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TRANSFIELD SERVICES PTY. LTD.

EastLink Ventilation Stack Emission Monitoring Report October - December 2011

Submitted to:
Transfield Services Pty. Ltd.,
EastLink Operations Centre,
2 Hillcrest Avenue,
Ringwood, 3134

REPORT

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The results of the tests, calibrations and/or measurements included in this
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1.0 INTRODUCTION

EastLink is a 39-kilometre motorway running between Donvale in Melbourne's north-east to Frankston in Melbourne's south-east with two tunnels under the Mulum Mulum Valley. Transfield Services, who are responsible for operation and maintenance of the road, commissioned Golder Associates Pty. Ltd. to provide continuous emission monitoring services for the EastLink motorway project. The services provided include:

- Operations and maintenance services for the EastLink ventilation stack continuous emission monitoring systems (CEMS)
- NATA endorsed emission monitoring reports.

Monitoring commenced on the 29th June, 2008 with the opening of the EastLink motorway. Results for the sampling period 1st October, 2011 to 31st December, 2011 inclusive are contained in the following report.



2.0 DISCHARGES TO AIR

EastLink has discharges to air servicing two road tunnels. Discharge Point No. 1 (DP1) services the inbound (Melba) tunnel and Discharge Point No. 2 (DP2) services the outbound (Mullum Mullum) tunnel.

The locations of the discharges to air are described in Table 1 and presented in Figure 1.

Table 1: Discharges to Air

Discharge Point No.	Station Name	Location
1	Western ventilation stack	Western end of inbound tunnel (Melba) - Donvale
2	Eastern ventilation stack	Eastern end of outbound tunnel (Mullum Mullum) – Ringwood

Monitoring equipment is housed in temperature controlled cabinets located at the base of each of the ventilation stacks. Particulate and gaseous sample inlets are installed inside the plenum chamber of each of the ventilation stacks.

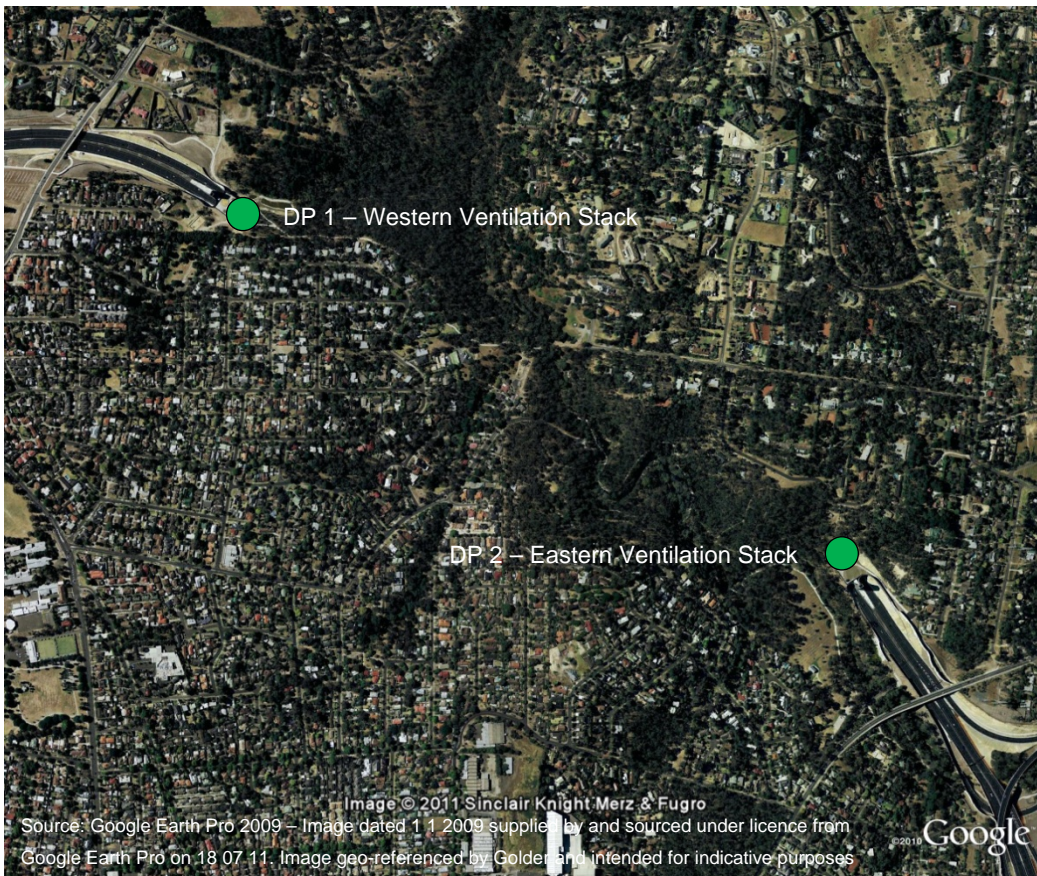


Figure 1: Ventilation Stack Locations



3.0 VENTILATION STACK MONITORING PARAMETERS

The following parameters are monitored continuously, with averages logged at 5 minute intervals:

- Particulate matter with an equivalent aerodynamic diameter less than 2.5 microns (PM_{2.5})
- Particulate matter with an equivalent aerodynamic diameter less than 10 microns (PM₁₀)
- Total oxides of nitrogen (NO_x)
- Nitric oxide (NO)
- Nitrogen dioxide (NO₂)
- Carbon monoxide (CO)
- Stack velocity
- Stack temperature
- Ambient pressure.



4.0 METHODS

4.1 PM_{2.5}

PM_{2.5} concentrations in the tunnel ventilation stacks are determined using a 1400 Series Tapered Element Oscillating Microbalance (TEOM) analyser, located in the plenum chamber of the ventilation stacks.

Exhaust gas is drawn through a PM_{2.5} size selective inlet (PM₁₀ WINS head fitted with a PM_{2.5} sharp cut cyclone (SCC)) at 1 m³/h. The flow is then isokinetically split into two streams; 1 l/min stream which passes through the filter on the mass transducer and a 15.7 l/min bypass stream.

The sample stream is heated to 50°C to maintain a low and therefore relatively constant humidity.

Measurements are made in real-time (2 s intervals) with the 5-minute averages logged. 1-hour averages are then calculated from the logged data.

The PM_{2.5} monitoring method is based on the requirements of Australian Standard AS 3580.9.8, *“Methods for Sampling and Analysis of Ambient Air: Determination of Suspended Particulate Matter – PM₁₀ Continuous Direct Mass Method Using a Tapered Element Oscillating Microbalance Analyser”*.

4.2 PM₁₀

PM₁₀ concentrations in the tunnel ventilation stacks are determined using a 1400 Series Tapered Element Oscillating Microbalance (TEOM) analyser, located in the plenum chamber of the ventilation stacks.

Exhaust gas is drawn through a PM₁₀ size selective inlet (PM₁₀ WINS head) at 1 m³/h. The flow is then isokinetically split into two streams; 1 l/min stream which passes through the filter on the mass transducer and a 15.7 l/min bypass stream.

The sample stream is heated to 50°C to maintain a low and therefore relatively constant humidity.

Measurements are made in real-time (2 s intervals) with the 5-minute averages logged. 1-hour averages are then calculated from the logged data.

The PM₁₀ monitoring method is based on the requirements of Australian Standard AS 3580.9.8, *“Methods for Sampling and Analysis of Ambient Air: Determination of Suspended Particulate Matter – PM₁₀ Continuous Direct Mass Method Using a Tapered Element Oscillating Microbalance Analyser”*.

4.3 Carbon Monoxide

Carbon monoxide concentrations in the tunnel ventilation stacks are determined by infra-red gas filter correlation analysers.

Automatic calibrations are carried out daily against a NATA certified reference gas mixture. Manual calibrations are conducted at one month intervals.

The carbon monoxide monitoring method is based on the requirements of Australian Standard AS 3580.7.1, *“Determination of Carbon Monoxide – Direct Reading Instrumental Method”*.



4.4 Oxides of Nitrogen

Oxides of nitrogen concentrations in the tunnel ventilation stacks are determined by chemiluminescence gas analysers.

Automatic calibrations are carried out daily against a NATA certified reference gas mixture. Manual calibrations are conducted at one month intervals.

The oxides of nitrogen (NO, NO₂ and NO_x) monitoring method is based on the requirements of Australian Standard AS 3580.5.1, "*Determination of Oxides of Nitrogen – Chemiluminescence Method*".

4.5 Stack Velocity

Stack gas velocity was determined using an optical flow sensor that complies with USEPA Code of Federal Regulations (CFR 40) Part 75, "*Continuous Emission Monitoring*" requirements.



5.0 MEASUREMENT UNCERTAINTY

Table 2: Measurement Uncertainty

Parameter	Method	Estimated Uncertainty
PM ₁₀	TEOM	± 5%
PM _{2.5}	TEOM	± 5%
NO, NO ₂ , NO _x	Chemiluminescence	± 10%
CO	Infra-red gas filter correlation	± 10%
Stack velocity	Optical flow sensor	± 0.1 m/s or 5% of reading, whichever is greater



6.0 VENTILATION STACK EMISSION MONITORING PERIOD: 01/10/2011 – 31/10/2011

6.1 Data Capture

Data capture is defined as the number of valid data periods collected divided by the number of available data periods. Valid data excludes periods where the instrument is unavailable due to calibration and maintenance and excludes periods where the data has been rejected due to quality assurance/data validation procedures.

The data capture statistics for the reporting period 1st October to 31st October, 2011 are shown in Table 3. Averages were only collected for those periods where the 5-minute data constituted 75% data capture.

Section 6.3 provides further information on the reasons for invalid data periods.

Table 3: Data Capture Statistics - 1 Hour Averages

Parameter	Station	Collected Periods	Available Periods	Data Capture
PM _{2.5}	Eastern	704	744	94.6%
	Western	743	744	99.9%
PM ₁₀	Eastern	742	744	99.7%
	Western	741	744	99.6%
NO, NO ₂	Eastern	711	744	95.6%
	Western	639	744	85.9%
CO	Eastern	711	744	95.6%
	Western	661	744	88.8%



6.2 Results

6.2.1 PM_{2.5}

PM_{2.5} was continuously monitored and 5 minute averages logged. The 5 minute average data was then transformed to 1 hour averages for reporting.

PM_{2.5} (1 hour average) mass rate of emission statistics for the reporting period are given in Table 4. A plot of PM_{2.5} (1 hour average) mass rate of emission for the reporting period is presented in Figure 2.

Table 4: PM_{2.5} Mass Rate Percentiles (1 Hour Average)

Station	PM _{2.5} Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th
Eastern	0.29	0.24	0.23	0.20	0.19	0.14	0.04
Western	0.27	0.21	0.19	0.15	0.12	0.09	0.03

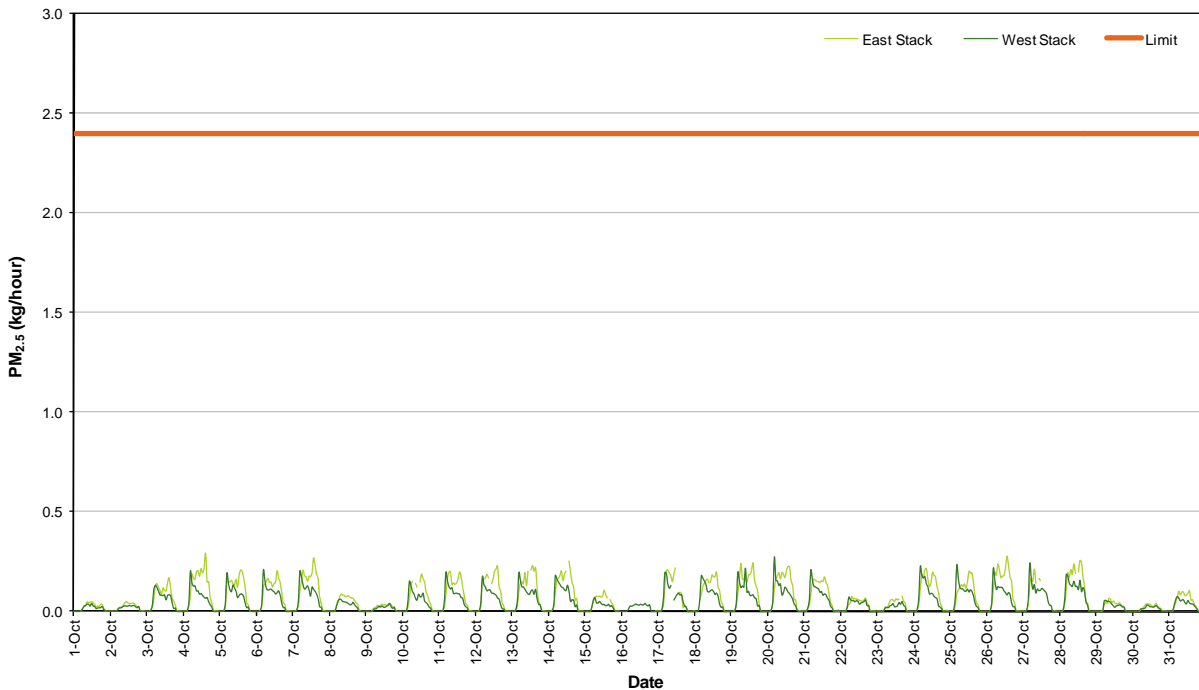


Figure 2: PM_{2.5} Mass Rate (1 Hour Average)



6.2.2 PM₁₀

PM₁₀ was continuously monitored and 5 minute averages logged. The 5 minute average data was then transformed to 1 hour averages for reporting.

PM₁₀ (1 hour average) mass rate of emission statistics for the reporting period are given in Table 5. A plot of PM₁₀ (1 hour average) mass rate of emission for the reporting period is presented in Figure 3.

Table 5: PM₁₀ Mass Rate Percentiles (1 Hour Average)

Station	PM ₁₀ Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th
Eastern	0.33	0.30	0.29	0.26	0.23	0.19	0.06
Western	0.94	0.31	0.29	0.22	0.18	0.13	0.05

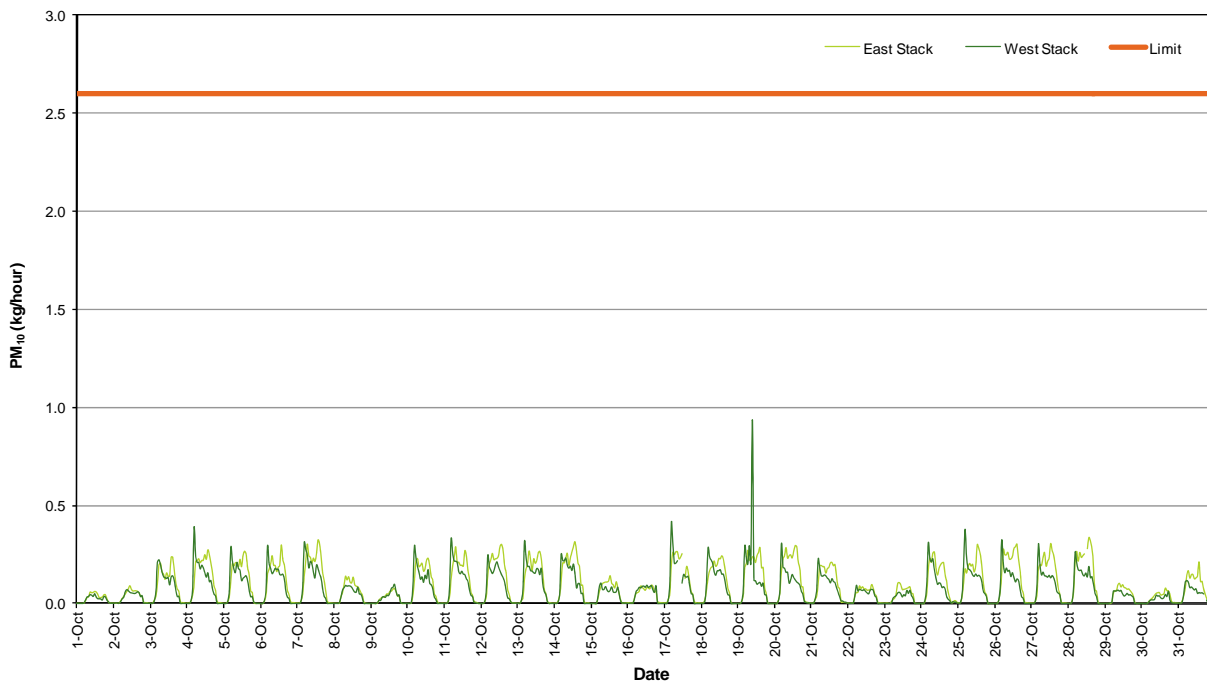


Figure 3: PM₁₀ Mass Rate (1 Hour Average)



6.2.3 Carbon Monoxide

Carbon monoxide (1 hour average) mass rate of emission statistics for the reporting period are given in Table 6. A plot of carbon monoxide (1 hour average) mass rate of emission for the reporting period is presented in Figure 4.

Table 6: Carbon Monoxide Mass Rate Percentiles (1 Hour Average)

Station	Carbon Monoxide Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th
Eastern	25	22	20	18	13	10	6.6
Western	22	19	17	13	10	7	4.8

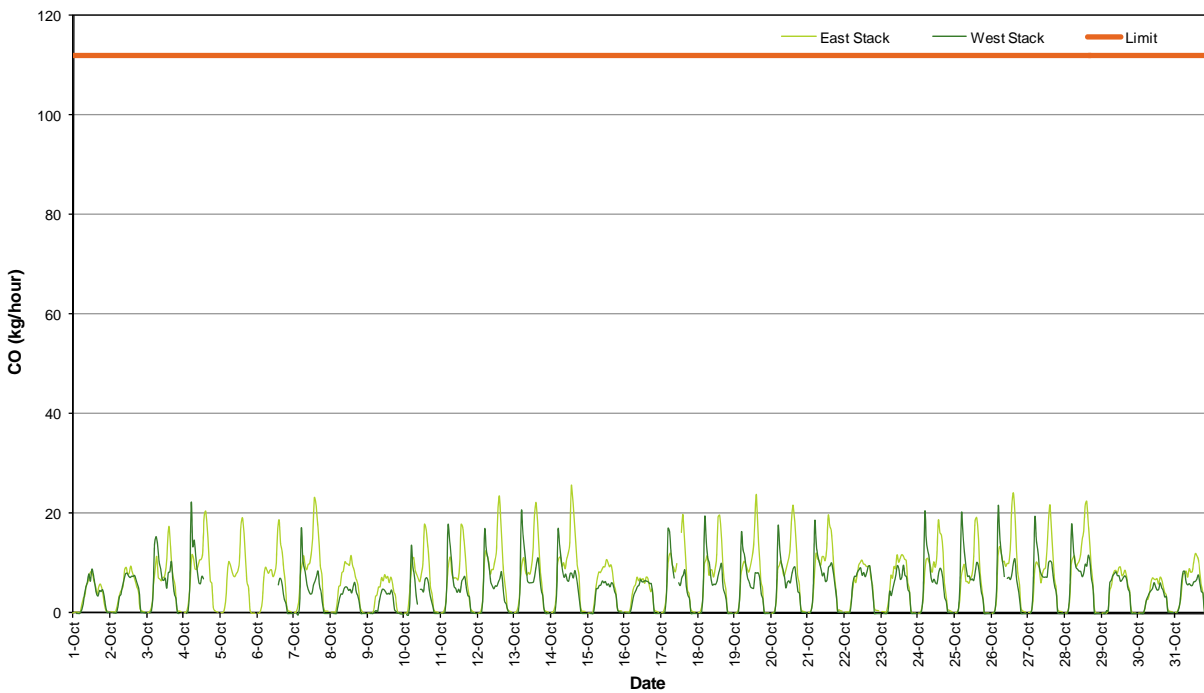


Figure 4: Carbon Monoxide Mass Rate (1 Hour Average)



6.2.4 Oxides of Nitrogen

6.2.4.1 Nitric Oxide

Nitric oxide (1 hour average) mass rate of emission statistics for the reporting period are given in Table 7. A plot of nitric oxide (1 hour average) mass rate of emission for the reporting period is presented in Figure 5.

Table 7: Nitric Oxide Mass Rate Percentiles (1 Hour Average)

Station	Nitric Oxide Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th
Eastern	4.2	3.6	3.5	3.2	2.7	2.2	1.0
Western	5.5	4.5	4.1	3.2	2.6	2.0	1.1

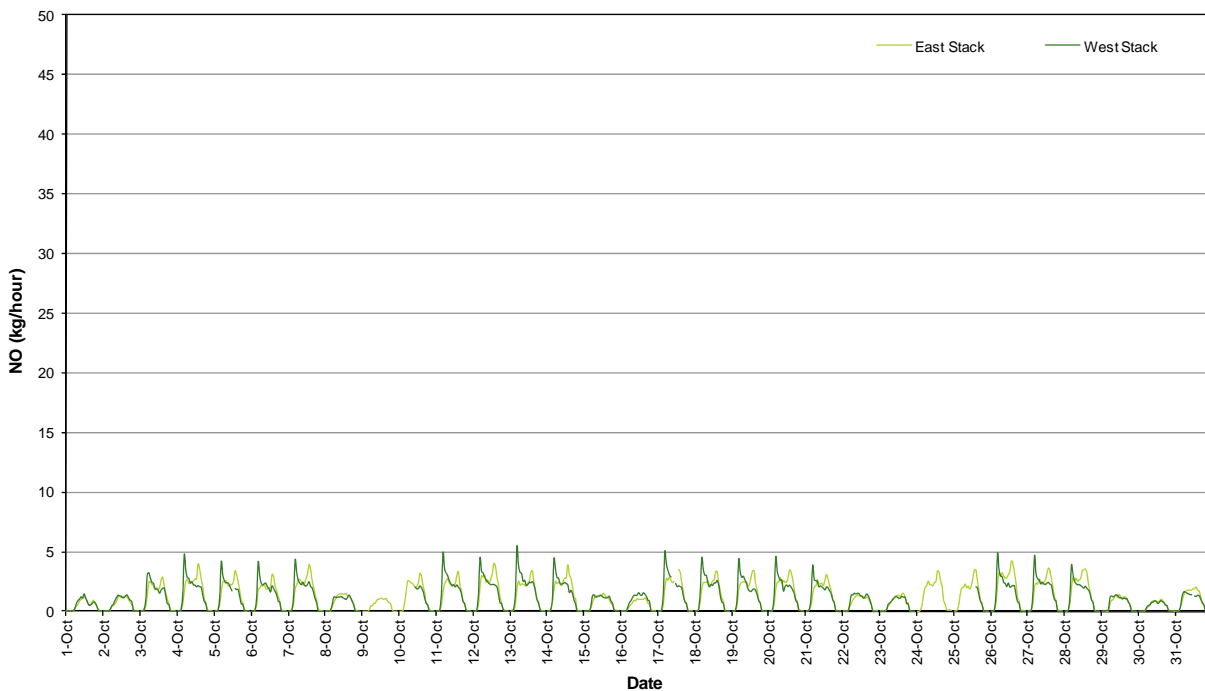


Figure 5: Nitric Oxide Mass Rate (1 Hour Average)



6.2.4.2 Nitrogen Dioxide

Nitrogen dioxide (1 hour average) mass rate of emission statistics for the reporting period are given in Table 8. A plot of nitrogen dioxide (1 hour average) mass rate of emission for the reporting period is presented in Figure 6.

Table 8: Nitrogen Dioxide Mass Rate Percentiles (1 Hour Average)

Station	Nitrogen Dioxide Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th
Eastern	0.5	0.5	0.4	0.4	0.3	0.2	0.1
Western	0.4	0.3	0.3	0.3	0.2	0.2	0.1

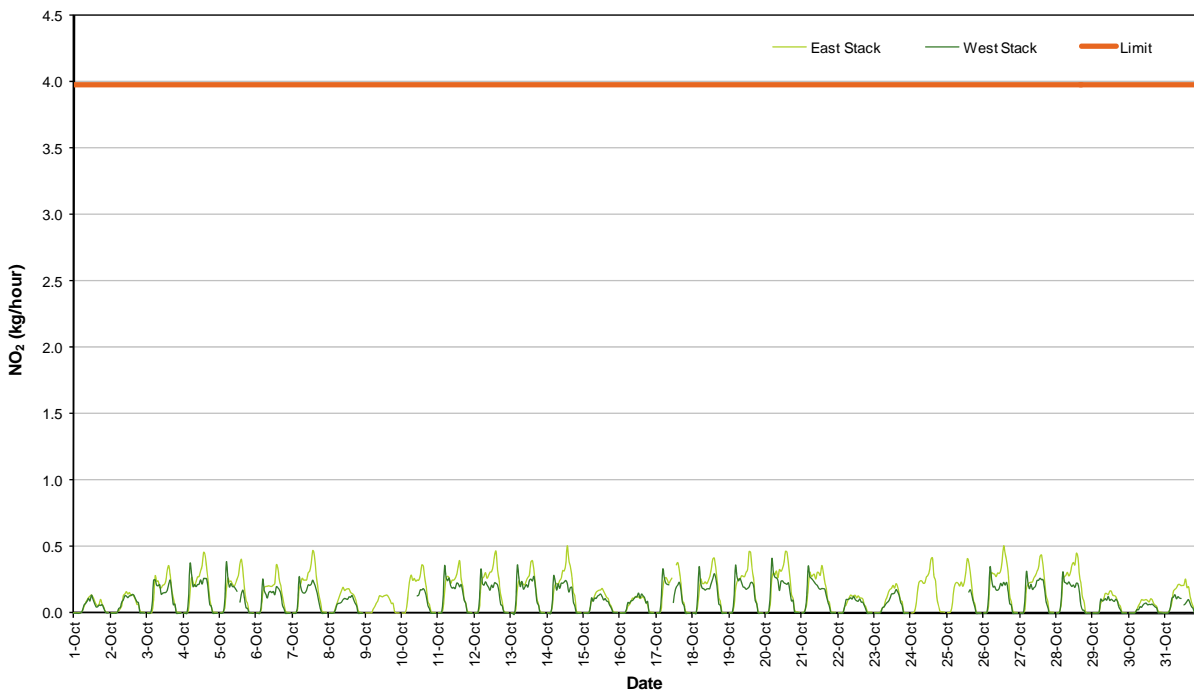


Figure 6: Nitrogen Dioxide Mass Rate (1 Hour Average)



6.2.5 Stack Velocity

The stack velocity (1 hour average) plot for the reporting period is presented in Figure 7.

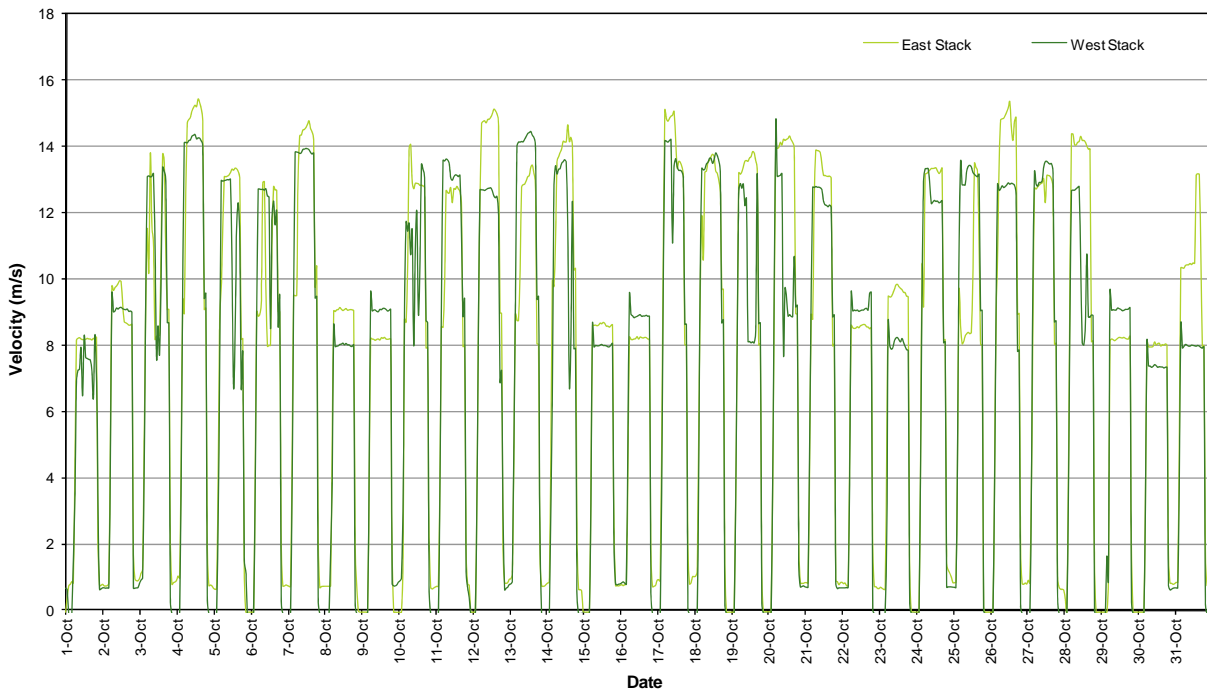


Figure 7: Stack Velocity (1 Hour Average)



6.3 Data Validation and Exceptions

Data contained in the report has been validated against performance and calibration requirements for each instrument. Data during maintenance and calibration periods has been removed from the validated data sets. Tables 9 and 10 list the data exceptions for the eastern and western ventilation stacks respectively. Data during automatic calibrations of the gaseous atmospheric contaminants has also been removed from the data sets.

Table 9: Data Exceptions - Eastern Ventilation Stack: October 2011

Start	End	Parameter	Reason
28/10/2011 12:45	28/10/2011 13:05	NO, NO ₂ , NO _x	Maintenance/calibration
17/10/2011 12:40	17/10/2011 12:55	CO	Maintenance/calibration
17/10/2011 13:15	17/10/2011 13:40	CO	Maintenance/calibration
28/10/2011 12:45	28/10/2011 13:05	CO	Maintenance/calibration
10/10/2011 8:10	10/10/2011 8:25	PM _{2.5}	Invalid data ¹
12/10/2011 10:10	12/10/2011 10:25	PM _{2.5}	Invalid data ¹
13/10/2011 12:35	13/10/2011 12:50	PM _{2.5}	Invalid data ¹
14/10/2011 13:40	14/10/2011 13:55	PM _{2.5}	Invalid data ¹
15/10/2011 16:00	15/10/2011 16:20	PM _{2.5}	Invalid data ¹
16/10/2011 3:00	16/10/2011 20:55	PM _{2.5}	Invalid data ¹
16/10/2011 22:10	16/10/2011 22:35	PM _{2.5}	Invalid data ¹
17/10/2011 5:45	17/10/2011 5:55	PM _{2.5}	Invalid data ¹
17/10/2011 7:20	17/10/2011 7:30	PM _{2.5}	Invalid data ¹
17/10/2011 10:50	17/10/2011 11:05	PM _{2.5}	Invalid data ¹
17/10/2011 13:05	17/10/2011 13:50	PM _{2.5}	Maintenance/calibration
18/10/2011 3:00	18/10/2011 3:20	PM _{2.5}	Invalid data ¹
18/10/2011 15:30	18/10/2011 15:40	PM _{2.5}	Invalid data ¹
23/10/2011 16:00	23/10/2011 16:15	PM _{2.5}	Invalid data ¹
27/10/2011 10:20	27/10/2011 10:35	PM _{2.5}	Invalid data ¹
27/10/2011 13:25	27/10/2011 17:40	PM _{2.5}	Invalid data ¹
27/10/2011 19:40	27/10/2011 20:15	PM _{2.5}	Invalid data ¹
28/10/2011 12:20	28/10/2011 13:00	PM _{2.5}	Maintenance/calibration
17/10/2011 13:05	17/10/2011 14:10	PM ₁₀	Maintenance/calibration
28/10/2011 12:35	28/10/2011 13:00	PM ₁₀	Maintenance/calibration

Note: ¹ – In the opinion of the reviewer.



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Table 10: Data Exceptions - Western Ventilation Stack: October 2011

Start	End	Parameter	Reason
3/10/2011 9:45	3/10/2011 10:00	NO, NO ₂ , NO _x	Maintenance/calibration
3/10/2011 22:00	3/10/2011 23:55	CO	Invalid data ¹
4/10/2011 13:45	6/10/2011 13:15	CO	Invalid data - Span drift
5/10/2011 13:25	5/10/2011 13:55	NO, NO ₂ , NO _x	Maintenance/calibration
9/10/2011 0:40	10/10/2011 9:55	NO, NO ₂ , NO _x	Invalid data - Span drift
10/10/2011 9:55	10/10/2011 10:20	NO, NO ₂ , NO _x	Maintenance/calibration
10/10/2011 10:25	10/10/2011 10:50	CO	Maintenance/calibration
17/10/2011 9:50	17/10/2011 10:20	CO	Maintenance/calibration
17/10/2011 10:15	17/10/2011 11:10	PM _{2.5}	Maintenance/calibration
17/10/2011 10:30	17/10/2011 10:50	NO, NO ₂ , NO _x	Maintenance/calibration
17/10/2011 10:35	17/10/2011 11:25	PM ₁₀	Maintenance/calibration
17/10/2011 11:10	17/10/2011 11:30	CO	Maintenance/calibration
17/10/2011 11:35	17/10/2011 12:00	NO, NO ₂ , NO _x	Maintenance/calibration
24/10/2011 0:40	25/10/2011 14:50	NO, NO ₂ , NO _x	Invalid data - Span drift
25/10/2011 14:50	25/10/2011 15:05	NO, NO ₂ , NO _x	Maintenance/calibration
26/10/2011 10:00	26/10/2011 10:25	CO	Maintenance/calibration
31/10/2011 12:15	31/10/2011 12:40	NO, NO ₂ , NO _x	Maintenance/calibration
31/10/2011 18:15	31/10/2011 18:30	PM ₁₀	Invalid data ¹

Note: ¹ – In the opinion of the reviewer.



7.0 VENTILATION STACK EMISSION MONITORING PERIOD: 01/11/2011 – 30/11/2011

7.1 Data Capture

Data capture is defined as the number of valid data periods collected divided by the number of available data periods. Valid data excludes periods where the instrument is unavailable due to calibration and maintenance and excludes periods where the data has been rejected due to quality assurance/data validation procedures.

The data capture statistics for the reporting period 1st November to 30th November, 2011 are shown in Table 11. Averages were only collected for those periods where the 5-minute data constituted 75% data capture.

Section 7.3 provides further information on the reasons for invalid data periods.

Table 11: Data Capture Statistics - 1 Hour Averages

Parameter	Station	Collected Periods	Available Periods	Data Capture
PM _{2.5}	Eastern	715	720	99.3%
	Western	718	720	99.7%
PM ₁₀	Eastern	716	720	99.4%
	Western	719	720	99.9%
NO, NO ₂	Eastern	690	720	95.8%
	Western	685	720	95.1%
CO	Eastern	690	720	95.8%
	Western	686	720	95.3%



7.2 Results

7.2.1 PM_{2.5}

PM_{2.5} was continuously monitored and 5 minute averages logged. The 5 minute average data was then transformed to 1 hour averages for reporting.

PM_{2.5} (1 hour average) mass rate of emission statistics for the reporting period are given in Table 12. A plot of PM_{2.5} (1 hour average) mass rate of emission for the reporting period is presented in Figure 8.

Table 12: PM_{2.5} Mass Rate Percentiles (1 Hour Average)

Station	PM _{2.5} Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th
Eastern	0.32	0.28	0.25	0.21	0.19	0.15	0.05
Western	0.31	0.24	0.22	0.18	0.14	0.10	0.03

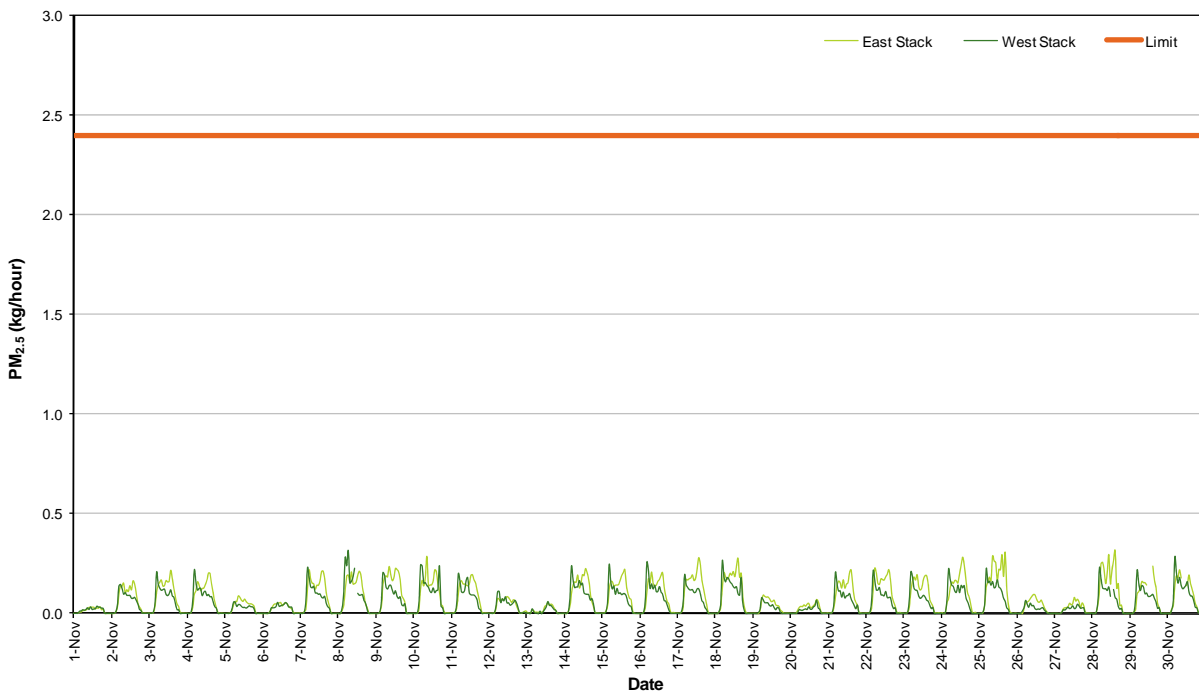


Figure 8: PM_{2.5} Mass Rate (1 Hour Average)



7.2.2 PM₁₀

PM₁₀ was continuously monitored and 5-minute averages logged. The 5 minute average data was then transformed to 1 hour averages for reporting.

PM₁₀ (1 hour average) mass rate of emission statistics for the reporting period are given in Table 13. A plot of PM₁₀ (1 hour average) mass rate of emission for the reporting period is presented in Figure 9.

Table 13: PM₁₀ Mass Rate Percentiles (1 Hour Average)

Station	PM ₁₀ Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th
Eastern	0.78	0.32	0.31	0.28	0.25	0.20	0.06
Western	0.46	0.30	0.27	0.21	0.19	0.13	0.05

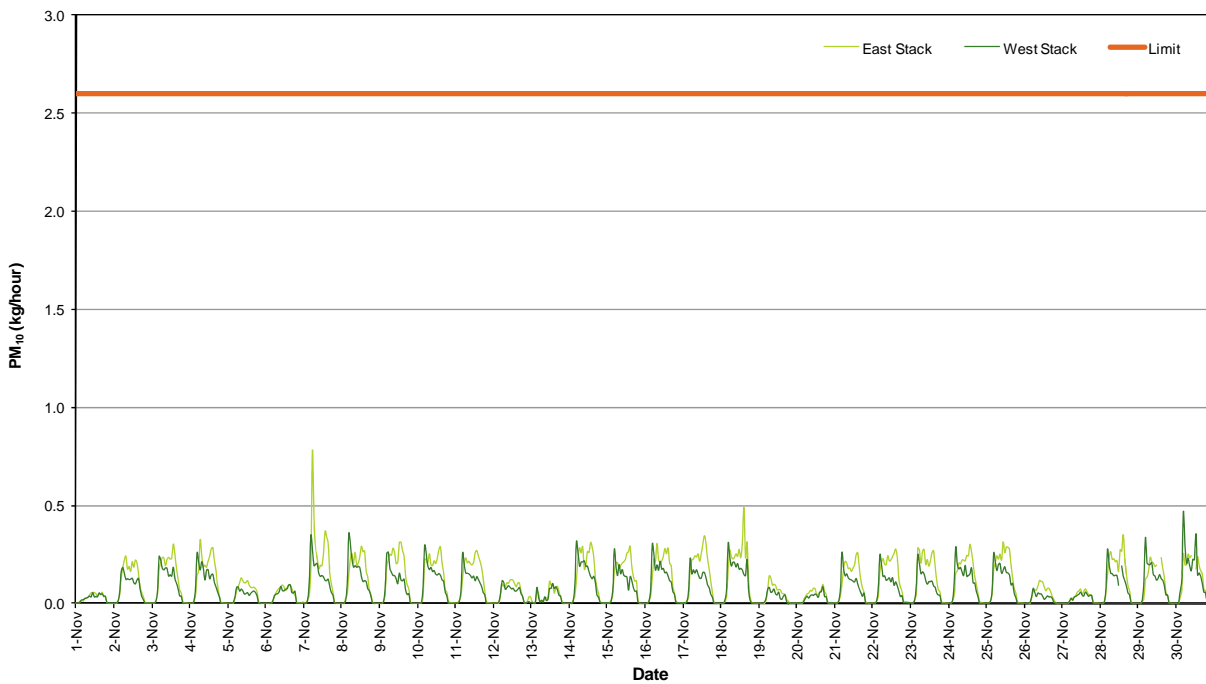


Figure 9: PM₁₀ Mass Rate (1 Hour Average)



7.2.3 Carbon Monoxide

Carbon monoxide (1 hour average) mass rate of emission statistics for the reporting period are given in Table 14. A plot of carbon monoxide (1 hour average) mass rate of emission for the reporting period is presented in Figure 10.

Table 14: Carbon Monoxide Mass Rate Percentiles (1 Hour Average)

Station	Carbon Monoxide Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th
Eastern	32	24	22	20	14	11	7.5
Western	25	21	19	15	12	9	6.3

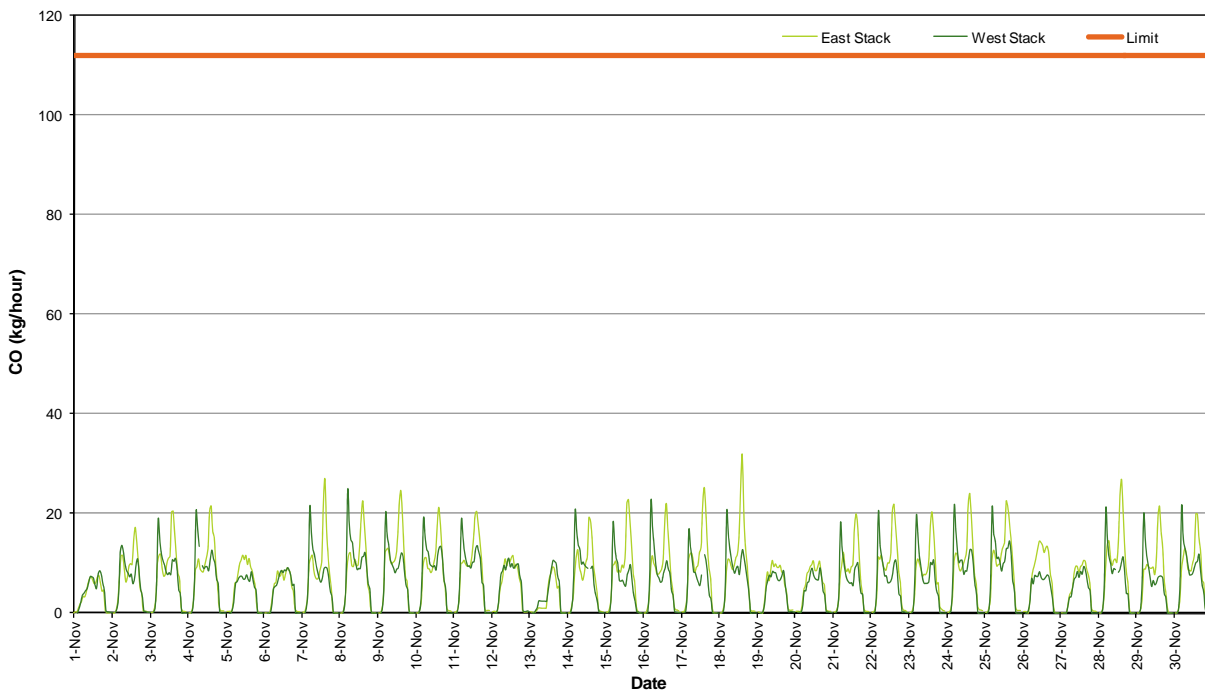


Figure 10: Carbon Monoxide Mass Rate (1 Hour Average)



7.2.4 Oxides of Nitrogen

7.2.4.1 Nitric Oxide

Nitric oxide (1-hour average) mass rate of emission statistics for the reporting period are given in Table 15. A plot of nitric oxide (1-hour average) mass rate of emission for the reporting period is presented in Figure 11.

Table 15: Nitric Oxide Mass Rate Percentiles (1 Hour Average)

Station	Nitric Oxide Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th
Eastern	3.9	3.8	3.6	3.3	2.7	2.3	1.1
Western	4.8	4.2	4.0	2.9	2.6	2.1	1.1

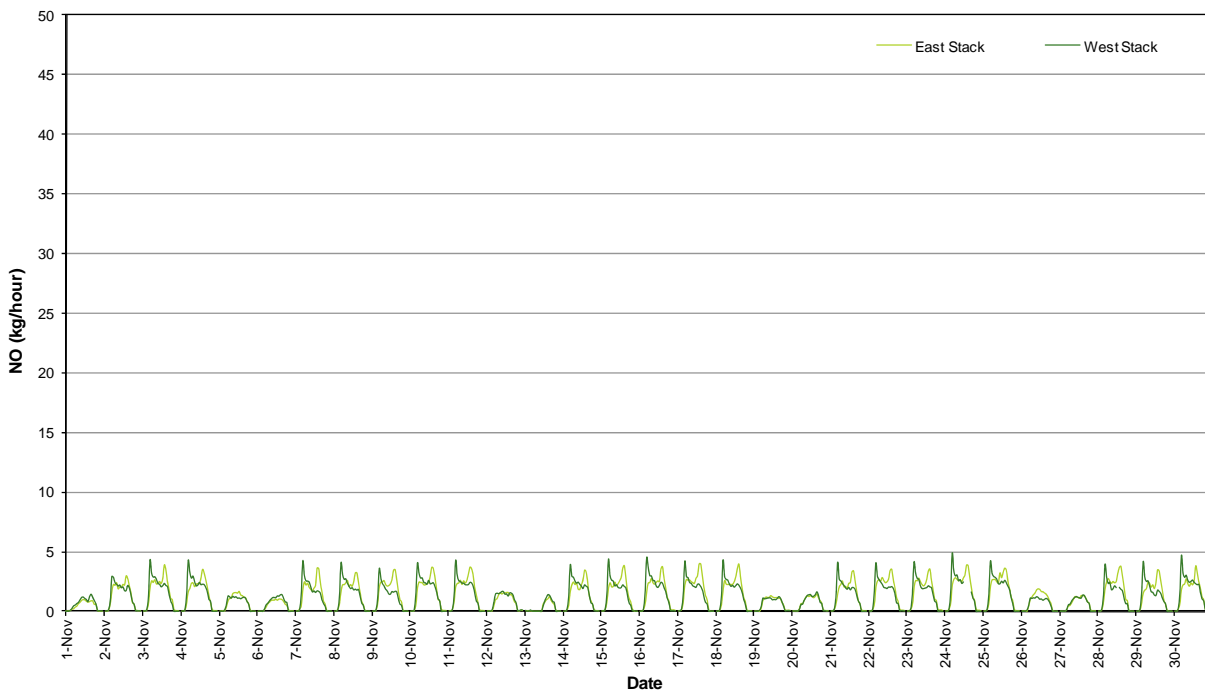


Figure 11: Nitric Oxide Mass Rate (1 Hour Average)



7.2.4.2 Nitrogen Dioxide

Nitrogen dioxide (1 hour average) mass rate of emission statistics for the reporting period are given in Table 16. A plot of nitrogen dioxide (1 hour average) mass rate of emission for the reporting period is presented in Figure 12.

Table 16: Nitrogen Dioxide Mass Rate Percentiles (1 Hour Average)

Station	Nitrogen Dioxide Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th
Eastern	0.6	0.5	0.5	0.4	0.3	0.2	0.1
Western	0.4	0.3	0.3	0.2	0.2	0.2	0.1

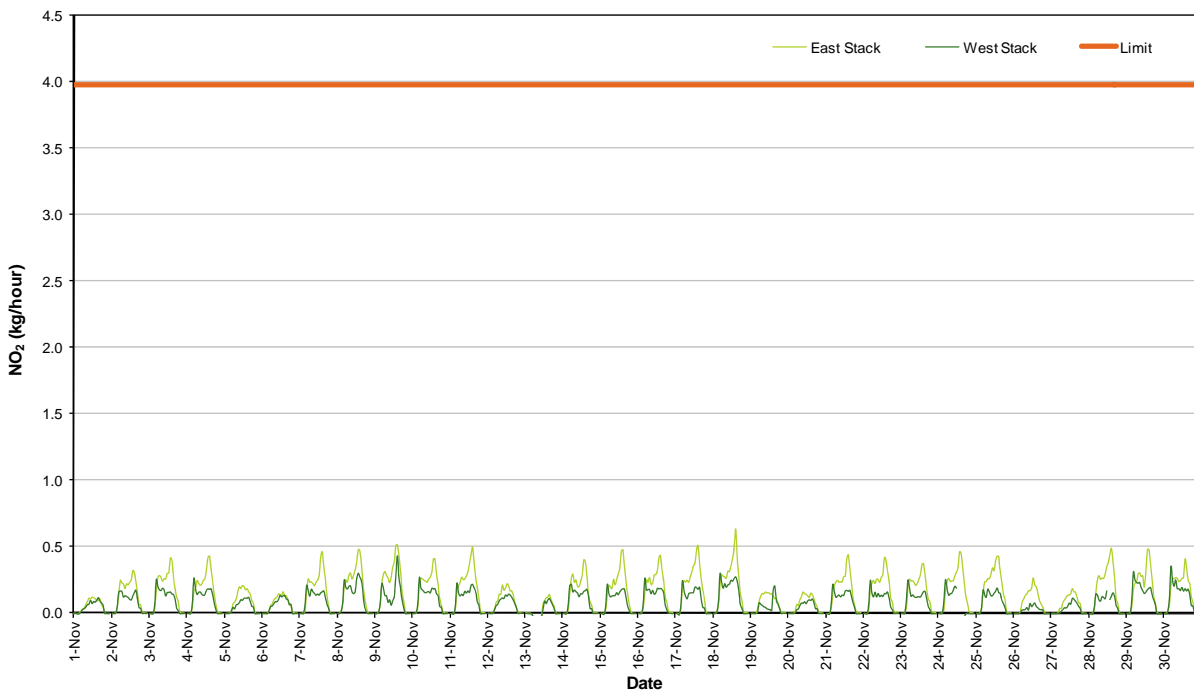


Figure 12: Nitrogen Dioxide Mass Rate (1 Hour Average)



7.2.5 Stack Velocity

The stack velocity (1 hour average) plot for the reporting period is presented in Figure 13.

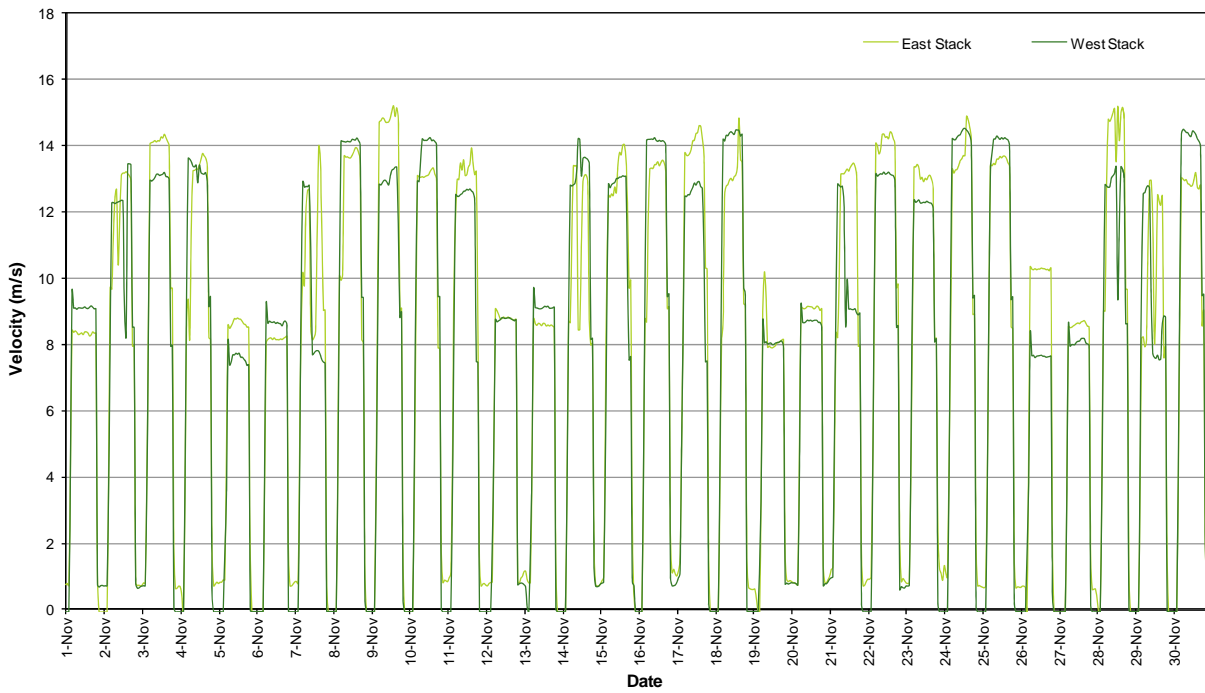


Figure 13: Stack Velocity (1 Hour Average)



7.3 Data Validation and Exceptions

Data contained in the report has been validated against performance and calibration requirements for each instrument. Data during maintenance and calibration periods has been removed from the validated data sets. Tables 17 and 18 list the data exceptions for the eastern and western ventilation stacks respectively. Data during automatic calibrations of the gaseous atmospheric contaminants has also been removed from the data sets.

Table 17: Data Exceptions - Eastern Ventilation Stack: November 2011

Start	End	Parameter	Reason
29/11/2011 12:10	29/11/2011 12:20	NO, NO ₂ , NO _x	Maintenance/calibration
29/11/2011 12:10	29/11/2011 12:20	CO	Maintenance/calibration
29/11/2011 12:35	29/11/2011 15:00	PM _{2.5}	Maintenance/calibration
29/11/2011 13:00	29/11/2011 13:50	PM ₁₀	Maintenance/calibration
29/11/2011 14:00	29/11/2011 15:00	PM ₁₀	Maintenance/calibration
30/11/2011 9:55	30/11/2011 11:35	PM _{2.5}	Maintenance/calibration
30/11/2011 10:45	30/11/2011 12:15	PM ₁₀	Maintenance/calibration

Table 18: Data Exceptions - Western Ventilation Stack: November 2011

Start	End	Parameter	Reason
4/11/2011 8:40	4/11/2011 9:00	CO	Maintenance/ calibration
8/11/2011 12:10	8/11/2011 12:40	PM _{2.5}	Invalid data ¹
14/11/2011 14:05	14/11/2011 14:40	CO	Maintenance/calibration
17/11/2011 13:50	17/11/2011 14:15	CO	Maintenance/calibration
24/11/2011 13:35	24/11/2011 17:10	NO, NO ₂ , NO _x	Maintenance/calibration
28/11/2011 12:40	28/11/2011 13:10	CO	Maintenance/calibration
28/11/2011 12:50	28/11/2011 13:45	PM _{2.5}	Maintenance/calibration
28/11/2011 13:05	28/11/2011 13:55	PM ₁₀	Maintenance/calibration
28/11/2011 13:10	28/11/2011 13:45	NO, NO ₂ , NO _x	Maintenance/calibration
30/11/2011 8:55	30/11/2011 9:00	NO, NO ₂ , NO _x	Invalid data ¹

Note: ¹ – In the opinion of the reviewer.



8.0 VENTILATION STACK EMISSION MONITORING PERIOD: 01/12/2011 – 31/12/2011

8.1 Data Capture

Data capture is defined as the number of valid data periods collected divided by the number of available data periods. Valid data excludes periods where the instrument is unavailable due to calibration and maintenance and excludes periods where the data has been rejected due to quality assurance/data validation procedures.

The data capture statistics for the reporting period 1st December to 31st December, 2011 are shown in Table 19. Averages were only collected for those periods where the 5 minute data constituted 75% data capture.

Section 8.3 provides further information on the reasons for invalid data periods.

Table 19: Data Capture Statistics - 1 Hour Averages

Parameter	Station	Collected Periods	Available Periods	Data Capture
PM _{2.5}	Eastern	735	744	98.8%
	Western	742	744	99.7%
PM ₁₀	Eastern	742	744	99.7%
	Western	727	744	97.7%
NO, NO ₂	Eastern	649	744	87.2%
	Western	585	744	78.6%
CO	Eastern	704	744	94.6%
	Western	710	744	95.4%



8.2 Results

8.2.1 PM_{2.5}

PM_{2.5} was continuously monitored and 5-minute averages logged. The 5-minute average data was then transformed to 1-hour averages for reporting.

PM_{2.5} (1-hour average) mass rate of emission statistics for the reporting period are given in Table 20. A plot of PM_{2.5} (1-hour average) mass rate of emission for the reporting period is presented in Figure 14.

Table 20: PM_{2.5} Mass Rate Percentiles (1 Hour Average)

Station	PM _{2.5} Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th
Eastern	0.37	0.30	0.28	0.24	0.20	0.14	0.05
Western	0.34	0.22	0.20	0.17	0.14	0.09	0.03

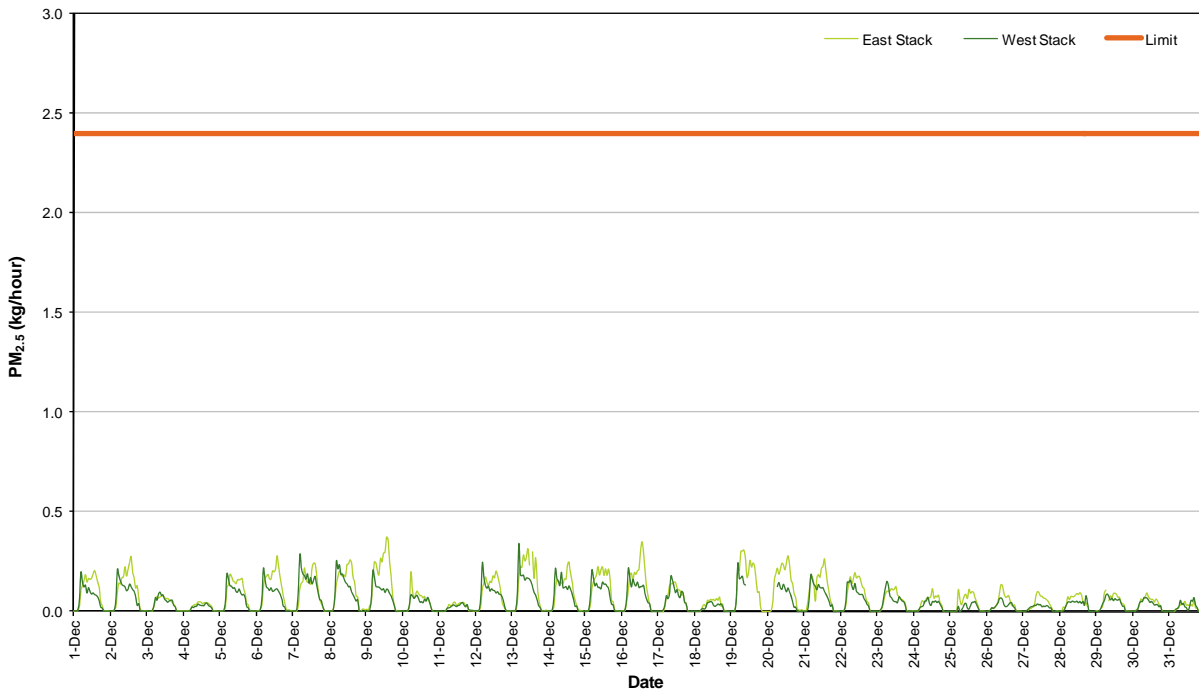


Figure 14: PM_{2.5} Mass Rate (1 Hour Average)



8.2.2 PM₁₀

PM₁₀ was continuously monitored and 5 minute averages logged. The 5 minute average data was then transformed to 1-hour averages for reporting.

PM₁₀ (1 hour average) mass rate of emission statistics for the reporting period are given in Table 21. A plot of PM₁₀ (1 hour average) mass rate of emission for the reporting period is presented in Figure 15.

Table 21: PM₁₀ Mass Rate Percentiles (1 Hour Average)

Station	PM ₁₀ Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th
Eastern	0.88	0.41	0.36	0.30	0.26	0.16	0.07
Western	0.65	0.35	0.33	0.25	0.21	0.14	0.06

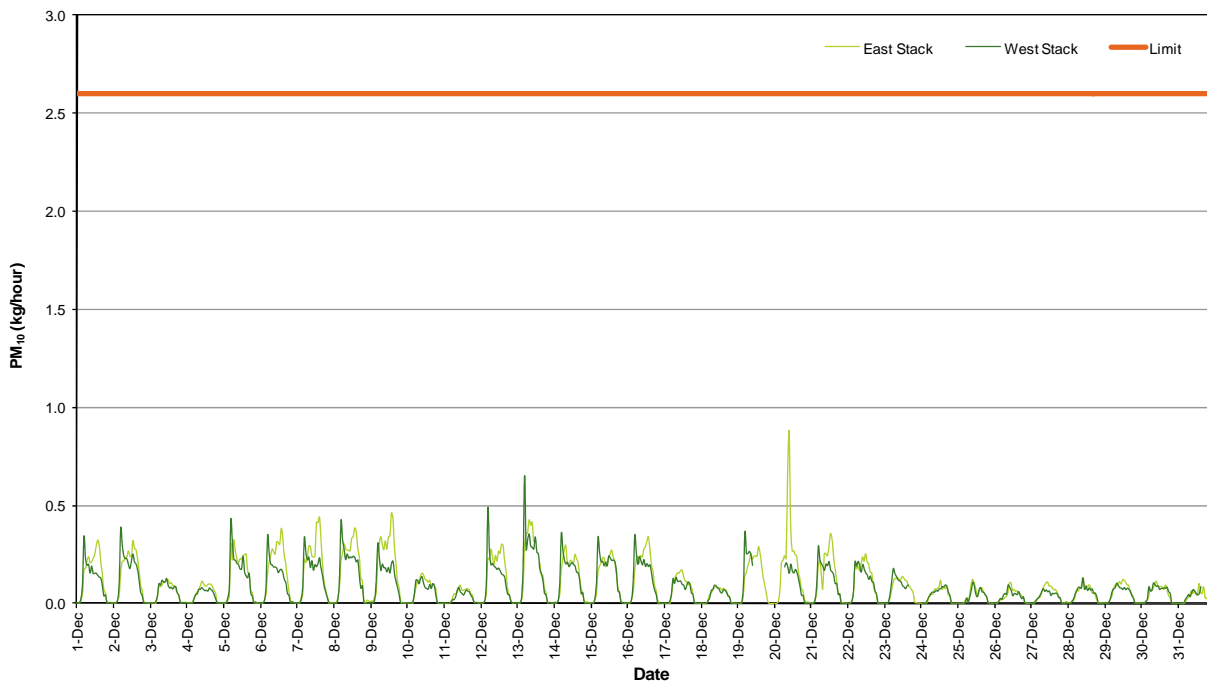


Figure 15: PM₁₀ Mass Rate (1 Hour Average)



8.2.3 Carbon Monoxide

Carbon monoxide (1 hour average) mass rate of emission statistics for the reporting period are given in Table 22. A plot of carbon monoxide (1 hour average) mass rate of emission for the reporting period is presented in Figure 16.

Table 22: Carbon Monoxide Mass Rate Percentiles (1 Hour Average)

Station	Carbon Monoxide Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th
Eastern	28	23	21	18	14	11	7.3
Western	29	22	18	14	12	9	5.9

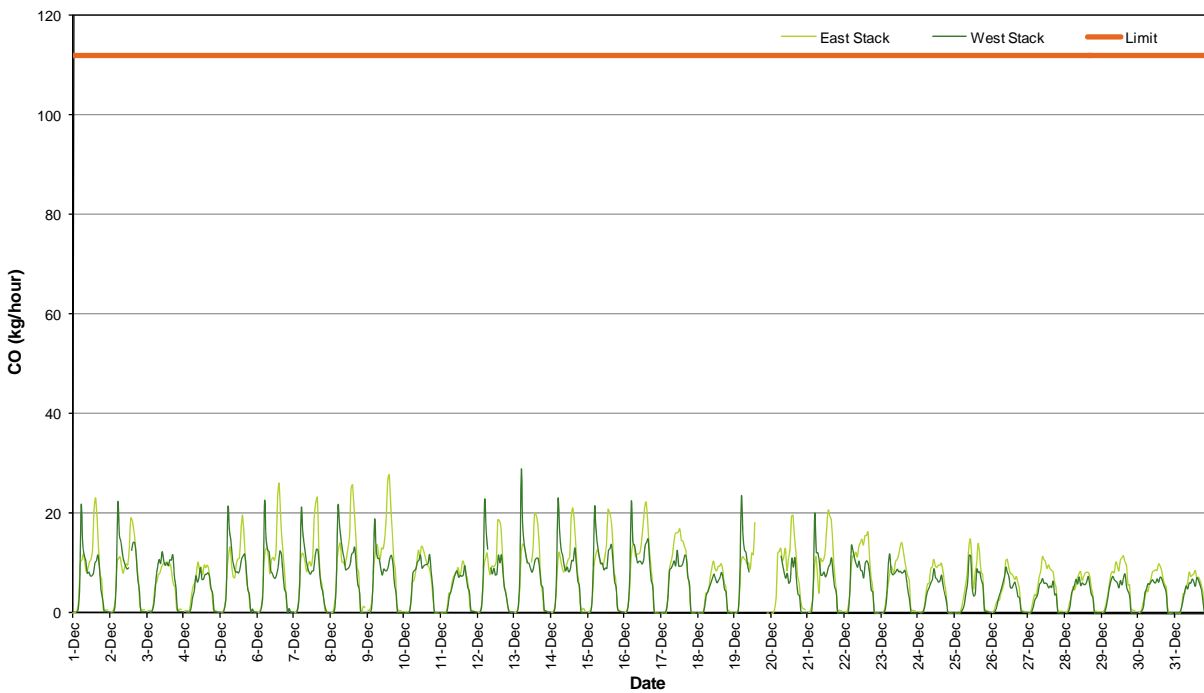


Figure 16: Carbon Monoxide Mass Rate (1 Hour Average)



8.2.4 Oxides of Nitrogen

8.2.4.1 Nitric Oxide

Nitric oxide (1-hour average) mass rate of emission statistics for the reporting period are given in Table 23. A plot of nitric oxide (1-hour average) mass rate of emission for the reporting period is presented in Figure 17.

Table 23: Nitric Oxide Mass Rate Percentiles (1 Hour Average)

Station	Nitric Oxide Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th
Eastern	4.6	3.9	3.6	3.2	2.7	2.0	0.92
Western	6.2	4.6	3.8	3.2	2.7	1.9	0.97

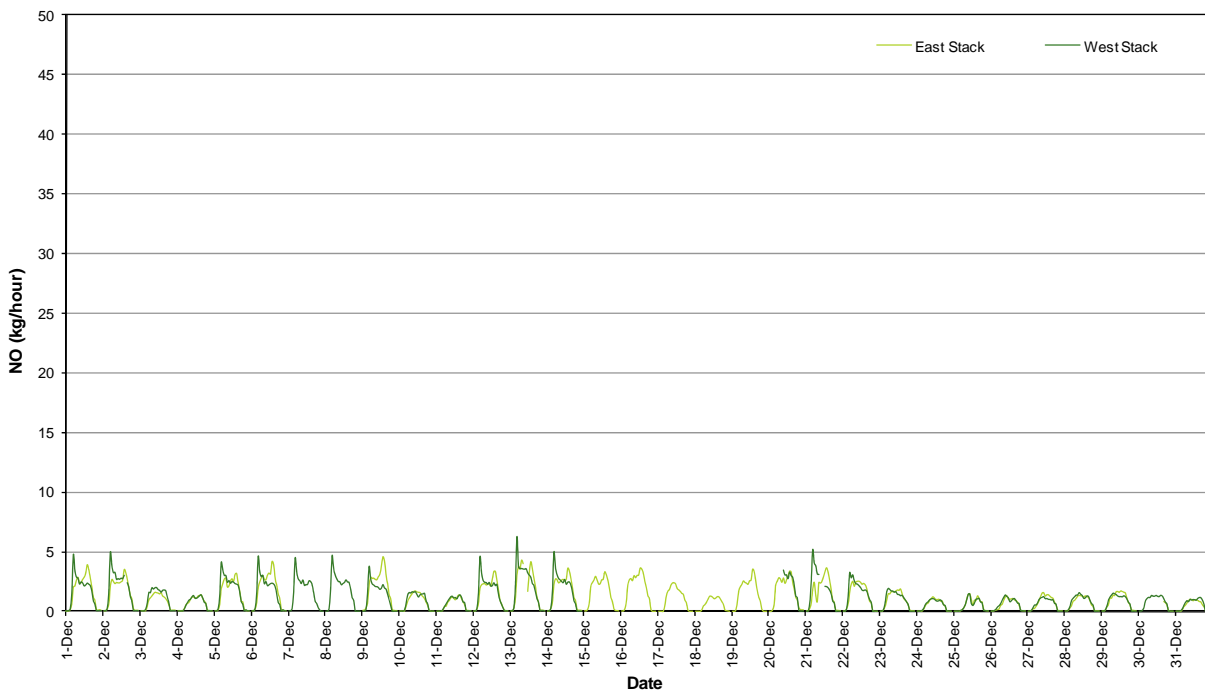


Figure 17: Nitric Oxide Mass Rate (1 Hour Average)



8.2.4.2 Nitrogen Dioxide

Nitrogen dioxide (1-hour average) mass rate of emission statistics for the reporting period are given in Table 24. A plot of nitrogen dioxide (1-hour average) mass rate of emission for the reporting period is presented in Figure 18.

Table 24: Nitrogen Dioxide Mass Rate Percentiles (1 Hour Average)

Station	Nitrogen Dioxide Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th
Eastern	0.7	0.5	0.5	0.4	0.4	0.3	0.1
Western	0.5	0.3	0.3	0.2	0.2	0.2	0.1

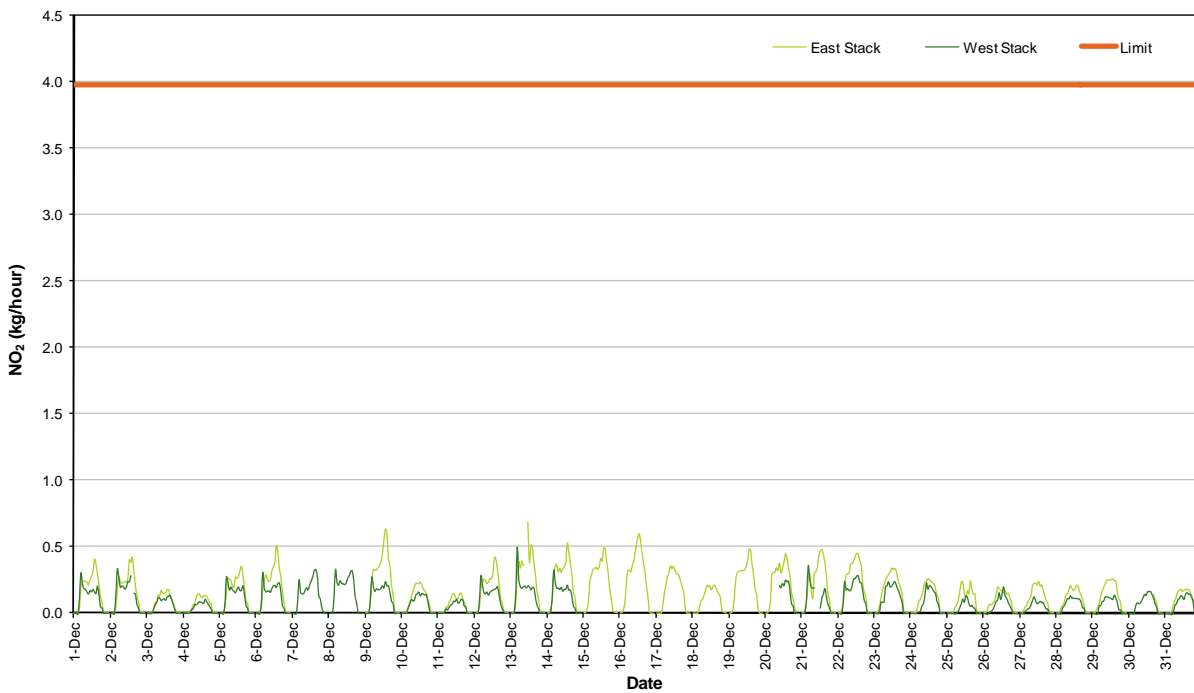


Figure 18: Nitrogen Dioxide Mass Rate (1 Hour Average)



8.2.5 Stack Velocity

The stack velocity (1 hour average) plot for the reporting period is presented in Figure 19.

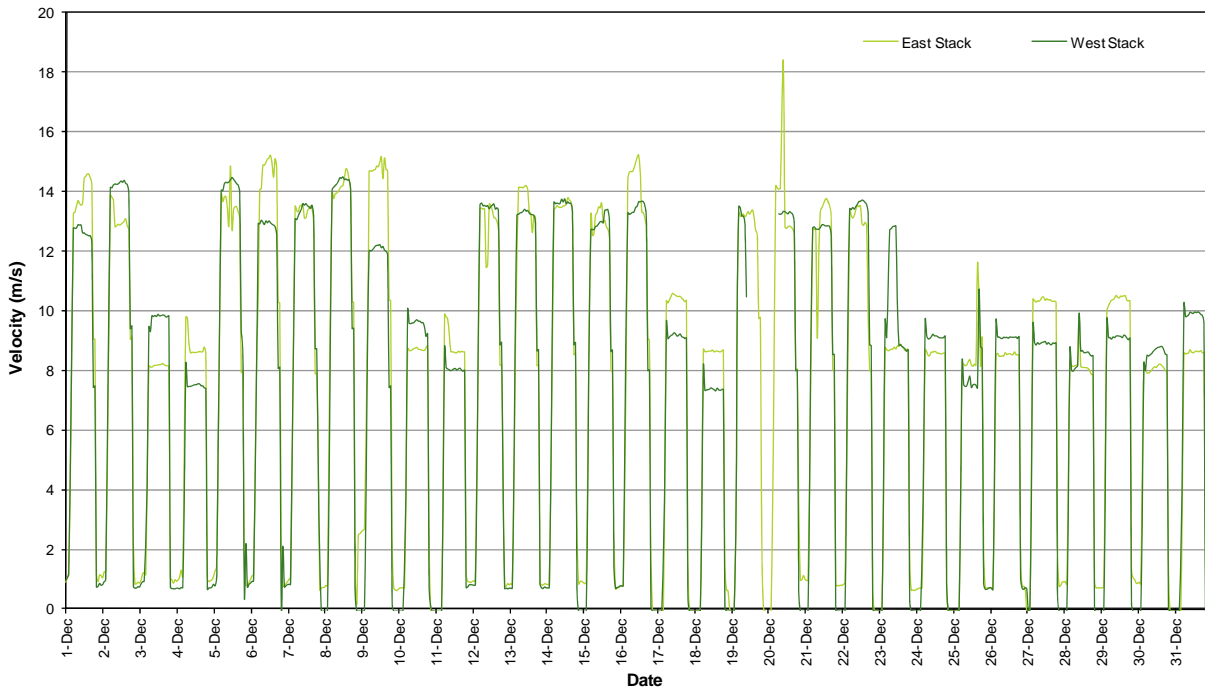


Figure 19: Stack Velocity (1 Hour Average)



8.3 Data Validation and Exceptions

Data contained in the report has been validated against performance and calibration requirements for each instrument. Data during maintenance and calibration periods has been removed from the validated data sets. Tables 25 and 26 list the data exceptions for the eastern and western ventilation stacks respectively. Data during automatic calibrations of the gaseous atmospheric contaminants has also been removed from the data sets.

Table 25: Data Exceptions - Eastern Ventilation Stack: December 2011

Start	End	Parameter	Reason
2/12/2011 13:30	2/12/2011 13:40	NO, NO ₂ , NO _x	Maintenance/calibration
2/12/2011 13:30	2/12/2011 13:35	CO	Maintenance/calibration
7/12/2011 0:40	8/12/2011 23:55	NO, NO ₂ , NO _x	Invalid data - Span drift
13/12/2011 10:15	13/12/2011 11:25	NO, NO ₂ , NO _x	Maintenance/calibration
13/12/2011 10:15	13/12/2011 11:25	CO	Maintenance/calibration
13/12/2011 12:45	13/12/2011 13:55	PM _{2.5}	Maintenance/calibration
13/12/2011 13:30	13/12/2011 14:50	PM ₁₀	Maintenance/calibration
19/12/2011 14:50	19/12/2011 21:25	CO	Maintenance/calibration
24/12/2011 22:25	24/12/2011 22:50	PM _{2.5}	Invalid data ¹
25/12/2011 22:30	25/12/2011 22:40	PM _{2.5}	Invalid data ¹
27/12/2011 3:05	27/12/2011 3:40	PM _{2.5}	Invalid data ¹
27/12/2011 20:55	27/12/2011 21:30	PM _{2.5}	Invalid data ¹
28/12/2011 20:35	28/12/2011 21:00	PM _{2.5}	Invalid data ¹
28/12/2011 22:40	28/12/2011 23:20	PM _{2.5}	Invalid data ¹
29/12/2011 3:05	29/12/2011 3:40	PM _{2.5}	Invalid data ¹
29/12/2011 8:40	29/12/2011 8:55	PM _{2.5}	Invalid data ¹
30/12/2011 00:00	30/12/2011 16:00	NO, NO ₂ , NO _x	Invalid data - Span drift

Note: ¹ - In the opinion of the reviewer.

Table 26: Data Exceptions - Western Ventilation Stack: December 2011

Start	End	Parameter	Reason
2/12/2011 15:15	2/12/2011 15:40	NO, NO ₂ , NO _x	Maintenance/calibration
15/12/2011 0:40	20/12/2011 10:10	NO, NO ₂ , NO _x	Invalid data - Span drift
21/12/2011 10:20	21/12/2011 12:20	NO, NO ₂ , NO _x	Maintenance/calibration
2/12/2011 13:10	2/12/2011 14:00	CO	Maintenance/calibration
2/12/2011 15:05	2/12/2011 15:15	CO	Maintenance/calibration
12/12/2011 8:20	12/12/2011 8:40	CO	Maintenance/calibration
19/12/2011 11:50	19/12/2011 13:05	CO	Maintenance/calibration
19/12/2011 11:35	19/12/2011 13:05	PM _{2.5}	Maintenance/calibration
19/12/2011 12:15	19/12/2011 13:25	PM ₁₀	Maintenance/calibration
23/12/2011 17:00	23/12/2011 23:55	PM ₁₀	Invalid data ¹
31/12/2011 16:25	31/12/2011 23:00	PM ₁₀	Invalid data ¹
19/12/2011 10:55	20/12/2011 6:25	Velocity	Data logger error

Note: ¹ - In the opinion of the reviewer.



9.0 DISCUSSION

9.1 Comparison with Licence Limits

EastLink emissions to air from the road tunnel ventilation stacks DP1 and DP2 are subject to the licence requirements contained in Environment Protection Authority (Victoria) Waste Discharge Licence No. EA 63607.

The maximum measured 1 hour average mass rate for each parameter is compared with the applicable licence limit in Table 27.

Table 27: Maximum (1 Hour Average) Mass Rate (01/10/2011 - 31/12/2011)

Discharge Point No.	Discharge Description	Compound	Mass Rate (kg/h)	Licence Limit (kg/h)
1	Western ventilation stack	PM _{2.5}	0.34	2.4
		PM ₁₀	0.94	2.6
		NO ₂	0.49	3.98
		CO	29	112
2	Eastern ventilation stack	PM _{2.5}	0.37	2.4
		PM ₁₀	0.88	2.6
		NO ₂	0.69	3.98
		CO	32	112

There were no exceedences of the licence limits for DP1 and DP2 during the reporting period.

Data capture statistics for 2011 year to date (01/01/2011 – 31/12/2011) are presented in Table 28.

Table 28: Data Capture Year to Date (%)

Station	NO ₂	CO	PM _{2.5}	PM ₁₀	Velocity
Eastern	93.0	97.2	97.8	98.2	99.9
Western	90.1	96.2	98.9	99.1	99.2



Report Signature Page

Handwritten signature of Mark Tulau in black ink.

Mark Tulau
Senior Air Quality Specialist

Handwritten signature of Frank Fleer in black ink.

Frank Fleer
Principal

MT/FF/SLH

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- End of Report -

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