

Acciona Samsung Bouygues Joint Venture (ASBJV)

WestConnex M4-M5 Link Project

Ambient Air Quality and Weather Monitoring

Validated Report

1st November 2022 – 30th November 2022

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Executive Summary

The WestConnex M4-M5 Link project is being constructed in two stages:

- Stage 1: WCX M4-M5 Link Mainline Tunnels
- Stage 2: Rozelle Interchange.

This Monthly Ambient Air Quality Monitoring Report is specific to Stage 1 of the project, which generally comprises twin mainline motorway tunnels between the M4 at Haberfield and the M8 at St Peters. Each tunnel would be around 7.5 kilometres long and would generally accommodate up to four lanes of traffic in each direction.

WCX M4-M5 Link Mainline tunnels air quality is monitored by hundreds of sensors and measures various pollutants across three main areas:

- Ambient air - air quality in the areas around the WCX M4-M5 Link Mainline tunnels
- Ventilation - air quality around the ventilation stacks
- In Tunnel - air quality inside the tunnels and portals (entrances to the tunnel)

This Report details ambient air measurements. It is part of the commitment to the Minister and the community to report air quality measurements in real-time (raw data as the measurements occur) as well as validated reports. It is important to re-publish the data in reports because the raw data needs to be checked and collated by approved air quality experts and 'translated' into a format that is easy to understand and can be interpreted by both experts and laypeople.

This report details results at four external ambient air quality monitoring stations located at Albert Street, Campbell St, Ramsay Street and Wattle Street between 1st November 2022 and 30th November 2022.

Report Summary

Percentage availability for all parameters at the WestConnex M4-M5 Link Ambient Air Quality Monitoring Network was above 95% during the reporting month except for PM_{2.5}, NO, NO₂ and NO_x data capture of Campbell Street station and PM_{2.5}, PM₁₀ and AT 2m data capture of Ramsay Street. Please refer to Table 13, and Tables 19-22 for details.

There were no exceedance of the air quality goals at the WestConnex M4-M5 Link Ambient Air Quality Monitoring Network for the reporting month. Please refer to Tables 14-17 in Section 5.2 – Air Quality Monthly Summary for further information.

There is an ongoing investigation on PM_{2.5} data in Ramsay St. which may need crosschecking the background settings on BAM 1020 and the data may be subject to review.

1.0 Introduction

Acoem Australasia (Ecotech) was commissioned by Acciona Samsung Bouygues Joint Venture (ASBJV) to provide monitoring and data reporting for the WCX M4-M5 Link Project ambient air quality and weather monitoring network, located as detailed in Table 1. Acoem Australasia (Ecotech) commenced data collection in December 2021.

This report presents the available data for November 2022.

The data presented in this report:

- Describes air quality measurements;
- Compares monitoring results;
- Has been quality assured;
- Complies with NATA accreditation requirements, where applicable.

2.0 Monitoring and Data Collection

2.1. Siting Details

The WCX M4-M5 Link Project monitoring network consists of four ambient air quality and weather monitoring stations. The stations' location and siting details are described below.

Table 1: WCX M4-M5 Link Project monitoring sites' locations

Site Name	Geographical Coordinates	Height Above Sea Level (m)
Albert Street	33°54'52.07"S, 151°10'45.07"E	12
Campbell Street	33°54'44.71"S, 151°10'43.76"E	15
Ramsay Street	33°52'26.20"S, 151°8'1.50"E	4
Wattle Street	33°52'32.88"S, 151° 8'2.67"E	16

A siting audit to assess sites for compliance with *AS/NZS 3580.1.1:2016* and *AS/NZS 3580.14:2014* have been completed as follows:

- Albert Street on 21/11/2022
- Campbell Street on 07/07/2022
- Ramsay Street on 08/11/2022
- Wattle Street on 23/11/2022

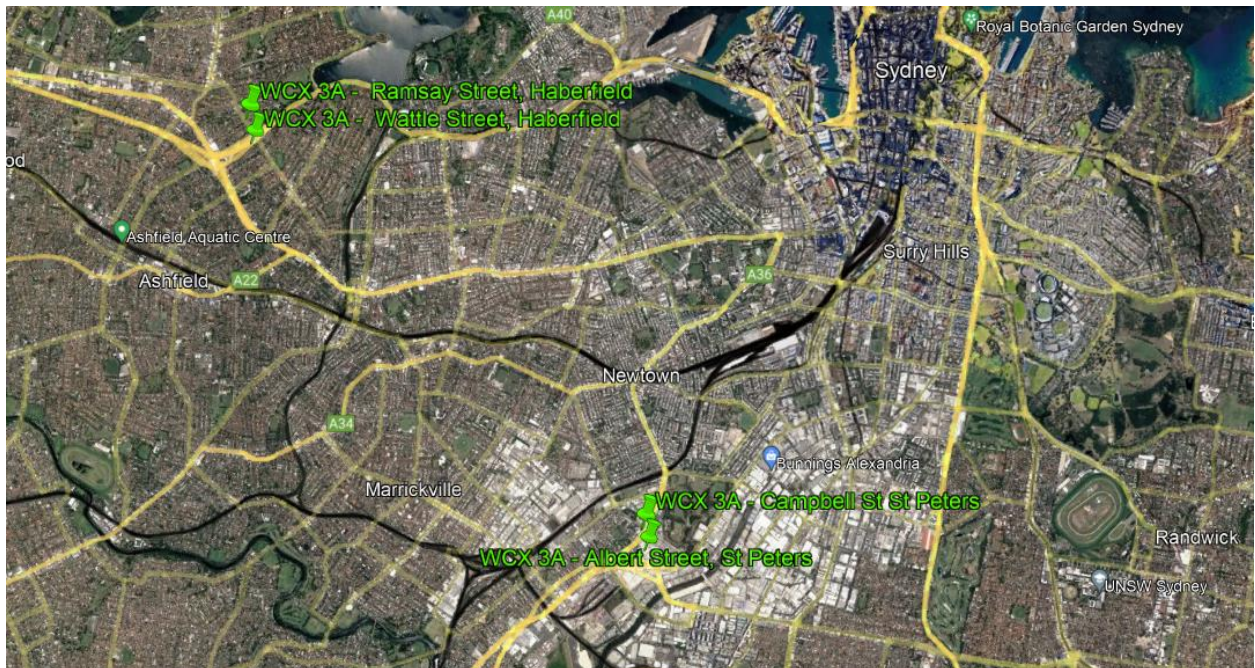


Figure 1: WCX M4-M5 Link Project Monitoring Station Locations

2.2. Monitored Parameters

Tables 2-4 below detail the parameters monitored and the instruments used at the WCX M4-M5 Link Project monitoring stations. Appendix 1 defines any abbreviated parameter names used throughout the report.

Table 2: Parameters measured at the WCX - Albert Street and Wattle Street monitoring stations

Station(s)	Parameter Measured	Instrument and Measurement Technique	Elevation
Albert Street Wattle Street	CO	Acoem Australasia (Ecotech) Serinus 30 – NDIR gas filter correlation infrared photometry	2 m
	NO, NO ₂ , NO _x	Acoem Australasia (Ecotech) Serinus 40 – gas phase chemiluminescence	2 m
	PM _{2.5}	Met One BAM 1020 – Beta ray attenuation	2 m
	PM ₁₀	Thermo – 1405 TEOM (Tapered Element Oscillating Microbalance)	2m
	Differential Temperature (Elevation 2m)	Acoem Australasia (Ecotech) E031220	2 m
	Differential Temperature (Elevation 10m)	Acoem Australasia (Ecotech) E031220	10 m
	Wind Speed (Horizontal, elevation 10m)	Gill Windsonic Op3	10 m
	Wind Direction (elevation 10m)	Gill Windsonic Op3	10 m
	Sigma	Calculation	-

Table 3: Parameters measured at the WCX – Campbell Street monitoring station

Station(s)	Parameter Measured	Instrument and Measurement Technique	Elevation
Campbell Street	CO	Acoem Australasia (Ecotech) Serinus 30 – NDIR gas filter correlation infrared photometry	2 m
	NO, NO ₂ , NO _x	Acoem Australasia (Ecotech) Serinus 40 – gas phase chemiluminescence	2 m
	PM _{2.5}	Met One BAM 1020 – Beta ray attenuation	2 m
	PM ₁₀	Thermo – 1400 ab TEOM (Tapered Element Oscillating Microbalance)	2m
	Differential Temperature (Elevation 2m)	Acoem Australasia (Ecotech) E031220	2 m
	Differential Temperature (Elevation 10m)	Acoem Australasia (Ecotech) E031220	10 m
	Wind Speed (Horizontal, elevation 10m)	Gill Windsonic Op3	10 m
	Wind Direction (elevation 10m)	Gill Windsonic Op3	10 m
	Sigma	Calculation	-

Table 4: Parameters measured at the WCX – Ramsay Street monitoring station

Station(s)	Parameter Measured	Instrument and Measurement Technique	Elevation
Ramsay Street	CO	Acoem Australasia (Ecotech) Serinus 30 – NDIR gas filter correlation infrared photometry	2 m
	NO, NO ₂ , NO _x	Acoem Australasia (Ecotech) Serinus 40 – gas phase chemiluminescence	2 m
	PM _{2.5}	Met One BAM 1020 – Beta ray attenuation	2 m
	PM ₁₀	Thermo – 1400 ab TEOM (Tapered Element Oscillating Microbalance)	2m
	Differential Temperature (Elevation 2m)	Met One 062MP	2 m
	Differential Temperature (Elevation 10m)	Met One 062MP	10 m
	Wind Speed (Horizontal, elevation 10m)	Gill Windsonic Op3	10 m
	Wind Direction (elevation 10m)	Gill Windsonic Op3	10 m
	Sigma	Calculation	-

2.3. Data Collection Methods

Table 5 below shows the methods used for data collection.

Table 5: Methods

Parameter Measured	Data Collection Methods Used	Description of Method
NO, NO ₂ , NO _x	AS 3580.5.1 - 2011	Methods for sampling and analysis of ambient air - Method 5.1: Determination of oxides of nitrogen-Chemiluminescence method
CO	AS 3580.7.1 - 2011	Methods for sampling and analysis of ambient air. Method 7.1: Determination of carbon monoxide—Direct-reading instrumental method
PM ₁₀ (TEOM)	AS 3580.9.8-2008	Methods for sampling and analysis of ambient air. Method 9.8: Determination of suspended particulate matter - PM ₁₀ continuous direct mass method using a tapered element oscillating microbalance analyser.
PM _{2.5} (BAM 1020)	AS/NZS 3580.9.12-2013 ¹	Methods for sampling and analysis of ambient Air - Method 9.12: Determination of suspended particulate matter—PM _{2.5} beta attenuation monitors
Vector Wind Speed (Horizontal)	AS 2923-1987 ²	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
Vector Wind Direction	AS 2923-1987 ²	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
Sigma	AS 2923-1987 ²	Methods of sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
Atmospheric Temperature	USEPA (2000) EPA 454/R-99-005 ²	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications

¹ As approved by the Department of Planning and Environment on 30th August 2021.

² Superseded by AS/NZ 3580.14 2014 but specifically referenced in ministerial conditions.

Note: Two different measurement techniques are used for monitoring PM₁₀ and PM_{2.5} at the WCX M4-M5 Link Project Stations. Studies conducted in Canada, the United States and other countries have found that the Tapered Element Oscillating Microbalance (TEOM) monitors can under report concentrations compared to the Beta Attenuation Monitors (BAM), especially when the air contains a large proportion of semi-volatile particulate matter, which may be the case during cooler seasons when the air contains less coarse dust and a greater proportion of semi-volatile organic compounds such as those associated with wood smoke. As a result, it is normal to see occasional periods where PM₁₀ < PM_{2.5} and this situation does not necessarily indicate a fault with either instrument.

2.3.1. NATA Endorsement and Conformity with Standards

Unless stated below, parameters are monitored at the WCX M4-M5 Link Project Stations according to the stated methods detailed in Table 5 above.

2.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) and Congrego logger situated at each of the monitoring sites. Each logger is equipped with a 4G modem for remote data collection. The recorded data is remotely collected from the Air Quality Monitoring Station (AQMS) loggers on a daily basis (using Airodis™ version 5.2) and stored at Acoem Australasia (Ecotech)'s Environmental Reporting Services (ERS) department in Melbourne, Australia. Data samples are logged in 5-minute intervals.

2.4. Data Validation and Reporting

2.4.1. Validation

The Acoem Australasia (Ecotech) ERS department performs daily data checks to ensure maximum data capture rates are maintained. Any equipment failures are communicated to the responsible field engineers for urgent rectification. Acoem Australasia (Ecotech) ERS maintains two distinct databases containing non-validated and validated data respectively.

The validated database is created by duplicating the non-validated database and then flagging data affected by instrument faults, calibrations and other maintenance activities. The data validation software requires the analyst to supply a valid reason (e.g., backed by maintenance notes, calibration sheets etc.) in the database for flagging any data as invalid.

Details of all invalid or missing data are recorded in the Valid Data Exception Tables.

Validation is performed by the analyst, and the validation is reviewed. Graphs and tables are generated based on the validated five minutes and one-hour data as appropriate.

2.4.2. Reporting

Data is reported in four Microsoft Excel format files named:

- *WCX M4-M5 Link Albert St Monthly Data Report November 2022.xls*
- *WCX M4-M5 Link Campbell St Monthly Data Report November 2022.xls*
- *WCX M4-M5 Link Ramsay St Monthly Data Report November 2022.xls*
- *WCX M4-M5 Link Wattle St Monthly Data Report November 2022.xls*

Each Excel file consists of 6 worksheets:

1. Cover
2. Contents
3. 5 Minute Data
4. 1 Hour Data
5. 24-hour Data
6. Valid Data Exception Report

The data contained in this report is based on Australian Eastern Standard Time.

All averages are calculated from the five-minute and the one-hour data. Averages are based on a minimum of 75% valid readings within the averaging period. Where data capture is low for a particular parameter, summary values (e.g., monthly maximum and minimum) may be based on less than 75% valid samples. The reader should use caution when interpreting these values as they may not be representative of conditions for the entire sample period.

Averaging periods of eight hours or less are reported for the end of the period, i.e., the hourly average 02:00am is for the data collected from 1:00am to 2:00am. One-hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days.

Table 6: Automatic Span / Zero/ Stabilisation and Background checks at WestConnex M4-M5 Link stations

Station	Parameter	Span / Zero / Stabilisation	Background
Albert St.	NO / NO ₂ / NO _x	01:00 – 01:25	n/a
	CO	01:00 – 01:25	23:55 – 00:00
Campbell St.	NO / NO ₂ / NO _x	01:00 – 01:45	n/a
	CO	01:00 – 01:45	23:45 – 23:50
Ramsay St.	NO / NO ₂ / NO _x	00:45 – 01:05	n/a
	CO	00:45 – 01:05	23:45 – 23:50
Wattle St.	NO / NO ₂ / NO _x	01:00 – 01:25	n/a
	CO	01:00 – 01:25	23:45 – 23:50

3.0 Air Quality Goals

The air quality goals and criteria for pollutants monitored at the WCX M4-M5 Link Project ambient monitoring sites are based on SSI-7485 Planning Approval Condition E6. The air quality goals and criteria are shown in Table 7 below.

Table 7: WCX M4-M5 Link Project - Air Quality Goals

Parameter	Time Period	Goal Level	Units
CO	8 hours (rolling, based on 1-hour averages)	9.0	ppm
NO ₂	1 hour	0.12	ppm
PM ₁₀	1 day	50	µg/m ³
	1 year	25	µg/m ³
PM _{2.5}	1 day	25	µg/m ³
	1 year	8	µg/m ³

Note:

This table includes all valid data points that exceed the defined air quality standards. The Ambient Air Quality NEPM includes a provision for excluding 1-day PM₁₀ or PM_{2.5} averages associated with “exceptional events” from the total exceedances of the Air Quality standard. The definition of an “exceptional event” is included below for reference. It is the responsibility of the end user of this data to evaluate whether any reported exceedances are associated with exceptional events and are eligible to be excluded from the exceedance total. Monitoring and reporting of exceedances during the operational project will be in accordance with the Planning Approval Conditions E10, E11 and E12.

As per the Ambient Air Quality NEPM, **Exceptional event** means a fire or dust occurrence that adversely affects air quality at a particular location, and causes an exceedance of 1-day average standards in excess of normal historical fluctuations and background levels, and is directly related to: bushfire; jurisdiction authorised hazard reduction burning; or continental scale windblown dust.

4.0 Calibrations and Maintenance

4.1. Units and Uncertainties

The uncertainties for each parameter have been determined by the manufacturer’s tolerance limits of the equipment’s parameters, and by the data collection standard method.

The reported uncertainties are expanded uncertainties, calculated using coverage factors which give a level of confidence of approximately 95%.

Table 8: Units and Uncertainties

Parameter	Units	Resolution	Uncertainty	Measurement Range ³
NO, NO _x (S40)	ppm	0.001 ppm	± (6% of reading + 0.011 ppm) k factor of 2.0	0 to 0.5 ppm LDL = 0.0004 ppm
NO ₂ (S40)	ppm	0.001 ppm	± (6% of reading + 0.011 ppm) k factor of 2.0	0 to 0.5 ppm LDL = 0.0004 ppm
CO (S30)	ppm	0.1 ppm	± (7% of reading + 0.8 ppm) k factor of 2.0	0 to 50 ppm LDL = 0.04 ppm
PM _{2.5} (BAM1020)	µg/m ³	1 µg/m ³	24Hr: ± (5.5% of reading + 4.0 µg/m ³) (in range 0 - 100 µg/m ³) Hr: ± (8% of reading + 8.0 µg/m ³) k factor of 2.0	0 to 1000 µg/m ³ LDL _{24hr} = 1.0 µg/m ³ LDL _{hr} = 4.8 µg/m ³
PM ₁₀ (TEOM)	µg/m ³	0.1 µg/m ³	± 5.0 µg/m ³ or 3.6% of reading, whichever is the greater K factor of 2.0	0 to 1 g/m ³ LDL = 5 µg/m ³
Vector Wind Speed	m/s	0.1 m/s	± 0.4 m/s or 2 % of reading, whichever is greater K factor of 2.0	0 to 30 m/s
Vector Wind Direction	Deg	1 deg	± 4 deg K factor of 2.0	0 to 360 deg <i>Starting threshold:</i> 0 m/s

³ Uncertainties may not be calculated based on the full measurement range. The max measurement range for gas analysers is defined as the full scale (FS=Span/0.8).

Parameter	Units	Resolution	Uncertainty	Measurement Range ³
Ambient Temperature	°K	0.1°K	± 0.6°K K factor of 2.0	263.15°K to 323.15°K

4.2. Maintenance

4.2.1. Calibration & Maintenance Summary Tables

The last calibrations for the following parameters were performed on the indicated dates. Data supplied after this time is subject to further validation, to be performed at the next calibration cycle.

Note: Maintenance and calibration dates may differ, as calibrations may be less frequent than scheduled maintenance visits.

Tables 9-12 indicate when the particulate and gas and meteorological equipment were last maintained/calibrated.

Table 9: WCX Albert Street Maintenance Table November 2022

Parameter	Date of Last Scheduled Maintenance	Maintenance Type ⁴	Date of Last Calibration	Calibration Cycle
NO, NO ₂ , NO _x	22/11/22	Yearly	22/11/22	Monthly
CO	22/11/22	Yearly	22/11/22	Monthly
PM ₁₀	21/11/22	Yearly	21/11/22	Yearly
PM _{2.5}	21/11/22	Yearly	21/11/22	Yearly
WS/WD/Sigma	22/11/22	Yearly	16/06/21 ⁵	2 Yearly
Differential Temperature 2m	22/11/22	Yearly	22/11/22	6 Monthly
Differential Temperature 10m	22/11/22	Yearly	22/11/22	6 Monthly

⁴ Additional visits may have been made as required.

⁵ Wind sensor calibrated on 16/06/21 and installed at this site on 27/10/21.

Table 10: WCX Campbell Street Maintenance Table November 2022

Parameter	Date of Last Scheduled Maintenance	Maintenance Type ⁶	Date of Last Calibration	Calibration Cycle
NO, NO ₂ , NO _x	10/11/22	Monthly	10/11/22	Monthly
CO	10/11/22	Monthly	10/11/22	Monthly
PM ₁₀	10/11/22	Monthly	10/01/22	Yearly
PM _{2.5}	10/11/22	2 Monthly	07/07/22	Yearly
WS/WD/Sigma	10/11/22	Monthly	23/03/21 ⁷	2 Yearly
Differential Temperature 2m	10/11/22	Monthly	07/07/22	6 Monthly
Differential Temperature 10m	10/11/22	Monthly	07/07/22	6 Monthly

⁶ Additional visits may have been made as required.

⁷ Wind sensor calibrated on 23/03/21 and installed at this site on 10/06/21.

Table 11: WCX Ramsay Street Maintenance Table November 2022

Parameter	Date of Last Scheduled Maintenance	Maintenance Type ⁸	Date of Last Calibration	Calibration Cycle
NO, NO ₂ , NO _x	10/11/22	Yearly	10/11/22	Monthly
CO	10/11/22	Yearly	10/11/22	Monthly
PM ₁₀	08/11/22	2 Yearly	08/11/22	Yearly
PM _{2.5}	08/11/22	2 Yearly	08/11/22	Yearly
WS/WD/Sigma	09/11/22	3 Monthly	24/02/22 ⁹	2 Yearly
Differential Temperature 2m	08/11/22	Yearly	08/11/22	6 Monthly
Differential Temperature 10m	08/11/22	Yearly	08/11/22	6 Monthly

⁸ Additional visits may have been made as required.

⁹ Wind sensor calibrated on 24/02/22 and installed at this site on 10/05/22.

Table 12: WCX Wattle Street Maintenance Table November 2022

Parameter	Date of Last Scheduled Maintenance	Maintenance Type ¹⁰	Date of Last Calibration	Calibration Cycle
NO, NO ₂ , NO _x	24/11/22	Yearly	24/11/22	Monthly
CO	24/11/22	Yearly	24/11/22	Monthly
PM ₁₀	23/11/22	Yearly	23/11/22	Yearly
PM _{2.5}	23/11/22	Yearly	23/11/22	Yearly
WS/WD/Sigma	23/11/22	Yearly	15/06/21 ¹¹	2 Yearly
Differential Temperature 2m	23/11/22	Yearly	23/11/22	6 Monthly
Differential Temperature 10m	23/11/22	Yearly	23/11/22	6 Monthly

¹⁰ Additional visits may have been made as required.

¹¹ Wind sensor calibrated on 15/06/21 and installed at this site on 01/11/21.

5.0 Results

5.1. Data Capture

Valid data capture refers to the amount of valid data collected during the report period. It is based on 5-minute data, for gaseous and meteorological parameters and 1-hour data for particulate parameters.

The percentage of valid data captured is calculated using the following equation:

$$\text{Valid Data capture} = (\text{Reported air quality data} / \text{Total data}) \times 100\%$$

Where:

- Reported air quality data = Number of samples (instrument readings) which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, equipment failures, planned and unplanned maintenance.
- Total data = Total number of samples (instrument readings) expected for the sampling period. Total data is calculated based on the same averaging period as “reported air quality data” and the duration of the corresponding report period. e.g., for 5-minute data collected over a month of 31 days, the total data would be equal to 12 (5-minute samples in an hour) x 24 (hours in a day) x 31 (days in a month) = 8928 samples.

Table 13 below displays data capture statistics for November 2022. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data capture are included in the Valid Data Exception Tables, see section 6.0.

Table 13: Data Capture for WCX M4-M5 Link Project Ambient Air Quality Network

Parameter	Data Capture (%)			
	Albert Street	Campbell Street	Ramsay Street	Wattle Street
PM _{2.5}	96.1	94.6	76.5	95.7
PM ₁₀	95.6	99.2	90.0	95.4
CO	96.5	88.8	95.4	95.7
NO, NO ₂ , NO _x	97.1	94.4	96.2	96.3
WS, WD, Sigma	99.2	99.2	97.9	95.3
AT 2m	99.2	99.2	93.7	98.2
AT 10m	99.2	99.2	97.9	98.2

5.2. Air Quality Monthly Summary

Tables 14-17 below include a summary of any exceedances recorded at the WCX M4-M5 Link Project stations during the reported period¹².

Table 14: WCX Albert Street Exceedances Recorded for November 2022

Parameter	Time Period	Value of Exceedance	Date of Exceedance
NO ₂ (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM ₁₀ (µg/m ³)	24-hour	-	-
	Annual ¹³	-	-
PM _{2.5} (µg/m ³)	24-hour	-	-
	Annual ¹⁴	-	-

¹² Exceedances are based on the decimal places reported.

¹³ Insufficient data to report annual average in 2022, any exceedances will be included in December 2022 report.

¹⁴ Insufficient data to report annual average in 2022, any exceedances will be included in December 2022 report.

Table 15: WCX Campbell Street Exceedances Recorded for November 2022

Parameter	Time Period	Value of Exceedance	Date of Exceedance
NO ₂ (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM ₁₀ (µg/m ³)	24-hour	-	-
	Annual ¹⁵	-	-
PM _{2.5} (µg/m ³)	24-hour	-	-
	Annual ¹⁶	-	-

¹⁵ Insufficient data to report annual average in 2022, any exceedances will be included in December 2022 report.

¹⁶ Insufficient data to report annual average in 2022, any exceedances will be included in December 2022 report.

Table 16: WCX Ramsay Street Exceedances Recorded for November 2022

Parameter	Time Period	Value of Exceedance	Date of Exceedance
NO ₂ (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM ₁₀ (µg/m ³)	24-hour	-	-
	Annual ¹⁷	-	-
PM _{2.5} (µg/m ³)	24-hour	-	-
	Annual ¹⁸	-	-

¹⁷ Insufficient data to report annual average in 2022, any exceedances will be included in December 2022 report.

¹⁸ Insufficient data to report annual average in 2022, any exceedances will be included in December 2022 report.

Table 17: WCX Wattle Street Exceedances Recorded for November 2022

Parameter	Time Period	Value of Exceedance	Date of Exceedance
NO ₂ (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM ₁₀ (µg/m ³)	24-hour	-	-
	Annual ¹⁹	-	-
PM _{2.5} (µg/m ³)	24-hour	-	-
	Annual ²⁰	-	-

¹⁹ Insufficient data to report annual average in 2022, any exceedances will be included in December 2022 report.

²⁰ Insufficient data to report annual average in 2022, any exceedances will be included in December 2022 report.

5.3. Tabulated data

5.3.1. Annual average

Table 18 displays monthly averages of the PM_{2.5} and PM₁₀ parameters collected at WCX M4-M5 Link ambient air monitoring stations for 2022. Averages shown are for the 2022 calendar year, up to the current reported month. Table requires at least 75% valid data to display a monthly average. Footer values are based on all available data for 2022 rather than the average of individual months. This gives an indication of performance against the annual objectives.

Table 18: PM₁₀ and PM_{2.5} averages at the WCX M4-M5 Link ambient air monitoring stations 2022

Month	Albert Street		Campbell Street		Ramsay Street		Wattle Street	
	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)
Jan-22	19.5	4.8	15.9	5.5	13.5	3.9	18.9	4.9
Feb-22	20.3	6.2	16.9	6.8	16.0	5.0	20.1	6.7
Mar-22	16.2	3.8	13.5	5.0	-	-	15.8	5.1
Apr-22	14.6	5.5	12.0	5.9	-	-	15.3	5.7
May-22	16.2	6.8	13.1	6.8	-	6.1	16.4	6.3
Jun-22	14.9	6.7	12.6	7.1	13.5	7.1	17.8	6.6
Jul-22	14.1	6.2	12.5	6.4	11.1	7.4	16.5	6.5
Aug-22	13.5	5.1	11.7	4.9	10.9	6.6	15.7	5.0
Sep-22	16.2	4.8	13.9	5.6	12.2	4.5	16.6	4.9
Oct-22	15.0	4.0	13.2	5.1	11.5	4.5	14.3	3.2
Nov-22	16.5	4.4	13.3	4.8	12.8	5.9	16.4	3.8
Dec-22	-	-	-	-	-	-	-	-
Average	16.1	5.3	13.5	5.8	12.7	5.6	16.7	5.3

5.4. Graphic Representations

This section displays graphs of the pollutants and meteorological parameters monitored at the WCX M4-M5 Link Project for November 2022. The graphs are based on validated 5 minutes or 1-hour data as appropriate.

CO 8-Hour (Rolling, based on 1-Hour Averages)

November 2022

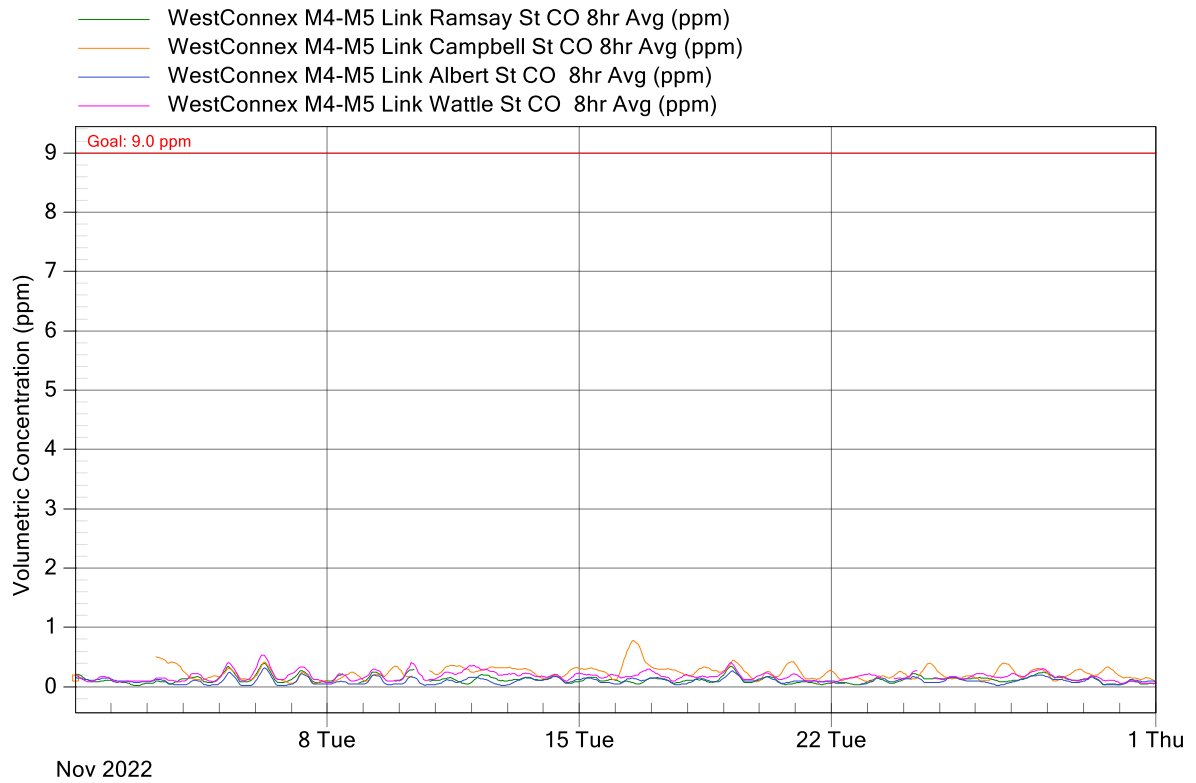


Figure 2: WCX M4-M5 Link Project Air Monitoring Stations - CO 8-Hour Rolling Graph for November 2022

NO₂ 1-Hour Averages

November 2022

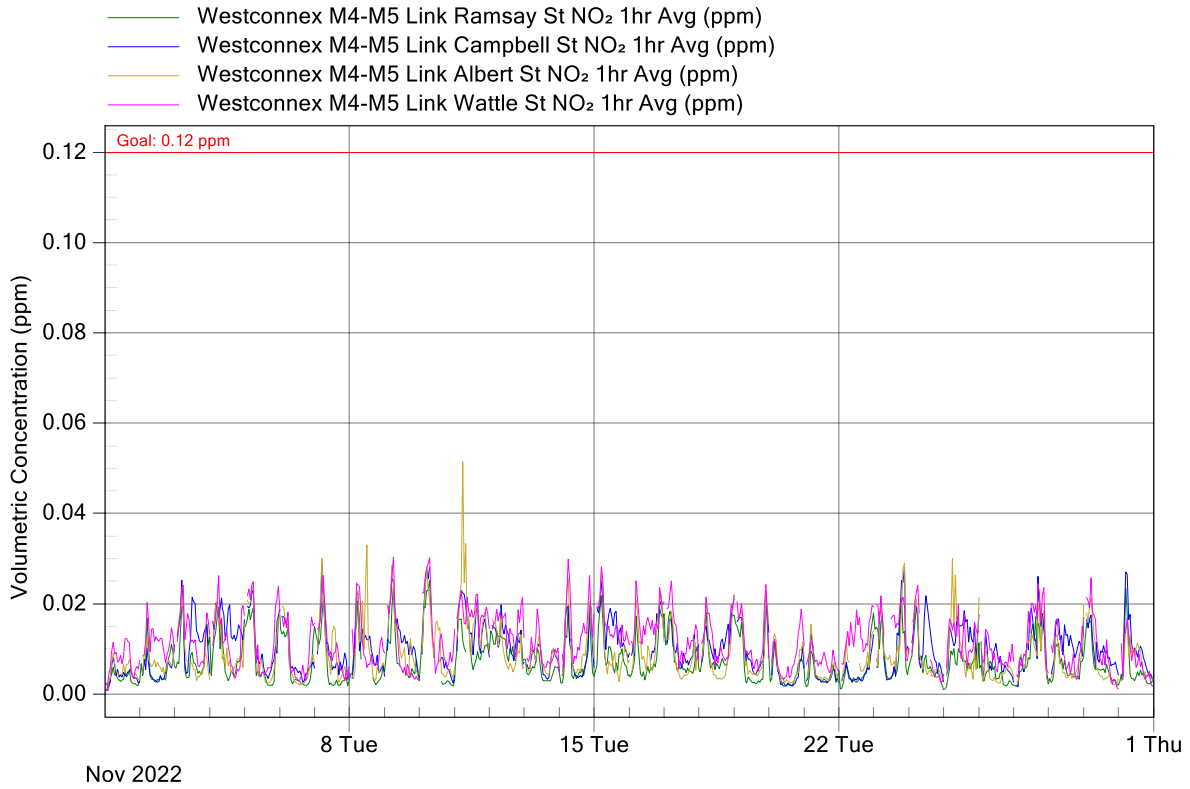


Figure 3: WCX M4-M5 Link Project Air Monitoring Stations - NO₂ 1-Hour Averages Graph for November 2022

PM₁₀ 24-Hour Averages

November 2022

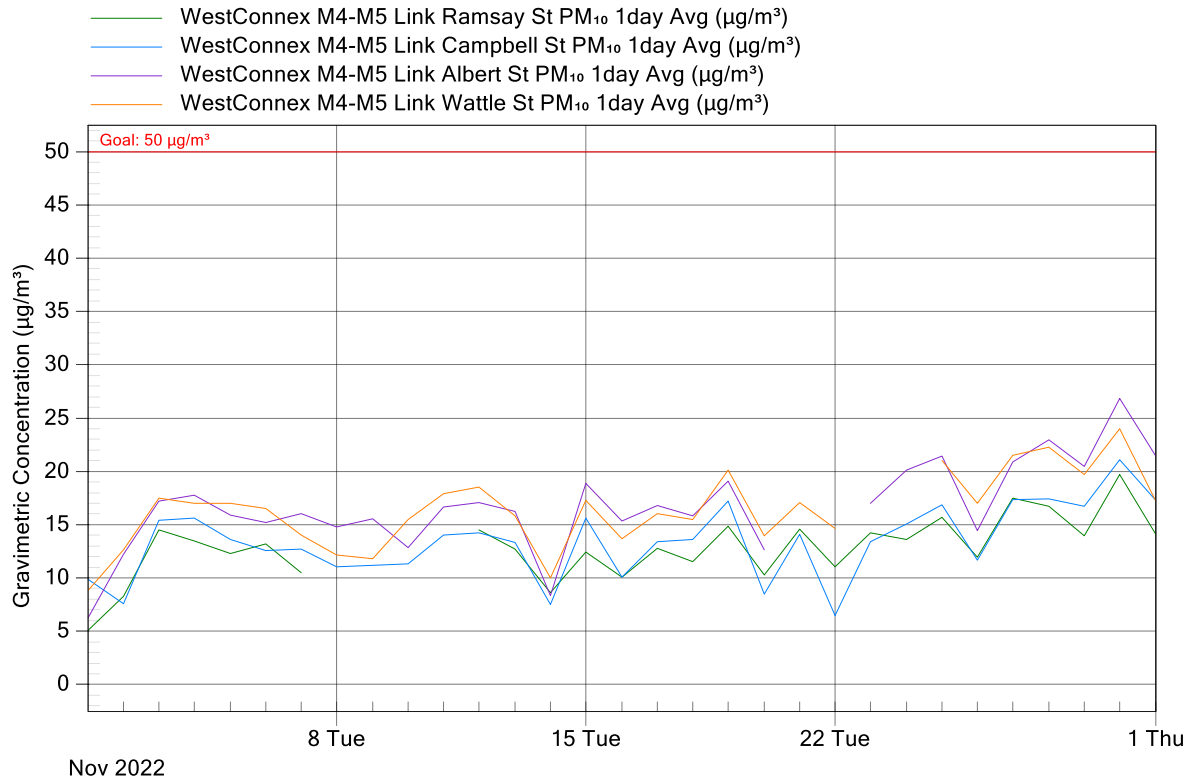


Figure 4: WCX M4-M5 Link Project Air Monitoring Stations - PM₁₀ 24-Hour Averages Graph for November 2022

PM_{2.5} 24-Hour Averages

November 2022

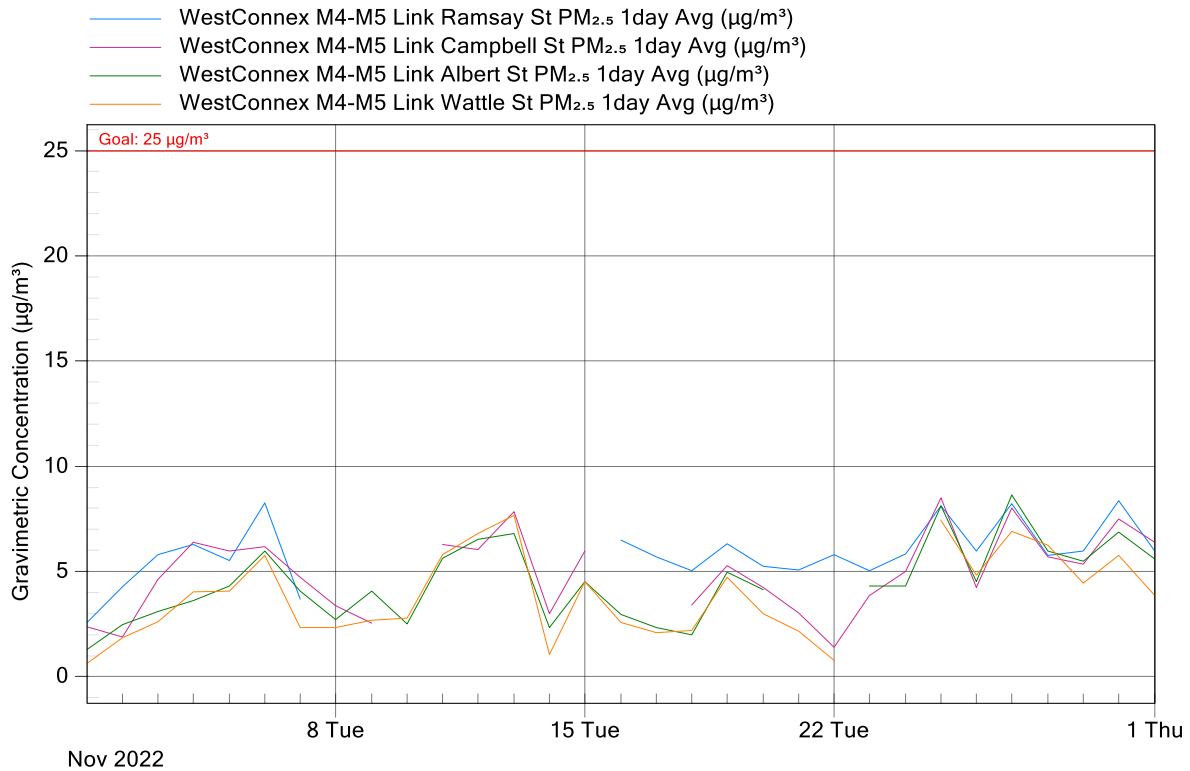
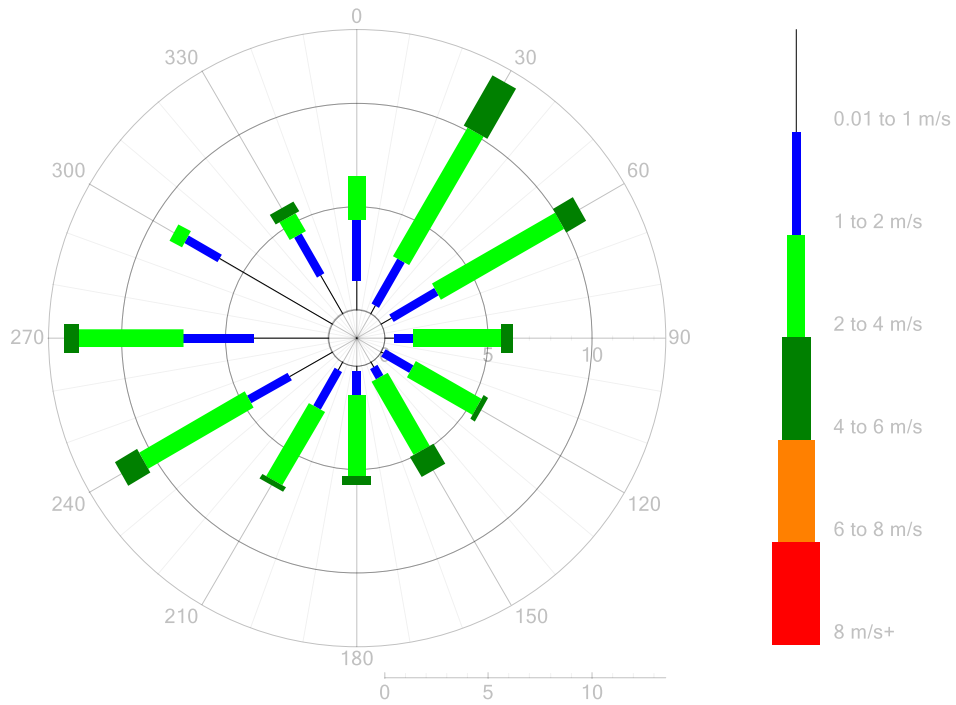


Figure 5: WCX M4-M5 Link Project Air Monitoring Stations - PM_{2.5} 24-Hour Averages Graph for November 2022

Albert St - Wind Rose (1-Hour Averages)

Wind Rose

November 2022



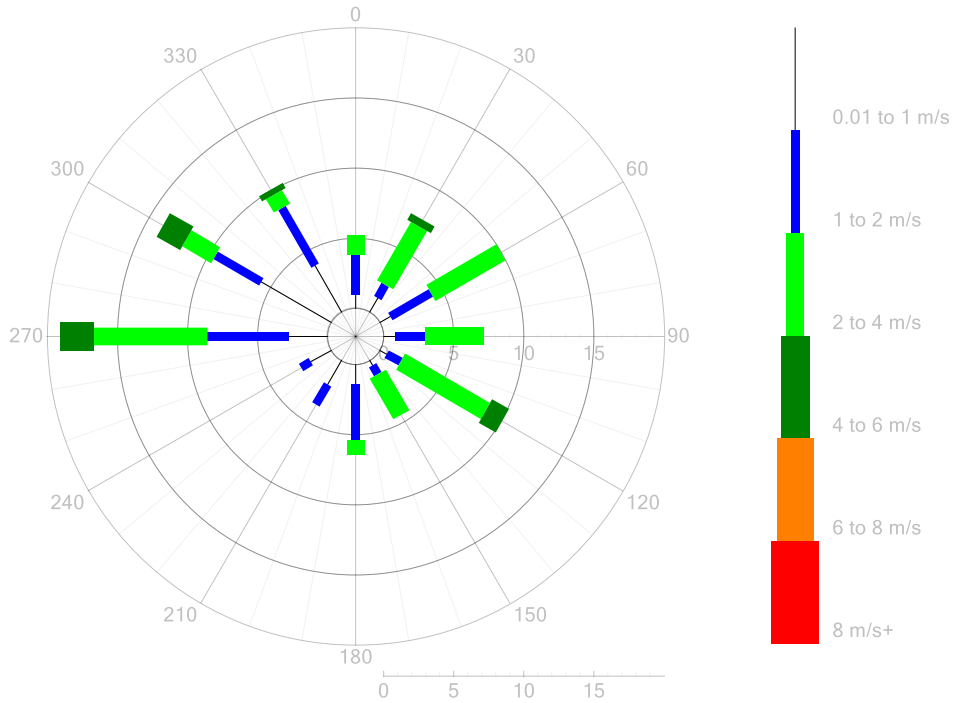
0.0% calm
99.2% valid data present

Figure 6: WCX Albert Street – Wind Rose for November 2022

Campbell St - Wind Rose (1-Hour Averages)

Wind Rose

November 2022



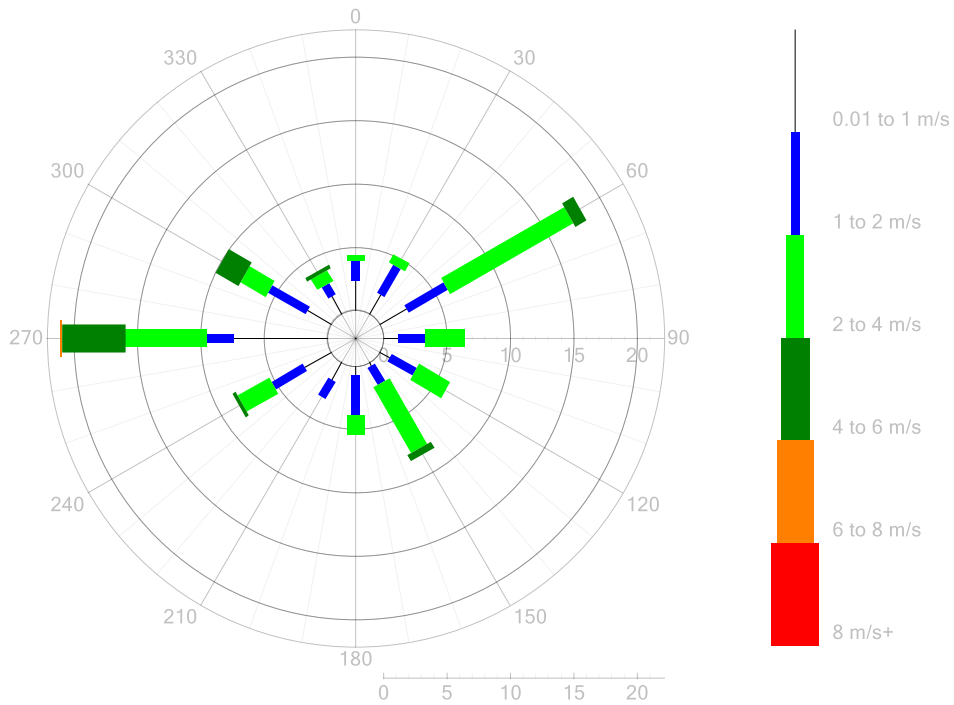
0.0% calm
99.2% valid data present

Figure 7: WCX Campbell Street – Wind Rose for November 2022

Ramsay St - Wind Rose (1-Hour Averages)

Wind Rose

November 2022



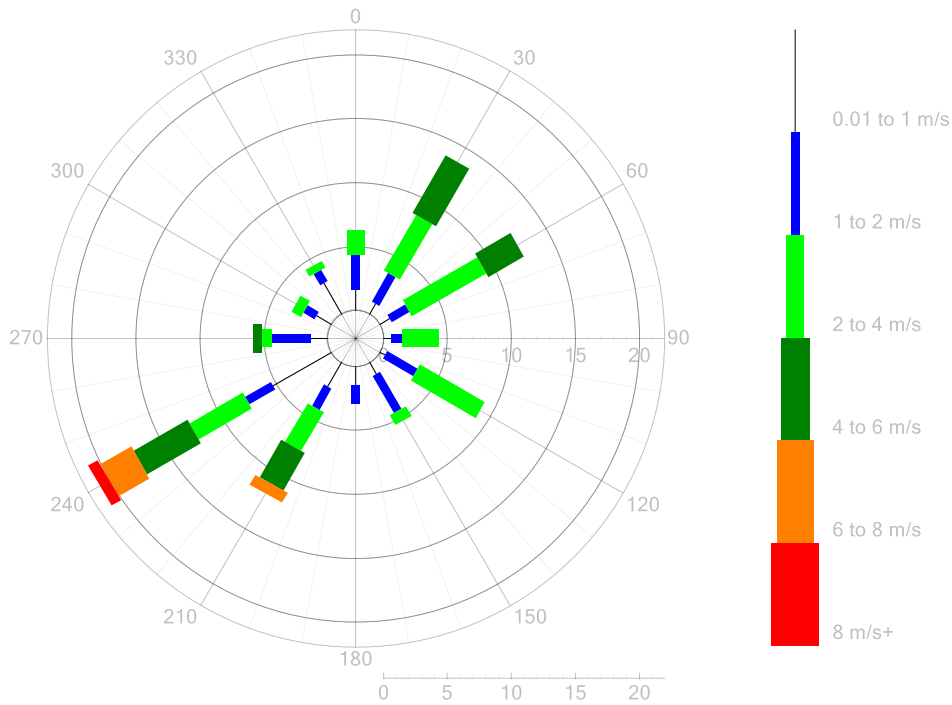
0.0% calm
97.6% valid data present

Figure 8: WCX Ramsay Street – Wind Rose for November 2022

Wattle St - Wind Rose (1-Hour Averages)

Wind Rose

November 2022



0.0% calm
95.1% valid data present

Figure 9: WCX Wattle Street – Wind Rose for November 2022

6.0 Valid Data Exception Tables

Tables 19–22 below detail all changes made to the raw data set during the validation process. An explanation of reasons given in the table can be found in Appendix 2.

Table 19: WCX Albert Street Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/11/22 00:05	30/11/22 00:10	Background checks, once daily for 5 to 10 minutes	CO	NK	15/12/22
01/11/22 01:00	30/11/22 01:25	Automatic span and zero checks, once daily from 01:00 to 01:25	CO, NO, NO ₂ , NO _x	NK	15/12/22
04/11/22 00:15	14/11/22 00:00	Static offset of -0.05 ppm applied to correct unstable baseline	CO	NK	15/12/22
08/11/22 08:45	20/11/22 09:20	Instrument fault - Intermittent negative spikes due to possible moisture interference	PM ₁₀	NK	15/12/22
10/11/22 12:15	10/11/22 12:15	Instrument fault - Unrealistic negative readings	NO, NO ₂ , NO _x	NK	15/12/22
21/11/22 09:50	21/11/22 13:05	Scheduled yearly maintenance - Instrument calibrations followed by instrument stabilisation, siting audits completed	PM _{2.5} , PM ₁₀	NK	15/12/22
21/11/22 13:10	22/11/22 08:05	BAM 1020 & TEOM zero check performed	PM _{2.5} , PM ₁₀	NK	15/12/22
22/11/22 08:10	22/11/22 13:40	Scheduled yearly maintenance - Instrument calibration and checks, BAM & TEOM zero filters removed & inlets installed	All parameters	NK	15/12/22

Table 20: WCX Campbell Street Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/11/22 00:00	02/11/22 23:40	Unrealistic data - Data trend is not tracking nearby sites	CO	NK	15/12/22
01/11/22 00:00	16/11/22 00:55	Intermittent linear multiplier applied as required to correct span A values range from 0.98 to 1.00 and B values range from 0.70 to 0.93	NO, NO ₂ , NO _x	NK	15/12/22
01/11/22 01:00	30/11/22 01:45	Automatic span and zero checks, once daily from 01:00 to 01:45	CO, NO, NO ₂ , NO _x	NK	15/12/22
02/11/22 23:45	30/11/22 23:45	Background checks, once daily for 5 to 10 minutes	CO	NK	15/12/22
02/11/22 23:55	01/12/22 00:00	Intermittent static offsets applied as required to correct unstable baseline Values range from -0.22 ppm to +0.36 ppm	CO	NK	15/12/22
02/11/22 23:55	24/11/22 23:40	Intermittent linear offsets applied as required to correct unstable baseline A value of 0.00 ppm and B values range from -0.86 ppm to +0.51 ppm	CO	NK	15/12/22
08/11/22 07:40	08/11/22 07:40	Data transmission errors	All parameters	NK	15/12/22
10/11/22 08:00	10/11/22 14:10	Scheduled 2 monthly maintenance - Instrument calibrations followed by instrument stabilisation	All parameters	NK	15/12/22
16/11/22 05:30	16/01/22 07:45	Instrument fault - Status error	NO, NO ₂ , NO _x	NK	15/12/22
16/11/22 07:50	16/01/22 15:05	Non scheduled maintenance - Instrument troubleshooting followed by instrument stabilisation	NO, NO ₂ , NO _x	NK	15/12/22
16/11/22 13:00	17/11/22 10:00	Instrument fault - Communication down	PM _{2.5}	NK	15/12/22
17/11/22 11:00	17/11/22 20:00	Non scheduled maintenance - BAM troubleshooting followed by instrument stabilisation	PM _{2.5}	NK	15/12/22
23/11/22 22:35	23/11/22 22:45	Additional background check	CO	NK	15/12/22

Table 21: WCX Ramsay Street Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/11/22 00:00	08/11/22 07:00	Static offset of 4.2 µg/m ³ applied to correct the background	PM _{2.5}	NK	15/12/22
01/11/22 00:00	09/11/22 11:55	Static offset of +24 degrees applied to wind direction to correct alignment issue caused by misapplication of the magnetic declination angle	WD	NK	15/12/22
01/11/22 00:45	30/11/22 01:05	Automatic span and zero checks, once daily from 00:45 to 01:05 followed by instrument stabilisation	CO, NO, NO ₂ , NO _x	NK	15/12/22
01/11/22 23:45	30/11/22 23:50	Background checks, once daily for 5 to 10 minutes	CO	NK	15/12/22
02/11/22 01:15	29/11/22 23:40	Intermittent static offsets applied as required to correct unstable baseline. Values range from -0.58 ppm to +0.12 ppm	CO	NK	15/12/22
08/11/22 08:00	08/11/22 15:15	Scheduled 2 yearly maintenance - Instrument calibrations followed by instrument stabilisation, siting audits completed	All parameters	NK	15/12/22
08/11/22 15:20	10/11/22 08:55	BAM 1020 & TEOM zero check which has been interrupted by instrument fault & maintenances	PM ₁₀ , PM _{2.5}	NK	15/12/22
09/11/22 09:50	13/11/22 14:20	Intermittent unrealistic reading - Noisy data	AT 2m	NK	15/12/22
09/11/22 12:00	09/11/22 15:00	Scheduled yearly maintenance - TEOM troubleshooting & Wind direction adjustment	All parameters	NK	15/12/22
09/11/22 16:30	30/11/22 17:30	Intermittent data transmission error	AT 2m, AT 10m, WS, WD, Sigma, CO, NO, NO ₂ , NO _x , PM ₁₀	NK	15/12/22
10/11/22 09:00	10/11/22 14:25	Scheduled yearly maintenance - Instrument calibrations followed by instrument stabilisation, TEOM zero filter removed and inlet installed	All parameters	NK	15/12/22
10/11/22 15:00	15/11/22 06:00	BAM 1020 zero check failed - background check performed	PM _{2.5}	NK	15/12/22
10/11/22 15:00	11/11/22 08:45	Instrument fault - Data flatlined	PM ₁₀	NK	15/12/22
11/11/22 08:50	11/11/22 09:35	Non scheduled maintenance - TEOM troubleshooting	AT 2m, AT 10m, WS, WD, Sigma, CO, NO, NO ₂ , NO _x , PM ₁₀	NK	15/12/22

Start Date	End Date	Reason	Change Details	User Name	Change Date
15/11/22 07:00	15/11/22 07:00	Non scheduled maintenance - BAM background value updated, zero filter removed and inlet installed	PM _{2.5}	NK	15/12/22
18/11/22 20:20	18/11/22 20:20	Unrealistic negative readings	PM ₁₀	NK	15/12/22

Table 22: WCX Wattle Street Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/11/22 01:00	30/11/22 01:25	Automatic span and zero checks, once daily from 01:00 to 01:25	CO, NO, NO ₂ , NO _x	NK	15/12/22
01/11/22 00:00	01/12/22 00:00	Static offset of -0.15 ppm applied to correct unstable baseline.	CO	NK	15/12/22
01/11/22 23:00	30/11/22 23:00	Data affected by met power supply reset every night for 5 to 10 minutes	AT 2m, AT 10m	NK	15/12/22
01/11/22 23:45	30/11/22 23:50	Background checks, once daily for 5 to 10 minutes followed by intermittent instrument stabilisation	CO	NK	15/12/22
04/11/22 12:40	29/11/22 14:05	Intermittent unrealistic negative readings	NO, NO ₂ , NO _x	NK	15/12/22
07/11/22 19:00	08/11/22 19:25	Instrument fault - Intermittent status error	CO, NO, NO ₂ , NO _x	NK	15/12/22
14/11/22 10:30	14/11/22 10:30	Instrument fault - Flow error	PM ₁₀	NK	15/12/22
15/11/22 21:20	20/11/22 08:55	Instrument fault - Intermittent negative spikes due to possible moisture interference	PM ₁₀	NK	15/12/22
23/11/22 08:00	23/11/22 12:10	Scheduled yearly maintenance - Instrument calibrations followed by instrument stabilisation, siting audits completed	All parameters	NK	15/12/22
23/11/22 12:15	24/11/22 07:55	BAM 1020 & TEOM zero check performed	PM _{2.5} , PM ₁₀	NK	15/12/22
24/11/22 08:00	24/11/22 14:25	Scheduled yearly maintenance - Instrument calibration and checks, BAM & TEOM zero filters removed & inlets installed	All parameters	NK	15/12/22
27/11/22 23:40	28/11/22 22:55	Instrument fault - Data flatlined	WS, WD & Sigma	NK	15/12/22
01/11/22 01:00	30/11/22 01:25	Automatic span and zero checks, once daily from 01:00 to 01:25	CO, NO, NO ₂ , NO _x	NK	15/12/22
01/11/22 00:00	01/12/22 00:00	Static offset of -0.15 ppm applied to correct unstable baseline.	CO	NK	15/12/22

7.0 Report Summary

- Percentage availability for all parameters at the WestConnex M4-M5 Link Ambient Air Quality Monitoring Network was above 95% during the reporting month except for PM_{2.5}, NO, NO₂ and NO_x data capture of Campbell St. station and PM_{2.5}, PM₁₀ and AT 2m data capture of Ramsay St. station that were mainly due to Instrument yearly maintenances.

Please refer to Table 13, and Tables 19-22 for details.

- There were no exceedance of the air quality goals at the WestConnex M4-M5 Link Ambient Air Quality Monitoring Network for the reporting month.

Please refer to Tables 14-17 in Section 5.2 – Air Quality Monthly Summary for further information.

- There is an ongoing investigation on PM_{2.5} data in Ramsay St. which may need crosschecking the background settings on BAM1020 and the data may be subject to review.

Appendix 1 - Definitions & Abbreviations

ERS	Environmental Reporting Services
AQMS	Air Quality Monitoring Station
AQM	Air Quality Monitor
BAM	Beta Attenuation Monitors
TEOM	Tapered Element Oscillating Microbalance
°	Degrees (True North)
K	Kelvin
LDL	Lower Detectable Limit
$\mu\text{g}/\text{m}^3$	Micrograms per cubic metre at standard temperature and pressure (0°C and 101.3 kPa)
AT	Ambient Temperature
calm	Wind conditions where the wind speed is below the operating range of the wind sensor
CO	Carbon monoxide
mg/m^3	Milligrams per cubic metre at standard temperature and pressure (0°C and 101.3 kPa)
mm	Millimeter
NO	Nitric oxide
NO ₂	Nitrogen dioxide
NO _x	Oxides of nitrogen
PM ₁₀	Particulate less than 10 microns in equivalent aerodynamic diameter
PM _{2.5}	Particulate less than 2.5 microns in equivalent aerodynamic diameter

ppb	Parts per billion
ppm	Parts per million
RH	Relative Humidity
WD	Vector Wind Direction
WS	Vector Wind Speed

Appendix 2 - Explanation of Exception Table

Automatic filter tape advance refers to the movement of the filter paper by the analyser to an unused spot.

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.

Automatic span/zero check. The E-Sampler is programmed to perform a zero calibration check whereby air is passed through filter element, removing particulates, before entering the sensor in the analyser. Data is invalidated when these checks occur.

Beta count failure refers to a fault in the functioning of the EBAM. A one minute beta count was less than the maximum acceptable counts during operation.

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

Calibration correction factor 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

Commissioning refers to the initial setup and calibration of the instrument when it is first installed. For some instruments there may be a stabilisation period before normal operation commences.

Data transmission error refers to a period of time when the instrument could not transmit data. This may be due to interference, or a problem with the phone line or modem.

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.

Gap in 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 a lack of data due to an instrument being shut down for repair, maintenance, or factory calibration.

Linear offset or multiplier refers to when an offset or multiplier has been applied between two points where the values of the offset or multiplier are different and the correction is interpolated between the two points.

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 switched off 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.

Overnight zero out of tolerance refers to when the automatic zero reading measured by the analyser falls outside the expected 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.

Static offset or multiplier refers to when a single offset or multiplier has been applied to the data between two points either to increase or decrease the measured value.

Tape break refers to the breaking of the EBAM/BAM sample tape during operation.

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