

**APPENDIX 3B – AIR QUALITY
MONITORING DATA**

Summary of Annual Average Dust Deposition

| EPL 12425 ID No. | 3 | 4 | - | 6 | - | 9 | 10 | 11 | 12 | 26 |
|--|------|------|------|------|------|------|------|-------|------|------|
| Monitoring ID No. | DG4 | DG5 | DG7* | DG8 | DG10 | DG11 | DG12 | DG13 | DG14 | DG15 |
| 2011 Annual Average Total Insoluble Matter (g/m ² /month) | 0.40 | 1.13 | 1.22 | 0.94 | 3.02 | 1.30 | 3.73 | 1.95 | 1.88 | |
| 2012 Annual Average Total Insoluble Matter (g/m ² /month) | 2.80 | 0.73 | 1.52 | 1.03 | 1.19 | 1.41 | 6.52 | 2.38 | 2.18 | |
| 2013 Annual Average Total Insoluble Matter (g/m ² /month) | 1.20 | 0.60 | | 1.43 | 2.04 | 1.98 | 3.26 | 1.94 | 1.04 | 1.00 |
| 2014 Annual Average Total Insoluble Matter (g/m ² /month) | 1.68 | 0.83 | | 1.48 | 3.31 | 1.28 | 3.28 | 2.81 | 1.43 | 0.85 |
| 2015 Annual Average Total Insoluble Matter (g/m ² /month) | 0.90 | 0.80 | | 1.09 | 3.61 | 1.94 | 2.91 | 5.91 | 1.16 | 0.75 |
| 2016 Annual Average Total Insoluble Matter (g/m ² /month) | 1.30 | 1.34 | | 1.10 | 1.88 | 4.18 | 2.48 | 33.81 | 4.80 | 1.64 |
| | 1.1 | 1.5 | | 1.5 | 4.2 | 2.9 | 3.4 | 27.2 | 13.9 | 1.4 |

Notes: Green shaded cells indicated internal dust depositional monitoring sites at heritage sites.. *At the end of the 2012 reporting period DG7 was relocated from the Mittville Property to Araluen Road. Araluen Road is situated to the north east of Wollar Village. The new dust gauge is identified as DG15.

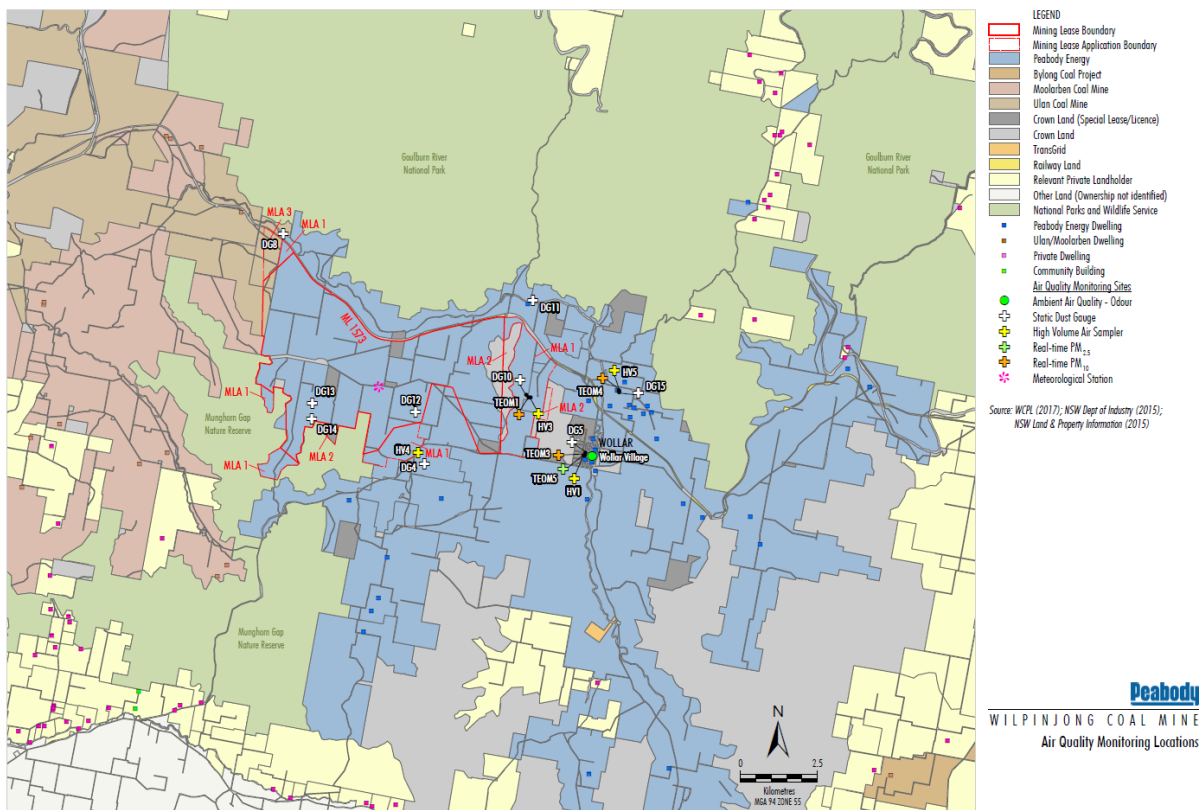
Summary of TSP and PM₁₀ Results

| Monitoring Locations [#] | | | | | | | |
|---|--------------|-------------|--------------|--------------|--------------------|--------------|--------------|
| EPL 12425 ID No. | 13 | 19 | 20 | 27 | - | 25 | 28 |
| Monitoring ID No. | HV1 | HV3 | HV4 | HV5 | TEOM1 [^] | TEOM3 | TEOM4 |
| 2012 Results | | | | | | | |
| PM ₁₀ (µg/m ³) recorded range* | 2.8 – 21.7 | - | 12.0 – 21.8 | ** | 3.4 - 60.3 | ** | ** |
| PM ₁₀ (µg/m ³) annual average | 9.1 | - | 9.7 | ** | 9.7 | ** | ** |
| TSP (µg/m ³) recorded range* | - | 1.9 – 47.0 | - | - | - | - | - |
| TSP (µg/m ³) annual average | - | 18.8 | - | - | - | - | - |
| 2013 Results | | | | | | | |
| PM ₁₀ (µg/m ³) recorded range* | 1.2 – 43.7 | - | 2 – 55.1 | 1.8 – 49.8 | 3.0 – 82.5 | 2.4 – 55.6 | 0.7 – 68.9 |
| PM ₁₀ (µg/m ³) annual average | 10.84 | - | 12.4 | 15.71 | 18.5 | 13.1 | 16.8 |
| TSP (µg/m ³) recorded range* | - | 3.1 – 77.6 | - | - | - | - | - |
| TSP (µg/m ³) annual average | - | 27.45 | - | - | - | - | - |
| 2014 Results | | | | | | | |
| PM ₁₀ (µg/m ³) recorded range* | 1.70 - 41.20 | - | 1.80 – 37.70 | 2.80 – 47.80 | 1.8-69.5 | 2.65 – 59.12 | 1.18 – 53.96 |
| PM ₁₀ (µg/m ³) annual average | 11.15 | - | 11.95 | 14.58 | 17.3 | 13.2 | 13.5 |
| TSP (µg/m ³) recorded range* | - | 7.20 – 59.0 | - | - | - | - | - |
| TSP (µg/m ³) annual average | - | 23.09 | - | - | - | - | - |
| 2015 Results | | | | | | | |
| PM ₁₀ (µg/m ³) recorded range* | 1.1 – 29.3 | - | 1.9 – 40.0 | 1.0 – 35.3 | 2.2 – 87.8 | 1.4 – 78.5 | 0.1 – 77.3 |
| PM ₁₀ (µg/m ³) annual average | 9.99 | - | 11.52 | 11.68 | 14.1 | 11.26 | 14.16 |
| TSP (µg/m ³) recorded range* | - | 3.7 – 68.7 | - | - | - | - | - |
| TSP (µg/m ³) annual average | - | 22.74 | - | - | - | - | - |

Summary of TSP and PM₁₀ Results cont.

| Monitoring Locations [#] | | | | | | | |
|---|------------|--------------|------------|------------|------------|------------|-------------------------|
| EPL 12425 ID No. | 13 | 19 | 20 | 27 | - | 25 | 28 |
| Monitoring ID No. | HV1 | HV3 | HV4 | HV5 | TEOM1^ | TEOM3 | TEOM4 |
| 2016 Results | | | | | | | |
| PM10 (µg/m ³) recorded range* | 1.5 – 23.0 | - | 1.8 – 25.2 | 2.5 – 34.2 | 3.3 – 41.7 | 0.4 – 34.4 | 0.0 – 51.1 ¹ |
| PM10 (µg/m ³) annual average | 9.78 | - | 11.69 | 13.95 | 15.0 | 10.2 | 11.3 |
| TSP (µg/m ³) recorded range* | - | 3.9 – 82.0 | - | - | - | - | - |
| TSP (µg/m ³) annual average | - | 27.59 | - | - | - | - | - |
| 2017 Results | | | | | | | |
| PM10 (µg/m ³) recorded range* | 2.1 - 28.2 | - | 4.5 - 69.1 | 5.1 - 55.4 | 2.9 - 86.7 | 0.9 - 52.2 | 0.9 - 50.9 |
| PM10 (µg/m ³) annual average | 12.2 | - | 16.7 | 16.6 | 18.4 | 9.5 | 12.8 |
| TSP (µg/m ³) recorded range* | - | 10.1 - 142.0 | - | - | - | - | - |
| TSP (µg/m ³) annual average | - | 38.1 | - | - | - | - | - |

Air Quality Monitoring Stations



Air Quality Monitoring Stations (Wollar)



| | | | |
|---------------|------------------------------------|-------------------------------------|-----------------------------|
| LEGEND | | Noise Monitoring Sites | |
| | Peabody Energy | | Attended Noise |
| | Crown Land (Special Lease/Licence) | | Real-time Noise |
| | Crown Land | Blasting Monitoring Sites | |
| | Railway Land | | Fixed Blast |
| | Relevant Private Landholder | Air Quality Monitoring Sites | |
| | Landholder Reference Number | | Ambient Air Quality - Odour |
| | Peabody Energy Dwelling | | Static Dust Gauge |
| | Community Building | | High Volume Air Sampler |
| | Private Dwelling | | Real-time PM _{2.5} |
| | # Special Lease/Licence Holder | | Real-time PM ₁₀ |

Source: WCPL (2017); NSW Dept of Industry (2015); NSW Land & Property Information (2016)

Peabody
 WILPINJONG COAL MINE
 Wollar Environmental Monitoring Sites

2017 Ambient Air Quality Monitoring Reports

Peabody Energy

Wilpinjong Coal Wollar

Ambient Air Quality Monitoring Validated Report

1st January – 31st January 2017

Report No.: DAT11654

Report issue date: 28th February 2017

Maintenance contract: MC951

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| Revision History | | | |
|------------------|-----------|------------|-----------------|
| Revision | Report ID | Date | Analyst |
| 0 | DAT11654 | 28/02/2017 | Camila Trindade |



Table of Contents

Customer Details..... 2

Revision History 2

Table of Contents..... 3

List of Figures 4

List of Tables 5

1.0 Executive Summary.....6

2.0 Introduction7

3.0 Monitoring and Data Collection.....7

 3.1. Siting Details..... 7

 3.2. Monitored Parameters 9

 3.3. Data Collection Methods 10

 3.3.1. Compliance with Standards 11

 3.3.2. Data Acquisition 11

 3.4. Data Validation and Reporting..... 11

 3.4.1. Validation 11

 3.4.2. Reporting..... 12

4.0 Air Quality Goals.....13

 4.1. Air Quality Summary 13

5.0 Calibrations and Maintenance.....14

 5.1. Units and Uncertainties 14

 5.2. Automatic Checks 15

 5.3. Maintenance 15



5.3.1. Calibration & Maintenance Summary Tables 15

6.0 Results.....17

6.1. Data Capture 17

6.2. Graphic Representations 18

7.0 Valid Data Exception Tables23

8.0 Report Summary.....24

Appendix 1 - Definitions & Abbreviations25

Appendix 2 - Explanation of Exception Table.....26

List of Figures

Figure 1: Wilpinjong Mine Monitoring Station Location..... 8

Figure 2: NO - 1 hour data 18

Figure 3: NO₂ - 1 hour data 19

Figure 4: NO_x - 1 hour data 19

Figure 5: SO₂ - 1 hour data 20

Figure 6: H₂S - 1 hour data 20

Figure 7: BTX - 1 hour data..... 21

Figure 8: WS - 1 hour data 21

Figure 9: Wind Rose 22

List of Tables

| | |
|---|----|
| Table 1: Wilpinjong Mine monitoring site location | 7 |
| Table 2: Parameters measured at the Wilpinjong Mine monitoring station..... | 9 |
| Table 3: Methods | 10 |
| Table 4: Wilpinjong Air Quality Goals (NEPM) | 13 |
| Table 5: Exceedences Recorded..... | 13 |
| Table 6: Units and Uncertainties..... | 14 |
| Table 7: Automatic checks for NO, NO ₂ , NO _x , SO ₂ , H ₂ S and BTX..... | 15 |
| Table 8: Wilpinjong Wollar Maintenance Table | 16 |
| Table 9: Data Capture for Wilpinjong Wollar Station | 17 |
| Table 10: Wollar Valid Data Exception Table | 23 |

1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene, *p*-Xylene, wind speed and wind direction.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for January 2017. Data capture for the different pollutants is presented in Table 9.

2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for January 2017.

The data presented in this report:

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

3.0 Monitoring and Data Collection

3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

Table 1: Wilpinjong Mine monitoring site location

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|-----------|----------------------------------|----------------------------|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with AS/NZS 3580.1.1:2007 “Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment”.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to AS/NZS 3580.1.1:2007.



Figure 1: Wilpinjong Mine Monitoring Station Location

3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

Table 2: Parameters measured at the Wilpinjong Mine monitoring station

| Parameter Measured | Instrument and Measurement Technique |
|--|--|
| BTX (Benzene, Toluene and <i>p</i> -Xylene) | Synspec GC955 - Gas Chromatography |
| H ₂ S | Ecotech EC9852 - fluorescence |
| NO, NO ₂ , NO _x | Ecotech EC9841 gas phase chemiluminescence |
| SO ₂ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Gill Windsonic |
| Wind Direction (10m) | Gill Windsonic |

3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

Table 3: 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 |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| SO ₂ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
| H ₂ S | Ecotech Laboratory Manual | In-house method 6.5 Hydrogen sulfide by fluorescence |
| BTX | Manufacturer’s Instructions | Gas Chromatography Synspec CG955 Series Manual |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.

3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger 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.

3.4. Data Validation and Reporting

3.4.1. 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 minute data.

3.4.2. Reporting

The reported data is in a Microsoft Excel format file named “*Wilpinjong Coal Validated Data Report Jan-17.xls*”. The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5 Minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

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

All averages are calculated from the five minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days.

4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

Table 4: Wilpinjong Air Quality Goals (NEPM)

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|-----------------|-------------|------------------|-------|-------------------------------|
| NO ₂ | 1 year | 30 | ppb | None |
| NO ₂ | 1 hour | 120 | ppb | 1 day a year |
| SO ₂ | 1 hour | 200 | ppb | 1 day a year |
| SO ₂ | 1 day | 80 | ppb | 1 day a year |
| SO ₂ | 1 year | 20 | ppb | None |

4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

Table 5: Exceedences Recorded

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|-----------------|-------------|---------------------|--------------------|
| NO ₂ | 1 hour | - | - |
| SO ₂ | 1 hour | - | - |
| SO ₂ | 1 day | - | - |

5.0 Calibrations and Maintenance

5.1. 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 6: Units and Uncertainties

| Parameter | Units | Resolution | Uncertainty | Measurement Range ¹ |
|--|-------|------------|--|--|
| NO, NO _x (EC9841) | ppm | 1 ppb | ± 14 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| NO ₂ (EC9841) | ppm | 1 ppb | ± 16 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| SO ₂ (EC9850) | ppm | 1 ppb | ± 14 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| H ₂ S | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and <i>p</i> -Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.01 m/s or 2.0% of reading, whichever is greater (K factor of 1.96) | 0 m/s to 60 m/s |
| Vector Wind Direction | Deg | 1 deg | ±2 deg K factor of 2.11 | 0 deg to 360 deg Starting threshold: 0 m/s |

¹ Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, NO₂ and NO_x by EC 9841 and SO₂ by EC9850 are calculated based on a measurement range of 0-125 ppb.

5.2. Automatic Checks

Automatic span and zero calibration checks run every night for NO, NO₂, NO_x and SO₂, every 2nd night for H₂S and weekly for BTX.

Background checks run each night for SO₂ and H₂S.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

Table 7: Automatic checks for NO, NO₂, NO_x, SO₂, H₂S and BTX

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---------------------------------------|--|-------------------------------------|
| NO, NO ₂ , NO _x | 00:45 to 01:40 every day | N/A |
| SO ₂ | 00:45 to 01:40 every day | 23:45 to 23:50 every day |
| H ₂ S | 01:35 to 02:35 every 2 nd day | 23:45 to 23:50 every day |
| BTX | 02:45 to 04:45 every 7 th day | N/A |

5.3. Maintenance

Scheduled monthly maintenance was performed 25-27th January.

5.3.1. 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.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

Table 8: Wilpinjong Wollar Maintenance Table

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---------------------------------------|--------------------------|------------------|--------------------------|-------------------|
| NO, NO ₂ , NO _x | 27/01/2017 | Monthly | 27/01/2017 | Monthly |
| SO ₂ | 25/01/2017 | Monthly | 25/01/2017 | Monthly |
| H ₂ S | 25/01/2017 | Monthly | 25/01/2017 | Monthly |
| BTX | 27/01/2017 | Monthly | 27/01/2017 | Yearly |
| Wind Speed | 25/01/2017 | Monthly | 21/05/2015 | 2-Yearly |
| Wind Direction | 25/01/2017 | Monthly | 21/05/2015 | 2-Yearly |

6.0 Results

6.1. Data Capture

Data capture is based on 1 hour averages, calculated from 5 minute data, and refers to the amount of available data collected during the report period.

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

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

Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for December 2016. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

Table 9: Data Capture for Wilpinjong Wollar Station

| Parameter | Data Capture % |
|---------------------------------------|----------------|
| NO, NO ₂ , NO _x | 95.6 |
| SO ₂ | 95.1 |
| H ₂ S | 95.7 |
| Benzene | 88.0 |
| Toluene | 84.7 |
| p-Xylene | 15.1 |
| WS, WD | 99.0 |

6.2. Graphic Representations

Validated 5 minute data for NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

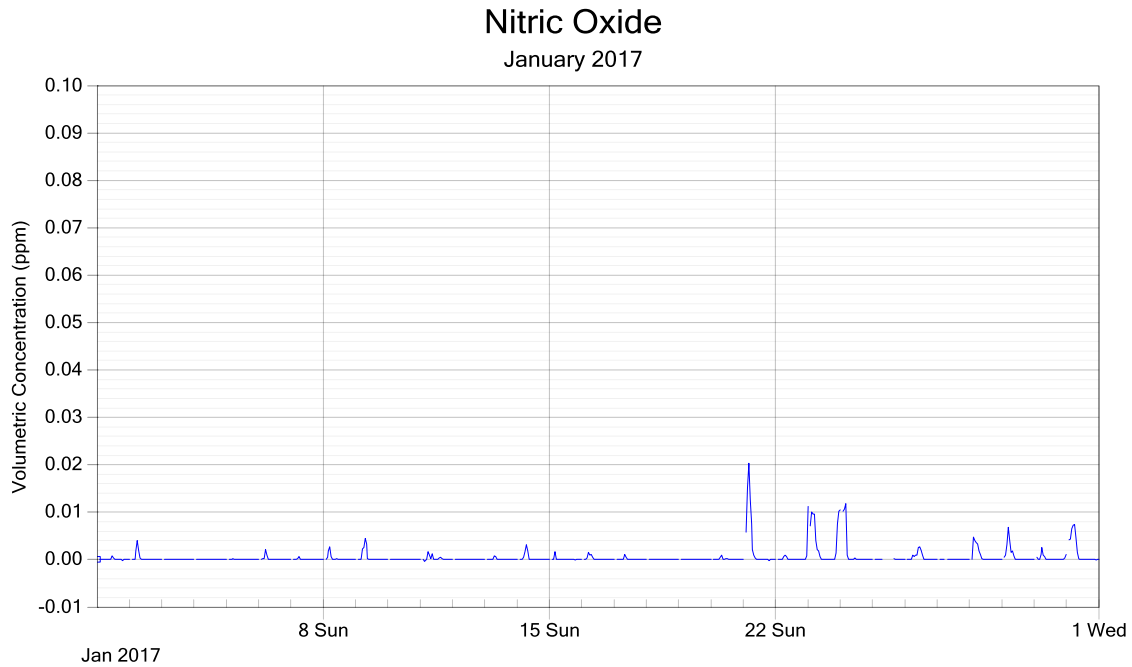


Figure 2: NO - 1 hour data

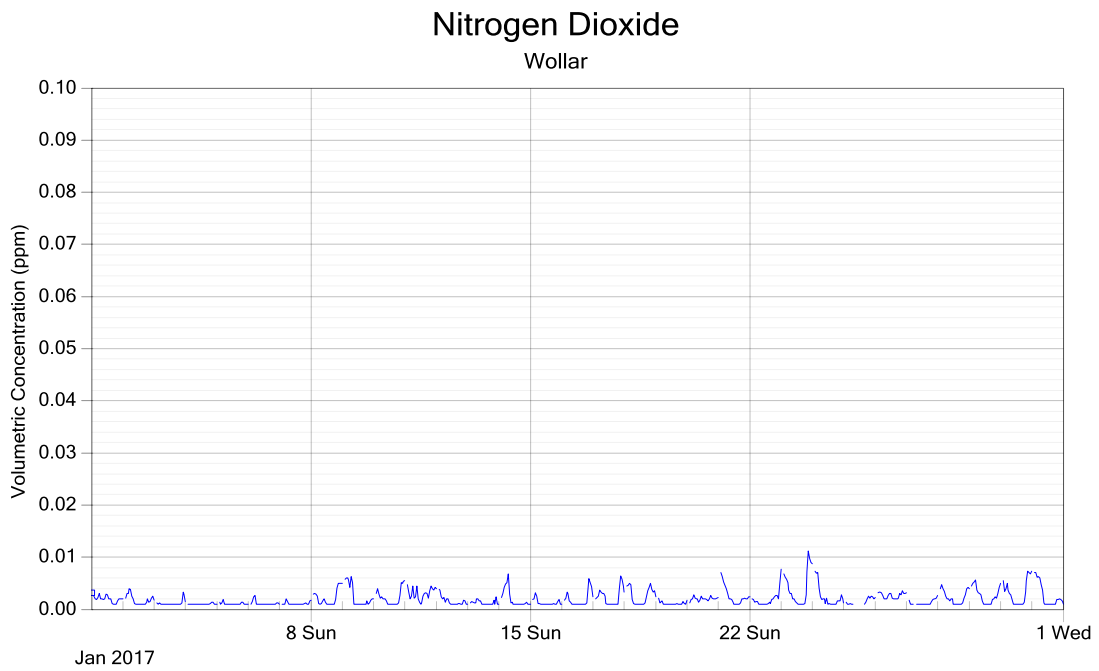


Figure 3: NO₂ - 1 hour data

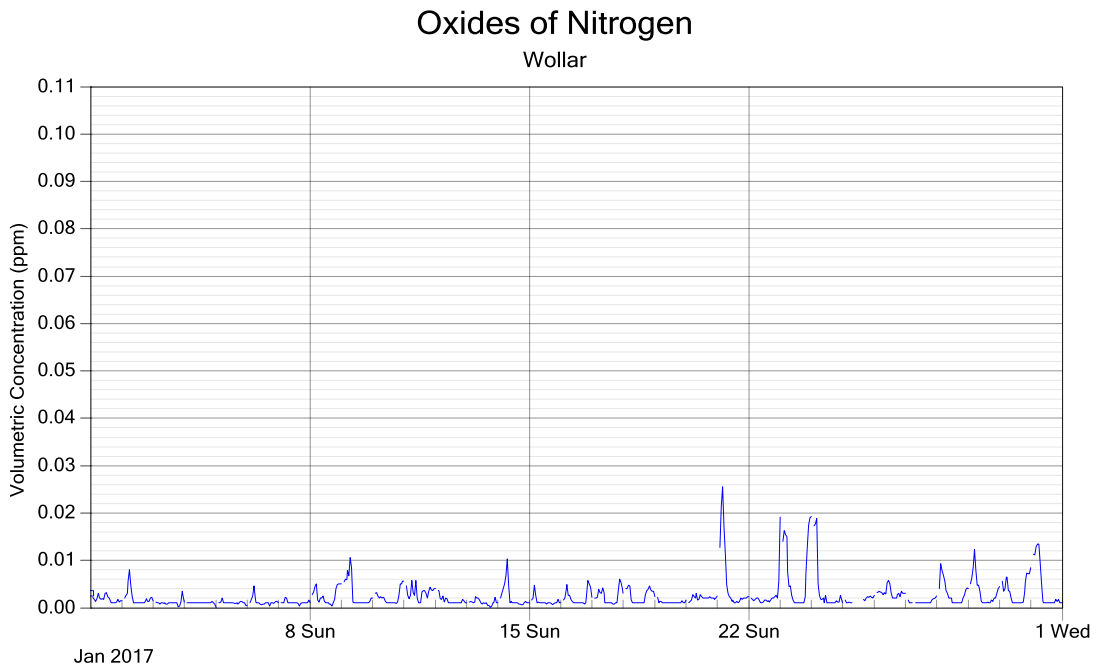


Figure 4: NO_x - 1 hour data

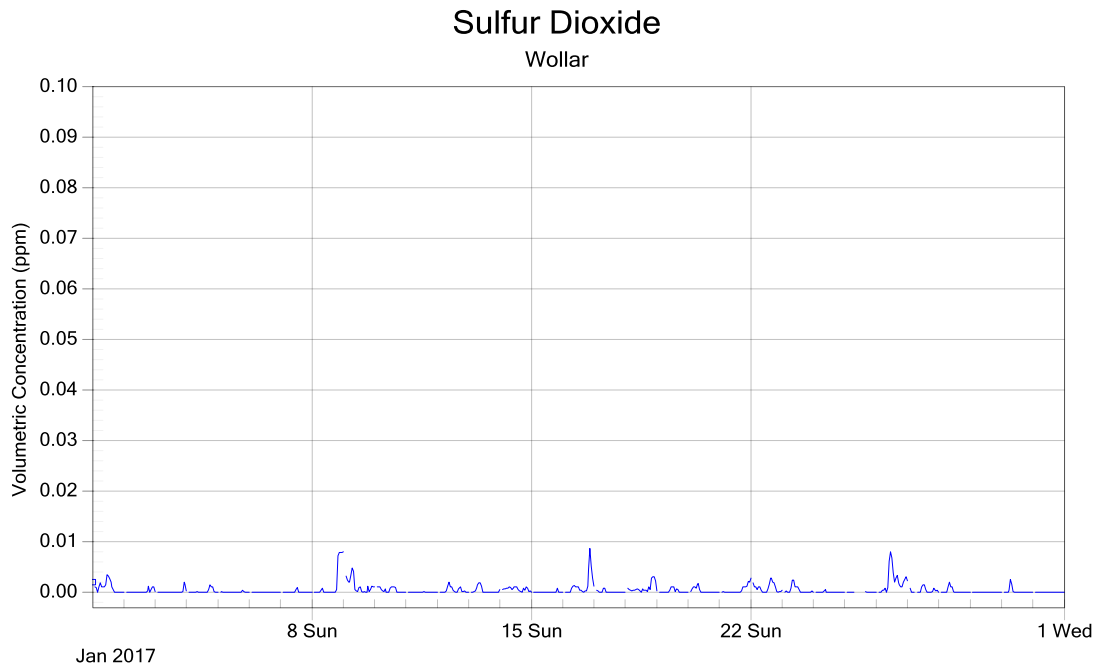


Figure 5: SO₂ - 1 hour data

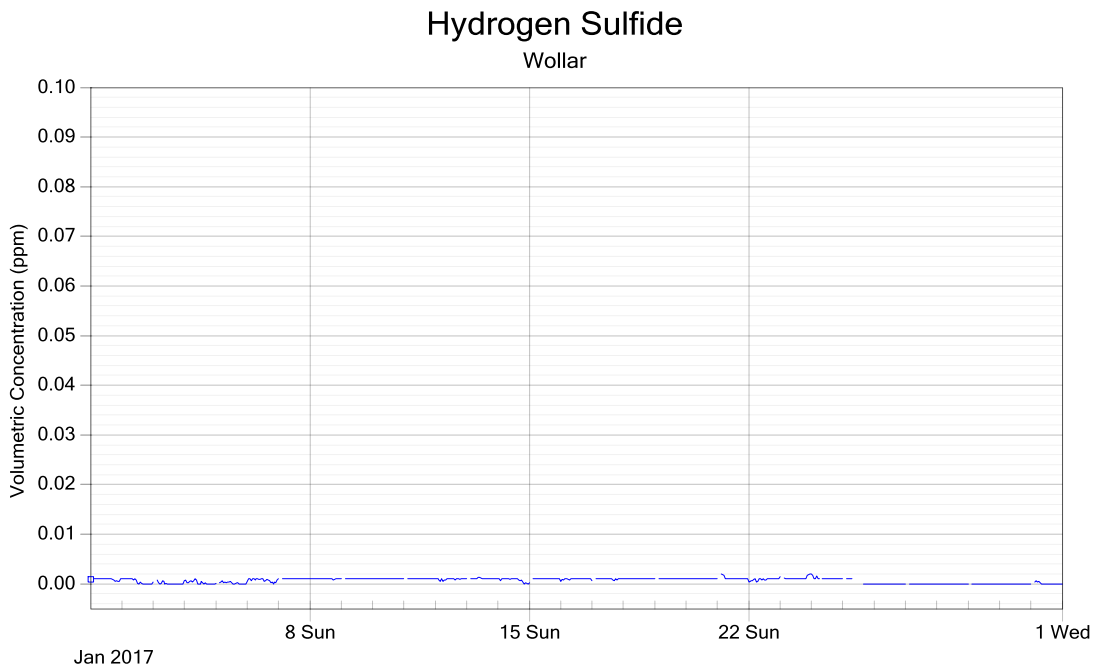


Figure 6: H₂S - 1 hour data

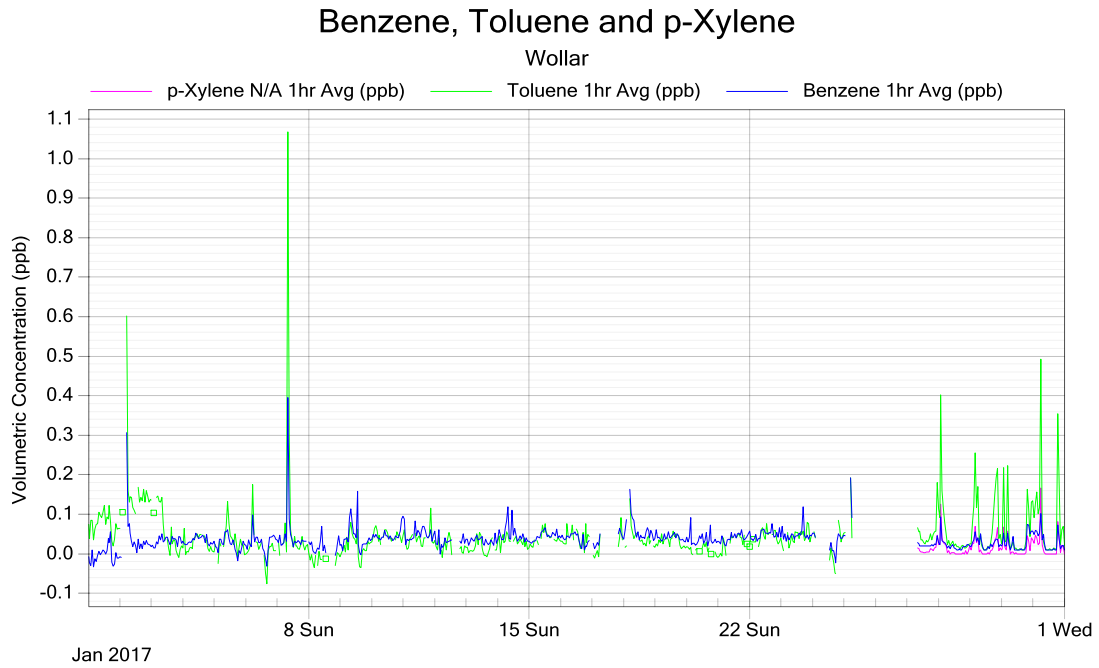


Figure 7: BTX - 1 hour data

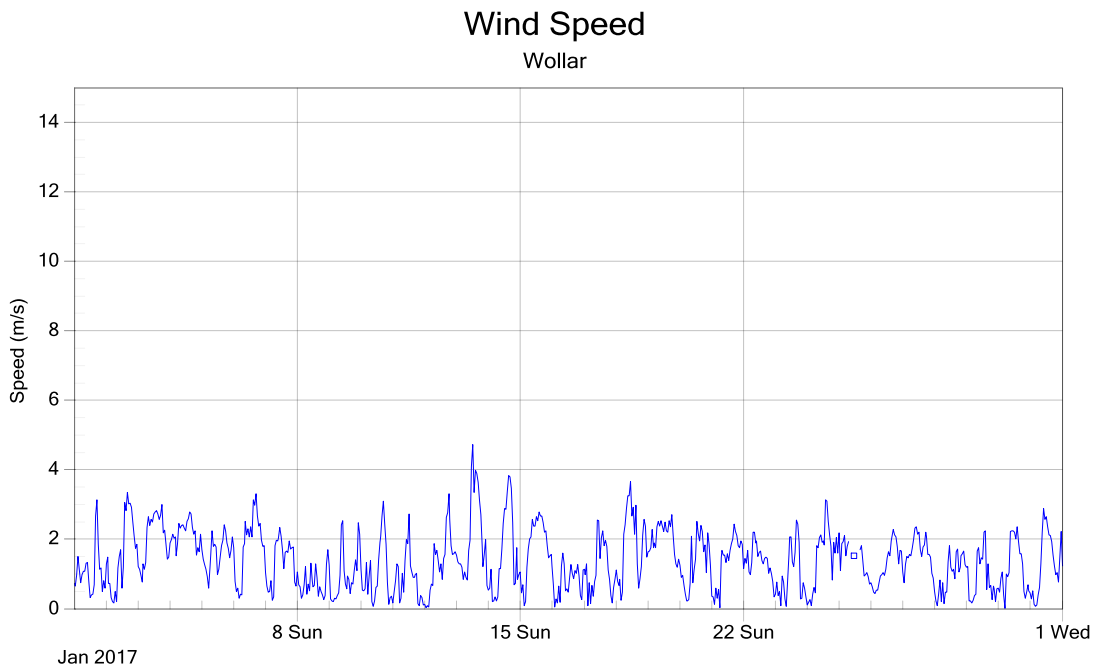


Figure 8: WS - 1 hour data

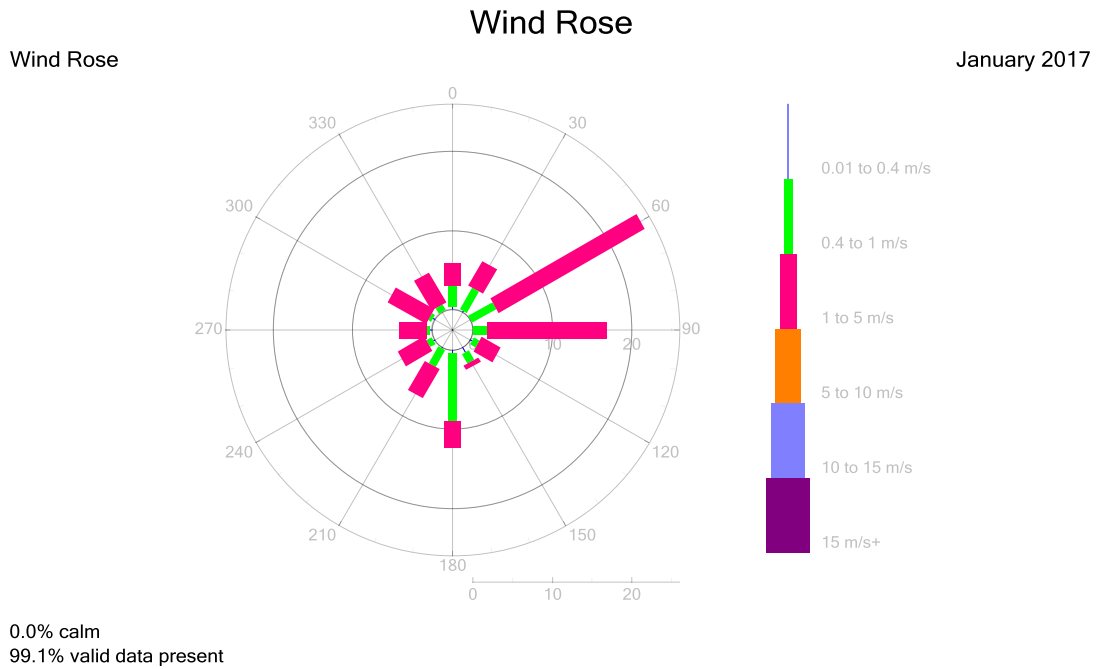


Figure 9: Wind Rose

7.0 Valid Data Exception Tables

The tables below details 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 10: Wollar Valid Data Exception Table

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---------------------|---------------------|--|---------------------------------------|-----------|-------------|
| 1/01/2017 0:00 | 25/01/2017 7:20 | Data outside of calibration tolerance | Xyl | CT | 28/02/2017 |
| 2/01/2017 1:00 | 24/01/2017 19:20 | Data intermittent was not detected by the analyser | Ben, Tol | CT | 28/02/2017 |
| 8/01/2017 14:05 | 24/01/2017 13:00 | Intermittent instrument out of operation mode | Ben, Tol | CT | 28/02/2017 |
| 24/01/2017 7:35 | 24/01/2017 8:05 | Brief power interruption and subsequent instrument stabilisation | All parameters | CT | 28/02/2017 |
| 25/01/2017 7:55 | 25/01/2017 16:00 | Scheduled 6 monthly maintenance - replaced BTX analyser | All parameters | CT | 27/02/2017 |
| 25/01/2017 16:05 | 27/01/2017 7:25 | Continued maintenance. Subsequent instrument stabilisation | Ben, Tol, Xyl | CT | 28/02/2017 |
| 27/01/2017 6:20 | 27/01/2017 17:25 | Cont. 6 monthly maintenance | NO, NO ₂ , NO _x | CT | 28/02/2017 |

8.0 Report Summary

The data capture for Wollar was below 95% for some measured parameters.

Please refer to Data Capture Percentage Table 9 on page 17 for details, and Table 10 on page 23 for valid data exceptions.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

-----END OF REPORT-----

Appendix 1 - Definitions & Abbreviations

| | |
|------------------|---------------------------------------|
| BTX | Benzene, Toluene and <i>p</i> -Xylene |
| H ₂ S | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| NO ₂ | Nitrogen dioxide |
| NO _x | Oxides of nitrogen |
| ppb | Parts per billion |
| SO ₂ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

Appendix 2 - Explanation of Exception Table

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.

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

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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.

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

Peabody Energy

Wilpinjong Coal Wollar

Ambient Air Quality Monitoring

Validated Report

1st February – 28th February 2017

Report No.: DAT11723

Report issue date: 28th March 2017

Maintenance contract: MC951

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| Revision History | | | |
|------------------|-----------|------------|---------------|
| Revision | Report ID | Date | Analyst |
| 0 | DAT11723 | 28/03/2017 | Robyn Edwards |

Report by:

Robyn EDWARDS



Approved Signatory:

Jon ALEXANDER





Table of Contents

Customer Details..... 2

Revision History 2

Table of Contents..... 3

List of Figures 4

List of Tables 5

1.0 Executive Summary.....6

2.0 Introduction7

3.0 Monitoring and Data Collection.....7

 3.1. Siting Details..... 7

 3.2. Monitored Parameters 9

 3.3. Data Collection Methods 10

 3.3.1. Compliance with Standards 11

 3.3.2. Data Acquisition 11

 3.4. Data Validation and Reporting..... 11

 3.4.1. Validation 11

 3.4.2. Reporting..... 12

4.0 Air Quality Goals.....13

 4.1. Air Quality Summary 13

5.0 Calibrations and Maintenance.....14

 5.1. Units and Uncertainties 14

 5.2. Automatic Checks 15

 5.3. Maintenance 15



5.3.1. Calibration & Maintenance Summary Tables 15

6.0 Results.....17

6.1. Data Capture 17

6.2. Graphic Representations 18

7.0 Valid Data Exception Tables23

8.0 Report Summary.....24

Appendix 1 - Definitions & Abbreviations25

Appendix 2 - Explanation of Exception Table.....26

List of Figures

Figure 1: Wilpinjong Mine Monitoring Station Location..... 8

Figure 2: NO - 1 hour data 18

Figure 3: NO₂ - 1 hour data 19

Figure 4: NO_x - 1 hour data 19

Figure 5: SO₂ - 1 hour data 20

Figure 6: H₂S - 1 hour data 20

Figure 7: BTX - 1 hour data..... 21

Figure 8: WS - 1 hour data 21

Figure 9: Wind Rose 22

List of Tables

| | |
|---|----|
| Table 1: Wilpinjong Mine monitoring site location | 7 |
| Table 2: Parameters measured at the Wilpinjong Mine monitoring station..... | 9 |
| Table 3: Methods | 10 |
| Table 4: Wilpinjong Air Quality Goals (NEPM) | 13 |
| Table 5: Exceedences Recorded..... | 13 |
| Table 6: Units and Uncertainties..... | 14 |
| Table 7: Automatic checks for NO, NO ₂ , NO _x , SO ₂ , H ₂ S and BTX..... | 15 |
| Table 8: Wilpinjong Wollar Maintenance Table | 16 |
| Table 9: Data Capture for Wilpinjong Wollar Station | 17 |
| Table 10: Wollar Valid Data Exception Table | 23 |

1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene, *p*-Xylene, wind speed and wind direction.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for February 2017. Data capture for the different pollutants is presented in Table 9.

2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for February 2017.

The data presented in this report:

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

3.0 Monitoring and Data Collection

3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

Table 1: Wilpinjong Mine monitoring site location

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|-----------|----------------------------------|----------------------------|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with AS/NZS 3580.1.1:2007 “Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment”.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to AS/NZS 3580.1.1:2007.



Figure 1: Wilpinjong Mine Monitoring Station Location

3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

Table 2: Parameters measured at the Wilpinjong Mine monitoring station

| Parameter Measured | Instrument and Measurement Technique |
|--|--|
| BTX (Benzene, Toluene and <i>p</i> -Xylene) | Synspec GC955 - Gas Chromatography |
| H ₂ S | Ecotech EC9852 - fluorescence |
| NO, NO ₂ , NO _x | Ecotech EC9841 gas phase chemiluminescence |
| SO ₂ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Gill Windsonic |
| Wind Direction (10m) | Gill Windsonic |

3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

Table 3: 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 |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| SO ₂ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
| H ₂ S | Ecotech Laboratory Manual | In-house method 6.5 Hydrogen sulfide by fluorescence |
| BTX | Manufacturer’s Instructions | Gas Chromatography Synspec CG955 Series Manual |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.

3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger 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.

3.4. Data Validation and Reporting

3.4.1. 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 minute data.

3.4.2. Reporting

The reported data is in a Microsoft Excel format file named “*Wilpinjong Coal Validated Data Report Feb-17.xls*”. The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5 Minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

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

All averages are calculated from the five minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days.

4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

Table 4: Wilpinjong Air Quality Goals (NEPM)

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|-----------------|-------------|------------------|-------|-------------------------------|
| NO ₂ | 1 year | 30 | ppb | None |
| NO ₂ | 1 hour | 120 | ppb | 1 day a year |
| SO ₂ | 1 hour | 200 | ppb | 1 day a year |
| SO ₂ | 1 day | 80 | ppb | 1 day a year |
| SO ₂ | 1 year | 20 | ppb | None |

4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

Table 5: Exceedences Recorded

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|-----------------|-------------|---------------------|--------------------|
| NO ₂ | 1 hour | - | - |
| SO ₂ | 1 hour | - | - |
| SO ₂ | 1 day | - | - |

5.0 Calibrations and Maintenance

5.1. 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 6: Units and Uncertainties

| Parameter | Units | Resolution | Uncertainty | Measurement Range ¹ |
|--|-------|------------|--|--|
| NO, NO _x (EC9841) | ppm | 1 ppb | ± 14 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| NO ₂ (EC9841) | ppm | 1 ppb | ± 16 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| SO ₂ (EC9850) | ppm | 1 ppb | ± 14 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| H ₂ S | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and <i>p</i> - Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.01 m/s or 2.0% of reading, whichever is greater (K factor of 1.96) | 0 m/s to 60 m/s |
| Vector Wind Direction | Deg | 1 deg | ±2 deg K factor of 2.11 | 0 deg to 360 deg Starting threshold: 0 m/s |

¹ Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, NO₂ and NO_x by EC 9841 and SO₂ by EC9850 are calculated based on a measurement range of 0-125 ppb.

5.2. Automatic Checks

Automatic span and zero calibration checks run every night for NO, NO₂, NO_x and SO₂, every 2nd night for H₂S and weekly for BTX.

Background checks run each night for SO₂ and H₂S.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

Table 7: Automatic checks for NO, NO₂, NO_x, SO₂, H₂S and BTX

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---------------------------------------|--|-------------------------------------|
| NO, NO ₂ , NO _x | 00:45 to 01:25 every day | N/A |
| SO ₂ | 00:45 to 01:25 every day | 23:45 to 23:50 every day |
| H ₂ S | 01:35 to 02:35 every 2 nd day | 23:45 to 23:50 every day |
| BTX | 02:45 to 05:10 every 7 th day | N/A |

5.3. Maintenance

Scheduled monthly maintenance was performed on 27th February.

5.3.1. 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.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

Table 8: Wilpinjong Wollar Maintenance Table

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---------------------------------------|--------------------------|------------------|--------------------------|-------------------|
| NO, NO ₂ , NO _x | 27/02/2017 | Monthly | 27/02/2017 | Monthly |
| SO ₂ | 27/02/2017 | Monthly | 27/02/2017 | Monthly |
| H ₂ S | 27/02/2017 | Monthly | 27/02/2017 | Monthly |
| BTX | 27/02/2017 | Monthly | 27/01/2017 | Yearly |
| Wind Speed | 27/02/2017 | Monthly | 21/05/2015 | 2-Yearly |
| Wind Direction | 27/02/2017 | Monthly | 21/05/2015 | 2-Yearly |

6.0 Results

6.1. Data Capture

Data capture is based on 1 hour averages, calculated from 5 minute data, and refers to the amount of available data collected during the report period.

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

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

Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for February 2017. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

Table 9: Data Capture for Wilpinjong Wollar Station

| Parameter | Data Capture % |
|---------------------------------------|----------------|
| NO, NO ₂ , NO _x | 95.5 |
| SO ₂ | 95.2 |
| H ₂ S | 95.3 |
| Benzene | 96.1 |
| Toluene | 96.1 |
| <i>p</i> -Xylene | 96.1 |
| WS, WD | 98.8 |

6.2. Graphic Representations

Validated 5 minute data for NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

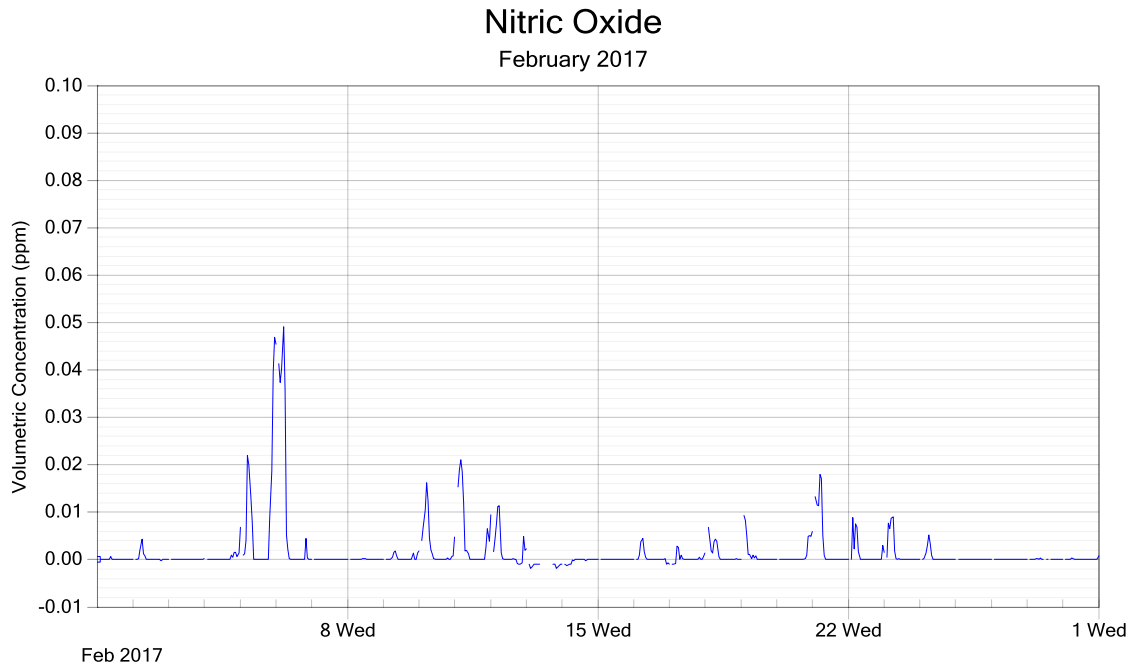


Figure 2: NO - 1 hour data

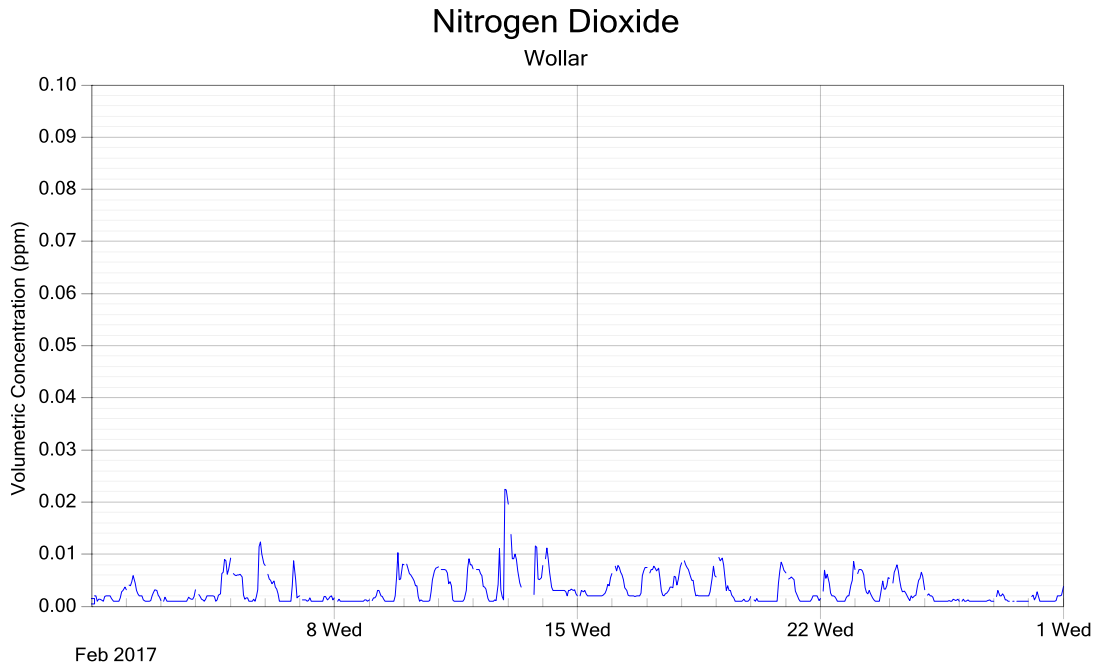


Figure 3: NO₂ - 1 hour data

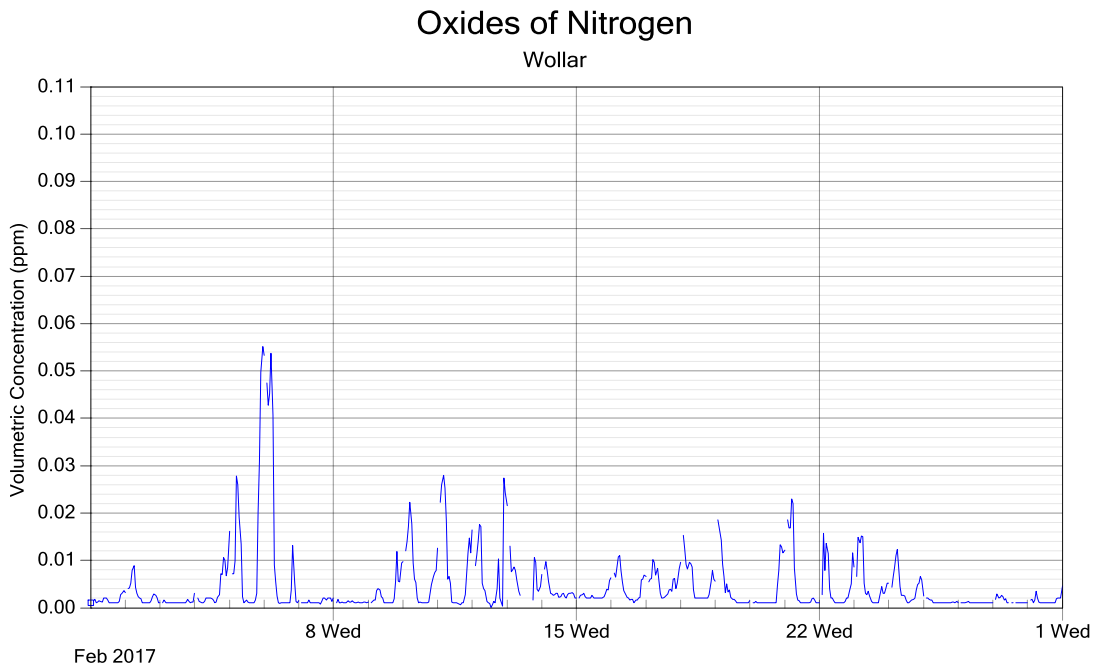


Figure 4: NO_x - 1 hour data

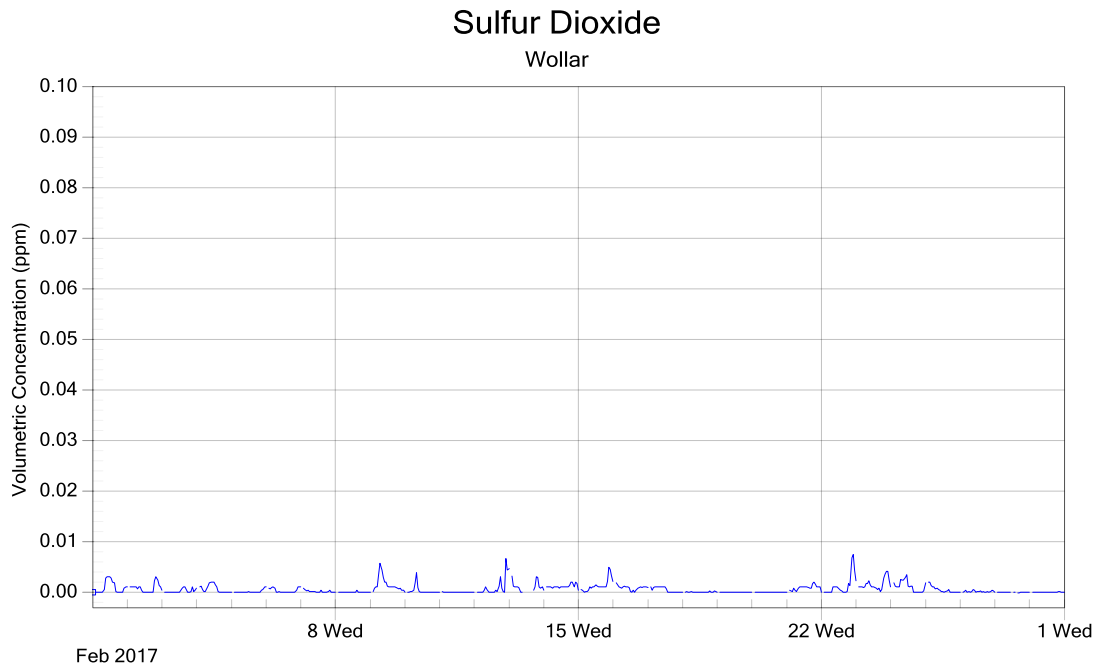


Figure 5: SO₂ - 1 hour data

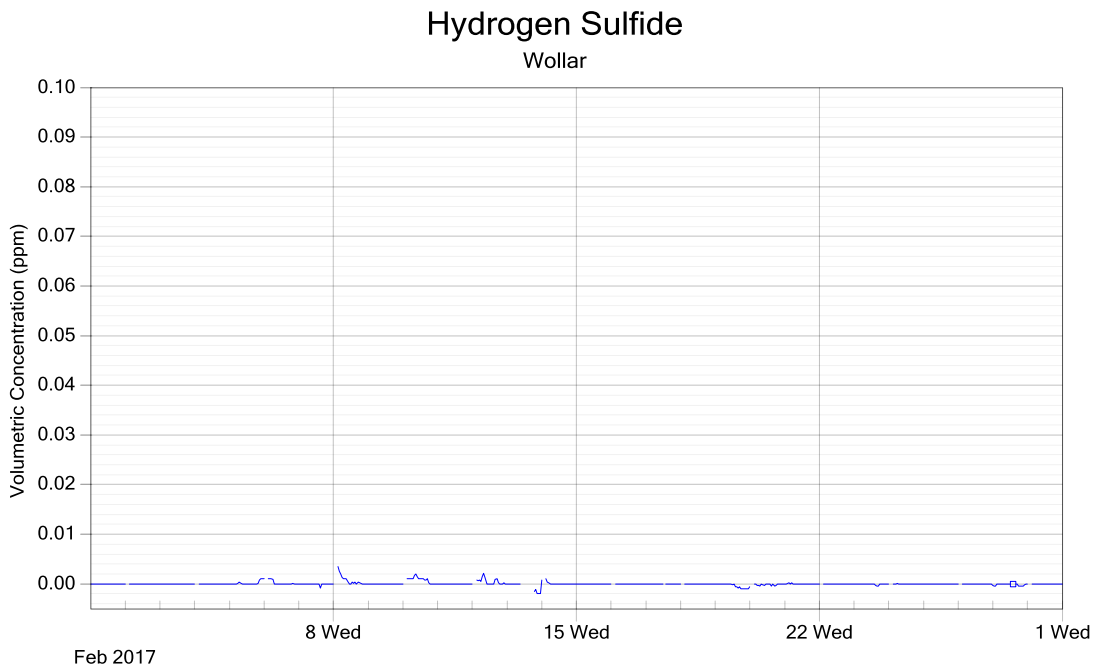


Figure 6: H₂S - 1 hour data

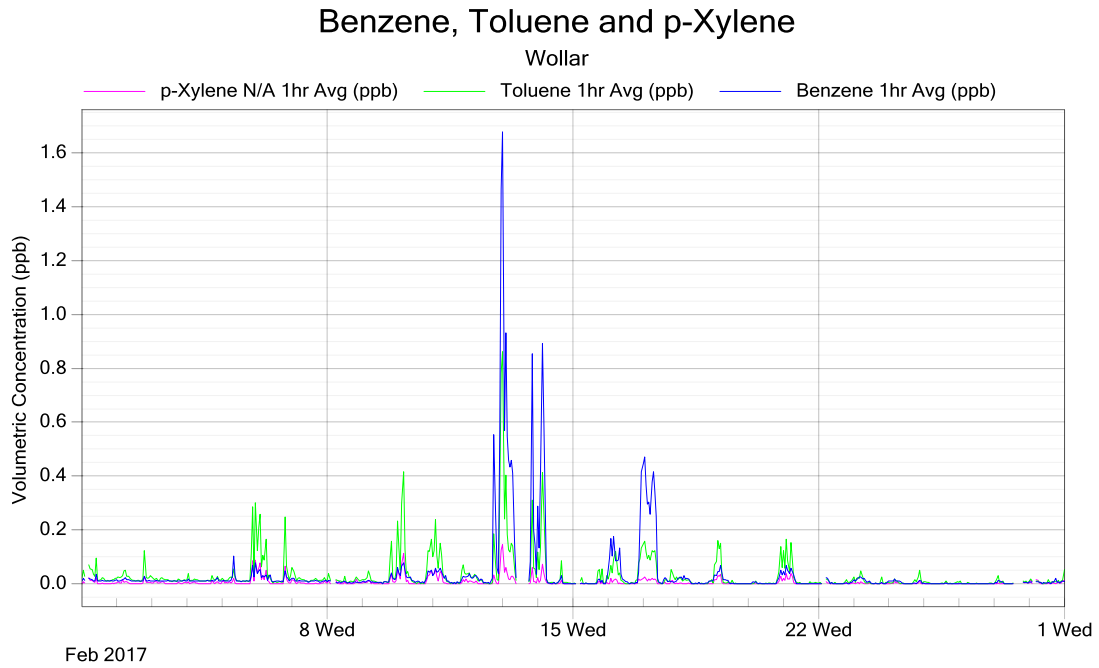


Figure 7: BTX - 1 hour data

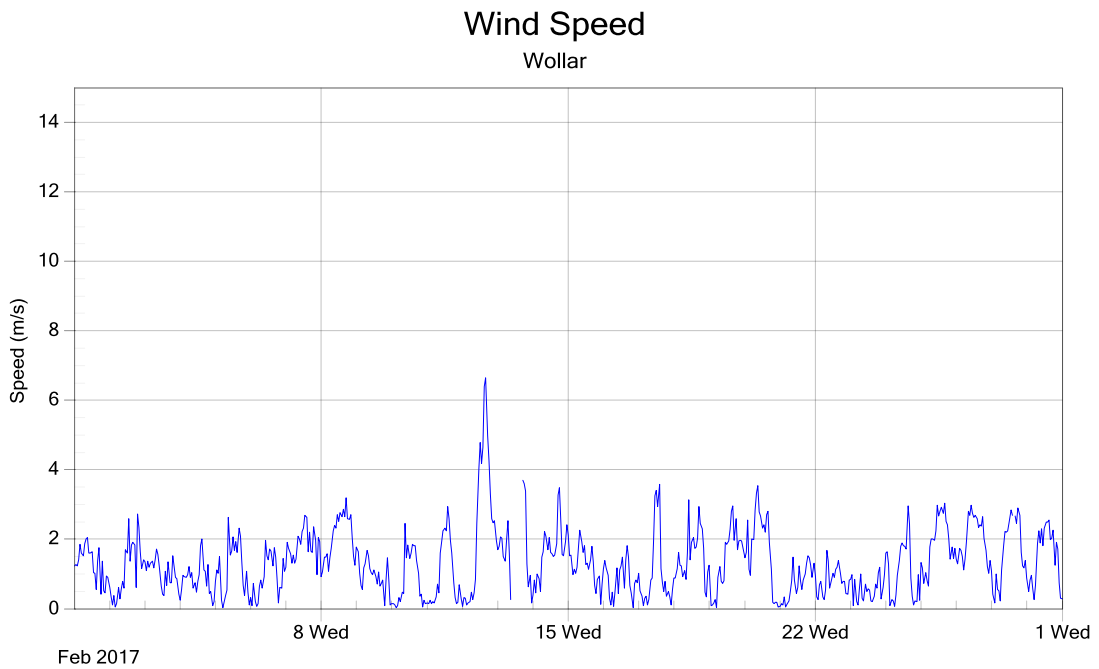


Figure 8: WS - 1 hour data

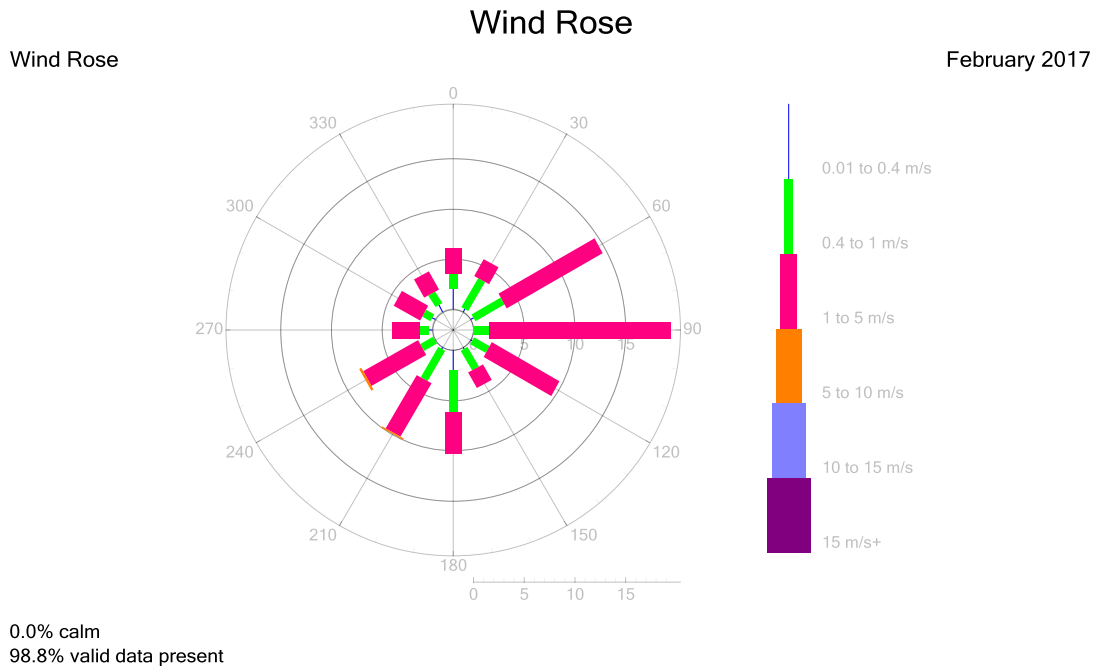


Figure 9: Wind Rose

7.0 Valid Data Exception Tables

The tables below details 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 10: Wollar Valid Data Exception Table

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---------------------|---------------------|--|----------------|-----------|-------------|
| 07/02/2017 14:55 | 17/02/2017 14:05 | Intermittent brief power interruptions and instrument stabilisation | All parameters | RE | 27/03/2017 |
| 13/02/2017 09:50 | 13/02/2017 18:25 | Power interruption and subsequent instrument stabilisation | All parameters | RE | 27/03/2017 |
| 27/02/2017 11:50 | 27/02/2017 19:30 | Scheduled monthly maintenance and stabilisation – intermittent data affected | All parameters | RE | 27/03/2017 |

8.0 Report Summary

The data capture for Wollar was above 95% for the reporting month.

Please refer to Data Capture Percentage Table 9 on page 17 for details, and Table 10 on page 23 for valid data exceptions.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech’s NATA scope of accreditation. Please refer to section 3.3.1 for details.

-----END OF REPORT-----

Appendix 1 - Definitions & Abbreviations

| | |
|------------------|---------------------------------------|
| BTX | Benzene, Toluene and <i>p</i> -Xylene |
| H ₂ S | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| NO ₂ | Nitrogen dioxide |
| NO _x | Oxides of nitrogen |
| ppb | Parts per billion |
| SO ₂ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

Appendix 2 - Explanation of Exception Table

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.

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Peabody Energy

Wilpinjong Coal Wollar

Ambient Air Quality Monitoring Validated Report

1st March – 31st March 2017

Report No.: DAT11841

Report issue date: 28th April 2017

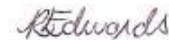
Maintenance contract: MC951

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| Revision History | | | |
|------------------|-----------|------------|---------------|
| Revision | Report ID | Date | Analyst |
| 0 | DAT11841 | 28/04/2017 | Robyn Edwards |

Report by: Robyn EDWARDS



Approved Signatory: Jon ALEXANDER





Table of Contents

Customer Details..... 2

Revision History 2

Table of Contents..... 3

List of Figures 4

List of Tables 5

1.0 Executive Summary.....6

2.0 Introduction7

3.0 Monitoring and Data Collection.....7

 3.1. Siting Details..... 7

 3.2. Monitored Parameters 9

 3.3. Data Collection Methods 10

 3.3.1. Compliance with Standards 11

 3.3.2. Data Acquisition 11

 3.4. Data Validation and Reporting..... 11

 3.4.1. Validation 11

 3.4.2. Reporting..... 12

4.0 Air Quality Goals.....13

 4.1. Air Quality Summary 13

5.0 Calibrations and Maintenance.....14

 5.1. Units and Uncertainties 14

 5.2. Automatic Checks 15

 5.3. Maintenance 15



5.3.1. Calibration & Maintenance Summary Tables 15

6.0 Results.....17

6.1. Data Capture 17

6.2. Graphic Representations 18

7.0 Valid Data Exception Tables23

8.0 Report Summary.....24

Appendix 1 - Definitions & Abbreviations25

Appendix 2 - Explanation of Exception Table.....26

List of Figures

Figure 1: Wilpinjong Mine Monitoring Station Location..... 8

Figure 2: NO - 1 hour data 18

Figure 3: NO₂ - 1 hour data 19

Figure 4: NO_x - 1 hour data 19

Figure 5: SO₂ - 1 hour data 20

Figure 6: H₂S - 1 hour data 20

Figure 7: BTX - 1 hour data..... 21

Figure 8: WS - 1 hour data 21

Figure 9: Wind Rose 22

List of Tables

| | |
|---|----|
| Table 1: Wilpinjong Mine monitoring site location | 7 |
| Table 2: Parameters measured at the Wilpinjong Mine monitoring station..... | 9 |
| Table 3: Methods | 10 |
| Table 4: Wilpinjong Air Quality Goals (NEPM) | 13 |
| Table 5: Exceedences Recorded..... | 13 |
| Table 6: Units and Uncertainties..... | 14 |
| Table 7: Automatic checks for NO, NO ₂ , NO _x , SO ₂ , H ₂ S and BTX..... | 15 |
| Table 8: Wilpinjong Wollar Maintenance Table | 16 |
| Table 9: Data Capture for Wilpinjong Wollar Station | 17 |
| Table 10: Wollar Valid Data Exception Table | 23 |

1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene, *p*-Xylene, wind speed and wind direction.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for March 2017. Data capture for the different pollutants is presented in Table 9.

2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for March 2017.

The data presented in this report:

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

3.0 Monitoring and Data Collection

3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

Table 1: Wilpinjong Mine monitoring site location

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|-----------|----------------------------------|----------------------------|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with AS/NZS 3580.1.1:2007 “Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment”.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to AS/NZS 3580.1.1:2007.



Figure 1: Wilpinjong Mine Monitoring Station Location

3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

Table 2: Parameters measured at the Wilpinjong Mine monitoring station

| Parameter Measured | Instrument and Measurement Technique |
|--|--|
| BTX (Benzene, Toluene and <i>p</i> -Xylene) | Synspec GC955 - Gas Chromatography |
| H ₂ S | Ecotech EC9852 - fluorescence |
| NO, NO ₂ , NO _x | Ecotech EC9841 gas phase chemiluminescence |
| SO ₂ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Gill Windsonic |
| Wind Direction (10m) | Gill Windsonic |

3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

Table 3: 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 |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| SO ₂ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
| H ₂ S | Ecotech Laboratory Manual | In-house method 6.5 Hydrogen sulfide by fluorescence |
| BTX | Manufacturer’s Instructions | Gas Chromatography Synspec CG955 Series Manual |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.

3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger 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.

3.4. Data Validation and Reporting

3.4.1. 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 minute data.

3.4.2. Reporting

The reported data is in a Microsoft Excel format file named “*Wilpinjong Coal Validated Data Report Mar-17.xls*”. The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5 Minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

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

All averages are calculated from the five minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days.

4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

Table 4: Wilpinjong Air Quality Goals (NEPM)

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|-----------------|-------------|------------------|-------|-------------------------------|
| NO ₂ | 1 year | 30 | ppb | None |
| NO ₂ | 1 hour | 120 | ppb | 1 day a year |
| SO ₂ | 1 hour | 200 | ppb | 1 day a year |
| SO ₂ | 1 day | 80 | ppb | 1 day a year |
| SO ₂ | 1 year | 20 | ppb | None |

4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

Table 5: Exceedences Recorded

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|-----------------|-------------|---------------------|--------------------|
| NO ₂ | 1 hour | - | - |
| SO ₂ | 1 hour | - | - |
| SO ₂ | 1 day | - | - |

5.0 Calibrations and Maintenance

5.1. 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 6: Units and Uncertainties

| Parameter | Units | Resolution | Uncertainty | Measurement Range ¹ |
|--|-------|------------|--|--|
| NO, NO _x (EC9841) | ppm | 1 ppb | ± 14 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| NO ₂ (EC9841) | ppm | 1 ppb | ± 16 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| SO ₂ (EC9850) | ppm | 1 ppb | ± 14 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| H ₂ S | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and <i>p</i> - Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.01 m/s or 2.0% of reading, whichever is greater (K factor of 1.96) | 0 m/s to 60 m/s |
| Vector Wind Direction | Deg | 1 deg | ±2 deg K factor of 2.11 | 0 deg to 360 deg Starting threshold: 0 m/s |

¹ Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, NO₂ and NO_x by EC 9841 and SO₂ by EC9850 are calculated based on a measurement range of 0-125 ppb.

5.2. Automatic Checks

Automatic span and zero calibration checks run every night for NO, NO₂, NO_x and SO₂, every 2nd night for H₂S and weekly for BTX.

Background checks run each night for SO₂ and H₂S.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

Table 7: Automatic checks for NO, NO₂, NO_x, SO₂, H₂S and BTX

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---------------------------------------|--|-------------------------------------|
| NO, NO ₂ , NO _x | 00:45 to 01:25 every day | N/A |
| SO ₂ | 00:45 to 01:25 every day | 23:45 to 23:50 every day |
| H ₂ S | 01:35 to 02:35 every 2 nd day | 23:45 to 23:50 every day |
| BTX | 02:45 to 05:10 every day | N/A |

5.3. Maintenance

Scheduled monthly maintenance was performed on 14th March. An additional remote calibration was performed on 19th March on the NO_x analyser, and a further unscheduled site visit was made on 24th March to resolve issues with the H₂S converter.

5.3.1. 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.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

Table 8: Wilpinjong Wollar Maintenance Table

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---------------------------------------|--------------------------|------------------|--------------------------|-------------------|
| NO, NO ₂ , NO _x | 19/03/2017 | Unscheduled | 19/03/2017 | Monthly |
| SO ₂ | 14/03/2017 | Monthly | 27/02/2017 | Monthly |
| H ₂ S | 24/03/2017 | Unscheduled | 24/03/2017 ² | Monthly |
| BTX | 27/02/2017 | Monthly | 27/01/2017 | Yearly |
| Wind Speed | 14/03/2017 | Monthly | 21/05/2015 | 2-Yearly |
| Wind Direction | 14/03/2017 | Monthly | 21/05/2015 | 2-Yearly |

² Calibration to be confirmed

6.0 Results

6.1. Data Capture

Data capture is based on 1 hour averages, calculated from 5 minute data, and refers to the amount of available data collected during the report period.

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

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

Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for March 2017. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

Table 9: Data Capture for Wilpinjong Wollar Station

| Parameter | Data Capture % |
|---------------------------------------|----------------|
| NO, NO ₂ , NO _x | 95.4 |
| SO ₂ | 95.2 |
| H ₂ S | 92.5 |
| Benzene | 88.2 |
| Toluene | 88.2 |
| <i>p</i> -Xylene | 88.2 |
| WS, WD | 99.0 |

6.2. Graphic Representations

Validated 5 minute data for NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

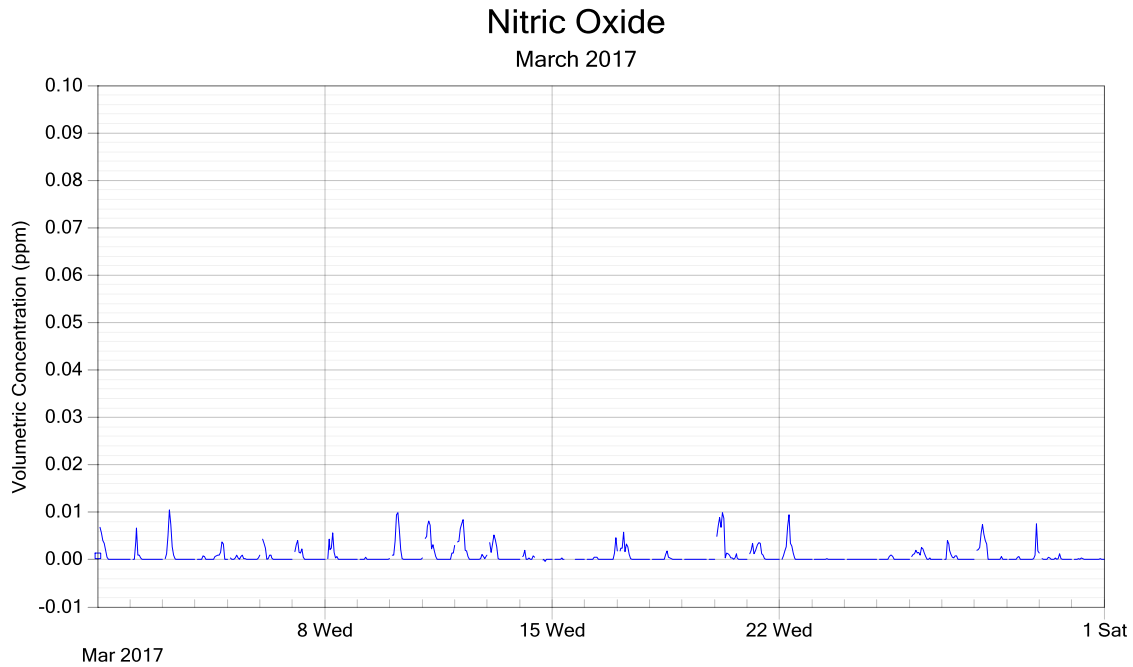


Figure 2: NO - 1 hour data

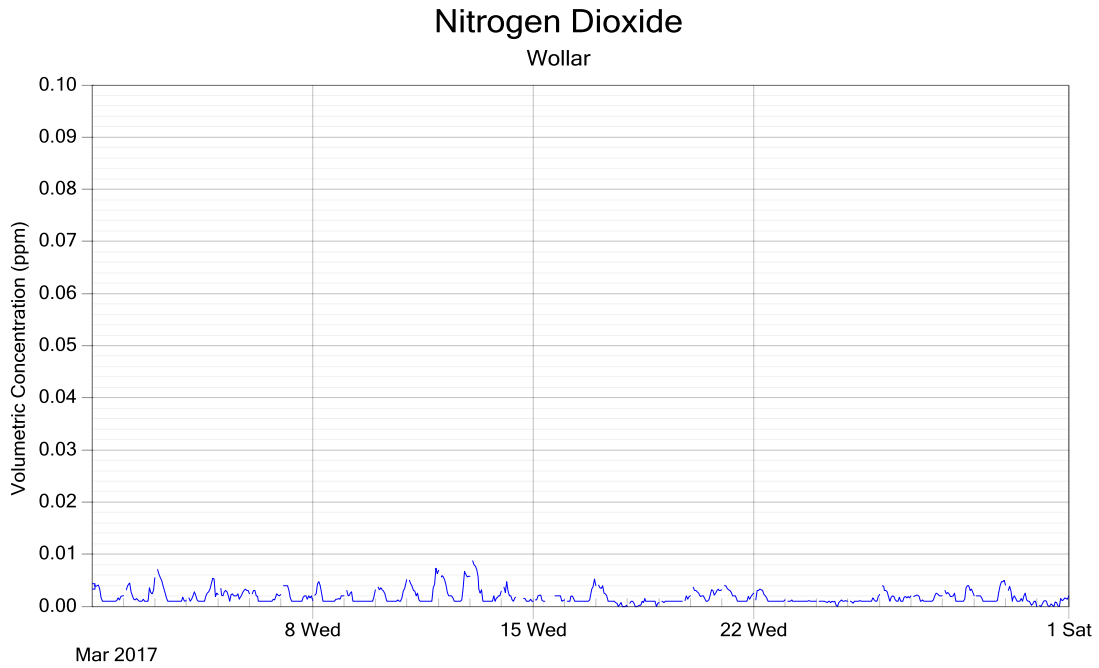


Figure 3: NO₂ - 1 hour data

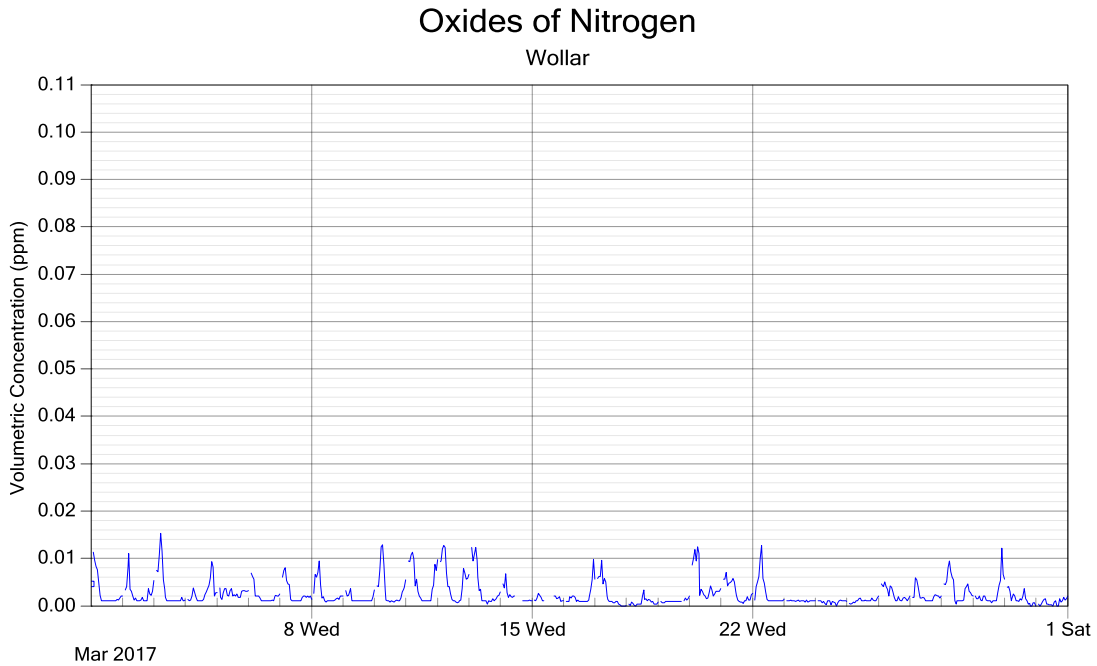


Figure 4: NO_x - 1 hour data

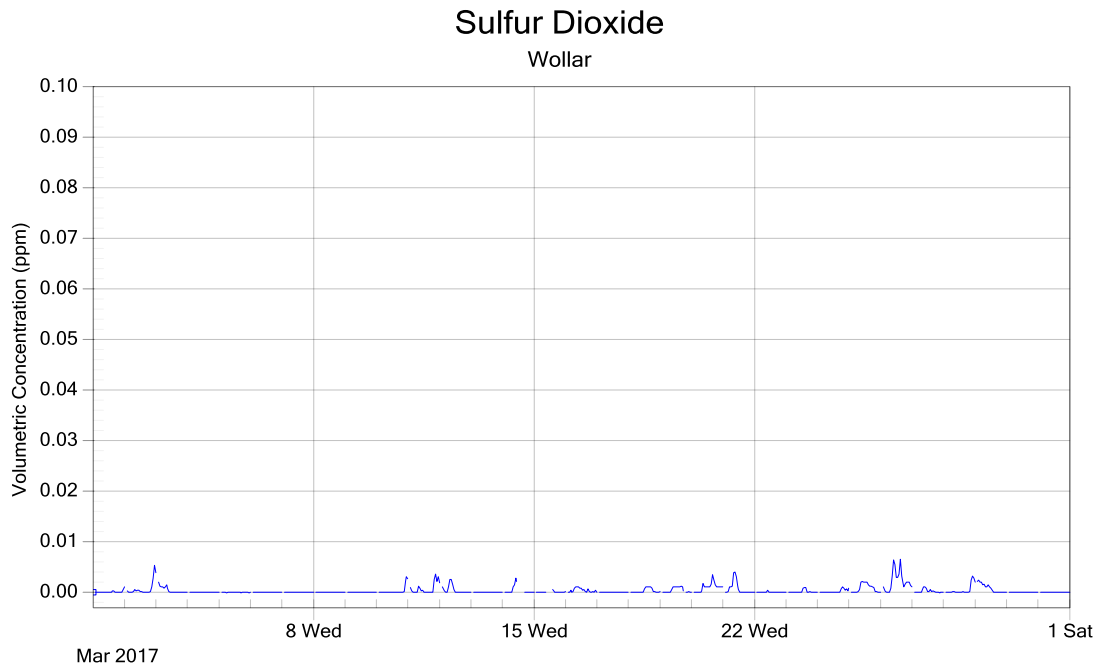


Figure 5: SO₂ - 1 hour data

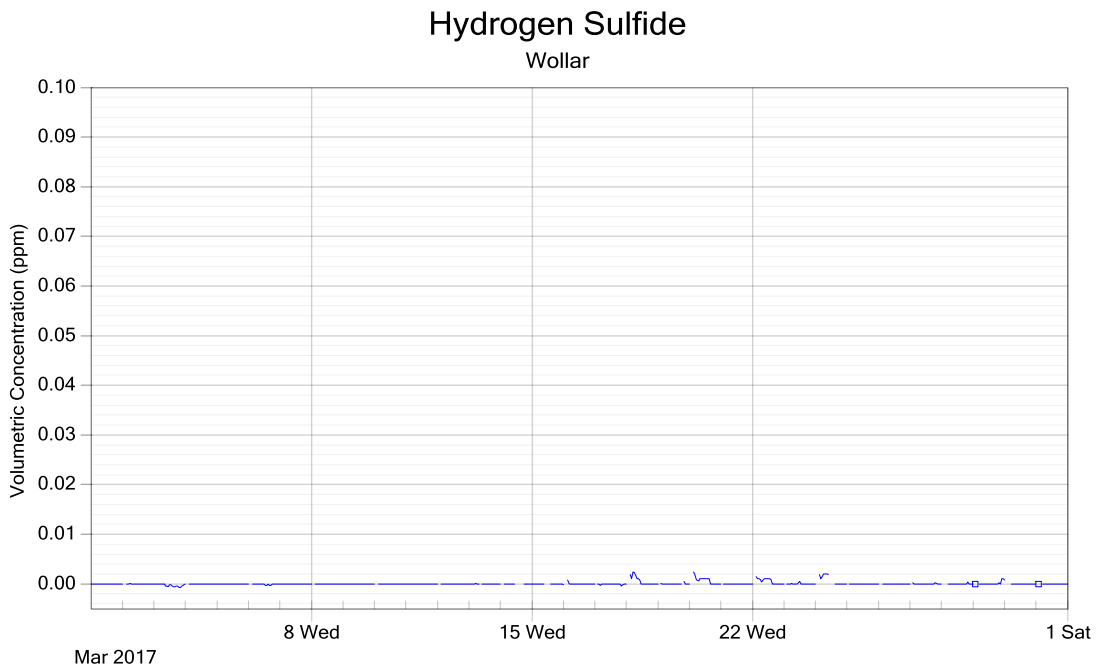


Figure 6: H₂S - 1 hour data

Benzene, Toluene and p-Xylene

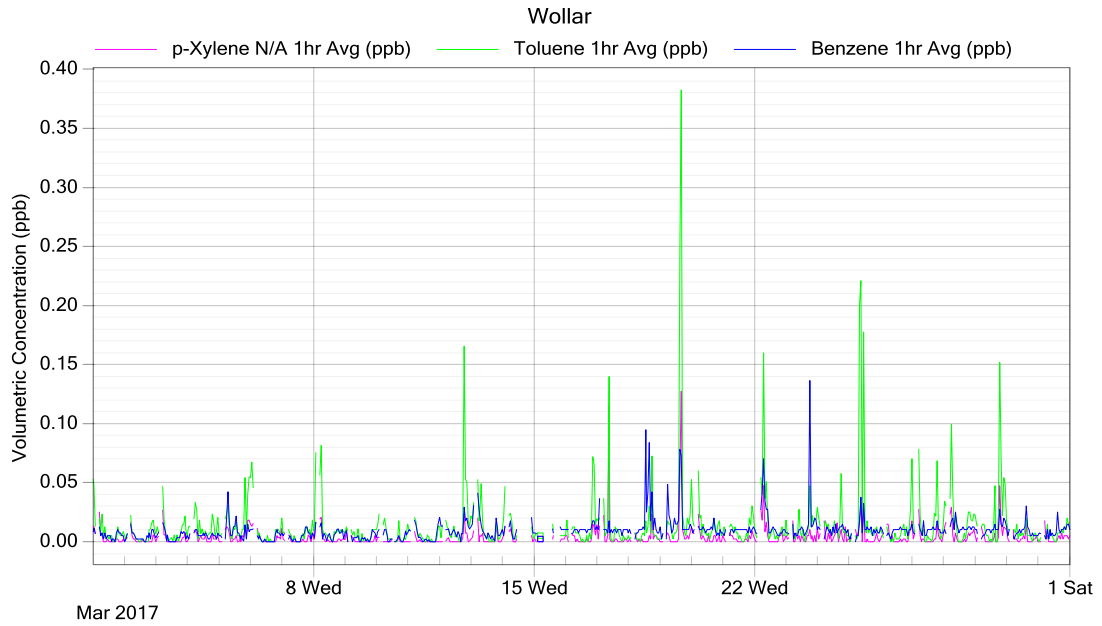


Figure 7: BTX - 1 hour data

Wind Speed

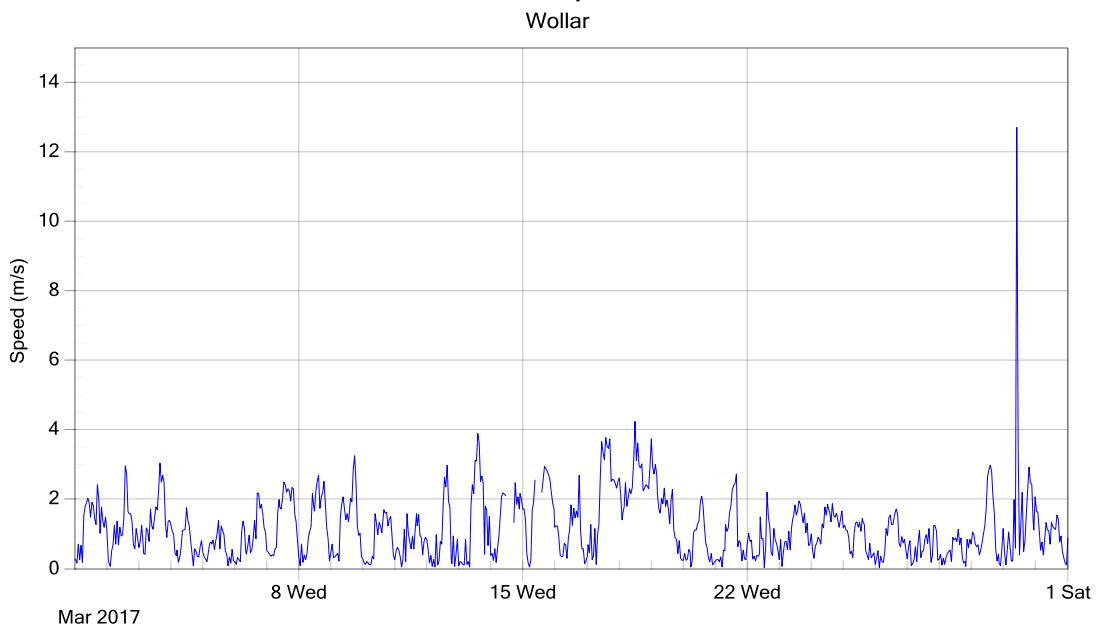


Figure 8: WS - 1 hour data

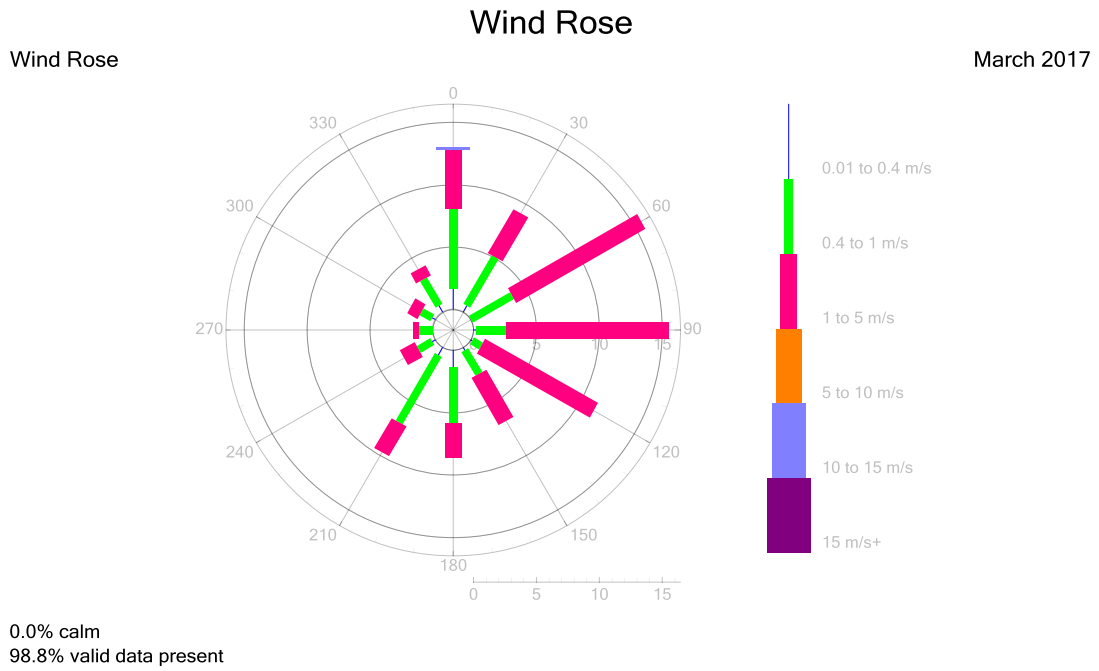


Figure 9: Wind Rose

7.0 Valid Data Exception Tables

The tables below details 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 10: Wollar Valid Data Exception Table

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---------------------|---------------------|--|---------------------------------------|-----------|-------------|
| 10/03/2017 13:35 | 10/03/2017 13:55 | Power interruption | BTX | RE | 24/04/2017 |
| 13/03/2017 08:50 | 14/03/2017 17:30 | Intermittent short H ₂ S instrument power interruption and stabilisation | H ₂ S, BTX, WS & WD | RE | 24/04/2017 |
| 13/03/2017 09:05 | 14/03/2017 17:45 | Automatic instrument checks following short H ₂ S instrument power interruption and stabilisation | SO ₂ & H ₂ S | RE | 24/04/2017 |
| 14/03/2017 12:15 | 14/03/2017 16:35 | Scheduled monthly maintenance – intermittent data affected | All parameters | RE | 24/04/2017 |
| 14/03/2017 16:35 | 15/03/2017 19:20 | Instrument intermittently in service mode | BTX | RE | 24/04/2017 |
| 15/03/2017 06:15 | 15/03/2017 19:15 | Continued scheduled maintenance – intermittent data affected | All parameters | RE | 24/04/2017 |
| 15/03/2017 16:25 | 19/03/2017 19:00 | Static multiplier of +1.06 applied to correct overnight span values | NO, NO ₂ , NO _x | RE | 24/04/2017 |
| 15/03/2017 16:25 | 31/03/2017 23:55 | Static offset of +0.002ppm applied to correct zero baseline | NO ₂ & NO _x | RE | 24/04/2017 |
| 16/03/2017 00:45 | 27/03/2017 01:25 | Intermittent data affected by overnight calibration cycles on NO _x and SO ₂ analyser | H ₂ S | RE | 24/04/2017 |
| 19/03/2017 19:05 | 19/03/2017 19:45 | Unscheduled maintenance – calibrations performed remotely to correct spans | NO, NO ₂ , NO _x | RE | 24/04/2017 |
| 24/03/2017 10:45 | 24/03/2017 14:40 | Unscheduled maintenance due to absence of overnight spans | H ₂ S | RE | 24/04/2017 |



| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---------------------|---------------------|---|------------------|-----------|-------------|
| 28/03/2017 02:45 | 30/03/2017 04:40 | Data affected daily during BTX overnight calibration span | H ₂ S | RE | 24/04/2017 |

8.0 Report Summary

The data capture for Wollar was above 95% for the reporting month; with the exception of H₂S, and BTX.

Please refer to Data Capture Percentage Table 9 on page 17 for details, and Table 10 on page 23 for valid data exceptions.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

-----END OF REPORT-----

Appendix 1 - Definitions & Abbreviations

| | |
|------------------|---------------------------------------|
| BTX | Benzene, Toluene and <i>p</i> -Xylene |
| H ₂ S | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| NO ₂ | Nitrogen dioxide |
| NO _x | Oxides of nitrogen |
| ppb | Parts per billion |
| SO ₂ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

Appendix 2 - Explanation of Exception Table

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.

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 affected by environmental conditions – wind speed / wind speed gust spike refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

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.

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.

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

Peabody Energy

Wilpinjong Coal Wollar

Ambient Air Quality Monitoring

Validated Report

1st April – 30th April 2017

Report No.: DAT11956

Report issue date: 26th May 2017

Maintenance contract: MC951

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| Revision History | | | |
|------------------|-----------|------------|---------------|
| Revision | Report ID | Date | Analyst |
| 0 | DAT11956 | 26/05/2017 | Robyn Edwards |

Report by:

Robyn EDWARDS



Approved Signatory:

Jon ALEXANDER





Table of Contents

Customer Details..... 2

Revision History 2

Table of Contents..... 3

List of Figures 4

List of Tables 5

1.0 Executive Summary.....6

2.0 Introduction7

3.0 Monitoring and Data Collection.....7

 3.1. Siting Details..... 7

 3.2. Monitored Parameters 9

 3.3. Data Collection Methods 10

 3.3.1. Compliance with Standards 11

 3.3.2. Data Acquisition 11

 3.4. Data Validation and Reporting..... 11

 3.4.1. Validation 11

 3.4.2. Reporting..... 12

4.0 Air Quality Goals.....13

 4.1. Air Quality Summary 13

5.0 Calibrations and Maintenance.....14

 5.1. Units and Uncertainties 14

 5.2. Automatic Checks 15

 5.3. Maintenance 15



5.3.1. Calibration & Maintenance Summary Tables 15

6.0 Results.....17

6.1. Data Capture 17

6.2. Graphic Representations 18

7.0 Valid Data Exception Tables23

8.0 Report Summary.....23

Appendix 1 - Definitions & Abbreviations25

Appendix 2 - Explanation of Exception Table.....26

List of Figures

Figure 1: Wilpinjong Mine Monitoring Station Location..... 8

Figure 2: NO - 1 hour data 18

Figure 3: NO₂ - 1 hour data 19

Figure 4: NO_x - 1 hour data 19

Figure 5: SO₂ - 1 hour data 20

Figure 6: H₂S - 1 hour data 20

Figure 7: BTX - 1 hour data..... 21

Figure 8: WS - 1 hour data 21

Figure 9: Wind Rose 22

List of Tables

| | |
|---|----|
| Table 1: Wilpinjong Mine monitoring site location | 7 |
| Table 2: Parameters measured at the Wilpinjong Mine monitoring station..... | 9 |
| Table 3: Methods | 10 |
| Table 4: Wilpinjong Air Quality Goals (NEPM) | 13 |
| Table 5: Exceedences Recorded..... | 13 |
| Table 6: Units and Uncertainties..... | 14 |
| Table 7: Automatic checks for NO, NO ₂ , NO _x , SO ₂ , H ₂ S and BTX..... | 15 |
| Table 8: Wilpinjong Wollar Maintenance Table | 16 |
| Table 9: Data Capture for Wilpinjong Wollar Station | 17 |
| Table 10: Wollar Valid Data Exception Table | 23 |

1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene, *p*-Xylene, wind speed and wind direction.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for April 2017. Data capture for the different pollutants is presented in Table 9.

2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for April 2017.

The data presented in this report:

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

3.0 Monitoring and Data Collection

3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

Table 1: Wilpinjong Mine monitoring site location

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|-----------|----------------------------------|----------------------------|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with AS/NZS 3580.1.1:2007 “Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment”.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to AS/NZS 3580.1.1:2007.



Figure 1: Wilpinjong Mine Monitoring Station Location

3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

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Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.

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Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger 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.

3.4. Data Validation and Reporting

3.4.1. 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.

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The reported data is in a Microsoft Excel format file named “*Wilpinjong Coal Validated Data Report Apr-17.xls*”. The Excel file consists of 5 Excel worksheets:

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3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

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

All averages are calculated from the five minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days.

4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

Table 4: Wilpinjong Air Quality Goals (NEPM)

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|-----------------|-------------|------------------|-------|-------------------------------|
| NO ₂ | 1 year | 30 | ppb | None |
| NO ₂ | 1 hour | 120 | ppb | 1 day a year |
| SO ₂ | 1 hour | 200 | ppb | 1 day a year |
| SO ₂ | 1 day | 80 | ppb | 1 day a year |
| SO ₂ | 1 year | 20 | ppb | None |

4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

Table 5: Exceedences Recorded

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|-----------------|-------------|---------------------|--------------------|
| NO ₂ | 1 hour | - | - |
| SO ₂ | 1 hour | - | - |
| SO ₂ | 1 day | - | - |

5.0 Calibrations and Maintenance

5.1. 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 6: Units and Uncertainties

| Parameter | Units | Resolution | Uncertainty | Measurement Range ¹ |
|--|-------|------------|--|--|
| NO, NO _x (EC9841) | ppm | 1 ppb | ± 14 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| NO ₂ (EC9841) | ppm | 1 ppb | ± 16 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| SO ₂ (EC9850) | ppm | 1 ppb | ± 14 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| H ₂ S | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and <i>p</i> - Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.01 m/s or 2.0% of reading, whichever is greater (K factor of 1.96) | 0 m/s to 60 m/s |
| Vector Wind Direction | Deg | 1 deg | ±2 deg K factor of 2.11 | 0 deg to 360 deg Starting threshold: 0 m/s |

¹ Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, NO₂ and NO_x by EC 9841 and SO₂ by EC9850 are calculated based on a measurement range of 0-125 ppb.

5.2. Automatic Checks

Automatic span and zero calibration checks run every night for NO, NO₂, NO_x and SO₂, every 2nd night for H₂S and weekly for BTX.

Background checks run each night for SO₂ and H₂S.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

Table 7: Automatic checks for NO, NO₂, NO_x, SO₂, H₂S and BTX

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---------------------------------------|--|-------------------------------------|
| NO, NO ₂ , NO _x | 00:45 to 01:25 every day | N/A |
| SO ₂ | 00:45 to 01:25 every day | 23:45 to 23:50 every day |
| H ₂ S | 01:35 to 02:35 every 2 nd day | 23:45 to 23:50 every day |
| BTX | 02:45 to 05:10 every day | N/A |

5.3. Maintenance

Scheduled monthly maintenance was performed on 18th and 19th April 2017.

5.3.1. 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.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

Table 8: Wilpinjong Wollar Maintenance Table

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---------------------------------------|--------------------------|------------------|--------------------------|-------------------|
| NO, NO ₂ , NO _x | 19/04/2017 | Monthly | 19/04/2017 | Monthly |
| SO ₂ | 19/04/2017 | Monthly | 19/04/2017 | Monthly |
| H ₂ S | 19/04/2017 | Monthly | 19/04/2017 | Monthly |
| BTX | 27/02/2017 | Monthly | 27/01/2017 | Yearly |
| Wind Sensor | 19/04/2017 | Monthly | 21/05/2015 | 2-Yearly |

6.0 Results

6.1. Data Capture

Data capture is based on 1 hour averages, calculated from 5 minute data, and refers to the amount of available data collected during the report period.

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

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

Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for April 2017. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

Table 9: Data Capture for Wilpinjong Wollar Station

| Parameter | Data Capture % |
|---------------------------------------|----------------|
| NO, NO ₂ , NO _x | 93.5 |
| SO ₂ | 95.0 |
| H ₂ S | 83.9 |
| Benzene | 90.3 |
| Toluene | 90.3 |
| <i>p</i> -Xylene | 90.3 |
| WS, WD | 98.6 |

6.2. Graphic Representations

Validated 5 minute data for NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

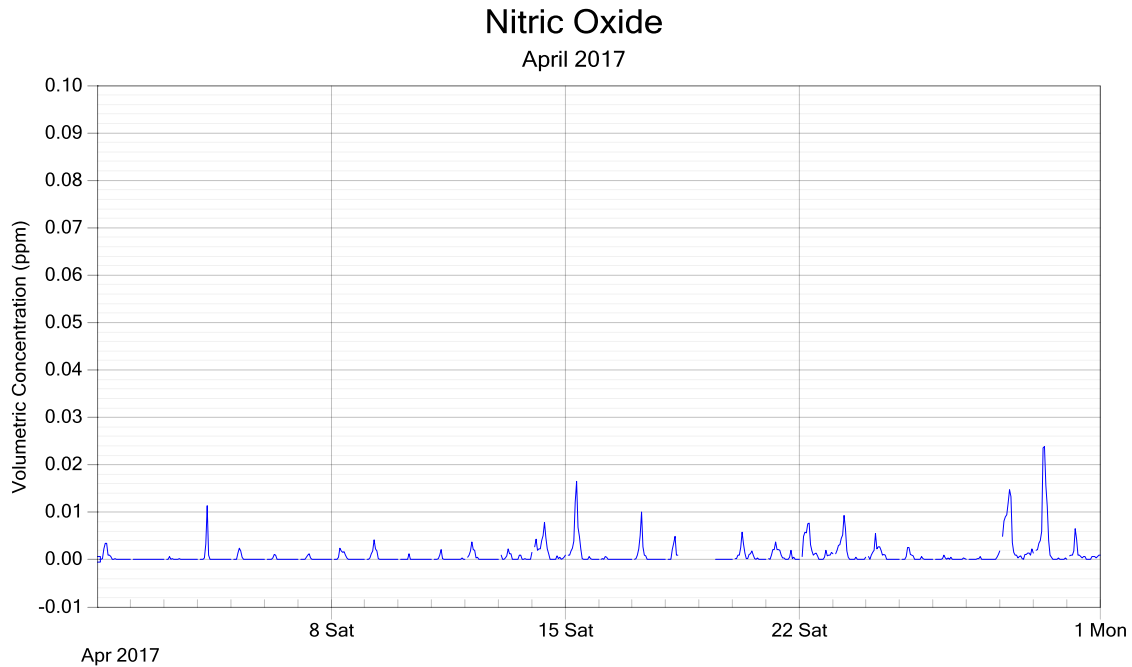


Figure 2: NO - 1 hour data

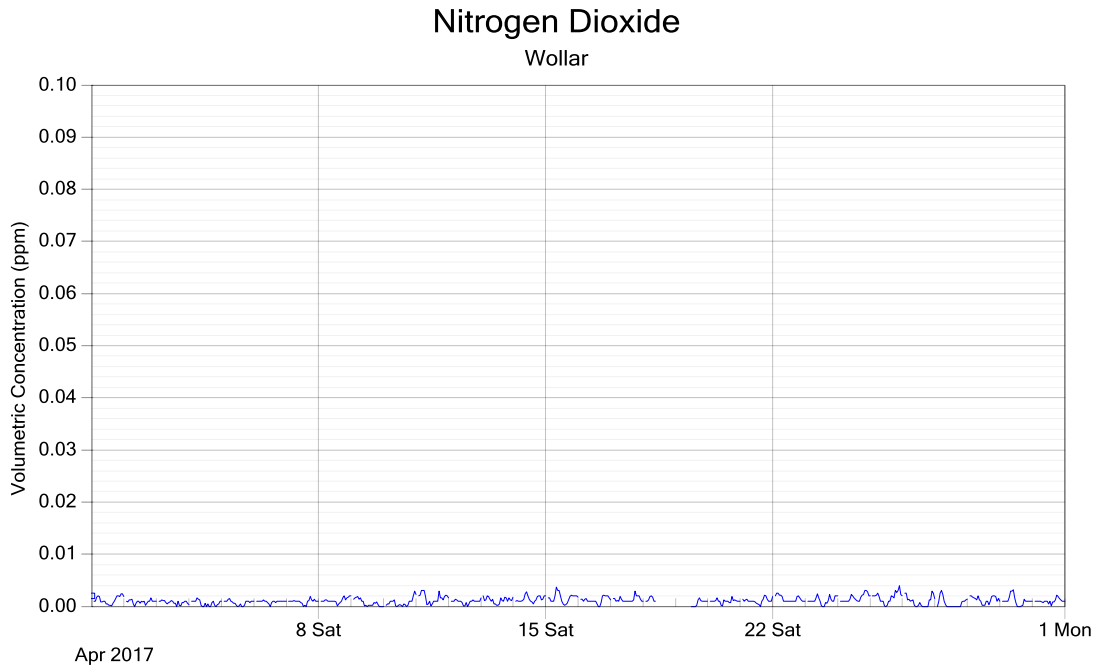


Figure 3: NO₂ - 1 hour data

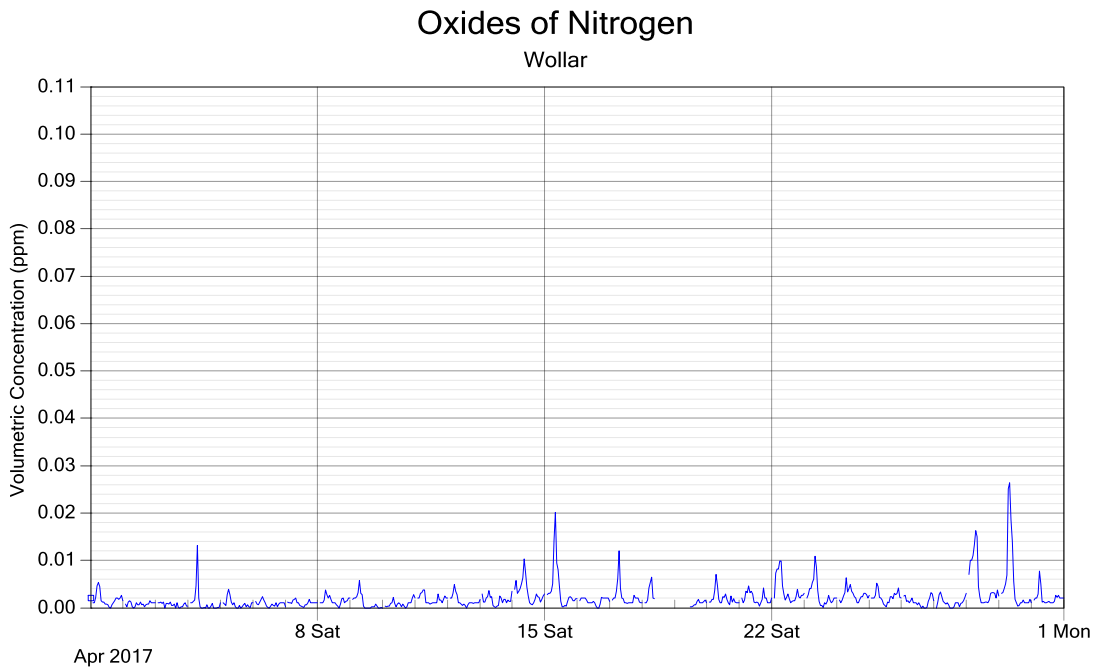


Figure 4: NO_x - 1 hour data

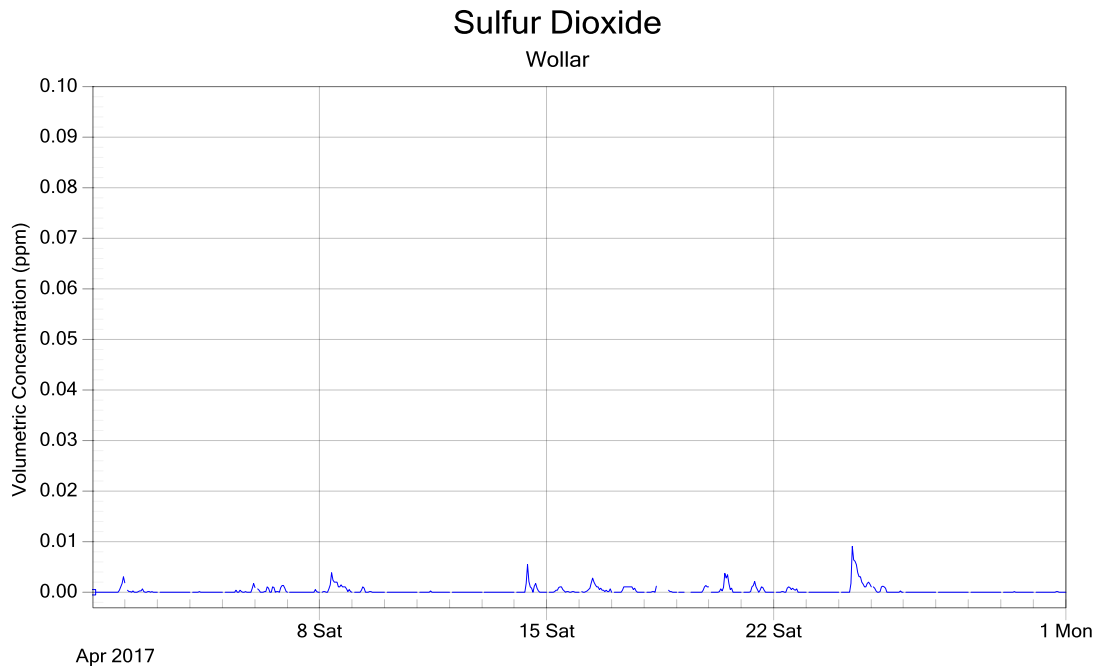


Figure 5: SO₂ - 1 hour data

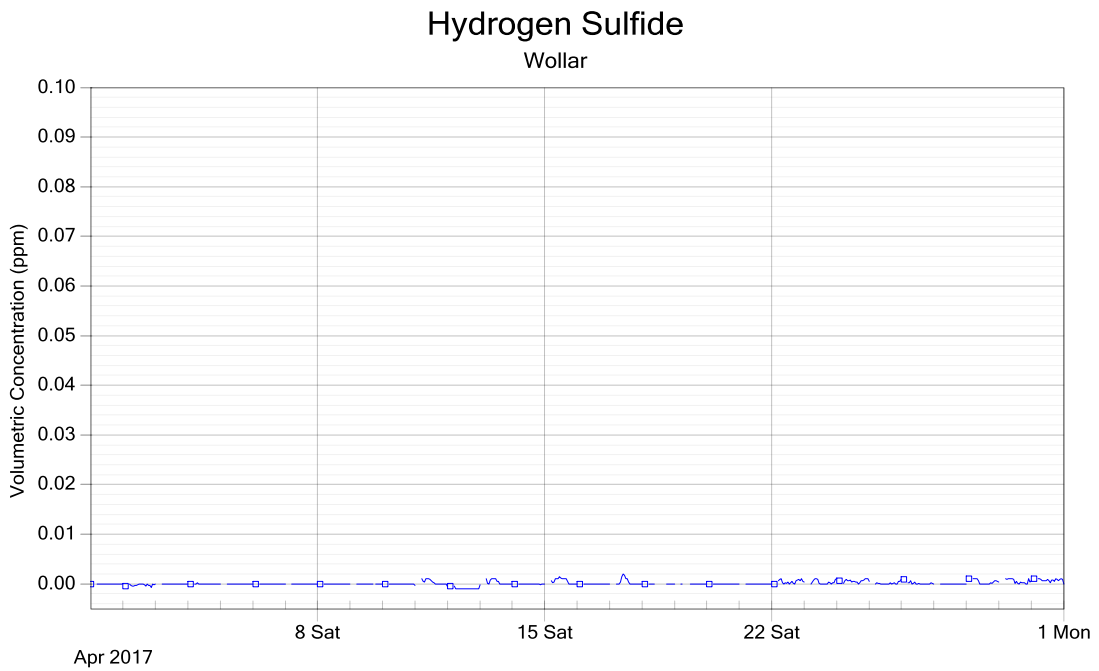


Figure 6: H₂S - 1 hour data

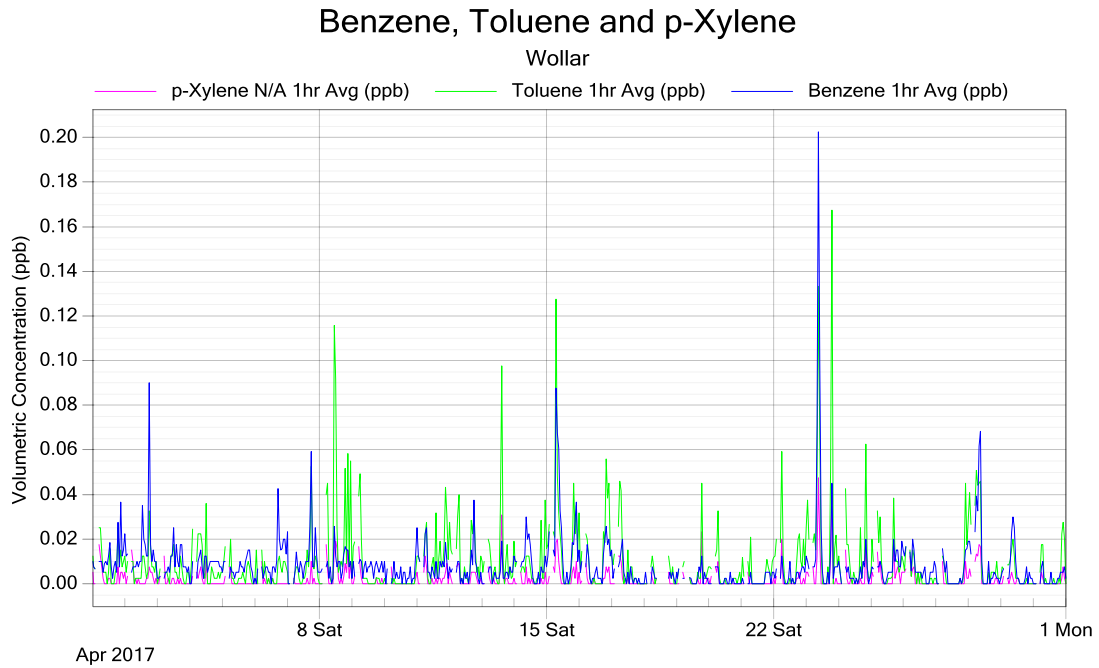


Figure 7: BTX - 1 hour data

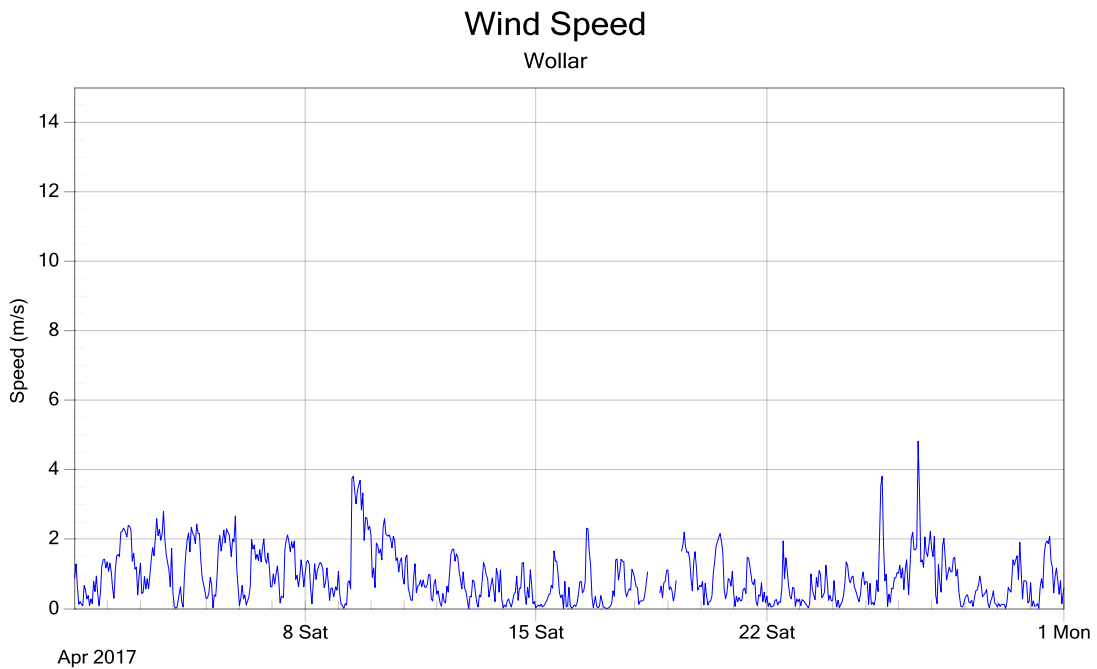


Figure 8: WS - 1 hour data

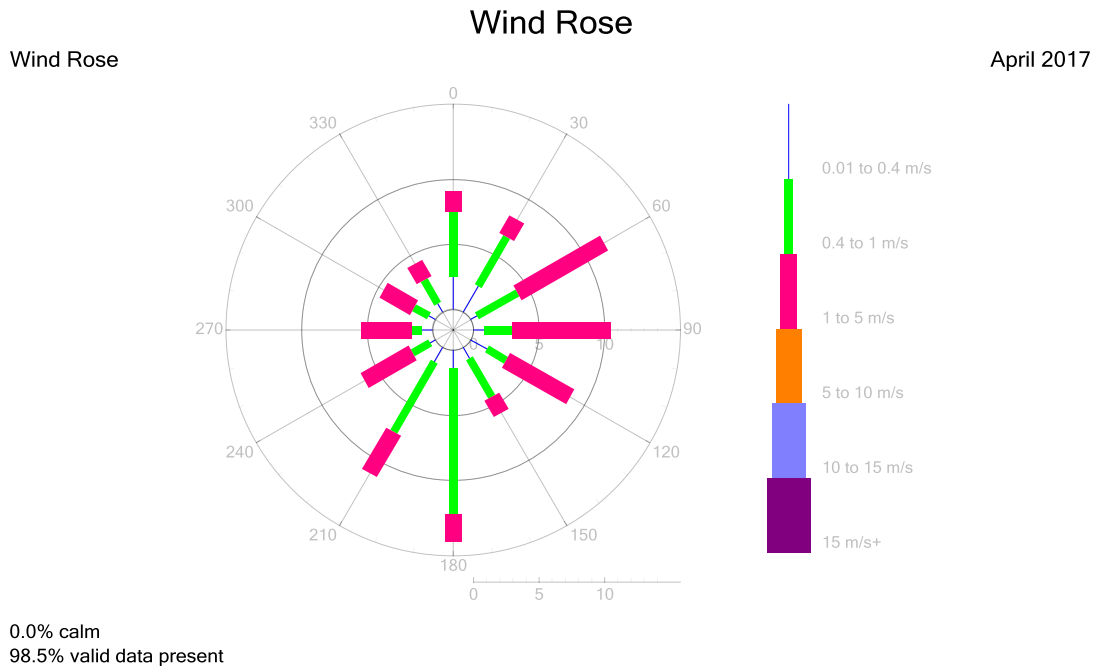


Figure 9: Wind Rose

7.0 Valid Data Exception Tables

The tables below details 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 10: Wollar Valid Data Exception Table

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---------------------|---------------------|---|--|-----------|-------------|
| 01/04/2017 00:00 | 18/04/2017 10:35 | Static offset of +0.002ppm applied to correct zero baseline | NO ₂ & NO _x | RE | 24/04/2017 |
| 01/04/2017 00:45 | 30/04/2017 01:25 | Data affected by overnight calibration cycles on NO _x and SO ₂ analyser | H ₂ S | RE | 25/05/2017 |
| 01/04/2017 02:45 | 30/04/2017 04:40 | Data affected daily during BTX overnight calibration span | H ₂ S | RE | 25/05/2017 |
| 09/04/2017 18:05 | 09/04/2017 18:30 | Short power interruption and stabilisation | H ₂ S, SO ₂ , BTX, WS & WD | RE | 25/05/2017 |
| 18/04/2017 10:40 | 18/04/2017 17:50 | Scheduled monthly maintenance | All parameters | RE | 25/05/2017 |
| 18/04/2017 17:55 | 19/04/2017 07:00 | Instrument left in 'out of service' mode overnight | NO, NO ₂ , NO _x | RE | 25/05/2017 |
| 19/04/2017 07:05 | 19/04/2017 11:40 | Continued scheduled maintenance – intermittent data affected | All parameters | RE | 25/05/2017 |

8.0 Report Summary

The data capture for Wollar was below 95% for the reporting month; with the exception of SO₂ and wind speed and direction.

Please refer to Data Capture Percentage Table 9 for details; and Table 10 for valid data exceptions.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

-----END OF REPORT-----

Appendix 1 - Definitions & Abbreviations

| | |
|------------------|---------------------------------------|
| BTX | Benzene, Toluene and <i>p</i> -Xylene |
| H ₂ S | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| NO ₂ | Nitrogen dioxide |
| NO _x | Oxides of nitrogen |
| ppb | Parts per billion |
| SO ₂ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

Appendix 2 - Explanation of Exception Table

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.

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 affected by environmental conditions – wind speed / wind speed gust spike refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

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.

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.

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

Peabody Energy

Wilpinjong Coal Wollar

Ambient Air Quality Monitoring

Validated Report

1st May – 31st May 2017

Report No.: DAT12058

Report issue date: 28th June 2017

Maintenance contract: MC951

ECOTECH PTY LTD. ABN: 32005752081

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|------------------|-----------|------------|---------------|
| Revision | Report ID | Date | Analyst |
| 0 | DAT12058 | 28/06/2017 | Robyn Edwards |

Report by: Robyn EDWARDS



Approved Signatory: Jon ALEXANDER



Table of Contents

Customer Details..... 2

Revision History 2

Table of Contents..... 3

List of Figures 4

List of Tables 5

1.0 Executive Summary.....6

2.0 Introduction7

3.0 Monitoring and Data Collection.....7

3.1. Siting Details..... 7

3.2. Monitored Parameters 9

3.3. Data Collection Methods 10

3.3.1. Compliance with Standards 11

3.3.2. Data Acquisition 11

3.4. Data Validation and Reporting..... 11

3.4.1. Validation 11

3.4.2. Reporting..... 12

4.0 Air Quality Goals.....13

4.1. Air Quality Summary 13

5.0 Calibrations and Maintenance.....14

5.1. Units and Uncertainties 14

5.2. Automatic Checks 15

5.3. Maintenance 15



5.3.1. Calibration & Maintenance Summary Tables 15

6.0 Results.....17

6.1. Data Capture 17

6.2. Graphic Representations 18

7.0 Valid Data Exception Tables23

8.0 Report Summary.....24

Appendix 1 - Definitions & Abbreviations25

Appendix 2 - Explanation of Exception Table.....26

List of Figures

Figure 1: Wilpinjong Mine Monitoring Station Location..... 8

Figure 2: NO - 1 hour data 18

Figure 3: NO₂ - 1 hour data 19

Figure 4: NO_x - 1 hour data 19

Figure 5: SO₂ - 1 hour data 20

Figure 6: H₂S - 1 hour data 20

Figure 7: BTX - 1 hour data..... 21

Figure 8: WS - 1 hour data 21

Figure 9: Wind Rose 22

List of Tables

| | |
|---|----|
| Table 1: Wilpinjong Mine monitoring site location | 7 |
| Table 2: Parameters measured at the Wilpinjong Mine monitoring station..... | 9 |
| Table 3: Methods | 10 |
| Table 4: Wilpinjong Air Quality Goals (NEPM) | 13 |
| Table 5: Exceedences Recorded..... | 13 |
| Table 6: Units and Uncertainties..... | 14 |
| Table 7: Automatic checks for NO, NO ₂ , NO _x , SO ₂ , H ₂ S and BTX..... | 15 |
| Table 8: Wilpinjong Wollar Maintenance Table | 16 |
| Table 9: Data Capture for Wilpinjong Wollar Station | 17 |
| Table 10: Wollar Valid Data Exception Table | 23 |

1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene, *p*-Xylene, wind speed and wind direction.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for May 2017. Data capture for the different pollutants is presented in Table 9.

2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for May 2017.

The data presented in this report:

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

3.0 Monitoring and Data Collection

3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

Table 1: Wilpinjong Mine monitoring site location

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|-----------|----------------------------------|----------------------------|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with AS/NZS 3580.1.1:2007 “Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment”.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to AS/NZS 3580.1.1:2007.



Figure 1: Wilpinjong Mine Monitoring Station Location

3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

Table 2: Parameters measured at the Wilpinjong Mine monitoring station

| Parameter Measured | Instrument and Measurement Technique |
|--|--|
| BTX (Benzene, Toluene and <i>p</i> -Xylene) | Synspec GC955 - Gas Chromatography |
| H ₂ S | Ecotech EC9852 - fluorescence |
| NO, NO ₂ , NO _x | Ecotech EC9841 gas phase chemiluminescence |
| SO ₂ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Gill Windsonic |
| Wind Direction (10m) | Gill Windsonic |

3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

Table 3: 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 |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| SO ₂ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
| H ₂ S | Ecotech Laboratory Manual | In-house method 6.5 Hydrogen sulfide by fluorescence |
| BTX | Manufacturer’s Instructions | Gas Chromatography Synspec CG955 Series Manual |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.

3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger 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.

3.4. Data Validation and Reporting

3.4.1. 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-minute data.

3.4.2. Reporting

The reported data is in a Microsoft Excel format file named “*Wilpinjong Coal Validated Data Report May-17.xls*”. The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5 Minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

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

All averages are calculated from the five-minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days.

4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

Table 4: Wilpinjong Air Quality Goals (NEPM)

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|-----------------|-------------|------------------|-------|-------------------------------|
| NO ₂ | 1 year | 30 | ppb | None |
| NO ₂ | 1 hour | 120 | ppb | 1 day a year |
| SO ₂ | 1 hour | 200 | ppb | 1 day a year |
| SO ₂ | 1 day | 80 | ppb | 1 day a year |
| SO ₂ | 1 year | 20 | ppb | None |

4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

Table 5: Exceedences Recorded

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|-----------------|-------------|---------------------|--------------------|
| NO ₂ | 1 hour | - | - |
| SO ₂ | 1 hour | - | - |
| SO ₂ | 1 day | - | - |

5.0 Calibrations and Maintenance

5.1. 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 6: Units and Uncertainties

| Parameter | Units | Resolution | Uncertainty | Measurement Range ¹ |
|--|-------|------------|--|--|
| NO, NO _x (EC9841) | ppm | 1 ppb | ± 14 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| NO ₂ (EC9841) | ppm | 1 ppb | ± 16 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| SO ₂ (EC9850) | ppm | 1 ppb | ± 14 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| H ₂ S | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and <i>p</i> - Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.01 m/s or 2.0% of reading, whichever is greater (K factor of 1.96) | 0 m/s to 60 m/s |
| Vector Wind Direction | Deg | 1 deg | ±2 deg K factor of 2.11 | 0 deg to 360 deg Starting threshold: 0 m/s |

¹ Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, NO₂ and NO_x by EC 9841 and SO₂ by EC9850 are calculated based on a measurement range of 0-125 ppb.

5.2. Automatic Checks

Automatic span and zero calibration checks run every night for NO, NO₂, NO_x and SO₂, every 2nd night for H₂S and daily for BTX.

Background checks run each night for SO₂ and H₂S.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

Table 7: Automatic checks for NO, NO₂, NO_x, SO₂, H₂S and BTX

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---------------------------------------|--|-------------------------------------|
| NO, NO ₂ , NO _x | 00:45 to 01:25 every day | N/A |
| SO ₂ | 00:45 to 01:25 every day | 23:45 to 23:50 every day |
| H ₂ S | 01:35 to 02:35 every 2 nd day | 23:45 to 23:50 every day |
| BTX | 02:45 to 05:10 every day | N/A |

5.3. Maintenance

Scheduled monthly maintenance was performed on 22/05/2017.

5.3.1. 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.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

Table 8: Wilpinjong Wollar Maintenance Table

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---------------------------------------|--------------------------|------------------|--------------------------|-------------------|
| NO, NO ₂ , NO _x | 29/05/2017 | Unscheduled | 23/05/2017 | Monthly |
| SO ₂ | 29/05/2017 | Unscheduled | 22/05/2017 | Monthly |
| H ₂ S | 29/05/2017 | Unscheduled | 29/05/2017 | Monthly |
| BTX | 22/05/2017 | 3 Monthly | 27/01/2017 | Yearly |
| Wind Sensor | 22/05/2017 | 3 Monthly | 21/05/2015 | 2 Yearly |

6.0 Results

6.1. Data Capture

Data capture is based on 1 hour averages, calculated from 5-minute data, and refers to the amount of available data collected during the report period.

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

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

Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for May 2017. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

Table 9: Data Capture for Wilpinjong Wollar Station

| Parameter | Data Capture % |
|---------------------------------------|----------------|
| NO, NO ₂ , NO _x | 95.2 |
| SO ₂ | 94.7 |
| H ₂ S | 83.8 |
| Benzene | 79.4 |
| Toluene | 79.4 |
| <i>p</i> -Xylene | 79.4 |
| WS, WD | 98.3 |

6.2. Graphic Representations

Validated 5 minute data for NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

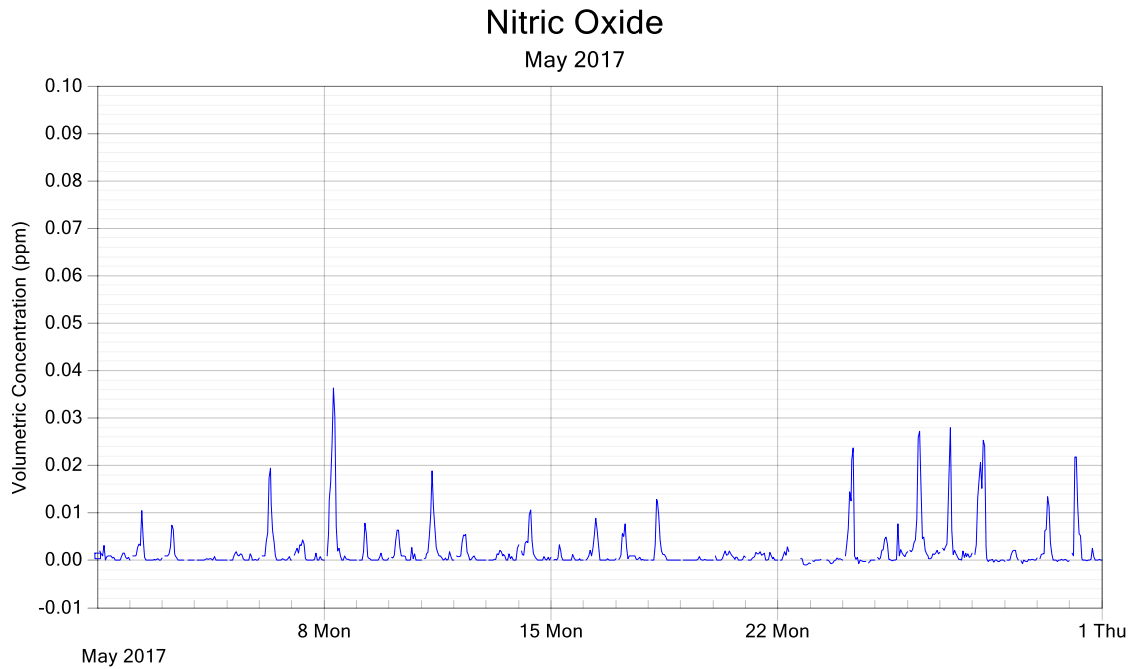


Figure 2: NO - 1 hour data

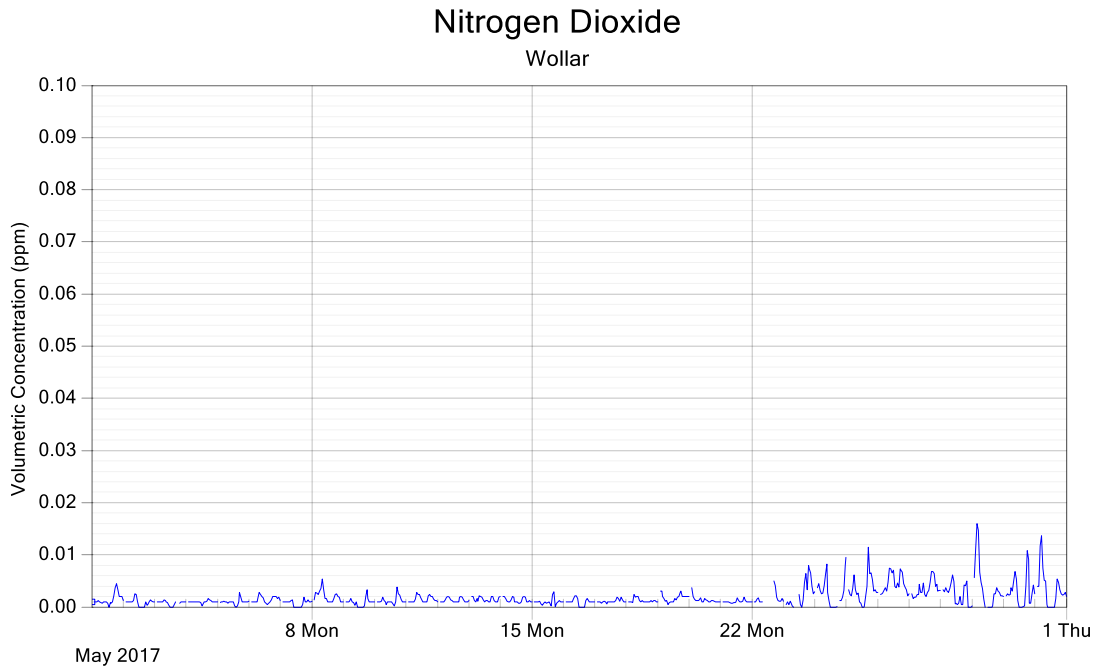


Figure 3: NO₂ - 1 hour data

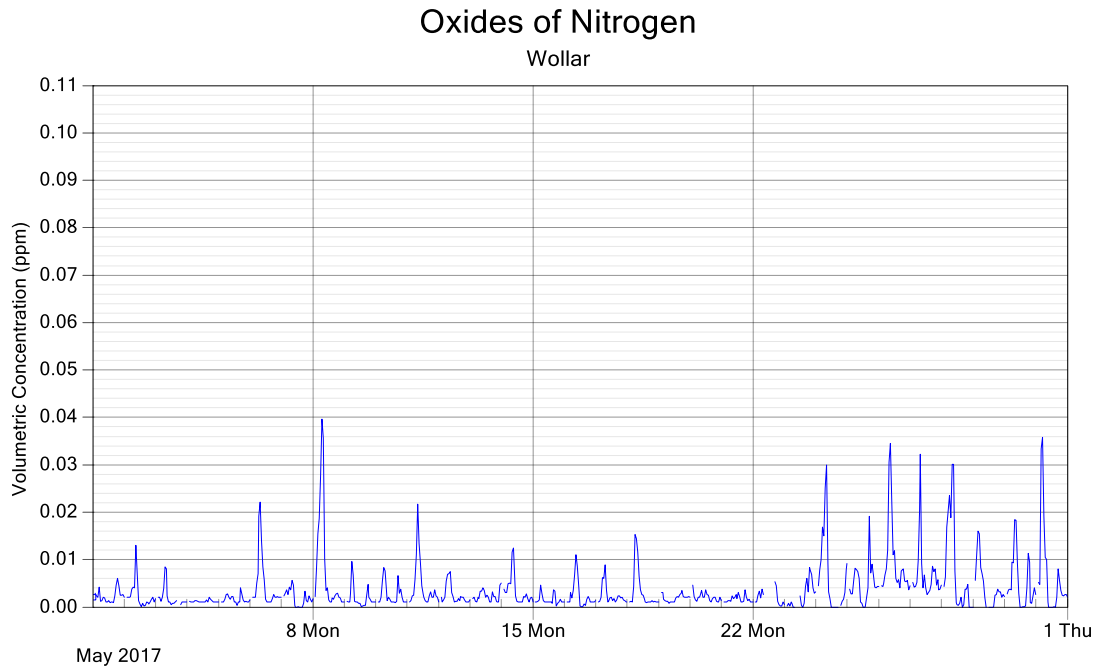


Figure 4: NO_x - 1 hour data

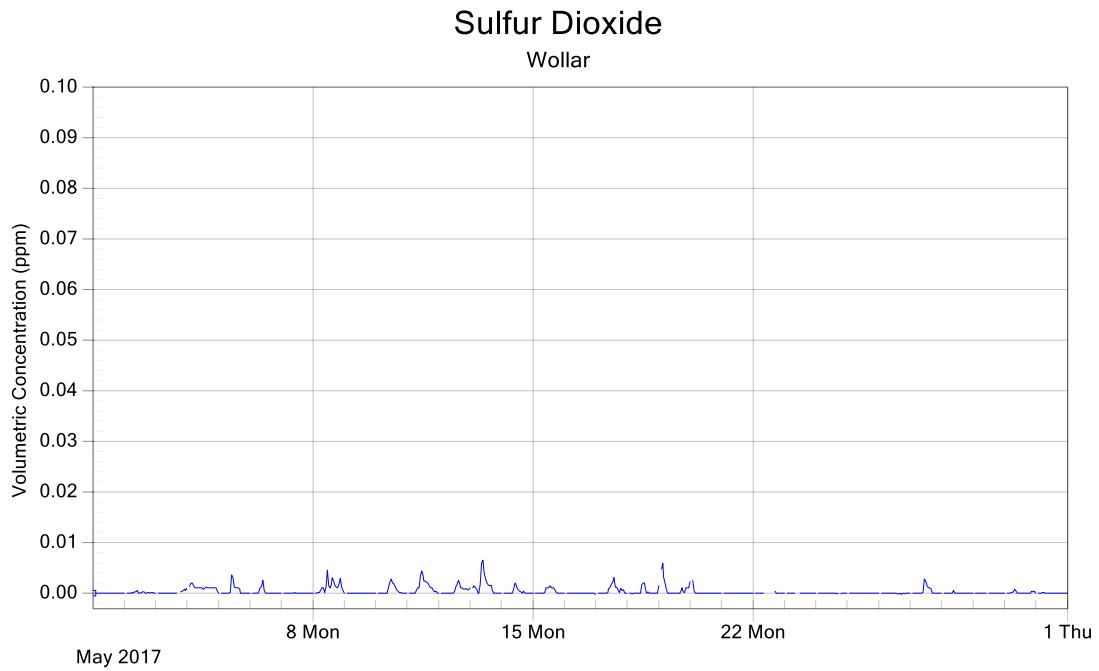


Figure 5: SO₂ - 1 hour data

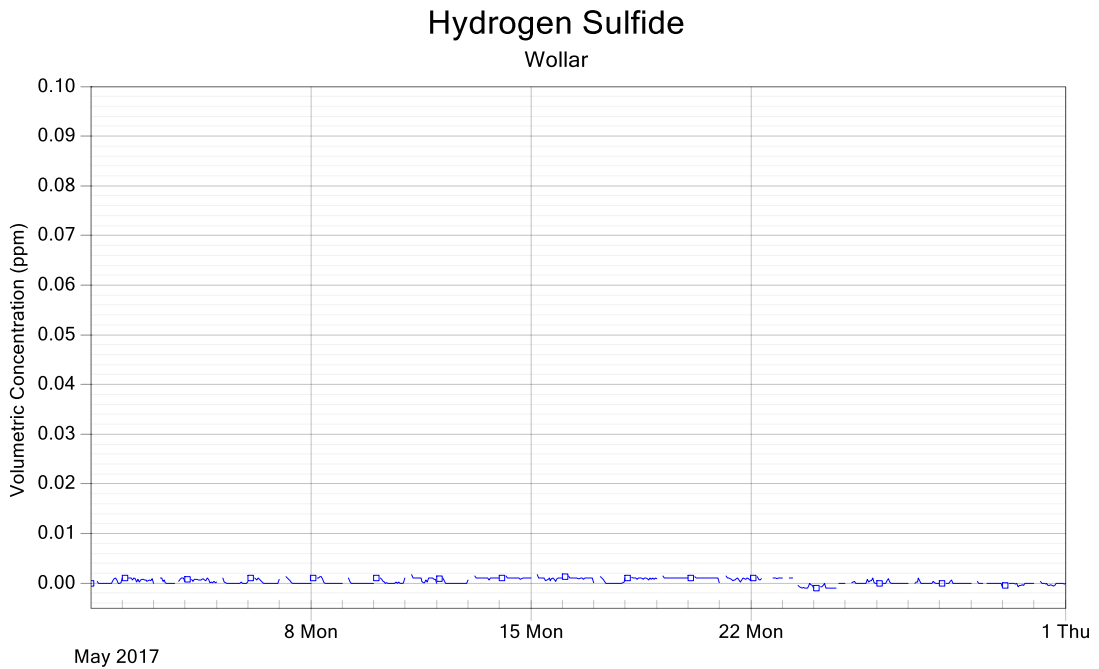


Figure 6: H₂S - 1 hour data

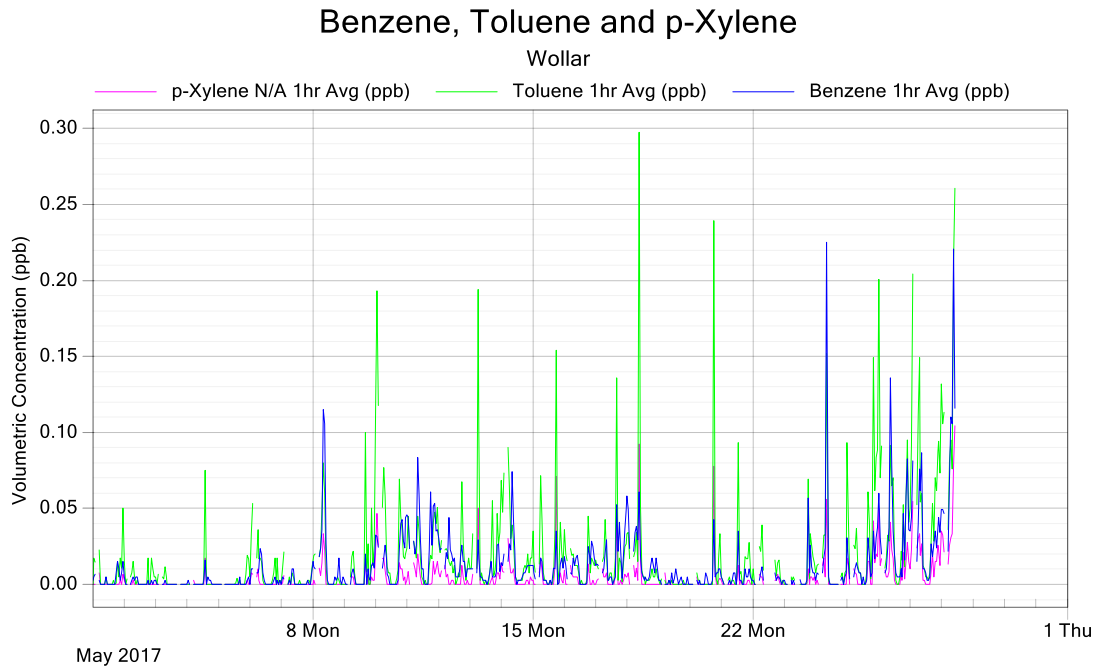


Figure 7: BTX - 1 hour data

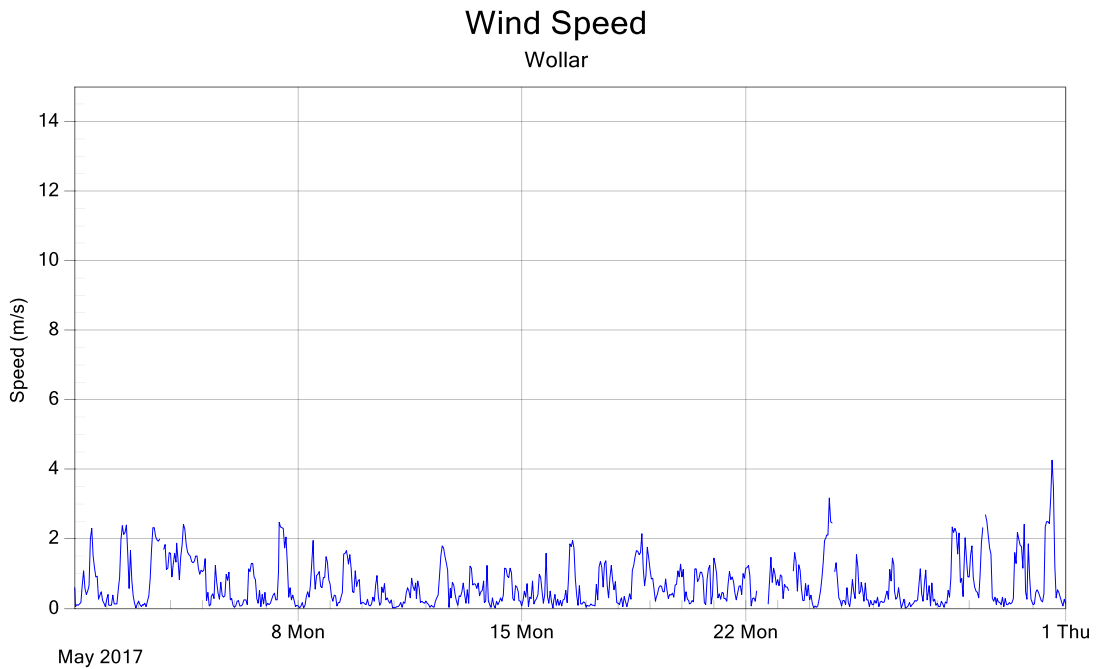


Figure 8: WS - 1 hour data

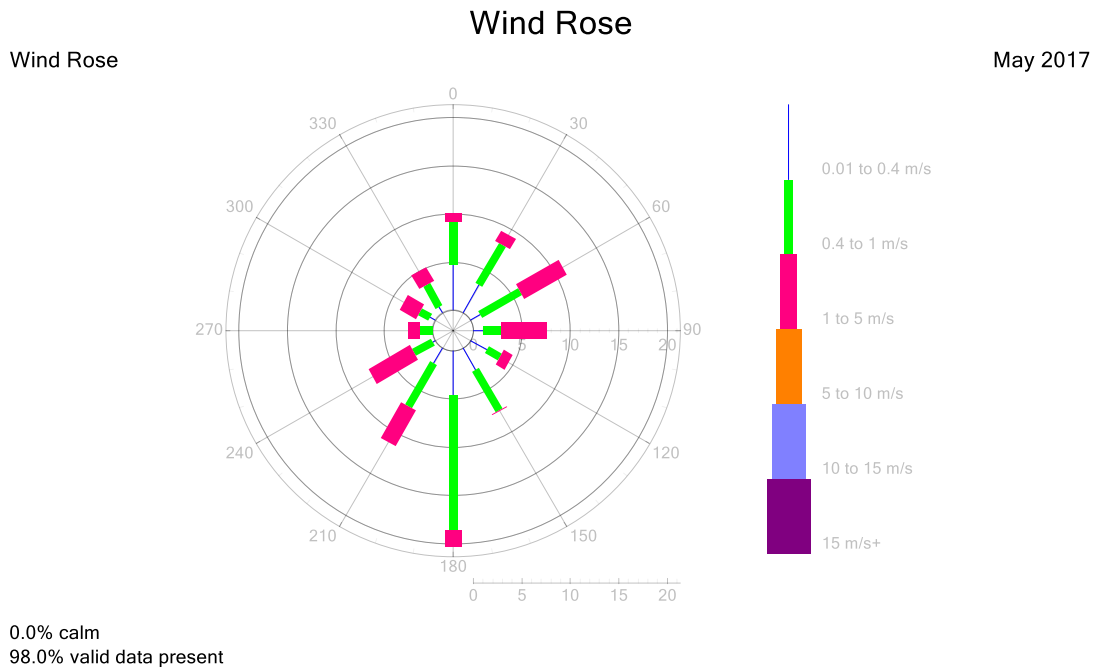


Figure 9: Wind Rose

7.0 Valid Data Exception Tables

The table 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 10: Wollar Valid Data Exception Table

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---------------------|---------------------|--|------------------|-----------|-------------|
| 01/05/2017 02:45 | 31/05/2017 04:40 | Data affected daily during BTX overnight calibration span | H ₂ S | RE | 23/06/2017 |
| 03/05/2017 17:10 | 03/05/2017 19:05 | Short power interruption and stabilisation | All parameters | RE | 23/06/2017 |
| 22/05/2017 09:20 | 22/05/2017 16:25 | Scheduled maintenance – monthly tasks performed and NO _x analyser replacement | All parameters | RE | 23/06/2017 |
| 23/05/2017 09:25 | 23/05/2017 12:10 | Unscheduled maintenance – resolved raised H ₂ S issues | All parameters | RE | 23/06/2017 |
| 24/05/2017 18:00 | 24/05/2017 18:35 | Unscheduled maintenance – remote connection checks following maintenance | All parameters | RE | 23/06/2017 |
| 28/05/2017 11:15 | 31/05/2017 23:55 | Instrument fault – Synspec oven failure | BTX | RE | 23/06/2017 |
| 28/05/2017 15:15 | 28/05/2017 15:40 | Short power interruption | BTX | RE | 23/06/2017 |
| 29/05/2017 10:35 | 29/05/2017 11:40 | Unscheduled maintenance – resolve further issues with H ₂ S analyser | All parameters | RE | 23/06/2017 |

8.0 Report Summary

The data capture for Wollar was below 95% for the reporting month; with the exception of NO_x and wind speed and direction.

Please refer to Data Capture Percentage Table 9 for details; and Table 10 for valid data exceptions.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

-----END OF REPORT-----

Appendix 1 - Definitions & Abbreviations

| | |
|------------------|---------------------------------------|
| BTX | Benzene, Toluene and <i>p</i> -Xylene |
| H ₂ S | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| NO ₂ | Nitrogen dioxide |
| NO _x | Oxides of nitrogen |
| ppb | Parts per billion |
| SO ₂ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

Appendix 2 - Explanation of Exception Table

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.

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 affected by environmental conditions – wind speed / wind speed gust spike refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

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.

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.

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

Peabody Energy

Wilpinjong Coal Wollar

Ambient Air Quality Monitoring

Validated Report

1st June – 30th June 2017

Report No.: DAT12176

Report issue date: 28th July 2017

Maintenance contract: MC951

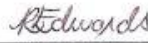
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| Revision History | | | |
|------------------|-----------|------------|---------------|
| Revision | Report ID | Date | Analyst |
| 0 | DAT12176 | 28/07/2017 | Robyn Edwards |

Report by:

Robyn EDWARDS



Approved Signatory:

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Table of Contents

Customer Details..... 2

Revision History 2

Table of Contents..... 3

List of Figures 4

List of Tables 5

1.0 Executive Summary.....6

2.0 Introduction7

3.0 Monitoring and Data Collection.....7

 3.1. Siting Details..... 7

 3.2. Monitored Parameters 9

 3.3. Data Collection Methods 10

 3.3.1. Compliance with Standards 11

 3.3.2. Data Acquisition 11

 3.4. Data Validation and Reporting..... 11

 3.4.1. Validation 11

 3.4.2. Reporting..... 12

4.0 Air Quality Goals.....13

 4.1. Air Quality Summary 13

5.0 Calibrations and Maintenance.....14

 5.1. Units and Uncertainties 14

 5.2. Automatic Checks 15

 5.3. Maintenance 15



5.3.1. Calibration & Maintenance Summary Tables 15

6.0 Results.....17

6.1. Data Capture 17

6.2. Graphic Representations 18

7.0 Valid Data Exception Tables23

8.0 Report Summary.....24

Appendix 1 - Definitions & Abbreviations25

Appendix 2 - Explanation of Exception Table.....26

List of Figures

Figure 1: Wilpinjong Mine Monitoring Station Location..... 8

Figure 2: NO 1-hour averaged data 18

Figure 3: NO₂ 1-hour averaged data 19

Figure 4: NO_x 1-hour averaged data 19

Figure 5: SO₂ 1-hour averaged data 20

Figure 6: H₂S 1-hour averaged data 20

Figure 7: BTX 1-hour averaged data 21

Figure 8: WS 1-hour averaged data 21

Figure 9: Wind Rose 22

List of Tables

| | |
|---|----|
| Table 1: Wilpinjong Mine monitoring site location | 7 |
| Table 2: Parameters measured at the Wilpinjong Mine monitoring station..... | 9 |
| Table 3: Methods | 10 |
| Table 4: Wilpinjong Air Quality Goals (NEPM) | 13 |
| Table 5: Exceedences Recorded..... | 13 |
| Table 6: Units and Uncertainties..... | 14 |
| Table 7: Automatic checks for NO, NO ₂ , NO _x , SO ₂ , H ₂ S and BTX..... | 15 |
| Table 8: Wilpinjong Wollar Maintenance Table | 16 |
| Table 9: Data Capture for Wilpinjong Wollar Station | 17 |
| Table 10: Wollar Valid Data Exception Table | 23 |

1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene, *p*-Xylene, wind speed and wind direction.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for June 2017. Data capture for the different pollutants is presented in Table 9.

2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for June 2017.

The data presented in this report:

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

3.0 Monitoring and Data Collection

3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

Table 1: Wilpinjong Mine monitoring site location

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|-----------|----------------------------------|----------------------------|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with AS/NZS 3580.1.1:2007 “Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment”.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to AS/NZS 3580.1.1:2007.



Figure 1: Wilpinjong Mine Monitoring Station Location

3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

Table 2: Parameters measured at the Wilpinjong Mine monitoring station

| Parameter Measured | Instrument and Measurement Technique |
|--|--|
| BTX (Benzene, Toluene and <i>p</i> -Xylene) | Synspec GC955 - Gas Chromatography |
| H ₂ S | Ecotech EC9852 - fluorescence |
| NO, NO ₂ , NO _x | Ecotech EC9841 gas phase chemiluminescence |
| SO ₂ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Gill Windsonic |
| Wind Direction (10m) | Gill Windsonic |

3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

Table 3: 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 |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| SO ₂ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
| H ₂ S | Ecotech Laboratory Manual | In-house method 6.5 Hydrogen sulfide by fluorescence |
| BTX | Manufacturer’s Instructions | Gas Chromatography Synspec CG955 Series Manual |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.

3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger 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.

3.4. Data Validation and Reporting

3.4.1. 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-minute data.

3.4.2. Reporting

The reported data is in a Microsoft Excel format file named “*Wilpinjong Coal Validated Data Report Jun-17.xls*”. The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5-minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

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

All averages are calculated from the five-minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One-hour averages are calculated based on a clock hour. One-day averages are calculated based on calendar days.

4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

Table 4: Wilpinjong Air Quality Goals (NEPM)

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|-----------------|-------------|------------------|-------|-------------------------------|
| NO ₂ | 1 year | 30 | ppb | None |
| NO ₂ | 1 hour | 120 | ppb | 1 day a year |
| SO ₂ | 1 hour | 200 | ppb | 1 day a year |
| SO ₂ | 1 day | 80 | ppb | 1 day a year |
| SO ₂ | 1 year | 20 | ppb | None |

4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

Table 5: Exceedences Recorded

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|-----------------|-------------|---------------------|--------------------|
| NO ₂ | 1 hour | - | - |
| SO ₂ | 1 hour | - | - |
| SO ₂ | 1 day | - | - |

5.0 Calibrations and Maintenance

5.1. 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 6: Units and Uncertainties

| Parameter | Units | Resolution | Uncertainty | Measurement Range ¹ |
|--|-------|------------|--|--|
| NO, NO _x (EC9841) | ppm | 1 ppb | ± 14 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| NO ₂ (EC9841) | ppm | 1 ppb | ± 16 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| SO ₂ (EC9850) | ppm | 1 ppb | ± 14 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| H ₂ S | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and <i>p</i> - Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.01 m/s or 2.0% of reading, whichever is greater (K factor of 1.96) | 0 m/s to 60 m/s |
| Vector Wind Direction | Deg | 1 deg | ±2 deg K factor of 2.11 | 0 deg to 360 deg Starting threshold: 0 m/s |

¹ Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, NO₂ and NO_x by EC 9841 and SO₂ by EC9850 are calculated based on a measurement range of 0-125 ppb.

5.2. Automatic Checks

Automatic span and zero calibration checks run every night for NO, NO₂, NO_x and SO₂, every 2nd night for H₂S and daily for BTX.

Background checks run each night for SO₂ and H₂S.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

Table 7: Automatic checks for NO, NO₂, NO_x, SO₂, H₂S and BTX

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---------------------------------------|--|-------------------------------------|
| NO, NO ₂ , NO _x | 00:45 to 01:25 every day | N/A |
| SO ₂ | 00:45 to 01:25 every day | 23:45 to 23:50 every day |
| H ₂ S | 01:35 to 02:35 every 2 nd day | 23:45 to 23:50 every day |
| BTX | 02:45 to 05:10 every day | N/A |

5.3. Maintenance

Scheduled monthly maintenance was performed on 21/06/2017.

Two unscheduled visits were made on 15/06/2017 to remove the BTX analyser, and on 26/06/2017 to change the gas regulator on the gas bottle following a raised fault for incomplete calibration cycles.

5.3.1. 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.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

Table 8: Wilpinjong Wollar Maintenance Table

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---------------------------------------|--------------------------|---------------------|--------------------------|-------------------|
| NO, NO ₂ , NO _x | 26/06/2017 | Unscheduled | 26/06/2017 | Monthly |
| SO ₂ | 26/06/2017 | Unscheduled | 26/06/2017 | Monthly |
| H ₂ S | 21/06/2017 | Monthly | 26/06/2017 | Monthly |
| BTX | 15/06/2017 | Removed for repairs | 27/01/2017 | Yearly |
| Wind Sensor | 21/06/2017 | Monthly | 21/05/2015 | 2-yearly |

6.0 Results

6.1. Data Capture

Data capture is based on 1-hour averages, calculated from 5-minute data, and refers to the amount of available data collected during the report period.

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

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

Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for June 2017. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

Table 9: Data Capture for Wilpinjong Wollar Station

| Parameter | Data Capture % |
|---------------------------------------|----------------|
| NO, NO ₂ , NO _x | 95.0 |
| SO ₂ | 94.9 |
| H ₂ S | 92.1 |
| Benzene | 0.0 |
| Toluene | 0.0 |
| <i>p</i> -Xylene | 0.0 |
| WS, WD | 98.4 |

6.2. Graphic Representations

Validated 5-minute data for NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

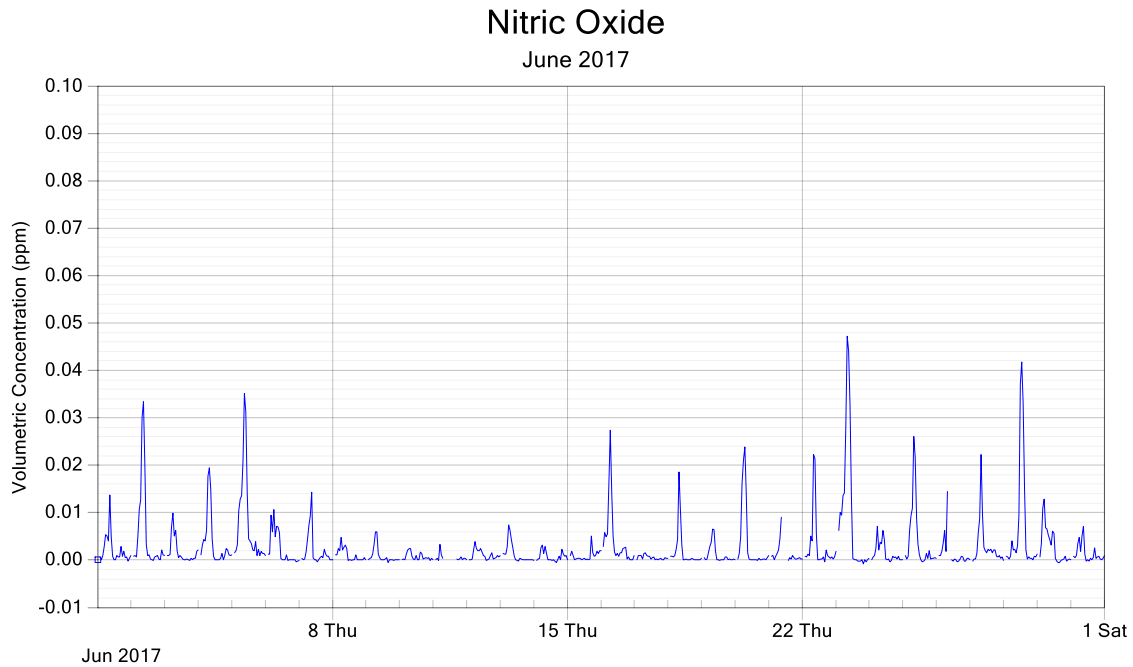


Figure 2: NO 1-hour averaged data

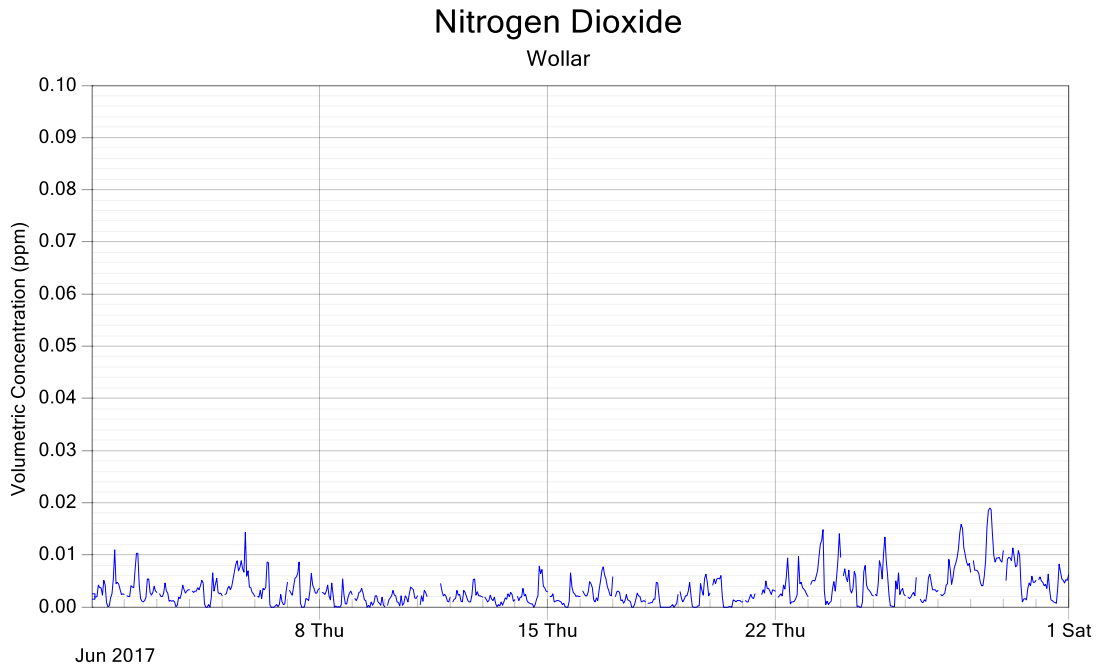


Figure 3: NO₂ 1-hour averaged data

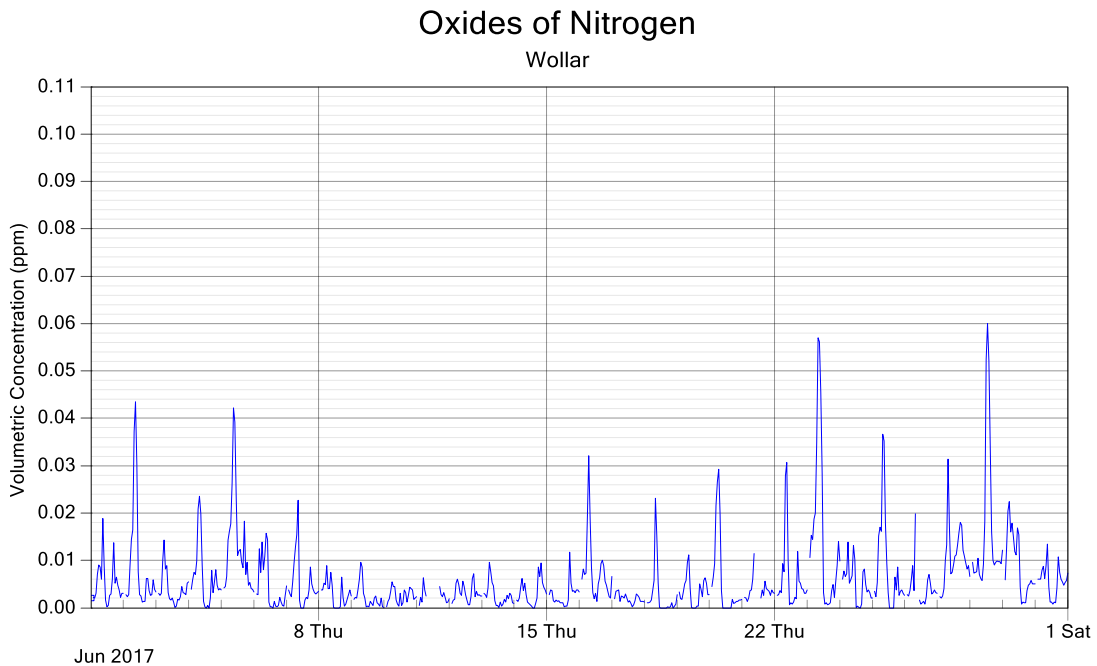


Figure 4: NO_x 1-hour averaged data

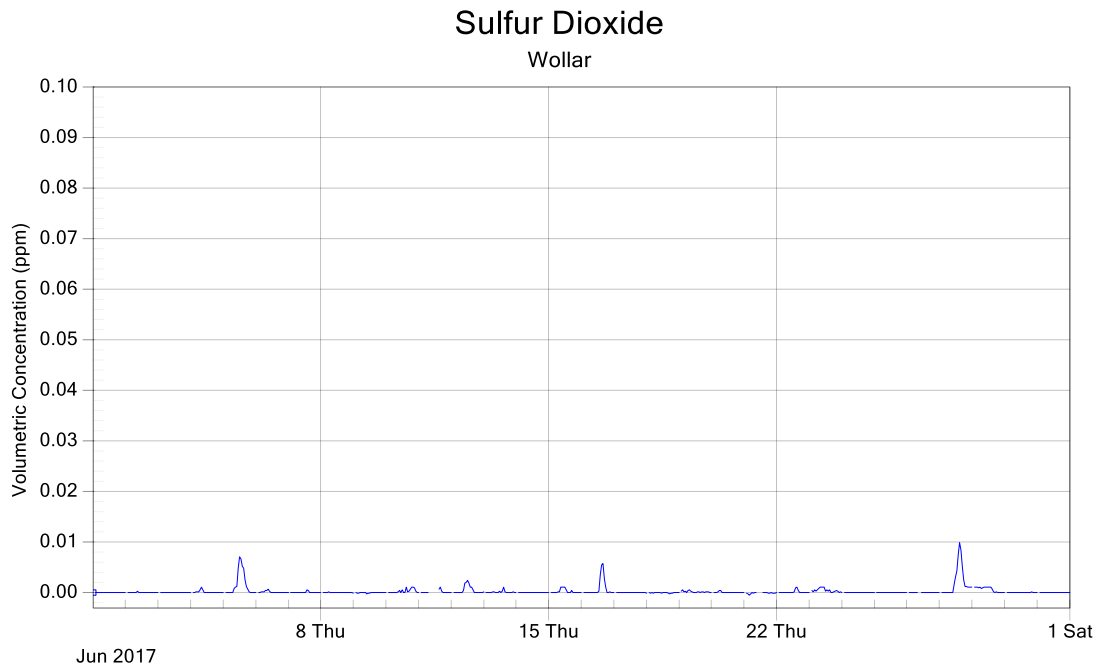


Figure 5: SO₂ 1-hour averaged data

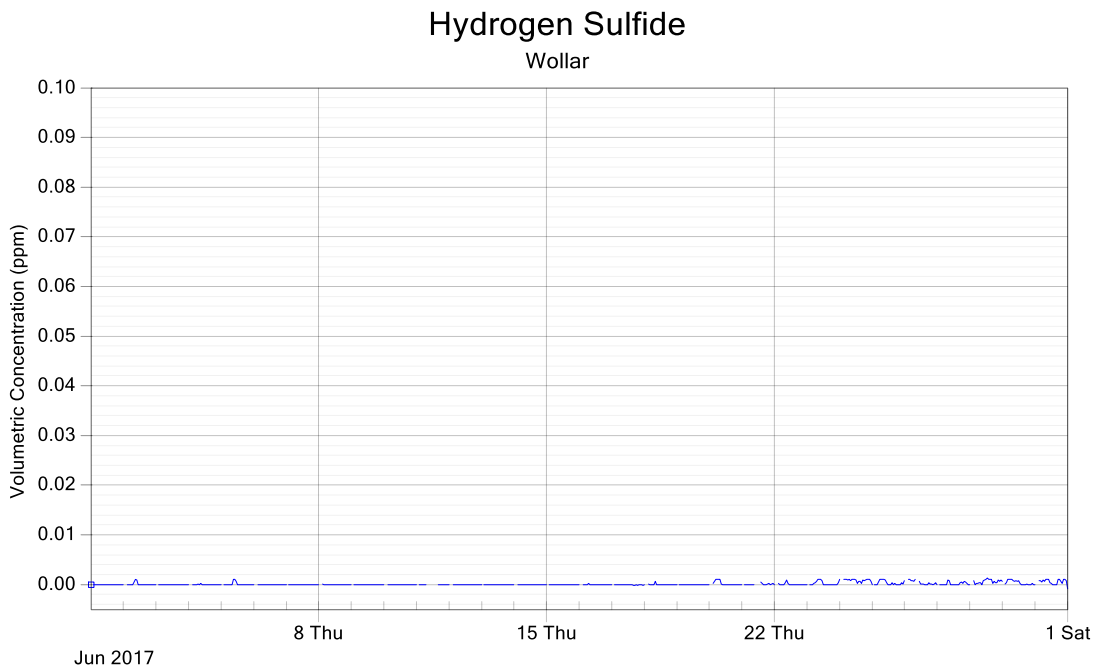


Figure 6: H₂S 1-hour averaged data

Benzene, Toluene and p-Xylene

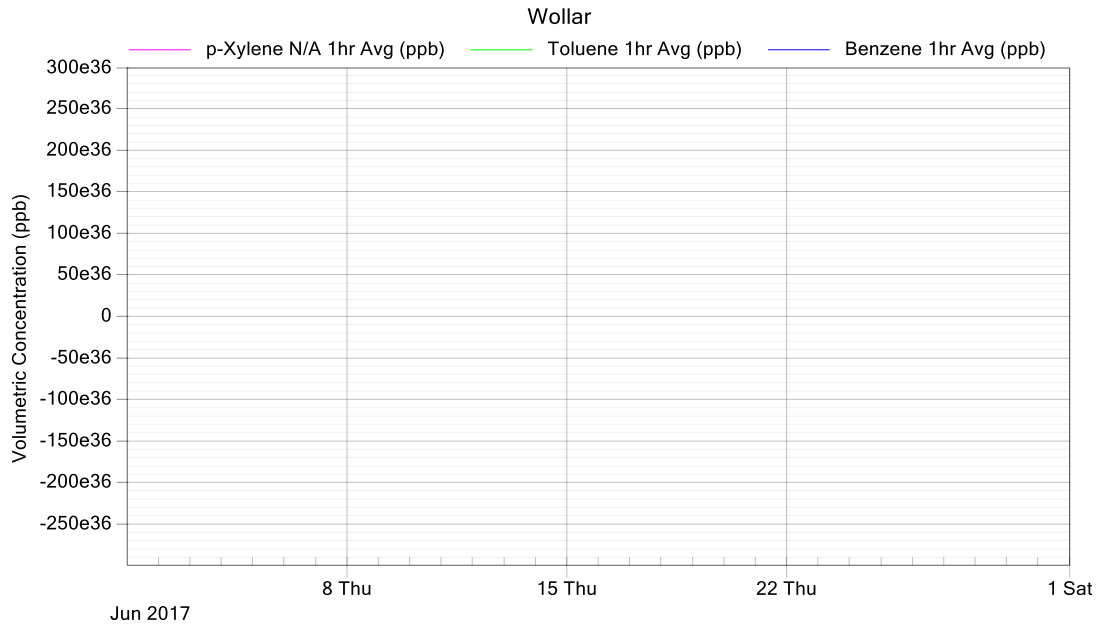


Figure 7: BTX 1-hour averaged data

Wind Speed

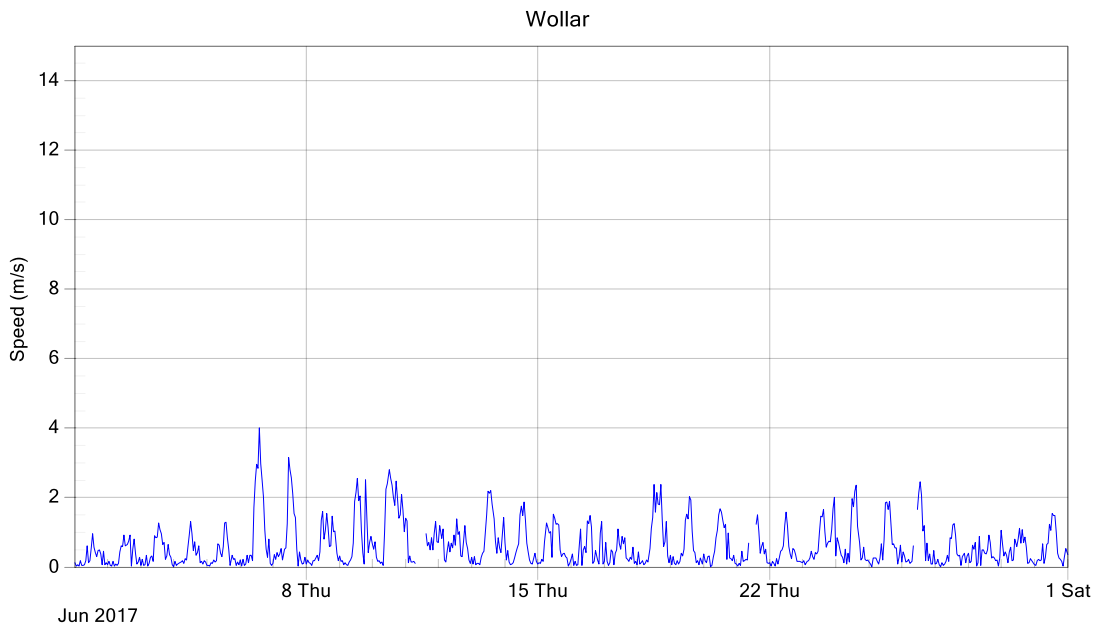


Figure 8: WS 1-hour averaged data

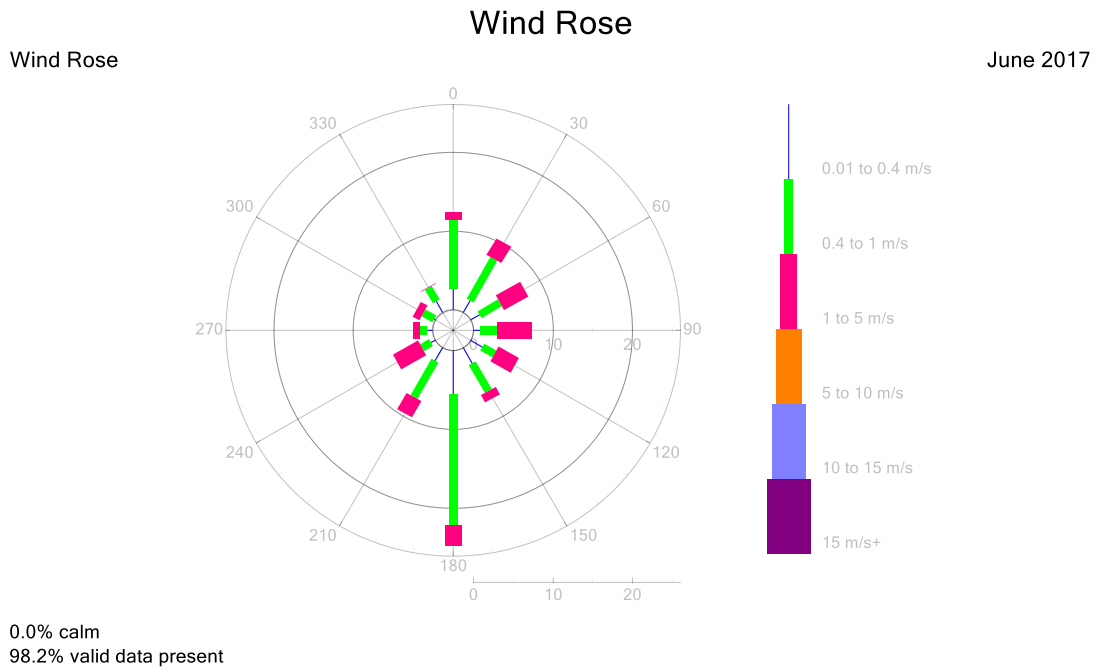


Figure 9: Wind Rose

7.0 Valid Data Exception Tables

The table 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 10: Wollar Valid Data Exception Table

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---------------------|---------------------|---|---------------------------------------|-----------|-------------|
| 1/06/2017 0:00 | 30/06/2017 23:55 | Instrument fault - Synspec oven failed, did not restore following power interruption on 11/06/2017 & removed for repair on 15/06/2017 | BTX | RE | 20/07/2017 |
| 7/06/2017 1:30 | 11/06/2017 7:55 | Linear multiplier applied to correct span values where A= 1.07 and B= 1.15 | NO, NO ₂ , NO _x | CT | 28/07/2017 |
| 11/06/2017 8:00 | 11/06/2017 16:15 | Power interruption and stabilisation | All parameters | RE | 20/07/2017 |
| 15/06/2017 1:30 | 26/06/2017 9:25 | Overnight spans out of tolerance due to gas bottle regulator fault | NO, NO ₂ , NO _x | RE | 20/07/2017 |
| 21/06/2017 10:00 | 21/06/2017 13:25 | Scheduled maintenance – monthly tasks performed | All parameters | RE | 20/07/2017 |
| 21/06/2017 13:35 | 1/07/2017 0:00 | Static offset of 0.001ppm to correct baseline | H ₂ S | CT | 28/07/2017 |
| 26/06/2017 9:30 | 26/06/2017 11:05 | Unscheduled maintenance – resolved raised span/zero fault | All parameters | RE | 20/07/2017 |

8.0 Report Summary

The data capture for Wollar was below 95% for the reporting month; with the exception of NO_x, wind speed and direction.

Please refer to Data Capture Percentage Table 9 for details; and Table 10 for valid data exceptions.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

-----END OF REPORT-----

Appendix 1 - Definitions & Abbreviations

| | |
|------------------|---------------------------------------|
| BTX | Benzene, Toluene and <i>p</i> -Xylene |
| H ₂ S | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| NO ₂ | Nitrogen dioxide |
| NO _x | Oxides of nitrogen |
| ppb | Parts per billion |
| SO ₂ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

Appendix 2 - Explanation of Exception Table

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.

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 affected by environmental conditions – wind speed / wind speed gust spike refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

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.

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.

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

Peabody Energy

Wilpinjong Coal Wollar

Ambient Air Quality Monitoring

Validated Report

1st July – 31st July 2017

Report No.: DAT12282

Report issue date: 30th August 2017

Maintenance contract: MC951

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| Revision | Report ID | Date | Analyst |
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Table of Contents

| | | |
|------------|--|-----------|
| 1.0 | Executive Summary..... | 6 |
| 2.0 | Introduction | 7 |
| 3.0 | Monitoring and Data Collection..... | 7 |
| 3.1. | Siting Details..... | 7 |
| 3.2. | Monitored Parameters | 9 |
| 3.3. | Data Collection Methods | 10 |
| 3.3.1. | Compliance with Standards | 11 |
| 3.3.2. | Data Acquisition | 11 |
| 3.4. | Data Validation and Reporting..... | 11 |
| 3.4.1. | Validation | 11 |
| 3.4.2. | Reporting..... | 12 |
| 4.0 | Air Quality Goals..... | 13 |
| 4.1. | Air Quality Summary | 13 |
| 5.0 | Calibrations and Maintenance..... | 14 |
| 5.1. | Units and Uncertainties | 14 |
| 5.2. | Automatic Checks | 15 |
| 5.3. | Maintenance | 15 |
| 5.3.1. | Calibration & Maintenance Summary Tables | 16 |
| 6.0 | Results..... | 17 |
| 6.1. | Data Capture | 17 |
| 6.2. | Graphic Representations | 18 |



| | | |
|------------|---|-----------|
| 7.0 | Valid Data Exception Tables | 23 |
| 8.0 | Report Summary..... | 24 |
| | Appendix 1 - Definitions & Abbreviations | 25 |
| | Appendix 2 - Explanation of Exception Table..... | 26 |

List of Figures

| | |
|--|----|
| Figure 1: Wilpinjong Mine Monitoring Station Location..... | 8 |
| Figure 2: NO 1-hour averaged data | 18 |
| Figure 3: NO ₂ 1-hour averaged data | 19 |
| Figure 4: NO _x 1-hour averaged data | 19 |
| Figure 5: SO ₂ 1-hour averaged data | 20 |
| Figure 6: H ₂ S 1-hour averaged data | 20 |
| Figure 7: BTX 1-hour averaged data | 21 |
| Figure 8: WS 1-hour averaged data | 21 |
| Figure 9: Wind Rose | 22 |

List of Tables

| | |
|---|----|
| Table 1: Wilpinjong Mine monitoring site location | 7 |
| Table 2: Parameters measured at the Wilpinjong Mine monitoring station..... | 9 |
| Table 3: Methods | 10 |
| Table 4: Wilpinjong Air Quality Goals (NEPM) | 13 |
| Table 5: Exceedences Recorded..... | 13 |
| Table 6: Units and Uncertainties..... | 14 |
| Table 7: Automatic checks for NO, NO ₂ , NO _x , SO ₂ , H ₂ S and BTX..... | 15 |
| Table 8: Wilpinjong Wollar Maintenance Table | 16 |
| Table 9: Data Capture for Wilpinjong Wollar Station | 17 |
| Table 10: Wollar Valid Data Exception Table | 23 |

1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene, *p*-Xylene, wind speed and wind direction.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for July 2017. Data capture for the different pollutants is presented in Table 9.

2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for July 2017.

The data presented in this report:

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

3.0 Monitoring and Data Collection

3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

Table 1: Wilpinjong Mine monitoring site location

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|-----------|----------------------------------|----------------------------|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with AS/NZS 3580.1.1:2007 “Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment”.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to AS/NZS 3580.1.1:2007.



Figure 1: Wilpinjong Mine Monitoring Station Location

3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

Table 2: Parameters measured at the Wilpinjong Mine monitoring station

| Parameter Measured | Instrument and Measurement Technique |
|--|--|
| BTX (Benzene, Toluene and <i>p</i> -Xylene) | Synspec GC955 - Gas Chromatography |
| H ₂ S | Ecotech EC9852 - fluorescence |
| NO, NO ₂ , NO _x | Ecotech EC9841 gas phase chemiluminescence |
| SO ₂ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Gill Windsonic |
| Wind Direction (10m) | Gill Windsonic |

3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

Table 3: 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 |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| SO ₂ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
| H ₂ S | Ecotech Laboratory Manual | In-house method 6.5 Hydrogen sulfide by fluorescence |
| BTX | Manufacturer’s Instructions | Gas Chromatography Synspec CG955 Series Manual |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.

3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger 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.

3.4. Data Validation and Reporting

3.4.1. 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-minute data.

3.4.2. Reporting

The reported data is in a Microsoft Excel format file named “*Wilpinjong Coal Validated Data Report July-17.xls*”. The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5-minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

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

All averages are calculated from the five-minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One-hour averages are calculated based on a clock hour. One-day averages are calculated based on calendar days.

4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

Table 4: Wilpinjong Air Quality Goals (NEPM)

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|-----------------|-------------|------------------|-------|-------------------------------|
| NO ₂ | 1 year | 30 | ppb | None |
| NO ₂ | 1 hour | 120 | ppb | 1 day a year |
| SO ₂ | 1 hour | 200 | ppb | 1 day a year |
| SO ₂ | 1 day | 80 | ppb | 1 day a year |
| SO ₂ | 1 year | 20 | ppb | None |

4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

Table 5: Exceedences Recorded

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|-----------------|-------------|---------------------|--------------------|
| NO ₂ | 1 hour | - | - |
| SO ₂ | 1 hour | - | - |
| SO ₂ | 1 day | - | - |

5.0 Calibrations and Maintenance

5.1. 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 6: Units and Uncertainties

| Parameter | Units | Resolution | Uncertainty | Measurement Range ¹ |
|--|-------|------------|--|--|
| NO, NO _x (EC9841) | ppm | 1 ppb | ± 14 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| NO ₂ (EC9841) | ppm | 1 ppb | ± 16 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| SO ₂ (EC9850) | ppm | 1 ppb | ± 14 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| H ₂ S | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and <i>p</i> - Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.01 m/s or 2.0% of reading, whichever is greater (K factor of 1.96) | 0 m/s to 60 m/s |
| Vector Wind Direction | Deg | 1 deg | ±2 deg K factor of 2.11 | 0 deg to 360 deg Starting threshold: 0 m/s |

¹ Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, NO₂ and NO_x by EC 9841 and SO₂ by EC9850 are calculated based on a measurement range of 0-125 ppb.

5.2. Automatic Checks

Automatic span and zero calibration checks run every night for NO, NO₂, NO_x and SO₂, every 2nd night for H₂S and weekly for BTX.

Background checks run each night for SO₂ and H₂S.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

Table 7: Automatic checks for NO, NO₂, NO_x, SO₂, H₂S and BTX

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---------------------------------------|--|-------------------------------------|
| NO, NO ₂ , NO _x | 00:45 to 01:25 every day | N/A |
| SO ₂ | 00:45 to 01:25 every day | 23:45 to 23:50 every day |
| H ₂ S | 01:35 to 02:35 every 2 nd day | 23:45 to 23:50 every day |
| BTX | 02:45 to 05:25 weekly | N/A |

5.3. Maintenance

Scheduled monthly maintenance was performed on 12/07/2017.

Four unscheduled visits were made:

- 11/07/2017 to install the new BTX analyser, and
- 14/07/2017 to replace the Gas calibrator (Instrument ID:04-1126 was transferred in and ID: 99-0563 was transferred out), and
- 17/07/2017 remote access to BTX analyser to fix the time zone and the clock
- 19/07/2017 remote calibration was performed for NO_x analyser to fix the span drift

5.3.1. 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.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

Table 8: Wilpinjong Wollar Maintenance Table

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---------------------------------------|--------------------------|------------------|--------------------------|-------------------|
| NO, NO ₂ , NO _x | 19/07/2017 | Unscheduled | 12/07/2017 | Monthly |
| SO ₂ | 12/07/2017 | Monthly | 12/07/2017 | Monthly |
| H ₂ S | 12/07/2017 | Monthly | 12/07/2017 | Monthly |
| BTX | 19/07/2017 | Unscheduled | 27/01/2017 | Yearly |
| Wind Sensor | 12/07/2017 | Monthly | 22/07/2015 | 2-yearly |

6.0 Results

6.1. Data Capture

Data capture is based on 1-hour averages, calculated from 5-minute data, and refers to the amount of available data collected during the report period.

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

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

Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for July 2017. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

Table 9: Data Capture for Wilpinjong Wollar Station

| Parameter | Data Capture % |
|---------------------------------------|----------------|
| NO, NO ₂ , NO _x | 32.8 |
| SO ₂ | 95.7 |
| H ₂ S | 95.3 |
| Benzene | 27.5 |
| Toluene | 27.5 |
| <i>p</i> -Xylene | 27.5 |
| WS, WD | 98.8 |

6.2. Graphic Representations

Validated 5-minute data for NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

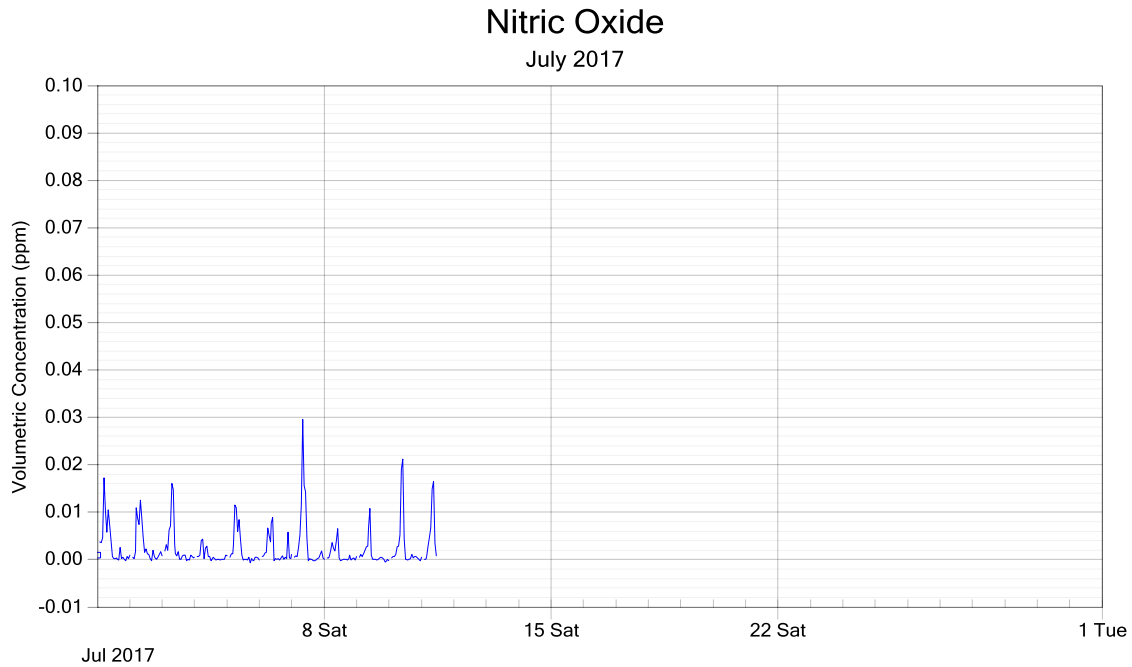


Figure 2: NO 1-hour averaged data

Nitrogen Dioxide

July 2017

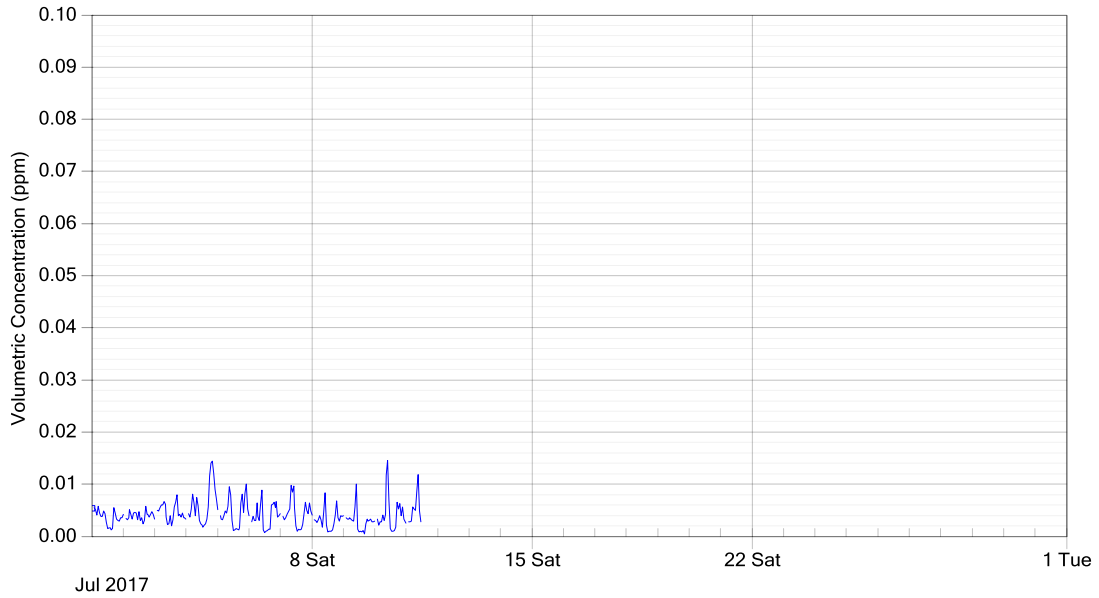


Figure 3: NO₂ 1-hour averaged data

Oxides of Nitrogen

July 2017

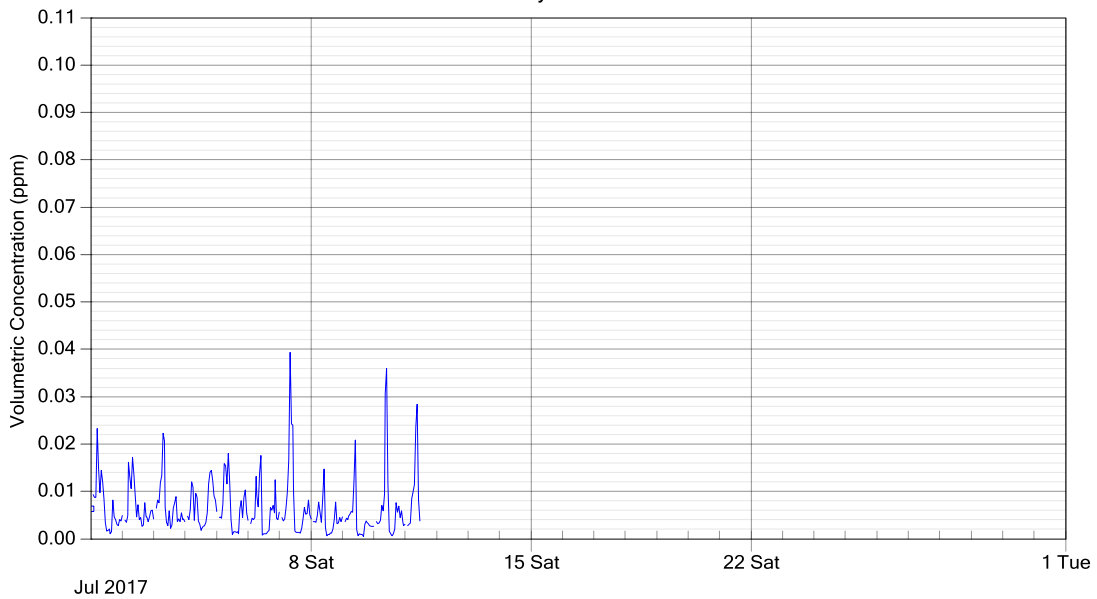


Figure 4: NO_x 1-hour averaged data

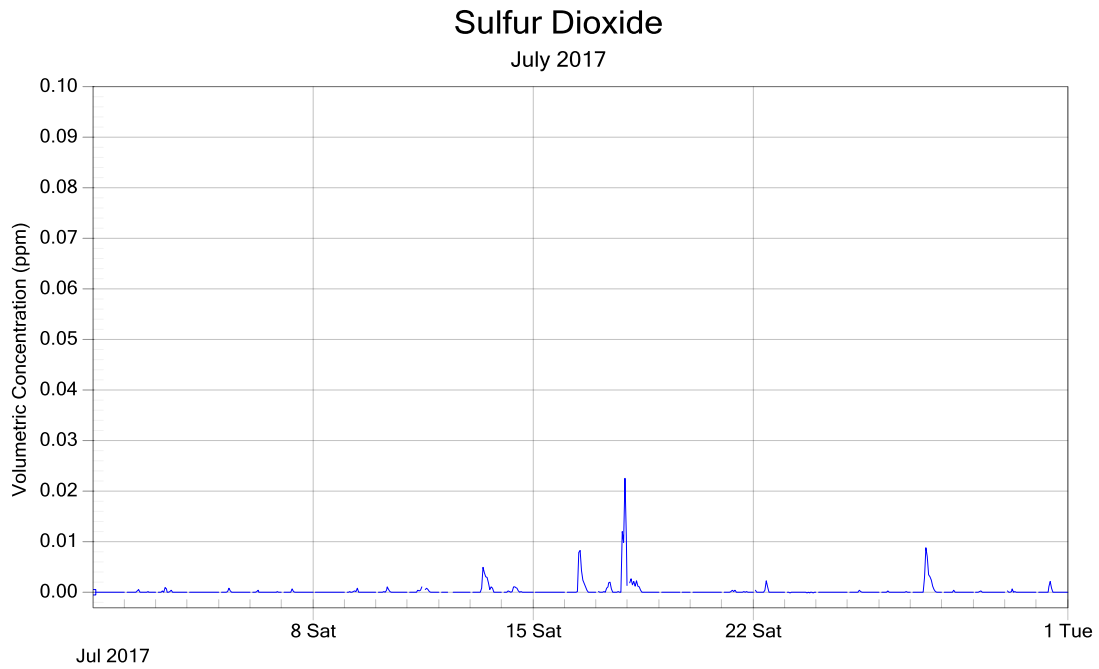


Figure 5: SO₂ 1-hour averaged data

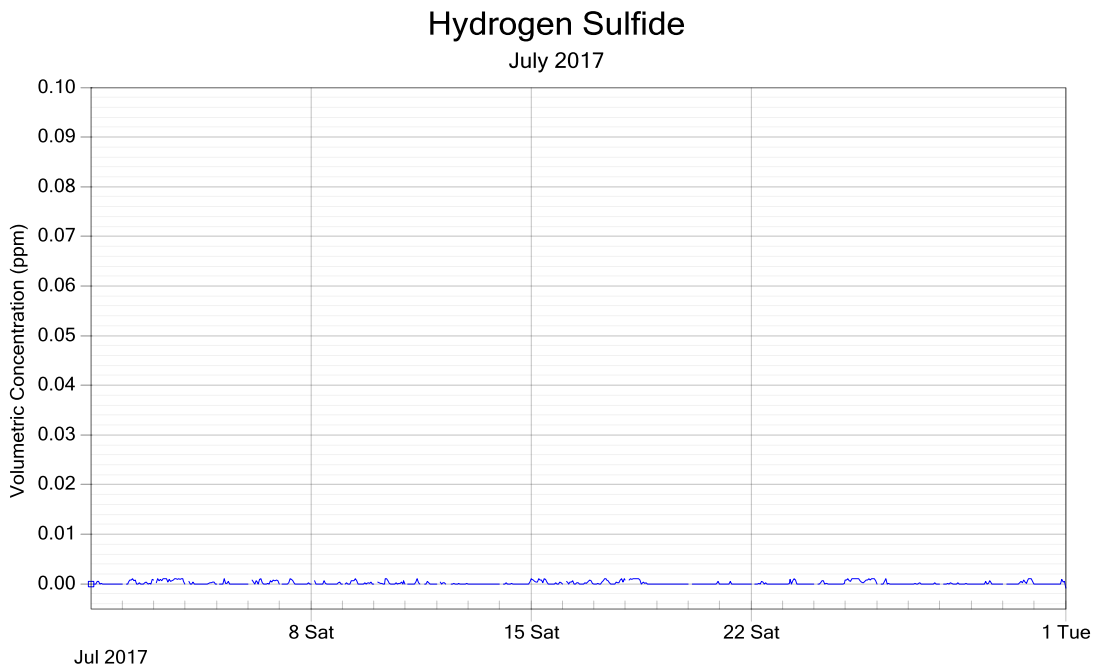


Figure 6: H₂S 1-hour averaged data

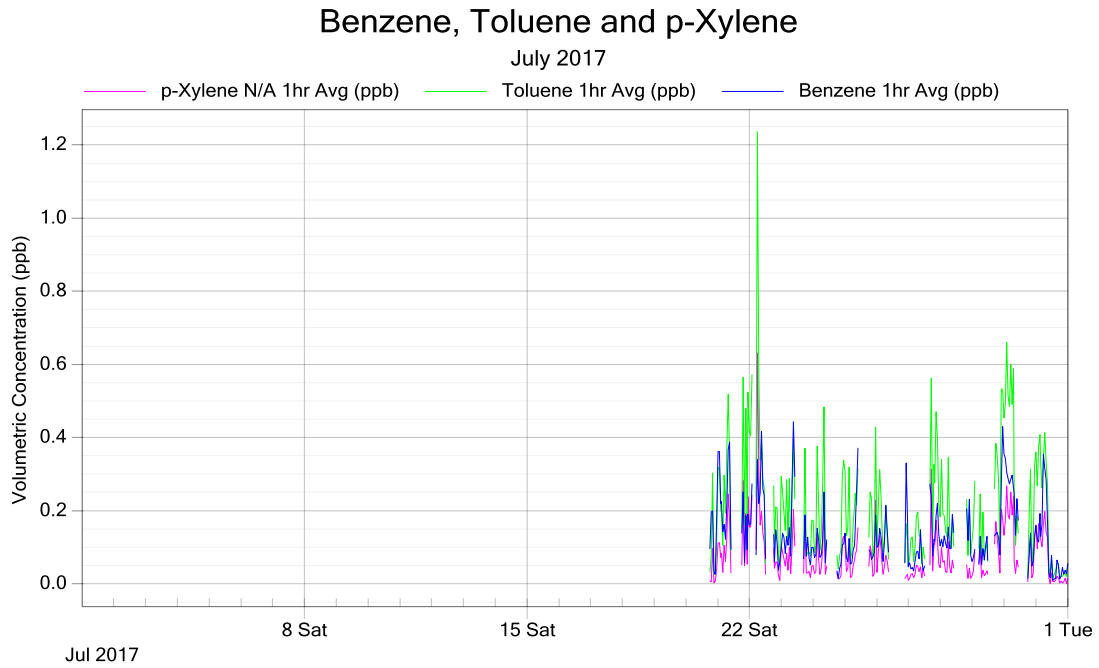


Figure 7: BTX 1-hour averaged data

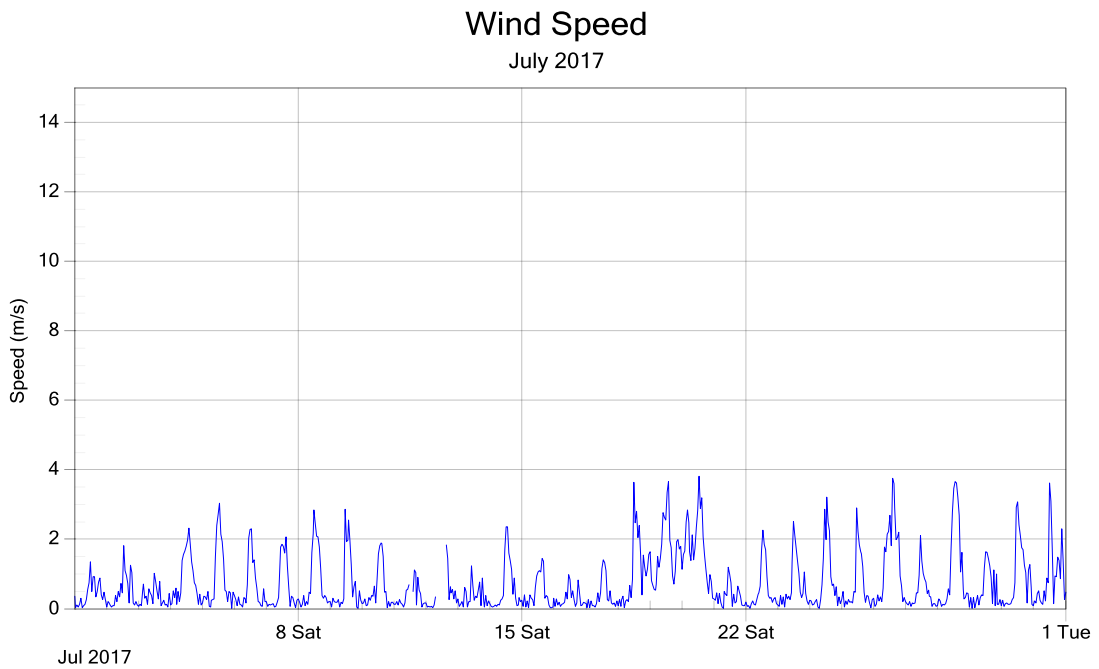


Figure 8: WS 1-hour averaged data

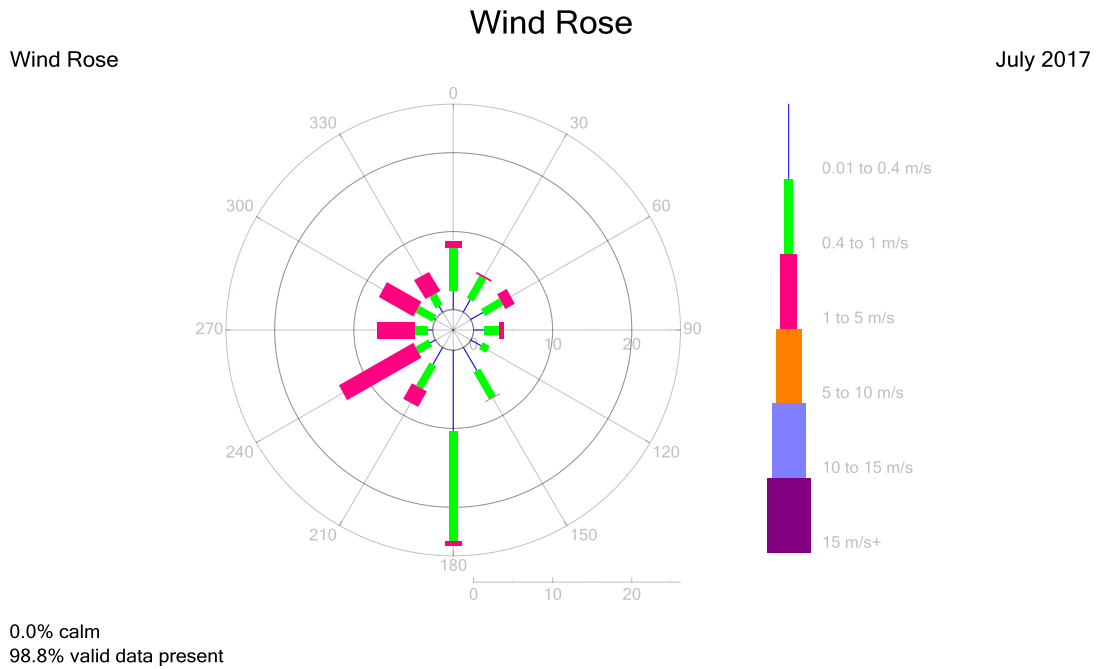


Figure 9: Wind Rose

7.0 Valid Data Exception Tables

The table 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 10: Wollar Valid Data Exception Table

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---------------------|---------------------|--|---------------------------------------|-----------|-------------|
| 30/06/2017 1:30 | 3/07/2017 0:40 | Linear multiplier applied to correct span values where A= 0.87 & B= 0.88 | NO, NO ₂ , NO _x | EP | 23/08/2017 |
| 1/07/2017 0:00 | 11/07/2017 12:30 | Instrument fault - Synspec oven failed | BTX | EP | 23/08/2017 |
| 1/07/2017 0:00 | 1/08/2017 0:00 | Static offset of 0.001ppm to correct baseline | H ₂ S | EP | 23/08/2017 |
| 4/07/2017 1:30 | 7/07/2017 0:40 | Static multiplier of 1.09 applied to correct span values | NO, NO ₂ , NO _x | CT | 28/08/2017 |
| 11/07/2017 12:35 | 11/07/2017 15:40 | Non-scheduled maintenance -Synpec analyser installed | All channels | EP | 23/08/2017 |
| 11/07/2017 14:15 | 1/08/2017 0:00 | Instrument fault - not responding to span check | NO, NO ₂ , NO _x | CT | 28/08/2017 |
| 11/07/2017 15:45 | 14/07/2017 9:35 | Instrument stabilisation | BTX | CT | 29/08/2017 |
| 12/07/2017 7:45 | 12/07/2017 14:50 | Scheduled maintenance – monthly tasks performed | All parameters | EP | 23/08/2017 |
| 14/07/2017 9:40 | 14/07/2017 16:15 | Non-scheduled maintenance - Synpec analyser not communicating due to Gas cal failure | BTX | EP | 23/08/2017 |
| 14/07/2017 16:20 | 20/07/2017 18:10 | Instrument stabilisation and settings adjusted in the analyser | BTX | CT | 28/08/2017 |
| 19/07/2017 17:15 | 19/07/2017 17:50 | Remote calibration performed | SO ₂ | EP | 23/08/2017 |



| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---------------------|---------------------|---|------------------|-----------|-------------|
| 21/07/2017 10:50 | 30/07/2017 17:25 | Intermittent instrument fault - BTX unresponsive for extended period. Possibly affected by changes in shelter temperature | BTX | CT | 28/08/2017 |
| 28/07/2017 12:45 | 28/07/2017 12:55 | Additional background check and following instrument stabilisation | H ₂ S | EP | 23/08/2017 |

8.0 Report Summary

The data capture for Wollar was below 95% for the reporting month; with the exception of NO_x, benzene, toluene and p-xylene.

Please refer to Data Capture Percentage Table 9 for details; and Table 10 for valid data exceptions.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech’s NATA scope of accreditation. Please refer to section 3.3.1 for details.

-----END OF REPORT-----

Appendix 1 - Definitions & Abbreviations

| | |
|------------------|---------------------------------------|
| BTX | Benzene, Toluene and <i>p</i> -Xylene |
| H ₂ S | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| NO ₂ | Nitrogen dioxide |
| NO _x | Oxides of nitrogen |
| ppb | Parts per billion |
| SO ₂ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

Appendix 2 - Explanation of Exception Table

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.

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 affected by environmental conditions – wind speed / wind speed gust spike refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

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.

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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.

Power Interruption refers to no power to the station therefore no data was collected at this time.

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

Peabody Energy

Wilpinjong Coal Wollar

Ambient Air Quality Monitoring

Validated Report

1st August – 31st August 2017

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Maintenance contract: MC951

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| Revision History | | | |
|------------------|-----------|------------|--------------|
| Revision | Report ID | Date | Analyst |
| 0 | DAT12412 | 28/09/2017 | Elmira Parto |

Report by Elmira Parto



Approved by Caroline Knight

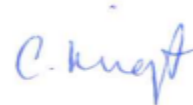


Table of Contents

| | | |
|------------|--|-----------|
| 1.0 | Executive Summary..... | 6 |
| 2.0 | Introduction | 7 |
| 3.0 | Monitoring and Data Collection..... | 7 |
| 3.1. | Siting Details..... | 7 |
| 3.2. | Monitored Parameters | 9 |
| 3.3. | Data Collection Methods | 10 |
| 3.3.1. | Compliance with Standards | 11 |
| 3.3.2. | Data Acquisition | 11 |
| 3.4. | Data Validation and Reporting..... | 11 |
| 3.4.1. | Validation | 11 |
| 3.4.2. | Reporting..... | 12 |
| 4.0 | Air Quality Goals..... | 13 |
| 4.1. | Air Quality Summary | 13 |
| 5.0 | Calibrations and Maintenance..... | 14 |
| 5.1. | Units and Uncertainties | 14 |
| 5.2. | Automatic Checks | 15 |
| 5.3. | Maintenance | 15 |
| 5.3.1. | Calibration & Maintenance Summary Tables | 16 |
| 6.0 | Results..... | 17 |
| 6.1. | Data Capture | 17 |
| 6.2. | Graphic Representations | 18 |



| | | |
|------------|---|-----------|
| 7.0 | Valid Data Exception Tables | 23 |
| 8.0 | Report Summary..... | 25 |
| | Appendix 1 - Definitions & Abbreviations | 26 |
| | Appendix 2 - Explanation of Exception Table..... | 27 |

List of Figures

| | |
|--|----|
| Figure 1: Wilpinjong Mine Monitoring Station Location..... | 8 |
| Figure 2: NO 1-hour averaged data | 18 |
| Figure 3: NO ₂ 1-hour averaged data | 19 |
| Figure 4: NO _x 1-hour averaged data | 19 |
| Figure 5: SO ₂ 1-hour averaged data | 20 |
| Figure 6: H ₂ S 1-hour averaged data | 20 |
| Figure 7: BTX 1-hour averaged data | 21 |
| Figure 8: WS 1-hour averaged data | 21 |
| Figure 9: Wind Rose | 22 |

List of Tables

| | |
|---|----|
| Table 1: Wilpinjong Mine monitoring site location | 7 |
| Table 2: Parameters measured at the Wilpinjong Mine monitoring station..... | 9 |
| Table 3: Methods | 10 |
| Table 4: Wilpinjong Air Quality Goals (NEPM) | 13 |
| Table 5: Exceedences Recorded..... | 13 |
| Table 6: Units and Uncertainties..... | 14 |
| Table 7: Automatic checks for NO, NO ₂ , NO _x , SO ₂ , H ₂ S and BTX..... | 15 |
| Table 8: Wilpinjong Wollar Maintenance Table | 16 |
| Table 9: Data Capture for Wilpinjong Wollar Station | 17 |
| Table 10: Wollar Valid Data Exception Table | 23 |

1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene, *p*-Xylene, wind speed and wind direction.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for August 2017. Data capture for the different pollutants is presented in Table 9.

Benzene, Toluene and Xylene data monitored at the Wollar station after 7/08/2017 is not included in this report as the data is pending further investigation into instrument performance and calibration. Data will be issued on completion of this investigation.

2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for August 2017.

The data presented in this report:

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

3.0 Monitoring and Data Collection

3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

Table 1: Wilpinjong Mine monitoring site location

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|-----------|----------------------------------|----------------------------|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with AS/NZS 3580.1.1:2007 “Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment”.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to AS/NZS 3580.1.1:2007.



Figure 1: Wilpinjong Mine Monitoring Station Location

3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

Table 2: Parameters measured at the Wilpinjong Mine monitoring station

| Parameter Measured | Instrument and Measurement Technique |
|--|--|
| BTX (Benzene, Toluene and <i>p</i> -Xylene) | Synspec GC955 - Gas Chromatography |
| H ₂ S | Ecotech EC9852 - fluorescence |
| NO, NO ₂ , NO _x | Ecotech EC9841 gas phase chemiluminescence |
| SO ₂ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Gill Windsonic |
| Wind Direction (10m) | Gill Windsonic |

3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

Table 3: 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 |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| SO ₂ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
| H ₂ S | Ecotech Laboratory Manual | In-house method 6.5 Hydrogen sulfide by fluorescence |
| BTX | Manufacturer’s Instructions | Gas Chromatography Synspec CG955 Series Manual |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.
- Measurement of the wind data from 22/7/2017 up to 6/09/2017 is not covered by Ecotech's NATA scope of accreditation as the 2 yearly calibration is overdue.

3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger 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.

3.4. Data Validation and Reporting

3.4.1. 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-minute data.

3.4.2. Reporting

The reported data is in a Microsoft Excel format file named “*Wilpinjong Coal Validated Data Report August-17.xls*”. The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5-minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

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

All averages are calculated from the five-minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One-hour averages are calculated based on a clock hour. One-day averages are calculated based on calendar days.

4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

Table 4: Wilpinjong Air Quality Goals (NEPM)

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|-----------------|-------------|------------------|-------|-------------------------------|
| NO ₂ | 1 year | 30 | ppb | None |
| NO ₂ | 1 hour | 120 | ppb | 1 day a year |
| SO ₂ | 1 hour | 200 | ppb | 1 day a year |
| SO ₂ | 1 day | 80 | ppb | 1 day a year |
| SO ₂ | 1 year | 20 | ppb | None |

4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

Table 5: Exceedences Recorded

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|-----------------|-------------|---------------------|--------------------|
| NO ₂ | 1 hour | - | - |
| SO ₂ | 1 hour | - | - |
| SO ₂ | 1 day | - | - |

5.0 Calibrations and Maintenance

5.1. 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 6: Units and Uncertainties

| Parameter | Units | Resolution | Uncertainty | Measurement Range ¹ |
|--|-------|------------|--|--|
| NO, NO _x (EC9841) | ppm | 1 ppb | ± 14 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| NO ₂ (EC9841) | ppm | 1 ppb | ± 16 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| SO ₂ (EC9850) | ppm | 1 ppb | ± 14 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| H ₂ S | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and <i>p</i> - Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.01 m/s or 2.0% of reading, whichever is greater (K factor of 1.96) | 0 m/s to 60 m/s |
| Vector Wind Direction | Deg | 1 deg | ±2 deg K factor of 2.11 | 0 deg to 360 deg Starting threshold: 0 m/s |

¹ Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, NO₂ and NO_x by EC 9841 and SO₂ by EC9850 are calculated based on a measurement range of 0-125 ppb.

5.2. Automatic Checks

Automatic span and zero calibration checks run every night for NO, NO₂, NO_x and SO₂, every 2nd night for H₂S and weekly for BTX.

Background checks run each night for SO₂ and H₂S.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

Table 7: Automatic checks for NO, NO₂, NO_x, SO₂, H₂S and BTX

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---------------------------------------|--|-------------------------------------|
| NO, NO ₂ , NO _x | 00:45 to 01:25 every day | N/A |
| SO ₂ | 00:45 to 01:25 every day | 23:45 to 23:50 every day |
| H ₂ S | 01:35 to 02:35 every 2 nd day | 23:45 to 23:50 every day |
| BTX | 02:45 to 05:25 weekly | N/A |

5.3. Maintenance

Scheduled monthly maintenance was performed on 07/08/2017.

Four unscheduled visits were made:

- 21/08/2017 to replace the zero air generator (Instrument ID:01-0659 was transferred in and ID: 04-0225 was transferred out) an additional gas calibrator and zero air generator was installed for calibration of the BTX analyser (Gas Calibrator ID:04-0477 and Zero Air Generator ID: 06-0577)
- 22/08/2017 NO_x analyser was replaced (Instrument ID: 02-0385 was transferred in and ID: 96-0329 was transferred out), H₂S analyser was replaced (Instrument ID: 97-0373 was transferred in and Instrument ID: 02-0368 was transferred out)
- 28/08/2017 to install a separate scrubber for BTX analyser
- 29/08/2017 to replace the logger and run the span for BTX and H₂S

5.3.1. 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.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

Table 8: Wilpinjong Wollar Maintenance Table

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---------------------------------------|--------------------------|------------------|--------------------------|-------------------|
| NO, NO ₂ , NO _x | 22/08/2017 | Unscheduled | 22/08/2017 | Monthly |
| SO ₂ | 21/08/2017 | Unscheduled | 21/08/2017 | Monthly |
| H ₂ S | 29/08/2017 | Unscheduled | 29/08/2017 | Monthly |
| BTX | 29/08/2017 | Unscheduled | 29/08/2017 | Yearly |
| Wind Sensor | 7/08/2017 | 3 Monthly | 22/07/2015 | 2-yearly |

6.0 Results

6.1. Data Capture

Data capture is based on 1-hour averages, calculated from 5-minute data, and refers to the amount of available data collected during the report period.

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

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

Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for August 2017. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

Table 9: Data Capture for Wilpinjong Wollar Station

| Parameter | Data Capture % |
|---------------------------------------|----------------|
| NO, NO ₂ , NO _x | 25.4 |
| SO ₂ | 51.2 |
| H ₂ S | 4.3 |
| Benzene | TBA |
| Toluene | TBA |
| <i>p</i> -Xylene | TBA |
| WS, WD | 94.9 |

6.2. Graphic Representations

Validated 5-minute data for NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

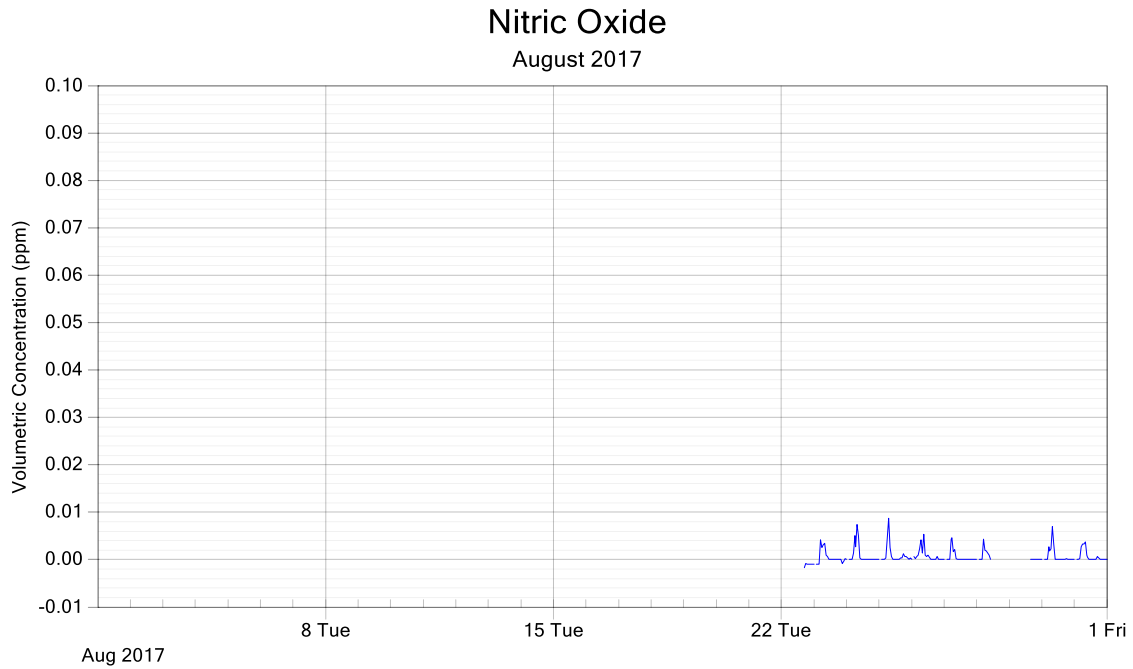


Figure 2: NO 1-hour averaged data

Nitrogen Dioxide

August 2017

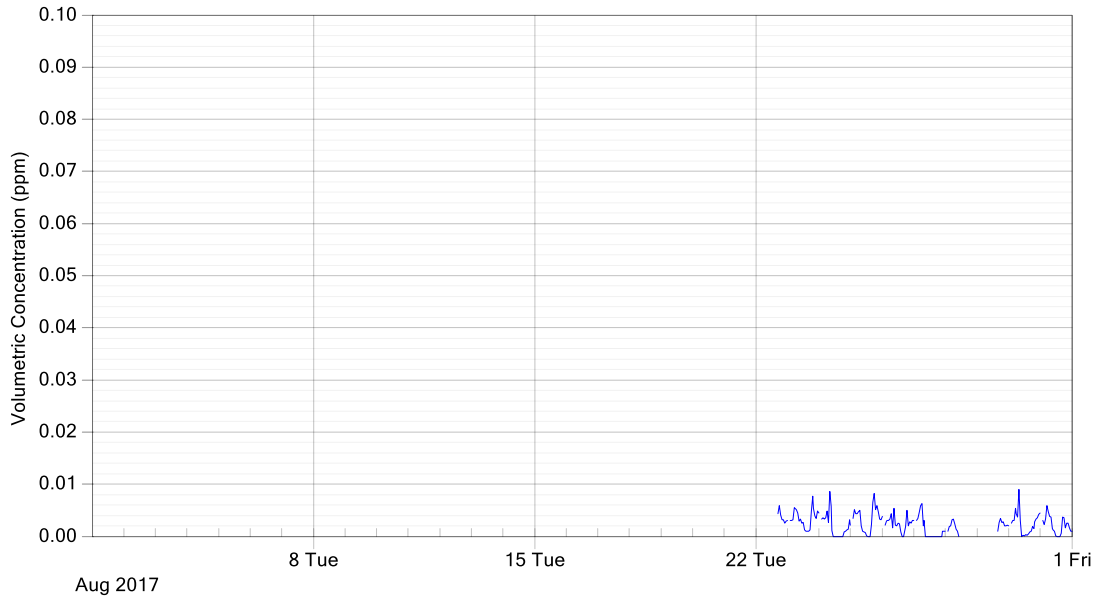


Figure 3: NO₂ 1-hour averaged data

Oxides of Nitrogen

August 2017

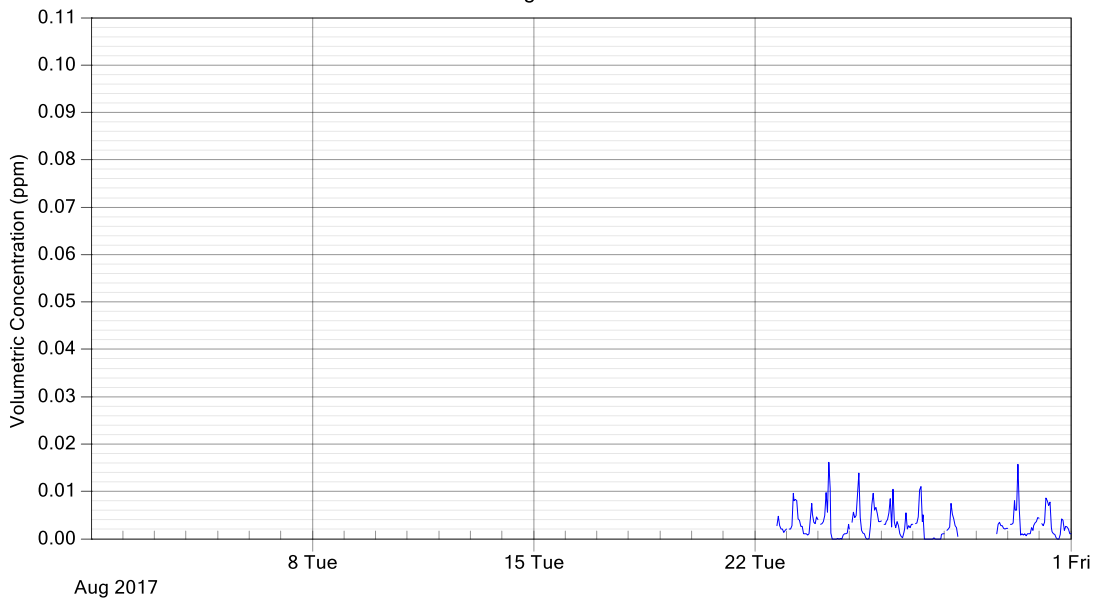


Figure 4: NO_x 1-hour averaged data

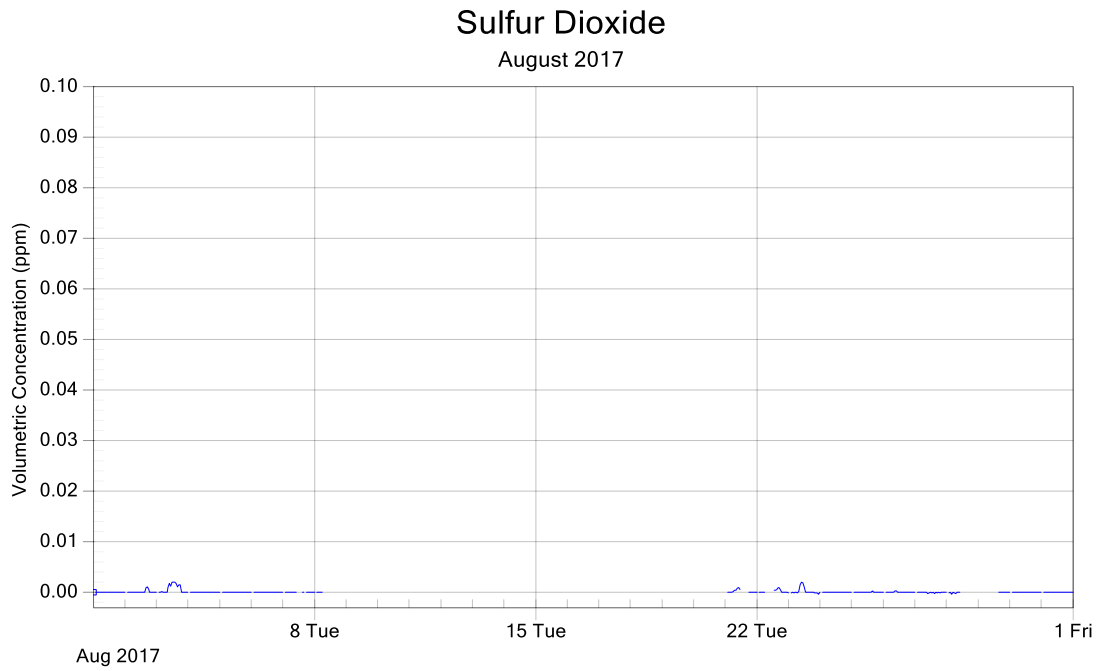


Figure 5: SO₂ 1-hour averaged data

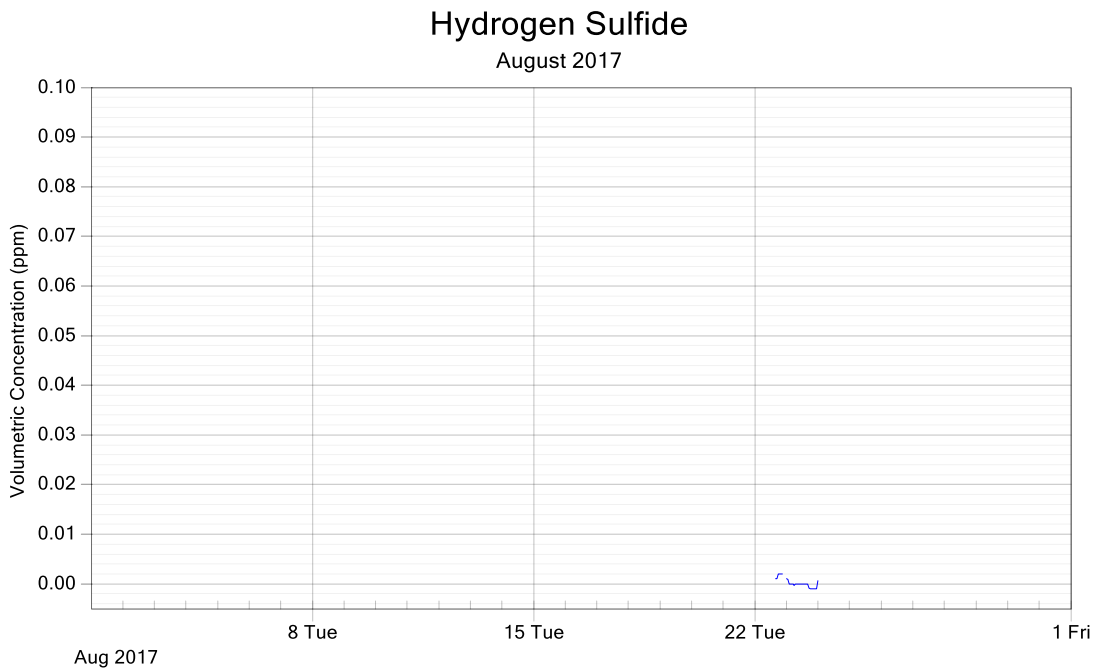


Figure 6: H₂S 1-hour averaged data

Benzene, Toluene and p-Xylene

August 2017

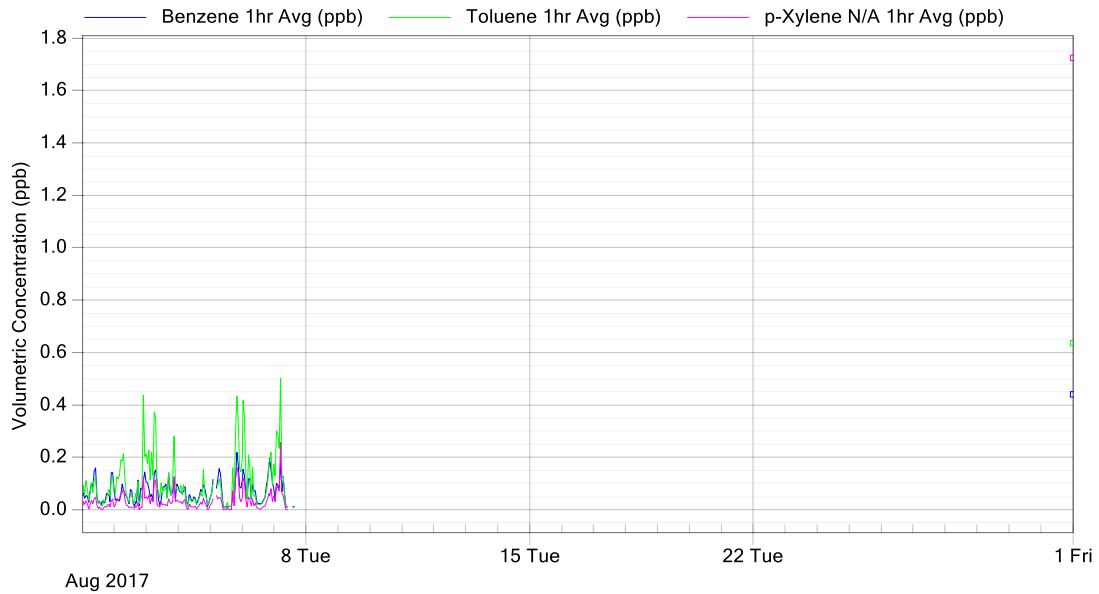


Figure 7: BTX 1-hour averaged data

Wind Speed

August 2017

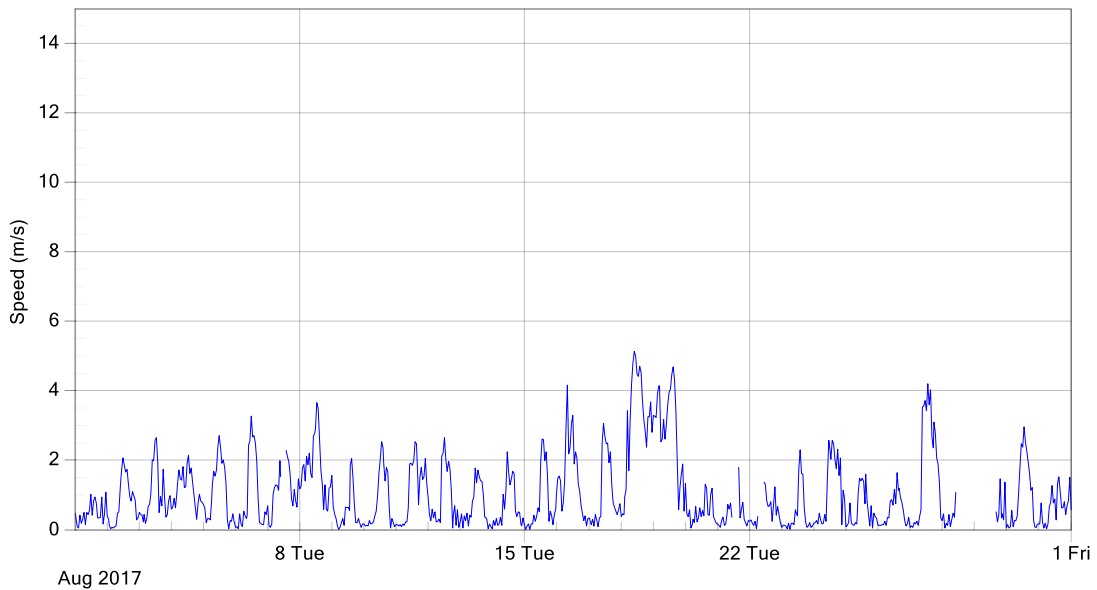


Figure 8: WS 1-hour averaged data

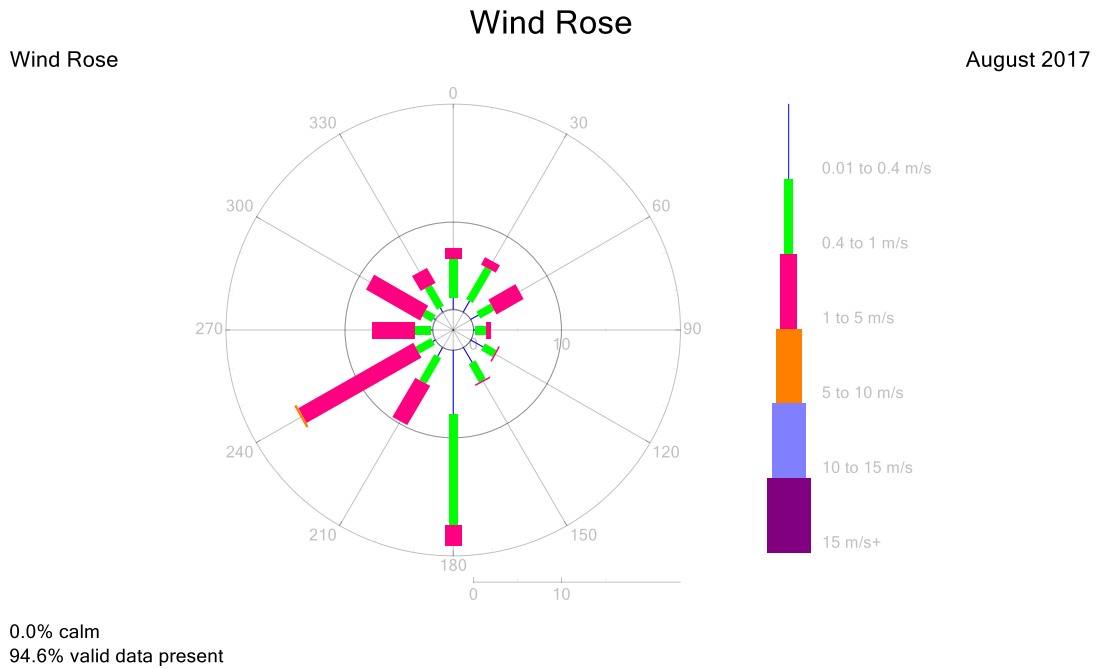


Figure 9: Wind Rose

7.0 Valid Data Exception Tables

The table 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 10: Wollar Valid Data Exception Table

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---------------------|---------------------|---|--|-----------|-------------|
| 11/07/2017 14:15 | 7/08/2017 10:50 | Instrument fault - Pump faulty | NO, NO ₂ , NO _x | EP | 21/09/2017 |
| 1/08/2017 0:00 | 22/08/2017 7:30 | Instrument fault - high voltage out of range | H ₂ S | EP | 21/09/2017 |
| 7/08/2017 10:55 | 7/08/2017 17:45 | Scheduled maintenance – monthly tasks performed | H ₂ S , SO ₂ , BTX, NO, NO ₂ , NO _x | EP | 21/09/2017 |
| 7/08/2017 17:50 | 21/08/2017 12:40 | Instrument fault - not responding possibly affected by high shelter temperature and out of calibration for more than 7 days | NO, NO ₂ , NO _x | EP | 21/09/2017 |
| 7/08/2017 17:50 | 1/09/2017 0:00 | Data under investigation | BTX | EP | 21/09/2017 |
| 8/08/2017 7:50 | 21/08/2017 0:40 | Instrument out of calibration for more than 7 days | SO ₂ | EP | 21/09/2017 |
| 21/08/2017 12:45 | 21/08/2017 15:55 | Logger failure due to maintenance | All parameters | EP | 21/09/2017 |
| 21/08/2017 15:55 | 21/08/2017 17:40 | Non-scheduled maintenance - Faulty zero air generator replaced, an additional gas calibrator was installed for BTX | All parameters | EP | 21/09/2017 |
| 21/08/2017 17:45 | 22/08/2017 7:30 | Instrument fault - calibration outside tolerance | NO, NO ₂ , NO _x | EP | 21/09/2017 |

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---------------------|---------------------|---|---------------------|-----------|-------------|
| 22/08/2017 7:35 | 22/08/2017 17:00 | Non-scheduled maintenance - Replaced NO _x and H ₂ S analysers | All parameters | EP | 21/09/2017 |
| 22/08/2017 15:35 | 28/08/2017 11:25 | Instrument fault | Xylene | EP | 21/09/2017 |
| 22/08/2017 17:05 | 6/09/2017 10:50 | Static offset of -0.002ppm applied to correct the baseline | NO, NO _x | EP | 21/09/2017 |
| 24/08/2017 2:25 | 28/08/2017 11:25 | Instrument fault - calibration outside tolerance | H ₂ S | EP | 21/09/2017 |
| 28/08/2017 11:05 | 28/08/2017 17:00 | Non-scheduled maintenance | All parameters | EP | 21/09/2017 |
| 28/08/2017 17:05 | 29/08/2017 7:20 | Logger failure | All parameters | EP | 21/09/2017 |
| 29/08/2017 7:25 | 29/08/2017 15:20 | Non-scheduled maintenance - Replaced the logger | All parameters | EP | 21/09/2017 |
| 29/08/2017 15:25 | 1/09/2017 0:00 | Instrument fault - calibration outside tolerance | H ₂ S | EP | 21/09/2017 |

8.0 Report Summary

The data capture for Wollar was below 95% for the reporting month. Please refer to Data Capture Percentage Table 9 for details; and Table 10 for valid data exceptions.

Benzene, Toluene and Xylene data monitored at the Wollar station after 7/08/2017 is not included in this report as the data is pending further investigation into instrument performance and calibration. Data will be issued on completion of this investigation.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

-----END OF REPORT-----

Appendix 1 - Definitions & Abbreviations

| | |
|------------------|---------------------------------------|
| BTX | Benzene, Toluene and <i>p</i> -Xylene |
| H ₂ S | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| NO ₂ | Nitrogen dioxide |
| NO _x | Oxides of nitrogen |
| ppb | Parts per billion |
| SO ₂ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

Appendix 2 - Explanation of Exception Table

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.

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 affected by environmental conditions – wind speed / wind speed gust spike refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

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.

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.

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

Peabody Energy

Wilpinjong Coal Wollar

Ambient Air Quality Monitoring

Validated Report

1st September – 30th September 2017

Report No.: DAT12476

Report issue date: 27th October 2017

Maintenance contract: MC951

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| Phone | +61 (02) 6370 2527 |

| Revision History | | | |
|------------------|-----------|------------|--------------|
| Revision | Report ID | Date | Analyst |
| 0 | DAT12476 | 27/10/2017 | Elmira Parto |

Report by Elmira Parto



Approved by Jon Alexander



Table of Contents

| | | |
|------------|--|-----------|
| 1.0 | Executive Summary..... | 6 |
| 2.0 | Introduction | 7 |
| 3.0 | Monitoring and Data Collection..... | 7 |
| 3.1. | Siting Details..... | 7 |
| 3.2. | Monitored Parameters | 9 |
| 3.3. | Data Collection Methods | 10 |
| 3.3.1. | Compliance with Standards | 11 |
| 3.3.2. | Data Acquisition | 11 |
| 3.4. | Data Validation and Reporting..... | 11 |
| 3.4.1. | Validation | 11 |
| 3.4.2. | Reporting..... | 12 |
| 4.0 | Air Quality Goals..... | 13 |
| 4.1. | Air Quality Summary | 13 |
| 5.0 | Calibrations and Maintenance..... | 14 |
| 5.1. | Units and Uncertainties | 14 |
| 5.2. | Automatic Checks | 15 |
| 5.3. | Maintenance | 15 |
| 5.3.1. | Calibration & Maintenance Summary Tables | 15 |
| 6.0 | Results..... | 17 |
| 6.1. | Data Capture | 17 |
| 6.2. | Graphic Representations | 18 |



| | | |
|------------|---|-----------|
| 7.0 | Valid Data Exception Tables | 23 |
| 8.0 | Report Summary..... | 25 |
| | Appendix 1 - Definitions & Abbreviations | 26 |
| | Appendix 2 - Explanation of Exception Table..... | 27 |

List of Figures

| | |
|--|----|
| Figure 1: Wilpinjong Mine Monitoring Station Location..... | 8 |
| Figure 2: NO 1-hour averaged data | 18 |
| Figure 3: NO ₂ 1-hour averaged data | 19 |
| Figure 4: NO _x 1-hour averaged data | 19 |
| Figure 5: SO ₂ 1-hour averaged data | 20 |
| Figure 6: H ₂ S 1-hour averaged data | 20 |
| Figure 7: BTX 1-hour averaged data | 21 |
| Figure 8: WS 1-hour averaged data | 21 |
| Figure 9: Wind Rose | 22 |

List of Tables

| | |
|---|----|
| Table 1: Wilpinjong Mine monitoring site location | 7 |
| Table 2: Parameters measured at the Wilpinjong Mine monitoring station..... | 9 |
| Table 3: Methods | 10 |
| Table 4: Wilpinjong Air Quality Goals (NEPM) | 13 |
| Table 5: Exceedences Recorded..... | 13 |
| Table 6: Units and Uncertainties..... | 14 |
| Table 7: Automatic checks for NO, NO ₂ , NO _x , SO ₂ , H ₂ S and BTX..... | 15 |
| Table 8: Wilpinjong Wollar Maintenance Table | 16 |
| Table 9: Data Capture for Wilpinjong Wollar Station | 17 |
| Table 10: Wollar Valid Data Exception Table | 23 |

1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene, *p*-Xylene, wind speed and wind direction.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for September 2017. Data capture for the different pollutants is presented in Table 9.

Benzene, Toluene and Xylene data monitored at the Wollar station after 7/08/2017 is not included in this report as the data is pending further investigation into instrument performance and calibration. Data will be issued on completion of this investigation.

2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for September 2017.

The data presented in this report:

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

3.0 Monitoring and Data Collection

3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

Table 1: Wilpinjong Mine monitoring site location

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|-----------|----------------------------------|----------------------------|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with AS/NZS 3580.1.1:2007 “Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment”.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to AS/NZS 3580.1.1:2007.



Figure 1: Wilpinjong Mine Monitoring Station Location

3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

Table 2: Parameters measured at the Wilpinjong Mine monitoring station

| Parameter Measured | Instrument and Measurement Technique |
|--|--|
| BTX (Benzene, Toluene and <i>p</i> -Xylene) | Synspec GC955 - Gas Chromatography |
| H ₂ S | Ecotech EC9852 - fluorescence |
| NO, NO ₂ , NO _x | Ecotech EC9841 gas phase chemiluminescence |
| SO ₂ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Gill Windsonic |
| Wind Direction (10m) | Gill Windsonic |

3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

Table 3: 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 |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| SO ₂ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
| H ₂ S | Ecotech Laboratory Manual | In-house method 6.5 Hydrogen sulfide by fluorescence |
| BTX | Manufacturer’s Instructions | Gas Chromatography Synspec CG955 Series Manual |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.
- Measurement of the wind data from 22/7/2017 up to 6/09/2017 is not covered by Ecotech's NATA scope of accreditation as the 2 yearly calibration is overdue.

3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger 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.

3.4. Data Validation and Reporting

3.4.1. 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-minute data.

3.4.2. Reporting

The reported data is in a Microsoft Excel format file named “*Wilpinjong Coal Validated Data Report September-17.xls*”. The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5-minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

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

All averages are calculated from the five-minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One-hour averages are calculated based on a clock hour. One-day averages are calculated based on calendar days.

4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

Table 4: Wilpinjong Air Quality Goals (NEPM)

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|-----------------|-------------|------------------|-------|-------------------------------|
| NO ₂ | 1 year | 30 | ppb | None |
| NO ₂ | 1 hour | 120 | ppb | 1 day a year |
| SO ₂ | 1 hour | 200 | ppb | 1 day a year |
| SO ₂ | 1 day | 80 | ppb | 1 day a year |
| SO ₂ | 1 year | 20 | ppb | None |

4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

Table 5: Exceedences Recorded

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|-----------------|-------------|---------------------|--------------------|
| NO ₂ | 1 hour | - | - |
| SO ₂ | 1 hour | - | - |
| SO ₂ | 1 day | - | - |

5.0 Calibrations and Maintenance

5.1. 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 6: Units and Uncertainties

| Parameter | Units | Resolution | Uncertainty | Measurement Range ¹ |
|--|-------|------------|--|--|
| NO, NO _x (EC9841) | ppm | 1 ppb | ± 14 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| NO ₂ (EC9841) | ppm | 1 ppb | ± 16 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| SO ₂ (EC9850) | ppm | 1 ppb | ± 14 ppb K factor of 2.01 | 0 ppb to 500 ppb |
| H ₂ S | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and <i>p</i> - Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.01 m/s or 2.0% of reading, whichever is greater (K factor of 1.96) | 0 m/s to 60 m/s |
| Vector Wind Direction | Deg | 1 deg | ±2 deg K factor of 2.11 | 0 deg to 360 deg Starting threshold: 0 m/s |

¹ Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, NO₂ and NO_x by EC 9841 and SO₂ by EC9850 are calculated based on a measurement range of 0-125 ppb.

5.2. Automatic Checks

Automatic span and zero calibration checks run every night for NO, NO₂, NO_x and SO₂, every 2nd night for H₂S and weekly for BTX.

Background checks run each night for SO₂ and H₂S.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

Table 7: Automatic checks for NO, NO₂, NO_x, SO₂, H₂S and BTX

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---------------------------------------|--|-------------------------------------|
| NO, NO ₂ , NO _x | 00:45 to 01:25 every day | N/A |
| SO ₂ | 00:45 to 01:25 every day | 23:45 to 23:50 every day |
| H ₂ S | 01:35 to 02:35 every 2 nd day | 23:45 to 23:50 every day |
| BTX | 02:45 to 05:25 weekly | N/A |

5.3. Maintenance

Scheduled monthly maintenance was performed on 06/09/2017.

Four unscheduled visits were made:

- 08/09/2017 the logger restored and NO_x calibration was performed
- 27/09/2017 a remote calibration was performed to adjust the H₂S span

5.3.1. 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.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

Table 8: Wilpinjong Wollar Maintenance Table

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---------------------------------------|--------------------------|------------------|--------------------------|-------------------|
| NO, NO ₂ , NO _x | 08/09/2017 | Unscheduled | 08/09/2017 | Monthly |
| SO ₂ | 06/09/2017 | Monthly | 06/09/2017 | Monthly |
| H ₂ S | 27/09/2017 | Unscheduled | 27/09/2017 | Monthly |
| BTX | 06/09/2017 | Monthly | 06/09/2017 | Yearly |
| Wind Sensor | 06/09/2017 | Monthly | 22/07/2015 | 2-yearly |

6.0 Results

6.1. Data Capture

Data capture is based on 1-hour averages, calculated from 5-minute data, and refers to the amount of available data collected during the report period.

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

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

Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for September 2017. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

Table 9: Data Capture for Wilpinjong Wollar Station

| Parameter | Data Capture % |
|---------------------------------------|----------------|
| NO, NO ₂ , NO _x | 76.1 |
| SO ₂ | 93.4 |
| H ₂ S | 76.1 |
| Benzene | TBA |
| Toluene | TBA |
| <i>p</i> -Xylene | 0.0 |
| WS, WD | 97.0 |

6.2. Graphic Representations

Validated 5-minute data for NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

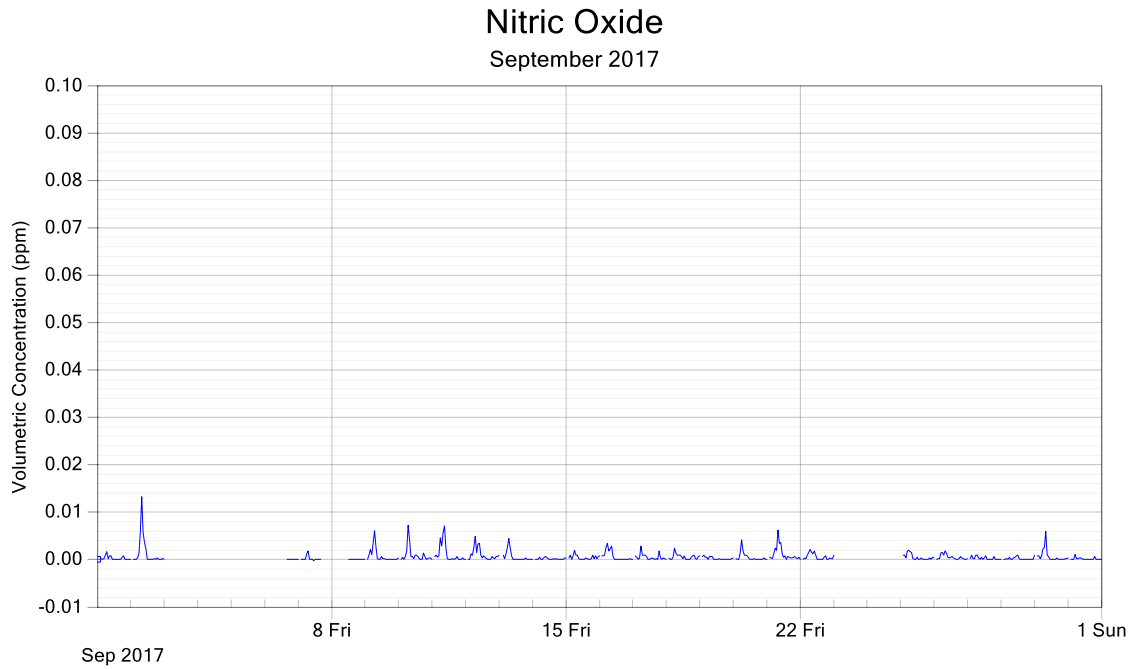


Figure 2: NO 1-hour averaged data

Nitrogen Dioxide

September 2017

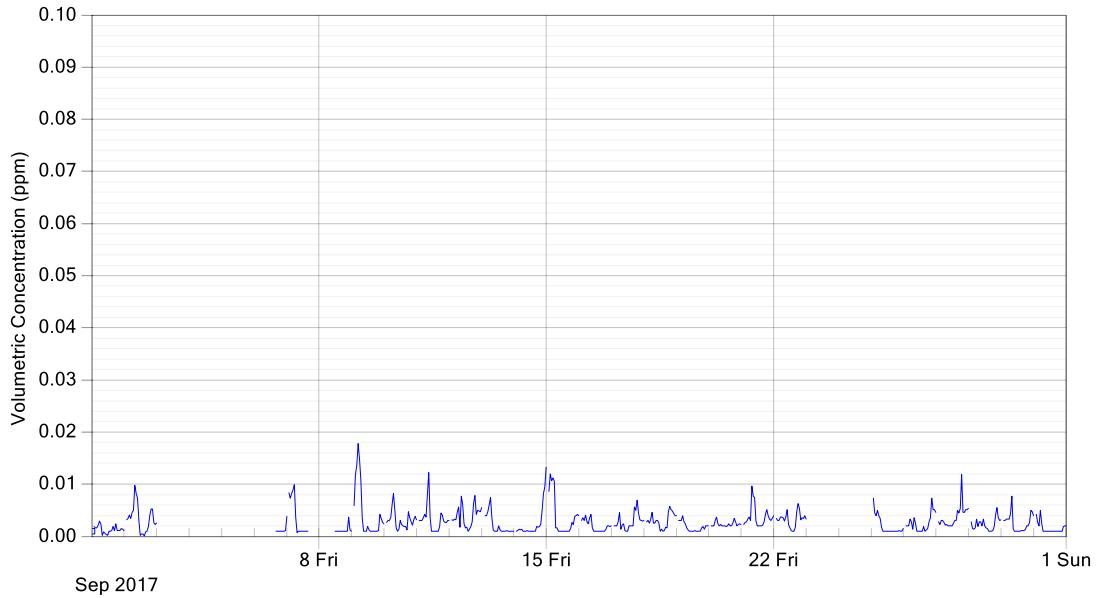


Figure 3: NO₂ 1-hour averaged data

Oxides of Nitrogen

September 2017

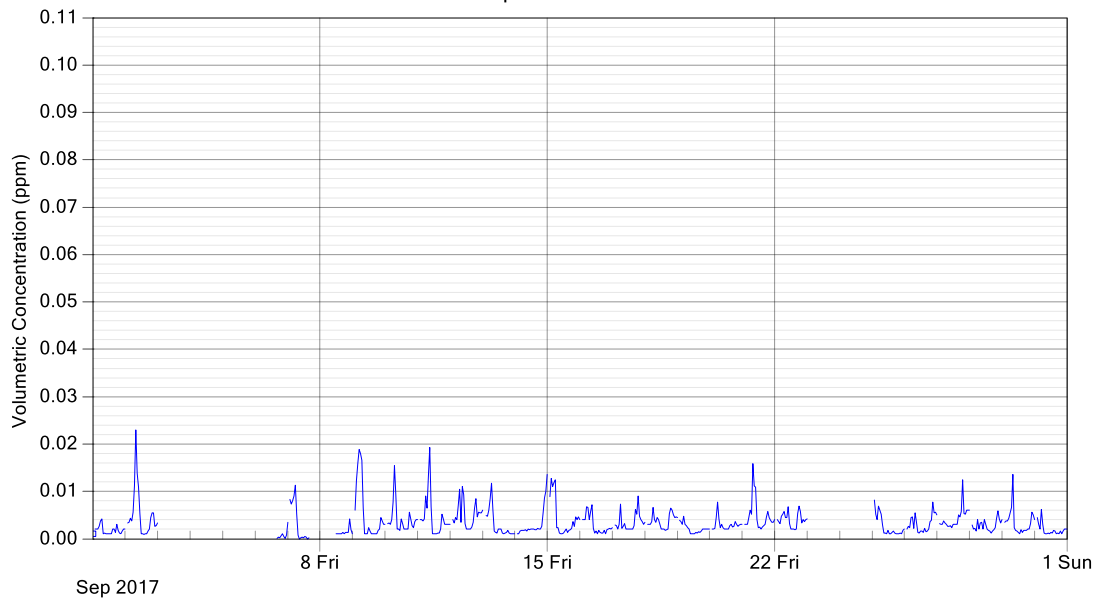


Figure 4: NO_x 1-hour averaged data

Sulfur Dioxide

September 2017

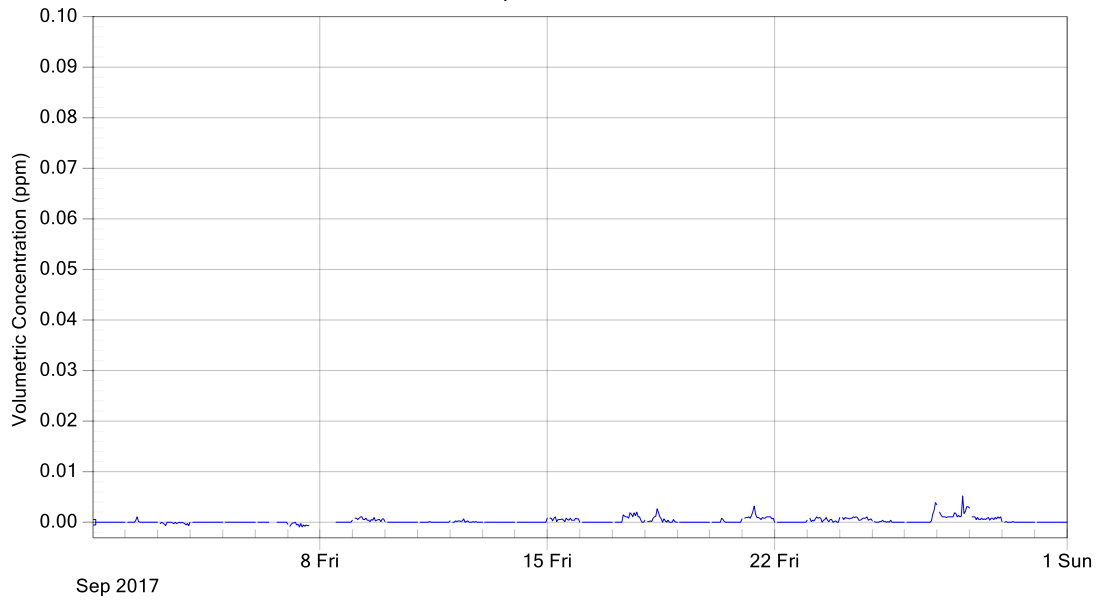


Figure 5: SO₂ 1-hour averaged data

Hydrogen Sulfide

September 2017

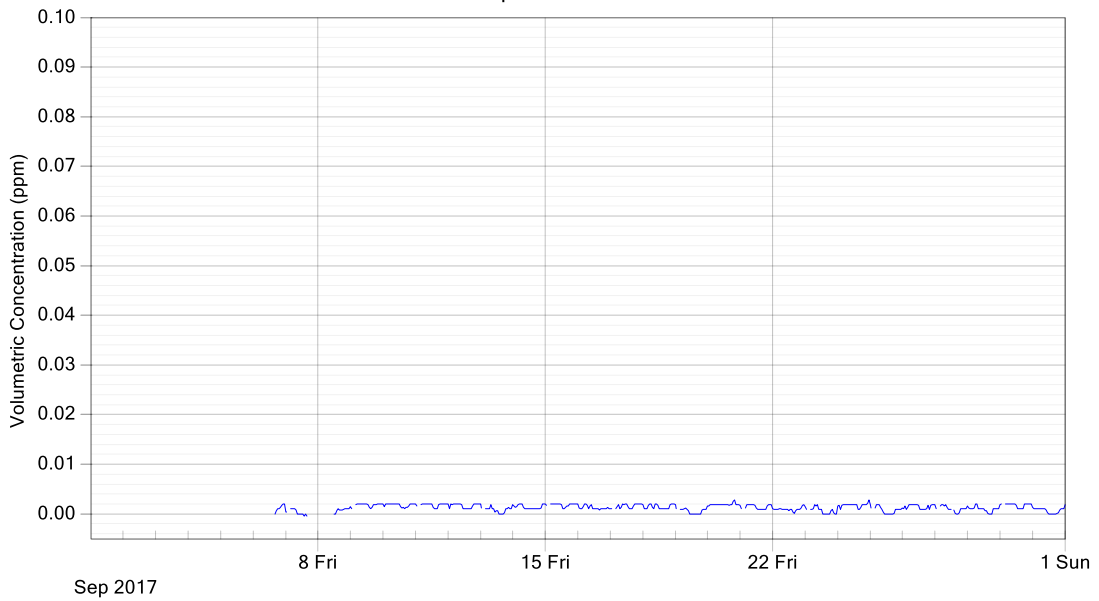


Figure 6: H₂S 1-hour averaged data

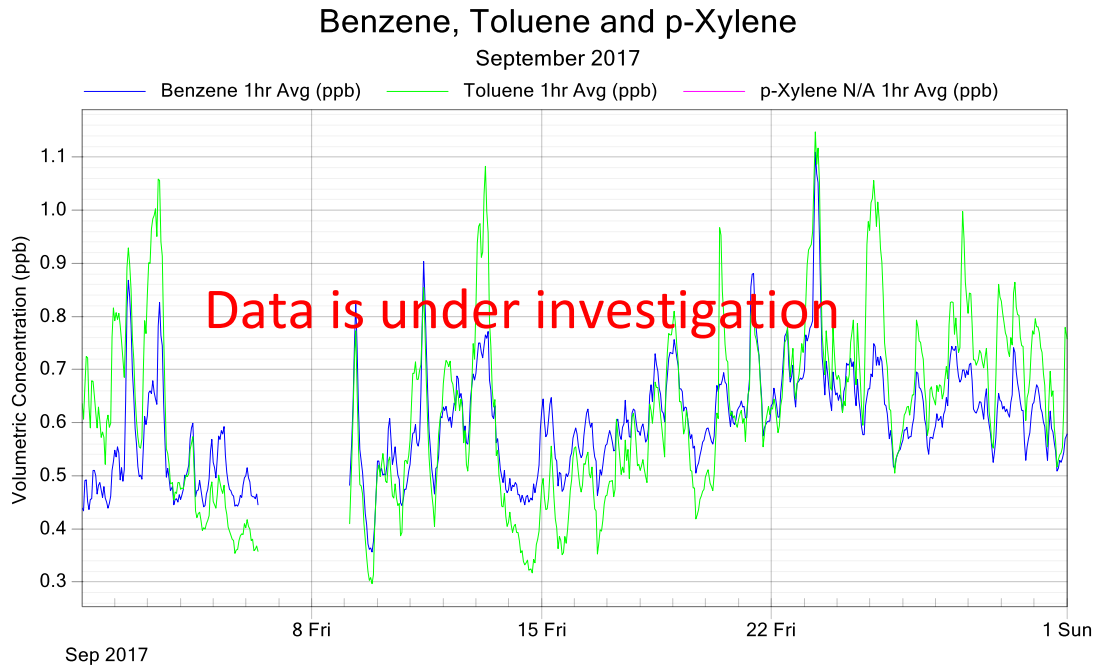


Figure 7: BTX 1-hour averaged data

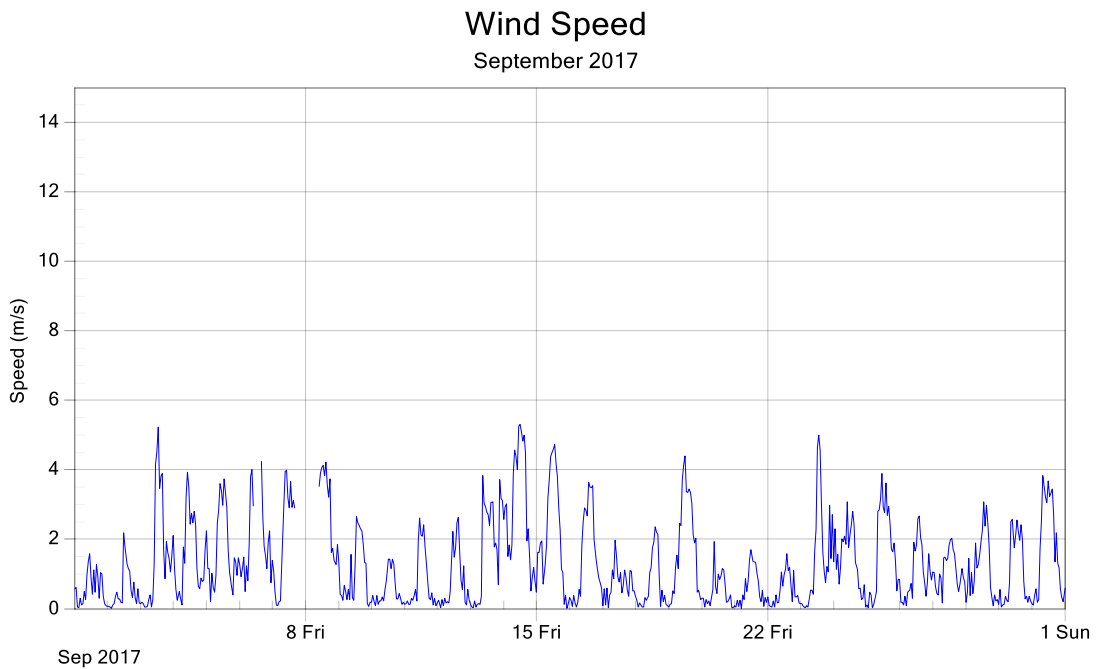


Figure 8: WS 1-hour averaged data

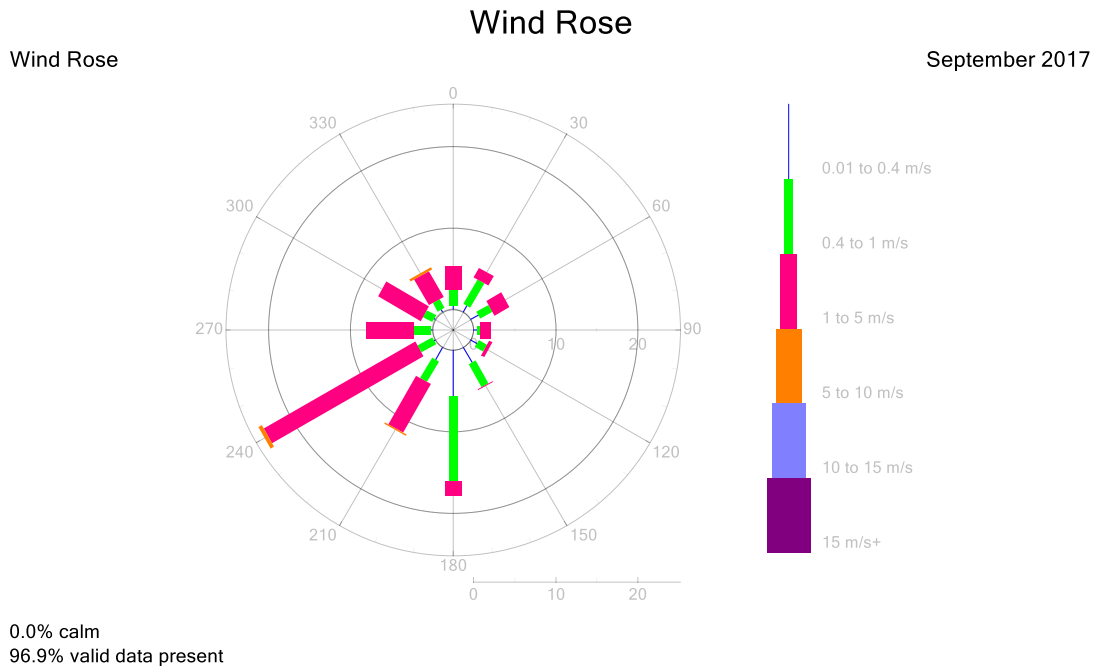


Figure 9: Wind Rose

7.0 Valid Data Exception Tables

The table 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 10: Wollar Valid Data Exception Table

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---------------------|--------------------|--|---------------------------------------|-----------|-------------|
| 22/08/2017 17:05 | 3/09/2017 0:40 | Static offset of -0.002ppm applied to correct the baseline | NO, NO _x | EP | 19/10/2017 |
| 1/09/2017 0:00 | 1/10/2017 0:00 | Instrument fault | Xylene | EP | 19/10/2017 |
| 1/09/2017 0:00 | 1/10/2017 0:00 | Data under investigation | Benzene and Toluene | EP | 19/10/2017 |
| 1/09/2017 0:00 | 6/09/2017 10:50 | Instrument fault - high voltage out of range | H ₂ S | EP | 19/10/2017 |
| 1/09/2017 1:30 | 3/09/2017 0:40 | Linear multiplier (A = 1 and B=1.12) applied to data correct the drifted span | NO, NO ₂ , NO _x | EP | 19/10/2017 |
| 3/09/2017 1:30 | 6/09/2017 10:50 | Instrument fault - calibration outside tolerance | NO, NO ₂ , NO _x | EP | 19/10/2017 |
| 6/09/2017 10:55 | 6/09/2017 15:50 | Scheduled maintenance – monthly tasks performed | All parameters | EP | 19/10/2017 |
| 6/09/2017 15:55 | 7/09/2017 17:20 | Instrument fault | BTX | EP | 19/10/2017 |
| 7/09/2017 17:25 | 8/09/2017 9:35 | Data gap due to logger crashed | All parameters | EP | 19/10/2017 |
| 8/09/2017 9:40 | 8/09/2017 14:15 | Non-scheduled maintenance and subsequent instrument stabilisation - Fix the logger and manual calibration performed for NO _x analyser | All parameters | EP | 19/10/2017 |

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---------------------|---------------------|--|---------------------------------------|-----------|-------------|
| 8/09/2017 14:20 | 9/09/2017 3:50 | Instrument stabilisation following maintenance | Benzene and Toluene | EP | 19/10/2017 |
| 19/09/2017 3:40 | 27/09/2017 12:40 | Static multiplier (0.92) applied to data to correct the drifted span | H ₂ S | EP | 19/10/2017 |
| 23/09/2017 1:30 | 25/09/2017 0:40 | Instrument fault - calibration outside tolerance | NO, NO ₂ , NO _x | EP | 19/10/2017 |
| 27/09/2017 12:45 | 27/09/2017 13:30 | Non-scheduled maintenance - Remote calibration performed for H ₂ S analyser to fix the span drift | H ₂ S | EP | 19/10/2017 |
| 30/09/2017 16:30 | 30/09/2017 16:30 | Data gap | All parameters | EP | 19/10/2017 |

8.0 Report Summary

The data capture for Wollar was below 95% for the reporting month. Please refer to Data Capture Percentage Table 9 for details; and Table 10 for valid data exceptions.

Benzene, Toluene and Xylene data monitored at the Wollar station after 7/08/2017 is not included in this report as the data is pending further investigation into instrument performance and calibration. Data will be issued on completion of this investigation.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

-----END OF REPORT-----

Appendix 1 - Definitions & Abbreviations

| | |
|------------------|---------------------------------------|
| BTX | Benzene, Toluene and <i>p</i> -Xylene |
| H ₂ S | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| NO ₂ | Nitrogen dioxide |
| NO _x | Oxides of nitrogen |
| ppb | Parts per billion |
| SO ₂ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

Appendix 2 - Explanation of Exception Table

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.

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 affected by environmental conditions – wind speed / wind speed gust spike refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

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.

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.

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

Peabody Energy

Wilpinjong Coal Wollar

Ambient Air Quality Monitoring

Validated Report_Amended

1st October – 31st October 2017

Report No.: DAT12579Rev1

Report issue date: 20th February 2018

Maintenance contract: MC951

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| Revision History | | | |
|------------------|-----------|------------|--------------|
| Revision | Report ID | Date | Analyst |
| 0 | DAT12579 | 28/11/2017 | Elmira Parto |
| 1 | DAT12579 | 20/02/2018 | Elmira Parto |

Refer to Appendix 3 for details of amendments

Report by Elmira Parto



Approved by Jon Alexander



Table of Contents

Customer Details..... 2

Revision History 2

List of Figures 4

List of Tables 5

1.0 Executive Summary.....6

2.0 Introduction7

3.0 Monitoring and Data Collection.....7

3.1. Siting Details..... 7

3.2. Monitored Parameters 9

3.3. Data Collection Methods 10

3.3.1. Compliance with Standards 11

3.3.2. Data Acquisition 11

3.4. Data Validation and Reporting..... 11

3.4.1. Validation 11

3.4.2. Reporting..... 12

4.0 Air Quality Goals.....13

4.1. Air Quality Summary 13

5.0 Calibrations and Maintenance.....14

5.1. Units and Uncertainties 14

5.2. Automatic Checks 15

5.3. Maintenance 15

5.3.1. Calibration & Maintenance Summary Tables 16

6.0 Results.....17



| | |
|---|-----------|
| 6.1. Data Capture | 17 |
| 6.2. Graphic Representations | 18 |
| 7.0 Valid Data Exception Tables | 23 |
| 8.0 Report Summary..... | 25 |
| Appendix 1 - Definitions & Abbreviations | 26 |
| Appendix 2 - Explanation of Exception Table..... | 27 |
| Appendix 3 – Amendments | 29 |

List of Figures

| | |
|--|----|
| Figure 1: Wilpinjong Mine Monitoring Station Location..... | 8 |
| Figure 2: NO 1-hour averaged data | 18 |
| Figure 3: NO ₂ 1-hour averaged data | 19 |
| Figure 4: NO _x 1-hour averaged data | 19 |
| Figure 5: SO ₂ 1-hour averaged data | 20 |
| Figure 6: H ₂ S 1-hour averaged data | 20 |
| Figure 7: BTX 1-hour averaged data | 21 |
| Figure 8: WS 1-hour averaged data | 21 |
| Figure 9: Wind Rose | 22 |

List of Tables

| | |
|---|----|
| Table 1: Wilpinjong Mine monitoring site location | 7 |
| Table 2: Parameters measured at the Wilpinjong Mine monitoring station..... | 9 |
| Table 3: Methods | 10 |
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| Table 5: Exceedences Recorded..... | 13 |
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| Table 7: Automatic checks for NO, NO ₂ , NO _x , SO ₂ , H ₂ S and BTX..... | 15 |
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1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene, *p*-Xylene, wind speed and wind direction.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for October 2017. Data capture for the different pollutants is presented in Table 9.

2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for October 2017.

The data presented in this report:

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

3.0 Monitoring and Data Collection

3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

Table 1: Wilpinjong Mine monitoring site location

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|-----------|----------------------------------|----------------------------|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with AS/NZS 3580.1.1:2007 “Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment”.

The station is classified as a neighbourhood station according to AS/NZS 3580.1.1:2007.



Figure 1: Wilpinjong Mine Monitoring Station Location

3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

Table 2: Parameters measured at the Wilpinjong Mine monitoring station

| Parameter Measured | Instrument and Measurement Technique |
|--|--|
| BTX (Benzene, Toluene and <i>p</i> -Xylene) | Synspec GC955 - Gas Chromatography |
| H ₂ S | Ecotech EC9852 - fluorescence |
| NO, NO ₂ , NO _x | Ecotech EC9841 gas phase chemiluminescence |
| SO ₂ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Gill Windsonic |
| Wind Direction (10m) | Gill Windsonic |

3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

Table 3: 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 |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| SO ₂ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
| H ₂ S | Ecotech Laboratory Manual | In-house method 6.5 Hydrogen sulfide by fluorescence |
| BTX | Manufacturer’s Instructions | Gas Chromatography Synspec CG955 Series Manual |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.
- The siting of Wollar station does not comply with AS/NZS 3580.1.1:2007 as of 27/2/2016 due to the yearly audit task is overdue.

3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger 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.

3.4. Data Validation and Reporting

3.4.1. 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-minute data.

3.4.2. Reporting

The reported data is in a Microsoft Excel format file named “*Wilpinjong Coal Validated Data Report October-17.xls*”. The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5-minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

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

All averages are calculated from the five-minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One-hour averages are calculated based on a clock hour. One-day averages are calculated based on calendar days.

4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

Table 4: Wilpinjong Air Quality Goals (NEPM)

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|-----------------|-------------|------------------|-------|-------------------------------|
| NO ₂ | 1 year | 0.030 | ppm | None |
| NO ₂ | 1 hour | 0.120 | ppm | 1 day a year |
| SO ₂ | 1 hour | 0.200 | ppm | 1 day a year |
| SO ₂ | 1 day | 0.080 | ppm | 1 day a year |
| SO ₂ | 1 year | 0.020 | ppm | None |

4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

Table 5: Exceedences Recorded

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|-----------------|-------------|---------------------|--------------------|
| NO ₂ | 1 hour | - | - |
| SO ₂ | 1 hour | - | - |
| SO ₂ | 1 day | - | - |

5.0 Calibrations and Maintenance

5.1. 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 6: Units and Uncertainties

| Parameter | Units | Resolution | Uncertainty | Measurement Range ¹ |
|---|-------|------------|--|--|
| NO, NO _x (EC9841) | ppm | 0.001 ppm | ± 0.014 ppm K factor of 2.01 | 0.000 ppm to 0.500 ppm |
| NO ₂ (EC9841) | ppm | 0.001 ppm | ± 0.016 ppm K factor of 2.01 | 0 ppb to 0.500 ppb |
| SO ₂ (EC9850) | ppm | 0.001 ppm | ± 0.014 ppm K factor of 2.01 | 0.000 ppm to 0.500 ppm |
| H ₂ S | ppm | 1 ppb | 15.2% of reading or ± 0.019 ppm, whichever is greater K factor of 2 | 0.000 ppm to 0.500 ppm |
| Benzene, Toluene and <i>p</i> -Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.01 m/s or 2.0% of reading, whichever is greater (K factor of 1.96) | 0 m/s to 60 m/s |
| Vector Wind Direction | Deg | 1 deg | ±2 deg K factor of 2.11 | 0 deg to 360 deg Starting threshold: 0 m/s |

¹ Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, NO₂ and NO_x by EC 9841 and SO₂ by EC9850 are calculated based on a measurement range of 0-125 ppb.

5.2. Automatic Checks

Automatic span and zero calibration checks run every night for NO, NO₂, NO_x and SO₂, every 2nd night for H₂S and weekly for BTX.

Background checks run each night for SO₂ and H₂S.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

Table 7: Automatic checks for NO, NO₂, NO_x, SO₂, H₂S and BTX

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---------------------------------------|--|-------------------------------------|
| NO, NO ₂ , NO _x | 00:45 to 01:25 every day | N/A |
| SO ₂ | 00:45 to 01:25 every day | 23:45 to 23:50 every day |
| H ₂ S | 01:35 to 02:35 every 2 nd day | 23:45 to 23:50 every day |
| BTX | 02:45 to 05:25 weekly | N/A |

5.3. Maintenance

Scheduled monthly maintenance was performed over two days on 09/10/2017 and 10/09/2017. NO_x analyser was replaced (Instrument ID: 07-0853 was transferred in and ID: 02-0385 transferred out).

An unscheduled visits was made:

- 12/10/2017 a remote calibration was performed on NO_x and SO₂ analysers to adjust the span
- 19/10/2017 a remote calibration was performed to adjust the H₂S span
- 26/10/2017 a remote calibration was performed on NO_x and SO₂ analysers

5.3.1. 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.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

Table 8: Wilpinjong Wollar Maintenance Table

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---------------------------------------|--------------------------|------------------|--------------------------|-------------------|
| NO, NO ₂ , NO _x | 09/10/2017 | Monthly | 26/10/2017 | Monthly |
| SO ₂ | 09/10/2017 | Monthly | 09/10/2017 | Monthly |
| H ₂ S | 10/10/2017 | Monthly | 19/10/2017 | Monthly |
| BTX | 10/10/2017 | Monthly | 10/10/2017 | Yearly |
| Wind Sensor | 09/10/2017 | Monthly | 22/07/2015 | 2-yearly |

6.0 Results

6.1. Data Capture

Data capture is based on 1-hour averages, calculated from 5-minute data, and refers to the amount of available data collected during the report period.

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

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

Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for October 2017. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

Table 9: Data Capture for Wilpinjong Wollar Station

| Parameter | Data Capture % |
|---------------------------------------|----------------|
| NO, NO ₂ , NO _x | 95.3 |
| SO ₂ | 94.9 |
| H ₂ S | 92.8 |
| Benzene | 96.8 |
| Toluene | 96.8 |
| <i>p</i> -Xylene | 0.0 |
| WS, WD | 98.7 |

6.2. Graphic Representations

Validated 5-minute data for NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

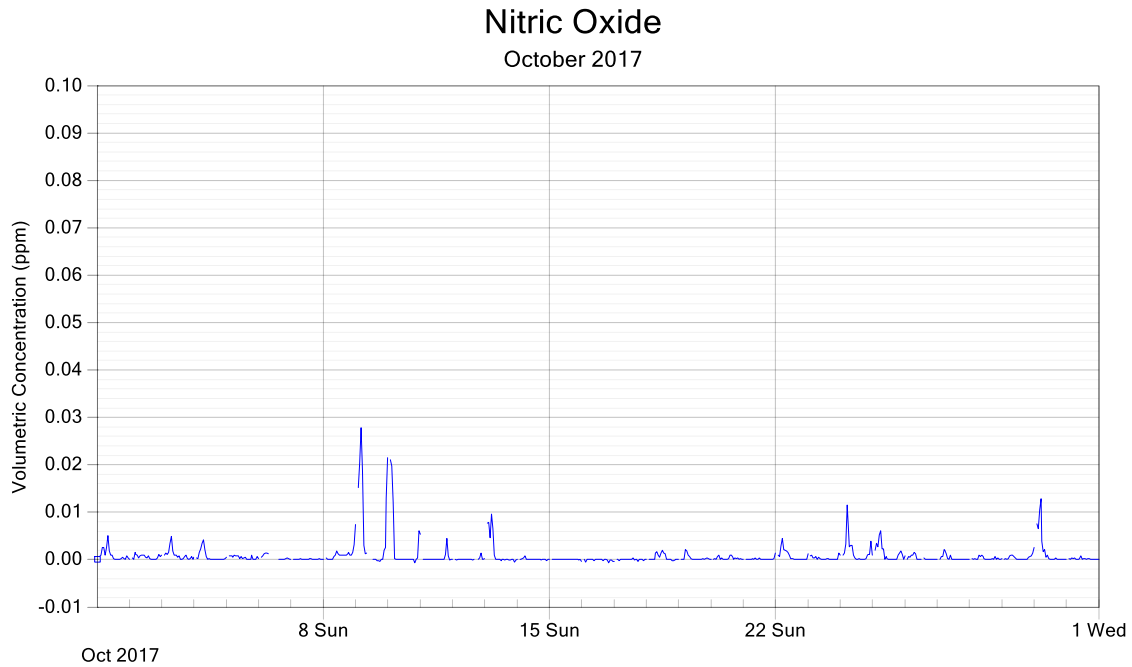


Figure 2: NO 1-hour averaged data

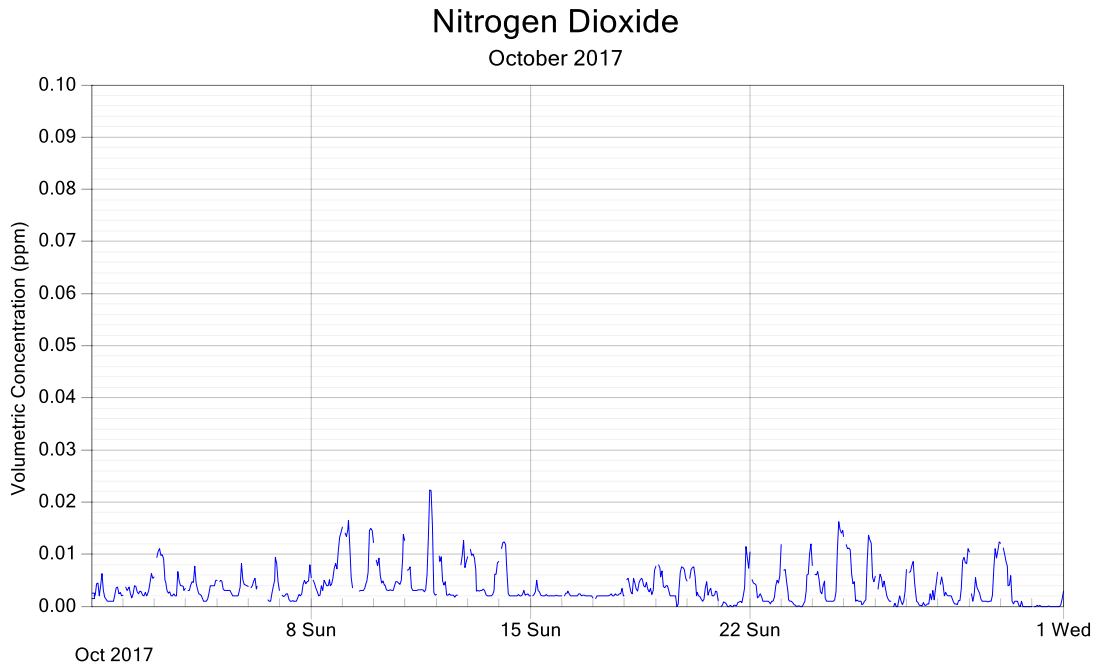


Figure 3: NO₂ 1-hour averaged data

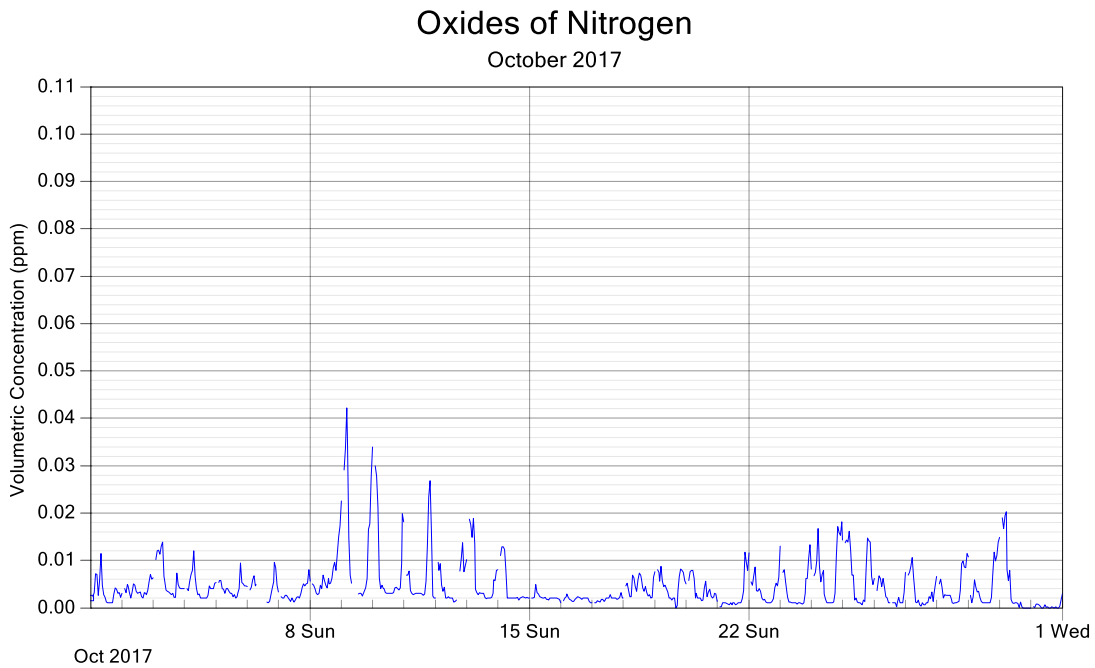


Figure 4: NO_x 1-hour averaged data

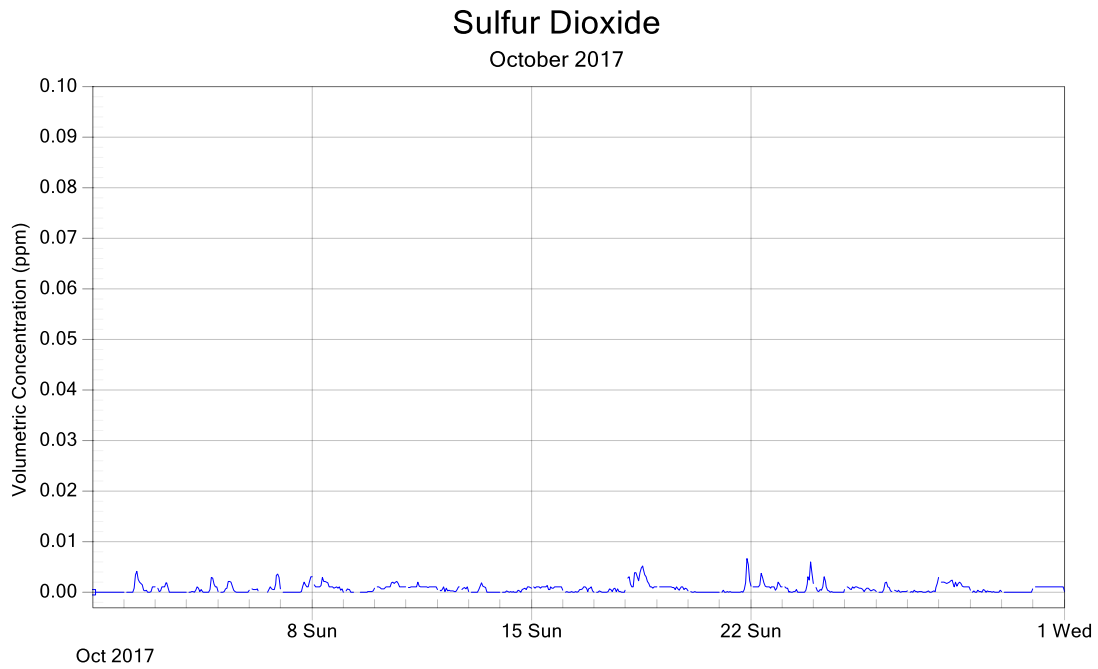


Figure 5: SO₂ 1-hour averaged data

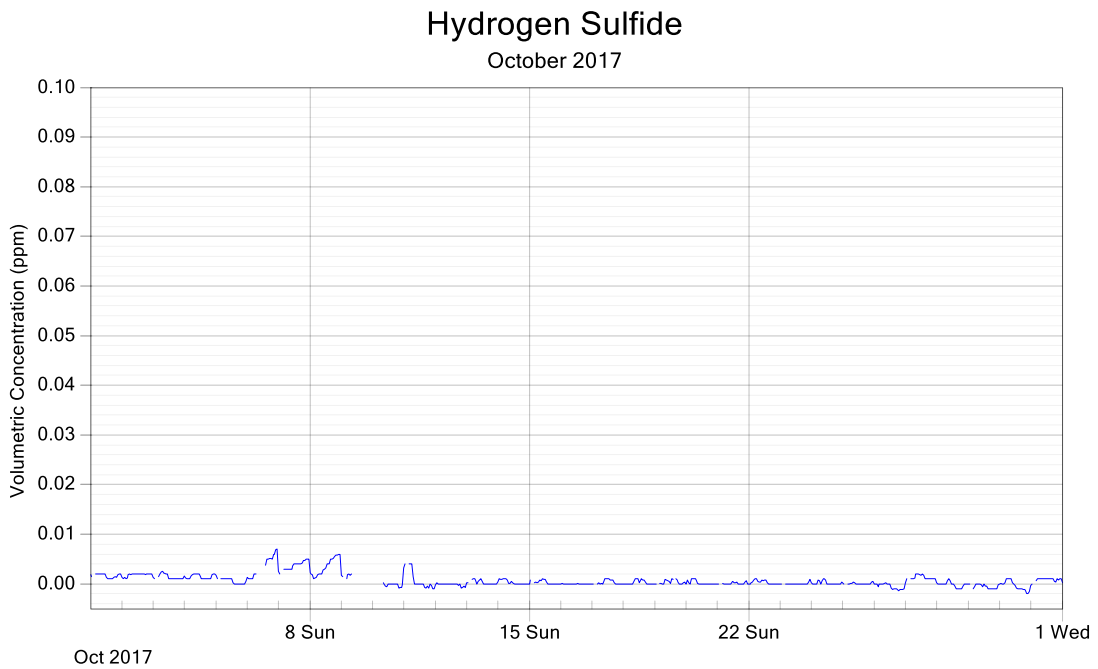


Figure 6: H₂S 1-hour averaged data

Benzene, Toluene and p-Xylene

October 2017

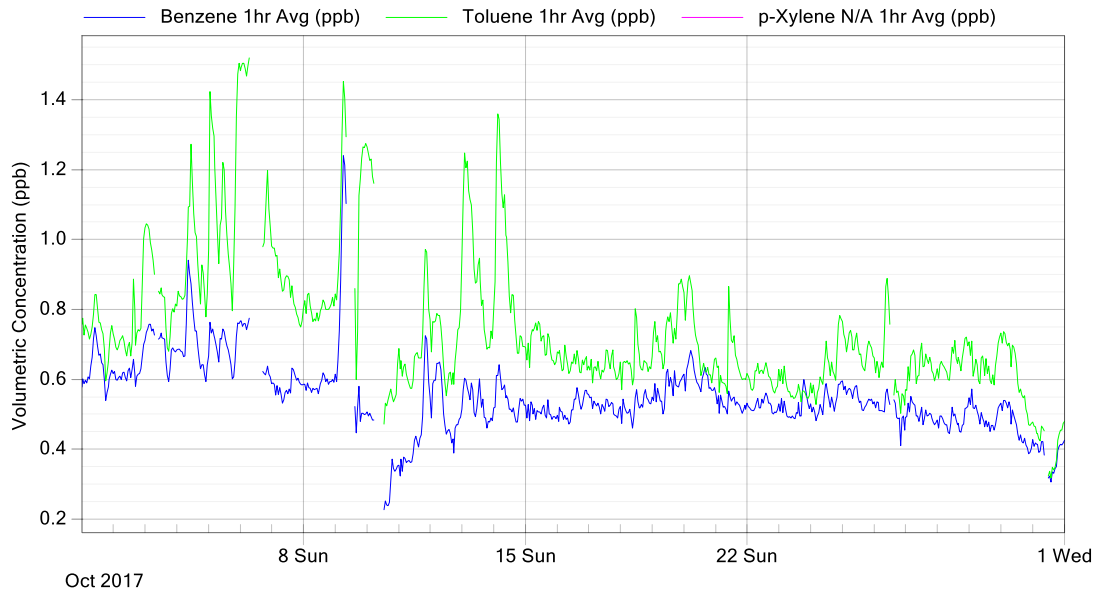


Figure 7: BTX 1-hour averaged data

Wind Speed

October 2017

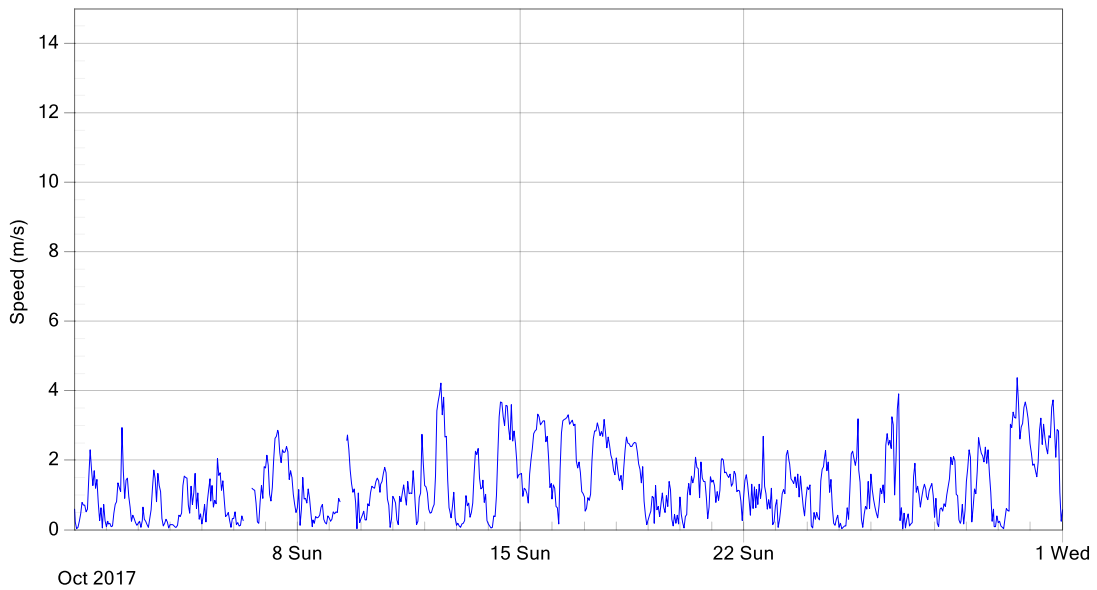


Figure 8: WS 1-hour averaged data

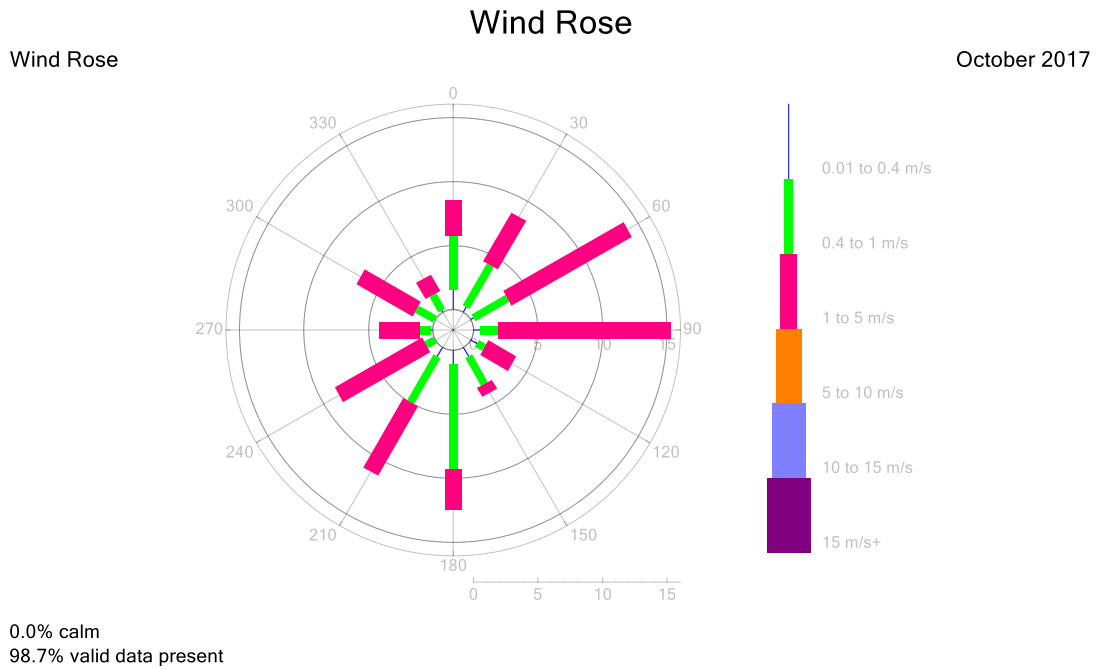


Figure 9: Wind Rose

7.0 Valid Data Exception Tables

The table 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 10: Wollar Valid Data Exception Table

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---------------------|---------------------|--|---|-----------|-------------|
| 1/10/2017 0:00 | 1/11/2017 0:00 | Instrument fault | Xylene | EP | 14/11/2017 |
| 3/10/2017 8:30 | 31/10/2017 11:15 | Intermittent instrument restarted and subsequent instrument stabilisation | Benzene, Toluene | EP | 14/11/2017 |
| 6/10/2017 7:55 | 6/10/2017 16:20 | Power interruption and subsequent instruments stabilisation | All parameters | EP | 14/11/2017 |
| 9/10/2017 9:25 | 9/10/2017 14:35 | Scheduled monthly maintenance and subsequent instrument stabilisation (first visit) | All parameters | EP | 14/11/2017 |
| 9/10/2017 13:05 | 10/10/2017 6:05 | Instrument left in out of order mode | H ₂ S | EP | 14/11/2017 |
| 10/10/2017 1:30 | 12/10/2017 17:40 | Linear multiplier (A = 1 and B=1.069) applied to data correct the drifted span | NO, NO ₂ , NO _x | EP | 14/11/2017 |
| 10/10/2017 6:10 | 10/10/2017 12:55 | Scheduled monthly maintenance and subsequent instrument stabilisation (second visit) | BTX, H ₂ S | EP | 14/11/2017 |
| 12/10/2017 17:40 | 12/10/2017 18:20 | Non-scheduled maintenance to adjust the span drift | SO ₂ , NO, NO ₂ , NO _x | EP | 14/11/2017 |
| 13/10/2017 3:30 | 19/10/2017 15:00 | Linear multiplier (A = 1 and B=1.117) applied to data correct the drifted span | H ₂ S | EP | 14/11/2017 |
| 16/10/2017 15:20 | 16/10/2017 15:20 | Unrealistic negative readings | NO, NO ₂ , NO _x | EP | 14/11/2017 |

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---------------------|---------------------|--|---|-----------|-------------|
| 19/10/2017 15:05 | 19/10/2017 16:00 | Non-scheduled maintenance to adjust the span drift | SO ₂ ,H ₂ S, NO, NO ₂ , NO _x | EP | 14/11/2017 |
| 26/10/2017 13:15 | 26/10/2017 13:45 | Non-scheduled maintenance | SO ₂ , NO, NO ₂ , NO _x | EP | 14/11/2017 |
| 26/10/2017 13:30 | 26/10/2017 15:00 | Data affected by rapid change of the enclosure temperature | Benzene, Toluene | EP | 14/11/2017 |

8.0 Report Summary

The data capture for most of the parameters at Wollar was above 95% for the reporting month. The exceptions were H₂S, SO₂ and p-xylene. Please refer to Data Capture Percentage Table 9 for details; and Table 10 for valid data exceptions.

Benzene, Toluene and Xylene data monitored at the Wollar station after 7/08/2017 is not included in this report as the data is pending further investigation into instrument performance and calibration. Data will be issued on completion of this investigation.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

-----END OF REPORT-----

Appendix 1 - Definitions & Abbreviations

| | |
|------------------|---------------------------------------|
| BTX | Benzene, Toluene and <i>p</i> -Xylene |
| H ₂ S | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| NO ₂ | Nitrogen dioxide |
| NO _x | Oxides of nitrogen |
| ppb | Parts per billion |
| SO ₂ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

Appendix 2 - Explanation of Exception Table

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.

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 affected by environmental conditions – wind speed / wind speed gust spike refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

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.

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.

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

Appendix 3 – Amendments

This amended report supersedes previously issued versions of the report. Refer to the revision history table on page 2 for details of previous revisions. The following modification has been made in this revision:

- On completion of the investigation, into the BTX analyser’s performance and calibration, Benzene and Toluene data deemed as valid, therefore included in this report.

Peabody Energy

Wilpinjong Coal Wollar

Ambient Air Quality Monitoring

Validated Report

1st November – 30th November 2017

Report No.: DAT12704

Report issue date: 28th December 2017

Maintenance contract: MC951

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| Revision History | | | |
|------------------|-----------|------------|--------------|
| Revision | Report ID | Date | Analyst |
| 0 | DAT12704 | 28/12/2017 | Elmira Parto |

Report by Elmira Parto



Approved by Jon Alexander



Table of Contents

| | |
|---|-----------|
| Customer Details..... | 2 |
| Revision History | 2 |
| List of Figures | 4 |
| List of Tables | 5 |
| 1.0 Executive Summary..... | 6 |
| 2.0 Introduction | 7 |
| 3.0 Monitoring and Data Collection..... | 7 |
| 3.1. Siting Details..... | 7 |
| 3.2. Monitored Parameters | 9 |
| 3.3. Data Collection Methods | 10 |
| 3.3.1. Compliance with Standards | 11 |
| 3.3.2. Data Acquisition | 11 |
| 3.4. Data Validation and Reporting..... | 11 |
| 3.4.1. Validation | 11 |
| 3.4.2. Reporting..... | 12 |
| 4.0 Air Quality Goals..... | 13 |
| 4.1. Air Quality Summary | 13 |
| 5.0 Calibrations and Maintenance..... | 14 |
| 5.1. Units and Uncertainties | 14 |
| 5.2. Automatic Checks | 15 |
| 5.3. Maintenance | 15 |
| 5.3.1. Calibration & Maintenance Summary Tables | 15 |
| 6.0 Results..... | 17 |



| | |
|---|-----------|
| 6.1. Data Capture | 17 |
| 6.2. Graphic Representations | 18 |
| 7.0 Valid Data Exception Tables | 23 |
| 8.0 Report Summary..... | 25 |
| Appendix 1 - Definitions & Abbreviations | 26 |
| Appendix 2 - Explanation of Exception Table..... | 27 |

List of Figures

| | |
|--|----|
| Figure 1: Wilpinjong Mine Monitoring Station Location..... | 8 |
| Figure 2: NO 1-hour averaged data | 18 |
| Figure 3: NO ₂ 1-hour averaged data | 19 |
| Figure 4: NO _x 1-hour averaged data | 19 |
| Figure 5: SO ₂ 1-hour averaged data..... | 20 |
| Figure 6: H ₂ S 1-hour averaged data | 20 |
| Figure 7: BTX 1-hour averaged data | 21 |
| Figure 8: WS 1-hour averaged data | 21 |
| Figure 9: Wind Rose | 22 |

List of Tables

| | |
|---|----|
| Table 1: Wilpinjong Mine monitoring site location | 7 |
| Table 2: Parameters measured at the Wilpinjong Mine monitoring station..... | 9 |
| Table 3: Methods | 10 |
| Table 4: Wilpinjong Air Quality Goals (NEPM) | 13 |
| Table 5: Exceedences Recorded..... | 13 |
| Table 6: Units and Uncertainties..... | 14 |
| Table 7: Automatic checks for NO, NO ₂ , NO _x , SO ₂ , H ₂ S and BTX..... | 15 |
| Table 8: Wilpinjong Wollar Maintenance Table | 16 |
| Table 9: Data Capture for Wilpinjong Wollar Station | 17 |
| Table 10: Wollar Valid Data Exception Table | 23 |

1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene, *p*-Xylene, wind speed and wind direction.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for November 2017. Data capture for the different pollutants is presented in Table 9.

2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for November 2017.

The data presented in this report:

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

3.0 Monitoring and Data Collection

3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

Table 1: Wilpinjong Mine monitoring site location

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|-----------|----------------------------------|----------------------------|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with AS/NZS 3580.1.1:2007 “Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment”.

The station is classified as a neighbourhood station according to AS/NZS 3580.1.1:2007.



Figure 1: Wilpinjong Mine Monitoring Station Location

3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

Table 2: Parameters measured at the Wilpinjong Mine monitoring station

| Parameter Measured | Instrument and Measurement Technique |
|--|--|
| BTX (Benzene, Toluene and <i>p</i> -Xylene) | Synspec GC955 - Gas Chromatography |
| H ₂ S | Ecotech EC9852 - fluorescence |
| NO, NO ₂ , NO _x | Ecotech EC9841 gas phase chemiluminescence |
| SO ₂ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Gill Windsonic |
| Wind Direction (10m) | Gill Windsonic |

3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

Table 3: 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 |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| SO ₂ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
| H ₂ S | Ecotech Laboratory Manual | In-house method 6.5 Hydrogen sulfide by fluorescence |
| BTX | Manufacturer’s Instructions | Gas Chromatography Synspec CG955 Series Manual |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
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3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.
- The siting of Wollar station does not comply with AS/NZS 3580.1.1:2007 as of 27/2/2016 due to the yearly audit task being overdue.

3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger 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.

3.4. Data Validation and Reporting

3.4.1. 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-minute data.

3.4.2. Reporting

The reported data is in a Microsoft Excel format file named “*Wilpinjong Coal Validated Data Report November-17.xls*”. The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5-minute Averages
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The data contained in this report is based on Australian Eastern Standard Time.

All averages are calculated from the five-minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One-hour averages are calculated based on a clock hour. One-day averages are calculated based on calendar days.

4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

Table 4: Wilpinjong Air Quality Goals (NEPM)

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|-----------------|-------------|------------------|-------|-------------------------------|
| NO ₂ | 1 year | 0.030 | ppm | None |
| NO ₂ | 1 hour | 0.120 | ppm | 1 day a year |
| SO ₂ | 1 hour | 0.200 | ppm | 1 day a year |
| SO ₂ | 1 day | 0.080 | ppm | 1 day a year |
| SO ₂ | 1 year | 0.020 | ppm | None |

4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

Table 5: Exceedences Recorded

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|-----------------|-------------|---------------------|--------------------|
| NO ₂ | 1 hour | - | - |
| SO ₂ | 1 hour | - | - |
| SO ₂ | 1 day | - | - |

5.0 Calibrations and Maintenance

5.1. 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 6: Units and Uncertainties

| Parameter | Units | Resolution | Uncertainty | Measurement Range ¹ |
|---|-------|------------|--|--|
| NO, NO _x (EC9841) | ppm | 0.001 ppm | ± 0.014 ppm K factor of 2.01 | 0.000 ppm to 0.500 ppm |
| NO ₂ (EC9841) | ppm | 0.001 ppm | ± 0.016 ppm K factor of 2.01 | 0 ppb to 0.500 ppb |
| SO ₂ (EC9850) | ppm | 0.001 ppm | ± 0.014 ppm K factor of 2.01 | 0.000 ppm to 0.500 ppm |
| H ₂ S | ppm | 1 ppb | 15.2% of reading or ± 0.019 ppm, whichever is greater K factor of 2 | 0.000 ppm to 0.500 ppm |
| Benzene, Toluene and <i>p</i> -Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.01 m/s or 2.0% of reading, whichever is greater (K factor of 1.96) | 0 m/s to 60 m/s |
| Vector Wind Direction | Deg | 1 deg | ±2 deg K factor of 2.11 | 0 deg to 360 deg Starting threshold: 0 m/s |

¹ Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, NO₂ and NO_x by EC 9841 and SO₂ by EC9850 are calculated based on a measurement range of 0-125 ppb.

5.2. Automatic Checks

Automatic span and zero calibration checks run every night for NO, NO₂, NO_x and SO₂, every 2nd night for H₂S and weekly for BTX.

Background checks run each night for SO₂ and H₂S.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

Table 7: Automatic checks for NO, NO₂, NO_x, SO₂, H₂S and BTX

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---------------------------------------|--|-------------------------------------|
| NO, NO ₂ , NO _x | 00:45 to 01:25 every day | N/A |
| SO ₂ | 00:45 to 01:25 every day | 23:45 to 23:50 every day |
| H ₂ S | 01:35 to 02:35 every 2 nd day | 23:45 to 23:50 every day |
| BTX | 02:45 to 05:25 weekly | N/A |

5.3. Maintenance

Scheduled monthly maintenance was performed on 06/11/2017.

Unscheduled visits was made:

- 14/11/2017 a remote calibration was performed on H₂S analysers to adjust the span
- 21/11/2017 a remote calibration was performed to adjust the H₂S span
- 22/11/2017 a remote calibration was performed to adjust the H₂S span

5.3.1. 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.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

Table 8: Wilpinjong Wollar Maintenance Table

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---------------------------------------|--------------------------|------------------|--------------------------|-------------------|
| NO, NO ₂ , NO _x | 06/11/2017 | Monthly | 06/11/2017 | Monthly |
| SO ₂ | 06/11/2017 | Monthly | 06/11/2017 | Monthly |
| H ₂ S | 22/11/2017 | Unscheduled | 22/11/2017 | Monthly |
| BTX | 06/11/2017 | Monthly | 06/11/2017 | Yearly |
| Wind Sensor | 06/11/2017 | Monthly | 22/07/2015 | 2-yearly |

6.0 Results

6.1. Data Capture

Data capture is based on 1-hour averages, calculated from 5-minute data, and refers to the amount of available data collected during the report period.

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

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

Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for November 2017. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

Table 9: Data Capture for Wilpinjong Wollar Station

| Parameter | Data Capture % |
|---------------------------------------|----------------|
| NO, NO ₂ , NO _x | 96.0 |
| SO ₂ | 95.5 |
| H ₂ S | 58.3 |
| Benzene | 97.4 |
| Toluene | 97.4 |
| <i>p</i> -Xylene | 0.0 |
| WS, WD | 99.3 |

6.2. Graphic Representations

Validated 5-minute data for NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

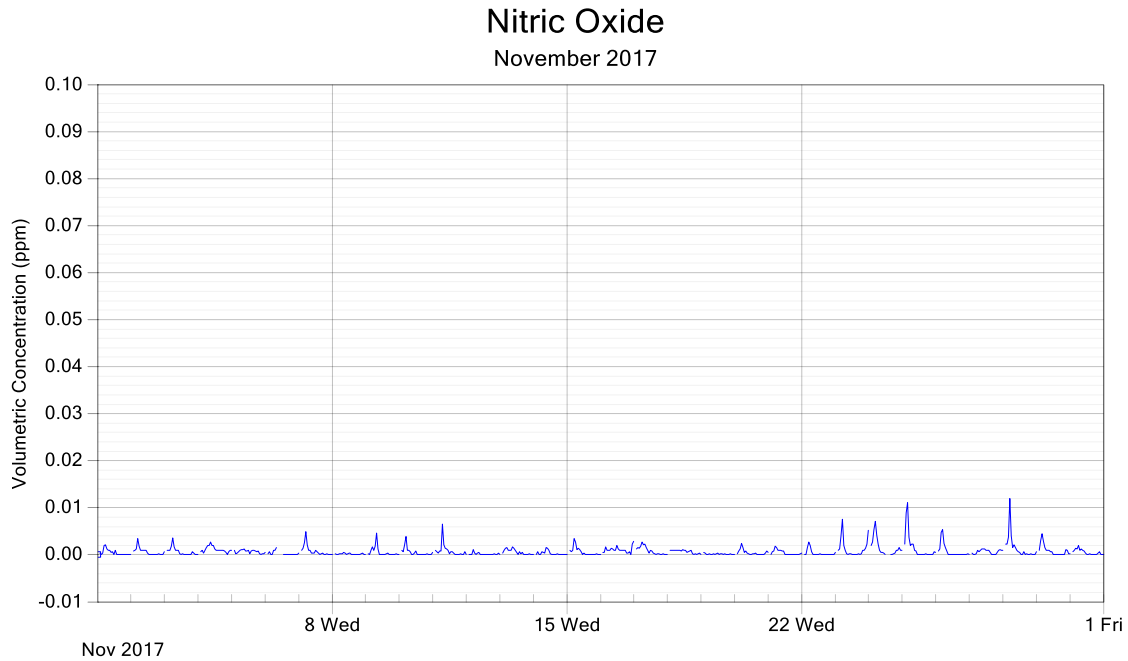


Figure 2: NO 1-hour averaged data

Nitrogen Dioxide

November 2017

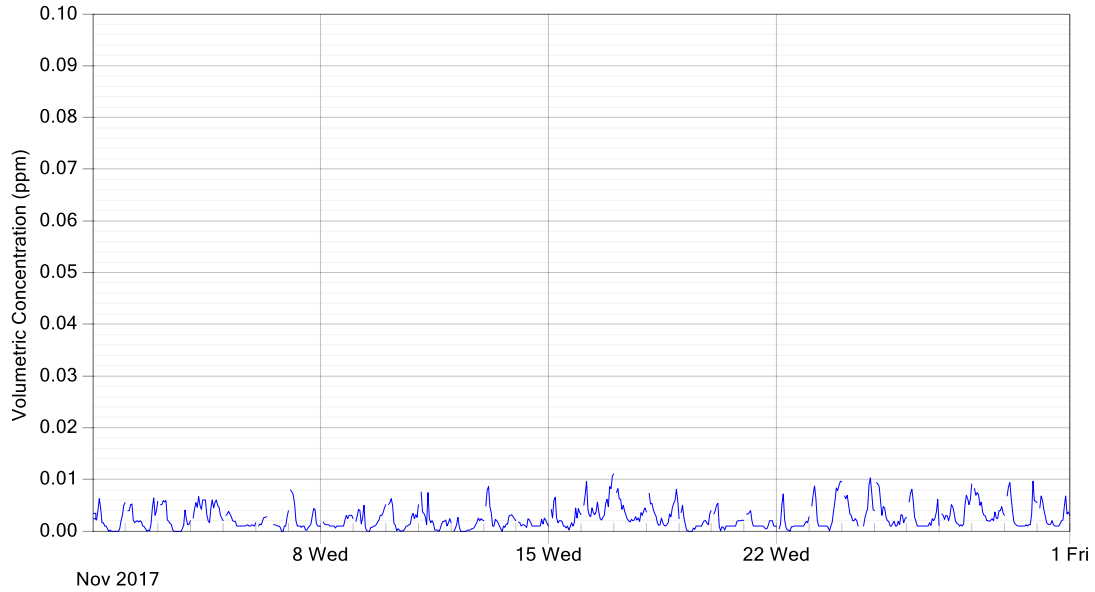


Figure 3: NO₂ 1-hour averaged data

Oxides of Nitrogen

November 2017

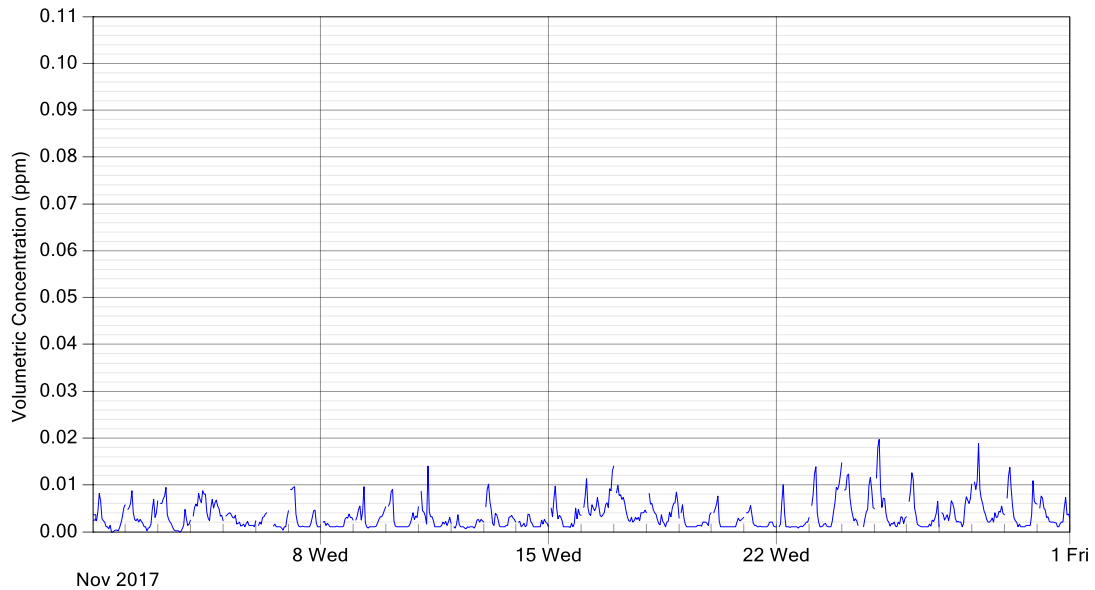


Figure 4: NO_x 1-hour averaged data

Sulfur Dioxide

November 2017

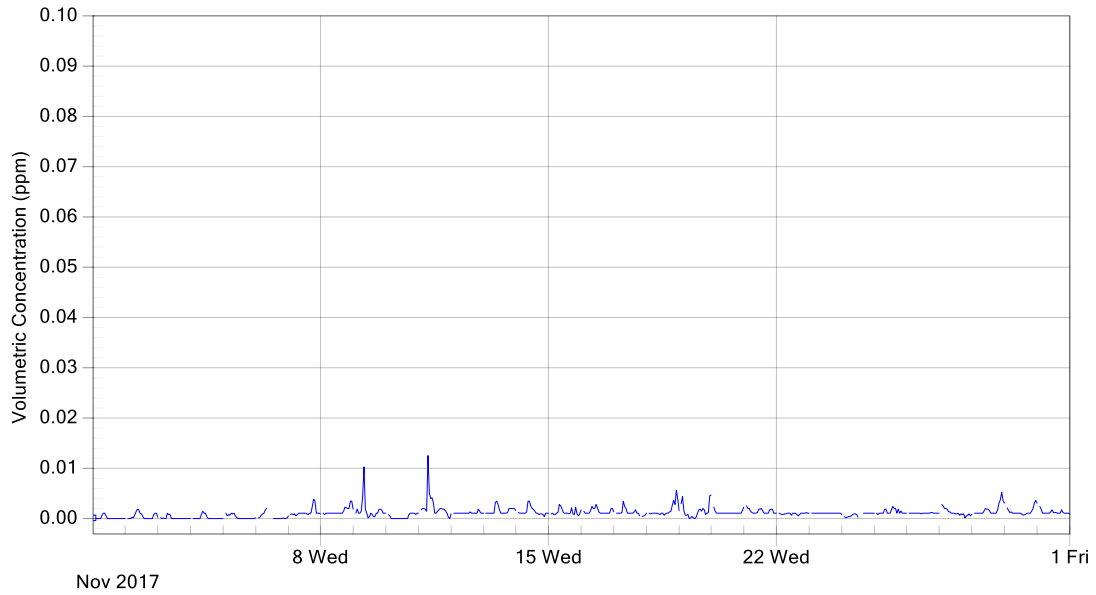


Figure 5: SO₂ 1-hour averaged data

Hydrogen Sulfide

November 2017

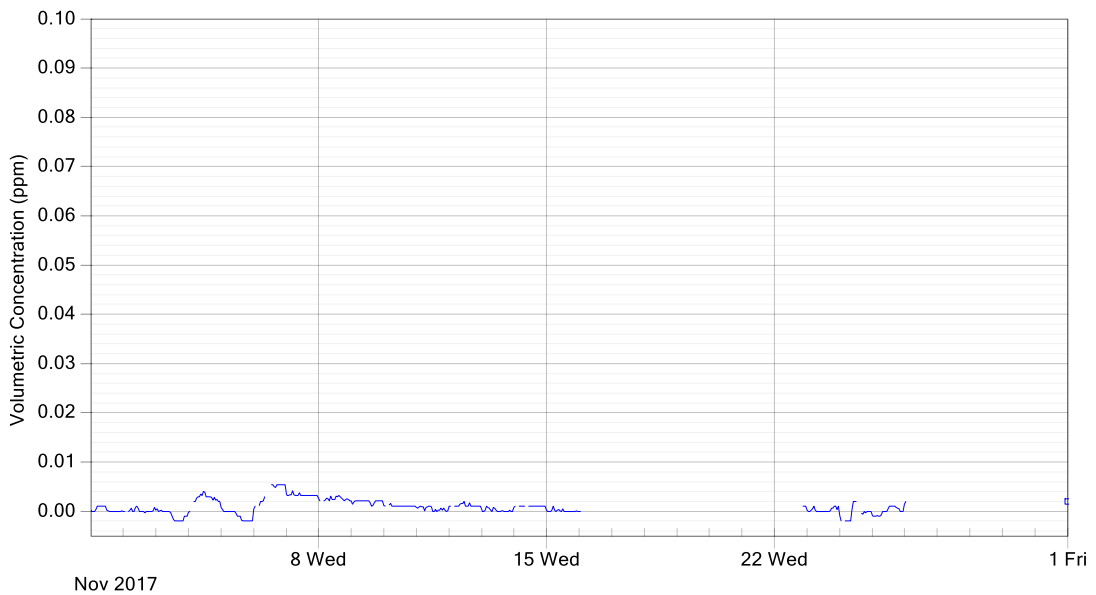


Figure 6: H₂S 1-hour averaged data

Benzene, Toluene and p-Xylene

November 2017

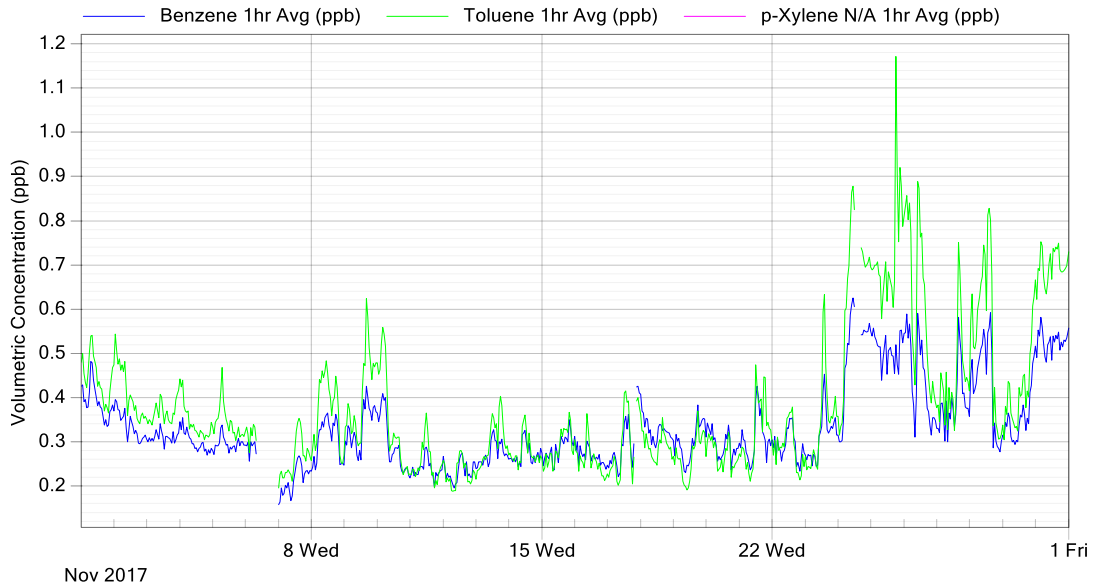


Figure 7: BTX 1-hour averaged data

Wind Speed

November 2017

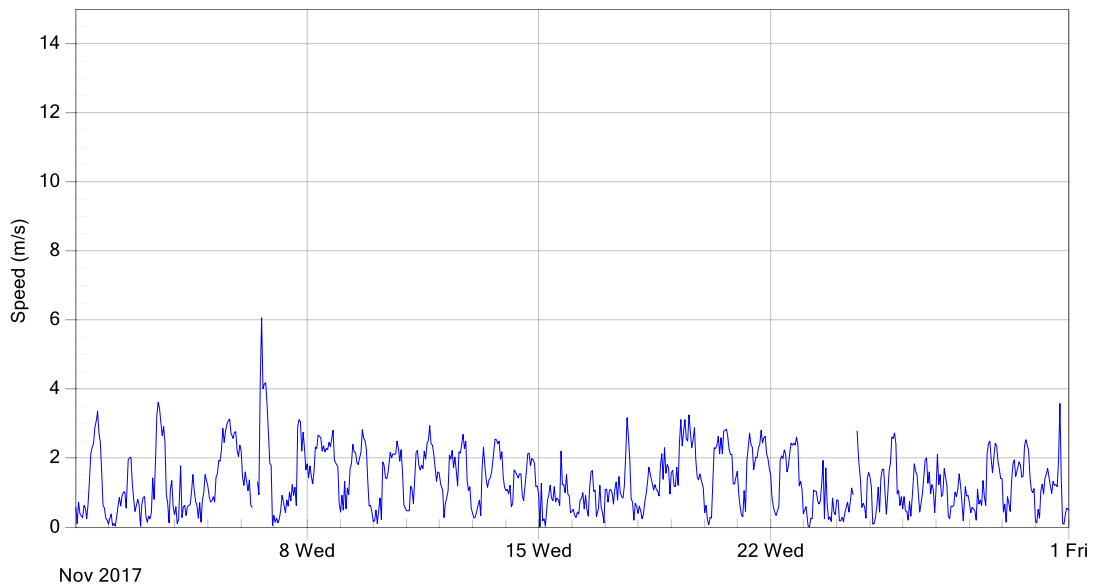


Figure 8: WS 1-hour averaged data

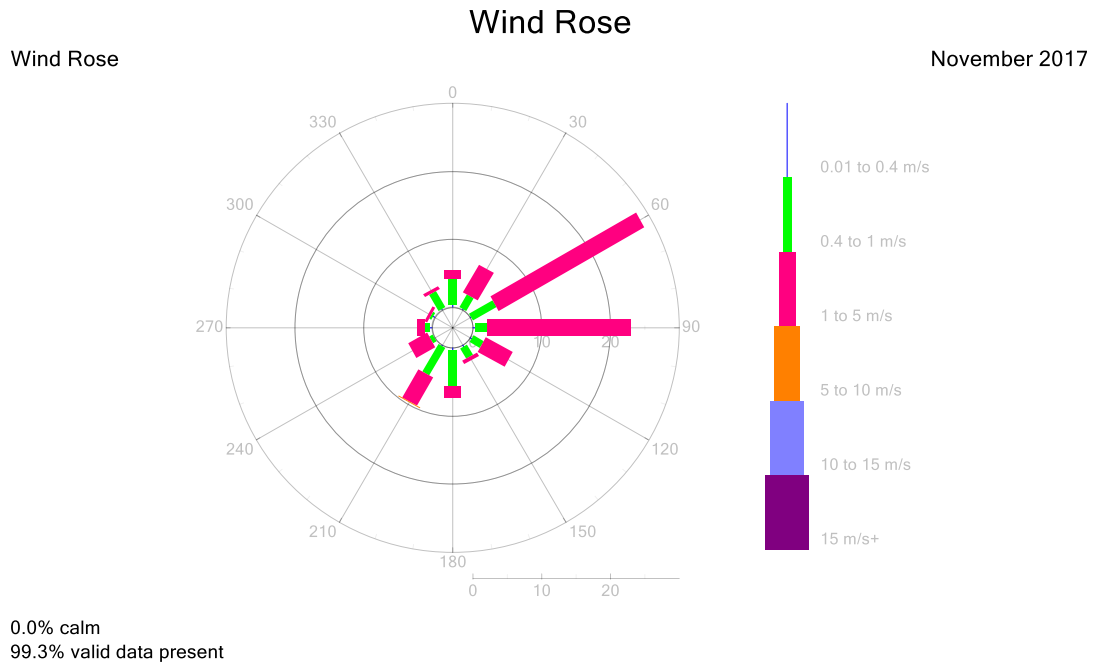


Figure 9: Wind Rose

7.0 Valid Data Exception Tables

The table 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 10: Wollar Valid Data Exception Table

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---------------------|---------------------|---|---|-----------|-------------|
| 1/11/2017 0:00 | 1/12/2017 0:00 | Unrealistic readings | Xylene | EP | 14/12/2017 |
| 4/11/2017 3:40 | 6/11/2017 8:45 | Static offset (0.001 ppm) applied to data to adjust the baseline | H ₂ S | EP | 14/12/2017 |
| 6/11/2017 8:50 | 6/11/2017 23:30 | Scheduled monthly maintenance and subsequent instrument stabilisation | All parameters | EP | 14/12/2017 |
| 6/11/2017 11:35 | 14/11/2017 9:10 | Linear multiplier (A = 1.07 and B=1) applied to data correct the drifted span | H ₂ S | EP | 14/12/2017 |
| 6/11/2017 11:35 | 21/11/2013 11:30 | Static offset (0.003 ppm) applied to data to adjust the baseline | H ₂ S | EP | 14/12/2017 |
| 14/11/2017 9:15 | 14/11/2014 10:20 | Remote calibration to adjust the span drift | H ₂ S | EP | 14/12/2017 |
| 16/11/2017 3:40 | 21/11/2017 11:30 | Calibration check outside of tolerance | H ₂ S | EP | 14/12/2017 |
| 17/11/2017 19:20 | 17/11/2017 20:50 | Intermittent instrument stabilisation after suspected brief power interruptions | NO, NO ₂ , NO _x , SO ₂ , H ₂ S, BTX | EP | 14/12/2017 |
| 21/11/2017 11:35 | 21/11/2017 20:30 | Remote calibration to adjust the span and instrument stabilisation | H ₂ S | EP | 14/12/2017 |
| 21/11/2017 20:35 | 22/11/2017 19:50 | Calibration check outside of tolerance | H ₂ S | EP | 14/12/2017 |
| 22/11/2017 19:55 | 22/11/2017 21:10 | Remote calibration to adjust the H ₂ S span and instrument stabilisation | SO ₂ , H ₂ S, WS, WD, BTX | EP | 14/12/2017 |

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---------------------|---------------------|---|--|-----------|-------------|
| 22/11/2017 21:15 | 24/11/2017 13:05 | Static offset (0.002 ppm) applied to data to adjust the baseline | H ₂ S | EP | 14/12/2017 |
| 24/11/2017 13:10 | 24/11/2017 14:55 | Power interruption at site | All parameters | AE | 22/12/2017 |
| 24/11/2017 15:00 | 24/11/2017 16:15 | Instrument stabilisation after power interruption | NO, NO ₂ , NO _x , SO ₂ , H ₂ S, BTX | EP | 14/12/2017 |
| 24/11/2017 15:35 | 25/11/2017 0:05 | Static offset (-0.010 ppm) applied to data to adjust the baseline | H ₂ S | EP | 14/12/2017 |
| 26/11/2017 3:40 | 1/12/2017 0:00 | Calibration check outside of tolerance | H ₂ S | EP | 14/12/2017 |

8.0 Report Summary

The data capture for most of the parameters a Wollar was above 95% for the reporting month. The exceptions were H₂S and p-xylene. Please refer to Data Capture Percentage Table 9 for details; and Table 10 for valid data exceptions.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

-----END OF REPORT-----

Appendix 1 - Definitions & Abbreviations

| | |
|------------------|---------------------------------------|
| BTX | Benzene, Toluene and <i>p</i> -Xylene |
| H ₂ S | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| NO ₂ | Nitrogen dioxide |
| NO _x | Oxides of nitrogen |
| ppb | Parts per billion |
| SO ₂ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

Appendix 2 - Explanation of Exception Table

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.

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 affected by environmental conditions – wind speed / wind speed gust spike refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

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.

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.

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

Peabody Energy

Wilpinjong Coal Wollar

Ambient Air Quality Monitoring

Validated Report

1st December – 31st December 2017

Report No.: DAT12821

Report issue date: 25th January 2018

Maintenance contract: MC951

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|------------------|-----------|------------|--------------|
| Revision | Report ID | Date | Analyst |
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Report by Elmira Parto



Approved by Amanda Elliott



Table of Contents

| | |
|---|-----------|
| Customer Details..... | 2 |
| Revision History | 2 |
| List of Figures | 4 |
| List of Tables | 5 |
| 1.0 Executive Summary..... | 6 |
| 2.0 Introduction | 7 |
| 3.0 Monitoring and Data Collection..... | 7 |
| 3.1. Siting Details..... | 7 |
| 3.2. Monitored Parameters | 9 |
| 3.3. Data Collection Methods | 10 |
| 3.3.1. Compliance with Standards | 11 |
| 3.3.2. Data Acquisition | 11 |
| 3.4. Data Validation and Reporting..... | 11 |
| 3.4.1. Validation | 11 |
| 3.4.2. Reporting..... | 12 |
| 4.0 Air Quality Goals..... | 13 |
| 4.1. Air Quality Summary | 13 |
| 5.0 Calibrations and Maintenance..... | 14 |
| 5.1. Units and Uncertainties | 14 |
| 5.2. Automatic Checks | 15 |
| 5.3. Maintenance | 15 |
| 5.3.1. Calibration & Maintenance Summary Tables | 15 |
| 6.0 Results..... | 17 |

| | |
|---|-----------|
| 6.1. Data Capture | 17 |
| 6.2. Graphic Representations | 18 |
| 7.0 Valid Data Exception Tables | 23 |
| 8.0 Report Summary..... | 24 |
| Appendix 1 - Definitions & Abbreviations | 25 |
| Appendix 2 - Explanation of Exception Table..... | 26 |

List of Figures

| | |
|--|----|
| Figure 1: Wilpinjong Mine Monitoring Station Location..... | 8 |
| Figure 2: NO 1-hour averaged data | 18 |
| Figure 3: NO ₂ 1-hour averaged data | 19 |
| Figure 4: NO _x 1-hour averaged data | 20 |
| Figure 5: SO ₂ 1-hour averaged data..... | 20 |
| Figure 6: H ₂ S 1-hour averaged data | 21 |
| Figure 7: BTX 1-hour averaged data | 21 |
| Figure 8: WS 1-hour averaged data | 22 |
| Figure 9: Wind Rose | 22 |

List of Tables

| | |
|---|----|
| Table 1: Wilpinjong Mine monitoring site location | 7 |
| Table 2: Parameters measured at the Wilpinjong Mine monitoring station..... | 9 |
| Table 3: Methods | 10 |
| Table 4: Wilpinjong Air Quality Goals (NEPM) | 13 |
| Table 5: Exceedences Recorded..... | 13 |
| Table 6: Units and Uncertainties..... | 14 |
| Table 7: Automatic checks for NO, NO ₂ , NO _x , SO ₂ , H ₂ S and BTX..... | 15 |
| Table 8: Wilpinjong Wollar Maintenance Table | 16 |
| Table 9: Data Capture for Wilpinjong Wollar Station | 17 |
| Table 10: Wollar Valid Data Exception Table | 23 |

1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene, *p*-Xylene, wind speed and wind direction.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for December 2017. Data capture for the different pollutants is presented in Table 9.

Xylene data monitored at the Wollar station is not included for this month as the data is pending further investigation into instrument performance and calibration. Data will be issued on completion of this investigation.

2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for December 2017.

The data presented in this report:

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

3.0 Monitoring and Data Collection

3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

Table 1: Wilpinjong Mine monitoring site location

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|-----------|----------------------------------|----------------------------|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with AS/NZS 3580.1.1:2007 “Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment”.

The station is classified as a neighbourhood station according to AS/NZS 3580.1.1:2007.



Figure 1: Wilpinjong Mine Monitoring Station Location

3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

Table 2: Parameters measured at the Wilpinjong Mine monitoring station

| Parameter Measured | Instrument and Measurement Technique |
|--|--|
| BTX (Benzene, Toluene and <i>p</i> -Xylene) | Synspec GC955 - Gas Chromatography |
| H ₂ S | Ecotech EC9852 - fluorescence |
| NO, NO ₂ , NO _x | Ecotech EC9841 gas phase chemiluminescence |
| SO ₂ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Gill Windsonic |
| Wind Direction (10m) | Gill Windsonic |

3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

Table 3: 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 |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| SO ₂ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
| H ₂ S | Ecotech Laboratory Manual | In-house method 6.5 Hydrogen sulfide by fluorescence |
| BTX | Manufacturer’s Instructions | Gas Chromatography Synspec CG955 Series Manual |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.
- Measurement of wind data does not comply with AS 3580.14-2014 as of 22/07/2017 due to the 2 yearly wind tunnel calibration task being overdue.

3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger 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.

3.4. Data Validation and Reporting

3.4.1. 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-minute data.

3.4.2. Reporting

The reported data is in a Microsoft Excel format file named “*Wilpinjong Coal Validated Data Report December-17.xls*”. The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5-minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

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

All averages are calculated from the five-minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One-hour averages are calculated based on a clock hour. One-day averages are calculated based on calendar days.

4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

Table 4: Wilpinjong Air Quality Goals (NEPM)

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|-----------------|-------------|------------------|-------|-------------------------------|
| NO ₂ | 1 year | 0.030 | ppm | None |
| NO ₂ | 1 hour | 0.120 | ppm | 1 day a year |
| SO ₂ | 1 hour | 0.200 | ppm | 1 day a year |
| SO ₂ | 1 day | 0.080 | ppm | 1 day a year |
| SO ₂ | 1 year | 0.020 | ppm | None |

4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

Table 5: Exceedences Recorded

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|-----------------|-------------|---------------------|--------------------|
| NO ₂ | 1 hour | - | - |
| SO ₂ | 1 hour | - | - |
| SO ₂ | 1 day | - | - |

5.0 Calibrations and Maintenance

5.1. 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 6: Units and Uncertainties

| Parameter | Units | Resolution | Uncertainty | Measurement Range ¹ |
|---|-------|------------|--|--|
| NO, NO _x (EC9841) | ppm | 0.001 ppm | ± 0.014 ppm K factor of 2.01 | 0.000 ppm to 0.500 ppm |
| NO ₂ (EC9841) | ppm | 0.001 ppm | ± 0.016 ppm K factor of 2.01 | 0 ppm to 0.500 ppm |
| SO ₂ (EC9850) | ppm | 0.001 ppm | ± 0.014 ppm K factor of 2.01 | 0.000 ppm to 0.500 ppm |
| H ₂ S | ppm | 1 ppb | 15.2% of reading or ± 0.019 ppm, whichever is greater K factor of 2 | 0.000 ppm to 0.500 ppm |
| Benzene, Toluene and <i>p</i> -Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.01 m/s or 2.0% of reading, whichever is greater (K factor of 1.96) | 0 m/s to 60 m/s |
| Vector Wind Direction | Deg | 1 deg | ±2 deg K factor of 2.11 | 0 deg to 360 deg Starting threshold: 0 m/s |

¹ Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, NO₂ and NO_x by EC 9841 and SO₂ by EC9850 are calculated based on a measurement range of 0-125 ppb.

5.2. Automatic Checks

Automatic span and zero calibration checks run every night for NO, NO₂, NO_x and SO₂, every 2nd night for H₂S and weekly for BTX.

Background checks run each night for SO₂ and H₂S.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

Table 7: Automatic checks for NO, NO₂, NO_x, SO₂, H₂S and BTX

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---------------------------------------|--|-------------------------------------|
| NO, NO ₂ , NO _x | 00:45 to 01:25 every day | N/A |
| SO ₂ | 00:45 to 01:25 every day | 23:45 to 23:50 every day |
| H ₂ S | 01:35 to 02:35 every 2 nd day | 23:45 to 23:50 every day |
| BTX | 03:45 to 6:10 weekly | N/A |

5.3. Maintenance

Scheduled monthly maintenance was performed on 14/12/2017.

Unscheduled visits were made:

- 09/12/2017 a remote calibration was performed on the H₂S analyser to adjust the span.
- 19/12/2017 to reset the wind sensor and H₂S convertor after a power interruption caused them to be lock up.

5.3.1. 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.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

Table 8: Wilpinjong Wollar Maintenance Table

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---------------------------------------|--------------------------|------------------|--------------------------|-------------------|
| NO, NO ₂ , NO _x | 14/12/2017 | Monthly | 14/12/2017 | Monthly |
| SO ₂ | 14/12/2017 | Monthly | 14/12/2017 | Monthly |
| H ₂ S | 19/12/2017 | Unscheduled | 14/12/2017 | Monthly |
| BTX | 14/12/2017 | Monthly | 14/12/2017 | Yearly |
| Wind Sensor | 19/12/2017 | Unscheduled | 22/07/2015 | 2-yearly |

6.0 Results

6.1. Data Capture

Data capture is based on 1-hour averages, calculated from 5-minute data, and refers to the amount of available data collected during the report period.

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

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

Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for December 2017. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

Table 9: Data Capture for Wilpinjong Wollar Station

| Parameter | Data Capture % |
|---------------------------------------|----------------|
| NO, NO ₂ , NO _x | 96.7 |
| SO ₂ | 96.1 |
| H ₂ S | 0.0 |
| Benzene | 94.0 |
| Toluene | 94.0 |
| <i>p</i> -Xylene | ² |

² Data is under investigation

| Parameter | Data Capture % |
|-----------|----------------|
| WS, WD | 76.8 |

6.2. Graphic Representations

Validated 5-minute data for NO, NO₂, NO_x, SO₂, H₂S, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

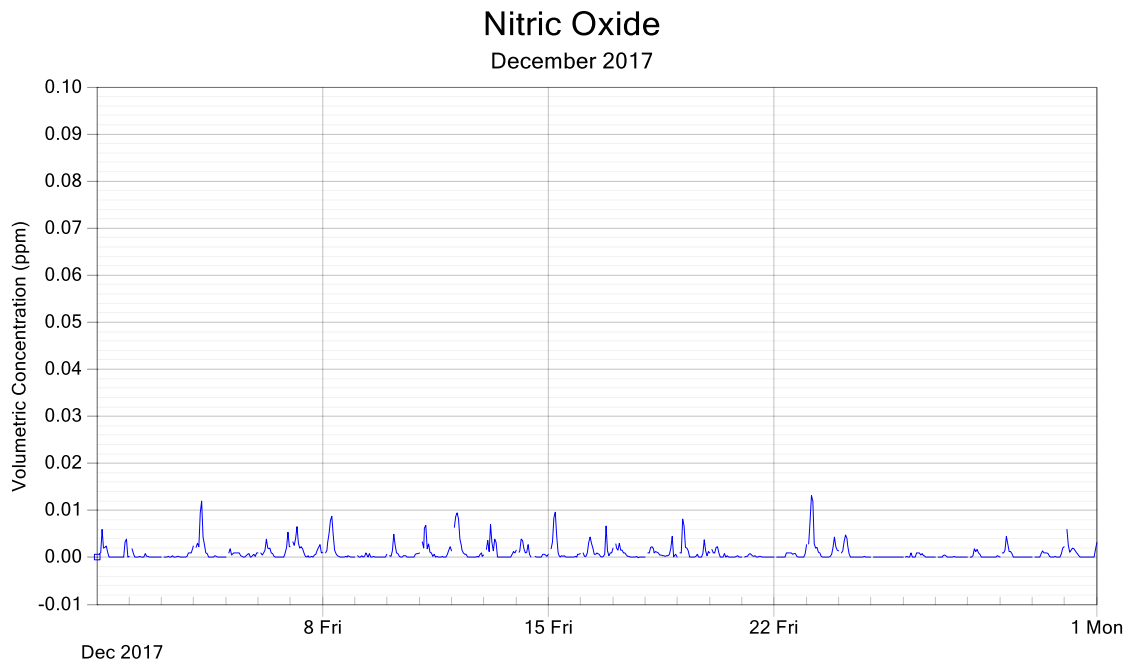


Figure 2: NO 1-hour averaged data

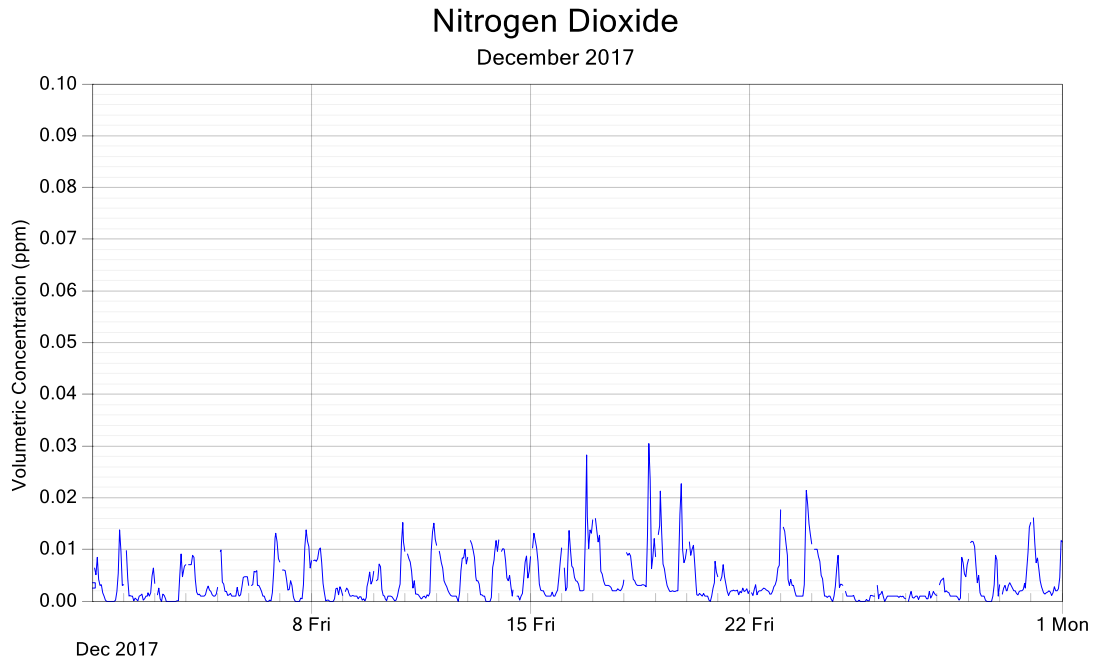


Figure 3: NO₂ 1-hour averaged data

Oxides of Nitrogen

December 2017

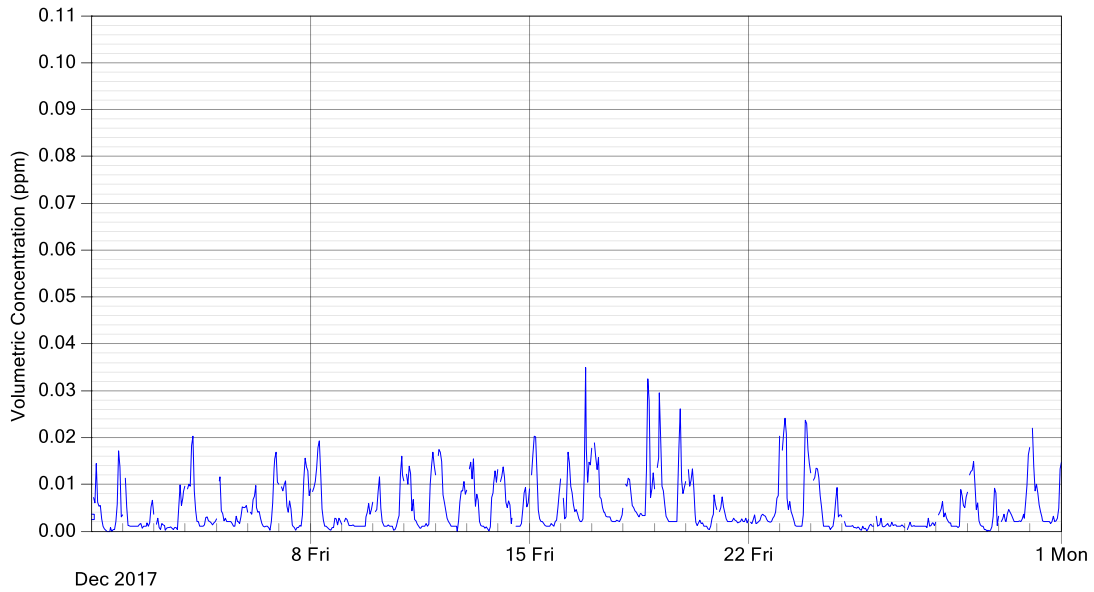


Figure 4: NO_x 1-hour averaged data

Sulfur Dioxide

December 2017

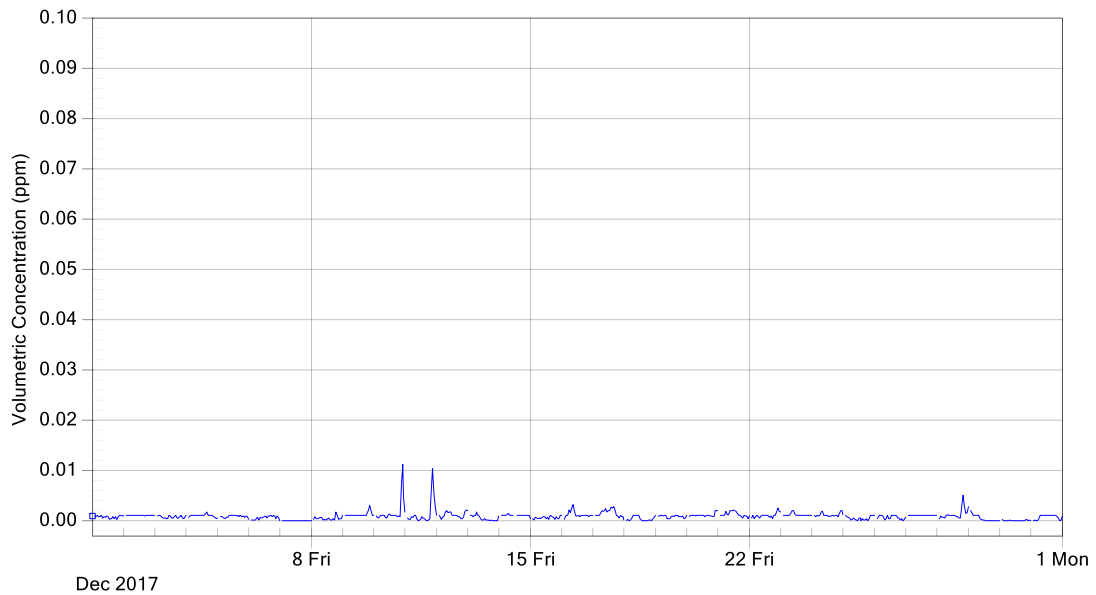


Figure 5: SO₂ 1-hour averaged data

Hydrogen Sulfide

December 2017

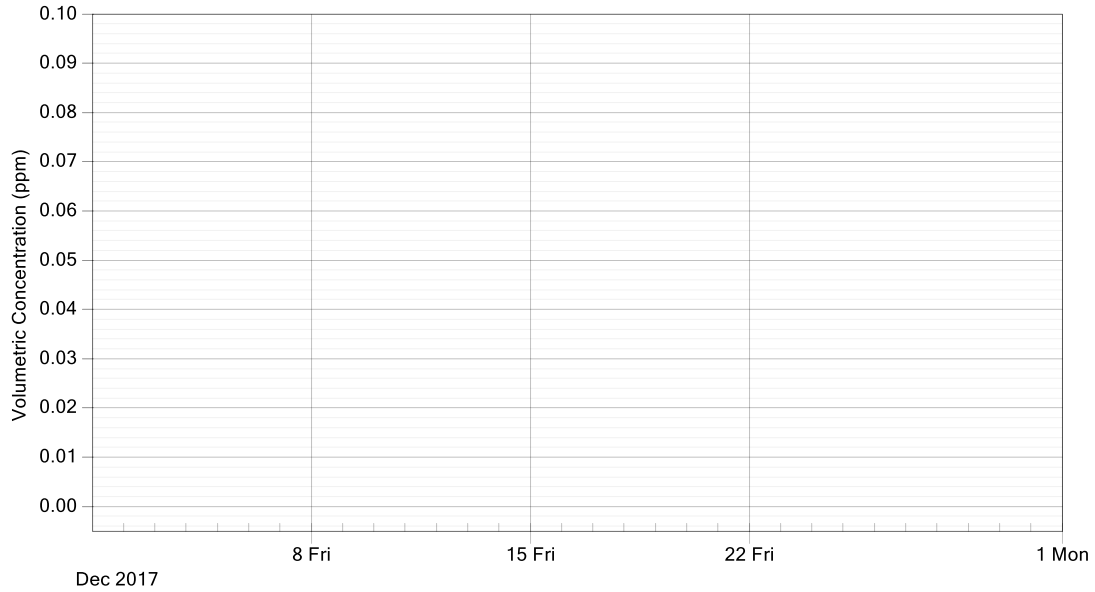


Figure 6: H₂S 1-hour averaged data

Benzene, Toluene and p-Xylene

December 2017

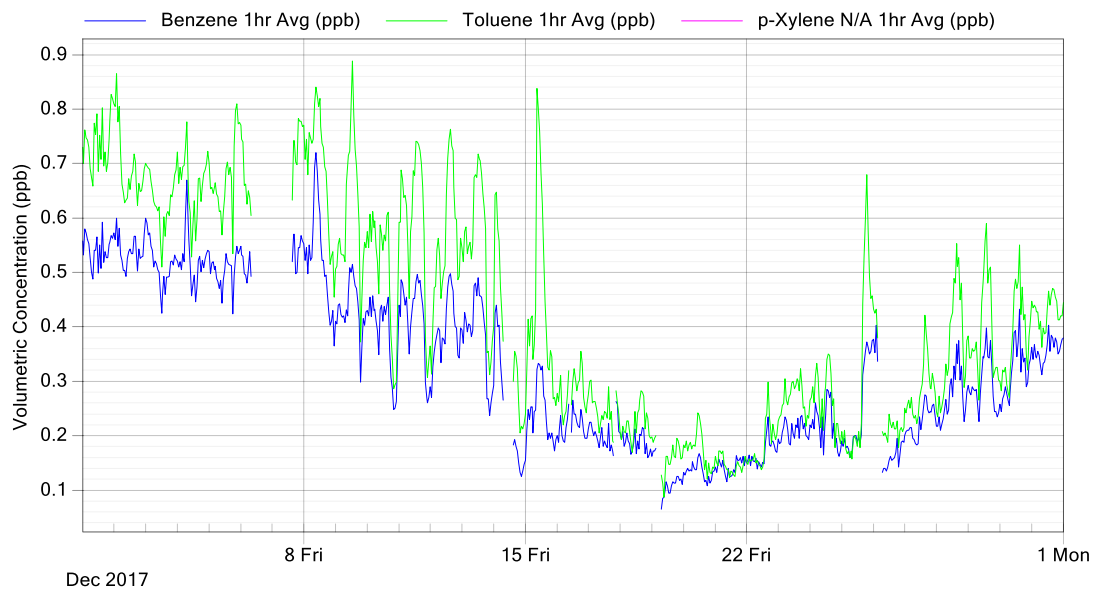


Figure 7: BTX 1-hour averaged data

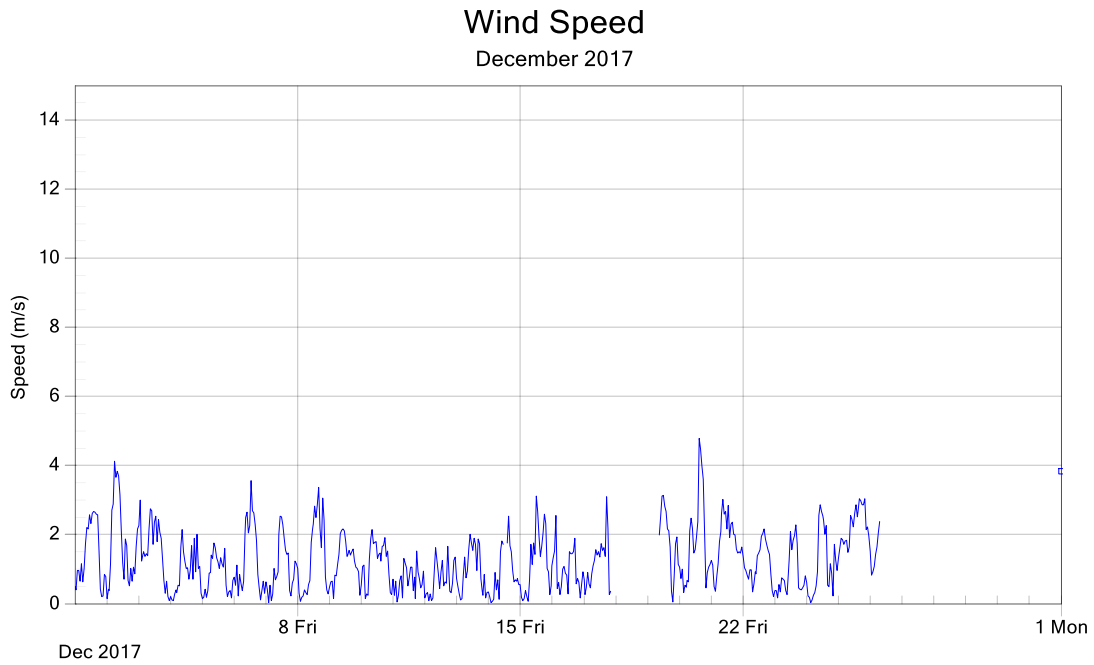


Figure 8: WS 1-hour averaged data

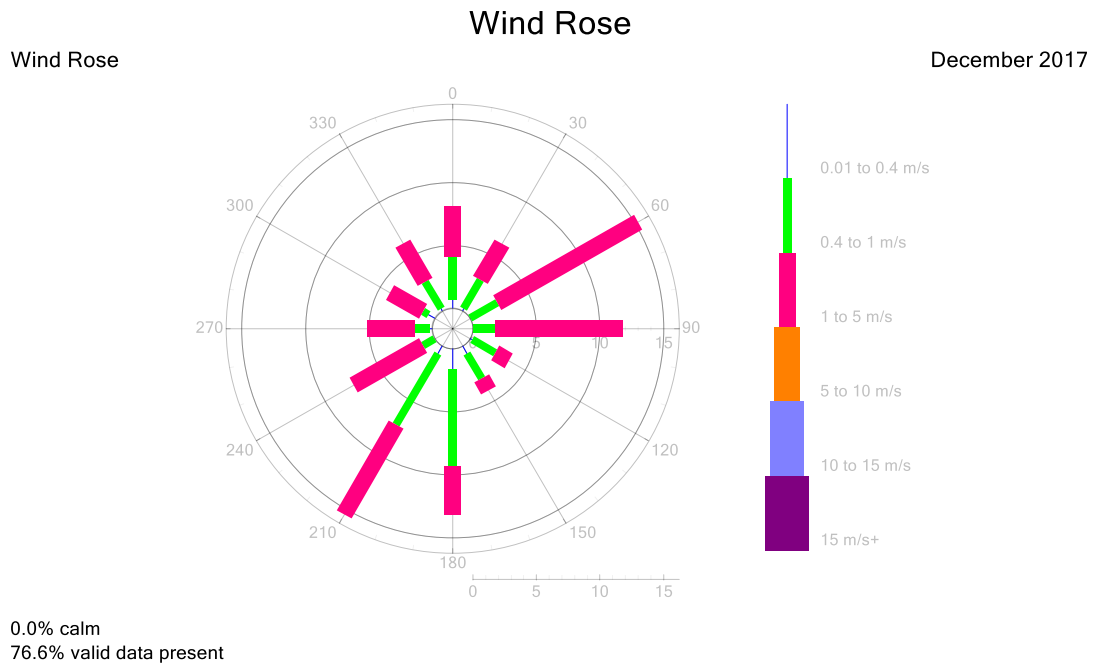


Figure 9: Wind Rose

7.0 Valid Data Exception Tables

The table 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 10: Wollar Valid Data Exception Table

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---------------------|---------------------|---|---|-----------|-------------|
| 1/12/2017 0:00 | 9/12/2017 8:55 | Calibration check outside of tolerance | H ₂ S | EP | 23/01/2018 |
| 1/12/2017 0:00 | 1/01/2018 0:00 | Data under investigation | Xylene | EP | 25/01/2018 |
| 6/12/2017 9:15 | 17/12/2017 20:45 | Intermittent possible power failure and subsequent instrument stabilisation and running additional background check | WS,WD, SO ₂ , H ₂ S, Benzene, Toluene | EP | 23/01/2018 |
| 9/12/2017 9:00 | 9/12/2017 10:05 | Remote calibration to adjust the span drift | H ₂ S | EP | 23/01/2018 |
| 9/12/2017 10:20 | 14/12/2017 10:20 | Calibration outside of the tolerance | H ₂ S | EP | 23/01/2018 |
| 14/12/2017 8:10 | 14/12/2017 14:40 | Scheduled monthly maintenance and subsequent instrument stabilisation | All parameters | EP | 23/01/2018 |
| 14/12/2017 14:05 | 1/01/2018 0:00 | Calibration check outside of tolerance | H ₂ S | EP | 23/01/2018 |
| 16/12/2017 2:25 | 16/12/2017 2:35 | Unrealistic negative readings | NO, NO ₂ , NO _x | EP | 23/01/2018 |
| 17/12/2017 21:00 | 1/01/2018 0:00 | Intermittent wind sensor fault after power failure | WS,WD | EP | 23/01/2018 |
| 18/12/2017 8:50 | 29/12/2017 8:55 | Intermittent data transmission error | WS,WD, Benzene, Toluene | EP | 25/01/2018 |



| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|--------------------|---------------------|--|-------------------------|-----------|-------------|
| 19/12/2017 3:45 | 19/12/2017 6:40 | Automatic calibration check and subsequent instrument stabilisation | Benzene, Toluene | EP | 23/01/2018 |
| 19/12/2017 8:15 | 19/12/2017 11:45 | Unscheduled maintenance - Reset wind sensors and H ₂ S converter after power interruption | WS,WD, H ₂ S | EP | 23/01/2018 |
| 26/12/2017 3:45 | 26/12/2017 6:55 | Automatic calibration check and subsequent instrument stabilisation | Benzene, Toluene | EP | 23/01/2018 |

8.0 Report Summary

The data capture for most of the parameters a Wollar was below 95% for the reporting month. The exceptions were SO₂ and NO, NO₂, NO_x Please refer to Data Capture Percentage Table 9 for details; and Table 10 for valid data exceptions.

Xylene data monitored at the Wollar station is not included for this month as the data is pending further investigation into instrument performance and calibration. Data will be issued on completion of this investigation.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech’s NATA scope of accreditation. Please refer to section 3.3.1 for details.

-----END OF REPORT-----

Appendix 1 - Definitions & Abbreviations

| | |
|------------------|---------------------------------------|
| BTX | Benzene, Toluene and <i>p</i> -Xylene |
| H ₂ S | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| NO ₂ | Nitrogen dioxide |
| NO _x | Oxides of nitrogen |
| ppb | Parts per billion |
| SO ₂ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

Appendix 2 - Explanation of Exception Table

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.

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 affected by environmental conditions – wind speed / wind speed gust spike refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

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.

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.

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