TODOROSKI AIR SCIENCES

LAKE MACQUARIE – WYONG

REVIEW OF MONTHLY AMBIENT AIR QUALITY DATA

MAY 2015

NSW Environment Protection Authority

26 August 2015

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Prepared by

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Lake Macquarie – Wyong

Review of Monthly Ambient Air Quality Data

May 2015

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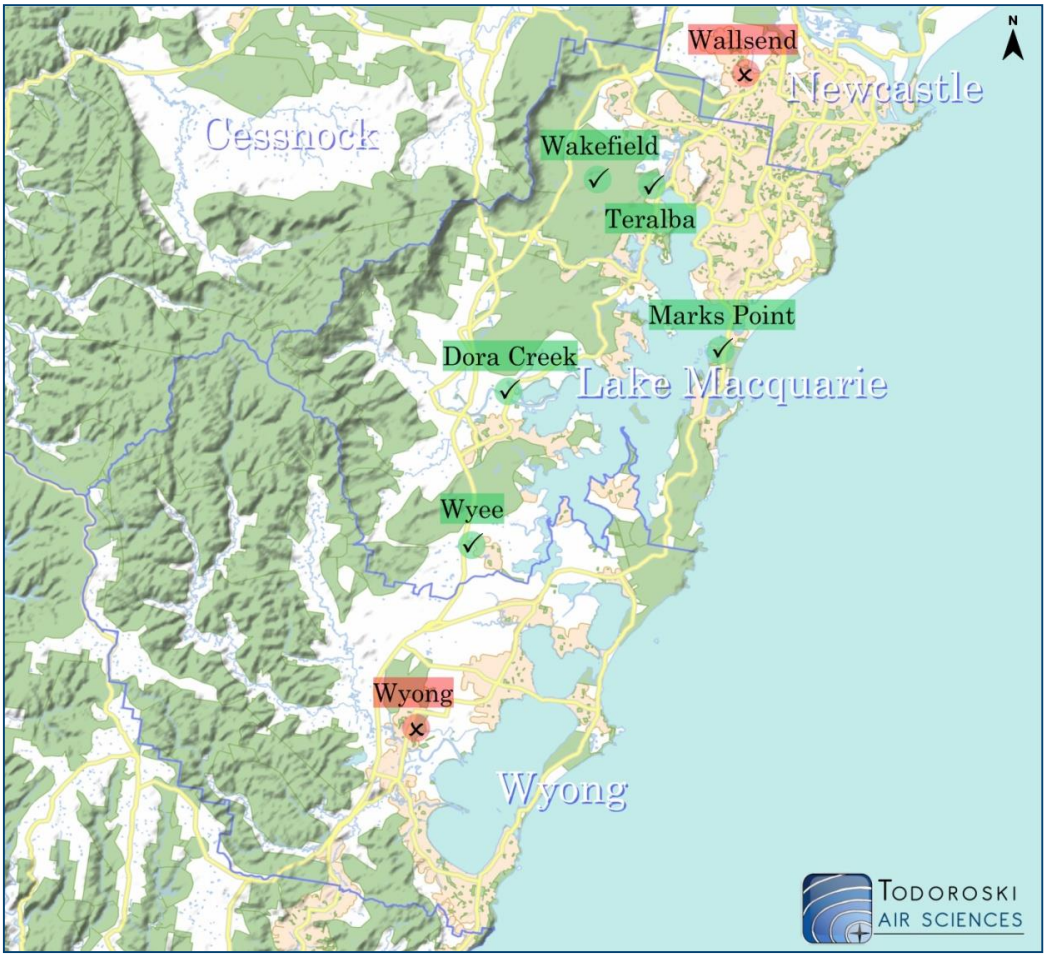
EXECUTIVE SUMMARY

This report has been prepared by Todoroski Air Sciences for the NSW Environment Protection Authority (NSW EPA) and presents ambient air quality monitoring data recorded in the Lake Macquarie - Wyong region for the month of May 2015. The results indicate that the air quality was generally very good in the Lake Macquarie - Wyong region during May.

The data summary (shown below) indicates that in May 2015, the Wallsend and Wyong TEOM recorded PM_{10} levels above the applicable criterion of 50µg/m³. All other data recorded in May were below the applicable criteria. Further details are provided in the report. The 24-hour average data are provided in the Appendices.

Lake Macquarie - Wyong Air Quality Pictorial Summary - May 2015



Lake Macquarie – Wyong Air Quality Tabular Summary - May 2015

Site	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	SO_2 (µg/m³)
	24-hour average	24-hour average	24-hour average	1-hour average	1-hour average
	Air Quality Impact Criteria				
	50	25*	228	246	570
Wallsend	×	✓	✓	✓	✓
Wyong	×	✓	✓	✓	✓
Dora Creek	-	-	✓	✓	✓
Marks Point	-	-	✓	✓	✓
Wyee	-	✓	✓	✓	✓
Wakefield HVAS	✓	-	-	-	-
Teralba HVAS	✓	-	-	-	-

✓ - All data below applicable criteria
× - At least one elevated level above applicable criteria
- - Not applicable
HVAS - High Volume Air Sampler
* - Advisory reporting standard for $PM_{2.5}$ concentrations (refer to Section 5.1)

1 INTRODUCTION

This report has been prepared by Todoroski Air Sciences on behalf of the NSW EPA. It provides a summary and analysis of the available ambient air quality and meteorological data collected in the Lake Macquarie - Wyong region during May 2015.

2 PROJECT SCOPE

The following outlines the scope of work for this project.

- Provide a monthly report written in plain English to the NSW EPA summarising and analysing available air quality data and meteorological information.
- The report will be published on the EPA's website and will assess the available data from monitoring stations operated by the NSW Office of Environment and Heritage (OEH) at Wyong and Wallsend, and by industry at Wyee, Marks Point, Dora Creek, Wakefield and Teralba.
- The aim is to provide a simplified report that is accessible and contains results that would be clearly understood by the general public.

The work is for the period from September 2013 to June 2015.

3 THE PURPOSE OF AMBIENT MONITORING

It is important to note that the data presented in this report are from both EPA and Industry monitoring sites. The EPA and the industry sites collect data for different purposes and this needs to be understood when comparing the data to the criteria.

EPA monitoring sites are specifically designed to measure the likely levels of pollutants that the general population in the area would experience (i.e. an underlying population exposure level), whereas industry monitoring sites are specifically designed to measure maximum levels in a particular location that may be affected by a particular industry.

Data from EPA sites can be compared with national air quality standards. Where the levels measured at EPA monitoring sites are above the national standards on a prolonged and consistent basis, this indicates that some investigation of the potential cause of the issue may be warranted to determine whether any action on a regional level would reduce or better manage the pollutant levels. In the case of PM_{10}, it is noted that the national standards permit five days annually above the criteria to allow for events such as bushfires and dust storms.

Data from industry monitoring sites can be compared with EPA impact assessment criteria. Where the levels measured at industry monitoring sites are above the impact assessment criteria on a prolonged and consistent basis, this indicates that further investigation is warranted to determine whether industry is responsible, and if so whether action to reduce or better manage the pollutant can be taken.

Whether there is any harmful effect on an individual due to an air pollutant will depend on many additional factors, and not just on the measured level of a pollutant. These factors include the total exposure to the pollutant, individual circumstances (age, health, body mass, levels of pollutants at work), levels of other pollutants in the area, and many other factors.

Where pollutant levels are below the criteria generally, harm would not be expected to occur, but it does not follow that harm automatically occurs when pollutant levels are above the criteria.

The criteria serve to highlight potential issues with the levels of pollutants that may warrant more detailed examination. The criteria may also serve to prioritise action in various areas, for example areas with the highest pollutant levels and highest populations or highest exposure would be expected to receive priority action.

3.1 More about air quality

More information about air quality can be found via the following links:

- The Air Quality Index (AQI) was developed by the NSW EPA as an easily understood means of rating the pollutant level relative to its pollutant criteria.
    - http://www.environment.nsw.gov.au/AQMS/aboutaqi.htm

- Aqicn.org provides a near real-time AQI values for monitoring locations around the world. It should be noted that the AQI presented on this website is calculated differently to the NSW EPA AQI and is less stringent than those used in Australia, thus a direct comparison may not be valid.
    - http://aqicn.org/map/world/

- The NSW OEH website air quality page provides hourly updates of the AQI and data readings from the NSW EPA monitoring sites, and can provide daily forecasts for Sydney and alerts for elevated levels at Wallsend a Wyong, for example. The web tool also presents near real-time wind and pollutant data readings overlaid on regional maps for the Upper Hunter and Newcastle.
    - http://www.environment.nsw.gov.au/aqms/aqi.htm

- The Lower Hunter Particle Characterisation Study aims to determine the composition of particulate samples collected at monitoring sites at Beresfield, Newcastle, Stockton and Mayfield, and to identify the potential major sources of fine particulates in Newcastle and the Lower Hunter. Progress reports are published on the OEH website provided below.
    - http://www.environment.nsw.gov.au/aqms/lowhunterparticle.htm

- The Air Emissions in My Community web tool presents the estimated emission quantities of various substances and their sources by postcode (and larger) sized areas in an easy to use graphical interface. This is one of the best inventories of emissions that is available, but it is important to appreciate that it cannot include all sources of emissions. It is important to also understand that pollutant emissions are not the same as the pollutant levels that this report presents. Emissions in a given area are one of several important factors that affect pollutant levels in an area, for example the dispersion of the emissions in the atmosphere and how the emissions are released are critical in determining the air quality pollutant levels.
    - http://www.epa.nsw.gov.au/air/airemissionsapp/airemissionswebtool.aspx

- The NSW Health website provides information on how air pollution affects health and steps for reducing your air pollution and limiting your exposure.
    - http://www.health.nsw.gov.au/environment/air/Pages/default.aspx

4 AIR QUALITY MONITORING SITES

Figure 4-1 and **Table 4-1** summarise the locations and recorded parameters of the monitoring sites in the Lake Macquarie - Wyong region in May 2015.

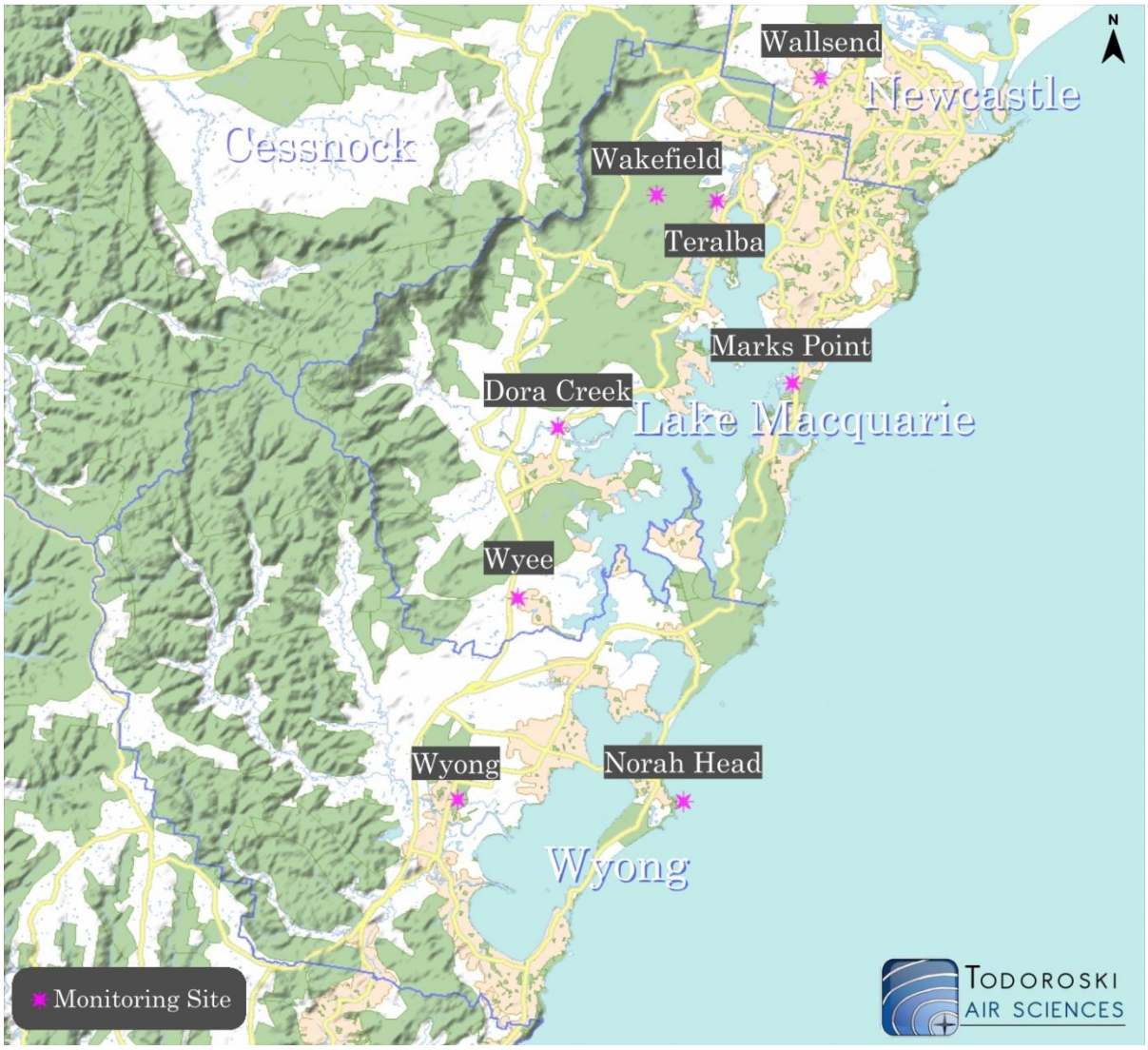


Figure 4-1: Monitoring site locations

Table 4-1: Monitoring sites

Monitoring Station	Type	Recorded Parameters	Recording Periods
Wallsend	NSW EPA site	PM_{10} (TEOM), $PM_{2.5}$, NO_2, SO_2, WS, WD	Hourly/Daily
Wyong	NSW EPA site	PM_{10} (TEOM), $PM_{2.5}$, NO_2, SO_2, WS, WD	Hourly/Daily
Marks Point	Industry site	NO_2, SO_2, WS, WD	Hourly
Wyee	Industry site	$PM_{2.5}$, NO_2, SO_2, WS, WD	Hourly
Dora Creek	Industry site	NO_2, SO_2, WS, WD	Hourly
Norah Head	BOM weather station	WS, WD	Hourly
Wakefield HVAS	Industry site	PM_{10} (HVAS)	Every 6th Day
Teralba HVAS	Industry site	PM_{10} (HVAS)	Every 6th Day

PM_{10} - Particulate matter < 10µm
$PM_{2.5}$ - Particulate matter < 2.5µm
TEOM - Tapered Element Oscillating Microbalance (which samples air continuously)
NO_2 - Nitrogen dioxide
SO_2 - Sulfur dioxide
HVAS - High volume air sampler (which samples for a 24-hour period every 6 days)
WS - Wind speed
WD - Wind direction
BOM - Bureau of Meteorology

5 AIR QUALITY CRITERIA

The sections below identify the key pollutants currently being monitored at the Lake Macquarie - Wyong air quality monitoring sites and the applicable air quality criteria.

5.1 Particulate matter

Particulate matter consists of particles of varying size and composition. The total mass of all particles suspended in air is defined as the Total Suspended Particulate matter (TSP). The upper size range for TSP is nominally taken to be 30 micrometres (µm) as in practice particles larger than 30 to 50µm will settle out of the atmosphere too quickly to be regarded as air pollutants.

The TSP is defined further into two sub-components. They are PM_{10} particles, particulate matter with aerodynamic diameters of 10µm or less, and $PM_{2.5}$, particulate matter with aerodynamic diameters of 2.5µm or less.

Table 5-1 summarises the air quality goals that are relevant to particulate pollutants as outlined in the NSW Environment Protection Agency (EPA) document "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" (**NSW DEC, 2005**).

Table 5-1: EPA air quality impact assessment criteria

Pollutant	Averaging Period	Criterion
Total suspended particulates (TSP)	Annual	90µg/m^3
Particulate Matter < 10µm (PM_{10})	Annual	30µg/m^3
	24-hour	50µg/m^3

Source: **NSW DEC, 2005**

5.1.1 $PM_{2.5}$ concentrations

The NSW EPA currently do not have impact assessment criteria for $PM_{2.5}$ concentrations, however the National Environment Protection Council (NEPC) has released a variation to the National Environment Protection Measure (NEPM) (**NEPC, 2003**) to include advisory reporting standards for $PM_{2.5}$ (see **Table 5-2**). As with the NEPM goals, the advisory reporting standards apply to the average, or general exposure of a population, rather than to "hot spot" locations such as industry monitoring sites.

Table 5-2: Advisory standard for $PM_{2.5}$ concentrations

Pollutant	Averaging Period	Concentration
Particulate Matter < 2.5µm ($PM_{2.5}$)	24-hour	25µg/m^3
	Annual	8µg/m^3

Source: **NEPC, 2003**

5.2 Other air pollutants

Nitrogen dioxide (NO_2) is reddish-brown in colour (at high concentrations) with a characteristic odour and can irritate the lungs and lower resistance to respiratory infections such as influenza. NO_2 belongs to a family of reactive gases called nitrogen oxides (NO_x). These gases form when fuel is burned at high temperatures, and mainly originates from motor vehicles, power generators and industrial boilers (**USEPA, 2013**). NO_x may also be generated by blasting activities. It is important to note that when formed, NO_2 is generally a small fraction of the total NO_x generated.

Sulfur dioxide (SO_2) is a colourless, toxic gas with a pungent and irritating smell. It commonly arises in industrial emissions due to the sulfur content of the fuel. SO_2 can have impacts upon human health

and the habitability of the environment for flora and fauna. SO_2 emissions are a precursor to acid rain, which can be an issue in the northern hemisphere; however it is not known to be an issue in NSW.

Table 5-3 summarises the air quality goals for NO_2 and SO_2.

Table 5-3: Air quality impact assessment criteria for air pollutants

Pollutant	Averaging period	Criterion
Nitrogen Dioxide (NO_2)	1-hour	246µg/m^3
	Annual	62µg/m^3
Sulfur Dioxide (SO_2)	10-minute	712µg/m^3
	1-hour	570µg/m^3
	24-hour	228µg/m^3
	Annual	60µg/m^3

Source: **NSW DEC, 2005**

5.3 Summary of applicable criteria for this assessment

The particulate and gaseous pollutants monitored in the Lake Macquarie – Wyong region have air quality criteria which are averaged over short and long time periods. Annually averaged criteria require a full year of data.

As this report only looks at one month of ambient air quality data, the annual average criteria are not applicable. The SO_2 10-minute average criterion was not included as 10-minute monitoring data are not available. Therefore the criteria relevant to this assessment are those averaged over the shorter time periods (1-hour and 24-hours).

Table 5-4 summarises the applicable air quality criteria for this assessment.

Table 5-4: Air quality impact assessment criteria used in this assessment

Pollutant	Averaging Period	Type	Concentration
Particulate Matter < 10µm (PM_{10})	24-hour	Criterion	50µg/m^3
Particulate Matter < 2.5µm ($PM_{2.5}$)	24-hour	Advisory Reporting Standard	25µg/m^3
Nitrogen Dioxide (NO_2)	1-hour	Criterion	246µg/m^3
Sulfur Dioxide (SO_2)	1-hour	Criterion	570µg/m^3
	24-hour	Criterion	228µg/m^3

6 METEOROLOGICAL MONITORING DATA

Representative wind speed and direction data have been obtained from the Lake Macquarie - Wyong air quality monitoring stations. The data are presented as a series windroses. For an example of how to read a windrose, refer to **Figure A-1** in **Appendix A**.

Figure 6-1 presents the May 2015 windroses for Wallsend, Dora Creek, Marks Point, Wyee, Norah Head and Wyong.

The figure shows that the meteorological stations recorded winds which varied depending on the local influence of environmental features such as terrain, vegetation and buildings. Overall the stations recorded variable winds which typically originated from the north-westerly to south-westerly directions.

The Norah Head weather station recorded wind speeds which were generally higher than those recorded at the other stations. This is expected as the Norah Head weather station is located in an unsheltered coastal location that would be largely influenced by sea breezes.

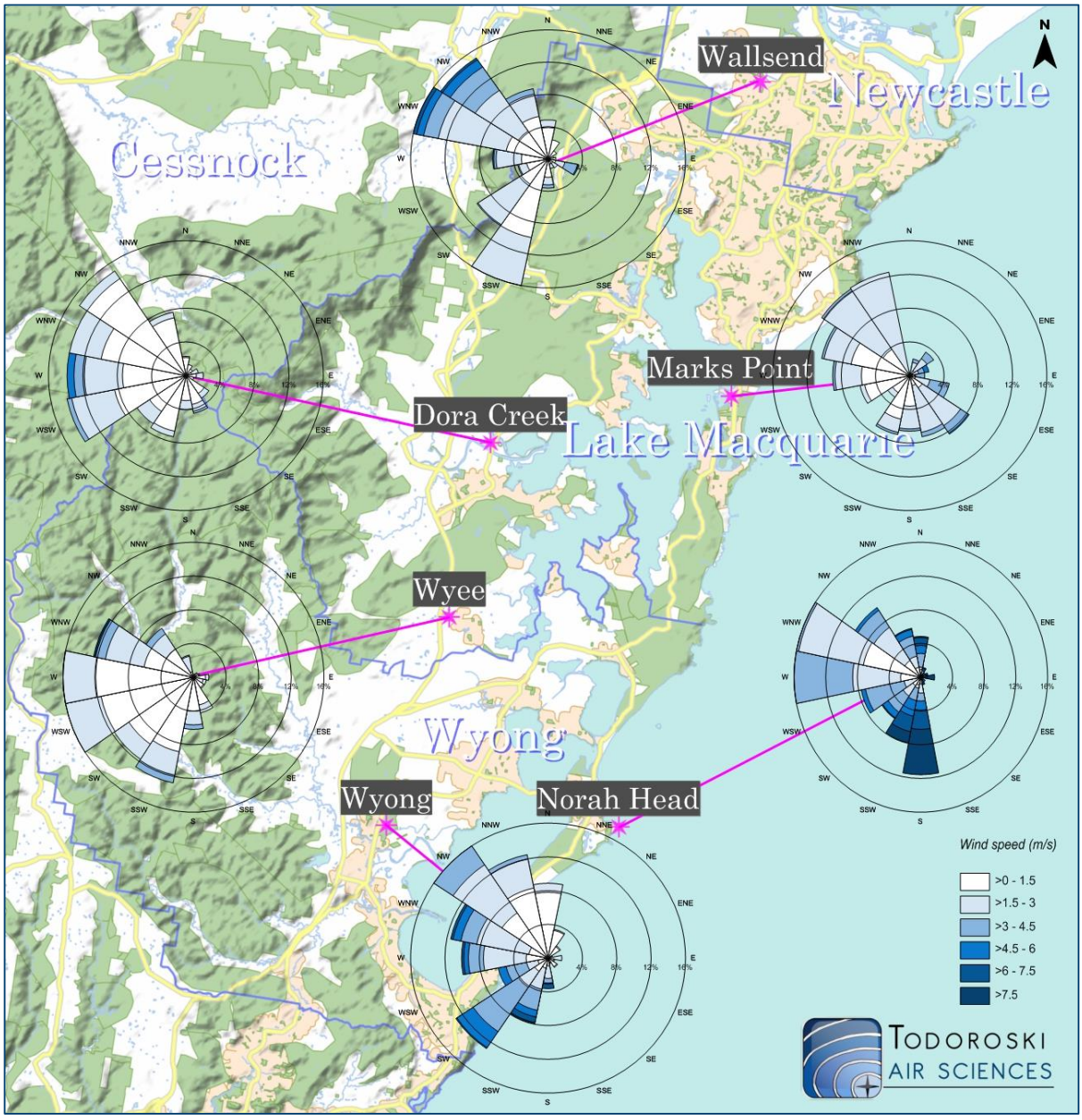


Figure 6-1: May windroses – Wallsend, Dora Creek, Marks Point, Wyee, Norah Head and Wyong

The meteorological stations recorded variable winds which typically originated from the north-westerly to south south-westerly directions in May 2015.

7 AMBIENT AIR QUALITY MONITORING DATA

7.1 Preamble

The monitoring data in this report are presented in raw form as provided to Todoroski Air Sciences by the NSW EPA.

The 24-hour average data presented in this report have been averaged using the 1-hour average readings. Days which contain less than 75% data (less than 18 hours of 1-hour average data) have not been included in this report.

The $PM_{2.5}$ monitoring data recorded at the Wyee monitoring station are currently undergoing a full quality assurance analysis. The Wyee $PM_{2.5}$ data presented in this report may therefore be subject to revision.

All of the monitoring data provided to Todoroski Air Sciences are presented in this report. The data are shown in the results and appendices as relevant. Hourly data are presented in a graphical format in **Appendix B** and 24-hour average data are presented in tabulated format in **Appendix C**.

7.2 Analysis of Monitoring Data

Table 7-1 presents a summary of the maximum pollutant levels measured during May 2015. The results indicate the Wallsend and Wyong TEOMs recorded a PM_{10} level above the criterion of 50µg/m^3. The ambient air concentrations recorded by all other monitors were below the relevant criteria during May.

Table 7-1: Maximum pollutant levels - May 2015

Site	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	SO_2 (µg/m^3)
	24-hour average	24-hour average	24-hour average	1-hour average	1-hour average
	Air Quality Impact Criteria				
	50	25*	228	246	570
Wallsend	**77.5**	13.8	14.3	47.0	88.6
Wyong	**58.6**	7.8	5.0	50.9	18.9
Dora Creek	-	-	3.4	93.8	5.7
Marks Point	-	-	10.6	52.1	76.1
Wyee	-	6.1	7.2	39.6	20.1
Wakefield HVAS	11.1	-	-	-	-
Teralba HVAS	14.0	-	-	-	-

* Advisory reporting standard for $PM_{2.5}$ concentrations (refer to Section 5.1)

- Not applicable

7.3 PM_{10}

Figure 7-1 presents all of the 24-hour average PM_{10} monitoring results recorded in the Lake Macquarie - Wyong region in May 2015.

Relative to the Air Quality Index, as shown by the coloured bands in the figure, PM_{10} levels were generally very good at all monitors for May 2015. The Wallsend monitor recorded good levels 32% of the time and the Wyong monitor recorded good levels 3% of the time. The Wallsend and Wyong monitors each recorded one day of very poor and poor levels respectively.

The Wallsend and Wyong monitors each recorded 24-hour average PM_{10} levels over the criterion level of 50µg/m^3 on 6 May 2015. All other data recorded at the Lake Macquarie - Wyong monitoring sites were below the PM_{10} criterion level in May.

Figure B-1 to **Figure B-2** in **Appendix B** present the 1-hour average PM_{10} data in graphical form for each individual site. There is no criterion that applies to 1-hour average PM_{10} levels and these 1-hour results are not intended to be compared with the PM_{10} criterion. It is a normal occurrence, and it is expected that in the normal environment 1-hour average PM_{10} levels will fluctuate more significantly than 24-hour average PM_{10} levels.

7.4 $PM_{2.5}$

Figure 7-2 presents all of the 24-hour average $PM_{2.5}$ monitoring data recorded in the Lake Macquarie - Wyong region in May 2015.

Relative to the Air Quality Index, as shown by the coloured bands in the figure, the data indicate that $PM_{2.5}$ levels were generally very good at all monitors at all times with the exception of the Wallsend monitor which recorded good levels 26% of the time.

All data recorded at the Lake Macquarie - Wyong monitoring sites were below the 24-hour average $PM_{2.5}$ advisory reporting standard of 25µg/m^3 in May 2015.

Figure B-3 to **Figure B-5** in **Appendix B** present the 1-hour average $PM_{2.5}$ data in graphical form for each individual site. There is no criterion that applies to 1-hour average $PM_{2.5}$ levels and these 1-hour results are not intended to be compared with the $PM_{2.5}$ advisory reporting standard. It is a normal occurrence, and it is expected that in the normal environment 1-hour average $PM_{2.5}$ levels will fluctuate more significantly than 24-hour average $PM_{2.5}$ levels.

We note the Wyee monitoring site, and to a lesser extent the Wallsend and Wyong sites, on occasion recorded periods in which $PM_{2.5}$ levels were less than zero. In some situations the concentration of the pollutant being measured may be very close to zero, in which case the measured value (after adjusting for drift of zero and span and any other corrections) may be less than the measurement limit of detection (**NEPC, 2001**), and in these circumstances the output may be negative.

The monitors may also record short term positive or negative values due to instrument faults, the presence of moisture within the instrument or volatile matter (which can register as a solid mass at first, but then evaporates, registering negative mass at a later time).

7.5 Nitrogen dioxide NO_2

Figure 7-3 presents the 1-hour average NO_2 monitoring data recorded in the Lake Macquarie - Wyong region in May 2015.

Relative to the Air Quality Index, as shown by the coloured bands in the figure, the data indicate the NO_2 levels were very good at all monitors at all times with the exception of the Dora Creek monitor which recorded good levels approximately 1% of the time

All data were below the applicable criterion on all days.

7.6 Sulfur dioxide SO_2

Figure 7-4 presents the 1-hour average SO_2 monitoring data recorded in the Lake Macquarie - Wyong region in May 2015.

Relative to the Air Quality Index, as shown by the coloured bands in the figure, the data indicate the SO_2 levels were very good all of the time at all of the monitors.

All data were below the applicable criterion on all days.

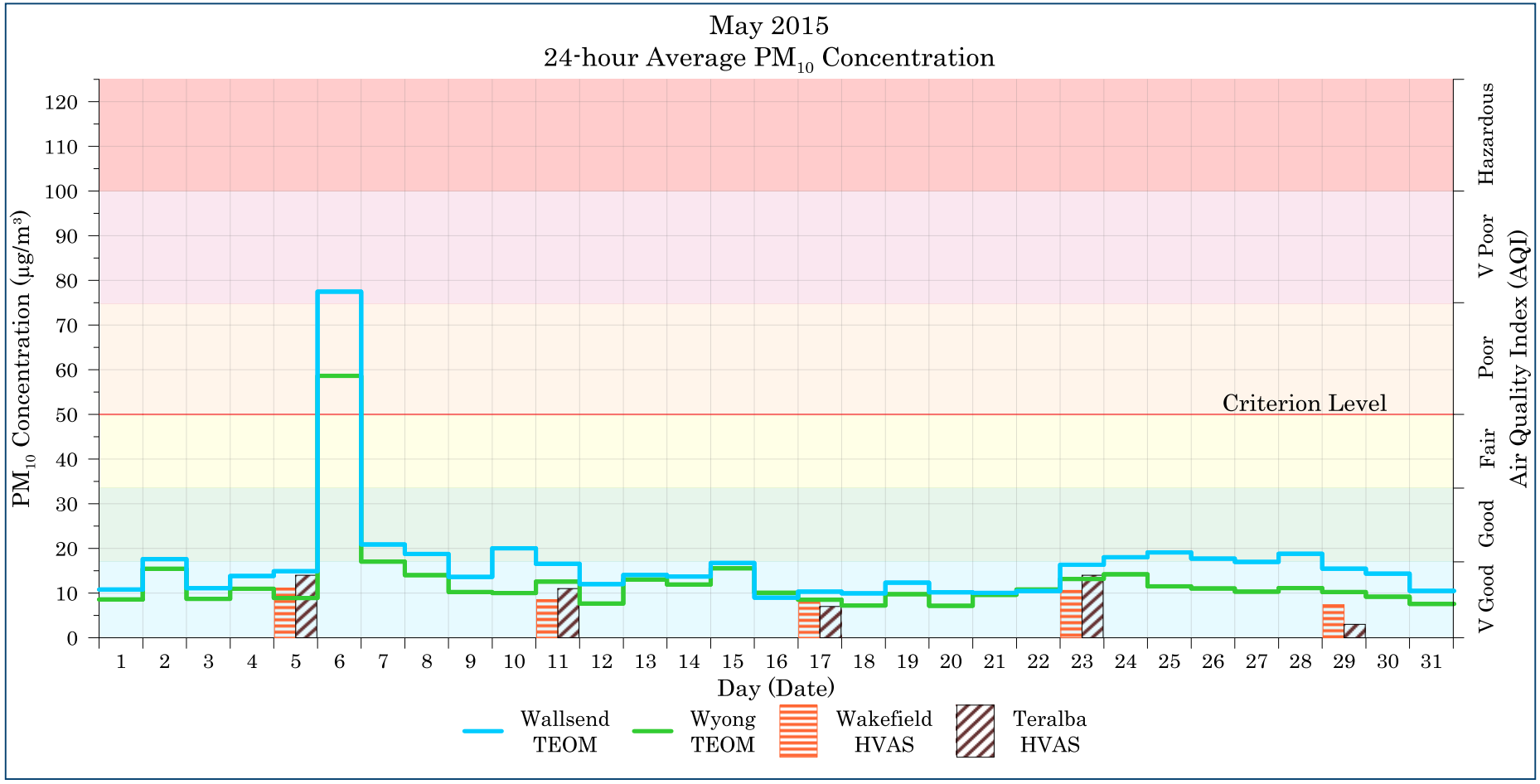


Figure 7-1: Lake Macquarie - Wyong 24-hour average PM_{10} levels – May 2015

PM_{10} levels were generally very good at all monitors for May 2015. The Wallsend monitor recorded good levels 32% of the time and the Wyong monitor recorded good levels 3% of the time. The Wallsend and Wyong monitors recorded one day of very poor and poor levels respectively. All other data recorded at the Lake Macquarie - Wyong monitoring sites were below the 24-hour average criterion of 50µg/m³.

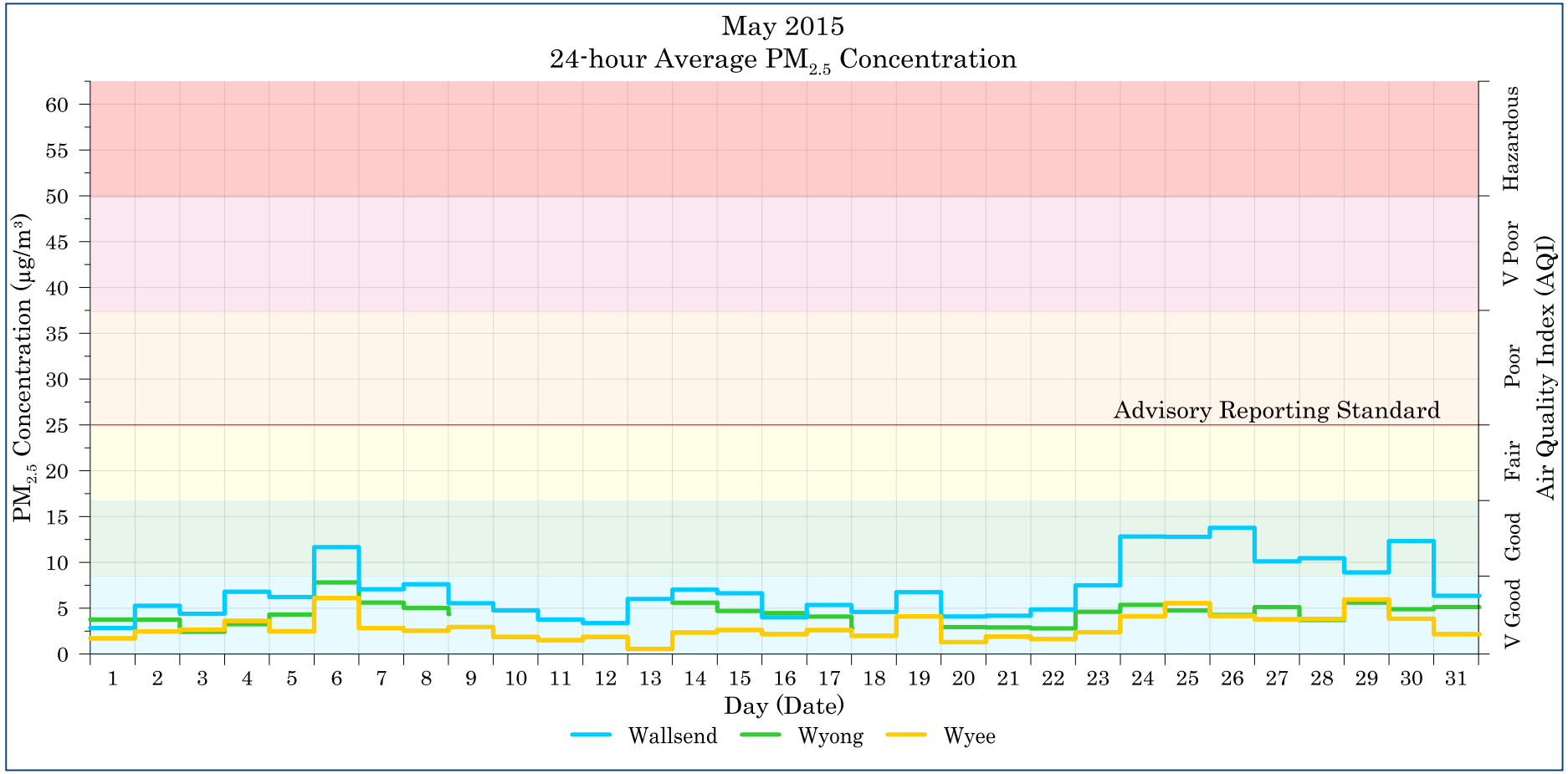


Figure 7-2: Lake Macquarie - Wyong 24-hour average $PM_{2.5}$ levels – May 2015

$PM_{2.5}$ levels were generally very good at all monitors at all times with the exception of the Wallsend monitor which recorded good levels 26% of the time. All data recorded at the Lake Macquarie - Wyong monitoring sites were below the 24-hour average $PM_{2.5}$ advisory reporting standard of 25µg/m^3.

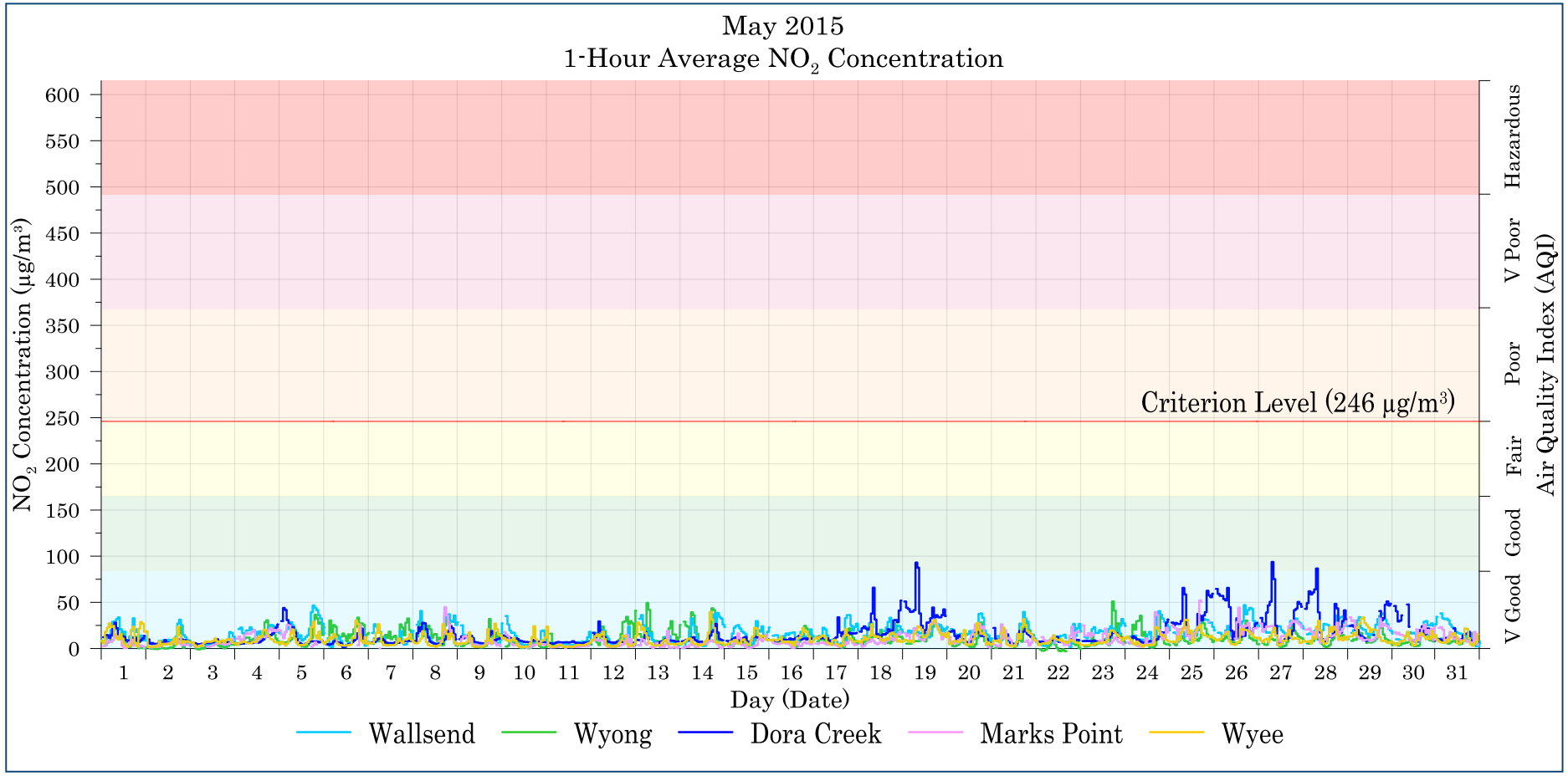


Figure 7-3: Lake Macquarie - Wyong 1-hour average NO_2 levels – May 2015

All data recorded at the Lake Macquarie - Wyong monitoring sites were below the 1-hour average NO_2 criterion level of 246µg/m^3 in May 2015. Measured levels of NO_2 were very good at all monitors at all times with the exception of the Dora Creek monitor which recorded good levels approximately 1% of the time..

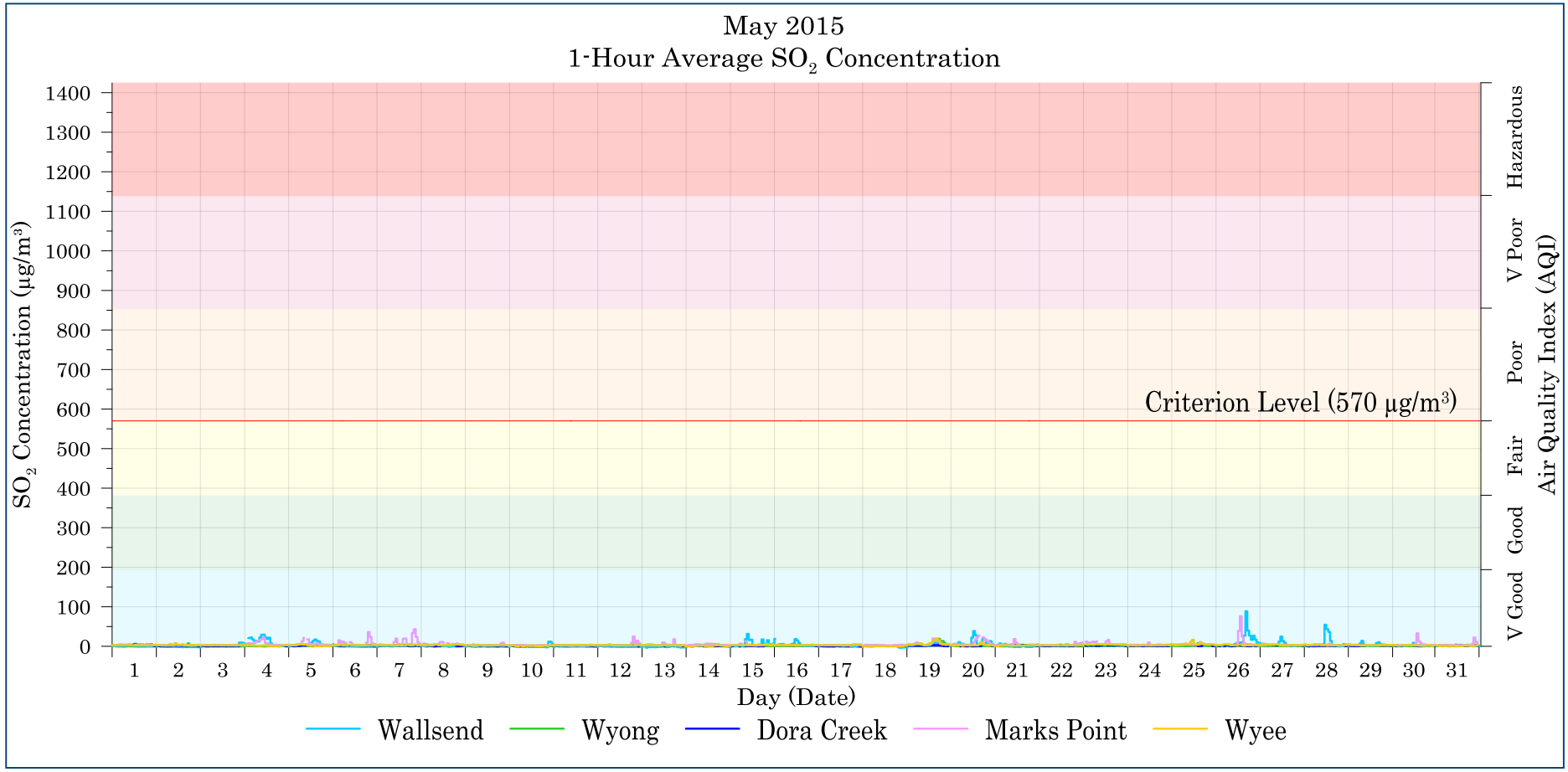


Figure 7-4: Lake Macquarie - Wyong 1-hour average SO_2 levels – May 2015

All data recorded at the Lake Macquarie - Wyong monitoring sites were below the 1-hour average SO_2 criterion level of 570µg/m^3 in May 2015. Measured levels of SO_2 were very good at all monitors at all times.

8 ANALYSIS OF ELEVATED POLLUTANT LEVELS

8.1 Wallsend and Wyong TEOM monitors - 6 May 2015

- 24-hour average PM_{10} level of 77.5µg/m^3 - Wallsend
- 24-hour average PM_{10} level of 58.6µg/m^3 - Wyong

Figure 8-1 presents a plot of the 1-hour average PM_{10}, wind speed and wind direction data recorded at Wallsend on 6 May 2015. The 1-hour average PM_{10} levels recorded at Wyong have also been included.

The data presented in **Figure 8-1** show that the Wallsend monitor recorded elevated PM_{10} levels during periods of low wind speeds from the west. The Wallsend and Wyong monitors recorded similar trends in PM_{10} levels on 6 May, with elevated PM_{10} levels from approximately 2am to 6pm.

Further investigation identified that on 6 May 2015, a wide area of NSW was affected by a large dust storm which originated in the Victorian Mallee and the southwest of NSW. A NSW OEH media release (**NSW OEH, 2015**) on 6 May stated that this was a natural event which occurred at a time when cultivation was underway for winter crops. A cold front caused the dust to be whipped up and carried east and north.

A summary of all of the 24-hour average PM_{10} data recorded at the NSW OEH air quality monitors located across NSW has been presented in **Table 8-1**. The results indicate that elevated PM_{10} levels were widespread across NSW on 6 May.

It is very likely that elevated PM_{10} levels recorded at Wallsend and Wyong on 6 May were caused by the dust storm which impacted a large area of NSW.

Table 8-1: NSW EPA PM_{10} air quality monitoring data for 5 and 6 May 2015

Region	Monitor	5 May 2015	6 May 2015	Region	Monitor	5 May 2015	6 May 2015
Sydney central-east	Randwick	24.9	**77.4**	Central coast	Wyong	8.9	**58.6**
	Rozelle	19.5	**60.3**	Lower Hunter/ Newcastle Region	Wallsend	14.9	**77.5**
	Lindfield	16	**56.4**		Carrington	17.9	**80.6**
	Liverpool	33.6	**68.6**		Stockton	33.1	**96.9**
	Chullora	23.2	**64.6**		Newcastle	15.1	**70.4**
	Earlwood	23.6	**66.5**		Mayfield	13.8	**84.7**
Sydney north-west	Richmond	18	49.3		Beresfield	12.1	**64.9**
	St Marys	22.2	**53**	Upper Hunter	Muswellbrook	10.7	**72.6**
	Vineyard	16.5	**59**		Singleton	17.2	**85.3**
	Prospect	23.5	**68.7**		Maison Dieu	16.4	**77.3**
Sydney south-west	Bargo	38.6	**52.2**		Camberwell	18.7	**86.7**
	Bringelly	26.9	**57**		Singleton Northwest	21.3	**84**
	Campbelltown	33.5	**69.7**		Mount Thorley	15.2	**85.2**
	Camden	29.3	**62.4**		Bulga	10.1	**60.6**
	Oakdale	34.5	**61.7**		Muswellbrook Northwest	10.4	**72.9**
Illawarra	Wollongong	33.6	45.8		Wybong	8.3	**79.5**
	Kembla Grange	38.7	47.4		Aberdeen	8.5	**64.8**
	Albion Park South	38.6	37.8		Singleton South	15.1	**82.5**
North-west slopes	Tamworth	13.4	**52.7**		Jerrys Plains	7.6	**70**
Central tablelands	Bathurst	40.9	**94.6**		Warkworth	10	**68.2**
South-west slopes	Albury	**92.5**	24.5		Merriwa	7.2	**83**
	Wagga Wagga North	**145.1**	**74.3**				

Source: **OEH, 2015**

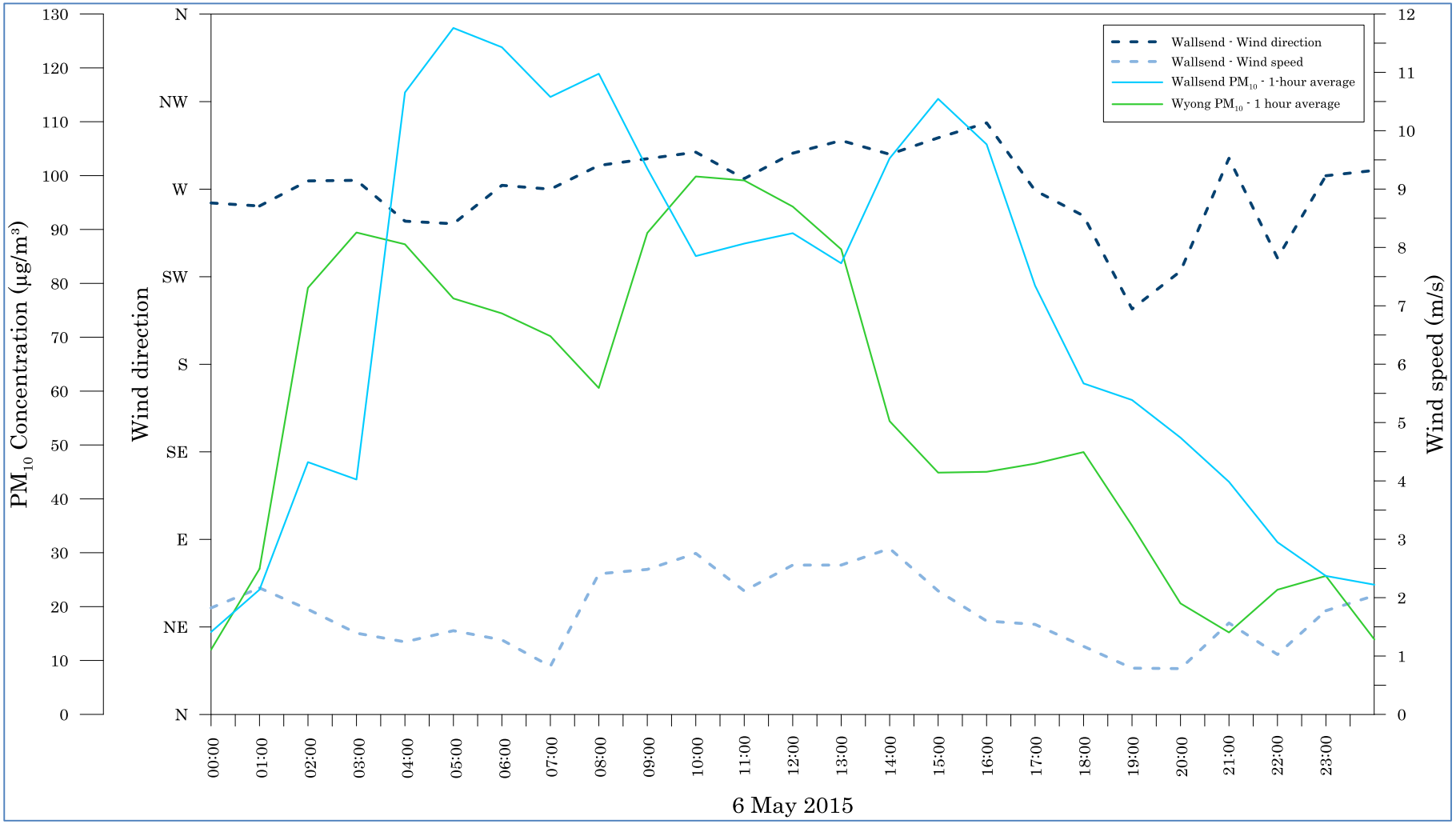


Figure 8-1: Analysis of elevated PM_{10} levels on 6 May 2015 - Wallsend and Wyong

The Wallsend monitor recorded elevated PM_{10} levels during periods of relatively low wind speeds from the west. The Wallsend and Wyong monitors recorded similar trends in PM_{10} levels on 6 May, with elevated PM_{10} levels from approximately 2am to 6pm. This indicates that the dust originated from the west.

9 CONCLUSIONS

The results indicate that the monitoring stations recorded very good air quality for the majority of May 2015.

The Wallsend and Wyong TEOM monitors recorded 24-hour average levels above the criterion of 50µg/m^3 on 6 May 2015. These elevated levels were very likely caused by a dust storm which led to levels above the criteria at almost all of the monitoring locations in NSW.

Relative to the Air Quality Index:

- The measured levels of NO_2 were very good to good at all monitors at all times;
- The measured levels of SO_2 were very good at all monitors at all times;
- The measured levels of $PM_{2.5}$ were very good to good at all times for all locations; and,
- The measured PM_{10} levels were generally very good to good at all locations. The Wallsend and Wyong monitors recorded very poor and poor levels respectively on 6 May.

On this basis it can be concluded that the air quality in the Lake Macquarie - Wyong region was generally very good in May 2015.

10 REFERENCES

NEPC (2001)

"National Environment Protection (Ambient Air Quality) Measure Technical Paper No. 5 Data Collection and Handling", National Environment Protection Council, May 2001.

NEPC (2003)

"Variation to the National Environment Protection (Ambient Air Quality) Measure for Particles as $PM_{2.5}$", National Environment Protection Council, May 2003.

NSW DEC (2005)

"Approved Methods for the Modelling and Assessment of Air Pollutants in NSW", Department of Environment and Conservation (NSW), August 2005.

NSW OEH (2015)

Mallee dust storm blankets NSW, Office of Environment & Heritage website. <http://www.environment.nsw.gov.au/media/OEHmedia15050602.htm>

NSW OEH (2015)

Air quality data NSW, Office of Environment & Heritage website. <www.environment.nsw.gov.au/AQMS/search.htm>

USEPA (2013)

Health Effects of Pollution, United States Environmental Protection Agency website. <http://www.epa.gov/region07/air/quality/health.htm>, accessed May 2013.

Appendix A

How to read a windrose

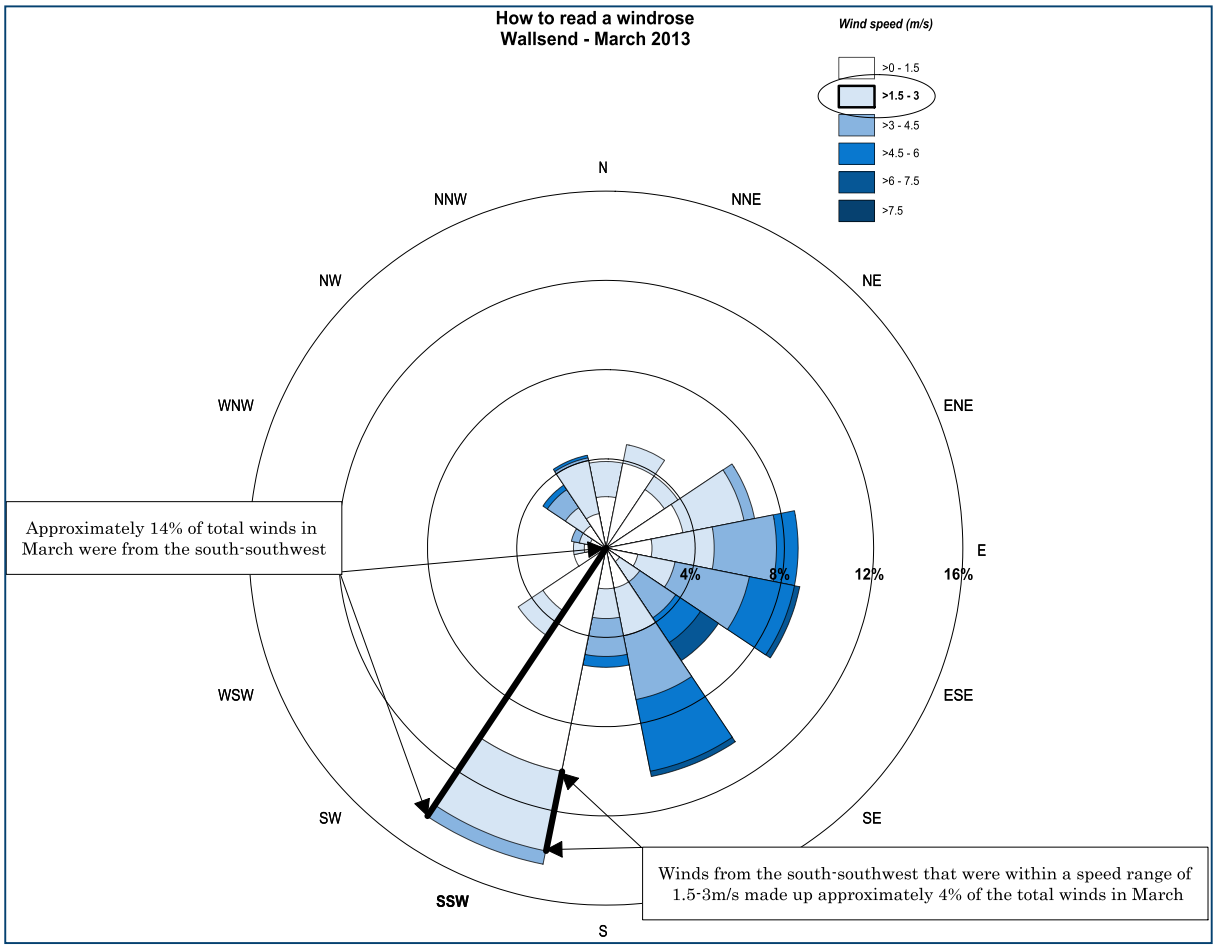


Figure A-1: How to read a windrose

Appendix B

Monitoring Data (Graphical)

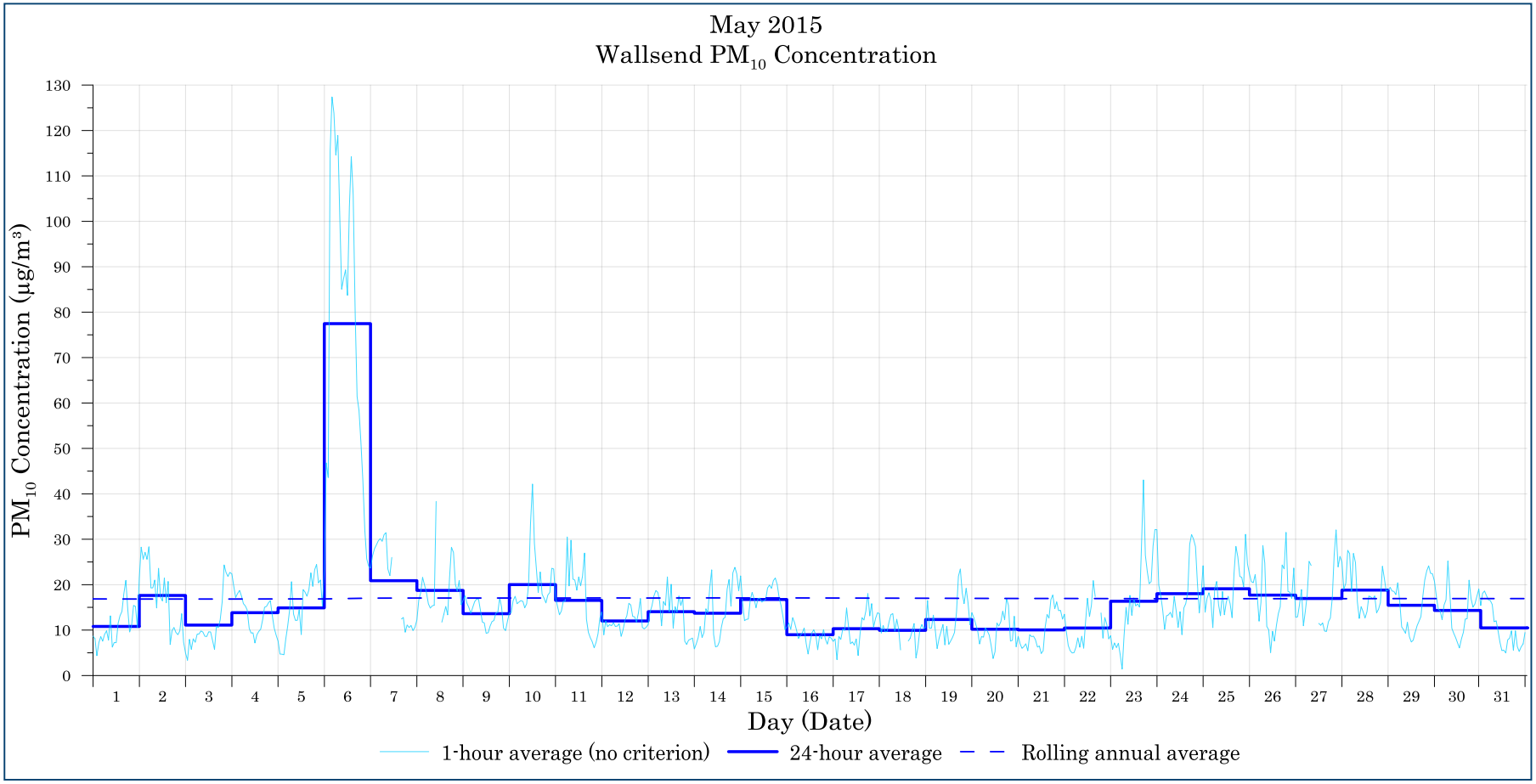


Figure B-1: Wallsend PM_{10} concentration - May

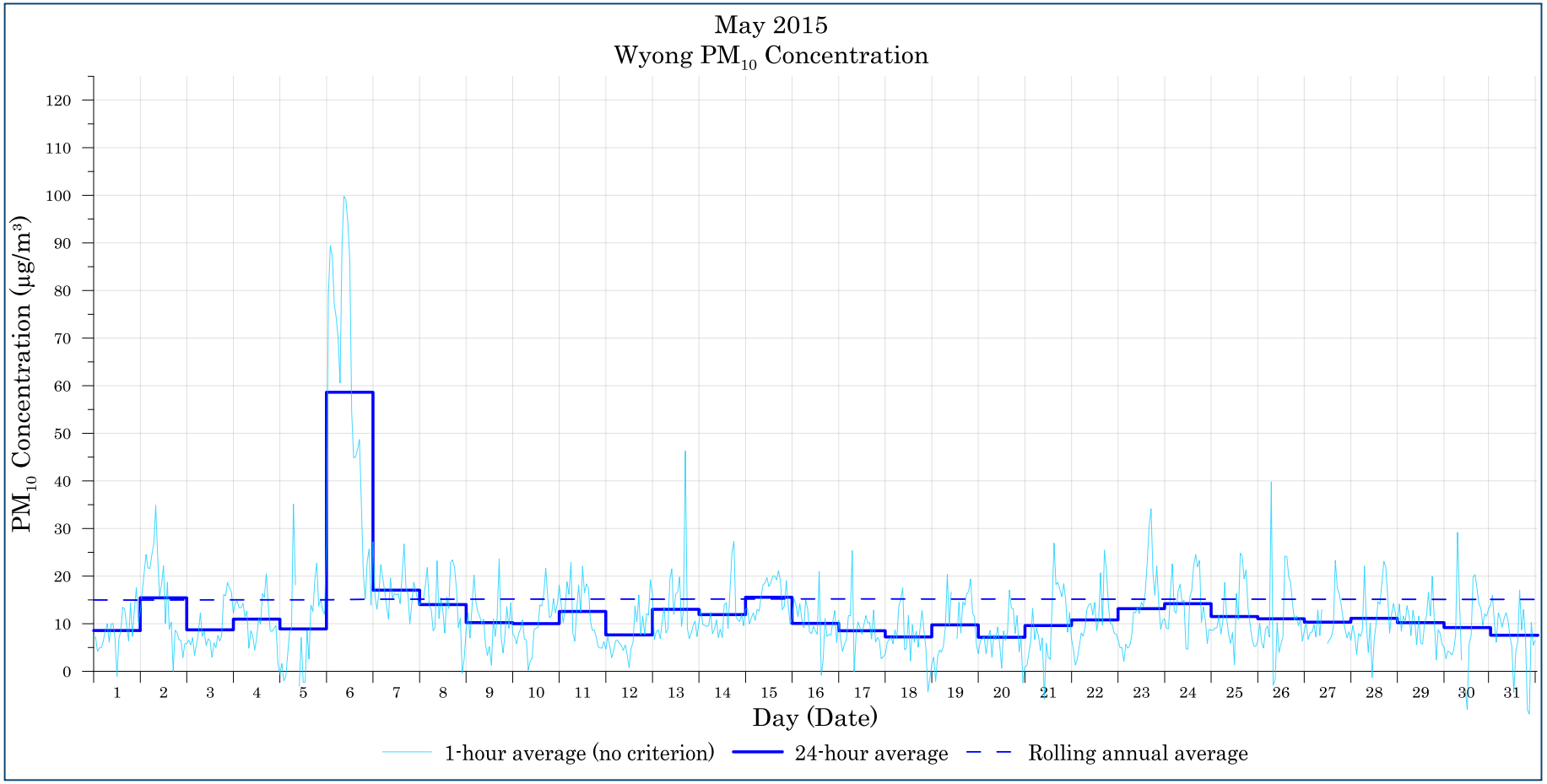


Figure B-2: Wyong PM_{10} concentration - May

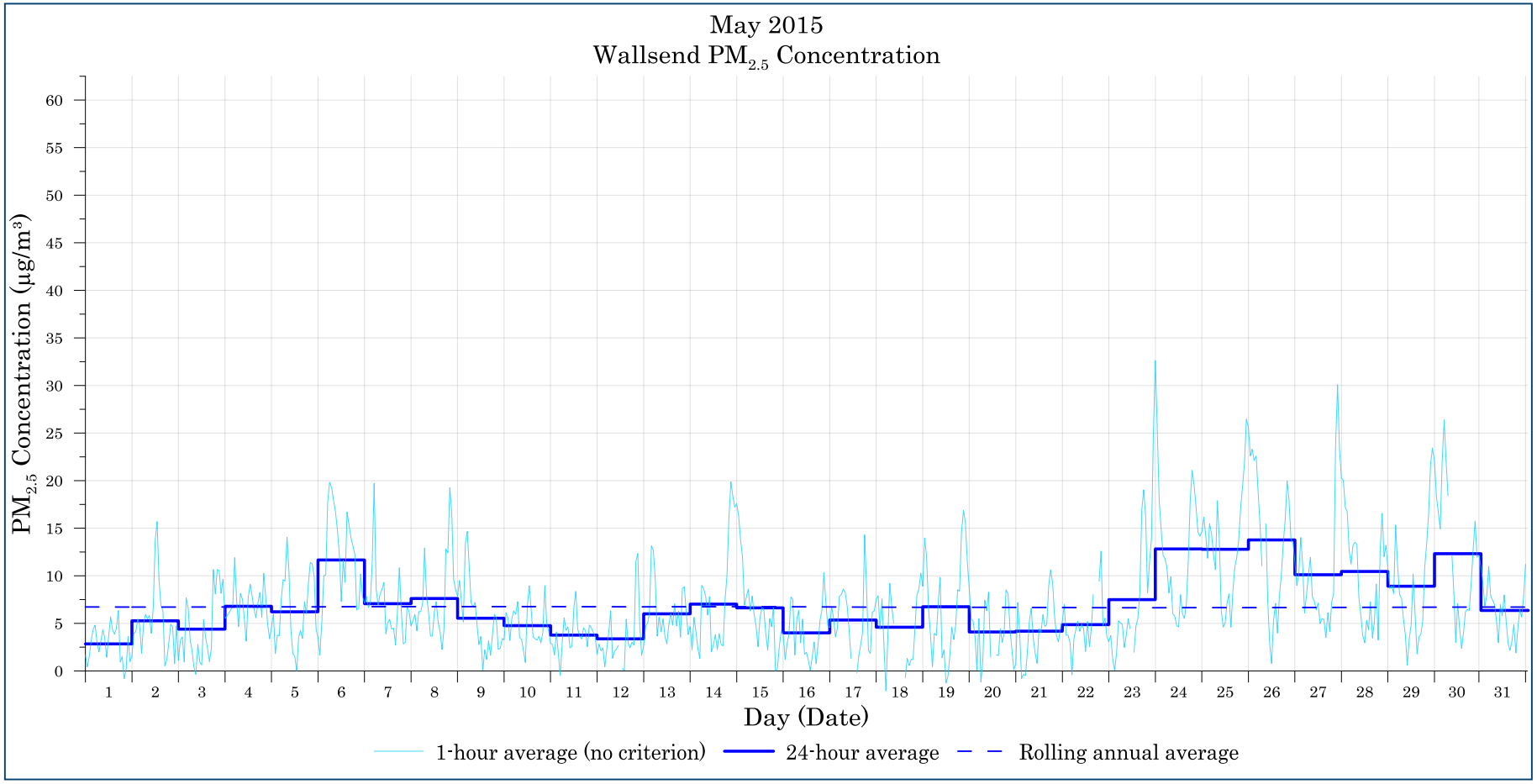


Figure B-3: Wallsend $PM_{2.5}$ concentration - May

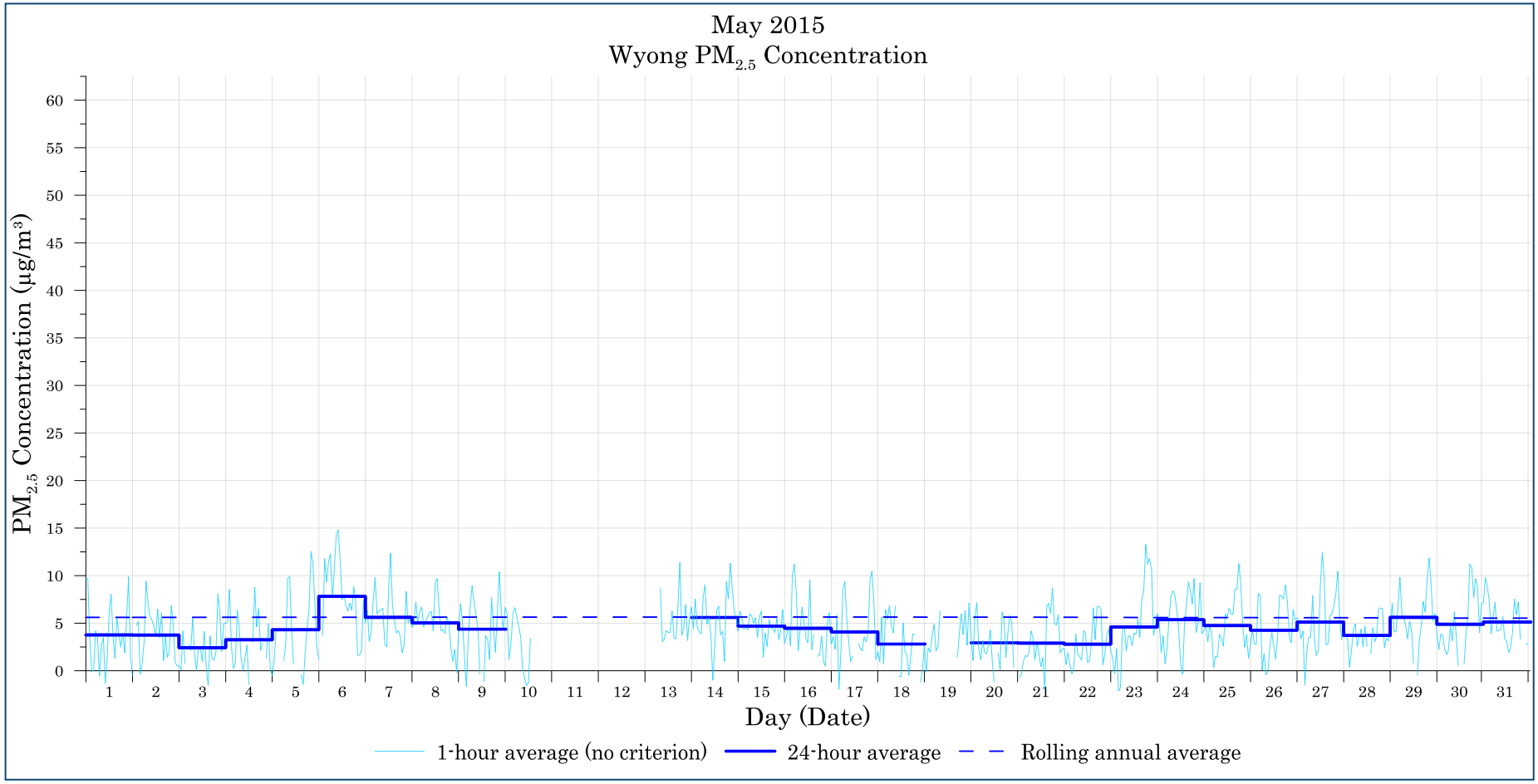


Figure B-4: Wyong $PM_{2.5}$ concentration - May

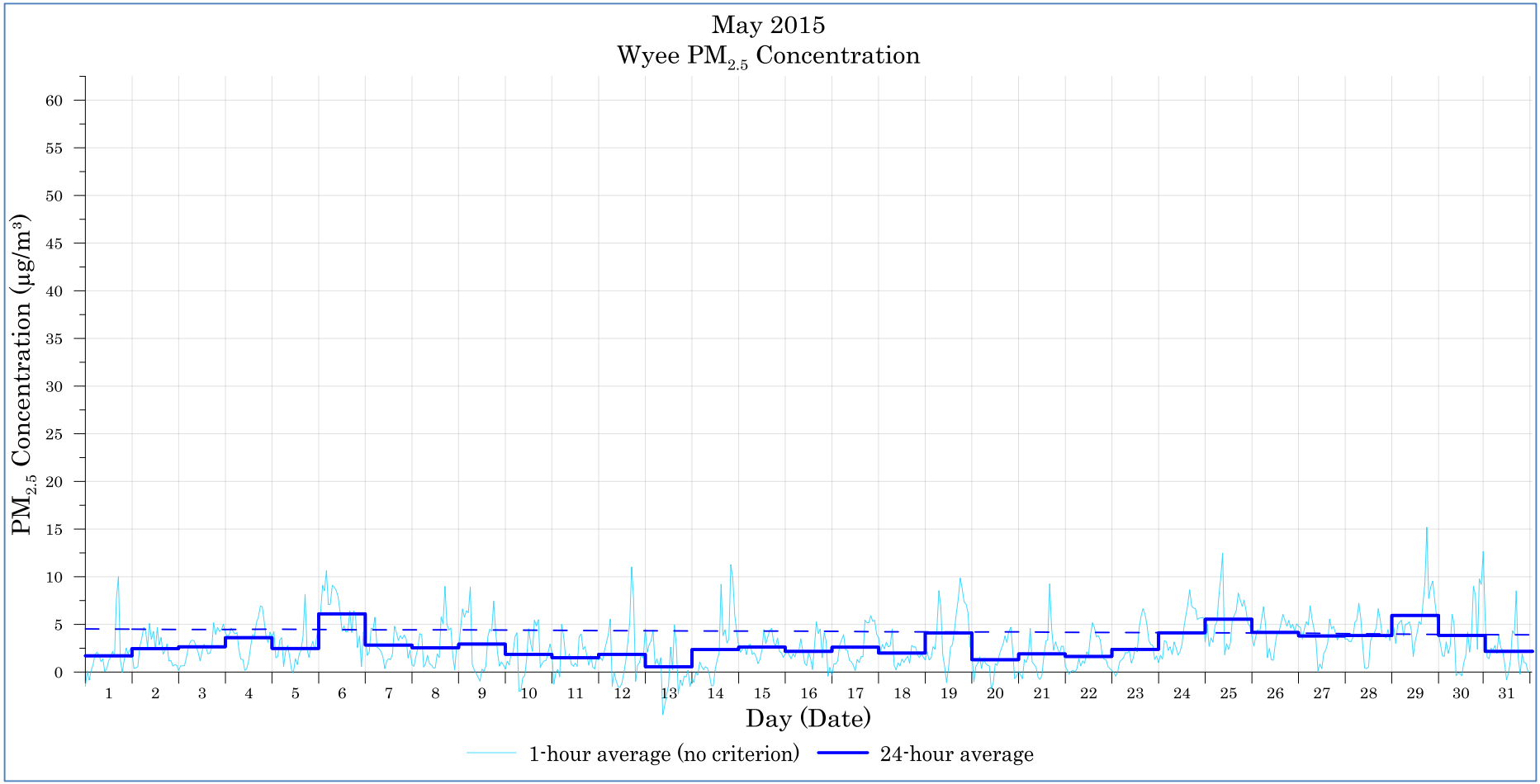


Figure B-5: Wyee $PM_{2.5}$ concentration - May

Appendix C

Monitoring Data (Tabulated)

Table C-1: May 24-hour average monitoring data

Date	PM_{10} (µg/m³)		$PM_{2.5}$ (µg/m³)			SO_2 (µg/m³)				
	Wallsend	Wyong	Wallsend	Wyong	Wyee	Wallsend	Wyong	Dora Creek	Marks Point	Wyee
1/05/2015	10.8	8.6	2.8	3.8	1.7	1.4	-0.5	3.4	3.6	2.7
2/05/2015	17.6	15.4	5.3	3.8	2.5	-1.4	0.2	1.6	3.2	3.5
3/05/2015	11.1	8.7	4.4	2.4	2.6	1.5	-0.5	0.9	3.4	2.8
4/05/2015	13.8	11.0	6.8	3.3	3.6	11.6	0.2	-	7.7	1.8
5/05/2015	14.9	8.9	6.2	4.3	2.5	4.6	0.8	1.9	6.3	2.2
6/05/2015	77.5	58.6	11.7	7.8	6.1	-0.3	1.6	2.1	8.1	2.8
7/05/2015	20.9	17.1	7.1	5.6	2.8	0.3	1.7	1.8	10.6	2.8
8/05/2015	18.8	14.0	7.6	5.0	2.5	0.3	1.4	-	5.7	3.4
9/05/2015	13.6	10.2	5.5	4.4	2.9	-0.7	0.6	2.0	3.6	2.5
10/05/2015	20.0	10.0	4.8	-	1.9	0.1	0.3	-	2.9	1.4
11/05/2015	16.6	12.6	3.8	-	1.5	-0.9	0.3	2.1	2.3	3.0
12/05/2015	12.0	7.7	3.4	-	1.9	-1.0	0.9	2.7	4.9	2.8
13/05/2015	14.1	13.0	6.0	-	0.6	-1.4	0.7	-	4.4	2.8
14/05/2015	13.7	11.9	7.0	5.6	2.4	0.9	0.4	1.4	4.3	1.2
15/05/2015	16.7	15.6	6.6	4.7	2.6	6.2	0.2	-	4.1	3.1
16/05/2015	9.0	10.1	4.0	4.5	2.2	4.7	0.6	2.3	3.3	2.8
17/05/2015	10.3	8.5	5.3	4.1	2.6	-0.8	0.4	0.8	3.0	3.1
18/05/2015	9.9	7.2	4.6	2.8	2.0	-0.6	0.5	0.8	3.1	0.2
19/05/2015	12.3	9.8	6.7	-	4.1	2.4	5.0	1.7	6.5	7.2
20/05/2015	10.2	7.1	4.1	2.9	1.3	9.5	0.3	-	9.3	3.1
21/05/2015	10.0	9.6	4.2	2.9	1.9	0.8	0.3	2.8	5.3	2.1
22/05/2015	10.5	10.8	4.9	2.8	1.6	-	0.1	1.5	4.2	2.6
23/05/2015	16.3	13.2	7.5	4.6	2.4	-	0.6	2.2	7.2	4.9
24/05/2015	18.0	14.2	12.8	5.4	4.1	-	0.9	0.9	3.9	2.7
25/05/2015	19.1	11.5	12.8	4.7	5.5	-	2.0	-	4.9	5.9
26/05/2015	17.7	11.0	13.8	4.3	4.2	14.3	0.8	1.5	-	3.2
27/05/2015	17.0	10.3	10.1	5.1	3.8	4.5	0.4	2.5	4.0	3.1
28/05/2015	18.8	11.1	10.5	3.7	3.8	7.8	0.7	1.0	3.5	3.3
29/05/2015	15.5	10.2	8.9	5.6	5.9	3.8	0.9	1.6	3.2	3.1
30/05/2015	14.3	9.2	12.3	4.9	3.8	1.6	0.4	-	5.4	2.3
31/05/2015	10.5	7.6	6.4	5.1	2.2	1.5	0.5	2.6	4.6	1.1

- Not applicable

Table C-2: May 24-hour average HVAS monitoring data

Date	PM_{10} (HVAS) (µg/m³)	
	Wakefield (Westside)	Teralba
5/05/2015	11.1	14.0
11/05/2015	8.5	11.0
17/05/2015	8.4	7.0
23/05/2015	10.6	14.0
29/05/2015	7.4	3.0

- Not applicable