Air quality in Newcastle: Autumn 2017

Air quality in Newcastle from 1 March 2017 to 31 May 2017 was generally good.

- Levels of fine particulate matter $PM_{2.5}$ (particles less than or equal to 2.5 microns in diameter), nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and ammonia (NH_3) were all below benchmark concentrations.
- Daily average levels for particulate matter PM_{10} (particles less than or equal to 10 microns in diameter) were above the 50 µg/m^3 benchmark on 11 days during autumn 2017 (12–13, 15–16, 18–20 and 25 March, 16 and 18 April, and 17 May). These occurred at Stockton, predominantly under northeast winds. Maximum daily PM_{10} levels on these days ranged from 51.1 to 72.2 µg/m^3 and averaged 59.2 µg/m^3. Stockton particle levels are influenced by sea salt from onshore winds.

Days above benchmark concentrations

Stockton recorded 11 days above the PM_{10} daily benchmark during autumn 2017. All other air quality levels remained within the relevant benchmarks in the Newcastle region during autumn 2017.

Table 1: Number of days above the relevant benchmarks – autumn 2017

Station	PM_{10} **daily** [50 µg/m^3 benchmark]	$PM_{2.5}$ **daily** [25 µg/m^3 benchmark]	SO_2 **hourly** [20 pphm benchmark]	SO_2 **daily** [8 pphm benchmark]	NO_2 **hourly** [12 pphm benchmark]	NH_3 **hourly** [46 pphm benchmark]
Beresfield	0	0	0	0	0	-
Carrington	0	0	0	0	0	-
Mayfield	0	0	0	0	0	-
Newcastle	0	0	0	0	0	-
Stockton	11	0	0	0	0	0
Wallsend	0	0	0	0	0	-

µg/m^3 = microgram per cubic metre and pphm = parts per hundred million by volume (i.e. parts of pollutant per hundred million parts of air) - = not monitored

Daily time series plots

Daily average $PM_{2.5}$ and one hour maximum concentrations of NO_2, SO_2 and NH_3 remained below the benchmarks during autumn 2017.

Daily average PM_{10} concentrations were above the benchmark on 11 days during autumn 2017, occurring at Stockton which is influenced by sea salt spray under onshore winds. More information on the elevated particle levels at Stockton is included in a section below.

Hourly NH_3 levels remained below the assessment criteria during autumn 2017, although levels increased in the latter half of the season. This pattern was similar to previous autumn seasons. Hourly levels above 10 pphm (parts per hundred million) occurred during the cooler mornings under light north-westerly winds and generally on days influenced by a high-pressure system, when surface conditions are typically most stable. The Orica ammonia plant at Kooragang ceased production from February to April 2017 during major routine maintenance. The remainder of Orica's Kooragang facility continued to operate during this time.

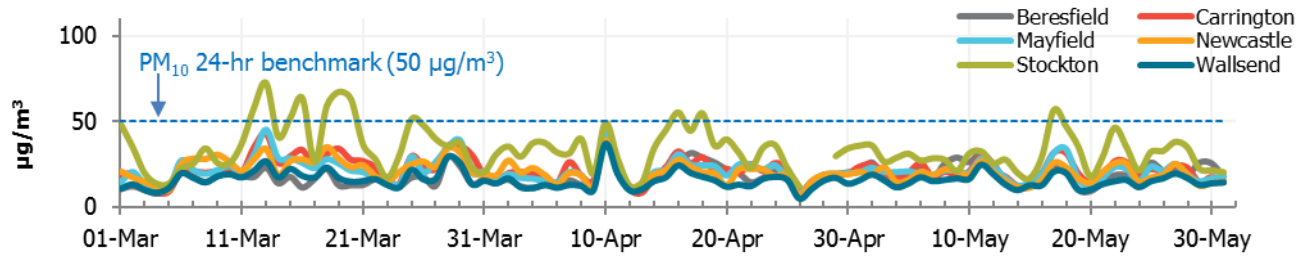

Figure 1: Daily average PM_{10} during autumn 2017

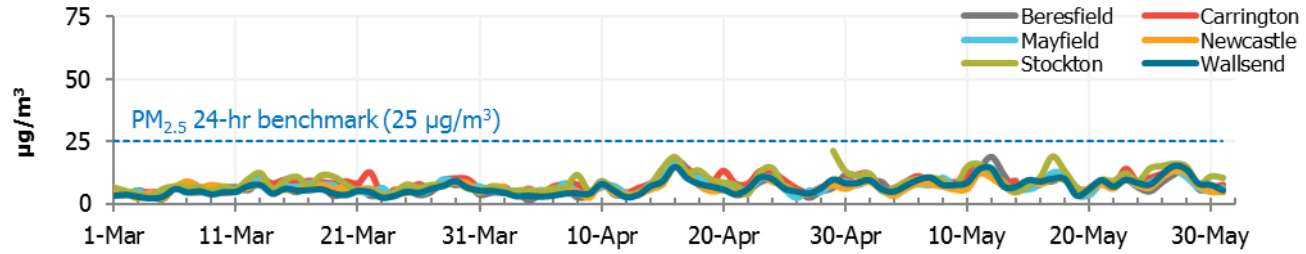

Figure 2: Daily average $PM_{2.5}$ during autumn 2017

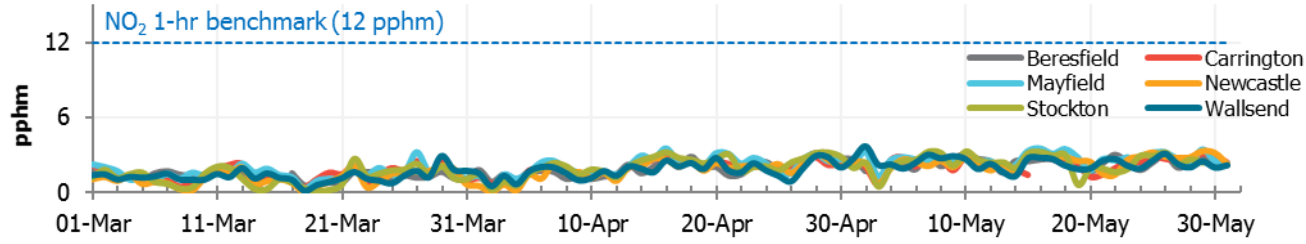

Figure 3: Daily 1-hr maximum NO_2 during autumn 2017

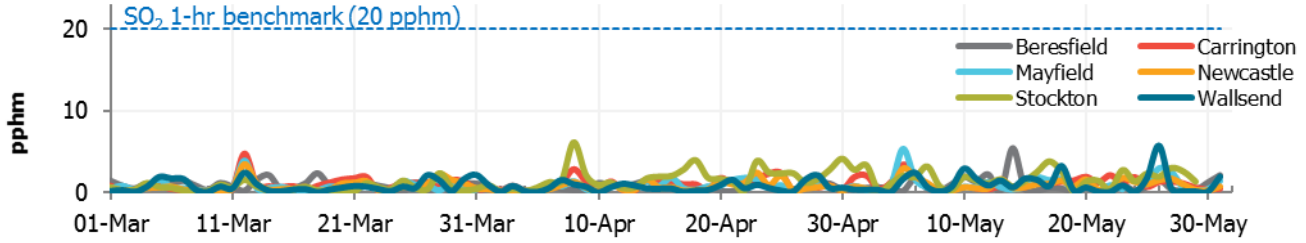

Figure 4: Daily 1-hr maximum SO_2 during autumn 2017

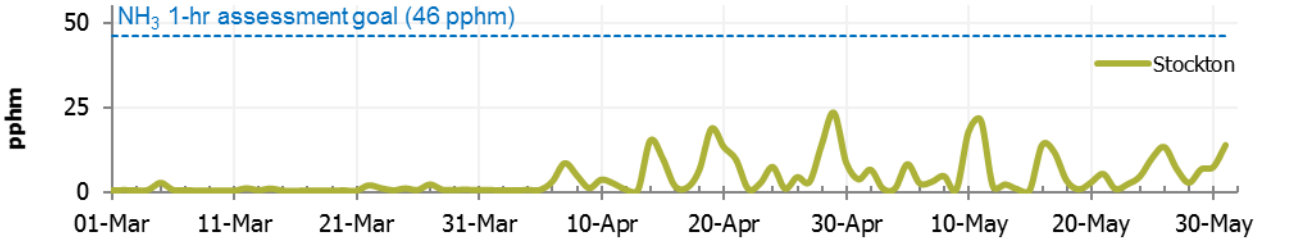

Figure 5: Daily 1-hr maximum NH_3 during autumn 2017

Pollution roses

The seasonal pollution rose maps[1] show that PM_{10} and $PM_{2.5}$ levels generally remained low during autumn. A small portion of elevated hourly PM_{10} levels (>75 µg/m^3)[2] occurred at Stockton under northeast winds.

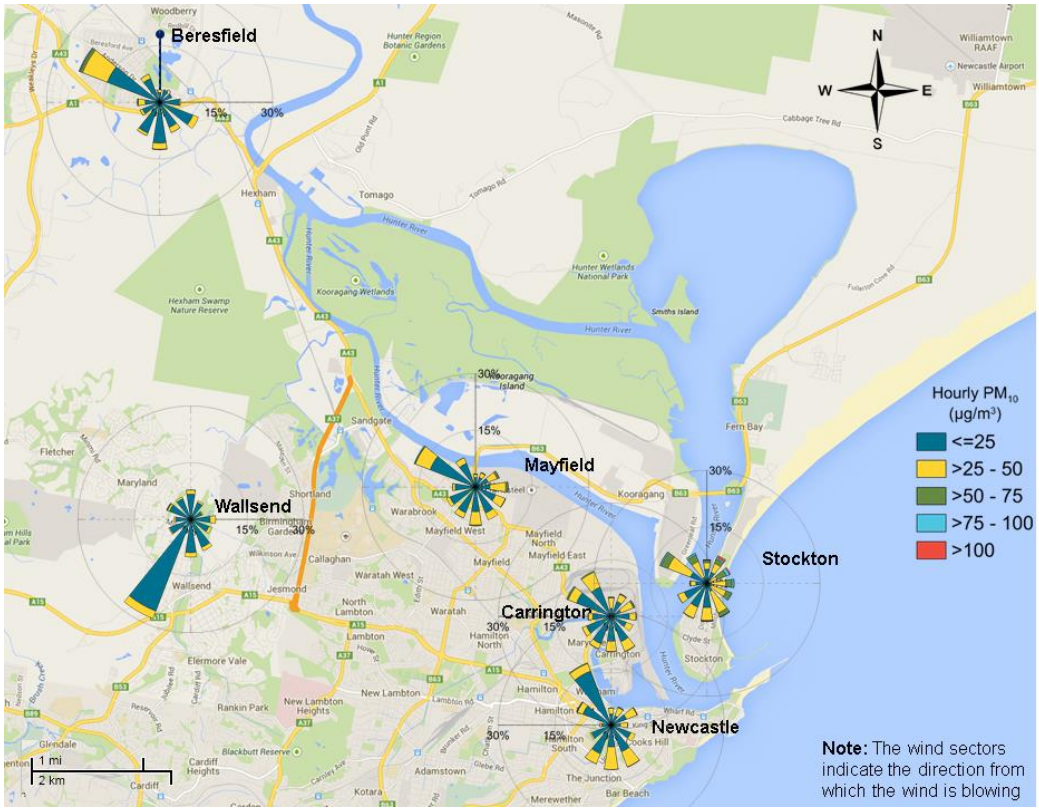

Figure 6: Hourly PM_{10} pollution roses for the Newcastle region for autumn 2017

Figure 7: Hourly $PM_{2.5}$ pollution roses for the Newcastle region for autumn 2017

[1] Pollution roses show the wind direction and particle levels at a location. The length of each bar around the circle shows the percentage of time that the wind blows from a particular direction. The colours along the bars indicate categories of particle levels.

[2] Note: There are no standards for hourly PM_{10}/$PM_{2.5}$ in the National Environment Protection (Ambient Air Quality) Measure (Air NEPM)

Annual air quality trends in the Newcastle region

A comparison of annual average PM_{10} and $PM_{2.5}$ levels shows the trends in particle levels. The benchmarks for annual average particle levels are 25 µg/m^3 for PM_{10} and 8 µg/m^3 for $PM_{2.5}$, based on a calendar year.

Figure 8 shows the PM_{10} and $PM_{2.5}$ *rolling* annual averages, based on the 12-month periods, to the end of autumn for 2014 to 2017. The comparison shows that, although there has been some variability at some sites, particle levels to the end of autumn 2017 are generally consistent with earlier years.

Rolling annual averages are not intended to be compared to the annual benchmarks. The rolling annual averages provide a guide to long term trends, using the most up to date monitoring data.

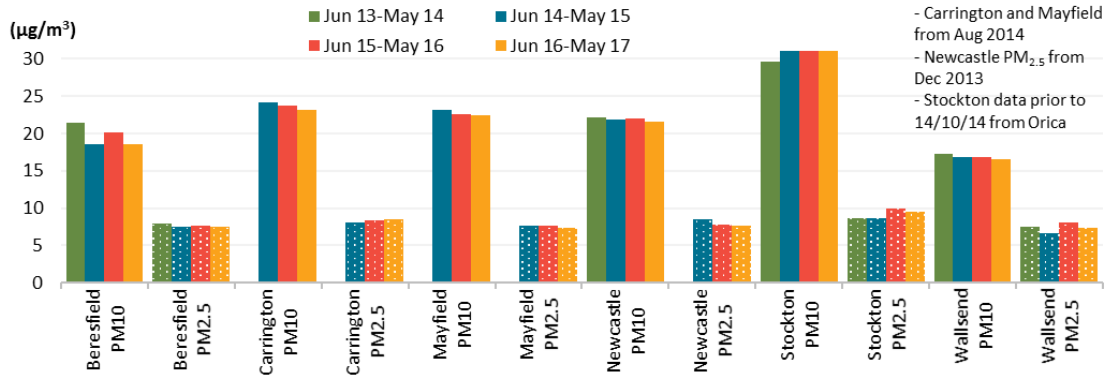

Figure 8: PM_{10} and $PM_{2.5}$ rolling annual averages to the end of autumn 2017

Seasonal comparisons

This section compares air quality levels in autumn 2017 with previous autumn seasons, where data were available. Monitoring at Stockton commenced in October 2012[3] and at Mayfield and Carrington in August 2014. Monitoring of $PM_{2.5}$ at Newcastle commenced in December 2013.

All days were below benchmark concentrations for NO_2 and SO_2 in autumn during the past five years at Beresfield, Newcastle, Stockton and Wallsend and since monitoring began at Carrington and Mayfield. There were no days above the NH_3 assessment criterion at Stockton for the past five autumn seasons.

There were no days above the $PM_{2.5}$ benchmark in the region during autumn 2017. In earlier years, Wallsend recorded one day above the $PM_{2.5}$ benchmark during autumn 2013.

Stockton recorded 11 days above the daily PM_{10} benchmark in autumn 2017. This is lower than autumn 2016 when 27 days were recorded over the benchmark, although similar to autumn 2015 with 10 days over the benchmark. Two days were recorded over the PM_{10} benchmark at Stockton in autumn 2014 and one day in autumn 2013. At the other sites, one day was recorded over the PM_{10} benchmark at all sites in May 2015 during a statewide dust storm.

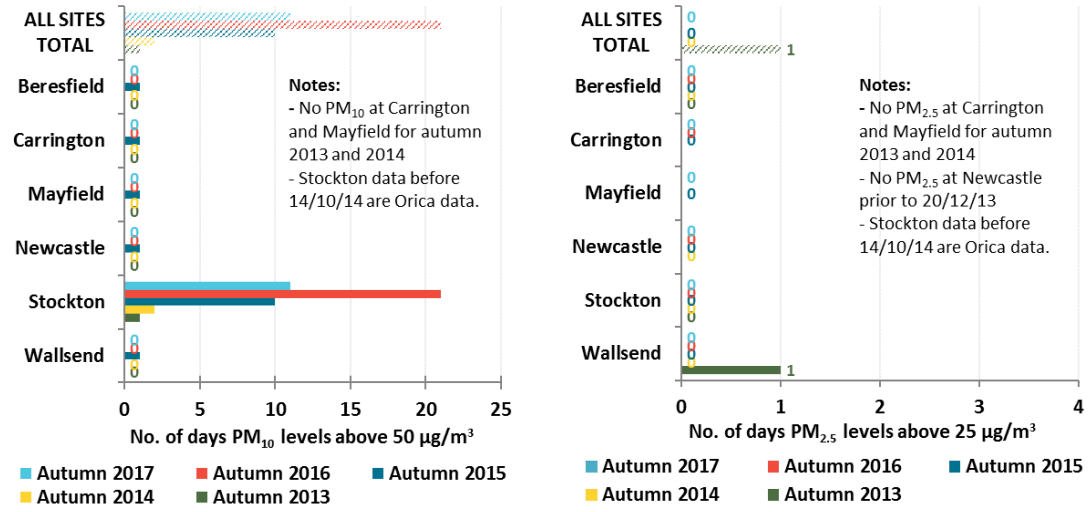

Figure 9: Number of days above the PM_{10} and $PM_{2.5}$ benchmarks: autumn 2017, 2016, 2015, 2014 and 2013

[3] Orica originally undertook Stockton air quality monitoring; from October 2014 it was undertaken by the Office of Environment and Heritage as part of the Newcastle Local Air Quality Monitoring Network.

Autumn particle air quality trends in the Newcastle region

Figure 10 and Figure 11 show daily average levels of PM_{10} during autumn 2017, compared to the daily maximum and minimum (i.e. range) of PM_{10} levels for the autumn periods from 2013 to 2016, at Stockton and Newcastle. These show that daily PM_{10} levels were variable in comparison with the same days in the three previous years, with levels on some days higher than seen in the previous three years, while others lower. This variability may be partly due to the low number of years of historic data available for comparison. Rainfall was well above average in March, average in April and below average in May.

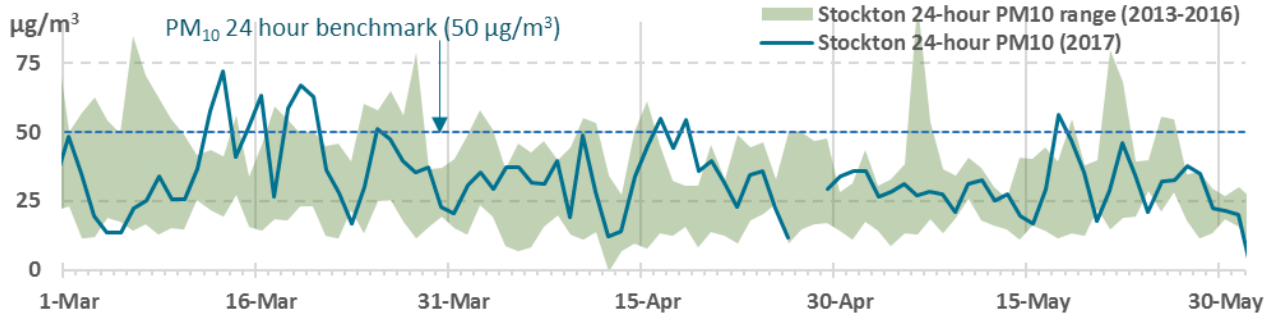

Figure 10: Stockton daily average PM_{10} during autumn 2017 plotted against the daily maximum and minimum PM_{10} levels recorded from autumn 2013 to 2016

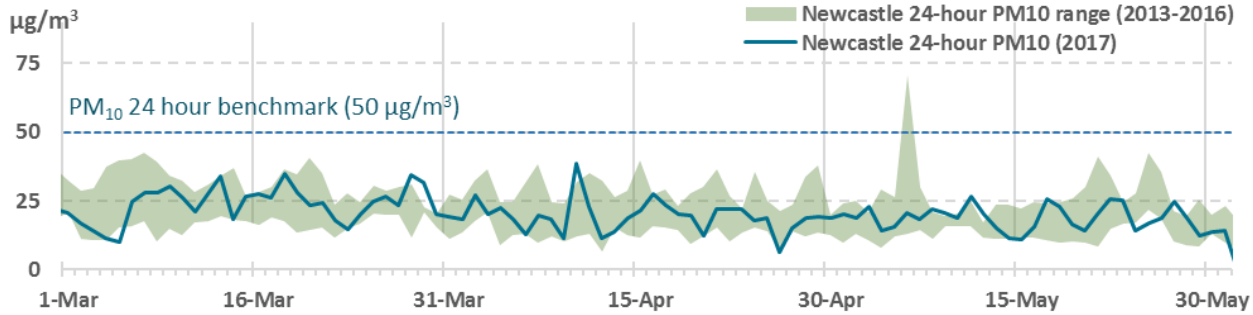

Figure 11: Newcastle daily average PM_{10} during autumn 2017 plotted against the daily maximum and minimum PM_{10} levels recorded from autumn 2013 to 2016

Figure 12 and Figure 13 show daily average levels of $PM_{2.5}$ during autumn 2017, compared to the daily maximum and minimum levels from autumn 2014 to 2016, at Stockton and Newcastle. These show that daily $PM_{2.5}$ levels were generally lower in the first half of autumn 2017 compared to earlier years, especially at Newcastle, although some elevated levels were seen in the latter half.

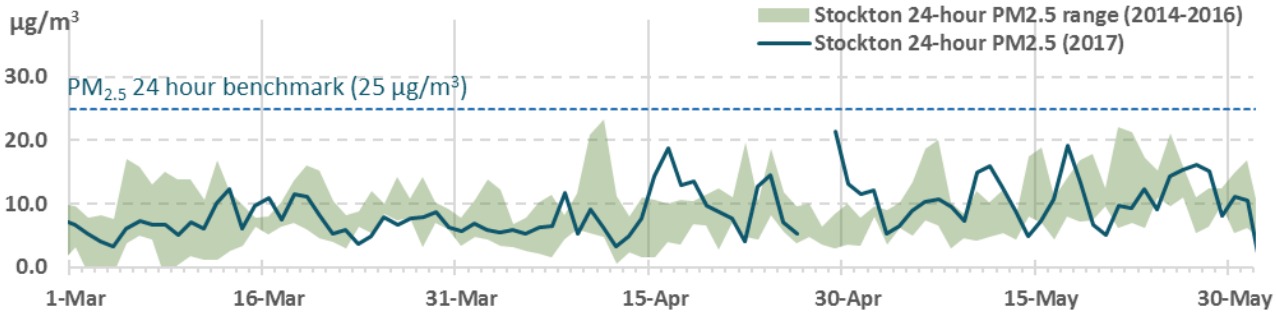

Figure 12: Stockton daily average $PM_{2.5}$ during autumn 2017 plotted against the daily maximum and minimum $PM_{2.5}$ levels recorded from autumn 2014 to 2016

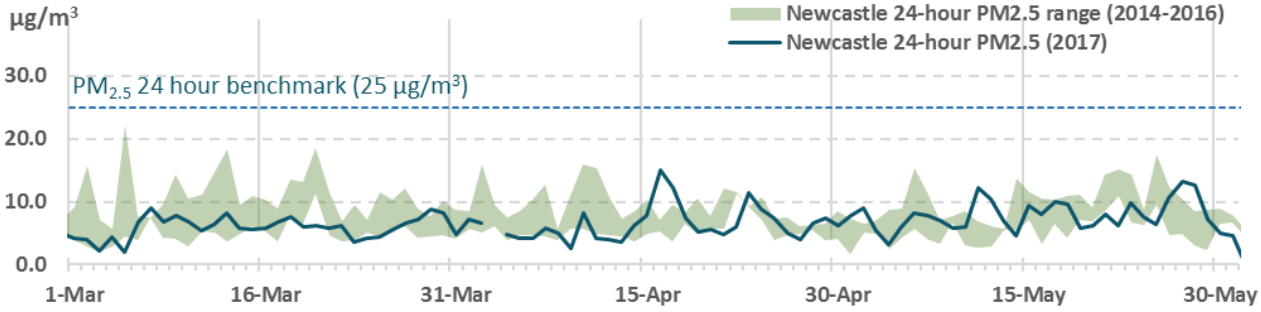

Figure 13: Newcastle daily average $PM_{2.5}$ during autumn 2017 plotted against the daily maximum and minimum $PM_{2.5}$ levels recorded from autumn 2014 to 2016

Meteorological summary

Rainfall and temperature[4]

The Newcastle region generally experienced average rainfall during autumn 2017 compared to the long-term records. However, there was variability through the season with rainfall very much above average in March and below to very much below average in May. Autumn 2017 was wetter compared to autumn 2016 with 200 to 400 millimetres more rain, while drier than autumn 2015 with 200 to 400 millimetres less rain.

Maximum temperatures in Newcastle were average to above average and minimum temperatures were above average during the season.

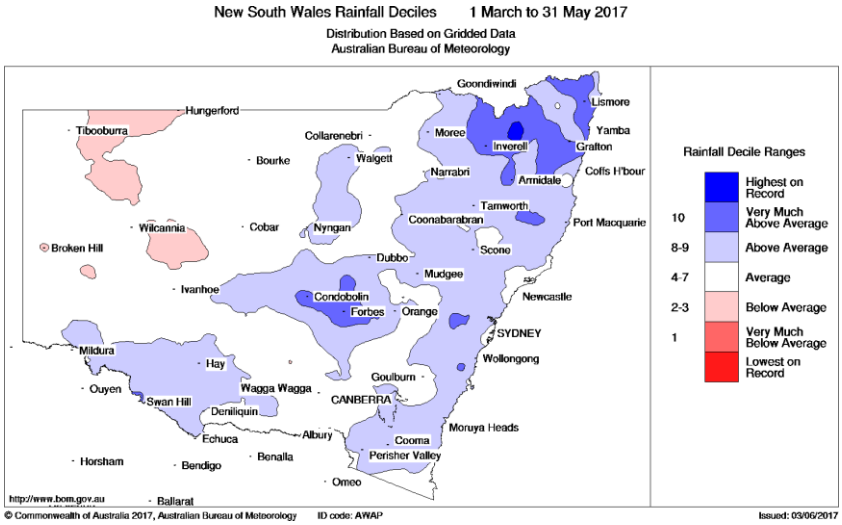

Figure 14: NSW rainfall deciles – autumn 2017

Wind

The winds were variable in the region during autumn 2017. Winds typically change from onshore easterly flows during the warmer months to offshore westerly flows as conditions cool. As an example, Figure 15 shows that at Stockton, easterly component winds prevailed 35% of the time and these were moderate (above five metres per second) 5% of the time.

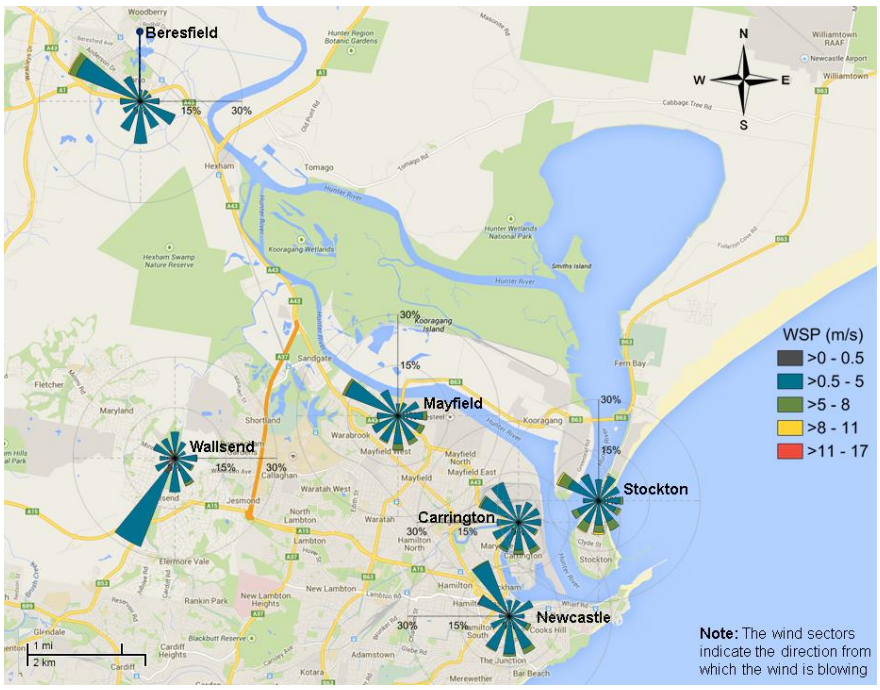

Figure 15: Wind rose map[5] for the Newcastle region for autumn 2017

[4] Rainfall and temperature information are from the Bureau of Meteorology New South Wales autumn 2017 climate statement and climate maps (accessed June 2017).

[5] Wind roses show the wind direction and speed at a location. The length of each bar around the circle in these wind roses show the percentage of time that the wind blows from a particular direction. The colours along the bars indicate the wind speed categories.

Stockton

The Stockton monitoring site continued to record a higher number of days over the PM_{10} benchmark compared to other sites in the region.

In autumn 2017, elevated hourly PM_{10} levels (>75 µg/m^3)[6] occurred 4.4% of the time. The majority of these, approximately 64% of the time, occurred under onshore easterly component winds (Figure 16). This indicates the potential contribution of sea salt, with the Lower Hunter Particle Characterisation Study finding sea salt to be a major contributor of particles at the site.

Elevated hourly PM_{10} levels were from the northwest sector 1% of time during the season.

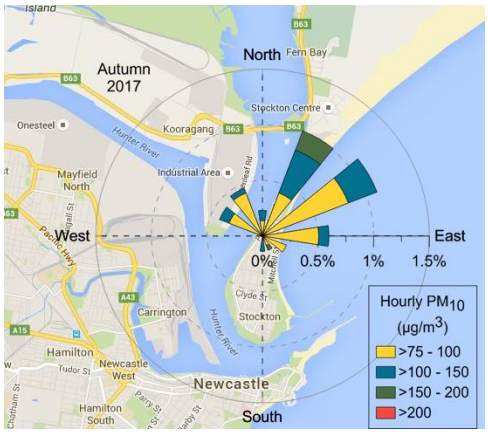

Figure 16: Stockton autumn 2017 pollution rose – proportion of hourly averaged PM_{10} levels >75 µg/m^3 by wind direction

Network performance

The target network performance is at least 95% available data for all parameters. For NO_2, SO_2 and NH_3, due to daily calibrations, the maximum online time that can be attained is 96%.

Table 2: Online performance (%) during autumn 2017

Station	Particles PM_{10} daily	Particles $PM_{2.5}$ daily	Gases SO_2 hourly	Gases NO_2 hourly	Gases NH_3 hourly	Meteorology Wind hourly
Beresfield	100	100	95	92	-	100
Carrington	100	95	92	92	-	88
Mayfield	100	100	94	94	-	99
Newcastle	100	99	95	95	-	100
Stockton	98	98	94	94	94	100
Wallsend	100	100	96	95	-	100

- = not monitored

The reduced online times were mainly due to:

- Carrington $PM_{2.5}$ – maintenance issue (four days)
- Carrington wind – sensor damage (10 days).

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[6] 75 µg/m^3 was chosen as a lower cut-off point to highlight only those hours with relatively elevated hourly PM_{10} levels. There is no standard for hourly PM_{10} in the National Environment Protection (Ambient Air Quality) Measure (Air NEPM).