Air quality monitoring program in Cadia area: June to November 2024

Report to the NSW Environment Protection Authority, Cadia Area Air Quality Monitoring Study

Department of Climate Change, Energy, the Environment and Water

NSW GOVERNMENT

Acknowledgement of Country

Department of Climate Change, Energy, the Environment and Water acknowledges the Traditional Custodians of the lands where we work and live.

We pay our respects to Elders past, present and emerging.

This resource may contain images or names of deceased persons in photographs or historical content.

Artist and designer Nikita Ridgeway from Aboriginal design agency Boss Lady Creative Designs created the People and Community symbol.

Cover photo: The Walls lookout. David ten Broeke/DCCEEW

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Background

The NSW Department of Climate Change, Energy, the Environment and Water (the department) is working with the NSW Environment Protection Authority (NSW EPA) to investigate possible impacts on local air quality from Newcrest Mining Limited's Cadia East mining activity.

An initial report[1] was published in August 2024 outlining the study objective, site selection, and results from August 2023 to May 2024. This progress report presents data from June to November 2024, providing an analysis of air quality in the Cadia area for winter and spring.

Data was collected from 3 Air Quality Monitoring Stations (AQMS), 2 DustTraks (DRX) sites, 6 Directional High Volume Air Samplers (DHVAS), and 36 low-cost Purple Air (PA) sensors.

Two DHVAS are also co-located with automatic weather stations (AWS) (see Table 3 in Appendix 1). For further information on the location of these sites, please refer to the initial report (see More information section).

Results

Daily average particle levels, measured as PM2.5 and PM10[2] at Orange, Bathurst, and Millthorpe AQMSs remained in the 'good' to 'fair' air quality categories[3] 97% of the time during the study period (June to November 2024).

Daily PM10 levels at all 5 sites remained in the 'good' air quality category throughout this study period.

Orange and Millthorpe recorded 5 and 1 days respectively (6 days in total) of 'poor' air quality due to PM2.5 (daily average exceeded 25 µg/m^3). All these days occurred during winter and were likely caused by wood heater smoke.

There were no daily PM10 exceedances during the study period at all 5 sites. Daily average PM2.5 measured by Purple Air low-cost sensors remained below 25 µg/m^3 across the Cadia area throughout the study period.

Heavy metals at the 6 DHVAS sites remained very low during June to November 2024, with most samples below the Limit of Reporting[4] at many sites. Copper and zinc were consistently detected at each DHVAS, with nickel detected at Tallwood only.

Particles

From June to November 2024, the maximum daily average PM10 was 47.5 µg/m^3 and maximum PM2.5 was 38.4 µg/m^3. Figure 1 and Figure 2 shows the daily average PM10 and PM2.5 (respectively) from 1 June to 30 November 2024.

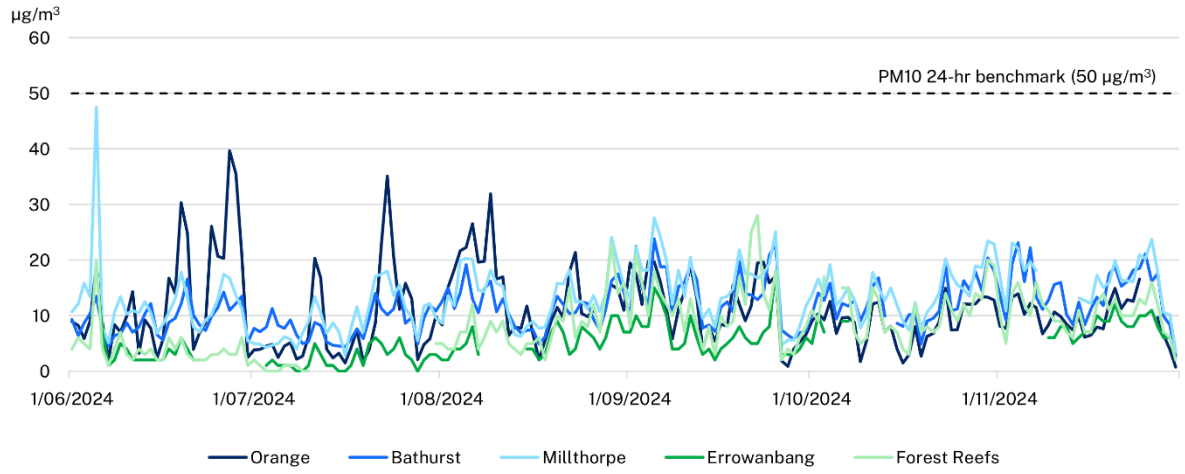

Figure 1 **Daily average PM10 from June to November 2024 at 5 sites in the Cadia area**

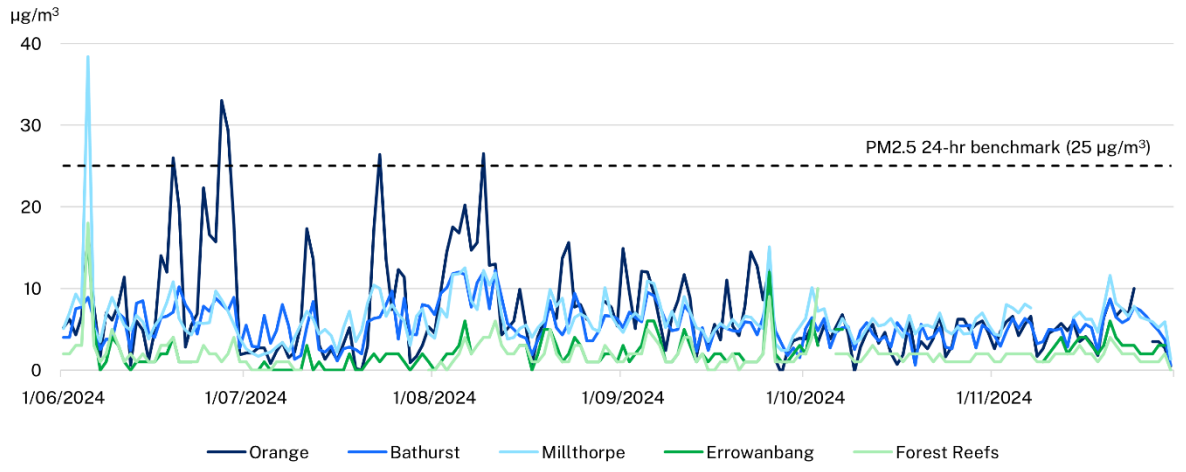

Figure 2 **Daily average PM2.5 from June to November 2024 at 5 sites in the Cadia area**

Note: Particle data collected at Orange, Bathurst, and Millthorpe is from NATA-accredited instrumentation while data collected at Errowanbang and Forest Reefs is from indicative monitors.

There were no exceedances of the daily average PM10 benchmark (50 µg/m^3) during winter or spring 2024.

The PM2.5 daily average benchmark is 25 µg/m^3. The benchmark was exceeded on 6 days (5 at Orange and 1 at Millthorpe), all during winter, likely due to woodsmoke from domestic heating. Long term trends observed at these sites since the commencement of this study in August 2023 are shown in Appendix 2. These trends show the daily average PM10 in the 'good' to 'fair' range 100% of the time at all 5 sites, while PM2.5 has exceeded the daily benchmark on several occasions since 1 August 2023.

The daily average PM10 and PM2.5 for each season at each site was low, as shown in Table 1.

Table 1 **Daily average and minimum-maximum range for PM10 and PM2.5 during winter and spring 2024**

Station	Winter (June-August)		Spring (September-November)	
	PM10 (µg/m^3)	PM2.5 (µg/m^3)	PM10 (µg/m^3)	PM2.5 (µg/m^3)
Orange	11.8 (1.5-39.7)	8.8 (0.0-33)	10.0 (0.7-19.8)	5.3 (0.0-14.9)
Bathurst	9.8 (4.4-19.2)	6.1 (1.1-12.2)	13.5 (2.6-23.8)	5.0 (0.6-10.4)
Millthorpe	11.7 (2.9-47.5)	6.6 (1.7-38.7)	15.3 (3.6-27.6)	6.1 (1.3-15.1)
Errowanbang	3.7 (0.0-19.0)	1.7 (0.0-16.0)	6.5 (2.0-18.0)	2.6 (1.0-12.0)
Forest Reefs	5.4 (0.0-23.0)	2.1 (0.0-18.0)	10.7 (2.0-28.0)	1.9 (0.0-10.0)

Rainfall was average during winter, and below average during spring in the Cadia area (see climate maps in Appendix 3), contributing to increased PM10 at most sites during spring 2024.

While the PM10 daily benchmark was not exceeded during this period, PM10 levels were occasionally elevated (hourly air quality categories of ‘fair’ or higher) at all sites. These elevated levels were observed for fewer than 1% of hours (44 hours) at the 5 Cadia area sites over the June to November 2024 period. Of the 5 sites, Forest Reefs recorded the highest number of elevated hours (0.5% or 21 hours). This is lower than the state average of 1.8% of hours.

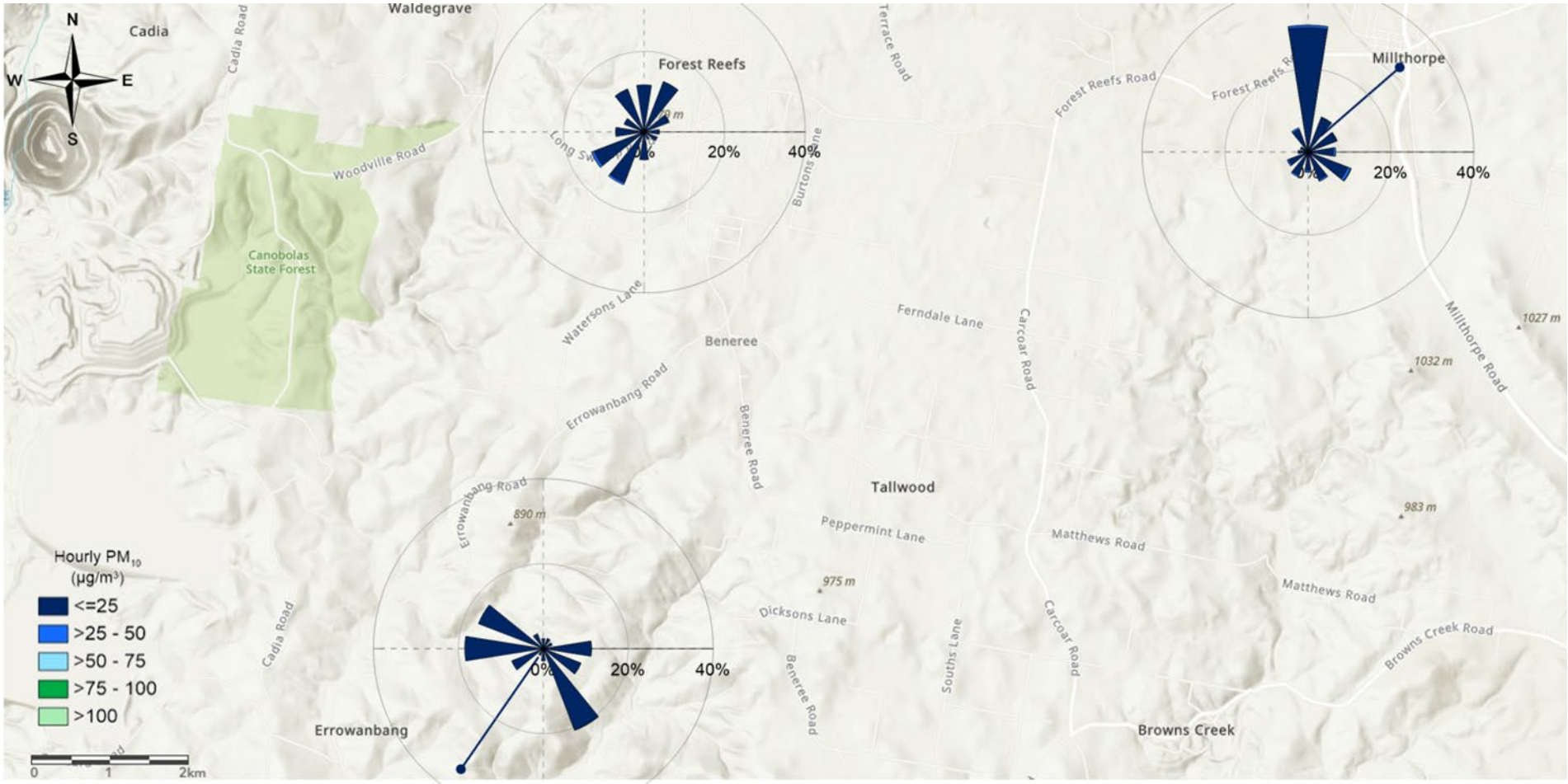

Figure 3 Hourly PM10 pollution rose map for the Cadia area during winter 2024

Note: The wind sectors indicate the direction from which the wind is blowing. Hourly PM10 data was retrieved from indicative instruments at Forest Reefs and Errowanbang, and from compliance instruments at Millthorpe.

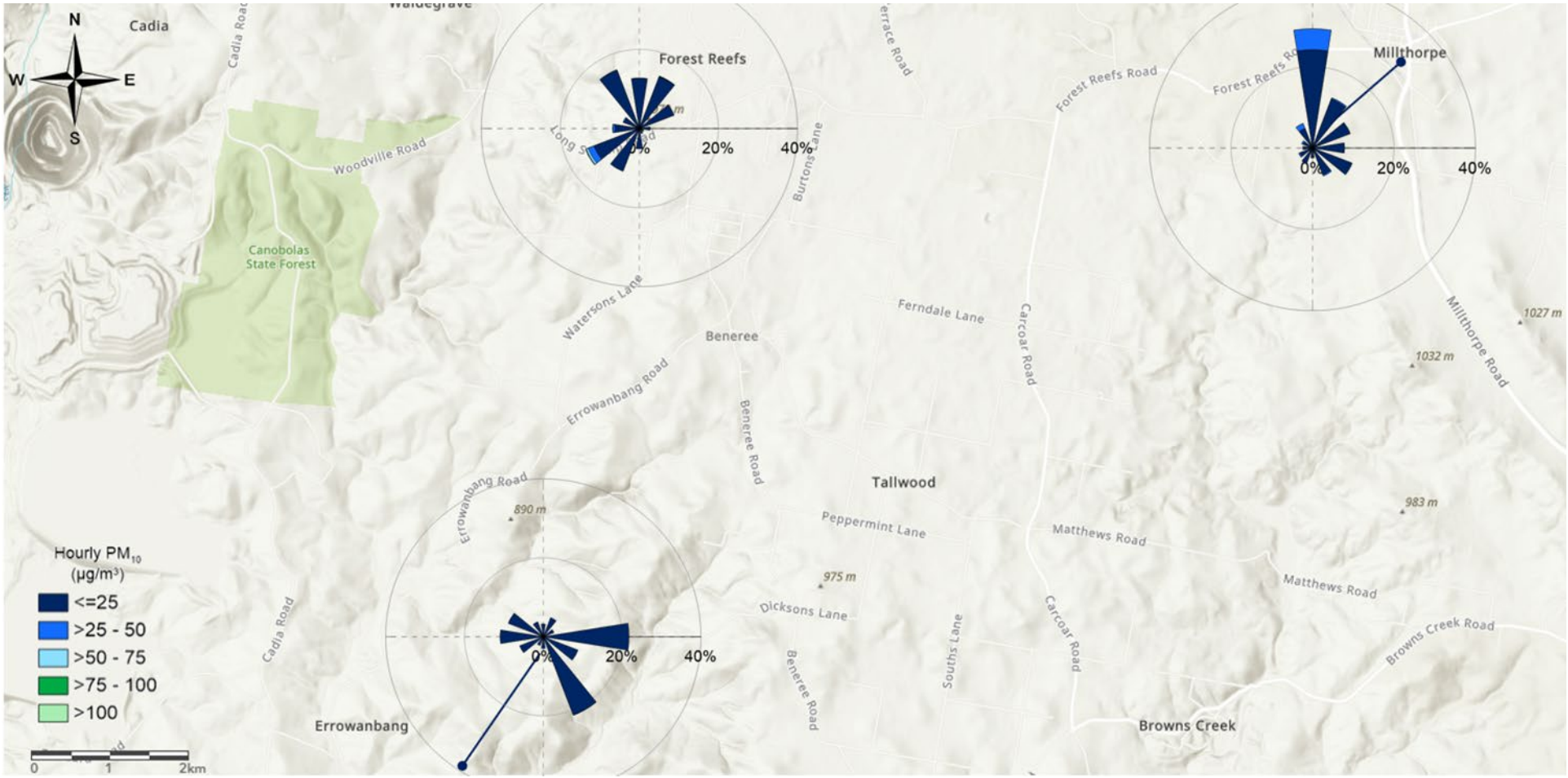

Figure 4 Hourly PM10 pollution rose map for the Cadia area during spring 2024

Note: The wind sectors indicate the direction from which the wind is blowing. Hourly PM10 data was retrieved from indicative instruments at Forest Reefs and Errowanbang, and from compliance instruments at Millthorpe.

Pollution roses in Figure 3 and Figure 4 show PM10 concentrations at:

- Forest Reefs coming from the north west, north east and south west
- Millthorpe from the north, north east and south east
- Errowanbang from the east, south east and west.

Thirty-six low-cost Purple Air sensors measuring PM2.5 were distributed to residents throughout the Cadia area community. Figure 5 shows the composite daily average PM2.5 measured across the network of PAs during June to November 2024.

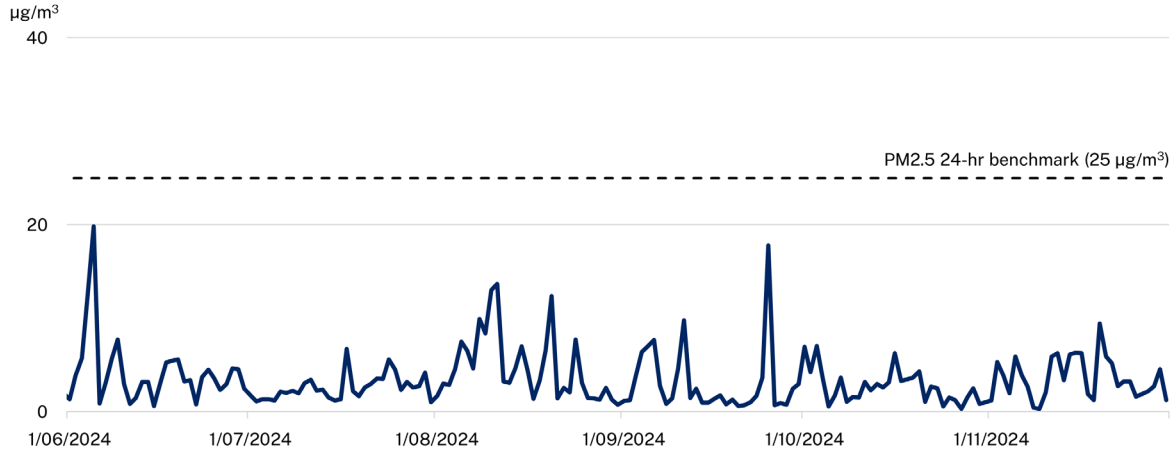

Figure 5 **Composite daily average PM2.5 as measured by low-cost PA sensors from June to November 2024**

The composite daily average trend in the PA PM2.5 data in the Cadia area show general agreement with PM2.5 data collected at AQMSs in Orange, Bathurst, and Millthorpe, and DRXs in Errowanbang and Forest Reefs (Figure 2).

Heavy metals in total suspended particles

There were 64 valid samples collected between 5 June and 21 November 2024 using directional sampling (DHVAS) with sampling periods of 14 days. Figure 6 shows the minimum, maximum and average total suspended particles (TSP) for each site, while Table 2 shows the maximum heavy metal concentration measured in TSP samples at each site.

Average TSP levels at the background site Four Mile Creek were 12.5 µg/m^3, lower than the sites to the east of the mine (Forest Reefs, Errowanbang, and Tallwood), and similar to the sites to the west (Panuara and Panuara SW).

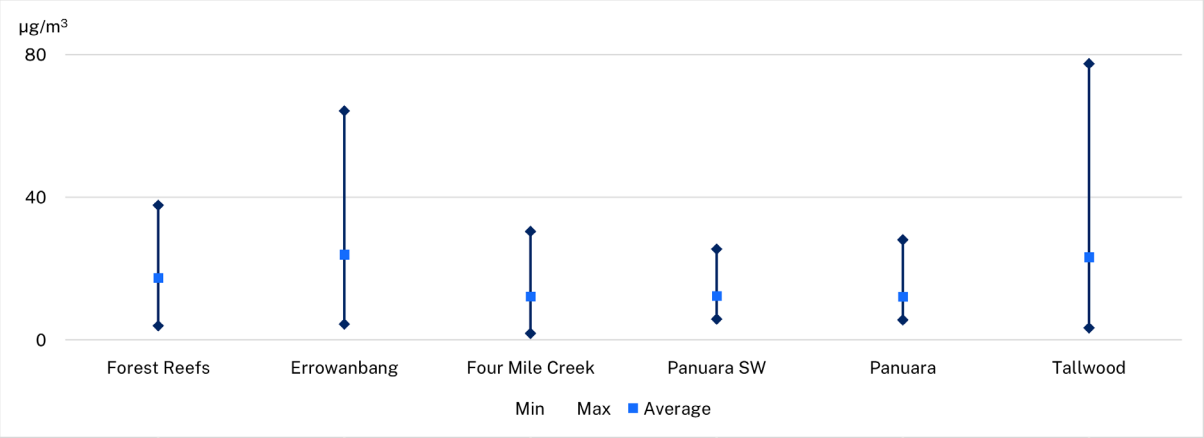

Figure 6 **Minimum to maximum range and average TSP at each DHVAS site from June to November 2024**

Results from the heavy metal analysis of the 64 samples found low levels of copper and zinc at all sites, with low levels of nickel also detected at one site (Table 2). Where detected, levels of copper, zinc and nickel were all very close to the Limit of Reporting[4].

Levels of heavy metals in Table 2 fall below the daily average guidelines for copper (50 µg/m^3), zinc (150 µg/m^3) and nickel (0.12 µg/m^3) used by the Queensland Government[5].

Table 2 Maximum concentrations of heavy metals in total suspended particles samples

Concentration, µg/m³	Lead	Selenium	Cadmium	Mercury	Copper	Molybdenum	Nickel	Zinc	Arsenic
Four Mile Creek	<LOR	<LOR	<LOR	<LOR	0.040	<LOR	<LOR	0.013	<LOR
Forest Reefs	<LOR	<LOR	<LOR	<LOR	0.023	<LOR	<LOR	0.026	<LOR
Errowanbang	<LOR	<LOR	<LOR	<LOR	0.014	<LOR	<LOR	0.017	<LOR
Panuara SW	<LOR	<LOR	<LOR	<LOR	0.050	<LOR	<LOR	0.015	<LOR
Panuara	<LOR	<LOR	<LOR	<LOR	0.060	<LOR	<LOR	0.011	<LOR
Tallwood	<LOR	<LOR	<LOR	<LOR	0.009	<LOR	0.015	0.027	<LOR
Limit of Reporting[4] (LOR)	<0.007	<0.007	<0.004	<0.0003	<0.004	<0.004	<0.004	<0.004	<0.007
QLD guidelines[5]	2.0	NA	2.0	NA	50.0	NA	0.12	120.0	0.3

Notes: n.d.: not detected. Concentrations were below the Limit of Reporting (LOR)

NA: no Queensland guideline available for Selenium, Mercury and Molybdenum

Appendix 1: Monitoring site information

Table 3 Cadia area air quality monitoring sites

Site	Purpose	Parameters	Establishment	Approximate location in relation to Cadia mine operations
Orange AQMS	Reference	Particles, gases, meteorology	January 2019	26km NNE
Bathurst AQMS	Reference	Particles, gases, meteorology	July 2000	54km E
Millthorpe AQMS	Air quality monitoring	Particles, gases, meteorology	July 2023	17km ENE
Four Mile Creek DHVAS	Background	TSP, heavy metals	February 2024	8km NW
Panuara DHVAS	Source sampling	TSP, heavy metals	February 2024	5km W
Panuara SW DHVAS	Source sampling	TSP, heavy metals	February 2024	8km SW
Tallwood DHVAS	Source sampling	TSP, heavy metals	March 2024	9km SE
Errowanbang AWS, DRX & DHVAS	Source sampling and indicative monitoring	Particles, TSP, heavy metals, meteorology	November 2023	8km SSE
Forest Reefs AWS, DRX & DHVAS	Source sampling and indicative monitoring	Particles, TSP, heavy metals, meteorology	November 2023	6km NE

Notes: AQMS stations are compliance monitoring stations and DRX instruments use indicative monitoring. Data from DHVAS is independently tested by ALS Global.

Particles refer to PM10 and PM2.5, Gases refer to NO/ NO_2/ NOx, SO_2, CO, and ozone. Heavy metals refer to lead, selenium, cadmium, mercury, copper, molybdenum, nickel, zinc, and arsenic.

Appendix 2: Comparison of data from entire study period

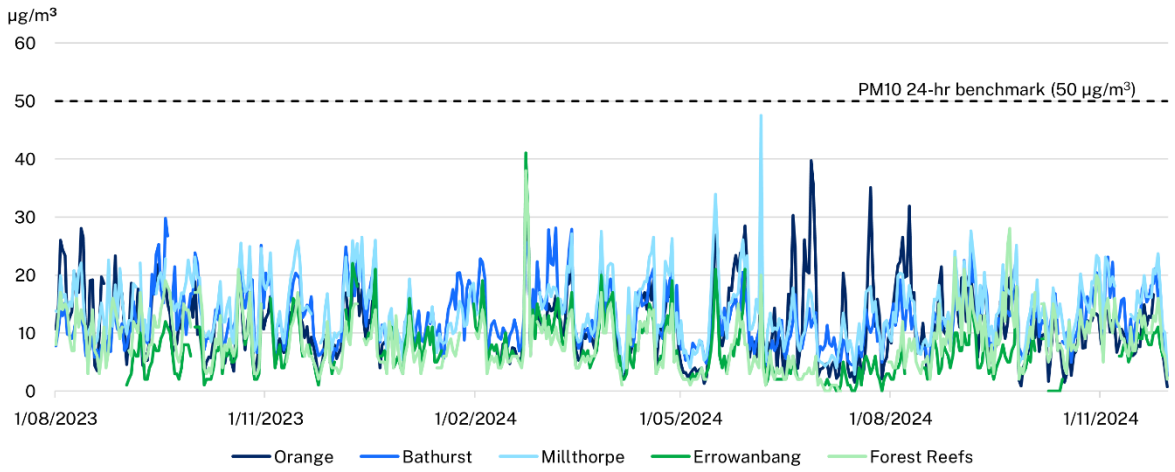

Figure 7 **Daily average PM10 at 5 sites in Cadia area from 1 August 2023 to 30 November 2024**

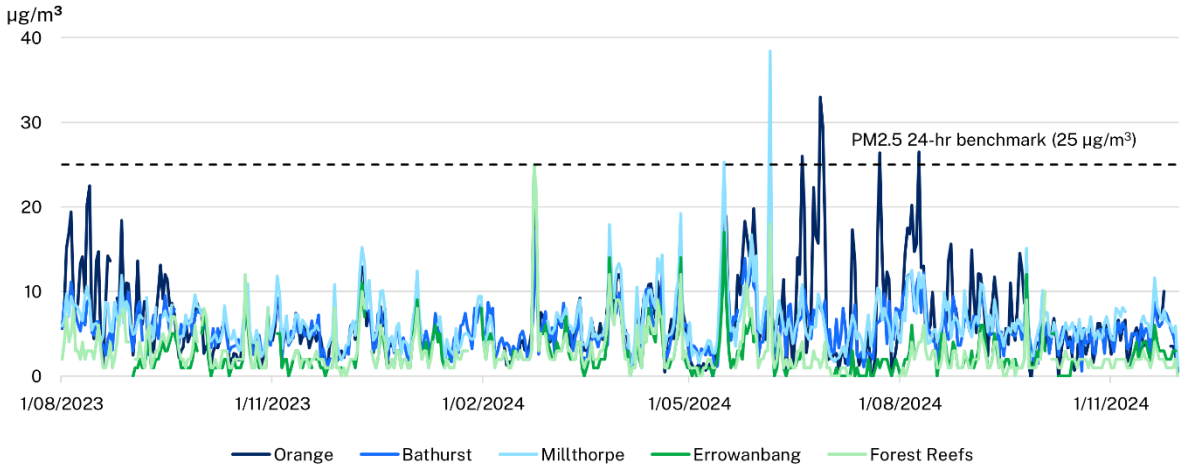

Figure 8 **Daily average PM2.5 at 5 sites in Cadia area from 1 August 2023 to 30 November 2024**

Appendix 3: Climate maps for winter and spring 2024

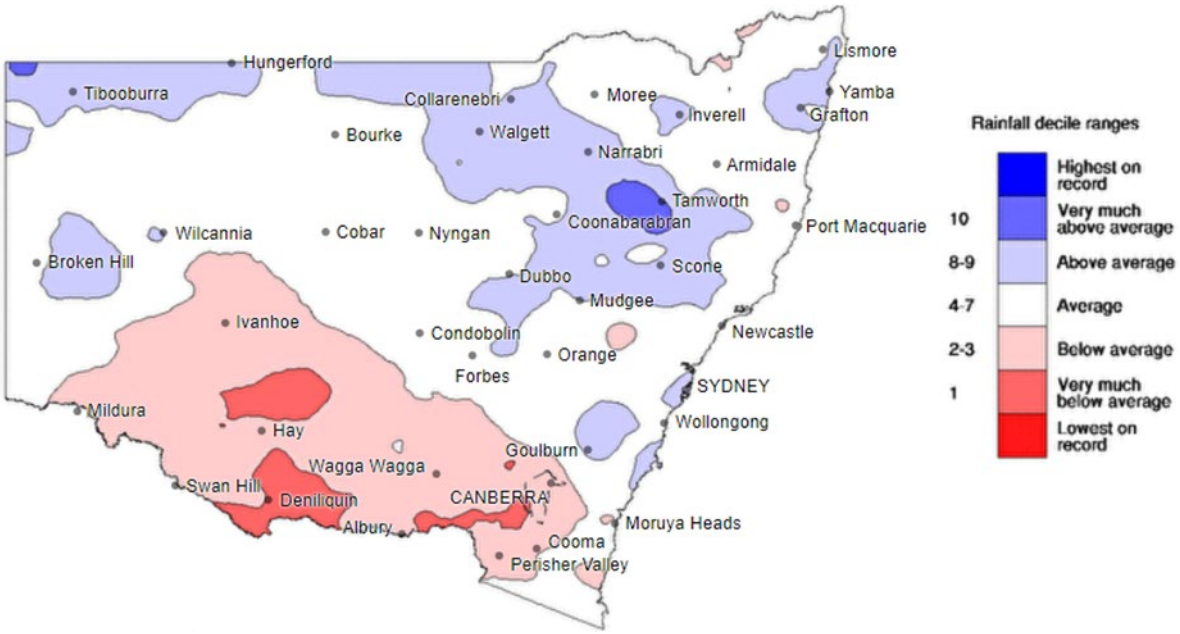

Figure 9 NSW rainfall deciles – winter 2024

Figure credit: ©Commonwealth of Australia 2024, Bureau of Meteorology. Base period: 1900-Aug 2024. Dataset: AGCD v2. Issued 20/11/2024

Figure 10 NSW maximum temperature deciles – winter 2024

Figure credit: ©Commonwealth of Australia 2024, Bureau of Meteorology. Base period: 1900-Aug 2024. Dataset: AGCD v2. Issued 21/09/2024

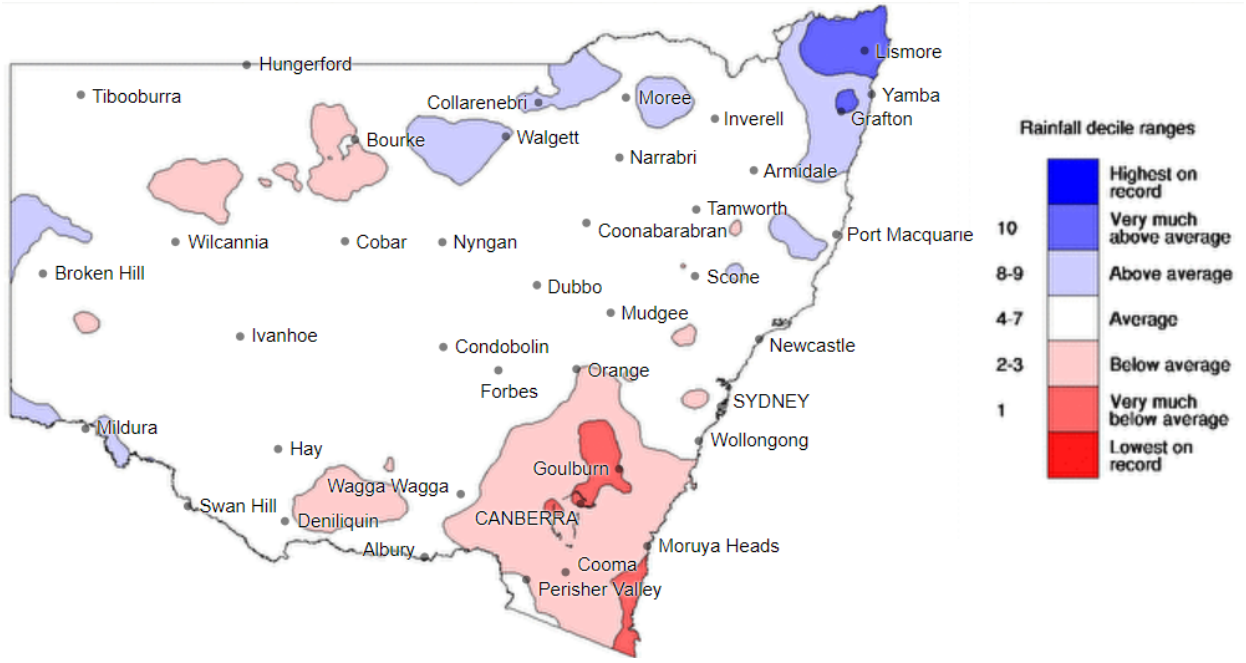

Figure 11 NSW rainfall deciles – spring 2024

Figure credit: ©Commonwealth of Australia 2024, Bureau of Meteorology. Base period: 1900-Nov 2024. Dataset: AGCD v2. Issued 30/11/2024

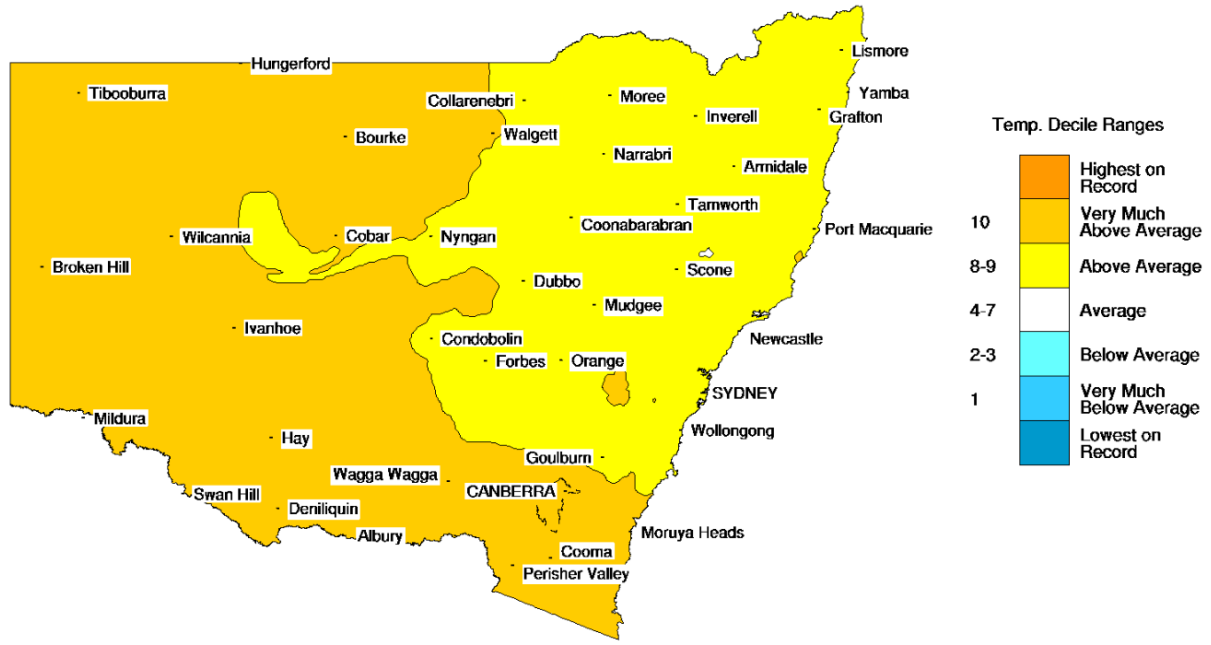

Figure 12 NSW maximum temperature deciles – spring 2024

Figure credit: ©Commonwealth of Australia 2024, Bureau of Meteorology. Base period: 1900-Nov 2024. Dataset: AGCD v2. Issued 3/12/2024

[1] DCCEEW (Department of Climate Change, Energy, the Environment and Water), 'Air Quality monitoring program in Cadia area: Initial Report', (2024) Accessed in October 2024. https://www.environment.nsw.gov.au/research-and-publications/publications-search/air-quality-monitoring-program-in-cadia-area-initial-report

[2] PM10 and PM2.5 refer to airborne particles, less than or equal to 2.5 and 10 micrometres in diameter, respectively, measured in micrograms per cubic metre ($\mu g/m^3$).

[3] Air quality categories are colour indicators used to summarise air quality measurements into 5 categories: 'Good', 'Fair', 'Poor', 'Very Poor', or 'Extremely Poor'.

[4] Limit of Reporting (LOR) is defined as the smallest or lowest concentration of a substance that a method can accurately detect. Queensland Government, 'Environmental Protection (Water) Policy 2009 – monitoring and sampling manual: Sampling design and preparation' (2018)

[5] Queensland Government's daily average guidelines for heavy metals in ambient particulate matter. These are the most appropriate Australian guidelines for heavy metals in ambient particulate matter. Queensland's daily averages are for non-directional sampling and are included only as a comparative tool. Queensland does not have guideline concentrations for selenium, mercury or molybdenum.