



Department of Planning, Industry and Environment

# New South Wales Annual Compliance Report 2020

National Environment Protection (Ambient Air  
Quality) Measure



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# Acronyms, abbreviations and glossary

Following is a list of acronyms, abbreviations and terms used in this report.

| Term               | Meaning  |
|--------------------|--|
| AAQ NEPM           | National Environment Protection (Ambient Air Quality) Measure  |
| ABS                | Australian Bureau of Statistics  |
| AEST               | Australian Eastern Standard Time   |
| Ambient air        | The external air environment (does not include the air environment inside buildings or structures)   |
| AS/NZS             | Australian Standard/New Zealand Standard   |
| BAM                | Beta attenuation monitor   |
| BHELP              | Broken Hill Environment Lead Program   |
| C                  | Compliant (with AAQ NEPM standards and goals)  |
| CAM                | Clean Air Metric   |
| CBD                | Central Business District  |
| CO                 | Carbon monoxide  |
| DPIE               | Department of Planning, Industry and Environment   |
| EPA                | Environment Protection Authority   |
| EU                 | European Union   |
| FDMS               | Filter dynamics measurement system   |
| FRM                | Federal Reference Method (USEPA)   |
| GIS                | Geographic information system  |
| GMR                | Greater Metropolitan Region  |
| GREP               | Government Resource Efficiency Policy  |
| HRB                | Hazard reduction burn(s)   |
| KOALA              | Knowing Our Ambient Local Air-Quality (low-cost sensors)   |
| LBL                | Load-based licensing   |
| Monitoring station | A facility for measuring the concentration of one or more pollutants in the ambient air; also referred to as 'monitoring site'             |
| m/s                | Metres/second  |
| Mt                 | Mountain   |
| NATA               | National Association of Testing Authorities  |
| N-C                | Not compliant (with AAQ NEPM standards and goals)  |
| ND                 | Not demonstrated — this means that 75% availability of data in at least one yearly quarter was not demonstrated at this monitoring station |
| NEPC               | National Environment Protection Council  |
| NEPM               | National Environment Protection Measure  |
| NO                 | Nitric oxide   |
| NO <sub>2</sub>    | Nitrogen dioxide   |



| Term              | Meaning   |
|-------------------|---|
| NO <sub>x</sub>   | Nitrogen dioxides   |
| O <sub>3</sub>    | Ozone   |
| Pb                | Lead  |
| PM2.5             | Particulate matter with an aerodynamic diameter of 2.5 micrometres or less  |
| PM10              | Particulate matter with an aerodynamic diameter of 10 micrometres or less   |
| POEO Act          | <i>Protection of the Environment Operations Act 1997</i>  |
| ppm               | Parts per million – parts of pollutant per million parts of air by volume   |
| SO <sub>2</sub>   | Sulfur dioxide  |
| TEOM              | Tapered element oscillating microbalance  |
| TSP               | Total suspended particles   |
| USEPA             | United States Environmental Protection Agency   |
| µg/m <sup>3</sup> | Microgram of pollutant (1 millionth of a gram) per cubic metre of air, referenced to temperature of 0°C (273.15 K) and absolute pressure of 101.325 kilopascals (kPa)     |
| VOCs              | Volatile organic compounds — chemical species that have high enough vapour pressure to exist at least partially as a gas at standard atmospheric temperature and pressure |
| VR1/2             | Vapour recovery stage 1/stage 2 technology  |

## Summary

The *National Environment Protection (Ambient Air Quality) Measure* (AAQ NEPM or NEPM) sets national standards and goals for air quality. This measure is implemented in New South Wales under the *Protection of the Environment Operations Act 1997* (POEO Act), the *Protection of the Environment Operations (Clean Air) Regulation 2010* and the *Protection of the Environment Operations (General) Regulation 2009*.

This annual compliance report is required under clause 18 of the AAQ NEPM. It presents NSW air quality monitoring data for 2020, assessed against the requirements of the AAQ NEPM in effect at that time (Australian Government 2016). Air quality concentration data are available on the NSW Department of Planning, Industry and Environment (DPIE) public website.

The NSW AAQ NEPM Compliance Monitoring Network (the network) is a part of the NSW Government's broader ambient air quality monitoring network (as described in Section A). In 2020, the network comprised 36 air quality monitoring stations. The NSW Government operates the network in accordance with the NSW Air Quality Monitoring Plan, the AAQ NEPM technical papers (NEPC various years) and the department's accreditation by the National Association of Testing Authorities (NATA).

A separate report (DPIE 2021b) contains the appendices referred to in this document.

## Assessment of compliance with the AAQ NEPM

The AAQ NEPM (February 2016 amendment, Australian Government 2016) sets requirements for the monitoring and reporting of air pollutants with reference to:

- air quality standards, as levels of pollutants against which air quality can be assessed
- goals for air pollutant levels, to achieve the air quality standards
- circumstances which led to exceedances of standards, including the influence of natural events and fire management on airborne particulate matter, measured as PM10 (particles of diameter less than 10 microns) and PM2.5 (particles of diameter less than 2.5 microns)
- population exposures to PM2.5 (annually).

The AAQ NEPM was further amended and took effect in May 2021 (Australian Government 2021). This amendment includes updated standards for ozone, nitrogen dioxide and sulfur dioxide, and has additional requirements to report population exposure for nitrogen dioxide and photochemical oxidants (as ozone), in addition to PM2.5.

In this compliance report, the monitoring data from 2020 are assessed against the AAQ NEPM standards in effect at the time, that is, as amended in February 2016 (see Section B, Standards and goals, Table 6). All references in this report to clauses in the AAQ NEPM also refer to the February 2016 amended version.

## Summary of compliance with AAQ NEPM goals by pollutant (2020)

Compliance status for each monitoring station with respect to NEPM goals in 2020 is summarised in Table 1. This includes every applicable AAQ NEPM standard for the following pollutants, where measured:

- particulate matter – as PM10 and PM2.5
- gaseous pollutants – ozone (O<sub>3</sub>), carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>) and sulfur dioxide (SO<sub>2</sub>).

Note that monitoring for lead (Pb) in New South Wales ceased in 2004 as ambient lead concentrations fell well below existing standards after unleaded motor fuel was introduced.

**Table 1 Summary of compliance with AAQ NEPM goals for particles and gases (2020)**

| Region/Station           | CO     | NO <sub>2</sub>  | SO <sub>2</sub>             | Ozone      |            | PM10        |        | PM2.5       |        |     |
|--------------------------|--------|------------------|-----------------------------|------------|------------|-------------|--------|-------------|--------|-----|
|                          | 8-hour | 1-hour<br>1-year | 1-hour<br>24-hour<br>1-year | 1-<br>hour | 4-<br>hour | 24-<br>hour | 1-year | 24-<br>hour | 1-year |     |
| <b>Sydney East</b>       |        |                  |                             |            |            |             |        |             |        |     |
| 1 Chullora               | C      | C                | C                           | C          | C          | C           | C      | C           | C      | N-C |
| 2 Cook and Phillip       | C      | C                | C                           | C          | C          | ND          | ND     | ND          | ND     | ND  |
| 3 Earlwood               | -      | C                | -                           | C          | C          | C           | C      | C           | C      | C   |
| 4 Macquarie Park         | C      | C                | C                           | C          | C          | C           | C      | C           | C      | C   |
| 5 Randwick               | -      | C                | C                           | C          | C          | C           | C      | ND          | ND     | ND  |
| 6 Rozelle                | C      | C                | C                           | C          | C          | C           | C      | C           | C      | C   |
| <b>Sydney North West</b> |        |                  |                             |            |            |             |        |             |        |     |
| 7 Parramatta North       | C      | C                | C                           | C          | C          | C           | C      | C           | C      | N-C |
| 8 Prospect               | C      | C                | C                           | C          | C          | C           | C      | N-C         | N-C    | N-C |
| 9 Richmond               | -      | C                | C                           | C          | C          | C           | C      | N-C         | N-C    | N-C |
| 10 Rouse Hill            | C      | C                | C                           | C          | C          | N-C         | C      | N-C         | C      | C   |
| 11 St Marys              | -      | C                | -                           | C          | N-C        | C           | C      | ND          | ND     | ND  |
| <b>Sydney South West</b> |        |                  |                             |            |            |             |        |             |        |     |
| 12 Bargo                 | -      | C                | C                           | C          | C          | C           | C      | C           | C      | C   |
| 13 Bringelly             | -      | ND               | ND                          | ND         | ND         | C           | C      | C           | C      | N-C |
| 14 Camden                | C      | C                | -                           | C          | N-C        | C           | C      | C           | C      | C   |
| 15 Campbelltown W        | C      | C                | C                           | C          | N-C        | C           | C      | C           | C      | C   |
| 16 Liverpool             | C      | C                | C                           | C          | C          | N-C         | C      | N-C         | N-C    | N-C |
| 17 Oakdale               | -      | C                | -                           | C          | C          | C           | C      | C           | C      | C   |
| <b>Illawarra</b>         |        |                  |                             |            |            |             |        |             |        |     |
| 18 Albion Park South     | -      | C                | C                           | C          | C          |             | C      | C           | C      | C   |

| Region/Station             | CO<br>8-hour | NO <sub>2</sub><br>1-hour<br>1-year | SO <sub>2</sub><br>1-hour<br>24-hour<br>1-year | Ozone      |            | PM10        |        | PM2.5       |        |  |
|----------------------------|--------------|-------------------------------------|--|------------|------------|-------------|--------|-------------|--------|--|
|                            |              |                                     |  | 1-<br>hour | 4-<br>hour | 24-<br>hour | 1-year | 24-<br>hour | 1-year |  |
| 19 Kembla Grange           | -            | C                                   | -  | C          | C          | N-C         | C      | C           | C      |  |
| 20 Wollongong              | C            | C                                   | C  | C          | C          | C           | C      | ND          | ND     |  |
| <b>Central Coast</b>       |              |                                     |  |            |            |             |        |             |        |  |
| 21 Wyong                   | C            | C                                   | C  | C          | C          | N-C         | C      | C           | C      |  |
| <b>Lower Hunter</b>        |              |                                     |  |            |            |             |        |             |        |  |
| 22 Beresfield              | -            | C                                   | C  | C          | C          | C           | C      | C           | C      |  |
| 23 Newcastle               | C            | C                                   | C  | C          | C          | C           | C      | N-C         | ND     |  |
| 24 Wallsend                | -            | C                                   | C  | C          | C          | C           | C      | C           | C      |  |
| <b>Upper Hunter</b>        |              |                                     |  |            |            |             |        |             |        |  |
| 25 Aberdeen                | -            | -                                   | -  | -          | -          | C           | C      | -           | -      |  |
| 26 Muswellbrook            | -            | ND                                  | ND   | -          | -          | N-C         | C      | N-C         | N-C    |  |
| 27 Singleton               | -            | C                                   | C  | -          | -          | N-C         | C      | N-C         | N-C    |  |
| <b>Central Tablelands</b>  |              |                                     |  |            |            |             |        |             |        |  |
| 28 Bathurst                | -            | -                                   | -  | -          | -          | C           | C      | C           | C      |  |
| 29 Orange                  | -            | -                                   | -  | -          | -          | C           | C      | N-C         | N-C    |  |
| <b>North West Slopes</b>   |              |                                     |  |            |            |             |        |             |        |  |
| 30 Gunnedah                | -            | C                                   | -  | C          | C          | C           | C      | N-C         | C      |  |
| 31 Narrabri                | -            | -                                   | -  | -          | -          | C           | C      | C           | C      |  |
| 32 Tamworth                | -            | -                                   | -  | -          | -          | C           | C      | C           | C      |  |
| <b>Northern Tablelands</b> |              |                                     |  |            |            |             |        |             |        |  |
| 33 Armidale                | -            | -                                   | -  | -          | -          | N-C         | C      | N-C         | N-C    |  |
| <b>South West Slopes</b>   |              |                                     |  |            |            |             |        |             |        |  |
| 34 Albury                  | -            | -                                   | -  | -          | -          | N-C         | C      | C           | N-C    |  |
| 35 Wagga Wagga<br>Nth      | -            | -                                   | -  | -          | -          | N-C         | C      | C           | N-C    |  |
| <b>Southern Tablelands</b> |              |                                     |  |            |            |             |        |             |        |  |
| 36 Goulburn                | -            | C                                   | -  | C          | N-C        | C           | C      | C           | N-C    |  |
| <b>Total station count</b> | 13           | 28                                  | 21   | 26         | 26         | 36          | 36     | 35          | 35     |  |
| <b>Not demonstrated</b>    | 0            | 2                                   | 2  | 1          | 1          | 1           | 1      | 4           | 5      |  |
| <b>Compliant</b>           | 13           | 26                                  | 19   | 25         | 21         | 26          | 35     | 21          | 17     |  |
| <b>Non-Compliant</b>       | 0            | 0                                   | 0  | 0          | 4          | 9           | 0      | 10          | 13     |  |

Notes:

ND = not demonstrated.

C = compliant.

N-C = non-compliant.

- = not monitored at this station.

## Description of compliance against standards and goals

Compliance against AAQ NEPM standards and goals are described below for all criteria pollutants, for all NSW NEPM air quality monitoring network stations monitoring the pollutant.

### Carbon monoxide

All 13 stations complied with the carbon monoxide (rolling 8-hour) standard and goal.

### Nitrogen dioxide

Twenty-six of 28 stations complied with the nitrogen dioxide (1-hour and annual average) standards and goals. Two stations, Bringelly in South West Sydney and Muswellbrook in the Upper Hunter, did not have the required data coverage and were consequently assigned 'not demonstrated' (ND) status.

### Sulfur dioxide

Nineteen of 21 stations complied with the sulfur dioxide (1-hour, 24-hour and annual average) standards and goals. Bringelly and Muswellbrook did not have the required data coverage and were consequently assigned ND status.

### Ozone

Twenty-six stations in the NSW NEPM air quality monitoring network monitored ozone during 2020, with 25 stations meeting the 75% data availability requirement. Bringelly station in South West Sydney did not have the required data coverage and was consequently assigned ND status for both standards and goals (1-hour ozone and 4-hour ozone).

Overall, there were 6 exceedance days over either or both ozone standards.

#### *Ozone 1-hour standard*

The NEPM 1-hour standard was exceeded on 3 calendar days in 2020, including a 2-day episode observed across western Sydney during 31 January to 1 February.

#### *Compliance with the 1-hour ozone goal*

The NEPM goal for the 1-hour ozone standard allows one exceedance day per year.

Twenty-five of 26 stations met the NEPM 1-hour ozone goal. Eleven stations recorded one allowable exceedance day, and 14 stations recorded no exceedance days.

Bringelly station in Sydney South West also recorded one exceedance day, however, due to data availability criteria of 75% not being met for the first quarter, it cannot be determined if this was the only exceedance at this location. As a result, the station is designated ND status and excluded from this station count.

#### *Ozone 4-hour standard*

The NEPM 4-hour standard was exceeded on six calendar days in 2020. Two days occurred during January 2020, exclusively at Goulburn station which also recorded the highest number of exceedance days (four). A two-day episode during 31 January to 1 February was observed at Goulburn and across several western Sydney stations.

#### *Compliance with the 4-hour ozone goal*

The NEPM goal for the 4-hour ozone standard allows one exceedance day per year.

Twenty-one of 26 stations met the NEPM 4-hour ozone goal. Fourteen stations recorded one allowable exceedance day, and 7 stations had no exceedance days. Bringelly station was assigned ND status due to not meeting data availability requirements.

The 4 non-compliant (N-C) stations were St Marys in Sydney North West, Campbelltown West and Camden in Sydney South West, and Goulburn in Southern Tablelands.

## Particles summary

During 2020, 86 days above national particle standards were recorded across the network. Between January and February 2020, significantly elevated particle levels were recorded at all monitoring locations across the State. The major influence on elevated particle pollution was smoke from the Black Summer bushfires during the 2019–20 summer season, and like the previous year, widespread dust storms also significantly impacted on air quality during early 2020. Drought and low rainfall resulted in poor groundcover in central and western parts of the State, significantly contributing to increased dust levels under high winds. Other influences which led to elevated particle concentrations during the year were hazard reduction burning, wood smoke from domestic wood heating and site-specific local dust.

### *Particles as PM10*

Thirty-six stations in the NSW AAQ NEPM network monitored PM10 in 2020, and 35 stations met the requirement for at least 75% data availability. Cook and Phillip station in Sydney East did not achieve the required data coverage.

### *PM10 24-hour standard*

The PM10 24-hour standard was exceeded on 55 calendar days.

Thirty-nine of the 55 event days were attributed to exceptional causes only, 15 days to non-exceptional causes only, and one calendar day was identified where both exceptional and non-exceptional causes impacted different sites on the same day.

The majority of the exceptional event days were impacted by smoke from the 2019–20 Black Summer bushfires during January and February 2020. Others were impacted by widespread dust storms, or a combination of bushfire smoke and widespread dust storms. One such event is described in Section E of the report.

The non-exceptional event days were due to particles from either local-scale or regional-scale dust emissions associated with reduced groundcover, particularly in semi-arid and agricultural areas in western and central New South Wales.

### *Compliance with the PM10 24-hour goal*

Twenty-six of 36 stations met the NEPM goal for 24-hour PM10, having recorded zero exceedance days after excluding exceptional events. Compliance could not be determined for Cook and Phillip station, which was assigned ND status. Nine stations were non-compliant due to the impact of local- and regional-scale dust events.

### *PM10 annual standard*

Thirty-five of 36 stations met the NEPM goal for annual PM10, having recorded annual average concentrations below the annual standard of 25.0 microgram per cubic metre ( $\mu\text{g}/\text{m}^3$ ). Compliance could not be determined for Cook and Phillip station, which was assigned ND status.

Wagga Wagga North (South West Slopes) recorded the highest annual average PM10 concentration ( $23.2 \mu\text{g}/\text{m}^3$ ) during 2020.

### *Particles as PM<sub>2.5</sub>*

Thirty-five stations in the NSW AAQ NEPM network monitored PM<sub>2.5</sub> in 2020. Five stations did not meet the required data coverage of at least 75% data availability: Cook and Phillip and Randwick (Sydney East), St Marys (Sydney North West), Wollongong (Illawarra) and Newcastle (Lower Hunter).

#### *PM<sub>2.5</sub> 24-hour standard*

The PM<sub>2.5</sub> 24-hour standard was exceeded on 59 calendar days.

Thirty-two of the 59 days were attributed to exceptional events only, 24 days to only non-exceptional causes, and three calendar days were identified where both exceptional and non-exceptional causes impacted different sites on the same day.

The period of January and February 2020 had the highest number of exceptional events (28 days), attributed to days impacted by smoke from the Black Summer bushfires, and days impacted by a mix of dust and burning. Bushfire smoke, on 5 January 2020, led to the highest daily PM<sub>2.5</sub> level (560 µg/m<sup>3</sup>) since 1994, at Wagga Wagga North in the South West Slopes. Seven days between May 2020 to October 2020 were attributed to hazard reduction burns in the Sydney and Central Tablelands regions.

The non-exceptional event days were due to smoke from domestic wood heating, observed across 10 stations: Liverpool (Sydney South West), Rouse Hill, Richmond and Prospect (Sydney North West), Newcastle (Lower Hunter), Singleton and Muswellbrook (Upper Hunter), Armidale (Northern Tablelands), Orange (Central Tablelands) and Gunnedah (North West Slopes). Several of these wood smoke days (20 days) were exclusive to Armidale station.

A multi-day, multi-station wood smoke episode is described in Section E.

#### *Compliance with the PM<sub>2.5</sub> 24-hour goal*

Twenty-one of 35 stations met the NEPM goal for 24-hour PM<sub>2.5</sub>, having recorded zero exceedances after exclusion of exceptional events. Compliance could not be determined for four stations with insufficient data coverage, and which were assigned ND status.

Ten stations were non-compliant, impacted by domestic wood heating during autumn and winter months, as mentioned above. This count includes Newcastle station, which despite insufficient data coverage, was classified non-compliant due to a wood smoke event day.

#### *PM<sub>2.5</sub> annual standard*

Seventeen of 35 stations met the NEPM goal for annual PM<sub>2.5</sub>, having recorded PM<sub>2.5</sub> annual average concentrations below the annual standard of 8.0 µg/m<sup>3</sup>. Thirteen stations exceeded the standard, and five stations with insufficient data coverage were assigned ND status.

## **Population exposure to PM<sub>2.5</sub>**

A nationally consistent agreement between participating jurisdictions does not yet exist on the population exposure evaluation and reporting, which is required under the AAQ NEPM. The New South Wales approach to PM<sub>2.5</sub> exposure mapping is included in Section F, with detailed assessment for 2020 presented.

The population-weighted average exposure of residents to PM<sub>2.5</sub> is expressed as the Clean Air Metric (CAM). In 2020, the population-weighted average exposure of residents to PM<sub>2.5</sub> in the NSW Greater Metropolitan Region was 97% of the NEPM standard. Historically, the CAM was at an all-time high in 2019, rising from 96% in 2016 to 132% in 2020, due primarily to elevated PM<sub>2.5</sub> levels widely observed during the 2019–20 Black Summer bushfires. For

2020, the level of exposure to PM<sub>2.5</sub> was in line with 2016 and 2018, due also in part to widespread rainfall following the conclusion of the 2019–20 bushfire season in February 2020.



## Section A – Monitoring summary

### Overview on air quality monitoring in New South Wales

The NSW Government operated a network of 94 monitoring stations as of 31 December 2020. This broader network comprised 39 indicative monitoring stations in the Rural Air Quality Monitoring Network, and 55 National Association of Testing Authorities (NATA) accredited air quality monitoring stations in NSW metropolitan and regional centres. These 94 monitoring stations are:

- 39 stations in the Rural Air Quality Monitoring Network
  - These stations monitor impact of dust and smoke in rural New South Wales, South Australia and Victoria, measured as airborne particulate matter PM<sub>10</sub>, PM<sub>2.5</sub>, and total suspended particles (TSP). Suitable indicative monitors are applied due to relatively remote station locations. As indicative monitors are not compliant with the Australian Standards relevant for *National Environment Protection (Ambient Air Quality) Measure* (AAQ NEPM or NEPM), data are not assessed against national air quality standards.
- 27 stations in the NSW Greater Metropolitan Region (GMR)
  - 19 stations in the Greater Sydney region
  - 3 stations in the Lower Hunter region
  - 3 stations in the Illawarra region
  - 1 station in the Central Coast region
  - 1 station in the Lake Macquarie region
- 9 stations in NSW regional centres
  - 2 stations in the Central Tablelands region
  - 2 stations in the Mid North Coast region
  - 1 station in the Northern Tablelands region
  - 1 station in the North West Slopes region
  - 1 station in the Southern Tablelands region
  - 2 stations in the South West Slopes region
- 19 stations in industry-funded, NSW Government–operated networks
  - 14 stations in the Upper Hunter Air Quality Monitoring Network, monitoring air quality affected by coalmining and coal-fired power generation
  - 3 stations in the Newcastle Local Air Quality Monitoring Network, monitoring air quality affected by industrial activity around the port of Newcastle
  - 2 stations in the Namoi/North West Slopes Air Quality Monitoring Network, monitoring air quality affected by coal mines in the region.

## The NSW AAQ NEPM Compliance Monitoring Network

The AAQ NEPM requires the NSW Government to report annually on compliance with the national standards and goals for air quality measured at designated monitoring stations, to assess the exposure of the general population to air pollution.

### Monitoring stations

For the purposes of assessing compliance against the AAQ NEPM, 36 air quality monitoring stations from the above-mentioned broader network are included in this report for the 2020 calendar year. The 36 stations comprising the 2020 AAQ NEPM Compliance Monitoring Network (the network) are listed in Table 2 and shown in Figure 1 and Figure 2.

In summary, the Compliance Monitoring Network in 2020 comprised:

- 24 stations in the NSW GMR (see map in Figure 1) including:
  - 17 stations in Greater Sydney region
  - 3 stations in Illawarra
  - 1 station on the Central Coast
  - 3 stations in the Lower Hunter.

For Greater Sydney region, note that given the large population and therefore larger number of stations in Sydney, the stations are often reported for the Sydney air quality subregions as presented on the NSW Air Quality website. For NEPM compliance purposes, all Sydney subregion stations are considered within the Greater Sydney region.

- 12 stations in NSW regional centres (see map in Figure 2) including:
  - 2 stations in the Central Tablelands
  - 3 stations in the North West Slopes
  - 1 station in the Northern Tablelands
  - 2 stations in the South West Slopes
  - 1 station in the Southern Tablelands
  - 3 stations in the Upper Hunter, for the purposes of this report.

These are defined within their broader air quality regions as reported on the NSW Air Quality website. For NEPM compliance purposes, each station represents the air quality considered typical for that urban area, otherwise designated as NEPM air quality region, and not necessarily the broader air quality region.

The NSW AAQ NEPM Compliance Monitoring Network is designed to measure air quality experienced by the general population and to capture pollution events which impact population centres. This means that the location of monitoring stations in each region is selected to optimise both population coverage and representation of the occurrences of higher pollutant concentrations. Constraints which can limit availability of suitable sites include security, accessibility, representativeness and availability for long-term monitoring.

### New AAQ NEPM network sites, and campaign monitoring in 2020

Four stations, commissioned pre-2020, were incorporated into the AAQ NEPM network during 2020, and are included in this report:

- Muswellbrook, Upper Hunter (commissioned 8 December 2010)
- Singleton, Upper Hunter (commissioned 12 December 2010)
- Aberdeen, Upper Hunter (commissioned 15 December 2011)

- Cook and Phillip (also called Sydney CBD), Sydney East (commissioned 9 October 2019).

Five newly commissioned stations were incorporated into the AAQ NEPM network during 2020. Since the (at least 75%) data coverage requirement was not met, these stations are excluded from this report:

- Coffs Harbour, Mid North Coast (commissioned as a bushfire emergency site on 27 November 2019, and incorporated into the AAQ NEPM network on 6 April 2020)
- Penrith, Sydney North West (commissioned 13 November 2020)
- Morisset, Lake Macquarie (commissioned 26 November 2020)
- Lidcombe, Sydney East (commissioned 8 December 2020).

Commencing in November 2020, several regional stations monitored ozone on a 'campaign' basis. Due to insufficient coverage, such data are excluded from this report:

- Bathurst and Orange (Central Tablelands)
- Tamworth (North West Slopes)
- Albury and Wagga Wagga North (South West Slopes).

### Station classifications

The NSW Government assesses the air quality to which the general population is exposed in a region by monitoring criterion air pollutants across a network of stations. The network is a mixture of trend (T), performance (P), mix (T/P), and campaign (C) air quality monitoring stations.

- **Trend** designation (T) is used where the parameter has been operating at a station (or equivalent nearby location) continuously for more than a decade and captures most pollution events that occur across the region.
- **Performance** designation (P) applies when monitoring has been ongoing for less than a decade, or where a station measures criteria pollutants not monitored at trend stations, or where a station is sited to measure pollutants at the upper bounds of the concentrations likely to be experienced in a region.
- **Campaign** designation (C) is used when monitoring is scoped for shorter monitoring periods, including for characterising air quality experienced by certain communities, or for monitoring for specific pollutants or pollution sources, or for monitoring at temporary locations.

**Table 2 Stations reported as part of the NSW AAQ NEPM Compliance Monitoring Network (2020)**

| Region/Station                               | Start year | Overall <sup>1</sup> | PM10 | PM2.5 | Ozone | NO <sub>2</sub> | CO | SO <sub>2</sub> |
|--|------------|----------------------|------|-------|-------|-----------------|----|-----------------|
| <b>Sydney East</b>                           |            |                      |      |       |       |                 |    |                 |
| 1 Chullora <sup>2</sup>                      | 2003       | T                    | T    | T     | T     | T               | T  | T               |
| 2 Cook and Phillip (Sydney CBD) <sup>3</sup> | 2019       | P                    | P    | P     | P     | P               | P  | P               |
| 3 Earlwood                                   | 1998       | T                    | T    | T     | T     | T               |    |                 |
| 4 Macquarie Park <sup>4</sup>                | 2017       | P                    | P    | P     | P     | P               | P  | P               |
| 5 Randwick                                   | 1995       | T/P                  | T    | P     | T     | T               |    | T               |

| Region/Station                   |                                | Start year | Overall <sup>1</sup> | PM10 | PM2.5 | Ozone | NO <sub>2</sub> | CO | SO <sub>2</sub> |
|----------------------------------|--------------------------------|------------|----------------------|------|-------|-------|-----------------|----|-----------------|
| 6                                | Rozelle                        | 1978       | T/P                  | T    | P     | T     | T               | T  | P               |
| <b>Sydney North West</b>         |                                |            |                      |      |       |       |                 |    |                 |
| 7                                | Parramatta North <sup>5</sup>  | 2017       | P                    | P    | P     | P     | P               | P  | P               |
| 8                                | Prospect <sup>6</sup>          | 2007       | T/P                  | T    | P     | T     | T               | T  | T               |
| 9                                | Richmond                       | 1992       | T                    | T    | T     | T     | T               |    | T               |
| 10                               | Rouse Hill <sup>7</sup>        | 2019       | P                    | P    | P     | P     | P               | P  | P               |
| 11                               | St Marys                       | 1992       | T/P                  | T    | P     | T     | T               |    |                 |
| <b>Sydney South West</b>         |                                |            |                      |      |       |       |                 |    |                 |
| 12                               | Bargo                          | 1996       | T/P                  | T    | P     | T     | T               |    | T               |
| 13                               | Bringelly                      | 1992       | T/P                  | T    | P     | T     | T               |    | T               |
| 14                               | Camden                         | 2012       | P                    | P    | P     | P     | P               | P  |                 |
| 15                               | Campbelltown West <sup>8</sup> | 2012       | P                    | P    | P     | P     | P               | P  | P               |
| 16                               | Liverpool                      | 1990       | T/P                  | T    | T     | T     | T               | T  | P               |
| 17                               | Oakdale                        | 1996       | T/P                  | T    | P     | T     | T               |    |                 |
| <b>Illawarra</b>                 |                                |            |                      |      |       |       |                 |    |                 |
| 18                               | Albion Park South <sup>9</sup> | 2005       | T/P                  | T    | P     | T     | T               |    | T               |
| 19                               | Kembla Grange                  | 1994       | P                    | P    | P     | P     | P               |    |                 |
| 20                               | Wollongong                     | 1993       | T                    | T    | T     | T     | T               | T  | T               |
| <b>Central Coast</b>             |                                |            |                      |      |       |       |                 |    |                 |
| 21                               | Wyong                          | 2012       | P                    | P    | P     | P     | P               | P  | P               |
| <b>Lower Hunter</b>              |                                |            |                      |      |       |       |                 |    |                 |
| 22                               | Beresfield                     | 1993       | T                    | T    | T     | T     | T               |    | T               |
| 23                               | Newcastle                      | 1992       | T/P                  | T    | P     | T     | T               | T  | T               |
| 24                               | Wallsend                       | 1992       | T                    | T    | T     | T     | T               |    | T               |
| <b>Upper Hunter<sup>10</sup></b> |                                |            |                      |      |       |       |                 |    |                 |
| 25                               | Aberdeen                       | 2011       | T                    | T    |       |       |                 |    |                 |
| 26                               | Muswellbrook                   | 2010       | T/P                  | T    | T     |       | P               |    | P               |
| 27                               | Singleton                      | 2010       | T/P                  | T    | T     |       | P               |    | P               |
| <b>Central Tablelands</b>        |                                |            |                      |      |       |       |                 |    |                 |
| 28                               | Bathurst <sup>11</sup>         | 2000       | T/P                  | T    | P     |       |                 |    |                 |
| 29                               | Orange <sup>12</sup>           | 2019       | P                    | P    | P     |       |                 |    |                 |
| <b>North West Slopes</b>         |                                |            |                      |      |       |       |                 |    |                 |
| 30                               | Gunnedah                       | 2017       | P                    | P    | P     | P     | P               |    |                 |
| 31                               | Narrabri                       | 2017       | P                    | P    | P     |       |                 |    |                 |
| 32                               | Tamworth                       | 2000       | T/P                  | T    | P     |       |                 |    |                 |

| Region/Station                   | Start year | Overall <sup>1</sup> | PM10 | PM2.5 | Ozone | NO <sub>2</sub> | CO | SO <sub>2</sub> |
|----------------------------------|------------|----------------------|------|-------|-------|-----------------|----|-----------------|
| <b>Northern Tablelands</b>       |            |                      |      |       |       |                 |    |                 |
| 33 Armidale                      | 2018       | P                    | P    | P     |       |                 |    |                 |
| <b>South West Slopes</b>         |            |                      |      |       |       |                 |    |                 |
| 34 Albury                        | 2000       | T/P                  | T    | P     |       |                 |    |                 |
| 35 Wagga Wagga Nth <sup>13</sup> | 2011       | T/P                  | T    | P     |       |                 |    |                 |
| <b>Southern Tablelands</b>       |            |                      |      |       |       |                 |    |                 |
| 36 Goulburn <sup>14</sup>        | 2019       | P                    | P    | P     | P     | P               |    |                 |

## Notes:

1. P = performance; T = trend (>10 years monitoring); C = campaign (temporary). 'Overall' describes the mixture of pollutant monitoring as completely performance (P), completely trend (T) or a mixture (T/P).
2. Chullora monitoring station replaced Lidcombe station (1972–2002) in 2003.
3. Cook and Phillip monitoring station, also called Sydney CBD, commissioned in September 2019.
4. Macquarie Park station replaced Lindfield station (1994–2019) in 2019. Lindfield data is not included in trend analysis due to non-conformant siting (specifically requirements for distance from trees).
5. Parramatta North monitoring station is at the same location as the former Westmead air quality monitoring station (which operated between 1980 and 2004).
6. Prospect monitoring station replaced Blacktown station (1992–2004) in 2007.
7. Rouse Hill monitoring station replaced Vineyard station (1994–2016) in May 2019.
8. Campbelltown West monitoring station replaced Macarthur station (2004–2012) in September 2012.
9. Albion Park South monitoring station replaced Albion Park station (1997–2005) in 2005.
10. These stations represent general population exposure in the Upper Hunter Air Quality Monitoring Network.
11. Ozone was measured at Bathurst as campaign monitoring between 2001 and 2006.
12. Orange monitoring station was commissioned in January 2019, and ozone monitoring in November 2020 for a summer campaign.
13. Wagga Wagga North monitoring station replaced Wagga Wagga station (2000–2011) in 2011.
14. Goulburn monitoring station was commissioned in November 2019.

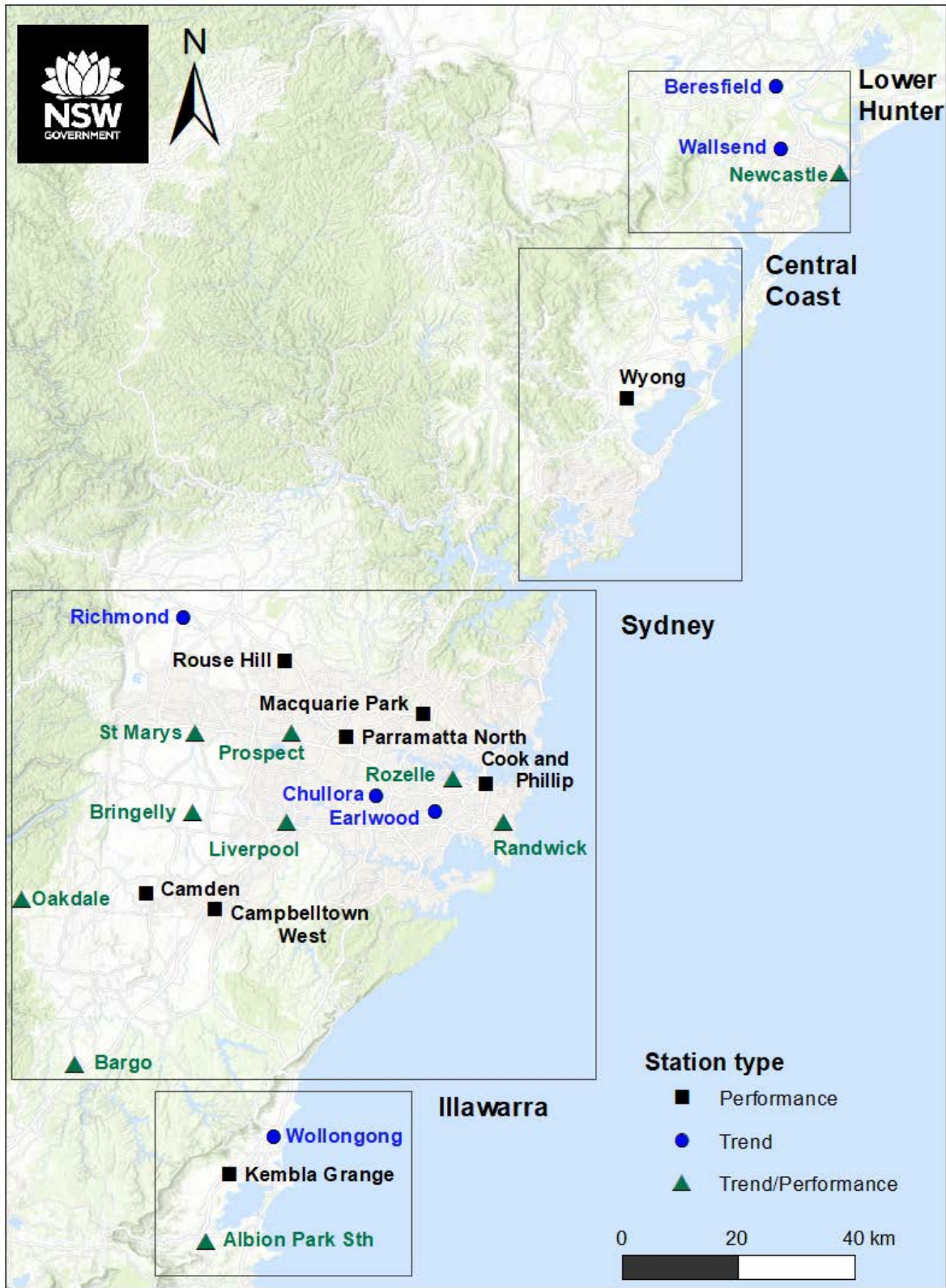
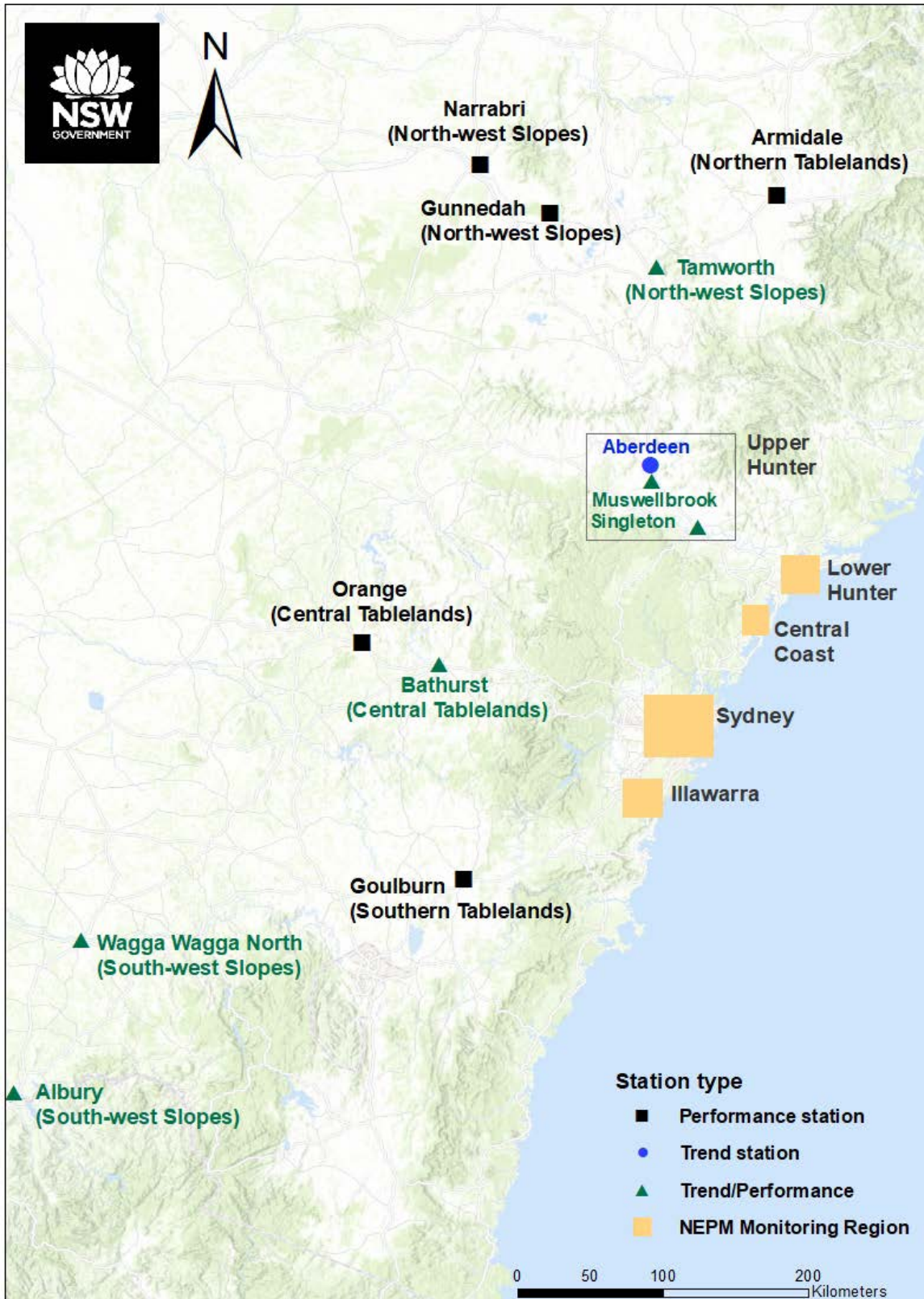


Figure 1 NSW AAQ NEPM Compliance Monitoring Network in the NSW Greater Metropolitan Region including Greater Sydney, Illawarra, Central Coast and Lower Hunter regions (24 stations in 2020)



**Figure 2** NSW AAQ NEPM Compliance Monitoring Network in NSW regional centres including Upper Hunter, North West Slopes, Northern Tablelands, Mid North Coast, Central Tablelands, South West Slopes and Southern Tablelands regions (12 stations in 2020)

## Non-conforming stations

Most stations operating within the AAQ NEPM network in 2020 met AAQ NEPM siting and exposure criteria, except for those included in Table 3, for reasons detailed.

Some stations used in trend analyses did not comply with siting requirements during some of the period between 2011 and 2019, and information is included where available.

**Table 3 Stations not complying with all siting and exposure criteria**

| Station          | Siting criteria not met                                | Comments  | Period   |
|------------------|--|---|----------|
| Armidale         | Distance to road >50 m                                 | Located less than 15 m from road  | 2018–now |
| Cook and Phillip | Distance to road >50 m                                 | Located less than 15 m from road  | 2019–now |
| Chullora         | Clear sky angle >120°<br>Distance to nearby tree >10 m | Trees have grown since site established                                   | 2011–now |
| Earlwood         | Distance to road >50 m                                 | Sited in a carpark and 35 m from road                                     | 2011–now |
| Goulburn         | Distance to road >50 m                                 | Located less than 15 m from road  | 2019–now |
| Gunnedah         | Distance to road >50 m                                 | Sited within 10 m of a suburban road, and just within 50 m of the highway | 2017–now |
| Liverpool        | Clear sky angle >120°                                  | Trees have grown since site was established                               | 2011     |
| Muswellbrook     | Distance to road >50 m                                 | Located less than 15 m from road  | 2011–now |
| Rozelle          | Clear sky angle >120°<br>Distance to nearby tree >10 m | Established trees in a heritage area                                      | 2011–now |

## NATA Accreditation

The NSW Government is accredited by NATA for the measurement of all AAQ NEPM parameters (accreditation number 14209), as required under clause 12 of the AAQ NEPM.

The last reassessment of the Air Quality Monitoring laboratory and associated monitoring stations by NATA was completed in July 2020.

## Monitoring methods

The NSW NEPM Compliance Monitoring Network uses instruments in accordance with relevant Australian Standards, specified in Schedule 3 of the AAQ NEPM (Table 4).



**Table 4 Australian Standard methods and instrumentations currently used in the NSW AAQ NEPM Compliance Monitoring Network**

| Pollutant                     | Standard              | Title  | Instrumentation method                          |
|-------------------------------|-----------------------|--|---|
| Carbon monoxide               | AS 3580.7.1:2011      | Method 7.1: Determination of carbon monoxide – Direct-reading instrumental method  | Gas filter correlation/ infrared                |
| Nitrogen dioxide              | AS 3580.5.1:2011      | Method 5.1: Determination of oxides of nitrogen – Direct-reading instrumental method   | Gas-phase chemiluminescence                     |
| Photochemical oxidant (ozone) | AS 3580.6.1:2016      | Method 6.1: Determination of ozone – Direct-reading instrumental method  | Non-dispersive ultraviolet                      |
| Sulfur dioxide                | AS 3580.4.1:2008      | Method 4.1: Determination of sulfur dioxide – Direct-reading instrumental method   | Pulsed fluorescence                             |
| Particles as PM10             | AS 3580.9.8:2008      | Method 9.8: Determination of suspended particulate matter – PM10 continuous direct mass method using a tapered element oscillating microbalance analyser               | Tapered element oscillating microbalance (TEOM) |
|                               | AS/NZS 3580.9.13:2013 | Method 9.13: Determination of suspended particulate matter – PM2.5 <sup>1</sup> continuous direct mass method using a tapered element oscillating microbalance monitor | (TEOM-FDMS) <sup>1</sup>                        |
| Particles as PM2.5            | AS 3580.9.10:2017     | Method 9.10: Determination of suspended particulate matter – PM2.5 low volume sampler – Gravimetric method   | Federal Reference Method (FRM) Sampler          |
|                               | AS/NZS 3580.9.12:2013 | Method 9.12: Determination of suspended particulate matter – PM2.5 beta attenuation monitors   | Beta attenuation monitor (BAM)                  |
|                               | AS/NZS 3580.9.13:2013 | Method 9.13: Determination of suspended particulate matter – PM2.5 continuous direct mass method using a tapered element oscillating microbalance monitor              | (TEOM-FDMS) <sup>1</sup>                        |

1. TEOM-FDMS (filter dynamics measurement systems), simultaneously measures PM2.5 and PM10. The instrument is used at Armidale, Cook and Phillip, Goulburn, Gunnedah, Narrabri and Orange stations.

AS = Australian Standard; NZS = New Zealand Standard.

## Section B – Assessment of compliance with standards and goals

This section presents detailed data and information describing the compliance status for the 36 stations comprising the AAQ NEPM Compliance Monitoring Network (the network), that are included for reporting in the 2020 calendar year.

Table 5 outlines stations which did not meet the criteria for data availability during 2020 and therefore impacting their compliance against the NEPM for 2020.

Table 6 includes air quality standards and goals specified in Schedule 2 of the AAQ NEPM.

Table 7 through Table 12 provide the following detailed statistics for each pollutant monitored at each station reported during 2020:

- data availability rate (quarterly and annual)
- annual mean concentration (where 1-year average standard exists)
- assessment of compliance, including the number of days where standards were exceeded.

Each pollutant at each site is assessed against the national standards and goals (Table 6).

### Data availability during 2020

Of the 36 monitoring stations with continuous real-time monitors, seven stations listed in Table 5 did not meet the requirement for at least 75% data availability in a quarter (Q), for at least one pollutant measured at the site. The other 29 stations (see Table 1) did comply with the data coverage requirement for all pollutants measured at the site.

**Table 5 Stations not meeting the data availability criteria (2020)**

| Station          | Criteria of at least 75% data availability requirement was not met for                               | Comments  |
|------------------|--|---|
| Cook and Phillip | PM10 and PM2.5 in Q1 due to instrument problems  | Power outage issues in January. No daily standard exceedances recorded during periods with data, though exceedances may have been missed during the first quarter (Q1). Compliance against the daily and annual standards for PM10 and PM2.5 was designated not demonstrated (ND) status. |
| Randwick         | PM2.5 in Q3 due to instrument barometric pressure sensor failure                                     | No daily standard exceedances were recorded during periods with data, but exceedances may have been missed during Q3. Compliance against the daily and annual standards for PM2.5 was ND.   |
| St Marys         | PM2.5 in Q1 due to leaks and detector problems requiring unscheduled maintenance                     | No daily standard exceedances were recorded during periods with data, but there may have been exceedances missed during Q1. Compliance against the daily and annual standards for PM2.5 was ND.   |
| Bringelly        | Ozone, NO <sub>2</sub> and SO <sub>2</sub> in Q1, due to instrument failures and storm power outages | For ozone, the station recorded one allowable exceedance of both the 1-hour and 4-hour ozone standards, meaning that compliance was ND.   |

| Station      | Criteria of at least 75% data availability requirement was not met for                | Comments   |
|--------------|---|--|
|              |   | Compliance against relevant NO <sub>2</sub> and SO <sub>2</sub> standards were ND.   |
| Wollongong   | PM2.5 in Q2 due to flow problems requiring data invalidation                          | No daily standard exceedances recorded during periods with data, but exceedances may have been missed during Q2. Compliance against the PM2.5 daily and annual standards was ND. |
| Newcastle    | PM2.5 across two-quarters (Q1 and Q2), due to instrument problems                     | The station demonstrated non-compliance (N-C) with the daily PM2.5 standard due to one exceedance during 2020. However, compliance against the PM2.5 annual standard was ND.     |
| Muswellbrook | SO <sub>2</sub> and NO <sub>2</sub> in Q2 due to ambient air supply fan motor failure | Compliance against the relevant NO <sub>2</sub> and SO <sub>2</sub> standards could not be demonstrated (ND).  |

## Compliance assessment requirements

### Standards and goals

Air quality is assessed against the standards and goals as specified in Schedule 2 of the AAQ NEPM (amended February 2016, Australian Government 2016).

The applicable AAQ NEPM standards (maximum concentration) are provided in column three of Table 6. The goals of the AAQ NEPM are to achieve the standards, to the extent expressed as the maximum allowable number of exceedances (in day/s) per year as provided in column four of the table.

**Table 6 Air quality standards and goals specified in Schedule 2 of the AAQ NEPM**

| Pollutant                         | Averaging period       | AAQ NEPM standard (maximum concentration) | AAQ NEPM goal <sup>1</sup> (maximum number of allowable exceedances) |
|-----------------------------------|------------------------|---|--|
| Carbon monoxide                   | 8-hour rolling average | 9.0 ppm                                   | 1 day a year   |
| Nitrogen dioxide                  | 1-hour average         | 0.120 ppm                                 | 1 day a year   |
|                                   | 1-year average         | 0.030 ppm                                 | None   |
| Photochemical oxidants – as ozone | 1-hour average         | 0.100 ppm                                 | 1 day a year   |
|                                   | 4-hour rolling average | 0.080 ppm                                 | 1 day a year   |
| Sulfur dioxide                    | 1-hour average         | 0.200 ppm                                 | 1 day a year   |
|                                   | 1-day average          | 0.080 ppm                                 | 1 day a year   |
|                                   | 1-year average         | 0.020 ppm                                 | None   |
| Particles as PM10                 | 1-day average          | 50.0 µg/m <sup>3</sup>                    | None <sup>1</sup>  |
|                                   | 1-year average         | 25.0 µg/m <sup>3</sup>                    | None   |
| Particles as PM2.5                | 1-day average          | 25.0 µg/m <sup>3</sup>                    | None <sup>1</sup>  |

| Pollutant | Averaging period | AAQ NEPM standard (maximum concentration) | AAQ NEPM goal <sup>1</sup> (maximum number of allowable exceedances) |
|-----------|------------------|---|--|
|           | 1-year average   | 8.0 µg/m <sup>3</sup>                     | None   |
| Lead      | 1-year average   | 0.5 µg/m <sup>3</sup>                     | None   |

1. The maximum allowable number of exceedance days for particles as PM<sub>2.5</sub> and as PM<sub>10</sub> exclude days which are attributable to an exceptional particulate event, explained in further detail below.

## Categories used to assess compliance

The categories 'Met', 'Not met' and 'ND' (not demonstrated) used in the Compliance summaries (2020) subsection below indicate compliance status as follows:

- A station's performance is assessed as '**not demonstrated**' (**ND**) if it has data availability rates less than 75% in any quarter, even if it records no exceedances or the number of exceedance days is allowable. Data losses may be due to instrument failures, closures to allow relocation or upgrading of the station, or because the station was established during the reporting year. See Table 5.
- A station's performance is assessed as **complying with the NEPM** (i.e. '**Met**' or **C**) if the number of exceedances is no more than that specified in Schedule 2 of the AAQ NEPM.
- A station is assessed as **not compliant with the NEPM** (i.e. '**Not met**' or **N-C** for non-compliant) if there are more than the number of exceedances specified in Schedule 2 of the AAQ NEPM. This applies even in the case where the station does not meet the data availability criterion for any given quarter or the year.

For particles, days exceeding standard are divided into 'exceptional' and 'non-exceptional' events. Exceptional event days are not counted towards the NEPM goal of 'no days above [i.e. exceeding] the particle standards in a year'. The non-assessable exceedance events are detailed below.

## Exceptional event days for particles

An exceptional event means a fire or dust occurrence that adversely affects air quality at a particular location and causes an exceedance of 1-day average standards in excess of normal historical fluctuations and background levels; and is directly related to bushfire, jurisdiction-authorised hazard reduction burning or continental-scale windblown dust.

(National Environment Protection (Ambient Air Quality) Measure, February 2016, clause 2)

The AAQ NEPM clause 18(3C) requires that jurisdictions exclude monitoring data determined as being directly associated with an exceptional event when assessing goal compliance against PM<sub>10</sub> and PM<sub>2.5</sub> 1-day average standards. However, in accordance with clause 18(3A), all measured data are included when reporting compliance against 1-year average standards, including that directly associated with an exceptional event.

In this report, 1-day particulate exceedances clearly influenced by air pollution events such as natural bushfires, hazard reduction burning and widescale windblown dust storms are classified as exceptional event days. For PM<sub>10</sub>, daily exceedances influenced by regional and local dust sources (i.e. non-continental-scale events) are classified as non-exceptional

events. For PM<sub>2.5</sub>, daily exceedances influenced by smoke from wood heating are classified as non-exceptional events.

A brief comment describing the cause of events is given in Appendix A (in separate report) where the cause was able to be determined. The absence of a comment does not necessarily indicate the absence of such influences; instead, no clear information may be available. In some cases, such as at Wagga Wagga North, it is likely that there has been an influence of more widespread airborne dust contributing to the exceedance. However, the scale of transport of windblown dust in these events could not be shown to be consistent with what would be defined as continental-scale events. Such cases have been classified as non-exceptional events, due to dust sources which may be local or perhaps regional in nature.

## Calculation and reporting methods

The calculation and reporting methods used comply with the requirements described in the *National Environment Protection (Ambient Air Quality) Measure Technical Paper No. 8: Annual Reports* (NEPC Peer Review Committee 2002).

### Daily averages

Daily averages are calculated from hourly averages, as described in National Environment Protection (Ambient Air Quality) Measure Technical Paper No. 5: Data Collection and Handling (NEPC Peer Review Committee 2001).

### Correction factors for particles

For particulate matter as PM<sub>10</sub>, an internal correction factor for United States Environmental Protection Agency (USEPA) equivalency has been applied to PM<sub>10</sub> tapered element oscillating microbalance (TEOM) data, but there has been no subsequent treatment or temperature adjustment. PM<sub>2.5</sub> measurements were made by using beta attenuation monitor (BAM) or TEOM-FDMS (filter dynamics measurement system) instruments.

In this report, PM<sub>2.5</sub> data collected pre-2012 by using TEOMs do not include the internal correction for USEPA PM<sub>10</sub> equivalency or any subsequent treatment or adjustment for temperature. PM<sub>2.5</sub> measurements using the USEPA Federal Reference Method (FRM) are reported for the Chullora monitoring station.

### Data availability rates

Data availability rates are presented as either percentages of valid data or numbers of valid days. When presented as a percentage, the value is the number of averaging periods in which the data are valid, divided by the total number of averaging periods in the year (or quarter, as appropriate). When presented as the number of valid days, the value represents the number of days during the year when at least 75% of averaging periods during the day are valid. In other words, a valid day has at least 18 valid hours.

#### *Calibration hour*

For gaseous pollutants, the calibration hour is included in the calculation of data availability rates. The New South Wales Department of Planning, Industry and Environment (DPIE) does daily automated instrument calibration checks for carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), ozone (O<sub>3</sub>), and sulfur dioxide (SO<sub>2</sub>) during the early morning. Hourly data obtained during the calibration check are considered invalid for reporting purposes. Hence, for these pollutants the maximum number of valid 1-hour averages in a day is 23. Therefore, for gaseous pollutants, the maximum annual 1-hour data availability is 96%.

*Data availability and reporting periods*

Each reporting period (e.g. quarter) and AAQ NEPM standard averaging period must have at least 75% data availability. For example, the carbon monoxide AAQ NEPM standard is based on 8-hour rolling averages. A valid 8-hour rolling average is calculated as the average of the valid 1-hour averages over the preceding eight hours (from the time point), when at least six of those hours (75%) hold valid data.

*Data availability for pollutants reported against more than one standard*

For pollutants reported against more than one AAQ NEPM standard, data availability rates may not be the same for each standard. For instance, when ozone is measured, one hour of each day is lost during calibration checks. This affects data availability rates for reporting against the 1-hour standard for the associated hour, but it may not affect data availability rates for reporting against the 4-hour standard. Thus, the maximum data availability rate is only 96% for the 1-hour standard, but it can be 100% for the 4-hour standard.

## Compliance summaries (2020)

Compliance with the AAQ NEPM standards is summarised in the following tables for each of the criteria pollutants.

Bold 'Not met' entries in the following tables highlight stations that were assessed as **not compliant with the NEPM**.

### Carbon monoxide

**Table 7 2020 compliance summary for carbon monoxide**

| Region/Station           | Data availability rate<br>(% of hours) |      |      |      |      | Number of<br>exceedance<br>days | Performance<br>against the<br>standard and goal |
|--------------------------|--|------|------|------|------|---------------------------------|---|
|                          | Q1                                     | Q2   | Q3   | Q4   | Year |                                 |   |
| <b>Sydney East</b>       |  |      |      |      |      |                                 |   |
| Chullora                 | 97.0                                   | 97.9 | 96.8 | 94.3 | 96.6 | 0                               | Met   |
| Cook and Phillip         | 93.8                                   | 95.1 | 96.1 | 95.2 | 92.9 | 0                               | Met   |
| Macquarie Park           | 98.7                                   | 100  | 98.1 | 99.6 | 99.3 | 0                               | Met   |
| Rozelle                  | 98.7                                   | 97.4 | 97.6 | 99.0 | 98.5 | 0                               | Met   |
| <b>Sydney North West</b> |  |      |      |      |      |                                 |   |
| Parramatta North         | 98.8                                   | 97.2 | 98.8 | 99.1 | 98.8 | 0                               | Met   |
| Prospect                 | 98.7                                   | 99.4 | 98.2 | 99.6 | 99.0 | 0                               | Met   |
| Rouse Hill               | 98.6                                   | 98.3 | 100  | 98.6 | 98.9 | 0                               | Met   |
| <b>Sydney South West</b> |  |      |      |      |      |                                 |   |
| Camden                   | 98.3                                   | 96.7 | 98.1 | 98.5 | 98.0 | 0                               | Met   |
| Campbelltown<br>West     | 98.1                                   | 99.3 | 96.3 | 99.6 | 98.2 | 0                               | Met   |
| Liverpool                | 96.2                                   | 97.9 | 98.1 | 98.1 | 95.9 | 0                               | Met   |
| <b>Illawarra</b>         |  |      |      |      |      |                                 |   |
| Wollongong               | 97.8                                   | 96.5 | 96.8 | 98.9 | 97.4 | 0                               | Met   |

| Region/Station       | Data availability rate<br>(% of hours) |      |      |      |      | Number of<br>exceedance<br>days | Performance<br>against the<br>standard and goal |
|----------------------|--|------|------|------|------|---------------------------------|---|
|                      | Q1                                     | Q2   | Q3   | Q4   | Year |                                 |   |
| <b>Central Coast</b> |  |      |      |      |      |                                 |   |
| Wyong                | 96.7                                   | 96.5 | 99.2 | 97.1 | 96.5 | 0                               | Met   |
| <b>Lower Hunter</b>  |  |      |      |      |      |                                 |   |
| Newcastle            | 96.8                                   | 99.7 | 97.8 | 98.3 | 96.5 | 0                               | Met   |

## Nitrogen dioxide

**Table 8 2020 compliance summary for nitrogen dioxide**

| Region/Station           | Data availability<br>(% of hours) |      |      |      |      | Number of<br>exceedance<br>days | Annual<br>Mean<br>(ppm) | Performance<br>against<br>standards and<br>goals |        |
|--------------------------|-----------------------------------|------|------|------|------|---------------------------------|-------------------------|--|--------|
|                          | Q1                                | Q2   | Q3   | Q4   | Year |                                 |                         | 1-hour   | Annual |
| <b>Sydney East</b>       |                                   |      |      |      |      |                                 |                         |  |        |
| Chullora                 | 94.9                              | 94.2 | 93.9 | 92.8 | 93.9 | 0                               | 0.009                   | Met  | Met    |
| Cook and Phillip         | 80.8                              | 89.5 | 90.8 | 91.3 | 88.1 | 0                               | 0.013                   | Met  | Met    |
| Earlwood                 | 92.6                              | 92.3 | 91.9 | 95.4 | 93.0 | 0                               | 0.009                   | Met  | Met    |
| Macquarie Park           | 95.1                              | 95.7 | 93.7 | 95.4 | 94.9 | 0                               | 0.004                   | Met  | Met    |
| Randwick                 | 92.9                              | 94.1 | 94.0 | 94.6 | 93.9 | 0                               | 0.005                   | Met  | Met    |
| Rozelle                  | 95.4                              | 93.7 | 95.3 | 94.7 | 94.8 | 0                               | 0.008                   | Met  | Met    |
| <b>Sydney North West</b> |                                   |      |      |      |      |                                 |                         |  |        |
| Parramatta North         | 95.1                              | 93.0 | 93.3 | 95.0 | 94.1 | 0                               | 0.007                   | Met  | Met    |
| Prospect                 | 94.2                              | 95.4 | 93.5 | 94.8 | 94.5 | 0                               | 0.007                   | Met  | Met    |
| Richmond                 | 94.9                              | 94.3 | 93.8 | 89.3 | 93.1 | 0                               | 0.003                   | Met  | Met    |
| Rouse Hill               | 95.5                              | 94.2 | 95.6 | 94.8 | 95.0 | 0                               | 0.005                   | Met  | Met    |
| St Marys                 | 94.9                              | 92.9 | 95.2 | 94.0 | 94.2 | 0                               | 0.004                   | Met  | Met    |
| <b>Sydney South West</b> |                                   |      |      |      |      |                                 |                         |  |        |
| Bargo                    | 93.5                              | 95.7 | 94.5 | 92.0 | 93.9 | 0                               | 0.005                   | Met  | Met    |
| Bringelly                | 68.1                              | 88.8 | 91.9 | 83.0 | 83.0 | 0                               | 0.003 <sup>1</sup>      | ND   | ND     |
| Camden                   | 94.6                              | 93.8 | 94.3 | 93.2 | 93.9 | 0                               | 0.004                   | Met  | Met    |
| Campbelltown<br>West     | 93.9                              | 92.4 | 93.3 | 95.5 | 93.8 | 0                               | 0.009                   | Met  | Met    |
| Liverpool                | 85.3                              | 93.0 | 91.4 | 95.2 | 91.3 | 0                               | 0.011                   | Met  | Met    |
| Oakdale                  | 95.3                              | 95.6 | 95.5 | 93.0 | 94.8 | 0                               | 0.001                   | Met  | Met    |
| <b>Illawarra</b>         |                                   |      |      |      |      |                                 |                         |  |        |
| Albion Park South        | 95.5                              | 93.9 | 95.5 | 94.6 | 94.8 | 0                               | 0.003                   | Met  | Met    |
| Kembla Grange            | 95.3                              | 91.1 | 88.9 | 92.9 | 92.1 | 0                               | 0.004                   | Met  | Met    |

| Region/Station             | Data availability<br>(% of hours) |      |      |      |      | Number of<br>exceedance<br>days | Annual<br>Mean<br>(ppm) | Performance<br>against<br>standards and<br>goals |        |
|----------------------------|-----------------------------------|------|------|------|------|---------------------------------|-------------------------|--|--------|
|                            | Q1                                | Q2   | Q3   | Q4   | Year |                                 |                         | 1-hour   | Annual |
| Wollongong                 | 91.3                              | 92.4 | 92.7 | 94.8 | 92.8 | 0                               | 0.006                   | Met  | Met    |
| <b>Central Coast</b>       |                                   |      |      |      |      |                                 |                         |  |        |
| Wyong                      | 93.5                              | 91.3 | 95.1 | 93.3 | 93.3 | 0                               | 0.003                   | Met  | Met    |
| <b>Lower Hunter</b>        |                                   |      |      |      |      |                                 |                         |  |        |
| Beresfield                 | 90.8                              | 91.5 | 90.3 | 92.4 | 91.2 | 0                               | 0.007                   | Met  | Met    |
| Newcastle                  | 87.8                              | 94.4 | 93.0 | 93.0 | 92.1 | 0                               | 0.005                   | Met  | Met    |
| Wallsend                   | 93.8                              | 95.5 | 95.4 | 93.7 | 94.6 | 0                               | 0.006                   | Met  | Met    |
| <b>Upper Hunter</b>        |                                   |      |      |      |      |                                 |                         |  |        |
| Muswellbrook               | 94.6                              | 74.1 | 93.6 | 94.7 | 89.3 | 0                               | 0.008 <sup>1</sup>      | ND   | ND     |
| Singleton                  | 86.3                              | 94.5 | 95.4 | 92.0 | 92.1 | 0                               | 0.006                   | Met  | Met    |
| <b>North West Slopes</b>   |                                   |      |      |      |      |                                 |                         |  |        |
| Gunnedah                   | 93.2                              | 95.7 | 94.7 | 94.1 | 94.4 | 0                               | 0.003                   | Met  | Met    |
| <b>Southern Tablelands</b> |                                   |      |      |      |      |                                 |                         |  |        |
| Goulburn                   | 89.7                              | 95.4 | 95.4 | 91.8 | 93.1 | 0                               | 0.003                   | Met  | Met    |

1. Italicised annual mean is included where annual data availability was above the 75% requirement but did not meet the 75% requirement in at least one-quarter (also italicised). Performance against the 1-hour and annual standards cannot be determined in such cases, and any annual averages reported should be taken as indicative only.

ND = not demonstrated.

## Sulfur dioxide

**Table 9 2020 compliance summary for sulfur dioxide**

| Region/<br>Station       | Data availability<br>(% of hours) |      |      |      |      | Number of<br>exceedance<br>days |       | Annual<br>Mean<br>(ppm) | Performance against<br>standards and goals |       |        |
|--------------------------|-----------------------------------|------|------|------|------|---------------------------------|-------|-------------------------|--|-------|--------|
|                          | Q1                                | Q2   | Q3   | Q4   | Year | 1-<br>hour                      | Daily |                         | 1-<br>hour                                 | Daily | Annual |
| <b>Sydney East</b>       |                                   |      |      |      |      |                                 |       |                         |  |       |        |
| Chullora                 | 95.3                              | 94.2 | 92.6 | 92.7 | 93.7 | 0                               | 0     | 0.000                   | Met  | Met   | Met    |
| Cook and<br>Phillip      | 81.0                              | 90.6 | 92.3 | 80.9 | 86.2 | 0                               | 0     | 0.000                   | Met  | Met   | Met    |
| Macquarie<br>Park        | 95.5                              | 95.7 | 93.9 | 95.4 | 95.1 | 0                               | 0     | 0.000                   | Met  | Met   | Met    |
| Randwick                 | 95.2                              | 94.2 | 95.5 | 94.8 | 94.9 | 0                               | 0     | 0.001                   | Met  | Met   | Met    |
| Rozelle                  | 95.4                              | 93.7 | 95.3 | 94.7 | 94.8 | 0                               | 0     | 0.000                   | Met  | Met   | Met    |
| <b>Sydney North West</b> |                                   |      |      |      |      |                                 |       |                         |  |       |        |
| Parramatta<br>North      | 95.6                              | 95.0 | 93.5 | 95.1 | 94.8 | 0                               | 0     | 0.001                   | Met  | Met   | Met    |



| Region/<br>Station       | Data availability<br>(% of hours) |      |      |      |      | Number of<br>exceedance<br>days |       | Annual<br>Mean<br>(ppm) | Performance against<br>standards and goals |       |        |
|--------------------------|-----------------------------------|------|------|------|------|---------------------------------|-------|-------------------------|--|-------|--------|
|                          | Q1                                | Q2   | Q3   | Q4   | Year | 1-<br>hour                      | Daily |                         | 1-<br>hour                                 | Daily | Annual |
| Prospect                 | 94.8                              | 95.4 | 93.7 | 92.8 | 94.1 | 0                               | 0     | 0.001                   | Met  | Met   | Met    |
| Richmond                 | 94.5                              | 94.9 | 91.5 | 89.3 | 92.5 | 0                               | 0     | 0.000                   | Met  | Met   | Met    |
| Rouse Hill               | 95.5                              | 94.3 | 95.5 | 94.8 | 95.0 | 0                               | 0     | 0.000                   | Met  | Met   | Met    |
| <b>Sydney South West</b> |                                   |      |      |      |      |                                 |       |                         |  |       |        |
| Bargo                    | 93.5                              | 95.7 | 94.3 | 94.7 | 94.6 | 0                               | 0     | 0.000                   | Met  | Met   | Met    |
| Bringelly                | 66.3                              | 95.6 | 91.6 | 95.0 | 87.2 | 0                               | 0     | 0.000 <sup>1</sup>      | ND   | ND    | ND     |
| Campbelltown<br>West     | 93.9                              | 95.1 | 94.2 | 95.5 | 94.7 | 0                               | 0     | 0.000                   | Met  | Met   | Met    |
| Liverpool                | 83.7                              | 95.4 | 95.3 | 95.2 | 92.4 | 0                               | 0     | 0.001                   | Met  | Met   | Met    |
| <b>Illawarra</b>         |                                   |      |      |      |      |                                 |       |                         |  |       |        |
| Albion Park<br>South     | 91.4                              | 93.9 | 95.4 | 92.8 | 93.4 | 0                               | 0     | 0.000                   | Met  | Met   | Met    |
| Wollongong               | 89.5                              | 92.4 | 92.8 | 95.0 | 92.4 | 0                               | 0     | 0.001                   | Met  | Met   | Met    |
| <b>Central Coast</b>     |                                   |      |      |      |      |                                 |       |                         |  |       |        |
| Wyong                    | 94.1                              | 93.3 | 94.1 | 93.3 | 93.7 | 0                               | 0     | 0.001                   | Met  | Met   | Met    |
| <b>Lower Hunter</b>      |                                   |      |      |      |      |                                 |       |                         |  |       |        |
| Beresfield               | 91.9                              | 95.6 | 93.7 | 95.0 | 94.1 | 0                               | 0     | 0.001                   | Met  | Met   | Met    |
| Newcastle                | 89.4                              | 95.5 | 94.7 | 94.1 | 93.4 | 0                               | 0     | 0.001                   | Met  | Met   | Met    |
| Wallsend                 | 94.6                              | 94.9 | 94.7 | 90.9 | 93.8 | 0                               | 0     | 0.002                   | Met  | Met   | Met    |
| <b>Upper Hunter</b>      |                                   |      |      |      |      |                                 |       |                         |  |       |        |
| Muswellbrook             | 95.7                              | 74.1 | 93.8 | 93.3 | 89.2 | 0                               | 0     | 0.002 <sup>1</sup>      | ND   | ND    | ND     |
| Singleton                | 95.3                              | 94.1 | 95.7 | 93.3 | 94.6 | 0                               | 0     | 0.002                   | Met  | Met   | Met    |

1. Italicised annual mean denotes where annual data availability was above the 75% requirement, but where station did not meet the 75% requirement during at least one-quarter (also italicised). In these examples, performance against the various standards cannot be determined, and the annual average should be taken as indicative only.

ND = Not demonstrated.

## Ozone

**Table 10 2020 compliance summary for ozone**

| Region/Station     | Data availability<br>(% of hours) |      |      |      |      | Number of<br>exceedance<br>days |        | Performance<br>against standards<br>and goals |        |
|--------------------|-----------------------------------|------|------|------|------|---------------------------------|--------|---|--------|
|                    | Q1                                | Q2   | Q3   | Q4   | Year | 1-hour                          | 4-hour | 1-hour  | 4-hour |
| <b>Sydney East</b> |                                   |      |      |      |      |                                 |        |   |        |
| Chullora           | 95.6                              | 94.2 | 93.8 | 94.7 | 94.6 | 1                               | 1      | Met   | Met    |
| Cook and Phillip   | 79.4                              | 90.1 | 87.1 | 91.1 | 87.0 | 0                               | 0      | Met   | Met    |

| Region/Station             | Data availability<br>(% of hours) |      |      |      |      | Number of<br>exceedance<br>days |        | Performance<br>against standards<br>and goals |                |
|----------------------------|-----------------------------------|------|------|------|------|---------------------------------|--------|---|----------------|
|                            | Q1                                | Q2   | Q3   | Q4   | Year | 1-hour                          | 4-hour | 1-hour  | 4-hour         |
| Earlwood                   | 95.3                              | 95.5 | 94.8 | 90.7 | 94.1 | 0                               | 1      | Met   | Met            |
| Macquarie Park             | 88.3                              | 95.7 | 94.9 | 89.9 | 92.2 | 1                               | 1      | Met   | Met            |
| Randwick                   | 95.3                              | 94.1 | 95.4 | 95.1 | 95.0 | 0                               | 1      | Met   | Met            |
| Rozelle                    | 95.4                              | 93.6 | 95.2 | 95.2 | 94.8 | 0                               | 0      | Met   | Met            |
| <b>Sydney North West</b>   |                                   |      |      |      |      |                                 |        |   |                |
| Parramatta North           | 95.7                              | 94.9 | 94.7 | 95.1 | 95.1 | 0                               | 1      | Met   | Met            |
| Prospect                   | 95.3                              | 95.3 | 93.8 | 94.9 | 94.8 | 1                               | 1      | Met   | Met            |
| Richmond                   | 94.8                              | 95.2 | 90.4 | 90.9 | 92.8 | 0                               | 1      | Met   | Met            |
| Rouse Hill                 | 95.5                              | 94.2 | 94.3 | 94.8 | 94.7 | 0                               | 1      | Met   | Met            |
| St Marys                   | 95.1                              | 95.2 | 95.2 | 94.0 | 94.9 | 1                               | 3      | Met   | <b>Not met</b> |
| <b>Sydney South West</b>   |                                   |      |      |      |      |                                 |        |   |                |
| Bargo                      | 92.0                              | 94.0 | 93.4 | 95.3 | 93.7 | 1                               | 1      | Met   | Met            |
| Bringelly                  | 64.9 <sup>1</sup>                 | 95.6 | 95.2 | 95.0 | 87.7 | 1                               | 1      | ND  | ND             |
| Camden                     | 94.5                              | 95.2 | 94.2 | 94.2 | 94.5 | 1                               | 2      | Met   | <b>Not met</b> |
| Campbelltown West          | 95.2                              | 95.1 | 94.7 | 95.5 | 95.1 | 1                               | 2      | Met   | <b>Not met</b> |
| Liverpool                  | 84.8                              | 95.2 | 95.3 | 95.2 | 92.6 | 1                               | 1      | Met   | Met            |
| Oakdale                    | 95.6                              | 95.7 | 95.4 | 93.1 | 94.9 | 1                               | 1      | Met   | Met            |
| <b>Illawarra</b>           |                                   |      |      |      |      |                                 |        |   |                |
| Albion Park South          | 89.0                              | 93.5 | 91.8 | 94.7 | 92.3 | 1                               | 1      | Met   | Met            |
| Kembla Grange              | 95.5                              | 91.2 | 93.6 | 89.8 | 92.5 | 0                               | 1      | Met   | Met            |
| Wollongong                 | 93.9                              | 92.4 | 93.8 | 92.5 | 93.1 | 0                               | 0      | Met   | Met            |
| <b>Central Coast</b>       |                                   |      |      |      |      |                                 |        |   |                |
| Wyong                      | 95.0                              | 92.3 | 95.2 | 93.3 | 93.9 | 1                               | 1      | Met   | Met            |
| <b>Lower Hunter</b>        |                                   |      |      |      |      |                                 |        |   |                |
| Beresfield                 | 94.4                              | 92.6 | 90.5 | 94.8 | 93.1 | 0                               | 0      | Met   | Met            |
| Newcastle                  | 90.9                              | 95.4 | 95.1 | 94.4 | 94.0 | 0                               | 0      | Met   | Met            |
| Wallsend                   | 89.3                              | 95.2 | 95.3 | 92.3 | 93.1 | 0                               | 0      | Met   | Met            |
| <b>North West Slopes</b>   |                                   |      |      |      |      |                                 |        |   |                |
| Gunnedah                   | 93.4                              | 95.6 | 91.6 | 91.6 | 93.0 | 0                               | 0      | Met   | Met            |
| <b>Southern Tablelands</b> |                                   |      |      |      |      |                                 |        |   |                |
| Goulburn                   | 95.1                              | 95.4 | 95.5 | 94.1 | 95.0 | 0                               | 4      | Met   | <b>Not met</b> |

1. Italicised annual mean denotes where annual data availability was above the 75% requirement, but where station did not meet the 75% requirement during at least one-quarter (also italicised). In these examples, performance against the various standards cannot be determined, and the annual average should be taken as indicative only.

ND = Not demonstrated.

## Particles as PM10

**Table 11 2020 compliance summary for particles as PM10**

| Region/Station           | Data availability<br>(% of days) |      |      |      |      | Number of<br>exceedance<br>days <sup>1</sup> | Annual<br>Mean<br>( $\mu\text{g}/\text{m}^3$ ) | Performance<br>against<br>standards and<br>goals |        |
|--------------------------|----------------------------------|------|------|------|------|--|--|--|--------|
|                          | Q1                               | Q2   | Q3   | Q4   | Year |  |  | Daily  | Annual |
| <b>Sydney East</b>       |                                  |      |      |      |      |  |  |  |        |
| Chullora                 | 100                              | 97.8 | 100  | 96.7 | 98.6 | 7  | 20.5   | Met  | Met    |
| Cook and Phillip         | 63.7                             | 91.2 | 96.7 | 95.7 | 86.9 | 4  | 15.7 <sup>2</sup>                              | ND   | ND     |
| Earlwood                 | 97.8                             | 100  | 100  | 100  | 99.5 | 9  | 18.5   | Met  | Met    |
| Macquarie Park           | 98.9                             | 100  | 96.7 | 100  | 98.9 | 7  | 15.7   | Met  | Met    |
| Randwick                 | 98.9                             | 100  | 97.8 | 100  | 99.2 | 9  | 19.5   | Met  | Met    |
| Rozelle                  | 100                              | 93.4 | 97.8 | 100  | 97.8 | 7  | 18.1   | Met  | Met    |
| <b>Sydney North West</b> |                                  |      |      |      |      |  |  |  |        |
| Parramatta North         | 100                              | 97.8 | 100  | 100  | 99.5 | 9  | 19.3   | Met  | Met    |
| Prospect                 | 100                              | 100  | 97.8 | 100  | 99.5 | 10   | 20.2   | Met  | Met    |
| Richmond                 | 91.2                             | 100  | 96.7 | 87.0 | 93.7 | 9  | 17.0   | Met  | Met    |
| Rouse Hill               | 97.8                             | 100  | 97.8 | 98.9 | 98.6 | <b>10</b>                                    | <b>(1)</b> 18.3                                | <b>Not met</b>                                   | Met    |
| St Marys                 | 100                              | 100  | 96.7 | 100  | 99.2 | 11   | 18.9   | Met  | Met    |
| <b>Sydney South West</b> |                                  |      |      |      |      |  |  |  |        |
| Bargo                    | 94.5                             | 97.8 | 96.7 | 100  | 97.3 | 6  | 16.0   | Met  | Met    |
| Bringelly                | 97.8                             | 100  | 100  | 97.8 | 98.9 | 11   | 18.3   | Met  | Met    |
| Camden                   | 97.8                             | 93.4 | 96.7 | 100  | 97.0 | 9  | 16.6   | Met  | Met    |
| Campbelltown West        | 100                              | 97.8 | 100  | 100  | 99.5 | 10   | 17.0   | Met  | Met    |
| Liverpool                | 87.9                             | 100  | 100  | 96.7 | 96.2 | <b>7</b>                                     | <b>(2)</b> 20.8                                | <b>Not met</b>                                   | Met    |
| Oakdale                  | 100                              | 100  | 97.8 | 98.9 | 99.2 | 10   | 14.4   | Met  | Met    |
| <b>Illawarra</b>         |                                  |      |      |      |      |  |  |  |        |
| Albion Park South        | 100                              | 93.4 | 100  | 98.9 | 98.1 | 10   | 17.1   | Met  | Met    |
| Kembla Grange            | 100                              | 93.4 | 97.8 | 97.8 | 97.3 | <b>19</b>                                    | <b>(7)</b> 21.5                                | <b>Not met</b>                                   | Met    |
| Wollongong               | 90.1                             | 96.7 | 97.8 | 98.9 | 95.9 | 11   | 18.8   | Met  | Met    |
| <b>Central Coast</b>     |                                  |      |      |      |      |  |  |  |        |
| Wyong                    | 98.9                             | 100  | 97.8 | 100  | 99.2 | <b>5</b>                                     | <b>(1)</b> 15.9                                | <b>Not met</b>                                   | Met    |
| <b>Lower Hunter</b>      |                                  |      |      |      |      |  |  |  |        |
| Beresfield               | 98.9                             | 100  | 100  | 97.8 | 99.2 | 6  | 18.5   | Met  | Met    |

| Region/Station             | Data availability<br>(% of days) |      |      |      |      | Number of<br>exceedance<br>days <sup>1</sup> | Annual<br>Mean<br>(µg/m <sup>3</sup> ) | Performance<br>against<br>standards and<br>goals |                |     |
|----------------------------|----------------------------------|------|------|------|------|--|--|--|----------------|-----|
|                            | Q1                               | Q2   | Q3   | Q4   | Year |  |  | Daily  | Annual         |     |
| Newcastle                  | 94.5                             | 100  | 100  | 96.7 | 97.8 | 9  | 22.4                                   | Met  | Met            |     |
| Wallsend                   | 98.9                             | 100  | 97.8 | 100  | 99.2 | 6  | 17.7                                   | Met  | Met            |     |
| <b>Upper Hunter</b>        |                                  |      |      |      |      |  |  |  |                |     |
| Aberdeen                   | 100                              | 97.8 | 100  | 100  | 99.5 | 8  | 17.8                                   | Met  | Met            |     |
| Muswellbrook               | 100                              | 97.8 | 98.9 | 98.9 | 98.9 | <b>15</b>                                    | <b>(1)</b>                             | 22.5   | <b>Not met</b> | Met |
| Singleton                  | 100                              | 100  | 97.8 | 100  | 99.5 | <b>10</b>                                    | <b>(1)</b>                             | 20.5   | <b>Not met</b> | Met |
| <b>Central Tablelands</b>  |                                  |      |      |      |      |  |  |  |                |     |
| Bathurst                   | 97.8                             | 100  | 100  | 95.7 | 98.4 | 14   | 17.0                                   | Met  | Met            |     |
| Orange                     | 94.5                             | 97.8 | 95.7 | 100  | 97.0 | 12   | 17.9                                   | Met  | Met            |     |
| <b>North West Slopes</b>   |                                  |      |      |      |      |  |  |  |                |     |
| Gunnedah                   | 83.5                             | 97.8 | 98.9 | 100  | 95.1 | 3  | 13.9                                   | Met  | Met            |     |
| Narrabri                   | 100                              | 97.8 | 100  | 94.6 | 98.1 | 8  | 12.4                                   | Met  | Met            |     |
| Tamworth                   | 97.8                             | 98.9 | 100  | 97.8 | 98.6 | 8  | 16.8                                   | Met  | Met            |     |
| <b>Northern Tablelands</b> |                                  |      |      |      |      |  |  |  |                |     |
| Armidale                   | 100                              | 100  | 100  | 96.7 | 99.2 | <b>4</b>                                     | <b>(1)</b>                             | 13.7   | <b>Not met</b> | Met |
| <b>South West Slopes</b>   |                                  |      |      |      |      |  |  |  |                |     |
| Albury                     | 94.5                             | 100  | 100  | 95.7 | 97.5 | <b>19</b>                                    | <b>(1)</b>                             | 20.1   | <b>Not met</b> | Met |
| Wagga Wagga<br>North       | 96.7                             | 100  | 96.7 | 100  | 98.4 | <b>25</b>                                    | <b>(5)</b>                             | 23.2   | <b>Not met</b> | Met |
| <b>Southern Tablelands</b> |                                  |      |      |      |      |  |  |  |                |     |
| Goulburn                   | 98.9                             | 93.4 | 98.9 | 97.8 | 97.3 | 18   | 19.2                                   | Met  | Met            |     |

1. This number includes non-exceptional exceedance days shown in brackets. For example, '10 (1)' for Rouse Hill means there were 10 exceedance days in total recorded, of which 1 was non-exceptional (considered assessable event) and the remaining nine were exceptional event days (non-assessable).

2. Italicised annual mean is included where annual data availability was above the 75% requirement, but where at least one-quarter (also italicised) did not meet the 75% requirement. In these examples, the annual average should be taken as indicative only, and performance against the 1-year standard cannot be determined.

ND = Not demonstrated.

## Particles as PM2.5

**Table 12 2020 compliance summary for particles as PM2.5**

| Region/Station           | Data availability<br>(% of days) |      |      |      |      | Number of<br>exceedance<br>days <sup>1</sup> | Annual<br>Mean<br>( $\mu\text{g}/\text{m}^3$ ) | Performance<br>against<br>standards and<br>goals |                 |
|--------------------------|----------------------------------|------|------|------|------|--|--|--|-----------------|
|                          | Q1                               | Q2   | Q3   | Q4   | Year |  |  | Daily  | Annual          |
| <b>Sydney East</b>       |                                  |      |      |      |      |  |  |  |                 |
| Chullora                 | 100                              | 93.4 | 100  | 97.8 | 97.8 | 9  | <b>8.8</b>                                     | Met  | <b>Not met</b>  |
| Cook and Phillip         | 63.7                             | 91.2 | 96.7 | 95.7 | 86.9 | 7  | 7.8 <sup>2</sup>                               | ND <sup>3</sup>                                  | ND <sup>2</sup> |
| Earlwood                 | 97.8                             | 100  | 91.3 | 100  | 97.3 | 9  | 8.0  | Met  | Met             |
| Macquarie Park           | 98.9                             | 100  | 97.8 | 98.9 | 98.9 | 8  | 7.1  | Met  | Met             |
| Randwick                 | 96.7                             | 100  | 71.7 | 100  | 92.1 | 8  | 7.6 <sup>2</sup>                               | ND <sup>3</sup>                                  | ND <sup>2</sup> |
| Rozelle                  | 100                              | 100  | 93.5 | 100  | 98.4 | 8  | 7.5  | Met  | Met             |
| <b>Sydney North West</b> |                                  |      |      |      |      |  |  |  |                 |
| Parramatta North         | 98.9                             | 89.0 | 100  | 96.7 | 96.2 | 10   | <b>8.2</b>                                     | Met  | <b>Not met</b>  |
| Prospect                 | 100                              | 92.3 | 97.8 | 100  | 97.5 | <b>13</b>                                    | <b>(2)</b> <b>8.6</b>                          | <b>Not met</b>                                   | <b>Not met</b>  |
| Richmond                 | 90.1                             | 96.7 | 94.6 | 84.8 | 91.5 | <b>9</b>                                     | <b>(1)</b> <b>8.4</b>                          | <b>Not Met</b>                                   | <b>Not met</b>  |
| Rouse Hill               | 97.8                             | 96.7 | 96.7 | 98.9 | 97.5 | <b>10</b>                                    | <b>(1)</b> 7.1                                 | <b>Not met</b>                                   | Met             |
| St Marys                 | 72.5                             | 94.5 | 89.1 | 100  | 89.1 | 9  | 7.6 <sup>2</sup>                               | ND <sup>3</sup>                                  | ND <sup>2</sup> |
| <b>Sydney South West</b> |                                  |      |      |      |      |  |  |  |                 |
| Bargo                    | 93.4                             | 97.8 | 96.7 | 91.3 | 94.8 | 14   | 7.8  | Met  | Met             |
| Bringelly                | 93.4                             | 97.8 | 95.7 | 96.7 | 95.9 | 12   | <b>8.5</b>                                     | Met  | <b>Not met</b>  |
| Camden                   | 97.8                             | 97.8 | 95.7 | 100  | 97.8 | 11   | 7.7  | Met  | Met             |
| Campbelltown West        | 100                              | 97.8 | 95.7 | 100  | 98.4 | 12   | 7.5  | Met  | Met             |
| Liverpool                | 86.8                             | 96.7 | 100  | 95.7 | 94.8 | <b>7</b>                                     | <b>(1)</b> <b>9.1</b>                          | <b>Not met</b>                                   | <b>Not met</b>  |
| Oakdale                  | 96.7                             | 96.7 | 96.7 | 98.9 | 97.3 | 11   | 6.7  | Met  | Met             |
| <b>Illawarra</b>         |                                  |      |      |      |      |  |  |  |                 |
| Albion Park South        | 100                              | 97.8 | 100  | 98.9 | 99.2 | 10   | 6.8  | Met  | Met             |
| Kembla Grange            | 94.5                             | 93.4 | 97.8 | 97.8 | 95.9 | 11   | 7.0  | Met  | Met             |
| Wollongong               | 80.2                             | 69.2 | 89.1 | 98.9 | 84.4 | 10   | 7.8 <sup>2</sup>                               | ND <sup>3</sup>                                  | ND <sup>2</sup> |
| <b>Central Coast</b>     |                                  |      |      |      |      |  |  |  |                 |
| Wyong                    | 93.4                             | 100  | 95.7 | 93.5 | 95.6 | 3  | 5.6  | Met  | Met             |

| Region/Station             | Data availability<br>(% of days) |      |      |      |      | Number of<br>exceedance<br>days <sup>1</sup> | Annual<br>Mean<br>( $\mu\text{g}/\text{m}^3$ ) | Performance<br>against<br>standards and<br>goals |                |                 |
|----------------------------|----------------------------------|------|------|------|------|--|--|--|----------------|-----------------|
|                            | Q1                               | Q2   | Q3   | Q4   | Year |  |  | Daily  | Annual         |                 |
| <b>Lower Hunter</b>        |                                  |      |      |      |      |  |  |  |                |                 |
| Beresfield                 | 92.3                             | 100  | 100  | 94.6 | 96.7 | 8  | 7.7  | Met  | Met            |                 |
| Newcastle                  | 73.6                             | 28.6 | 97.8 | 94.6 | 73.8 | <b>5</b>                                     | <b>(1)</b>                                     | na <sup>4</sup>                                  | <b>Not met</b> | ND <sup>4</sup> |
| Wallsend                   | 98.9                             | 100  | 95.7 | 100  | 98.6 | 5  | 7.3  | Met  | Met            |                 |
| <b>Upper Hunter</b>        |                                  |      |      |      |      |  |  |  |                |                 |
| Muswellbrook               | 100                              | 95.6 | 96.7 | 98.9 | 97.8 | <b>9</b>                                     | <b>(2)</b>                                     | <b>9.3</b>                                       | <b>Not met</b> | <b>Not met</b>  |
| Singleton                  | 100                              | 100  | 94.6 | 97.8 | 98.1 | <b>6</b>                                     | <b>(1)</b>                                     | <b>8.4</b>                                       | <b>Not met</b> | <b>Not met</b>  |
| <b>Central Tablelands</b>  |                                  |      |      |      |      |  |  |  |                |                 |
| Bathurst                   | 97.8                             | 100  | 100  | 96.7 | 98.6 | 13   | 7.6  | Met  | Met            |                 |
| Orange                     | 94.5                             | 97.8 | 95.7 | 100  | 97.0 | <b>15</b>                                    | <b>(3)</b>                                     | <b>9.1</b>                                       | <b>Not met</b> | <b>Not met</b>  |
| <b>North West Slopes</b>   |                                  |      |      |      |      |  |  |  |                |                 |
| Gunnedah                   | 97.8                             | 97.8 | 98.9 | 100  | 98.6 | <b>6</b>                                     | <b>(1)</b>                                     | 7.7  | <b>Not met</b> | Met             |
| Narrabri                   | 100                              | 97.8 | 100  | 94.6 | 98.1 | 1  | 5.5  | Met  | Met            |                 |
| Tamworth                   | 97.8                             | 97.8 | 98.9 | 96.7 | 97.8 | 4  | 6.8  | Met  | Met            |                 |
| <b>Northern Tablelands</b> |                                  |      |      |      |      |  |  |  |                |                 |
| Armidale                   | 100                              | 100  | 100  | 96.7 | 99.2 | <b>27</b>                                    | <b>(23)</b>                                    | <b>9.2</b>                                       | <b>Not met</b> | <b>Not met</b>  |
| <b>South West Slopes</b>   |                                  |      |      |      |      |  |  |  |                |                 |
| Albury                     | 92.3                             | 97.8 | 97.8 | 84.8 | 93.2 | 16   | <b>11.1</b>                                    | Met  | <b>Not met</b> |                 |
| Wagga Wagga<br>North       | 97.8                             | 100  | 96.7 | 98.9 | 98.4 | 13   | <b>10.7</b>                                    | Met  | <b>Not met</b> |                 |
| <b>Southern Tablelands</b> |                                  |      |      |      |      |  |  |  |                |                 |
| Goulburn                   | 98.9                             | 93.4 | 98.9 | 97.8 | 97.3 | 16   | <b>11.8</b>                                    | Met  | <b>Not met</b> |                 |

1. This number includes non-exceptional exceedance days shown in brackets. For example, '13(2)' for Prospect means there were 13 exceedance days in total recorded, of which 2 were non-exceptional (considered assessable event) and the remaining 11 were exceptional event days (non-assessable).

2. Italicised annual mean is included where annual data availability was above the 75% requirement, but where at least one-quarter (also italicised) did not meet the 75% requirement. In these examples, the annual average should be taken as indicative only, and performance against the annual standard cannot be determined. Hence ND<sup>2</sup>.

3. Compliance status remains 'ND' in these examples because even if there was insufficient data coverage during any quarter, and no exceedances were recorded during periods with data, the station cannot be assessed to have complied with the daily standard, as it could be the case that there was insufficient evidence to demonstrate non-compliance. Hence ND<sup>3</sup>.

4. 'na' means the PM2.5 annual average at Newcastle is not reported due to < 75% data availability across the entire year, caused by ongoing instrument fault during 11 March to 4 June 2020. Hence ND<sup>4</sup>.

### Monitoring and reporting using Federal Reference Method for PM2.5

A background to PM2.5 monitoring and the reporting of Federal Reference Method (FRM) data in New South Wales is provided in the *New South Wales Annual Compliance Report 2018* (DPIE 2020c).

The compliance summary for 2020 is shown below.

**Table 13** 2020 PM2.5 compliance summary, Federal Reference Method (FRM) method

| Region/<br>Station | Data availability rate <sup>1</sup><br>(% of days) |      |     |      |      | Number of<br>exceedance<br>days <sup>2</sup> | Annual<br>Mean<br>(µg/m <sup>3</sup> ) | Performance against<br>standards and goals |        |
|--------------------|--|------|-----|------|------|--|--|--|--------|
|                    | Q1   | Q2   | Q3  | Q4   | Year |  |  | Daily                                      | Annual |
| <b>Sydney East</b> |  |      |     |      |      |  |  |  |        |
| Chullora           | 89.0   | 92.3 | 100 | 94.6 | 94.3 | 2 <sup>3</sup> (0)                           | 7.8                                    | Met  | Met    |

1. Data availability rates are based on a one-day-in-three sampling regime.

2. Non-exceptional exceedance days shown in brackets, considered assessable events (none in this case).

3. The two (exceptional) exceedance days are 12 January 2020 (45.8 µg/m<sup>3</sup>) and 24 January 2020 (37.1 µg/m<sup>3</sup>).

## Section C – Analysis of air quality

This section summarises air quality data from the AAQ NEPM network of stations, detailing recorded exceedances of national air quality standards during 2020. Table 14 through Table 25 include data availability during 2020 (counted as days), and the two highest values (daily maxima). Also included are the associated timestamps when the maxima were observed. (e.g. 'date' for daily averages, or 'date, hour' for shorter-term averages).

For those pollutants which recorded exceedances of national standards, being ozone and particles, a summary of exceedances is at Table 19 (ozone), Table 21 (PM10) and Table 23 (PM2.5). All **bold** entries mean an exceedance of national standards.

### Notes on daily maxima

As an AAQ NEPM requirement for standards with averaging periods of less than 24 hours, the daily maxima are reported regardless of the number of valid hours in the day. For example, the daily 1-hour maxima for NO<sub>2</sub> during the year at a site may have occurred on a day on which the 75% data requirement was not met.

For ozone and carbon monoxide, standards which are calculated against rolling averages, the second highest values are those which occur on a different calendar day than the highest value, so that the underlying averaging periods do not overlap.

## Carbon monoxide

Table 14 Summary for CO: daily maximum rolling 8-hour average concentrations (2020)

| Region/Station           | Number of valid days | Daily maximum rolling 8-hour average (ppm) |            |                         |            |
|--------------------------|----------------------|--|------------|-------------------------|------------|
|                          |                      | Highest                                    | Date, hour | 2 <sup>nd</sup> highest | Date, hour |
| <b>Sydney East</b>       |                      |  |            |                         |            |
| Chullora                 | 346                  | 1.9  | 08 Jan, 15 | 1.4                     | 09 Jan, 01 |
| Cook and Phillip         | 331                  | 2.8  | 08 Jan, 12 | 1.5                     | 09 Jan, 01 |
| Macquarie Park           | 361                  | 2.4  | 08 Jan, 13 | 1.6                     | 09 Jan, 01 |
| Rozelle                  | 356                  | 2.6  | 08 Jan, 13 | 1.6                     | 09 Jan, 01 |
| <b>Sydney North West</b> |                      |  |            |                         |            |
| Parramatta North         | 359                  | 2.0  | 08 Jan, 15 | 1.5                     | 09 Jan, 01 |
| Prospect                 | 359                  | 1.8  | 08 Jan, 16 | 1.4                     | 09 Jan, 01 |
| Rouse Hill               | 359                  | 1.9  | 08 Jan, 17 | 1.5                     | 09 Jan, 01 |
| <b>Sydney South West</b> |                      |  |            |                         |            |
| Camden                   | 353                  | 2.6  | 05 Jan, 07 | 2.2                     | 08 Jan, 18 |
| Campbelltown West        | 354                  | 2.3  | 08 Jan, 18 | 1.6                     | 09 Jan, 02 |
| Liverpool                | 342                  | 2.1  | 08 Jan, 18 | 1.6                     | 09 Jan, 02 |
| <b>Central Coast</b>     |                      |  |            |                         |            |
| Wyong                    | 347                  | 1.7  | 08 Jan, 17 | 1.3                     | 09 Jan, 01 |
| <b>Illawarra</b>         |                      |  |            |                         |            |
| Wollongong               | 352                  | 3.3  | 08 Jan, 16 | 1.7                     | 09 Jan, 01 |



| Region/Station      | Number of valid days | Daily maximum rolling 8-hour average (ppm) |            |                         |            |
|---------------------|----------------------|--|------------|-------------------------|------------|
|                     |                      | Highest                                    | Date, hour | 2 <sup>nd</sup> highest | Date, hour |
| <b>Lower Hunter</b> |                      |  |            |                         |            |
| Newcastle           | 349                  | 2.6  | 08 Jan, 15 | 1.5                     | 09 Jan, 01 |

There were no recorded days over the 8-hour CO standard in 2020.

Within the AAQ NEPM network of monitoring stations, the maximum 8-hourly CO average was 3.3 ppm, recorded at Wollongong in the Illawarra on 8 January 2020, during the extreme bushfire emergency period. This day recorded the highest CO for all NSW Greater Metropolitan Region (GMR) sites measuring CO at many locations. It is noted that Camden station, where CO levels were the second highest, was offline during the morning hours of 8 January.

## Nitrogen dioxide

**Table 15 Summary for NO<sub>2</sub>: maximum 1-hour average concentrations (2020)**

| Region/Station           | Number of valid days | Daily maximum 1-hour average (ppm) |            |                         |            |
|--------------------------|----------------------|------------------------------------|------------|-------------------------|------------|
|                          |                      | Highest                            | Date, hour | 2 <sup>nd</sup> highest | Date, hour |
| <b>Sydney East</b>       |                      |                                    |            |                         |            |
| Chullora                 | 356                  | 0.052                              | 19 Mar, 22 | 0.048                   | 20 Mar, 01 |
| Cook and Phillip         | 331                  | 0.046                              | 16 Jan, 09 | 0.045                   | 27 Aug, 19 |
| Earlwood                 | 352                  | 0.040                              | 19 Mar, 21 | 0.037                   | 02 Sep, 20 |
| Macquarie Park           | 362                  | 0.030                              | 04 Sep, 10 | 0.030                   | 15 Nov, 24 |
| Randwick                 | 355                  | 0.037                              | 20 Mar, 09 | 0.034                   | 16 Jan, 10 |
| Rozelle                  | 361                  | 0.043                              | 04 Jan, 14 | 0.037                   | 04 Sep, 12 |
| <b>Sydney North West</b> |                      |                                    |            |                         |            |
| Parramatta North         | 359                  | 0.037                              | 20 Jul, 08 | 0.037                   | 04 Sep, 09 |
| Prospect                 | 362                  | 0.043                              | 15 Apr, 21 | 0.040                   | 05 Jun, 19 |
| Richmond                 | 350                  | 0.035                              | 10 Jan, 24 | 0.031                   | 04 Sep, 18 |
| Rouse Hill               | 361                  | 0.034                              | 28 Sep, 24 | 0.033                   | 13 Aug, 19 |
| St Marys                 | 358                  | 0.034                              | 04 Sep, 15 | 0.031                   | 07 Oct, 18 |
| <b>Sydney South West</b> |                      |                                    |            |                         |            |
| Bargo                    | 356                  | 0.045                              | 19 Mar, 23 | 0.042                   | 04 Jan, 21 |
| Bringelly                | 305                  | 0.030                              | 04 Sep, 16 | 0.025                   | 08 Jul, 18 |
| Campbelltown West        | 359                  | 0.051                              | 19 Mar, 23 | 0.045                   | 15 Apr, 22 |
| Camden                   | 356                  | 0.037                              | 05 Jan, 05 | 0.028                   | 04 Sep, 16 |
| Liverpool                | 348                  | 0.048                              | 15 Apr, 20 | 0.047                   | 19 Mar, 22 |
| Oakdale                  | 362                  | 0.055                              | 05 Jan, 04 | 0.042                   | 04 Jan, 22 |
| <b>Illawarra</b>         |                      |                                    |            |                         |            |
| Albion Park South        | 361                  | 0.039                              | 19 Mar, 19 | 0.032                   | 14 Apr, 17 |

| Region/Station             | Number of valid days | Daily maximum 1-hour average (ppm) |            |                         |            |
|----------------------------|----------------------|------------------------------------|------------|-------------------------|------------|
|                            |                      | Highest                            | Date, hour | 2 <sup>nd</sup> highest | Date, hour |
| Kembla Grange              | 348                  | 0.038                              | 01 Feb, 21 | 0.034                   | 04 Jan, 18 |
| Wollongong                 | 351                  | 0.041                              | 22 Jul, 09 | 0.040                   | 02 Oct, 20 |
| <b>Central Coast</b>       |                      |                                    |            |                         |            |
| Wyong                      | 355                  | 0.035                              | 31 Jul, 03 | 0.032                   | 11 Aug, 19 |
| <b>Lower Hunter</b>        |                      |                                    |            |                         |            |
| Beresfield                 | 346                  | 0.035                              | 22 Jan, 05 | 0.031                   | 01 Sep, 22 |
| Newcastle                  | 354                  | 0.034                              | 20 Jul, 19 | 0.032                   | 03 Sep, 22 |
| Wallsend                   | 361                  | 0.029                              | 06 Aug, 20 | 0.028                   | 22 Jan, 06 |
| <b>Upper Hunter</b>        |                      |                                    |            |                         |            |
| Muswellbrook               | 339                  | 0.039                              | 03 Oct, 21 | 0.038                   | 22 Jan, 21 |
| Singleton                  | 345                  | 0.033                              | 08 Jan, 22 | 0.032                   | 16 Jan, 20 |
| <b>South West Slopes</b>   |                      |                                    |            |                         |            |
| Gunnedah                   | 359                  | 0.028                              | 04 Dec, 23 | 0.027                   | 02 Jul, 19 |
| <b>Southern Tablelands</b> |                      |                                    |            |                         |            |
| Goulburn                   | 355                  | 0.099                              | 05 Jan, 01 | 0.061                   | 04 Jan, 23 |

There were no days over the 1-hour NO<sub>2</sub> standard in 2020.

Within the AAQ NEPM network of air quality monitoring stations, the maximum 1-hour NO<sub>2</sub> concentration of 0.099 ppm was recorded on 5 January 2020, during the extreme 2019–20 bushfire period, at Goulburn in the Southern Tablelands. High pollution levels at Goulburn during the Black Summer bushfires were associated with southerly changes concentrating smoke from the NSW South Coast bushfires towards the Southern Tablelands and further inland, impacting not just particle pollution but gaseous pollution as well. Before this event day in 2020, Goulburn station, on 31 December 2019, saw the first-ever recorded exceedance of the NO<sub>2</sub> standard in the NSW network since 1998.

## Sulfur dioxide

Table 16 Summary for SO<sub>2</sub>: daily maximum 1-hour average concentrations (2020)

| Region/Station           | Number of valid days | Daily maximum 1-hour average (ppm) |            |                         |            |
|--------------------------|----------------------|------------------------------------|------------|-------------------------|------------|
|                          |                      | Highest                            | Date, hour | 2 <sup>nd</sup> highest | Date, hour |
| <b>Sydney East</b>       |                      |                                    |            |                         |            |
| Chullora                 | 356                  | 0.015                              | 18 Mar, 10 | 0.013                   | 23 Oct, 10 |
| Cook and Phillip         | 326                  | 0.019                              | 20 Jun, 04 | 0.016                   | 29 Aug, 24 |
| Macquarie Park           | 363                  | 0.035                              | 15 Nov, 24 | 0.021                   | 23 Oct, 09 |
| Randwick                 | 362                  | 0.014                              | 15 Oct, 09 | 0.013                   | 08 Oct, 10 |
| Rozelle                  | 361                  | 0.016                              | 30 Aug, 03 | 0.013                   | 02 Oct, 23 |
| <b>Sydney North West</b> |                      |                                    |            |                         |            |

| Region/Station           | Number of valid days | Daily maximum 1-hour average (ppm) |            |                         |            |
|--------------------------|----------------------|------------------------------------|------------|-------------------------|------------|
|                          |                      | Highest                            | Date, hour | 2 <sup>nd</sup> highest | Date, hour |
| Parramatta North         | 360                  | 0.020                              | 01 Feb, 21 | 0.016                   | 31 Jan, 10 |
| Prospect                 | 359                  | 0.018                              | 31 Jan, 11 | 0.017                   | 10 Jan, 22 |
| Richmond                 | 350                  | 0.012                              | 25 Feb, 21 | 0.010                   | 31 Jan, 10 |
| Rouse Hill               | 361                  | 0.019                              | 10 Jan, 22 | 0.017                   | 27 Nov, 23 |
| <b>Sydney South West</b> |                      |                                    |            |                         |            |
| Bargo                    | 359                  | 0.012                              | 24 Jul, 18 | 0.010                   | 21 Oct, 09 |
| Bringelly                | 333                  | 0.022                              | 24 Jul, 15 | 0.008                   | 21 Oct, 09 |
| Campbelltown West        | 362                  | 0.012                              | 21 Oct, 09 | 0.011                   | 24 Jul, 15 |
| Liverpool                | 350                  | 0.015                              | 24 Jul, 14 | 0.014                   | 21 Oct, 09 |
| <b>Illawarra</b>         |                      |                                    |            |                         |            |
| Albion Park South        | 355                  | 0.022                              | 10 Jan, 19 | 0.018                   | 21 Sep, 18 |
| Wollongong               | 349                  | 0.000                              | 01 Mar, 06 | 0.019                   | 11 Jun, 17 |
| <b>Central Coast</b>     |                      |                                    |            |                         |            |
| Wyong                    | 358                  | 0.069                              | 31 Jan, 09 | 0.051                   | 27 Nov, 17 |
| <b>Lower Hunter</b>      |                      |                                    |            |                         |            |
| Beresfield               | 359                  | 0.038                              | 04 Dec, 13 | 0.036                   | 11 Jul, 13 |
| Newcastle                | 355                  | 0.040                              | 12 Aug, 13 | 0.035                   | 20 Jun, 13 |
| Wallsend                 | 357                  | 0.040                              | 09 Jul, 11 | 0.035                   | 31 Oct, 20 |
| <b>Upper Hunter</b>      |                      |                                    |            |                         |            |
| Muswellbrook             | 337                  | 0.135                              | 19 May, 15 | 0.107                   | 07 Jun, 15 |
| Singleton                | 360                  | 0.055                              | 14 Apr, 12 | 0.051                   | 18 Feb, 12 |

Table 17 Summary of SO<sub>2</sub>: maximum daily (24-hour) average concentrations (2020)

| Region/Station           | Number of valid days | Maximum 24-hour average (ppm) |        |                         |        |
|--------------------------|----------------------|-------------------------------|--------|-------------------------|--------|
|                          |                      | Highest                       | Date   | 2 <sup>nd</sup> highest | Date   |
| <b>Sydney East</b>       |                      |                               |        |                         |        |
| Chullora                 | 356                  | 0.004                         | 23 Oct | 0.003                   | 25 Feb |
| Cook and Phillip         | 326                  | 0.003                         | 18 Mar | 0.003                   | 26 Nov |
| Macquarie Park           | 363                  | 0.004                         | 23 Oct | 0.004                   | 01 Mar |
| Randwick                 | 362                  | 0.004                         | 18 Mar | 0.004                   | 26 Nov |
| Rozelle                  | 361                  | 0.003                         | 18 Mar | 0.002                   | 08 Sep |
| <b>Sydney North West</b> |                      |                               |        |                         |        |
| Parramatta North         | 360                  | 0.005                         | 31 Jan | 0.004                   | 01 Mar |
| Prospect                 | 359                  | 0.004                         | 31 Jan | 0.004                   | 10 Jan |
| Richmond                 | 350                  | 0.003                         | 31 Jan | 0.002                   | 25 Feb |

| Region/Station           | Number of valid days | Maximum 24-hour average (ppm) |        |                         |        |
|--------------------------|----------------------|-------------------------------|--------|-------------------------|--------|
|                          |                      | Highest                       | Date   | 2 <sup>nd</sup> highest | Date   |
| Rouse Hill               | 361                  | 0.005                         | 31 Jan | 0.004                   | 10 Jan |
| <b>Sydney South West</b> |                      |                               |        |                         |        |
| Bargo                    | 359                  | 0.003                         | 31 Jan | 0.002                   | 14 Apr |
| Bringelly                | 333                  | 0.003                         | 24 Jul | 0.002                   | 31 Jan |
| Campbelltown West        | 362                  | 0.002                         | 21 Oct | 0.002                   | 24 Jul |
| Liverpool                | 350                  | 0.003                         | 24 Jul | 0.003                   | 31 Jan |
| <b>Illawarra</b>         |                      |                               |        |                         |        |
| Albion Park South        | 355                  | 0.005                         | 01 Feb | 0.005                   | 10 Jan |
| Wollongong               | 349                  | 0.004                         | 17 Sep | 0.004                   | 10 Dec |
| <b>Central Coast</b>     |                      |                               |        |                         |        |
| Wyong                    | 358                  | 0.008                         | 31 Jan | 0.006                   | 01 Dec |
| <b>Lower Hunter</b>      |                      |                               |        |                         |        |
| Beresfield               | 359                  | 0.008                         | 23 May | 0.006                   | 01 Jan |
| Newcastle                | 355                  | 0.007                         | 12 Aug | 0.006                   | 01 Jul |
| Wallsend                 | 357                  | 0.010                         | 17 Jul | 0.009                   | 01 Jan |
| <b>Upper Hunter</b>      |                      |                               |        |                         |        |
| Muswellbrook             | 337                  | 0.015                         | 30 Dec | 0.014                   | 19 Oct |
| Singleton                | 360                  | 0.011                         | 23 May | 0.011                   | 14 Apr |

There were no days over the 1-hour SO<sub>2</sub> standard or the 24-hour SO<sub>2</sub> standard in 2020. Annual SO<sub>2</sub> averages also remained well below the national standard.

Within the AAQ NEPM network of monitoring stations, the maximum 1-hour SO<sub>2</sub> was 0.135 ppm, recorded at Muswellbrook station in the Upper Hunter on 19 May 2020. Muswellbrook also recorded the maximum 24-hour average SO<sub>2</sub> of 0.015 ppm on 30 December 2020.

## Ozone

**Table 18 Summary for ozone: daily maximum 1-hour average concentrations (2020)**

| Region/Station     | Number of valid days | Maximum 1-hour average (ppm) |            |                         |            |
|--------------------|----------------------|------------------------------|------------|-------------------------|------------|
|                    |                      | Highest                      | Date       | 2 <sup>nd</sup> highest | Date       |
| <b>Sydney East</b> |                      |                              |            |                         |            |
| Chullora           | 360                  | <b>0.107</b>                 | 01 Feb, 13 | 0.092                   | 04 Jan, 17 |
| Cook and Phillip   | 327                  | 0.059                        | 08 Jan, 10 | 0.053                   | 03 Feb, 16 |
| Earlwood           | 358                  | 0.091                        | 04 Jan, 16 | 0.084                   | 01 Feb, 13 |
| Macquarie Park     | 350                  | <b>0.102</b>                 | 04 Jan, 17 | 0.090                   | 01 Feb, 11 |
| Randwick           | 362                  | 0.090                        | 04 Jan, 13 | 0.076                   | 08 Jan, 16 |
| Rozelle            | 361                  | 0.083                        | 04 Jan, 19 | 0.077                   | 08 Jan, 16 |

| Region/Station             | Number of valid days | Maximum 1-hour average (ppm) |            |                         |            |
|----------------------------|----------------------|------------------------------|------------|-------------------------|------------|
|                            |                      | Highest                      | Date       | 2 <sup>nd</sup> highest | Date       |
| <b>Sydney North West</b>   |                      |                              |            |                         |            |
| Parramatta North           | 363                  | 0.093                        | 01 Feb, 11 | 0.085                   | 31 Jan, 16 |
| Prospect                   | 362                  | <b>0.102</b>                 | 31 Jan, 16 | 0.089                   | 01 Feb, 11 |
| Richmond                   | 350                  | 0.093                        | 31 Jan, 17 | 0.086                   | 28 Jan, 16 |
| Rouse Hill                 | 360                  | 0.091                        | 31 Jan, 16 | 0.087                   | 02 Feb, 13 |
| St Marys                   | 360                  | <b>0.115</b>                 | 31 Jan, 15 | 0.095                   | 01 Feb, 12 |
| <b>Sydney South West</b>   |                      |                              |            |                         |            |
| Bargo                      | 352                  | <b>0.114</b>                 | 31 Jan, 17 | 0.089                   | 03 Jan, 16 |
| Bringelly                  | 334                  | <b>0.112</b>                 | 31 Jan, 15 | 0.092                   | 01 Feb, 16 |
| Campbelltown West          | 363                  | <b>0.108</b>                 | 01 Feb, 12 | 0.097                   | 31 Jan, 15 |
| Camden                     | 360                  | <b>0.107</b>                 | 31 Jan, 15 | 0.094                   | 28 Jan, 15 |
| Liverpool                  | 348                  | <b>0.102</b>                 | 01 Feb, 12 | 0.085                   | 04 Jan, 12 |
| Oakdale                    | 361                  | <b>0.116</b>                 | 31 Jan, 16 | 0.085                   | 08 Jan, 16 |
| <b>Illawarra</b>           |                      |                              |            |                         |            |
| Albion Park South          | 347                  | <b>0.102</b>                 | 01 Feb, 15 | 0.079                   | 04 Jan, 12 |
| Kembla Grange              | 349                  | 0.089                        | 01 Feb, 15 | 0.078                   | 08 Jan, 15 |
| Wollongong                 | 352                  | 0.079                        | 04 Jan, 14 | 0.072                   | 16 Nov, 14 |
| <b>Central Coast</b>       |                      |                              |            |                         |            |
| Wyong                      | 358                  | <b>0.101</b>                 | 04 Jan, 12 | 0.079                   | 21 Jan, 14 |
| Beresfield                 | 356                  | 0.093                        | 04 Jan, 11 | 0.075                   | 01 Feb, 16 |
| Newcastle                  | 358                  | 0.090                        | 04 Jan, 11 | 0.088                   | 08 Jan, 13 |
| Wallsend                   | 356                  | 0.083                        | 04 Jan, 10 | 0.072                   | 01 Feb, 15 |
| <b>South West Slopes</b>   |                      |                              |            |                         |            |
| Gunnedah                   | 351                  | 0.080                        | 03 Jan, 15 | 0.080                   | 06 Jan, 13 |
| <b>Southern Tablelands</b> |                      |                              |            |                         |            |
| Goulburn                   | 360                  | 0.092                        | 02 Jan, 15 | 0.092                   | 31 Jan, 22 |

**Table 19 Summary for ozone: daily maximum rolling 4-hour average concentrations (2020)**

| Region/Station     | Number of valid days | Maximum rolling 4-hour average (ppm) |            |                         |            |
|--------------------|----------------------|--------------------------------------|------------|-------------------------|------------|
|                    |                      | Highest                              | Date, hour | 2 <sup>nd</sup> highest | Date, hour |
| <b>Sydney East</b> |                      |                                      |            |                         |            |
| Chullora           | 361                  | <b>0.098</b>                         | 01 Feb, 14 | 0.080                   | 04 Jan, 19 |
| Cook and Phillip   | 324                  | 0.047                                | 08 Jan, 19 | 0.046                   | 03 Feb, 17 |
| Earlwood           | 358                  | <b>0.085</b>                         | 04 Jan, 17 | 0.075                   | 01 Feb, 15 |
| Macquarie Park     | 350                  | <b>0.086</b>                         | 04 Jan, 19 | 0.079                   | 01 Feb, 12 |

| Region/Station             | Number of valid days | Maximum rolling 4-hour average (ppm) |            |                         |            |
|----------------------------|----------------------|--------------------------------------|------------|-------------------------|------------|
|                            |                      | Highest                              | Date, hour | 2 <sup>nd</sup> highest | Date, hour |
| Randwick                   | 362                  | <b>0.081</b>                         | 04 Jan, 16 | 0.072                   | 08 Jan, 16 |
| Rozelle                    | 361                  | 0.078                                | 04 Jan, 20 | 0.069                   | 08 Jan, 18 |
| <b>Sydney North West</b>   |                      |                                      |            |                         |            |
| Parramatta North           | 362                  | <b>0.081</b>                         | 01 Feb, 14 | 0.075                   | 31 Jan, 17 |
| Prospect                   | 362                  | <b>0.093</b>                         | 31 Jan, 17 | 0.079                   | 01 Feb, 13 |
| Richmond                   | 352                  | <b>0.086</b>                         | 31 Jan, 18 | 0.080                   | 02 Feb, 14 |
| Rouse Hill                 | 360                  | <b>0.083</b>                         | 31 Jan, 17 | 0.075                   | 08 Jan, 15 |
| St Marys                   | 359                  | <b>0.107</b>                         | 31 Jan, 17 | <b>0.081</b>            | 28 Jan, 16 |
| <b>Sydney South West</b>   |                      |                                      |            |                         |            |
| Bargo                      | 353                  | <b>0.106</b>                         | 31 Jan, 18 | 0.080                   | 03 Jan, 17 |
| Bringelly                  | 334                  | <b>0.101</b>                         | 31 Jan, 17 | 0.080                   | 01 Feb, 14 |
| Campbelltown West          | 363                  | <b>0.091</b>                         | 31 Jan, 17 | <b>0.081</b>            | 01 Feb, 18 |
| Camden                     | 360                  | <b>0.096</b>                         | 31 Jan, 17 | <b>0.083</b>            | 28 Jan, 16 |
| Liverpool                  | 348                  | <b>0.093</b>                         | 01 Feb, 14 | 0.076                   | 31 Jan, 16 |
| Oakdale                    | 361                  | <b>0.102</b>                         | 31 Jan, 18 | 0.077                   | 08 Jan, 18 |
| <b>Illawarra</b>           |                      |                                      |            |                         |            |
| Albion Park South          | 347                  | <b>0.084</b>                         | 01 Feb, 16 | 0.074                   | 04 Jan, 14 |
| Kembla Grange              | 349                  | <b>0.081</b>                         | 01 Feb, 15 | 0.074                   | 08 Jan, 16 |
| Wollongong                 | 352                  | 0.071                                | 04 Jan, 15 | 0.063                   | 08 Jan, 16 |
| <b>Central Coast</b>       |                      |                                      |            |                         |            |
| Wyong                      | 358                  | <b>0.089</b>                         | 04 Jan, 14 | 0.067                   | 26 Jan, 15 |
| <b>Lower Hunter</b>        |                      |                                      |            |                         |            |
| Beresfield                 | 356                  | 0.076                                | 04 Jan, 13 | 0.071                   | 01 Feb, 16 |
| Newcastle                  | 358                  | 0.080                                | 04 Jan, 13 | 0.074                   | 08 Jan, 15 |
| Wallsend                   | 356                  | 0.079                                | 04 Jan, 13 | 0.071                   | 01 Feb, 16 |
| <b>South West Slopes</b>   |                      |                                      |            |                         |            |
| Gunnedah                   | 352                  | 0.078                                | 03 Jan, 16 | 0.076                   | 06 Jan, 14 |
| <b>Southern Tablelands</b> |                      |                                      |            |                         |            |
| Goulburn                   | 360                  | <b>0.091</b>                         | 31 Jan, 23 | <b>0.089</b>            | 02 Jan, 17 |

## Days above ozone standards

The list of ozone exceedances observed across NSW sites, on 6 days during 2020, is provided in Table 20. Ozone levels peaked during the warmer months of January and February 2020, with all 6 days occurring during the extreme 2019–20 summer bushfire period. In comparison, there were 33 days in 2019 when ozone levels exceeded national standards.

- Two out of the 6 days (1 January and 2 January) were observed only at Goulburn in the Southern Tablelands, and one day (4 January) was observed at Sydney and Central Coast stations. These events were associated with bushfire smoke transported from multiple regions during the intense summer bushfire period.
- In what was the most extensive ozone event driven by heatwave conditions, two exceedance days (31 January and 1 February) were observed at several GMR stations in Sydney, as well as at Goulburn in the Southern Tablelands. On these days, both the 1-hour and 4-hour standards were exceeded. This episode is described below in detail.

**Table 20 Days exceeding ozone 1-hour and ozone 4-hour AAQ NEPM standards (2020)**

| Date   | Region              | Stations exceeding standard concentration (pphm) <sup>1</sup> |                         |
|--------|---------------------|---|-------------------------|
|        |                     | 1-hour ozone  | 4-hour ozone            |
| 01 Jan | Southern Tablelands |   | Goulburn (8.1)          |
| 02 Jan | Southern Tablelands |   | Goulburn (8.9)          |
| 04 Jan | Sydney East         | Macquarie Park (10.2)   | Macquarie Park (8.6)    |
|        | Sydney East         |   | Earlwood (8.5)          |
|        | Sydney East         |   | Randwick (8.1)          |
|        | Central Coast       | Wyong (10.1)  | Wyong (8.9)             |
| 28 Jan | Sydney North West   |   | St Marys (8.1)          |
|        | Sydney South West   |   | Camden (8.3)            |
| 31 Jan | Sydney North West   | Prospect (10.2)   | Prospect (9.3)          |
|        | Sydney North West   |   | Richmond (8.6)          |
|        | Sydney North West   |   | Rouse Hill (8.4)        |
|        | Sydney North West   | St Marys (11.5)   | St Marys (10.7)         |
|        | Sydney South West   | Bargo (11.4)  | Bargo (10.6)            |
|        | Sydney South West   | Bringelly (11.2)  | Bringelly (10.1)        |
|        | Sydney South West   | Camden (10.8)   | Camden (9.6)            |
|        | Sydney South West   |   | Campbelltown West (9.1) |
|        | Sydney South West   | Oakdale (11.6)  | Oakdale (10.2)          |
|        | Southern Tablelands |   | Goulburn (9.1)          |
| 01 Feb | Sydney East         | Chullora (10.7)   | Chullora (9.8)          |
|        | Sydney North West   |   | Parramatta North (8.1)  |
|        | Sydney North West   |   | St Marys (8.1)          |
|        | Sydney South West   | Campbelltown West (10.8)                                      | Campbelltown West (8.1) |
|        | Sydney South West   | Liverpool (10.2)  | Liverpool (9.3)         |
|        | Illawarra           | Albion Park South (10.2)                                      | Albion Park South (8.4) |
|        | Illawarra           |   | Kembla Grange (8.1)     |
|        | Southern Tablelands |   | Goulburn (8.4)          |

1. pphm = parts per hundred million; divide by 100 to convert to parts per million (ppm).

## Two-day ozone episode during 31 January 2020 and 1 February 2020

During 31 January and 1 February, ozone levels above the national standards were recorded at 10 stations including 5 in Sydney South West, 4 in Sydney North West and one at Goulburn in the Southern Tablelands. This 2-day episode occurred during heatwave conditions across New South Wales. The maximum temperature in Sydney on 31 January was 40.5°C at Richmond, and on 1 February it was 46.4°C at St Marys (both stations in Sydney North West).

A blocking high-pressure system in the Tasman Sea and low-pressure trough over central New South Wales combined to bring hot air from central Australia towards the east coast. Stable atmospheric conditions combined with afternoon sea breezes resulted in elevated ozone across Sydney. The maximum on 31 January 2020 was observed across stations in western Sydney, with the maximum 1-hour ozone at Oakdale in Sydney South West (0.116 ppm), and the maximum 4-hour average of 0.106 ppm at St Marys in Sydney North West. On 1 February 2020, ozone standards were exceeded at 8 stations including two each in Sydney South West, Sydney North West and Illawarra, one in Sydney East and one at Goulburn in the Southern Tablelands. Further details are on the NSW Annual Air Quality Statement 2020: gases webpage.

## Particles as PM10

**Table 21 Summary for PM10: maximum daily (24-hour) average concentrations (2020)**

| Region/Station           | Number of valid days | Maximum 24-hour average ( $\mu\text{g}/\text{m}^3$ ) |        |                         |        |
|--------------------------|----------------------|--|--------|-------------------------|--------|
|                          |                      | Highest  | Date   | 2 <sup>nd</sup> highest | Date   |
| <b>Sydney East</b>       |                      |  |        |                         |        |
| Chullora                 | 361                  | <b>167.9</b>   | 23 Jan | <b>63.4</b>             | 12 Jan |
| Cook and Phillip         | 318                  | <b>130.8</b>   | 08 Jan | <b>57.9</b>             | 12 Jan |
| Earlwood                 | 364                  | <b>116.7</b>   | 08 Jan | <b>60.9</b>             | 05 Jan |
| Macquarie Park           | 362                  | <b>146.7</b>   | 23 Jan | <b>54.0</b>             | 12 Jan |
| Randwick                 | 363                  | <b>137.3</b>   | 08 Jan | <b>63.0</b>             | 05 Jan |
| Rozelle                  | 358                  | <b>113.5</b>   | 08 Jan | <b>58.0</b>             | 25 Jan |
| <b>Sydney North West</b> |                      |  |        |                         |        |
| Parramatta North         | 364                  | <b>188.9</b>   | 23 Jan | <b>61.6</b>             | 04 Jan |
| Prospect                 | 364                  | <b>245.8</b>   | 23 Jan | <b>68.4</b>             | 04 Jan |
| Richmond                 | 343                  | <b>237.7</b>   | 23 Jan | <b>70.4</b>             | 04 Jan |
| Rouse Hill               | 361                  | <b>220.3</b>   | 23 Jan | <b>57.6</b>             | 10 Dec |
| St Marys                 | 363                  | <b>260.3</b>   | 23 Jan | <b>73.1</b>             | 11 Jan |
| <b>Sydney South West</b> |                      |  |        |                         |        |
| Bargo                    | 356                  | <b>265.7</b>   | 23 Jan | <b>58.5</b>             | 25 Jan |
| Bringelly                | 362                  | <b>241.8</b>   | 23 Jan | <b>64.0</b>             | 01 Jan |
| Camden                   | 355                  | <b>268.6</b>   | 23 Jan | <b>76.2</b>             | 12 Jan |
| Campbelltown West        | 364                  | <b>249.7</b>   | 23 Jan | <b>73.3</b>             | 12 Jan |
| Liverpool                | 352                  | <b>195.1</b>   | 23 Jan | <b>59.4</b>             | 11 Jan |



| Region/Station             | Number of valid days | Maximum 24-hour average ( $\mu\text{g}/\text{m}^3$ ) |        |                         |        |
|----------------------------|----------------------|--|--------|-------------------------|--------|
|                            |                      | Highest  | Date   | 2 <sup>nd</sup> highest | Date   |
| Oakdale                    | 363                  | <b>248.9</b>   | 23 Jan | <b>81.6</b>             | 01 Jan |
| <b>Illawarra</b>           |                      |  |        |                         |        |
| Albion Park South          | 359                  | <b>153.3</b>   | 23 Jan | <b>79.1</b>             | 12 Jan |
| Kembla Grange              | 356                  | <b>187.7</b>   | 23 Jan | <b>82.5</b>             | 12 Jan |
| Wollongong                 | 351                  | <b>121.6</b>   | 08 Jan | <b>65.4</b>             | 05 Jan |
| <b>Central Coast</b>       |                      |  |        |                         |        |
| Wyong                      | 363                  | <b>90.5</b>  | 08 Jan | 47.7                    | 12 Jan |
| <b>Lower Hunter</b>        |                      |  |        |                         |        |
| Beresfield                 | 363                  | <b>77.7</b>  | 08 Jan | <b>51.4</b>             | 01 Jan |
| Newcastle                  | 358                  | <b>116.2</b>   | 08 Jan | <b>53.2</b>             | 12 Jan |
| Wallsend                   | 363                  | <b>77.9</b>  | 08 Jan | <b>50.7</b>             | 02 Jan |
| <b>Upper Hunter</b>        |                      |  |        |                         |        |
| Aberdeen                   | 364                  | <b>267.7</b>   | 11 Jan | <b>55.9</b>             | 21 Jan |
| Singleton                  | 364                  | <b>82.4</b>  | 05 Jan | <b>57.6</b>             | 19 Aug |
| Muswellbrook               | 362                  | <b>181.0</b>   | 11 Jan | <b>60.5</b>             | 21 Jan |
| <b>Central Tablelands</b>  |                      |  |        |                         |        |
| Bathurst                   | 360                  | <b>320.4</b>   | 23 Jan | <b>86.8</b>             | 04 Jan |
| Orange                     | 355                  | <b>291.8</b>   | 23 Jan | <b>99.2</b>             | 02 Feb |
| <b>North West Slopes</b>   |                      |  |        |                         |        |
| Gunnedah                   | 348                  | <b>101.2</b>   | 20 Aug | 40.2                    | 06 Jun |
| Narrabri                   | 359                  | <b>119.6</b>   | 20 Jan | <b>77.8</b>             | 06 Jan |
| Tamworth                   | 361                  | <b>178.0</b>   | 23 Jan | <b>77.3</b>             | 21 Jan |
| <b>Northern Tablelands</b> |                      |  |        |                         |        |
| Armidale                   | 363                  | 112.5  | 20 Aug | 45.0                    | 21 Jan |
| <b>South West Slopes</b>   |                      |  |        |                         |        |
| Albury                     | 357                  | <b>298.3</b>   | 07 Jan | <b>122.3</b>            | 13 Jan |
| Wagga Wagga North          | 360                  | <b>295.3</b>   | 02 Jan | <b>119.5</b>            | 08 Jan |
| <b>Southern Tablelands</b> |                      |  |        |                         |        |
| Goulburn                   | 356                  | <b>556.7</b>   | 01 Jan | 158.1                   | 11 Jan |

## Days above daily PM10 standard

During 2020, the Black Summer bushfires were the major contributors to days above the daily PM10 standard. The most intense PM10 pollution days were 8 January 2020 and 23 January 2020 when 9 and 17 stations, respectively, (of 36) recorded their daily PM10 maxima (Table 21). The maximum daily PM10 concentration recorded across stations in metropolitan and regional population centres was  $556.7 \mu\text{g}/\text{m}^3$ , at Goulburn in the Southern Tablelands on 1 January 2020, due to bushfire smoke.

During the full year, across 36 reporting sites, daily PM10 standard exceedances were recorded on 55 calendar days. A full table of PM10 events is provided in Appendix A (see DPIE 2021b), grouped by region, and including details like PM10 concentrations observed and information supporting the event classification.

The information in Appendix A is summarised at Table 22, as a list of calendar days when daily PM10 concentrations were above the standard, the different particle sources determining the event classification (or cause), as well as the number of stations impacted by each. Non-exceptional or assessable events are represented with underlined text and data.

The PM10 calendar days summary (Table 22) shows a considerable number of daily PM10 exceedances (37 of 55 days) occurred during January and February 2020, during the 2019–20 Black Summer bushfires. In fact, many of the days (39 of 55) were due to exceptional causes, 15 days to non-exceptional causes only, and one calendar day was identified where both exceptional and non-exceptional causes impacted different sites on the same day.

With respect to non-exceptional events, a 2-day dust storm was observed during late winter which impacted multiple stations in the State and crossed state boundaries. This study is described in Section E of the report.

Local dust was also a major driver for non-exceptional events (14 calendar days). Seven of these were recorded in the Illawarra region at Kembla Grange station, located in the vicinity of a racecourse for which local earthworks impacted measurements at the site during much of September and November. South West Slopes region was also notably impacted by 5 non-exceptional events due to dust at Wagga Wagga North station, determined to be either locally or regionally sourced. Details are provided in Appendix A.

**Table 22**      **Calendar days when daily PM10 was exceeded (2020), and the attributed source**  
Numbers in columns indicate the number of stations above standard attributed to the source. Non-exceptional event days are underlined.

| Date daily PM10 standard was exceeded | Source    |     |                  |                         |                      |                   |                   | Total no. stations above daily PM10 benchmark that day <sup>1</sup> |
|---------------------------------------|-----------|-----|------------------|-------------------------|----------------------|-------------------|-------------------|---|
|                                       | Bush-fire | HRB | Wide-spread dust | Mix of dust and burning | <u>Regional dust</u> | <u>Local dust</u> | <u>Wood smoke</u> |   |
| 1) 01 Jan                             | 19        |     |                  | 8                       |                      |                   |                   | 27  |
| 2) 02 Jan                             | 18        |     |                  |                         |                      |                   |                   | 18  |
| 3) 03 Jan                             | 3         |     |                  | 3                       |                      |                   |                   | 6   |
| 4) 04 Jan                             | 7         |     |                  | 22                      |                      |                   |                   | 29  |
| 5) 05 Jan                             | 22        |     |                  | 8                       |                      |                   |                   | 30  |
| 6) 06 Jan                             | 2         |     |                  | 2                       |                      |                   |                   | 4   |
| 7) 07 Jan                             | 3         |     |                  |                         |                      |                   |                   | 3   |
| 8) 08 Jan                             | 23        |     |                  | 5                       |                      |                   |                   | 28  |
| 9) 09 Jan                             | 2         |     | 1                |                         |                      |                   |                   | 3   |
| 10) 10 Jan                            |           |     | 5                |                         |                      |                   |                   | 5   |
| 11) 11 Jan                            | 15        |     | 4                | 3                       |                      |                   |                   | 22  |
| 12) 12 Jan                            | 26        |     |                  |                         |                      |                   |                   | 26  |
| 13) 13 Jan                            | 4         |     |                  |                         |                      |                   |                   | 4   |

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| Date daily PM10 standard was exceeded | Source    |     |                  |                         |                      |                   |                   | Total no. stations above daily PM10 benchmark that day <sup>1</sup> |
|---------------------------------------|-----------|-----|------------------|-------------------------|----------------------|-------------------|-------------------|---|
|                                       | Bush-fire | HRB | Wide-spread dust | Mix of dust and burning | <u>Regional dust</u> | <u>Local dust</u> | <u>Wood smoke</u> |   |
| 14) 14 Jan                            | 3         |     |                  |                         |                      |                   |                   | 3   |
| 15) 15 Jan                            | 2         |     |                  |                         |                      |                   |                   | 2   |
| 16) 16 Jan                            | 1         |     |                  |                         |                      |                   |                   | 1   |
| 17) 17 Jan                            | 4         |     |                  |                         |                      |                   |                   | 4   |
| 18) 18 Jan                            | 1         |     |                  |                         |                      |                   |                   | 1   |
| 19) 19 Jan                            |           |     | 1                |                         |                      |                   |                   | 1   |
| 20) 20 Jan                            |           |     | 5                |                         |                      |                   |                   | 5   |
| 21) 21 Jan                            |           |     | 3                |                         |                      |                   |                   | 3   |
| 22) 23 Jan                            |           |     | 8                | 21                      |                      |                   |                   | 29  |
| 23) 24 Jan                            |           |     |                  | 27                      |                      |                   |                   | 27  |
| 24) 25 Jan                            | 1         |     | 18               | 1                       |                      |                   |                   | 20  |
| 25) 27 Jan                            | 1         |     |                  |                         |                      |                   |                   | 1   |
| 26) 30 Jan                            | 1         |     |                  |                         |                      |                   |                   | 1   |
| 27) <u>31 Jan</u>                     |           |     |                  |                         | <u>2</u>             |                   |                   | <u>2 (2)</u>  |
| 28) 01 Feb                            | 1         |     | 5                |                         |                      |                   |                   | 6   |
| 29) 02 Feb                            | 1         |     | 3                |                         |                      |                   |                   | 4   |
| 30) 03 Feb                            |           |     | 1                |                         |                      |                   |                   | 1   |
| 31) 04 Feb                            | 1         |     |                  | 1                       |                      |                   |                   | 2   |
| 32) 05 Feb                            |           |     |                  | 2                       |                      |                   |                   | 2   |
| 33) 06 Feb                            | 1         |     |                  |                         |                      |                   |                   | 1   |
| 34) 07 Feb                            | 1         |     |                  |                         |                      |                   |                   | 1   |
| 35) 18 Feb                            |           |     | 1                |                         |                      |                   |                   | 1   |
| 36) 19 Feb                            |           |     | 5                |                         |                      |                   |                   | 5   |
| 37) <u>28 Feb</u>                     |           |     |                  |                         |                      | <u>1</u>          |                   | <u>1 (1)</u>  |
| 38) <u>02 Mar</u>                     |           |     |                  |                         |                      | <u>1</u>          |                   | <u>1 (1)</u>  |
| 39) <u>03 Mar</u>                     |           |     |                  |                         | <u>1</u>             |                   |                   | <u>1 (1)</u>  |
| 40) <u>22 Jul</u>                     |           |     |                  |                         |                      | <u>1</u>          | <u>1</u>          | <u>2 (2)</u>  |
| 41) 19 Aug                            |           |     | 2                |                         |                      |                   |                   | 2   |
| 42) 20 Aug                            |           |     | 4                |                         |                      |                   |                   | 4   |
| 43) <u>02 Sep</u>                     |           |     |                  |                         |                      | <u>1</u>          |                   | <u>1 (1)</u>  |
| 44) <u>04 Sep</u>                     |           |     |                  |                         |                      | <u>1</u>          |                   | <u>1 (1)</u>  |
| 45) <u>07 Sep</u>                     |           |     |                  |                         |                      | <u>1</u>          |                   | <u>1 (1)</u>  |
| 46) <u>08 Sep</u>                     |           |     |                  |                         |                      | <u>1</u>          |                   | <u>1 (1)</u>  |
| 47) <u>15 Sep</u>                     |           |     |                  |                         |                      | <u>1</u>          |                   | <u>1 (1)</u>  |

| Date daily PM10 standard was exceeded | Source    |     |                  |                         |               |            |            | Total no. stations above daily PM10 benchmark that day <sup>1</sup> |
|---------------------------------------|-----------|-----|------------------|-------------------------|---------------|------------|------------|---|
|                                       | Bush-fire | HRB | Wide-spread dust | Mix of dust and burning | Regional dust | Local dust | Wood smoke |   |
| 48) <u>16 Sep</u>                     |           |     |                  |                         |               | <u>1</u>   |            | <u>1 (1)</u>  |
| 49) <u>20 Nov</u>                     |           |     |                  |                         |               | <u>1</u>   |            | <u>1 (1)</u>  |
| 50) <u>21 Nov</u>                     |           |     |                  |                         |               | <u>1</u>   |            | <u>1 (1)</u>  |
| 51) <u>28 Nov</u>                     |           |     |                  |                         |               | <u>1</u>   |            | <u>1 (1)</u>  |
| 52) <u>29 Nov</u> <sup>2</sup>        |           |     |                  | 1                       | <u>2</u>      | <u>1</u>   |            | <u>4 (3)</u>  |
| 53) 01 Dec                            | 1         |     |                  |                         |               |            |            | 1   |
| 54) 05 Dec                            |           |     | 1                |                         |               |            |            | 1   |
| 55) <u>10 Dec</u>                     |           |     |                  |                         |               | <u>1</u>   |            | <u>1 (1)</u>  |

1. Interpreting numbers in this column, for example, '4(3)' on 29 Nov means there were 4 stations on this day that exceeded the daily PM10 standard, of which 3 stations were impacted by non-exceptional causes (non-continental-scale dust) and the remaining one was impacted by an exceptional cause (mix of dust and burning).

2. This calendar day is classified non-exceptional due to non-continental-scale dust event at some stations. This day also is classified exceptional at another station, due to a combination of hazard reduction burning and dust.

HRB = hazard reduction burn.

## Particles as PM2.5

Table 23 Summary for PM2.5: maximum 24-hour (daily) average concentrations (2020)

| Region/Station           | Number of valid days | Maximum 24-hour average ( $\mu\text{g}/\text{m}^3$ ) |        |                         |        |
|--------------------------|----------------------|--|--------|-------------------------|--------|
|                          |                      | Highest  | Date   | 2 <sup>nd</sup> highest | Date   |
| <b>Sydney East</b>       |                      |  |        |                         |        |
| Chullora                 | 358                  | <b>86.2</b>  | 08 Jan | <b>47.7</b>             | 12 Jan |
| Cook and Phillip         | 318                  | <b>112.5</b>   | 08 Jan | <b>42.0</b>             | 12 Jan |
| Earlwood                 | 356                  | <b>85.1</b>  | 08 Jan | <b>42.6</b>             | 12 Jan |
| Macquarie Park           | 362                  | <b>77.8</b>  | 08 Jan | <b>43.6</b>             | 30 Aug |
| Randwick                 | 337                  | <b>114.8</b>   | 08 Jan | <b>43.2</b>             | 12 Jan |
| Rozelle                  | 360                  | <b>87.3</b>  | 08 Jan | <b>41.1</b>             | 12 Jan |
| <b>Sydney North West</b> |                      |  |        |                         |        |
| Parramatta North         | 352                  | <b>72.9</b>  | 08 Jan | <b>46.5</b>             | 12 Jan |
| Prospect                 | 357                  | <b>70.8</b>  | 08 Jan | <b>47.2</b>             | 12 Jan |
| Richmond                 | 335                  | <b>93.0</b>  | 05 Jan | <b>55.3</b>             | 08 Jan |
| Rouse Hill               | 357                  | <b>61.3</b>  | 08 Jan | <b>42.6</b>             | 05 Jan |
| St Marys                 | 326                  | <b>82.5</b>  | 05 Jan | <b>68.5</b>             | 08 Jan |
| <b>Sydney South West</b> |                      |  |        |                         |        |

| Region/Station             | Number of valid days | Maximum 24-hour average ( $\mu\text{g}/\text{m}^3$ ) |        |                         |        |
|----------------------------|----------------------|--|--------|-------------------------|--------|
|                            |                      | Highest  | Date   | 2 <sup>nd</sup> highest | Date   |
| Bargo                      | 347                  | 121.9  | 05 Jan | 104.6                   | 06 Sep |
| Bringelly                  | 351                  | 78.1   | 05 Jan | 64.2                    | 08 Jan |
| Camden                     | 358                  | 149.3  | 05 Jan | 59.5                    | 12 Jan |
| Campbelltown West          | 360                  | 69.0   | 08 Jan | 58.4                    | 12 Jan |
| Liverpool                  | 347                  | 73.6   | 08 Jan | 42.9                    | 11 Jan |
| Oakdale                    | 356                  | 161.6  | 05 Jan | 71.1                    | 04 Jan |
| <b>Illawarra</b>           |                      |  |        |                         |        |
| Albion Park South          | 363                  | 96.3   | 08 Jan | 62.7                    | 12 Jan |
| Kembla Grange              | 351                  | 100.4  | 08 Jan | 62.7                    | 12 Jan |
| Wollongong                 | 309                  | 100.9  | 08 Jan | 61.5                    | 12 Jan |
| <b>Central Coast</b>       |                      |  |        |                         |        |
| Wyong                      | 350                  | 63.9   | 08 Jan | 32.6                    | 24 Jan |
| <b>Lower Hunter</b>        |                      |  |        |                         |        |
| Beresfield                 | 354                  | 49.7   | 08 Jan | 45.6                    | 04 Jan |
| Newcastle                  | 270                  | 78.5   | 08 Jan | 39.1                    | 05 Jan |
| Wallsend                   | 361                  | 56.8   | 08 Jan | 38.4                    | 04 Jan |
| <b>Upper Hunter</b>        |                      |  |        |                         |        |
| Singleton                  | 359                  | 46.0   | 08 Jan | 40.5                    | 02 Jan |
| Muswellbrook               | 358                  | 49.1   | 05 Jan | 34.3                    | 02 Jan |
| <b>Central Tablelands</b>  |                      |  |        |                         |        |
| Bathurst                   | 361                  | 207.3  | 05 Jan | 115.9                   | 01 Jan |
| Orange                     | 355                  | 92.3   | 01 Jan | 78.4                    | 05 Jan |
| <b>North West Slopes</b>   |                      |  |        |                         |        |
| Gunnedah                   | 361                  | 34.7   | 06 Jun | 30.3                    | 09 Jan |
| Narrabri                   | 359                  | 42.4   | 06 Jan | 23.1                    | 09 Jan |
| Tamworth                   | 358                  | 52.6   | 05 Jan | 31.8                    | 11 Jan |
| <b>Northern Tablelands</b> |                      |  |        |                         |        |
| Armidale                   | 363                  | 53.7   | 05 Jan | 43.9                    | 22 Jul |
| <b>South West Slopes</b>   |                      |  |        |                         |        |
| Albury                     | 341                  | 275.2  | 07 Jan | 195.6                   | 14 Jan |
| Wagga Wagga North          | 360                  | 559.5  | 05 Jan | 219.5                   | 02 Jan |
| <b>Southern Tablelands</b> |                      |  |        |                         |        |
| Goulburn                   | 356                  | 516.1  | 01 Jan | 479.9                   | 05 Jan |

**Table 24 Summary for PM2.5 by FRM: Maximum daily average concentrations (2020)**

| Region/Station     | Number of valid days | Maximum 24-hour average ( $\mu\text{g}/\text{m}^3$ ) |        |                         |        |
|--------------------|----------------------|--|--------|-------------------------|--------|
|                    |                      | Highest  | Date   | 2 <sup>nd</sup> highest | Date   |
| <b>Sydney East</b> |                      |  |        |                         |        |
| Chullora           | 115                  | <b>45.8</b>  | 12 Jan | <b>37.1</b>             | 24-Jan |

### Days above daily PM2.5 standard

During 2020, the Black Summer bushfires were the major contributors to days above the daily PM2.5 standard. The most intense PM2.5 pollution day was 8 January 2020 when 19 stations (of 35) recorded their daily PM2.5 maxima (Table 23). The maximum daily PM2.5 concentration recorded across stations in metropolitan and regional population centres was  $559.5 \mu\text{g}/\text{m}^3$ , at Wagga Wagga North in the South West Slopes on 5 January 2020, due to bushfire smoke.

Across the 35 reporting sites, daily PM2.5 exceedances were recorded on 59 calendar days. A full table of PM2.5 events is provided in Appendix A (see DPIE 2021b), grouped by air quality reporting region, and including details like PM2.5 concentrations observed and information supporting the event classification.

The information in Appendix A is summarised at Table 25 (calendar days summary), which presents a list of calendar days when daily PM2.5 concentrations were above the benchmark, the sources determining event classification, as well as the number of stations impacted by each source. Non-exceptional or assessable events are represented with underlined text in the date. Thirty-two of the 59 days were attributed to exceptional events only, 24 days to only non-exceptional causes, and three calendar days were identified where both exceptional and non-exceptional causes impacted different sites on the same day.

The PM2.5 calendar days summary (Table 25) shows a considerable number of exceedances (28 of 59 days) occurred during January and February 2020, during the Black Summer bushfires. The most extensive PM2.5 pollution days were 5 January 2020 and 8 January 2020 when 10 and 19 stations, respectively, recorded their maximum daily PM2.5 concentrations (Table 23). When comparing stations across NSW metropolitan and regional population centres, the maximum daily PM2.5 concentration recorded was  $559.5 \mu\text{g}/\text{m}^3$  at Wagga Wagga North in the South West Slopes on 5 January 2020, due to bushfire smoke.

Domestic wood heating was another major driver for non-exceptional events in 2020, with 24 calendar days when wood smoke was the only cause for daily PM2.5 exceedances. Though wood smoke impacts were observed across 10 stations, Armidale station in the Northern Tablelands region recorded the highest number of wood smoke days (20 days exclusively at Armidale).

A large-scale two-day wood smoke event was observed during 6 and 7 June 2020, with elevated PM2.5 at 8 stations across the State due to wood smoke. Also, during late winter, a 2-day hazard reduction burning episode was observed at multiple stations in Sydney. Both cases are described in Section E.

**Table 25 Calendar days when daily PM2.5 was above the standard (2020), and attributed source**

Non-exceptional event days are underlined. Numbers in columns indicate the number of stations above the benchmark attributed to the source.

| Date daily PM2.5 standard was exceeded | Source   |     |                 |                         |                   | Total no. stations above daily PM2.5 standard that day <sup>1</sup> |
|--|----------|-----|-----------------|-------------------------|-------------------|---|
|  | Bushfire | HRB | Widespread dust | Mix of dust and burning | <u>Wood smoke</u> |   |
| 1) 01 Jan                              | 15       |     |                 | 4                       |                   | 19  |
| 2) 02 Jan                              | 22       |     |                 |                         |                   | 22  |
| 3) 03 Jan                              | 7        |     |                 |                         |                   | 7   |
| 4) 04 Jan                              | 8        |     |                 | 17                      |                   | 25  |
| 5) 05 Jan                              | 23       |     |                 | 7                       |                   | 30  |
| 6) 06 Jan                              | 6        |     |                 | 1                       |                   | 7   |
| 7) 07 Jan                              | 4        |     |                 |                         |                   | 4   |
| 8) 08 Jan                              | 23       |     |                 | 5                       |                   | 28  |
| 9) 09 Jan                              | 9        |     |                 |                         |                   | 9   |
| 10) 10 Jan                             |          |     | 2               |                         |                   | 2   |
| 11) 11 Jan                             | 21       |     | 1               | 3                       |                   | 25  |
| 12) 12 Jan                             | 26       |     |                 |                         |                   | 26  |
| 13) 13 Jan                             | 14       |     |                 |                         |                   | 14  |
| 14) 14 Jan                             | 4        |     |                 |                         |                   | 4   |
| 15) 15 Jan                             | 4        |     |                 |                         |                   | 4   |
| 16) 16 Jan                             | 2        |     |                 |                         |                   | 2   |
| 17) 17 Jan                             | 19       |     |                 |                         |                   | 19  |
| 18) 18 Jan                             | 1        |     |                 |                         |                   | 1   |
| 19) 23 Jan                             |          |     | 1               | 14                      |                   | 15  |
| 20) 24 Jan                             |          |     |                 | 2                       |                   | 20  |
| 21) 25 Jan                             |          |     |                 | 1                       |                   | 1   |
| 22) 27 Jan                             | 1        |     |                 |                         |                   | 1   |
| 23) 29 Jan                             | 1        |     |                 |                         |                   | 1   |
| 24) 01 Feb                             |          |     | 1               |                         |                   | 1   |
| 25) 04 Feb                             | 2        |     |                 | 1                       |                   | 3   |
| 26) 05 Feb                             |          |     |                 | 1                       |                   | 1   |
| 27) 06 Feb                             | 1        |     |                 |                         |                   | 1   |
| 28) 07 Feb                             | 1        |     |                 |                         |                   | 1   |
| 29) <u>05 May</u>                      |          |     |                 |                         | <u>1</u>          | <u>1 (1)</u>  |
| 30) 06 May                             |          | 1   |                 |                         |                   | 1   |

| Date daily PM2.5 standard was exceeded | Source   |     |                 |                         |            | Total no. stations above daily PM2.5 standard that day <sup>1</sup> |
|--|----------|-----|-----------------|-------------------------|------------|---|
|  | Bushfire | HRB | Widespread dust | Mix of dust and burning | Wood smoke |   |
| 31) <u>11 May</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 32) <u>12 May</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 33) <u>13 May</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 34) <u>31 May</u>                      |          |     |                 |                         | <u>2</u>   | <u>2 (2)</u>  |
| 35) <u>04 Jun</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 36) <u>05 Jun</u> <sup>2</sup>         |          | 1   |                 |                         | <u>1</u>   | <u>2 (1)</u>  |
| 37) <u>06 Jun</u> <sup>2</sup>         |          | 1   |                 |                         | <u>4</u>   | <u>5 (4)</u>  |
| 38) <u>07 Jun</u>                      |          |     |                 |                         | <u>6</u>   | <u>6 (6)</u>  |
| 39) <u>08 Jun</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 40) <u>27 Jun</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 41) <u>28 Jun</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 42) <u>29 Jun</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 43) <u>01 Jul</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 44) <u>02 Jul</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 45) <u>06 Jul</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 46) <u>07 Jul</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 47) <u>08 Jul</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 48) <u>18 Jul</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 49) <u>19 Jul</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 50) <u>20 Jul</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 51) <u>22 Jul</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 52) <u>23 Jul</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 53) <u>01 Aug</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 54) <u>05 Aug</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 55) <u>12 Aug</u>                      |          |     |                 |                         | <u>1</u>   | <u>1 (1)</u>  |
| 56) 29-Aug                             |          | 4   |                 |                         |            | 4   |
| 57) <u>30-Aug</u> <sup>2</sup>         |          | 6   |                 |                         | <u>1</u>   | <u>7 (1)</u>  |
| 58) 06-Sep                             |          | 1   |                 |                         |            | 1   |
| 59) 03-Oct                             |          | 2   |                 |                         |            | 2   |

1. Interpreting numbers in this column, for example, '7(1)' on 30/08/2020 means there were 7 stations on this day that exceeded the daily PM2.5 standard, of which 1 station was impacted by a non-exceptional cause (wood smoke) and the remaining six were impacted by an exceptional cause (hazard reduction burning).

2. These three calendar days are classified non-exceptional at some stations but classified exceptional at others.

HRB = hazard reduction burn.



## Assessment of progress toward achieving the goal (2020)

The *National Environment Protection (Ambient Air Quality) Measure* (NEPM or AAQ NEPM) is implemented under the *Protection of the Environment Operations Act 1997* (POEO Act), the *Protection of the Environment Operations (Clean Air) Regulation 2010* and the *Protection of the Environment Operations (General) Regulation 2009*.

The POEO Act sets the statutory framework for managing air quality in New South Wales. The *Protection of the Environment Operations (Clean Air) Regulation 2010* provides measures to control emissions from industry, motor vehicles and fuels, domestic solid fuel heaters (e.g. wood heaters) and open burning. The *Protection of the Environment Operations (General) Regulation 2009* establishes the licensing scheme for major industrial premises and economic incentives for licensed businesses and industry to reduce pollution, including emissions to air.

In New South Wales, the Department of Planning, Industry and Environment (DPIE) and the Environment Protection Authority (EPA) work together to reduce the impacts of air pollution. The department develops policies and programs to improve compliance with NEPM goals and protect public health, and operates a comprehensive air quality monitoring network and undertakes air quality forecasting to provide timely information so people can reduce their risk of exposure. The EPA develops and implements regulation, conducts compliance activities and provides expert technical advice on air quality issues. Both agencies work closely with stakeholders to inform, educate and involve stakeholders in improving air quality management.

Air quality in New South Wales in early 2020 was greatly affected by the unprecedented, extensive bushfires and dust storms which continued from 2019. This resulted in poorer air quality across the State. Later, from March 2020 onwards, air quality trends were defined by the impact of the COVID-19 lockdown, resulting in reduced vehicle traffic and an associated reduction of some air pollutants. See the NSW Annual Air Quality Statement 2020: focus areas webpage.

The NEPM standards and goals are a driver for air quality management strategies and a benchmark against which progress in managing air quality can be assessed.

### Air quality management in the GMR and regional New South Wales

The department and the EPA deliver numerous actions that target the pollutants of most concern in New South Wales, namely particles in the Greater Metropolitan Region (GMR) and some regional centres, and ground-level ozone by targeting precursor emissions. These actions are designed to improve knowledge about air emissions, air quality and the impacts of air pollution; inform and engage the community and other stakeholders; and reduce air quality impacts from industry, vehicles, and commercial and domestic activities.

At 31 December 2020, the department operated 94 monitoring stations in the NSW air quality monitoring network, which comprised several networks. Air quality data and information are made publicly available on the department's website, updated hourly. Automated text messages and emails are sent to subscribers when air quality is measured to exceed national air quality standards for gases, or national reporting levels for particles. A daily forecast is also sent to subscribers and published on the department's website for the Sydney region. The department also collaborates with the EPA, other agencies and science partners to deliver research to inform air policies and programs.

The following is an outline of the key mechanisms for managing air quality and the activities implemented in 2020.

## Air emissions inventory

The Air Emissions Inventory for the NSW GMR is a detailed technical snapshot of major sources of air pollution. The inventory estimates emissions for hundreds of substances released to the atmosphere from natural and human-made sources within the GMR and has been updated every 5 years. The inventory is created retrospectively based on collected and modelled data from a broad range of government, industry, commercial, household and technical sources.

The latest available detailed inventory data for 2013 was finalised in December 2019 and are available in a technical report: *Air Emissions Inventory for the Greater Metropolitan Region in New South Wales: 2013 Calendar Year* (EPA 2019).

The community can access inventory information about local sources of air pollution via the Air Emissions in my Community web tool. The tool presents aggregated data and charts for different geographic areas within the GMR, down to local council and postcode level. The community web tool was also updated in 2019, and inventory data for the 2003, 2008 and 2013 inventories can be shown, displaying trends over the 10-year period spanning the three inventories.

## Air quality monitoring

At 31 December 2020, the NSW air quality monitoring network totalled 94 stations, consisting of 55 NATA-accredited stations plus 39 indicative rural monitoring sites. The network provides detailed air quality information that is available on the web and updated hourly. Information about the network and current and historic data can be found on the Air Quality Monitoring Network webpage.

In 2020, a background air quality monitoring station was commissioned at the existing Merriwa site in the Upper Hunter region. This site now measures concentrations of criteria gaseous pollutants and PM<sub>2.5</sub>. This supplements existing PM<sub>10</sub> and meteorological measurements undertaken there since 2012 as part of the industry-funded Upper Hunter Air Quality Monitoring Network.

In 2020, new monitoring stations commenced operation in Penrith in Sydney North West region, Morisset in Lake Macquarie in the Central Coast region, and Lidcombe station in Sydney East region. The number of rural network sites which provide indicative information on both PM<sub>2.5</sub> and PM<sub>10</sub>, apart from total suspended particles (TSP), increased from 20 to 36 sites during 2020.

Monitoring of 'black carbon' has been extended from six locations to 10 across the NSW network in 2020. This includes locations in Sydney, Wollongong, Newcastle, Central Coast, Wagga Wagga, Armidale and Merriwa. Black carbon is a component of PM<sub>2.5</sub> and is formed from combustion, particularly of fossil fuels. It is associated with short-term and long-term health impacts and is a contributor to climate change. These measurements will inform health impact population assessments of air pollution in New South Wales.

Air incident monitoring and modelling capabilities have been established for incidents where air quality impacts may be experienced by the community for a period of several days or longer. This is also referred to as 'campaign monitoring'. The air incident monitors are fitted with telemetry and communications systems coupled with web reporting capabilities for rapid transfer of information to the department's publicly accessible website. The department has 2 types of incident monitors:

- two portable monitoring stations each equipped with compliance air quality monitors that meet Australian Standards and the AAQ NEPM requirements, and other non-compliance instruments and meteorological monitors

- three portable measuring stations equivalent to those in the NSW rural network stations to measure particles that are powered and can be deployed rapidly in emergency situations.

Deployment of emergency monitoring was a major factor in responding to air quality issues arising from the significant bushfire emergency which impacted New South Wales in the 2019–20 bushfire season. One emergency station was deployed to Port Macquarie in late July to monitor air quality impacts from an underground peat fire, which later contributed to bushfires in the region. Due to the increasing intensity of the bushfires, two stations were deployed in Coffs Harbour and Lismore in November 2019. Additionally, due to the availability of indicative sensors being tested for the rural network upgrade, 7 emergency sites were established during the summer. Three of these were deployed on the North Coast in November (Grafton, Taree and Coffs Harbour), 2 on the South Coast in December 2019 (Batemans Bay and Ulladulla), and one each on the far South Coast (Merimbula) and Snowy Mountains (Cooma) in January 2020.

## Review of the NSW Air Quality Monitoring Plan

A review of the *NSW Air Quality Monitoring Plan* was conducted from 2017 to 2019. The review was undertaken to ensure the current monitoring network is meeting community needs and the objectives of the AAQ NEPM. The revised NSW Air Quality Monitoring Plan, which includes individual plans for 5 regions in the State, was released in December 2020.

## Blue Mountains and Lithgow Air Watch

Blue Mountains and Lithgow Air Watch was a 12-month, EPA-led, local air quality monitoring project established to provide a better picture of air quality in the region. Monitoring began in June 2019 and concluded in May 2020. Air Watch was undertaken in partnership with a range of Blue Mountains community groups and volunteers, Department of Planning, Industry and Environment, Blue Mountains City and Lithgow councils, Doctors for the Environment, Western Sydney University and the Nepean Blue Mountains Local Health District.

Air Watch comprised:

- One air quality monitoring station located at Katoomba, which measured particles (PM10 and PM2.5), sulfur dioxide, carbon monoxide, ozone, oxides of nitrogen, visibility and meteorology. Monitoring was undertaken in accordance with Standards Australia methods and can be compared to the national AAQ NEPM standards.
- 12 low-cost sensors, known as KOALAs (Knowing Our Ambient Local Air-Quality), were located at schools and businesses in Wentworth Falls, Springwood, Katoomba and Lithgow. The KOALAs are indicative instruments and measure particles (PM2.5, PM10) and carbon monoxide in real time, demonstrating trends in air quality only.

The data were available in near-real-time with links from the EPA's website.

Quarterly reports of the data by season (winter, spring, summer and autumn), have been published on the EPA's website. They show that air quality within the Blue Mountains and Lithgow region is generally of good quality outside of natural events such as bushfires and dust storms. The final project interpretation report, analysing the full 12 months of data, was published on the EPA's Blue Mountains and Lithgow Air Watch webpage in November 2020.

## Air emissions and health impacts research

### Broken Hill Environmental Lead Study

Sampling for the Broken Hill Environmental Lead Study concluded in March 2020. This four-year study was commissioned by the Broken Hill Environmental Lead Program (BHELP) and the EPA in 2016 to inform remediation efforts underway as part of a program to address lead contamination and exposures. This collaborative study by BHELP and Department of Planning, Industry and Environment aims to monitor airborne and deposited lead and assess contributions of current emissions from mining leases and emissions from non-mining areas. Currently, a one-day-in-6 sampling schedule continues at four locations, to monitor against the NEPM health goal for ambient lead.

### Sydney Air Quality Study

This multi-year study commenced in 2016 to improve understanding of air quality and the impacts of air pollution in the greater Sydney region. The study will extend the evidence base for air policies and programs, providing information on past, current and future air quality and its impacts on public health and the environment in the greater Sydney region. The study will support evidence-based air policies and programs by identifying persistent and emerging issues and highlighting opportunities to improve air quality and realise public health and economic benefits.

The air quality, exposure and health impact modelling capabilities were established during the study. The first study report covering results from the first phase of the study (2017–2019) was published in October 2020 (DPIE 2020a).

The next phase of the study will present new findings on the health costs of air pollution. The health burden analysis based on results published in the first report will be finalised in collaboration with NSW Health and the EPA.

### Enhancing air quality forecasting in New South Wales

This program was established to progressively expand the scope of and enhance air quality forecasting capabilities in New South Wales. The department issues a daily air quality forecast for the greater Sydney region, and the overall accuracy of forecasts is currently considered to be moderate. Through this program the department is working towards more accurately forecasting air quality for greater Sydney and its subregions and is progressively expanding forecasting to the whole of the NSW GMR.

The program involves several projects to develop specific advanced tools and capabilities, some involving collaboration with science partners. A trajectory and dispersion modelling system has been in operation for the State. This system, named 'HYSPLIT', has produced daily plume forecasts since July 2019. During the 2019–20 bushfire season, improvements were made in smoke emissions modelling to better characterise smoke impacts from the unprecedented scale of wildfires on regional air quality. See the Air Quality Special Statement Spring–Summer 2019–20: focus area webpage.

## Industry emissions

In 2020 the EPA continued to implement its regulatory responsibilities, including the licensing of scheduled industry activities, and conducting compliance and enforcement programs. The POEO Act, the Protection of the Environment Operations (Clean Air) Regulation 2010 and the Protection of the Environment Operations (General) Regulation 2009 set the framework for managing air pollution from major industries in New South Wales.

## Load-based licensing

The EPA's load-based licensing scheme requires some environment protection licensees to pay part of their annual licence fees based on the load of certain air and water pollutants their activities release to the environment. By tying the fees payable to pollutant loads, the scheme aims to provide an ongoing economic incentive for licensees to improve their environmental performance beyond the levels required by regulation or licence conditions alone. In 2020 the EPA continued to progress a review of the LBL scheme, which aims to improve the scheme's efficiency and effectiveness.

## Coal-fired power stations

In 2018 the EPA completed a detailed compliance *Review of Coal Fired Power Stations Air Emissions and Monitoring* (EPA 2018a). The review involved detailed analysis of large amounts of monitoring data and operating information. Since then, the EPA has continued to work with power station licensees to further standardise and strengthen environmental licence conditions and consulted with industry on proposed environment protection licence variations. The EPA issued variations to the licences of all 5 NSW coal-fired power stations in July 2020. The changes strengthen monitoring and reporting requirements and tighten air emission limits.

## Non-road diesel and marine emissions

The EPA's *Diesel and Marine Emissions Management Strategy* (EPA 2015) sets out NSW actions to address emissions from non-road diesel equipment, diesel locomotives operating in New South Wales, and shipping.

In 2020 the department continued to administer the *NSW Government Resource Efficiency Policy* (GREP). The GREP (OEH 2019) includes requirements to address non-road diesel engine emissions through government procurement and contracts. The department undertook a review of the GREP in 2018 to analyse whole-of-government progress towards implementation, identify challenges faced by agencies, and determine if reforms are required.

For non-road diesel engines, government agencies must continue to comply with European Union (EU) or USEPA standards when purchasing or leasing such equipment. Agencies must also consider air emissions from contractor-supplied equipment in tender processes for construction projects over \$10 million. The tender selection process either incorporates a weighting for air emission standards in conjunction with other environmental considerations, or a statement by contractors on how they will reduce emissions from their equipment. Air emission standards of engines are aligned with the current EU and USEPA levels which are accepted internationally, with a lead time of 2 years compared to the introduction dates overseas.

## Locomotives

Amendments to the POEO Act to regulate railway rolling stock operations, in addition to railway infrastructure operators, came into effect in July 2019. The regulatory amendments mean that operators of rolling stock are required to hold an environment protection licence and are directly accountable for their environmental performance, including management of air emissions.

The licences were issued by the EPA in August 2020, following extensive consultation with the rail industry and input from community and other relevant stakeholders to develop the conditions.

## Vehicle and fuel emissions

### Regulation of motorway tunnel ventilation stacks

In July 2019 the POEO Act was amended to include changes to the way that road tunnel ventilation stacks are regulated. From 5 March 2020 motorway tunnel ventilation stack environment protection licences place strict operating requirements on air emissions from ventilation stacks. The licences also require air quality monitoring of tunnel ventilation stacks, and the monitoring data to be made publicly available through tunnel operators' websites and provided to the EPA for review. As part of its regulatory role, the EPA undertakes compliance activities to ensure ventilation stacks are operated according to the licence conditions.

### Smoky vehicles program

In New South Wales it is an offence for a vehicle to emit excessive air impurities for a continuous period of more than 10 seconds. Penalty notices may be issued to the registered owners of vehicles emitting excessive air impurities. The public can also report smoky vehicles via the EPA's Environment Line website or mobile phone application. In 2019–20 financial year the EPA issued 804 advisory letters based on public reports, of which 621 advisory letters were to diesel vehicle owners. An average of 183 smoky vehicle reports are received each month from the public (more than 2100 public reports over the year), indicating a high level of awareness in the community of the unacceptability of excessive visible emissions.

In addition, 49 defective vehicle notices were issued in 2019–20 of which 38 were for diesel vehicles. A defective vehicle notice requires the vehicle owner to carry out any necessary repairs so that the vehicle no longer emits excessive smoke and to provide evidence to the EPA that those repairs were carried out. Failure to provide evidence that the vehicle is no longer emitting excessive smoke may result in the vehicle's registration being suspended.

### Vapour recovery at service stations

Vapour recovery stage 1 technology (VR1) captures displaced petrol vapours from storage tanks when a tanker delivers fuel to a service station, while vapour recovery stage 2 technology (VR2) captures petrol vapours displaced at the bowser when a motorist refuels.

The EPA's Vapour Recovery Compliance Program was completed in 2017. Regulatory responsibility for petrol vapour recovery at service stations across Sydney, Wollongong, Newcastle and the Central Coast metropolitan areas, as well as the Lower Hunter and Illawarra regions, transitioned from the EPA to local councils in 2017. At that time, 99% of petrol service stations required to have VR1 equipment installed and operating were compliant, and 98% of petrol service stations required to install VR2 equipment were compliant.

Implementation of vapour recovery at these service stations has reduced emissions of volatile organic compounds (VOCs) by an estimated 5750 tonnes per year.

### Summer low-volatility petrol

To manage ozone formation in the Sydney region, regulatory requirements limit petrol volatility to 62 kilopascals (a measure of vapour pressure) over the summer period from 15 November to 15 March each year. Petrol importers and blenders must test and report to the EPA on batch volatility. The petrol volatility limits reduce VOC emissions in the Sydney region by an estimated 4000 tonnes each summer.

## National vehicle and fuel standards

The Australian Government is responsible for fuel quality and vehicle emission standards for new on-road vehicles. These standards are being reviewed. The NSW Government's 2021 submission on the Commonwealth's draft regulation impact statements on *Emission Standards for Cleaner Air* called for the earliest adoption of Euro 6/VI standards for all light/heavy diesel vehicles. The impact of improved emission and fuel standards over time is detailed in the *Trends in Motor Vehicles and their Emissions Technical Paper* (EPA 2018b).

The NSW Government has consistently supported tighter national vehicle and fuel standards, and in 2020 was represented on the national Fuel Standards Consultative Committee by the department.

## Wood smoke management

The EPA supports local councils across the State in managing wood smoke through periodic wood smoke reduction programs and providing community education materials for use by councils. Previous social research undertaken for the EPA identified the lack of awareness of wood smoke impacts on health as the key barrier to changing people's wood heater use.

In 2017 the EPA developed a range of educational materials for councils to raise public awareness about wood smoke impacts and the correct operation of wood heaters. The materials are now available in English and five community languages: Arabic, Cantonese, Hindi, Mandarin and Vietnamese. The local community education campaign materials are available on the EPA's Council Resource Kit webpage.

The EPA also regulates the sale of wood heaters. All appliances must meet minimum emission and efficiency standards as set out in the Protection of the Environment (Clean Air) Regulation 2010. From 1 September 2019, all new wood heaters sold in New South Wales must comply with tighter efficiency and emission standards under Australia/New Zealand Standards AS/NZS 4012 and AS/NZS 4013.

## Hunter region coal mines dust management

Throughout spring and summer of the 2019–20 financial year, the EPA implemented operation *Bust the Dust* to ensure that open cut coal mines in the Upper Hunter minimised particle emissions. The EPA inspected mines on days most likely to have adverse weather conditions, using Bureau of Meteorology weather predictions. Using drones, most mines were observed implementing best practice dust controls, however, due to the extremely hot, dry and windy weather, dust was observed blowing off exposed areas of mine sites. During the program excessive dust was generated in the Hunter Valley on 10 days, this was a 50% reduction on earlier drought-impacted years from 2012 to 2014. The second year of the *Bust the Dust* program commenced in September 2021.

## Section D – Analysis of data trends

This section comprises the first of two parts of this report where pollutant trends and longer-term statistical summaries for the past 10 years are presented.

This section, Section D, presents a statistical summary for each pollutant standard showing:

- percentile distribution of pollutant concentrations at each station during 2020
- 10-year trends in maxima for each pollutant standard at each station.

A second component of the trends analysis is provided in Appendix B of this report (see DPIE 2021). This analysis presents, by station, the percentile distribution trends over the last 10 years for each pollutant standard.

### Notes on tables in this section

- All *italicised* entries mean that the data availability for that year was between 15% and 75%. Note that for some examples, annual statistics have been included even if the data availability is less than 15% where extremely high values were noted at the end of 2019. Values that are not italicised have greater than 75% data availability for the year. However, the requirement for 75% data availability in each quarter has not been applied to previous years' data; for that requirement, the specific NEPM reports for those years should be consulted.
- ppm = parts per million.
- All **bold** entries mean the national standard was exceeded.

## Carbon monoxide

**Table 26** Statistical summary for CO in 2020: daily maximum rolling 8-hour average concentrations

| Region/Station           | Maximum (ppm) | Percentile (ppm) |                  |                  |                  |                  |                  |
|--------------------------|---------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                          |               | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| <b>Sydney East</b>       |               |                  |                  |                  |                  |                  |                  |
| Chullora                 | 1.9           | 0.8              | 0.7              | 0.6              | 0.5              | 0.3              | 0.2              |
| Cook and Phillip         | 2.8           | 0.7              | 0.6              | 0.5              | 0.4              | 0.3              | 0.2              |
| Macquarie Park           | 2.4           | 0.9              | 0.8              | 0.6              | 0.5              | 0.4              | 0.3              |
| Rozelle                  | 2.6           | 1.0              | 0.8              | 0.7              | 0.5              | 0.4              | 0.3              |
| <b>Sydney North West</b> |               |                  |                  |                  |                  |                  |                  |
| Parramatta North         | 2.0           | 1.1              | 0.9              | 0.8              | 0.7              | 0.4              | 0.3              |
| Prospect                 | 1.8           | 1.0              | 0.9              | 0.6              | 0.5              | 0.3              | 0.1              |
| Rouse Hill               | 1.9           | 0.8              | 0.7              | 0.6              | 0.5              | 0.3              | 0.2              |
| <b>Sydney South West</b> |               |                  |                  |                  |                  |                  |                  |
| Camden                   | 2.6           | 1.1              | 0.7              | 0.4              | 0.3              | 0.3              | 0.2              |
| Campbelltown West        | 2.3           | 1.0              | 0.8              | 0.7              | 0.5              | 0.4              | 0.3              |
| Liverpool                | 2.1           | 1.3              | 1.2              | 0.9              | 0.7              | 0.5              | 0.2              |
| <b>Central Coast</b>     |               |                  |                  |                  |                  |                  |                  |



| Region/Station      | Maximum (ppm) | Percentile (ppm) |                  |                  |                  |                  |                  |
|---------------------|---------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                     |               | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Wyong               | 1.7           | 0.7              | 0.5              | 0.4              | 0.3              | 0.3              | 0.2              |
| <b>Illawarra</b>    |               |                  |                  |                  |                  |                  |                  |
| Wollongong          | 3.3           | 1.0              | 0.8              | 0.5              | 0.5              | 0.4              | 0.2              |
| <b>Lower Hunter</b> |               |                  |                  |                  |                  |                  |                  |
| Newcastle           | 2.6           | 1.1              | 0.8              | 0.7              | 0.5              | 0.4              | 0.3              |

**Table 27 Annual maximum rolling 8-hour average concentrations for CO (ppm) 2011–2020**

| Region/Station               | 2011 | 2012 | 2013       | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|------------------------------|------|------|------------|------|------|------|------|------|------|------|
| <b>Sydney East</b>           |      |      |            |      |      |      |      |      |      |      |
| Chullora                     | 1.5  | 2.0  | 2.5        | 1.7  | 1.4  | 1.6  | 1.2  | 3.4  | 1.4  | 1.9  |
| Cook and Phillip             | -    | -    | -          | -    | -    | -    | -    | -    | 1.8  | 2.8  |
| Macquarie Park               | -    | -    | -          | -    | -    | -    | 0.5  | 2.5  | 3.5  | 2.4  |
| Rozelle                      | 1.4  | 2.2  | 1.8        | 1.1  | 1.1  | 1.2  | 0.9  | 0.7  | 2.2  | 2.6  |
| <b>Sydney North West</b>     |      |      |            |      |      |      |      |      |      |      |
| Parramatta North             | -    | -    | -          | -    | -    | -    | -    | 1.1  | 3.2  | 2.0  |
| Prospect                     | 1.7  | 1.8  | 1.6        | 1.3  | 1.5  | 1.5  | 1.1  | 1.1  | 2.8  | 1.8  |
| Rouse Hill                   | -    | -    | -          | -    | -    | -    | -    | -    | 3.6  | 1.9  |
| <b>Sydney South West</b>     |      |      |            |      |      |      |      |      |      |      |
| Camden                       | -    | 0.3  | 1.9        | 0.6  | 0.5  | 0.5  | 0.5  | 0.7  | 2.0  | 2.6  |
| Campbelltown West /Macarthur | 1.1  | 0.7  | <b>9.1</b> | 0.9  | 1.0  | 1.2  | 0.8  | 1.5  | 2.9  | 2.3  |
| Liverpool                    | 2.4  | 1.9  | 2.1        | 2.2  | 1.8  | 1.9  | 1.8  | 1.9  | 1.8  | 2.1  |
| <b>Central Coast</b>         |      |      |            |      |      |      |      |      |      |      |
| Wyong                        | -    | 0.4  | 0.8        | 0.5  | 0.4  | 0.6  | 0.6  | 0.9  | 2.4  | 1.7  |
| <b>Illawarra</b>             |      |      |            |      |      |      |      |      |      |      |
| Wollongong                   | 1.2  | 1.2  | 2.7        | 0.9  | 0.8  | 0.9  | 0.7  | 0.9  | 2.3  | 3.3  |
| <b>Lower Hunter</b>          |      |      |            |      |      |      |      |      |      |      |
| Newcastle                    | 1.5  | 1.3  | 1.4        | 2.4  | 1.5  | 1.4  | 1.1  | 1.0  | 1.5  | 2.6  |

## Nitrogen dioxide

**Table 28** Statistical summary for NO<sub>2</sub> in 2020: daily maximum 1-hour average concentrations

| Region/Station           | Maximum (ppm) | Percentile (ppm) |                  |                  |                  |                  |                  |
|--------------------------|---------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                          |               | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| <b>Sydney East</b>       |               |                  |                  |                  |                  |                  |                  |
| Chullora                 | 0.052         | 0.047            | 0.039            | 0.035            | 0.032            | 0.026            | 0.021            |
| Cook and Phillip         | 0.046         | 0.044            | 0.041            | 0.035            | 0.033            | 0.028            | 0.023            |
| Earlwood                 | 0.040         | 0.036            | 0.035            | 0.030            | 0.027            | 0.024            | 0.019            |
| Macquarie Park           | 0.030         | 0.026            | 0.023            | 0.020            | 0.018            | 0.015            | 0.011            |
| Randwick                 | 0.037         | 0.031            | 0.028            | 0.025            | 0.023            | 0.021            | 0.015            |
| Rozelle                  | 0.043         | 0.037            | 0.035            | 0.032            | 0.029            | 0.024            | 0.018            |
| <b>Sydney North West</b> |               |                  |                  |                  |                  |                  |                  |
| Parramatta North         | 0.037         | 0.036            | 0.034            | 0.029            | 0.026            | 0.023            | 0.018            |
| Prospect                 | 0.043         | 0.039            | 0.036            | 0.032            | 0.029            | 0.024            | 0.018            |
| Richmond                 | 0.035         | 0.025            | 0.021            | 0.017            | 0.015            | 0.012            | 0.007            |
| Rouse Hill               | 0.034         | 0.032            | 0.031            | 0.026            | 0.023            | 0.017            | 0.012            |
| St Marys                 | 0.034         | 0.030            | 0.025            | 0.020            | 0.018            | 0.015            | 0.011            |
| <b>Sydney South West</b> |               |                  |                  |                  |                  |                  |                  |
| Bargo                    | 0.045         | 0.039            | 0.034            | 0.030            | 0.026            | 0.021            | 0.015            |
| Bringelly                | 0.030         | 0.022            | 0.020            | 0.018            | 0.015            | 0.012            | 0.008            |
| Camden                   | 0.037         | 0.026            | 0.020            | 0.017            | 0.015            | 0.012            | 0.008            |
| Campbelltown West        | 0.051         | 0.041            | 0.039            | 0.036            | 0.033            | 0.027            | 0.022            |
| Liverpool                | 0.048         | 0.038            | 0.037            | 0.035            | 0.033            | 0.027            | 0.023            |
| Oakdale                  | 0.055         | 0.020            | 0.013            | 0.009            | 0.008            | 0.005            | 0.003            |
| <b>Central Coast</b>     |               |                  |                  |                  |                  |                  |                  |
| Wyong                    | 0.035         | 0.026            | 0.025            | 0.022            | 0.019            | 0.015            | 0.011            |
| <b>Illawarra</b>         |               |                  |                  |                  |                  |                  |                  |
| Albion Park South        | 0.039         | 0.030            | 0.027            | 0.023            | 0.018            | 0.013            | 0.008            |
| Kembla Grange            | 0.038         | 0.030            | 0.028            | 0.023            | 0.020            | 0.015            | 0.010            |
| Wollongong               | 0.041         | 0.036            | 0.035            | 0.032            | 0.029            | 0.023            | 0.017            |
| <b>Lower Hunter</b>      |               |                  |                  |                  |                  |                  |                  |
| Beresfield               | 0.035         | 0.031            | 0.030            | 0.026            | 0.025            | 0.020            | 0.016            |
| Newcastle                | 0.034         | 0.031            | 0.030            | 0.028            | 0.025            | 0.021            | 0.015            |
| Wallsend                 | 0.029         | 0.027            | 0.027            | 0.024            | 0.023            | 0.018            | 0.013            |
| <b>Upper Hunter</b>      |               |                  |                  |                  |                  |                  |                  |
| Singleton                | 0.033         | 0.031            | 0.028            | 0.026            | 0.023            | 0.019            | 0.015            |
| Muswellbrook             | 0.039         | 0.035            | 0.032            | 0.029            | 0.027            | 0.023            | 0.019            |

| Region/Station             | Maximum (ppm) | Percentile (ppm) |                  |                  |                  |                  |                  |
|----------------------------|---------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                            |               | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| <b>North West Slopes</b>   |               |                  |                  |                  |                  |                  |                  |
| Gunnedah                   | 0.028         | 0.025            | 0.024            | 0.022            | 0.019            | 0.015            | 0.010            |
| <b>Southern Tablelands</b> |               |                  |                  |                  |                  |                  |                  |
| Goulburn                   | 0.099         | 0.030            | 0.028            | 0.025            | 0.021            | 0.014            | 0.009            |

Table 29 Annual maximum 1-hour average concentrations for NO<sub>2</sub> (ppm) 2011–202

| Region/Station              | 2011  | 2012  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  |
|-----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| <b>Sydney East</b>          |       |       |       |       |       |       |       |       |       |       |
| Chullora                    | 0.051 | 0.059 | 0.055 | 0.064 | 0.054 | 0.046 | 0.060 | 0.057 | 0.070 | 0.052 |
| Cook and Phillip            | -     | -     | -     | -     | -     | -     | -     | -     | 0.110 | 0.046 |
| Earlwood                    | 0.046 | 0.051 | 0.048 | 0.040 | 0.053 | 0.043 | 0.067 | 0.050 | 0.061 | 0.040 |
| Macquarie Park              | -     | -     | -     | -     | -     | -     | 0.037 | 0.030 | 0.026 | 0.030 |
| Randwick                    | 0.053 | 0.041 | 0.046 | 0.047 | 0.043 | 0.044 | 0.041 | 0.040 | 0.051 | 0.037 |
| Rozelle                     | 0.050 | 0.062 | 0.070 | 0.055 | 0.060 | 0.050 | 0.061 | 0.057 | 0.090 | 0.043 |
| <b>Sydney North West</b>    |       |       |       |       |       |       |       |       |       |       |
| Parramatta North            | -     | -     | -     | -     | -     | -     | -     | 0.064 | 0.070 | 0.037 |
| Prospect                    | 0.039 | 0.050 | 0.049 | 0.047 | 0.053 | 0.053 | 0.060 | 0.051 | 0.049 | 0.043 |
| Richmond                    | 0.029 | 0.046 | 0.032 | 0.028 | 0.024 | 0.030 | 0.026 | 0.030 | 0.030 | 0.035 |
| Rouse Hill/Vineyard         | 0.037 | 0.050 | 0.038 | 0.033 | 0.031 | 0.032 | -     | -     | 0.050 | 0.034 |
| St Marys                    | 0.036 | 0.043 | 0.037 | 0.031 | 0.032 | 0.042 | 0.037 | 0.037 | 0.033 | 0.034 |
| <b>Sydney South West</b>    |       |       |       |       |       |       |       |       |       |       |
| Bargo                       | 0.046 | 0.044 | 0.068 | 0.036 | 0.048 | 0.046 | 0.066 | 0.048 | 0.066 | 0.045 |
| Bringelly                   | 0.029 | 0.038 | 0.037 | 0.025 | 0.027 | 0.030 | 0.036 | 0.036 | 0.034 | 0.030 |
| Camden                      | -     | 0.022 | 0.036 | 0.032 | 0.026 | 0.029 | 0.044 | 0.029 | 0.030 | 0.037 |
| Campbelltown West/Macarthur | 0.045 | 0.049 | 0.054 | 0.055 | 0.062 | 0.054 | 0.061 | 0.054 | 0.059 | 0.051 |
| Liverpool                   | 0.046 | 0.046 | 0.056 | 0.044 | 0.060 | 0.047 | 0.064 | 0.062 | 0.050 | 0.048 |
| Oakdale                     | 0.027 | 0.022 | 0.019 | 0.026 | 0.024 | 0.022 | 0.022 | 0.029 | 0.028 | 0.055 |
| <b>Central Coast</b>        |       |       |       |       |       |       |       |       |       |       |
| Wyong                       | -     | 0.029 | 0.041 | 0.034 | 0.032 | 0.046 | 0.051 | 0.035 | 0.036 | 0.035 |
| <b>Illawarra</b>            |       |       |       |       |       |       |       |       |       |       |
| Albion Park South           | 0.040 | 0.037 | 0.039 | 0.038 | 0.047 | 0.043 | 0.038 | 0.039 | 0.041 | 0.039 |
| Kembla Grange               | 0.037 | 0.039 | 0.036 | 0.031 | 0.034 | 0.039 | 0.037 | 0.037 | 0.042 | 0.038 |
| Wollongong                  | 0.043 | 0.049 | 0.050 | 0.038 | 0.060 | 0.043 | 0.057 | 0.043 | 0.040 | 0.041 |
| <b>Lower Hunter</b>         |       |       |       |       |       |       |       |       |       |       |

| Region/Station             | 2011  | 2012  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019               | 2020  |
|----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|--------------------|-------|
| Beresfield                 | 0.042 | 0.044 | 0.041 | 0.039 | 0.049 | 0.041 | 0.040 | 0.040 | 0.056              | 0.035 |
| Newcastle                  | 0.038 | 0.038 | 0.042 | 0.046 | 0.044 | 0.038 | 0.037 | 0.045 | 0.044              | 0.034 |
| Wallsend                   | 0.037 | 0.034 | 0.043 | 0.034 | 0.042 | 0.037 | 0.037 | 0.035 | 0.042              | 0.029 |
| <b>Upper Hunter</b>        |       |       |       |       |       |       |       |       |                    |       |
| Muswellbrook               | -     | 0.044 | 0.042 | 0.039 | 0.042 | 0.042 | 0.045 | 0.047 | 0.058              | 0.039 |
| Singleton                  | -     | 0.040 | 0.041 | 0.036 | 0.032 | 0.032 | 0.036 | 0.035 | 0.037              | 0.033 |
| <b>North West Slopes</b>   |       |       |       |       |       |       |       |       |                    |       |
| Gunnedah                   | -     | -     | -     | -     | -     | -     | -     | 0.034 | 0.036              | 0.028 |
| <b>Southern Tablelands</b> |       |       |       |       |       |       |       |       |                    |       |
| Goulburn                   | -     | -     | -     | -     | -     | -     | -     | -     | 0.161 <sup>1</sup> | 0.099 |

1. Annual data coverage <15% due to station being commissioned in November 2019, however, the standard was exceeded during the Black Summer bushfire season.

**Table 30 Annual average concentrations for NO<sub>2</sub> (ppm) 2011–202**

| Region/Station              | 2011  | 2012  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  |
|-----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| <b>Sydney East</b>          |       |       |       |       |       |       |       |       |       |       |
| Chullora                    | 0.013 | 0.013 | 0.013 | 0.013 | 0.013 | 0.013 | 0.012 | 0.012 | 0.012 | 0.009 |
| Cook and Phillip            | -     | -     | -     | -     | -     | -     | -     | -     | 0.012 | 0.013 |
| Earlwood                    | 0.009 | 0.009 | 0.010 | 0.008 | 0.008 | 0.010 | 0.011 | 0.010 | 0.010 | 0.009 |
| Macquarie Park              | -     | -     | -     | -     | -     | -     | 0.005 | 0.006 | 0.005 | 0.004 |
| Randwick                    | 0.007 | 0.006 | 0.007 | 0.006 | 0.008 | 0.008 | 0.007 | 0.007 | 0.007 | 0.005 |
| Rozelle                     | 0.011 | 0.012 | 0.011 | 0.011 | 0.011 | 0.011 | 0.011 | 0.010 | 0.010 | 0.008 |
| <b>Sydney North West</b>    |       |       |       |       |       |       |       |       |       |       |
| Parramatta North            | -     | -     | -     | -     | -     | -     | -     | 0.011 | 0.010 | 0.007 |
| Prospect                    | 0.010 | 0.010 | 0.011 | 0.010 | 0.011 | 0.010 | 0.010 | 0.009 | 0.009 | 0.007 |
| Richmond                    | 0.005 | 0.005 | 0.005 | 0.004 | 0.004 | 0.004 | 0.005 | 0.005 | 0.005 | 0.003 |
| Rouse Hill/Vineyard         | 0.006 | 0.006 | 0.005 | 0.005 | 0.005 | 0.005 | -     | -     | 0.006 | 0.005 |
| St Marys                    | 0.006 | 0.005 | 0.005 | 0.004 | 0.004 | 0.004 | 0.004 | 0.005 | 0.004 | 0.004 |
| <b>Sydney South West</b>    |       |       |       |       |       |       |       |       |       |       |
| Bargo                       | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.006 | 0.006 | 0.006 | 0.005 |
| Bringelly                   | 0.005 | 0.005 | 0.005 | 0.004 | 0.004 | 0.005 | 0.005 | 0.006 | 0.005 | 0.003 |
| Camden                      | -     | 0.005 | 0.004 | 0.004 | 0.004 | 0.004 | 0.005 | 0.005 | 0.005 | 0.004 |
| Campbelltown West/Macarthur | 0.008 | 0.009 | 0.010 | 0.010 | 0.010 | 0.010 | 0.011 | 0.011 | 0.011 | 0.009 |
| Liverpool                   | 0.010 | 0.009 | 0.011 | 0.010 | 0.010 | 0.012 | 0.012 | 0.012 | 0.012 | 0.011 |
| Oakdale                     | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.001 | 0.002 | 0.002 | 0.001 |
| <b>Central Coast</b>        |       |       |       |       |       |       |       |       |       |       |
| Wyong                       | -     | 0.004 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.004 | 0.004 | 0.003 |

| Region/Station             | 2011  | 2012  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  |
|----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| <b>Illawarra</b>           |       |       |       |       |       |       |       |       |       |       |
| Albion Park South          | 0.002 | 0.004 | 0.004 | 0.004 | 0.003 | 0.004 | 0.004 | 0.004 | 0.004 | 0.003 |
| Kembla Grange              | 0.004 | 0.005 | 0.005 | 0.004 | 0.005 | 0.005 | 0.004 | 0.005 | 0.005 | 0.004 |
| Wollongong                 | 0.008 | 0.009 | 0.008 | 0.008 | 0.008 | 0.006 | 0.006 | 0.007 | 0.006 | 0.006 |
| <b>Lower Hunter</b>        |       |       |       |       |       |       |       |       |       |       |
| Beresfield                 | 0.009 | 0.009 | 0.009 | 0.009 | 0.009 | 0.008 | 0.009 | 0.009 | 0.008 | 0.007 |
| Newcastle                  | 0.007 | 0.008 | 0.008 | 0.007 | 0.007 | 0.008 | 0.007 | 0.007 | 0.008 | 0.005 |
| Wallsend                   | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.007 | 0.008 | 0.007 | 0.007 | 0.006 |
| <b>Upper Hunter</b>        |       |       |       |       |       |       |       |       |       |       |
| Muswellbrook               | #     | 0.010 | 0.009 | 0.010 | 0.009 | 0.009 | 0.010 | 0.010 | 0.010 | 0.008 |
| Singleton                  | #     | 0.009 | 0.009 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.007 | 0.006 |
| <b>North West Slopes</b>   |       |       |       |       |       |       |       |       |       |       |
| Gunnedah                   | -     | -     | -     | -     | -     | -     | -     | 0.005 | 0.005 | 0.003 |
| <b>Southern Tablelands</b> |       |       |       |       |       |       |       |       |       |       |
| Goulburn                   | -     | -     | -     | -     | -     | -     | -     | -     | #     | 0.003 |

# Annual data availability <15% at these stations, hence annual averages cannot be determined.

## Sulfur dioxide

### Sulfur dioxide 1-hour standard

**Table 31 Statistical summary for SO<sub>2</sub> in 2020: daily maximum 1-hour average concentrations**

| Region/Station           | Maximum (ppm) | Percentile (ppm) |                  |                  |                  |                  |                  |
|--------------------------|---------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                          |               | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| <b>Sydney East</b>       |               |                  |                  |                  |                  |                  |                  |
| Chullora                 | 0.015         | 0.012            | 0.011            | 0.007            | 0.004            | 0.002            | 0.001            |
| Cook and Phillip         | 0.019         | 0.013            | 0.010            | 0.006            | 0.004            | 0.002            | 0.001            |
| Macquarie Park           | 0.035         | 0.020            | 0.016            | 0.010            | 0.006            | 0.002            | 0.001            |
| Randwick                 | 0.014         | 0.011            | 0.010            | 0.007            | 0.005            | 0.003            | 0.002            |
| Rozelle                  | 0.016         | 0.009            | 0.009            | 0.007            | 0.005            | 0.002            | 0.001            |
| <b>Sydney North West</b> |               |                  |                  |                  |                  |                  |                  |
| Parramatta North         | 0.020         | 0.013            | 0.009            | 0.007            | 0.005            | 0.003            | 0.001            |
| Prospect                 | 0.018         | 0.014            | 0.011            | 0.007            | 0.005            | 0.002            | 0.001            |
| Richmond                 | 0.012         | 0.010            | 0.006            | 0.004            | 0.003            | 0.001            | 0.001            |
| Rouse Hill               | 0.019         | 0.016            | 0.011            | 0.007            | 0.005            | 0.002            | 0.001            |
| <b>Sydney South West</b> |               |                  |                  |                  |                  |                  |                  |
| Bargo                    | 0.012         | 0.008            | 0.006            | 0.003            | 0.002            | 0.001            | 0.001            |

| Region/Station       | Maximum (ppm) | Percentile (ppm) |                  |                  |                  |                  |                  |
|----------------------|---------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                      |               | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Bringelly            | 0.022         | 0.006            | 0.005            | 0.004            | 0.003            | 0.002            | 0.001            |
| Campbelltown West    | 0.012         | 0.007            | 0.006            | 0.004            | 0.003            | 0.002            | 0.001            |
| Liverpool            | 0.015         | 0.010            | 0.008            | 0.005            | 0.004            | 0.002            | 0.001            |
| <b>Central Coast</b> |               |                  |                  |                  |                  |                  |                  |
| Wyong                | 0.069         | 0.038            | 0.028            | 0.017            | 0.009            | 0.004            | 0.001            |
| <b>Illawarra</b>     |               |                  |                  |                  |                  |                  |                  |
| Albion Park South    | 0.022         | 0.016            | 0.015            | 0.012            | 0.009            | 0.003            | 0.000            |
| Wollongong           | 0.020         | 0.015            | 0.014            | 0.011            | 0.008            | 0.006            | 0.002            |
| <b>Lower Hunter</b>  |               |                  |                  |                  |                  |                  |                  |
| Beresfield           | 0.038         | 0.026            | 0.023            | 0.017            | 0.014            | 0.009            | 0.005            |
| Newcastle            | 0.040         | 0.027            | 0.022            | 0.015            | 0.011            | 0.006            | 0.003            |
| Wallsend             | 0.040         | 0.033            | 0.026            | 0.020            | 0.014            | 0.010            | 0.005            |
| <b>Upper Hunter</b>  |               |                  |                  |                  |                  |                  |                  |
| Muswellbrook         | 0.135         | 0.072            | 0.069            | 0.048            | 0.031            | 0.018            | 0.006            |
| Singleton            | 0.055         | 0.045            | 0.039            | 0.030            | 0.024            | 0.012            | 0.005            |

## Sulfur dioxide 24-hour standard

**Table 32 Statistical summary for SO<sub>2</sub> in 2020: daily (24-hour) average concentrations**

| Region/Station           | Maximum (ppm) | Percentile (ppm) |                  |                  |                  |                  |                  |
|--------------------------|---------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                          |               | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| <b>Sydney East</b>       |               |                  |                  |                  |                  |                  |                  |
| Chullora                 | 0.004         | 0.003            | 0.002            | 0.002            | 0.001            | 0.001            | 0.000            |
| Cook and Phillip         | 0.003         | 0.003            | 0.002            | 0.001            | 0.001            | 0.001            | 0.000            |
| Macquarie Park           | 0.004         | 0.003            | 0.002            | 0.002            | 0.001            | 0.000            | 0.000            |
| Randwick                 | 0.004         | 0.003            | 0.003            | 0.002            | 0.002            | 0.001            | 0.001            |
| Rozelle                  | 0.003         | 0.002            | 0.002            | 0.002            | 0.001            | 0.001            | 0.000            |
| <b>Sydney North West</b> |               |                  |                  |                  |                  |                  |                  |
| Parramatta North         | 0.005         | 0.003            | 0.002            | 0.002            | 0.001            | 0.001            | 0.001            |
| Prospect                 | 0.004         | 0.003            | 0.002            | 0.002            | 0.001            | 0.001            | 0.000            |
| Richmond                 | 0.003         | 0.002            | 0.002            | 0.001            | 0.001            | 0.000            | 0.000            |
| Rouse Hill               | 0.005         | 0.003            | 0.002            | 0.002            | 0.001            | 0.001            | 0.000            |
| <b>Sydney South West</b> |               |                  |                  |                  |                  |                  |                  |
| Bargo                    | 0.003         | 0.002            | 0.001            | 0.001            | 0.001            | 0.000            | 0.000            |
| Bringelly                | 0.003         | 0.002            | 0.001            | 0.001            | 0.001            | 0.001            | 0.000            |
| Campbelltown West        | 0.002         | 0.002            | 0.002            | 0.001            | 0.001            | 0.001            | 0.000            |

| Region/Station       | Maximum (ppm) | Percentile (ppm) |                  |                  |                  |                  |                  |
|----------------------|---------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                      |               | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Liverpool            | 0.003         | 0.002            | 0.002            | 0.001            | 0.001            | 0.001            | 0.000            |
| <b>Central Coast</b> |               |                  |                  |                  |                  |                  |                  |
| Wyong                | 0.008         | 0.005            | 0.004            | 0.003            | 0.002            | 0.001            | 0.000            |
| <b>Illawarra</b>     |               |                  |                  |                  |                  |                  |                  |
| Albion Park South    | 0.005         | 0.005            | 0.004            | 0.003            | 0.002            | 0.000            | 0.000            |
| Wollongong           | 0.004         | 0.004            | 0.003            | 0.002            | 0.002            | 0.001            | 0.000            |
| <b>Lower Hunter</b>  |               |                  |                  |                  |                  |                  |                  |
| Beresfield           | 0.008         | 0.006            | 0.005            | 0.004            | 0.003            | 0.002            | 0.001            |
| Newcastle            | 0.007         | 0.005            | 0.004            | 0.003            | 0.002            | 0.001            | 0.001            |
| Wallsend             | 0.010         | 0.007            | 0.006            | 0.004            | 0.003            | 0.002            | 0.001            |
| <b>Upper Hunter</b>  |               |                  |                  |                  |                  |                  |                  |
| Muswellbrook         | 0.015         | 0.013            | 0.010            | 0.008            | 0.006            | 0.004            | 0.001            |
| Singleton            | 0.011         | 0.010            | 0.008            | 0.006            | 0.004            | 0.002            | 0.001            |

Table 33 Annual maximum 1-hour average concentrations for SO<sub>2</sub> (ppm) 2011–2020

| Region/Station              | 2011  | 2012  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  |
|-----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| <b>Sydney East</b>          |       |       |       |       |       |       |       |       |       |       |
| Chullora                    | 0.026 | 0.025 | 0.012 | 0.019 | 0.014 | 0.014 | 0.014 | 0.021 | 0.026 | 0.015 |
| Cook and Phillip            | -     | -     | -     | -     | -     | -     | -     | -     | 0.018 | 0.019 |
| Macquarie Park              | -     | -     | -     | -     | -     | -     | 0.023 | 0.044 | 0.029 | 0.035 |
| Randwick                    | 0.023 | 0.023 | 0.027 | 0.026 | 0.031 | 0.034 | 0.029 | 0.021 | 0.029 | 0.014 |
| Rozelle                     | -     | -     | -     | -     | 0.028 | 0.020 | 0.024 | 0.030 | 0.032 | 0.016 |
| <b>Sydney North West</b>    |       |       |       |       |       |       |       |       |       |       |
| Parramatta North            | -     | -     | -     | -     | -     | -     | -     | 0.021 | 0.030 | 0.020 |
| Prospect                    | 0.014 | 0.012 | 0.020 | 0.019 | 0.027 | 0.021 | 0.023 | 0.025 | 0.021 | 0.018 |
| Richmond                    | 0.010 | 0.013 | 0.010 | 0.009 | 0.032 | 0.025 | 0.034 | 0.017 | 0.023 | 0.012 |
| Rouse Hill/Vineyard         | 0.013 | 0.011 | 0.011 | 0.010 | 0.017 | 0.014 | -     | -     | 0.033 | 0.019 |
| <b>Sydney South West</b>    |       |       |       |       |       |       |       |       |       |       |
| Bargo                       | 0.010 | 0.009 | 0.017 | 0.010 | 0.009 | 0.010 | 0.010 | 0.010 | 0.020 | 0.012 |
| Bringelly                   | 0.011 | 0.015 | 0.011 | 0.009 | 0.007 | 0.006 | 0.009 | 0.011 | 0.028 | 0.022 |
| Campbelltown West/Macarthur | 0.014 | 0.008 | 0.009 | 0.012 | 0.011 | 0.016 | 0.011 | 0.016 | 0.020 | 0.012 |
| Liverpool                   | -     | -     | -     | -     | -     | 0.007 | 0.011 | 0.020 | 0.016 | 0.015 |
| <b>Central Coast</b>        |       |       |       |       |       |       |       |       |       |       |
| Wyong                       | -     | 0.030 | 0.029 | 0.040 | 0.069 | 0.032 | 0.047 | 0.062 | 0.061 | 0.069 |
| <b>Illawarra</b>            |       |       |       |       |       |       |       |       |       |       |

| Region/Station      | 2011  | 2012  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  |
|---------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Albion Park South   | 0.035 | 0.027 | 0.039 | 0.016 | 0.036 | 0.022 | 0.030 | 0.031 | 0.025 | 0.022 |
| Wollongong          | 0.018 | 0.017 | 0.040 | 0.019 | 0.019 | 0.020 | 0.047 | 0.039 | 0.034 | 0.020 |
| <b>Lower Hunter</b> |       |       |       |       |       |       |       |       |       |       |
| Beresfield          | 0.060 | 0.037 | 0.031 | 0.031 | 0.082 | 0.033 | 0.054 | 0.070 | 0.068 | 0.038 |
| Newcastle           | 0.033 | 0.034 | 0.052 | 0.064 | 0.036 | 0.055 | 0.050 | 0.039 | 0.046 | 0.040 |
| Wallsend            | 0.044 | 0.035 | 0.050 | 0.046 | 0.034 | 0.038 | 0.056 | 0.079 | 0.050 | 0.040 |
| <b>Upper Hunter</b> |       |       |       |       |       |       |       |       |       |       |
| Muswellbrook        | -     | 0.145 | 0.148 | 0.190 | 0.104 | 0.210 | 0.113 | 0.120 | 0.130 | 0.135 |
| Singleton           | -     | 0.083 | 0.053 | 0.091 | 0.063 | 0.077 | 0.099 | 0.067 | 0.096 | 0.055 |

Table 34 Annual maximum 24-hour average concentrations for SO<sub>2</sub> (ppm) 2011–2020

| Region/Station              | 2011  | 2012  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  |
|-----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| <b>Sydney East</b>          |       |       |       |       |       |       |       |       |       |       |
| Chullora                    | 0.005 | 0.004 | 0.003 | 0.004 | 0.003 | 0.003 | 0.003 | 0.003 | 0.004 | 0.004 |
| Cook and Phillip            | -     | -     | -     | -     | -     | -     | -     | -     | 0.003 | 0.003 |
| Macquarie Park              | -     | -     | -     | -     | -     | -     | 0.003 | 0.007 | 0.004 | 0.004 |
| Randwick                    | 0.005 | 0.005 | 0.004 | 0.004 | 0.004 | 0.003 | 0.008 | 0.004 | 0.005 | 0.004 |
| Rozelle                     | -     | -     | -     | -     | 0.005 | 0.005 | 0.003 | 0.005 | 0.005 | 0.003 |
| <b>Sydney North West</b>    |       |       |       |       |       |       |       |       |       |       |
| Parramatta North            | -     | -     | -     | -     | -     | -     | -     | 0.005 | 0.006 | 0.005 |
| Prospect                    | 0.003 | 0.003 | 0.004 | 0.005 | 0.003 | 0.004 | 0.004 | 0.005 | 0.004 | 0.004 |
| Richmond                    | 0.003 | 0.002 | 0.002 | 0.002 | 0.003 | 0.002 | 0.004 | 0.005 | 0.004 | 0.003 |
| Rouse Hill/Vineyard         | 0.003 | 0.002 | 0.003 | 0.002 | 0.002 | 0.003 | -     | -     | 0.005 | 0.005 |
| <b>Sydney South West</b>    |       |       |       |       |       |       |       |       |       |       |
| Bargo                       | 0.002 | 0.002 | 0.003 | 0.002 | 0.002 | 0.004 | 0.002 | 0.002 | 0.006 | 0.003 |
| Bringelly                   | 0.002 | 0.002 | 0.002 | 0.003 | 0.001 | 0.002 | 0.002 | 0.003 | 0.004 | 0.003 |
| Campbelltown West/Macarthur | 0.002 | 0.002 | 0.002 | 0.004 | 0.002 | 0.002 | 0.003 | 0.004 | 0.004 | 0.002 |
| Liverpool                   | -     | -     | -     | -     | -     | 0.002 | 0.003 | 0.004 | 0.004 | 0.003 |
| <b>Central Coast</b>        |       |       |       |       |       |       |       |       |       |       |
| Wyong                       | -     | 0.004 | 0.005 | 0.004 | 0.009 | 0.004 | 0.007 | 0.008 | 0.006 | 0.008 |
| <b>Illawarra</b>            |       |       |       |       |       |       |       |       |       |       |
| Albion Park South           | 0.010 | 0.010 | 0.009 | 0.005 | 0.007 | 0.006 | 0.008 | 0.008 | 0.008 | 0.005 |
| Wollongong                  | 0.009 | 0.005 | 0.008 | 0.005 | 0.004 | 0.004 | 0.005 | 0.009 | 0.006 | 0.004 |
| <b>Lower Hunter</b>         |       |       |       |       |       |       |       |       |       |       |
| Beresfield                  | 0.012 | 0.009 | 0.005 | 0.007 | 0.008 | 0.008 | 0.008 | 0.007 | 0.009 | 0.008 |
| Newcastle                   | 0.009 | 0.007 | 0.007 | 0.006 | 0.007 | 0.007 | 0.006 | 0.007 | 0.006 | 0.007 |



| Region/Station      | 2011  | 2012  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  |
|---------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Wallsend            | 0.007 | 0.005 | 0.005 | 0.008 | 0.007 | 0.006 | 0.010 | 0.008 | 0.009 | 0.010 |
| <b>Upper Hunter</b> |       |       |       |       |       |       |       |       |       |       |
| Muswellbrook        | -     | 0.017 | 0.022 | 0.018 | 0.017 | 0.023 | 0.022 | 0.021 | 0.024 | 0.015 |
| Singleton           | -     | 0.018 | 0.008 | 0.008 | 0.009 | 0.010 | 0.010 | 0.013 | 0.012 | 0.011 |

Table 35 Annual average concentration for SO<sub>2</sub> (ppm) 2011–2020

| Region/Station              | 2011  | 2012  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  |
|-----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| <b>Sydney East</b>          |       |       |       |       |       |       |       |       |       |       |
| Chullora                    | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 |
| Cook and Phillip            | -     | -     | -     | -     | -     | -     | -     | -     | 0.001 | 0.000 |
| Macquarie Park              | -     | -     | -     | -     | -     | -     | 0.000 | 0.001 | 0.001 | 0.000 |
| Randwick                    | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| Rozelle                     | -     | -     | -     | -     | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 |
| <b>Sydney North West</b>    |       |       |       |       |       |       |       |       |       |       |
| Parramatta North            | -     | -     | -     | -     | -     | -     | -     | 0.001 | 0.001 | 0.000 |
| Prospect                    | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 |
| Richmond                    | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Rouse Hill/Vineyard         | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -     | -     | 0.001 | 0.000 |
| <b>Sydney South West</b>    |       |       |       |       |       |       |       |       |       |       |
| Bargo                       | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Bringelly                   | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 |
| Campbelltown West/Macarthur | 0.000 | 0.000 | 0.001 | 0.001 | 0.000 | 0.000 | 0.001 | 0.001 | 0.001 | 0.000 |
| Liverpool                   | -     | -     | -     | -     | -     | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| <b>Central Coast</b>        |       |       |       |       |       |       |       |       |       |       |
| Wyong                       | -     | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| <b>Illawarra</b>            |       |       |       |       |       |       |       |       |       |       |
| Albion Park South           | 0.001 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 |
| Wollongong                  | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| <b>Lower Hunter</b>         |       |       |       |       |       |       |       |       |       |       |
| Beresfield                  | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | 0.001 | 0.002 | 0.002 | 0.002 | 0.001 |
| Newcastle                   | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 |
| Wallsend                    | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.002 | 0.002 |
| <b>Upper Hunter</b>         |       |       |       |       |       |       |       |       |       |       |
| Muswellbrook                | 0.003 | 0.002 | 0.002 | 0.003 | 0.002 | 0.002 | 0.002 | 0.003 | 0.003 | 0.002 |
| Singleton                   | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.002 | 0.002 |

## Ozone

### Ozone 1-hour standard

**Table 36** Statistical summary for ozone in 2020: daily maximum 1-hour average concentrations

| Region/Station           | Maximum (ppm) | Percentile (ppm) |                  |                  |                  |                  |                  |
|--------------------------|---------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                          |               | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| <b>Sydney East</b>       |               |                  |                  |                  |                  |                  |                  |
| Chullora                 | <b>0.107</b>  | 0.066            | 0.062            | 0.054            | 0.047            | 0.034            | 0.029            |
| Cook and Phillip         | 0.059         | 0.048            | 0.042            | 0.037            | 0.032            | 0.027            | 0.022            |
| Earlwood                 | 0.091         | 0.062            | 0.059            | 0.051            | 0.043            | 0.034            | 0.028            |
| Macquarie Park           | <b>0.102</b>  | 0.074            | 0.069            | 0.057            | 0.048            | 0.037            | 0.030            |
| Randwick                 | 0.090         | 0.083            | 0.074            | 0.063            | 0.051            | 0.040            | 0.032            |
| Rozelle                  | 0.083         | 0.068            | 0.060            | 0.051            | 0.044            | 0.035            | 0.029            |
| <b>Sydney North West</b> |               |                  |                  |                  |                  |                  |                  |
| Parramatta North         | 0.093         | 0.078            | 0.071            | 0.062            | 0.052            | 0.038            | 0.031            |
| Prospect                 | <b>0.102</b>  | 0.082            | 0.073            | 0.063            | 0.052            | 0.039            | 0.032            |
| Richmond                 | 0.093         | 0.073            | 0.061            | 0.050            | 0.044            | 0.036            | 0.030            |
| Rouse Hill               | 0.091         | 0.082            | 0.075            | 0.065            | 0.051            | 0.038            | 0.031            |
| St Marys                 | <b>0.115</b>  | 0.080            | 0.075            | 0.064            | 0.051            | 0.039            | 0.031            |
| <b>Sydney South West</b> |               |                  |                  |                  |                  |                  |                  |
| Bargo                    | <b>0.114</b>  | 0.082            | 0.076            | 0.06             | 0.054            | 0.038            | 0.030            |
| Bringelly                | <b>0.112</b>  | 0.082            | 0.076            | 0.067            | 0.053            | 0.041            | 0.031            |
| Camden                   | <b>0.107</b>  | 0.088            | 0.081            | 0.066            | 0.054            | 0.042            | 0.032            |
| Campbelltown West        | <b>0.108</b>  | 0.085            | 0.078            | 0.063            | 0.05             | 0.037            | 0.029            |
| Liverpool                | <b>0.102</b>  | 0.076            | 0.068            | 0.059            | 0.051            | 0.036            | 0.030            |
| Oakdale                  | <b>0.116</b>  | 0.081            | 0.079            | 0.064            | 0.052            | 0.041            | 0.032            |
| <b>Central Coast</b>     |               |                  |                  |                  |                  |                  |                  |
| Wyong                    | <b>0.101</b>  | 0.070            | 0.068            | 0.052            | 0.046            | 0.036            | 0.031            |
| <b>Illawarra</b>         |               |                  |                  |                  |                  |                  |                  |
| Albion Park South        | <b>0.102</b>  | 0.063            | 0.055            | 0.048            | 0.042            | 0.033            | 0.030            |
| Kembla Grange            | 0.089         | 0.064            | 0.06             | 0.049            | 0.042            | 0.033            | 0.029            |
| Wollongong               | 0.079         | 0.066            | 0.059            | 0.051            | 0.042            | 0.034            | 0.029            |
| <b>Lower Hunter</b>      |               |                  |                  |                  |                  |                  |                  |
| Beresfield               | 0.093         | 0.072            | 0.063            | 0.053            | 0.045            | 0.035            | 0.029            |
| Newcastle                | 0.090         | 0.074            | 0.054            | 0.047            | 0.041            | 0.035            | 0.030            |
| Wallsend                 | 0.083         | 0.070            | 0.062            | 0.051            | 0.044            | 0.036            | 0.029            |
| <b>North West Slopes</b> |               |                  |                  |                  |                  |                  |                  |

| Region/Station             | Maximum (ppm) | Percentile (ppm) |                  |                  |                  |                  |                  |
|----------------------------|---------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                            |               | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Gunnedah                   | 0.080         | 0.072            | 0.065            | 0.058            | 0.050            | 0.041            | 0.034            |
| <b>Southern Tablelands</b> |               |                  |                  |                  |                  |                  |                  |
| Goulburn                   | 0.092         | 0.075            | 0.073            | 0.054            | 0.045            | 0.037            | 0.031            |

## Ozone 4-hour standard

**Table 37** Statistical summary for ozone in 2020: daily maximum rolling 4-hour average concentrations

| Region/Station           | Maximum (ppm) | Percentile (ppm) |                  |                  |                  |                  |                  |
|--------------------------|---------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                          |               | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| <b>Sydney East</b>       |               |                  |                  |                  |                  |                  |                  |
| Chullora                 | <b>0.098</b>  | 0.060            | 0.057            | 0.050            | 0.043            | 0.033            | 0.027            |
| Cook and Phillip         | 0.047         | 0.042            | 0.039            | 0.034            | 0.030            | 0.025            | 0.021            |
| Earlwood                 | <b>0.085</b>  | 0.058            | 0.053            | 0.047            | 0.041            | 0.033            | 0.027            |
| Macquarie Park           | <b>0.086</b>  | 0.065            | 0.062            | 0.051            | 0.045            | 0.035            | 0.028            |
| Randwick                 | <b>0.081</b>  | 0.062            | 0.056            | 0.048            | 0.041            | 0.034            | 0.030            |
| Rozelle                  | 0.078         | 0.062            | 0.053            | 0.047            | 0.041            | 0.033            | 0.028            |
| <b>Sydney North West</b> |               |                  |                  |                  |                  |                  |                  |
| Parramatta North         | <b>0.081</b>  | 0.071            | 0.064            | 0.057            | 0.049            | 0.036            | 0.030            |
| Prospect                 | <b>0.093</b>  | 0.075            | 0.067            | 0.057            | 0.049            | 0.036            | 0.030            |
| Richmond                 | <b>0.086</b>  | 0.073            | 0.066            | 0.056            | 0.046            | 0.038            | 0.031            |
| Rouse Hill               | <b>0.083</b>  | 0.073            | 0.068            | 0.058            | 0.046            | 0.036            | 0.030            |
| St Marys                 | <b>0.107</b>  | 0.078            | 0.066            | 0.056            | 0.046            | 0.036            | 0.030            |
| <b>Sydney South West</b> |               |                  |                  |                  |                  |                  |                  |
| Bargo                    | <b>0.106</b>  | 0.075            | 0.067            | 0.054            | 0.049            | 0.036            | 0.029            |
| Bringelly                | <b>0.101</b>  | 0.074            | 0.068            | 0.058            | 0.049            | 0.038            | 0.030            |
| Camden                   | <b>0.096</b>  | 0.075            | 0.069            | 0.058            | 0.049            | 0.039            | 0.031            |
| Campbelltown West        | <b>0.091</b>  | 0.074            | 0.070            | 0.058            | 0.047            | 0.035            | 0.028            |
| Liverpool                | <b>0.093</b>  | 0.069            | 0.062            | 0.055            | 0.046            | 0.034            | 0.029            |
| Oakdale                  | <b>0.102</b>  | 0.071            | 0.068            | 0.058            | 0.049            | 0.039            | 0.032            |
| <b>Central Coast</b>     |               |                  |                  |                  |                  |                  |                  |
| Wyong                    | <b>0.089</b>  | 0.064            | 0.056            | 0.048            | 0.042            | 0.035            | 0.029            |
| <b>Illawarra</b>         |               |                  |                  |                  |                  |                  |                  |
| Albion Park South        | <b>0.084</b>  | 0.060            | 0.050            | 0.044            | 0.039            | 0.032            | 0.029            |
| Kembla Grange            | <b>0.081</b>  | 0.059            | 0.053            | 0.045            | 0.039            | 0.032            | 0.028            |
| Wollongong               | 0.071         | 0.061            | 0.052            | 0.047            | 0.040            | 0.032            | 0.028            |
| <b>Lower Hunter</b>      |               |                  |                  |                  |                  |                  |                  |

| Region/Station             | Maximum (ppm) | Percentile (ppm) |                  |                  |                  |                  |                  |
|----------------------------|---------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                            |               | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Beresfield                 | 0.076         | 0.061            | 0.059            | 0.050            | 0.041            | 0.033            | 0.027            |
| Newcastle                  | 0.080         | 0.062            | 0.051            | 0.044            | 0.038            | 0.034            | 0.028            |
| Wallsend                   | 0.079         | 0.064            | 0.058            | 0.047            | 0.040            | 0.034            | 0.028            |
| <b>North West Slopes</b>   |               |                  |                  |                  |                  |                  |                  |
| Gunnedah                   | 0.078         | 0.067            | 0.061            | 0.055            | 0.048            | 0.040            | 0.033            |
| <b>Southern Tablelands</b> |               |                  |                  |                  |                  |                  |                  |
| Goulburn                   | <b>0.091</b>  | <b>0.081</b>     | 0.069            | 0.053            | 0.043            | 0.036            | 0.030            |

Table 38 Annual maximum 1-hour average concentrations for ozone (ppm) 2011–2020

| Region/Station              | 2011         | 2012  | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         |
|-----------------------------|--------------|-------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>Sydney East</b>          |              |       |              |              |              |              |              |              |              |              |
| Chullora                    | <b>0.114</b> | 0.080 | <b>0.105</b> | 0.079        | 0.093        | 0.090        | <b>0.114</b> | 0.092        | <b>0.176</b> | <b>0.107</b> |
| Cook and Phillip            | -            | -     | -            | -            | -            | -            | -            | -            | 0.107        | 0.059        |
| Earlwood                    | 0.099        | 0.082 | <b>0.101</b> | 0.069        | 0.093        | 0.092        | <b>0.109</b> | 0.072        | <b>0.179</b> | 0.091        |
| Macquarie Park              | -            | -     | -            | -            | -            | -            | <i>0.091</i> | 0.087        | <b>0.122</b> | <b>0.102</b> |
| Randwick                    | 0.073        | 0.066 | 0.075        | 0.066        | <b>0.113</b> | 0.099        | <b>0.116</b> | 0.073        | <b>0.150</b> | 0.090        |
| Rozelle                     | 0.093        | 0.069 | 0.073        | 0.067        | 0.099        | 0.089        | <b>0.114</b> | 0.078        | <b>0.179</b> | 0.083        |
| <b>Sydney North West</b>    |              |       |              |              |              |              |              |              |              |              |
| Parramatta North            | -            | -     | -            | -            | -            | -            | -            | <b>0.102</b> | <b>0.157</b> | 0.093        |
| Prospect                    | <b>0.126</b> | 0.080 | <b>0.111</b> | <b>0.103</b> | 0.085        | <b>0.104</b> | <b>0.123</b> | <b>0.105</b> | <b>0.132</b> | <b>0.102</b> |
| Richmond                    | <b>0.116</b> | 0.085 | 0.095        | 0.090        | 0.094        | 0.081        | 0.093        | <b>0.103</b> | <b>0.137</b> | 0.093        |
| Rouse Hill/Vineyard         | 0.094        | 0.080 | <b>0.105</b> | <b>0.112</b> | 0.088        | 0.076        | -            | -            | <b>0.112</b> | 0.091        |
| St Marys                    | <b>0.136</b> | 0.085 | <b>0.110</b> | 0.100        | 0.082        | <b>0.101</b> | <b>0.110</b> | <b>0.105</b> | <b>0.137</b> | <b>0.115</b> |
| <b>Sydney South West</b>    |              |       |              |              |              |              |              |              |              |              |
| Bargo                       | <b>0.126</b> | 0.091 | 0.095        | <b>0.105</b> | 0.083        | 0.105        | 0.095        | <b>0.102</b> | <b>0.128</b> | <b>0.114</b> |
| Bringelly                   | <b>0.125</b> | 0.088 | <b>0.108</b> | <b>0.124</b> | 0.087        | 0.094        | 0.098        | <b>0.110</b> | <b>0.144</b> | <b>0.112</b> |
| Camden                      | -            | 0.095 | <b>0.110</b> | <b>0.123</b> | 0.086        | 0.097        | <b>0.122</b> | <b>0.112</b> | <b>0.138</b> | <b>0.107</b> |
| Campbelltown West/Macarthur | 0.131        | 0.080 | 0.094        | <b>0.124</b> | 0.086        | 0.091        | 0.094        | <b>0.110</b> | <b>0.131</b> | <b>0.108</b> |
| Liverpool                   | <b>0.103</b> | 0.079 | <b>0.117</b> | <b>0.103</b> | 0.087        | 0.095        | <b>0.135</b> | <b>0.111</b> | <b>0.157</b> | <b>0.102</b> |
| Oakdale                     | <b>0.126</b> | 0.089 | 0.095        | <b>0.110</b> | 0.084        | 0.083        | 0.095        | 0.097        | <b>0.147</b> | <b>0.116</b> |
| <b>Central Coast</b>        |              |       |              |              |              |              |              |              |              |              |
| Wyong                       | -            | 0.078 | 0.079        | 0.076        | 0.097        | 0.086        | <b>0.121</b> | 0.075        | 0.100        | <b>0.101</b> |
| <b>Illawarra</b>            |              |       |              |              |              |              |              |              |              |              |
| Albion Park South           | <b>0.118</b> | 0.067 | <b>0.120</b> | 0.094        | 0.079        | <b>0.104</b> | <b>0.117</b> | 0.076        | 0.099        | <b>0.102</b> |

| Region/Station             | 2011         | 2012  | 2013         | 2014  | 2015         | 2016         | 2017         | 2018         | 2019                     | 2020  |
|----------------------------|--------------|-------|--------------|-------|--------------|--------------|--------------|--------------|--------------------------|-------|
| Kembla Grange              | <b>0.121</b> | 0.068 | <b>0.126</b> | 0.094 | <b>0.104</b> | <b>0.114</b> | <b>0.122</b> | 0.070        | 0.100                    | 0.089 |
| Wollongong                 | 0.084        | 0.065 | <b>0.112</b> | 0.077 | 0.092        | 0.095        | <b>0.107</b> | 0.066        | <b>0.111</b>             | 0.079 |
| <b>Lower Hunter</b>        |              |       |              |       |              |              |              |              |                          |       |
| Beresfield                 | 0.071        | 0.070 | 0.077        | 0.090 | 0.077        | 0.085        | 0.083        | <b>0.107</b> | <b>0.126</b>             | 0.093 |
| Newcastle                  | 0.066        | 0.071 | 0.081        | 0.065 | 0.074        | 0.077        | 0.086        | 0.067        | <b>0.104</b>             | 0.090 |
| Wallsend                   | 0.071        | 0.080 | 0.084        | 0.087 | 0.071        | 0.086        | <b>0.106</b> | 0.086        | <b>0.110</b>             | 0.083 |
| <b>North West Slopes</b>   |              |       |              |       |              |              |              |              |                          |       |
| Gunnedah                   | -            | -     | -            | -     | -            | -            | -            | 0.063        | 0.094                    | 0.080 |
| <b>Southern Tablelands</b> |              |       |              |       |              |              |              |              |                          |       |
| Goulburn                   | -            | -     | -            | -     | -            | -            | -            | -            | <b>0.147<sup>1</sup></b> | 0.092 |

1. Annual data availability <15% due to station being commissioned in November 2019, however, this value is likely to be the annual maximum as occurred during the Black Summer bushfires.

**Table 39 Annual maximum rolling 4-hour average concentrations for ozone (ppm) 2011–2020**

| Region/Station              | 2011         | 2012         | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         |
|-----------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>Sydney East</b>          |              |              |              |              |              |              |              |              |              |              |
| Chullora                    | <b>0.096</b> | 0.068        | <b>0.094</b> | 0.073        | 0.078        | 0.077        | <b>0.110</b> | <b>0.082</b> | <b>0.121</b> | <b>0.098</b> |
| Cook and Phillip            | -            | -            | -            | -            | -            | -            | -            | -            | 0.075        | 0.047        |
| Earlwood                    | <b>0.088</b> | 0.068        | <b>0.082</b> | 0.065        | <b>0.081</b> | <b>0.082</b> | <b>0.087</b> | 0.065        | <b>0.125</b> | <b>0.085</b> |
| Macquarie Park              | -            | -            | -            | -            | -            | -            | <b>0.087</b> | 0.080        | <b>0.105</b> | <b>0.086</b> |
| Randwick                    | 0.069        | 0.063        | 0.067        | 0.061        | <b>0.085</b> | <b>0.090</b> | <b>0.102</b> | 0.069        | <b>0.111</b> | <b>0.081</b> |
| Rozelle                     | 0.080        | 0.054        | 0.063        | 0.060        | 0.079        | 0.075        | <b>0.109</b> | 0.066        | <b>0.149</b> | 0.078        |
| <b>Sydney North West</b>    |              |              |              |              |              |              |              |              |              |              |
| Parramatta North            | -            | -            | -            | -            | -            | -            | -            | <b>0.095</b> | <b>0.122</b> | <b>0.081</b> |
| Prospect                    | <b>0.114</b> | 0.073        | <b>0.104</b> | <b>0.097</b> | 0.070        | 0.078        | <b>0.106</b> | <b>0.091</b> | <b>0.122</b> | <b>0.093</b> |
| Richmond                    | <b>0.088</b> | 0.070        | 0.076        | 0.073        | 0.074        | 0.070        | <b>0.085</b> | <b>0.087</b> | <b>0.120</b> | <b>0.086</b> |
| Rouse Hill/Vineyard         | 0.075        | 0.070        | <b>0.090</b> | 0.075        | 0.071        | 0.064        | -            | -            | <b>0.101</b> | <b>0.083</b> |
| St Marys                    | <b>0.121</b> | 0.072        | <b>0.101</b> | <b>0.085</b> | 0.071        | <b>0.081</b> | <b>0.096</b> | <b>0.094</b> | <b>0.118</b> | <b>0.107</b> |
| <b>Sydney South West</b>    |              |              |              |              |              |              |              |              |              |              |
| Bargo                       | <b>0.098</b> | <b>0.083</b> | <b>0.082</b> | <b>0.093</b> | 0.074        | 0.080        | <b>0.086</b> | <b>0.084</b> | <b>0.125</b> | <b>0.106</b> |
| Bringelly                   | <b>0.118</b> | 0.072        | <b>0.102</b> | <b>0.113</b> | 0.078        | 0.080        | <b>0.089</b> | <b>0.092</b> | <b>0.111</b> | <b>0.101</b> |
| Camden                      | -            | <b>0.084</b> | <b>0.090</b> | <b>0.110</b> | 0.072        | 0.075        | <b>0.108</b> | <b>0.094</b> | <b>0.115</b> | <b>0.096</b> |
| Campbelltown West/Macarthur | <b>0.122</b> | 0.073        | <b>0.082</b> | <b>0.111</b> | 0.079        | 0.077        | <b>0.091</b> | <b>0.098</b> | <b>0.117</b> | <b>0.091</b> |
| Liverpool                   | <b>0.095</b> | 0.071        | <b>0.110</b> | <b>0.087</b> | 0.077        | 0.086        | <b>0.117</b> | <b>0.093</b> | <b>0.115</b> | <b>0.093</b> |
| Oakdale                     | <b>0.098</b> | <b>0.081</b> | <b>0.081</b> | <b>0.088</b> | 0.070        | 0.067        | 0.080        | <b>0.082</b> | <b>0.130</b> | <b>0.102</b> |
| <b>Central Coast</b>        |              |              |              |              |              |              |              |              |              |              |

| Region/Station             | 2011         | 2012  | 2013         | 2014  | 2015         | 2016         | 2017         | 2018         | 2019                     | 2020         |
|----------------------------|--------------|-------|--------------|-------|--------------|--------------|--------------|--------------|--------------------------|--------------|
| Wyong                      | -            | 0.066 | 0.072        | 0.069 | <b>0.091</b> | 0.079        | <b>0.105</b> | 0.067        | <b>0.090</b>             | <b>0.089</b> |
| <b>Illawarra</b>           |              |       |              |       |              |              |              |              |                          |              |
| Albion Park South          | <b>0.099</b> | 0.064 | <b>0.100</b> | 0.079 | 0.075        | <b>0.098</b> | <b>0.102</b> | 0.073        | 0.078                    | <b>0.084</b> |
| Kembla Grange              | <b>0.105</b> | 0.061 | <b>0.103</b> | 0.080 | 0.079        | <b>0.102</b> | <b>0.098</b> | 0.059        | <b>0.092</b>             | <b>0.081</b> |
| Wollongong                 | 0.078        | 0.061 | <b>0.091</b> | 0.068 | <b>0.083</b> | <b>0.085</b> | <b>0.094</b> | 0.061        | <b>0.094</b>             | 0.071        |
| <b>Lower Hunter</b>        |              |       |              |       |              |              |              |              |                          |              |
| Beresfield                 | 0.064        | 0.067 | 0.074        | 0.077 | 0.067        | 0.068        | 0.079        | <b>0.089</b> | <b>0.107</b>             | 0.076        |
| Newcastle                  | 0.063        | 0.057 | 0.075        | 0.056 | 0.066        | 0.069        | 0.073        | 0.058        | <b>0.097</b>             | 0.080        |
| Wallsend                   | 0.059        | 0.070 | 0.078        | 0.065 | 0.062        | 0.078        | <b>0.097</b> | 0.068        | <b>0.097</b>             | 0.079        |
| <b>North West Slopes</b>   |              |       |              |       |              |              |              |              |                          |              |
| Gunnedah                   | -            | -     | -            | -     | -            | -            | -            | 0.058        | <b>0.087</b>             | 0.078        |
| <b>Southern Tablelands</b> |              |       |              |       |              |              |              |              |                          |              |
| Goulburn                   | -            | -     | -            | -     | -            | -            | -            | -            | <b>0.137<sup>1</sup></b> | 0.091        |

1. Annual data availability <15% due to station being commissioned in November 2019, but this value is likely to be the annual maximum as occurred during the Black Summer bushfires.

## Particles as PM10

### PM10 daily standard

Table 40 Statistical summary for PM10 in 2020: 24-hour average concentrations

| Region/Station           | Maximum ( $\mu\text{g}/\text{m}^3$ ) | Percentile ( $\mu\text{g}/\text{m}^3$ ) |                  |                  |                  |                  |                  |
|--------------------------|--------------------------------------|---|------------------|------------------|------------------|------------------|------------------|
|                          |                                      | 99 <sup>th</sup>                        | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| <b>Sydney East</b>       |                                      |   |                  |                  |                  |                  |                  |
| Chullora                 | <b>167.9</b>                         | <b>66.9</b>                             | <b>52.8</b>      | 37.7             | 31.8             | 23.9             | 17.6             |
| Cook and Phillip         | <b>130.8</b>                         | <b>50.5</b>                             | <b>39.2</b>      | 30.5             | 25.1             | 18.0             | 14.0             |
| Earlwood                 | <b>116.7</b>                         | <b>67.8</b>                             | <b>53.4</b>      | 34.7             | 29.4             | 21.8             | 15.8             |
| Macquarie Park           | <b>146.7</b>                         | <b>62.0</b>                             | <b>51.2</b>      | 33.5             | 24.9             | 17.0             | 13.3             |
| Randwick                 | <b>137.3</b>                         | <b>67.0</b>                             | <b>59.2</b>      | 37.5             | 30.9             | 22.9             | 16.6             |
| Rozelle                  | <b>113.5</b>                         | <b>67.7</b>                             | <b>50.9</b>      | 34.4             | 28.6             | 21.0             | 15.9             |
| <b>Sydney North West</b> |                                      |   |                  |                  |                  |                  |                  |
| Parramatta North         | <b>188.9</b>                         | <b>71.8</b>                             | <b>54.6</b>      | 37.7             | 30.4             | 21.8             | 16.5             |
| Prospect                 | <b>245.8</b>                         | <b>81.5</b>                             | <b>59.4</b>      | 40.3             | 31.7             | 23.0             | 16.8             |
| Richmond                 | <b>237.7</b>                         | <b>79.9</b>                             | <b>60.9</b>      | 35.6             | 26.8             | 18.4             | 13.3             |
| Rouse Hill               | <b>220.3</b>                         | <b>80.2</b>                             | <b>55.3</b>      | 36.2             | 29.1             | 20.6             | 14.8             |
| St Marys                 | <b>260.3</b>                         | <b>89.6</b>                             | <b>66.4</b>      | 39.4             | 31.0             | 21.3             | 14.6             |
| <b>Sydney South West</b> |                                      |   |                  |                  |                  |                  |                  |

| Region/Station             | Maximum ( $\mu\text{g}/\text{m}^3$ ) | Percentile ( $\mu\text{g}/\text{m}^3$ ) |                  |                  |                  |                  |                  |
|----------------------------|--------------------------------------|---|------------------|------------------|------------------|------------------|------------------|
|                            |                                      | 99 <sup>th</sup>                        | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Bargo                      | 265.7                                | 135.2                                   | 47.3             | 31.5             | 25.3             | 17.6             | 12.2             |
| Bringelly                  | 241.8                                | 82.3                                    | 63.1             | 37.7             | 30.8             | 21.6             | 14.6             |
| Camden                     | 268.6                                | 88.4                                    | 64.7             | 35.1             | 26.0             | 18.0             | 12.8             |
| Campbelltown West          | 249.7                                | 85.1                                    | 60.3             | 33.9             | 27.4             | 18.9             | 13.4             |
| Liverpool                  | 195.1                                | 71.3                                    | 51.1             | 38.6             | 32.7             | 24.7             | 18.3             |
| Oakdale                    | 248.9                                | 85.1                                    | 74.0             | 32.2             | 22.6             | 15.3             | 9.9              |
| <b>Central Coast</b>       |                                      |   |                  |                  |                  |                  |                  |
| Wyang                      | 90.5                                 | 59.8                                    | 46.8             | 36.2             | 28.4             | 18.6             | 13.3             |
| <b>Illawarra</b>           |                                      |   |                  |                  |                  |                  |                  |
| Albion Park South          | 153.3                                | 90.8                                    | 64.8             | 35.4             | 28.2             | 19.8             | 13.7             |
| Kembla Grange              | 187.7                                | 94.6                                    | 73.4             | 52.0             | 37.7             | 25.6             | 16.3             |
| Wollongong                 | 121.6                                | 82.5                                    | 63.6             | 39.2             | 33.1             | 22.2             | 15.0             |
| <b>Lower Hunter</b>        |                                      |   |                  |                  |                  |                  |                  |
| Beresfield                 | 77.7                                 | 55.0                                    | 46.7             | 37.1             | 29.7             | 22.2             | 16.3             |
| Newcastle                  | 116.2                                | 75.3                                    | 52.2             | 43.4             | 34.1             | 27.1             | 20.5             |
| Wallsend                   | 77.9                                 | 65.4                                    | 44.0             | 34.7             | 28.7             | 20.5             | 15.5             |
| <b>Upper Hunter</b>        |                                      |   |                  |                  |                  |                  |                  |
| Aberdeen                   | 267.7                                | 78.0                                    | 53.5             | 38.6             | 31.5             | 19.8             | 14.3             |
| Muswellbrook               | 181.0                                | 83.0                                    | 58.2             | 44.7             | 35.4             | 25.7             | 19.3             |
| Singleton                  | 82.4                                 | 65.3                                    | 55.7             | 42.6             | 34.3             | 25.8             | 17.7             |
| <b>Central Tablelands</b>  |                                      |   |                  |                  |                  |                  |                  |
| Bathurst                   | 320.4                                | 185.2                                   | 76.9             | 45.1             | 26.7             | 16.2             | 11.0             |
| Orange                     | 291.8                                | 130.3                                   | 75.1             | 42.7             | 29.7             | 20.1             | 12.8             |
| <b>North West Slopes</b>   |                                      |   |                  |                  |                  |                  |                  |
| Gunnedah                   | 101.2                                | 52.8                                    | 38.5             | 28.0             | 23.8             | 17.5             | 12.0             |
| Narrabri                   | 119.6                                | 80.3                                    | 65.3             | 30.9             | 20.5             | 13.0             | 9.1              |
| Tamworth                   | 178.0                                | 99.8                                    | 53.3             | 34.6             | 24.8             | 18.6             | 13.4             |
| <b>Northern Tablelands</b> |                                      |   |                  |                  |                  |                  |                  |
| Armidale                   | 112.5                                | 50.5                                    | 42.5             | 34.7             | 28.3             | 17.8             | 10.5             |
| <b>South West Slopes</b>   |                                      |   |                  |                  |                  |                  |                  |
| Albury                     | 298.3                                | 181.1                                   | 116.4            | 51.2             | 27.1             | 18.9             | 14.0             |
| Wagga Wagga North          | 295.3                                | 140.4                                   | 96.3             | 59.5             | 41.6             | 24.8             | 16.8             |
| <b>Southern Tablelands</b> |                                      |   |                  |                  |                  |                  |                  |
| Goulburn                   | 556.7                                | 263.9                                   | 139.1            | 50.2             | 22.1             | 15.5             | 10.6             |

**Table 41 Annual maximum 24-hour average concentrations for PM10 ( $\mu\text{g}/\text{m}^3$ )**

| Region/Station              | 2011  | 2012 | 2013  | 2014 | 2015 | 2016  | 2017 | 2018  | 2019  | 2020  |
|-----------------------------|-------|------|-------|------|------|-------|------|-------|-------|-------|
| <b>Sydney East</b>          |       |      |       |      |      |       |      |       |       |       |
| Chullora                    | 65.2  | 52.4 | 69.4  | 40.0 | 64.6 | 63.5  | 63.0 | 90.7  | 140.4 | 167.9 |
| Cook and Phillip            | -     | -    | -     | -    | -    | -     | -    | -     | 116.8 | 130.8 |
| Earlwood                    | 124.9 | 44.2 | 63.1  | 45.2 | 66.5 | 42.9  | 59.8 | 86.5  | 129.4 | 116.7 |
| Macquarie Park              | -     | -    | -     | -    | -    | -     | 49.6 | 85.6  | 187.3 | 146.7 |
| Rozelle                     | 39.4  | 40.7 | 58.5  | 43.8 | 60.3 | 58.8  | 54.1 | 88.3  | 142.7 | 113.5 |
| Randwick                    | 40.1  | 43.7 | 55.3  | 46.1 | 77.4 | 44.1  | 56.1 | 95.5  | 127.7 | 137.3 |
| <b>Sydney North West</b>    |       |      |       |      |      |       |      |       |       |       |
| Parramatta North            | -     | -    | -     | -    | -    | -     | -    | 107.4 | 195.3 | 188.9 |
| Prospect                    | 41.5  | 38.7 | 81.8  | 44.3 | 68.7 | 110.1 | 61.1 | 113.3 | 182.8 | 245.8 |
| Richmond                    | 46.2  | 99.2 | 112.7 | 40.0 | 49.3 | 102.8 | 51.5 | 116.3 | 193.4 | 237.7 |
| Rouse Hill/Vineyard         | 32.7  | 34.3 | 67.8  | 41.9 | 59.0 | 105.4 | -    | -     | 216.2 | 220.3 |
| St Marys                    | 73.9  | 34.3 | 93.0  | 45.0 | 53.0 | 100.2 | 49.8 | 100.5 | 159.8 | 260.3 |
| <b>Sydney South West</b>    |       |      |       |      |      |       |      |       |       |       |
| Bargo                       | 89.7  | 45.2 | 208.9 | 50.8 | 52.2 | 58.4  | 53.5 | 60.8  | 188.9 | 265.7 |
| Bringelly                   | 86.0  | 40.1 | 97.2  | 42.6 | 57.0 | 61.6  | 83.7 | 92.9  | 134.0 | 241.8 |
| Camden                      | -     | 35.6 | 98.1  | 41.4 | 62.4 | 43.6  | 48.4 | 68.1  | 139.2 | 268.6 |
| Campbelltown West/Macarthur | 38.1  | 39.3 | 56.9  | 49.4 | 69.7 | 50.1  | 53.1 | 72.3  | 132.0 | 249.7 |
| Liverpool                   | 68.8  | 42.5 | 98.5  | 40.8 | 68.6 | 68.7  | 73.6 | 101.5 | 178.9 | 195.1 |
| Oakdale                     | 54.7  | 38.9 | 99.0  | 56.3 | 61.7 | 75.9  | 46.8 | 105.1 | 216.8 | 248.9 |
| <b>Central Coast</b>        |       |      |       |      |      |       |      |       |       |       |
| Wyong                       | -     | 37.4 | 70.2  | 41.9 | 58.6 | 46.0  | 63.4 | 138.3 | 128.4 | 90.5  |
| <b>Illawarra</b>            |       |      |       |      |      |       |      |       |       |       |
| Albion Park South           | 51.0  | 43.9 | 69.0  | 48.3 | 41.2 | 43.1  | 44.6 | 94.4  | 104.3 | 153.3 |
| Kembla Grange               | 55.5  | 57.2 | 102.2 | 99.2 | 62.8 | 56.3  | 67.7 | 71.8  | 115.8 | 187.7 |
| Wollongong                  | 48.5  | 47.5 | 94.3  | 45.3 | 45.8 | 52.9  | 55.2 | 59.7  | 117.6 | 121.6 |
| <b>Lower Hunter</b>         |       |      |       |      |      |       |      |       |       |       |
| Beresfield                  | 42.8  | 50.8 | 55.3  | 45.4 | 64.9 | 48.0  | 49.4 | 149.1 | 136.7 | 77.7  |
| Newcastle                   | 49.2  | 48.7 | 69.0  | 53.7 | 70.4 | 89.1  | 55.0 | 146.0 | 125.8 | 116.2 |
| Wallsend                    | 38.9  | 38.1 | 52.5  | 43.4 | 77.5 | 65.5  | 47.9 | 136.5 | 127.9 | 77.9  |
| <b>Upper Hunter</b>         |       |      |       |      |      |       |      |       |       |       |
| Aberdeen                    | -     | 45.8 | 42.7  | 50.4 | 64.8 | 41.2  | 59.4 | 178.9 | 246.7 | 267.7 |
| Muswellbrook                | 46.5  | 51.0 | 55.6  | 53.0 | 72.6 | 43.9  | 56.5 | 185.9 | 231.3 | 181.0 |
| Singleton                   | 60.5  | 63.6 | 62.7  | 54.5 | 85.3 | 60.8  | 57.0 | 198.0 | 206.1 | 82.4  |
| <b>Central Tablelands</b>   |       |      |       |      |      |       |      |       |       |       |



| Region/Station             | 2011 | 2012 | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019               | 2020  |
|----------------------------|------|------|-------|-------|-------|-------|-------|-------|--------------------|-------|
| Bathurst                   | 24.3 | 55.5 | 145.0 | 42.8  | 94.6  | 34.1  | 49.9  | 274.1 | 296.6              | 320.4 |
| Orange                     | -    | -    | -     | -     | -     | -     | -     | -     | 423.7              | 291.8 |
| <b>North West Slopes</b>   |      |      |       |       |       |       |       |       |                    |       |
| Gunnedah                   | -    | -    | -     | -     | -     | -     | -     | 234.9 | 205.2              | 101.2 |
| Narrabri                   | -    | -    | -     | -     | -     | -     | -     | 221.7 | 232.6              | 119.6 |
| Tamworth                   | 50.9 | 55.1 | 47.5  | 66.6  | 52.7  | 51.7  | 54.1  | 145.4 | 240.2              | 178.0 |
| <b>Northern Tablelands</b> |      |      |       |       |       |       |       |       |                    |       |
| Armidale                   | -    | -    | -     | -     | -     | -     | -     | 157.5 | 309.7              | 112.5 |
| <b>South West Slopes</b>   |      |      |       |       |       |       |       |       |                    |       |
| Albury                     | 28.0 | 54.4 | 59.2  | 159.6 | 92.5  | 51.0  | 48.8  | 107.8 | 222.4              | 298.3 |
| Wagga Wagga Nth            | 56.3 | 67.2 | 110.7 | 88.2  | 145.1 | 114.7 | 171.6 | 127.2 | 251.7              | 295.3 |
| <b>Southern Tablelands</b> |      |      |       |       |       |       |       |       |                    |       |
| Goulburn                   | -    | -    | -     | -     | -     | -     | -     | -     | 494.1 <sup>1</sup> | 556.7 |

1 . Annual data availability <15% due to station being commissioned in November 2019, however, this value is likely to be the annual maximum as occurred during the Black Summer bushfires.

## PM10 annual standard

**Table 42 Annual average PM10 concentrations ( $\mu\text{g}/\text{m}^3$ ) 2011–2020**

| Region/Station           | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|--------------------------|------|------|------|------|------|------|------|------|------|------|
| <b>Sydney East</b>       |      |      |      |      |      |      |      |      |      |      |
| Chullora                 | 19.8 | 18.1 | 18.3 | 18.1 | 17.5 | 18.1 | 20.1 | 21.9 | 24.6 | 20.5 |
| Cook and Phillip         | -    | -    | -    | -    | -    | -    | -    | -    | 29.6 | 15.7 |
| Earlwood                 | 18.0 | 19.5 | 19.9 | 18.3 | 17.2 | 17.6 | 18.0 | 19.8 | 23.0 | 18.5 |
| Randwick                 | 16.0 | 17.9 | 18.8 | 18.1 | 18.6 | 18.0 | 19.2 | 21.2 | 24.1 | 19.5 |
| Rozelle                  | 16.6 | 16.9 | 18.3 | 17.9 | 16.7 | 16.8 | 18.1 | 18.4 | 22.7 | 18.1 |
| Macquarie Park           | -    | -    | -    | -    | -    | -    | 15.2 | 17.2 | 19.9 | 15.7 |
| <b>Sydney North West</b> |      |      |      |      |      |      |      |      |      |      |
| Parramatta North         | -    | -    | -    | -    | -    | -    | -    | 21.6 | 25.5 | 19.3 |
| Prospect                 | 15.8 | 17.2 | 19.2 | 17.6 | 17.6 | 18.9 | 18.9 | 21.9 | 26.0 | 20.2 |
| Richmond                 | 13.2 | 15.1 | 17.4 | 15.4 | 12.8 | 16.0 | 16.0 | 18.7 | 24.2 | 17.0 |
| Rouse Hill/Vineyard      | 14.0 | 14.4 | 16.1 | 16.3 | 15.9 | 17.0 | -    | -    | 27.3 | 18.3 |
| St Marys                 | 14.7 | 14.5 | 16.0 | 16.7 | 15.0 | 16.1 | 16.2 | 19.4 | 24.6 | 18.9 |
| <b>Sydney South West</b> |      |      |      |      |      |      |      |      |      |      |
| Bargo                    | 12.9 | 14.3 | 15.3 | 14.3 | 13.2 | 14.3 | 13.9 | 16.9 | 21.2 | 16.0 |
| Bringelly                | 15.9 | 15.7 | 17.0 | 16.6 | 15.8 | 16.9 | 19.8 | 21.3 | 23.6 | 18.3 |
| Camden                   | -    | 20.1 | 15.4 | 15.6 | 13.8 | 14.4 | 14.7 | 17.5 | 22.5 | 16.6 |

## New South Wales Ambient Air Quality Annual Compliance Report 2020

| Region/Station              | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018        | 2019        | 2020 |
|-----------------------------|------|------|------|------|------|------|------|-------------|-------------|------|
| Campbelltown West/Macarthur | 13.2 | 15.1 | 15.5 | 17.0 | 15.6 | 16.1 | 15.7 | 17.9        | 22.3        | 17.0 |
| Liverpool                   | 18.1 | 19.8 | 20.9 | 19.0 | 18.4 | 19.5 | 20.6 | 24.2        | <b>27.7</b> | 20.8 |
| Oakdale                     | 10.7 | 11.7 | 13.6 | 13.1 | 11.4 | 12.2 | 12.1 | 15.4        | 22.4        | 14.4 |
| <b>Central Coast</b>        |      |      |      |      |      |      |      |             |             |      |
| Wyong                       | -    | 21.9 | 16.6 | 15.1 | 14.9 | 15.2 | 16.1 | 18.0        | 21.1        | 15.9 |
| <b>Illawarra</b>            |      |      |      |      |      |      |      |             |             |      |
| Albion Park South           | 13.6 | 13.6 | 14.7 | 16.2 | 14.0 | 14.9 | 15.3 | 17.8        | 19.5        | 17.1 |
| Kembla Grange               | 16.8 | 18.3 | 18.5 | 17.3 | 17.7 | 20.0 | 20.5 | 22.7        | <b>25.5</b> | 21.5 |
| Wollongong                  | 17.0 | 18.0 | 17.6 | 17.7 | 16.9 | 17.3 | 18.1 | 19.8        | 22.6        | 18.8 |
| <b>Lower Hunter</b>         |      |      |      |      |      |      |      |             |             |      |
| Beresfield                  | 17.2 | 21.3 | 21.4 | 19.4 | 18.8 | 19.1 | 19.6 | 21.6        | <b>25.9</b> | 18.5 |
| Newcastle                   | 19.1 | 20.6 | 22.7 | 21.4 | 21.4 | 21.6 | 22.4 | 24.5        | <b>28.4</b> | 22.4 |
| Wallsend                    | 14.2 | 14.9 | 17.4 | 16.9 | 16.7 | 16.6 | 17.4 | 19.4        | 22.9        | 17.7 |
| <b>Upper Hunter</b>         |      |      |      |      |      |      |      |             |             |      |
| Aberdeen                    | -    | 17.0 | 17.3 | 17.9 | 15.2 | 15.6 | 17.6 | 22.3        | <b>29.5</b> | 17.8 |
| Muswellbrook                | 19.3 | 21.8 | 22.6 | 21.4 | 19.1 | 19.2 | 21.7 | <b>27.2</b> | <b>34.4</b> | 22.5 |
| Singleton                   | 19.8 | 22.3 | 23.3 | 21.0 | 19.3 | 19.3 | 20.8 | 24.0        | <b>30.1</b> | 20.5 |
| <b>Central Tablelands</b>   |      |      |      |      |      |      |      |             |             |      |
| Bathurst                    | 11.0 | 13.4 | 15.1 | 14.6 | 13.4 | 13.3 | 14.1 | 18.8        | <b>27.4</b> | 17.0 |
| Orange                      | -    | -    | -    | -    | -    | -    | -    | -           | <b>28.3</b> | 17.9 |
| <b>North West Slopes</b>    |      |      |      |      |      |      |      |             |             |      |
| Gunnedah                    | -    | -    | -    | -    | -    | -    | -    | 18.9        | 24.8        | 13.9 |
| Narrabri                    | -    | -    | -    | -    | -    | -    | -    | 14.3        | 23.2        | 12.4 |
| Tamworth                    | 13.1 | 15.9 | 16.6 | 15.8 | 14.1 | 15.3 | 15.3 | 20.1        | <b>33.7</b> | 16.8 |
| <b>Northern Tablelands</b>  |      |      |      |      |      |      |      |             |             |      |
| Armidale                    | -    | -    | -    | -    | -    | -    | -    | 17.6        | <b>27.9</b> | 13.7 |
| <b>South West Slopes</b>    |      |      |      |      |      |      |      |             |             |      |
| Albury                      | 12.3 | 14.3 | 15.8 | 15.9 | 14.6 | 15.1 | 15.8 | 19.8        | 23.4        | 20.1 |
| Wagga Wagga Nth/Wagga Wagga | 15.5 | 18.8 | 22.1 | 20.7 | 19.9 | 20.6 | 20.6 | <b>27.4</b> | <b>35.3</b> | 23.2 |
| <b>Southern Tablelands</b>  |      |      |      |      |      |      |      |             |             |      |
| Goulburn                    | -    | -    | -    | -    | -    | -    | -    | -           | #           | 19.2 |

# Annual data availability <15% due to station being commissioned in November 2019, hence annual average cannot be determined.

## Particles as PM2.5

The current USEPA-approved (United States Environmental Protection Agency) method for PM2.5 compliance monitoring (also known as the Federal Reference Method, FRM) is a non-continuous (i.e. batch), one-day-in-three technique that requires pre- and post-laboratory weighing. As this involves a substantial delay in acquiring and reporting data, the New South Wales jurisdiction uses continuous monitoring techniques for near-real-time reporting of air quality (e.g. by using TEOM or BAM monitors).

The latest AAQ NEPM (Australian Government 2021) requires the reporting of all PM2.5 data measured using all relevant methods, including the compliance method (FRM) and the continuous monitoring technique used.

### Pre-2010 PM2.5 data reporting

Before 2010, TEOMs were used in New South Wales for PM2.5 continuous monitoring. The TEOM measurement data were recorded as corrected values, after internally applying the USEPA PM10 equivalency factors (of  $A = 3$  and  $B = 1.03$  where  $y = A + Bx$ ). The rationale was to achieve results comparable to the PM2.5 reference methods. Thus, before 2010, USEPA equivalency factors were used in all PM2.5 reporting by New South Wales. During 2010, all PM2.5 data was recalculated by removing the PM10 equivalency factor (i.e. now  $A = 0$  and  $B = 1$ ). This approach harmonised NSW reporting of PM2.5 with that of other Australian jurisdictions.

All data included in this report, for all years, do not have any equivalency factors applied.

### Post-2012 PM2.5 monitoring technique

During 2012, New South Wales commenced a staggered phasing out of continuous TEOM PM2.5 monitors, by replacing with the USEPA-equivalent method for PM2.5 continuous monitoring, namely beta attenuation monitors (BAMs). The BAM method differs from TEOM in terms of sample treatment, using lower temperatures intermittently to reduce moisture levels in the sample stream. This technique is intended to promote greater retention of volatile components adsorbed to the fine particulate matter.

### PM2.5 daily standard

**Table 43** Statistical summary for PM2.5 in 2020: 24-hour average concentrations

| Region/Station           | Maximum ( $\mu\text{g}/\text{m}^3$ ) | Percentile ( $\mu\text{g}/\text{m}^3$ ) |                  |                  |                  |                  |                  |
|--------------------------|--------------------------------------|---|------------------|------------------|------------------|------------------|------------------|
|                          |                                      | 99 <sup>th</sup>                        | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| <b>Sydney East</b>       |                                      |   |                  |                  |                  |                  |                  |
| Chullora                 | <b>86.2</b>                          | <b>36.2</b>                             | <b>30.3</b>      | 19.6             | 15.4             | 9.9              | 6.9              |
| Cook and Phillip         | <b>112.5</b>                         | <b>35.2</b>                             | <b>25.8</b>      | 16.9             | 13.7             | 9.5              | 6.3              |
| Earlwood                 | <b>85.1</b>                          | <b>32.3</b>                             | <b>27.4</b>      | 18.8             | 14.7             | 9.5              | 6.1              |
| Macquarie Park           | <b>77.8</b>                          | <b>34.4</b>                             | <b>29.6</b>      | 16.2             | 12.4             | 8.1              | 5.5              |
| Randwick                 | <b>114.8</b>                         | <b>36.2</b>                             | <b>27.7</b>      | 16.1             | 12.3             | 8.6              | 6.0              |
| Rozelle                  | <b>87.3</b>                          | <b>33.7</b>                             | <b>27.9</b>      | 18.0             | 13.6             | 8.8              | 5.9              |
| <b>Sydney North West</b> |                                      |   |                  |                  |                  |                  |                  |
| Parramatta North         | <b>72.9</b>                          | <b>36.0</b>                             | <b>29.8</b>      | 20.7             | 14.7             | 9.3              | 6.5              |

| Region/Station             | Maximum<br>( $\mu\text{g}/\text{m}^3$ ) | Percentile ( $\mu\text{g}/\text{m}^3$ ) |                  |                  |                  |                  |                  |
|----------------------------|---|---|------------------|------------------|------------------|------------------|------------------|
|                            |   | 99 <sup>th</sup>                        | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Prospect                   | 70.8                                    | 37.9                                    | 30.9             | 21.2             | 15.4             | 9.5              | 7.0              |
| Richmond                   | 93.0                                    | 45.7                                    | 29.3             | 19.9             | 13.9             | 10.2             | 6.8              |
| Rouse Hill                 | 61.3                                    | 37.4                                    | 26.9             | 19.2             | 13.6             | 8.1              | 5.4              |
| St Marys                   | 82.5                                    | 39.0                                    | 27.2             | 16.3             | 11.1             | 8.8              | 6.2              |
| <b>Sydney South West</b>   |   |   |                  |                  |                  |                  |                  |
| Bargo                      | 121.9                                   | 68.0                                    | 54.4             | 19.2             | 11.2             | 8.0              | 5.0              |
| Bringelly                  | 78.1                                    | 47.7                                    | 32.3             | 20.7             | 14.3             | 10.2             | 6.8              |
| Camden                     | 149.3                                   | 46.1                                    | 35.8             | 18.5             | 12.9             | 8.2              | 5.5              |
| Campbelltown West          | 69.0                                    | 47.9                                    | 36.1             | 17.4             | 13.1             | 8.6              | 5.4              |
| Liverpool                  | 73.6                                    | 33.1                                    | 25.4             | 20.8             | 16.8             | 11.2             | 7.5              |
| Oakdale                    | 161.6                                   | 60.7                                    | 41.8             | 16.2             | 9.7              | 6.4              | 4.6              |
| <b>Central Coast</b>       |   |   |                  |                  |                  |                  |                  |
| Wyong                      | 63.9                                    | 23.2                                    | 19.4             | 12.8             | 10.2             | 6.4              | 4.6              |
| <b>Illawarra</b>           |   |   |                  |                  |                  |                  |                  |
| Albion Park South          | 96.3                                    | 51.5                                    | 36.0             | 16.8             | 10.7             | 7.3              | 4.9              |
| Kembla Grange              | 100.4                                   | 47.1                                    | 40.1             | 17.6             | 11.7             | 7.1              | 4.9              |
| Wollongong                 | 100.9                                   | 46.8                                    | 40.9             | 17.1             | 13.1             | 8.3              | 5.9              |
| <b>Lower Hunter</b>        |   |   |                  |                  |                  |                  |                  |
| Beresfield                 | 49.7                                    | 35.7                                    | 27.5             | 16.4             | 13.4             | 9.3              | 6.4              |
| Newcastle                  | 78.5                                    | 32.7                                    | 25.0             | 20.0             | 13.4             | 9.4              | 6.6              |
| Wallsend                   | 56.8                                    | 32.9                                    | 21.8             | 16.9             | 12.8             | 8.6              | 6.1              |
| <b>Upper Hunter</b>        |   |   |                  |                  |                  |                  |                  |
| Muswellbrook               | 49.1                                    | 33.3                                    | 28.5             | 19.3             | 17.4             | 11.8             | 8.2              |
| Singleton                  | 46.0                                    | 28.0                                    | 24.2             | 18.5             | 15.1             | 10.4             | 7.0              |
| <b>Central Tablelands</b>  |   |   |                  |                  |                  |                  |                  |
| Bathurst                   | 207.3                                   | 34.5                                    | 30.2             | 18.5             | 11.6             | 8.0              | 5.3              |
| Orange                     | 92.3                                    | 43.7                                    | 34.3             | 23.2             | 17.4             | 11.4             | 6.4              |
| <b>Northern Tablelands</b> |   |   |                  |                  |                  |                  |                  |
| Armidale                   | 53.7                                    | 37.4                                    | 33.4             | 28.1             | 23.1             | 11.7             | 5.8              |
| <b>North West Slopes</b>   |   |   |                  |                  |                  |                  |                  |
| Gunnedah                   | 34.7                                    | 28.1                                    | 23.6             | 20.0             | 16.7             | 9.5              | 5.9              |
| Narrabri                   | 42.4                                    | 19.7                                    | 17.0             | 11.6             | 9.2              | 6.7              | 4.7              |
| Tamworth                   | 52.6                                    | 26.5                                    | 21.4             | 15.9             | 11.6             | 8.5              | 5.7              |
| <b>South West Slopes</b>   |   |   |                  |                  |                  |                  |                  |
| Albury                     | 275.2                                   | 155.7                                   | 84.3             | 23.6             | 14.7             | 9.9              | 6.6              |
| Wagga Wagga North          | 559.5                                   | 69.9                                    | 43.2             | 21.1             | 16.0             | 9.8              | 6.1              |

| Region/Station             | Maximum<br>( $\mu\text{g}/\text{m}^3$ ) | Percentile ( $\mu\text{g}/\text{m}^3$ ) |                  |                  |                  |                  |                  |
|----------------------------|---|---|------------------|------------------|------------------|------------------|------------------|
|                            |   | 99 <sup>th</sup>                        | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| <b>Southern Tablelands</b> |   |   |                  |                  |                  |                  |                  |
| Goulburn                   | 516.1                                   | 168.2                                   | 89               | 23.7             | 14.1             | 9.2              | 5.3              |

**Table 44** Statistical summary for PM<sub>2.5</sub> in 2020: 24-hour average concentration by Federal Reference Method (FRM)

| Region/Station     | Maximum<br>( $\mu\text{g}/\text{m}^3$ ) | Percentile ( $\mu\text{g}/\text{m}^3$ ) |                  |                  |                  |                  |                  |
|--------------------|---|---|------------------|------------------|------------------|------------------|------------------|
|                    |   | 99 <sup>th</sup>                        | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| <b>Sydney East</b> |   |   |                  |                  |                  |                  |                  |
| Chullora           | 45.8                                    | 35.8                                    | 23.0             | 19.7             | 14.0             | 9.6              | 5.8              |

**Table 45** Annual maximum 24-hour average concentrations PM<sub>2.5</sub> ( $\mu\text{g}/\text{m}^3$ )

| Region/Station           | 2011 | 2012  | 2013 | 2014 | 2015 | 2016 | 2017 | 2018  | 2019  | 2020  |
|--------------------------|------|-------|------|------|------|------|------|-------|-------|-------|
| <b>Sydney East</b>       |      |       |      |      |      |      |      |       |       |       |
| Chullora                 | 23.9 | 23.4  | 49.1 | 23.1 | 37.2 | 49.4 | 44.7 | 29.1  | 97.6  | 86.2  |
| Cook and Phillip         | -    | -     | -    | -    | -    | -    | -    | -     | 96.5  | 112.5 |
| Earlwood                 | 23.6 | 20.7  | 37.3 | 22.7 | 28.0 | 33.3 | 50.9 | 28.5  | 86.2  | 85.1  |
| Macquarie Park           | -    | -     | -    | -    | -    | -    | 24.1 | 58.4  | 152.0 | 77.8  |
| Randwick                 | -    | -     | -    | -    | -    | -    | 48.7 | 31.8  | 95.2  | 114.8 |
| Rozelle                  | -    | -     | -    | -    | 36.0 | 49.4 | 36.3 | 19.2  | 101.8 | 87.3  |
| <b>Sydney North West</b> |      |       |      |      |      |      |      |       |       |       |
| Parramatta North         | -    | -     | -    | -    | -    | -    | -    | 42.1  | 130.1 | 72.9  |
| Prospect                 | -    | -     | -    | -    | 29.6 | 84.9 | 30.1 | 47.5  | 134.1 | 70.8  |
| Richmond                 | 42.9 | 116.7 | 97.6 | 29.1 | 24.5 | 83.4 | 34.3 | 123.9 | 141.2 | 93.0  |
| Rouse Hill               | -    | -     | -    | -    | -    | -    | -    | -     | 183.5 | 61.3  |
| St Marys                 | -    | -     | -    | -    | -    | 93.2 | 38.2 | 80.5  | 88.3  | 82.5  |
| <b>Sydney South West</b> |      |       |      |      |      |      |      |       |       |       |
| Bargo                    | -    | -     | -    | -    | -    | 11.5 | 20.9 | 38.1  | 170.7 | 121.9 |
| Bringelly                | -    | -     | -    | -    | -    | 21.6 | 55.7 | 55.6  | 178.0 | 78.1  |
| Camden                   | -    | 19.5  | 69.9 | 18.5 | 25.0 | 36.0 | 27.7 | 37.0  | 155.3 | 149.3 |
| Campbelltown West        | -    | -     | -    | -    | 15.7 | 35.8 | 25.0 | 45.4  | 106.0 | 69.0  |
| Liverpool                | 38.0 | 24.9  | 73.8 | 24.3 | 32.2 | 50.8 | 59.2 | 45.4  | 156.0 | 73.6  |
| Oakdale                  | -    | -     | -    | -    | -    | -    | 33.0 | 75.4  | 250.2 | 161.6 |
| <b>Central Coast</b>     |      |       |      |      |      |      |      |       |       |       |
| Wyong                    | -    | 14.7  | 55.8 | 19.7 | 13.2 | 19.8 | 27.2 | 18.1  | 202.1 | 63.9  |
| <b>Illawarra</b>         |      |       |      |      |      |      |      |       |       |       |
| Albion Park South        | -    | -     | -    | -    | 21.1 | 30.7 | 19.3 | 29.4  | 49.4  | 96.3  |

| Region/Station             | 2011        | 2012        | 2013         | 2014        | 2015        | 2016        | 2017        | 2018        | 2019                     | 2020         |
|----------------------------|-------------|-------------|--------------|-------------|-------------|-------------|-------------|-------------|--------------------------|--------------|
| Kembla Grange              | -           | -           | -            | -           | 23.8        | <b>32.0</b> | 21.3        | 21.9        | <b>70.1</b>              | <b>100.4</b> |
| Wollongong                 | 17.7        | 15.6        | <b>118.7</b> | 17.3        | <b>31.6</b> | <b>33.7</b> | 24.7        | <b>47.6</b> | <b>81.5</b>              | <b>100.9</b> |
| <b>Lower Hunter</b>        |             |             |              |             |             |             |             |             |                          |              |
| Beresfield                 | 18.8        | 22.4        | <b>40.8</b>  | 19.0        | <b>25.9</b> | <b>27.9</b> | 18.7        | 24.9        | <b>100.5</b>             | <b>49.7</b>  |
| Newcastle                  | -           | -           | -            | 21.2        | <b>30.2</b> | <b>66.1</b> | 18.0        | 20.2        | <b>95.5</b>              | <b>78.5</b>  |
| Wallsend                   | 16.2        | 16.2        | <b>37.0</b>  | 18.0        | 24.0        | <b>50.7</b> | 20.4        | 20.2        | <b>108.3</b>             | <b>56.8</b>  |
| <b>Upper Hunter</b>        |             |             |              |             |             |             |             |             |                          |              |
| Singleton                  | 21.5        | 19.5        | 22.6         | <b>28.5</b> | 24.9        | <b>27.7</b> | <b>29.6</b> | 19.2        | <b>69.3</b>              | <b>46.0</b>  |
| Muswellbrook               | <b>28.3</b> | <b>26.4</b> | <b>36.6</b>  | <b>27.4</b> | <b>31.2</b> | <b>29.4</b> | <b>31.1</b> | <b>26.5</b> | <b>77.4</b>              | <b>49.1</b>  |
| <b>Central Tablelands</b>  |             |             |              |             |             |             |             |             |                          |              |
| Bathurst                   | -           | -           | -            | -           | -           | 15.0        | 17.5        | <b>40.5</b> | <b>199.5</b>             | <b>207.3</b> |
| Orange                     | -           | -           | -            | -           | -           | -           | -           | -           | <b>387.4</b>             | <b>92.3</b>  |
| <b>North West Slopes</b>   |             |             |              |             |             |             |             |             |                          |              |
| Gunnedah                   | -           | -           | -            | -           | -           | -           | -           | <b>50.7</b> | <b>94.1</b>              | <b>34.7</b>  |
| Narrabri                   | -           | -           | -            | -           | -           | -           | -           | <b>26.3</b> | <b>87.7</b>              | <b>42.4</b>  |
| Tamworth                   | -           | -           | -            | -           | -           | 17.6        | 21.6        | 24.2        | <b>164.2</b>             | <b>52.6</b>  |
| <b>Northern Tablelands</b> |             |             |              |             |             |             |             |             |                          |              |
| Armidale                   | -           | -           | -            | -           | -           | -           | -           | <b>40.0</b> | <b>267.3</b>             | <b>53.7</b>  |
| <b>South West Slopes</b>   |             |             |              |             |             |             |             |             |                          |              |
| Albury                     | -           | -           | -            | -           | -           | -           | 18.7        | <b>30.4</b> | <b>167.1</b>             | <b>275.2</b> |
| Wagga Wagga North          | 15.4        | 23.2        | <b>29.9</b>  | <b>27.6</b> | 24.2        | <b>28.1</b> | <b>32.5</b> | 21.6        | <b>239.6</b>             | <b>559.5</b> |
| <b>Southern Tablelands</b> |             |             |              |             |             |             |             |             |                          |              |
| Goulburn                   | -           | -           | -            | -           | -           | -           | -           | -           | <b>333.7<sup>1</sup></b> | <b>516.1</b> |

1. Annual data availability <15% due to station being commissioned in November 2019, however, this value is likely to be the annual maximum as occurred during the Black Summer bushfires.

**Table 46 Annual maximum 24-hour average concentrations PM2.5 ( $\mu\text{g}/\text{m}^3$ ) by Federal Reference Method (FRM)**

| Region/Station     | 2011 | 2012 | 2013        | 2014 | 2015        | 2016 | 2017        | 2018        | 2019        | 2020        |
|--------------------|------|------|-------------|------|-------------|------|-------------|-------------|-------------|-------------|
| <b>Sydney East</b> |      |      |             |      |             |      |             |             |             |             |
| Chullora           | 16.7 | 12.4 | <b>53.9</b> | 18.9 | <b>38.6</b> | 21.0 | <b>27.9</b> | <b>39.6</b> | <b>87.5</b> | <b>45.8</b> |

## PM2.5 annual standard

**Table 47 Annual average concentrations for PM2.5 ( $\mu\text{g}/\text{m}^3$ )**

| Region/Station     | 2011 | 2012 | 2013       | 2014       | 2015 | 2016 | 2017       | 2018       | 2019        | 2020       |
|--------------------|------|------|------------|------------|------|------|------------|------------|-------------|------------|
| <b>Sydney East</b> |      |      |            |            |      |      |            |            |             |            |
| Chullora           | 5.9  | 6.0  | <b>8.4</b> | <b>9.0</b> | 8.0  | 8.0  | <b>9.5</b> | <b>8.6</b> | <b>11.7</b> | <b>8.8</b> |

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| Region/Station            | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---------------------------|------|------|------|------|------|------|------|------|------|------|
| Cook and Phillip          | -    | -    | -    | -    | -    | -    | -    | -    | 15.6 | 7.8  |
| Earlwood                  | 5.4  | 5.6  | 7.9  | 7.8  | 8.5  | 8.1  | 7.3  | 7.8  | 10.5 | 8.0  |
| Macquarie Park            | -    | -    | -    | -    | -    | -    | 6.3  | 7.0  | 9.2  | 7.1  |
| Randwick                  | -    | -    | -    | -    | -    | -    | 6.9  | 7.6  | 10.8 | 7.6  |
| Rozelle                   | -    | -    | -    | -    | 7.2  | 7.4  | 7.2  | 7.3  | 10.3 | 7.5  |
| <b>Sydney North West</b>  |      |      |      |      |      |      |      |      |      |      |
| Parramatta North          | -    | -    | -    | -    | -    | -    | -    | 9.2  | 10.5 | 8.2  |
| Prospect                  | -    | -    | -    | -    | 8.2  | 8.7  | 7.7  | 8.5  | 11.9 | 8.6  |
| Richmond                  | 4.7  | 5.3  | 8.4  | 6.7  | 7.7  | 7.9  | 7.0  | 8.1  | 13.1 | 8.4  |
| Rouse Hill                | -    | -    | -    | -    | -    | -    | -    | -    | 12.7 | 7.1  |
| St Marys                  | -    | -    | -    | -    | -    | 7.9  | 7.0  | 7.8  | 9.8  | 7.6  |
| <b>Sydney South West</b>  |      |      |      |      |      |      |      |      |      |      |
| Bargo                     | -    | -    | -    | -    | -    | -    | 6.3  | 6.8  | 10.4 | 7.8  |
| Bringelly                 | -    | -    | -    | -    | -    | 7.6  | 7.5  | 8.0  | 11.3 | 8.5  |
| Camden                    | -    | 7.8  | 6.5  | 6.3  | 6.2  | 6.4  | 6.7  | 7.2  | 11.8 | 7.7  |
| Campbelltown West         | -    | -    | -    | -    | 7.9  | 7.9  | 7.4  | 8.4  | 11.8 | 7.5  |
| Liverpool                 | 5.9  | 8.5  | 9.4  | 8.6  | 8.5  | 8.8  | 8.9  | 10.1 | 12.8 | 9.1  |
| Oakdale                   | -    | -    | -    | -    | -    | -    | 6.1  | 6.9  | 13.2 | 6.7  |
| <b>Central Coast</b>      |      |      |      |      |      |      |      |      |      |      |
| Wyong                     | -    | 7.3  | 6.7  | 5.5  | 5.2  | 5.7  | 5.8  | 6.8  | 10.5 | 5.6  |
| <b>Illawarra</b>          |      |      |      |      |      |      |      |      |      |      |
| Albion Park South         | -    | -    | -    | -    | 6.4  | 7.2  | 6.6  | 6.8  | 8.6  | 6.8  |
| Kembla Grange             | -    | -    | -    | -    | 6.7  | 6.6  | 6.9  | 7.0  | 8.8  | 7.0  |
| Wollongong                | 4.6  | 4.6  | 7.8  | 7.0  | 7.6  | 7.4  | 7.1  | 7.3  | 9.0  | 7.8  |
| <b>Lower Hunter</b>       |      |      |      |      |      |      |      |      |      |      |
| Beresfield                | 5.5  | 7.9  | 8.2  | 7.5  | 7.3  | 7.4  | 7.6  | 8.7  | 12.1 | 7.7  |
| Newcastle                 | -    | -    | -    | 8.1  | 7.8  | 7.8  | 7.4  | 7.8  | 10.9 | 8.1  |
| Wallsend                  | 4.8  | 5.1  | 7.7  | 6.7  | 7.3  | 8.0  | 7.3  | 7.5  | 10.4 | 7.3  |
| <b>Upper Hunter</b>       |      |      |      |      |      |      |      |      |      |      |
| Singleton                 | 7.6  | 8.0  | 7.9  | 7.8  | 7.6  | 7.9  | 8.2  | 8.1  | 10.9 | 8.4  |
| Muswellbrook              | 9.1  | 10.1 | 9.4  | 9.7  | 8.7  | 8.4  | 9.4  | 9.4  | 12.2 | 9.3  |
| <b>Central Tablelands</b> |      |      |      |      |      |      |      |      |      |      |
| Bathurst                  | -    | -    | -    | -    | -    | 5.9  | 6.1  | 7.0  | 11.3 | 7.6  |
| Orange                    | -    | -    | -    | -    | -    | -    | -    | -    | 15.8 | 9.1  |
| <b>North West Slopes</b>  |      |      |      |      |      |      |      |      |      |      |
| Gunnedah                  | -    | -    | -    | -    | -    | -    | -    | 9.0  | 11.2 | 7.7  |
| Narrabri                  | -    | -    | -    | -    | -    | -    | -    | 4.9  | 7.8  | 5.5  |

| Region/Station             | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|----------------------------|------|------|------|------|------|------|------|------|------|------|
| Tamworth                   | -    | -    | -    | -    | -    | 7.6  | 7.8  | 8.3  | 14.4 | 6.8  |
| <b>Northern Tablelands</b> |      |      |      |      |      |      |      |      |      |      |
| Armidale                   | -    | -    | -    | -    | -    | -    | -    | 11.6 | 17.2 | 9.2  |
| <b>South West Slopes</b>   |      |      |      |      |      |      |      |      |      |      |
| Albury                     | -    | -    | -    | -    | -    | -    | 7.3  | 7.3  | 10.1 | 11.1 |
| Wagga Wagga North          | 7.0  | 8.7  | 7.9  | 7.5  | 7.6  | 7.4  | 8.1  | 8.4  | 11.3 | 10.7 |
| <b>Southern Tablelands</b> |      |      |      |      |      |      |      |      |      |      |
| Goulburn                   | -    | -    | -    | -    | -    | -    | -    | -    | #    | 11.8 |

# Annual data availability <15% as station commissioned in November 2019, hence, annual average cannot be determined.

**Table 48 Annual average concentration for PM<sub>2.5</sub> (µg/m<sup>3</sup>) using Federal Reference Method**

| Region/Station     | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|--------------------|------|------|------|------|------|------|------|------|------|------|
| <b>Sydney East</b> |      |      |      |      |      |      |      |      |      |      |
| Chullora           | 6.2  | -    | 7.2  | 7.2  | 6.9  | 6.9  | 7.4  | 7.8  | 10.4 | 7.8  |



## Section E – Episode analysis

In New South Wales, concentrations of particles (as PM<sub>10</sub> and PM<sub>2.5</sub>) and ozone can sometimes exceed national standards. This section presents a brief analysis of selected particle events during 2020 that were noteworthy due to their significance. This is not intended to be an exhaustive coverage of all air pollution events, noting that Appendix A (see DPIE 2021b) provides a comprehensive list of particle event days, justifying their classification as either exceptional or non-exceptional under the AAQ NEPM.

For the purposes of this report, air pollution events during 2020 belong to 2 key periods: those occurring during the Black Summer bushfires in January to mid-February, and those outside this period.

### January to mid-February 2020

The 2019–20 Black Summer bushfire crisis that began in 2019 continued through January to mid-February 2020. Against the backdrop of regular smoke days during the bushfires, multiple dust storm events were also observed in this period, as much of the State was experiencing persistent and severe drought conditions. These conditions resulted in significant particle pollution across the State during January to mid-February 2020.

Detailed descriptions of events from this period are the focus of earlier reports listed below, and, for brevity, are not replicated here:

- NSW Air Quality Special Statement Spring–Summer 2019–20
- NSW Annual Air Quality Statement 2020
- Blue Mountains Air Watch, Spring–Summer 2019–20 (DPIE 2021a).

### March to December 2020

Outside the above-mentioned period of intense bushfires and dust storms, air quality during 2020 was defined by two events of interest:

- air quality impact of the COVID-19 lockdown, most importantly between mid-March and early May 2020
- particle pollution events during the colder months of June to August 2020.

In the following sections, a recent case study published by the department investigating the COVID-19 lockdown period is summarised. Following this, short case studies describing high particle pollution events during the colder months are presented, when 26 days above the particle benchmarks were recorded across the State. A brief analysis is presented of three selected case studies in this period that were multi-day particle pollution events observed across multiple stations. Analysis of these events includes measurements of pollutants, wind and synoptic meteorology, satellite images and modelling such as back-trajectory analysis showing sources of pollution monitored at impacted locations. The case analyses are provided in date order and include information and context describing the causes and possible sources driving the events.

## Air quality impact of the COVID-19 lockdown: a summary

### Synopsis

Vehicular exhaust emissions are a key contributor to urban air pollution in New South Wales. There were three phases during 2020 when vehicular traffic was impacted due to travel restrictions imposed across the State due to the COVID-19 pandemic.

Department scientists recently published a comprehensive study (Duc et al. 2021) comparing air quality impacts during four time periods in 2020: pre-COVID, the first COVID-19 lockdown, gradual easing, and further easing phases of travel restrictions in 2020. The full study compares nitrogen oxides (NO<sub>x</sub>) concentrations in 2020 against previous years at:

- a roadside air quality monitoring station (Bradfield Highway, Milsons Point, Sydney)
- ambient air quality monitoring stations in the NSW Greater Metropolitan Region (GMR), including stations in Sydney, Illawarra, Central Coast and the Lower Hunter.

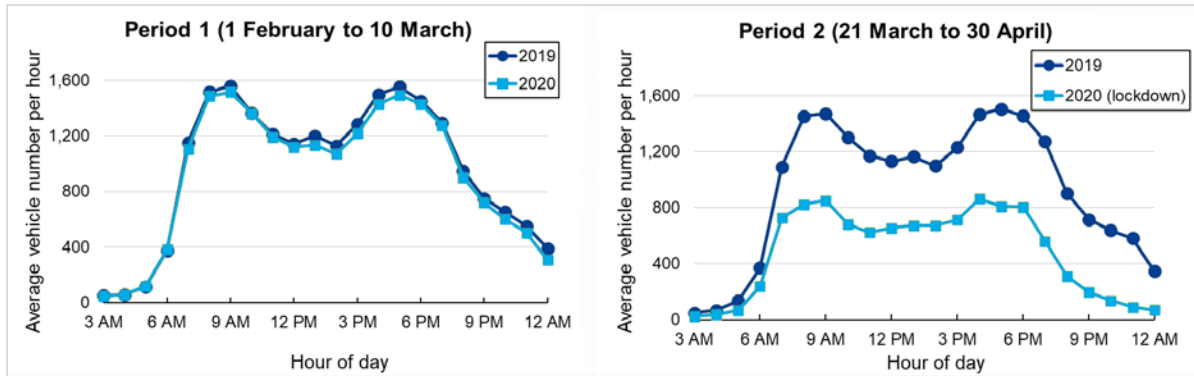
The analysis of data from the roadside Bradfield Highway monitoring station is summarised, focussed on the first COVID-19 lockdown period (21 March to 30 April 2020) when restrictions on non-essential travel were imposed across the State. More information is available in the NSW Annual Air Quality Statement 2020: focus areas (COVID-19) webpage.

### Observations and analysis from a Sydney roadside air quality monitoring station

In Sydney, on-road vehicle traffic is responsible for greater than 60% of NO<sub>x</sub> emissions (DPIE 2020a). NO<sub>x</sub> describes the combination of two important atmospheric gases: nitric oxide (NO) and nitrogen dioxide (NO<sub>2</sub>). Most NO<sub>x</sub> emitted from vehicles is in the form of NO but is converted in the atmosphere to NO<sub>2</sub>, the primary pollutant of concern for human health. Changes in vehicular traffic is expected to have a large impact on total NO<sub>x</sub> emissions, and therefore nitrogen dioxide (NO<sub>2</sub>) concentrations in the air.

Cahill Expressway is one of the major roads which feeds to the southern access of the Sydney Harbour Bridge, and the busiest road in New South Wales in terms of daily vehicle numbers. Using data available from the NSW Roads and Maritime Services' Traffic Volume Viewer, Figure 3 (left panel) compares weekday vehicle numbers at Cahill Expressway during the same period in 2019 and 2020 (1 February to 10 March), which represents a period free of any vehicular traffic restrictions (Period 1) or bushfire smoke. The right panel is for the period 21 March to 30 April (Period 2) for 2019 and 2020, including the first COVID-19 lockdown period in 2020.

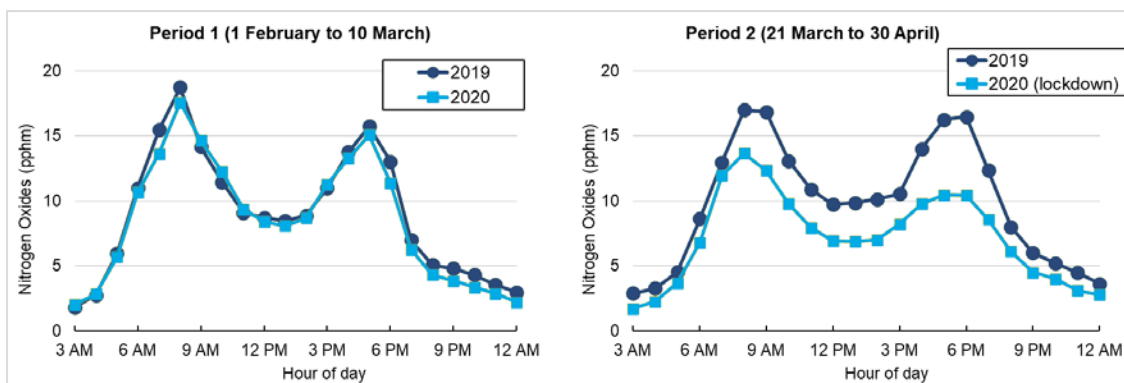
It is evident that for Period 1, vehicular traffic volumes were similar across the two years. In contrast, the traffic volumes for Period 2 show significant differences between the two years, with a near 50% reduction in the daytime traffic volumes for the 2020 COVID-19 lockdown period when compared to the same period in 2019. This indicates a significant change in commuting behaviour resulting from travel restrictions.



**Figure 3** Weekday vehicle numbers on Cahill Expressway, by hour of day, compared for pre-lockdown and lockdown periods in 2019 and 2020  
 Left panel is pre-lockdown, Period 1 (1 February to 10 March). Right panel is COVID-19 lockdown, Period 2 (21 March to 30 April 2020)

Bradfield Highway air quality monitoring station is a roadside station in Milsons Point, located adjacent to the Cahill Expressway. Bradfield Highway air quality monitoring station was established in October 2018; hence this analysis is focused on 2019 and 2020. Figure 4 (left panel) compares weekday NOx concentrations at the Bradfield Highway station during the same, pre-lockdown periods in 2019 and 2020 (1 February to 10 March, Period 1). On the right panel, Period 2 (21 March to 30 April) includes the first COVID-19 lockdown in 2020.

It is evident that for Period 1, NOx concentrations were similar over the two years 2019 and 2020. However, when the COVID-19 lockdown period (21 March to 30 April) is compared across the two years, there was a notable reduction in NOx concentrations at Bradfield Highway station, consistent with the reduction in vehicle numbers at Cahill Expressway. Changes in commuters’ behaviours during the lockdown in Sydney are reflected in the lower NOx concentrations measured at the roadside station during the lockdown. The difference between 2019 and 2020 NOx concentrations narrowed for other times of the year when restrictions were either absent or when restrictions gradually eased.



**Figure 4** Weekday average NOx concentrations at Bradfield Highway roadside station, by hour of day, compared for 2019 and 2020  
 Left panel is pre-lockdown period 1 (1 February to 10 March). Right panel is COVID-19 lockdown, Period 2 (21 March to 30 April 2020)

## Wood smoke during winter long weekend, 6–8 June 2020

### Synopsis

Calm conditions across the State and successive temperature inversions (BOM 2020a) during the June long weekend (6–8 June 2020), provided conditions conducive to higher than average wood heater usage, and consequently widespread wood smoke. This was the only widespread winter wood smoke event, observed at 8 stations across five NSW regions, and resulting in multiple exceedances of the daily PM<sub>2.5</sub> standard outside of the Black Summer bushfires.

### Observed impacts

Across the three-day long weekend, 8 air quality stations exceeded the daily PM<sub>2.5</sub> standard of 25 µg/m<sup>3</sup> (microgram per cubic metre) across five air quality regions (Table 49). A total of 11 exceedances were observed across the three days, with the highest number of stations impacted on Sunday 7 June 2020. The highest daily PM<sub>2.5</sub> concentration in the period was recorded at Richmond (36.3 µg/m<sup>3</sup>) on 7 June. Outside the bushfire period that ended in February 2020, this event recorded the only other days above the PM<sub>2.5</sub> benchmark at Gunnedah, Newcastle, Richmond, Singleton (1 day for each) and Muswellbrook (2 days).

### Analysis

#### A blocking high-pressure system produced cold and stable conditions

A high-pressure system located over the Great Australian Bight was persistent, slowly moving eastward during the weekend (Figure 5). This produced dry and stable atmospheric conditions across the State, with strong inversions for each of the three days for Western Sydney (BOM 2020a). On 6 June, several regional stations recorded their minimum temperatures in the month; the lowest temperatures in the network was –4°C at Goulburn air quality monitoring station.

#### Elevated PM<sub>2.5</sub> was prevalent across large parts of New South Wales on 6 and 7 June

Air quality impacts from domestic wood heaters were most widespread across regional New South Wales on 6 June. On this day, Gunnedah air quality station recorded its highest PM<sub>2.5</sub> daily average for the event (34.7 µg/m<sup>3</sup>), when the regional city also recorded its lowest temperature for the month (–0.6°C) (BOM 2021a). Over the 2 days, several other stations recorded elevated PM<sub>2.5</sub> daily averages of between 20 and 25 µg/m<sup>3</sup>, at least 80% of the daily standard. These included 5 stations in Sydney (Liverpool, Parramatta North, Chullora, Cook and Phillip, and Earlwood), one in the lower Hunter (Wallsend), and 3 southern regional NSW cities (Goulburn, Wagga Wagga North and Albury).

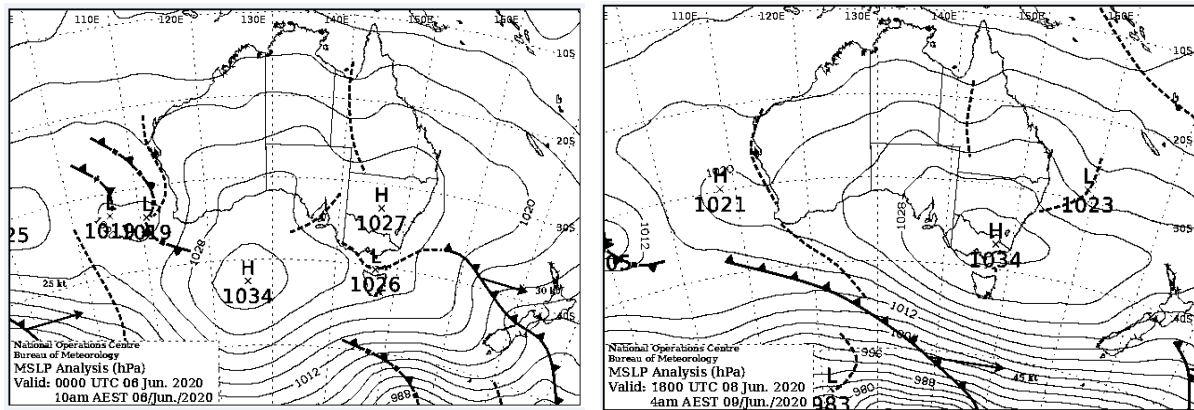
#### A trend of overnight to early morning elevated PM<sub>2.5</sub> attributed to wood smoke

Smoke emissions from domestic wood heaters during calm conditions can cause high ambient PM<sub>2.5</sub> concentrations. Elevated overnight and early morning concentrations is a common diurnal trend for particle pollution in winter, driven by the formation of temperature inversions trapping pollutants close to the ground overnight. Air quality often improves as the inversion lifts on sunrise and particle pollution can more easily disperse. During this weekend, such a trend was evident from hourly particle concentrations observed at many stations (Figure 6).

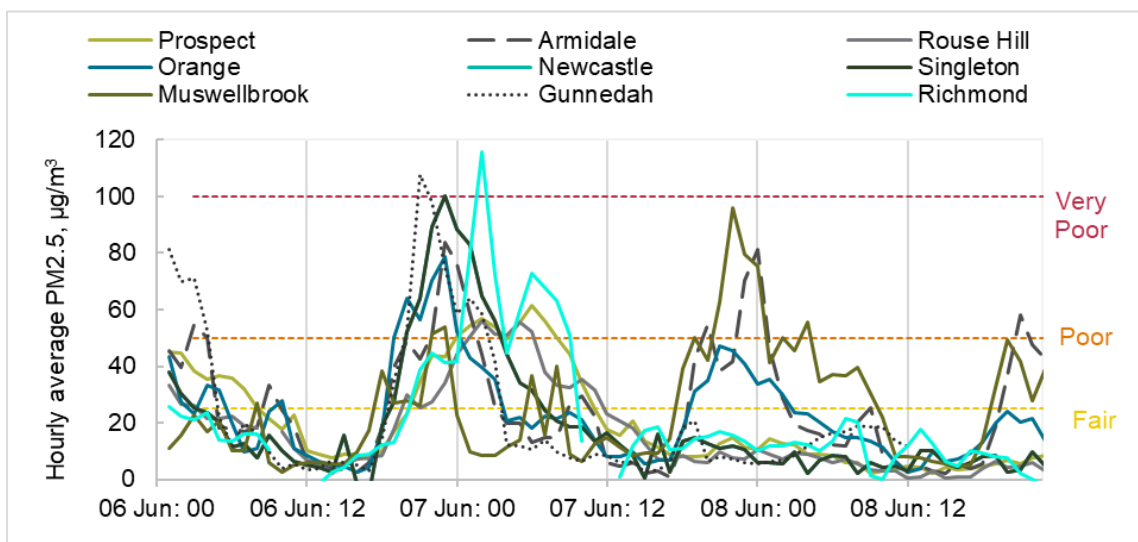
**Table 49** Eight stations<sup>1</sup> exceeded the daily PM<sub>2.5</sub> standard (25 µg/m<sup>3</sup>) due to wood smoke

| Region              | Station      | Daily PM <sub>2.5</sub> concentration, µg/m <sup>3</sup> |                |                |
|---------------------|--------------|--|----------------|----------------|
|                     |              | Sat 06/06/2020   | Sun 07/06/2020 | Mon 08/06/2020 |
| Northern Tablelands | Armidale     | 30.2   | 27.2           |                |
| North West Slopes   | Gunnedah     | 34.7   |                |                |
| Upper Hunter        | Muswellbrook |  | 28.6           | 28.0           |
| Upper Hunter        | Singleton    |  | 26.5           |                |
| Lower Hunter        | Newcastle    | 27.6   |                |                |
| Sydney North West   | Prospect     | 26.2   | 29.3           |                |
| Sydney North West   | Richmond     |  | 36.3           |                |
| Sydney North West   | Rouse Hill   |  | 26.3           |                |

1. In addition to the stations listed in the table, Orange air quality monitoring station (Central Tablelands region) also exceeded the daily PM<sub>2.5</sub> standard on 6 June 2020 during hazard reduction burning.



**Figure 5** Synoptic charts for 10 am AEST 6 June 2020 (left), and 4 am AEST 9 June 2020 (right)  
Source: [Analysis Chart Archive](#), Bureau of Meteorology



**Figure 6** Typical diurnal trend in PM<sub>2.5</sub> concentrations during the June 2020 long weekend showed elevated levels predominantly occurring overnight when calm and still conditions prevailed

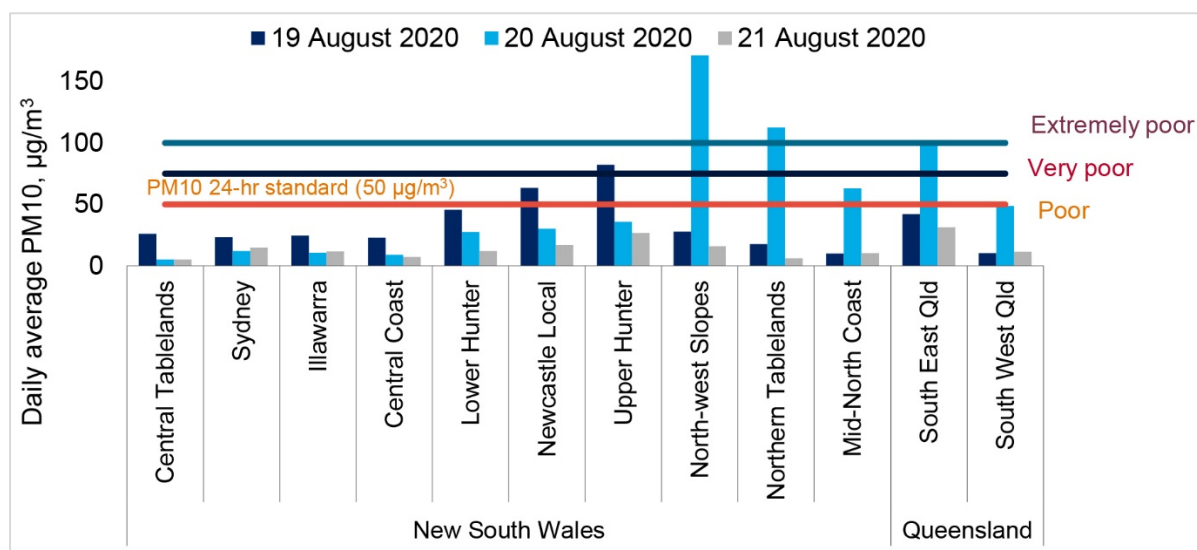
## Late winter dust storm crossing State boundaries during 19–20 August 2020

### Synopsis

In what was the only widespread dust event outside early 2020, a large-scale dust storm impacted western and northern NSW, as well as southern Queensland, over a 2-day period (19–20 August). This non-exceptional winter event was driven by high winds reaching up to 21 metres per second (m/s) caused by a cold front and a deep low-pressure system which uplifted dust from arid inland areas and transported these towards the north-east of the State.

### Observed impacts

Over the 2 days, dust impacted multiple regions located west of the Great Dividing Range in northern NSW, as well as parts of southern Queensland, while little dust was observed in areas of southern NSW like the South West Slopes. Figure 7 shows the maximum daily PM10 average concentrations for impacted regions in the 2 New South Wales and Queensland.



**Figure 7** Maximum daily PM10 averages ( $\mu\text{g}/\text{m}^3$ ) for New South Wales and Queensland regions, 19–21 August 2020  
(Source Queensland data: [Air Quality Monitoring Data](#) accessed 12/02/2021)

Indicative air quality monitors in rural NSW first recorded elevated dust during the early morning on 19 August. Hourly PM10 concentrations of above  $100 \mu\text{g}/\text{m}^3$  became widespread across western NSW, as dust was transported under moderate to strong west to south-westerly winds. The largest impact was at Broken Hill, which exceeded  $1000 \mu\text{g}/\text{m}^3$ .

In the standard network of air quality monitors, dust was first recorded at 4 pm on 19 August in the Central Tablelands region when hourly PM10 peaked at Orange and Bathurst. The Upper Hunter (8–9 pm) and Newcastle (9–10 pm) regions peaked that evening, as did Mid North Coast, Northern Tablelands and North West Slopes where elevated levels continued into the next day. On 20 August, many stations recorded PM10 daily averages above the 24-hour standard of  $50 \mu\text{g}/\text{m}^3$ . North West Slopes region was most impacted, and Tamworth recorded the event's highest daily average PM10 level of  $171 \mu\text{g}/\text{m}^3$ .

## Analysis

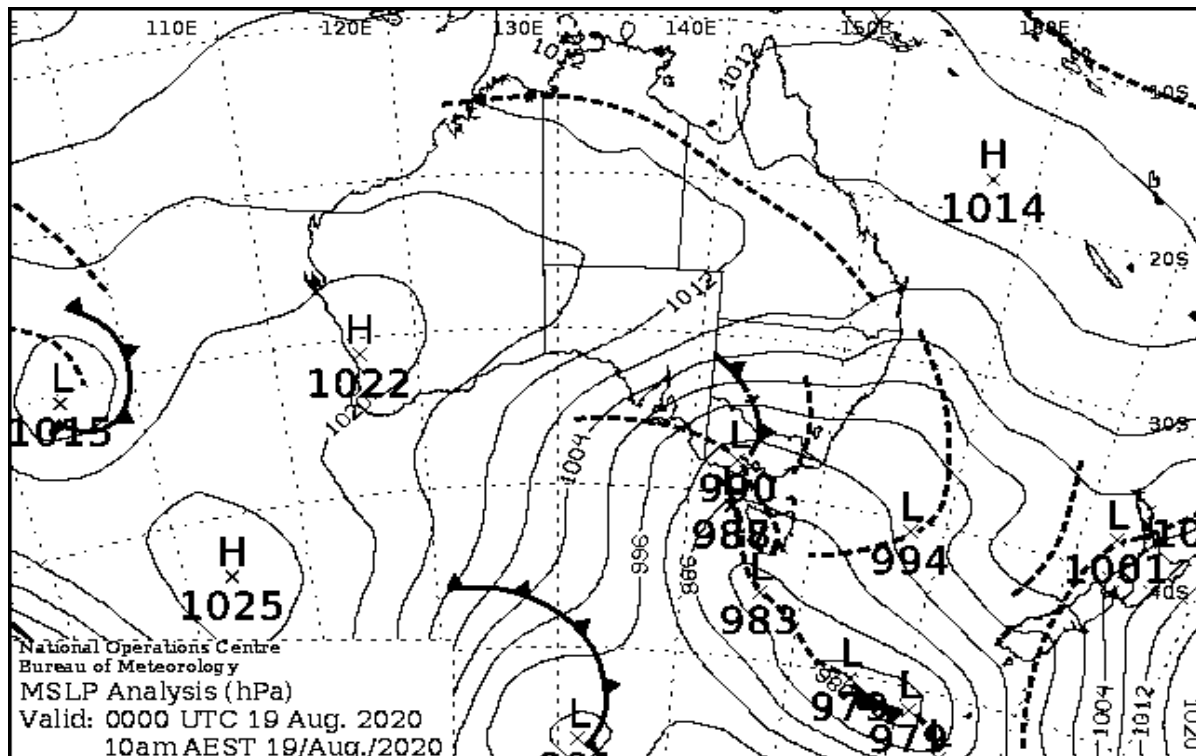
### A complex system of cold fronts with multiple low troughs generated high winds

A decaying cold front extended from southern Victoria to far-western New South Wales on 19 August (Figure 8), with a series of troughs surrounding the front (two ahead and another behind). Through the day, the front decayed with a trough located along the New South Wales – Victorian border. Overnight and into the next day, the troughs moved east towards the Tasman Sea, with another strong cold front coming onshore along the South Australia – Victorian border.

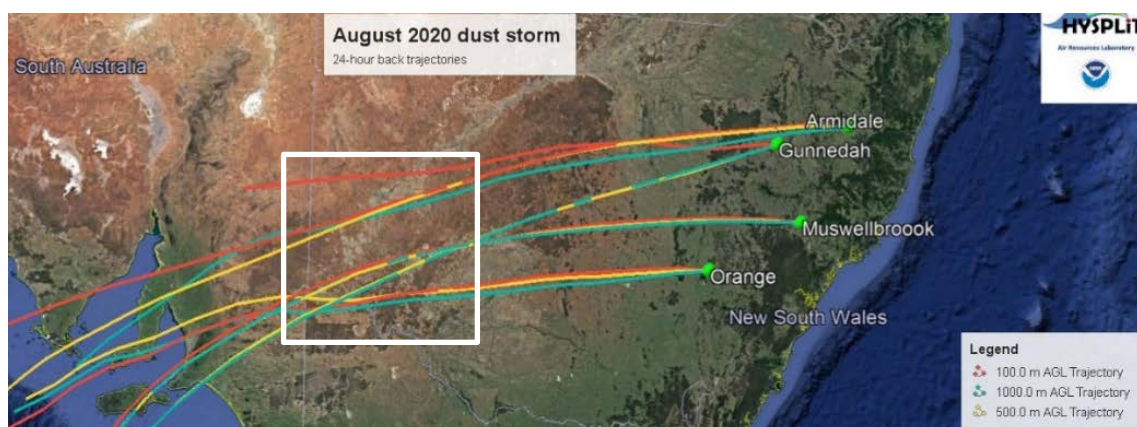
With this system moving towards the east coast, high winds were observed across western and northern New South Wales. For instance, Broken Hill recorded hourly wind gusts of up to 74 kilometres per hour (km/h) (BOM 2020b) at midday on 19 August. In the north-east of the State, Gunnedah recorded a surface wind of 35 km/h on 20 August, the highest in the month, when the station recorded its annual maximum daily PM10 concentration of 101  $\mu\text{g}/\text{m}^3$ .

### Reduced groundcover and low rainfall in the west of the State

The *DustWatch Report July 2020* (DPIE 2020b) noted that groundcover continued to improve for most of the State during winter 2020, but that even less groundcover was visible across the Darling River corridor and parts of salt lakes in eastern South Australia than in winter 2019. The report also noted that while most of New South Wales received very above-average rainfall in the 3 months to July, rain was very much below average for parts of the State's west and most of south-west. Multiple fronts picked up dust from arid inland areas affected by poor groundcover and low rainfall. Trajectory analysis (Figure 9) shows pathways for dust plumes as they arrived at air quality monitoring stations in the NSW network.



**Figure 8** Synoptic chart for 10 am AEST 19 August 2020  
Source: [Analysis Chart Archive](#), Bureau of Meteorology



**Figure 9** 24-hour back trajectories for dust plumes at air quality monitoring stations in Orange and Muswellbrook (arriving at 9 pm, 19 August), and Armidale and Gunnedah (arriving at 6 am, 20 August). The white box shows dust source areas and coloured lines show the path of air parcels.

## Sydney smoky during winter hazard reduction burning, 29–30 August 2020 (exceptional event)

### Synopsis

The State experienced a generally wet and mild year in 2020 (BOM 2021b), after an intense 2019–20 summer. Damp vegetation conditions resulted in fewer available times in cooler months for hazard reduction burning (HRB), compared to similar periods in previous years. As such, fewer widespread air pollution events were observed where days above NEPM particle benchmarks were attributed to HRB. This case study highlights the most significant HRB particle pollution event that impacted the Greater Sydney region.

### Observed impacts

Stations in Greater Sydney were most impacted by elevated PM<sub>2.5</sub> over the 2 days (29–30 August), but air quality impacts were observed more broadly, with smoke elevated at Illawarra and Lower Hunter stations also (e.g. Wollongong, Figure 10). Nine stations exceeded the daily PM<sub>2.5</sub> standard (Table 50). The first day (29 August) was mostly confined to western Sydney, with Prospect and Parramatta North most impacted. On the second day, Macquarie Park in Sydney East recorded the event's highest PM<sub>2.5</sub> daily average (43.6 µg/m<sup>3</sup>), also the highest for Sydney outside the summer bushfires.

### Analysis

#### Several HRBs were active in northern areas of Sydney

On 28 August, an approximate total burn area of 88 hectares was active in the northern areas of Sydney (RFS ICON data), including 66 hectares at Tuff Hill, Hills Shire, and 22 hectares at Dormitory Hill South, Hawkesbury. That evening, Sydney North West stations saw reduced visibility, and smoke persisted until midday the next day, though the daily PM<sub>2.5</sub> benchmark was not exceeded.

On 29 August, approximately 150 hectares of burns were active including 50 hectares at Banks Creek, Berowra Heights, and 100 hectares at Resolute, at West Head in the Ku-ring-gai Chase National Park. Smoke dispersion from these firegrounds north-west of Sydney



was assisted by north-westerly flows early in the day. However, an easterly sea breeze developed in the afternoon, trapping smoke and several stations saw poor visibility and air quality as a result (Figure 10).

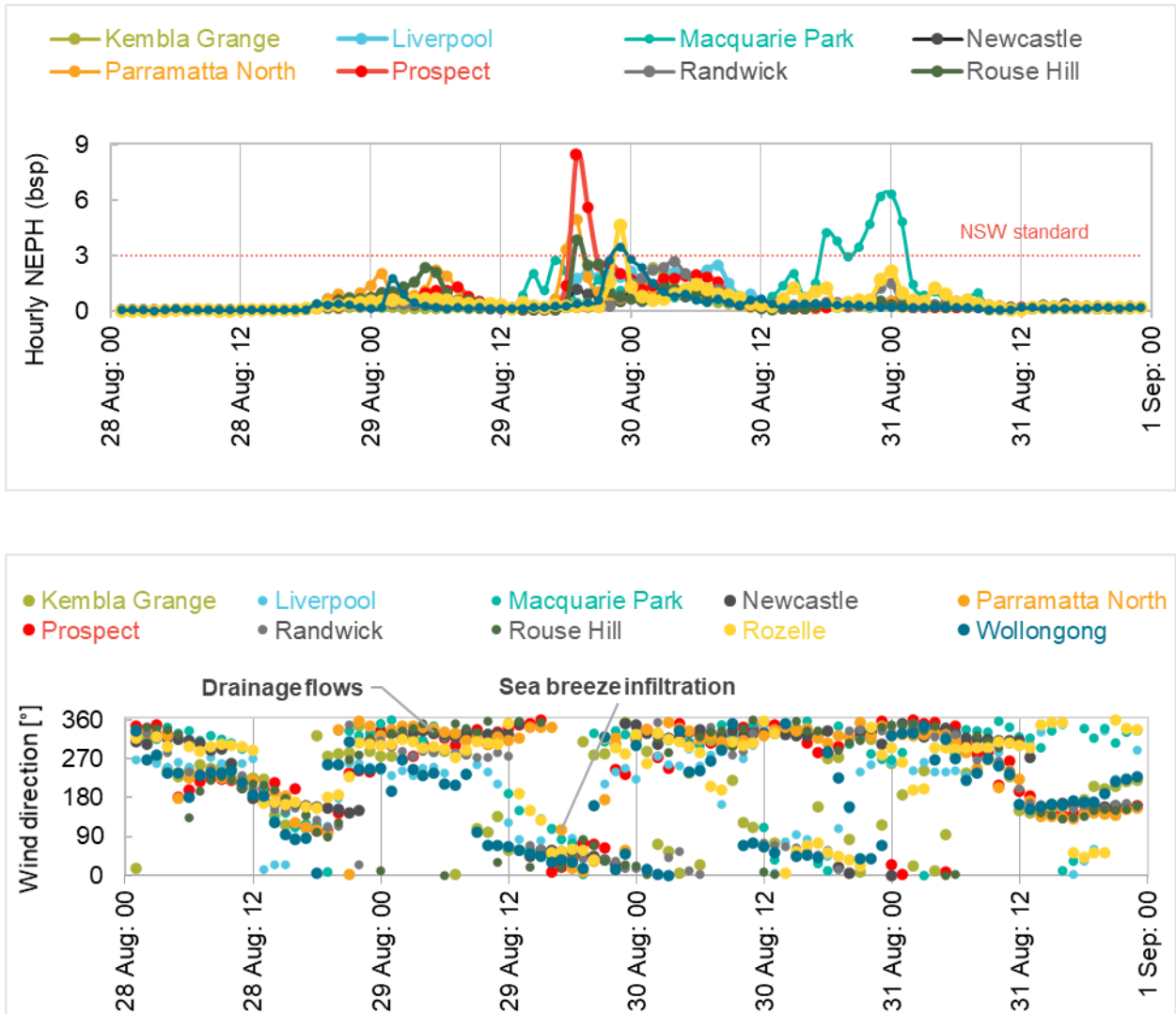
On 30 August, at least 175 hectares of hazard reduction burns were active in northern regions of Sydney: 75 hectares was at Pogson, Cherrybrook and Resolute HR was still active after being first lit previous day. Under the influence of northerly winds, Sydney East stations were downwind to these fires, and the event's highest daily PM<sub>2.5</sub> average was recorded at Macquarie Park. Sydney South West stations also exceeded the daily benchmark influenced by overnight calm conditions.

### Overnight stability trapped smoke, as did afternoon sea-breeze infiltration

A high-pressure system was stable over the State's east, slowly moving offshore during 29–30 August. Due to calm and stable conditions, temperature inversions likely formed on both evenings. Overnight winds were light and variable and temperatures across the east coast were very low (e.g. Bringelly dropped to 0.1°C on 29 August). These conditions trapped smoke from the HRBs close to ground, limiting dispersion, particularly during overnight to early morning periods. During daytimes, the competing effects of easterly sea breeze and inland drainage flows resulted in concentrations building up in certain locations, a dynamic seen on 29 August, when the arrival of the sea breeze at midday coincided with peak hourly PM<sub>2.5</sub> levels at multiple stations (evident also from NEPH measurements in Figure 10).

**Table 50** Nine Sydney stations exceeded the daily PM<sub>2.5</sub> standard (25 µg/m<sup>3</sup>)

| Region            | Station           | Daily PM <sub>2.5</sub> concentration, µg/m <sup>3</sup> |            |
|-------------------|-------------------|--|------------|
|                   |                   | 29/08/2020   | 30/08/2020 |
| Sydney North West | Prospect          | 37.1   |            |
| Sydney North West | Parramatta North  | 35.8   |            |
| Sydney North West | Rouse Hill        | 27.0   |            |
| Sydney South West | Liverpool         | 26.2   | 28.1       |
| Sydney East       | Macquarie Park    |  | 43.6       |
| Sydney East       | Randwick          |  | 31.4       |
| Sydney East       | Cook and Phillip  |  | 26.2       |
| Sydney South West | Bringelly         |  | 26.3       |
| Sydney South West | Campbelltown West |  | 26.3       |



**Figure 10** Wind directions at several stations from midnight 28 August to 31 August 2020 were generally from the north-west (top panel, drainage flows). However, sea-breeze infiltration on the afternoon of 29 August resulted in high nephelometer measurements (bottom panel), showing the impact of wind change in trapping smoke inland in many parts of Sydney. On the afternoon of 30 August, Sydney East region stations were downwind to large HRBs in the north of Sydney

## Section F – PM2.5 population exposure analysis

Clause 17 of the AAQ NEPM requires jurisdictions to report annual performance against air quality standards and goals, from June 2018, by evaluating population exposures to particles as PM2.5. This section sets out the approach New South Wales has adopted to assess PM2.5 population exposure and presents PM2.5 population exposure for 2020. At the time of this report, there is no agreed approach between participating jurisdictions on procedures or methods to ensure nationally consistent evaluation and reporting. The inter-jurisdictional Expert Working Group advising the AAQ NEPM review has endorsed the NSW approach to reporting population exposure, pending a more detailed assessment method being finalised.

### NSW approach to PM2.5 exposure assessment

The NSW Government developed a method to account for population exposure when tracking changes in average annual PM2.5 concentrations. The method focuses on a PM2.5-based metric, rather than a multi-pollutant metric. It combines population data from the Australian Bureau of Statistics (ABS) and air quality data from all NSW monitoring stations in the NSW Greater Metropolitan Region (GMR), including Greater Sydney, Lower Hunter, Central Coast and Illawarra. The NSW method generates population exposure to PM2.5 at 2 different spatial scales: Greater Sydney region and NSW GMR (as described in NSW Government 2017).

The method involves 2 main steps:

1. **Maps of annual population exposure to PM2.5 pollution** are generated using a spatial interpolation method. The maps summarise spatial distributions of annual population exposure to PM2.5 pollution, expressed as the product of population density (population per square kilometre, km<sup>2</sup>) and annual average PM2.5 concentrations (micrograms per cubic metre, µg/m<sup>3</sup>).
2. **The Clean Air Metric (CAM) is calculated** using PM2.5 data (only), for the selected region or area. The CAM values provide annual population-weighted air pollution levels, in two forms, as population-weighted:
  - a. PM2.5 concentrations
  - b. PM2.5 index against the annual NEPM standard.

This method provides a means to help track whether air quality management is delivering the greatest positive health outcomes for the people of New South Wales, in this case, people living in NSW Greater Metropolitan Region, where the majority of people in the State live.

This method provides a means to help track whether air quality management is delivering the greatest positive health outcomes for the majority of people of New South Wales.

### How annual PM2.5 exposure is calculated and mapped

Annual PM2.5 exposure is calculated through a series of steps involving spatial mapping techniques. The department generates maps for the Greater Sydney region and the NSW GMR. The steps are summarised below and illustrated with reference to the NSW GMR and Greater Sydney region in Figure 11 through Figure 13:

- Gather air quality data measured as the annual average PM2.5 concentrations (µg/m<sup>3</sup>), for all NSW air quality monitoring stations in the defined region or study area.

- Allocate an annual average PM2.5 concentration to each one square kilometre area (i.e. 1-km<sup>2</sup> grid cell) across the region, using a spatial interpolation technique called kriging. This creates a grid across the region of PM2.5 concentrations, one value per 1 km<sup>2</sup> (Figure 11).
- Gather ABS Usual Resident Population Data, as density per 1 km<sup>2</sup> grid cell for the defined region (population density, expressed as number of people per square kilometre) (Figure 12).
- Generate a map of annual PM2.5 exposure, as follows: for each 1-km<sup>2</sup> grid cell, multiply the cell's PM2.5 value (µg/m<sup>3</sup>) by the cell's population density value. The product is the population exposure to PM2.5 concentration for that cell (Figure 13).

Annual population exposure to PM2.5 pollution is assessed by analysing the spatial distribution of the exposure map, generated at the 1 km by 1 km resolution, or to the scale of a chosen study area.

### How the PM2.5 Clean Air Metric (CAM) is calculated

The CAM is calculated for annual averaged PM2.5, as both concentration and indexed against NEPM standard, where an index value of 100 is equivalent to the annual average PM2.5 standard of 8 µg/m<sup>3</sup>. This is done by applying the following steps to a chosen region:

- sum the annual population exposure to PM2.5 pollution (based on the method described above) for all grid cells across the region of interest
- divide the result by the total population of the region. The resulting CAM value is the region's annual average population-weighted PM2.5 concentration (µg/m<sup>3</sup>)
- the CAM can also be presented as the region's annual average population-weighted index, if divided by the annual NEPM standard for PM2.5.

### CAM calculated as 3-year rolling averages

While CAM is primarily calculated as an annual index, air quality can vary significantly from year-to-year due to exceptional events such as bushfires and dust storms, driven by climatological events like El Niño. To smooth out this natural variability, a 3-year rolling average is therefore applied to the CAM. This aligns with exposure reporting approaches used in the EU and the USEPA. It allows us to focus on assessing progress in addressing human sources contributing to poor air quality.

The NSW population exposure to PM2.5 pollution and the 2020 CAM values for the NSW GMR and Greater Sydney region are presented and discussed below.

## Annual PM2.5 exposure maps (2020)

### Spatial distribution, annual average PM2.5 concentrations (2020)

Figure 11 presents the estimated distribution of PM2.5 annual average concentrations across the GMR and the Greater Sydney region for 2020. PM2.5 annual average concentrations above the AAQ NEPM standard of 8 µg/m<sup>3</sup> were estimated across large areas of the GMR. This was due to the significant impact of the 2019–20 bushfire season during January and early February 2020.

The *Air Emissions Inventory for the Greater Metropolitan Region in New South Wales: 2013 calendar year* (EPA 2019) reported that the main sources of anthropogenic PM2.5 emissions in Sydney were household activity (primarily residential wood heating), natural sources (including prescribed burning), road and non-road transport and licensed industrial sources. In Newcastle, prescribed burning, licensed industrial sources, non-road transport and residential wood heating are the major direct emissions of PM2.5. This excludes PM2.5 that can be formed through secondary processes in the atmosphere.

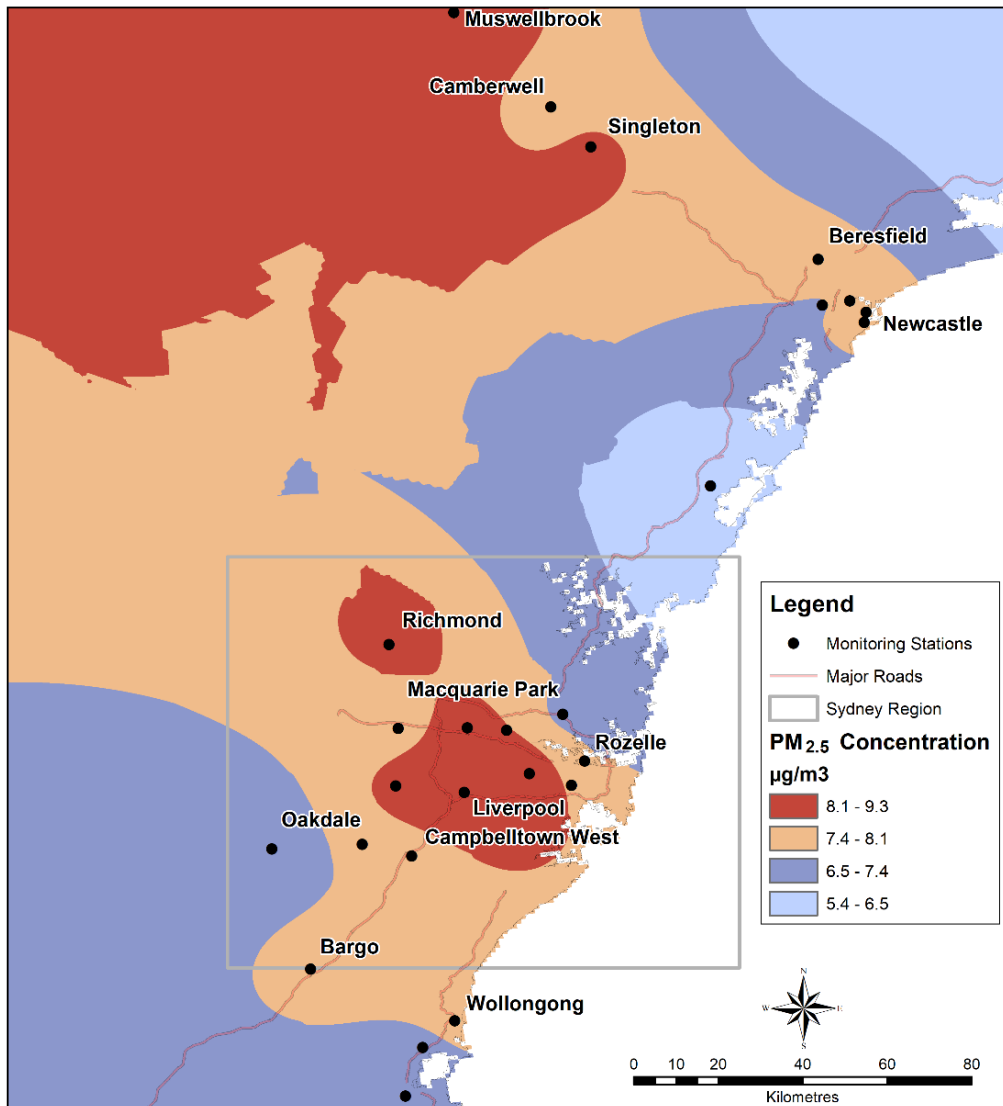


Figure 11 Spatial distribution of PM2.5 annual average concentration for 2020 for NSW Greater Metropolitan Region, including the Greater Sydney region (inset)

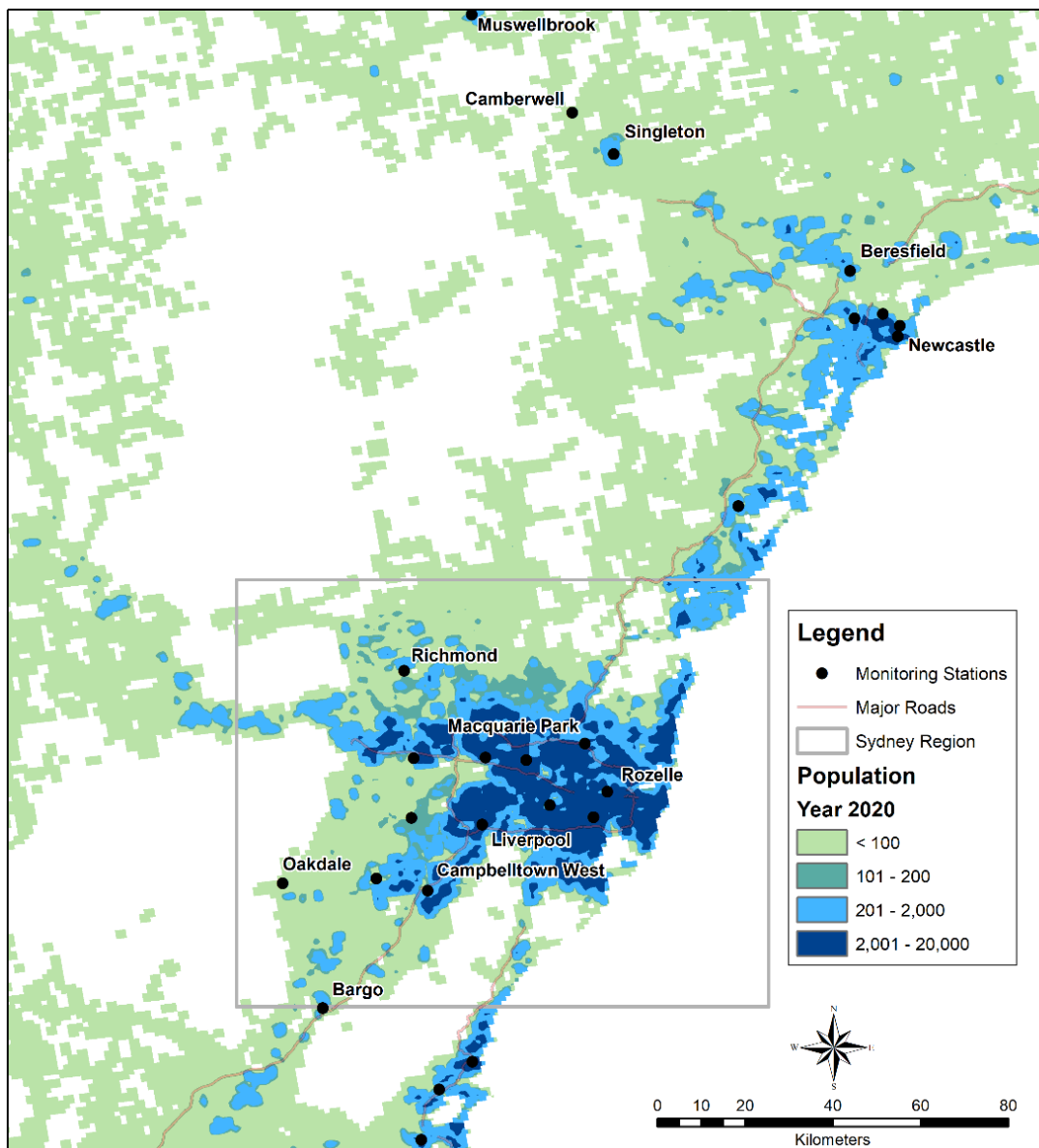
Figure 11 was generated using the method outlined above, with further details below:

1. the annual average PM<sub>2.5</sub> concentration ( $\mu\text{g}/\text{m}^3$ ) for 2020 at each NSW air quality monitoring station in the GMR was plotted on a map of the region
2. the GIS mapping technique known as kriging was applied to shade areas in proportion to the estimated annual average PM<sub>2.5</sub> concentrations across the region at the 1-km<sup>2</sup> resolution.

This technique created a grid of PM<sub>2.5</sub> concentrations in  $\mu\text{g}/\text{m}^3$ , one value per 1 km<sup>2</sup> across the region for 2020.

### Population density distribution (2020)

Figure 12 presents the population density for the GMR and Greater Sydney region for 2020, at a resolution of 1 km<sup>2</sup>, projected from ABS 2016 Census data (ABS 2016). The higher population densities are in central, north-west, south-west and east Sydney regions and along major transport corridors.



**Figure 12** Population density (population/km<sup>2</sup>) for the NSW GMR and Greater Sydney region (2020), projected from the ABS Census 2016

These population density values were used to calculate the population exposure to PM2.5 concentrations and the Clean Air Metric (CAM), as described below.

### Population exposure to PM2.5 (2020)

Population exposure to PM2.5 is expressed as values scaled to between 0 and 10. These are derived as the product of population density at 1-km<sup>2</sup> resolution and annual average PM2.5 concentration (population/km<sup>2</sup> x PM2.5). Figure 13 presents an estimate of the population's exposure to PM2.5 concentrations in the GMR in 2020. The main points to note are:

- the highest population exposure to PM2.5 pollution in the GMR during 2020 was in Sydney's CBD and along inner and central Sydney transport corridors (red shading)
- within the Greater Sydney region, population exposure to PM2.5 was generally lower in regions outside the Sydney CBD and transport corridors (yellow/orange shading)
- the population exposure to PM2.5 in Greater Western Sydney, the Central Coast and Lower Hunter (green and grey shading) was much lower than in the Sydney CBD and Sydney transport corridors.

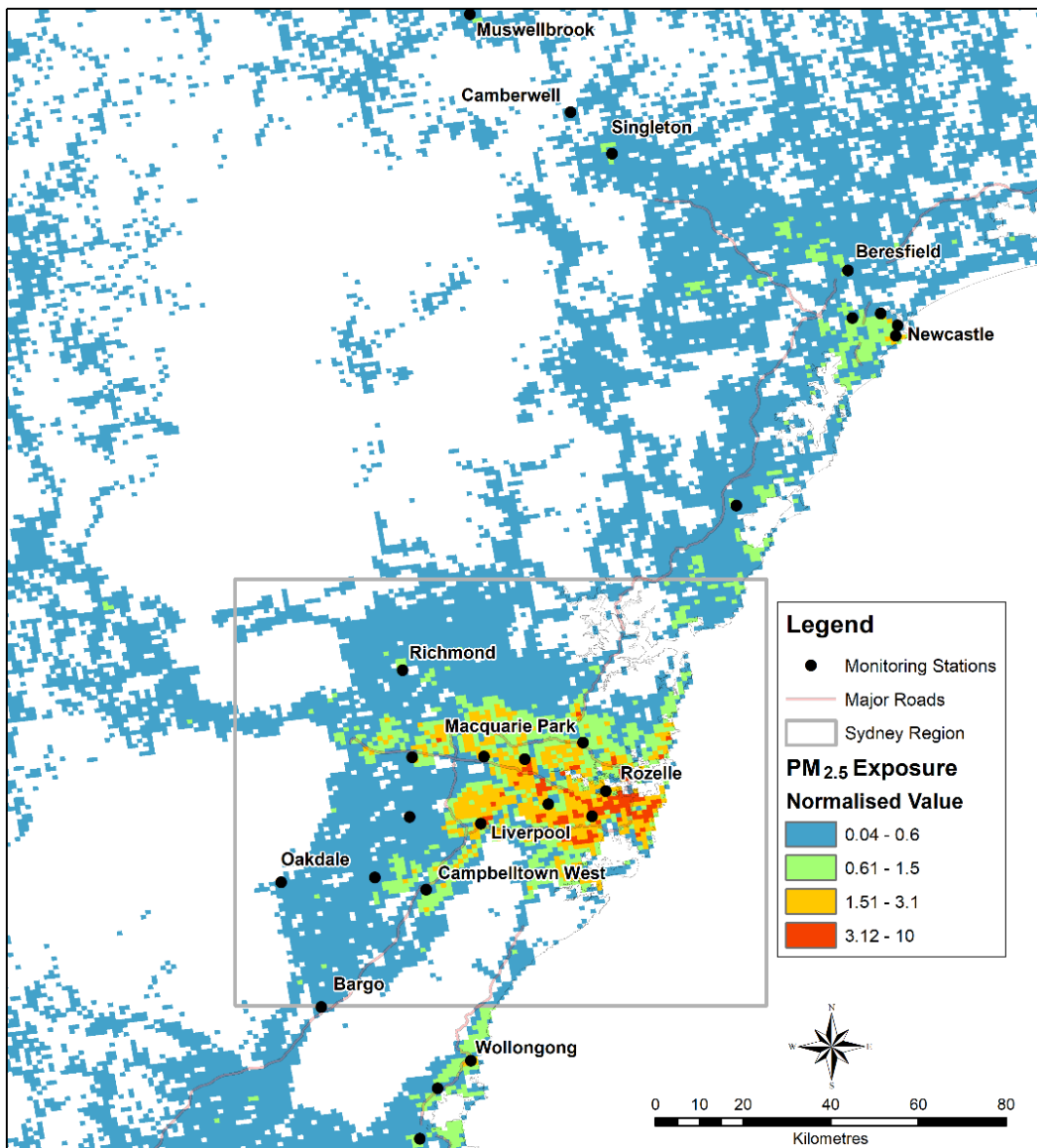


Figure 13 PM2.5 exposure for NSW GMR and Greater Sydney region, 2020

## Clean Air Metric (CAM)

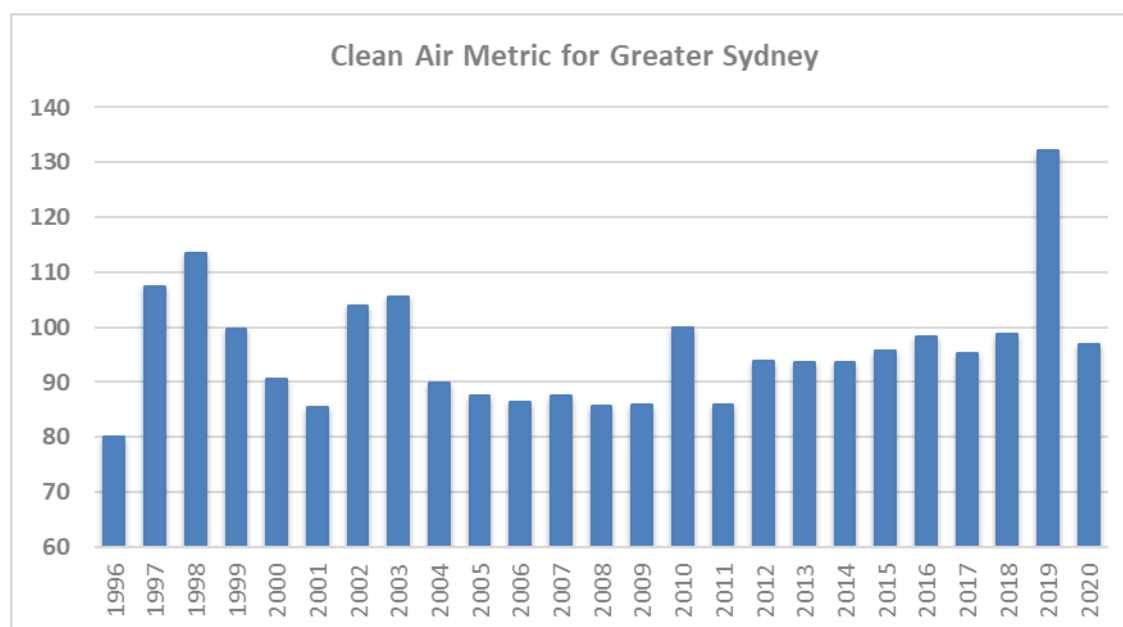
The values of population exposure to PM<sub>2.5</sub>, referred to above, were used to calculate the Clean Air Metric (CAM) expressed as an index (below).

### Annual CAM trend

Figure 14 and Figure 15 show the CAM time series for Greater Sydney region and the NSW GMR, respectively, for 1998 to 2020. The NSW Government commissioned the ABS to provide 1-km<sup>2</sup> resolution population data for all years from 1996 to 2020, based on the ABS Estimated Resident Population. This allowed calculation of the metric for previous years to track population exposure changes to air pollution over time.

Figure 14 shows the following recent trends for the Greater Sydney region:

- The population-weighted average exposure of residents to PM<sub>2.5</sub> in the Greater Sydney region rose from 99% in 2018 to 132% of the NEPM standard in 2019, due primarily to the 2019–20 bushfire season. In 2020, it fell to 97% due in part to widespread rainfall in 2020 following the conclusion of the 2019–20 bushfire season.
- The level of exposure to PM<sub>2.5</sub> in 2020 is in line with levels of exposure experienced in 2016 and 2018.

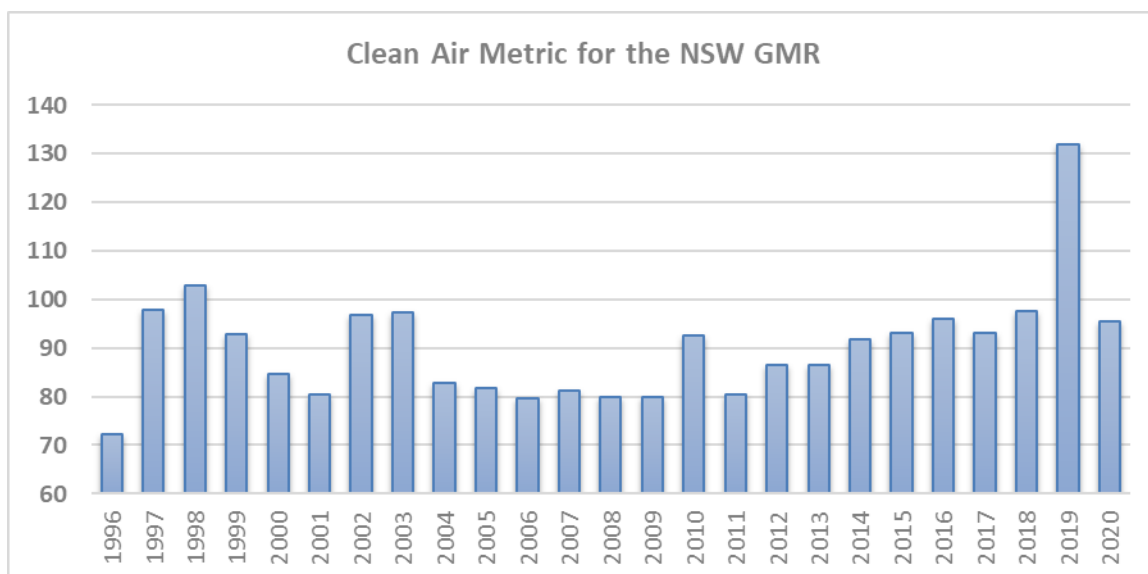


**Figure 14** Clean Air Metric (CAM) time series of PM<sub>2.5</sub> for the Greater Sydney region (1996–2020)

Figure 15 shows the following recent trends for the NSW GMR:

- the population-weighted average exposure of residents to PM<sub>2.5</sub> in the NSW GMR rose from 96% in 2016 to 132% (all time high) of the NEPM standard in 2019, due primarily to the 2019–20 bushfires
- in 2020, it fell to 97%, with the level of exposure to PM<sub>2.5</sub> in line with 2016 and 2018.





**Figure 15 Clean Air Metric (CAM) time series of PM2.5 for the NSW GMR (1996–2020)**

### CAM 3-year rolling averages

Table 51 presents 3-year rolling average CAM values in two formats: the 3-year rolling average PM2.5 population-weighted concentration (column 3), and the 3-year rolling average population-weighted index (percentage of the annual PM2.5 standard) (column 4).

These were calculated as follows:

- Calculate the 3-year rolling average PM2.5 concentrations for 2020, for each NSW air quality monitoring station in the NSW GMR, based on data for 2018 to 2020.
- Calculate and map for each 1-km<sup>2</sup> grid cell across the region, the 3-year rolling average population exposure to PM2.5 concentrations, using mapping methods above.
- Sum the 3-year average population exposure to PM2.5 concentration for all grid cells across the region. Divide the result by the total population of the region. The result is the region’s 3-year rolling average population-weighted PM2.5 concentration (µg/m<sup>3</sup>).
- Convert the region’s 3-year rolling average population-weighted PM2.5 concentration (µg/m<sup>3</sup>) to a 3-year rolling average population-weighted index. That is, multiply the region’s 3-year average population-weighted PM2.5 concentration by 100/8 (AAQ NEPM standard for the annual average PM2.5 concentration is 8 µg/m<sup>3</sup>).

**Table 51 CAM expressed as a 3-year rolling population-weighted PM2.5 concentration, and as a population-weighted PM2.5 index for the NSW GMR and the Greater Sydney region (2020)**

| Region         | Population 3-year average | CAM, 3-year average population-weighted PM2.5 concentration (µg/m <sup>3</sup> ) | CAM, 3-year average population-weighted PM2.5 index (against annual standard) |
|----------------|---------------------------|--|---|
| Greater Sydney | 5,064,116                 | 8.74   | 109   |
| NSW GMR        | 6,190,312                 | 8.67   | 108   |

Table 51 shows that in 2020 the CAM 3-year rolling average:

- for Greater Sydney region was 109, meaning the population-weighted average exposure of residents to PM<sub>2.5</sub> was 109% of the NEPM annual standard for PM<sub>2.5</sub>
- for NSW GMR was 108, meaning the population-weighted average exposure of residents to PM<sub>2.5</sub> was 108% of the NEPM annual standard for PM<sub>2.5</sub>.

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## More information

- [Air Emissions in my Community web tool](#)
- [Air Quality Monitoring Network webpage](#)
- [Air Quality Special Statement Spring–Summer 2019–20: focus area webpage](#)
- [Blue Mountains and Lithgow Air Watch webpage](#)
- [Broken Hill Environmental Lead Study](#)
- [EPA’s Council Resource Kit webpage](#)
- [EPA’s load-based licensing scheme](#)
- [National Association of Testing Authorities accreditation details](#)
- [NSW Air Quality Monitoring Plan](#)
- [NSW Air Quality Special Statement Spring–Summer 2019–20](#)
- [NSW Air Quality website](#)
- [NSW Annual Air Quality Statement 2020](#)
- [NSW Annual Air Quality Statement 2020: focus areas \(COVID-19\) webpage](#)
- [NSW Annual Air Quality Statement 2020: focus areas webpage](#)
- [NSW Annual Air Quality Statement 2020: gases webpage](#)
- [NSW Department of Planning, Industry and Environment \(DPIE\) public website](#)
- [Traffic Volume Viewer](#)