Acciona Samsung Bouygues Joint Venture (ASBJV)

WestConnex M4-M5 Link (WCX 3A) Project

Ambient Air Quality and Weather Monitoring

Validated Report

1st December 2021 – 31st December 2021

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Revision History			
Revision	**Report ID**	**Date**	**Analyst**
0	DAT17920	17/01/22	Diep LAM

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Executive Summary

The WestConnex WCX 3A - M4_M5 Link project is being constructed in two stages:

- Stage 1: WCX 3A - 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 compromises 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 3A - M4_M5 Link Mainline tunnels air quality is monitored by hundreds of sensors and measures various pollutants across three mains areas:

- Ambient air - air quality in the areas around the WCX 3A - 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 December 2021 and 30th December 2021.

Report Summary

Air quality sensors and related equipment were operating for the full month although there were some instrumentation issues (called 'Exceptions') during this time.

The data capture was below the 95% goal for some parameters in this report as shown in Table 12. The low data capture ranged from 69.2% to 94.7% for the month.

There were no exceedance of the air quality goals at the WCX 3A - M4_M5 Link Ambient Air Quality Monitoring Network for the reporting month. Please refer to Tables 13-16 in Section 5.2 – Air Quality Monthly Summary for further information.

The reasons for the exceptions are reported in Tables 18-21 and were mainly due to equipment requiring adjustment.

1.0   Introduction

Ecotech Pty Ltd was commissioned by Acciona Samsung Bouygues Joint Venture (ASBJV) to provide monitoring and data reporting for the WCX 3A - M4_M5 Link Project ambient air quality and weather monitoring network, located as detailed in Table 1. Ecotech commenced data collection in December 2021.

This report presents the available data for December 2021.

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 3A - M4_M5 Link Project monitoring network consists of six ambient air quality and weather monitoring stations. The stations' location and siting details are described below.

Table 1: WCX 3A - M4_M5 Link Project monitoring site's 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"	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"	16

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

- Albert Street on 28/10/2021
- Campbell Street on 06/01/2021
- Ramsay Street on 17/11/2021
- Wattle Street on 02/11/2021
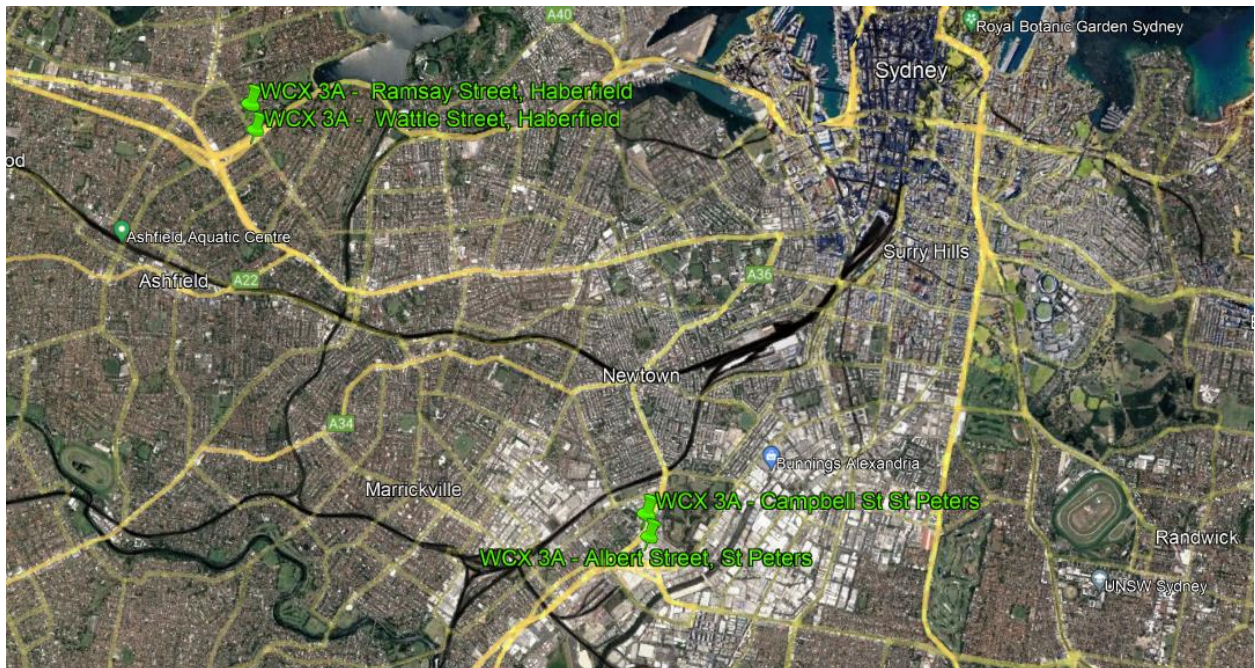
Figure 1: WCX 3A - M4_M5 Link Project Monitoring Station Locations

2.2.   Monitored Parameters

Tables 2-4 below detail the parameters monitored and the instruments used at the WCX 3A - M4_M5 Link Project monitoring stations. Appendix 1 defines any abbreviated parameter names used throughout the report.

Table 2: Parameters measured at the WCX 3A - Albert Street and Wattle Street monitoring stations

Station(s)	Parameter Measured	Instrument and Measurement Technique	Elevation
Albert Street Wattle Street	CO	Ecotech Serinus 30 – NDIR gas filter correlation infrared photometry	2 m
	NO, NO_2, NO_x	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)	Ecotech E031220	2 m
	Differential Temperature (Elevation 10m)	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 3A – Campbell Street monitoring station

Station(s)	Parameter Measured	Instrument and Measurement Technique	Elevation
Campbell Street	CO	Ecotech Serinus 30 – NDIR gas filter correlation infrared photometry	2 m
	NO, NO_2, NO_x	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)	Ecotech E031220	2 m
	Differential Temperature (Elevation 10m)	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 3A – Ramsay Street monitoring station

Station(s)	Parameter Measured	Instrument and Measurement Technique	Elevation
Ramsay Street	CO	Ecotech Serinus 30 – NDIR gas filter correlation infrared photometry	2 m
	NO, NO_2, NO_x	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[3]	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
Sigma	AS 2923-1987[3]	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[3]	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications

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[1] As approved by the Department of Planning and Environment on 8th September 2017.

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

[3] Superseded by AS/NZ 3580.14 2014 but specifically referenced in ministerial conditions.

Note: Two different measurement techniques are used for monitoring PM_{10} and $PM_{2.5}$ at the WCX 3A - 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 $PM_{10} < PM_{2.5}$ and this situation does not necessarily indicate a fault with either instrument.

2.3.1. NATA Endorsement and Conformity with Standards

Unless state below, parameters are monitored at The WCX 3A – M4_M5 Link Project Stations according to the methods detailed in Table 5 above.

- Ramsay St
  - Measurement of WS, WD and Sigma does not conform with *AS/NZS 3580.14-2014* and is not covered by Ecotech's NATA scope of accreditation as overdue calibration from 18/12/2021.

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 3G 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 5.1) and stored at 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 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. 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 3A - M4_M5 Link_Albert St_Monthly Data Report_December 2021.xls*
- *WCX 3A - M4_M5 Link_Campbell St_Monthly Data Report_December 2021.xls*
- *WCX 3A - M4_M5 Link_Ramsay St_Monthly Data Report_December 2021.xls*
- *WCX 3A - M4_M5 Link_Wattle St_Monthly Data Report_December 2021.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.

3.0   Air Quality Goals

The air quality goals and criteria for pollutants monitored at the WCX 3A - M4_M5 Link Project ambient monitoring sites are based on SSI 6307 Planning Approval Condition E9. The air quality goals and criteria are shown in Table 6 below.

Table 6: WCX 3A - 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	$\mu g/m^3$
	1 year	25	$\mu g/m^3$
$PM_{2.5}$	1 day	25	$\mu g/m^3$
	1 year	8	$\mu g/m^3$

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 PM_{10} 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 7: Units and Uncertainties

Parameter	Units	Resolution	Uncertainty	Measurement Range[4]
NO, NO_x (S40)	ppm	0.001 ppm	$\pm$ (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	$\pm$ (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	$\pm$ (7% of reading + 0.8 ppm) k factor of 2.0	0 to 50 ppm LDL = 0.04 ppm
$PM_{2.5}$ (BAM1020)	$\mu g/m^3$	1 $\mu g/m^3$	24Hr: $\pm$ (5.5% of reading + 4.0 $\mu g/m^3$) (in range 0 - 100 $\mu g/m^3$) Hr: $\pm$ (8% of reading + 8.0 $\mu g/m^3$) k factor of 2.0	0 to 1000 $\mu g/m^3$ LDL_{24hr} = 1.0 $\mu g/m^3$ LDL_{hr} = 4.8 $\mu g/m^3$
PM_{10} (TEOM)	$\mu g/m^3$	0.1 $\mu g/m^3$	$\pm$ 5.0 $\mu g/m^3$ or 3.6% of reading, whichever is the greater K factor of 2.0	0 to 1 g/m^3 LDL = 5 $\mu g/m^3$
Vector Wind Speed	m/s	0.1 m/s	$\pm$ 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	$\pm$ 4 deg K factor of 2.0	0 to 360 deg *Starting threshold:* 0 m/s

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[4] 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[4]
Ambient Temperature	°K	0.1°K	± 0.6°K K factor of 2.0	263.15°C to 323.15°C

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 8-11 indicate when the particulate and gas and meteorological equipment were last maintained/calibrated.

Table 8: WCX 3A - Albert Street Maintenance Table December 2021

Parameter	Date of Last Scheduled Maintenance	Maintenance Type[5]	Date of Last Calibration	Calibration Cycle
NO, NO_2, NO_x	13/12/21	Monthly	13/12/21	Monthly
CO	13/12/21	Monthly	13/12/21	Monthly
PM_{10}	13/12/21	Monthly	27/10/21	Yearly
$PM_{2.5}$	13/12/21	Monthly	27/10/21	Yearly
WS/WD/Sigma	13/12/21	Monthly	16/06/21[6]	2 Yearly
Differential Temperature 2m	13/12/21	Monthly	27/10/21	6 Monthly
Differential Temperature 10m	13/12/21	Monthly	27/10/21	6 Monthly

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[5] Additional visits may have been made as required.

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

Table 9: WCX 3A - Campbell Street Maintenance Table December 2021

Parameter	Date of Last Scheduled Maintenance	Maintenance Type[7]	Date of Last Calibration	Calibration Cycle
NO, NO_2, NO_x	14/12/21	Monthly	14/12/21	Monthly
CO	14/12/21	Monthly	31/12/21	Monthly
PM_{10}	14/12/21	Monthly	25/01/21	Yearly
$PM_{2.5}$	14/12/21	Monthly	06/01/21	Yearly
WS/WD/Sigma	14/12/21	Monthly	23/03/21[8]	2 Yearly
Differential Temperature 2m	14/12/21	Monthly	10/06/21	6 Monthly
Differential Temperature 10m	14/12/21	Monthly	10/06/21	6 Monthly

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[7] Additional visits may have been made as required.

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

Table 10: WCX 3A - Ramsay Street Maintenance Table December 2021

Parameter	Date of Last Scheduled Maintenance	Maintenance Type[9]	Date of Last Calibration	Calibration Cycle
NO, NO_2, NO_x	15/12/21	Monthly	15/12/21	Monthly
CO	15/12/21	Monthly	15/12/21	Monthly
PM_{10}	15/12/21	Monthly	16/11/21	Yearly
$PM_{2.5}$	14/12/21	Monthly	16/11/21	Yearly
WS/WD/Sigma	15/12/21	Monthly	18/12/19[10]	2 Yearly
Differential Temperature 2m	15/12/21	Monthly	17/11/21	6 Monthly
Differential Temperature 10m	15/12/21	Monthly	17/11/21	6 Monthly

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[9] Additional visits may have been made as required.

[10] Wind sensor calibrated on 18/12/19 and installed at this site on 14/01/20.

Table 11: WCX 3A - Wattle Street Maintenance Table December 2021

Parameter	Date of Last Scheduled Maintenance	Maintenance Type[11]	Date of Last Calibration	Calibration Cycle
NO, NO_2, NO_x	15/12/21	Monthly	15/12/21	Monthly
CO	15/12/21	Monthly	15/12/21	Monthly
PM_{10}	15/12/21	Monthly	01/11/21	Yearly
$PM_{2.5}$	15/12/21	Monthly	01/11/21	Yearly
WS/WD/Sigma	15/12/21	Monthly	15/06/21[12]	2 Yearly
Differential Temperature 2m	15/12/21	Monthly	01/11/21	6 Monthly
Differential Temperature 10m	15/12/21	Monthly	01/11/21	6 Monthly

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[11] Additional visits may have been made as required.

[12] 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:

Valid Data capture = (Reported air quality data / Total data) x 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 12 below displays data capture statistics for December 2021. **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 12: Data Capture for WCX 3A - M4_M5 Link Project Ambient Air Quality Network

Parameter	Data Capture (%)			
	Albert Street	Campbell Street	Ramsay Street	Wattle Street
$PM_{2.5}$	99.5	99.7	99.7	99.7
PM_{10}	99.5	99.7	99.7	99.8
CO	96.7	95.4	95.4	96.8
NO, NO_2, NO_x	97.4	96.3	96.3	97.7
WS, WD, Sigma	**94.7**	99.8	99.8	**69.2**
AT 2m	99.5	99.8	99.8	99.8
AT 10m	99.5	99.8	99.8	99.8

5.2.   Air Quality Monthly Summary

Tables 13-16 below include a summary of any exceedances recorded at the WCX 3A - M4_M5 Link Project stations during the reported period[13].

Table 13: WCX 3A - Albert Street Exceedances Recorded for December 2021

Parameter	Time Period	Value of Exceedance	Date of Exceedance
NO_2 (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM_{10} (µg/m³)	24-hour	-	-
	Annual[14]	-	-
$PM_{2.5}$ (µg/m³)	24-hour	-	-
	Annual[15]	-	-

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[13] Exceedances are based on the decimal places reported.

[14] Insufficient data to report annual average in 2021, any exceedances will be included in December 2022 report.

[15] Insufficient data to report annual average in 2021, any exceedances will be included in December 2022 report.

Table 14: WCX 3A - Campbell Street Exceedances Recorded for December 2021

Parameter	Time Period	Value of Exceedance	Date of Exceedance
NO_2 (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM_{10} (µg/m³)	24-hour	-	-
	Annual[16]	-	-
$PM_{2.5}$ (µg/m³)	24-hour	-	-
	Annual[17]	-	-

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[16] Insufficient data to report annual average in 2021, any exceedances will be included in December 2022 report.

[17] Insufficient data to report annual average in 2021, any exceedances will be included in December 2022 report.

Table 15: WCX 3A - Ramsay Street Exceedances Recorded for December 2021

Parameter	Time Period	Value of Exceedance	Date of Exceedance
NO_2 (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM_{10} (µg/m³)	24-hour	-	-
	Annual[18]	-	-
$PM_{2.5}$ (µg/m³)	24-hour	-	-
	Annual[19]	-	-

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[18] Insufficient data to report annual average in 2021, any exceedances will be included in December 2022 report.

[19] Insufficient data to report annual average in 2021, any exceedances will be included in December 2022 report.

Table 16: WCX 3A - Wattle Street Exceedances Recorded for December 2021

Parameter	Time Period	Value of Exceedance	Date of Exceedance
NO_2 (ppm)	1 hour		
CO (ppm)	8-hour rolling	-	-
PM_{10} (μg/m³)	24-hour	-	-
	Annual[20]	-	-
$PM_{2.5}$ (μg/m³)	24-hour	-	-
	Annual[21]	-	-

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[20] Insufficient data to report annual average in 2021, any exceedances will be included in December 2022 report.

[21] Insufficient data to report annual average in 2021, any exceedances will be included in December 2022 report.

5.3.   Tabulated data

5.3.1. Annual average

Table 17 displays monthly averages of the $PM_{2.5}$ and PM_{10} parameters collected at WCX 3A - M4_M5 Link ambient air monitoring stations for 2021. Averages shown are for the 2021 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 2021 rather than the average of individual months. This gives an indication of performance against the annual objectives.

Table 17: PM_{10} and $PM_{2.5}$ averages at the WCX 3A – M4_M5 Link ambient air monitoring stations 2021

Month	Albert Street		Campbell Street		Ramsay Street		Wattle Street	
	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)
Jan-21	-	-	-	-	-	-	-	-
Feb-21	-	-	-	-	-	-	-	-
Mar-21	-	-	-	-	-	-	-	-
Apr-21	-	-	-	-	-	-	-	-
May-21	-	-	-	-	-	-	-	-
Jun-21	-	-	-	-	-	-	-	-
Jul-21	-	-	-	-	-	-	-	-
Aug-21	-	-	-	-	-	-	-	-
Sep-21	-	-	-	-	-	-	-	-
Oct-21	-	-	-	-	-	-	-	-
Nov-21	-	5.7	15.4	5.1	14.0	4.2	-	5.3
Dec-21	18.0	5.4	14.8	4.9	14.0	4.3	19.3	5.0
Average	18.0	5.5	15.1	5.0	14.0	4.2	19.3	5.1

5.4.　　　Graphic Representations

This section displays graphs of the pollutants and meteorological parameters monitored at the WCX 3A - M4_M5 Link Project for December 2021. The graphs are based on validated 5 minutes or 1-hour data as appropriate.
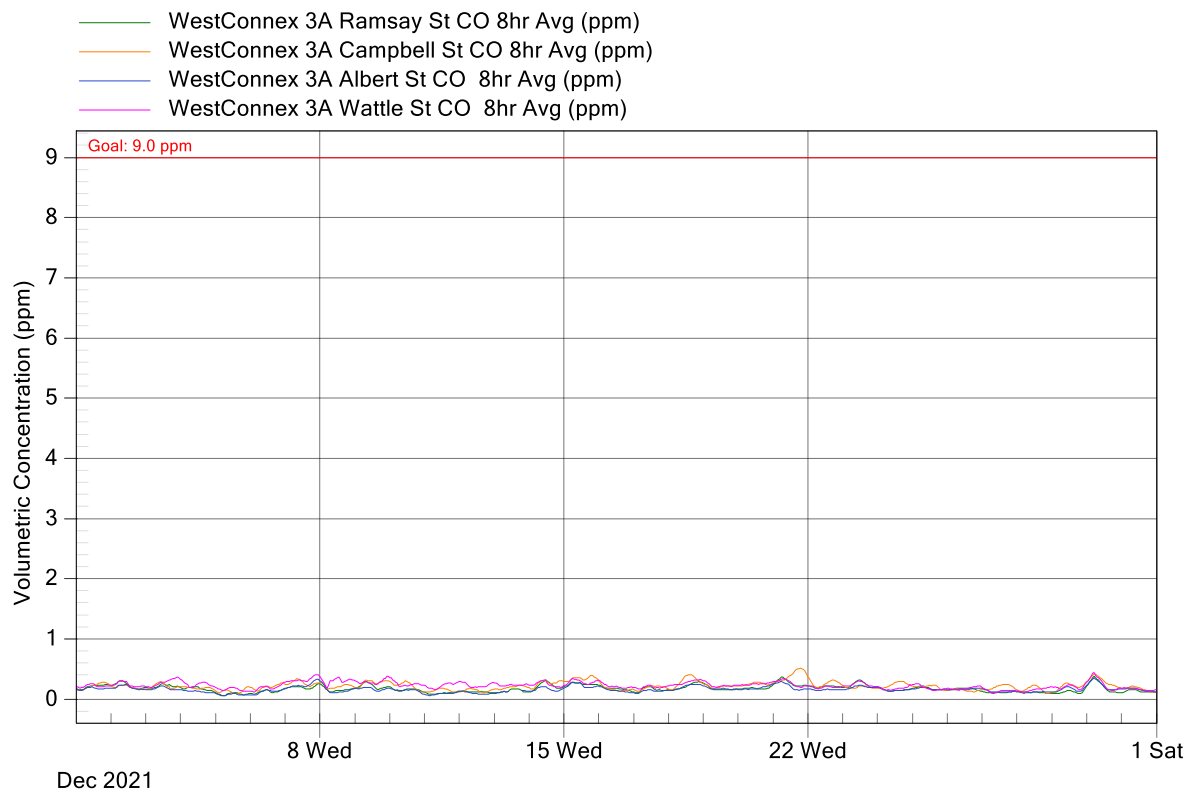

Figure 2: WCX 3A - M4_M5 Link Project Air Monitoring Stations - CO 8-Hour Rolling Graph for December 2021

NO₂ 1-Hour Averages
December 2021

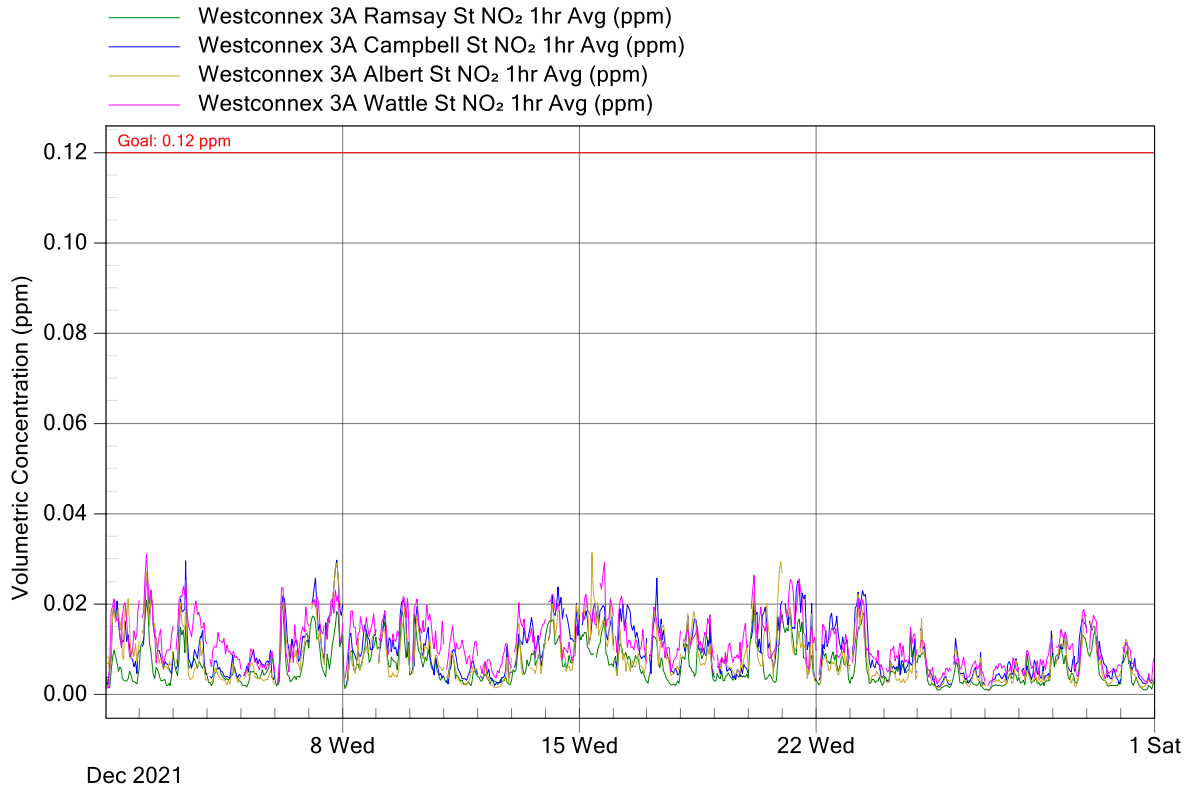**Figure 3: WCX 3A - M4_M5 Link Project Air Monitoring Stations - NO₂ 1-Hour Averages Graph for December 2021**
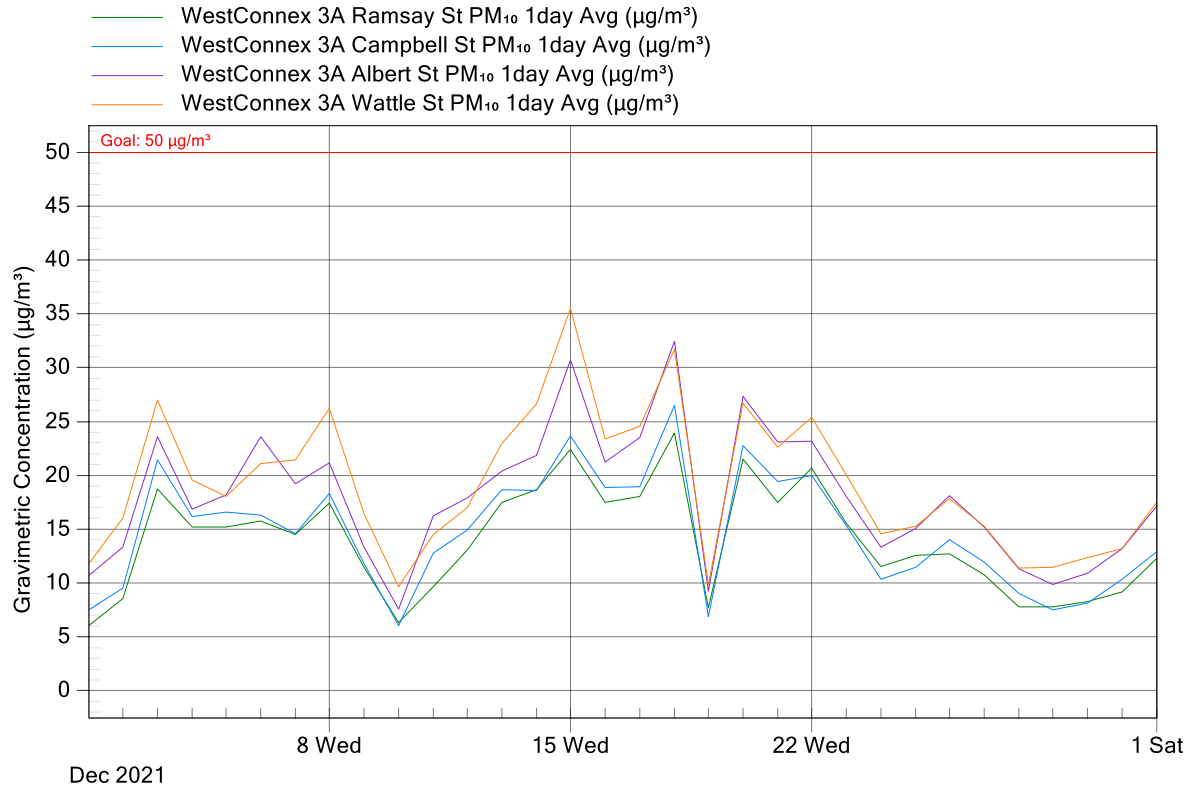
Figure 4: WCX 3A - M4_M5 Link Project Air Monitoring Stations - PM$_{10}$ 24-Hour Averages Graph for December 2021
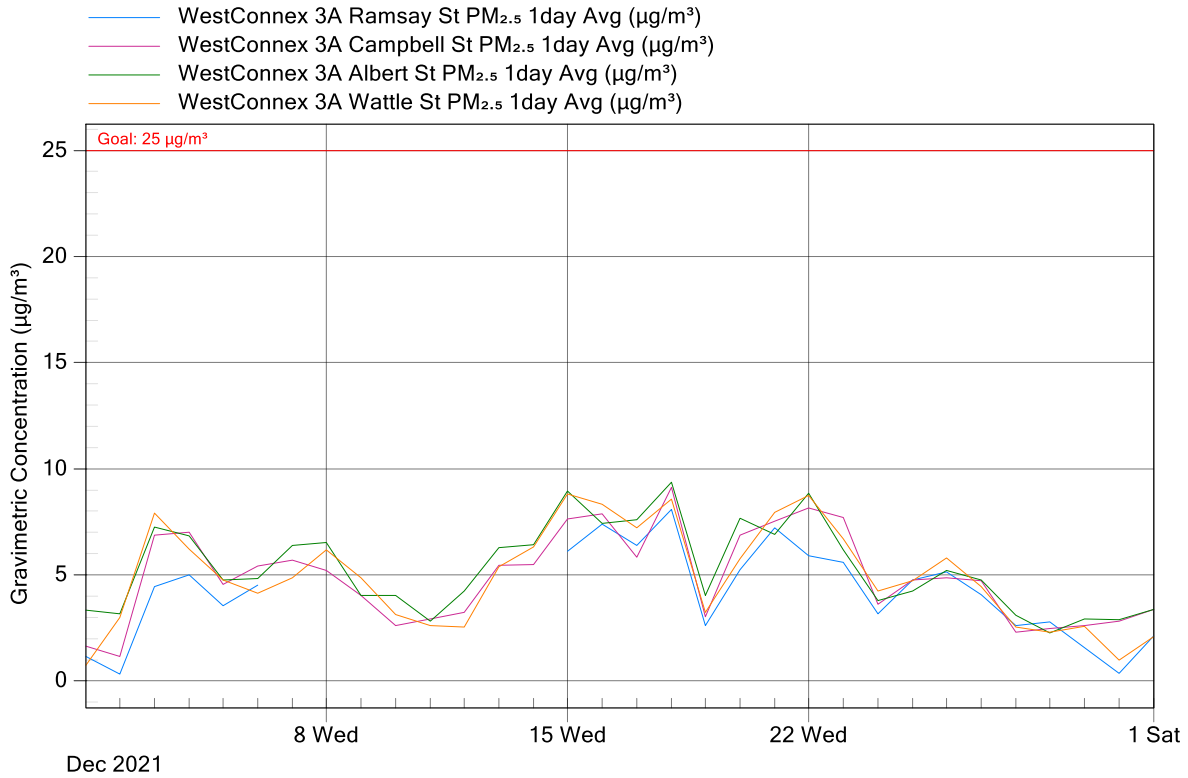
Figure 5: WCX 3A - M4_M5 Link Project Air Monitoring Stations - PM$_{2.5}$ 24-Hour Averages Graph for December 2021

Albert St - Wind Rose (1-Hour Averages)

Wind Rose
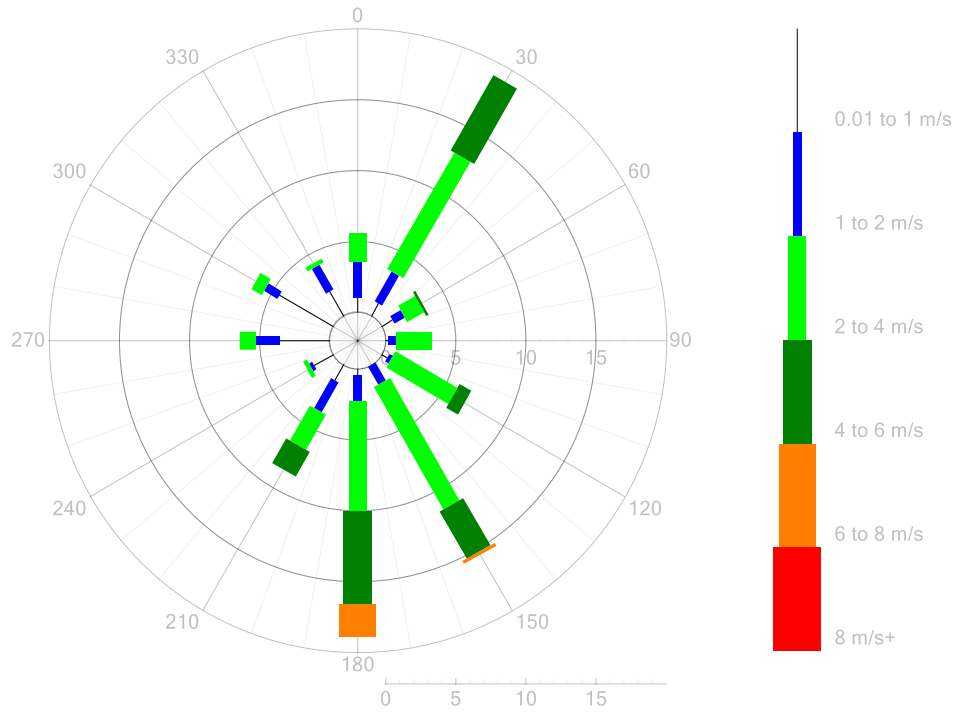
December 2021

0.0% calm
94.6% valid data present

Figure 6: WCX 3A - Albert Street – Wind Rose for December 2021

Campbell St - Wind Rose (1-Hour Averages)

Wind Rose   December 2021

0.0% calm
99.7% valid data present

Figure 7: WCX 3A - Campbell Street – Wind Rose for December 2021

Ramsay St - Wind Rose (1-Hour Averages)

Wind Rose

December 2021

0.0% calm
99.9% valid data present

Figure 8: WCX 3A - Ramsay Street – Wind Rose for December 2021

Wattle St - Wind Rose (1-Hour Averages)

Wind Rose   December 2021

0.0% calm
69.1% valid data present

Figure 9: WCX 3A - Wattle Street – Wind Rose for December 2021

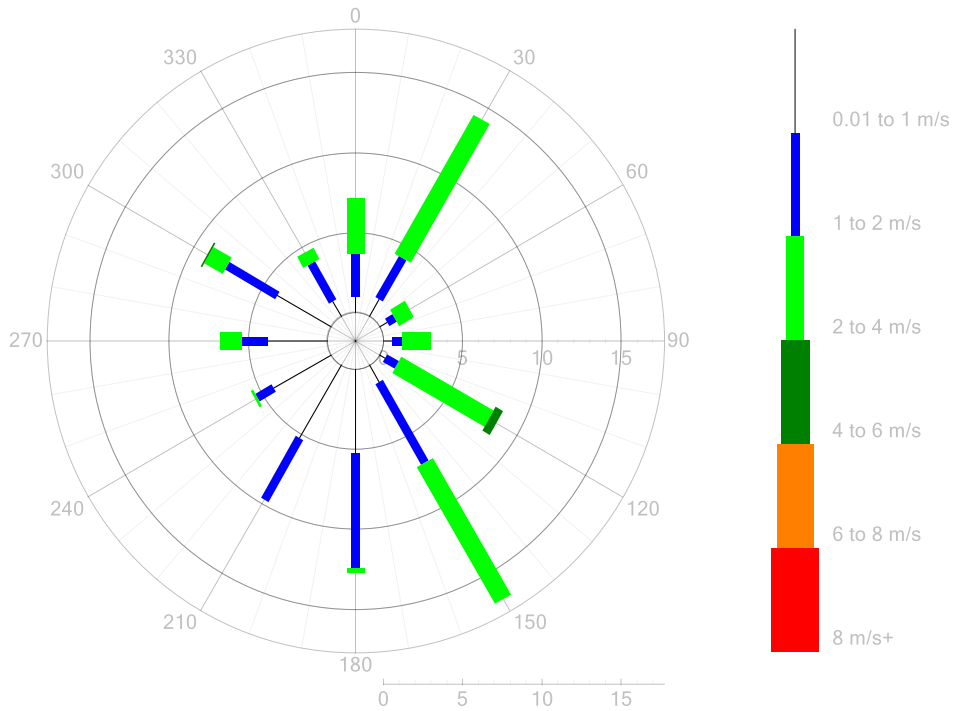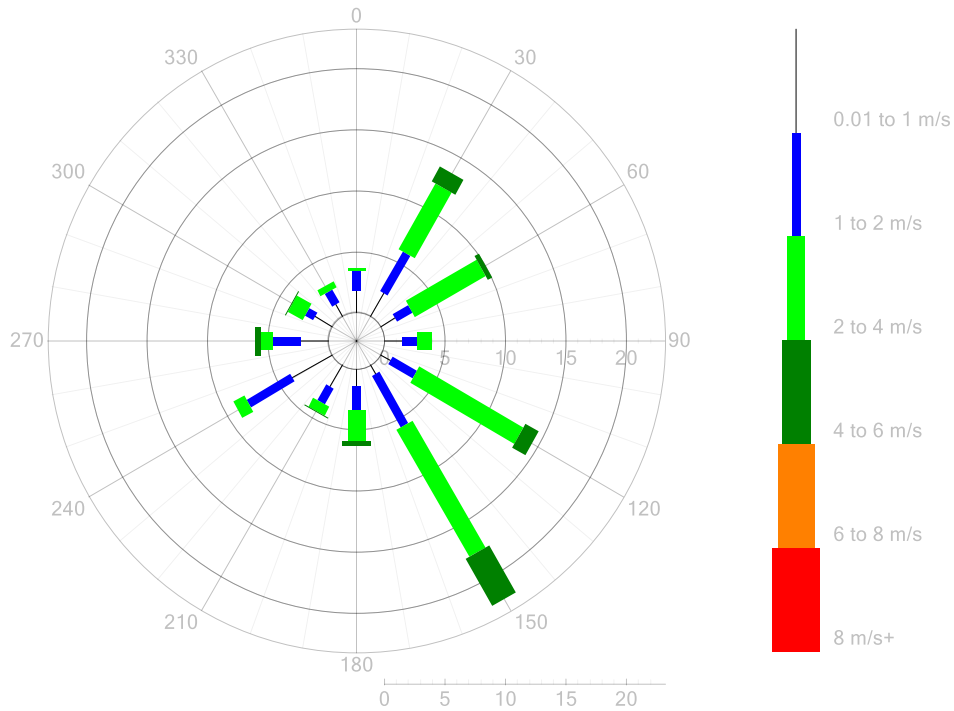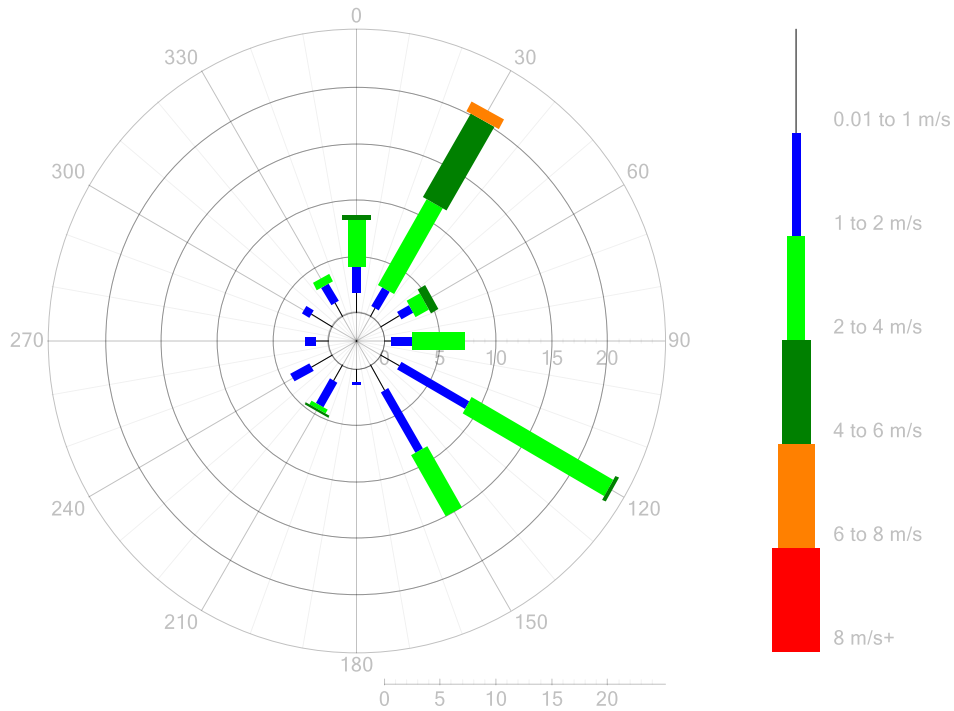## 6.0   Valid Data Exception Tables

Tables 18–21 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 18: WCX 3A - Albert Street Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/12/21 01:00	31/12/21 01:25	Automatic span and zero checks, once daily from 01:00 to 01:25 followed by instrument stabilisation	CO, NO, NO_2, NO_x	DL	17/01/22
01/12/21 23:50	31/12/21 23:55	Background checks, once daily for 5 to 10 minutes followed by instrument stabilisation	CO	DL	17/01/22
04/12/21 00:00	04/12/21 23:45	Linear offset of A = +0.05 ppm and B = 0.00 ppm applied as required to correct baseline drift	CO	DL	17/01/22
10/12/21 16:40	10/12/21 17:05	Remote maintenance followed by instrument stabilisation	AT 2m, AT 10m, WS, WD, Sigma, PM_{10}, CO, NO, NO_2, NO_x	DL	17/01/22
12/12/21 00:00	12/12/21 00:55	Static offset of +0.05 ppm applied to correct baseline	CO	DL	17/01/22
13/12/21 09:00	13/12/21 13:05	Scheduled monthly maintenance - Instrument calibrations followed by instrument stabilisation	All parameters	DL	17/01/22
13/12/21 13:10	13/12/21 23:45	Linear offset of A = +0.05 ppm and B = 0.00 ppm applied as required to correct baseline drift following the maintenance	CO	DL	17/01/22
15/12/21 00:00	15/12/21 00:55	Linear offset of A = +0.05 ppm and B = +0.10 ppm applied as required to correct baseline drift	CO	DL	17/01/22
20/12/21 08:40	20/12/21 08:40	Data transmission error	AT 2m, AT 10m, PM_{10}, CO, NO, NO_2, NO_x, WS, WD, Sigma	DL	17/01/22
24/12/21 00:00	25/12/21 11:40	Instrument fault - Data flatline	WS, WD & Sigma	DL	17/01/22
25/12/21 11:45	25/12/21 11:45	Non-scheduled maintenance - Recycled the power to meteorological power lead	AT 2m, AT 10m, WS, WD & Sigma	DL	17/01/22
27/12/21 00:00	28/12/21 00:55	Static offset of +0.05 ppm applied to correct baseline	CO	DL	17/01/22

Start Date	End Date	Reason	Change Details	User Name	Change Date
28/12/21 01:30	29/12/21 00:55	Linear offset of A = +0.05 ppm and B = 0.00 ppm applied as required to correct baseline drift	CO	DL	17/01/22
29/12/21 01:30	30/12/21 23:45	Static offset of +0.05 ppm applied to correct baseline	CO	DL	17/01/22

Table 19: WCX 3A - Campbell Street Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/12/21 00:00	31/12/21 00:55	Intermittent static offsets applied as required to correct unstable baseline *Values range from -0.35 ppm to 0.25 ppm*	CO	DL	17/01/22
01/12/21 01:00	31/12/21 01:45	Automatic span and zero checks, once daily from 01:00 to 01:45 followed by instrument stabilisation	CO, NO, NO$_2$, NO$_x$	DL	17/01/22
01/12/21 01:50	31/12/21 23:40	Intermittent linear offsets applied as required to correct unstable baseline *A values range from -0.30 ppm to 0.0 ppm and B values range from -0.60 ppm to +0.30 ppm*	CO	DL	17/01/22
01/12/21 05:35	31/12/21 12:45	Intermittent instrument fault - Status errors	CO	DL	17/01/22
01/12/21 23:45	31/12/21 23:50	Background checks, once daily for 5 to 10 minutes followed by instrument stabilisation	CO	DL	17/01/22
02/12/21 05:25	02/12/21 05:25	Data transmission error	AT 2m, AT 10m, PM$_{10}$, CO, NO, NO$_2$, NO$_x$, WS, WD, Sigma	DL	17/01/22
05/12/21 16:35	06/12/21 02:20	Intermittent unrealistic negative readings	NO, NO$_2$, NO$_x$	DL	17/01/22
14/12/21 14:00	14/12/21 15:15	Scheduled monthly maintenance - Instrument calibrations followed by instrument stabilisation	All parameters	DL	17/01/22
21/12/21 07:35	21/12/21 08:25	Unrealistic data - Possible moisture interference	PM$_{10}$	DL	17/01/22

Table 20: WCX 3A - Ramsay Street Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/12/21 00:45	31/12/21 10:10	Automatic span and zero checks, once daily from 00:45 to 01:05 followed by instrument stabilisation	CO, NO, NO_2, NO_x	DL	17/01/22
01/12/21 01:20	19/12/21 23:40	Intermittent linear offsets applied as required to correct unstable baseline *A values range from 0.00 ppm to +0.15 ppm and B values range from -0.20 ppm to +0.15 ppm*	CO	DL	17/01/22
01/12/21 23:50	31/12/21 23:45	Background checks, once daily for 5 to 10 minutes followed by instrument stabilisation	CO	DL	17/01/22
02/12/21 10:50	26/12/21 05:25	Intermittent static offsets applied as required to correct unstable baseline *Values range from -0.10 ppm to +0.10 ppm*	CO	DL	17/01/22
07/12/21 15:00	14/12/21 13:00	Instrument fault	$PM_{2.5}$	DL	17/01/22
10/12/21 22:10	11/12/21 00:25	Unrealistic data - Possible moisture interference	PM_{10}	DL	17/01/22
14/12/21 14:00	14/12/21 16:00	Scheduled monthly maintenance (1st Visit) - Instrument calibrations followed by instrument stabilisation	$PM_{2.5}$	DL	17/01/22
14/12/21 15:00	14/12/21 15:00	Data affected during maintenance	AT 10m. WS, WD & Sigma	DL	17/01/22
15/12/21 00:00	15/12/21 00:00	Instrument fault - Beta count error	$PM_{2.5}$	DL	17/01/22
15/12/21 10:00	15/12/21 12:00	Scheduled monthly maintenance (2nd Visit) - Instrument calibrations followed by instrument stabilisation	All parameters	DL	17/01/22

Table 21: WCX 3A - Wattle Street Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/12/21 01:00	31/12/21 01:25	Automatic span and zero checks, once daily from 01:00 to 01:25 followed by instrument stabilisation	CO, NO, NO$_2$, NO$_x$	DL	17/01/22
01/12/21 23:45	31/12/21 23:50	Background checks, once daily for 5 to 10 minutes followed by intermittent instrument stabilisation	CO	DL	17/01/22
05/12/21 17:35	27/12/21 08:35	Intermittent unrealistic negative readings	NO, NO$_2$, NO$_x$	DL	17/01/22
07/12/21 14:40	20/12/21 11:45	Intermittent instrument fault - Data flatline	WS, WD & Sigma	DL	17/01/22
07/12/21 23:40	02/12/21 00:55	Intermittent unrealistic data	CO	DL	17/01/22
15/12/21 13:00	15/12/21 14:35	Scheduled monthly maintenance - Instrument calibrations followed by instrument stabilisation	All parameters	DL	17/01/22
15/12/21 14:40	31/12/21 23:40	Static offset of -0.10 ppm applied to correct baseline following the maintenance	CO	DL	17/01/22

7.0   Report Summary

- Percentage availability for most parameters at WCX 3A - Albert Street station was above 95% during the reporting month, except for WS, WD and Sigma affected by data flatline.

- Percentage availability for all parameters at WCX 3A - Campbell Street station was above 95% during the reporting month.

- Percentage availability for all parameters at WCX 3A - Ramsay Street station was above 95% during the reporting month.

- Percentage availability for most parameters at WCX 3A - Wattle Street station was above 95% during the reporting month, except for WS, WD and Sigma affected by data flatline.

- Refer to Table 12, and Tables 18-21 for details.

- There were no exceedance of the air quality goals at the WCX 3A - M4_M5 Link Ambient Air Quality Monitoring Network for the reporting month. Please refer to Tables 13-16 in Section 5.2 – Air Quality Monthly Summary for further information.

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
$\mu g/m^3$	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	Millimeters
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 un-used 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.