

Good air quality in NSW during 2015

Data from the NSW Government's air quality monitoring network show that air quality in NSW during 2015 was good by international standards. The Air Quality Index was in the very good, good or fair category for at least 95 per cent of the time in the Sydney and Hunter regions and close to 100 per cent of the time in all other regions, demonstrating that air quality consistently meets relevant standards¹.

There were no exceedances of the nitrogen dioxide, sulfur dioxide and carbon monoxide standards, with levels remaining well below the relevant standards.

Ozone and particle levels occasionally exceeded the national standards in some areas.

In Sydney, daily PM_{2.5} (fine particle) levels met the new national daily standard of 25 micrograms per cubic metre ($\mu\text{g}/\text{m}^3$) on 361 days (99 per cent of days), while daily PM₁₀ (coarse particle) levels met the daily standard of 50 $\mu\text{g}/\text{m}^3$ on all days except 6 May (due to a dust storm) and 26 November (due to bushfires in the Illawarra and Hunter Valley).

Annual average PM₁₀ levels were below 25 $\mu\text{g}/\text{m}^3$ (the new national annual standard) at all sites across NSW except Stockton, where sea salt spray adds significantly to particle levels.

Annual average PM_{2.5} levels were slightly above the new national standard of 8 $\mu\text{g}/\text{m}^3$ at some sites in Sydney and at some sites of the Hunter Valley, but were below the standard in the Illawarra, Central Coast, rural NSW and other sites in Sydney and the Hunter Valley.

In preparation for the introduction of the new national standards the Office of Environment and Heritage has expanded PM_{2.5} monitoring by adding new monitors across the State.

Two significant particle pollution events – a dust storm on 5 and 6 May and extensive hazard reduction burning in late August – resulted in particle levels above the standards across much of the State, highlighting the impacts that exceptional events can have on air quality. Under new national standards, exceptional events such as these will be reported but not included in reporting compliance against standards.

The highest daily PM₁₀ of the year was recorded at Wagga Wagga (145 $\mu\text{g}/\text{m}^3$) during the 5 and 6 May dust storm event. The highest daily PM_{2.5} was recorded in Sydney at Chullora (37 $\mu\text{g}/\text{m}^3$) during widespread hazard reduction burning on 21 August.

Ozone levels above the standard occurred on at one or more sites on three days. Ozone levels peak in the warmer months from October to March. On 6 October an early season heatwave resulted in high ozone on the Central Coast, in eastern Sydney and Wollongong. This was the earliest ozone event seen in Sydney since 1987 and in Wollongong since 2000.

Ozone levels remained below the standard across Western Sydney and in the Lower Hunter throughout the year.

NSW climate in 2015

In 2015, NSW recorded temperatures were well above average while rainfall was close to average across the state.

¹ The Air Quality Index tracks multiple pollutants. If the level of pollutant exceeds its relevant standard, the whole AQI is recorded 100 or more and as POOR. Often during POOR pollutant events only one pollutant has exceeded a standard.

Statewide, the 2015 mean temperature was the equal seventh warmest on record. Overall, 2015 temperatures were in the warmest 10 per cent of years. Notable events included heatwaves in March, October (the warmest on record) and November and east coast lows in April, May and August that caused significant localised rainfall (BOM 2016).

The year began with a wet summer in NSW, particularly on the coast, and although temperatures were above average overall, they were closer to average in the east (BOM 2015a). During autumn, statewide temperatures were close to average and although rainfall was below average overall, several east coast lows caused severe coastal weather with well above average totals experienced in the Sydney, Hunter and New England regions (BOM 2015b). Rainfall and maximum temperatures during winter were close to average, with two significant cold outbreaks in July producing widespread snow across the tablelands (BOM 2015c). NSW experienced the second warmest spring on record, with several notable heatwaves including one in October when numerous early-season temperature records were broken. Rainfall was below average overall, although high in November (BOM 2015d).

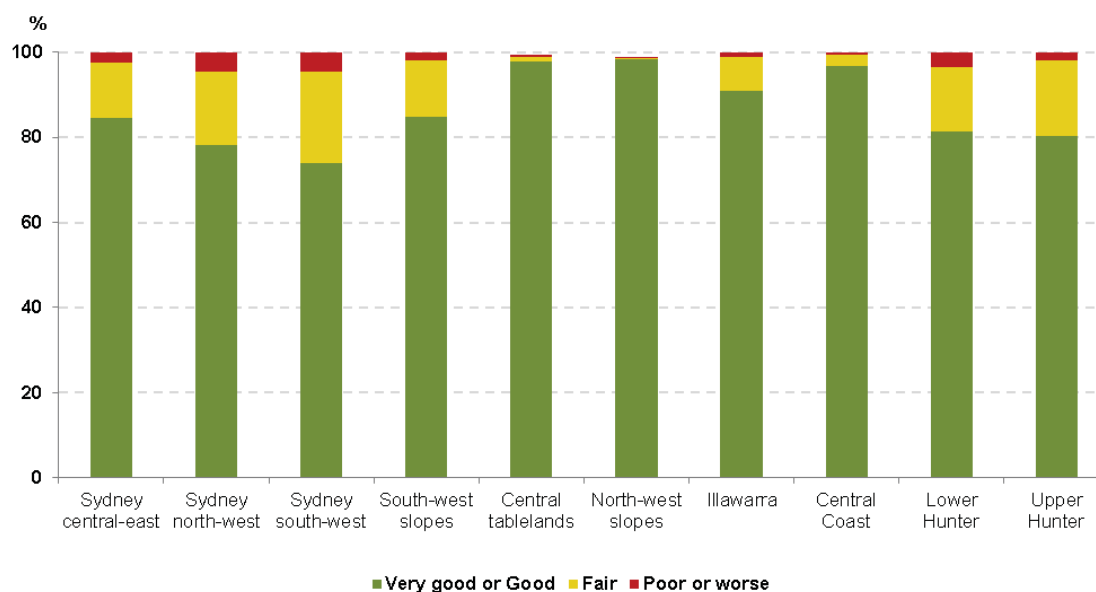
Air Quality Index

Most parts of NSW experienced good air quality during 2015. The Air Quality Index (AQI) was in the very good, good or fair category for at least 95 per cent of the time in the Sydney and Hunter regions and close to 100 per cent of the time in all other regions, demonstrating that air quality consistently meets relevant standards².

The AQI provides a comparison of air pollutants, standardising measurements of ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, air particles and visibility into one easy-to-understand index. An AQI of 100 or above indicates that one or more air pollutants have exceeded relevant standards. AQI values above 200 indicate that air quality is in the hazardous category, and people sensitive to air pollution are advised to avoid all outdoor physical activities. Find out more [about the AQI](#) on the OEH website.

AQI levels reached the hazardous category at one or more stations on nine days: six in Sydney, two in the Lower Hunter and one day on the South-west Slopes. These days were mostly associated with bushfires, hazard reduction burns and the dust storm of 5 and 6 May 2015 (OEH2015a,b).

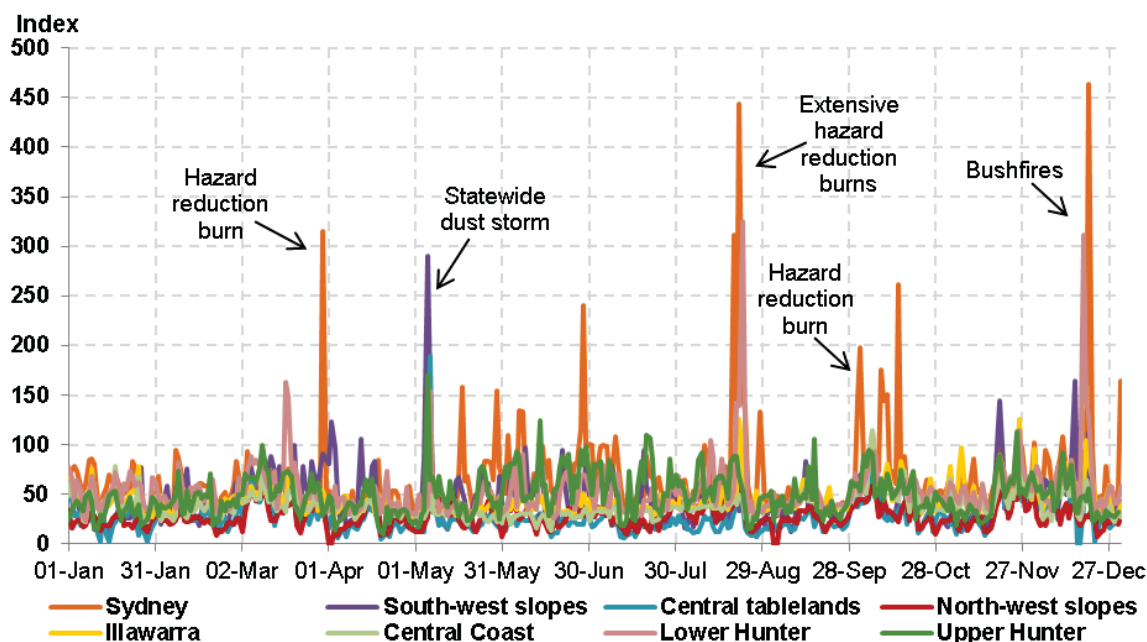
Figure 1: 2015 AQI categories as a percentage of time in each region



Note: Lower Hunter AQI: Newcastle, Beresfield and Wallsend data. Upper Hunter AQI: Muswellbrook and Singleton data

² See footnote 1

Figure 2: Regional AQI time series during 2015



Note: Sydney AQI levels are based on Sydney Central-east, Sydney South-west and Sydney North-west; Lower Hunter AQI levels use data from Beresfield, Newcastle and Wallsend; Upper Hunter AQI based on Muswellbrook and Singleton data

Ozone pollution

Ozone levels above national standards were recorded on three days during 2015. An early season heatwave led to widespread high ozone along the coast on 6 October.

Ozone levels remained below the standard across Western Sydney and in the Lower Hunter throughout the year.

On 6 October 2015 ozone levels above the national standards were seen at monitoring sites along the coast from Wyong through eastern Sydney and down to Wollongong (Table 1). Hourly ozone levels peaked at 11.3 parts per hundred million (pphm) at Randwick and 4-hour levels reached 9.1 pphm at Wyong and 8.3 pphm in Wollongong. This was the earliest ozone event seen in Sydney since 1987, and the earliest seen in Wollongong since 2000.

The event occurred during a period of record breaking early season extreme heat across southern Australia (BOM 2015e). The day was unseasonably hot with temperatures reaching 37°C in western Sydney and low to mid 30s on the coast. A high pressure system centred over the Tasman Sea directed hot north-westerly winds from inland Australia across NSW.

Usually on hot days air pollution is transported to western Sydney by north-easterly sea breezes. On 6 October the moderate north-westerly winds stopped typical sea-breeze formation in Sydney and sea breezes did not penetrate further inland than the immediate coastal region. As a result, elevated ozone levels were atypically confined to coastal sites.

Table 1: Days above the 1-hour and 4-hour ozone standards – 2015

Date	Stations where 1-hour average ozone standard exceeded (10 pphm)	Stations where 4-hour average ozone standard exceeded (8 pphm)
06/10/2015	Randwick (11.3)	Lindfield (8.3), Randwick (8.5), Wollongong (8.3), Wyong (9.1)
01/12/2015		Earlwood (8.2)
19/12/2015	Kembla Grange (10.4)	

Particle pollution

Particle levels met the national annual goal for PM₁₀ at all NEPM* stations except Wagga Wagga North and Stockton, while levels above the annual and daily PM_{2.5} standards were recorded at some stations in Sydney, the Illawarra and the Hunter Valley.

Daily PM₁₀ levels above the national standard of 50 µg/m³ were recorded for at least one day at most sites throughout the network in 2015. This was mainly a result of a statewide dust storm that originated from the Victorian Mallee and southern NSW regions and travelled throughout NSW during the 5 and 6 May (OEH2015a,b) (Table 2).

Table 2: Summary of PM₁₀ and PM_{2.5} observations in NSW – 2015

Region	Station	PM ₁₀				PM _{2.5}			
		Annual avg (µg/m ³)	Max. daily avg (µg/m ³)	Date of max	Days above standard	Annual avg. (µg/m ³)	Max. daily avg (µg/m ³)	Date of max	Days above standard
Sydney	Bargo	13.4	52.2	6 May	2				
Sydney	Bringelly	15.8	57.0	6 May	1				
Sydney	Camden	13.9	62.4	6 May	1	6.2	25.0	22 Aug	0
Sydney	Campbelltown W	15.6	69.8	6 May	1	–	15.7	10 Oct	0
Sydney	Chullora	17.5	64.6	6 May	1	8.0	37.2	21 Aug	1
Sydney	Earlwood	17.2	66.5	6 May	1	8.5	28.0	21 Aug	2
Sydney	Lindfield	14.0	56.4	6 May	1				
Sydney	Liverpool	18.5	68.6	6 May	1	8.5	32.2	21 Aug	2
Sydney	Oakdale	11.4	61.7	6 May	1				
Sydney	Prospect	17.6	68.7	6 May	1	8.2	29.6	28 Jun	1
Sydney	Randwick	18.6	77.4	6 May	1				
Sydney	Richmond	12.8	49.3	6 May	0	7.7	24.5	6 Jul	0
Sydney	Rozelle	16.7	60.3	6 May	1	7.2	33.4	21 Aug	1
Sydney	St Marys	15.0	53.0	6 May	1				
Sydney	Vineyard	15.9	59.0	6 May	1				
Illawarra	Albion Park S	14.0	41.2	26 Nov	0	6.4	21.1	21 Aug	0
Illawarra	Kembla Grange	17.8	62.8	26 Nov	1	–	23.8	21 Aug	0
Illawarra	Wollongong	16.9	45.8	6 May	0	7.6	31.6	21 Aug	1
Central Coast	Wyong	14.9	58.6	6 May	1	5.2	13.2	9 Mar	0
Newcastle	Beresfield	18.8	64.9	6 May	2	7.3	25.9	21 Aug	1
Newcastle	Carrington	22.8	80.6	6 May	4	8.1	30.7	22 Aug	1
Newcastle	Mayfield	21.7	84.8	6 May	4	7.4	30.2	20 Dec	2
Newcastle	Newcastle	21.4	70.4	6 May	3	7.8	28.4	22 Aug	1
Newcastle	Stockton	35.8	101.4	4 Oct	67	9.5	30.9	5 Jul	3
Newcastle	Wallsend	16.7	77.5	6 May	1	7.3	24.0	22 Aug	0
Upper Hunter	Aberdeen	15.2	64.8	6 May	1				
Upper Hunter	Camberwell*	22.0*	86.7*	6 May	11*	7.2*	23.9*	10 Mar	0*
Upper Hunter	Muswellbrook	19.1	72.6	6 May	2	8.7	31.2	14 Jun	3
Upper Hunter	Singleton	19.3	85.3	6 May	3	7.6	24.9	10 Mar	0
Rural NSW	Albury	14.6	92.5	5 May	2				
Rural NSW	Bathurst	13.4	94.6	6 May	2				
Rural NSW	Tamworth	14.1	52.7	6 May	1				
Rural NSW	Wagga Wagga N	19.9	145.1	5 May	7	7.6	24.2	8 Jun	0

Note: Levels above the standards are shown in **bold**.

– Annual average not reported (<75 per cent of data available as PM_{2.5} monitoring only began this year)

* Camberwell is a Small Upper Hunter Air Quality Monitoring Network community monitoring station which is not suitable for assessing performance against NEPM standards (see below, *Focus: Hunter Valley*)

The maximum daily PM₁₀ level during this dust storm was 145.1 µg/m³ recorded at Wagga Wagga North on 5 May.

Excluding this dust storm event, a similar or lower number of days above the PM₁₀ national standard occurred at all sites during 2015 compared to 2014.

To account for natural events, the national goal prior to 15 December 2015 allowed for up to five days each year when PM₁₀ can be above the standard. By this measure, all stations except Wagga Wagga North and Stockton met the goal in 2015 (Table 2). At Wagga Wagga particle levels are impacted by broad-scale agricultural activities (including stubble burning) and wood smoke emissions during the cooler months. At Stockton, particle levels are higher due to sea salt spray, mainly during the warmer months when onshore flows are predominant.

Annual average PM₁₀ levels were below 25 µg/m³ (the new standard) at all stations except Stockton (see below). Annual average PM₁₀ levels are higher in the Hunter Valley than elsewhere in the State.

During 2015, daily PM_{2.5} levels above the standard were occasionally recorded at some stations in Sydney, the Illawarra and the Hunter Valley (Table 2). Muswellbrook and Stockton recorded the most days above the standard (three days), followed by Earlwood, Liverpool and Mayfield (two days) and one day each at Chullora, Prospect, Rozelle, Wollongong, Beresfield, Carrington and Newcastle.

The maximum daily PM_{2.5} was 37.2 µg/m³ at Chullora on 21 August. On 21 and 22 August, the majority of sites in the Sydney, Illawarra and Lower Hunter regions recorded elevated PM_{2.5} values as a result of smoke from a number of large hazard reduction burns (RFS 2015b). Compared with 2014, more stations recorded days above the PM_{2.5} standard in 2015, due mainly to the hazard reduction burning over the weekend of 21 and 22 August.

Annual average PM_{2.5} levels were above the national standard at some stations in Sydney – Chullora (8.0 µg/m³), Earlwood (8.5 µg/m³), Liverpool (8.5 µg/m³), Prospect (8.2 µg/m³); at two stations in Newcastle – Carrington (8.1 µg/m³), Stockton (9.5 µg/m³); and at Muswellbrook (8.7 µg/m³).

Focus: Hunter Valley air quality

While levels of ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide in the Hunter Valley remained below national standards, particle levels in the Hunter Valley did exceed national standards at some stations.

Annual average PM_{2.5} levels in Stockton are higher than at other locations in the Hunter Valley. The main sources of PM_{2.5} within the Hunter are combustion related (transport, industry, wood fired heaters, bushfires) and natural (sea salt). PM₁₀ levels at the Upper Hunter monitoring stations that are closer to mines are generally higher than elsewhere in the region.

Larger population centres

Monitoring at larger population centres in the Hunter Valley during 2015 showed the following:

- All Hunter stations, except Stockton, met the PM₁₀ goal of five or less days over the standard (Table 2).
- Annual average PM₁₀ levels were below 25 µg/m³ (the new standard) at all stations except Stockton (see below).
- The maximum daily average PM₁₀ in the Upper Hunter was 85.3 µg/m³ (Singleton 6 May) and 101.4 µg/m³ in Newcastle (Stockton 4 October).
- Daily average PM₁₀ levels were above national standards on eight days at one or more large population centres (excluding Stockton – see below) compared to seven days in 2014.
- Levels were above the daily average PM₁₀ standard at Stockton on 67 days in 2015, mainly due to sea salt spray under predominant onshore flows in the warmer months.
- Levels above the PM_{2.5} daily national standard were recorded on occasion at Beresfield, Carrington, Mayfield, Newcastle, Stockton and Muswellbrook, while Carrington, Stockton and Muswellbrook also recorded PM_{2.5} levels above the annual standard (Table 2).
- Across the Hunter there were nine days during 2015 when daily PM_{2.5} levels exceeded the standard at one or more sites (Table 4), compared to six days during 2014. In the cooler months, use of wood-fired heaters influences PM_{2.5} levels at upper Hunter sites; elevated PM_{2.5} levels at Stockton were associated with north-westerly winds. Fires in August likely impacted PM_{2.5} levels throughout the region.
- A statewide dust storm originating from the Victorian Mallee and south west NSW region contributed to high PM₁₀ levels on 6 May (OEH2015a,b). Smoke from a bushfire near Kurri Kurri (RFS2015b) led to elevated PM₁₀ levels in the Hunter region on 26 November. High daily PM_{2.5} at Muswellbrook on other days occurred overnight under generally calm conditions, and was most likely from smoke from residential wood fires.

Small community and diagnostic sites in the Upper Hunter

Although comparing data from small community and diagnostic stations in the Upper Hunter Air Quality Monitoring Network (UHAQMN) with the National Environment Protection (Ambient Air Quality) Measure (Air NEPM) standards is not recommended, OEH recognises that there is a desire within the community to assess how pollution levels at these stations compare with the standards. Table 5 summarises daily PM₁₀ data from the smaller community, background and diagnostic stations within the UHAQMN.

During 2015, there were 17 days in the Upper Hunter when PM₁₀ levels above the standard were recorded at one or more stations (Table 6), an improvement compared to 26 days in 2014. Over 80 per cent of these events (14 days) occurred exclusively at stations designated as small community and diagnostic sites. Camberwell, Mount Thorley and Maison Dieu recorded the greatest number of days when levels were above the benchmark.

The most widespread event occurred on 6 May, when all stations reported levels above the daily PM₁₀ standard. Elevated particle levels on this day occurred as a result of a statewide dust storm that originated from the Victorian Mallee and south-west NSW (OEH2015a,b), with levels rising in the early morning, under south-west to north-west winds.

Table 3: Days above the PM₁₀ standard at Hunter Valley large population centres – 2015

Date	Stations exceeding the daily average PM ₁₀ national standard of 50 µg/m ³ (Values in brackets are the actual daily average at each station on the day.)
1/01/2015	Carrington (50.3)
6/05/2015	Aberdeen (64.8), Beresfield (64.9), Carrington (80.6), Mayfield (84.8), Muswellbrook (72.6), Newcastle (70.5), Singleton (85.3), Wallsend (77.5)
22/08/2015	Carrington (54.9)
17/09/2015	Singleton (53)
19/11/2015	Mayfield (52.7)
25/11/2015	Newcastle (54.8)
26/11/2015	Beresfield (57.5), Carrington (56.4), Mayfield (51.3), Muswellbrook (56.3), Newcastle (51.5), Singleton (51.4)
27/11/2015	Mayfield (53.8)

Table 4: Days above the PM_{2.5} reporting standard at Hunter Valley stations – 2015

Date	Stations exceeding the daily average PM _{2.5} national standard of 25 µg/m ³ (Values in brackets are the actual daily average at each station on the day.)
14/06/2015	Muswellbrook (31.2)
27/06/2015	Stockton (27.0)
4/07/2015	Stockton (27.4)
5/07/2015	Stockton (30.9)
21/07/2015	Muswellbrook (27.3)
22/07/2015	Muswellbrook (26.7)
21/08/2015	Beresfield (25.9)
22/08/2015	Carrington (30.7), Mayfield (27.7), Newcastle (28.4)
20/12/2015	Mayfield (30.2)

Table 5: Summary of PM₁₀ levels at Upper Hunter small community, background and diagnostic sites – 2015

Station type	Station	Annual average (µg/m ³)	Max daily avg PM ₁₀ (µg/m ³)	Date of maximum	6 th highest daily avg (µg/m ³)	Date of 6 th highest	Days above standard
Small community	Bulga	15.0	60.6	6/05/2015	35.8	10/03/2015	2
Small community	Camberwell	22.0	86.7	6/05/2015	55.8	1/12/2015	11
Small community	Jerrys Plains	15.5	70.0	6/05/2015	40.5	17/10/2015	1
Small community	Maison Dieu	20.4	77.3	6/05/2015	48.6	1/12/2015	5
Small community	Warkworth	18.2	68.2	6/05/2015	41.5	10/03/2015	3
Small community	Wybong	14.8	79.4	6/05/2015	41.5	12/12/2015	1
Background sites	Merriwa	13.2	83.0	6/05/2015	33.8	7/10/2015	1
Background sites	Singleton South	16.9	82.5	6/05/2015	37.5	5/10/2015	2
Diagnostic sites	Mount Thorley	19.8	85.2	6/05/2015	54.4	5/10/2015	7
Diagnostic sites	Muswellbrook NW	16.7	72.9	6/05/2015	38.3	7/10/2015	2
Diagnostic sites	Singleton NW	20.9	84.0	6/05/2015	46.4	1/12/2015	4

Note: Levels above the daily average PM₁₀ standard of 50 µg/m³ are shown in **bold**.

Table 6: Days above the PM₁₀ benchmark in the Upper Hunter – 2015

Date	Stations with daily average PM ₁₀ levels above 50 µg/m ³ (Values in brackets are the actual daily average at each station on the day.)
6/03/2015	Camberwell (57.1)
27/03/2015	Camberwell (57.5)
6/05/2015	Aberdeen (64.8), Bulga (60.6), Camberwell (86.7), Jerrys Plains (70), Maison Dieu (77.3), Merriwa (83), Mount Thorley (85.2), Muswellbrook (72.6), Muswellbrook NW (72.9), Singleton (85.3), Singleton NW (84), Singleton South (82.5), Warkworth (68.2), Wybong (79.5)
22/08/2015	Camberwell (51.4)
17/09/2015	Singleton (53)
4/10/2015	Camberwell (50.1), Mount Thorley (55.9)
5/10/2015	Mount Thorley (54.4)
6/10/2015	Maison Dieu (53.1), Mount Thorley (67), Singleton NW (63.1)
7/10/2015	Maison Dieu (65.4), Mount Thorley (64.4), Warkworth (52.7)
12/10/2015	Camberwell (53.3)
17/10/2015	Mount Thorley (53.1)
20/11/2015	Camberwell (62.8), Singleton NW (59.3)
25/11/2015	Camberwell (54.9)
26/11/2015	Camberwell (72.1), Maison Dieu (75.4), Mount Thorley (68.1), Muswellbrook (56.3), Muswellbrook NW (50.9), Singleton (51.4), Singleton NW (79.9), Singleton South (54.8)
1/12/2015	Camberwell (55.8)
11/12/2015	Camberwell (52.9), Maison Dieu (63.3)
15/12/2015	Bulga (57.6), Warkworth (54.0)

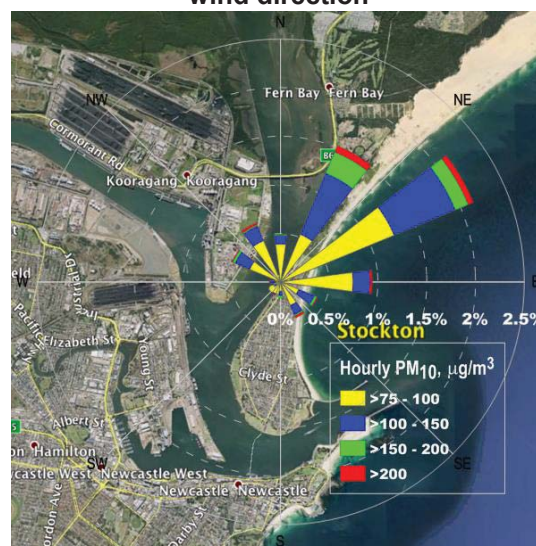
Key: Large population centre site, small community site, diagnostic site, background site

Stockton air quality

The Stockton station is located close to the coast. High PM₁₀ levels at the station are more often associated with north-easterly winds and exposure to sea salt spray as indicated in the pollution rose in Figure 3.

In 2015, the PM₁₀ particle levels were over the daily national standard at Stockton on 67 days and the PM₁₀ annual average was 35.8 µg/m³. The relative contribution of sea salt to particle levels in the Newcastle region will be better understood once the [Lower Hunter Particle Characterisation Study](#) is complete.

Figure 3: Hourly PM₁₀ levels >75 µg/m³ and wind direction



More information

Data from the NSW air quality monitoring network is updated hourly and made available online by the OEH at <http://www.environment.nsw.gov.au/AQMS/aqi.htm>. You can also subscribe to automated email and/or SMS air pollution alerts at <http://www.environment.nsw.gov.au/aqms/subscribe.htm>.

Information about sources of emissions in NSW is available from the NSW Air Emissions Inventory: <http://www.epa.nsw.gov.au/air/airinventory.htm>

Information about the principles and programs used in NSW to manage particle pollution is available at <http://www.epa.nsw.gov.au/air/20130784ManPartStr.htm>

Information about sources and actions to reduce emissions in the Upper Hunter: <http://www.environment.nsw.gov.au/aqms/uhaqmnfpcs.htm>.
<http://www.epa.nsw.gov.au/aqms/130158uphunta.htm>

Information about research into particle pollution is available at <http://www.environment.nsw.gov.au/aqms/uhaqmnfpcs.htm>
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Published by:

Office of Environment and Heritage

59 Goulburn Street, Sydney NSW 2000

PO Box A290, Sydney South NSW 1232

Phone: (02) 9995 5000 (switchboard)

Phone: 131 555 (environment information and publications requests)

Phone: 1300 361 967 (national parks, general environmental enquiries, and publications requests)

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