

Ventia – EastLink Tunnel

Ventilation Stack Air Quality Monitoring Validated Data Report

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Report prepared by: Tim Allfrey

NATA Accredited Laboratory
Number 19660

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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	24/01/2024		TA	BN

Prepared by



Tim Allfrey
 24 January 2024

Approved by



Bruno Nourdine
 24 January 2024

Distribution

Format	Recipient	Details
PDF	George Vasiliadis	Gvasiliadis@connecteast.com.au
PDF	Nick Huntington	NHuntington@connecteast.com.au

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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 stack 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 October 2023 to January 2024 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, Table 2 and Table 3 and 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 October 2023								
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	0.36	-	-	-
	CO	1-hour	112	kg/h	5.35	-	-	-
	PM _{2.5}	1-hour	2.4	kg/h	0.2	-	-	-
	PM ₁₀	1-hour	2.6	kg/h	0.4	-	-	-
Eastern Ventilation Stack (Discharge Point 2)	NO ₂	1-hour	3.98	kg/h	0.65	-	-	-
	CO	1-hour	112	kg/h	7.84	-	-	-
	PM _{2.5}	1-hour	2.4	kg/h	0.1	-	-	-
	PM ₁₀	1-hour	2.6	kg/h	0.4	-	-	-

Table 1: Exceedances of EPA Limits

EastLink Ventilation Stack Air Quality Limit Exceedances November 2023								
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	0.34	-	-	-
	CO	1-hour	112	kg/h	8.81	-	-	-
	PM _{2.5}	1-hour	2.4	kg/h	0.2	-	-	-
	PM ₁₀	1-hour	2.6	kg/h	0.4	-	-	-
Eastern Ventilation Stack (Discharge Point 2)	NO ₂	1-hour	3.98	kg/h	0.56	-	-	-
	CO	1-hour	112	kg/h	7.38	-	-	-
	PM _{2.5}	1-hour	2.4	kg/h	0.2	-	-	-
	PM ₁₀	1-hour	2.6	kg/h	0.4	-	-	-

Table 2: Exceedances of EPA Limits

EastLink Ventilation Stack Air Quality Limit Exceedances December 2023								
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	0.37	-	-	-
	CO	1-hour	112	kg/h	6.30	-	-	-
	PM _{2.5}	1-hour	2.4	kg/h	0.2	-	-	-
	PM ₁₀	1-hour	2.6	kg/h	0.3	-	-	-
Eastern Ventilation Stack (Discharge Point 2)	NO ₂	1-hour	3.98	kg/h	0.62	-	-	-
	CO	1-hour	112	kg/h	7.93	-	-	-
	PM _{2.5}	1-hour	2.4	kg/h	0.2	-	-	-
	PM ₁₀	1-hour	2.6	kg/h	0.4	-	-	-

Table 3: Exceedances of EPA Limits

1.2 Summary of Results

Summaries of the ventilation stack pollutants for the reporting period are presented in Table 4, Table 5 and Table 6 below. Maximum mass rates are provided for comparison to the limits.

EastLink Ventilation Stack Summary October 2023							
Location	Parameter	1hr Average Maximum	1 hr Average Minimum	Monthly Average	Monthly Total	Number of Exceedances	Data Availability (%)
Western Ventilation Stack	NO (kg/h)	3.16	-0.01	0.59	416.16	N/A	95.6%
	NO ₂ (kg/h)	0.36	0.00	0.07	50.95	0	95.6%
	CO (kg/h)	5.35	-0.06	1.62	1153.48	0	95.6%
	PM _{2.5} (kg/h)	0.2	0.0	0.0	19.4	0	95.8%
	PM ₁₀ (kg/h)	0.4	0.0	0.1	38.3	0	97.8%
Eastern Ventilation Stack	NO (kg/h)	3.07	-0.23	0.71	508.21	N/A	95.7%
	NO ₂ (kg/h)	0.65	0.00	0.13	94.92	0	95.7%
	CO (kg/h)	7.84	-0.05	1.89	1345.15	0	95.7%
	PM _{2.5} (kg/h)	0.1	0.0	0.0	24.8	0	99.6%
	PM ₁₀ (kg/h)	0.4	0.0	0.1	56.5	0	98.9%

Table 4: Summary of results

EastLink Ventilation Stack Summary November 2023							
Location	Parameter	1hr Average Maximum	1 hr Average Minimum	Monthly Average	Monthly Total	Number of Exceedances	Data Availability (%)
Western Ventilation Stack	NO (kg/h)	2.99	-0.01	0.59	408.61	N/A	95.7%
	NO ₂ (kg/h)	0.34	0.00	0.07	51.56	0	95.7%
	CO (kg/h)	8.81	-0.06	1.86	1279.00	0	95.7%
	PM _{2.5} (kg/h)	0.2	0.0	0.0	22.7	0	97.8%
	PM ₁₀ (kg/h)	0.4	0.0	0.1	41.0	0	99.7%
Eastern Ventilation Stack	NO (kg/h)	2.92	-0.18	0.70	484.07	N/A	95.7%
	NO ₂ (kg/h)	0.56	0.00	0.12	81.46	0	95.7%
	CO (kg/h)	7.38	-0.03	2.01	1383.81	0	95.7%
	PM _{2.5} (kg/h)	0.2	0.0	0.0	24.8	0	97.8%
	PM ₁₀ (kg/h)	0.4	0.0	0.1	54.9	0	99.7%

Table 5: Summary of results

EastLink Ventilation Stack Summary December 2023							
Location	Parameter	1hr Average Maximum	1 hr Average Minimum	Monthly Average	Monthly Total	Number of Exceedances	Data Availability (%)
Western Ventilation Stack	NO (kg/h)	2.79	-0.01	0.45	309.08	N/A	92.1%
	NO ₂ (kg/h)	0.37	0.00	0.06	38.97	0	92.1%
	CO (kg/h)	6.30	-0.04	1.67	1179.93	0	94.8%
	PM _{2.5} (kg/h)	0.2	0.0	0.0	17.4	0	88.2%
	PM ₁₀ (kg/h)	0.3	0.0	0.0	28.7	0	98.5%
Eastern Ventilation Stack	NO (kg/h)	3.09	-0.22	0.59	383.60	N/A	87.4%
	NO ₂ (kg/h)	0.62	0.00	0.11	73.56	0	87.4%
	CO (kg/h)	7.93	-0.02	1.94	1347.65	0	93.4%
	PM _{2.5} (kg/h)	0.2	0.0	0.0	20.9	0	84.4%
	PM ₁₀ (kg/h)	0.4	0.0	0.1	48.3	0	98.5%

Table 6: Summary of results

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 7 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 7: EPA Compliance Limits

The procedure for reporting 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 October 2023 to January 2024.

- 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 the 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
	In house method TP.005	
	AS 4323.1	
PM _{2.5}	In house method TP.026	Rupprecht & Patashnick TEOM
	AS 4323.1	
Temperature	In house method TP.012	PT100
Stack Velocity	USEAP (CFR 40) Part 75	OSI OFS2000

Table 8: Measurement methods and instrumentation

4.2 Ventilation Stacks

The locations of the EastLink Tunnel Western and Eastern ventilation stacks are detailed in Table 9 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 9: EastLink Tunnel ventilation stack GPS Coordinates

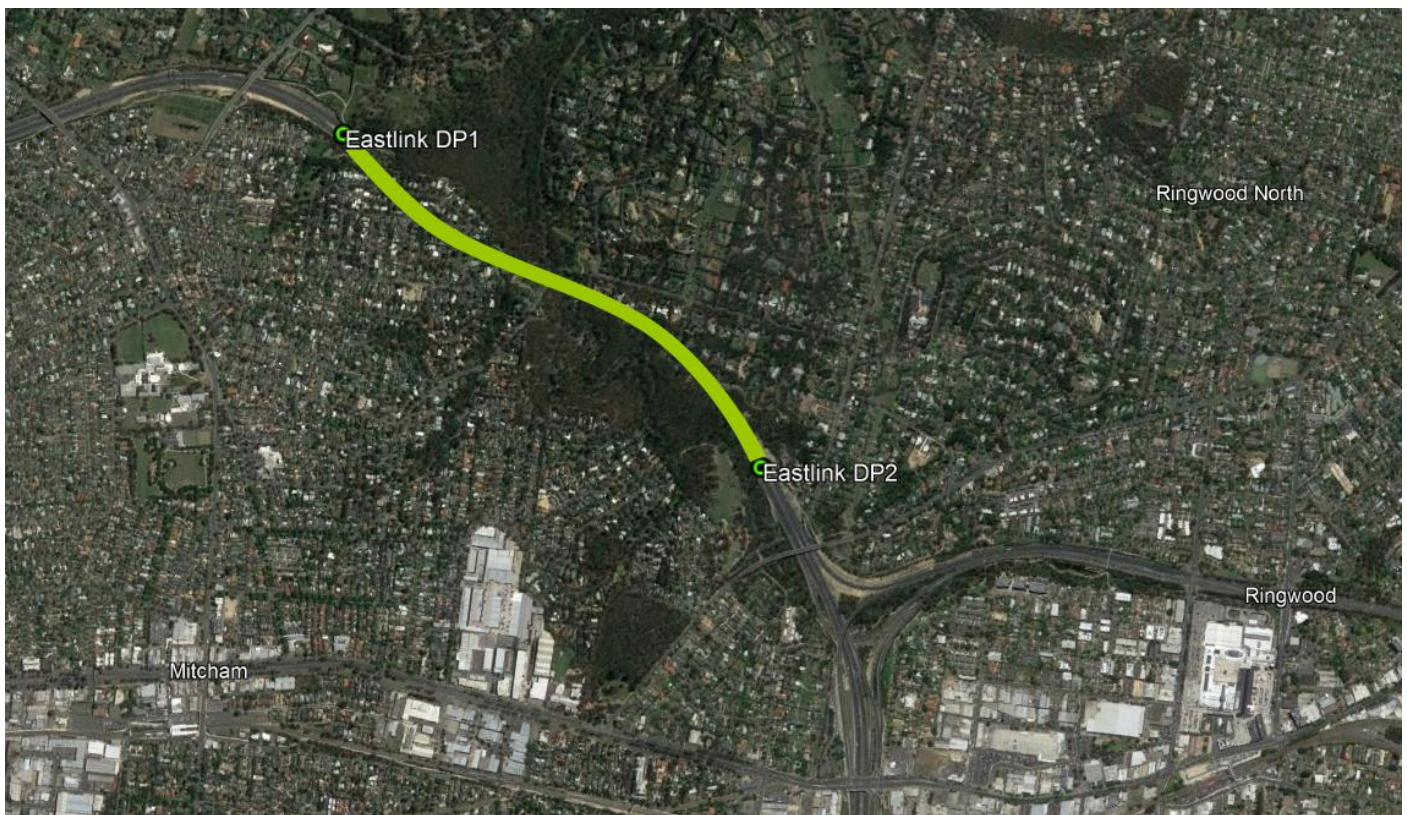


Figure 1: EastLink Tunnel ventilation stack locations

4.3 Data Collection

At each Air Quality Monitoring Station, data is logged to an 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' when the averaging periods of eight hours or less. IE the average data for 01:00 is the data from 00:00 through to 01:00. One-hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days. All averages are based on a minimum of 75% valid readings within the averaging period.

All data is reported at Australian Eastern Standard Time.

Validated data for Quarter 4 Month 1 is presented in the Excel workbook named " EastLink Q4M1 Validated data.xlsx"

The workbooks each consist of the following sheets:

- Sheet 1: Cover
- Sheet 2: M1 Data kg1h – Hourly data in kg/h
- Sheet 3: M1 Data g5m – 5-minute data in grams/5m
- Sheet 4: M1 Data mgm3 1h – 1-hour data in mg/m³
- Sheet 5: M1 Data mgm3 5m – 5-minute data in mg/m³
- Sheet 6: Eastern Validation Data
- Sheet 7: Western Validation Data

Validated data for Quarter 4 Month 2 is presented in the Excel workbook named " EastLink Q4M2 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 – 1-hour 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 4 Month 3 is presented in the Excel workbook named " EastLink Q4M3 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 – 1-hour 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 1-hour 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 10: Measurement units and uncertainties

5.2 Last Calibrations and Maintenance records

Instrumentation maintenance and last calibration dates are provided in Table 11, Table 12 and Table 13 below:

EastLink Ventilation Stack Maintenance and Calibrations October 2023				
Location	Parameter	Date of last scheduled maintenance	Maintenance type	Date of last calibration
Western Ventilation Stack (Discharge Point 1)	CO	25/10/2023	1 Monthly	25/10/2023
	NO, NO ₂	25/10/2023	1 Monthly	25/10/2023
	PM ₁₀	20/06/2023	12 Monthly	20/06/2023
	PM _{2.5}	20/06/2023	12 Monthly	20/06/2023
	Stack Velocity	31/08/2022	12 Monthly	31/08/2022
	Stack Temperature	31/03/2023	12 Monthly	31/03/2023
Eastern Ventilation Stack (Discharge Point 2)	CO	25/10/2023	1 Monthly	25/10/2023
	NO, NO ₂	25/10/2023	1 Monthly	25/10/2023
	PM ₁₀	20/06/2023	12 Monthly	20/06/2023
	PM _{2.5}	20/06/2023	12 Monthly	20/06/2023
	Stack Velocity	31/08/2022	12 Monthly	31/08/2022
	Stack Temperature	31/03/2023	12 Monthly	31/03/2023

Table 11: Instrument calibration dates

EastLink Ventilation Stack Maintenance and Calibrations November 2023				
Location	Parameter	Date of last scheduled maintenance	Maintenance type	Date of last calibration
Western Ventilation Stack (Discharge Point 1)	CO	27/11/2023	1 Monthly	27/11/2023
	NO, NO ₂	27/11/2023	1 Monthly	27/11/2023
	PM ₁₀	20/06/2023	12 Monthly	20/06/2023
	PM _{2.5}	20/06/2023	12 Monthly	20/06/2023
	Stack Velocity	31/08/2022	12 Monthly	31/08/2022
	Stack Temperature	31/03/2023	12 Monthly	31/03/2023
Eastern Ventilation Stack (Discharge Point 2)	CO	27/11/2023	1 Monthly	27/11/2023
	NO, NO ₂	27/11/2023	1 Monthly	27/11/2023
	PM ₁₀	20/06/2023	12 Monthly	20/06/2023
	PM _{2.5}	20/06/2023	12 Monthly	20/06/2023
	Stack Velocity	31/08/2022	12 Monthly	31/08/2022
	Stack Temperature	31/03/2023	12 Monthly	31/03/2023

Table 12: Instrument calibration dates

EastLink Ventilation Stack Maintenance and Calibrations December 2023				
Location	Parameter	Date of last scheduled maintenance	Maintenance type	Date of last calibration
Western Ventilation Stack (Discharge Point 1)	CO	14/12/2023	6 Monthly	14/12/2023
	NO, NO ₂	14/12/2023	6 Monthly	21/12/2023
	PM ₁₀	14/12/2023	6 Monthly	14/12/2023
	PM _{2.5}	14/12/2023	6 Monthly	14/12/2023
	Stack Velocity	31/08/2022	12 Monthly	31/08/2022
	Stack Temperature	14/12/2023	6 Monthly	14/12/2023
Eastern Ventilation Stack (Discharge Point 2)	CO	15/12/2023	6 Monthly	21/12/2023
	NO, NO ₂	15/12/2023	6 Monthly	21/12/2023
	PM ₁₀	15/12/2023	6 Monthly	15/12/2023
	PM _{2.5}	15/12/2023	6 Monthly	15/12/2023
	Stack Velocity	31/08/2022	12 Monthly	31/08/2022
	Stack Temperature	15/12/2023	6 Monthly	15/12/2023

Table 13: Instrument calibration dates

5.3 Automatic Instrument Calibration Checks

Table 14 below identifies the times at which the daily gaseous parameter automatic span and zero checks are performed.

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

Nightly span and zero times for NO, NO ₂ and CO		
Location	Parameter	Span / Zero cycle time
Western	CO	00:00 - 00:34
	NO, NO ₂	01:00 - 01:44
Eastern	CO	01:34 - 02:13
	NO, NO ₂	01:34 - 02:13

Table 14: Nightly span, zero and CO reference times.

6 Results

6.1

6.1.1 Data Availability

Data availability for the in the ventilation stack parameters are provided in Table 15 below. For further information on data availability please refer to section 6.1.5.

EastLink Ventilation Stack Data Availability October 2023								
Station		NO	NO ₂	CO	PM _{2.5}	PM ₁₀	Stack Velocity	Stack Temp.
Western	Data Availability	95.6%	95.6%	95.6%	95.8%	97.8%	100.0%	98.1%
	Collected Periods	711.0	711.0	711.0	713.0	728.0	744.0	730.0
	Available Periods	744.0	744.0	744.0	744.0	744.0	744.0	744.0
Eastern	Data Availability	95.7%	95.7%	95.7%	99.6%	98.9%	100.0%	100.0%
	Collected Periods	712.0	712.0	712.0	741.0	736.0	744.0	744.0
	Available Periods	744.0	744.0	744.0	744.0	744.0	744.0	744.0

Table 15: 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 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 October 2023								
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	0.36	-	-	-
	CO	1-hour	112	kg/h	5.35	-	-	-
	PM _{2.5}	1-hour	2.4	kg/h	0.2	-	-	-
	PM ₁₀	1-hour	2.6	kg/h	0.4	-	-	-
Eastern Ventilation Stack (Discharge Point 2)	NO ₂	1-hour	3.98	kg/h	0.65	-	-	-
	CO	1-hour	112	kg/h	7.84	-	-	-
	PM _{2.5}	1-hour	2.4	kg/h	0.1	-	-	-
	PM ₁₀	1-hour	2.6	kg/h	0.4	-	-	-

Table 16: 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 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 October 2023								
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)	3.16	2.78	2.54	1.92	1.32	0.92	0.47
	NO ₂ (kg/h)	0.36	0.29	0.25	0.20	0.15	0.11	0.08
	CO (kg/h)	5.35	4.86	4.69	4.32	3.47	2.60	1.84
	PM _{2.5} (kg/h)	0.2	0.1	0.1	0.1	0.1	0.0	0.0
	PM ₁₀ (kg/h)	0.4	0.3	0.3	0.2	0.1	0.1	0.1
Eastern Ventilation Stack	NO (kg/h)	3.07	2.60	2.43	2.14	1.76	1.38	0.49
	NO ₂ (kg/h)	0.65	0.53	0.49	0.39	0.31	0.23	0.12
	CO (kg/h)	7.84	6.44	5.85	4.92	3.88	3.17	2.25
	PM _{2.5} (kg/h)	0.1	0.1	0.1	0.1	0.1	0.1	0.0
	PM ₁₀ (kg/h)	0.4	0.3	0.3	0.2	0.2	0.1	0.1

Table 17: 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 - Monthly 1-hour mass rate NO₂

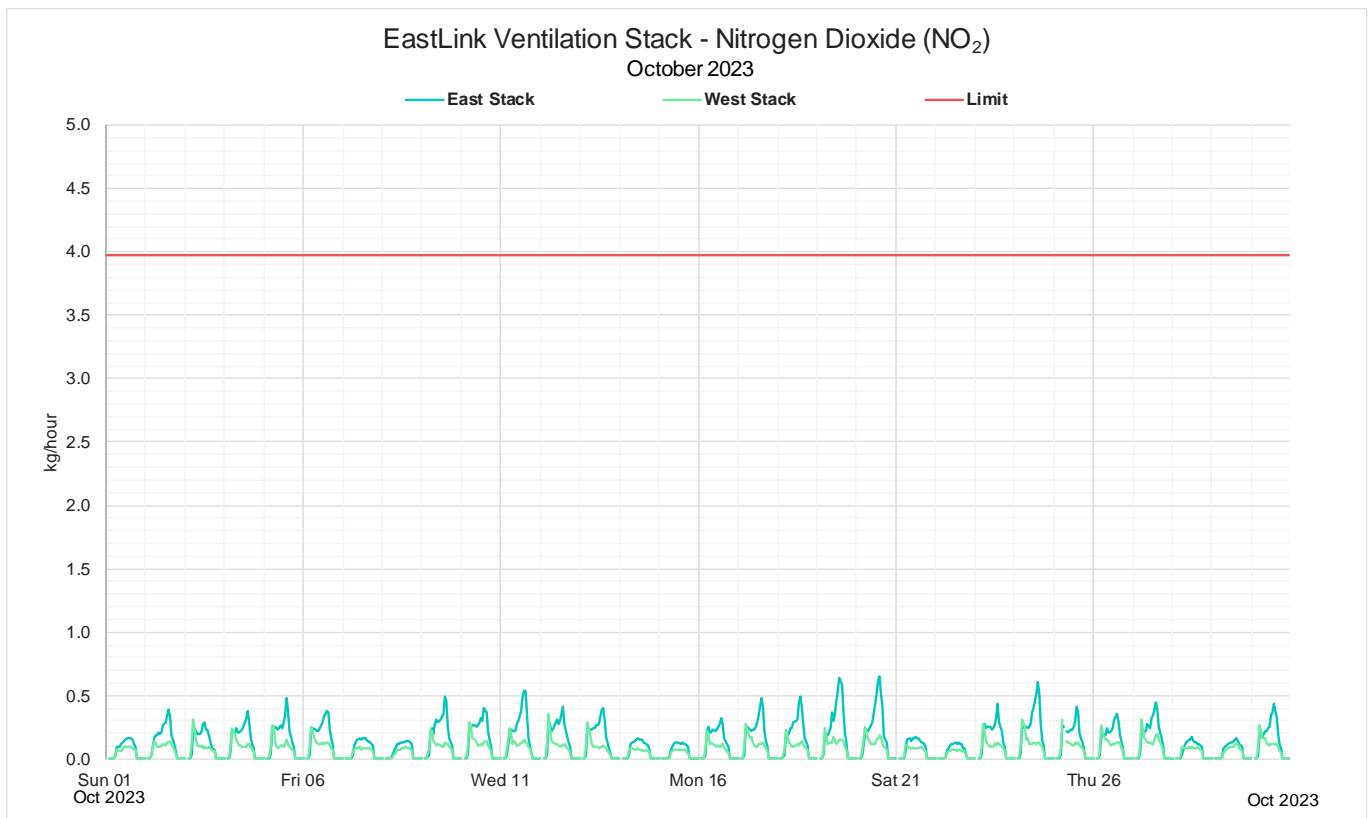


Figure 2: Monthly 1-hour mass rate NO₂

6.1.4.2 - Monthly 1-hour mass rate NO

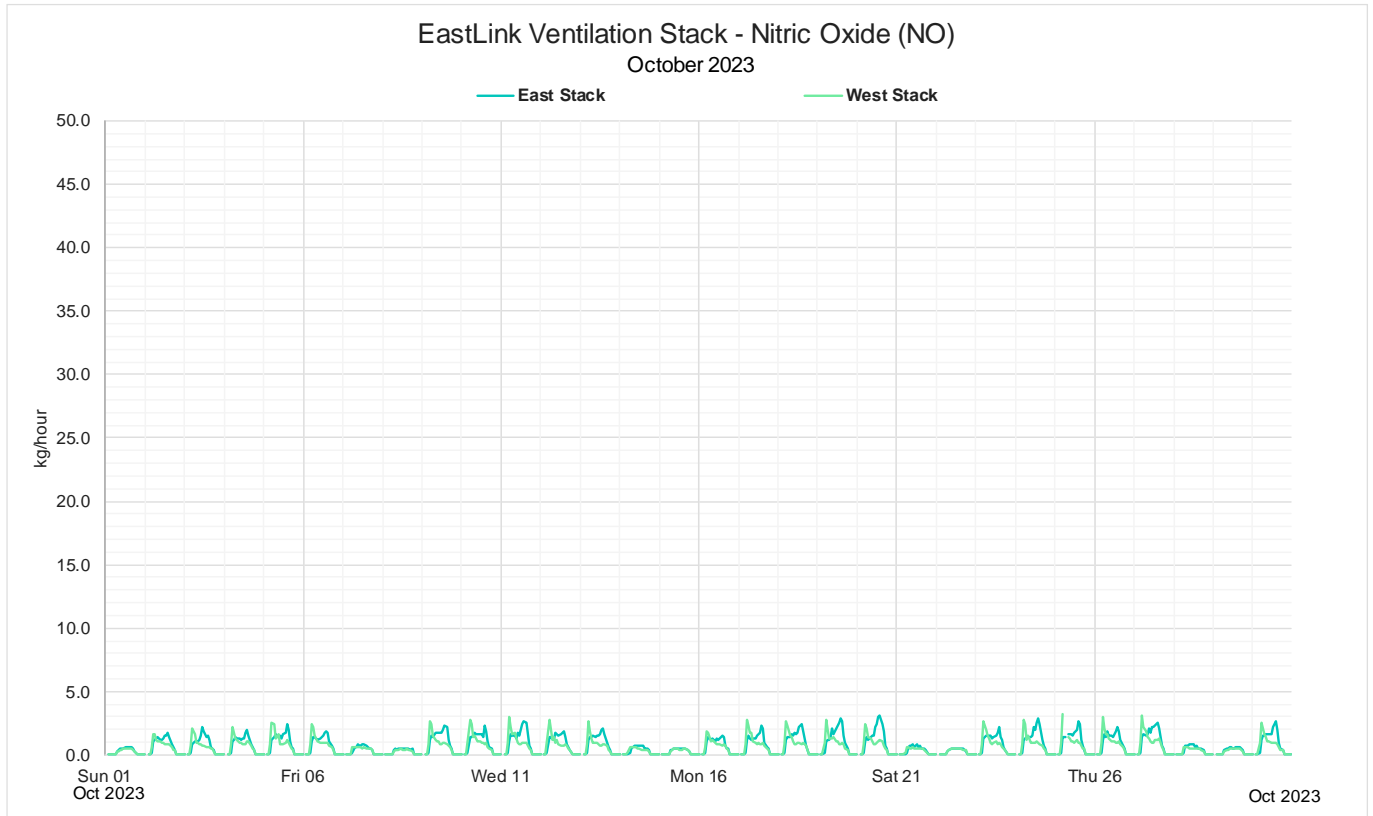


Figure 3: Monthly 1-hour mass rate NO

6.1.4.3 - Monthly 1-hour mass rate CO

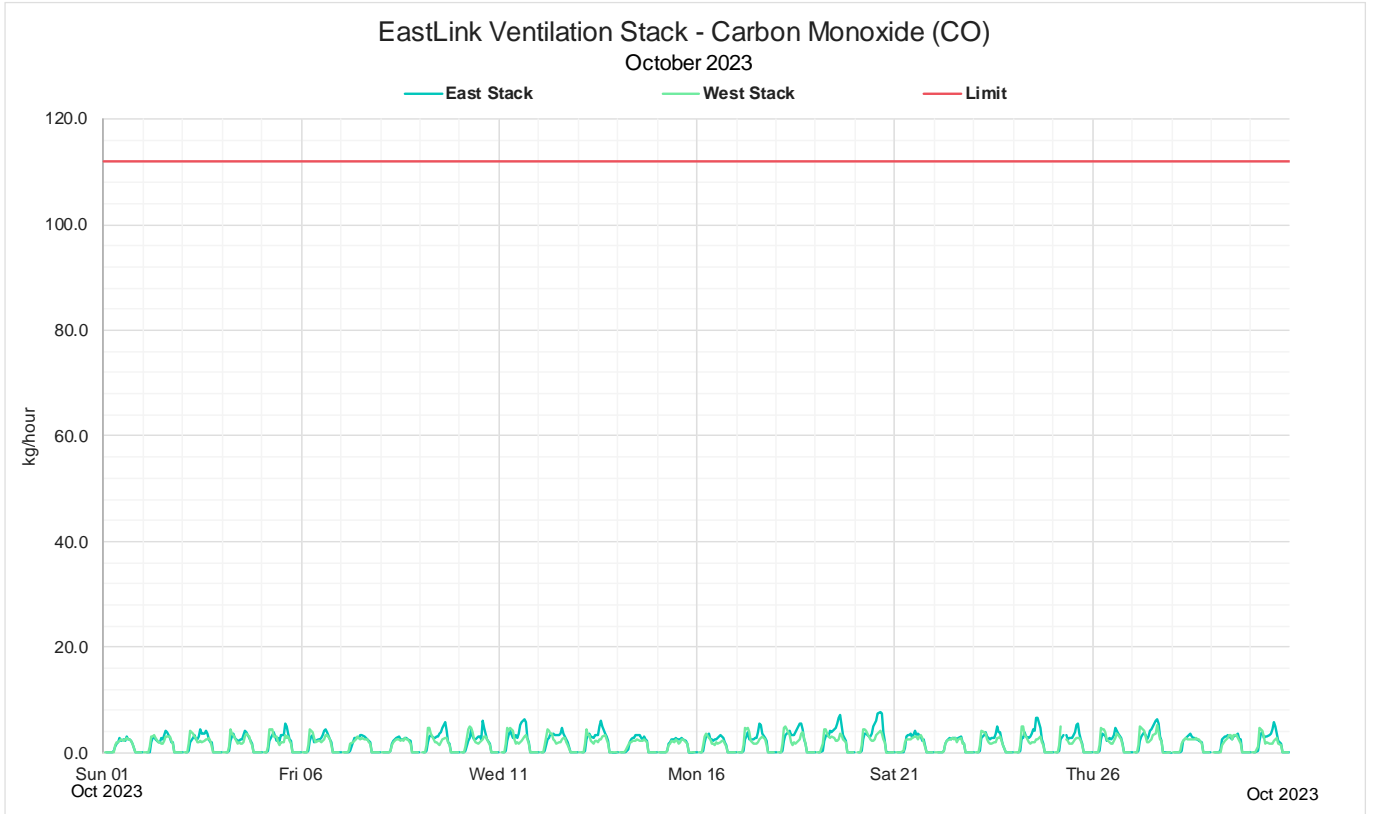


Figure 4: Monthly 1-hour mass rate CO

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

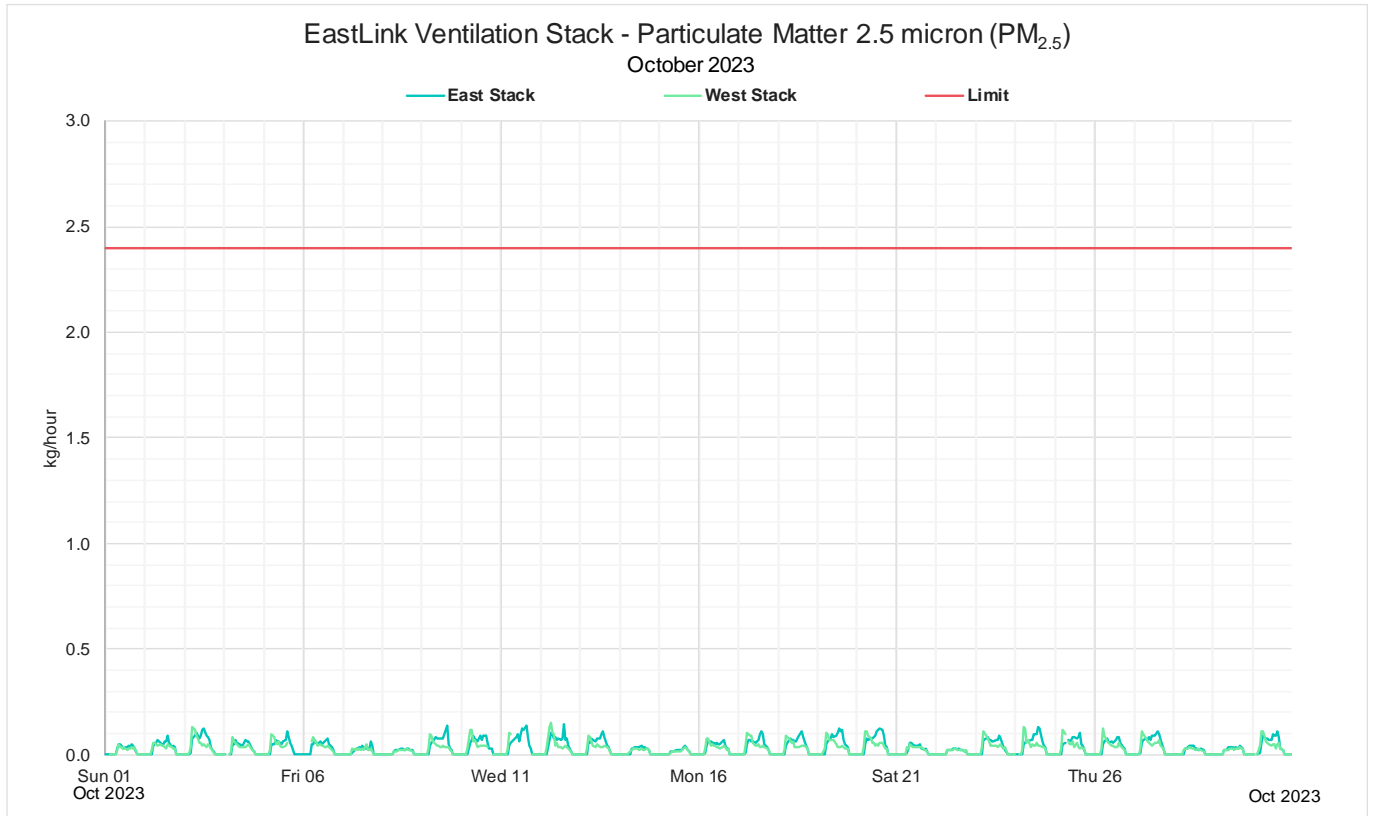


Figure 5: Monthly 1-hour mass rate PM_{2.5}

6.1.4.5 - Monthly 1-hour mass rate PM₁₀

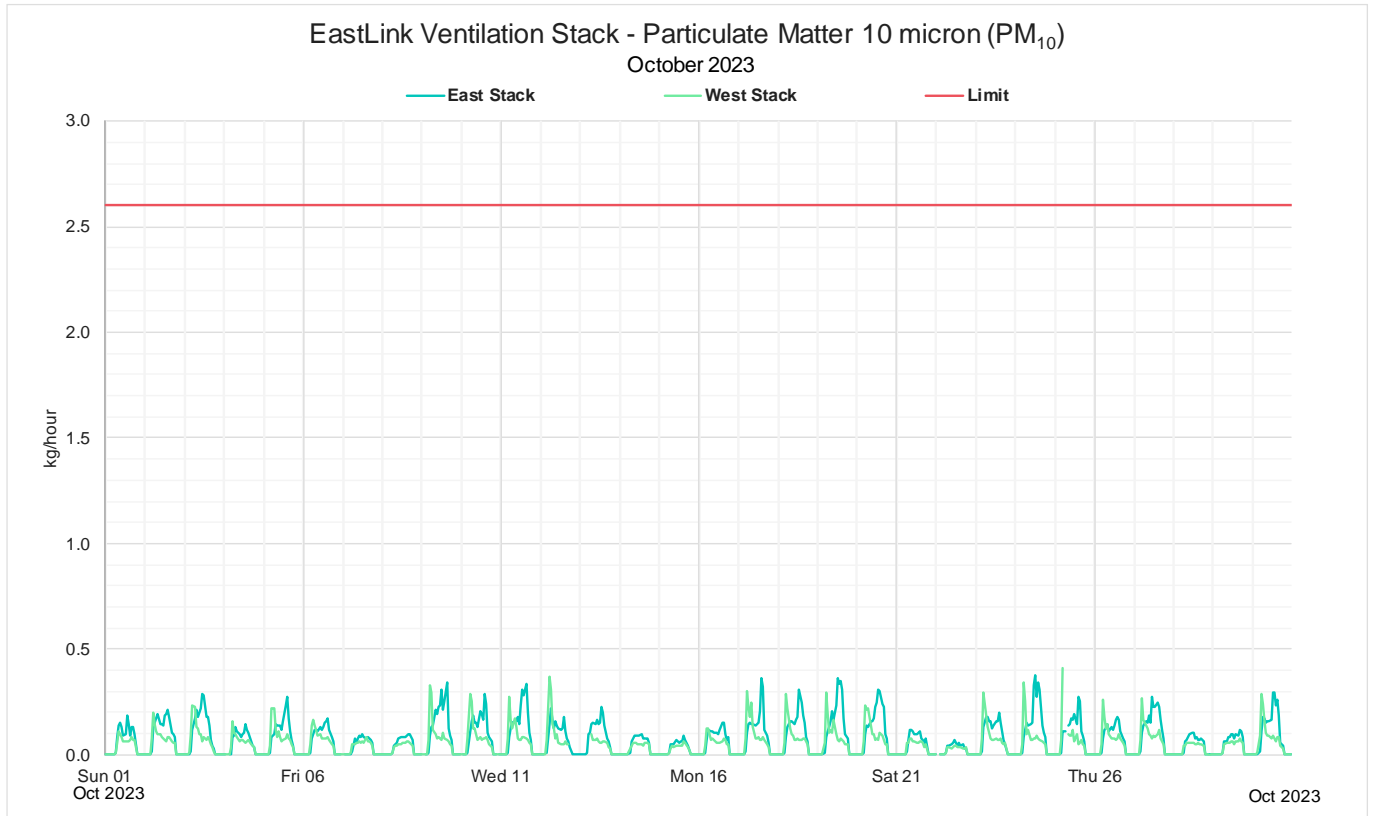


Figure 6: Monthly 1-hour mass rate PM₁₀

6.1.4.6 - Monthly 1-hour average stack velocity

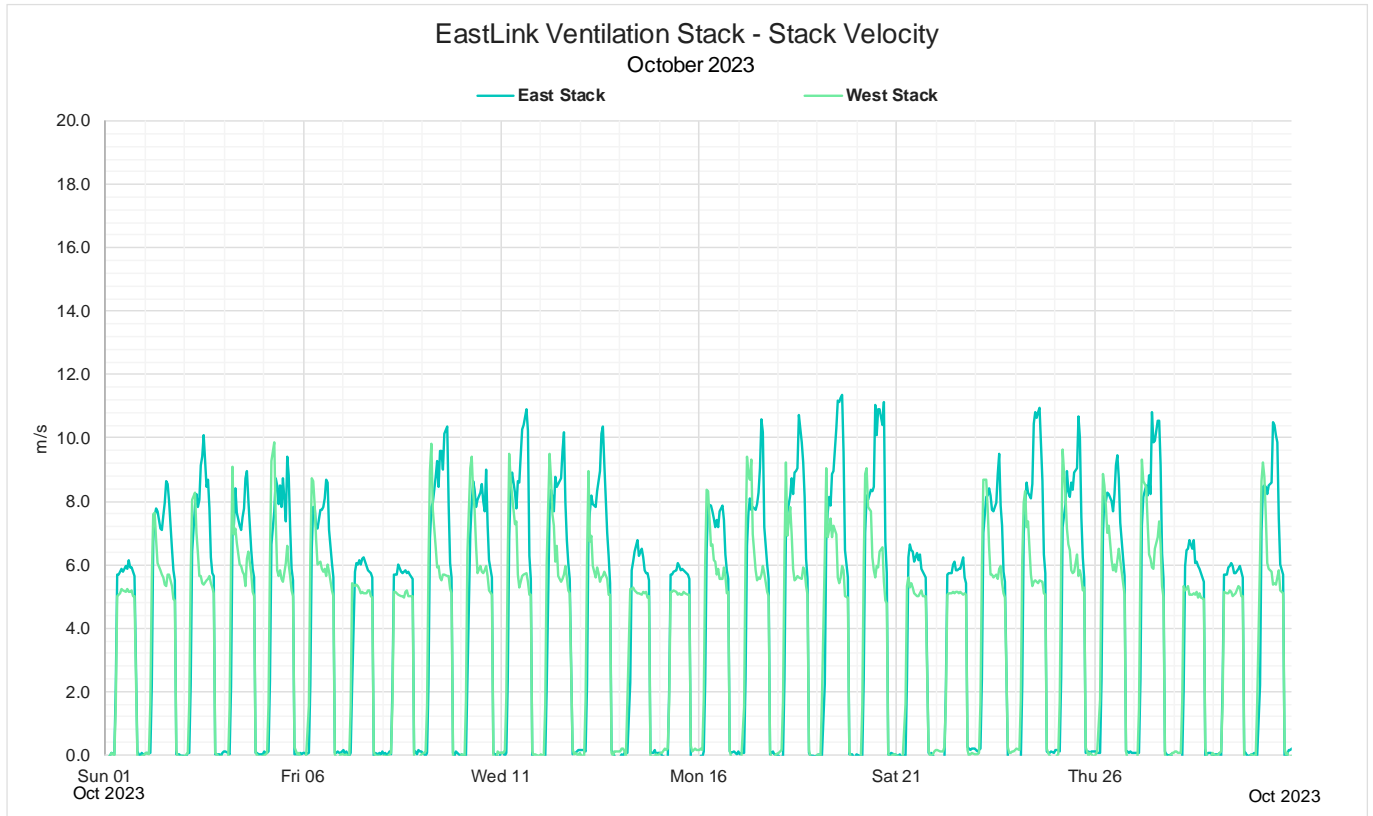


Figure 7: Monthly 1-hour average stack velocity

6.1.4.7 - Monthly 1-hour average stack temperature

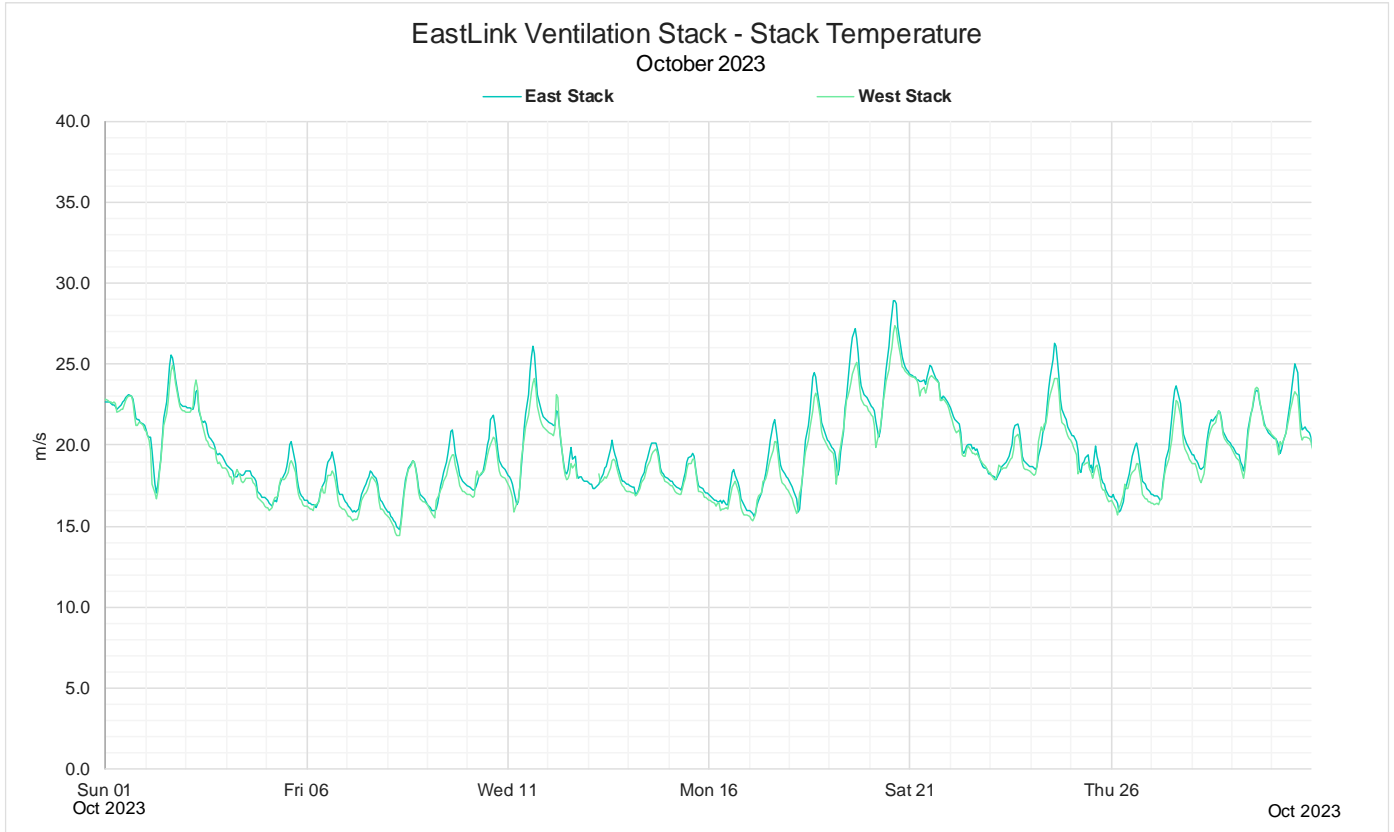


Figure 8: Monthly 1-hour average stack temperature

6.1.5 Data Validation Table

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

6.1.5.1 - Western Ventilation Stack

Eastlink Tunnel Western Ventilation Stack Data Validation October 2023						
Start Date	End Date	Parameters	Reason	Hours affected	User Name	Change Date
1/10/2023 0:00	1/11/2023 0:00	NO ₂ , NO _x	Static offset of +0.029 ppm applied to NO ₂ data. NO _x data corrected accordingly	N/A	DL	11/01/2024
1/10/2023 1:22	31/10/2023 3:49	PM _{2.5} , PM ₁₀	Intermittent unrealistic data - negative	N/A	DL	11/01/2024
2/10/2023 0:35	25/10/2023 6:42	CO	Static offset of +0.2 ppm applied to data	N/A	DL	11/01/2024
5/10/2023 15:08	6/10/2023 5:01	PM _{2.5}	Instrument offline	13.9	DL	11/01/2024
11/10/2023 6:51	11/10/2023 7:57	PM _{2.5}	Unrealistic data spike - PM _{2.5} > PM ₁₀	1.1	DL	11/01/2024
11/10/2023 8:02	11/10/2023 8:50	PM _{2.5}	Unrealistic data spike - PM _{2.5} > PM ₁₀	0.8	DL	11/01/2024
11/10/2023 10:34	11/10/2023 11:30	PM _{2.5}	Unrealistic data spike - PM _{2.5} > PM ₁₀	0.9	DL	11/01/2024
11/10/2023 13:04	11/10/2023 13:27	PM _{2.5}	Unrealistic data spike - PM _{2.5} > PM ₁₀	0.4	DL	11/01/2024
11/10/2023 14:09	11/10/2023 15:50	PM _{2.5}	Unrealistic data spike - PM _{2.5} > PM ₁₀	1.7	DL	11/01/2024
11/10/2023 17:35	11/10/2023 18:44	PM _{2.5}	Unrealistic data spike - PM _{2.5} > PM ₁₀	1.1	DL	11/01/2024
12/10/2023 17:56	13/10/2023 6:54	Stack Temp, PM ₁₀	Instrument offline	13.0	DL	11/01/2024
13/10/2023 6:55	13/10/2023 7:01	PM ₁₀	Unscheduled Maintenance	0.1	DL	11/01/2024
25/10/2023 6:43	25/10/2023 7:18	Stack Temp, NO, NO ₂ , NO _x , CO, PM ₁₀ , PM _{2.5}	Scheduled Monthly Maintenance	0.6	DL	11/01/2024
25/10/2023 7:19	1/11/2023 0:00	CO	Static offset of +0.1 ppm applied to data	N/A	DL	11/01/2024

Table 18: Western Ventilation Stack data validation

6.1.5.2 - Eastern Ventilation Stack

Eastlink Tunnel Eastern Ventilation Stack Data Validation October 2023						
Start Date	End Date	Parameters	Reason	Hours affected	User Name	Change Date
1/10/2023 0:00	25/10/2023 7:21	CO	Static offset of -0.2 ppm applied to data	N/A	DL	15/01/2024
3/10/2023 19:12	31/10/2023 1:54	PM _{2.5} , PM ₁₀	Intermittent unrealistic data - negative	N/A	DL	15/01/2024
25/10/2023 7:22	25/10/2023 7:57	Stack Temp, NO, NO ₂ , NO _x , CO, PM ₁₀ , PM _{2.5}	Scheduled Monthly Maintenance	0.6	DL	15/01/2024
25/10/2023 7:58	27/11/2023 7:35	CO	Linear offset applied to data: A = +0.3 ppm B = +0.1 ppm	N/A	DL	15/01/2024
31/10/2023 20:49	31/10/2023 20:49	All parameters	Data transmission error	0.0	DL	15/01/2024

Table 19: Eastern Ventilation Stack data validation

6.2

6.2.1 Data Availability

Data availability for the in the ventilation stack parameters are provided in Table 20 below. For further information on data availability please refer to section 6.1.5.

EastLink Ventilation Stack Data Availability November 2023								
Station		NO	NO ₂	CO	PM _{2.5}	PM ₁₀	Stack Velocity	Stack Temp.
Western	Data Availability	95.7%	95.7%	95.7%	97.8%	99.7%	100.0%	100.0%
	Collected Periods	689	689	689	704	718	720	720
	Available Periods	720	720	720	720	720	720	720
Eastern	Data Availability	95.7%	95.7%	95.7%	96.3%	99.4%	100.0%	100.0%
	Collected Periods	689	689	689	693	716	720	720
	Available Periods	720	720	720	720	720	720	720

Table 20: 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 21 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 November 2023								
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	0.34	-	-	-
	CO	1-hour	112	kg/h	8.81	-	-	-
	PM _{2.5}	1-hour	2.4	kg/h	0.2	-	-	-
	PM ₁₀	1-hour	2.6	kg/h	0.4	-	-	-
Eastern Ventilation Stack (Discharge Point 2)	NO ₂	1-hour	3.98	kg/h	0.56	-	-	-
	CO	1-hour	112	kg/h	7.38	-	-	-
	PM _{2.5}	1-hour	2.4	kg/h	0.2	-	-	-
	PM ₁₀	1-hour	2.6	kg/h	0.4	-	-	-

Table 21: 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 22 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 November 2023								
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)	2.99	2.71	2.54	1.97	1.41	0.96	0.46
	NO ₂ (kg/h)	0.34	0.29	0.26	0.22	0.16	0.12	0.08
	CO (kg/h)	8.81	5.59	5.22	4.76	4.19	2.99	2.08
	PM _{2.5} (kg/h)	0.2	0.1	0.1	0.1	0.1	0.1	0.0
	PM ₁₀ (kg/h)	0.4	0.3	0.2	0.2	0.1	0.1	0.1
Eastern Ventilation Stack	NO (kg/h)	2.92	2.59	2.45	2.07	1.76	1.34	0.51
	NO ₂ (kg/h)	0.56	0.45	0.42	0.35	0.29	0.20	0.10
	CO (kg/h)	7.38	6.36	5.76	4.93	4.24	3.36	2.48
	PM _{2.5} (kg/h)	0.2	0.1	0.1	0.1	0.1	0.1	0.0
	PM ₁₀ (kg/h)	0.4	0.3	0.3	0.2	0.2	0.1	0.1

Table 22: 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 - Monthly 1-hour mass rate NO₂

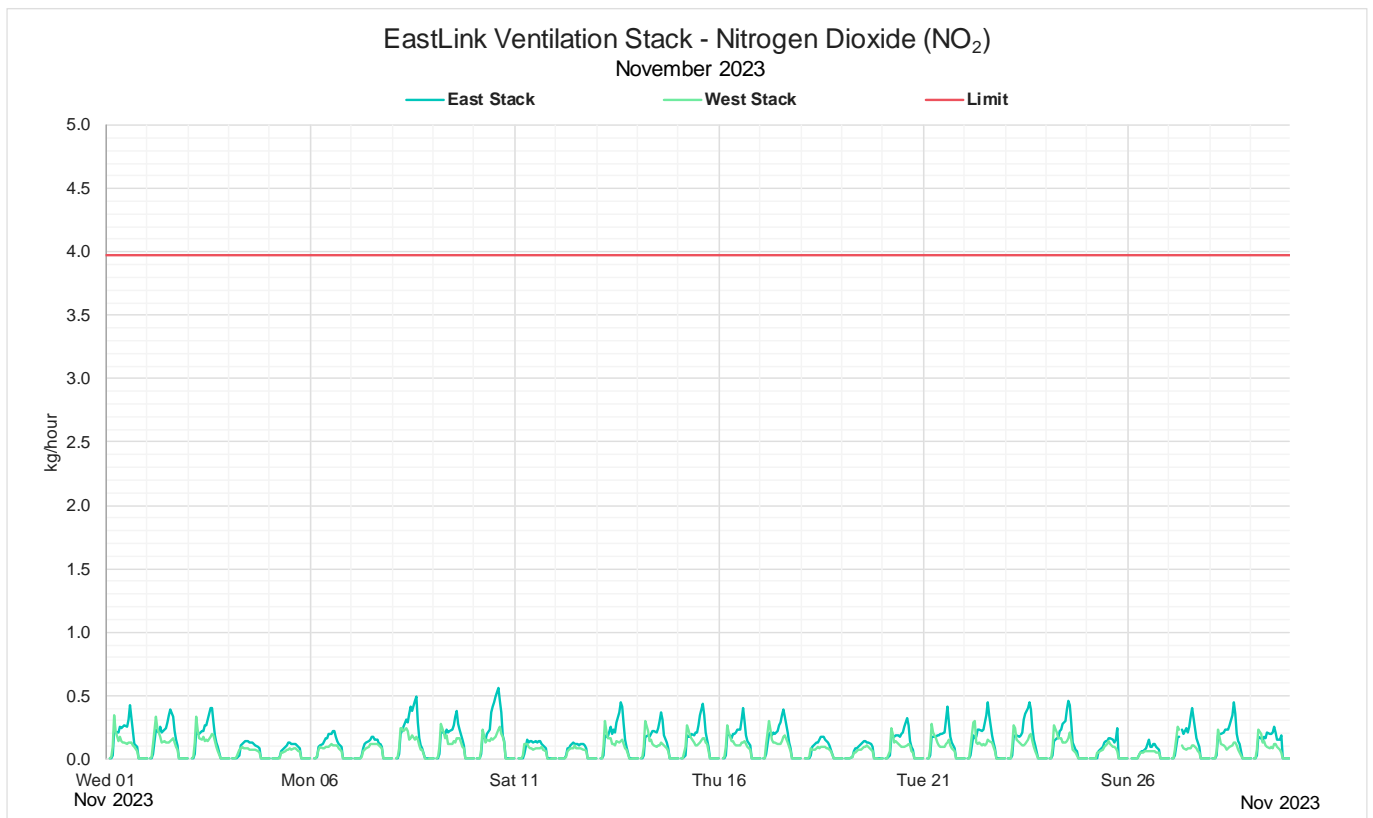


Figure 9: Monthly 1-hour mass rate NO₂

6.2.4.2 - Monthly 1-hour mass rate NO

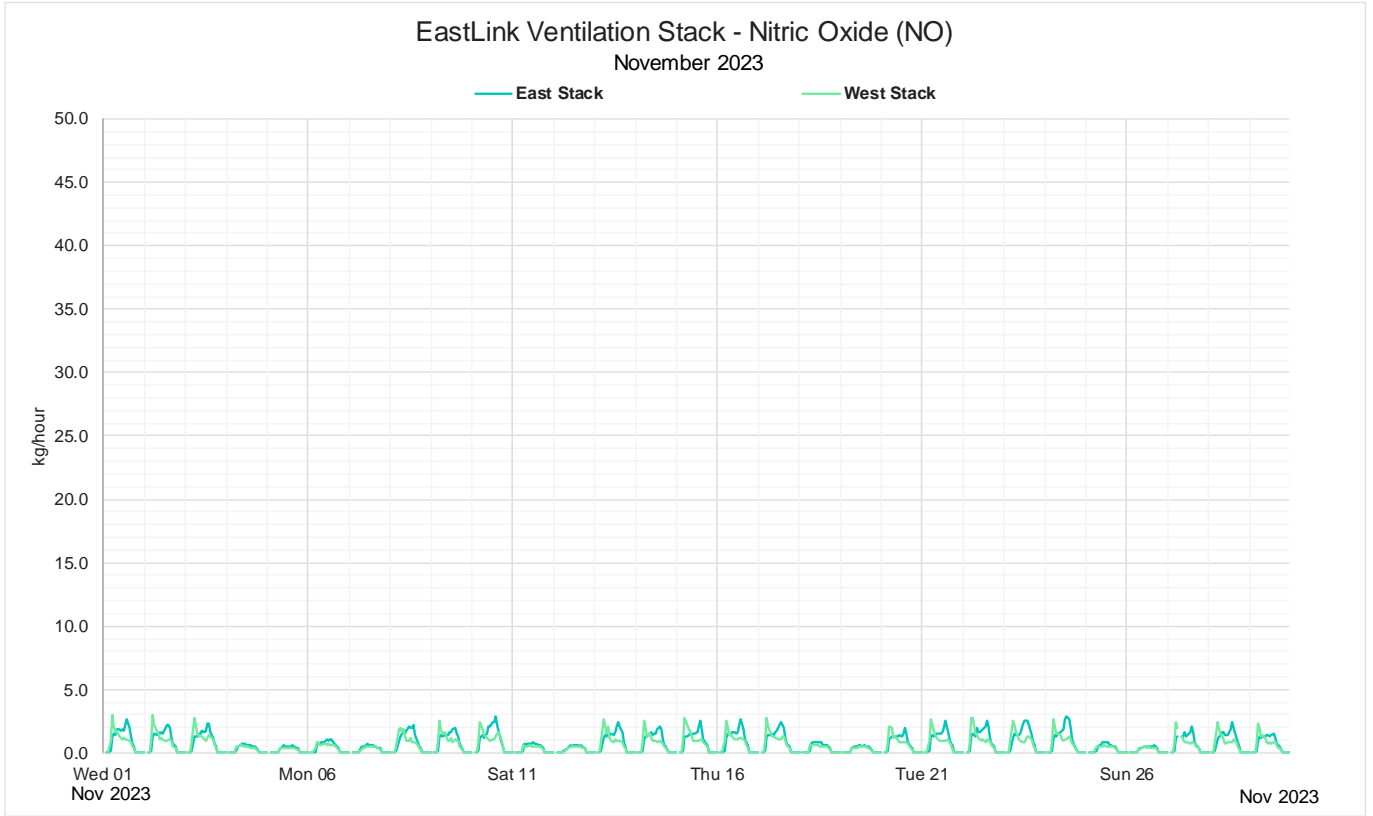


Figure 10: Monthly 1-hour mass rate NO

6.2.4.3 - Monthly 1-hour mass rate CO

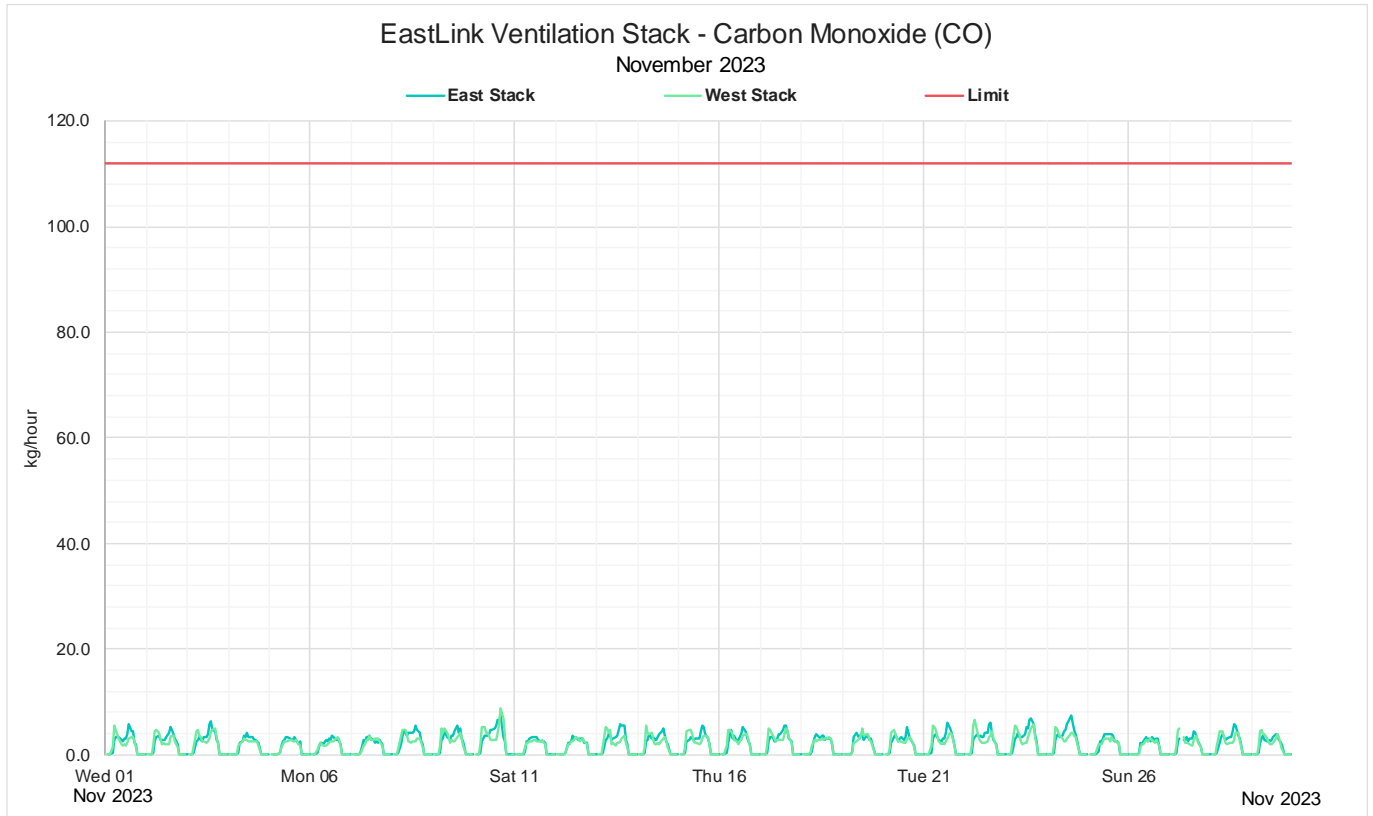


Figure 11: Monthly 1-hour mass rate CO

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

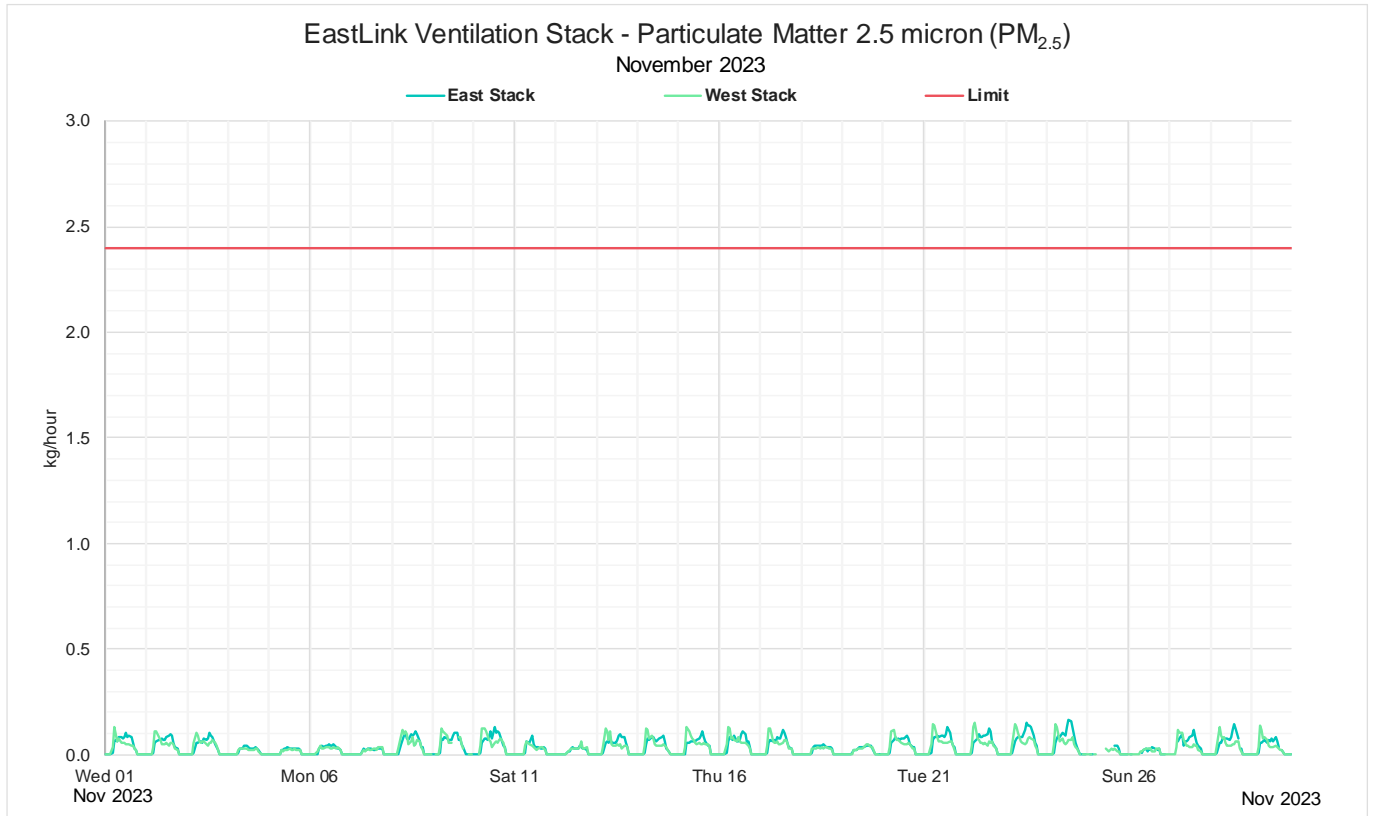


Figure 12: Monthly 1-hour mass rate PM_{2.5}

6.2.4.5 - Monthly 1-hour mass rate PM₁₀

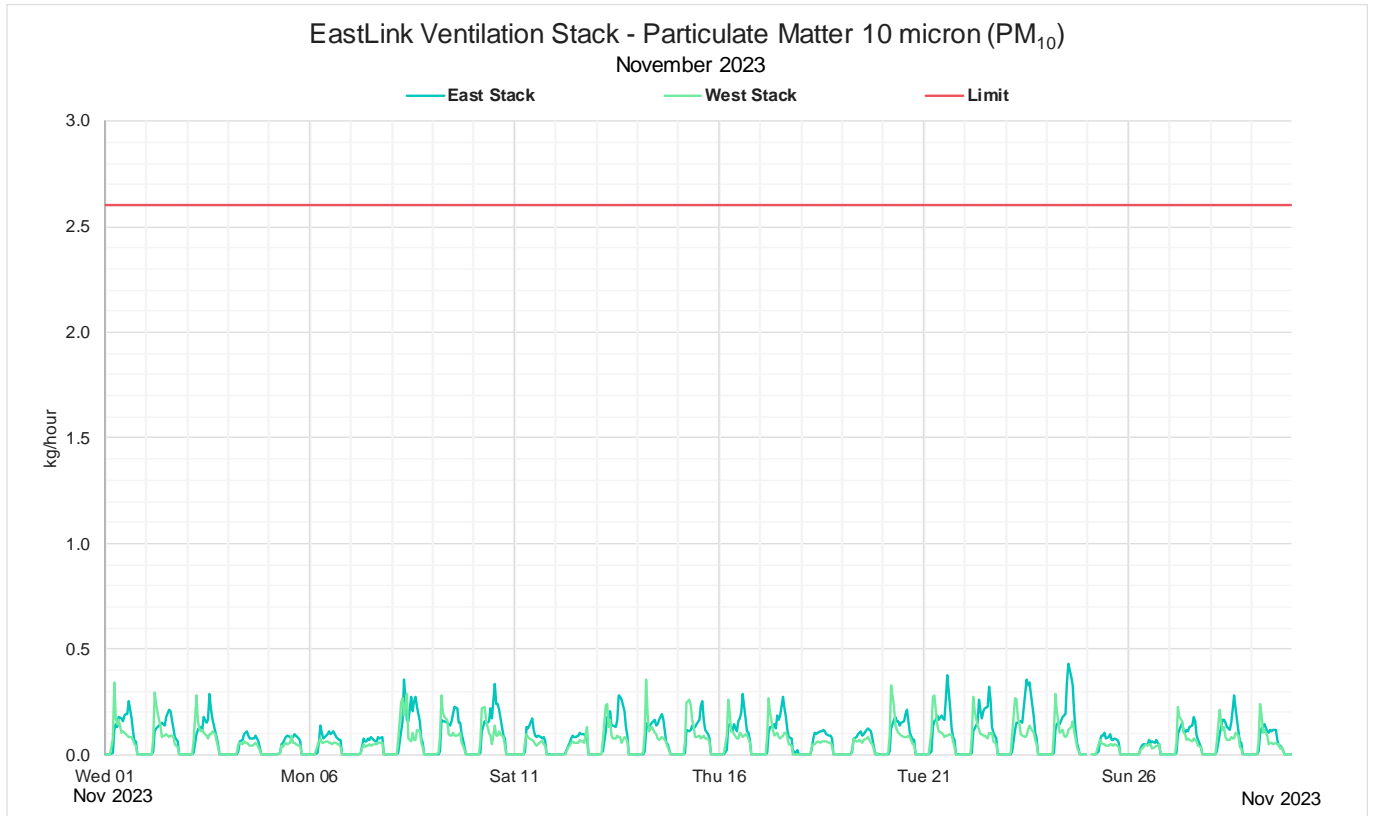


Figure 13: Monthly 1-hour mass rate PM₁₀

6.2.4.6 - Monthly 1-hour average stack velocity

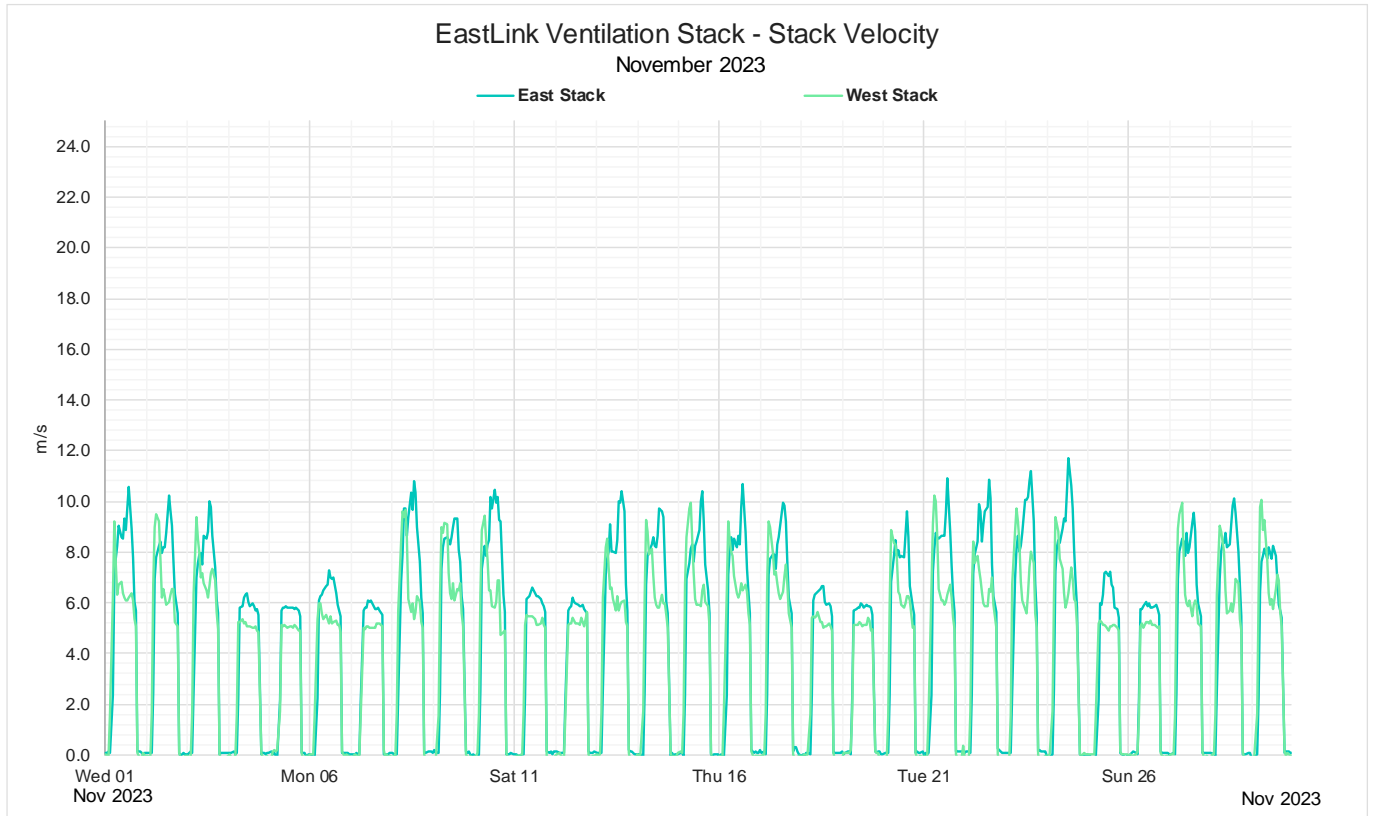


Figure 14: Monthly 1-hour average stack velocity

6.2.4.7 - Monthly 1-hour average stack temperature

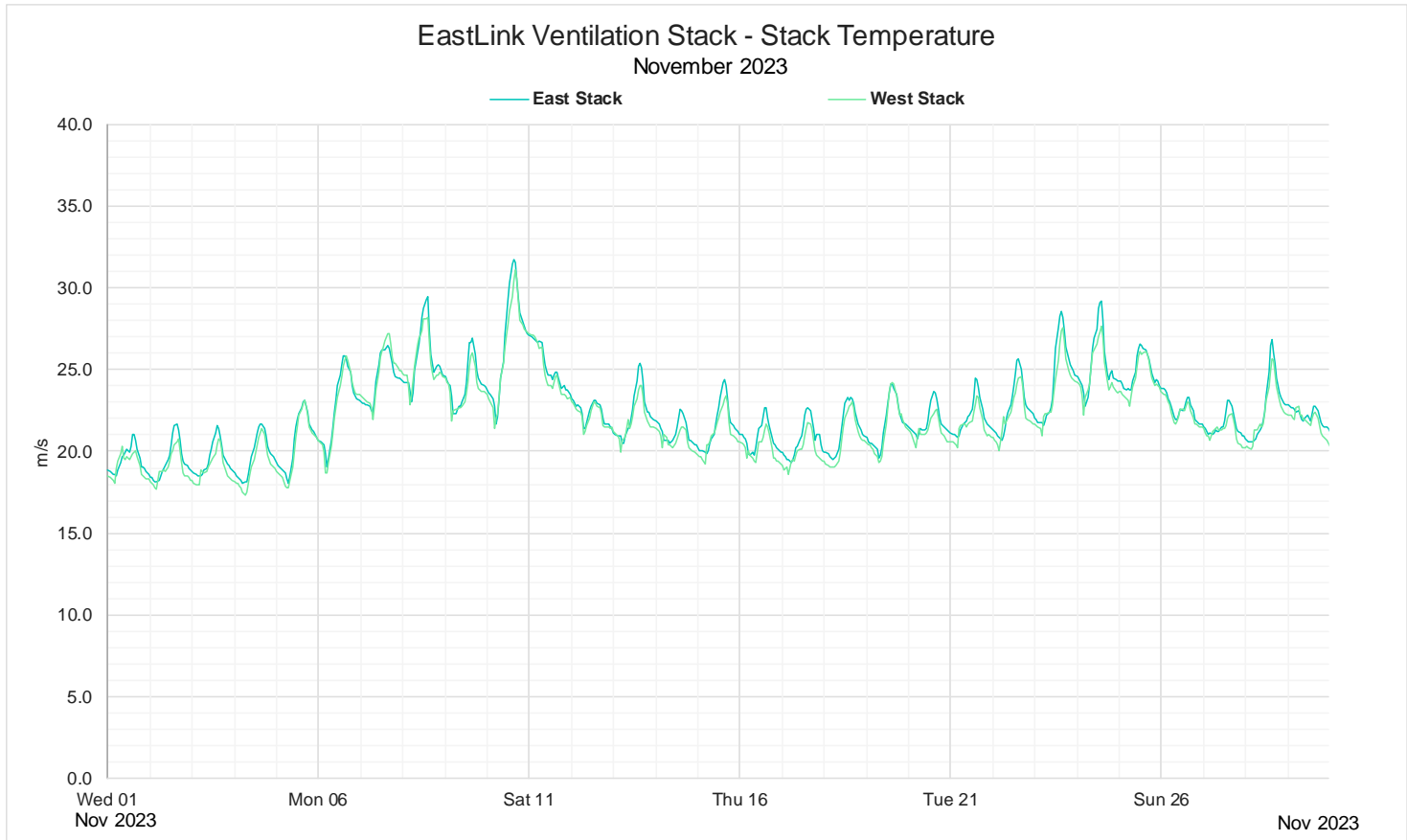


Figure 15: Monthly 1-hour average stack temperature

6.2.5 Data Validation Table

Data validation details for the ventilation stack parameters are provided in the Table 23 and Table 24 below.

6.2.5.1 - Western Ventilation Stack

Eastlink Tunnel Western Ventilation Stack Data Validation November 2023						
Start Date	End Date	Parameters	Reason	Hours affected	User Name	Change Date
1/11/2023 0:01	27/11/2023 6:59	CO	Static offset of +0.1 ppm applied to data	N/A	DL	15/01/2024
1/11/2023 0:01	1/12/2023 0:00	NO ₂ , NO _x	Static offset of +0.029 ppm applied to NO ₂ data. NO _x data corrected accordingly	N/A	DL	15/01/2024
1/11/2023 0:51	30/11/2023 23:56	PM _{2.5} , PM ₁₀	Intermittent unrealistic data - negative	N/A	DL	15/01/2024
2/11/2023 18:41	2/11/2023 18:42	Stack Velocity	Unrealistic data spike	0.0	DL	15/01/2024
8/11/2023 23:57	9/11/2023 1:28	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.5	DL	15/01/2024
9/11/2023 12:43	9/11/2023 13:37	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.9	DL	15/01/2024
9/11/2023 14:29	9/11/2023 15:09	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.7	DL	15/01/2024
9/11/2023 19:07	9/11/2023 20:28	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.4	DL	15/01/2024
10/11/2023 0:13	10/11/2023 1:03	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.8	DL	15/01/2024
10/11/2023 1:17	10/11/2023 2:31	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.2	DL	15/01/2024
18/11/2023 0:52	18/11/2023 0:53	Stack Velocity	Unrealistic data spike	0.0	DL	15/01/2024
24/11/2023 1:45	27/11/2023 6:58	NO, NO ₂	Linear multiplier applied to data: A = 1.078 B = 1.092 NO ₂ data corrected accordingly	N/A	DL	15/01/2024
24/11/2023 1:45	27/11/2023 6:58	NO ₂ , NO _x	Linear multiplier applied to data: A = 1.084 B = 1.097 NO ₂ data corrected accordingly	N/A	DL	15/01/2024
24/11/2023 20:08	24/11/2023 20:32	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.4	DL	15/01/2024
25/11/2023 6:05	25/11/2023 6:14	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.2	DL	15/01/2024
25/11/2023 6:23	25/11/2023 6:41	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.3	DL	15/01/2024
25/11/2023 6:50	25/11/2023 6:59	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.2	DL	15/01/2024
25/11/2023 8:44	25/11/2023 8:54	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.2	DL	15/01/2024
25/11/2023 9:25	25/11/2023 9:34	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.1	DL	15/01/2024

Eastlink Tunnel Western Ventilation Stack Data Validation November 2023						
Start Date	End Date	Parameters	Reason	Hours affected	User Name	Change Date
25/11/2023 10:12	25/11/2023 10:21	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.1	DL	15/01/2024
27/11/2023 6:59	27/11/2023 7:32	NO, NO ₂ , NO _x , CO	Scheduled Monthly Maintenance	0.5	DL	15/01/2024

Table 23: Western Ventilation Stack data validation

6.2.5.2 - Eastern Ventilation Stack

Eastlink Tunnel Eastern Ventilation Stack Data Validation November 2023						
Start Date	End Date	Parameters	Reason	Hours affected	User Name	Change Date
25/10/2023 7:58	27/11/2023 7:35	CO	Linear offset applied to data: A = +0.3 ppm B = +0.1 ppm	N/A	DL	15/01/2024
6/11/2023 8:42	30/11/2023 11:50	PM _{2.5} , PM ₁₀	Intermittent unrealistic data - negative	N/A	DL	15/01/2024
25/11/2023 0:05	25/11/2023 0:37	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.5	DL	15/01/2024
25/11/2023 4:03	25/11/2023 6:04	PM _{2.5}	Instrument fault	2.0	DL	15/01/2024
25/11/2023 6:09	25/11/2023 6:13	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.1	DL	15/01/2024
25/11/2023 6:13	25/11/2023 8:45	PM _{2.5}	Instrument fault	2.5	DL	15/01/2024
25/11/2023 9:15	25/11/2023 9:25	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.2	DL	15/01/2024
25/11/2023 9:57	25/11/2023 13:00	PM _{2.5}	Instrument fault	3.0	DL	15/01/2024
25/11/2023 13:40	25/11/2023 15:40	PM _{2.5}	Instrument fault	2.0	DL	15/01/2024
26/11/2023 0:32	26/11/2023 1:10	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.6	DL	15/01/2024
26/11/2023 3:19	26/11/2023 3:47	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.5	DL	15/01/2024
26/11/2023 4:04	26/11/2023 5:13	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.2	DL	15/01/2024
26/11/2023 7:26	26/11/2023 7:42	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.3	DL	15/01/2024
26/11/2023 10:36	26/11/2023 10:48	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.2	DL	15/01/2024
26/11/2023 16:01	26/11/2023 16:15	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.2	DL	15/01/2024
26/11/2023 22:00	26/11/2023 23:53	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.9	DL	15/01/2024
27/11/2023 1:06	27/11/2023 3:36	PM _{2.5}	Instrument fault	2.5	DL	15/01/2024
27/11/2023 4:15	27/11/2023 4:38	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.4	DL	15/01/2024

Eastlink Tunnel Eastern Ventilation Stack Data Validation November 2023						
Start Date	End Date	Parameters	Reason	Hours affected	User Name	Change Date
27/11/2023 5:15	27/11/2023 5:15	All parameters	Data transmission error	0.0	DL	15/01/2024
27/11/2023 7:36	27/11/2023 8:13	NO, NO ₂ , NO _x , CO, PM _{2.5}	Scheduled Monthly Maintenance	0.6	DL	15/01/2024
27/11/2023 8:14	1/12/2023 0:00	CO	Static offset of +0.3 ppm applied to data	N/A	DL	15/01/2024
28/11/2023 17:23	28/11/2023 17:57	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.6	DL	15/01/2024
29/11/2023 16:48	29/11/2023 17:00	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.2	DL	15/01/2024

Table 24: Eastern Ventilation Stack data validation

6.3

6.3.1 Data Availability

Data availability for the in the ventilation stack parameters are provided in Table 25 below. For further information on data availability please refer to section 6.2.5

EastLink Ventilation Stack Data Availability December 2023								
Station		NO	NO ₂	CO	PM _{2.5}	PM ₁₀	Stack Velocity	Stack Temp.
Western	Data Availability	92.1%	92.1%	94.8%	88.2%	98.5%	99.6%	99.5%
	Collected Periods	685.0	685.0	705.0	656.0	733.0	741.0	740.0
	Available Periods	744.0	744.0	744.0	744.0	744.0	744.0	744.0
Eastern	Data Availability	87.4%	87.4%	93.4%	84.4%	96.2%	97.7%	98.0%
	Collected Periods	650	650	695	628	716	727	729
	Available Periods	744	744	744	744	744	744	744

Table 25: ventilation stack data availability

6.3.2 Exceedances

Instances of the ventilation stack pollutants exceeding the EPA Limits goals during the reporting period are presented in Table 26 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 December 2023								
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	0.37	-	-	-
	CO	1-hour	112	kg/h	6.30	-	-	-
	PM _{2.5}	1-hour	2.4	kg/h	0.2	-	-	-
	PM ₁₀	1-hour	2.6	kg/h	0.3	-	-	-
Eastern Ventilation Stack (Discharge Point 2)	NO ₂	1-hour	3.98	kg/h	0.62	-	-	-
	CO	1-hour	112	kg/h	7.93	-	-	-
	PM _{2.5}	1-hour	2.4	kg/h	0.2	-	-	-
	PM ₁₀	1-hour	2.6	kg/h	0.4	-	-	-

Table 26: Exceedances of EPA Goals

6.3.3 Tabulated Results

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

Table 27 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 December 2023								
Location	Parameter	Maximum	99 th	98 th	95 th	90 th	75 th	50 th
			Percentile	Percentile	Percentile	Percentile	Percentile	Percentile
Western Ventilation Stack	NO (kg/h)	2.79	2.39	2.03	1.48	1.09	0.75	0.34
	NO ₂ (kg/h)	0.37	0.23	0.21	0.15	0.13	0.09	0.05
	CO (kg/h)	6.30	5.22	5.02	4.38	3.61	2.72	1.96
	PM _{2.5} (kg/h)	0.2	0.1	0.1	0.1	0.1	0.0	0.0
	PM ₁₀ (kg/h)	0.3	0.2	0.2	0.1	0.1	0.1	0.0
Eastern Ventilation Stack	NO (kg/h)	3.09	2.54	2.38	2.06	1.73	0.87	0.43
	NO ₂ (kg/h)	0.62	0.52	0.46	0.38	0.30	0.17	0.09
	CO (kg/h)	7.93	6.57	6.25	5.24	4.15	3.29	2.18
	PM _{2.5} (kg/h)	0.2	0.1	0.1	0.1	0.1	0.1	0.0
	PM ₁₀ (kg/h)	0.4	0.3	0.3	0.2	0.2	0.1	0.1

Table 27: Summary of 1-hour mass rate pollutant data

6.3.4 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.

6.3.4.1 - Monthly 1-hour mass rate NO₂

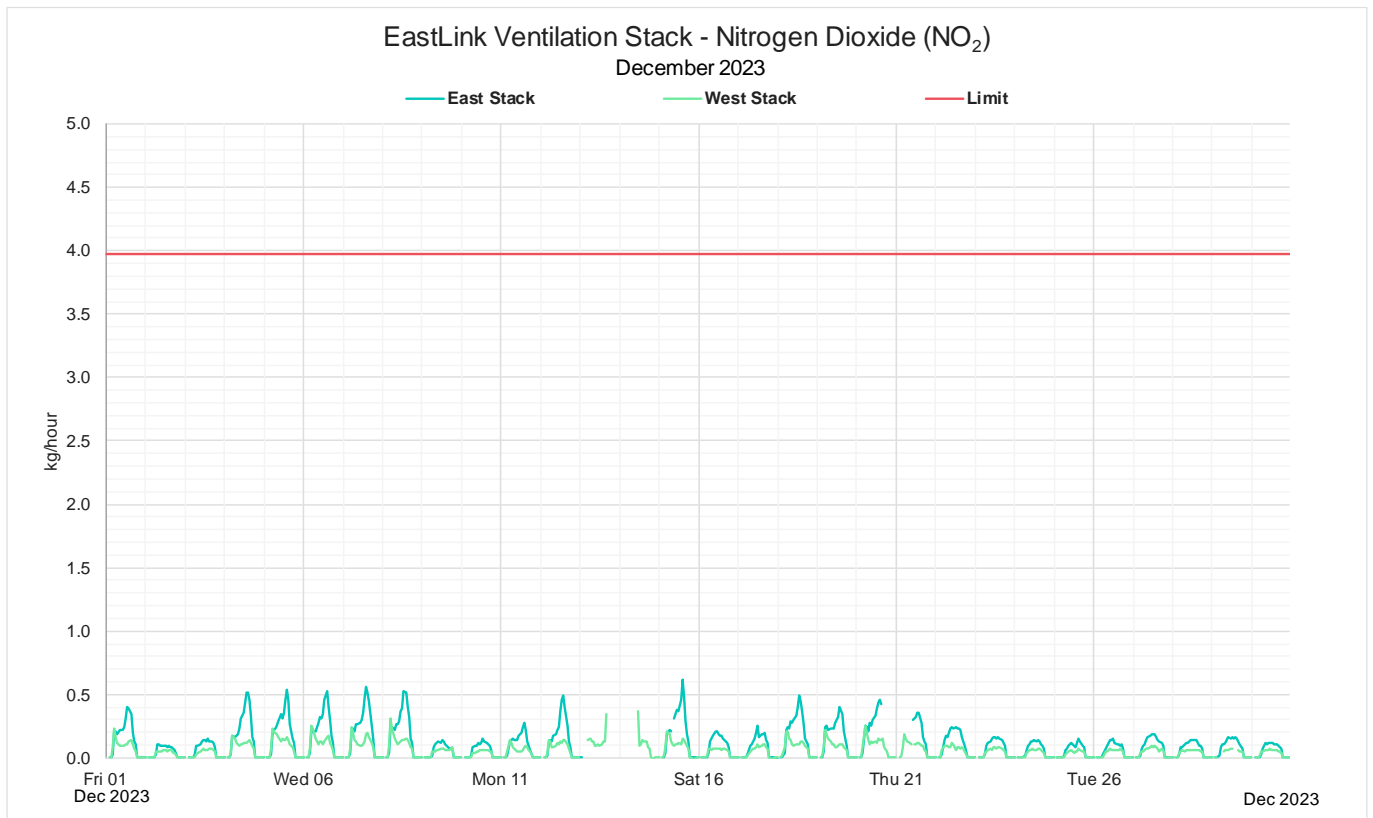


Figure 16: Monthly 1-hour mass rate NO₂

6.3.4.2 - Monthly 1-hour mass rate NO

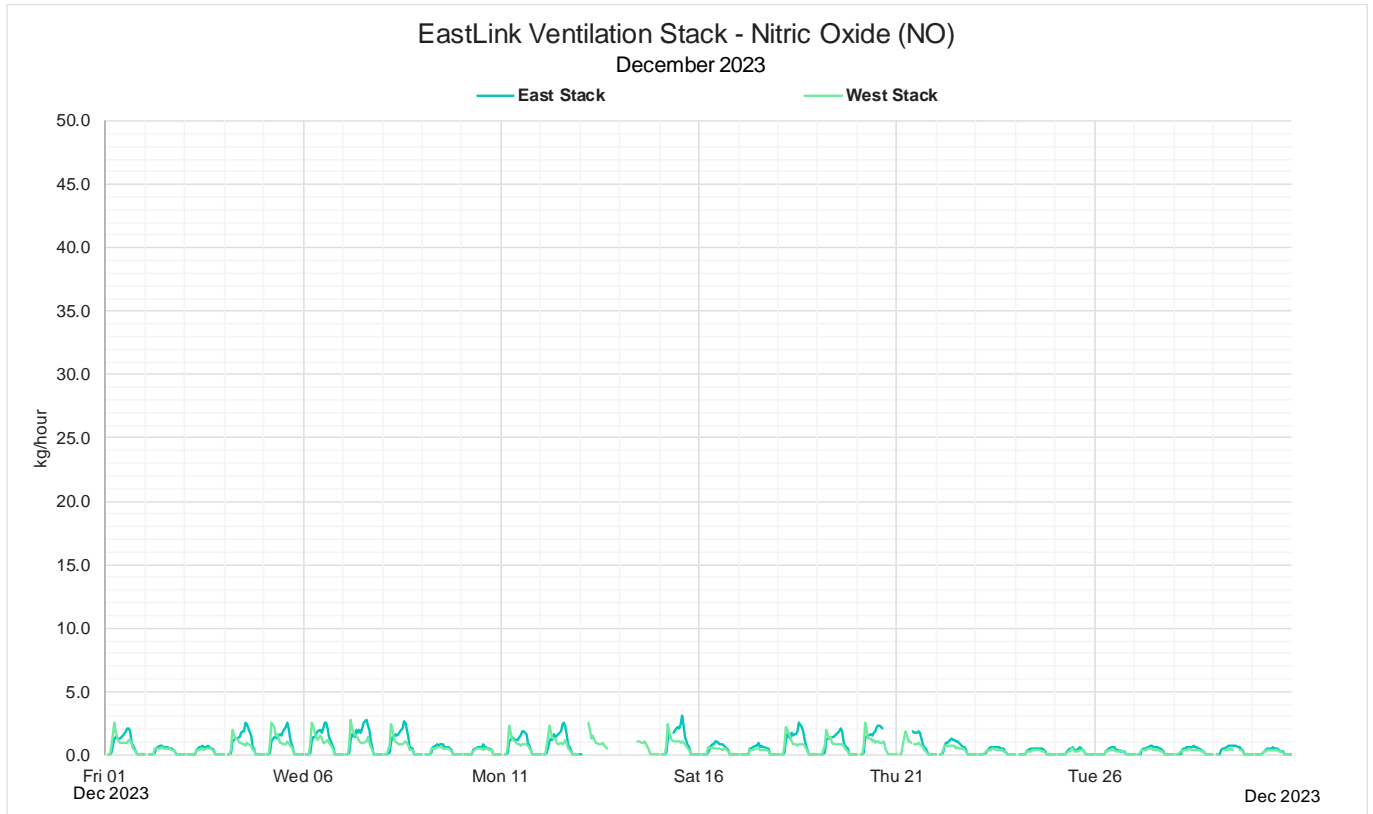


Figure 17: Monthly 1-hour mass rate NO

6.3.4.3 - Monthly 1-hour mass rate CO

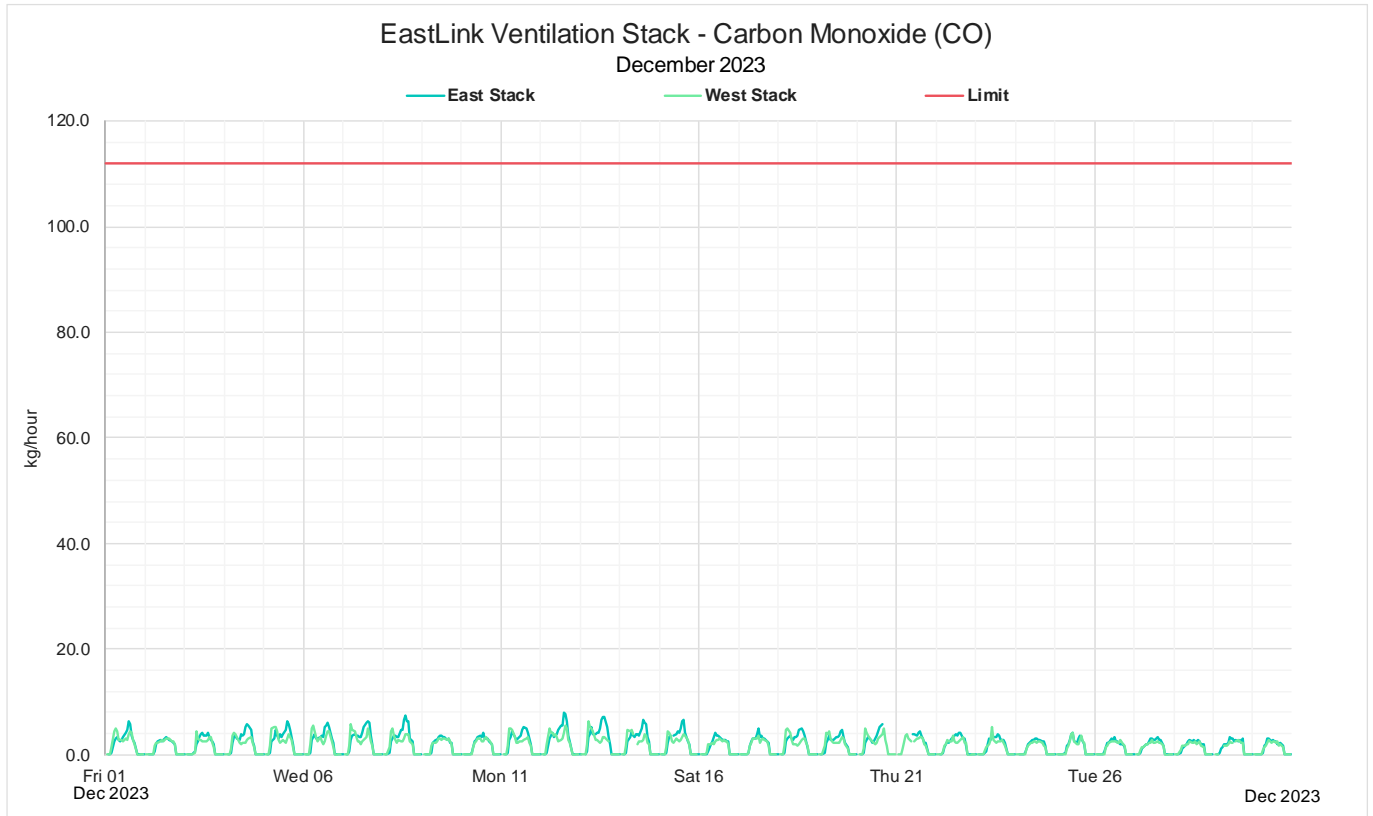


Figure 18: Monthly 1-hour mass rate CO

6.3.4.4 - Monthly 1-hour mass rate PM_{2.5}

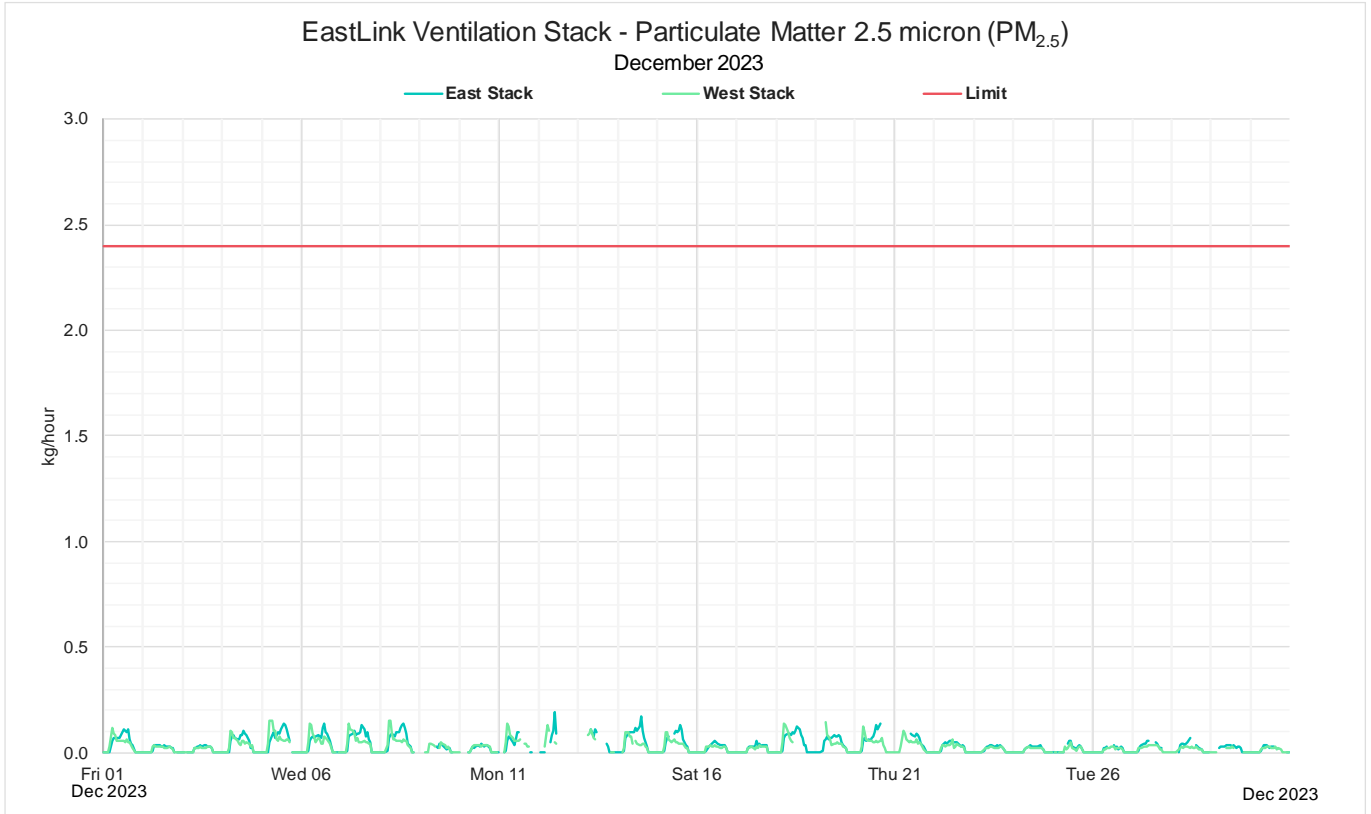


Figure 19: Monthly 1-hour mass rate PM_{2.5}

6.3.4.5 - Monthly 1-hour mass rate PM₁₀

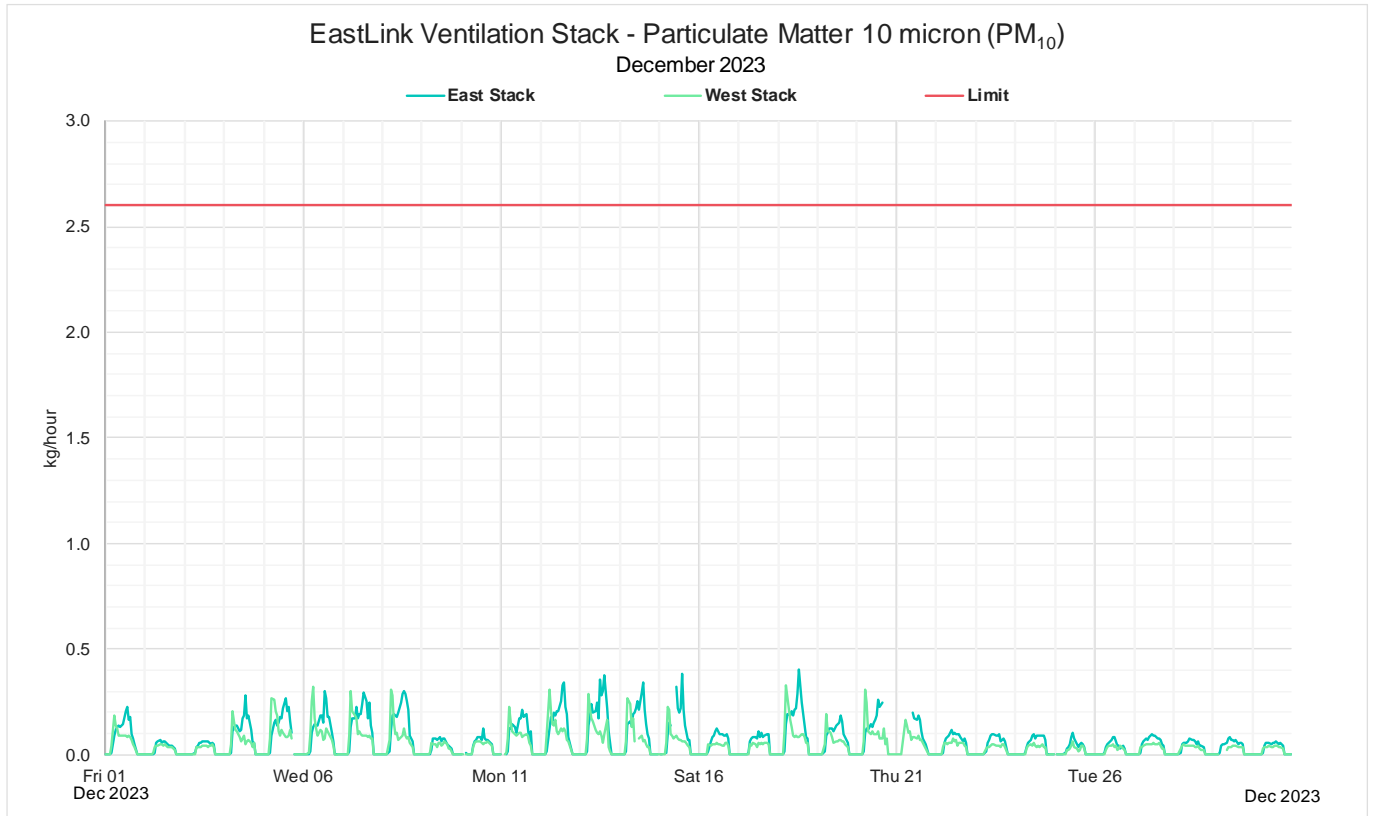


Figure 20: Monthly 1-hour mass rate PM₁₀

6.3.4.6 - Monthly 1-hour average stack velocity

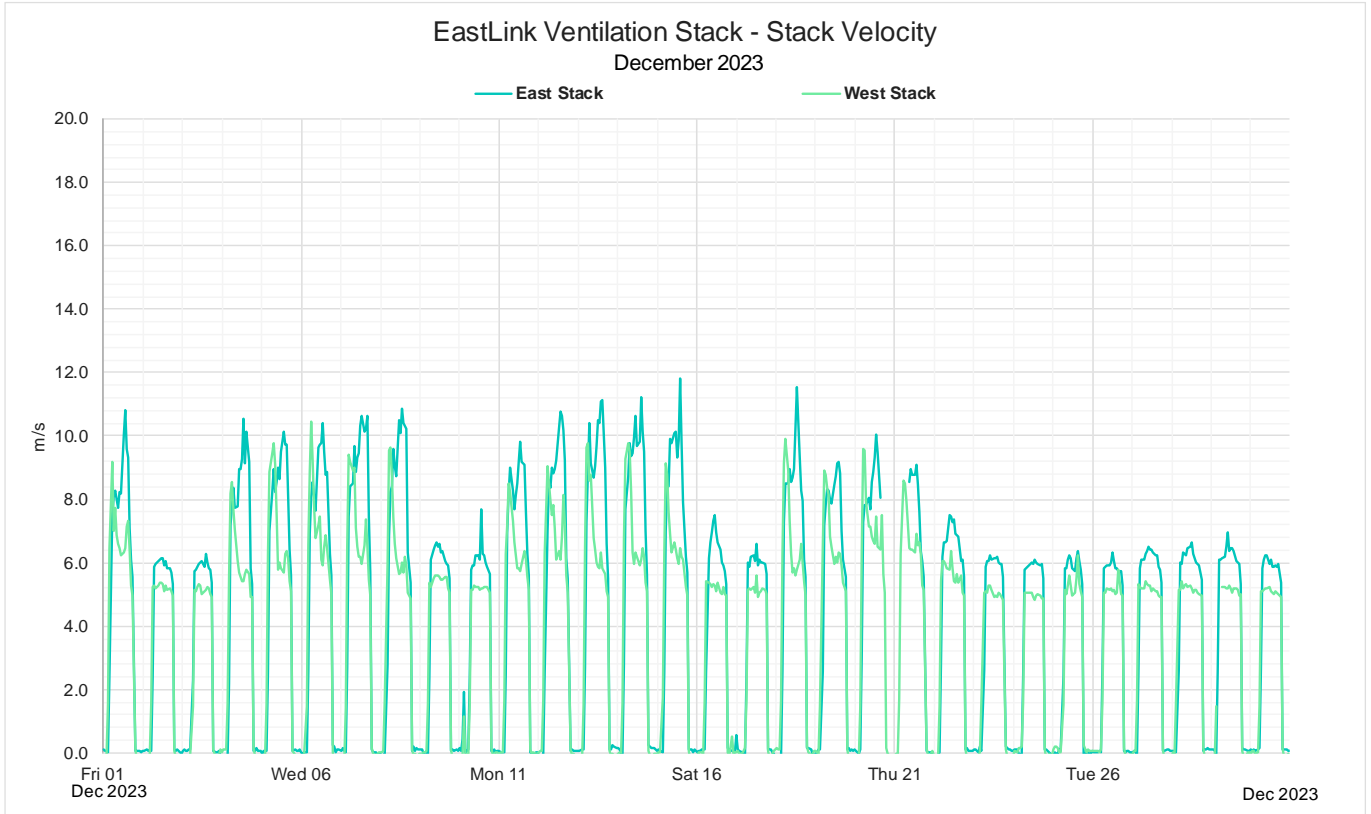


Figure 21: Monthly 1-hour average stack velocity

6.3.4.7 - Monthly 1-hour average stack temperature

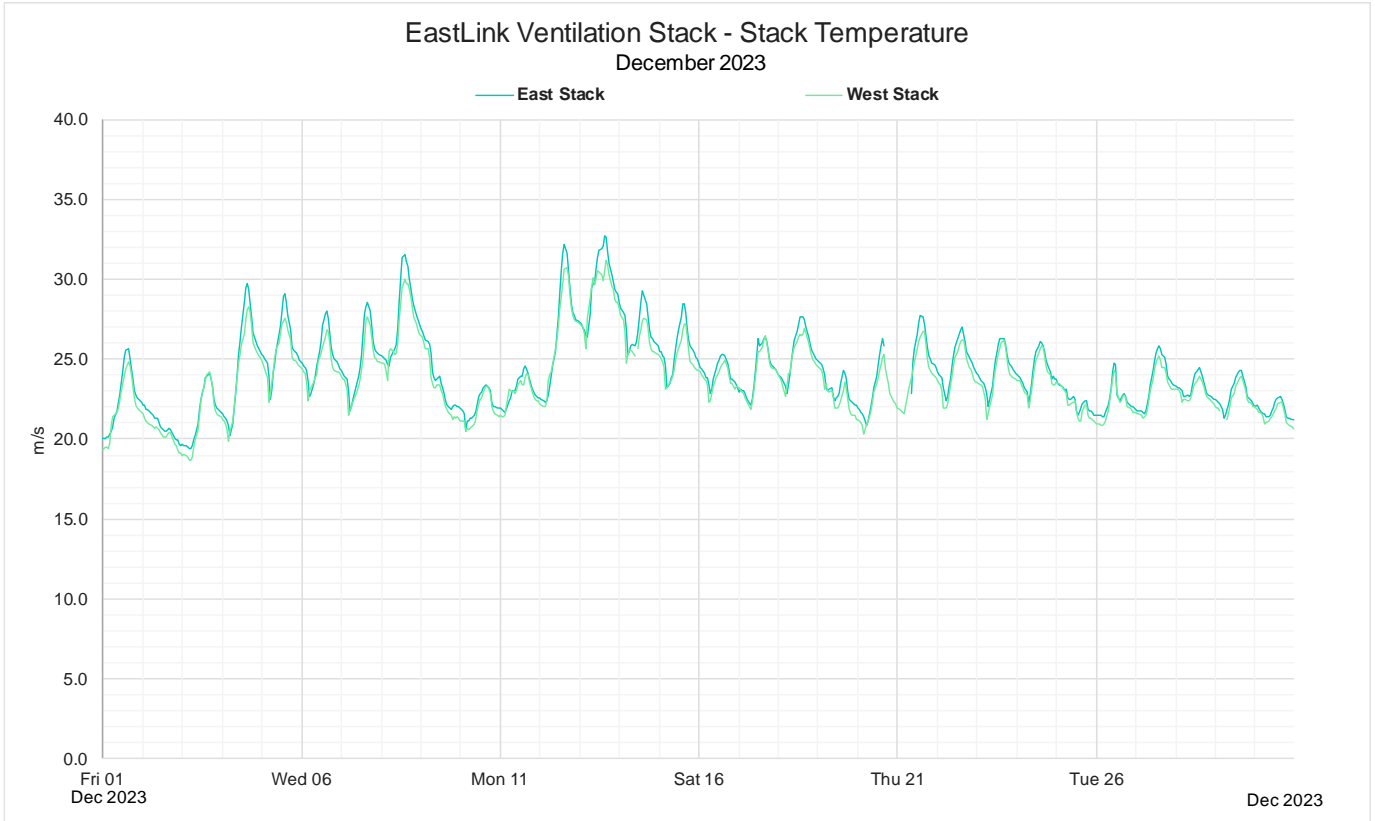


Figure 22: Monthly 1-hour average stack temperature

6.3.5 Data Validation Table

Data validation details for the ventilation stack parameters are provided in the Table 28 and Table 29 below.

6.3.5.1 - Western Ventilation Stack

Eastlink Tunnel Western Ventilation Stack Data Validation December 2023						
Start Date	End Date	Parameters	Reason	Hours affected	User Name	Change Date
1/12/2023 0:01	13/12/2023 17:57	NO ₂ , NO _x	Static offset of +0.029 ppm applied to NO ₂ data. NO _x data corrected accordingly	N/A	DL	15/01/2024
1/12/2023 1:18	30/12/2023 1:05	PM _{2.5} , PM ₁₀	Intermittent unrealistic data - negative	N/A	DL	15/01/2024
9/12/2023 10:43	9/12/2023 12:11	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.5	DL	15/01/2024
11/12/2023 14:10	11/12/2023 14:41	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.5	DL	15/01/2024
11/12/2023 19:17	11/12/2023 20:21	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.1	DL	15/01/2024
11/12/2023 22:23	11/12/2023 23:14	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.8	DL	15/01/2024
12/12/2023 0:42	12/12/2023 1:47	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.1	DL	15/01/2024
12/12/2023 2:48	12/12/2023 3:43	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.9	DL	15/01/2024
12/12/2023 7:33	12/12/2023 8:01	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.5	DL	15/01/2024
12/12/2023 8:16	12/12/2023 8:36	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.3	DL	15/01/2024
12/12/2023 9:06	12/12/2023 9:28	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.4	DL	15/01/2024
12/12/2023 11:54	12/12/2023 13:49	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.9	DL	15/01/2024
12/12/2023 14:05	12/12/2023 15:49	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.7	DL	15/01/2024
12/12/2023 16:45	12/12/2023 18:34	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.8	DL	15/01/2024
12/12/2023 20:12	12/12/2023 23:48	PM _{2.5}	Instrument fault	3.6	DL	15/01/2024
13/12/2023 0:07	13/12/2023 4:18	NO, NO ₂ , NO _x	Instrument fault	4.2	DL	15/01/2024
13/12/2023 1:11	13/12/2023 6:01	PM _{2.5}	Instrument fault	4.8	DL	15/01/2024
13/12/2023 11:37	13/12/2023 12:35	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.0	DL	15/01/2024
13/12/2023 12:45	13/12/2023 13:14	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.5	DL	15/01/2024
13/12/2023 13:24	13/12/2023 16:22	PM _{2.5}	Instrument fault	3.0	DL	15/01/2024

Eastlink Tunnel Western Ventilation Stack Data Validation December 2023						
Start Date	End Date	Parameters	Reason	Hours affected	User Name	Change Date
13/12/2023 16:32	13/12/2023 16:50	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.3	DL	15/01/2024
13/12/2023 16:51	13/12/2023 17:57	PM _{2.5}	Instrument offline	1.1	DL	15/01/2024
13/12/2023 17:58	13/12/2023 18:41	Stack Temp, PM _{2.5} , CO, NO, NO ₂ , NO _x	Unscheduled Maintenance	0.7	DL	15/01/2024
13/12/2023 18:31	14/12/2023 8:37	NO, NO ₂ , NO _x	Instrument removed for repair	14.1	DL	15/01/2024
14/12/2023 8:38	14/12/2023 11:43	Stack Temp, PM _{2.5} , PM ₁₀ , CO, NO, NO ₂	Scheduled 6 Monthly Maintenance	3.1	DL	15/01/2024
14/12/2023 10:53	21/12/2023 10:09	NO, NO ₂	Linear multiplier applied to data: A = 0.994 B = 1.078 NO ₂ data corrected accordingly	N/A	DL	15/01/2024
14/12/2023 10:53	21/12/2023 10:09	NO ₂ , NO _x	Linear multiplier applied to data: A = 0.988 B = 1.073 NO ₂ data corrected accordingly	N/A	DL	15/01/2024
18/12/2023 22:12	19/12/2023 5:16	PM _{2.5}	Instrument fault	7.1	DL	15/01/2024
21/12/2023 10:10	21/12/2023 10:43	CO, NO, NO ₂ , NO _x	Unscheduled Maintenance	0.6	DL	15/01/2024
21/12/2023 10:44	29/12/2023 13:14	NO, NO ₂	Linear multiplier applied to data: A = 0.987 B = 1.057 NO ₂ data corrected accordingly	N/A	DL	15/01/2024
21/12/2023 10:44	29/12/2023 13:14	NO ₂ , NO _x	Linear multiplier applied to data: A = 0.989 B = 1.062 NO ₂ data corrected accordingly	N/A	DL	15/01/2024
29/12/2023 4:11	29/12/2023 7:04	Stack Velocity, Stack Temp, PM _{2.5} , PM ₁₀	Instrument offline	2.9	DL	15/01/2024
29/12/2023 7:05	29/12/2023 8:32	Stack Velocity, Stack Temp, PM _{2.5} , PM ₁₀	Unscheduled Maintenance	1.5	DL	15/01/2024
29/12/2023 13:15	29/12/2023 15:28	CO, NO, NO ₂ , NO _x	Unscheduled Maintenance	2.2	DL	15/01/2024
29/12/2023 15:23	29/12/2023 19:29	PM _{2.5}	Instrument offline	4.1	DL	15/01/2024
29/12/2023 19:30	29/12/2023 19:55	PM _{2.5}	Unscheduled Maintenance	0.4	DL	15/01/2024
29/12/2023 19:56	29/12/2023 20:01	PM _{2.5}	Instrument warmup after maintenance	0.1	DL	15/01/2024

Table 28: Western Ventilation Stack data validation

6.3.5.2 - Eastern Ventilation Stack

Eastlink Tunnel Eastern Ventilation Stack Data Validation December 2023						
Start Date	End Date	Parameters	Reason	Hours affected	User Name	Change Date
1/12/2023 0:01	15/12/2023 8:09	CO	Static offset of +0.3 ppm applied to data	N/A	DL	15/01/2024
1/12/2023 3:22	26/12/2023 1:49	PM _{2.5} , PM ₁₀	Intermittent unrealistic data - negative	N/A	DL	15/01/2024
2/12/2023 19:47	2/12/2023 20:05	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.3	DL	15/01/2024
8/12/2023 22:08	8/12/2023 22:19	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.2	DL	15/01/2024
8/12/2023 23:22	8/12/2023 23:34	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.2	DL	15/01/2024
8/12/2023 23:54	9/12/2023 1:12	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.3	DL	15/01/2024
9/12/2023 3:10	9/12/2023 4:00	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.8	DL	15/01/2024
9/12/2023 4:24	9/12/2023 6:38	PM _{2.5}	Instrument fault	2.2	DL	15/01/2024
9/12/2023 7:48	9/12/2023 9:00	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.2	DL	15/01/2024
9/12/2023 9:01	9/12/2023 10:06	PM _{2.5}	Unscheduled Maintenance	1.1	DL	15/01/2024
9/12/2023 13:38	9/12/2023 14:13	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.6	DL	15/01/2024
11/12/2023 13:28	11/12/2023 14:48	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.3	DL	15/01/2024
11/12/2023 16:42	11/12/2023 18:05	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.4	DL	15/01/2024
11/12/2023 20:34	11/12/2023 20:47	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.2	DL	15/01/2024
11/12/2023 21:27	12/12/2023 0:28	PM _{2.5}	Instrument fault	3.0	DL	15/01/2024
12/12/2023 0:48	12/12/2023 0:53	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.1	DL	15/01/2024
12/12/2023 2:20	12/12/2023 2:26	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.1	DL	15/01/2024
12/12/2023 3:51	12/12/2023 3:56	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.1	DL	15/01/2024
12/12/2023 4:42	12/12/2023 4:44	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.0	DL	15/01/2024
12/12/2023 5:23	12/12/2023 6:18	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.9	DL	15/01/2024
12/12/2023 11:48	12/12/2023 13:16	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.5	DL	15/01/2024
12/12/2023 13:47	12/12/2023 15:14	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.5	DL	15/01/2024
12/12/2023 16:06	13/12/2023 2:09	PM _{2.5}	Instrument fault	10.1	DL	15/01/2024

Eastlink Tunnel Eastern Ventilation Stack Data Validation December 2023						
Start Date	End Date	Parameters	Reason	Hours affected	User Name	Change Date
13/12/2023 1:33	13/12/2023 1:34	All parameters	Data transmission error	0.0	DL	15/01/2024
13/12/2023 2:46	15/12/2023 1:33	NO, NO ₂ , NO _x	Calibration out of tolerance	46.8	DL	15/01/2024
13/12/2023 3:47	13/12/2023 4:04	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.3	DL	15/01/2024
13/12/2023 4:27	13/12/2023 4:31	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.1	DL	15/01/2024
13/12/2023 4:38	13/12/2023 7:46	PM _{2.5}	Instrument fault	3.1	DL	15/01/2024
13/12/2023 8:12	13/12/2023 8:18	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.1	DL	15/01/2024
13/12/2023 12:40	13/12/2023 14:12	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.5	DL	15/01/2024
13/12/2023 15:28	13/12/2023 16:54	PM _{2.5}	Unscheduled Maintenance	1.4	DL	15/01/2024
15/12/2023 8:10	15/12/2023 9:55	NO, NO ₂ , NO _x , CO, PM ₁₀ , PM _{2.5} , Stack Temp	Scheduled 6 Monthly Maintenance	1.7	DL	15/01/2024
15/12/2023 9:16	20/12/2023 16:42	CO	Linear offset applied to data: A = +0.2 ppm B = +0.3 ppm	N/A	DL	15/01/2024
20/12/2023 16:08	20/12/2023 16:42	PM _{2.5} , PM ₁₀	Instrument fault	0.6	DL	15/01/2024
20/12/2023 16:43	20/12/2023 17:49	All parameters	Power interruption due to aircon failure	1.1	DL	15/01/2024
20/12/2023 17:50	20/12/2023 19:00	All parameters	Unscheduled Maintenance	1.2	DL	15/01/2024
20/12/2023 19:01	21/12/2023 8:50	All parameters	Instrument remained offline	13.8	DL	15/01/2024
21/12/2023 8:51	21/12/2023 10:09	All parameters	Unscheduled Maintenance	1.3	DL	15/01/2024
21/12/2023 9:51	29/12/2023 18:48	CO	Linear offset applied to data: A = +0.2 ppm B = +0.4 ppm	N/A	DL	15/01/2024
25/12/2023 7:31	25/12/2023 8:39	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.1	DL	15/01/2024
26/12/2023 10:35	26/12/2023 13:13	PM _{2.5}	Instrument fault	2.6	DL	15/01/2024
27/12/2023 10:58	27/12/2023 11:56	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.0	DL	15/01/2024
27/12/2023 13:24	27/12/2023 14:04	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.7	DL	15/01/2024
27/12/2023 19:23	28/12/2023 3:52	PM _{2.5}	Instrument fault	8.5	DL	15/01/2024
28/12/2023 11:54	28/12/2023 11:59	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.1	DL	15/01/2024
28/12/2023 12:14	28/12/2023 12:52	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.6	DL	15/01/2024

Eastlink Tunnel Eastern Ventilation Stack Data Validation December 2023						
Start Date	End Date	Parameters	Reason	Hours affected	User Name	Change Date
28/12/2023 13:32	28/12/2023 14:26	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	0.9	DL	15/01/2024
29/12/2023 0:00	29/12/2023 1:55	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.9	DL	15/01/2024
29/12/2023 2:25	29/12/2023 4:28	PM _{2.5}	Instrument fault	2.1	DL	15/01/2024
29/12/2023 18:49	29/12/2023 18:56	All parameters	Unscheduled Maintenance	0.1	DL	15/01/2024
29/12/2023 18:50	1/01/2024 0:00	CO	Static offset of +0.3 ppm applied to data	N/A	DL	15/01/2024
30/12/2023 15:14	30/12/2023 18:36	PM _{2.5}	Instrument fault	3.4	DL	15/01/2024
30/12/2023 20:30	30/12/2023 21:55	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.4	DL	15/01/2024
31/12/2023 9:41	31/12/2023 13:37	PM _{2.5}	Instrument fault	3.9	DL	15/01/2024
31/12/2023 18:58	31/12/2023 22:29	PM _{2.5}	Instrument fault	3.5	DL	15/01/2024
31/12/2023 22:35	31/12/2023 23:56	PM _{2.5}	Unrealistic data - PM _{2.5} > PM ₁₀	1.4	DL	15/01/2024

Table 29: Eastern Ventilation Stack data validation

6.4 Data Availability Year to Date

Data availability statistics for year to date () are provided in Table 30 below:

EastLink Ventilation Stack Data Availability January 2023 to December 2023							
Station	NO	NO ₂	CO	PM _{2.5}	PM ₁₀	Stack Velocity	Stack Temp.
Western	94.2%	94.2%	94.4%	96.0%	97.5%	98.8%	98.2%
Eastern	94.2%	94.2%	94.7%	97.1%	97.8%	99.3%	98.7%

Table 30: EastLink Ventilation Stack year to date data availability

6.5 Annual Performance Statement Bubble Limits

The EPA License 2043 Condition LI_DA1 designates 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 (July 2021 to December 2023) are shown in Table 31 below.

EastLink Ventilation Stack Mass Rate July 2023 to December 2023				
Location	NO ₂	CO	PM _{2.5}	PM ₁₀
	Tonnes	Tonnes	Tonnes	Tonnes
Western Ventilation Stack (Discharge Point 1)	0.223	7.039	0.114	0.212
Eastern Ventilation Stack (Discharge Point 2)	0.560	7.432	0.142	0.309
Total	0.783	14.471	0.256	0.521
Percentage of Licence limit	2.2%	1.5%	1.2%	2.3%
Annual Limit (Tonnes)	35	980	21	23

Table 31: Annual Performance Statement stack emission rates

Figure 23 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.

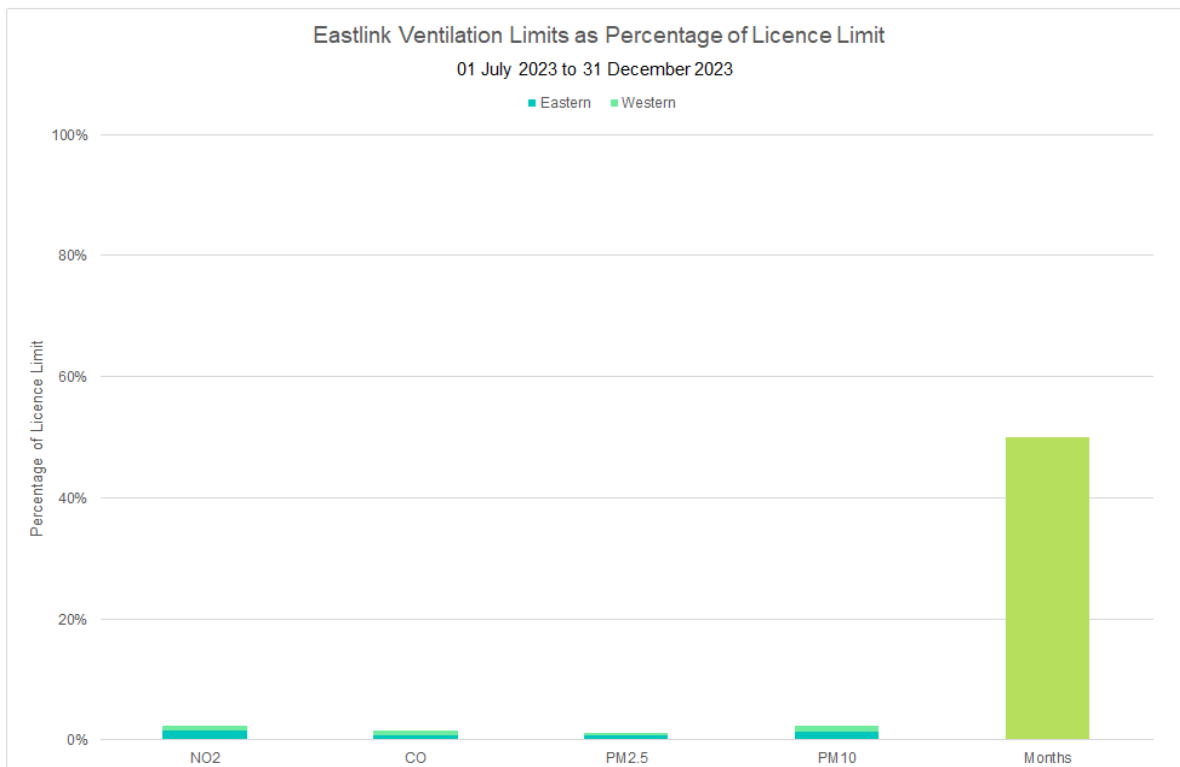


Figure 23: Annual Performance Statement stack emission rates

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.