

Ventia – EastLink Tunnel

Ventilation Stack Air Quality Monitoring Validated Data Report

01 August 2021 to 30 September 2021

Ref: DR.2021Q3.ETL

Issue Date: 12 November 2021

Report prepared by: Tim Allfrey

NATA Accredited Laboratory
Number 19660

Accredited for compliance with
ISO/IEC17025 – Testing

The results of the tests, calibrations
and/or measurements included in this
document are traceable to Australian /
national standards.



Norditech Pty Ltd
Unit 2/87 Station Road
Seven Hills NSW 2147

1300 572 822

info@norditech.com.au
norditech.com.au

Document Control

| Revision | Date | Details | Prepared By | Approved By |
|----------|------------|---------|-------------|-------------|
| 0 | 12/11/2021 | | TA | BN |
| | | | | |
| | | | | |

Prepared by



Tim Allfrey
 12 November 2021

Approved by



Bruno Nourdine
 12 November 2021

Distribution

| Format | Recipient | Details |
|--------|-------------------|--------------------------------|
| PDF | George Vasiliadis | Gvasiliadis@connecteast.com.au |
| | | |
| | | |
| | | |
| | | |

Table of Contents

| | | |
|---------|-------------------------------------------------------------------------------------------------|-----------|
| 1 | Executive Summary..... | 4 |
| 1.1 | Compliance to limits | 4 |
| 2 | Compliance Limits | 6 |
| 2.1 | Standards Compliance | 6 |
| 3 | Introduction..... | 7 |
| 4 | Explanation of Monitoring | 8 |
| 4.1 | Methodology..... | 8 |
| 4.2 | Ventilation Stacks | 9 |
| 4.3 | Data Collection | 10 |
| 4.4 | Data Validation | 10 |
| 4.5 | Reporting and Calculations..... | 11 |
| 4.5.1 | Data Availability..... | 11 |
| 4.5.2 | Unit Conversions..... | 11 |
| 5 | Calibrations and Maintenance | 12 |
| 5.1 | Units and Uncertainties | 12 |
| 5.2 | Last Calibrations and Maintenance performed..... | 13 |
| 5.3 | Automatic Instrument Calibration Checks | 14 |
| 6 | Results | 15 |
| 6.1 | August 2021 | 15 |
| 6.1.1 | Data Availability..... | 15 |
| 6.1.2 | Exceedances..... | 16 |
| 6.1.3 | Tabulated Results | 17 |
| 6.1.3.1 | <i>Statistical Summary of 1 hour Mass Rate Data Western and Eastern Ventilation Stacks.....</i> | <i>17</i> |
| 6.1.4 | Graphical Representations | 18 |
| 6.1.4.1 | <i>August 2021 - Monthly 1 hour mass rate CO</i> | <i>18</i> |
| 6.1.4.2 | <i>August 2021 - Monthly 1 hour mass rate NO</i> | <i>19</i> |
| 6.1.4.3 | <i>August 2021 - Monthly 1 hour mass rate CO</i> | <i>20</i> |
| 6.1.4.4 | <i>August 2021 - Monthly 1 hour mass rate PM_{2.5}.....</i> | <i>21</i> |
| 6.1.4.5 | <i>August 2021 - Monthly 1 hour mass rate PM₁₀.....</i> | <i>22</i> |
| 6.1.4.6 | <i>August 2021 - Monthly 1 hour average stack velocity.....</i> | <i>23</i> |
| 6.1.5 | Data Validation Table | 24 |
| 6.1.5.1 | <i>Western Ventilation Stack.....</i> | <i>24</i> |
| 6.1.5.2 | <i>Eastern Ventilation Stack.....</i> | <i>24</i> |
| 6.2 | September 2021 | 25 |
| 6.2.1 | Data Availability..... | 25 |
| 6.2.2 | Exceedances..... | 26 |
| 6.2.3 | Tabulated Results | 27 |
| 6.2.3.1 | <i>Statistical Summary of 1 hour mass rate data Western and Eastern Ventilation Stacks.....</i> | <i>27</i> |
| 6.2.4 | Graphical Representations | 28 |
| 6.2.4.1 | <i>September 2021 - Monthly 1 hour mass rate CO</i> | <i>28</i> |
| 6.2.4.2 | <i>September 2021 - Monthly 1 hour mass rate NO</i> | <i>29</i> |
| 6.2.4.3 | <i>September 2021 - Monthly 1 hour mass rate CO</i> | <i>30</i> |
| 6.2.4.4 | <i>September 2021 - Monthly 1 hour mass rate PM_{2.5}.....</i> | <i>31</i> |
| 6.2.4.5 | <i>September 2021 - Monthly 1 hour mass rate PM₁₀.....</i> | <i>32</i> |
| 6.2.4.6 | <i>September 2021 - Monthly 1 hour average stack velocity</i> | <i>33</i> |
| 6.2.5 | Data Validation Table | 34 |
| 6.2.5.1 | <i>Western Ventilation Stack.....</i> | <i>34</i> |
| 6.2.5.2 | <i>Eastern Ventilation Stack.....</i> | <i>34</i> |
| 6.3 | Data Availability Year to Date | 35 |
| 6.4 | Annual Performance Statement Bubble Limits..... | 36 |
| 7 | Report Summary | 37 |
| | Appendix 1 | 38 |

| | |
|------------------------------------|----|
| Glossary..... | 38 |
| Data Validation Explanations | 38 |

Figures

| | |
|----------------------------------------------------------------------------|----|
| Figure 1: EastLink Tunnel ventilation stack locations..... | 9 |
| Figure 2: August 2021 Monthly 1 hour mass rate NO ₂ | 18 |
| Figure 3: August 2021 Monthly 1 hour mass rate NO | 19 |
| Figure 4: August 2021 Monthly 1 hour mass rate CO | 20 |
| Figure 5: August 2021 Monthly 1 hour mass rate PM _{2.5} | 21 |
| Figure 6: August 2021 Monthly 1 hour mass rate PM ₁₀ | 22 |
| Figure 7: August 2021 Monthly 1 hour average stack velocity | 23 |
| Figure 8: September 2021 Monthly 1 hour mass rate NO ₂ | 28 |
| Figure 9: September 2021 Monthly 1 hour mass rate NO | 29 |
| Figure 10: September 2021 Monthly 1 hour mass rate CO | 30 |
| Figure 11: September 2021 Monthly 1 hour mass rate PM _{2.5} | 31 |
| Figure 12: September 2021 Monthly 1 hour mass rate PM ₁₀ | 32 |
| Figure 13: September 2021 Monthly 1 hour average stack velocity | 33 |
| Figure 14: Annual APS stack emission rates | 36 |

Tables

| | |
|---------------------------------------------------------------------------|----|
| Table 1: August 2021 Exceedances of EPA Limits | 4 |
| Table 2: September 2021 Exceedances of EPA Limits..... | 5 |
| Table 3: EPA Compliance Limits | 6 |
| Table 4: Measurement methods and instrumentation | 8 |
| Table 5: EastLink Tunnel ventilation stack GPS Coordinates..... | 9 |
| Table 6: Measurement units and uncertainties | 12 |
| Table 7: August 2021 Instrument calibration dates | 13 |
| Table 8: September 2021 Instrument calibration dates..... | 13 |
| Table 9: Nightly span, zero and CO reference times..... | 14 |
| Table 10: August 2021 ventilation stack data availability | 15 |
| Table 11: August 2021 Exceedances of EPA Goals | 16 |
| Table 12: August 2021 Summary of 1 hour mass rate pollutant data..... | 17 |
| Table 13: August 2021 Western Ventilation Stack data validation | 24 |
| Table 14: August 2021 Eastern Ventilation Stack data validation | 24 |
| Table 15: September 2021 ventilation stack data availability | 25 |
| Table 16: September 2021 Exceedances of EPA Goals..... | 26 |
| Table 17: September 2021 Summary of 1 hour mass rate pollutant data..... | 27 |
| Table 18: September 2021 Western Ventilation Stack data validation | 34 |
| Table 19: September 2021 Eastern Ventilation Stack data validation | 34 |
| Table 20: EastLink Ventilation Stack year to date data availability | 35 |
| Table 21: EastLink Ventilation Stack data validation | 36 |

1 Executive Summary

EastLink is a 39 km motorway running between Nunawading and Frankston, linking the Eastern, Monash Frankston and Peninsula Link freeways. Two 1.6 km tunnels pass under the Mullum Mullum Valley, with a ventilation at the end of each tunnel as an exit point for tunnel ventilation.

Two ventilation stacks provide ventilation for the tunnel, one at the western end of the tunnel at Discharge Point 1 (DP1), and one at the eastern end of the tunnel at Discharge Point 2 (DP2).

This report presents the monthly validated stack data for August 2021 to September 2021 to Ventia Pty Ltd for the EastLink Tunnel.

1.1 Compliance to limits

The Environment Protection Authority (Victoria) designates limits to which pollutant mass rates being discharged from the ventilation stacks must meet. (Environmental Licence No. 2043).

Instances of the ventilation stack pollutants exceeding the EPA Limits goals during the reporting period are presented in Table 1 and Table 2 below. Maximum mass rates are provided for comparison to the limits.

There were nil exceedances of the prescribed limits during the reporting period.

| EastLink Ventilation Stack Air Quality Limit Exceedances August 2021 | | | | | | | | |
|----------------------------------------------------------------------|-------------------|-------------|---------------|-------|-------------------|-----------------------|---------------------|-----------------------------|
| Location | Parameter | Time Period | Licence Limit | Units | Maximum Mass Rate | Number of exceedances | Value of exceedance | Date and Time of exceedance |
| Western Ventilation Stack (Discharge Point 1) | NO ₂ | 1 hour | 3.98 | kg/h | 0.26 | - | - | - |
| | CO | 1 hour | 112 | kg/h | 6.78 | - | - | - |
| | PM _{2.5} | 1 hour | 2.4 | kg/h | 0.19 | - | - | - |
| | PM ₁₀ | 1 hour | 2.6 | kg/h | 0.40 | - | - | - |
| Eastern Ventilation Stack (Discharge Point 2) | NO ₂ | 1 hour | 3.98 | kg/h | 0.53 | - | - | - |
| | CO | 1 hour | 112 | kg/h | 6.05 | - | - | - |
| | PM _{2.5} | 1 hour | 2.4 | kg/h | 0.18 | - | - | - |
| | PM ₁₀ | 1 hour | 2.6 | kg/h | 0.58 | - | - | - |

Table 1: August 2021 Exceedances of EPA Limits

| EastLink Ventilation Stack Air Quality Limit Exceedances September 2021 | | | | | | | | |
|-------------------------------------------------------------------------|-------------------|-------------|---------------|-------|-------------------|-----------------------|---------------------|-----------------------------|
| Location | Parameter | Time Period | Licence Limit | Units | Maximum Mass Rate | Number of exceedances | Value of exceedance | Date and Time of exceedance |
| Western Ventilation Stack (Discharge Point 1) | NO ₂ | 1 hour | 3.98 | kg/h | 0.27 | - | - | - |
| | CO | 1 hour | 112 | kg/h | 8.15 | - | - | - |
| | PM _{2.5} | 1 hour | 2.4 | kg/h | 0.16 | - | - | - |
| | PM ₁₀ | 1 hour | 2.6 | kg/h | 0.33 | - | - | - |
| Eastern Ventilation Stack (Discharge Point 2) | NO ₂ | 1 hour | 3.98 | kg/h | 0.52 | - | - | - |
| | CO | 1 hour | 112 | kg/h | 5.75 | - | - | - |
| | PM _{2.5} | 1 hour | 2.4 | kg/h | 0.13 | - | - | - |
| | PM ₁₀ | 1 hour | 2.6 | kg/h | 0.35 | - | - | - |

Table 2: September 2021 Exceedances of EPA Limits

2 Compliance Limits

Air quality limits are provided in Condition LI_DA1.13 of the Environment Protection Authority (Victoria) Licence No 2043 for the EastLink Tunnel. The air quality limits for 1 hour mass rates are shown in Table 3 below.

| EastLink Ventilation Stack Air Quality Limits | | | | | |
|-----------------------------------------------|-------------------|-------------|---------------|-------|-------------------------|
| Location | Parameter | Time Period | License Limit | Units | Applicable Licence |
| Western Ventilation Stack (Discharge Point 1) | NO ₂ | 1 hour | 3.98 | kg/h | EPA Vic Licence No 2043 |
| | CO | 1 hour | 112 | kg/h | |
| | PM _{2.5} | 1 hour | 2.4 | kg/h | |
| | PM ₁₀ | 1 hour | 2.6 | kg/h | |
| Eastern Ventilation Stack (Discharge Point 2) | NO ₂ | 1 hour | 3.98 | kg/h | EPA Vic Licence No 2043 |
| | CO | 1 hour | 112 | kg/h | |
| | PM _{2.5} | 1 hour | 2.4 | kg/h | |
| | PM ₁₀ | 1 hour | 2.6 | kg/h | |

Table 3: EPA Compliance Limits

The procedure for reporting of particulate matter results from the TEOMs and assessment of licence compliance is detailed in the EastLink Particulate Matter Protocol (PMP) dated 17/06/2013. The PMP requires validated uncorrected TEOM one hour clock average data to be compared to the following TEOM mass rate compliance limits for both DP1 and DP2.

- PM_{2.5}: 2.0 kg/h
- PM₁₀: 2.0 kg/h

2.1 Standards Compliance

Norditech's NATA Accreditation does not cover the following parameters monitored at the EastLink Tunnel ventilation stack air quality monitoring stations

- Measurement of Stack Flow.
- AS/NZS 3580.9.8 refers specifically to the monitoring of PM₁₀.

3 Introduction

Norditech were contracted by Ventia Pty Ltd in August 2021 to provide continuous stack air quality monitoring and reporting services for the EastLink Tunnel. Ventia Pty Ltd are responsible for the operation and maintenance of the motorway.

Norditech is a NATA accredited organisation (Accreditation Number 19660)

Addresses of relevant parties:

Norditech Pty Ltd

2/87 Station Rd
Seven Hills NSW 2147

Ventia Pty Ltd

2 Hillcrest Avenue
Ringwood VIC 3134

This report presents the validated Western and Eastern ventilation stack data for August 2021 to September 2021.

- Describes air quality measurements.
- Reports any readings above the relevant EPA Limits.
- Compares monitoring results.
- Has been quality assured.

4 Explanation of Monitoring

4.1 Methodology

In tunnel air is discharged via two ventilation stacks – one located at the Western end of the tunnel (DP1), and one located at the Eastern end (DP2). For each stack, monitoring as per the requirements of EPA Licence 2043 is undertaken.

Gaseous parameters are sampled by an extractive sampling system. Oxides of nitrogen are measured using chemiluminescence. Carbon monoxide is measured using non-dispersive infra-red absorption.

Particulates PM₁₀ and PM_{2.5} are measured using tapered element oscillating microbalances.

Stack gas velocity is measured using an optical flow sensor.

Monthly routine maintenance is undertaken by Norditech. Maintenance is performed as per the relevant Australian Standard or in house method. Maintenance cycles generally involve 1, 3, 6 and 12 monthly scheduled items.

The following instrumentation and methods are used in data collection:

| EastLink Ventilation Stack Measurement Methods | | |
|------------------------------------------------|------------------------|---------------------------------------------------------------------------------------|
| Parameter | Method | Instrument |
| CO | In house method TP.003 | Thermo Scientific 48i |
| NO, NO ₂ , NO _x | In house method TP.001 | Thermo Scientific 42i |
| PM ₁₀ | AS/NZS 3580.9.8 | Rupprecht & Patashnick TEOM with Ecotech and Norditech ISS isokinetic sampling system |
| | In house method TP.005 | |
| | AS 4323.1 | |
| PM _{2.5} | In house method TP.026 | Rupprecht & Patashnick TEOM with Ecotech and Norditech ISS isokinetic sampling system |
| | AS 4323.1 | |
| Temperature | In house method TP.012 | By TEOM |
| Stack Velocity | USEAP (CFR 40) Part 75 | OSI OFS2000 |

Table 4: Measurement methods and instrumentation

4.2 Ventilation Stacks

The locations of the EastLink Tunnel Western and Eastern ventilation stacks are detailed in Table 5 and Figure 1 below.

| EastLink Ventilation Stack Locations | | |
|--------------------------------------|---------------------------|--------------------------|
| Discharge Point | Site Name | GPS Coordinates |
| 1 | Western Ventilation Stack | -37.801229°, 145.196092° |
| 2 | Eastern Ventilation Stack | -37.808885°, 145.212012° |

Table 5: EastLink Tunnel ventilation stack GPS Coordinates

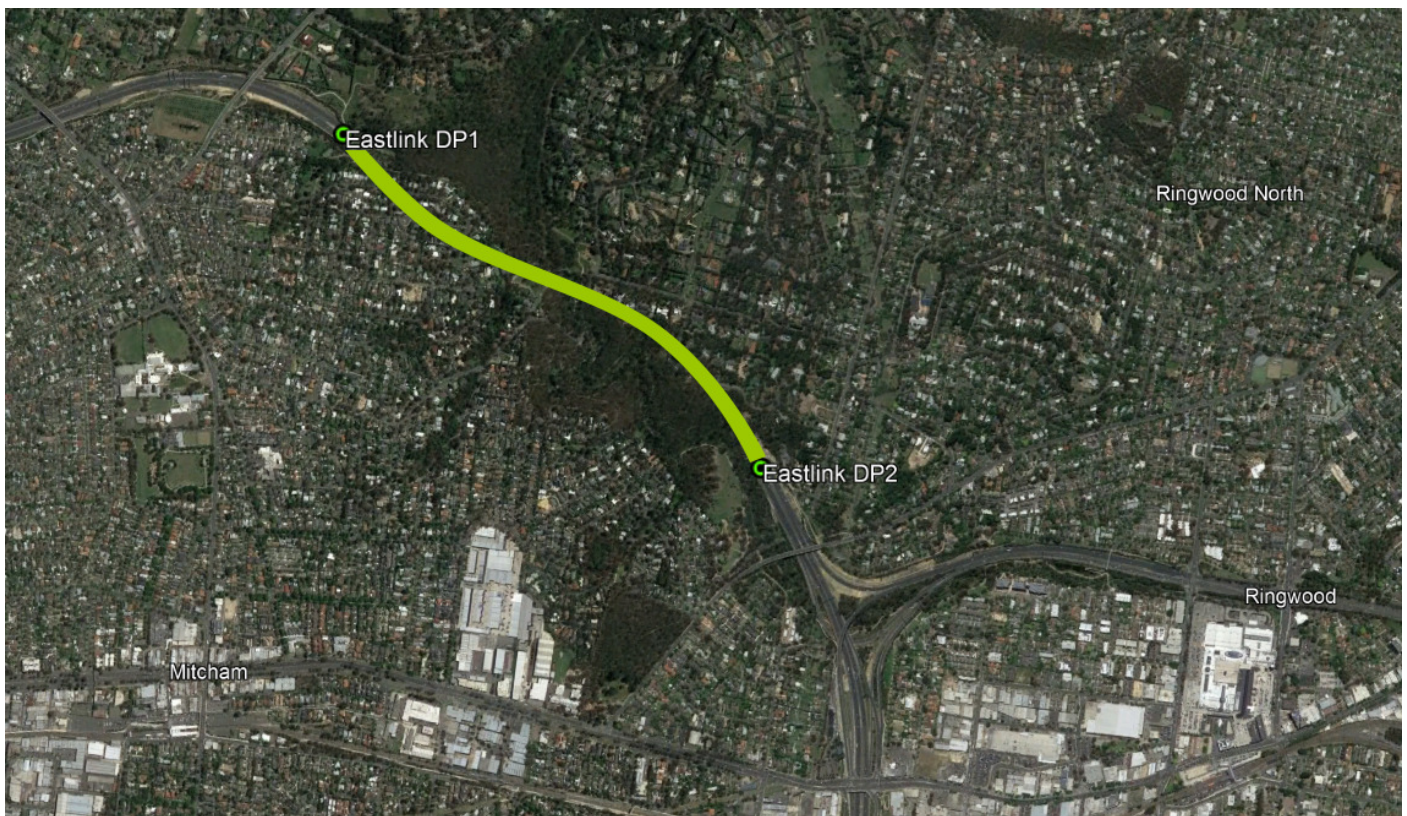


Figure 1: EastLink Tunnel ventilation stack locations

4.3 Data Collection

At each Air Quality Monitoring Station, data is logged to a EnviDAS data logger at 1 minute average intervals. Each 1 minute average is calculated from data sampled at 10 second intervals.

Data is transferred automatically to Norditech's data collection software via a TCP/IP link over 4G cellular network, at a frequency of not less than 1 hour. Two datasets are maintained by Norditech, one for data validation and reporting purposes, and a non-validated data set for reference purposes.

4.4 Data Validation

Data validation is performed as per Norditech's data validation procedure TP.022. The data validation process identifies any data that is deemed not to be valid. This data is flagged as invalid in the database and is removed from the reported data.

Data may be deemed invalid for several reasons, including but not limited to:

- Instrument fault
- Instrument calibration out of tolerance
- Maintenance activities

For further details and explanations of reasons for invalidating data, please refer to Appendix 1 – Data Validation Explanations.

Initial visual inspection of data is performed by inspection of graphs to identify any anomalies in the data set.

Site visit logs and maintenance and calibration certificates are cross referenced to the data set and any data affected by maintenance activities are flagged.

Instrument drift and calibration tolerances are checked and data flagged in the database as necessary as per NATA compliance requirements.

4.5 Reporting and Calculations

All calculations and averages are calculated from 1 minute average base data and are reported as 'end time'. IE the average data for 01:00 is the data from 00:00 through to 01:00.

All data is reported at Australian Eastern Standard Time.

Validated data for Quarter 3 Month 2 is presented in the Excel workbook named "202108 EastLink Q3M2 Validated data.xlsx"

The workbooks each consist of the following sheets:

- Sheet 1: Cover
- Sheet 2: M2 Data kg1h – Hourly data in kg/h
- Sheet 3: M2 Data g5m – 5 minute data in grams/5m
- Sheet 4: M2 Data mgm3 1h – 1hour data in mg/m³
- Sheet 5: M2 Data mgm3 5m – 5 minute data in mg/m³
- Sheet 6: Eastern Validation Data
- Sheet 7: Western Validation Data

Validated data for Quarter 3 Month 3 is presented in the Excel workbook named "202109 EastLink Q3M2 Validated data.xlsx"

The workbook consists of the following sheets:

- Sheet 1: Cover
- Sheet 2: M3 Data kg1h – Hourly data in kg/h
- Sheet 3: M3 Data g5m – 5 minute data in grams/5m
- Sheet 4: M3 Data mgm3 1h – 1hour data in mg/m³
- Sheet 5: M3 Data mgm3 5m – 5 minute data in mg/m³
- Sheet 6: Eastern Validation Data
- Sheet 7: Western Validation Data

4.5.1 Data Availability

Data availability refers to the amount of available data for the reporting period. Data availability is calculated using the following formula:

$$\text{Data availability \%} = \frac{\text{sum of available data points}}{\text{sum of possible data points}} * 100$$

Where:

- Sum of available data points is the number of validated 1 hour average data points for the reporting period
- Sum of possible data points is the number of theoretically available 1 hour data points for the reporting period

4.5.2 Unit Conversions

Stack velocity readings are converted to flow rate using the following stack areas:

- Western Stack area 35 m²
- Eastern Stack area 35 m²

Pollutant and flow data are reported at actual conditions.

5 Calibrations and Maintenance

5.1 Units and Uncertainties

| EastLink Ventilation Stack Instrument Units and Uncertainties | | | | |
|---------------------------------------------------------------|-------------------|------------|---------------------------------------------------------------------------------------|-------------------|
| Parameter | Units | Resolution | Uncertainty | Measurement Range |
| CO | mg/m ³ | 0.01 | ± 8.2% of reading at 62.5mg/m ³ (k=1.96) | 0 to 200 |
| NO | mg/m ³ | 0.01 | ± 8.1% of reading for range 25.7 – 32.8mg/m ³ (k=1.96) | 0 to 150 |
| NO ₂ | mg/m ³ | 0.01 | ± 8.5% of reading at 25.7mg/m ³ (k=1.96) | 0 to 150 |
| NO _x | mg/m ³ | 0.01 | ± 8.1% of reading for range 25.7 – 32.8mg/m ³ (k=1.96) | 0 to 150 |
| PM ₁₀ | µg/m ³ | 0.1 | ±5.0 µg/m ³ or 3.6% of reading, whichever is the greater. K factor of 1.96 | 0 to 5000 |
| PM _{2.5} | µg/m ³ | 0.1 | ±5.0 µg/m ³ or 3.6% of reading, whichever is the greater. K factor of 1.96 | 0 to 5000 |
| Temperature | °C | 0.1 | ±2.0 °C ¹ | -25 to 105 |
| Stack Velocity | m/s | 1 | ±0.1 m/s ¹ | -40 to +40 |

¹ Manufacturer's stated accuracy

Table 6: Measurement units and uncertainties

5.2 Last Calibrations and Maintenance performed

Instrumentation maintenance and last calibration dates are provided in Table 7 and Table 8 below:

| EastLink Ventilation Stack Maintenance and Calibrations August 2021 | | | | |
|---------------------------------------------------------------------|----------------|------------------------------------|------------------|--------------------------|
| Location | Parameter | Date of last scheduled maintenance | Maintenance type | Date of last calibration |
| Western Ventilation Stack (Discharge Point 1) | CO | 20/08/2021 | 1 Monthly | 20/08/2021 |
| | NO, NO2 | 20/08/2021 | 1 Monthly | 20/08/2021 |
| | PM10 | N/A | N/A | N/A |
| | PM2.5 | N/A | N/A | N/A |
| | Temperature | N/A | N/A | N/A |
| | Stack Velocity | N/A | N/A | TBA |
| Eastern Ventilation Stack (Discharge Point 2) | CO | 18/08/2021 | 1 Monthly | 18/08/2021 |
| | NO, NO2 | 18/08/2021 | 1 Monthly | 18/08/2021 |
| | PM10 | N/A | N/A | N/A |
| | PM2.5 | N/A | N/A | N/A |
| | Temperature | N/A | N/A | N/A |
| | Stack Velocity | N/A | N/A | TBA |

Table 7: August 2021 Instrument calibration dates

| EastLink Ventilation Stack Maintenance and Calibrations September 2021 | | | | |
|------------------------------------------------------------------------|----------------|------------------------------------|------------------|--------------------------|
| Location | Parameter | Date of last scheduled maintenance | Maintenance type | Date of last calibration |
| Western Ventilation Stack (Discharge Point 1) | CO | 30/09/2021 | 12 Monthly | 30/09/2021 |
| | NO, NO2 | 30/09/2021 | 12 Monthly | 30/09/2021 |
| | PM10 | 20/09/2021 | 12 Monthly | 20/09/2021 |
| | PM2.5 | 20/09/2021 | 12 Monthly | 20/09/2021 |
| | Temperature | 20/09/2021 | 12 Monthly | 20/09/2021 |
| | Stack Velocity | N/A | N/A | TBA |
| Eastern Ventilation Stack (Discharge Point 2) | CO | 30/09/2021 | 12 Monthly | 30/09/2021 |
| | NO, NO2 | 30/09/2021 | 12 Monthly | 30/09/2021 |
| | PM10 | 20/09/2021 | 12 Monthly | 20/09/2021 |
| | PM2.5 | 20/09/2021 | 12 Monthly | 20/09/2021 |
| | Temperature | 20/09/2021 | 12 Monthly | 20/09/2021 |
| | Stack Velocity | N/A | N/A | TBA |

Table 8: September 2021 Instrument calibration dates

5.3 Automatic Instrument Calibration Checks

Table 9 below identifies the times at which the daily gaseous parameter automatic span and zero checks are performed.

Further to the span and zero checks, the CO analysers perform nightly background reference cycles.

This data is removed from the dataset, however are not included in the data validation tables.

| Nightly span and zero times for NO, NO ₂ and CO | | |
|------------------------------------------------------------|---------------------|------------------------|
| Location | Parameter | Span / Zero cycle time |
| Western | CO | 00:00 - 00:45 |
| | NO, NO ₂ | 01:00 - 01:45 |
| Eastern | CO | 00:00 - 00:40 |
| | NO, NO ₂ | 00:00 - 00:40 |

Table 9: Nightly span, zero and CO reference times.

6 Results

6.1 August 2021

6.1.1 Data Availability

Data availability for the in ventilation stack parameters are provided in Table 10 below. For further information on data availability please refer to section 6.1.5.

| EastLink Ventilation Stack Data Availability August 2021 | | | | | | | |
|----------------------------------------------------------|-------------------|-------|-----------------|-------|-------------------|------------------|----------------|
| Station | | NO | NO ₂ | CO | PM _{2.5} | PM ₁₀ | Stack Velocity |
| Western | Data Availability | 81.6% | 81.6% | 81.7% | 84.1% | 87.2% | 86.4% |
| | Collected Periods | 607 | 607 | 608 | 626 | 649 | 643 |
| | Available Periods | 744 | 744 | 744 | 744 | 744 | 744 |
| Eastern | Data Availability | 89.8% | 89.8% | 95.2% | 90.3% | 94.6% | 99.9% |
| | Collected Periods | 668 | 668 | 708 | 672 | 704 | 743 |
| | Available Periods | 744 | 744 | 744 | 744 | 744 | 744 |

Table 10: August 2021 ventilation stack data availability

6.1.2 Exceedances

Instances of the ventilation stack pollutants exceeding the EPA Limits goals during the reporting period are presented in Table 11 below. Maximum mass rates are provided for comparison to the limits.

There were nil exceedances of the prescribed limits during the reporting period.

| EastLink Ventilation Stack Air Quality Limit Exceedances August 2021 | | | | | | | | |
|----------------------------------------------------------------------|-------------------|-------------|---------------|-------|-------------------|-----------------------|---------------------|-----------------------------|
| Location | Parameter | Time Period | Licence Limit | Units | Maximum Mass Rate | Number of exceedances | Value of exceedance | Date and Time of exceedance |
| Western Ventilation Stack (Discharge Point 1) | NO ₂ | 1 hour | 3.98 | kg/h | 0.26 | - | - | - |
| | CO | 1 hour | 112 | kg/h | 6.78 | - | - | - |
| | PM _{2.5} | 1 hour | 2.4 | kg/h | 0.19 | - | - | - |
| | PM ₁₀ | 1 hour | 2.6 | kg/h | 0.40 | - | - | - |
| Eastern Ventilation Stack (Discharge Point 2) | NO ₂ | 1 hour | 3.98 | kg/h | 0.53 | - | - | - |
| | CO | 1 hour | 112 | kg/h | 6.05 | - | - | - |
| | PM _{2.5} | 1 hour | 2.4 | kg/h | 0.18 | - | - | - |
| | PM ₁₀ | 1 hour | 2.6 | kg/h | 0.58 | - | - | - |

Table 11: August 2021 Exceedances of EPA Goals

6.1.3 Tabulated Results

6.1.3.1 Statistical Summary of 1 hour Mass Rate Data Western and Eastern Ventilation Stacks

Table 12 presents 1 hour mass rate statistical data for the Western and Eastern ventilation stacks.

1 hour mass rates are calculated from 1 minute average data.

| EastLink Ventilation Stack Summary August 2021 | | | | | | | | |
|------------------------------------------------|--------------------------|---------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| Location | Parameter | Maximum | 99 th Percentile | 98 th Percentile | 95 th Percentile | 90 th Percentile | 75 th Percentile | 50 th Percentile |
| Western Ventilation Stack | NO (kg/h) | 3.95 | 3.51 | 3.19 | 2.41 | 1.50 | 1.05 | 0.46 |
| | NO ₂ (kg/h) | 0.26 | 0.21 | 0.20 | 0.13 | 0.09 | 0.06 | 0.04 |
| | CO (kg/h) | 6.78 | 5.58 | 5.30 | 4.29 | 2.88 | 2.04 | 1.50 |
| | PM _{2.5} (kg/h) | 0.19 | 0.12 | 0.11 | 0.09 | 0.06 | 0.04 | 0.02 |
| | PM ₁₀ (kg/h) | 0.40 | 0.26 | 0.23 | 0.15 | 0.10 | 0.06 | 0.03 |
| Eastern Ventilation Stack | NO (kg/h) | 2.23 | 1.96 | 1.74 | 1.37 | 1.17 | 0.98 | 0.25 |
| | NO ₂ (kg/h) | 0.53 | 0.44 | 0.40 | 0.30 | 0.25 | 0.20 | 0.08 |
| | CO (kg/h) | 6.05 | 5.37 | 4.43 | 3.41 | 2.78 | 2.16 | 1.42 |
| | PM _{2.5} (kg/h) | 0.18 | 0.12 | 0.11 | 0.09 | 0.07 | 0.05 | 0.02 |
| | PM ₁₀ (kg/h) | 0.58 | 0.22 | 0.21 | 0.17 | 0.13 | 0.08 | 0.03 |

Table 12: August 2021 Summary of 1 hour mass rate pollutant data

6.1.4 Graphical Representations

The following charts present 1 hour mass rate data for NO, NO₂, CO, PM_{2.5}, PM₁₀ and Stack Velocity for the Western and Eastern ventilation stacks.

1 hour mass rates are calculated from 1 minute average data.

6.1.4.1 August 2021 - Monthly 1 hour mass rate CO

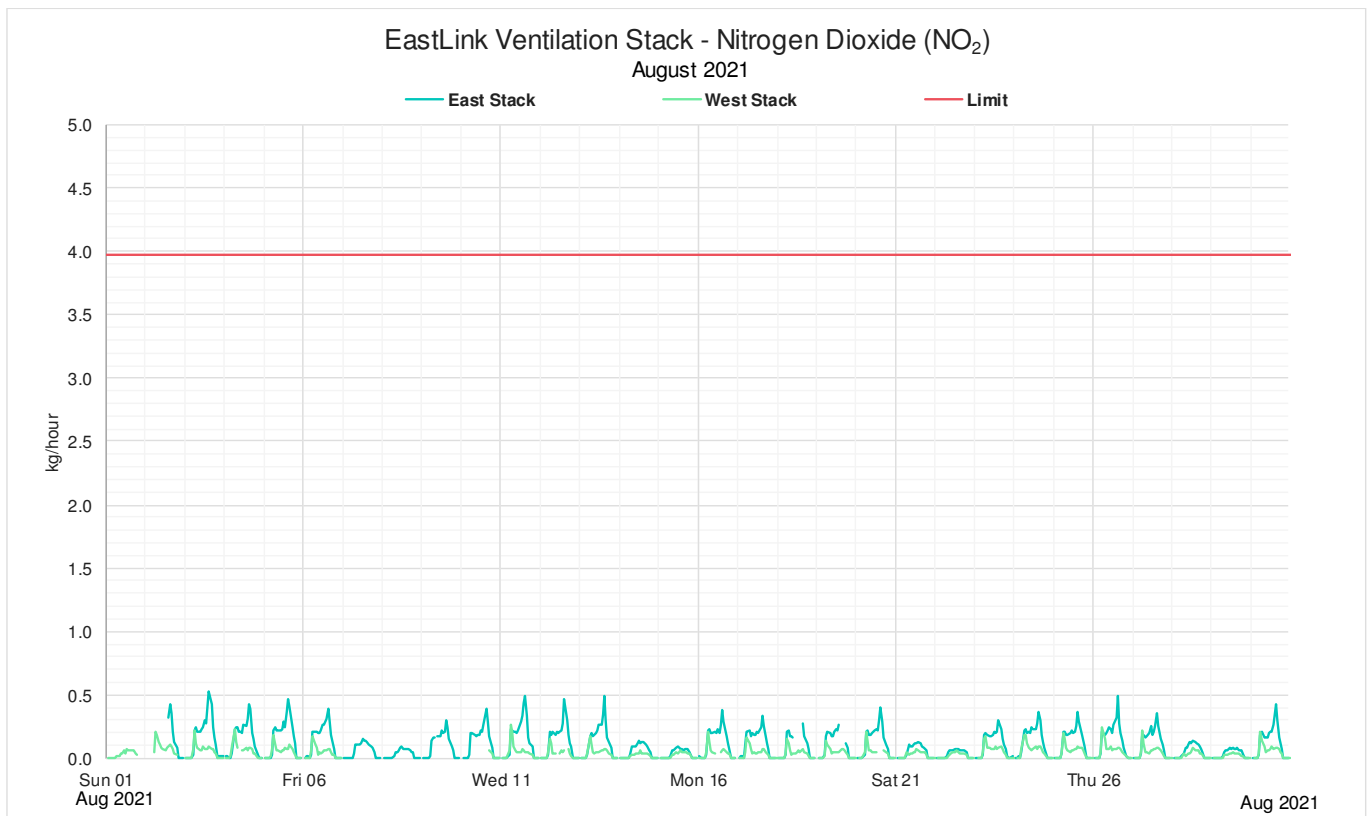


Figure 2: August 2021 Monthly 1 hour mass rate NO₂

6.1.4.2 August 2021 - Monthly 1 hour mass rate NO

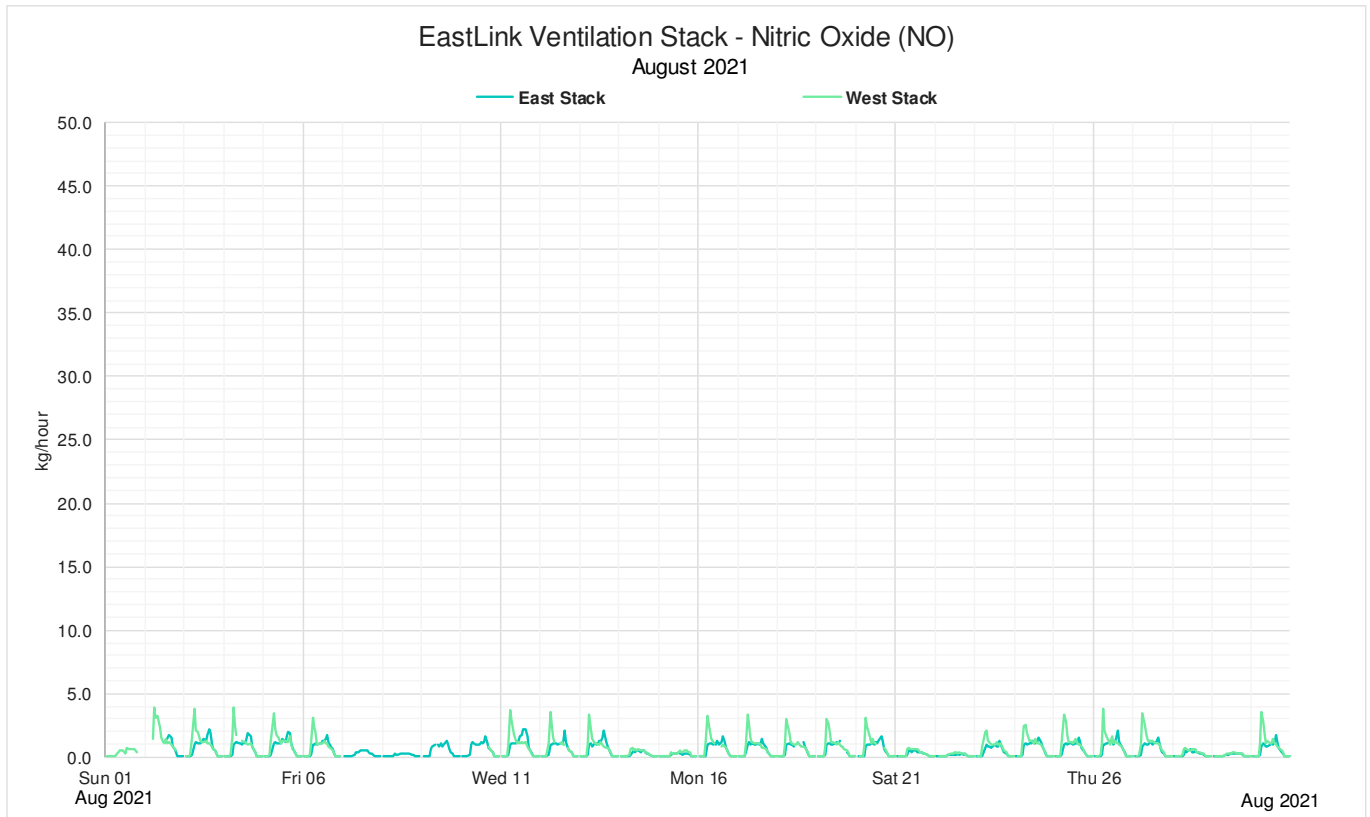


Figure 3: August 2021 Monthly 1 hour mass rate NO

6.1.4.3 August 2021 - Monthly 1 hour mass rate CO

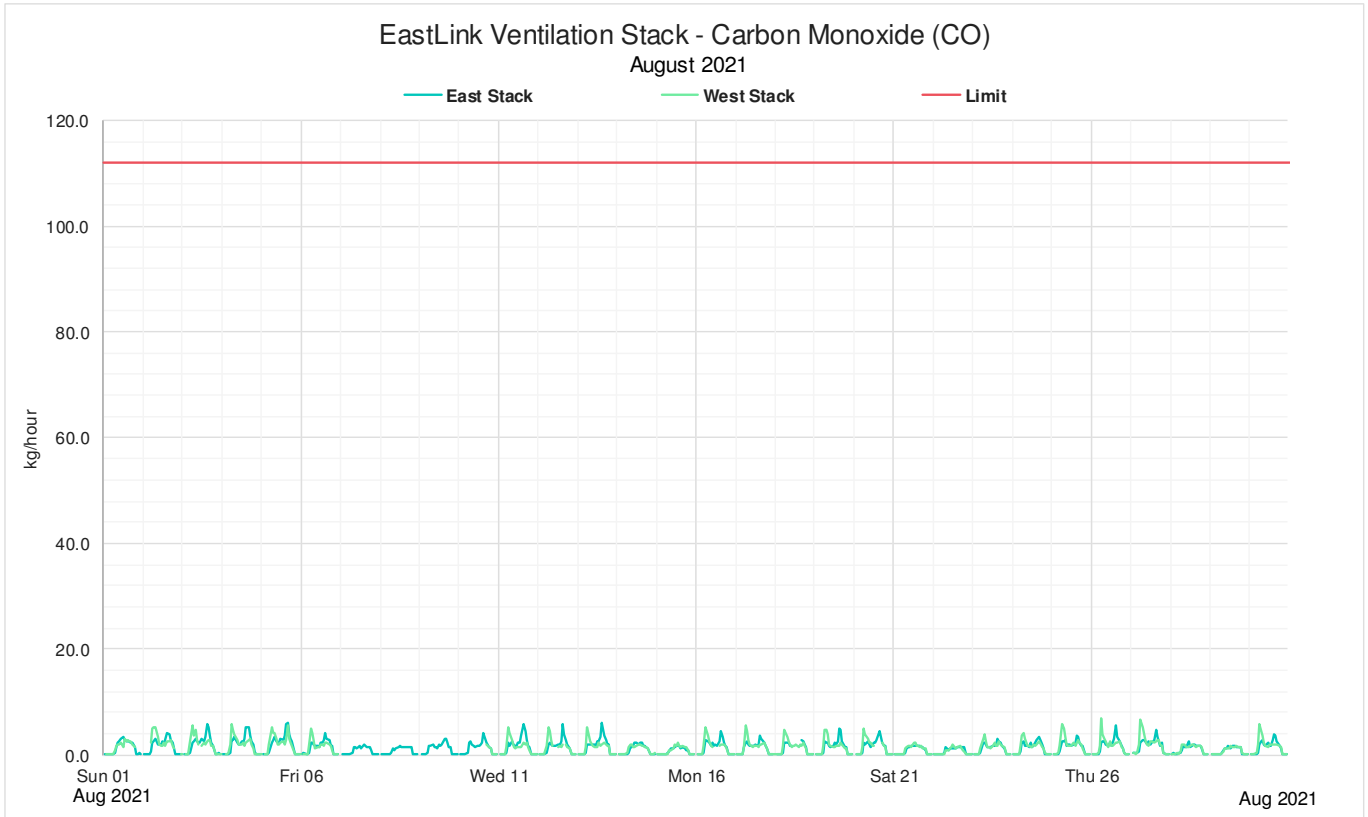


Figure 4: August 2021 Monthly 1 hour mass rate CO

6.1.4.4 August 2021 - Monthly 1 hour mass rate PM_{2.5}

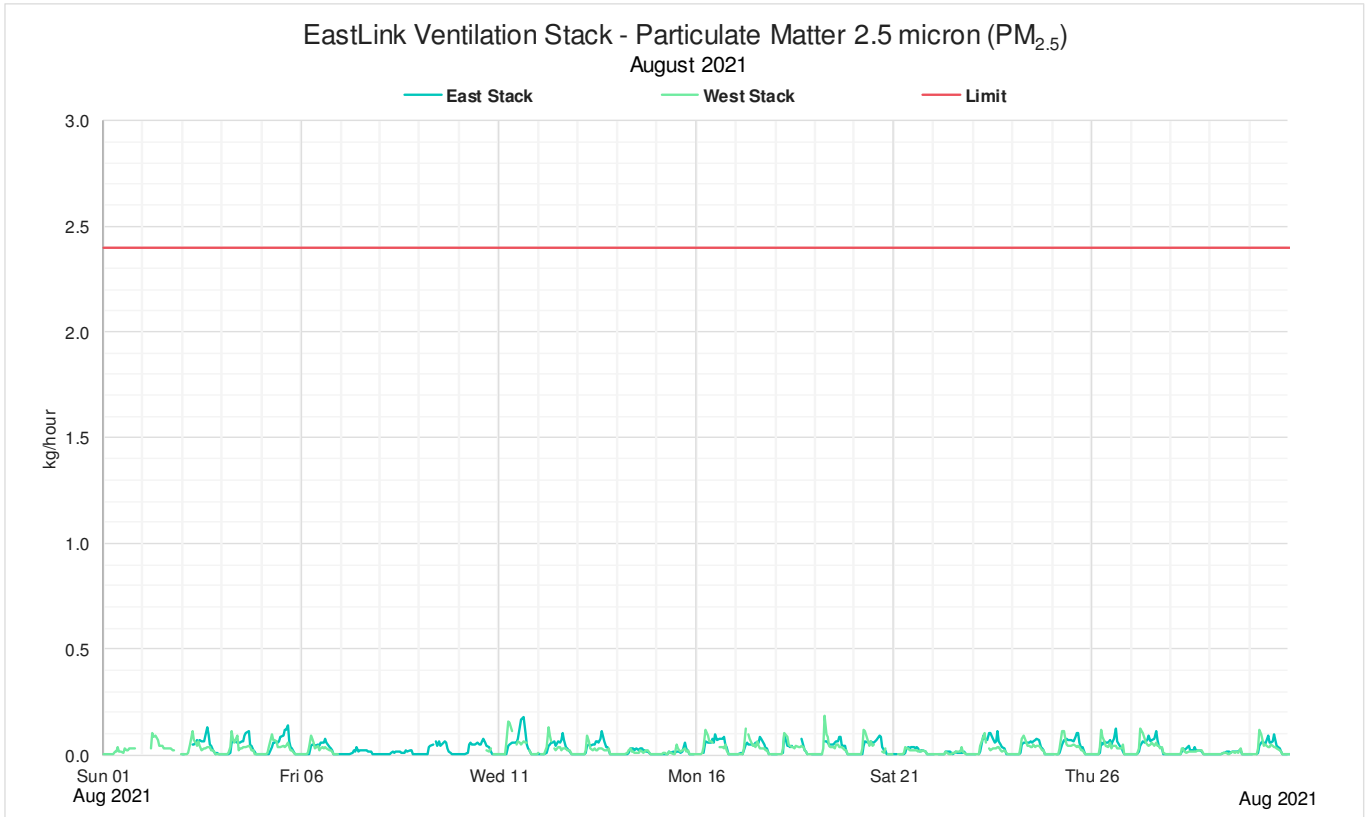


Figure 5: August 2021 Monthly 1 hour mass rate PM_{2.5}

6.1.4.5 August 2021 - Monthly 1 hour mass rate PM₁₀

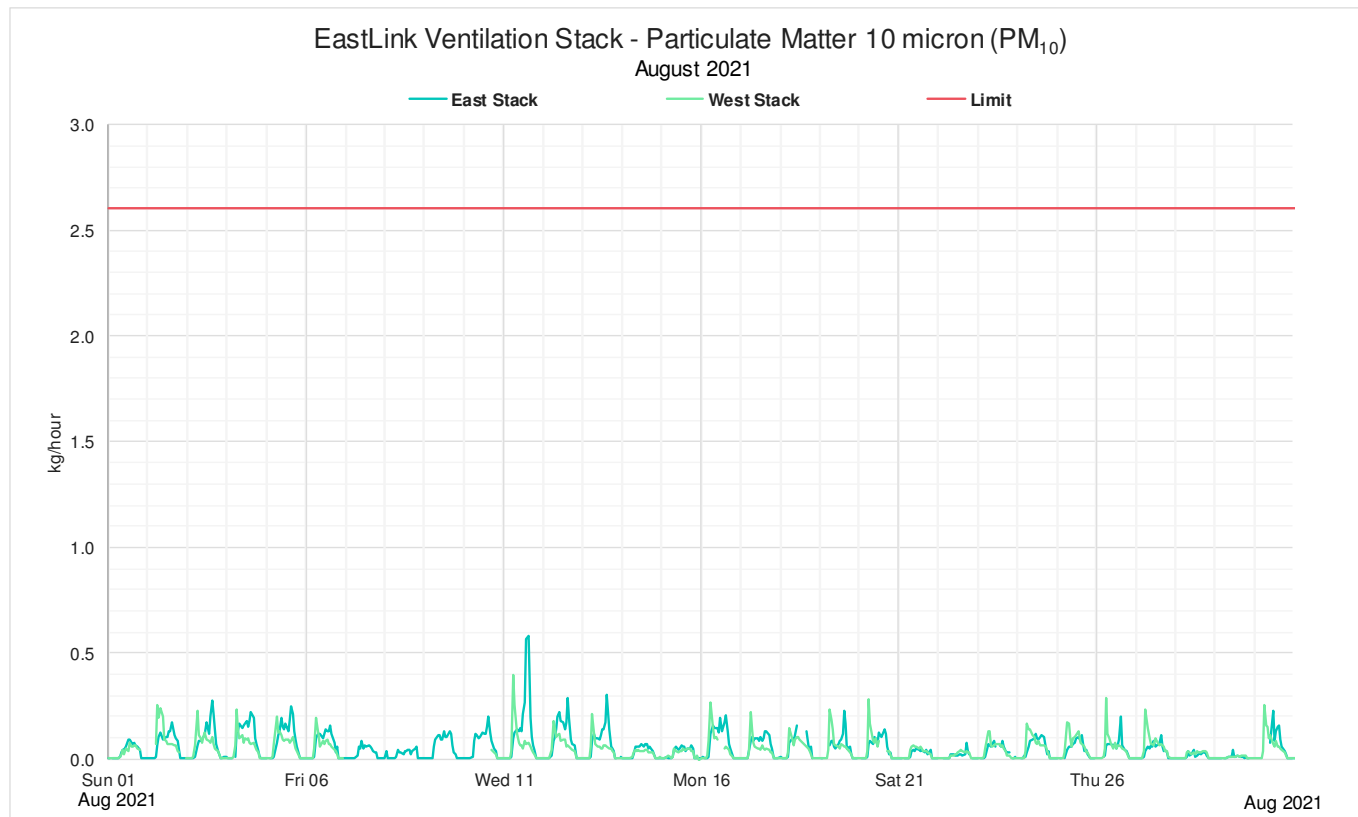


Figure 6: August 2021 Monthly 1 hour mass rate PM₁₀

6.1.4.6 August 2021 - Monthly 1 hour average stack velocity

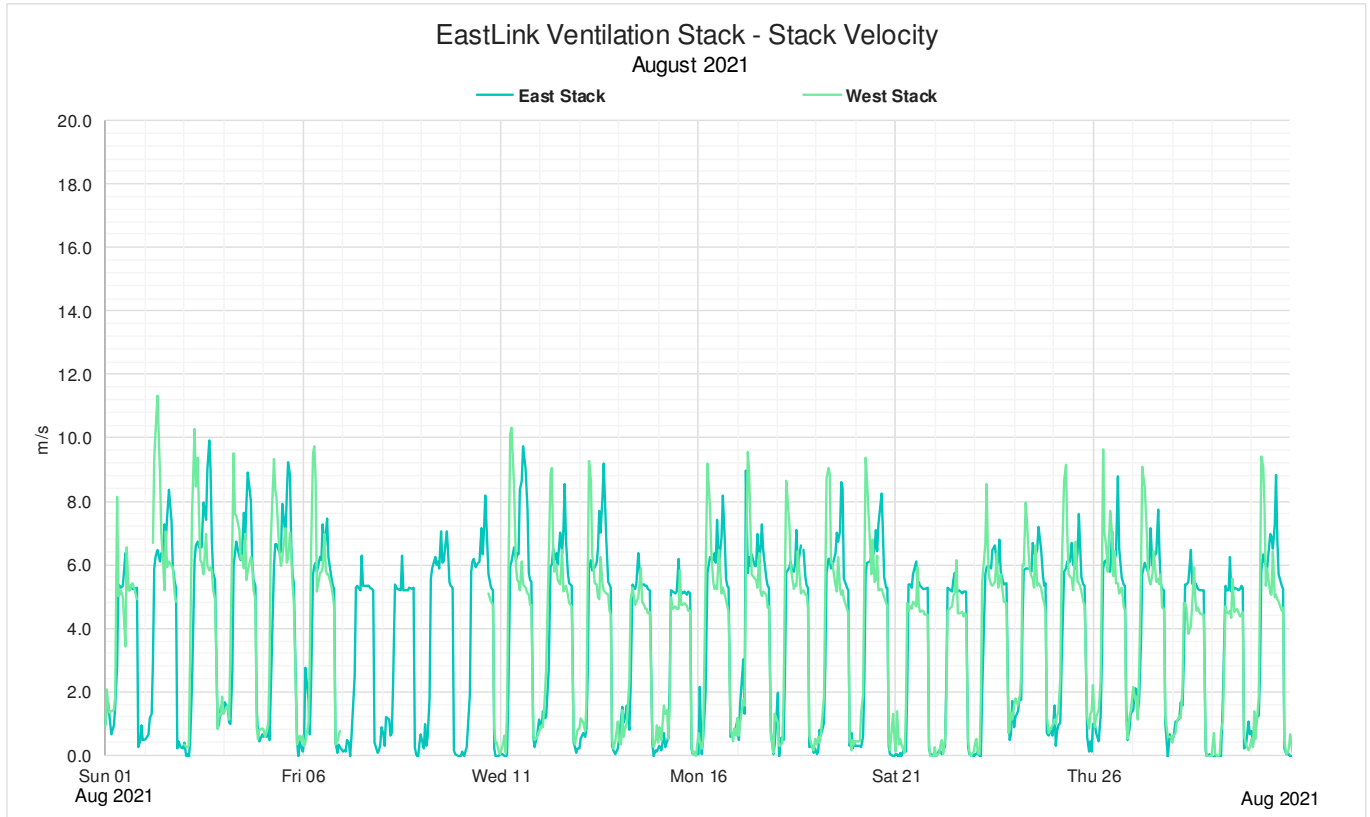


Figure 7: August 2021 Monthly 1 hour average stack velocity

6.1.5 Data Validation Table

Data validation details for the ventilation stack parameters are provided in the Table 13 and Table 14 below.

6.1.5.1 Western Ventilation Stack

| Eastlink Tunnel Western Ventilation Stack Data Validation August 2021 | | | | | | |
|-----------------------------------------------------------------------|------------------|--------------------------|------------------------------------------|----------------|-----------|-------------|
| Start Date | End Date | Parameters | Reason | Hours affected | User Name | Change Date |
| 1/08/2021 02:35 | 29/08/2021 03:12 | PM2.5, PM10 | Intermittent unrealistic data - negative | N/A | TA | 10/11/2021 |
| 1/08/2021 07:11 | 26/08/2021 10:21 | Stack Velocity | Intermittent unrealistic data - negative | N/A | TA | 10/11/2021 |
| 7/08/2021 00:29 | 10/08/2021 16:30 | All parameters | Data logger failure | 88.0 | TA | 10/11/2021 |
| 12/08/2021 10:02 | 12/08/2021 11:55 | NO, NO2, CO | Maintenance | 1.9 | TA | 10/11/2021 |
| 12/08/2021 10:02 | 31/08/2021 01:32 | PM2.5, PM10 | Intermittent 'not enough samples' | N/A | TA | 10/11/2021 |
| 20/08/2021 00:25 | 20/08/2021 00:38 | All parameters | Intermittent 'not enough samples' | N/A | TA | 10/11/2021 |
| 20/08/2021 13:05 | 20/08/2021 17:10 | NO, NO2, CO, PM2.5, PM10 | Maintenance | 4.1 | TA | 10/11/2021 |

This table details any missing data, data removed due to being deemed invalid, or data that has been adjusted.

Table 13: August 2021 Western Ventilation Stack data validation

6.1.5.2 Eastern Ventilation Stack

| Eastlink Tunnel Eastern Ventilation Stack Data Validation August 2021 | | | | | | |
|-----------------------------------------------------------------------|------------------|--------------------------|---------------------------------------------------------------------------------|----------------|-----------|-------------|
| Start Date | End Date | Parameters | Reason | Hours affected | User Name | Change Date |
| 1/08/2021 00:01 | 2/08/2021 23:59 | PM2.5 | Unrealistic data - excessive noise | 48.0 | TA | 10/11/2021 |
| 1/08/2021 00:40 | 2/08/2021 12:40 | NO, NO2 | Instrument calibration out of tolerance | 36.0 | TA | 10/11/2021 |
| 1/08/2021 00:15 | 31/08/2021 03:46 | PM2.5, PM10 | Intermittent unrealistic data - negative | N/A | TA | 10/11/2021 |
| 2/08/2021 12:41 | 2/08/2021 13:24 | NO, NO2 | Maintenance | 0.7 | TA | 10/11/2021 |
| 3/08/2021 02:43 | 3/08/2021 03:46 | PM2.5 | Unrealistic data - PM2.5 > PM10 | 1.1 | TA | 10/11/2021 |
| 12/08/2021 00:41 | 15/08/2021 00:00 | NO, NO2 | Multiplier applied to data: Multiplier A: 0.940770 Multiplier B: 0.940770 | N/A | TA | 10/11/2021 |
| 15/08/2021 00:41 | 18/08/2021 11:11 | NO, NO2 | Multiplier applied to data: Multiplier A: 1.082591 Multiplier B: 1.082591 | N/A | TA | 10/11/2021 |
| 18/08/2021 11:12 | 18/08/2021 16:00 | NO, NO2, CO, PM2.5, PM10 | Maintenance | 4.8 | TA | 10/11/2021 |
| 19/08/2021 14:57 | 19/08/2021 17:44 | NO, NO2 | Maintenance | 2.8 | TA | 10/11/2021 |

This table details any missing data, data removed due to being deemed invalid, or data that has been adjusted.

Table 14: August 2021 Eastern Ventilation Stack data validation

6.2 September 2021

6.2.1 Data Availability

Data availability for the in ventilation stack parameters are provided in Table 15 below. For further information on data availability please refer to section 6.2.5

| EastLink Ventilation Stack Data Availability September 2021 | | | | | | | |
|-------------------------------------------------------------|-------------------|-------|-----------------|-------|-------------------|------------------|----------------|
| Station | | NO | NO ₂ | CO | PM _{2.5} | PM ₁₀ | Stack Velocity |
| Western | Data Availability | 93% | 93% | 93% | 39% | 89% | 98% |
| | Collected Periods | 666.0 | 666.0 | 673.0 | 279.0 | 641.0 | 705.0 |
| | Available Periods | 720.0 | 720.0 | 720.0 | 720.0 | 720.0 | 720.0 |
| Eastern | Data Availability | 93.9% | 93.9% | 93.9% | 84.9% | 92.4% | 100.0% |
| | Collected Periods | 676 | 676 | 676 | 611 | 665 | 720 |
| | Available Periods | 720 | 720 | 720 | 720 | 720 | 720 |

Table 15: September 2021 ventilation stack data availability

6.2.2 Exceedances

Instances of the ventilation stack pollutants exceeding the EPA Limits goals during the reporting period are presented in Table 16 below. Maximum mass rates are provided for comparison to the limits.

There were nil exceedances of the prescribed limits during the reporting period.

| EastLink Ventilation Stack Air Quality Limit Exceedances September 2021 | | | | | | | | |
|-------------------------------------------------------------------------|-------------------|-------------|---------------|-------|-------------------|-----------------------|---------------------|-----------------------------|
| Location | Parameter | Time Period | Licence Limit | Units | Maximum Mass Rate | Number of exceedances | Value of exceedance | Date and Time of exceedance |
| Western Ventilation Stack (Discharge Point 1) | NO ₂ | 1 hour | 3.98 | kg/h | 0.27 | - | - | - |
| | CO | 1 hour | 112 | kg/h | 8.15 | - | - | - |
| | PM _{2.5} | 1 hour | 2.4 | kg/h | 0.16 | - | - | - |
| | PM ₁₀ | 1 hour | 2.6 | kg/h | 0.33 | - | - | - |
| Eastern Ventilation Stack (Discharge Point 2) | NO ₂ | 1 hour | 3.98 | kg/h | 0.52 | - | - | - |
| | CO | 1 hour | 112 | kg/h | 5.75 | - | - | - |
| | PM _{2.5} | 1 hour | 2.4 | kg/h | 0.13 | - | - | - |
| | PM ₁₀ | 1 hour | 2.6 | kg/h | 0.35 | - | - | - |

Table 16: September 2021 Exceedances of EPA Goals

6.2.3 Tabulated Results

6.2.3.1 Statistical Summary of 1 hour mass rate data Western and Eastern Ventilation Stacks

Table 17 presents 1 hour mass rate statistical data for the Western and Eastern ventilation stacks.

1 hour mass rates are calculated from 1 minute average data.

| EastLink Ventilation Stack Summary September 2021 | | | | | | | | |
|---------------------------------------------------|--------------------------|---------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| Location | Parameter | Maximum | 99 th Percentile | 98 th Percentile | 95 th Percentile | 90 th Percentile | 75 th Percentile | 50 th Percentile |
| Western Ventilation Stack | NO (kg/h) | 4.05 | 3.34 | 2.76 | 1.74 | 1.22 | 0.95 | 0.41 |
| | NO ₂ (kg/h) | 0.27 | 0.20 | 0.17 | 0.10 | 0.08 | 0.06 | 0.04 |
| | CO (kg/h) | 8.15 | 6.60 | 5.92 | 4.14 | 3.24 | 2.64 | 2.08 |
| | PM _{2.5} (kg/h) | 0.16 | 0.14 | 0.11 | 0.06 | 0.05 | 0.04 | 0.02 |
| | PM ₁₀ (kg/h) | 0.33 | 0.26 | 0.25 | 0.12 | 0.09 | 0.06 | 0.04 |
| Eastern Ventilation Stack | NO (kg/h) | 1.89 | 1.69 | 1.43 | 1.23 | 1.10 | 0.80 | 0.28 |
| | NO ₂ (kg/h) | 0.52 | 0.41 | 0.35 | 0.28 | 0.22 | 0.18 | 0.08 |
| | CO (kg/h) | 5.75 | 4.65 | 4.23 | 3.52 | 3.01 | 2.43 | 1.56 |
| | PM _{2.5} (kg/h) | 0.13 | 0.09 | 0.08 | 0.07 | 0.06 | 0.04 | 0.02 |
| | PM ₁₀ (kg/h) | 0.35 | 0.16 | 0.13 | 0.11 | 0.08 | 0.06 | 0.03 |

Table 17: September 2021 Summary of 1 hour mass rate pollutant data

6.2.4 Graphical Representations

The following charts present 1 hour mass rate data for NO, NO₂, CO, PM_{2.5}, PM₁₀ and Stack Velocity for the Western and Eastern ventilation stacks.

1 hour mass rates are calculated from 1 minute average data.

6.2.4.1 September 2021 - Monthly 1 hour mass rate CO

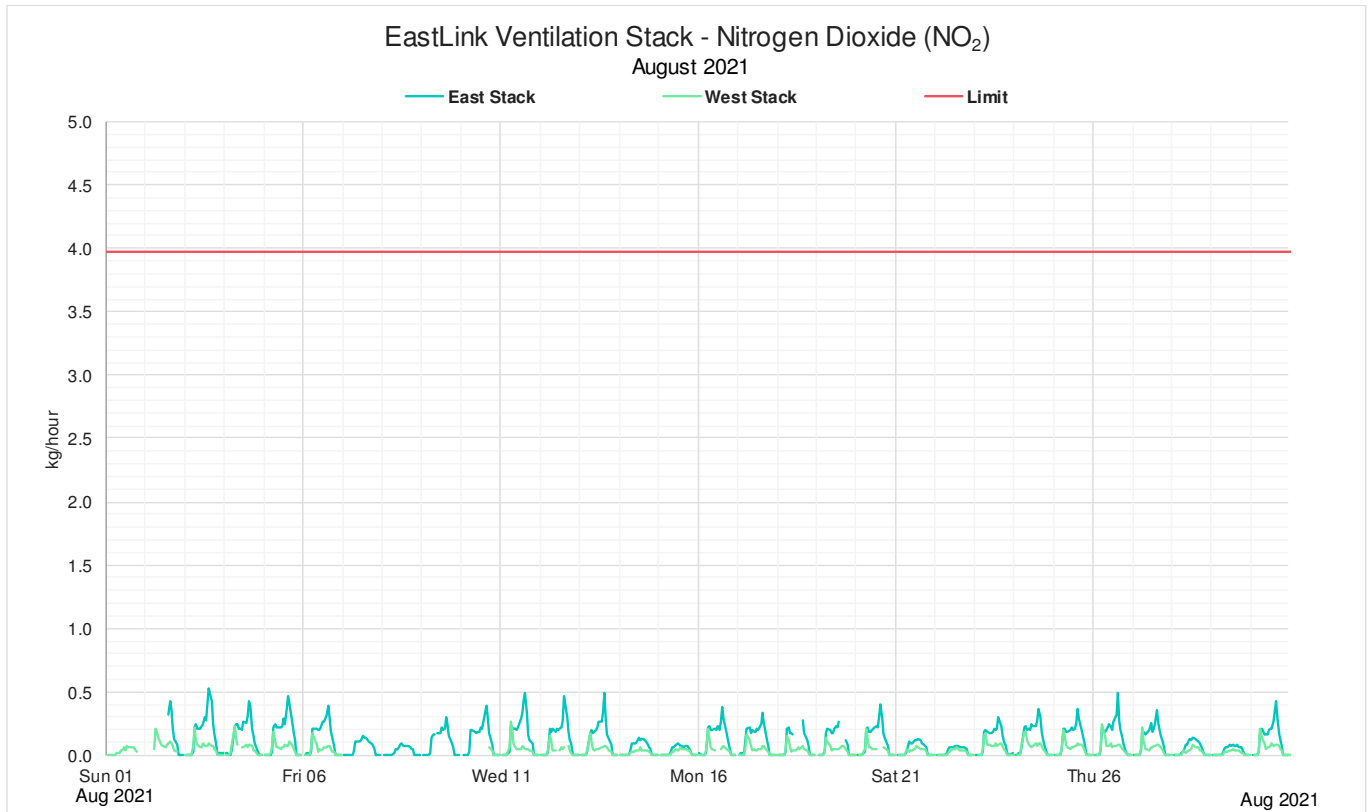


Figure 8: September 2021 Monthly 1 hour mass rate NO₂

6.2.4.2 September 2021 - Monthly 1 hour mass rate NO

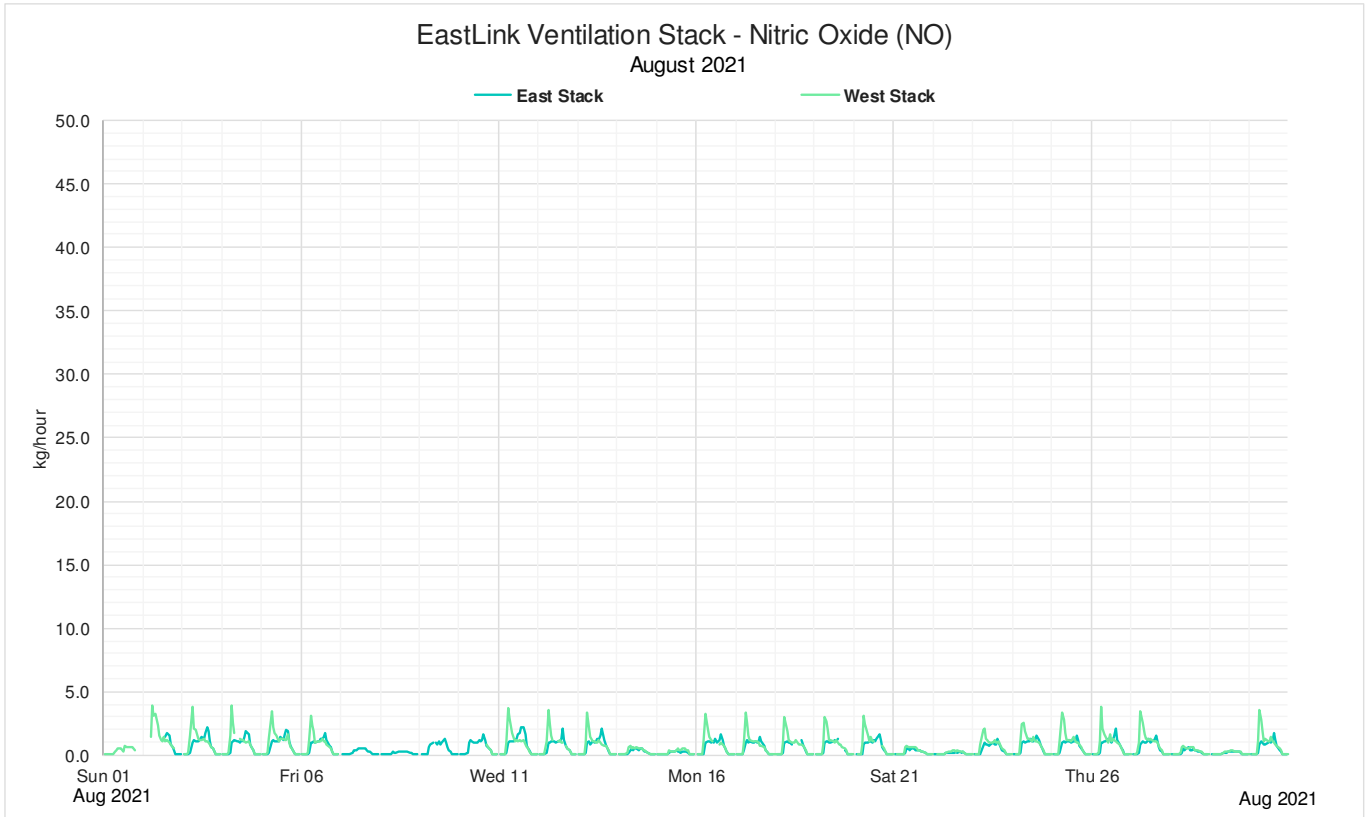


Figure 9: September 2021 Monthly 1 hour mass rate NO

6.2.4.3 September 2021 - Monthly 1 hour mass rate CO

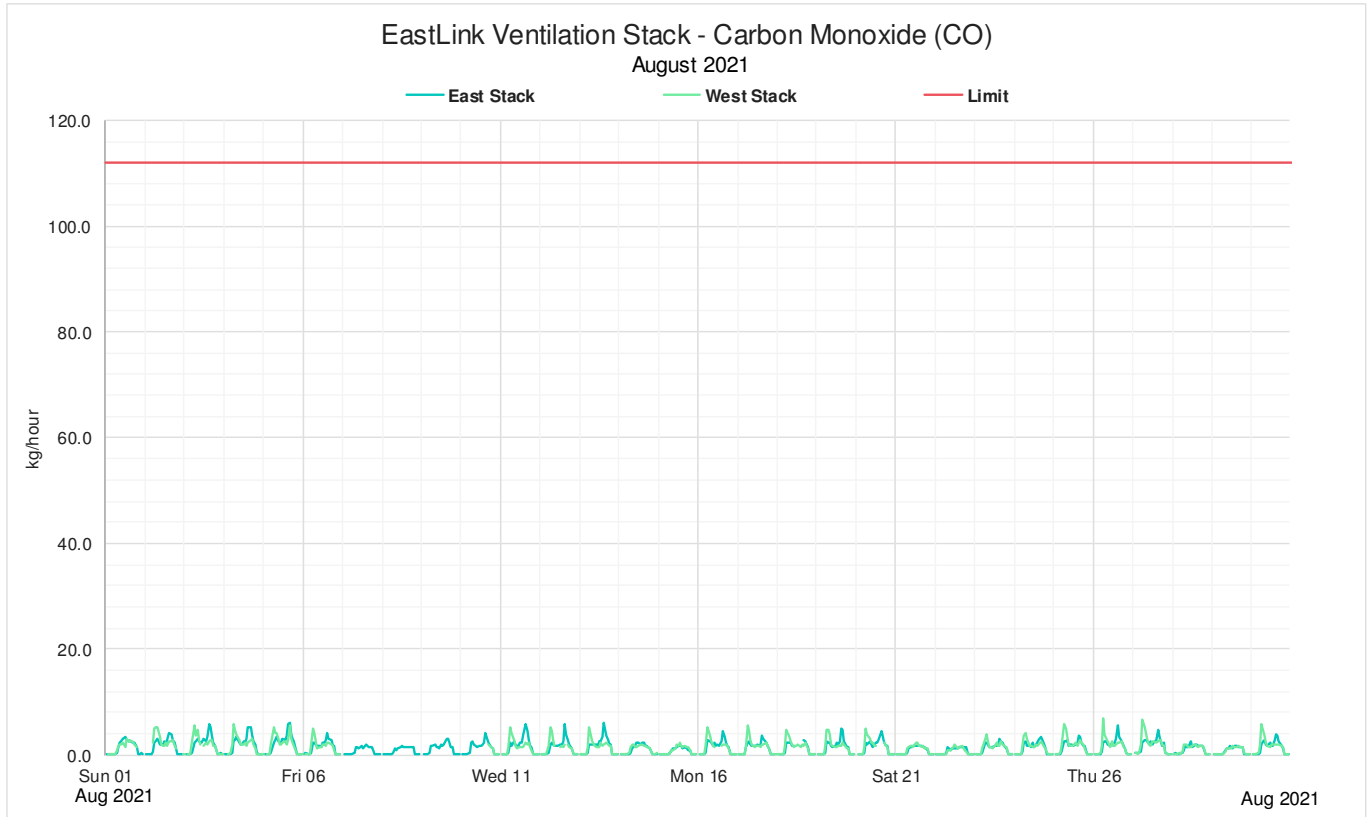


Figure 10: September 2021 Monthly 1 hour mass rate CO

6.2.4.4 September 2021 - Monthly 1 hour mass rate PM_{2.5}

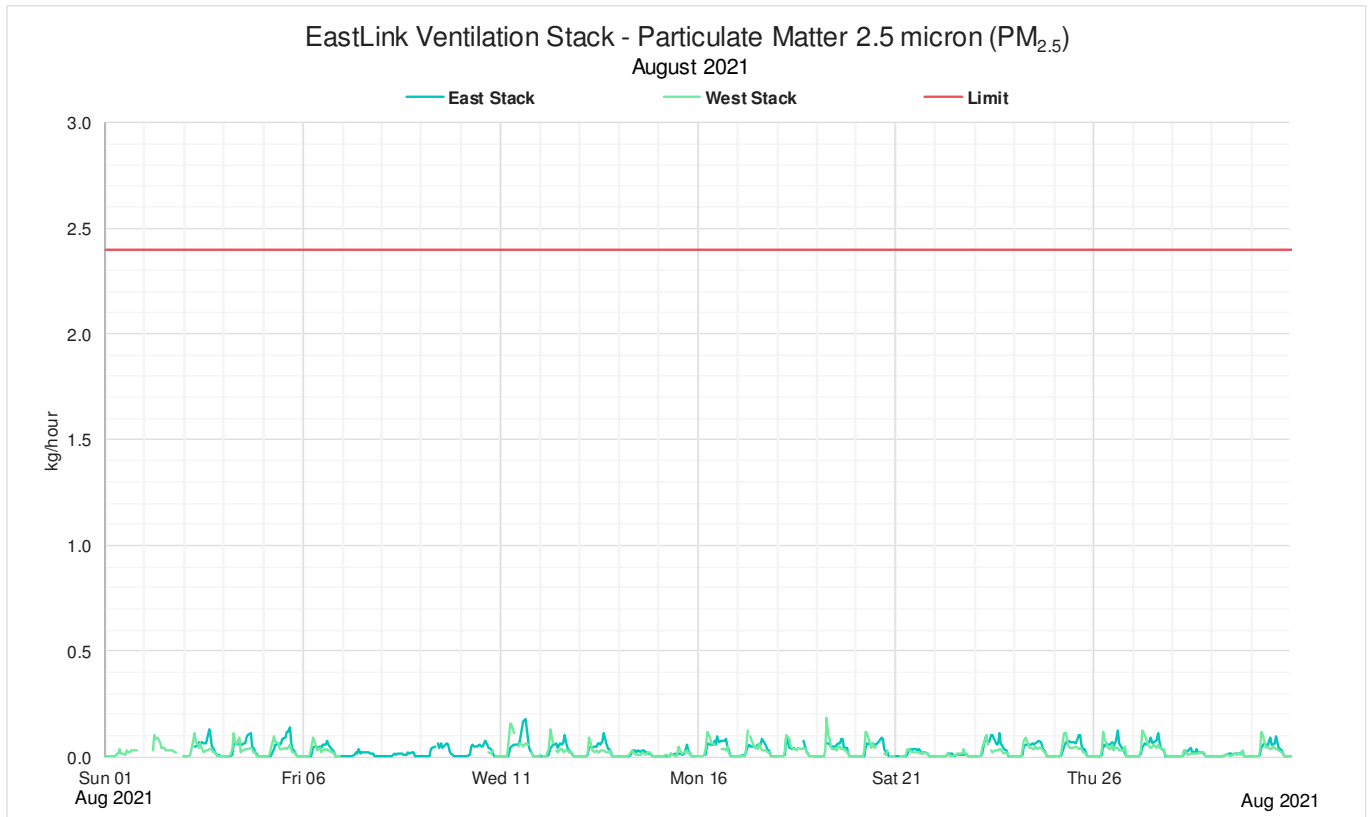


Figure 11: September 2021 Monthly 1 hour mass rate PM_{2.5}

6.2.4.5 September 2021 - Monthly 1 hour mass rate PM₁₀

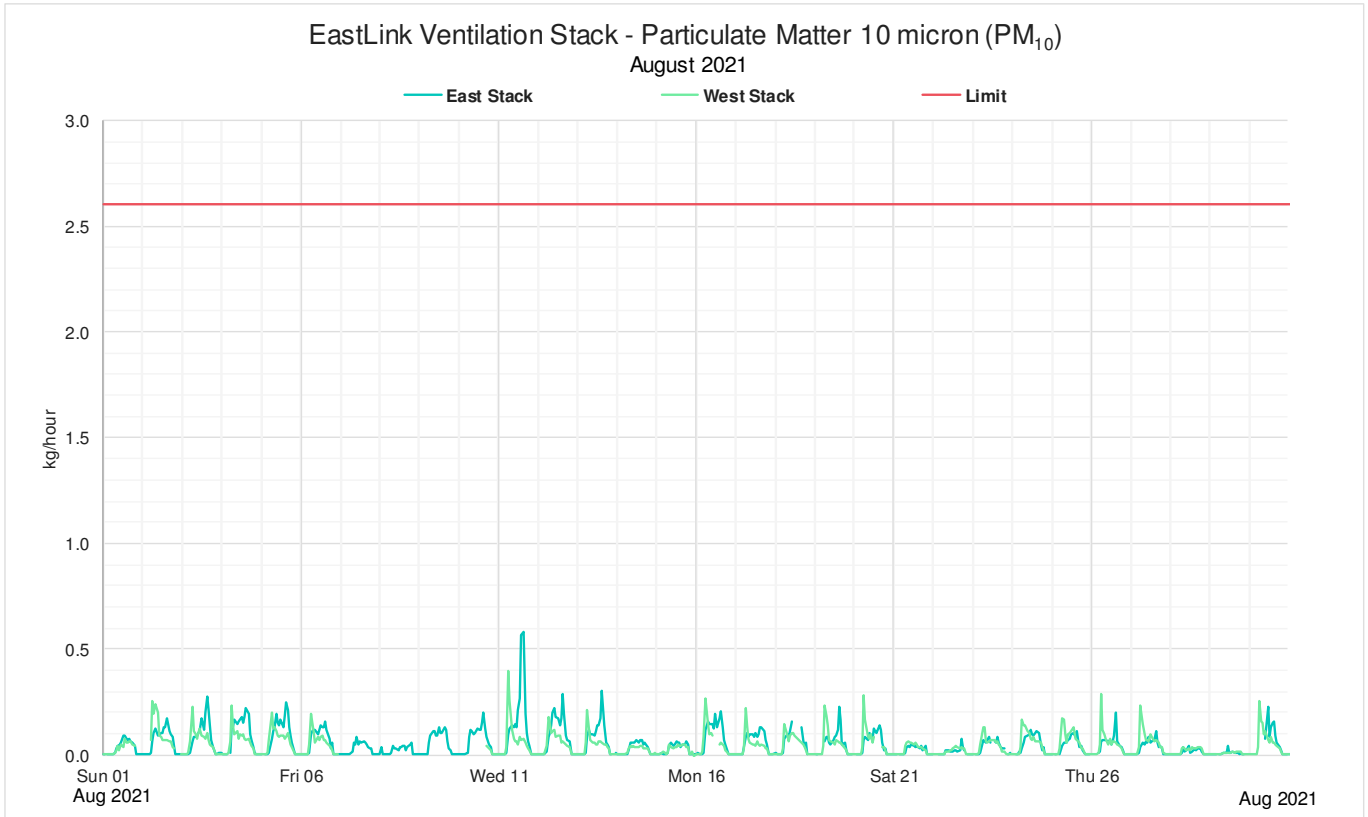


Figure 12: September 2021 Monthly 1 hour mass rate PM₁₀

6.2.4.6 September 2021 - Monthly 1 hour average stack velocity

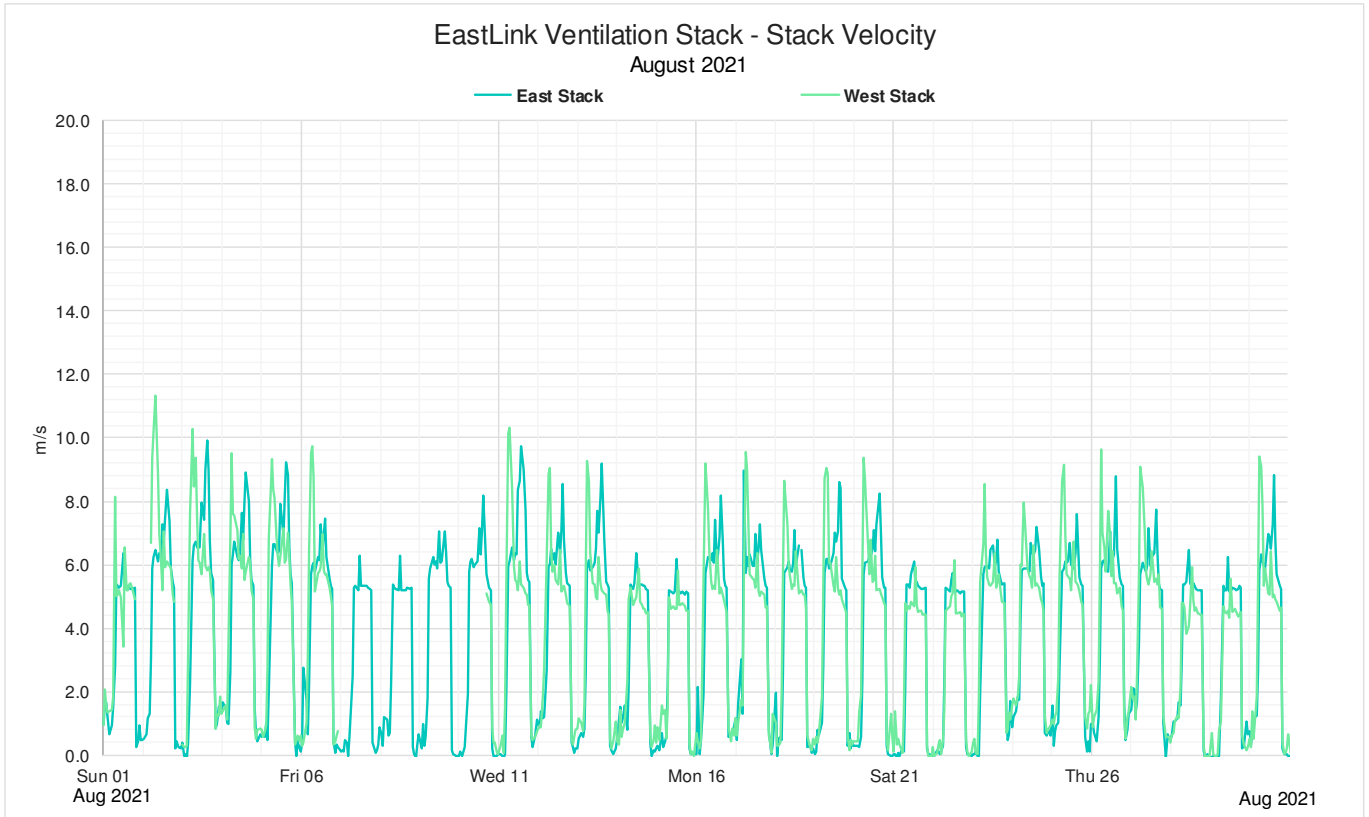


Figure 13: September 2021 Monthly 1 hour average stack velocity

6.2.5 Data Validation Table

Data validation details for the ventilation stack parameters are provided in the Table 18 and Table 19 below.

6.2.5.1 Western Ventilation Stack

| Eastlink Tunnel Western Ventilation Stack Data Validation September 2021 | | | | | | |
|--------------------------------------------------------------------------|------------------|--------------------------|------------------------------------|----------------|-----------|-------------|
| Start Date | End Date | Parameters | Reason | Hours affected | User Name | Change Date |
| 1/09/2021 17:06 | 1/09/2021 20:14 | NO, NO2 | Instrument fault | 3.1 | TA | 10/11/2021 |
| 1/09/2021 19:06 | 30/09/2021 23:59 | PM2.5, PM10 | Intermittent negative data | N/A | TA | 10/11/2021 |
| 1/09/2021 20:15 | 1/09/2021 21:17 | NO, NO2 | Maintenance | 1.0 | TA | 10/11/2021 |
| 1/09/2021 20:12 | 1/09/2021 21:35 | PM2.5 | Unrealistic data - excessive noise | 1.4 | TA | 10/11/2021 |
| 1/09/2021 23:59 | 23/09/2021 13:51 | Stack Velocity | Intermittent negative data | N/A | TA | 10/11/2021 |
| 3/09/2021 18:21 | 20/09/2021 12:38 | PM2.5 | Unrealistic data - excessive noise | 402.3 | TA | 10/11/2021 |
| 20/09/2021 12:39 | 20/09/2021 16:27 | PM2.5, PM10 | Maintenance | 3.8 | TA | 10/11/2021 |
| 20/09/2021 16:28 | 21/09/2021 09:22 | PM10 | Instrument fault | 16.9 | TA | 10/11/2021 |
| 30/09/2021 09:35 | 30/09/2021 12:16 | NO, NO2, CO, PM2.5, PM10 | Maintenance | 2.7 | TA | 10/11/2021 |

This table details any missing data, data removed due to being deemed invalid, or data that has been adjusted.

Table 18: September 2021 Western Ventilation Stack data validation

6.2.5.2 Eastern Ventilation Stack

| Eastlink Tunnel Eastern Ventilation Stack Data Validation September 2021 | | | | | | |
|--------------------------------------------------------------------------|------------------|--------------------------|---------------------------------------------------------------------------------|----------------|-----------|-------------|
| Start Date | End Date | Parameters | Reason | Hours affected | User Name | Change Date |
| 1/09/2021 00:17 | 30/09/2021 05:26 | PM2.5, PM10 | Intermittent unrealistic data - negative | N/A | TA | 10/11/2021 |
| 2/09/2021 10:50 | 2/09/2021 12:05 | NO, NO2, CO, PM2.5, PM10 | Instrument calibration out of tolerance | 1.2 | TA | 10/11/2021 |
| 2/09/2021 11:57 | 2/09/2021 11:57 | All parameters | Missing data | 0.0 | TA | 10/11/2021 |
| 2/09/2021 16:55 | 2/09/2021 17:30 | NO, NO2, CO | Maintenance | 0.6 | TA | 10/11/2021 |
| 10/09/2021 00:41 | 14/09/2021 07:26 | NO, NO2 | Multiplier applied to data: Multiplier A: 1.096011 Multiplier B: 1.096011 | N/A | TA | 10/11/2021 |
| 14/09/2021 07:27 | 14/09/2021 13:30 | NO, NO2, CO, PM2.5, PM10 | Maintenance | 6.0 | TA | 10/11/2021 |
| 15/09/2021 03:38 | 15/09/2021 04:04 | PM2.5 | Unrealistic data - PM2.5 > PM10 | 0.4 | TA | 10/11/2021 |
| 20/09/2021 10:14 | 20/09/2021 13:02 | PM2.5, PM10 | Maintenance | 2.8 | TA | 10/11/2021 |
| 20/09/2021 13:03 | 21/09/2021 00:00 | PM2.5, PM10 | Instrument stabilisation after maintenance | 11.0 | TA | 10/11/2021 |
| 30/09/2021 12:37 | 30/09/2021 15:17 | NO, NO2, CO, PM2.5, PM10 | Maintenance | 2.7 | TA | 10/11/2021 |

This table details any missing data, data removed due to being deemed invalid, or data that has been adjusted.

Table 19: September 2021 Eastern Ventilation Stack data validation

6.3 Data Availability Year to Date

Data availability statistics for year to date (01 January 2021 to 30 September 2021) are provided in Table 20 below:

| EastLink Ventilation Stack Data Availability January 2021 to September 2021 | | | | | | |
|-----------------------------------------------------------------------------|-----|-----------------|-----|-------------------|------------------|----------------|
| Station | NO | NO ₂ | CO | PM _{2.5} | PM ₁₀ | Stack Velocity |
| Western | 92% | 92% | 92% | 88% | 96% | 73% |
| Eastern | 88% | 88% | 95% | 96% | 98% | 100% |

Table 20: EastLink Ventilation Stack year to date data availability

6.4 Annual Performance Statement Bubble Limits

The EPA License 2043 Condition LI_DA1 defines annual emission rate bubble limits for discharge points 1 and 2. Annual emission rates are calculated from 1st July to 30th June each year to coincide with the Annual Performance Statement (APS) reporting period. Ventilation Stack emission rates year to date (01 July 2021 to 30 September 2021) are shown in Table 21 below.

| EastLink Ventilation Stack Mass Rate July 2021 to September 2021 | | | | |
|------------------------------------------------------------------|--------------|--------------|-------------------|------------------|
| Location | NO2 | CO | PM _{2.5} | PM ₁₀ |
| | Tonnes | Tonnes | Tonnes | Tonnes |
| Western Ventilation Stack (Discharge Point 1) | 0.217 | 3.040 | 0.053 | 0.092 |
| Eastern Ventilation Stack (Discharge Point 2) | 0.090 | 3.289 | 0.049 | 0.085 |
| Total | 0.307 | 6.329 | 0.102 | 0.177 |
| Percentage of Licence limit | 0.9% | 0.6% | 0.5% | 0.8% |
| Annual Limit (Tonnes) | 35 | 980 | 21 | 23 |

Table 21: EastLink Ventilation Stack data validation

Figure 14 below presents the ventilation stack emissions of each parameter as a percentage of the Licence limit compared with the percentage of elapse APS Reporting period.

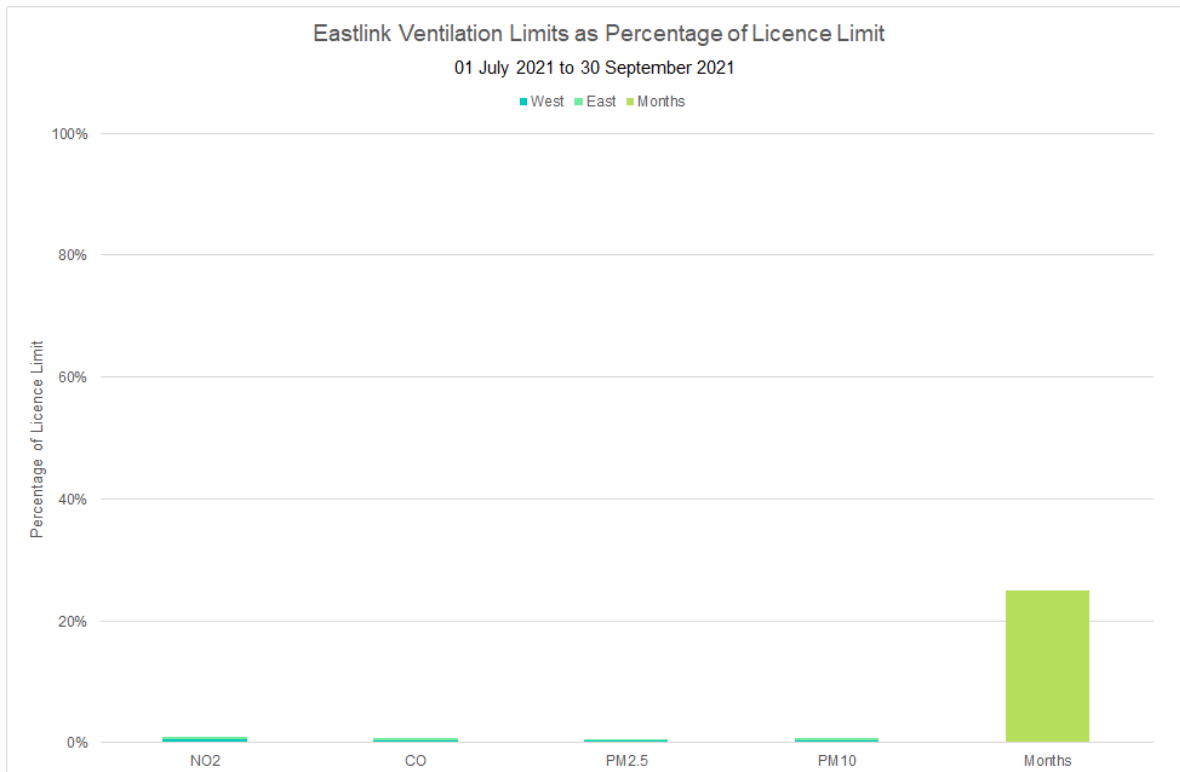


Figure 14: Annual Performance Statement stack emission rates

7 Report Summary

- There were nil exceedances of the prescribed limits during the reporting period.

Appendix 1

Glossary

The following terms and abbreviations are used in this report

| | |
|-------------------|------------------------------------------------------------------------------------------|
| CO | Carbon monoxide |
| DP1 | Discharge Point 1 |
| DP2 | Discharge Point 2 |
| kg/hour | Kilograms per hour |
| g/5m | Grams per 5 minutes |
| m ³ /s | Cubic meters per second |
| mg/m ³ | Milligrams per cubic meter at dry, standard temperature and pressure (0°C and 101.3 kPa) |
| NO | Nitric oxide |
| NO ₂ | Nitrogen dioxide |
| PM ₁₀ | Particulate less than 10 microns in equivalent aerodynamic diameter |
| PM _{2.5} | Particulate less than 2.5 microns in equivalent aerodynamic diameter |

Data Validation Explanations

Automatic background check refers to when analyser samples zero air and measures the level of the concentration voltage. This voltage is taken as the zero signal level and this value is subtracted from any subsequent readings as an active zero compensation. This is the analyser's fine zero measurement.

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

Offset or Multiplier 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

Data transmission error refers to a period of time when the instrument could not transmit data. This may be due to a communication fault between the logger and instrument.

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.

Missing 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 an unavailability 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 unavailable 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.

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.

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