

Air quality in the Upper Hunter: Winter 2020

Air quality in the Upper Hunter was generally good during winter 2020. Daily particle levels were within national benchmarks on 97% of days at Muswellbrook and Singleton. Hourly particle levels were in the good to fair air quality categories 96.9% and 99.4% of the time at Muswellbrook and Singleton, respectively. Regional air quality was greatly improved compared to the previous two years, as drought conditions continued to improve throughout most of New South Wales.

- Levels of nitrogen dioxide (NO₂) and sulfur dioxide (SO₂) were good, remaining below national benchmarks.
- Daily average levels of PM_{2.5} (particles less than or equal to 2.5 micrometres in diameter) were above the 25 µg/m³ benchmark on three days (6–8 June). PM_{2.5} levels were elevated within many NSW regions during this cold June long weekend. Regional maximum daily PM_{2.5} levels on these days ranged from 28.0 to 44.1 µg/m³.
 - Camberwell recorded levels over the benchmark on 6 June, with high hourly PM_{2.5} levels observed from 9pm to 11pm under cold calm conditions. The source for this event is undetermined, potentially due to woodsmoke.
 - Daily PM_{2.5} levels were over the benchmark at Muswellbrook (7 and 8 June) and Singleton (7 June) during this long weekend, likely due to woodsmoke.
- Daily average levels of PM₁₀ (particles less than or equal to 10 micrometres in diameter) were above the 50 µg/m³ benchmark on two days (19 and 31 August). Regional maximum daily PM₁₀ levels on these days ranged from 51.8 to 82.2 µg/m³.
 - The most widespread event occurred on 19 August, when 10 sites recorded daily PM₁₀ levels over the benchmark. This was an exceptional event, due to a widespread dust storm, affecting the North West Slopes, Northern Tablelands and the Mid North Coast the following day.
- The Merriwa background air quality monitoring station in the Upper Hunter region was upgraded in July 2020 to monitor PM_{2.5}, visibility, ozone, nitrogen oxides, carbon monoxide and sulfur dioxide.

Annual air quality trends in the Upper Hunter

A comparison of annual average PM₁₀ and PM_{2.5} levels shows the long-term trends. The national annual average benchmarks are 25 µg/m³ for PM₁₀ and 8 µg/m³ for PM_{2.5}, based on a calendar year.

The annual averages for the 2011 to 2019 calendar years can be found in the [Upper Hunter spring 2019 seasonal newsletter](#).

Figure 1 shows the PM₁₀ and PM_{2.5} rolling annual averages, based on the 12-month periods, from winter to winter 2012–13 to 2019–20. Rolling annual averages provide a guide to long-term trends, using the most up to date monitoring data, and are not intended to be compared to benchmarks.

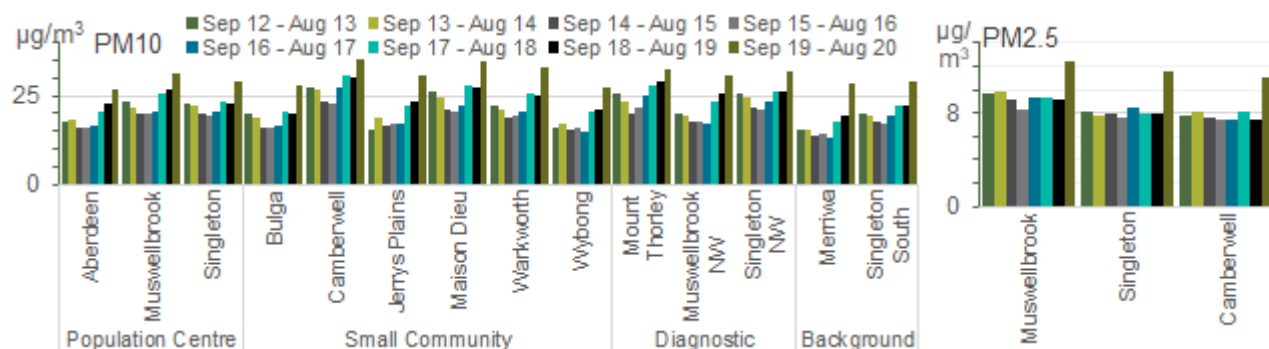


Figure 1 PM₁₀ and PM_{2.5} rolling annual averages to the end of winter: 2013 to 2020

The comparison in Figure 1 shows that rolling annual average particle levels during the 12 months from September 2019 to August 2020 were higher throughout the region than the same 12-month period in earlier years.

Particle levels in the 12 months to the end of winter 2020 included extreme air quality events in spring–summer 2019–20. Deteriorating air quality in spring–summer 2019–20 was associated with extensive bushfires across eastern parts of the State, frequent widespread dust storms and intense drought preceding the February coastal rainfall events. More information on the spring–summer 2019–20 bushfire season can be found at [NSW Air quality special statement spring-summer 2019-20](#) and the Upper Hunter [spring 2019](#) and [summer 2019–20](#) seasonal newsletters.

Weakening drought conditions in the region (Figure 2) following the rainfall events in February 2020 have improved air quality with fewer days over the particle benchmarks during winter 2020 (Table 1).

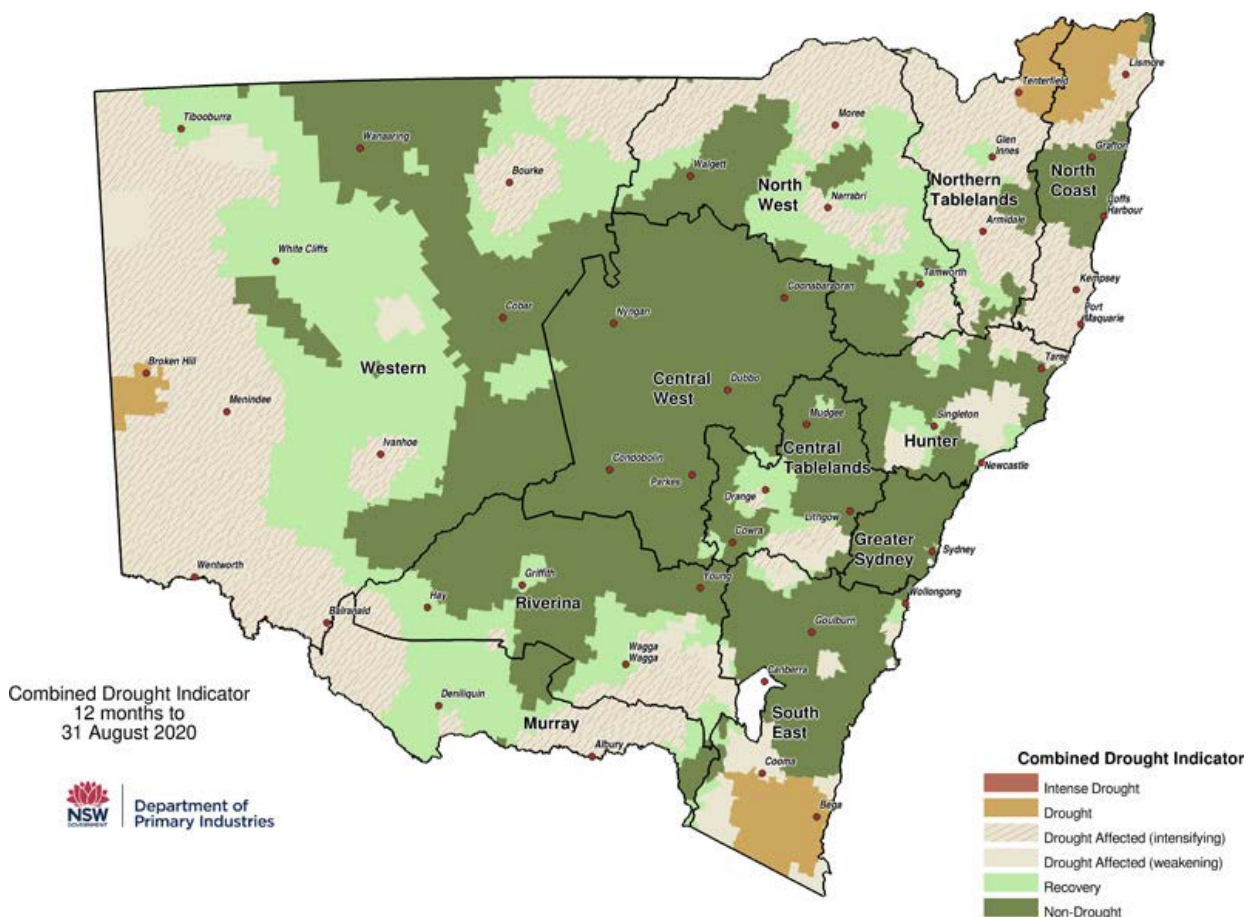


Figure 2 Department of Primary Industries NSW Combined Drought Indicator to 31 August 2020¹

¹ Sourced from Department of Primary Industries [NSW State seasonal update – August 2020](#) (accessed January 2021).

Days above benchmark concentrations

There were two days over the PM10 daily benchmark and three days over the PM2.5 daily benchmark in winter 2020.

Table 1 Number of days above the relevant national benchmarks – winter 2020

Station type*	Station	PM10 daily [50 µg/m ³ benchmark]	PM2.5 daily [25 µg/m ³ benchmark]	SO ₂ hourly [20 pphm benchmark]	SO ₂ daily [8 pphm benchmark]	NO ₂ hourly [12 pphm benchmark]
Population centre	Aberdeen	0	-	-	-	-
Population centre	Muswellbrook	1	2	0	0	0
Population centre	Singleton	1	1	0	0	0
Smaller community	Bulga	0	-	-	-	-
Smaller community	Camberwell	2	1	-	-	-
Smaller community	Jerrys Plains	1	-	-	-	-
Smaller community	Maison Dieu	1	-	-	-	-
Smaller community	Warkworth	1	-	-	-	-
Smaller community	Wybong	0	-	-	-	-
Diagnostic	Mount Thorley	1	-	-	-	-
Diagnostic	Muswellbrook NW	1	-	-	-	-
Diagnostic	Singleton NW	1	-	-	-	-
Background	Merriwa	0	0	0	0	0
Background	Singleton South	1	-	-	-	-

µg/m³ = micrograms per cubic metre

pphm = parts per hundred million by volume (i.e. parts of pollutant per hundred million parts of air)

- = not monitored

* For explanation, refer to the end of the report **Definitions: Upper Hunter monitoring station types**

Pollution roses from hourly particle data

The seasonal pollution rose maps² (Figure 3 and Figure 4) show that hourly PM₁₀ and PM_{2.5} levels³ were generally low during the season.

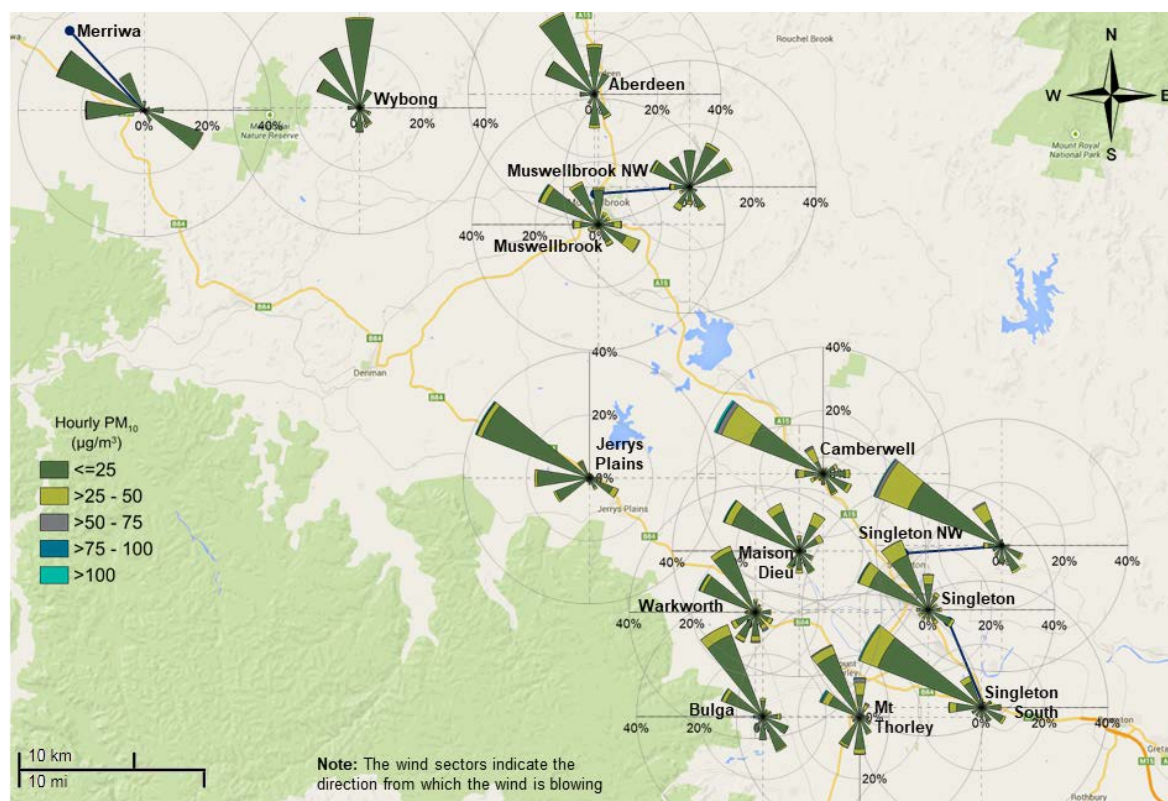


Figure 3 Hourly PM₁₀ pollution rose map for the Upper Hunter region for winter 2020

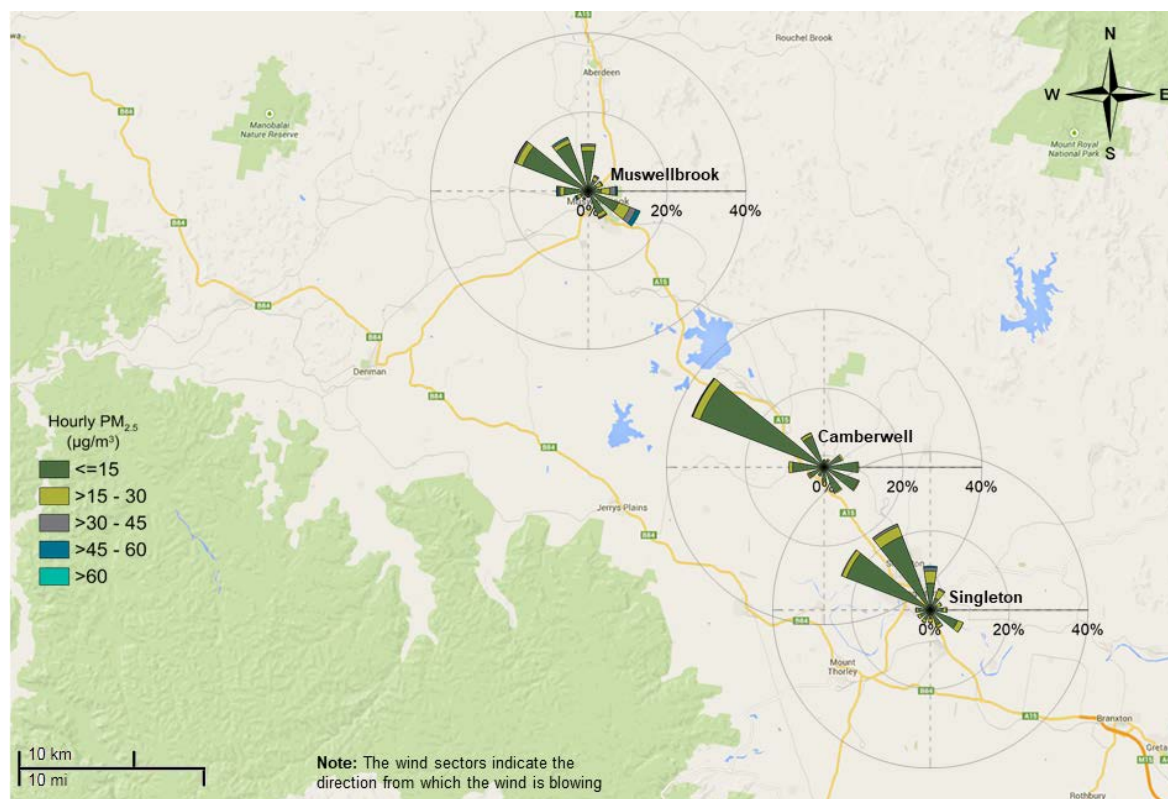


Figure 4 Hourly PM_{2.5} pollution rose map for the Upper Hunter region for winter 2020

² Pollution roses show wind direction and particle levels at a location. The length of each bar around the circle shows the percentage of time the wind blows from a particular direction. The colours along the bars indicate categories of particle levels.

³ There are no standards for hourly PM₁₀ or PM_{2.5} in the National Environment Protection (Ambient Air Quality) Measure.

Daily time series plots

Daily average time series plots for PM10 and PM2.5 and daily one-hour maximum plots for NO₂ and SO₂ show the concentrations throughout winter (Figure 5 to Figure 11). NO₂ and SO₂ remained below the benchmarks. PM10 and PM2.5 levels remained below the benchmark for most of the season. Peak PM10 levels were recorded on 19 August due to a widespread dust storm. PM2.5 levels were elevated on the cold long weekend, 6 to 8 June, due to woodsmoke.

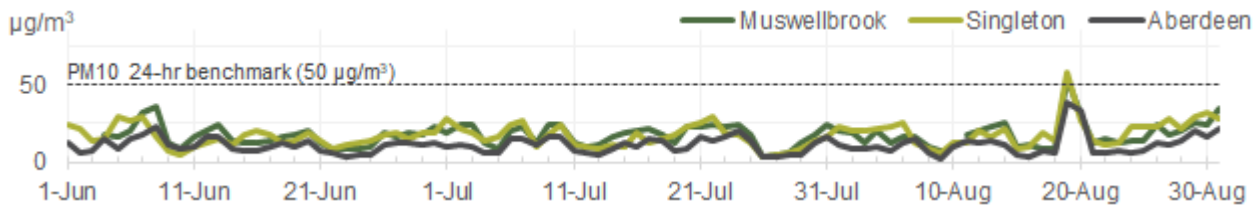


Figure 5 Population centre sites: daily average PM10 – winter 2020

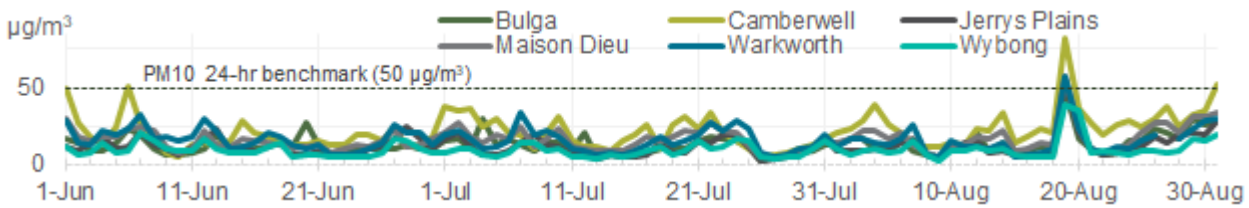


Figure 6 Smaller community sites: daily average PM10 – winter 2020

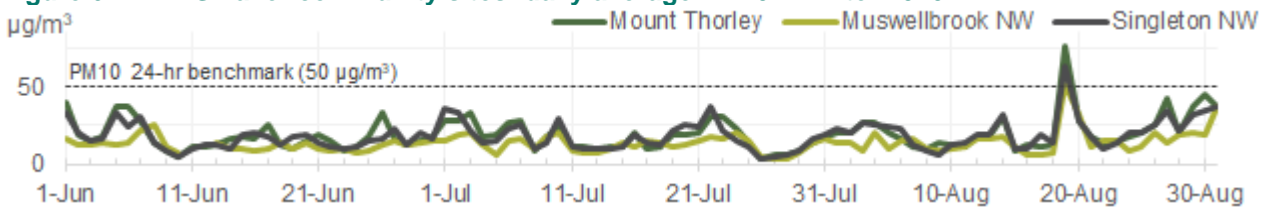


Figure 7 Diagnostic sites: daily average PM10 – winter 2020

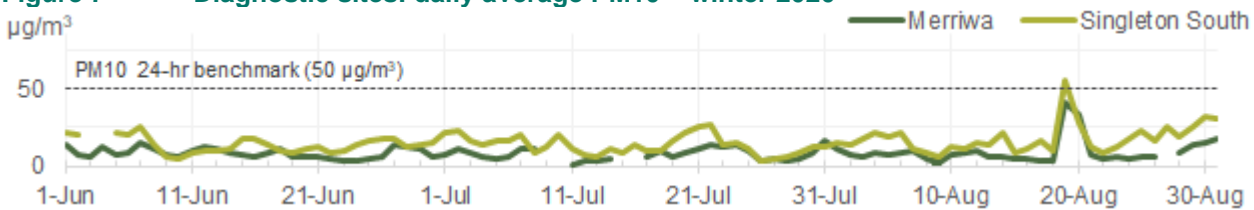


Figure 8 Background sites: daily average PM10 – winter 2020

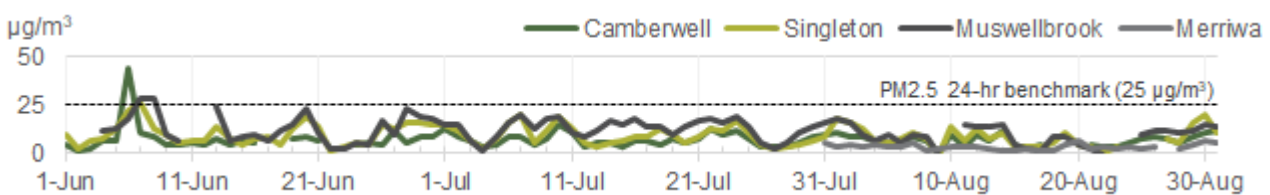


Figure 9 Daily average PM2.5 – winter 2020

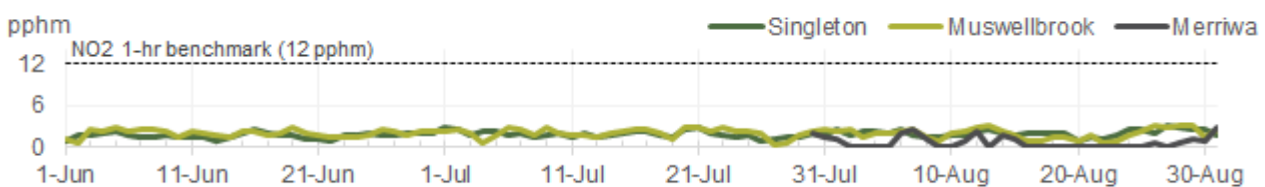


Figure 10 Daily 1-hr maximum NO₂ – winter 2020

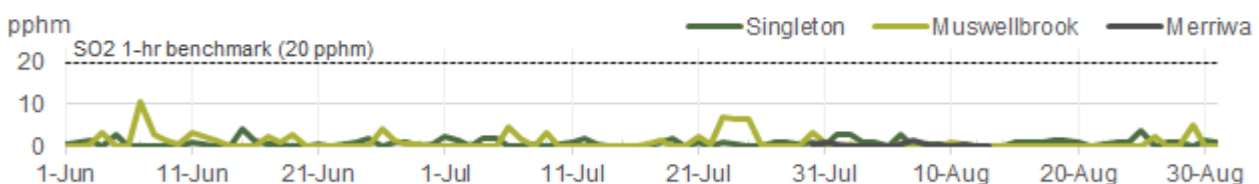


Figure 11 Daily 1-hr maximum SO₂ – winter 2020

Seasonal comparisons

This section compares air quality in winter 2020 with previous winter seasons (Figure 12).

All winter days were below national benchmark concentrations for NO₂ and SO₂ in the past nine years.

Daily average PM₁₀ levels were over the benchmark on two days during winter 2020. This was fewer days than the past three winters, with 22 days in winter 2019, 29 days in winter 2018 and 10 days in winter 2017. Earlier years, 2012 to 2016, recorded between zero and seven days over the benchmark.

Daily average PM_{2.5} levels were over the benchmark on three consecutive days in winter 2020, from 6 to 8 June. This was comparable to earlier years with zero to three days recorded over the daily PM_{2.5} benchmark during winter from 2012 to 2019.

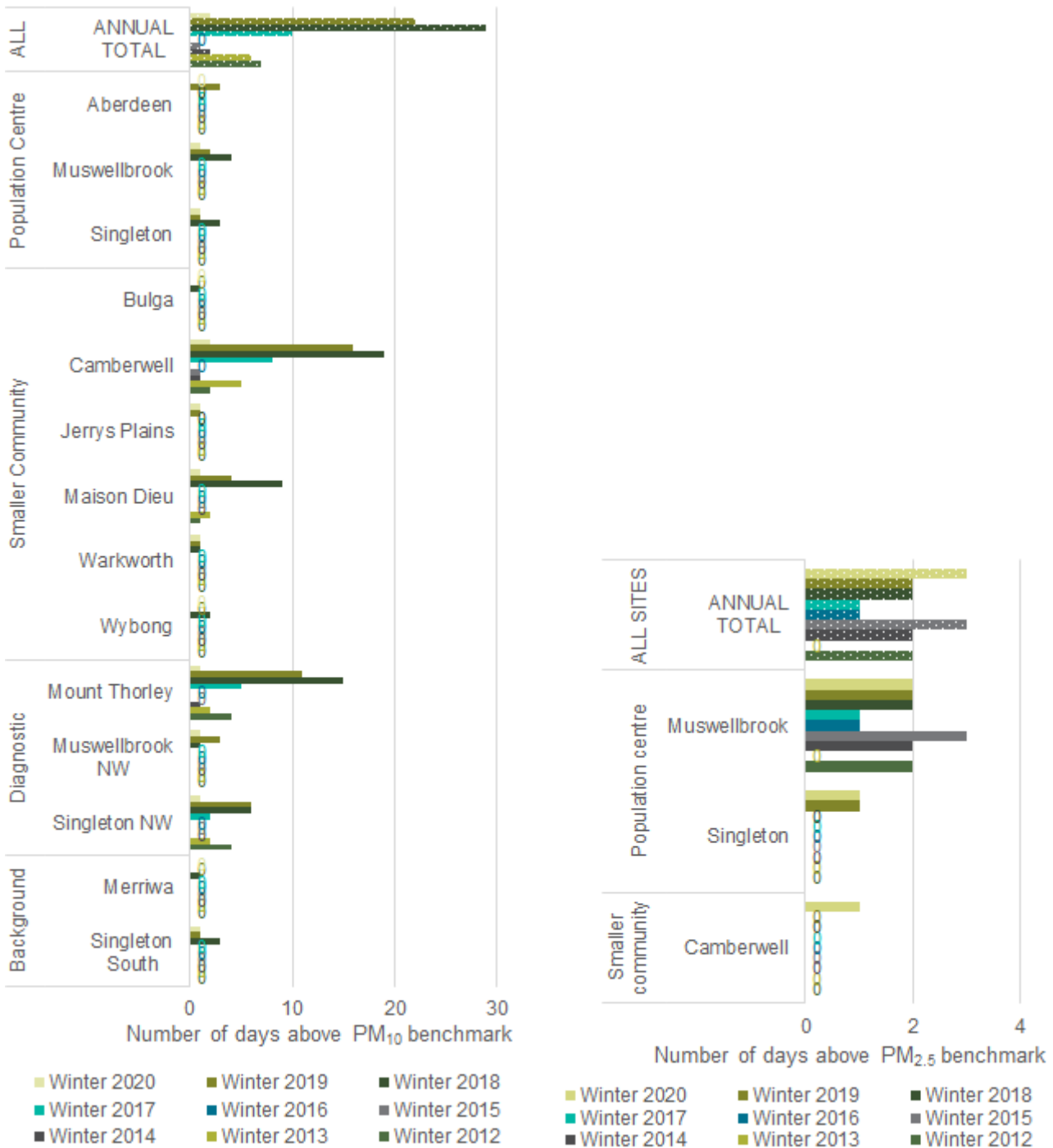


Figure 12 Number of days above the PM₁₀ and PM_{2.5} daily benchmarks – winter 2012 to 2020

Particle air quality trends in the Upper Hunter

Figure 13 and Figure 14 show daily average PM10 levels during winter 2020, compared to the daily maximum and minimum levels (i.e. shaded range) for winter periods from 2011 to 2019, at Singleton and Muswellbrook. Daily PM10 levels were generally within the historical range throughout the season. Rainfall levels were above average at Singleton during winter, with good falls, particularly from late July (Figure 15).

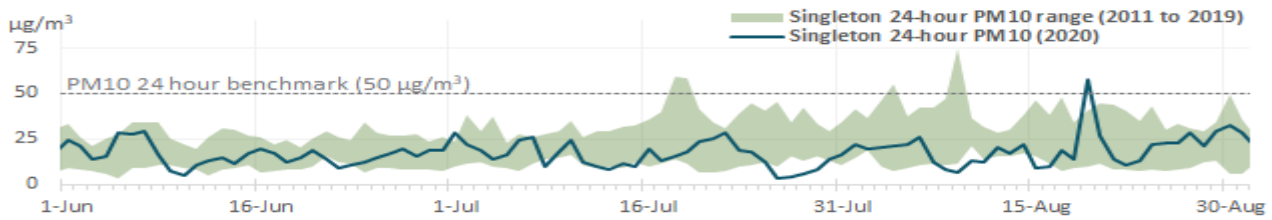


Figure 13 Singleton daily average PM10 during winter 2020 plotted against the daily maximum and minimum PM10 levels from 2011 to 2019

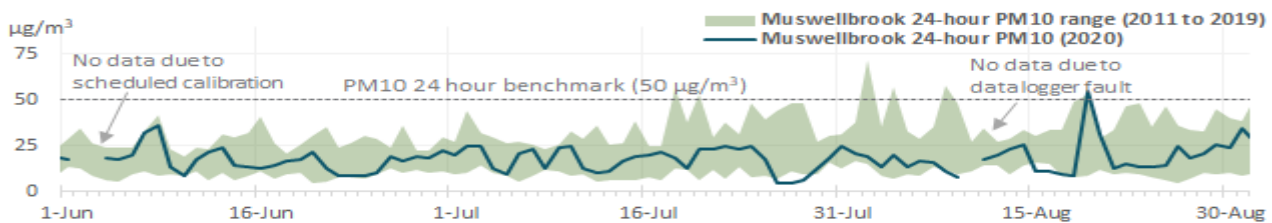


Figure 14 Muswellbrook daily average PM10 during winter 2020 plotted against the daily maximum and minimum PM10 levels from 2011 to 2019

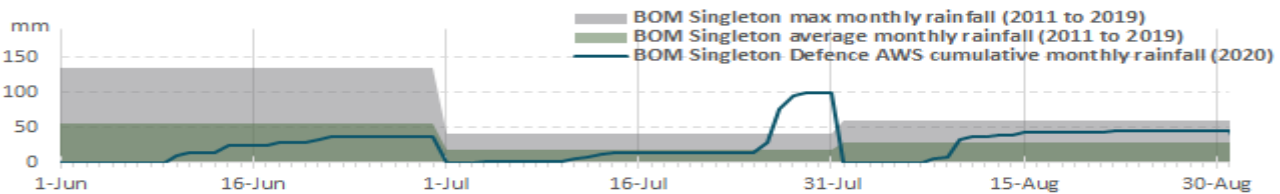


Figure 15 Bureau of Meteorology Singleton Defence AWS⁴ cumulative monthly rainfall in winter 2020 against maximum and average monthly rainfall from 2011 to 2019⁵

Figure 16 and Figure 17 show daily average PM2.5 levels during winter 2020, compared to the daily maximum and minimum levels (shaded range) for winter periods from 2011 to 2019, at Singleton and Muswellbrook. Daily PM2.5 levels were generally within the historical range throughout the season.

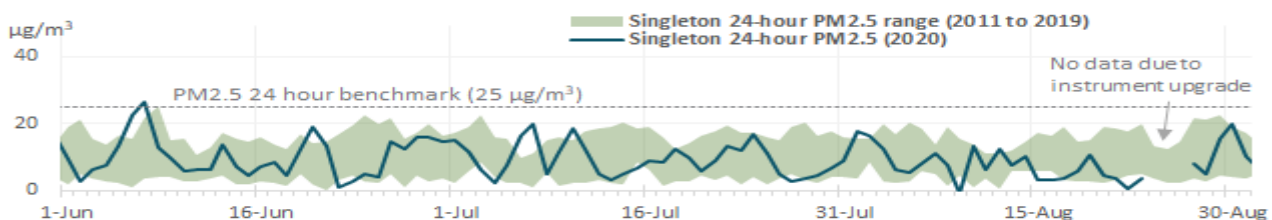


Figure 16 Singleton daily average PM2.5 during winter 2020 plotted against the daily maximum and minimum PM2.5 levels from 2011 to 2019

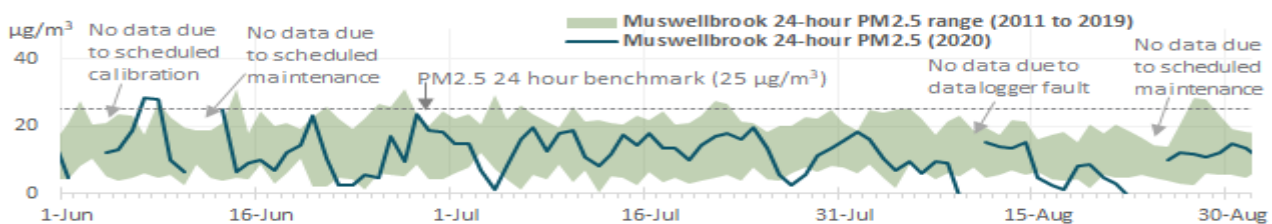


Figure 17 Muswellbrook daily average PM2.5 during winter 2020 plotted against the daily maximum and minimum PM2.5 levels from 2011 to 2019

⁴ Data obtained from the Bureau of Meteorology [Singleton Defence AWS monthly rainfall data](#) (accessed January 2021).

⁵ The Bureau of Meteorology STP station was decommissioned in January 2019. Therefore, statistics have been calculated from a combination of the [Singleton STP monthly rainfall data](#) (accessed March 2020) from January 2011 to March 2017 and [Singleton Defence AWS monthly rainfall data](#) from April 2017.

Meteorological summary

Rainfall and temperature⁶

The Upper Hunter generally experienced above average rainfall during winter 2020 (Figure 18). Winter 2020 was wetter than the past three winters, with around 100 to 200 millimetres more rain in winter 2020 compared to each winter from 2017 to 2019.

Maximum temperatures were average to above average (Figure 19), and minimum temperatures were above average during the season.

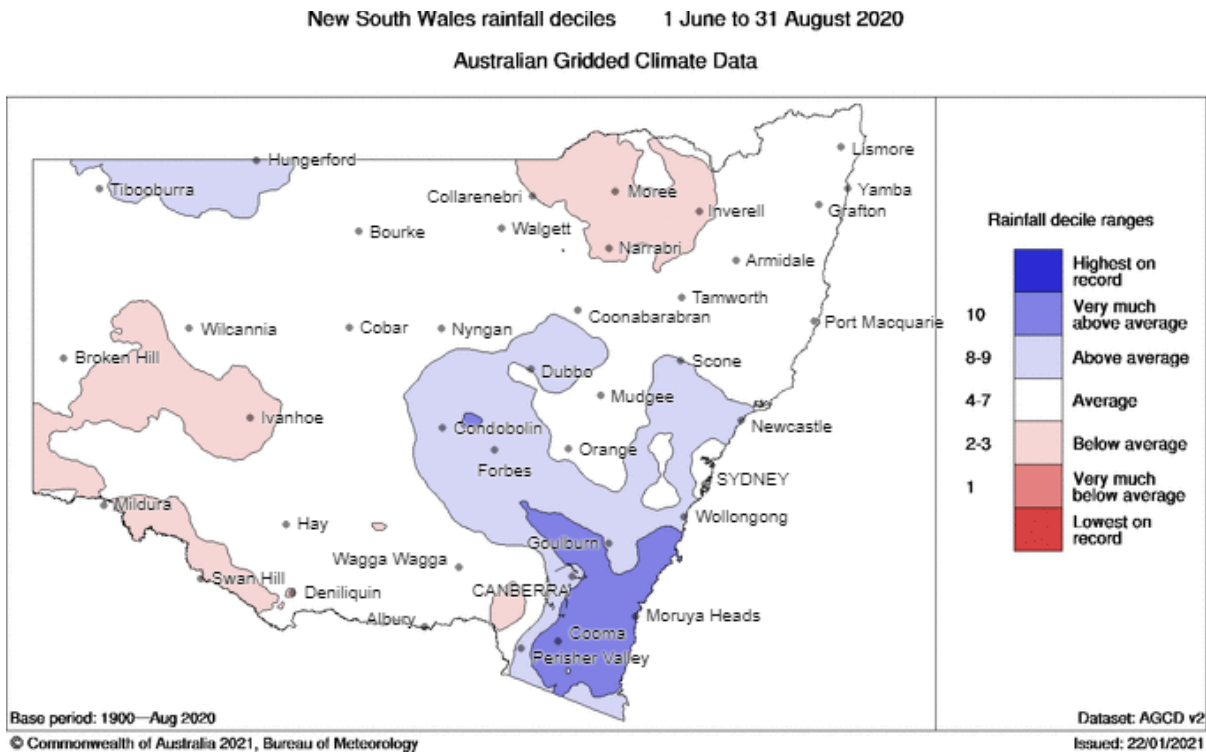


Figure 18 NSW rainfall deciles – winter 2020

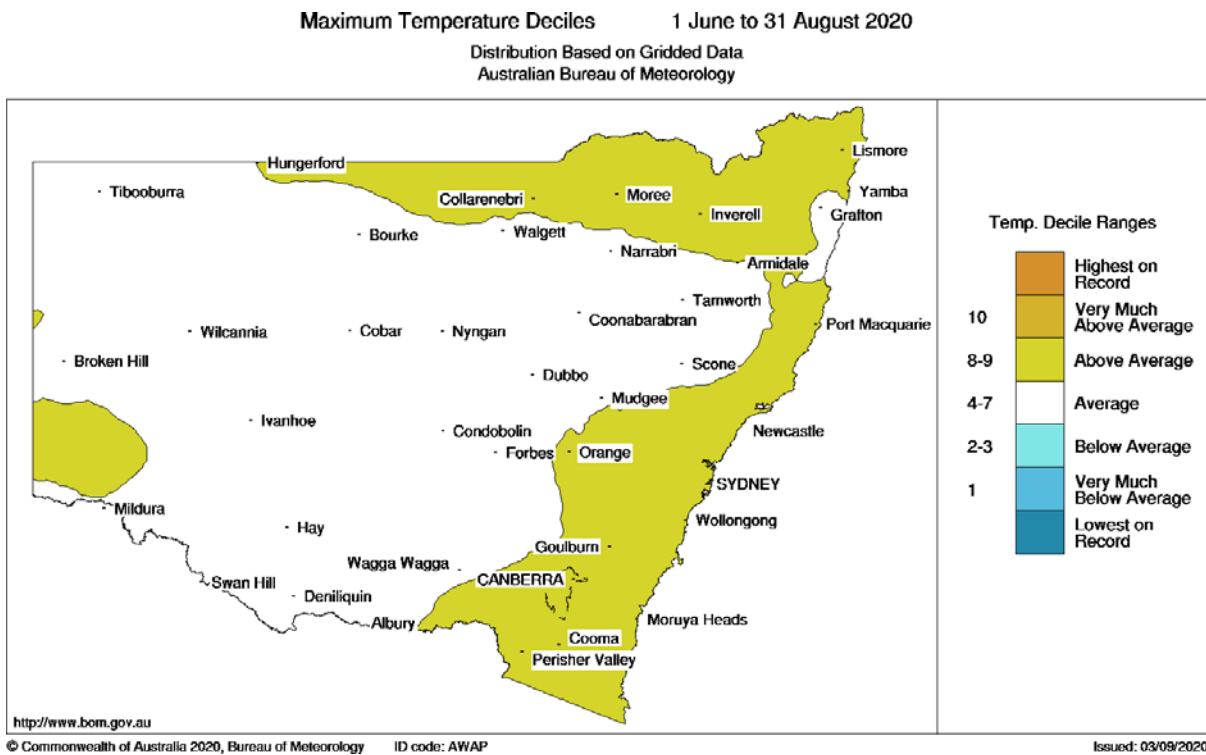


Figure 19 NSW maximum temperature deciles – winter 2020

⁶ Rainfall and temperature information is from the Bureau of Meteorology [New South Wales winter 2020 climate statement](#) (access January 2021) and [climate maps](#) (accessed January 2021).

Wind

The winds were predominantly from the north-west during winter 2020 (Figure 19), which was typical for this time of year. Wind speeds in winter 2020 were similar to winter 2019.

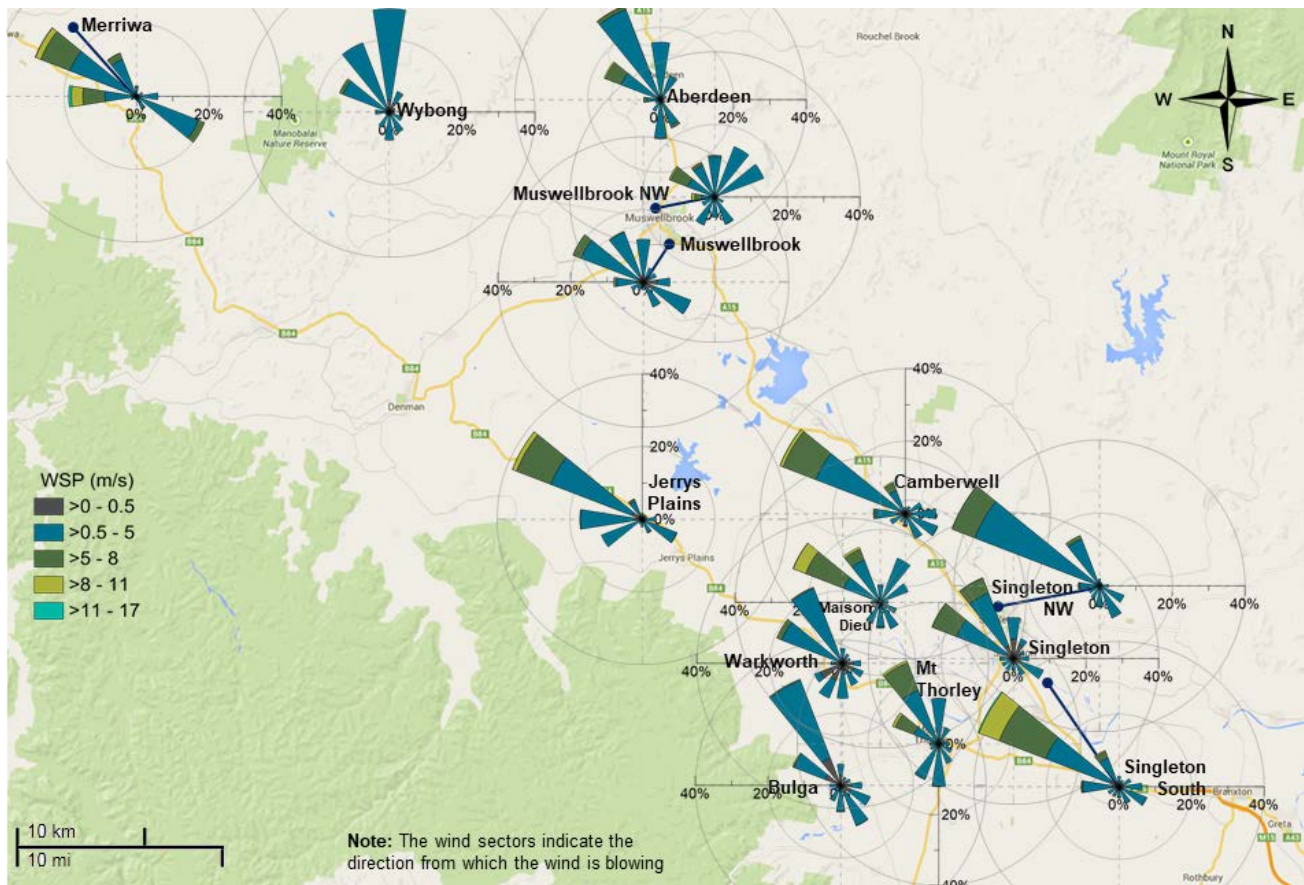


Figure 20 Wind rose map⁷ for the Upper Hunter region for winter 2020

⁷ Wind roses show the wind direction and speed at a location. The length of each bar around the circle show the percentage of time that the wind blows from a particular direction. The colours along the bars indicate the wind speed categories.

Network performance

The target network performance is at least 95% available data for all parameters. The maximum online time that can be attained for NO₂ and SO₂ is 96%, due to daily calibrations.

Table 2 Online performance (%) during winter 2020

Station	Particles PM10 daily	Particles PM2.5 daily	Gases SO ₂ hourly	Gases NO ₂ hourly	Meteorology Wind hourly
Aberdeen	100	-	-	-	100
Bulga	100	-	-	-	100
Camberwell	100	92	-	-	100
Jerrys Plains	98	-	-	-	100
Maison Dieu	100	-	-	-	98
Merriwa	95	34	15	34	98
Mount Thorley	100	-	-	-	100
Muswellbrook	97	92	95	95	100
Muswellbrook NW	98	-	-	-	97
Singleton	100	97	95	95	99
Singleton NW	100	-	-	-	100
Singleton South	98	-	-	-	100
Warkworth	99	-	-	-	100
Wybong	100	-	-	-	99

- = not monitored

The overall reduced online times were mainly due to:

- Camberwell PM2.5 – scheduled maintenance/calibrations (four days) and instrument upgrade (three days)
- Muswellbrook PM2.5 – scheduled maintenance/calibrations (six days) and datalogger fault (one day)
- Merriwa PM2.5, SO₂ and NO₂ – new parameters as part of the station upgrade in July 2020.

Definitions: Upper Hunter monitoring station types

The 14 monitoring stations in the Upper Hunter serve different purposes:

Larger population: stations near the larger population centres monitor the air quality in these centres.

Smaller communities: stations near smaller communities monitor the air quality at those locations.

Diagnostic: provide data that can help diagnose the likely sources and movement of particles across the region as a whole; they do not provide information about air quality at population centres.

Background: the stations near Merriwa and Singleton South are at both ends of the valley and provide background data, measuring air quality entering and leaving the Upper Hunter Valley under predominant winds (south-easterlies and north-westerlies).

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