TODOROSKI AIR SCIENCES

LOWER HUNTER AIR QUALITY REVIEW OF AMBIENT AIR QUALITY DATA

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Lower Hunter Air Quality Review of Ambient Air Quality Data

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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 Lower Hunter region for the month of November 2013. The results indicate that the air quality was generally good in the Lower Hunter Region during November.

The data summary (shown below) indicates that in November 2013, Newcastle and Fullerton St Stockton recorded 24-hour average PM_{10} levels above the criterion of 50µg/m^3. Wallsend and Fullerton St Stockton also recorded 24-hour average $PM_{2.5}$ levels above the advisory reporting standard of 25µg/m^3. All other data recorded in November were below the applicable criteria. Further details are provided in the report. The full data are provided in the Appendices.

Lower Hunter Air Quality Pictorial Summary - November 2013

Lower Hunter Air Quality Tabular Summary - November 2013

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)	NH_3 (ppm)
	24-hour average	24-hour average	24-hour average	1-hour average	1-hour average	1-hour average
	Air Quality Impact Criteria					
	50	25*	228	246	570	0.46
Wallsend	✓	×	✓	✓	✓	-
Newcastle	×	-	✓	✓	✓	-
Beresfield	✓	✓	✓	✓	✓	-
Fullerton St Stockton	×	×	-	✓	-	✓
Roxburgh St Stockton	-	-	-	✓	-	-
Fullerton St Stockton HVAS	✓	-	-	-	-	-
Steel River HVAS	✓	-	-	-	-	-
Mayfield 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 Lower Hunter region during November 2013.

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 recorded at: Beresfield, Wallsend, Newcastle, Mayfield, Steel River and Stockton.
- 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 of ten months from September 2013 to June 2014.

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.

The EPA monitoring sites are specifically designed to measure the likely levels of pollutants that the general population in the area would experience, whereas industry monitoring sites are specifically designed to measure the maximum pollutant levels that may occur due to a particular industry.

Data from the EPA sites can be compared with national air quality standards. Where the levels measured at the 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 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.

4 AIR QUALITY MONITORING SITES

Figure 4-1 and **Table 4-1** summarise the locations and recorded parameters of the air quality monitoring sites in the Lower Hunter in November 2013.

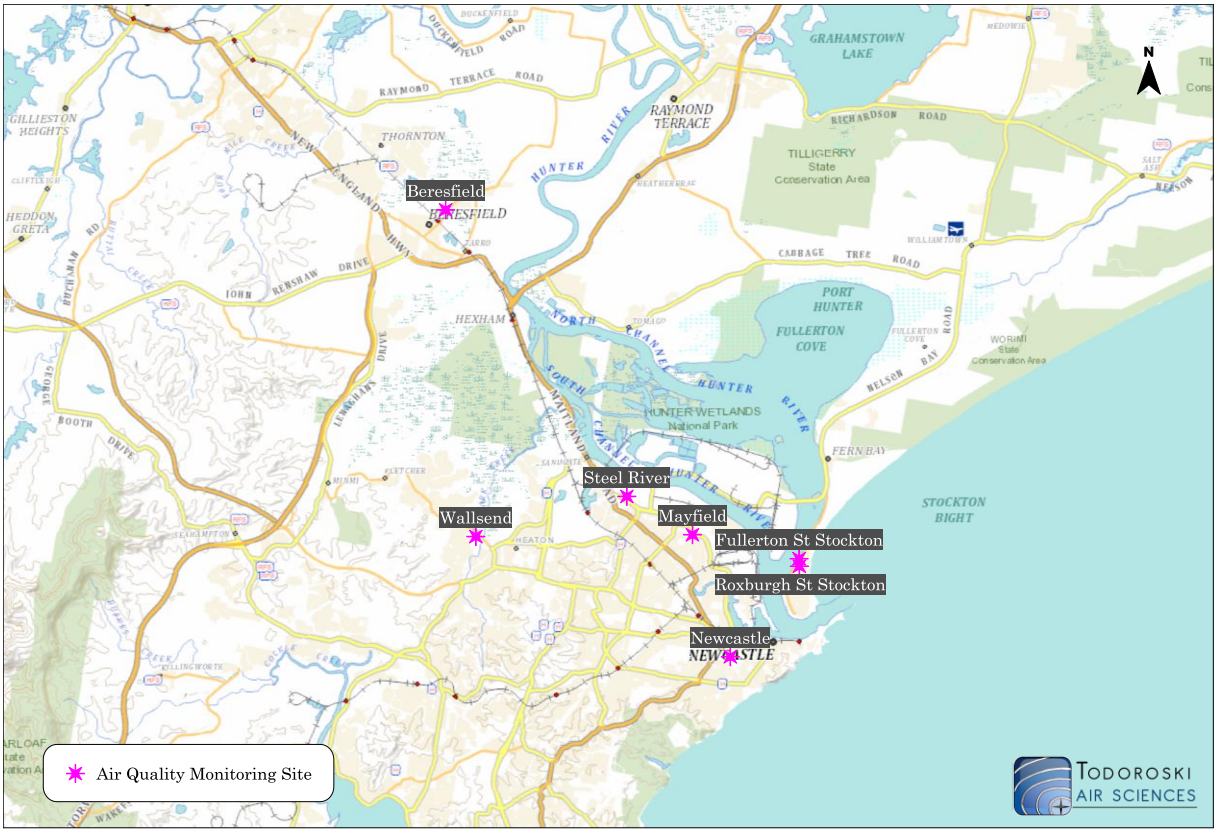

Figure 4-1: Monitoring site locations

Table 4-1: Monitoring sites

Monitoring Station	Type	Recorded Parameters	Recording Periods
Beresfield	NSW EPA site	PM_{10} (TEOM), $PM_{2.5}$, NO_2, SO_2, WS, WD	Hourly/Daily
Wallsend	NSW EPA site	PM_{10} (TEOM), $PM_{2.5}$, NO_2, SO_2, WS, WD	Hourly/Daily
Newcastle	NSW EPA site	PM_{10} (TEOM), NO_2, SO_2, WS, WD	Hourly/Daily
Fullerton St, Stockton	Industry site	PM_{10} (TEOM), $PM_{2.5}$, NO_2, NH_3, WS, WD	Hourly/Daily
Roxburgh St, Stockton	Industry site	NO_2	Hourly
Fullerton St, Stockton (HVAS)	Industry site	PM_{10} (HVAS)	Every 6th Day
Steel River	Industry site	PM_{10} (HVAS)	Every 6th Day
Mayfield	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
NH_3 - Ammonia
WS - Wind speed
WD - Wind direction
HVAS - High volume air sampler (which samples for a 24-hour period every 6 days)

5 AIR QUALITY CRITERIA

The sections below identify the key pollutants currently being monitored at the Lower Hunter 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.

Ammonia (NH_3) is a colourless gas with a pungent smell familiar to most people because ammonia is used in smelling salts and household cleaners such as bleach and window cleaning products. It also occurs naturally in air, soil and water and is found in fertilisers. Ammonia is a corrosive substance and the main toxic effects are restricted to the sites of direct contact with ammonia (i.e., skin, eyes, respiratory tract). For example, if you spilt a bottle of concentrated ammonia on the floor, you would smell a strong ammonia odour; you might cough, and your eyes might water because of irritation. If you were exposed to very high levels of ammonia, you would experience more harmful effects. For example, if you walked into a dense cloud of ammonia or if your skin comes in contact with concentrated ammonia, your skin, eyes, throat, or lungs may be severely burned (**ATSDR, 2004**).

Table 5-3 summarises the air quality goals for NO_2, SO_2 and NH_3.

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

Pollutant	Averaging period	Criterion
NO_2	1-hour	246µg/m^3
	Annual	62µg/m^3
SO_2	10-minute	712µg/m^3
	1-hour	570µg/m^3
	24-hour	228µg/m^3
	Annual	60µg/m^3
NH_3	1-hour	0.46ppm

Source: **NSW DEC, 2005**

5.3 Summary of applicable criteria for this assessment

The particulate and gaseous pollutants monitored in the Lower Hunter 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 annually averaged 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
Ammonia (NH_3)	1-hour	Criterion	0.46ppm

6 METEOROLOGICAL MONITORING DATA

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

Figure 6-1 presents the November 2013 windroses for Beresfield, Wallsend, Newcastle and Stockton.

The Beresfield weather station recorded a high proportion of south-southeast and southerly wind directions, with periods of wind from the northwest, west-northwest and east-southeast during November. Wind speeds recorded at this location were lower than those recorded at the coastal locations.

The predominant wind directions recorded at the Wallsend weather station were from the south-southwest and south-southeast. Wind speeds recorded at this location were generally lower than those recorded at the coastal locations.

The Newcastle weather station predominantly recorded wind directions from the south and south-southeast.

The Stockton weather station recorded wind speeds which were generally higher than the other stations, with the predominant wind direction from the south-southeast. The higher wind speeds at the Stockton weather station are to be expected as it is located in a relatively unsheltered coastal location.

Figure 6-1 shows some differences between the distributions of winds at the four meteorological stations. The variation in localised winds is clear to see, however the four locations also display a similar underlying trend in the wind distribution patterns, with the common winds tending to originate from the south and south-southeast.

The predominance of generally on-shore south and south-southeasterly winds is an indicator that air pollutant levels can be expected to be low. It is also an indicator that airborne sea salt levels may be high, and may affect the measured particulate levels.

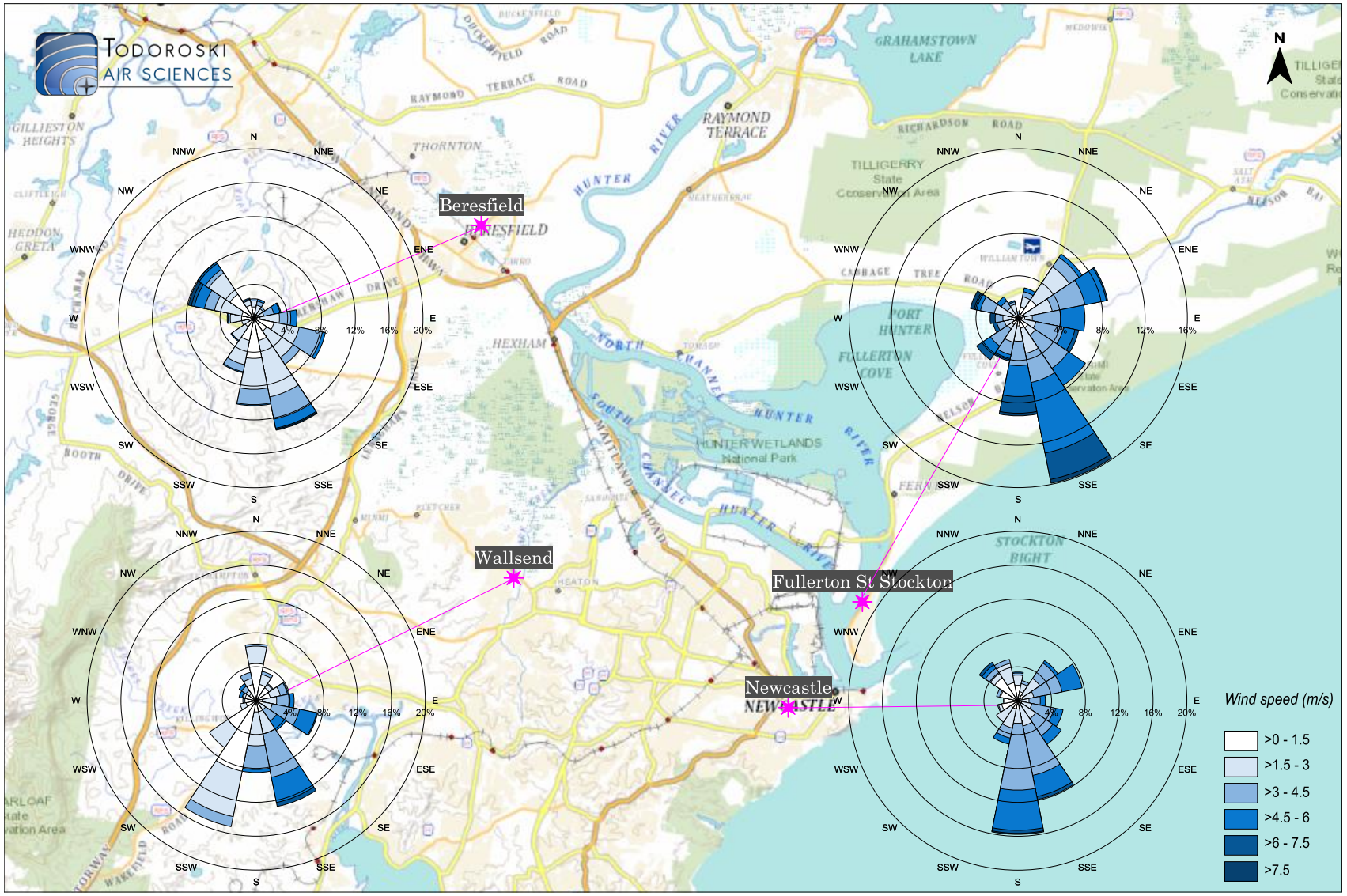

Figure 6-1: November Windroses - Beresfield, Wallsend, Newcastle and Stockton

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 Fullerton St Stockton monitoring site data included a note stating that:

- The data has undergone validation to remove erroneous data due to maintenance, instrument failures and nightly auto calibrations. Data gaps can be explained by this validation.
- The averaged data is based on a minimum of 75% data availability (i.e. a minimum of 75% of data is required to calculate an average for the time period, if below this, the cell will be blank).
- Data displayed on the www.stocktonairqualitymonitoring.com website have not undergone any validation, therefore there will be differences between the data in this report and the website at the time of writing this report.
- Small negative concentration readings are due to the instrument noise at low/zero concentration levels and are a normal part of the operation of gas and particulate analysers.

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.

All of the monitoring data provided to Todoroski Air Sciences are presented in graphical format in **Appendix B** and tabulated format in **Appendix C**.

7.2 Analysis of Monitoring Data

Table 7-1 presents a summary of the maximum pollutant levels occurring during November 2013. The results indicate that the Newcastle and Fullerton St Stockton monitors recorded 24-hour average PM_{10} levels above the criterion of 50µg/m^3, and the Wallsend and Fullerton St Stockton $PM_{2.5}$ monitors recorded 24-hour averages above the advisory reporting standard of 25µg/m^3. The ambient air concentrations recorded by all other monitors were below the relevant criteria during November 2013.

Table 7-1: Maximum pollutant levels - November 2013

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)	NH_3 (ppm)
	24-hour average	24-hour average	24-hour average	1-hour average	1-hour average	1-hour average
	Air Quality Impact Criteria					
	50	25*	228	246	570	0.46
Wallsend	45.7	**25.7**	6.8	43.2	39.3	-
Newcastle	**57.2**	-	17.4	60.2	110.0	-
Beresfield	40.4	16.9	10.7	63.9	81.2	-
Fullerton St Stockton	**70.6**	**27.3**	-	69.3	-	0.31
Roxburgh St Stockton	-	-	-	79.3	-	-
Fullerton St Stockton HVAS	46.4	-	-	-	-	-
Steel River HVAS	21.0	-	-	-	-	-
Mayfield HVAS	26.0	-	-	-	-	-

* 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 Lower Hunter region in November 2013.

Relative to the Air Quality Index, as shown by the coloured bands in the figure, PM_{10} levels were generally very good to fair at all locations with the exception of the Fullerton St Stockton monitor which experienced elevated levels on two days, and the Newcastle monitor which recorded one day of poor air quality.

The data indicate that the Fullerton St Stockton monitor recorded 24-hour average PM_{10} levels above the criterion of 50µg/m^3 on 7 and 8 November 2013, and the Newcastle monitor recorded a 24-hour average PM_{10} level above the criterion on 8 November 2013. All other data recorded at the Lower Hunter monitoring sites were below the 24-hour average PM_{10} criterion.

Figure B-1 to **Figure B-4** 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 Lower Hunter region in November 2013.

Relative to the Air Quality Index, as shown by the coloured bands in the figure, the data indicate that $PM_{2.5}$ levels were very good to good at all locations except the Fullerton St Stockton and Wallsend monitors which both recorded one day of poor levels. The Fullerton St Stockton monitor also recorded two days of fair conditions, and the Beresfield monitor recorded one day of fair levels.

The Fullerton St Stockton and Wallsend monitors recorded $PM_{2.5}$ levels above the 24-hour average advisory reporting standard of 25µg/m^3 on 8 November 2013. All other data were below the advisory reporting standard.

Figure B-5 to **Figure B-7** 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.

7.5 Nitrogen dioxide NO_2

Figure 7-3 presents the 1-hour average NO_2 monitoring data recorded in the Lower Hunter region in November 2013.

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 all of the time at all of the monitors.

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 Lower Hunter region in November 2013.

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 B-8 to **Figure B-10** in **Appendix B** present the 24-hour average SO_2 data in graphical form for each individual station.

7.7 Ammonia NH_3

Figure 7-5 presents the 1-hour average NH_3 monitoring data recorded at the Fullerton St Stockton monitor in November 2013.

The data indicate that the measured levels of NH_3 were generally low and were below the applicable criterion on all days.

Figure 7-5 also presents the 1-hour average wind direction data recorded at the Fullerton St Stockton monitor in November 2013. The figure shows that NH_3 levels above 0.1ppm were generally associated with winds from the west and west-northwest.

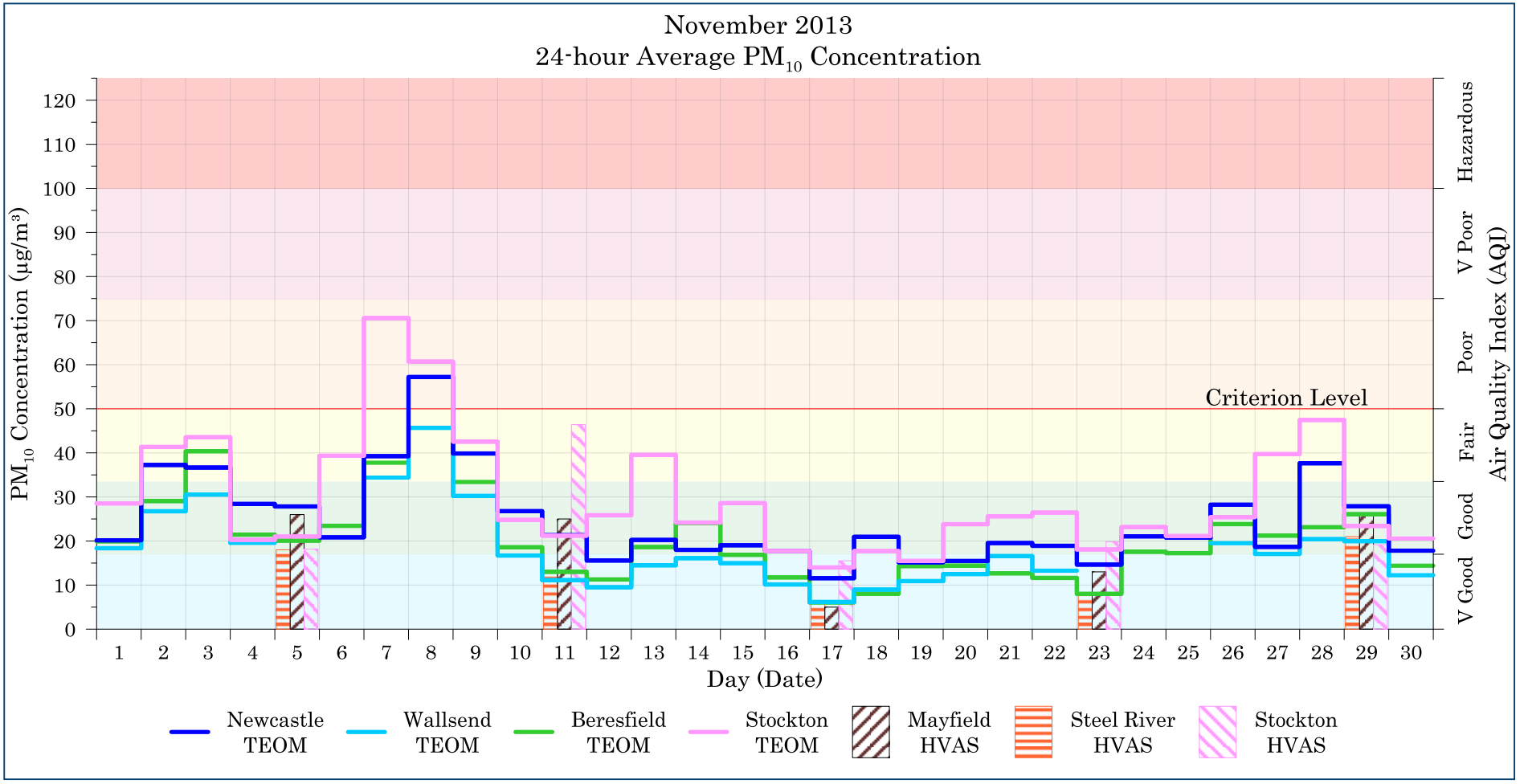

Figure 7-1: Lower Hunter 24-hour average PM_{10} levels – November 2013

The Fullerton St Stockton monitor recorded two 24-hour average PM_{10} levels above the criterion of 50µg/m^3 in November 2013. The Newcastle monitor also recorded a 24-hour average PM_{10} level over the criterion. PM_{10} levels were generally very good to good at all locations with the exception of Newcastle and Fullerton St Stockton which experienced fair levels approximately 15% to 25% of the time, and recorded poor levels on one and two days respectively.

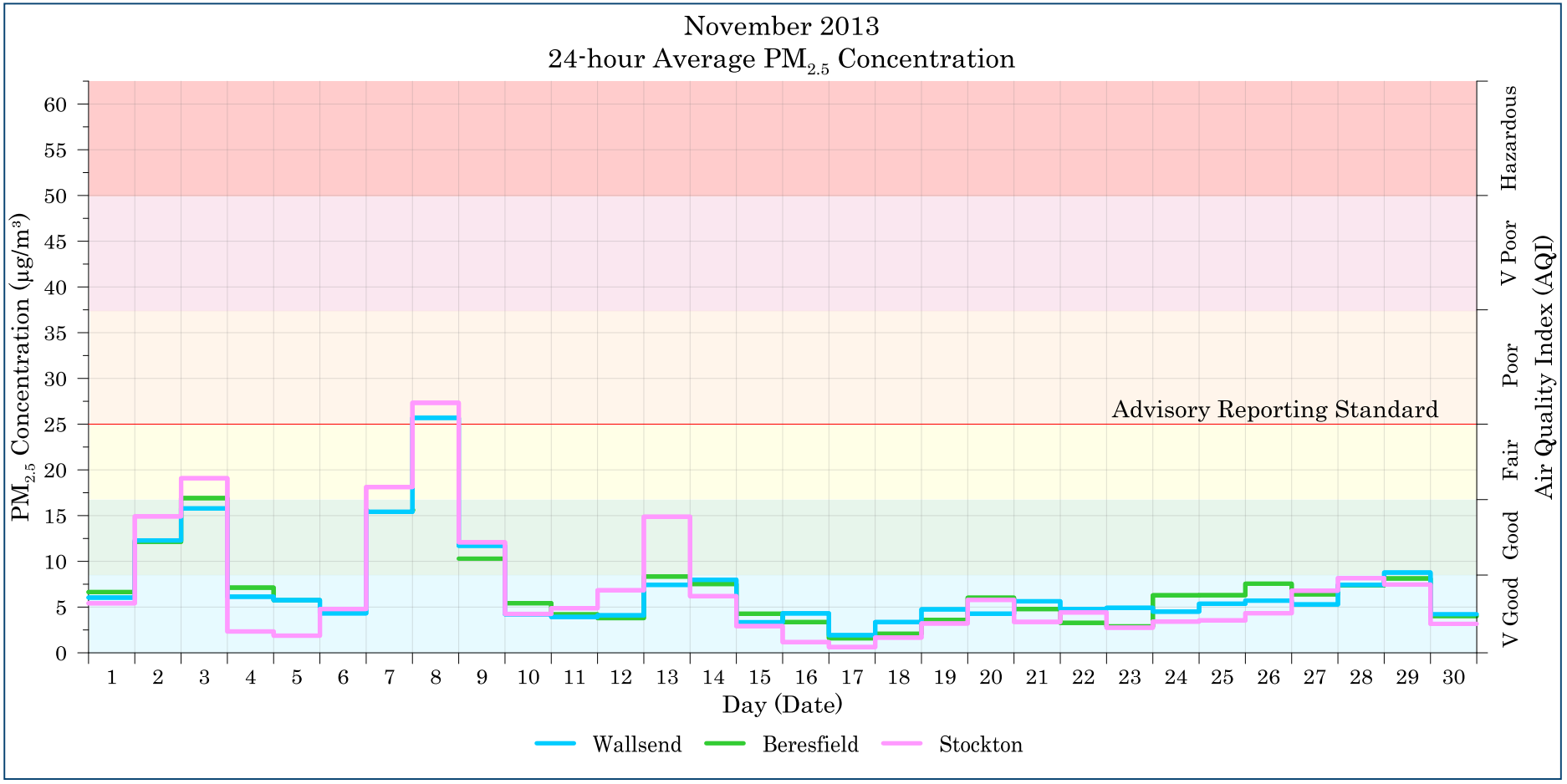

Figure 7-2: Lower Hunter 24-hour average $PM_{2.5}$ levels – November 2013

The Fullerton St Stockton and Wallsend monitors recorded $PM_{2.5}$ levels above the 24-hour average advisory reporting standard of 25µg/m^3 on 8 November 2013. $PM_{2.5}$ levels were very good to good at all locations except Fullerton St Stockton and Wallsend which recorded one day with poor levels. Fullerton St Stockton recorded fair levels on three occasions, while Beresfield had one day of fair air quality.

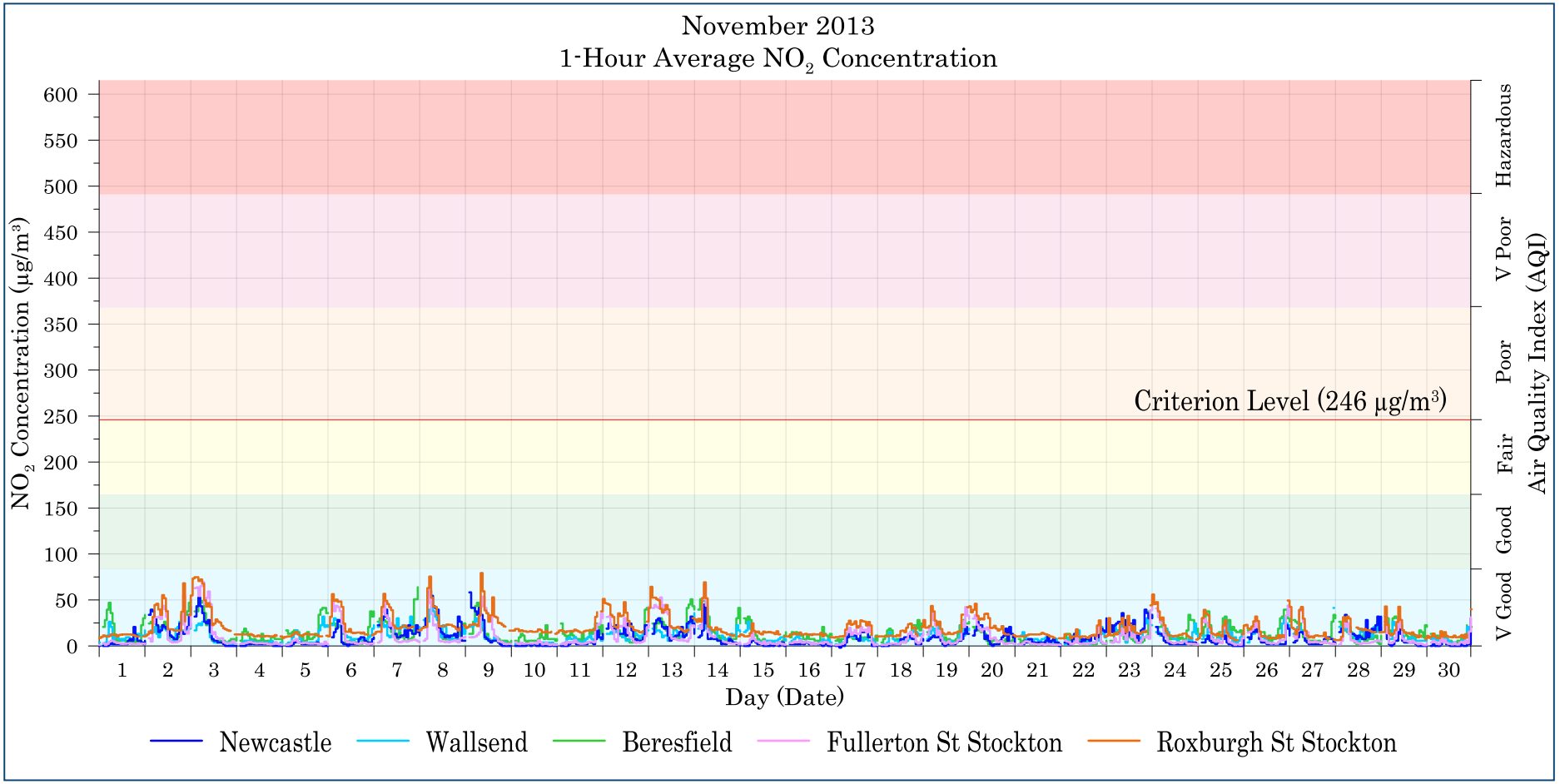

Figure 7-3: Lower Hunter 1-hour average NO_2 levels – November 2013

All data recorded at the Lower Hunter monitoring sites were below the 1-hour average NO_2 criterion level of 246µg/m^3 in November 2013. Measured levels of NO_2 were very good at all monitors at all times.

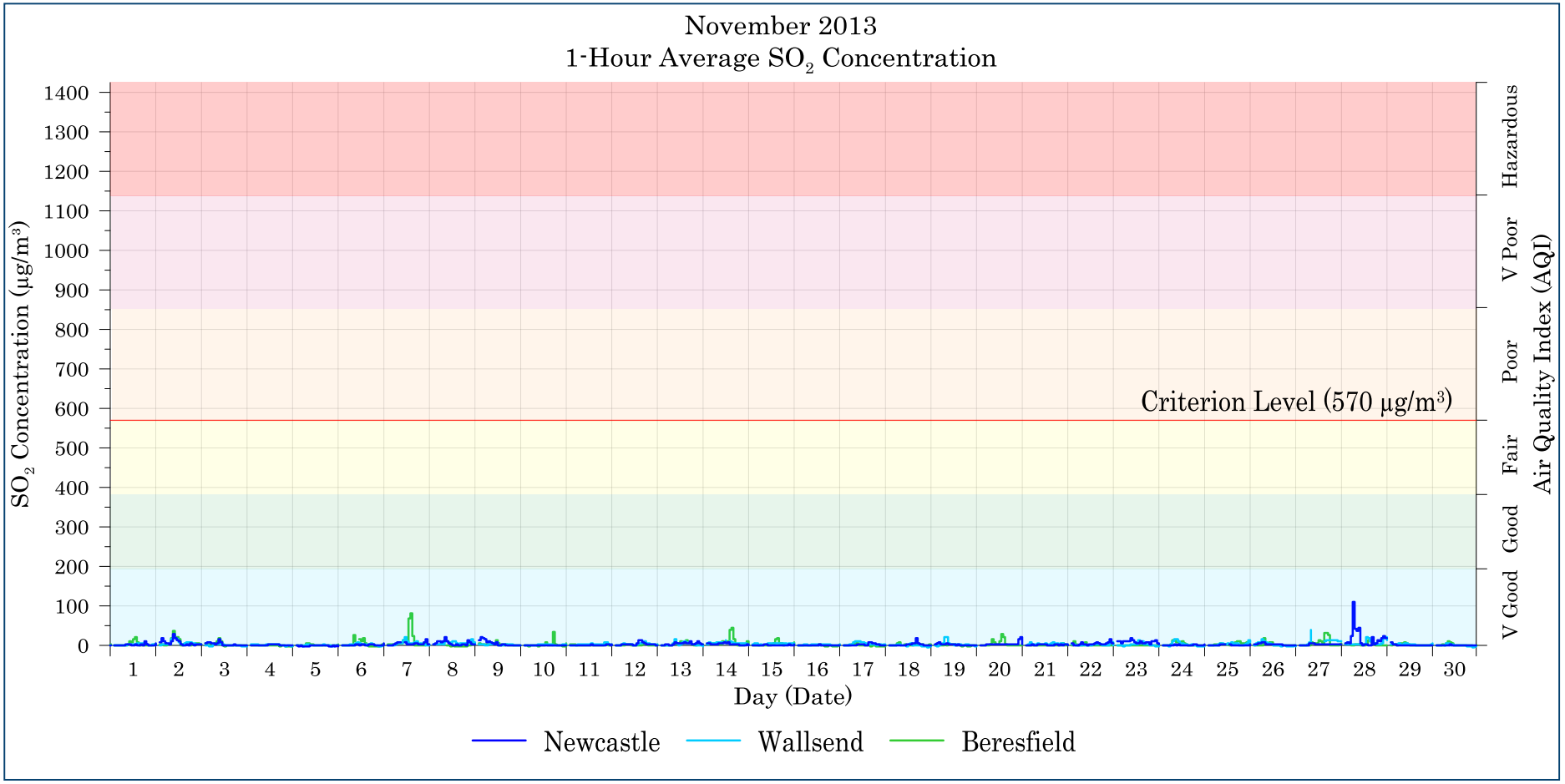

Figure 7-4: Lower Hunter 1-hour average SO_2 levels – November 2013

All data recorded at the Lower Hunter monitoring sites were below the 1-hour average SO_2 criterion level of 570µg/m^3 in November 2013. Measured levels of SO_2 were very good at all monitors at all times.

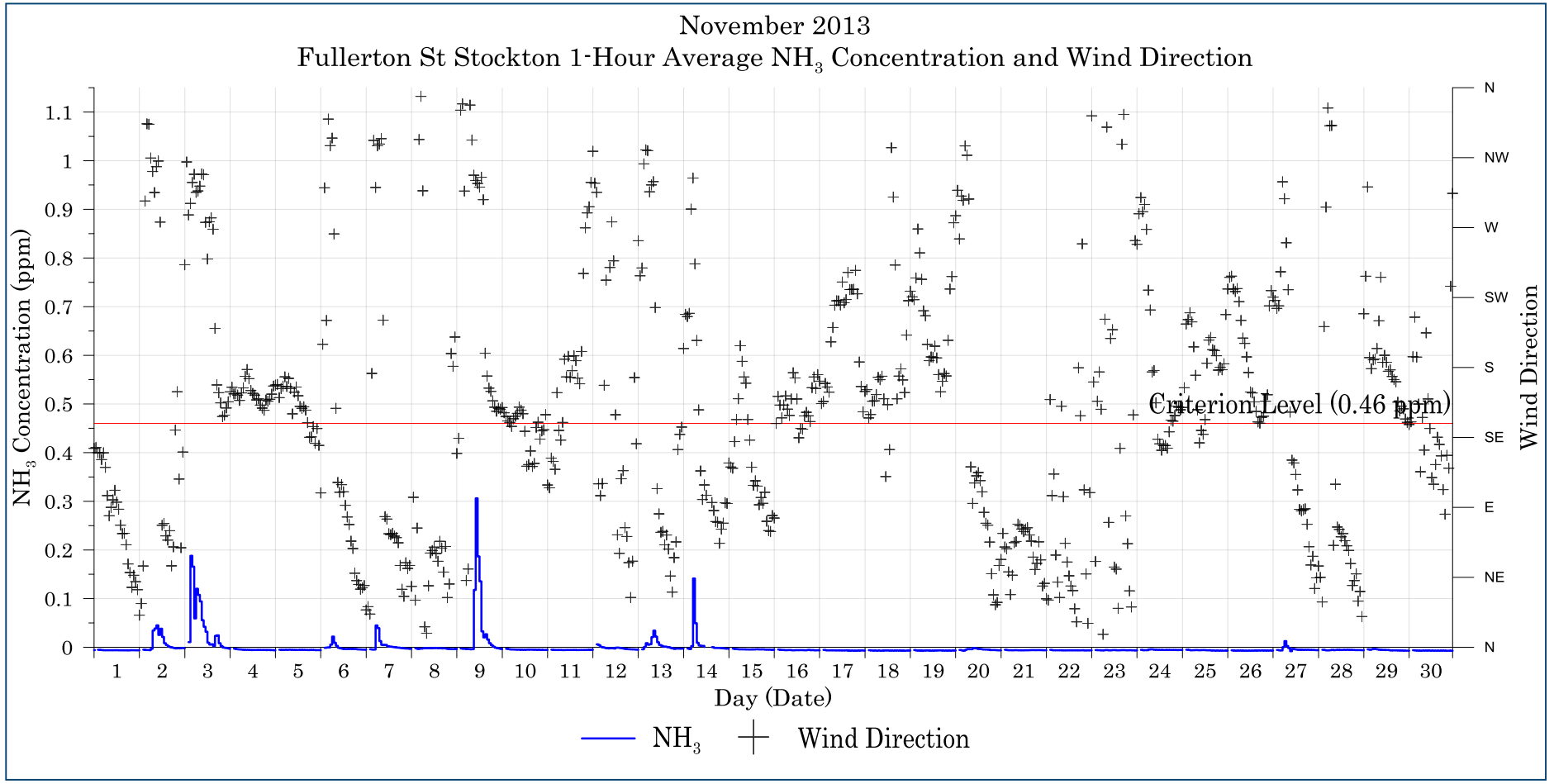

Figure 7-5: Lower Hunter 1-hour average NH_3 levels – November 2013

All NH_3 data recorded at the Fullerton St Stockton NH_3 monitor were below the 1-hour average criterion of 0.46ppm. Spikes in NH_3 are generally associated with winds from the north-west.

8 ANALYSIS OF ELEVATED POLLUTANT LEVELS

8.1 Fullerton St Stockton – 7 November 2013

- 24-hour average PM_{10} level of 70.6µg/m^3

Figure 8-1 presents a plot of the 1-hour average PM_{10}, wind speed and wind direction data recorded at Fullerton St Stockton on 7 November 2013. The 1-hour average PM_{10} levels recorded at Newcastle, Beresfield and Wallsend have also been included.

The data presented in **Figure 8-1** show that the Fullerton St Stockton monitor recorded elevated PM_{10} levels during periods of low wind speeds from the northeast.

The Fullerton St Stockton monitor recorded winds from the east-northeast and northeast for most of the day. The monitor also recorded a period of north-westerly winds between 4am and 10am.

The Fullerton St Stockton PM_{10} monitor generally recorded similar trends in PM_{10} levels to the Beresfield, Newcastle and Wallsend monitors, except for periods with low wind speeds from the northeast. The Fullerton St Stockton monitor recorded elevated levels during these periods relative to the other monitors.

All of the monitoring sites recorded higher PM_{10} levels after a change in wind direction to a east-north-easterly at midday. The Fullerton St Stockton monitor recorded relatively higher PM_{10} levels from 7pm to midnight.

Given the wind direction and the location of the Fullerton St Stockton monitor in relation to Stockton Beach, it is likely that the elevated PM_{10} levels recorded at the monitor from 7pm were impacted by heavily salt laden air or particulates blowing from the northeast along the surf break for the length of Stockton Beach, or a localised unknown source.

8.2 Fullerton St Stockton, Newcastle and Wallsend - 8 November 2013

- 24-hour average PM_{10} level of 60.7µg/m^3 at Fullerton St Stockton
- 24-hour average $PM_{2.5}$ level of 27.3µg/m^3 at Fullerton St Stockton
- 24-hour average PM_{10} level of 57.2µg/m^3 at Newcastle
- 24-hour average $PM_{2.5}$ level of 25.7µg/m^3 at Wallsend

Figure 8-2 and **Figure 8-3** present plots of the 1-hour average PM_{10} and $PM_{2.5}$, recorded at Fullerton St Stockton, Beresfield, Newcastle and Wallsend on 8 November. The wind speed and wind direction data recorded at Newcastle have also been included.

The figures show that PM_{10} and $PM_{2.5}$ levels recorded at all monitors were high for the duration of 8 November regardless of the wind conditions or the location of the monitors. This suggests that there may have been a regional event which impacted the particulate levels recorded by all the monitors.

Figure 8-4 presents a satellite image of the Lower Hunter and surrounding regions on 8 November 2013 (**NASA, 2014**). It can be seen from the satellite image that there were numerous bushfires burning to the west and north of the monitoring locations, as indicated by the red dots.

The northerly wind directions from 2am and 9am in **Figure 8-2** and **Figure 8-3** indicate that bushfire smoke from the fires to the north of the Lower Hunter region may have impacted the particulate readings at the monitors. It is also possible that smoke plumes from the fires to the west of the Lower Hunter region were blown out to sea under north-westerly winds (as seen in **Figure 8-4**) then drawn back into the Lower Hunter area with sea breeze activity.

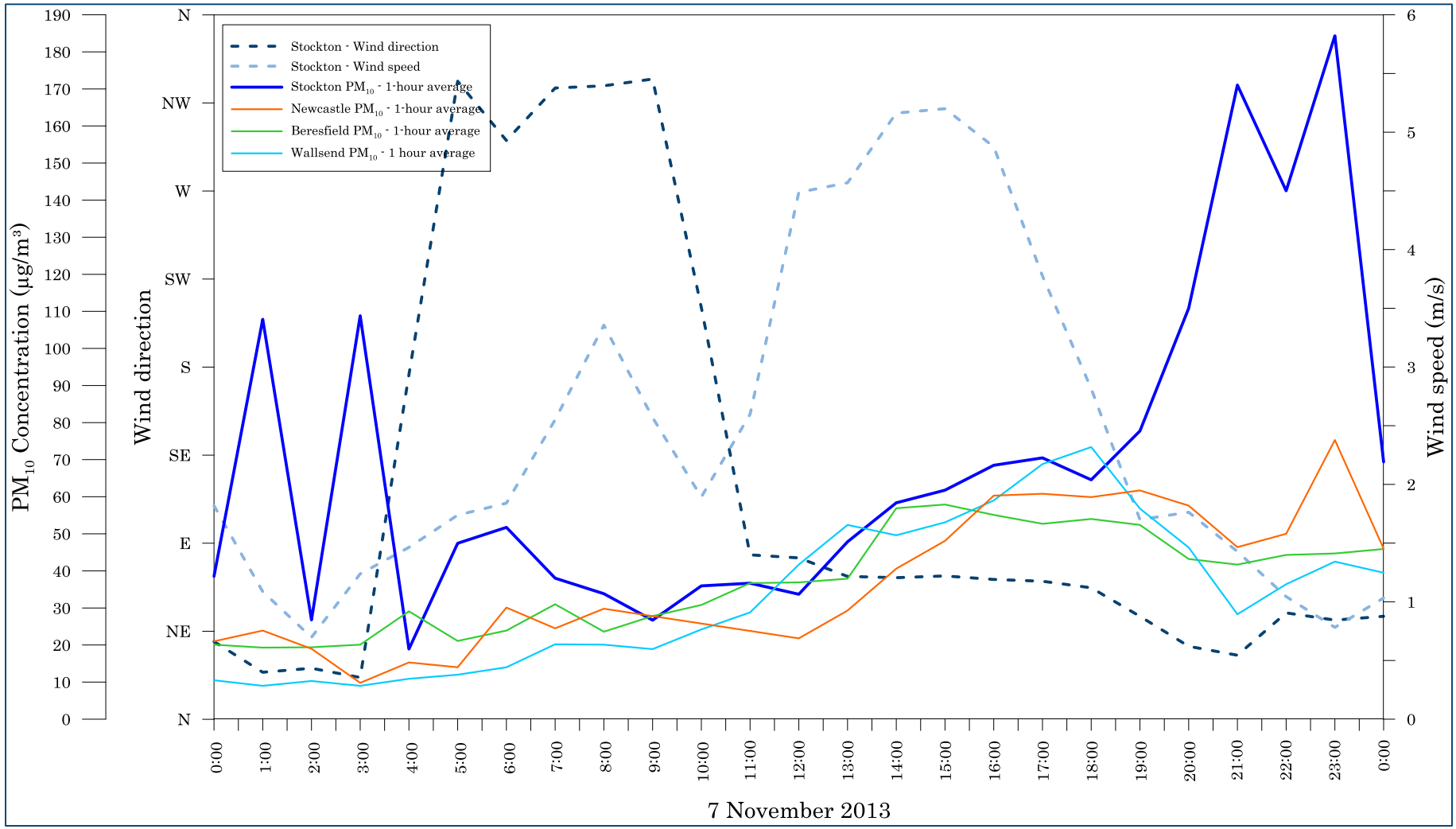

Figure 8-1: Analysis of elevated PM_{10} levels on 7 November 2013 – Fullerton St Stockton

The Fullerton St Stockton monitor recorded elevated PM_{10} levels during periods of winds from the northeast with speeds less than 2m/s.

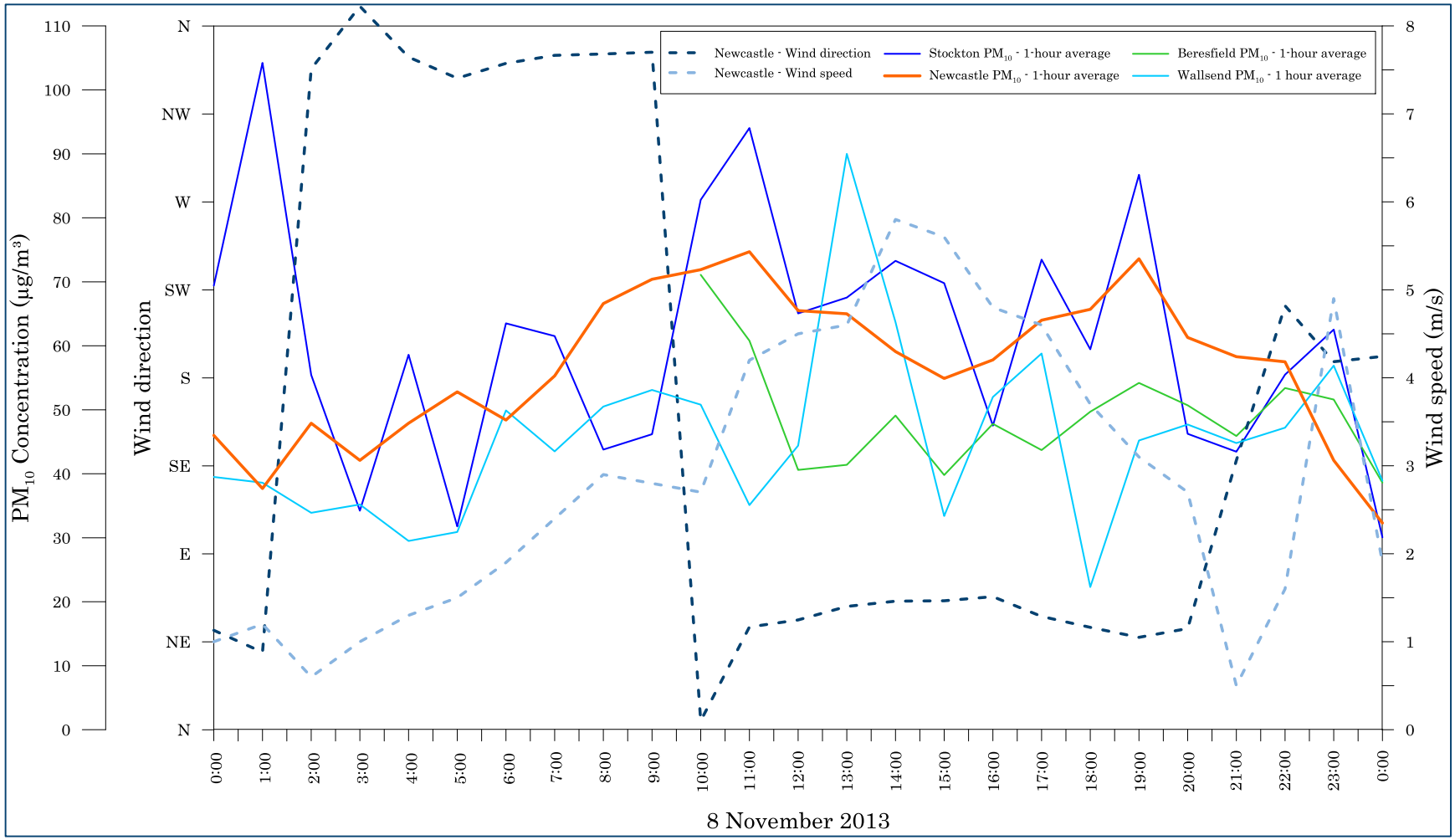

Figure 8-2: Analysis of elevated PM_{10} levels on 8 November 2013 – Fullerton St Stockton

All monitors recorded consistently high PM_{10} levels on 8 November 2013.

Figure 8-3: Analysis of elevated $PM_{2.5}$ levels on 8 November 2013 - Fullerton St Stockton

All monitors recorded consistently high $PM_{2.5}$ levels on 8 November 2013.

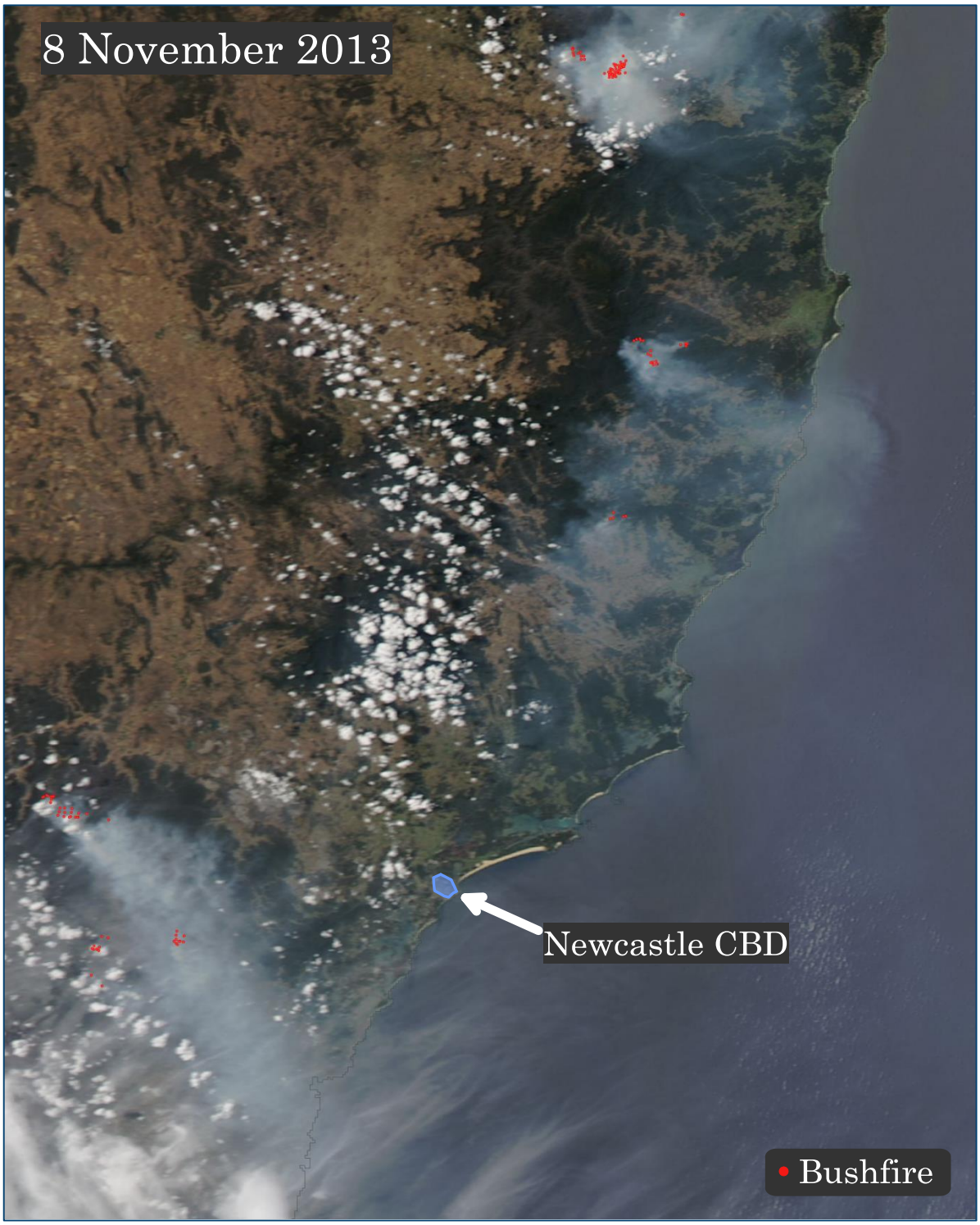

Figure 8-4: Satellite image of bushfires surrounding the Lower Hunter region, 8 November 2013

9 CONCLUSIONS

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

On 7 November the Fullerton St Stockton monitor recorded a 24-hour average level above the relevant criterion of 50µg/m^3. It is likely that the PM_{10} levels recorded at the monitor were impacted by heavily salt laden air or particulates blowing from the northeast along the surf break for the length of Stockton Beach, or a localised source of emissions.

On 8 November the Fullerton St Stockton and Newcastle PM_{10} monitors recorded 24-hour average PM_{10} levels above the relevant criterion. The Fullerton St Stockton and Wallsend $PM_{2.5}$ monitors also recorded 24-hour average $PM_{2.5}$ levels above the advisory reporting standard of 25µg/m^3. It is likely that the elevated PM_{10} and $PM_{2.5}$ levels recorded on this day were primarily due to smoke emitted from bushfires in the area surrounding the Lower Hunter region

All other data indicate pollutant levels were below the applicable criteria for the remaining periods.

Relative to the Air Quality Index:

- The measured levels of NO_2 were very good or 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 locations except Fullerton St Stockton and Wallsend monitors which both recorded one day of poor levels. The Fullerton St Stockton monitor also recorded two days of fair conditions, and the Beresfield monitor recorded one day of fair levels.
- The measured PM_{10} levels were very good to fair at all locations with the exception of the Fullerton St Stockton monitor which recorded poor levels on two days, and the Newcastle monitor which recorded one day of poor air quality.

On this basis it can be concluded that the air quality in the Lower Hunter was generally good during November 2013.

10 REFERENCES

ATSDR (2004)

"Public Health Statement for Ammonia", Agency for Toxic Substances and Disease Registry November 2004.

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.

USEPA (2013)

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

NASA (2014)

NASA Worldview Alpha website. <https://earthdata.nasa.gov/labs/worldview/>, accessed March 2014.

Appendix A

How to read a windrose

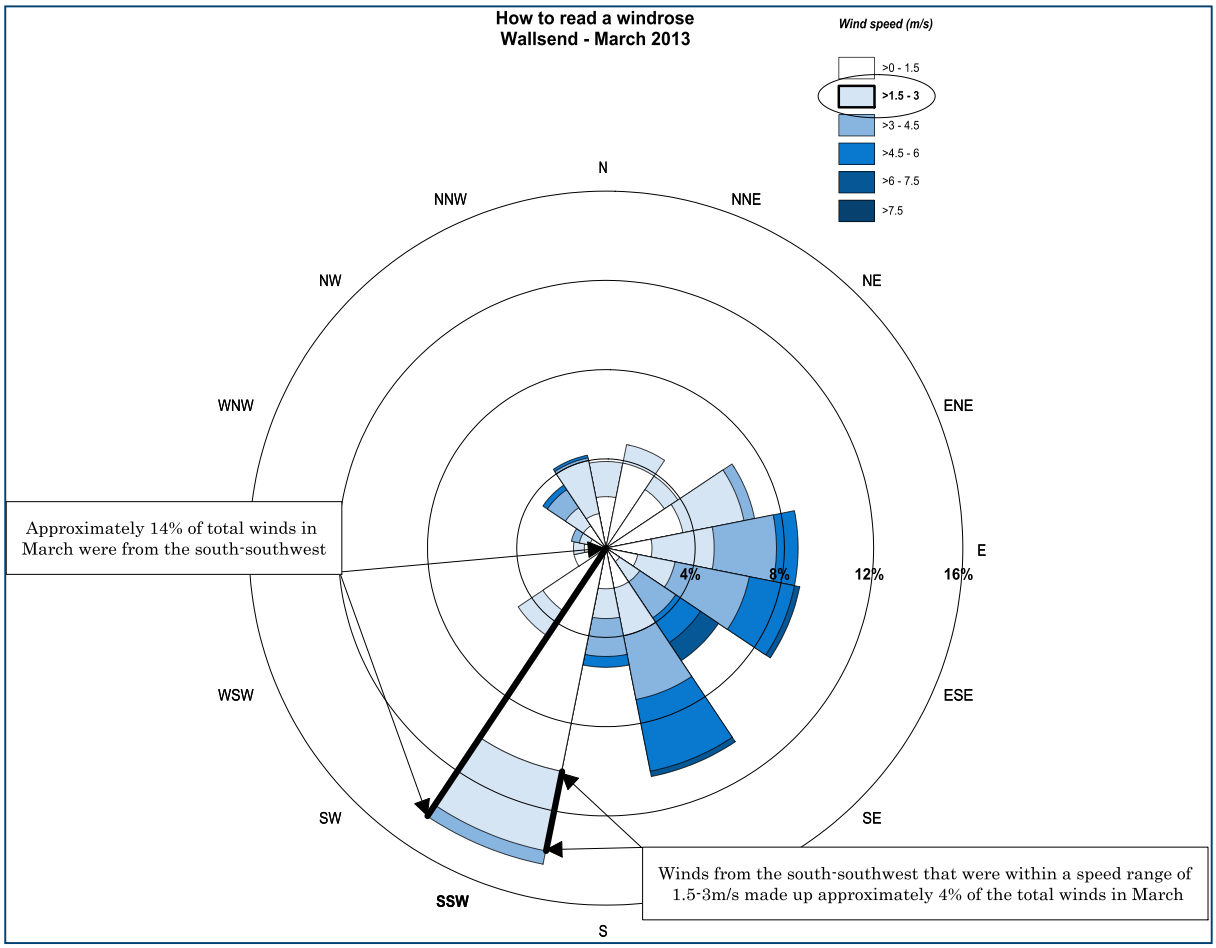

Figure A-1: How to read a windrose

Appendix B

Monitoring Data (Graphical)

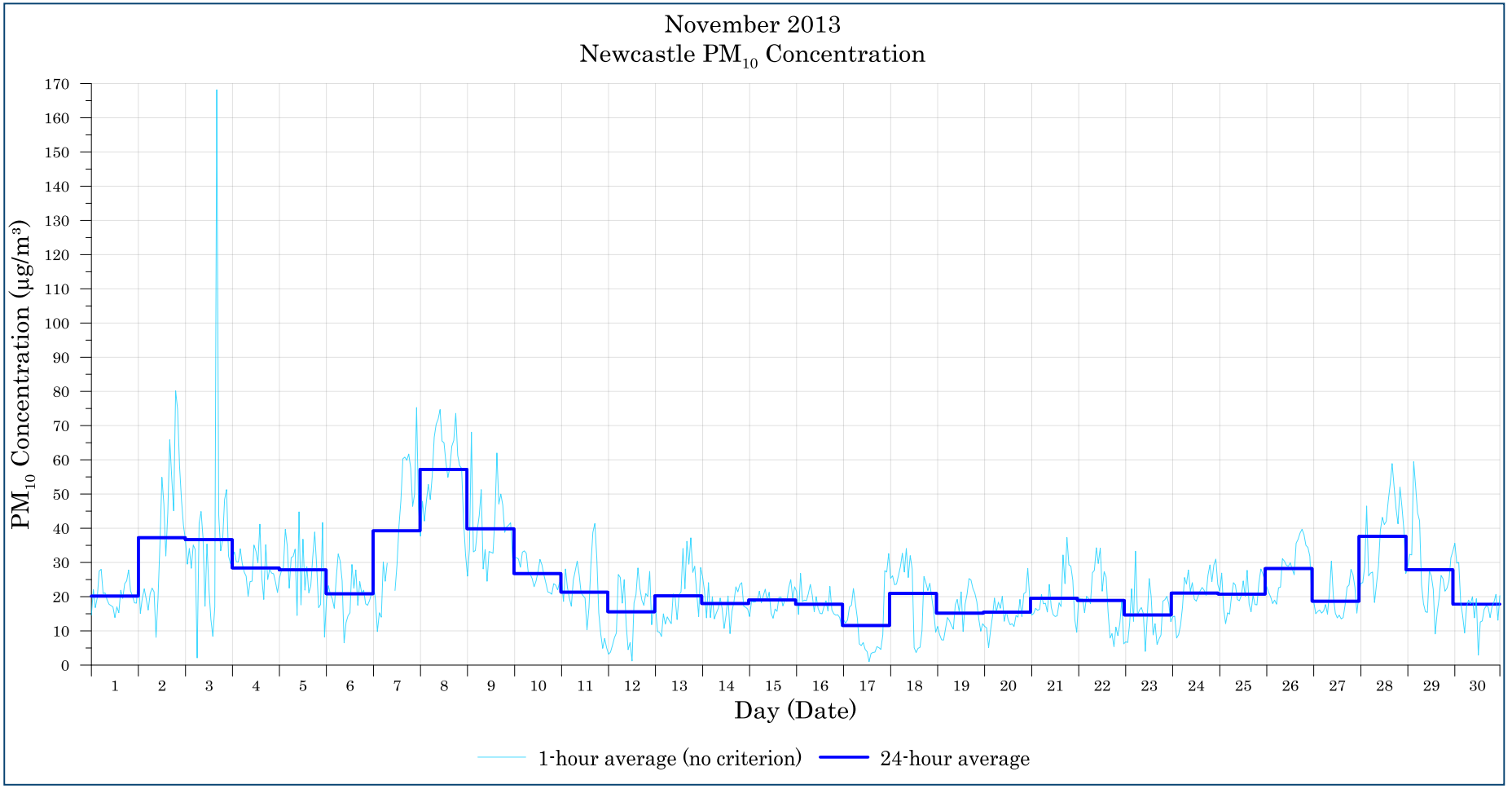

Figure B-1: Newcastle PM_{10} concentration - November

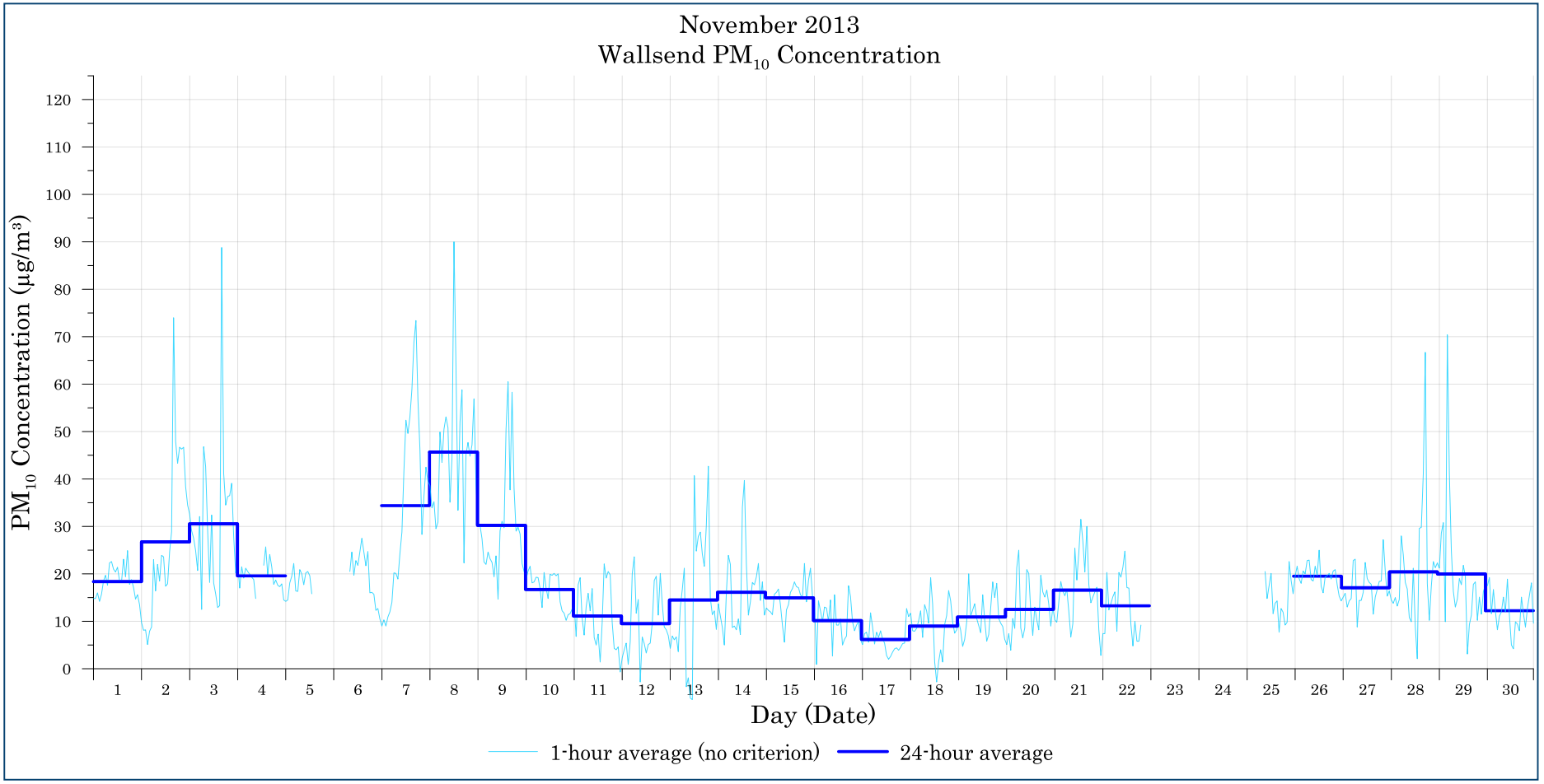

Figure B-2: Wallsend PM_{10} concentration - November

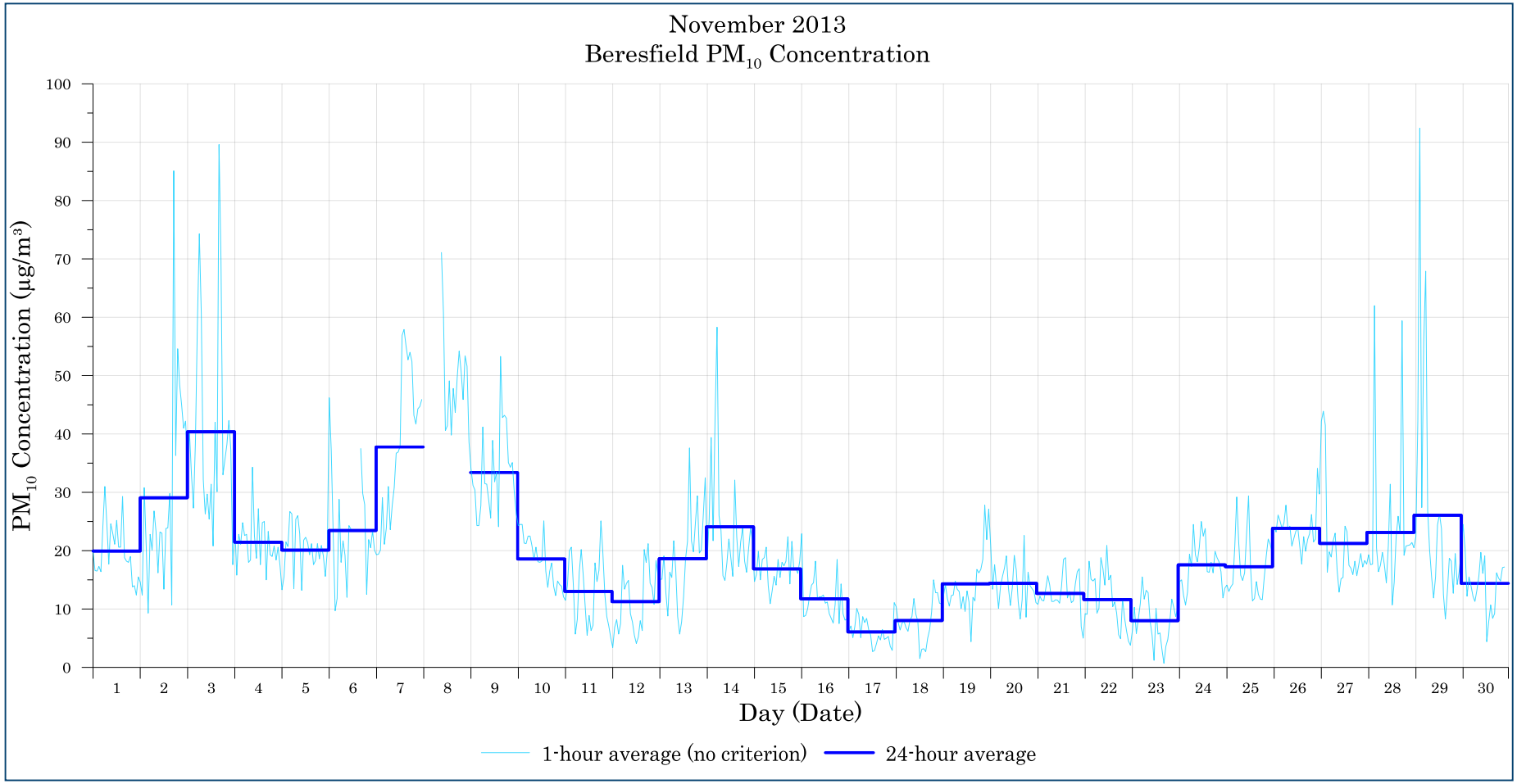

Figure B-3: Beresfield PM_{10} concentration - November

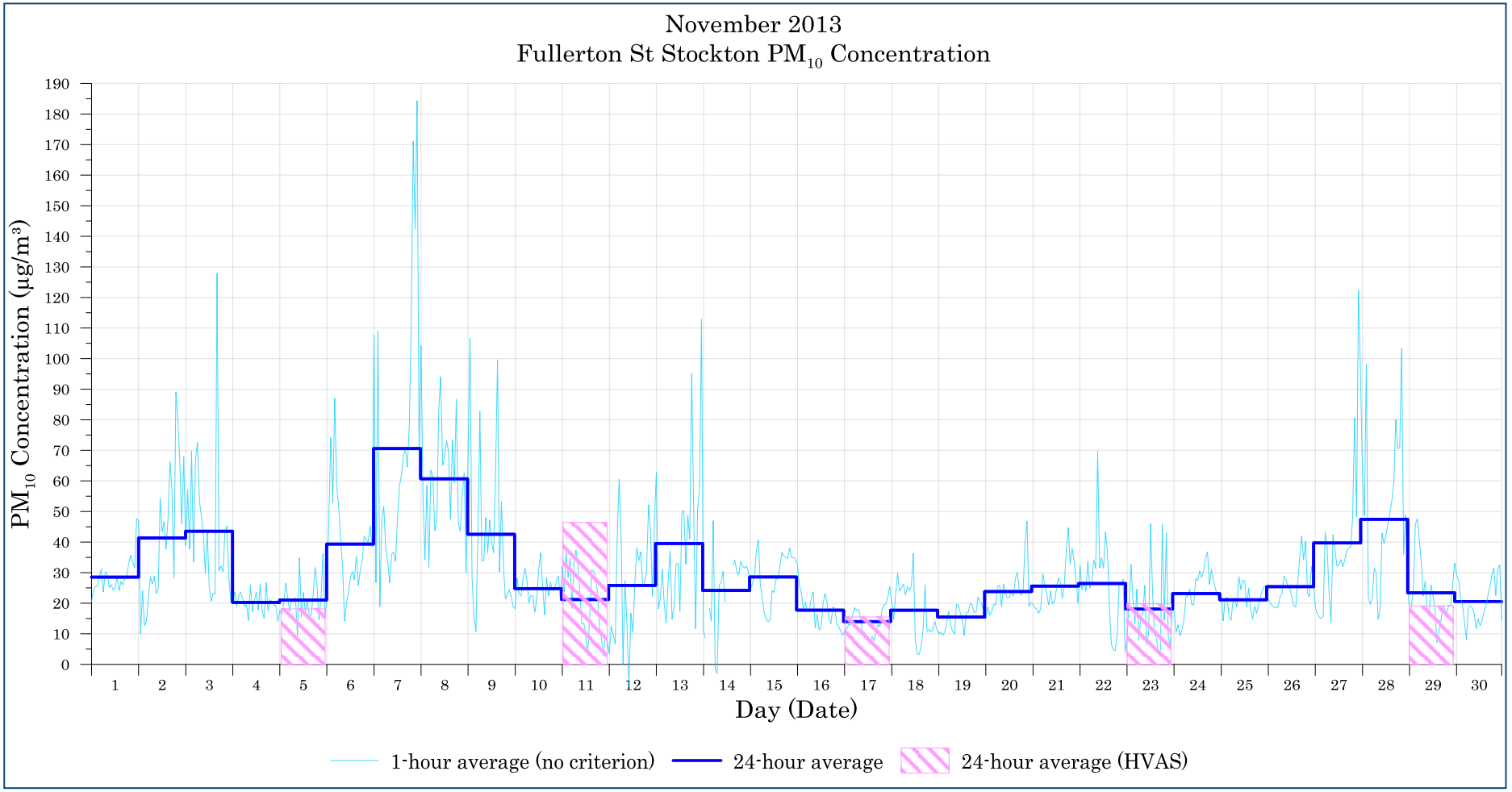

Figure B-4: Stockton PM_{10} concentration - November

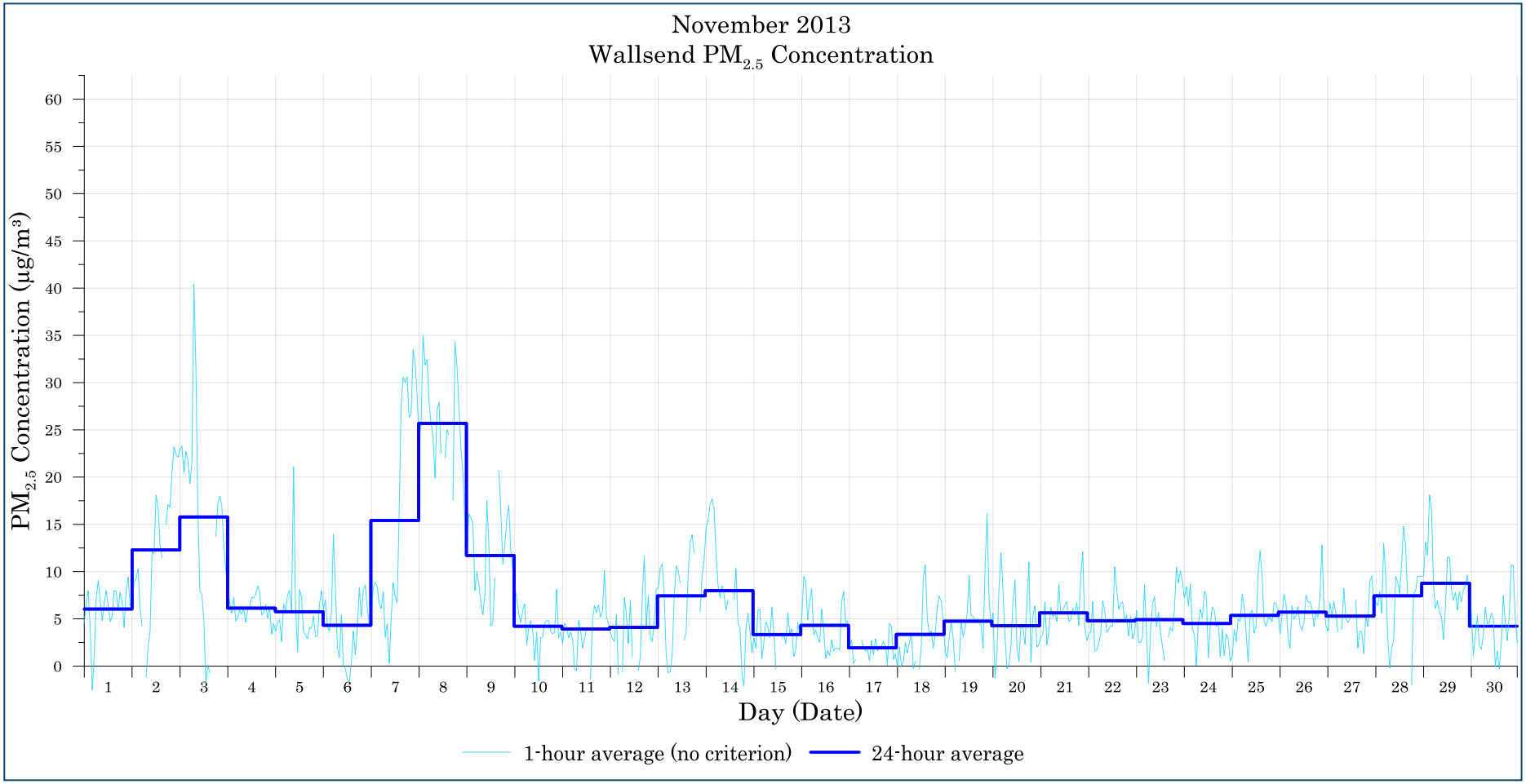

Figure B-5: Wallsend $PM_{2.5}$ concentration - November

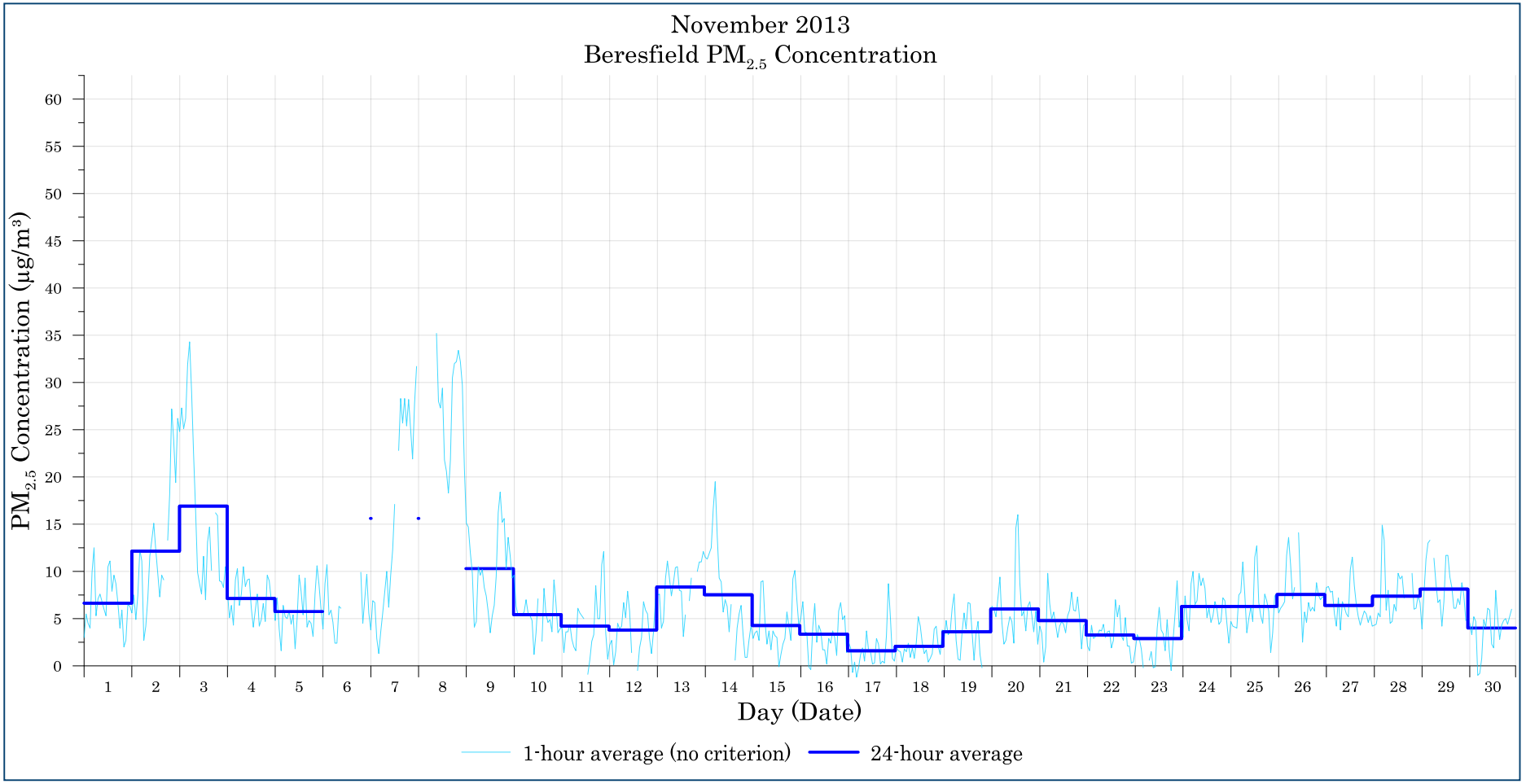

Figure B-6: Beresfield $PM_{2.5}$ concentration - November

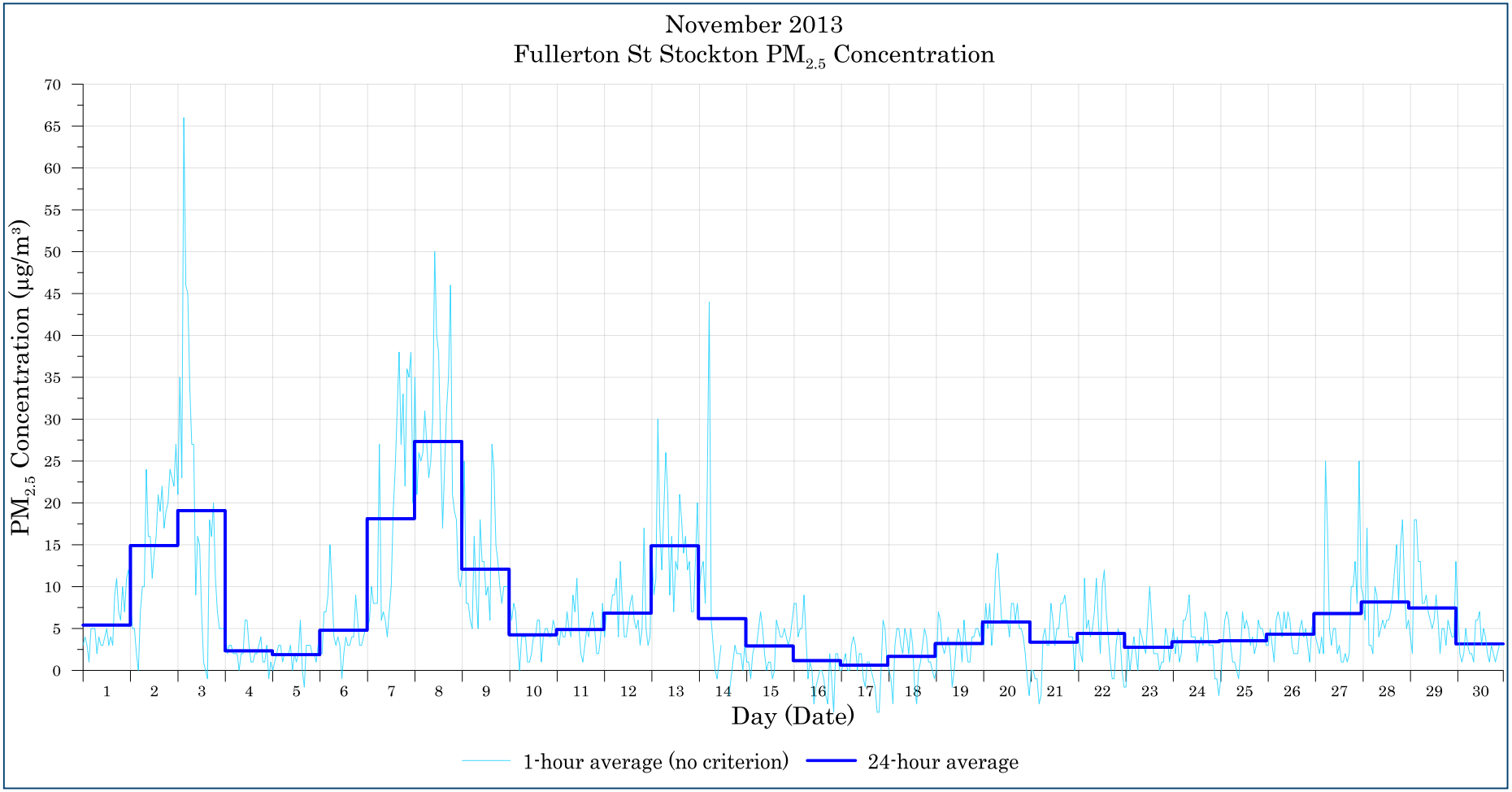

Figure B-7: Stockton $PM_{2.5}$ concentration - November

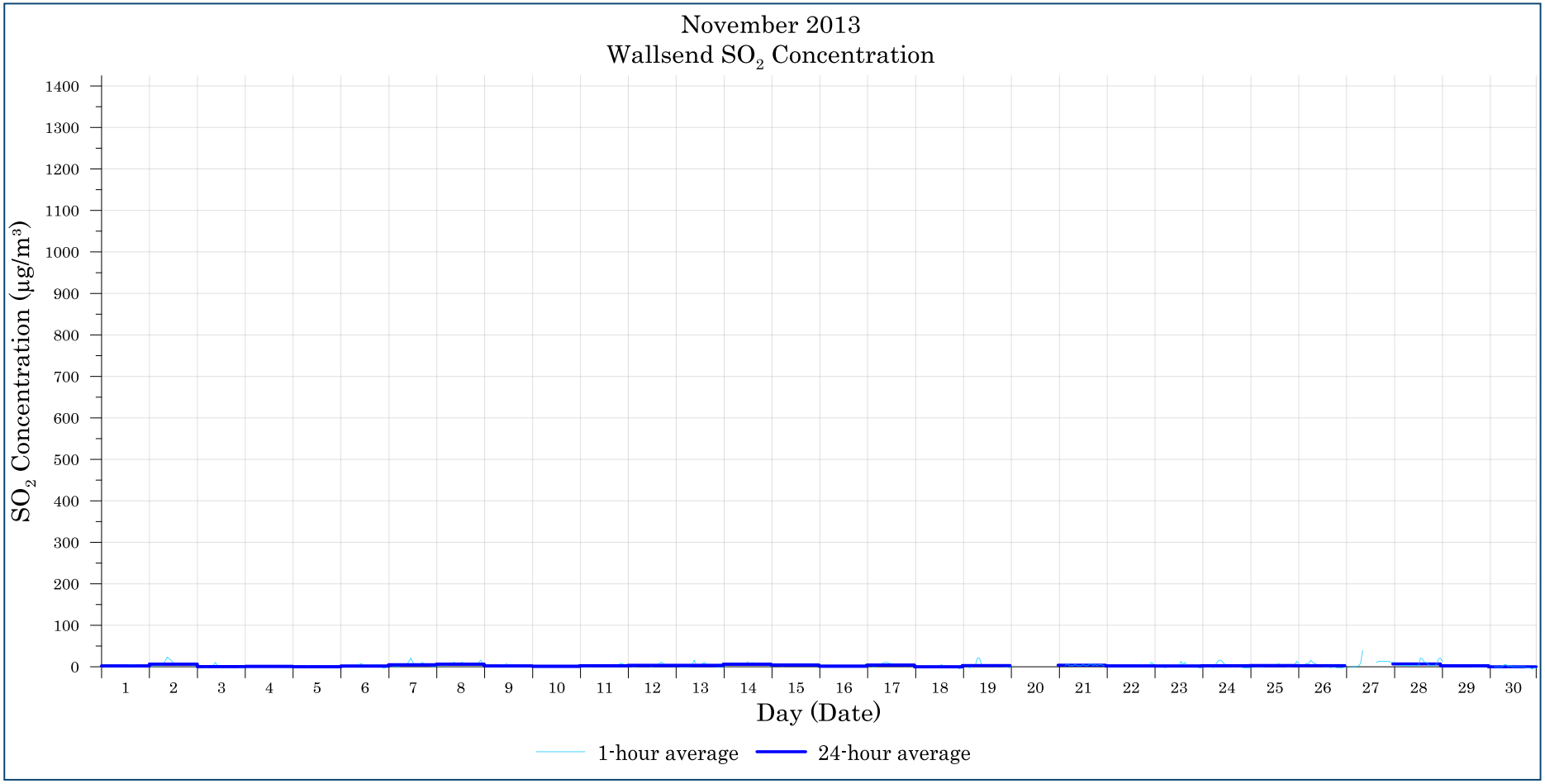

Figure B-8: Wallsend SO_2 concentration - November

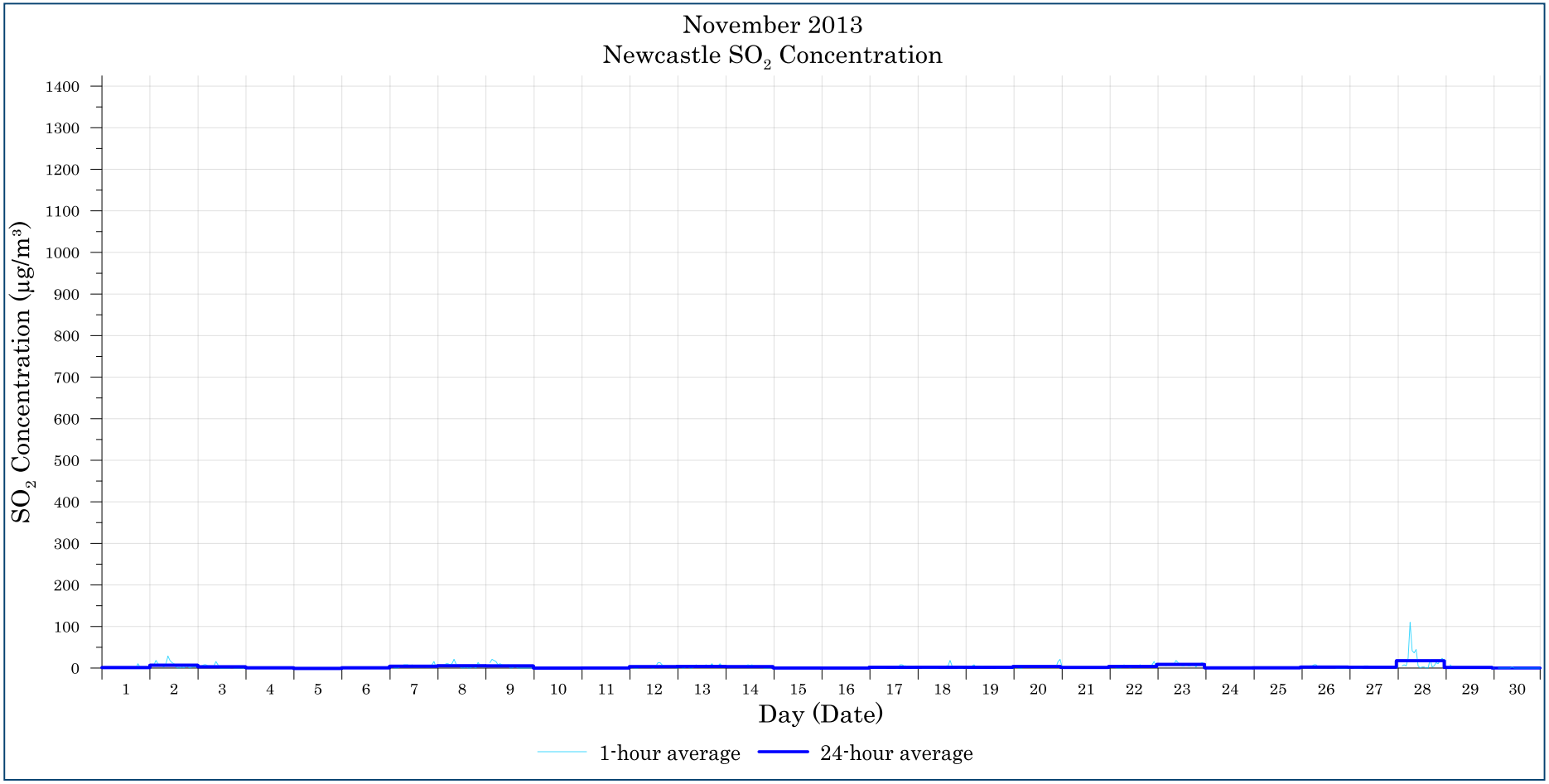

Figure B-9: Newcastle SO_2 concentration - November

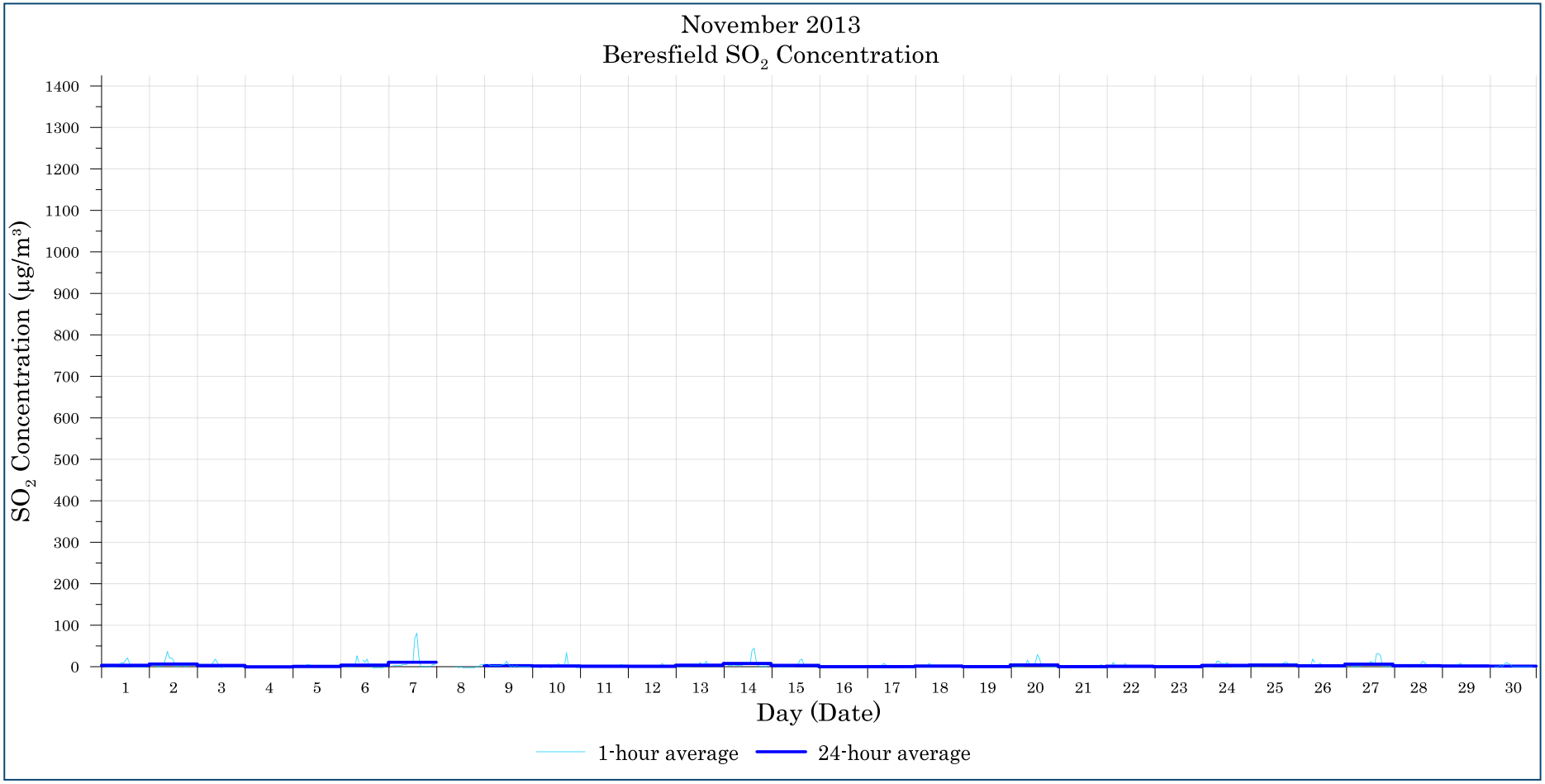

Figure B-10: Beresfield SO_2 concentration - November

Appendix C

Monitoring Data (Tabulated)

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

Date	PM_{10} (µg/m³)				$PM_{2.5}$ (µg/m³)			SO_2 (µg/m³)		
	Walls end	Newcastle	Beresfield	Fullerton St Stockton	Wallsend	Beresfield	Fullerton St Stockton	Wallsend	Newcastle	Beresfield
01/11/2013	18.4	20.2	19.9	28.5	6.0	6.6	5.4	1.9	1.1	3.1
02/11/2013	26.7	37.3	29.1	41.3	12.3	12.1	14.9	6.4	6.8	6.5
03/11/2013	30.6	36.7	40.4	43.6	15.8	16.9	19.1	0.6	3.0	2.8
04/11/2013	19.6	28.4	21.5	20.3	6.1	7.1	2.3	0.9	0.7	-0.6
05/11/2013	-	27.8	20.1	21.0	5.8	5.8	1.9	0.0	-0.9	0.7
06/11/2013	-	20.8	23.5	39.3	4.3	-	4.8	1.6	0.7	3.5
07/11/2013	34.4	39.2	37.8	70.6	15.4	15.6	18.1	4.8	4.5	10.7
08/11/2013	45.7	57.2	-	60.7	25.7	-	27.3	6.3	5.4	-
09/11/2013	30.2	39.9	33.4	42.5	11.7	10.3	12.1	1.9	5.1	2.6
10/11/2013	16.7	26.8	18.6	24.8	4.2	5.4	4.3	1.1	0.0	1.5
11/11/2013	11.1	21.3	13.0	21.2	3.9	4.2	4.9	2.6	0.3	1.0
12/11/2013	9.5	15.6	11.3	25.8	4.1	3.8	6.8	3.2	3.3	0.9
13/11/2013	14.5	20.2	18.6	39.5	7.4	8.3	14.9	3.2	4.1	3.3
14/11/2013	16.1	18.0	24.1	24.2	8.0	7.5	6.2	6.1	3.3	7.5
15/11/2013	15.0	19.0	16.9	28.6	3.3	4.3	2.9	4.2	0.3	3.0
16/11/2013	10.1	17.8	11.8	17.7	4.3	3.4	1.2	1.4	0.2	-0.1
17/11/2013	6.2	11.6	6.1	14.0	1.9	1.6	0.6	3.9	1.8	0.2
18/11/2013	9.0	21.0	8.0	17.7	3.4	2.1	1.7	-0.2	2.1	1.3
19/11/2013	10.9	15.2	14.3	15.5	4.8	3.6	3.2	3.0	1.8	0.2
20/11/2013	12.5	15.5	14.4	23.8	4.3	6.0	5.8	-	3.5	4.1
21/11/2013	16.6	19.5	12.7	25.6	5.6	4.8	3.4	3.9	1.4	0.2
22/11/2013	13.3	18.9	11.6	26.5	4.8	3.3	4.4	1.9	3.9	0.9
23/11/2013	-	14.7	8.0	18.1	4.9	2.9	2.8	1.7	8.8	0.0
24/11/2013	-	21.1	17.6	23.2	4.5	6.3	3.4	2.6	0.6	3.0
25/11/2013	-	20.8	17.3	21.1	5.4	6.3	3.5	2.8	0.7	3.8
26/11/2013	19.5	28.2	23.8	25.4	5.7	7.6	4.3	2.7	2.5	2.1
27/11/2013	17.1	18.7	21.2	39.7	5.3	6.4	6.8	-	2.3	6.3
28/11/2013	20.4	37.6	23.1	47.5	7.4	7.4	8.2	6.8	17.4	2.5
29/11/2013	20.0	27.9	26.1	23.4	8.8	8.1	7.5	2.5	1.4	1.5
30/11/2013	12.2	17.8	14.4	20.6	4.2	4.0	3.2	0.0	0.1	1.4
30/11/2013	12.2	17.8	14.4	20.6	4.2	4.0	3.2	0.0	0.1	1.4

- Not Applicable

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

Date	PM_{10} (HVAS) (µg/m³)		
	Steel River	Mayfield	Fullerton St Stockton
06/11/2013	18.0	26.0	18.2
12/11/2013	13.0	25.0	46.4
18/11/2013	6.0	5.0	15.5
24/11/2013	8.0	13.0	19.8
30/11/2013	21.0	26.0	19.2

- Not Applicable

Table C-3: 7 November 1-hour average PM_{10} monitoring data – Fullerton St Stockton

Fullerton St Stockton					Beresfield	Wallsend
Date	Time	WS (m/s)	WD (°)		PM_{10} (µg/m³)	
06/11/2013	24:00	2.5	38.2	45	20.1	10.5
07/11/2013	01:00	1.8	39.7	39	19.3	9.0
07/11/2013	02:00	1.1	24.0	108	19.4	10.3
07/11/2013	03:00	0.7	26.1	27	20.1	9.0
07/11/2013	04:00	1.2	21.4	109	29.1	10.9
07/11/2013	05:00	1.5	176.2	19	21.1	12.0
07/11/2013	06:00	1.7	326.1	47	23.9	14.0
07/11/2013	07:00	1.8	295.8	52	31.0	20.2
07/11/2013	08:00	2.6	322.6	38	23.6	20.1
07/11/2013	09:00	3.4	323.8	34	27.8	18.9
07/11/2013	10:00	2.6	327.2	27	30.8	24.2
07/11/2013	11:00	1.9	210.4	36	36.7	28.8
07/11/2013	12:00	2.6	84.0	37	36.9	41.7
07/11/2013	13:00	4.5	82.5	34	37.9	52.4
07/11/2013	14:00	4.6	73.0	48	56.9	49.6
07/11/2013	15:00	5.2	72.4	58	57.9	53.1
07/11/2013	16:00	5.2	73.3	62	55.1	59.0
07/11/2013	17:00	4.9	71.5	68	52.7	68.8
07/11/2013	18:00	3.8	70.6	70	54.0	73.4
07/11/2013	19:00	2.8	67.2	65	52.4	56.8
07/11/2013	20:00	1.7	52.6	78	43.2	46.3
07/11/2013	21:00	1.8	37.3	111	41.7	28.3
07/11/2013	22:00	1.4	32.7	171	44.3	36.4
07/11/2013	23:00	1.0	54.4	143	44.7	42.5
07/11/2013	24:00	0.8	50.7	184	45.9	39.5
08/11/2013	01:00	1.0	52.6	69	-	38.6

- Not Applicable

Table C-4: 8 November 1-hour average PM_{10} monitoring data

Date	Time	Newcastle		Beresfield	Wallsend	Fullerton St Stockton	Beresfield	Wallsend	Fullerton St Stockton
		WS (m/s)	WD (°)	PM_{10} (µg/m³)			$PM_{2.5}$ (µg/m³)		
07/11/2013	24:00	1.0	51	46.0	45.9	39.5	69.4	31.7	28.6	20.0
08/11/2013	01:00	1.2	40	37.7	-	38.6	104.2	-	23.8	35.0
08/11/2013	02:00	0.6	338	47.9	-	33.9	55.4	-	25.7	21.0
08/11/2013	03:00	1.0	10	42.1	-	35.2	34.2	-	35.0	26.0
08/11/2013	04:00	1.3	344	47.9	-	29.5	58.6	-	31.9	25.0
08/11/2013	05:00	1.5	333	52.8	-	30.9	31.8	-	32.4	26.0
08/11/2013	06:00	1.9	341	48.4	-	49.9	63.5	-	28.0	31.0
08/11/2013	07:00	2.4	345	55.3	-	43.5	61.5	-	25.7	27.0
08/11/2013	08:00	2.9	346	66.6	-	50.5	43.8	-	24.2	23.0
08/11/2013	09:00	2.8	347	70.4	-	53.1	46.2	-	19.9	25.0
08/11/2013	10:00	2.7	5	71.9	71.1	50.8	82.8	35.2	27.1	30.0
08/11/2013	11:00	4.2	53	74.7	60.8	35.1	94.0	28.0	27.9	50.0
08/11/2013	12:00	4.5	56	65.5	40.6	44.4	65.1	27.3	22.5	40.0
08/11/2013	13:00	4.6	63	65.0	41.4	90.0	67.5	29.4	-	38.0
08/11/2013	14:00	5.8	66	59.1	49.1	63.7	73.3	21.8	22.0	27.0
08/11/2013	15:00	5.6	66	54.9	39.8	33.4	69.8	20.6	25.0	17.0
08/11/2013	16:00	4.8	68	57.8	47.8	52.0	47.5	18.3	24.5	24.0
08/11/2013	17:00	4.6	58	64.0	43.7	58.8	73.5	21.8	-	31.0
08/11/2013	18:00	3.7	52	65.7	49.7	22.3	59.5	30.5	17.5	35.0
08/11/2013	19:00	3.1	47	73.6	54.2	45.2	86.7	32.0	34.3	46.0
08/11/2013	20:00	2.7	52	61.3	50.7	47.7	46.2	32.2	31.8	21.0
08/11/2013	21:00	0.5	138	58.3	45.9	44.8	43.4	33.4	27.4	19.0
08/11/2013	22:00	1.6	217	57.5	53.4	47.2	55.5	32.2	23.1	18.0
08/11/2013	23:00	4.9	188	42.1	51.6	56.9	62.5	29.7	20.4	11.0
08/11/2013	24:00	1.9	191	32.3	38.6	38.9	30.1	21.0	15.0	10.0
09/11/2013	01:00	0.1	123	26.0	34.0	30.4	69.3	15.1	11.9	12.0

- Not Applicable