0.2 | 0.1 |

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| | | | | |
|-----------|--------|------|------|------|
| 11-Dec-11 | +04:00 | 1.9 | 0.2 | 0.1 |
| 11-Dec-11 | +05:00 | 2.1 | 0.2 | 0.1 |
| 11-Dec-11 | +06:00 | 2.8 | 0.3 | 0.1 |
| 11-Dec-11 | +07:00 | 2.5 | 0.3 | 0.2 |
| 11-Dec-11 | +08:00 | 4.2 | 0.3 | 0.1 |
| 11-Dec-11 | +09:00 | 7.2 | 0.6 | 0.3 |
| 11-Dec-11 | +10:00 | 9.2 | 0.5 | 0.3 |
| 11-Dec-11 | +11:00 | 9.4 | 0.6 | 0.3 |
| 11-Dec-11 | +12:00 | 10.6 | 0.5 | 0.2 |
| 11-Dec-11 | +13:00 | 9.1 | 1.1 | 0.6 |
| 11-Dec-11 | +14:00 | 6.7 | 0.5 | 0.3 |
| 11-Dec-11 | +15:00 | 6.3 | 0.4 | 0.2 |
| 11-Dec-11 | +16:00 | 5.4 | 0.7 | 0.4 |
| 11-Dec-11 | +17:00 | 4.2 | 0.3 | 0.2 |
| 11-Dec-11 | +18:00 | 4.0 | 0.4 | 0.2 |
| 11-Dec-11 | +19:00 | 3.1 | 0.3 | 0.1 |
| 11-Dec-11 | +20:00 | 2.0 | 0.3 | 0.1 |
| 11-Dec-11 | +21:00 | 3.0 | 0.7 | 0.5 |
| 11-Dec-11 | +22:00 | 1.6 | 0.8 | 0.7 |
| 11-Dec-11 | +23:00 | 5.9 | 0.9 | 0.7 |
| 12-Dec-11 | +00:00 | 3.2 | 0.2 | 0.1 |
| 12-Dec-11 | +01:00 | 1.3 | 0.1 | 0.1 |
| 12-Dec-11 | +02:00 | 1.6 | 0.2 | 0.1 |
| 12-Dec-11 | +03:00 | 1.2 | 0.1 | 0.0 |
| 12-Dec-11 | +04:00 | 2.2 | 0.3 | 0.1 |
| 12-Dec-11 | +05:00 | 7.1 | 0.8 | 0.4 |
| 12-Dec-11 | +06:00 | 11.7 | 1.3 | 0.6 |
| 12-Dec-11 | +07:00 | 17.3 | 7.0 | 3.5 |
| 12-Dec-11 | +08:00 | 30.9 | 13.0 | 6.6 |
| 12-Dec-11 | +09:00 | 25.1 | 15.1 | 13.6 |
| 12-Dec-11 | +10:00 | 16.2 | 1.0 | 0.8 |
| 12-Dec-11 | +11:00 | 11.3 | 1.0 | 0.9 |
| 12-Dec-11 | +12:00 | 10.5 | 0.9 | 0.9 |
| 12-Dec-11 | +13:00 | 11.0 | 4.5 | 2.9 |
| 12-Dec-11 | +14:00 | 14.3 | 1.0 | 1.0 |
| 12-Dec-11 | +15:00 | 14.5 | 0.8 | 0.4 |
| 12-Dec-11 | +16:00 | 14.0 | 0.7 | 0.4 |
| 12-Dec-11 | +17:00 | 15.9 | 0.5 | 0.2 |
| 12-Dec-11 | +18:00 | 13.9 | 0.5 | 0.2 |
| 12-Dec-11 | +19:00 | 4.1 | 0.2 | 0.1 |
| 12-Dec-11 | +20:00 | 3.2 | 0.4 | 0.2 |
| 12-Dec-11 | +21:00 | 2.3 | 0.3 | 0.1 |
| 12-Dec-11 | +22:00 | 1.9 | 0.3 | 0.1 |
| 12-Dec-11 | +23:00 | 1.9 | 0.2 | 0.1 |
| 13-Dec-11 | +00:00 | 2.5 | 0.3 | 0.1 |
| 13-Dec-11 | +01:00 | 1.2 | 0.2 | 0.1 |
| 13-Dec-11 | +02:00 | 1.2 | 0.1 | 0.1 |
| 13-Dec-11 | +03:00 | 1.6 | 0.2 | 0.1 |
| 13-Dec-11 | +04:00 | 1.2 | 0.2 | 0.1 |
| 13-Dec-11 | +05:00 | 5.1 | 0.5 | 0.3 |
| 13-Dec-11 | +06:00 | 11.7 | 0.9 | 0.5 |

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| | | | | |
|-----------|--------|------|-----|-----|
| 13-Dec-11 | +07:00 | 14.2 | 0.7 | 0.4 |
| 13-Dec-11 | +08:00 | 20.7 | 0.6 | 0.3 |
| 13-Dec-11 | +09:00 | 23.7 | 0.6 | 0.3 |
| 13-Dec-11 | +10:00 | 18.9 | 1.4 | 0.7 |
| 13-Dec-11 | +11:00 | 13.2 | 0.6 | 0.3 |
| 13-Dec-11 | +12:00 | 15.1 | 1.2 | 1.1 |
| 13-Dec-11 | +13:00 | 15.2 | 1.0 | 0.7 |
| 13-Dec-11 | +14:00 | 15.2 | 1.0 | 0.8 |
| 13-Dec-11 | +15:00 | 14.5 | 0.6 | 0.3 |
| 13-Dec-11 | +16:00 | 13.1 | 0.8 | 0.4 |
| 13-Dec-11 | +17:00 | 13.0 | 0.7 | 0.3 |
| 13-Dec-11 | +18:00 | 16.5 | 0.7 | 0.4 |
| 13-Dec-11 | +19:00 | 3.2 | 0.4 | 0.2 |
| 13-Dec-11 | +20:00 | 4.2 | 0.4 | 0.2 |
| 13-Dec-11 | +21:00 | 3.6 | 0.4 | 0.2 |
| 13-Dec-11 | +22:00 | 3.2 | 0.4 | 0.2 |
| 13-Dec-11 | +23:00 | 2.2 | 1.4 | 1.2 |
| 14-Dec-11 | +00:00 | 1.5 | 0.8 | 1.1 |
| 14-Dec-11 | +01:00 | 2.5 | 0.3 | 0.1 |
| 14-Dec-11 | +02:00 | 1.2 | 0.1 | 0.1 |
| 14-Dec-11 | +03:00 | 1.3 | 0.2 | 0.1 |
| 14-Dec-11 | +04:00 | 1.5 | 0.2 | 0.1 |
| 14-Dec-11 | +05:00 | 9.4 | 0.8 | 0.4 |
| 14-Dec-11 | +06:00 | 16.7 | 1.1 | 0.6 |
| 14-Dec-11 | +07:00 | 14.6 | 0.9 | 0.4 |
| 14-Dec-11 | +08:00 | 16.2 | 0.5 | 0.2 |
| 14-Dec-11 | +09:00 | 6.9 | 0.6 | 0.3 |
| 14-Dec-11 | +10:00 | 6.0 | 0.7 | 0.4 |
| 14-Dec-11 | +11:00 | 10.0 | 0.5 | 0.3 |
| 14-Dec-11 | +12:00 | 10.8 | 1.6 | 0.8 |
| 14-Dec-11 | +13:00 | 12.0 | 0.5 | 0.3 |
| 14-Dec-11 | +14:00 | 9.8 | 0.5 | 0.2 |
| 14-Dec-11 | +15:00 | 11.7 | 0.7 | 0.4 |
| 14-Dec-11 | +16:00 | 10.3 | 1.0 | 0.5 |
| 14-Dec-11 | +17:00 | 14.7 | 0.7 | 0.4 |
| 14-Dec-11 | +18:00 | 12.2 | 3.0 | 1.5 |
| 14-Dec-11 | +19:00 | 11.3 | 2.1 | 1.1 |
| 14-Dec-11 | +20:00 | 2.9 | 0.4 | 0.2 |
| 14-Dec-11 | +21:00 | 3.1 | 0.4 | 0.2 |
| 14-Dec-11 | +22:00 | 3.1 | 2.6 | 1.9 |
| 14-Dec-11 | +23:00 | 2.6 | 0.9 | 1.1 |
| 15-Dec-11 | +00:00 | 2.0 | 0.7 | 0.4 |
| 15-Dec-11 | +01:00 | 7.6 | 0.5 | 0.3 |
| 15-Dec-11 | +02:00 | 1.3 | 0.2 | 0.1 |
| 15-Dec-11 | +03:00 | 1.6 | 0.2 | 0.1 |
| 15-Dec-11 | +04:00 | 1.6 | 0.2 | 0.1 |
| 15-Dec-11 | +05:00 | 11.8 | 0.7 | 0.4 |
| 15-Dec-11 | +06:00 | 14.1 | 1.2 | 0.6 |
| 15-Dec-11 | +07:00 | 15.2 | 0.8 | 0.4 |
| 15-Dec-11 | +08:00 | 25.6 | 0.7 | 0.3 |
| 15-Dec-11 | +09:00 | 23.9 | 0.6 | 0.3 |

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| | | | | |
|-----------|--------|------|------|-----|
| 15-Dec-11 | +10:00 | 23.0 | 0.6 | 0.3 |
| 15-Dec-11 | +11:00 | 16.2 | 0.6 | 0.3 |
| 15-Dec-11 | +12:00 | 19.8 | 0.9 | 0.5 |
| 15-Dec-11 | +13:00 | 21.2 | 0.8 | 0.4 |
| 15-Dec-11 | +14:00 | 14.6 | 0.6 | 0.3 |
| 15-Dec-11 | +15:00 | 13.6 | 0.7 | 0.4 |
| 15-Dec-11 | +16:00 | 12.2 | 0.7 | 0.4 |
| 15-Dec-11 | +17:00 | 12.2 | 0.6 | 0.3 |
| 15-Dec-11 | +18:00 | 14.5 | 0.6 | 0.3 |
| 15-Dec-11 | +19:00 | 18.7 | 0.5 | 0.2 |
| 15-Dec-11 | +20:00 | 2.2 | 0.3 | 0.1 |
| 15-Dec-11 | +21:00 | 5.9 | 0.6 | 0.3 |
| 15-Dec-11 | +22:00 | 4.4 | 3.4 | 3.1 |
| 15-Dec-11 | +23:00 | 3.3 | 3.2 | 3.1 |
| 16-Dec-11 | +00:00 | 2.1 | 1.2 | 1.0 |
| 16-Dec-11 | +01:00 | 2.1 | 0.3 | 0.1 |
| 16-Dec-11 | +02:00 | 1.8 | 0.2 | 0.1 |
| 16-Dec-11 | +03:00 | 1.3 | 0.2 | 0.1 |
| 16-Dec-11 | +04:00 | 1.8 | 0.2 | 0.1 |
| 16-Dec-11 | +05:00 | 8.7 | 0.8 | 0.4 |
| 16-Dec-11 | +06:00 | 17.2 | 1.2 | 0.6 |
| 16-Dec-11 | +07:00 | 19.9 | 0.9 | 0.4 |
| 16-Dec-11 | +08:00 | 25.7 | 1.5 | 1.4 |
| 16-Dec-11 | +09:00 | 28.0 | 2.0 | 1.5 |
| 16-Dec-11 | +10:00 | 25.0 | 0.7 | 0.3 |
| 16-Dec-11 | +11:00 | 21.1 | 0.7 | 0.4 |
| 16-Dec-11 | +12:00 | 23.9 | 19.4 | 9.7 |
| 16-Dec-11 | +13:00 | 19.2 | 0.6 | 0.3 |
| 16-Dec-11 | +14:00 | 19.4 | 0.7 | 0.4 |
| 16-Dec-11 | +15:00 | 18.9 | 1.8 | 1.4 |
| 16-Dec-11 | +16:00 | 18.2 | 1.1 | 0.9 |
| 16-Dec-11 | +17:00 | 21.2 | 1.0 | 0.9 |
| 16-Dec-11 | +18:00 | 28.7 | 2.4 | 1.4 |
| 16-Dec-11 | +19:00 | 25.8 | 0.6 | 0.3 |
| 16-Dec-11 | +20:00 | 4.2 | 0.6 | 0.3 |
| 16-Dec-11 | +21:00 | 4.2 | 1.4 | 1.2 |
| 16-Dec-11 | +22:00 | 6.2 | 1.7 | 1.4 |
| 16-Dec-11 | +23:00 | 3.5 | 0.4 | 0.2 |
| 17-Dec-11 | +00:00 | 4.1 | 0.6 | 0.3 |
| 17-Dec-11 | +01:00 | 2.7 | 0.4 | 0.2 |
| 17-Dec-11 | +02:00 | 3.4 | 0.4 | 0.2 |
| 17-Dec-11 | +03:00 | 2.2 | 0.3 | 0.2 |
| 17-Dec-11 | +04:00 | 1.4 | 0.2 | 0.1 |
| 17-Dec-11 | +05:00 | 5.1 | 0.6 | 0.3 |
| 17-Dec-11 | +06:00 | 6.2 | 0.6 | 0.3 |
| 17-Dec-11 | +07:00 | 5.1 | 0.5 | 0.3 |
| 17-Dec-11 | +08:00 | 5.7 | 0.5 | 0.2 |
| 17-Dec-11 | +09:00 | 9.1 | 0.4 | 0.2 |
| 17-Dec-11 | +10:00 | 13.2 | 0.5 | 0.2 |
| 17-Dec-11 | +11:00 | 12.2 | 0.9 | 0.4 |
| 17-Dec-11 | +12:00 | 14.6 | 0.6 | 0.3 |

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| | | | | |
|-----------|--------|------|-----|-----|
| 17-Dec-11 | +13:00 | 12.1 | 0.6 | 0.3 |
| 17-Dec-11 | +14:00 | 11.1 | 0.4 | 0.2 |
| 17-Dec-11 | +15:00 | 9.8 | 0.4 | 0.2 |
| 17-Dec-11 | +16:00 | 7.2 | 0.6 | 0.3 |
| 17-Dec-11 | +17:00 | 6.1 | 0.4 | 0.2 |
| 17-Dec-11 | +18:00 | 11.5 | 0.9 | 0.5 |
| 17-Dec-11 | +19:00 | 9.3 | 0.5 | 0.2 |
| 17-Dec-11 | +20:00 | 2.3 | 0.6 | 0.5 |
| 17-Dec-11 | +21:00 | 3.5 | 1.0 | 0.6 |
| 17-Dec-11 | +22:00 | 3.7 | 0.4 | 0.2 |
| 17-Dec-11 | +23:00 | 5.0 | 0.5 | 0.2 |
| 18-Dec-11 | +00:00 | 3.4 | 0.3 | 0.1 |
| 18-Dec-11 | +01:00 | 2.2 | 0.6 | 0.3 |
| 18-Dec-11 | +02:00 | 3.2 | 0.3 | 0.2 |
| 18-Dec-11 | +03:00 | 2.0 | 0.3 | 0.1 |
| 18-Dec-11 | +04:00 | 1.6 | 0.3 | 0.1 |
| 18-Dec-11 | +05:00 | 2.5 | 0.3 | 0.2 |
| 18-Dec-11 | +06:00 | 2.5 | 0.3 | 0.2 |
| 18-Dec-11 | +07:00 | 2.3 | 0.3 | 0.1 |
| 18-Dec-11 | +08:00 | 3.2 | 0.3 | 0.2 |
| 18-Dec-11 | +09:00 | 5.3 | 0.4 | 0.2 |
| 18-Dec-11 | +10:00 | 7.3 | 0.6 | 0.3 |
| 18-Dec-11 | +11:00 | 9.7 | 0.4 | 0.2 |
| 18-Dec-11 | +12:00 | 10.2 | 0.7 | 0.3 |
| 18-Dec-11 | +13:00 | 8.3 | 0.6 | 0.3 |
| 18-Dec-11 | +14:00 | 7.2 | 0.9 | 0.4 |
| 18-Dec-11 | +15:00 | 6.9 | 0.6 | 0.3 |
| 18-Dec-11 | +16:00 | 6.2 | 0.5 | 0.2 |
| 18-Dec-11 | +17:00 | 5.3 | 0.5 | 0.2 |
| 18-Dec-11 | +18:00 | 2.9 | 0.3 | 0.2 |
| 18-Dec-11 | +19:00 | 5.1 | 0.6 | 0.3 |
| 18-Dec-11 | +20:00 | 2.1 | 0.3 | 0.1 |
| 18-Dec-11 | +21:00 | 2.4 | 0.7 | 0.6 |
| 18-Dec-11 | +22:00 | 3.1 | 1.0 | 0.5 |
| 18-Dec-11 | +23:00 | 2.2 | 1.2 | 1.0 |
| 19-Dec-11 | +00:00 | 1.6 | 0.9 | 0.9 |
| 19-Dec-11 | +01:00 | 1.2 | 0.4 | 0.5 |
| 19-Dec-11 | +02:00 | 2.2 | 0.2 | 0.1 |
| 19-Dec-11 | +03:00 | 1.3 | 0.1 | 0.0 |
| 19-Dec-11 | +04:00 | 2.2 | 0.3 | 0.2 |
| 19-Dec-11 | +05:00 | 7.7 | 0.6 | 0.3 |
| 19-Dec-11 | +06:00 | 14.0 | 1.1 | 0.5 |
| 19-Dec-11 | +07:00 | 13.6 | 1.1 | 0.5 |
| 19-Dec-11 | +08:00 | 14.2 | 1.4 | 0.9 |
| 19-Dec-11 | +09:00 | 20.9 | 0.9 | 0.5 |
| 19-Dec-11 | +10:00 | 13.2 | 0.7 | 0.3 |
| 19-Dec-11 | +11:00 | 14.1 | 1.1 | 0.5 |
| 19-Dec-11 | +12:00 | 14.1 | 0.7 | 0.4 |
| 19-Dec-11 | +13:00 | 14.4 | 0.6 | 0.3 |
| 19-Dec-11 | +14:00 | 16.9 | 0.6 | 0.3 |
| 19-Dec-11 | +15:00 | 13.0 | 0.9 | 0.5 |

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| | | | | |
|-----------|--------|------|-----|-----|
| 19-Dec-11 | +16:00 | 10.4 | 0.6 | 0.3 |
| 19-Dec-11 | +17:00 | 12.1 | 0.7 | 0.4 |
| 19-Dec-11 | +18:00 | 15.6 | 1.1 | 0.5 |
| 19-Dec-11 | +19:00 | 13.3 | 1.4 | 1.4 |
| 19-Dec-11 | +20:00 | 4.0 | 1.3 | 0.6 |
| 19-Dec-11 | +21:00 | 2.3 | 1.6 | 0.8 |
| 19-Dec-11 | +22:00 | 2.0 | 0.6 | 0.4 |
| 19-Dec-11 | +23:00 | 1.7 | 1.0 | 0.9 |
| 20-Dec-11 | +00:00 | 2.0 | 1.3 | 1.0 |
| 20-Dec-11 | +01:00 | 1.4 | 0.4 | 0.4 |
| 20-Dec-11 | +02:00 | 1.4 | 0.1 | 0.1 |
| 20-Dec-11 | +03:00 | 2.0 | 0.2 | 0.1 |
| 20-Dec-11 | +04:00 | 2.1 | 0.2 | 0.1 |
| 20-Dec-11 | +05:00 | 8.8 | 0.6 | 0.3 |
| 20-Dec-11 | +06:00 | 9.4 | 0.9 | 0.4 |
| 20-Dec-11 | +07:00 | 13.3 | 0.7 | 0.4 |
| 20-Dec-11 | +08:00 | 20.2 | 0.5 | 0.3 |
| 20-Dec-11 | +09:00 | 17.3 | 1.8 | 1.4 |
| 20-Dec-11 | +10:00 | 18.4 | 1.8 | 1.4 |
| 20-Dec-11 | +11:00 | 14.1 | 1.3 | 1.2 |
| 20-Dec-11 | +12:00 | 16.1 | 0.6 | 0.3 |
| 20-Dec-11 | +13:00 | 18.7 | 0.8 | 0.8 |
| 20-Dec-11 | +14:00 | 9.8 | 1.6 | 1.4 |
| 20-Dec-11 | +15:00 | 12.1 | 1.6 | 1.5 |
| 20-Dec-11 | +16:00 | 10.1 | 0.7 | 0.3 |
| 20-Dec-11 | +17:00 | 10.4 | 0.6 | 0.3 |
| 20-Dec-11 | +18:00 | 11.2 | 0.6 | 0.3 |
| 20-Dec-11 | +19:00 | 2.5 | 0.4 | 0.2 |
| 20-Dec-11 | +20:00 | 3.4 | 0.4 | 0.2 |
| 20-Dec-11 | +21:00 | 3.2 | 0.7 | 0.4 |
| 20-Dec-11 | +22:00 | 3.9 | 0.3 | 0.2 |
| 20-Dec-11 | +23:00 | 2.2 | 0.2 | 0.1 |
| 21-Dec-11 | +00:00 | 1.6 | 0.3 | 0.1 |
| 21-Dec-11 | +01:00 | 3.1 | 0.1 | 0.1 |
| 21-Dec-11 | +02:00 | 1.2 | 0.1 | 0.1 |
| 21-Dec-11 | +03:00 | 1.3 | 0.1 | 0.1 |
| 21-Dec-11 | +04:00 | 1.6 | 0.2 | 0.1 |
| 21-Dec-11 | +05:00 | 8.2 | 0.7 | 0.4 |
| 21-Dec-11 | +06:00 | 13.5 | 1.1 | 0.6 |
| 21-Dec-11 | +07:00 | 13.7 | 0.6 | 0.3 |
| 21-Dec-11 | +08:00 | 21.9 | 0.7 | 0.4 |
| 21-Dec-11 | +09:00 | 22.3 | 0.5 | 0.3 |
| 21-Dec-11 | +10:00 | 17.1 | 0.4 | 0.2 |
| 21-Dec-11 | +11:00 | 8.7 | 0.7 | 0.4 |
| 21-Dec-11 | +12:00 | 8.7 | 0.9 | 0.4 |
| 21-Dec-11 | +13:00 | 11.7 | 0.6 | 0.3 |
| 21-Dec-11 | +14:00 | 10.1 | 1.0 | 0.5 |
| 21-Dec-11 | +15:00 | 11.9 | 1.1 | 0.7 |
| 21-Dec-11 | +16:00 | 10.5 | 0.6 | 0.3 |
| 21-Dec-11 | +17:00 | 10.9 | 0.7 | 0.3 |
| 21-Dec-11 | +18:00 | 9.6 | 0.4 | 0.2 |

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DOCUMENT No: TMF-2035-EV-0017

| | | | | |
|-----------|--------|------|-----|-----|
| 21-Dec-11 | +19:00 | 5.9 | 0.4 | 0.2 |
| 21-Dec-11 | +20:00 | 3.1 | 0.3 | 0.1 |
| 21-Dec-11 | +21:00 | 2.8 | 1.0 | 0.5 |
| 21-Dec-11 | +22:00 | 3.8 | 1.1 | 0.6 |
| 21-Dec-11 | +23:00 | 2.5 | 0.3 | 0.2 |
| 22-Dec-11 | +00:00 | 4.1 | 0.3 | 0.2 |
| 22-Dec-11 | +01:00 | 2.3 | 0.2 | 0.1 |
| 22-Dec-11 | +02:00 | 2.4 | 0.2 | 0.1 |
| 22-Dec-11 | +03:00 | 1.4 | 0.1 | 0.1 |
| 22-Dec-11 | +04:00 | 1.3 | 0.2 | 0.1 |
| 22-Dec-11 | +05:00 | 7.3 | 0.6 | 0.3 |
| 22-Dec-11 | +06:00 | 11.1 | 0.9 | 0.5 |
| 22-Dec-11 | +07:00 | 11.2 | 1.0 | 0.5 |
| 22-Dec-11 | +08:00 | 17.1 | 0.7 | 0.4 |
| 22-Dec-11 | +09:00 | 20.1 | 1.4 | 1.2 |
| 22-Dec-11 | +10:00 | 17.2 | 0.7 | 0.4 |
| 22-Dec-11 | +11:00 | 13.8 | 0.9 | 0.5 |
| 22-Dec-11 | +12:00 | 15.3 | 1.8 | 1.1 |
| 22-Dec-11 | +13:00 | 17.9 | 0.5 | 0.2 |
| 22-Dec-11 | +14:00 | 17.2 | 0.5 | 0.3 |
| 22-Dec-11 | +15:00 | 13.0 | 0.8 | 0.4 |
| 22-Dec-11 | +16:00 | 11.8 | 0.6 | 0.3 |
| 22-Dec-11 | +17:00 | 12.2 | 0.6 | 0.3 |
| 22-Dec-11 | +18:00 | 18.2 | 0.5 | 0.2 |
| 22-Dec-11 | +19:00 | 4.6 | 0.6 | 0.3 |
| 22-Dec-11 | +20:00 | 2.2 | 0.4 | 0.2 |
| 22-Dec-11 | +21:00 | 2.6 | 0.9 | 0.6 |
| 22-Dec-11 | +22:00 | 4.4 | 0.9 | 0.9 |
| 22-Dec-11 | +23:00 | 2.6 | 0.4 | 0.2 |
| 23-Dec-11 | +00:00 | 2.2 | 0.3 | 0.2 |
| 23-Dec-11 | +01:00 | 2.0 | 0.2 | 0.1 |
| 23-Dec-11 | +02:00 | 2.3 | 0.3 | 0.1 |
| 23-Dec-11 | +03:00 | 2.0 | 0.2 | 0.1 |
| 23-Dec-11 | +04:00 | 2.5 | 0.3 | 0.2 |
| 23-Dec-11 | +05:00 | 4.8 | 0.5 | 0.2 |
| 23-Dec-11 | +06:00 | 11.3 | 0.9 | 0.5 |
| 23-Dec-11 | +07:00 | 7.0 | 0.6 | 0.3 |
| 23-Dec-11 | +08:00 | 11.5 | 0.5 | 0.3 |
| 23-Dec-11 | +09:00 | 12.7 | 0.6 | 0.3 |
| 23-Dec-11 | +10:00 | 12.2 | 0.7 | 0.4 |
| 23-Dec-11 | +11:00 | 11.3 | 4.1 | 2.1 |
| 23-Dec-11 | +12:00 | 13.5 | 0.7 | 0.4 |
| 23-Dec-11 | +13:00 | 18.3 | 0.5 | 0.2 |
| 23-Dec-11 | +14:00 | 19.0 | 0.5 | 0.3 |
| 23-Dec-11 | +15:00 | 18.9 | 0.6 | 0.3 |
| 23-Dec-11 | +16:00 | 19.5 | 1.1 | 0.8 |
| 23-Dec-11 | +17:00 | 8.3 | 2.0 | 1.5 |
| 23-Dec-11 | +18:00 | 3.6 | 0.3 | 0.2 |
| 23-Dec-11 | +19:00 | 2.1 | 0.3 | 0.2 |
| 23-Dec-11 | +20:00 | 2.3 | 0.3 | 0.2 |
| 23-Dec-11 | +21:00 | 7.1 | 0.7 | 0.4 |

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Lane Cove Tunnel & Military Road E-Ramp



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| | | | | |
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| 23-Dec-11 | +23:00 | 4.1 | 0.5 | 0.2 |
| 24-Dec-11 | +00:00 | 2.0 | 0.2 | 0.1 |
| 24-Dec-11 | +01:00 | 2.0 | 0.2 | 0.1 |
| 24-Dec-11 | +02:00 | 2.0 | 0.2 | 0.1 |
| 24-Dec-11 | +03:00 | 2.3 | 0.3 | 0.2 |
| 24-Dec-11 | +04:00 | 2.1 | 0.2 | 0.1 |
| 24-Dec-11 | +05:00 | 2.2 | 0.3 | 0.1 |
| 24-Dec-11 | +06:00 | 3.0 | 0.3 | 0.1 |
| 24-Dec-11 | +07:00 | 3.1 | 0.4 | 0.2 |
| 24-Dec-11 | +08:00 | 4.1 | 0.5 | 0.2 |
| 24-Dec-11 | +09:00 | 3.1 | 0.3 | 0.2 |
| 24-Dec-11 | +10:00 | 5.0 | 0.5 | 0.3 |
| 24-Dec-11 | +11:00 | 6.1 | 0.6 | 0.3 |
| 24-Dec-11 | +12:00 | 4.3 | 0.4 | 0.2 |
| 24-Dec-11 | +13:00 | 2.3 | 0.6 | 0.3 |
| 24-Dec-11 | +14:00 | 8.8 | 0.4 | 0.2 |
| 24-Dec-11 | +15:00 | 3.4 | 0.3 | 0.2 |
| 24-Dec-11 | +16:00 | 4.7 | 0.5 | 0.3 |
| 24-Dec-11 | +17:00 | 3.6 | 0.4 | 0.2 |
| 24-Dec-11 | +18:00 | 4.2 | 0.5 | 0.2 |
| 24-Dec-11 | +19:00 | 3.1 | 1.2 | 0.7 |
| 24-Dec-11 | +20:00 | 3.0 | 0.4 | 0.2 |
| 24-Dec-11 | +21:00 | 2.5 | 0.3 | 0.1 |
| 24-Dec-11 | +22:00 | 2.1 | 0.3 | 0.1 |
| 24-Dec-11 | +23:00 | 3.1 | 0.4 | 0.2 |
| 25-Dec-11 | +00:00 | 2.1 | 0.2 | 0.1 |
| 25-Dec-11 | +01:00 | 3.1 | 0.3 | 0.2 |
| 25-Dec-11 | +02:00 | 2.7 | 0.2 | 0.1 |
| 25-Dec-11 | +03:00 | 1.1 | 0.1 | 0.1 |
| 25-Dec-11 | +04:00 | 1.8 | 0.2 | 0.1 |
| 25-Dec-11 | +05:00 | 2.0 | 0.2 | 0.1 |
| 25-Dec-11 | +06:00 | 2.1 | 0.2 | 0.1 |
| 25-Dec-11 | +07:00 | 2.3 | 0.2 | 0.1 |
| 25-Dec-11 | +08:00 | 4.2 | 0.2 | 0.1 |
| 25-Dec-11 | +09:00 | 5.0 | 0.4 | 0.2 |
| 25-Dec-11 | +10:00 | 4.1 | 0.5 | 0.3 |
| 25-Dec-11 | +11:00 | 9.2 | 0.3 | 0.2 |
| 25-Dec-11 | +12:00 | 9.9 | 0.5 | 0.3 |
| 25-Dec-11 | +13:00 | 4.2 | 0.4 | 0.2 |
| 25-Dec-11 | +14:00 | 3.1 | 0.4 | 0.2 |
| 25-Dec-11 | +15:00 | 4.4 | 0.4 | 0.2 |
| 25-Dec-11 | +16:00 | 9.6 | 3.8 | 2.5 |
| 25-Dec-11 | +17:00 | 5.7 | 0.4 | 0.2 |
| 25-Dec-11 | +18:00 | 3.7 | 0.5 | 0.3 |
| 25-Dec-11 | +19:00 | 4.3 | 0.5 | 0.3 |
| 25-Dec-11 | +20:00 | 3.1 | 0.4 | 0.2 |
| 25-Dec-11 | +21:00 | 2.0 | 0.2 | 0.1 |
| 25-Dec-11 | +22:00 | 3.6 | 0.3 | 0.1 |
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| 26-Dec-11 | +00:00 | 2.1 | 0.2 | 0.1 |

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| | | | | |
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| 26-Dec-11 | +03:00 | 1.3 | 0.1 | 0.1 |
| 26-Dec-11 | +04:00 | 1.7 | 0.3 | 0.2 |
| 26-Dec-11 | +05:00 | 3.1 | 0.4 | 0.2 |
| 26-Dec-11 | +06:00 | 1.9 | 0.2 | 0.1 |
| 26-Dec-11 | +07:00 | 2.4 | 0.3 | 0.2 |
| 26-Dec-11 | +08:00 | 3.1 | 0.3 | 0.2 |
| 26-Dec-11 | +09:00 | 5.1 | 0.5 | 0.3 |
| 26-Dec-11 | +10:00 | 5.1 | 0.6 | 0.3 |
| 26-Dec-11 | +11:00 | 7.1 | 0.7 | 0.4 |
| 26-Dec-11 | +12:00 | 5.9 | 0.5 | 0.3 |
| 26-Dec-11 | +13:00 | 5.2 | 0.4 | 0.2 |
| 26-Dec-11 | +14:00 | 4.6 | 0.4 | 0.2 |
| 26-Dec-11 | +15:00 | 4.8 | 0.5 | 0.3 |
| 26-Dec-11 | +16:00 | 4.1 | 0.5 | 0.2 |
| 26-Dec-11 | +17:00 | 4.7 | 0.5 | 0.2 |
| 26-Dec-11 | +18:00 | 3.1 | 0.3 | 0.2 |
| 26-Dec-11 | +19:00 | 4.0 | 0.3 | 0.2 |
| 26-Dec-11 | +20:00 | 2.2 | 1.5 | 1.0 |
| 26-Dec-11 | +21:00 | 4.2 | 0.6 | 0.3 |
| 26-Dec-11 | +22:00 | 4.2 | 0.3 | 0.1 |
| 26-Dec-11 | +23:00 | 4.2 | 0.3 | 0.1 |
| 27-Dec-11 | +00:00 | 4.2 | 0.3 | 0.1 |
| 27-Dec-11 | +01:00 | 3.3 | 0.2 | 0.1 |
| 27-Dec-11 | +02:00 | 2.5 | 0.1 | 0.1 |
| 27-Dec-11 | +03:00 | 2.2 | 0.2 | 0.1 |
| 27-Dec-11 | +04:00 | 2.2 | 0.2 | 0.1 |
| 27-Dec-11 | +05:00 | 2.3 | 0.3 | 0.2 |
| 27-Dec-11 | +06:00 | 2.7 | 0.2 | 0.1 |
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| 27-Dec-11 | +11:00 | 5.3 | 0.6 | 0.3 |
| 27-Dec-11 | +12:00 | 5.2 | 0.6 | 0.3 |
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| 27-Dec-11 | +14:00 | 5.1 | 0.5 | 0.3 |
| 27-Dec-11 | +15:00 | 2.3 | 0.3 | 0.2 |
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| 27-Dec-11 | +22:00 | 3.1 | 0.3 | 0.2 |
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| 28-Dec-11 | +01:00 | 2.9 | 0.4 | 0.4 |
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| 28-Dec-11 | +03:00 | 2.2 | 0.2 | 0.1 |

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| | | | | |
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| 28-Dec-11 | +07:00 | 5.3 | 0.4 | 0.2 |
| 28-Dec-11 | +08:00 | 6.2 | 0.6 | 0.3 |
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| 28-Dec-11 | +10:00 | 5.0 | 1.2 | 1.1 |
| 28-Dec-11 | +11:00 | 5.3 | 1.8 | 1.4 |
| 28-Dec-11 | +12:00 | 5.2 | 0.9 | 0.8 |
| 28-Dec-11 | +13:00 | 5.0 | 0.5 | 0.2 |
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| 28-Dec-11 | +19:00 | 3.2 | 0.3 | 0.2 |
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| 28-Dec-11 | +21:00 | 3.5 | 0.5 | 0.2 |
| 28-Dec-11 | +22:00 | 4.2 | 0.7 | 0.5 |
| 28-Dec-11 | +23:00 | 5.1 | 1.5 | 1.1 |
| 29-Dec-11 | +00:00 | 1.7 | 0.8 | 0.7 |
| 29-Dec-11 | +01:00 | 2.3 | 0.3 | 0.2 |
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| 29-Dec-11 | +08:00 | 6.3 | 0.5 | 0.2 |
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| 29-Dec-11 | +21:00 | 2.1 | 0.2 | 0.1 |
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| 30-Dec-11 | +02:00 | 5.7 | 0.4 | 0.2 |
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| 30-Dec-11 | +05:00 | 2.6 | 0.3 | 0.1 |
| 30-Dec-11 | +06:00 | 6.3 | 0.6 | 0.3 |

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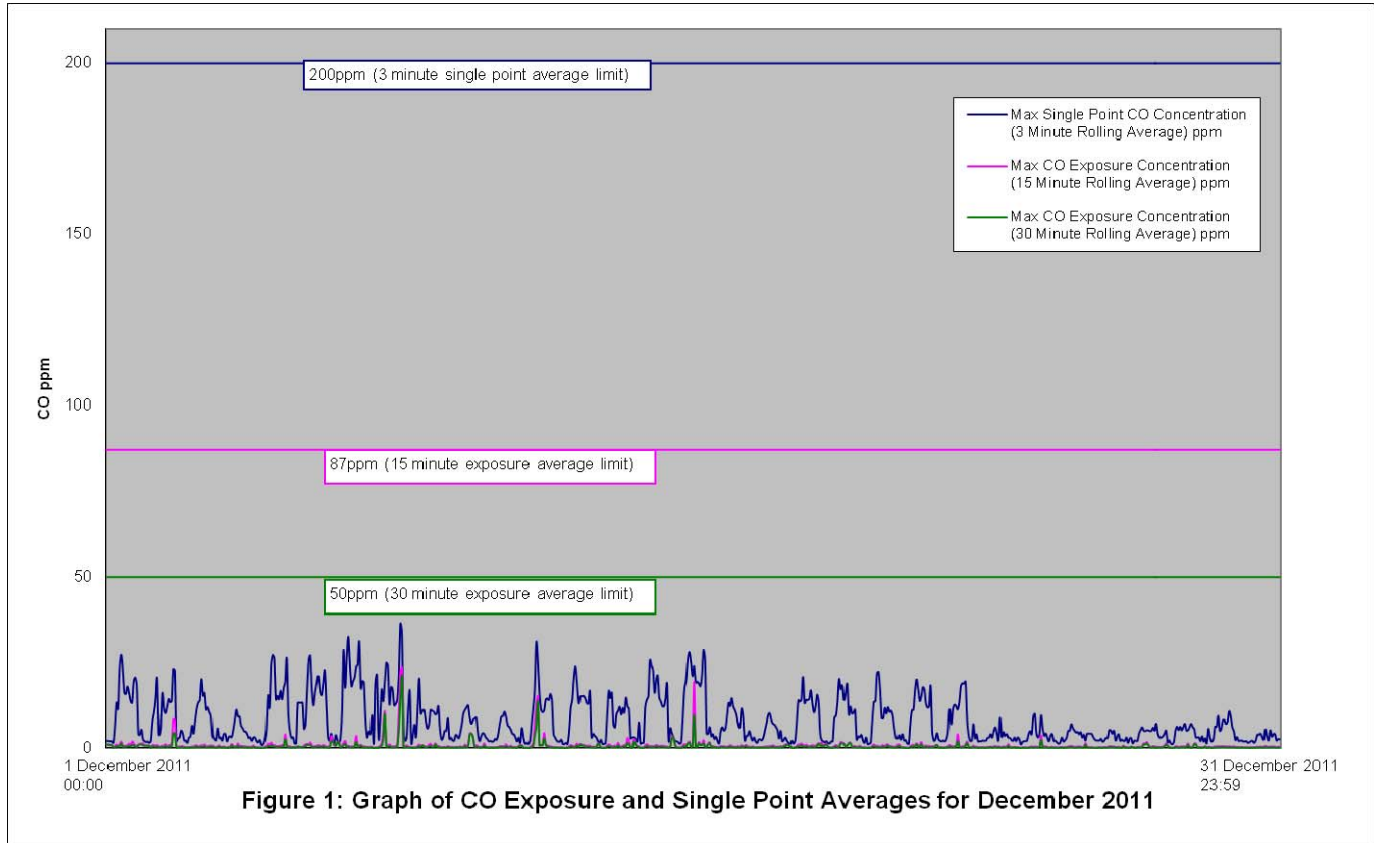
IN TUNNEL AIR QUALITY MONITORING DECEMBER 2011

DOCUMENT No: TMF-2035-EV-0017

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| 30-Dec-11 | +08:00 | 9.4 | 0.6 | 0.3 |
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| 30-Dec-11 | +10:00 | 5.7 | 0.6 | 0.3 |
| 30-Dec-11 | +11:00 | 8.1 | 0.5 | 0.3 |
| 30-Dec-11 | +12:00 | 8.2 | 0.6 | 0.3 |
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| 31-Dec-11 | +10:00 | 3.9 | 0.3 | 0.2 |
| 31-Dec-11 | +11:00 | 4.3 | 0.5 | 0.2 |
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| 31-Dec-11 | +21:00 | 2.3 | 0.2 | 0.1 |
| 31-Dec-11 | +22:00 | 2.7 | 0.4 | 0.2 |
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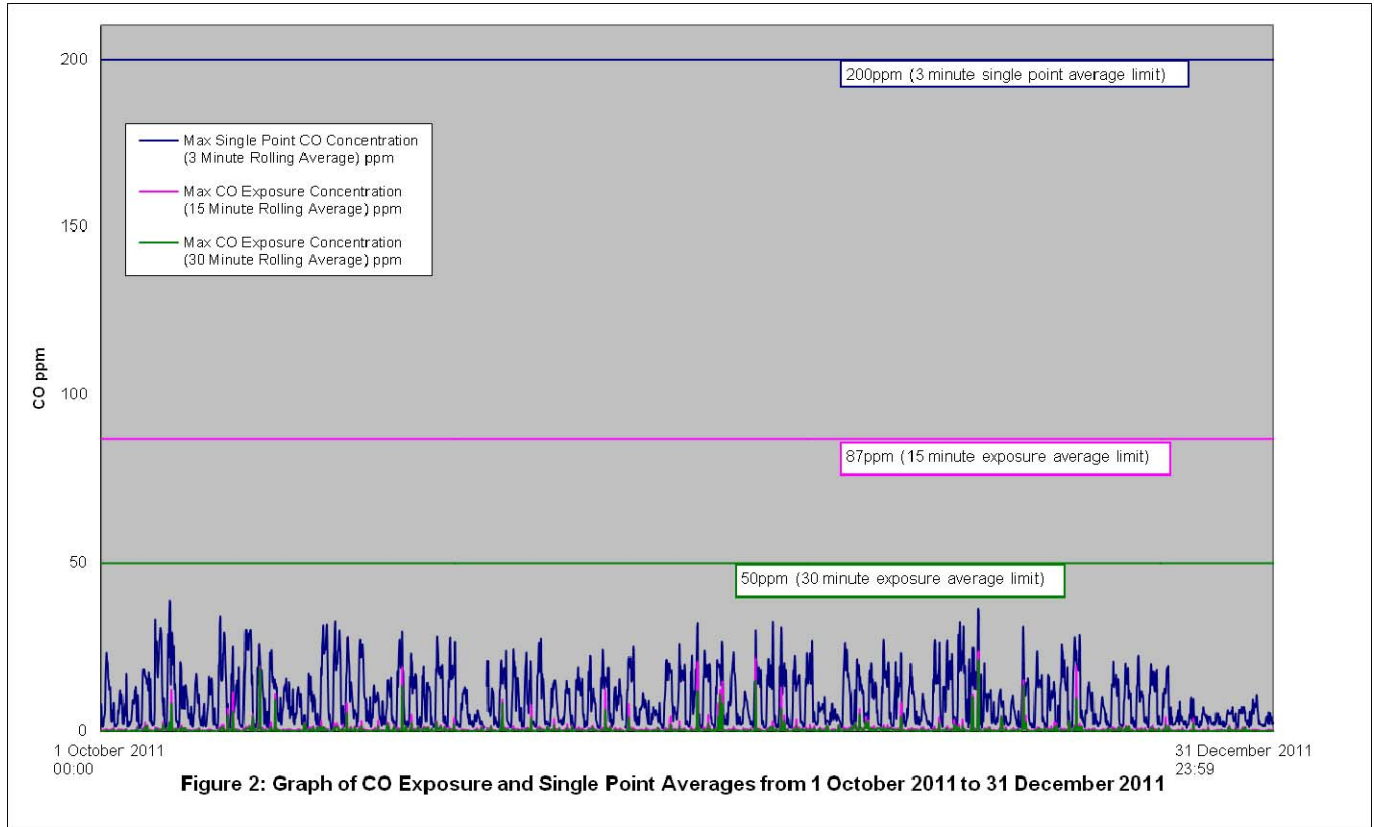
DOCUMENT No: TMF-2035-EV-0017



IN TUNNEL AIR QUALITY MONITORING DECEMBER 2011

DOCUMENT No: TMF-2035-EV-0017

5.2. Three Monthly Trend



5.3. Uncertainty

The uncertainty for the measurement of CO has been calculated at $\pm 12\%$.