Air quality monitoring program in Cadia area: Initial Report

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This resource may contain images or names of deceased persons in photographs or historical content.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: Pinnacles Loop walking track. Beowa National Park. John Spencer/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.

The leftover materials from processing mined ore are called tailings. Tailings typically consist of ground rock, metals, chemicals, organic matter and effluent from the process used to extract the desired metals, in this case gold and copper. Tailings are stored in tailings storage facilities (TSFs).

This study is in response to community concerns around visible emissions from the Cadia East mine's nearby TSFs.

Study objective

This study's objective is to monitor the level of airborne particles at several strategically chosen locations around Cadia East mine. Scientists call particles that measure 2.5 microns or less in diameter PM2.5 particles. Particles that measure 10 microns or less in diameter are called PM10 particles.

Human sources of particle pollution include:

- mining
- burning fossil fuels such as in coal-fired power stations
- motor vehicle emissions
- agricultural activity
- hazard reduction burns
- incinerators
- domestic wood heaters.

Natural sources of particle pollution include dust, salt spray and bushfires.

The air quality category (AQC) for PM2.5 and PM10 particle pollution is measured by how many micrograms per cubic metre there are of each pollutant in the air. The overall AQC for a particular location is determined by the worstPM2.5 and PM10 AQC ratings.

Table 1 **NSW's air quality category for hourly and 24-hour average particulate matter. Concentration units are micrograms per cubic metre (µg/m³)**

Air quality categories (AQCs)							
Pollutant	**Averaging period**	**Units**	**Good**	**Fair**	**Poor**	**Very poor**	**Extremely poor**
PM10	Hourly	µg m^{-3}	<50	50-100	100-200	200-600	>600
	24-hour	µg m^{-3}	<33.5	33.5-50	50-75	75-100	100 and above
PM2.5	Hourly	µg m^{-3}	<25	25-50	50-100	100-300	>300
	24-hour	µg m^{-3}	<16.75	16.75-25	25-37.5	37.5-50	50 and above

Site selection

Five of the department's air quality monitoring stations (AQMSs) are in the Central Tablelands region and near the Cadia mine to monitor the levels of PM2.5 and PM10 particle pollution. The stations located at Bathurst and Orange are permanent installations, while the stations at Millthorpe, Errowanbang, and Forest Reefs are temporary. Supporting this existing air quality monitoring network are:

- Directional High Volume Air Samplers (DHVAS) at Errowanbang, Forest Reefs, Four Mile Creek, Panuara, Panuara Southwest, and Tallwood. These have been selected based on local wind patterns and the proximity of the Cadia East mine site to residential areas.
- Automatic weather stations (AWS) and DustTrak (DRX) monitors at Errowanbang and Forest Reefs.
- 36 low-cost PurpleAir (PA) sensors that report real-time PM2.5 levels. These were distributed to residents throughout the Cadia area community.

For more details, see Figures 1 and 2.

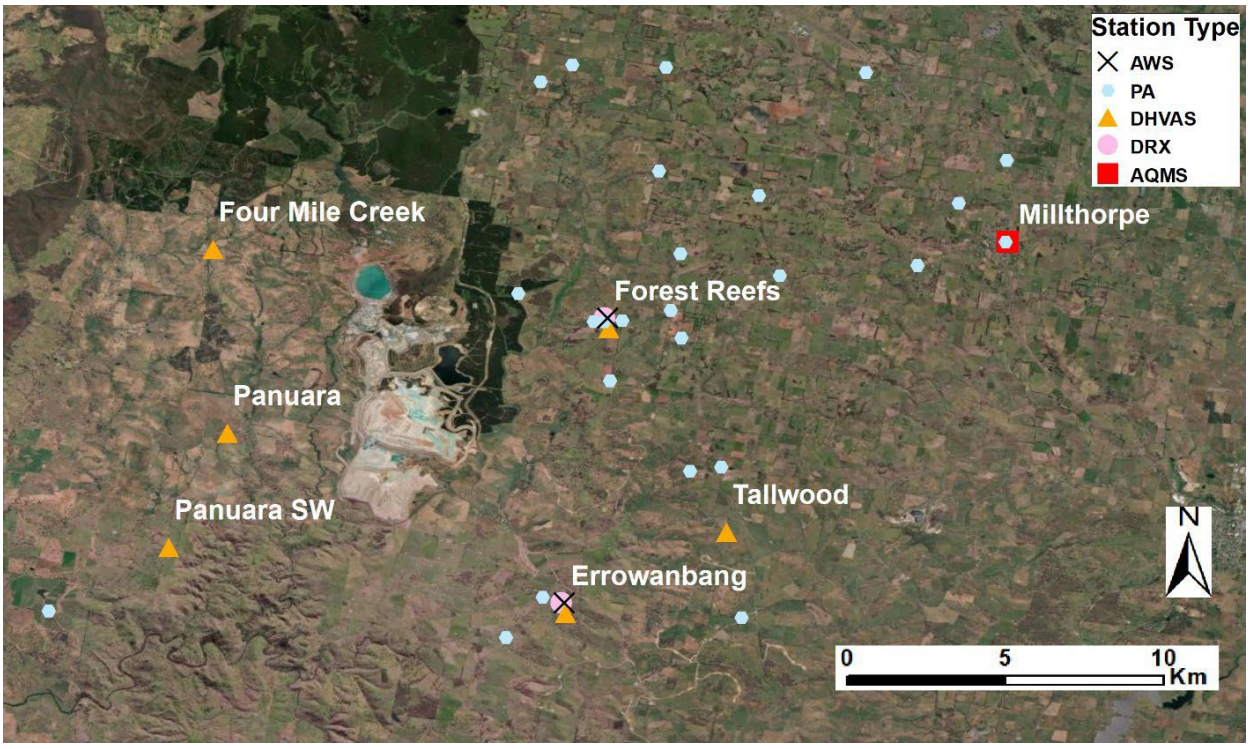

Figure 1 **Cadia area air monitoring map showing Directional High Volume Air Samplers (DHVAS), automatic weather stations (AWS), DustTrak (DRX) monitors, air quality monitoring station (AQMS) and PurpleAir (PA) low-cost sensors locations**

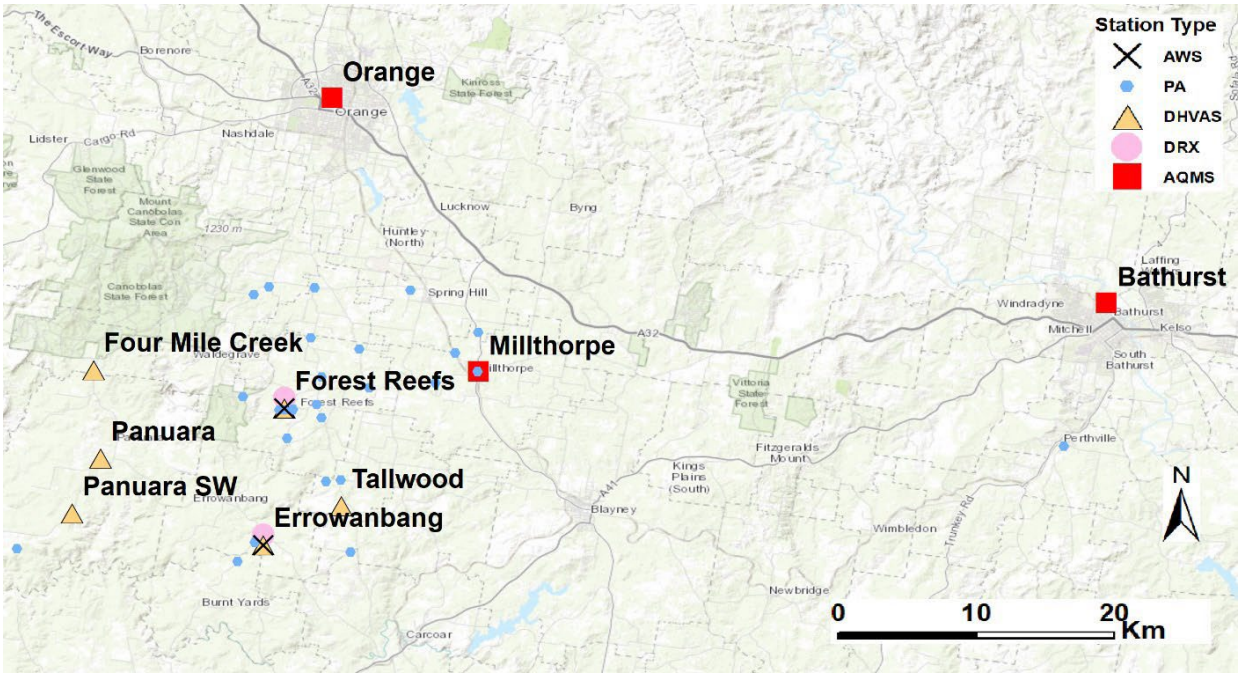

Figure 2 **Cadia area air quality monitoring map (similar as Figure 1) with respect to Central Tablelands region's Orange and Bathurst air quality monitoring stations**

Results and discussion

Particulate matter (PM)

What do the results show so far?

Daily and monthly average PM10 levels at Millthorpe (14 µg/m^3), Errowanbang (8.8 µg/m^3), and Forest Reefs AQMSs (7.8 µg/m^3), which are all near Cadia East mine, were similar to or lower than the levels recorded at the distant Orange (10.7 µg/m^3) and Bathurst (13.1 µg/m^3) stations (Figure 3). These levels suggest that the air mass in the region is well mixed and there is no likely significant source of PM10 pollution near Cadia East mine.

Note: Data from February 23–24 2024 was excluded in generating Figures 3 to 7 as air quality in Cadia area was influenced by hazard reduction burns in Victoria at that time.

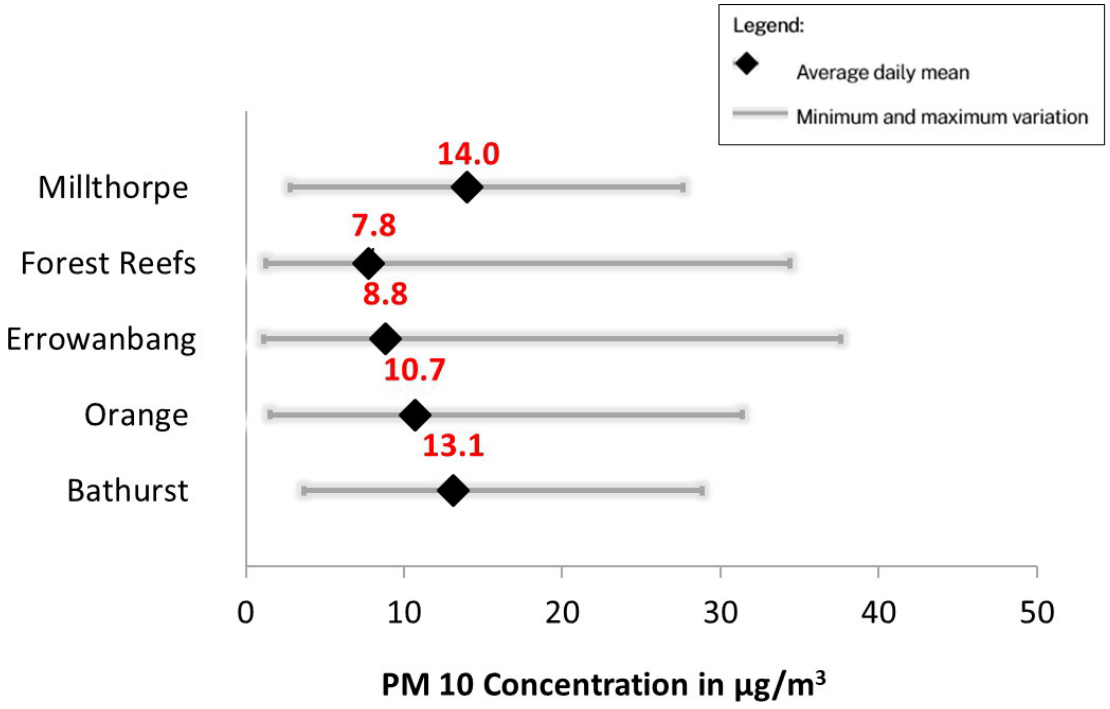

Figure 3 **Observed PM10 concentration variation in Cadia area from 10 November 2023 to 15 May 2024**

The AQMS data collected between 1 August 2023 and 15 May 2024 show that the average daily AQC was consistently good (PM2.5 levels below 25 µg/m^3 and PM10 levels below 50 µg/m^3). Notable exceptions were on 23 and 24 February 2024 when the AQC was poor at the Errowanbang and Forest Reefs sites. These exceptions coincided with hazard reduction burns in Victoria which also impacted the AQC across the Central Tablelands, Central West NSW, and Riverina-Murray regions of New South Wales.

Community air pollution monitoring

Of the 36 low-cost PurpleAir (PA) sensors in the community, several reported short-term (hourly) PM2.5 levels as high as 200 µg/m^3. These high levels may be due to highly localised sources such as wood heater smoke in cooler months or barbeques in warmer months. The daily average PM2.5 levels reported by the local network of 36 PurpleAir sensors varied between 020 µg/m^3 with a mean of 4.2 µg/m^3 between 1 July 2023 and 15 May 2024. These levels are similar to those reported by the calibrated and certified AQMSs at Errowanbang and Forest Reefs (Figure 4).

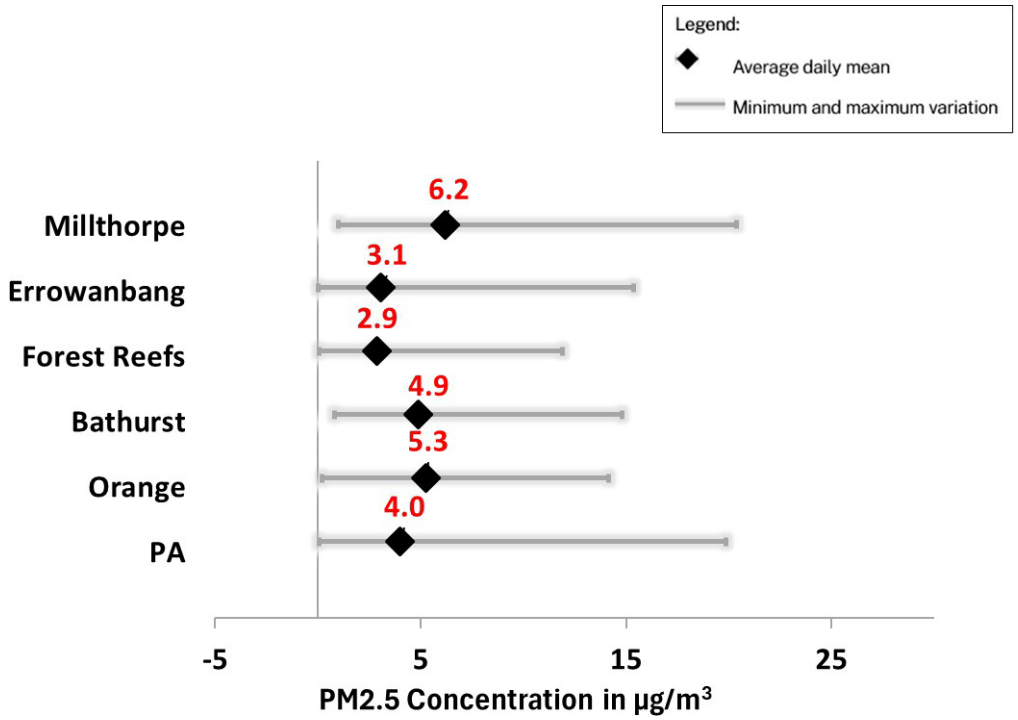

Figure 4 **Observed PM2.5 concentration variation in Cadia area from 10 November 2023 to 15 May 2024**

Measurement of metals in suspended particulate matter

Based on 54 valid samples from the local network of DHVAS, the average level of total suspended particles (TSPs) was 24.7 µg/m^3 as of 20 May 2024. Only 3 samples had detectable levels of lead (Pb) — 12, 14 and 62 micrograms per filter. This corresponds to lead concentrations of between 0.001 and 0.005 µg/m^3 (or around 0.003%) of the measured TSPs.

The TSP levels measured at the Four Mile Creek DHVAS were 21.6 µg/m^3 (considered the background level) which was similar to levels recorded at DHVAS operated downwind of Cadia East mine (Figure 5). These levels show that the mine does not make any significant contribution to the region's existing dust levels. If the mine was a primary dust source in the region, the DHVAS representing the mine source would be significantly higher than the DHVAS at Four Mile Creek.

While traces of both copper (0.015 µg/m^3) and zinc (0.008 µg/m^3) were consistently detected in DHVAS filter samples, only copper levels were marginally higher at sites upwind or downwind of Cadia East mine compared to the Four Mile Creek site. In contrast, Queensland's 24-hour average ambient particulate matter standards are 50 µg/m^3 for copper and 120 µg/m^3 for zinc. Levels of other metals (selenium, cadmium, mercury, molybdenum, nickel, and arsenic) were all below limits of detection.

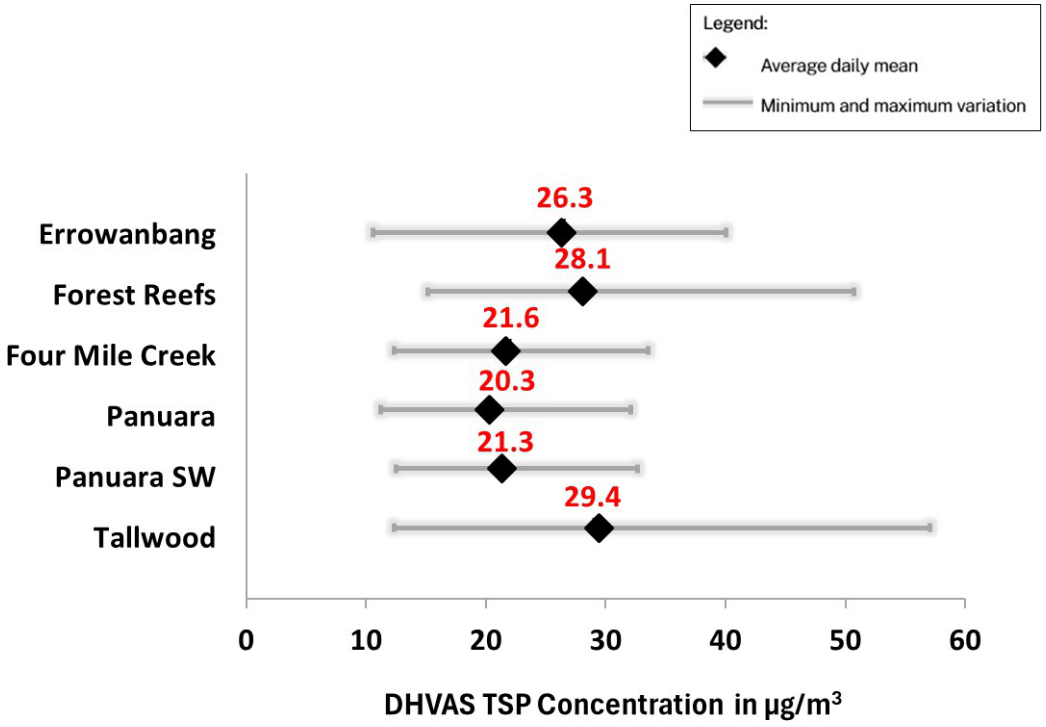

Figure 5 **Observed TSP concentration variation in Cadia area between November 2023 and May 2024**

Wind direction and particulate matter

At Millthorpe, winds were typically calm and influenced by the surrounding structures and buildings. Forest Reefs is slightly elevated and experienced stronger winds from the northeast. Errowanbang typically experienced easterly winds.

Pollution rose plots are used by scientists to classify pollutant levels based on wind direction. These plots can also be used to predict both the frequency and level of particle pollution based on different wind directions. During the study period (August 2023 to May 2024), there was no evidence of high particle pollution (PM2.5 or PM10) from Cadia mine.

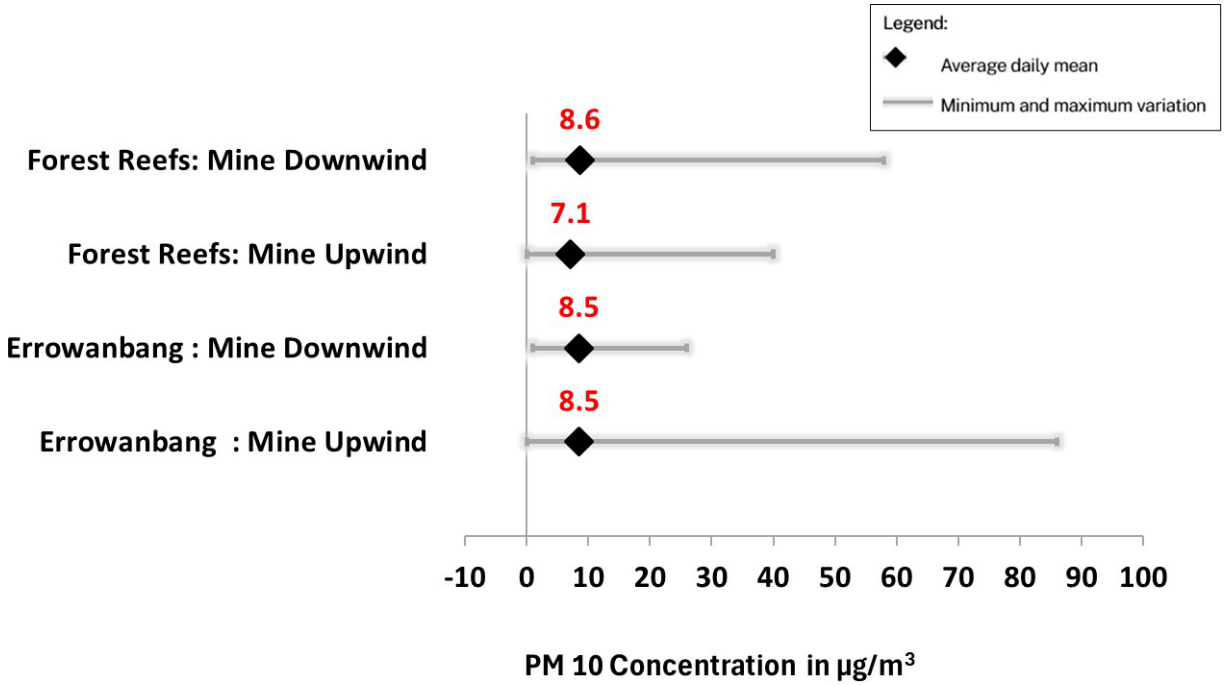

Figure 6 **Observed PM10 concentrations downwind and upwind of Cadia mine at Forest Reefs and Errowanbang between November 2023 and May 2024**

The mean concentration of PM10 observed downwind of the mine compared to upwind of the mine was:

- Forest Reefs: 8.6 µg/m^3 downwind compared to 7.1µg/m^3 upwind.
- Errowanbang: 8.5 µg/m^3 compared to 8.5 µg/m^3 upwind.

The slight PM10 concentrations difference between downwind and upwind of the mine would not indicate any substantial or aggravated dust pollution (Figure 6).

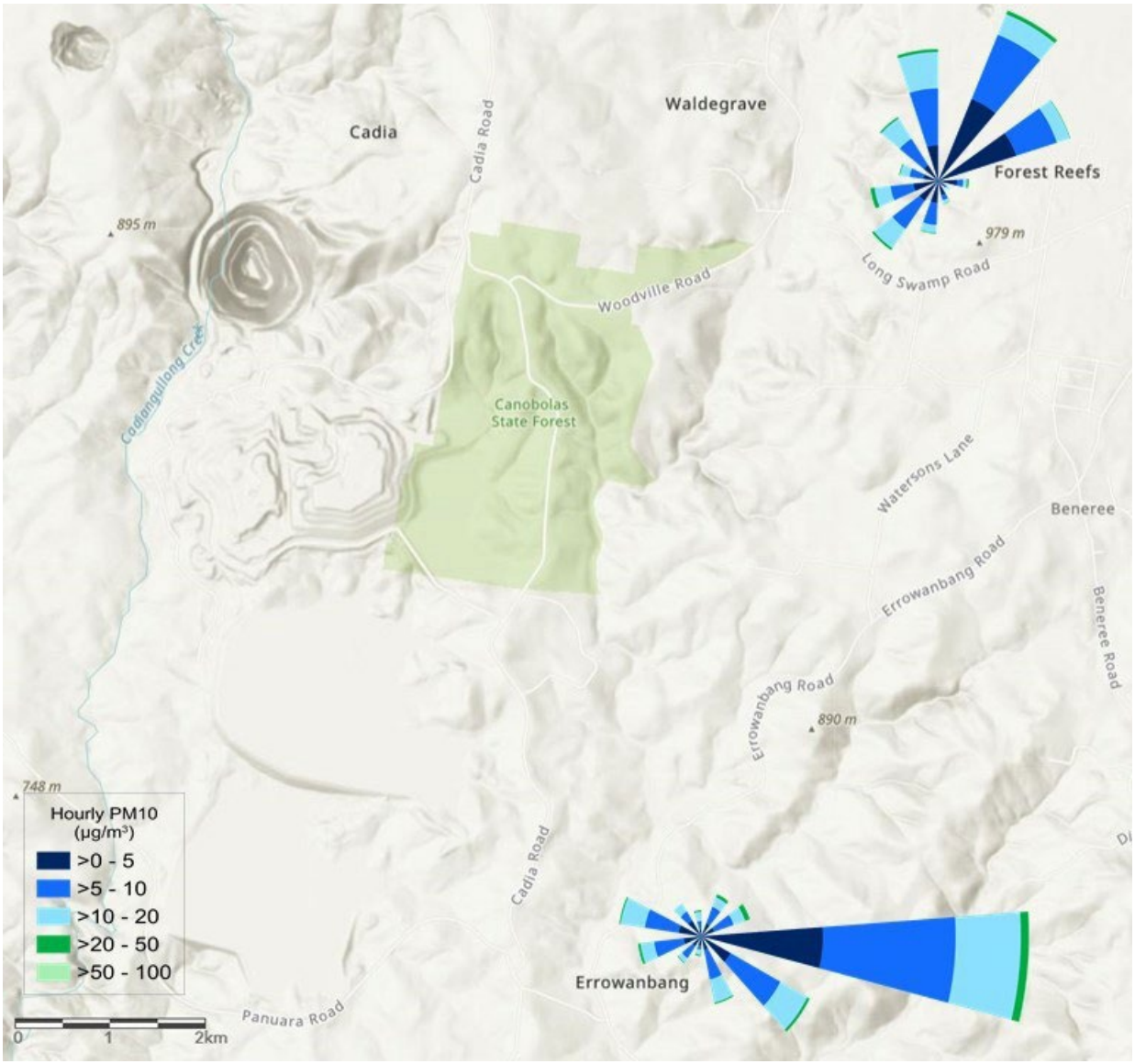

Figure 7 **Observed PM10 concentration variation at Forest Reefs and Errowanbang regarding wind direction between November 2023 and May 2024**

What happens next?

The NSW EPA will continue to monitor air quality in the Cadia area and provide ongoing updates as new seasonal data becomes available.

Annex I: Cadia area air quality monitoring site information

Table 2 **Cadia area air quality monitoring site information**

Site name	Site purpose	Equipment	Establishment date
Four Mile Creek (NW of mine)	Background	DHVAS	1/02/2024
Forest Reefs (NE of mine)	Source sampling and indicative monitoring	AWS, DHVAS, DRX	14/11/2023
Panuara (W of mine)	Source sampling	DHVAS	1/02/2024
Panuara SW (SW of mine)	Source sampling	DHVAS	1/02/2024
Errowanbang (S of mine)	Source sampling and indicative monitoring	AWS, DHVAS, DRX	14/11/2023
Tallwood (SE of mine)	Source sampling	DHVAS	27/03/2024
Millthorpe	Air Quality Monitoring Site	AQMS	28/07/2023
Orange	Reference site	AQMS	
Bathurst	Reference site	AQMS	

Observed concentration data

Table 3 **Mean, minimum and maximum concentrations of PM2.5 particles between 10 November 2023 and 15 May 2024**

Station	PM2.5 mean (µg/m^3)	PM2.5 minimum (µg/m^3)	PM2.5 maximum (µg/m^3)
Forest Reefs	2.9	0	11.9
Errowanbang	3.1	0	15.4
Millthorpe	6.2	1	20.4
Orange	5.3	0.2	14.2
Bathurst	4.9	0.8	14.8
PA network	4	0	19.9

Table 4 **Observed mean, minimum and maximum concentrations of PM10 particles between 10 November 2023 and 15 May 2024**

Station	PM10 mean (µg/m^3)	PM10 minimum (µg/m^3)	PM10 maximum (µg/m^3)
Forest Reefs	7.8	1.3	34.4
Errowanbang	8.8	1.1	37.6
Millthorpe	14	2.8	27.6
Orange	10.7	1.6	31.4
Bathurst	13.1	13.7	28.9

Table 5 **Observed mean, minimum and maximum TSP between 10 November 2023 and 15 May 2024**

Station	TSP mean (µg/m^3)	TSP minimum (µg/m^3)	TSP maximum (µg/m^3)
Forest Reefs	28.1	15.2	50.7
Errowanbang	26.3	10.6	40.0
Four Mile Creek	21.6	12.3	33.5
Panuara	20.3	11.2	32.1
Panuara SW	21.3	12.5	32.7
Tallwood	29.4	12.3	57.1

Annex II: Cadia area weather conditions during November 2023 to May 2024

Cadia area experienced above-average rainfall and warmer weather conditions during the reported monitoring period (shown in Figures 8 and 9).

Figure 8 **New South Wales rainfall deciles between November 2023 and May 2024, measured against data for between 1900 and May 2024 (Commonwealth of Australia 2024, Bureau of Meteorology)**

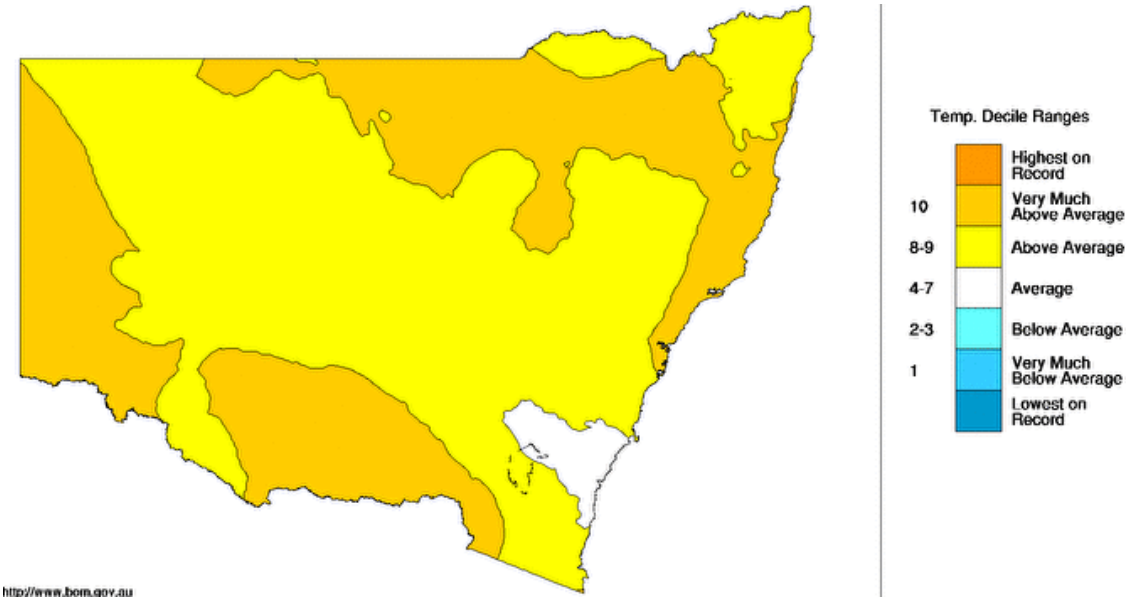

Figure 9 **New South Wales maximum temperature deciles between December 2023 and May 2024, measured against data for between 1900 and May 2024 (Commonwealth of Australia 2024, Bureau of Meteorology)**