



AIR QUALITY IMPACT ASSESSMENT BLAKEBROOK QUARRY MODIFICATION 4

Element Environment

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Air Quality Impact Assessment

Blakebrook Quarry Modification 4

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1 INTRODUCTION

Todoroski Air Sciences has prepared this report for Element Environment for the proposed modification to an existing asphalt plant within the Blakebrook Quarry site at Blakebrook, New South Wales (NSW) (hereafter referred to as the Project).

Key aspects of the modification sought for the Project is to allow for the an increase in the asphalt production to 100,000 tonnes per annum (tpa), the receipt and processing of up to 15,000tpa of Reclaimed Asphalt Pavement (RAP), 10,000tpa of recovered glass sand, 1,500tpa of crumb rubber and 350tpa of TonerPlas and a change in the operating hours for the asphalt plant to 24/7 operations.

The report presents an assessment of potential air quality impacts and greenhouse gas emissions associated with the Project. This air quality impact assessment has been prepared in general accordance with the New South Wales (NSW) Environment Protection Authority (EPA) document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2022**).

To assess the potential air quality impacts associated with the Project, this report comprises:

- ✦ A background to the Project and description of the proposed operations;
- ✦ A review of the existing meteorological and air quality environment surrounding the site;
- ✦ A description of the dispersion modelling approach and emission estimation used to assess potential air quality impacts; and,
- ✦ Presentation of the predicted results and discussion of the potential air quality impacts and associated mitigation and management measures.



2 PROJECT BACKGROUND

2.1 Local setting

The Project site is located at 550 Nimbin Road, Blakebrook, approximately 6.3 kilometres (km) northwest of Lismore. The area surrounding the Project site is predominantly comprised of rural agricultural land with scattered dwellings. The Project is located within the Blakebrook Quarry, which is owned and operated by Lismore City Council (LCC). The nearest residential dwelling is approximately 0.6km to the southwest of the Project site.

Figure 2-1 presents the location of the Project with reference to the assessment locations considered in this assessment. **Table 2-1** identifies each of the assessment locations.

Table 2-1: Assessment locations

Assessment location ID	Address	Description	Approximate distance to Project (km)
R1	538 Nimbin Road	Residential	0.6
R2	22 Keerong Road	Residential	0.9
R3	145 Pinchin Road	Residential	2.9
R4	166 Keerong Road	Residential	1.1
R5	365 Booerie Creek Road	Residential	1.2
R6	210 Booerie Creek Road	Residential	1.1
R7	484 Nimbin Road	Residential	0.6
R8	533 Nimbin Road	Residential	0.7
R9	577 Nimbin Road	Residential	1.1
R10	28 Keerong Road	Residential	1.0
R11	37 Keerong Road	Residential	1.2
R12	38 Keerong Road	Residential	1.2
R13	387 Booerie Creek Road	Residential	1.3
R14	329A Booerie Creek Road	Residential	1.3
R15	289 Booerie Creek Road	Residential	1.3
R16	277 Booerie Creek Road	Residential	1.3
R17	263 Booerie Creek Road	Residential	1.2

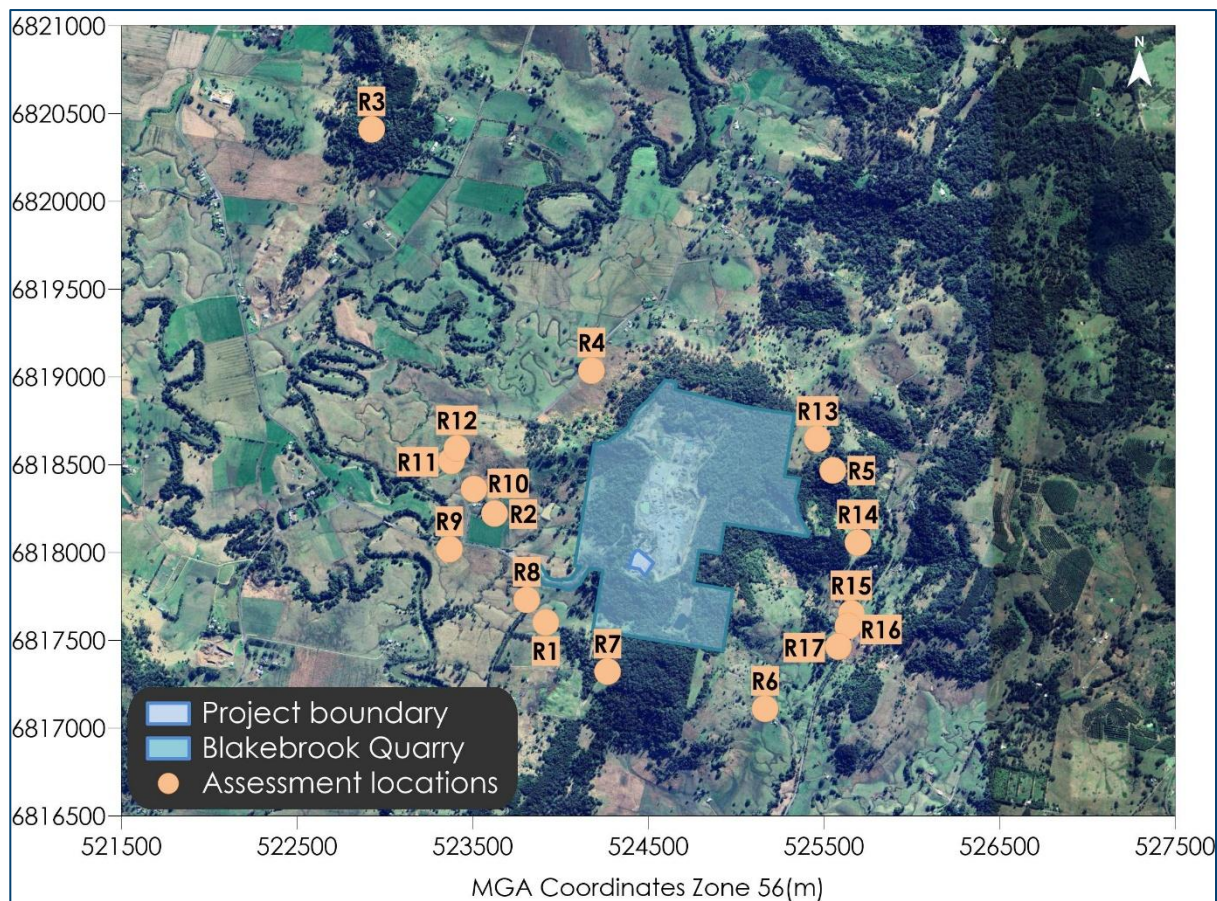


Figure 2-1: Project setting

Figure 2-2 presents a pseudo three-dimensional visualisation of the topography in the general vicinity of the Project. The Project site is situated on top of a ridge with elevation decreasing west of the site and mountainous terrain located to the east. There are several drainage areas in the region that may result in channels for air movement.

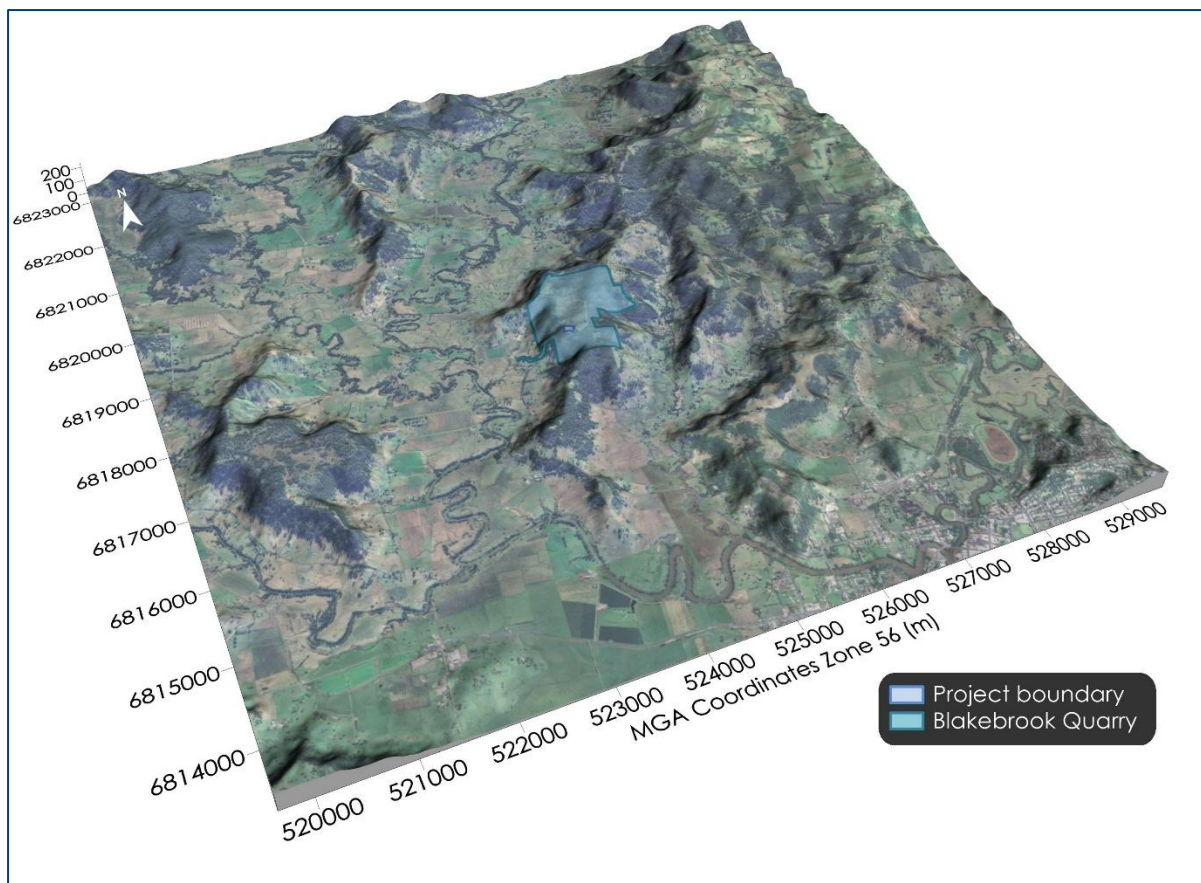


Figure 2-2: Representative visualisation of topography in the area surrounding the Project

2.2 Project description

The existing asphalt plant is operated by Downer EDI Works Pty Ltd (Downer). The quarry and ancillary asphalt plant at the site currently operate under State Significant Development (SSD) consent MP07_0020 which allows for the following:

- ✦ operation on the site until 31 December 2039;
- ✦ transport up to 600,000 tonnes of quarry products from the site per calendar year; and,
- ✦ transport up to 50,000 tonnes of asphalt from the site per calendar year.

Downer is now seeking approval to further modify development consent MP07_0020, under Section 4.55(2) of the EP&A Act, to allow:

- ✦ the receipt and processing of up to 15,000tpa of RAP and any-one-time storage of up to 10,000 tonnes (t) of RAP (unprocessed and processed combined) on the site;
- ✦ the receipt and processing of up to 10,000tpa of recovered glass sand and any-one-time storage of up to 2,500t of recovered glass sand on the site;
- ✦ the receipt and processing of up to 1,500tpa of crumb rubber and 350tpa of TonerPlas and any-one-time storage of up to 45t of crumb rubber and 20t of TonerPlas on the site;

- ✦ an increase in asphalt production and transportation limits from 50,000tpa to 100,000tpa;
- ✦ a change in operating hours of the asphalt plant (not the quarry) to allow 24/7 operations; and,
- ✦ minor administrative changes to a number of the existing consent conditions.

No changes are proposed to the existing operations of the quarry.

An indicative site layout is presented in **Figure 2-3**.

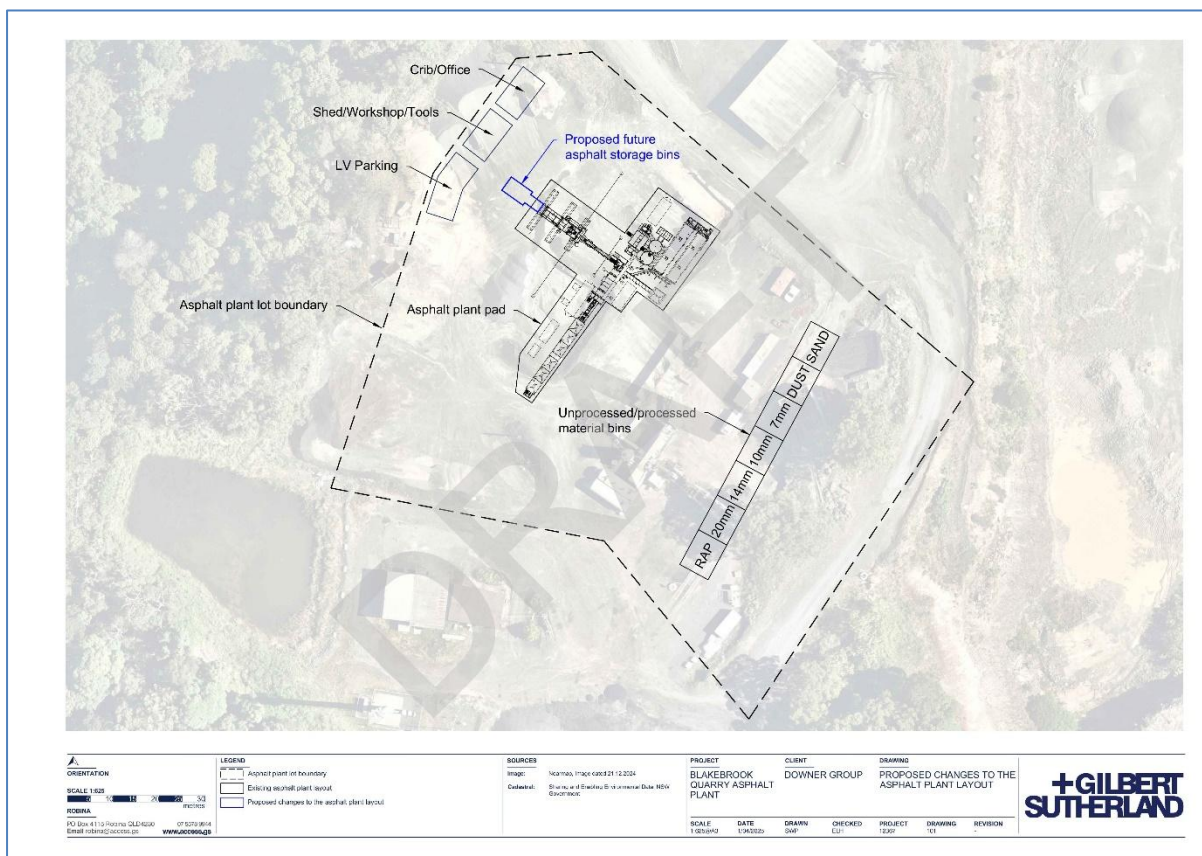


Figure 2-3: Indicative site layout

3 AIR QUALITY CRITERIA

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. The sections below identify the potential air emissions generated by the Project and the applicable air quality criteria.

3.1 Air pollutants

Table 3-1 summarises the air quality goals that are relevant to this assessment as outlined in the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (NSW EPA, 2022)*.

The air quality goals for key pollutants relate to the total pollutant burden in the air and not just the contribution from the Project. Consideration of background pollutant levels needs to be made when using these goals to assess potential impacts.

Table 3-1: NSW EPA air quality impact assessment criteria

Pollutant	Averaging Period	Criterion	Assessment location
TSP	Annual	90 µg/m ³	Receptor
PM ₁₀	Annual	25 µg/m ³	Receptor
	24 hour	50 µg/m ³	Receptor
PM _{2.5}	Annual	8 µg/m ³	Receptor
	24 hour	25 µg/m ³	Receptor
Deposited dust	Annual	2 g/m ² /month	Receptor
		4 g/m ² /month	Receptor
SO ₂	1 hour	215 µg/m ³	Receptor
	24 hour	57 µg/m ³	Receptor
NO ₂	1 hour	164 µg/m ³	Receptor
	Annual	31 µg/m ³	Receptor
CO	15 minute	100,000 µg/m ³	Receptor
	1 hour	30,000 µg/m ³	Receptor
	8 hour	10,000 µg/m ³	Receptor
Arsenic	1 hour	0.09 µg/m ³	Boundary
Beryllium	1 hour	0.004 µg/m ³	Boundary
Cadmium	1 hour	0.018 µg/m ³	Boundary
Chromium (VI)	1 hour	0.09 µg/m ³	Boundary
Copper	1 hour	3.7 µg/m ³	Boundary
Lead	Annual	0.5 µg/m ³	Receptor
Manganese	1 hour	18 µg/m ³	Boundary
Mercury	1 hour	0.18 µg/m ³	Boundary
Nickel	1 hour	0.18 µg/m ³	Boundary
Zinc	1 hour	90 µg/m ³	Boundary
Acetone	1 hour	22,000 µg/m ³	Boundary
Acetaldehyde	1 hour	42 µg/m ³	Boundary
Benzene	1 hour	29 µg/m ³	Boundary
Formaldehyde	1 hour	20 µg/m ³	Boundary
Toluene	1 hour	360 µg/m ³	Boundary
Xylene	1 hour	190 µg/m ³	Boundary
PAH (total)	1 hour	0.4 µg/m ³	Boundary

Source: **NSW EPA, 2022**

µg/m³ = micrograms per cubic metre

g/m²/month = grams per square metre per month

3.2 Odour

3.2.1 Introduction

Odour in a regulatory context needs to be considered in two similar, but different ways depending on the situation.

NSW legislation prohibits emissions that cause odour, including offensive odour, to occur at any off-site receptor. Offensive odour is evaluated in the field by authorised officers, who are obliged to consider the odour in the context of its receiving environment, frequency, duration, character etc. and to determine whether the odour would interfere with the comfort and repose of the normal person unreasonably. The POEO Act defines the term *offensive odour* to mean an odour—

"(a) that, by reason of its strength, nature, duration, character or quality, or the time at which it is emitted, or any other circumstances—

(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or

(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or

(b) that is of a strength, nature, duration, character or quality prescribed by the regulations or that is emitted at a time, or in other circumstances, prescribed by the regulations."

In this context, the concept of offensive odour is applied to operational facilities and relates to actual emissions in the air.

However, in the approval and planning process for proposed new operations or modifications to existing projects, no actual odour exists, and it is necessary to consider hypothetical odour. In this context, odour concentrations are used and are defined in odour units. The number of odour units represents the number of times that the odour would need to be diluted to reach a level that is just detectable to the human nose. Thus, by definition, odour less than an odour unit (1 OU), would not be detectable to most people.

The range of a person's ability to detect odour varies greatly in the population, as does their sensitivity to the type of odour. The wide-ranging response in how any particular odour is perceived by any individual poses specific challenges in the assessment of odour impacts and the application of specific air quality goals related to odour. The *Technical Framework (NSW DEC, 2006)* sets out a framework specifically to deal with such issues.

It needs to be noted that the term "odour" refers to complex mixtures of odours, and not "pure" odour arising from a single chemical. Odour from a single, known chemical rarely occurs (when it does, it is best to consider that specific chemical in terms of its concentration in the air). In most situations odour will be comprised of a cocktail of many substances that is referred to as a complex mixture of odour, or more simply odour.

For activities with potential to release significant odour it may be necessary to predict the likely odour impact that may arise. This is done by using air dispersion modelling which can calculate the level of



dilution of odours emitted from the source at the point that such odour reaches surrounding receptors. This approach allows the air dispersion model to produce results in terms of odour units.

The NSW criteria for acceptable levels of odour range from 2 to 7OU, with the more stringent 2OU criteria applicable to densely populated urban areas and the 7OU criteria applicable to sparsely populated rural areas, as outlined below.

3.2.2 Complex Mixtures of Odorous Air Pollutants

Table 3-2 presents the assessment criteria as outlined in the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (NSW EPA, 2022)*. This criterion has been refined to take into account the population densities of specific areas and is based on a 99th percentile of dispersion model predictions calculated as 1-second averages (nose-response time).

Table 3-2: Impact assessment criteria for complex mixtures of odorous air pollutants (nose-response-time average, 99th percentile)

Population of affected community	Impact assessment criteria for complex mixtures of odorous air pollutants (OU)
Urban ($\geq \sim 2000$) and/or schools and hospitals	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single rural residence ($\leq \sim 2$)	7.0

Source: **NSW EPA, 2022**

The NSW odour goals are based on the risk of odour impact within the general population of a given area. In sparsely populated areas, the criteria assume there is a lower risk that some individuals within the community would find the odour unacceptable, hence higher criteria apply.

Peak-to-mean factors are applied to account for any odour fluctuation above and below the mean odour level of the 1-hour averaging time. The criteria in **Table 3-2** are compared with modelled results which include peaking factors to account for the time-averaging limitations of air dispersion models. The peak-to-mean factors developed by **Katestone Scientific Pty Ltd (1995, 1998)** for the NSW EPA are applied to convert the modelled (1-hour) averaging time to 1-second peak concentrations.

A summary of the peak-to-mean values is provided in **Table 3-3**.

Table 3-3: Peak-to-mean values

Source Type	Pasquill-Gifford stability class	Near field P/M 60*	Far field P/M 60*
Area	A, B, C, D	2.5	2.5
	E, F	2.3	1.9
Line	A-F	6	6
Surface point	A, B, C	12	4
	D, E, F	25	7
Tall wake-free point	A, B, C	17	3
	D, E, F	35	6
Wake-affected point	A-F	2.3	2.3
Volume	A-F	2.3	2.3

*Ratio of peak 1-second average concentrations

4 EXISTING ENVIRONMENT

This section describes the existing environment including the climate and ambient air quality in the area surrounding the Project.

4.1 Local climatic conditions

Long-term climatic data from the closest Bureau of Meteorology (BoM) weather station with available data at Casino Airport AWS (Site No. 058208) were analysed to characterise the local climate in the proximity of the Project. Casino Airport AWS is located approximately 23.0km southwest of the Project.

Table 4-1 and **Figure 4-1** present a summary of data from the Casino Airport AWS collected over a 15 to 30 year period for the various meteorological parameters.

The data indicate that January is the hottest month with a mean maximum temperature of 30.6 degrees Celsius (°C) and July is the coldest month with a mean minimum temperature of 6.6°C.

Rainfall decreases during the cooler months, with an annual average rainfall of 1078.4 millimetres (mm) over 92.4 days. The data indicate that February and March is the wettest month with an average rainfall of 153.7mm over 9.8 and 11.6 days, respectively, and July is the driest month with an average rainfall of 32.5mm over 5.0 days.

Relative humidity levels exhibit variability over the day and seasonal fluctuations. Mean 9am relative humidity ranges from 61% in September and October to 81% in March. Mean 3pm relative humidity levels range from 41% in August and September to 58% in February.

Wind speeds exhibit seasonal variations with a greater spread of wind speed records between 9am and 3pm conditions during the warmer months compared to the cooler months. Mean 9am wind speeds range from 9.9 kilometres per hour (km/h) in March to 12.6km/h in September. Mean 3pm wind speeds range from 12.7km/h in May to 19.5km/h in October.

Table 4-1: Monthly climate statistics summary – Casino Airport AWS

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature													
Mean max. temp. (°C)	30.6	29.9	28.4	26.1	23.1	20.8	20.8	22.8	25.8	27.6	29.0	30.2	26.3
Mean min. temp. (°C)	19.1	18.9	17.8	14.2	10.7	8.2	6.6	7.2	10.3	13.5	15.9	17.9	13.4
Rainfall													
Rainfall (mm)	127.7	153.7	153.7	73.3	81.1	68.3	32.5	42.7	35.4	70.7	106.0	130.9	1078.4
No. of rain days (≥1mm)	9.2	9.8	11.6	8.4	7.8	6.0	5.0	4.3	4.7	7.2	8.7	9.7	92.4
9am conditions													
Mean temp. (°C)	23.6	22.8	21.3	19.9	16.7	13.9	13.1	15.0	19.1	21.3	21.8	23.4	19.3
Mean R.H. (%)	75.0	79.0	81.0	73.0	77.0	77.0	73.0	67.0	61.0	61.0	68.0	69.0	72.0
Mean W.S. (km/h)	10.4	10.1	9.9	10.4	10.7	10.8	11.2	11.7	12.6	12.5	11.9	11.3	11.1
3pm conditions													
Mean temp. (°C)	28.7	28.0	26.8	24.6	21.9	19.6	19.6	21.2	24.3	25.7	26.8	28.5	24.6
Mean R.H. (%)	54.0	58.0	57.0	53.0	54.0	53.0	46.0	41.0	41.0	44.0	50.0	50.0	50.0
Mean W.S. (km/h)	17.6	16.4	15.7	14.5	12.7	13.2	14.1	16.0	18.5	19.5	18.4	18.4	16.2

Source: **Bureau of Meteorology, 2025**

R.H. – Relative Humidity, W.S. – wind speed

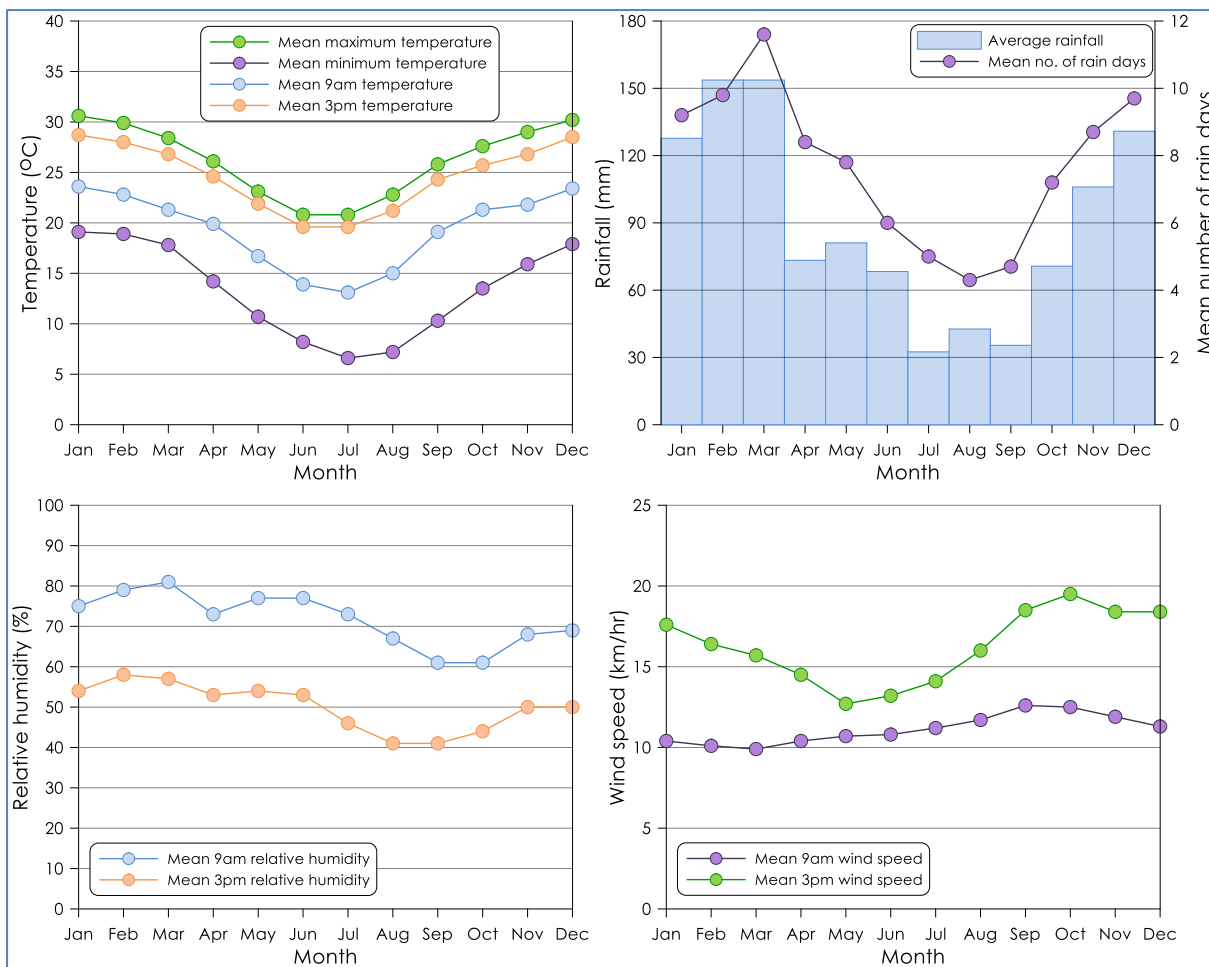


Figure 4-1: Monthly climate statistics summary – Casino Airport AWS

4.2 Local meteorological conditions

Annual and seasonal windroses for the Casino Airport AWS during the 2021 calendar period are presented in **Figure 4-2**. The 2021 calendar year was selected as the meteorological year for the dispersion modelling based on an analysis of data trends in meteorological data recorded and appropriate monitoring data for the area as outlined in **Appendix A**.

Analysis of the windroses shows that the wind directions predominately follow along a southeast to northwest axis with the greatest proportion of winds from the southeast. In summer, winds primarily occur from the east-southeast to south-southeast. In autumn, winds are greatest from the southeast with varied winds from the northwest quadrant. The winter windrose shows an opposite distribution as the summer, with winds occurring from the west-northwest to northwest. In spring the windrose shows a similar distribution pattern as the annual windrose with winds following along a southeast to northwest axis.

Annual and seasonal windroses for the Blakebrook Quarry weather station data for July 2022 to July 2025 is presented in **Figure 4-3**. The wind distribution patterns reflect the influence of the weather station’s location in relation to the local terrain and site features.

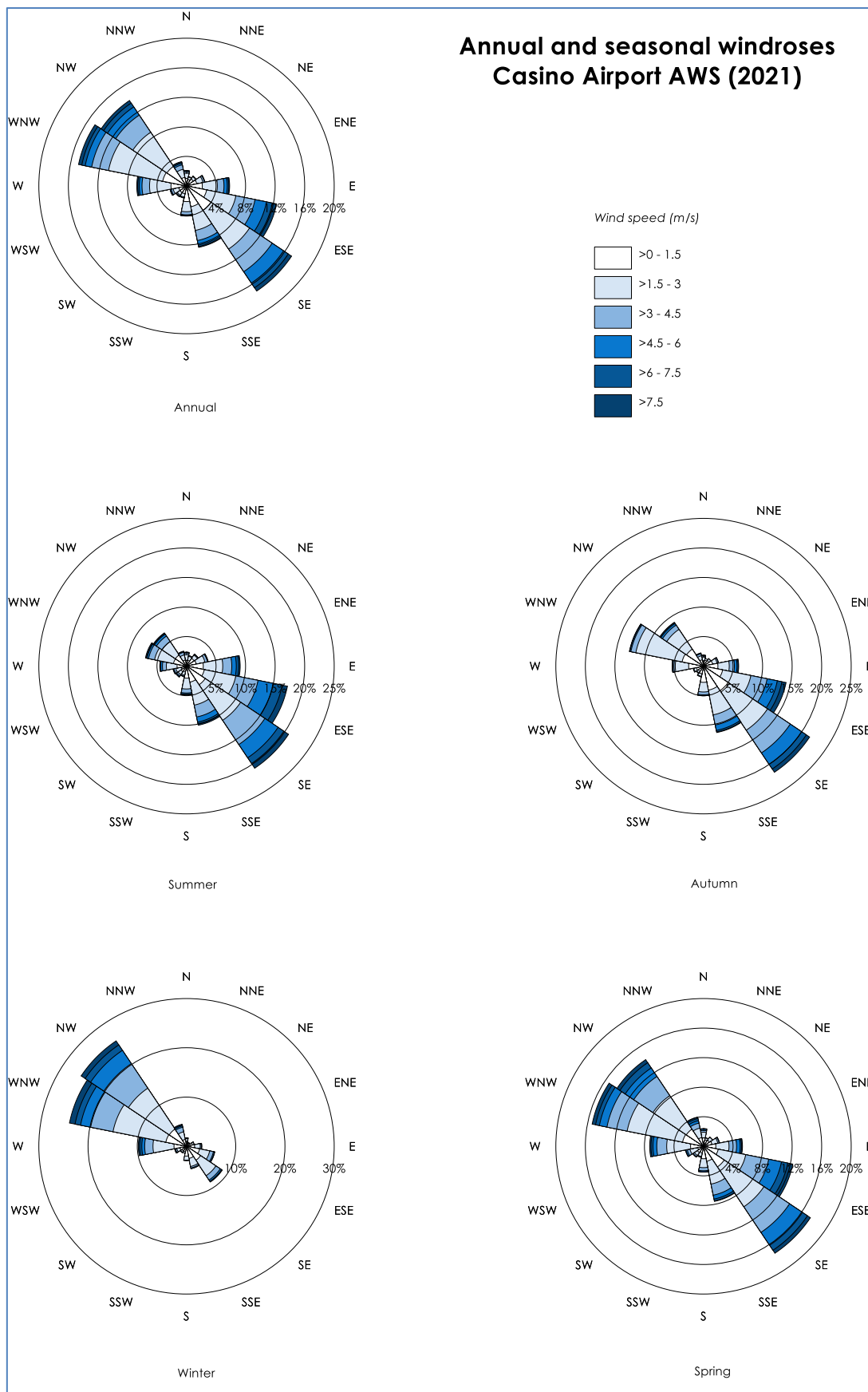


Figure 4-2 : Annual and seasonal windroses – Casino Airport AWS (2021)

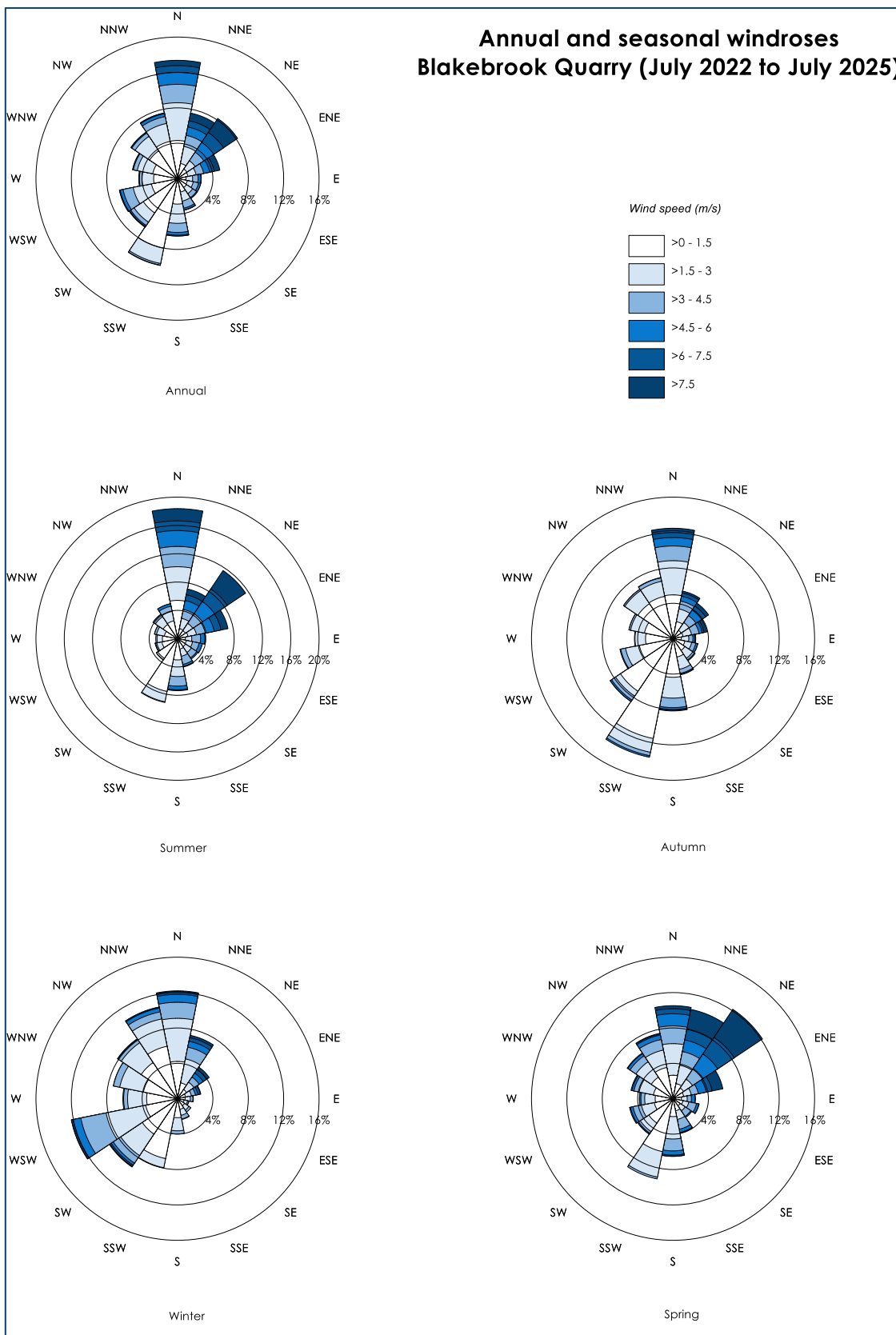


Figure 4-3: Annual and seasonal windroses – Blakebrook Quarry Weather Station (July 2022 to July 2025)

4.3 Local air quality monitoring

The main sources of air pollutants in the area surrounding the site would include emissions from agricultural activities, extractive industries such as the nearby Blakebrook Quarry, and other anthropogenic activities such as domestic wood heaters and motor vehicle exhaust.

Ambient air quality monitoring data from the Project site are not available. Therefore, the available data from the nearest air quality monitors operated by the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) were used to quantify the existing background level for assessed pollutants at the Project site.

These include the Coffs Harbour, Armidale and Port Macquarie monitors. The Coffs Harbour, Armidale and Port Macquarie monitors are located approximately 170.4km south, 247km southwest and 300km south of the Project, respectively.

The Coffs Harbour, Armidale and Port Macquarie monitors are positioned in more urban areas and would be subject to greater anthropogenic sources resulting in higher particulate levels compared to the Project site. Thus, it has been conservatively assumed that the background levels at these sites are to be used to quantify the existing ambient levels of air pollutants at the Project site.

4.3.1 PM₁₀ monitoring

A summary of the available PM₁₀ monitoring data from 2020 to 2024 for the monitoring stations is presented in **Table 4-2**. Recorded 24-hour average PM₁₀ concentrations are presented in **Figure 4-4**.

A review of **Table 4-2** indicates that the annual average PM₁₀ concentrations for the monitoring stations were below the relevant criterion of 25µg/m³ for all years.

The maximum 24-hour average PM₁₀ concentrations were found to exceed the relevant criterion of 50µg/m³ on occasion during the review period. Anomalously high PM₁₀ concentrations recorded at the monitors during January 2020 is attributed to wildfires and the drought period.

Table 4-2: Summary of PM₁₀ levels from monitoring stations (µg/m³)

Year	Coffs Harbour	Armidale	Port Macquarie	Criterion
	Annual average			
2020	11.9	13.7	14.4	25
2021	10.0	10.4	10.8	25
2022	9.3	9.7	9.1	25
2023	10.5	11.9	11.9	25
2024	10.5	9.1	11.2	25
Year	Maximum 24-hour average			Criterion
2020	65.2	112.5	249.9	50
2021	26.0	41.0	31.9	50
2022	32.1	50.6	31.5	50
2023	34.5	37.7	36.2	50
2024	25.4	39.1	57.9	50
2020	65.2	112.5	249.9	50

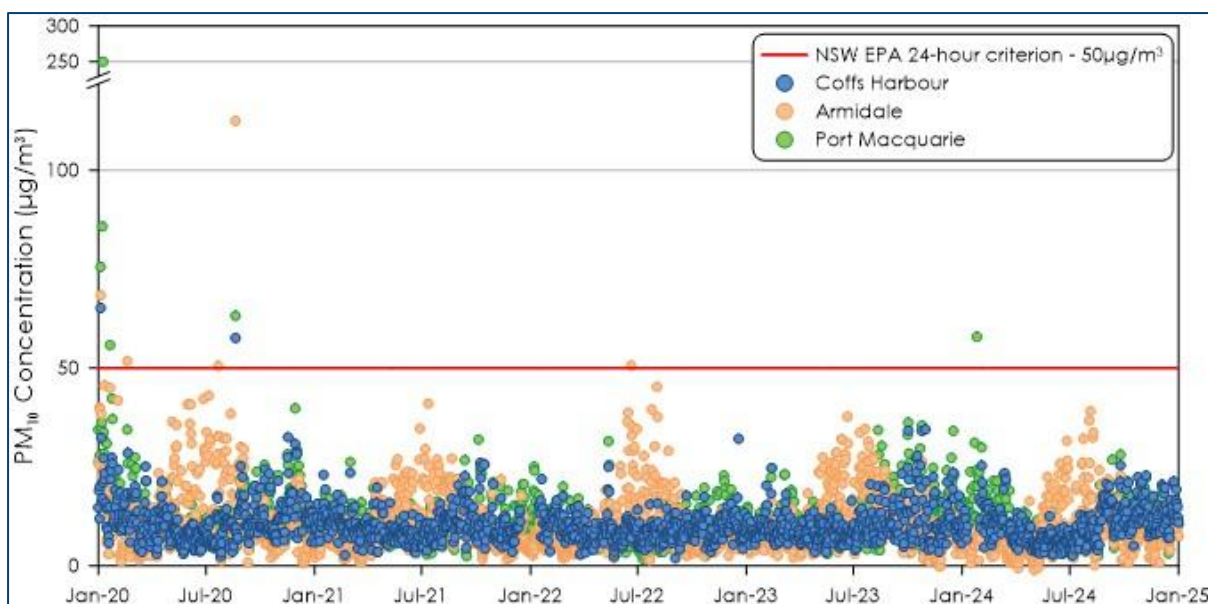


Figure 4-4: 24-hour average PM₁₀ concentrations

4.3.2 PM_{2.5} monitoring

A summary of the available PM_{2.5} monitoring data from 2020 to 2024 for the monitoring stations is presented in **Table 4-3**. Recorded 24-hour average PM_{2.5} concentrations are presented in **Figure 4-5**.

Table 4-3 indicates that the annual average PM_{2.5} concentrations for the Armidale monitoring station were above the relevant criterion of 8µg/m³ in 2020 and 2023.

The maximum 24-hour average PM_{2.5} concentrations were found to exceed the relevant criterion of 25µg/m³ for all years of the review period at Armidale and on occasion at Coffs Harbour and Port Macquarie. Similar to the PM₁₀ monitoring data, the mass bushfires affecting NSW in 2020 are seen in the PM_{2.5} monitoring data.

Table 4-3: Summary of PM_{2.5} levels from monitoring stations (µg/m³)

Year	Coffs Harbour	Armidale	Port Macquarie	Criterion
	Annual average			
2020	5.3	9.2	6.5	8
2021	3.9	7.2	4.6	8
2022	3.2	7.1	3.3	8
2023	4.3	8.6	5.1	8
2024	4.5	6.7	4.6	8
Year	Maximum 24-hour average			Criterion
2020	44.9	53.7	220.5	25
2021	12.6	35.0	14.7	25
2022	9.7	44.8	9.4	25
2023	17.7	31.8	30.5	25
2024	15.2	34.8	38.7	25

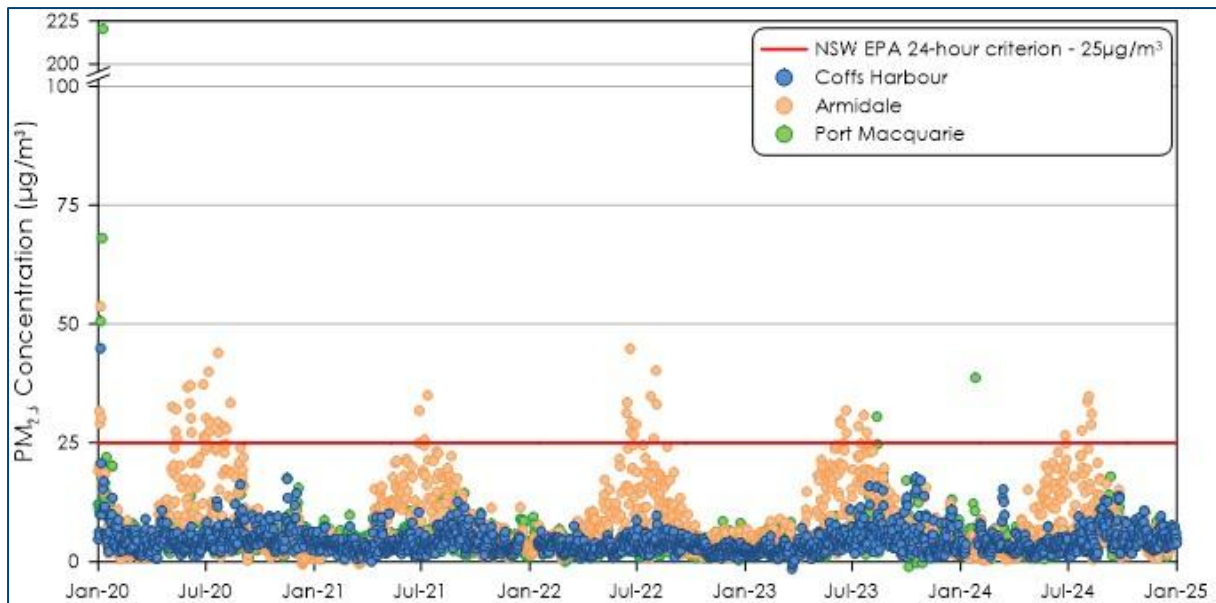


Figure 4-5: 24-hour average PM_{2.5} concentrations

4.3.3 SO₂ monitoring

Figure 4-6 and **Figure 4-7** present the daily maximum 1-hour average and daily 24-hour average SO₂ monitoring data, respectively, from the nearest NSW DCCEE monitoring site with available data. The data show that the levels were well below the 1-hour average and 24-hour average SO₂ criteria of 215µg/m³ and 57µg/m³, respectively.

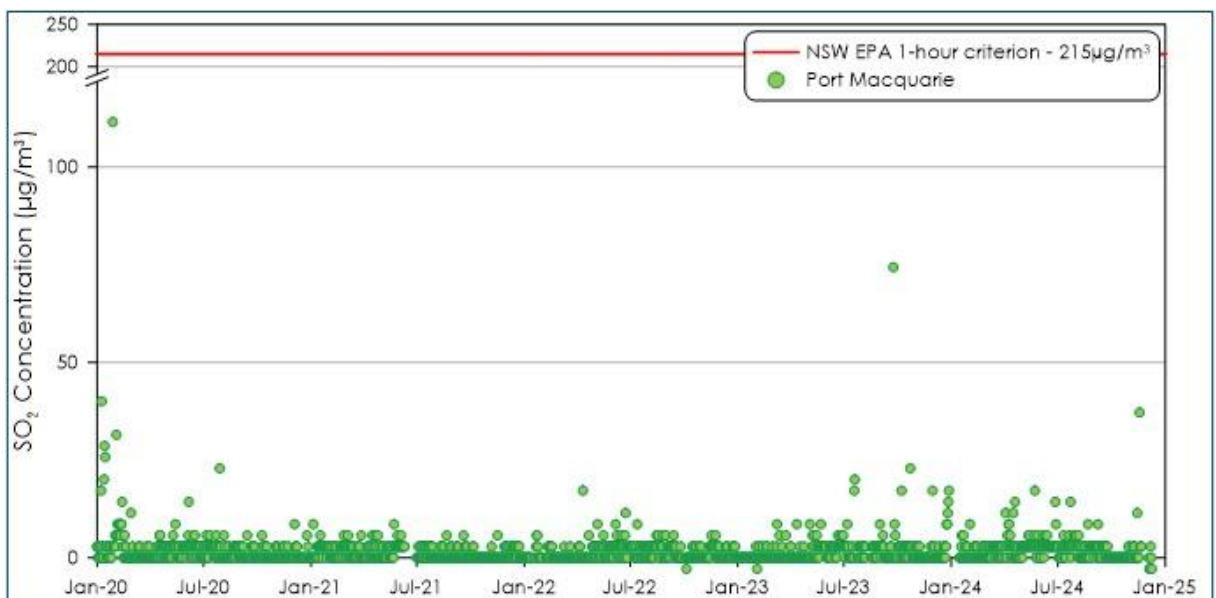


Figure 4-6: 1-hour average SO₂ concentrations

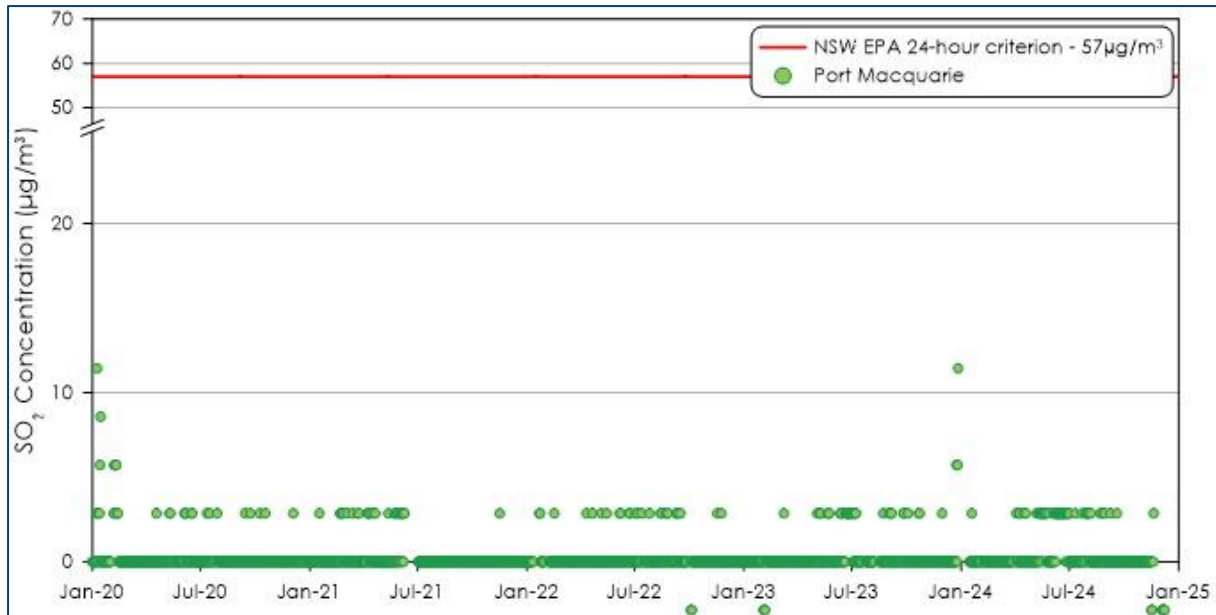


Figure 4-7: 24-hour average SO₂ concentrations

4.3.4 NO₂ monitoring

Figure 4-8 presents the daily maximum 1-hour average NO₂ monitoring data from the nearest NSW DCCEEW monitoring sites with available data. The data show that the levels were well below the relevant criterion of 164µg/m³ for all years of the review period. A seasonal trend can be seen in the NO₂ monitoring data at both stations with elevated levels occurring in the cooler months.

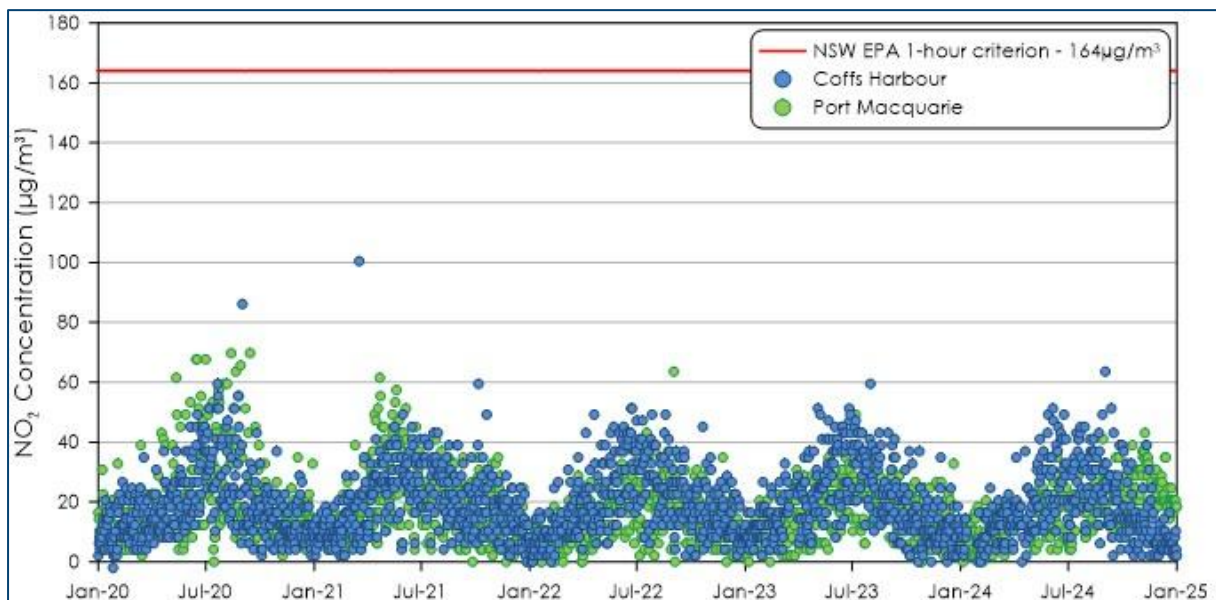


Figure 4-8: 1-hour average NO₂ concentrations

4.3.5 CO monitoring

Figure 4-8 presents the daily maximum rolling 8-hour average CO monitoring data from the nearest NSW DCCEEW monitoring sites with available data. The data show that the levels were well below the relevant criterion of 10mg/m³ for all years of the review period.

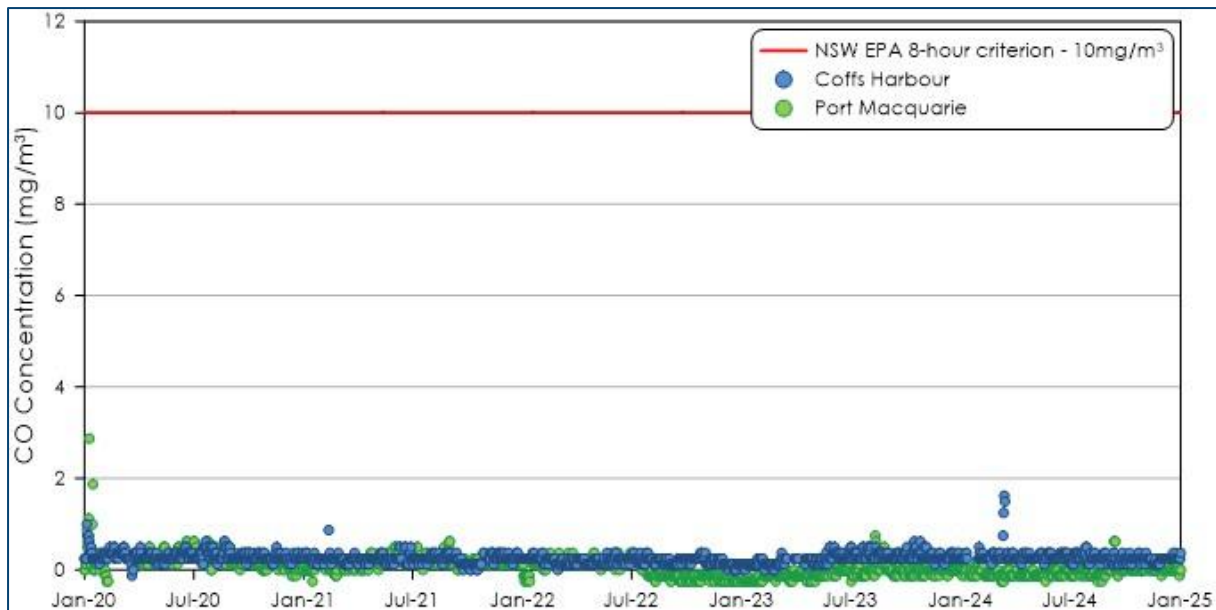


Figure 4-9: Rolling 8-hour average CO concentrations

4.3.6 Estimated background levels

The background air quality levels from the DCCEEW monitor at Coffs Harbour for the 2021 calendar year were used to represent the PM₁₀, PM_{2.5}, NO₂, and CO background levels for the Project and Port Macquarie has been used to represent SO₂ background levels.

In the absence of available data, estimates of the annual average background TSP and deposited dust concentrations can be determined from a relationship between PM₁₀, TSP and deposited dust concentrations and the measured PM₁₀ levels.

This relationship assumes that an annual average PM₁₀ concentration of 25µg/m³ corresponds to a TSP concentration of 90µg/m³ and a dust deposition value of 4g/m²/month. This assumption is based on the NSW EPA air quality impact criteria. Applying this relationship with the measured annual average PM₁₀ concentration of 10.0µg/m³ indicates an approximate annual average TSP concentration and deposition value of 36.0µg/m³ and 1.6g/m²/month, respectively.

The background air quality levels applied in this assessment are summarised in **Table 4-4**.

Table 4-4: Summary of background levels

Pollutant	Background level	Units
Annual average TSP	36.0	µg/m ³
24-hour average PM ₁₀	Daily varying	µg/m ³
Annual average PM ₁₀	10.0	µg/m ³
24-hour average PM _{2.5}	Daily varying	µg/m ³
Annual average PM _{2.5}	3.9	µg/m ³
Annual average deposited dust	1.6	g/m ² /month
1-hour average NO ₂	100.5	µg/m ³
Annual average NO ₂	6.2	µg/m ³
1-hour average SO ₂	8.6	µg/m ³
24-hour average SO ₂	2.9	µg/m ³
8-hour average CO	875.0	µg/m ³

5 DISPERSION MODELLING APPROACH

5.1 Introduction

The following sections are included to provide the reader with an understanding of the model and modelling approach applied for the assessment. The CALPUFF is an advanced air dispersion model which can deal with the effects of complex local terrain on the dispersion meteorology over the modelling domain in a three-dimensional, hourly varying time step.

The model was set up in general accord with the methods provided in the NSW EPA document *Generic Guidance and Optimum Model Setting for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia'* (TRC, 2011).

5.2 Modelling methodology

Modelling was undertaken using a combination of the CALPUFF Modelling System and the Weather Research and Forecasting model (WRF). The CALPUFF Modelling System includes three main components: CALMET, CALPUFF and CALPOST and a large set of pre-processing programs designed to interface the model to standard, routinely available meteorological and geophysical datasets.

5.2.1 Meteorological modelling

The WRF model was applied to the available data to generate a three-dimensional upper air data file for use in CALMET. The centre of analysis for the WRF modelling used is 524600mE and 6818280mN which is centrally located within the Blakebrook Quarry boundary. The simulation involved an outer grid of 30km with 15km grid spacing, with two nested grids with 3km and 1km grid spacing.

The CALMET domain was run on a domain of 10 x 10km with a 0.1km grid resolution. The available meteorological data the year 2021 from the surrounding BoM Casino Airport AWS and Lismore Airport AWS were included in the simulation.

5.2.2 Meteorological modelling evaluation

The outputs of the CALMET modelling are evaluated using visual analysis of the wind fields and extract data.

Local land use and detailed topographical information was included to produce realistic fine scale flow fields (such as terrain forced flows) in surrounding areas, as shown in **Figure 5-1**.

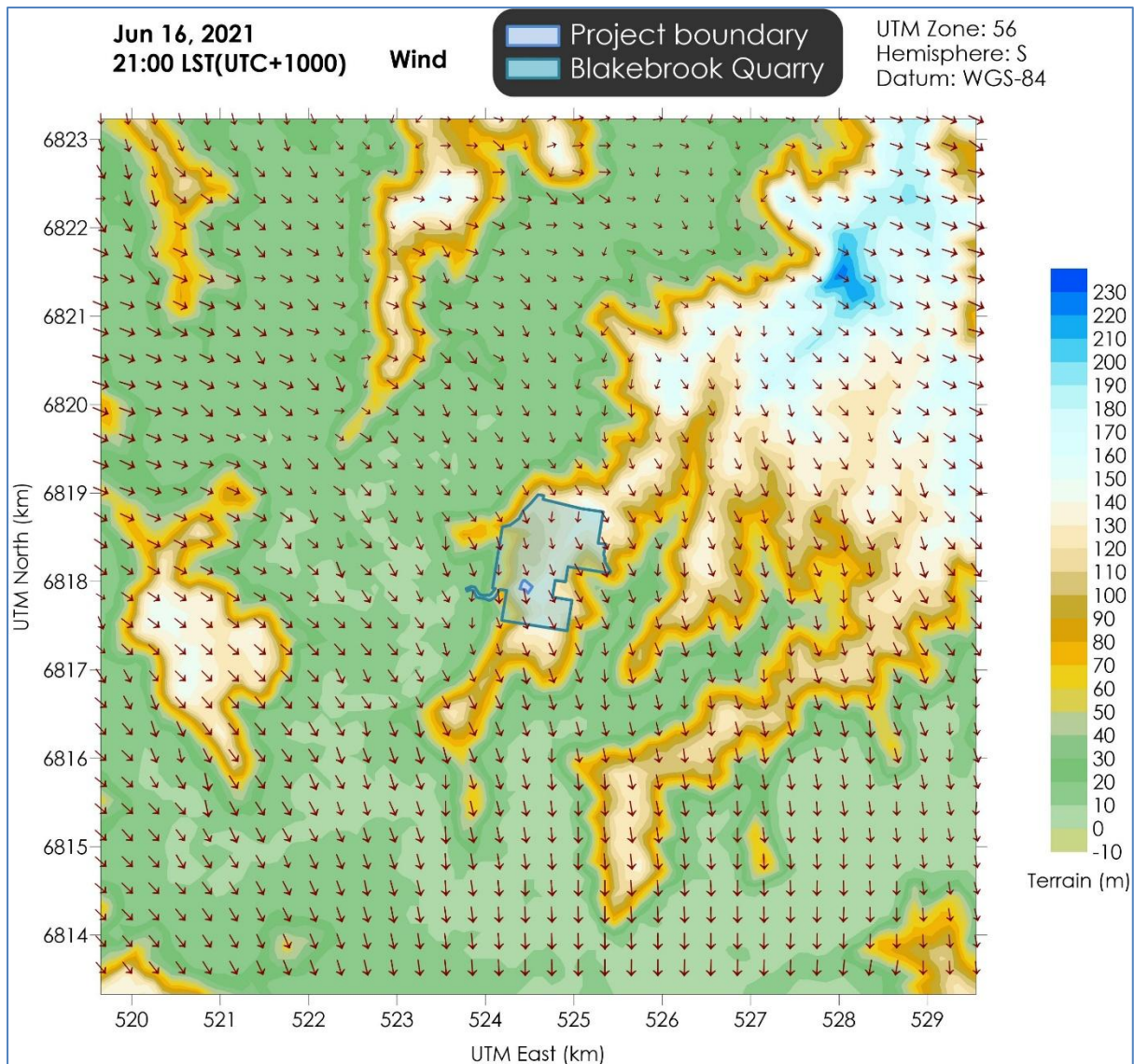


Figure 5-1: Representative 1-hour average snapshot of wind field for the Project

CALMET generated meteorological data were extracted from a point within the CALMET domain and are graphically represented in **Figure 5-2** and **Figure 5-3**.

Figure 5-2 presents the annual and seasonal windroses from the CALMET data. Overall, the windroses generated in the CALMET modelling reflect the expected wind distribution patterns of the area as determined based on the available measured data and the expected terrain effects on the prevailing winds.

Figure 5-3 includes graphs of the temperature, wind speed, mixing height and stability classification over the modelling period and shows sensible trends considered to be representative of the area.

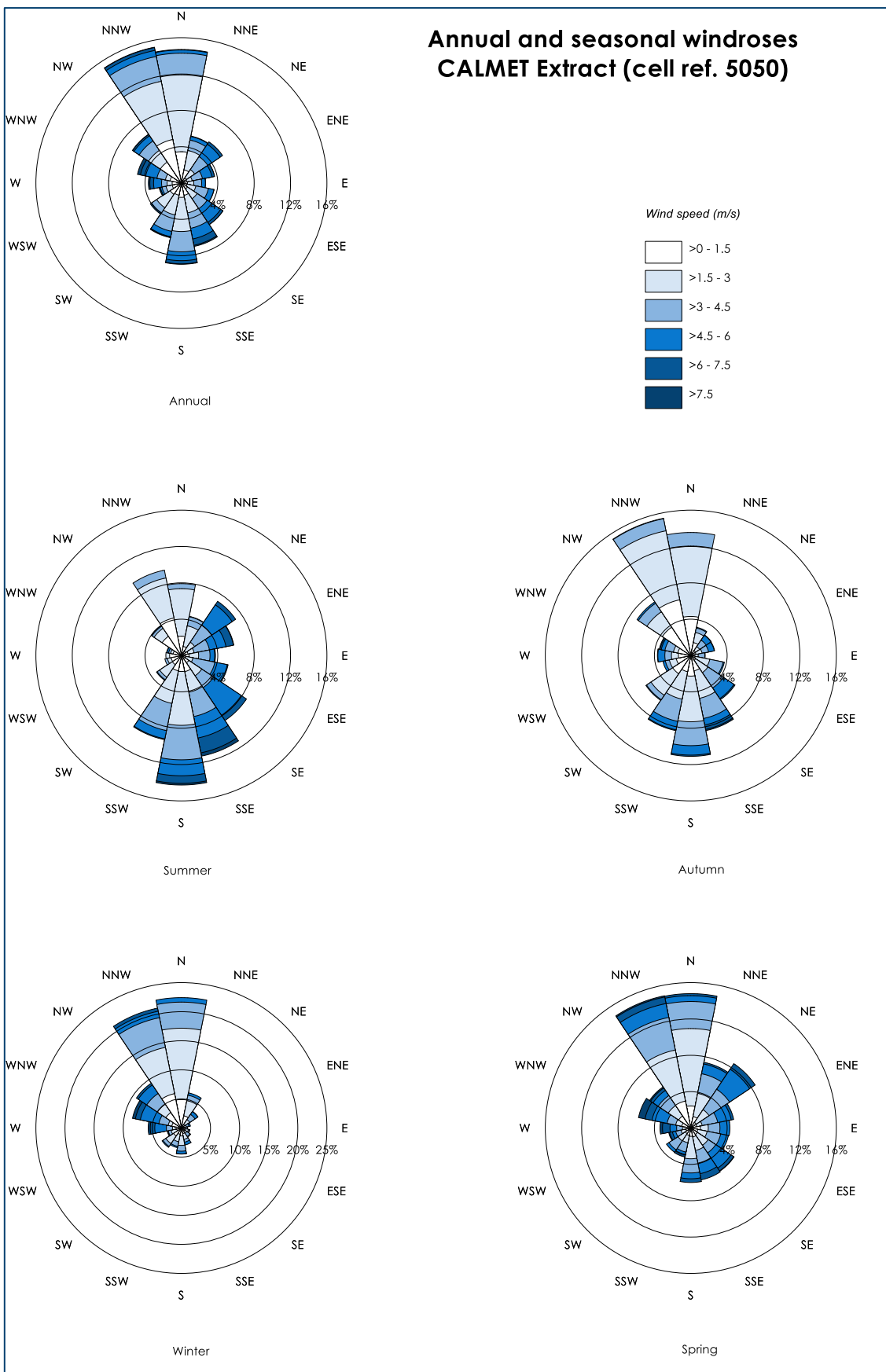


Figure 5-2: Annual and seasonal windroses from CALMET

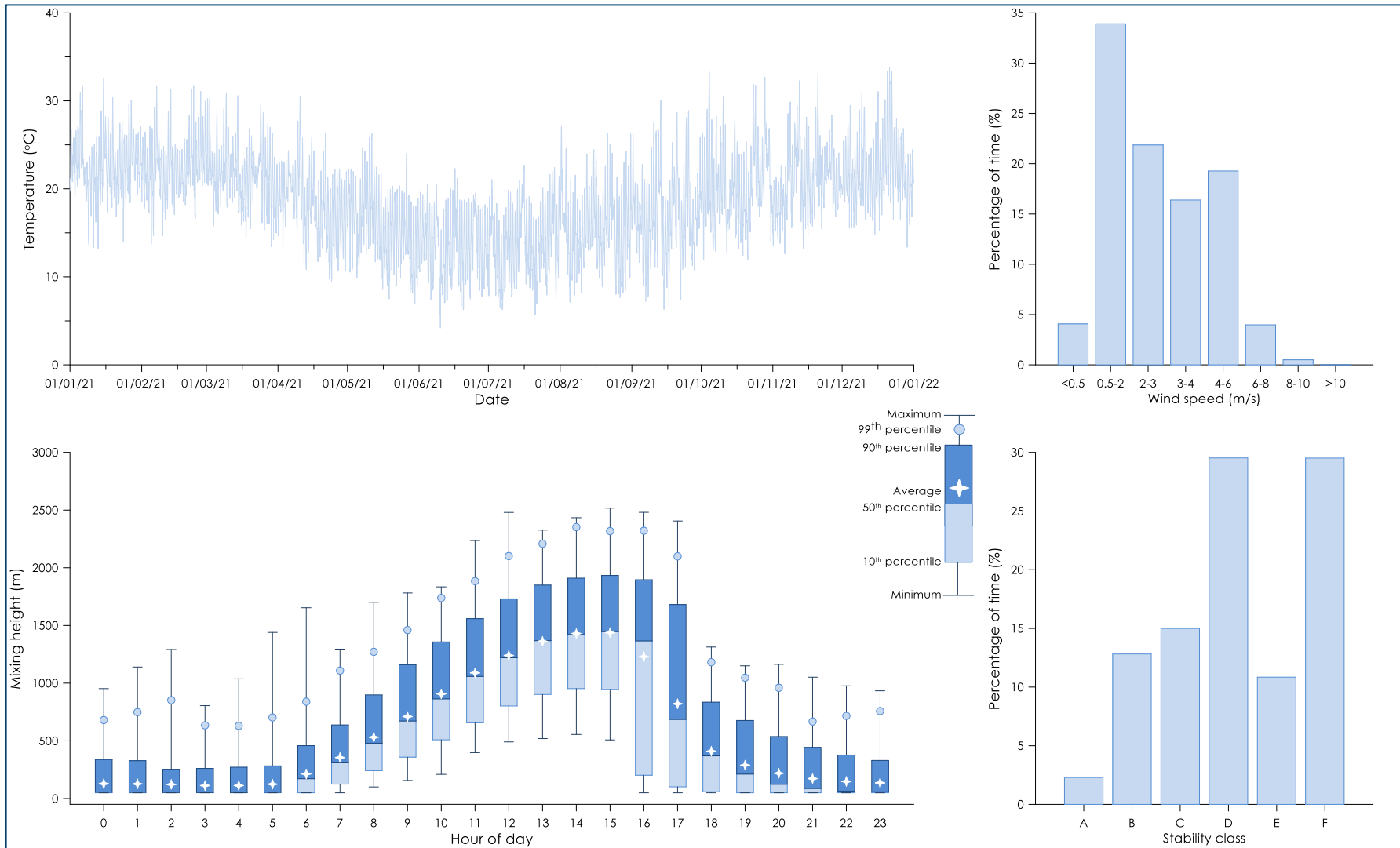


Figure 5-3: Meteorological analysis of CALMET

5.3 Dispersion modelling

The CALPUFF dispersion model, in conjunction with a CALMET generated meteorological data file, was applied to provide predictions of the ground level concentrations of potential pollutant concentrations associated with the operation of the Project.

Dust emissions from each operational activity of the Project were represented by a series of volume sources and were included in the CALPUFF model via an hourly varying emission file. Meteorological conditions associated with dust generation (such as wind speed) and levels of dust generating activity were considered in calculating the hourly varying emission rate for each source. It should be noted that as a conservative measure, the effect of the precipitation rate (rainfall) in reducing dust emissions has not been considered in this assessment.

Emissions from the asphalt plant stack exhaust have been modelled as a point source with parameters outlined in the following section.

Odour sources at the asphalt plant have been modelled as a volume source representing the truck waiting to be tarped and as a pseudo-stack source representing loading the truck with asphalt with a low efflux velocity.

Modelled source locations are shown in **Figure 5-4**.

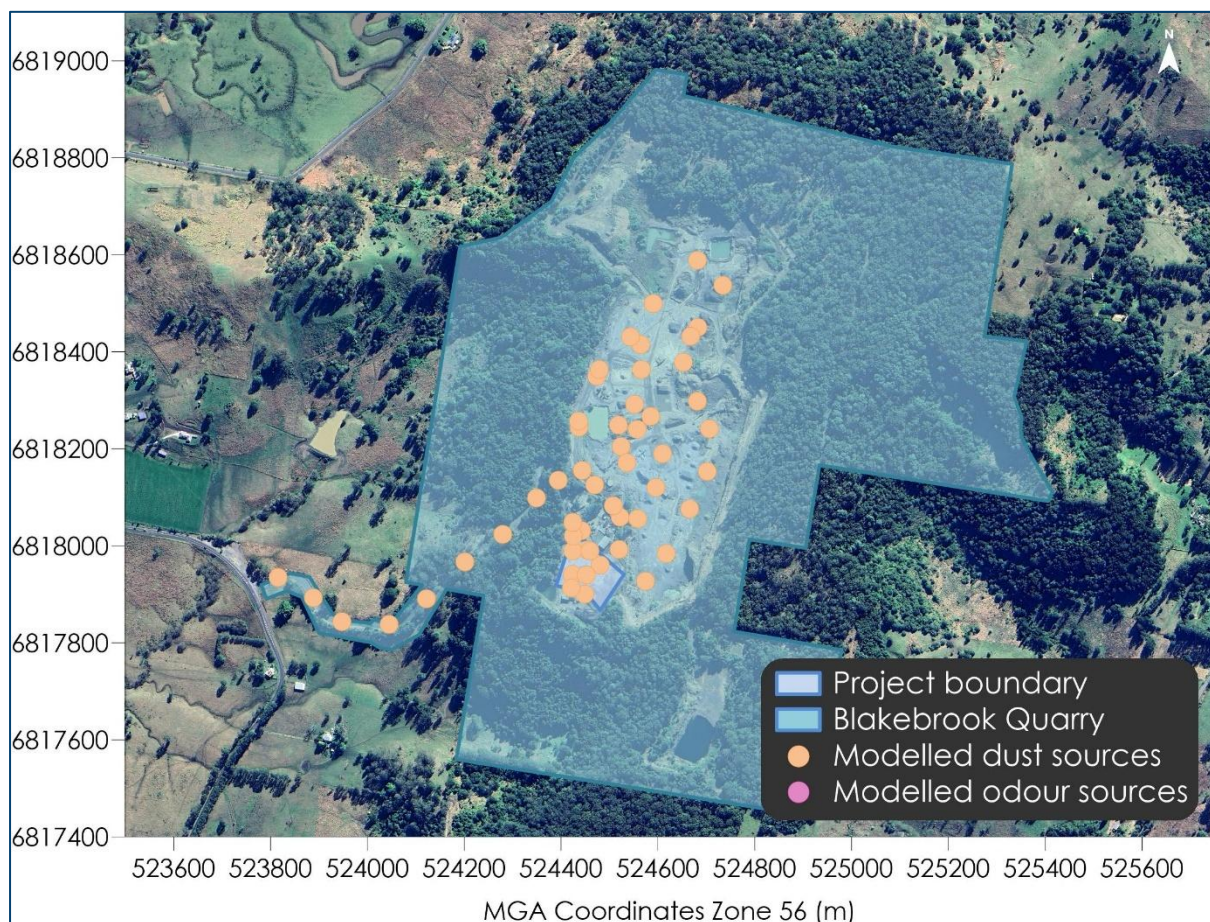


Figure 5-4: Modelled source locations

5.4 Emission estimation

5.4.1 Dust emission estimation

The main dust generating activities associated with operation of the Project are identified as the loading/unloading of material, vehicles travelling on-site and off-site, crushing and screening processes, and windblown dust from stockpiles. The on-site plant equipment also have the potential to generate particulate emissions from the diesel exhaust.

The modelled activities were chosen to represent potential worst-case dust impacts (i.e. highest dust generating activities and locations) in regard to the quantity of material handled and processed at the site.

Asphalt production is assumed to occur at the maximum rate of 100,000tpa with the Blakebrook Quarry extracting at a rate of 600,000tpa for the "average" scenario. A "peak" scenario, used to assess 24-hour average impacts, has been developed assuming a maximum of 55 daily truck trips for the asphalt plant, which equates to production rate of approximately 1,312 tonnes per day (tpd) based on an average 23.8t payload. Similarly, for the Blakebrook Quarry a maximum of 150 truck movements is assumed which results in approximately 4,950tpd based on a 33t payload. This is assumed to occur every day of the modelling period and represents a conservative approach and would result in annual tonnages exceeding the currently approved limits for the site.

Dust emission estimates have been calculated by analysing the various types of dust generating activities taking place and utilising suitable emissions sourced from both locally developed and United States Environmental Protection Agency (US EPA) developed documentation. A summary of the estimated annual TSP emissions is presented in **Table 5-1**. Detailed calculations of the dust emission estimates are provided in **Appendix B**.

Table 5-1: Summary of estimated dust emissions for the Project (kg/year)

Operation	Average scenario	Peak scenario
Project	16,729	41,147
Blakebrook Quarry	51,581	131,646
Total emissions (kg/yr.)	68,309	172,793

Note: values are rounded

Additionally, there would be numerous smaller or very distant sources that contribute to the total background dust level. Modelling these sources explicitly is impractical, however the residual level of dust due to all other such non-modelled sources, as estimated in **Section 4.3.6**, is included in the background dust levels.

5.4.2 Other pollutant emission estimation

Other pollutant emissions from the asphalt plant stack exhaust were modelled based on stack emission testing for similar asphalt operations and emission factors from the NPI emission estimation manual with the annual production rate of the asphalt plant.

The modelled emissions rates for each pollutant are summarised in **Table 5-2**. As a conservative approach, the emission rates for the plant stack exhaust are constant throughout the entire modelling period.

Table 5-2: Modelled emission rates for the Project (g/s)

Pollutant	Emission rate
PM ₁₀	0.33
CO	1.79
NO _x	0.37
SO ₂	0.01
Arsenic	1.74E-06
Beryllium	3.49E-07
Cadmium	6.98E-07
Chromium (VI)	1.55E-08
Copper	9.83E-06
Lead	5.39E-06
Manganese	1.74E-05
Mercury	1.17E-08
Nickel	2.38E-05
Zinc	6.66E-05
Acetone	1.01E-02
Acetaldehyde	1.01E-03
Benzene	1.90E-03
Formaldehyde	5.71E-03
Toluene	3.17E-04
Xylene	6.34E-04
Polycyclic Aromatic Hydrocarbons (PAH) (total)	2.38E-04

Modelled stack parameters for the Project are outlined in **Table 5-3**.

Table 5-3: Modelled stack parameters

Parameter	Variable	Unit
Stack height	4	m
Stack diameter	0.56	m
Exit velocity	16.6	m/s
Exit temperature	378	K

5.4.3 Odour emission estimation

During operations of the asphalt plant odour emissions would arise from loading asphalt to the truck, the truck waiting to be tarped once it has been loaded with asphalt and from the asphalt plant stack exhaust. Odour emissions were estimated based on available site specific odour sampling for the site (**Assured Environmental, 2021**) and a review of studies on similar types of asphalt batching operations, *Cameron Park Asphalt Remodelling* (**PAEHolmes, 2011**).

A summary of the odour emission rates for these sources applied is outlined in **Table 5-4**.

Table 5-4: Summary of odour emission rates for the Project

Source	Odour emission rate (ou.m ³ /s)
Loading asphalt to the truck	6,297
Truck waiting to be tarped	1,080
Plant stack exhaust	3,056

6 DISPERSION MODELLING RESULTS

This section presents the predicted air quality levels which may arise from air emissions generated by the Project.

6.1 Dust concentrations

The dispersion model predictions presented in this section include those for the operation of the Project in isolation (incremental impact) and the operation of the Project with consideration of other sources (total impact). The results show the predicted:

- ✦ Maximum 24-hour average PM_{2.5} and PM₁₀ concentrations;
- ✦ Annual average PM_{2.5}, PM₁₀ and TSP concentrations; and,
- ✦ Annual average dust (insoluble solids) deposition rates.

It is important to note that when assessing impacts per the maximum 24-hour average levels, these predictions are based on the highest predicted 24-hour average concentrations which were modelled at each point within the modelling domain for the worst day (i.e. a 24-hour period) during the one year long modelling period.

Associated isopleth diagrams of the dispersion modelling results are presented in **Appendix C**.

The total (cumulative) impact is defined as the operation of the Project combined with the estimated ambient background levels in **Section 4.3.6**.

Table 6-1 present the predicted incremental and cumulative particulate dispersion modelling results at each of the assessed receptor locations.

The predicted incremental results show that minimal incremental effects would arise at the residential receptor locations due to the Project. The predicted cumulative results indicate that the residential receptor locations are predicted to experience levels below the relevant criteria for each of the assessed dust metrics.

Table 6-1: Dust dispersion modelling results for assessment locations

Receptor ID	PM _{2.5} (µg/m ³)		PM ₁₀ (µg/m ³)		TSP (µg/m ³)	DD (g/m ² /mth)	PM _{2.5} (µg/m ³)	PM ₁₀ (µg/m ³)	TSP (µg/m ³)	DD* (g/m ² /mth)
	Incremental						Cumulative			
	24-hr ave.	Ann. ave.	24-hr ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.
	Air quality impact criteria									
-	-	-	-	-	-	2	8	25	90	4
R1	1.7	0.2	7.3	0.6	2.1	0.1	4.1	10.6	38.1	1.7
R2	1.2	0.1	4.0	0.2	0.7	<0.1	4.0	10.2	36.7	1.6
R3	0.5	<0.1	1.0	0.1	0.1	<0.1	3.9	10.1	36.1	1.6
R4	0.8	0.1	3.5	0.3	0.7	0.1	4.0	10.3	36.7	1.7
R5	0.9	<0.1	5.6	0.1	0.3	<0.1	3.9	10.1	36.3	1.6
R6	0.4	0.1	2.1	0.2	0.5	<0.1	4.0	10.2	36.5	1.6
R7	1.7	0.2	10.5	0.6	1.4	0.1	4.1	10.6	37.4	1.7
R8	2.4	0.2	9.7	0.6	2.2	0.1	4.1	10.6	38.2	1.7

Receptor ID	PM _{2.5} (µg/m ³)		PM ₁₀ (µg/m ³)		TSP (µg/m ³)	DD (g/m ² /mth)	PM _{2.5} (µg/m ³)	PM ₁₀ (µg/m ³)	TSP (µg/m ³)	DD* (g/m ² /mth)	
	Incremental						Cumulative				
	24-hr ave.	Ann. ave.	24-hr ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	
	Air quality impact criteria										
	-	-	-	-	-	2	8	25	90	4	
R9	0.7	<0.1	2.9	0.1	0.4	<0.1	3.9	10.1	36.4	1.6	
R10	0.9	0.1	3.1	0.2	0.5	<0.1	4.0	10.2	36.5	1.6	
R11	0.7	<0.1	2.5	0.1	0.3	<0.1	3.9	10.1	36.3	1.6	
R12	0.7	<0.1	2.5	0.1	0.3	<0.1	3.9	10.1	36.3	1.6	
R13	0.9	0.1	5.9	0.2	0.3	<0.1	4.0	10.2	36.3	1.6	
R14	0.4	<0.1	1.7	0.1	0.2	<0.1	3.9	10.1	36.2	1.6	
R15	0.4	<0.1	1.8	0.1	0.2	<0.1	3.9	10.1	36.2	1.6	
R16	0.5	<0.1	1.8	0.1	0.2	<0.1	3.9	10.1	36.2	1.6	
R17	0.5	<0.1	1.8	0.1	0.3	<0.1	3.9	10.1	36.3	1.6	

*Deposited dust

6.2 Assessment of Cumulative 24-hour average PM_{2.5} and PM₁₀ Concentrations

The results for incremental 24-hour average PM_{2.5} and PM₁₀ concentrations indicate there are some predicted exceedances of the relevant criteria at the receptors for the assessed scenarios.

When assessing the cumulative 24-hour average impacts based on model predictions an assessment of cumulative 24-hour average PM_{2.5} and PM₁₀ impacts was undertaken in accordance with Section 11.2 of the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (NSW EPA, 2022)*.

As shown in **Section 6.3**, maximum background levels in the past have reached the 24-hour average criteria levels. Due to this, the "Level 1 assessment – Maximum impact" would not be appropriate for assessing the potential cumulative 24-hour average impacts. In such situations, the "Level 2 assessment - Contemporaneous impact and background approach" was applied to assess potential impacts for PM_{2.5} and PM₁₀.

In simple terms, the Level 2 assessment involves matching one year of ambient air quality monitoring data with the corresponding Project only level predicted using the same day's weather data to account for the spatial and temporal variation in background levels on a given day.

Table 6-2 provides a summary of the findings from the Level 2 assessments for the nearest residential receptors in each direction for both PM_{2.5} and PM₁₀.

The results in **Table 6-2** indicate that the Project does not increase the number of days above the 24-hour average criterion at the assessed receptors for PM_{2.5} and PM₁₀. Based on this result it can be inferred that the Project does not increase the number of days above the 24-hour average PM_{2.5} and PM₁₀ criterion at any of the residential receptor locations surrounding the Project.

Detailed tables of the contemporaneous assessment results are provided in **Appendix D**.

Table 6-2: NSW EPA contemporaneous assessment - maximum number of additional days above 24-hour average criterion

Receptor ID	PM _{2.5}	PM ₁₀
R1	0	0
R7	0	0

Time series plots of the predicted cumulative 24-hour average PM₁₀ concentrations for the most impacted residential receptor (R1) are presented in **Figure 6-1**.

The orange bars in the figures represent the contribution from the Project and the blue bars represent the applied background levels. It is clear from the figures that the Project has a small influence at the assessed receptor locations and in most cases would be difficult to discern beyond the existing background level.

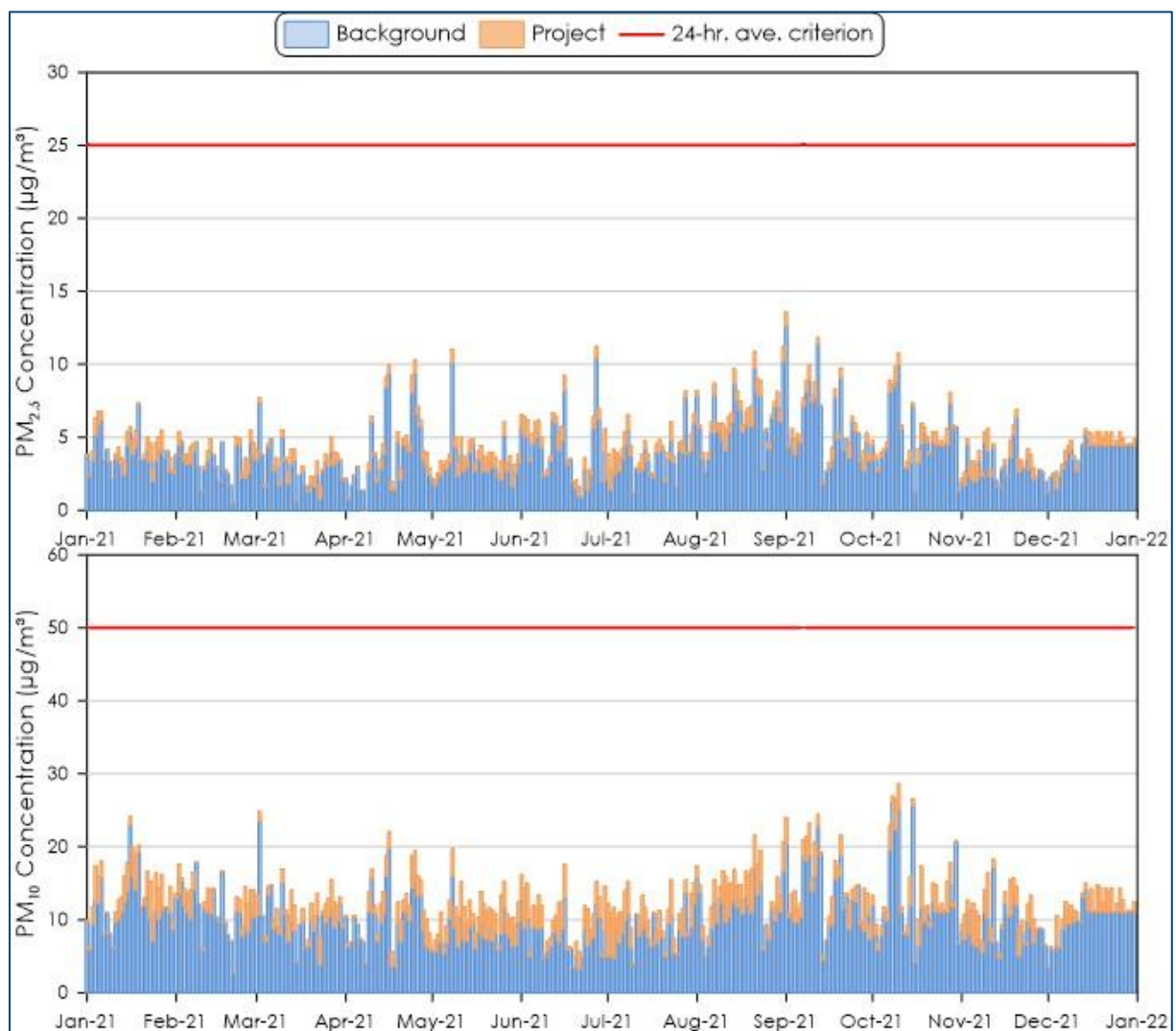


Figure 6-1: Time series plots of predicted cumulative 24-hour average PM₁₀ concentrations for R1

6.3 Other pollutants

The impact assessment criteria apply at the most impacted receptor or at any location off-site depending on the pollutant assessed.

Table 6-3 presents the predicted maximum impact at the worst affected assessment location or location beyond the site boundary receptor from asphalt plant exhaust stack emissions. Isopleth diagrams of the predicted impact for selected pollutants are presented in **Appendix D**.

The results indicate the maximum contribution from the Project at the receptor locations would be below the relevant criteria for each of the assessed pollutants.

Table 6-3: Predicted maximum impact at the worst affected receptor($\mu\text{g}/\text{m}^3$)

Pollutant	Averaging period	Incremental impact	Receptor ID	Background	Total impact	Criteria
NO ₂	1 hour	7.9	R7	100.5	108.4	164
	Annual	0.1	R7	6.2	6.3	31
SO ₂	1 hour	0.2	R7	8.6	8.8	215
	24 hour	0.03	R7	2.9	2.9	57
CO	15 minute	50.7	R7	-	50.7	100,000
	1 hour	38.4	R7	-	38.4	30,000
	8 hour	0.3	R7	875	875.3	10,000
Arsenic	1 hour	7.2E-05	Boundary	-	7.2E-05	0.09
Beryllium	1 hour	1.4E-05	Boundary	-	1.4E-05	0.004
Cadmium	1 hour	2.9E-05	Boundary	-	2.9E-05	0.018
Chromium (VI)	1 hour	7.9E-04	Boundary	-	7.9E-04	0.09
Copper	1 hour	4.1E-04	Boundary	-	4.1E-04	3.7
Lead	Annual	2.1E-06	R7	-	2.1E-06	0.5
Manganese	1 hour	7.2E-04	Boundary	-	7.2E-04	18
Mercury	1 hour	4.8E-07	Boundary	-	4.8E-07	0.18
Nickel	1 hour	9.8E-04	Boundary	-	9.8E-04	0.18
Zinc	1 hour	2.8E-03	Boundary	-	2.8E-03	90
Acetone	1 hour	0.42	Boundary	-	0.42	22,000
Acetaldehyde	1 hour	0.04	Boundary	-	0.04	42
Benzene	1 hour	0.08	Boundary	-	0.08	29
Formaldehyde	1 hour	0.24	Boundary	-	0.24	20
Toluene	1 hour	1.3E-02	Boundary	-	1.3E-02	360
Xylene	1 hour	0.03	Boundary	-	0.03	190
PAH (total)	1 hour	9.8E-03	Boundary	-	9.8E-03	0.4

6.4 Odour

The spatial distribution of the dispersion modelling predictions for the Project is presented as an isopleth diagram showing the 99th percentile nose-response ground level odour concentrations in **Figure C-14**.

Table 6-4 presents the discrete dispersion modelling results at each of the assessment locations. The results indicate that odour levels due to the Project will be below the applicable criteria at all assessment locations.

Table 6-4: 99th percentile nose-response average ground level odour concentrations – Incremental impact

Assessment location ID	Predicted level (OU)	Odour assessment criterion (OU)
R1	<1	7
R2	<1	7
R3	<1	7
R4	<1	7
R5	<1	7
R6	<1	7
R7	<1	7
R8	<1	7
R9	<1	7
R10	<1	7
R11	<1	7
R12	<1	7
R13	<1	7
R14	<1	7
R15	<1	7
R16	<1	7
R17	<1	7

7 MITIGATION AND MANAGEMENT

The operations of the Project have the potential to generate dust and odour emissions. To ensure that activities associated with the Project have a minimal effect on the surrounding environment, it is recommended that all reasonable and practicable dust mitigation measures be utilised.

Blakebrook Quarry site currently employ a number of air quality control measures that are included within the site's Air Quality Management Plan (**LCC, 2023**). It is recommended that existing air quality control measures continue to be applied.

The modelling predictions for the Project do not indicate any exceedance of the relevant dust impact assessment criteria at the residential receptors. Given this situation, there are no specific ambient air quality monitoring recommendations for the Project at the receptors. It is anticipated that the site's existing air quality monitoring network be maintained for the Project.

8 SUMMARY AND CONCLUSIONS

This report has assessed the potential air quality impacts associated with the proposed modification of the Downer Asphalt Plant at Lismore, NSW.

Air dispersion modelling was used to predict the potential for off-site dust, odour and air pollutant impacts in the surrounding area due to the proposed modification for the Project. The estimated air emissions applied in the modelling are likely to be conservative and would overestimate the actual impacts in reality.

The predicted ground level concentrations at the residential receptor locations would be below the relevant impact assessment criteria for each of the assessed dust metrics. It is predicted that all the assessed air pollutants generated by the operation of the Project would comply with the relevant assessment criteria at the applicable receptor locations and therefore would not lead to any unacceptable level of environmental harm or impact in the surrounding area.

The odour impact assessment indicates odour impacts due to the Project are below the applicable criterion at the assessment locations and would not lead to any unacceptable level of odour in the surrounding environment.

Nevertheless, the site would apply appropriate dust and odour management measures to minimise air emissions from the site.

Overall, the assessment demonstrates that the Project can operate without causing any significant air quality impact at residential receptor locations in the surrounding environment.

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"Compilation of Air Pollutant Emission Factors", AP-42, Fourth Edition United States Environmental Protection Agency, Office of Air and Radiation Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina 27711.



Appendix A

Selection of Meteorological Year



Selection of meteorological year

A statistical analysis of the latest five contiguous years of meteorological data from the nearest BoM weather station with suitable available data, Casino Airport AWS weather station, is presented in **Table A-1**.

The standard deviation of the latest five years of meteorological data spanning 2020 to 2024 was analysed against the available measured wind speed, temperature and relative humidity. The analysis indicates that all dataset years are close to the mean for wind speed, and 2021 is closest for wind temperature and relative humidity. On the basis of a score weighting analysis, 2021 was found to be most representative.

Table A-1: Statistical analysis results for Casino Airport AWS

Year	Wind speed	Temperature	Relative humidity	Score
2020	0.3	0.8	3.9	5.0
2021	0.3	0.5	2.8	3.6
2022	0.3	0.7	6.0	6.9
2023	0.3	1.1	3.8	5.2
2024	0.3	0.7	4.4	5.4

Figure A-1 shows the frequency distributions for wind speed, wind direction, temperature and relative humidity for the 2021 year compared with the mean of the 2020 to 2024 data set. The 2021 year data appear to be reasonably well aligned with the mean data.

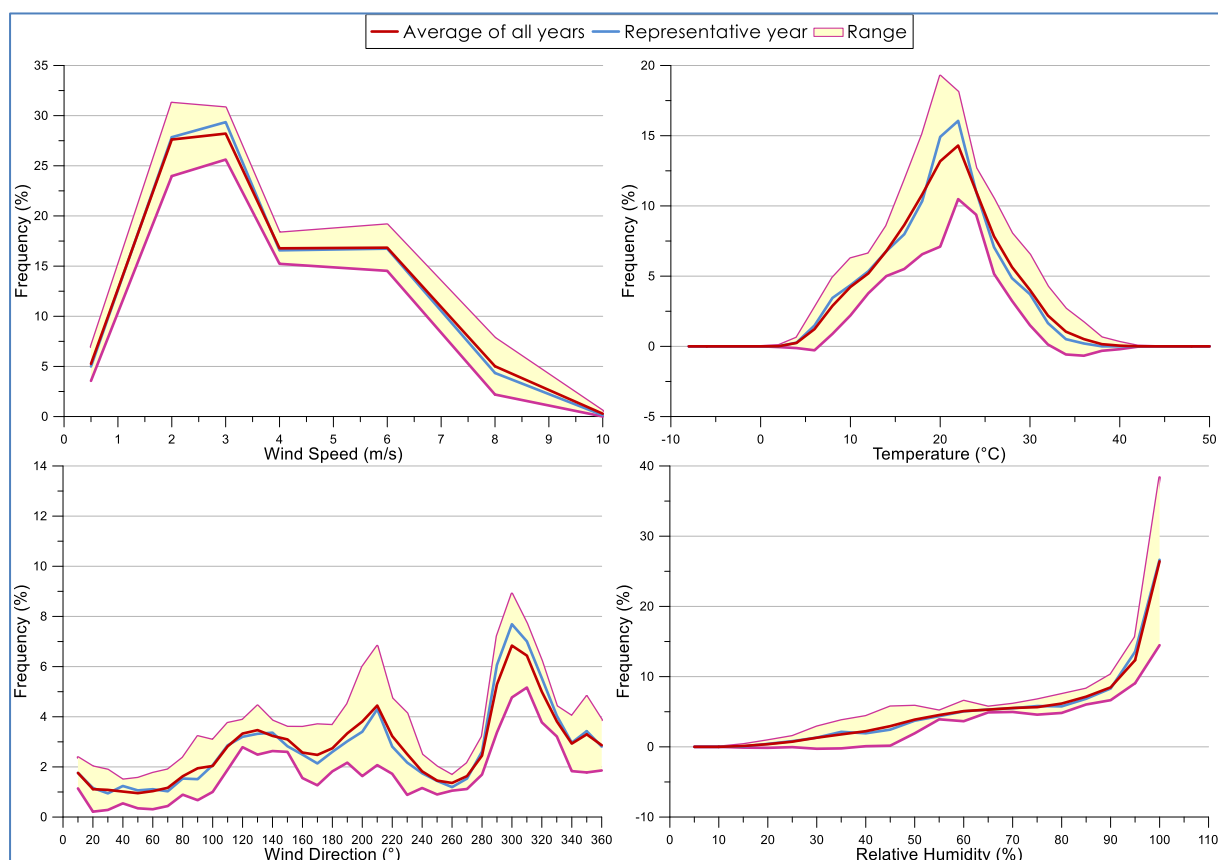


Figure A-1: Frequency distributions for wind speed, wind direction, temperature and relative humidity

Appendix B
Emission Calculations

Emission Calculation

The dust emissions from the Project have been estimated from the operational description of the proposed activities provided by the Proponent and have been combined with emissions factor equations and utilising suitable emission and load factors that relate to the quantity of dust emitted from particular activities based on intensity, the prevailing meteorological conditions and composition of the material being handled. Site specific variables including vehicle kilometres travelled (VKT) and stockpile areas are based on the indicative site layout plans provided.

Emission factors and associated controls have been sourced from:

- ✦ United States (US) EPA AP42 Emission Factors (**US EPA, 1985 and Updates**);
- ✦ Office of Environment and Heritage document, "NSW Coal Mining Benchmarking Study: Best Practise Measures for Reducing Non-Road Diesel Exhaust Emissions, Final Report" (**NSW EPA, 2015**).

The emission factor equations used for each dust generating activity are outlined in **Table B-1** below. A detailed dust emission inventory for the Project is presented in **Table B-2** and **Table B-3**.

Specific control factors applied for dust emissions estimates include the following:

- ✦ RAP processing activities occurring within a purpose-built enclosure – 70% control for enclosure; and,
- ✦ Wind erosion from stockpiles – 50% control for watering.



Table B-1: Emission factor equations

Activity	Emission factor equation		
	TSP	PM ₁₀	PM _{2.5}
Loading / emplacing material	$EF = 0.74 \times 0.0016 \times \left(\frac{U^{1.3}}{2.2} / \frac{M^{1.4}}{2} \right) kg / tonne$	$EF = 0.35 \times 0.0016 \times \left(\frac{U^{1.3}}{2.2} / \frac{M^{1.4}}{2} \right) kg/tonne$	$EF = 0.053 \times 0.0016 \times \left(\frac{U^{1.3}}{2.2} / \frac{M^{1.4}}{2} \right) kg/tonne$
Hauling on unsealed surfaces	$EF = \left(\frac{0.4536}{1.6093} \right) \times 4.9 \times (s/12)^{0.7} \times (1.1023 \times M/3)^{0.45} kg /VKT$	$EF = \left(\frac{0.4536}{1.6093} \right) \times 1.5 \times (s/12)^{0.9} \times (1.1023 \times M/3)^{0.45} kg /VKT$	$EF = \left(\frac{0.4536}{1.6093} \right) \times 0.15 \times (s/12)^{0.9} \times (1.1023 \times M/3)^{0.45} kg/VKT$
Hauling on sealed surfaces	$EF = 3.23 \times s.L^{0.91} \times (1.1023 \times W)^{1.02} kg /VKT$	$EF = 0.62 \times s.L^{0.91} \times (1.1023 \times W)^{1.02} kg /VKT$	$EF = 0.15 \times s.L^{0.91} \times (1.1023 \times W)^{1.02} kg /VKT$
Crushing	$EF = 0.0006 kg/tonne$	$EF = 0.00027 kg/tonne$	$EF = 0.00005 kg/tonne$
Screening	$EF = 0.0011 kg/tonne$	$EF = 0.00037 kg/tonne$	$EF = 0.000025 kg/tonne$
Conveying	$EF = 850 kg/ha/year$	$0.5 \times TSP$	$0.075 \times TSP$
Dozer	$(2.6 \times (s^{1.2}))/M^{1.3}$	$0.45 \times (s^{1.5})/M^{1.4} \times 0.75$	$(2.6 \times (s^{1.2}))/M^{1.3} \times 0.105$
Grader	$0.0034 \times S^{2.5} kg/h$	$0.6 \times (0.0056 \times S^{2.5}) kg/h$	$0.031 \times (0.0034 \times S^{2.5}) kg/h$
Wind erosion on stockpiles	$EF = 850 kg/ha/year$	$0.5 \times TSP$	$0.075 \times TSP$

EF = emission factor, U = wind speed (m/s), M = moisture content (%), s = silt content (%), s.L. = silt loading (g/m²), W = average weight of vehicle (tonne), VKT = vehicle kilometres travelled (km), S = vehicle speed (km/hr)



Table B-2: Dust Emissions Inventory - Average

Activity - Average	TSP emission	PM10 emission	PM25 emission	Intensity	Units	EF - TSP	EF - PM10	EF - PM25	Units	Var 1	Units	Var 2	Units	Var 3 - TSP / PM10 / PM25	Units	Var 4	Units	Var 5	Units	Var 6	Units	
Hauling RAP material on-site - paved	237	46	11	15,000	t/yr	0.0158	0.00304	0.000735	kg/t	32	t/l	1.9	km/rt	0.27 / 0.05 / 0.01	kg/VKT	2	S.L. g/m2	38	Ave weight (t)			
Hauling RAP material on-site - unpaved	444	113	11	15,000	t/yr	0.119	0.030	0.003	kg/t	32	t/l	1.6	km/rt	2.4 / 0.6 / 0.1	kg/VKT	4.8	S.C. %	38	Ave weight	75	C. %	
Unloading material to RAP stockpiles	26	12	2	15,000	t/yr	0.00174	0.00082	0.00012	kg/t	1.47	ave. ws	2	M.C. %									
Rehandle at stockpile	3	1	0	1,500	t/yr	0.00174	0.00082	0.00012	kg/t	1.47	ave. ws	2	M.C. %									
Loading material to crusher	26	12	2	15,000	t/yr	0.00174	0.00082	0.00012	kg/t	1.47	ave. ws	2	M.C. %									
Crushing	254	115	21	15,000	t/yr	0.00060	0.00027	0.00005	kg/t													
Screening	17	6	0	15,000	t/yr	0.0011	0.00037	0.000025	kg/t													
Unload to stockpile	26	12	2	15,000	t/yr	0.00174	0.00082	0.00012	kg/t	1.47	ave. ws	2	M.C. %									
Rehandle at stockpile	3	1	0	1,500	t/yr	0.00174	0.00082	0.00012	kg/t	1.47	ave. ws	2	M.C. %									
Hauling RAP material to plant - unpaved	444	113	11	15,000	t/yr	0.119	0.030	0.003	kg/t	32	t/l	1.6	km/rt	2.4 / 0.6 / 0.1	kg/VKT	4.8	S.C. %	38	Ave weight	75	C. %	
Hauling bitumen material on-site - paved	107	21	5	5,500	t/yr	0.0195	0.00375	0.000907	kg/t	22	t/l	1.9	km/rt	0.23 / 0.04 / 0.01	kg/VKT	2	S.L. g/m2	32	Ave weight (t)			
Hauling bitumen material on-site - unpaved	61	16	2	5,500	t/yr	0.045	0.011	0.001	kg/t	22	t/l	0.4	km/rt	2.2 / 0.6 / 0.1	kg/VKT	4.8	S.C. %	32	Ave weight	75	C. %	
Hauling aggregate on-site - paved	1,028	197	48	65,000	t/yr	0.0158	0.00304	0.000735	kg/t	32	t/l	1.9	km/rt	0.27 / 0.05 / 0.01	kg/VKT	2	S.L. g/m2	38	Ave weight (t)			
Hauling aggregate on-site - unpaved	537	137	14	65,000	t/yr	0.033	0.008	0.001	kg/t	32	t/l	0.4	km/rt	2.4 / 0.6 / 0.1	kg/VKT	4.8	S.C. %	38	Ave weight	75	C. %	
Hauling sand on-site - paved	190	36	9	12,000	t/yr	0.0158	0.00304	0.000735	kg/t	32	t/l	1.9	km/rt	0.27 / 0.05 / 0.01	kg/VKT	2	S.L. g/m2	38	Ave weight (t)			
Hauling sand on-site - unpaved	99	25	3	12,000	t/yr	0.033	0.008	0.001	kg/t	32	t/l	0.4	km/rt	2.4 / 0.6 / 0.1	kg/VKT	4.8	S.C. %	38	Ave weight	75	C. %	
Hauling filler on-site - paved	56	11	3	2,850	t/yr	0.0195	0.00375	0.000907	kg/t	22	t/l	1.9	km/rt	0.23 / 0.04 / 0.01	kg/VKT	2	S.L. g/m2	32	Ave weight (t)			
Hauling filler on-site - unpaved	32	8	1	2,850	t/yr	0.045	0.011	0.001	kg/t	22	t/l	0.4	km/rt	2.2 / 0.6 / 0.1	kg/VKT	4.8	S.C. %	32	Ave weight	75	C. %	
Unloading material to hopper	174	82	12	100,000	t/yr	0.00174	0.00082	0.00012	kg/t	1.47	ave. ws	2	M.C. %									
Unloading processed asphalt to dispatch truck	174	82	12	100,000	t/yr	0.00174	0.00082	0.00012	kg/t	1.47	ave. ws	2	M.C. %									
Hauling processed asphalt off-site - paved	1,615	310	75	100,000	t/yr	0.0162	0.00310	0.000750	kg/t	17	t/l	1.9	km/rt	0.14 / 0.03 / 0.01	kg/VKT	2	S.L. g/m2	20	Ave weight (t)			
Hauling processed asphalt off-site - unpaved	1,207	308	31	100,000	t/yr	0.048	0.012	0.001	kg/t	17	t/l	0.4	km/rt	1.8 / 0.5 / 0.05	kg/VKT	4.8	S.C. %	20	Ave weight	75	C. %	
Wind erosion from exposed stockpiles	9,234	4,617	693	21.7	ha	850	425	64	kg/ha/year													50 C. %
Exhaust emissions	733	733	711																			
Total emissions (kg/yr.)	16,729	7,015	1,678																			

Table B-3: Dust Emissions Inventory - Peak

Activity - Peak	TSP emission	PM10 emission	PM25 emission	Intensity	Units	EF - TSP	EF - PM10	EF - PM25	Units	Var 1	Units	Var 2	Units	Var 3 - TSP / PM10 / PM25	Units	Var 4	Units	Var 5	Units	Var 6	Units	
Hauling RAP material on-site - paved	1,132	217	53	71,558	t/yr	0.0158	0.00304	0.000735	kg/t	32	t/l	1.9	km/rt	0.27 / 0.05 / 0.01	kg/VKT	2	S.L. g/m2	38	Ave weight (t)			
Hauling RAP material on-site - unpaved	2,120	540	54	71,558	t/yr	0.119	0.030	0.003	kg/t	32	t/l	1.6	km/rt	2.4 / 0.6 / 0.1	kg/VKT	4.8	S.C. %	38	Ave weight	75	C. %	
Unloading material to RAP stockpiles	124	59	9	71,558	t/yr	0.00174	0.00082	0.00012	kg/t	1.47	ave. ws	2	M.C. %									
Rehandle at stockpile	12	6	1	7,156	t/yr	0.00174	0.00082	0.00012	kg/t	1.47	ave. ws	2	M.C. %									
Loading material to crusher	124	59	9	71,558	t/yr	0.00174	0.00082	0.00012	kg/t	1.47	ave. ws	2	M.C. %									
Crushing	254	115	21	71,558	t/yr	0.00060	0.00027	0.00005	kg/t													
Screening	79	26	2	71,558	t/yr	0.0011	0.00037	0.000025	kg/t													
Unload to stockpile	124	59	9	71,558	t/yr	0.00174	0.00082	0.00012	kg/t	1.47	ave. ws	2	M.C. %									
Rehandle at stockpile	12	6	1	7,156	t/yr	0.00174	0.00082	0.00012	kg/t	1.47	ave. ws	2	M.C. %									
Hauling RAP material to plant - unpaved	2,120	540	54	71,558	t/yr	0.119	0.030	0.003	kg/t	32	t/l	1.6	km/rt	2.4 / 0.6 / 0.1	kg/VKT	4.8	S.C. %	38	Ave weight	75	C. %	
Hauling bitumen material on-site - paved	512	98	24	26,238	t/yr	0.0195	0.00375	0.000907	kg/t	22	t/l	1.9	km/rt	0.23 / 0.04 / 0.01	kg/VKT	2	S.L. g/m2	32	Ave weight (t)			
Hauling bitumen material on-site - unpaved	293	75	7	26,238	t/yr	0.045	0.011	0.001	kg/t	22	t/l	0.4	km/rt	2.2 / 0.6 / 0.1	kg/VKT	4.8	S.C. %	32	Ave weight	75	C. %	
Hauling aggregate on-site - paved	4,905	942	228	310,085	t/yr	0.0158	0.00304	0.000735	kg/t	32	t/l	1.9	km/rt	0.27 / 0.05 / 0.01	kg/VKT	2	S.L. g/m2	38	Ave weight (t)			
Hauling aggregate on-site - unpaved	2,561	653	65	310,085	t/yr	0.033	0.008	0.001	kg/t	32	t/l	0.4	km/rt	2.4 / 0.6 / 0.1	kg/VKT	4.8	S.C. %	38	Ave weight	75	C. %	
Hauling sand on-site - paved	906	174	42	57,247	t/yr	0.0158	0.00304	0.000735	kg/t	32	t/l	1.9	km/rt	0.27 / 0.05 / 0.01	kg/VKT	2	S.L. g/m2	38	Ave weight (t)			
Hauling sand on-site - unpaved	473	121	12	57,247	t/yr	0.033	0.008	0.001	kg/t	32	t/l	0.4	km/rt	2.4 / 0.6 / 0.1	kg/VKT	4.8	S.C. %	38	Ave weight	75	C. %	
Hauling filler on-site - paved	93	18	4	4,771	t/yr	0.0195	0.00375	0.000907	kg/t	22	t/l	1.9	km/rt	0.23 / 0.04 / 0.01	kg/VKT	2	S.L. g/m2	32	Ave weight (t)			
Hauling filler on-site - unpaved	53	14	1	4,771	t/yr	0.045	0.011	0.001	kg/t	22	t/l	0.4	km/rt	2.2 / 0.6 / 0.1	kg/VKT	4.8	S.C. %	32	Ave weight	75	C. %	
Unloading material to hopper	833	394	60	478,724	t/yr	0.00174	0.00082	0.00012	kg/t	1.47	ave. ws	2	M.C. %									
Unloading processed asphalt to dispatch truck	833	394	60	478,724	t/yr	0.00174	0.00082	0.00012	kg/t	1.47	ave. ws	2	M.C. %									
Hauling processed asphalt off-site - paved	7,733	1,484	359	478,724	t/yr	0.0162	0.00310	0.000750	kg/t	17	t/l	1.9	km/rt	0.14 / 0.03 / 0.01	kg/VKT	2	S.L. g/m2	20	Ave weight (t)			
Hauling processed asphalt off-site - unpaved	5,778	1,473	147	478,724	t/yr	0.048	0.012	0.001	kg/t	17	t/l	0.4	km/rt	1.8 / 0.5 / 0.05	kg/VKT	4.8	S.C. %	20	Ave weight	75	C. %	
Wind erosion from exposed stockpiles	9,234	4,617	693	21.7	ha	850	425	64	kg/ha/year												50	C. %
Exhaust emissions	835	835	810																			
Total emissions (kg/yr.)	41,147	12,918	2,725																			

Appendix C

Isopleth Diagrams



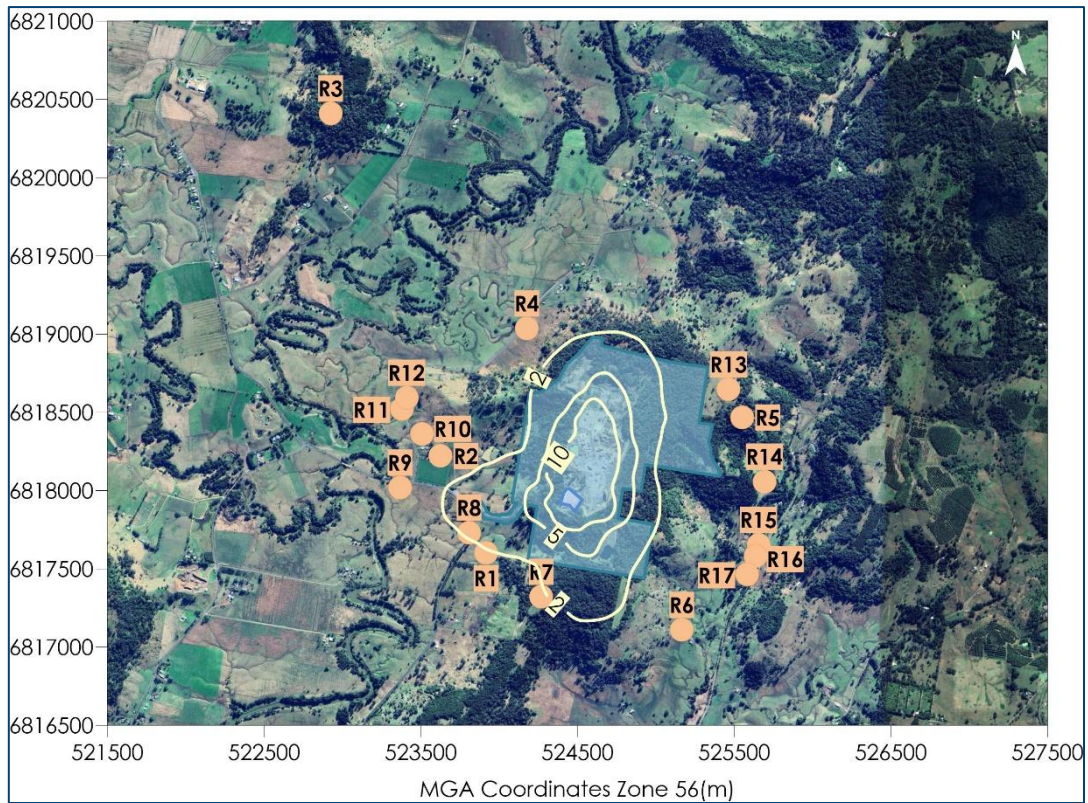


Figure C-1: Predicted incremental maximum 24-hour average PM_{2.5} concentrations (µg/m³)

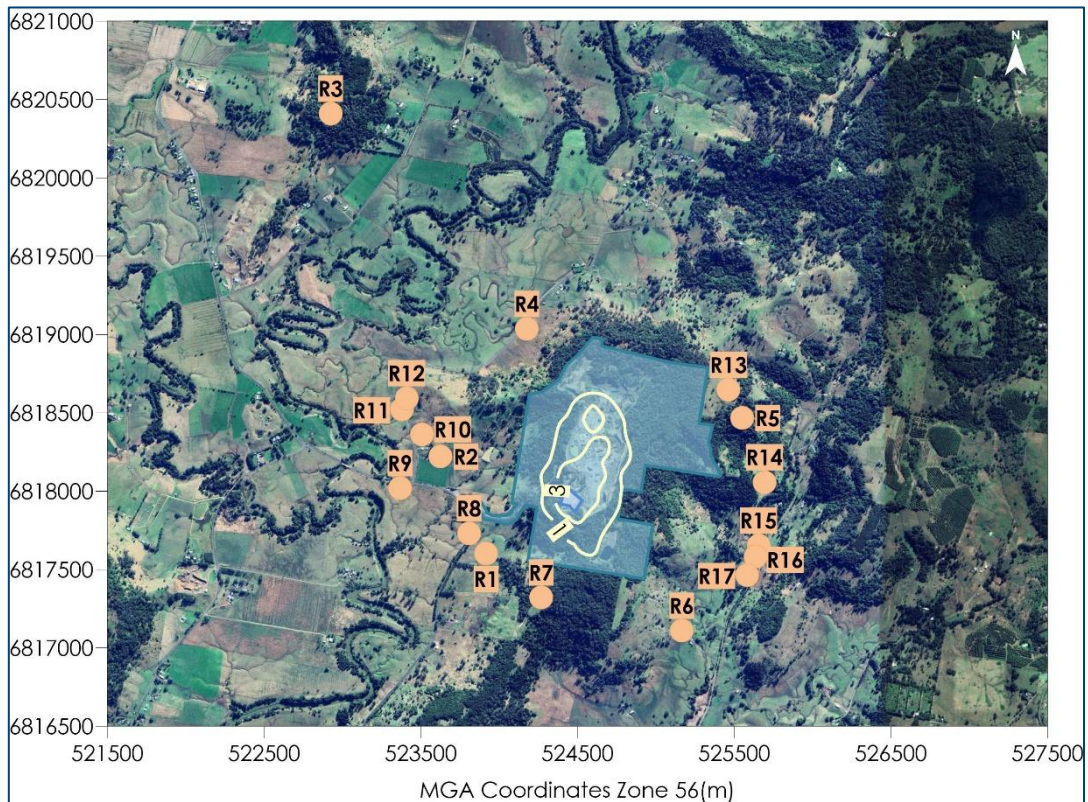


Figure C-2: Predicted incremental annual average PM_{2.5} concentrations (µg/m³)

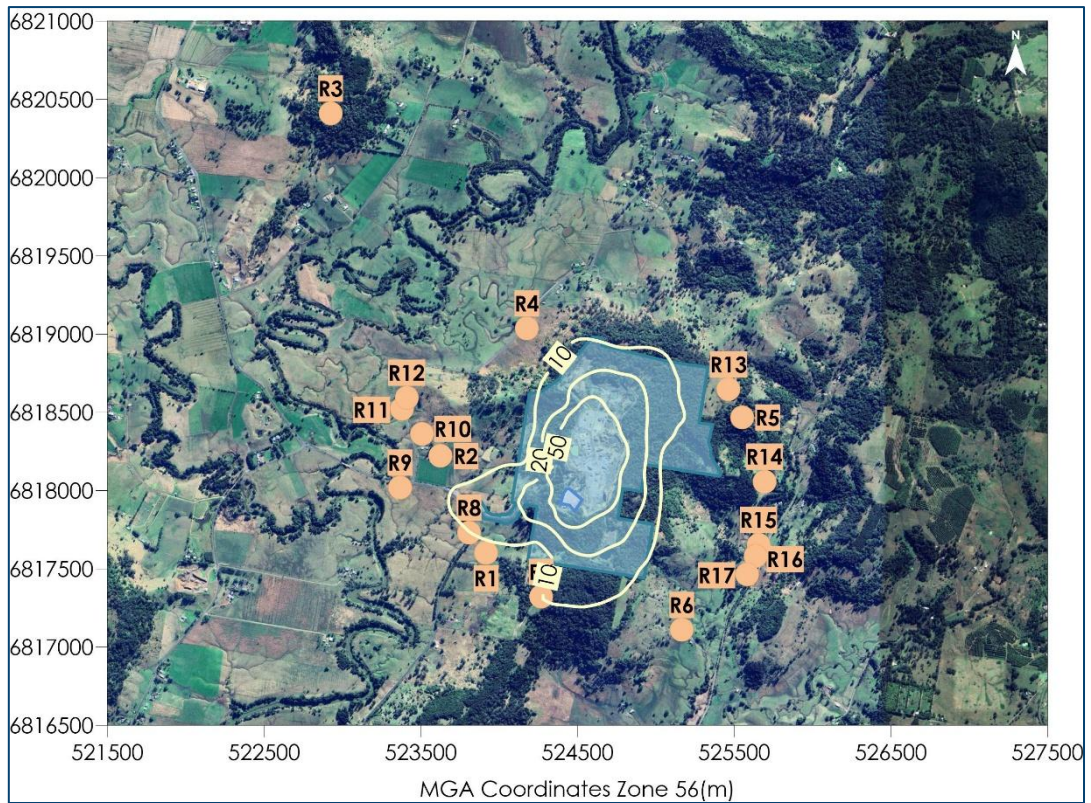


Figure C-3: Predicted incremental maximum 24-hour average PM₁₀ concentrations (µg/m³)

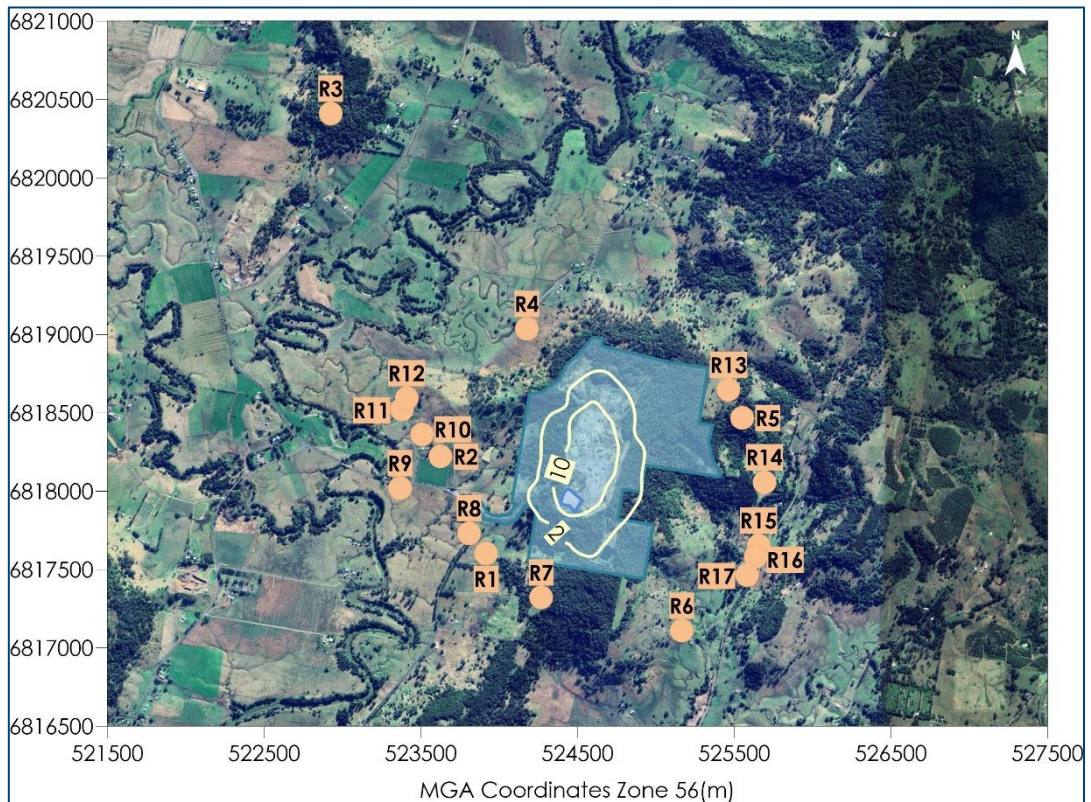


Figure C-4: Predicted incremental annual average PM₁₀ concentrations (µg/m³)

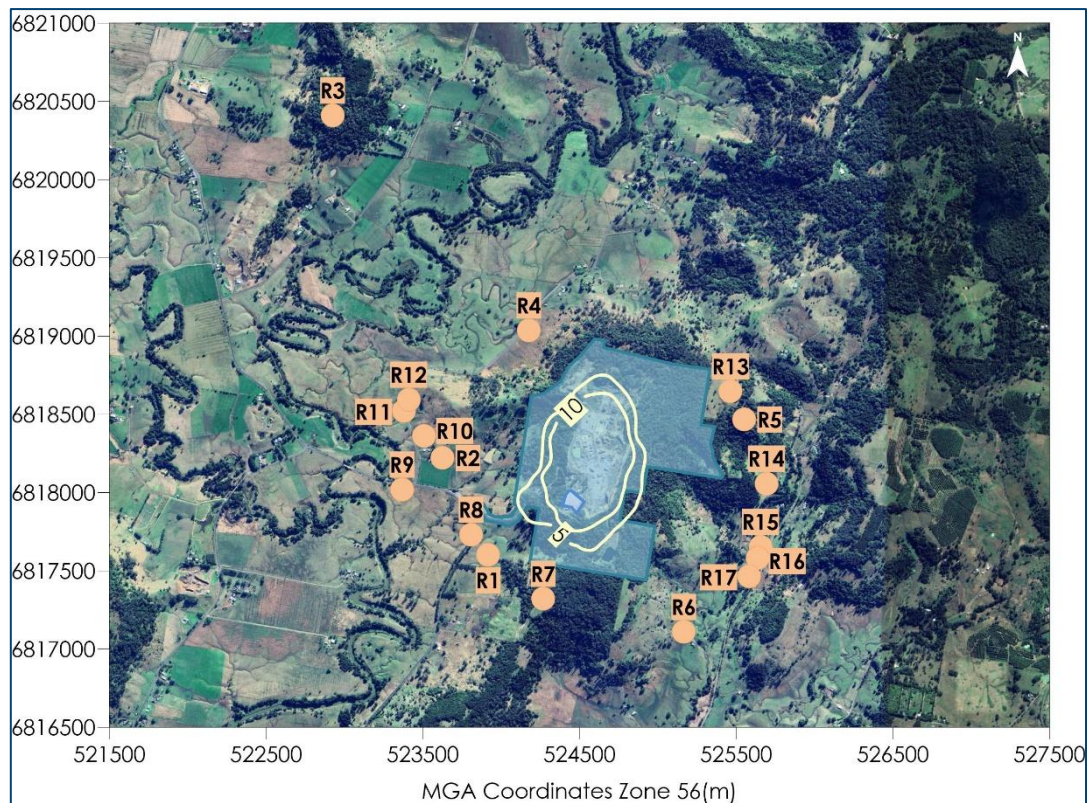


Figure C-5: Predicted incremental annual average TSP concentrations ($\mu\text{g}/\text{m}^3$)

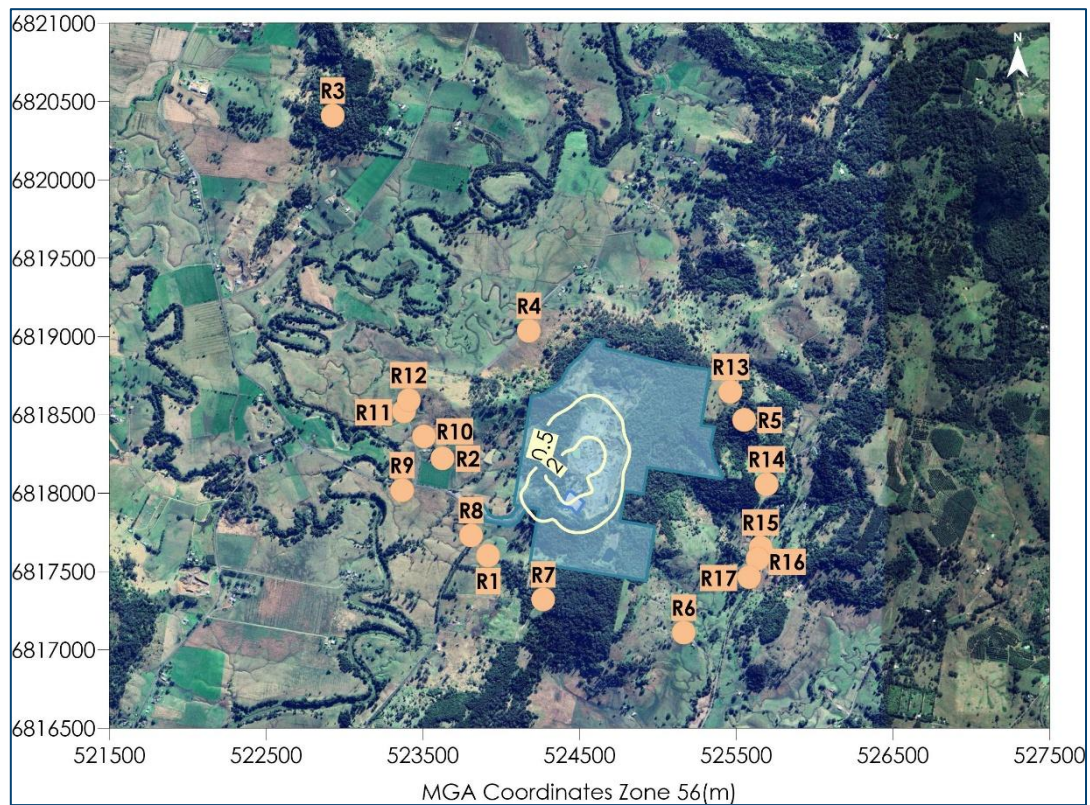


Figure C-6: Predicted incremental annual average dust deposition levels ($\text{g}/\text{m}^2/\text{month}$)

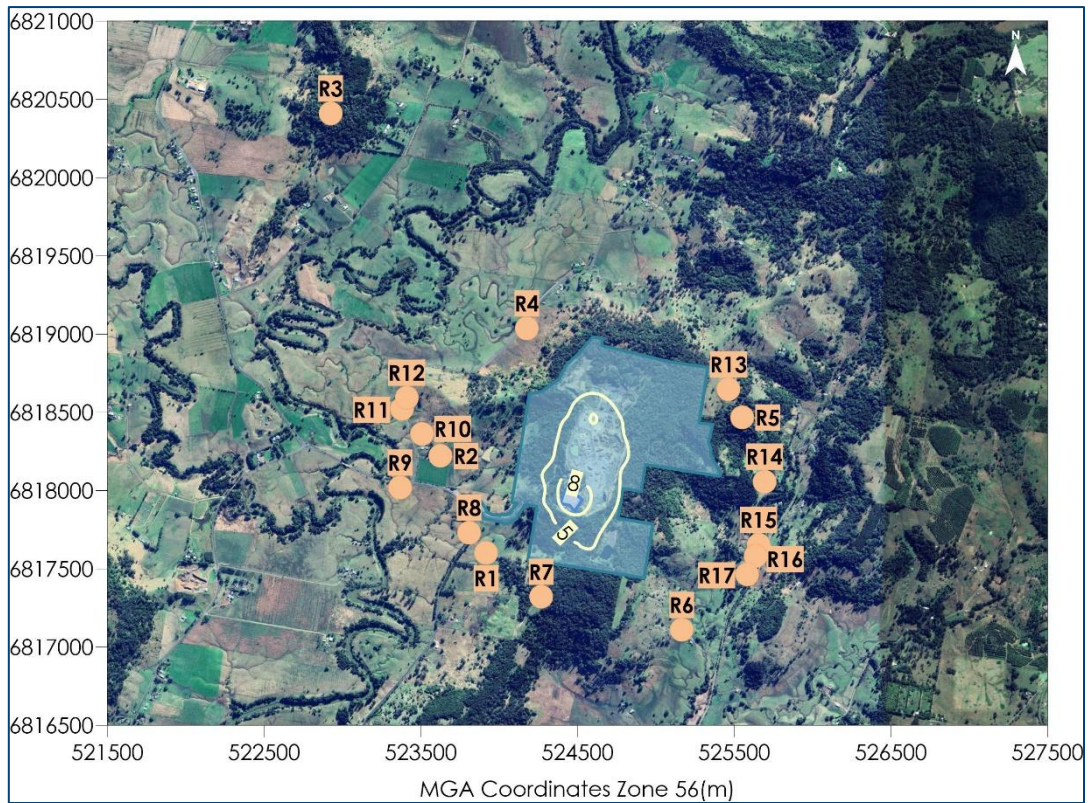


Figure C-7: Predicted cumulative annual average PM_{2.5} concentrations (µg/m³)

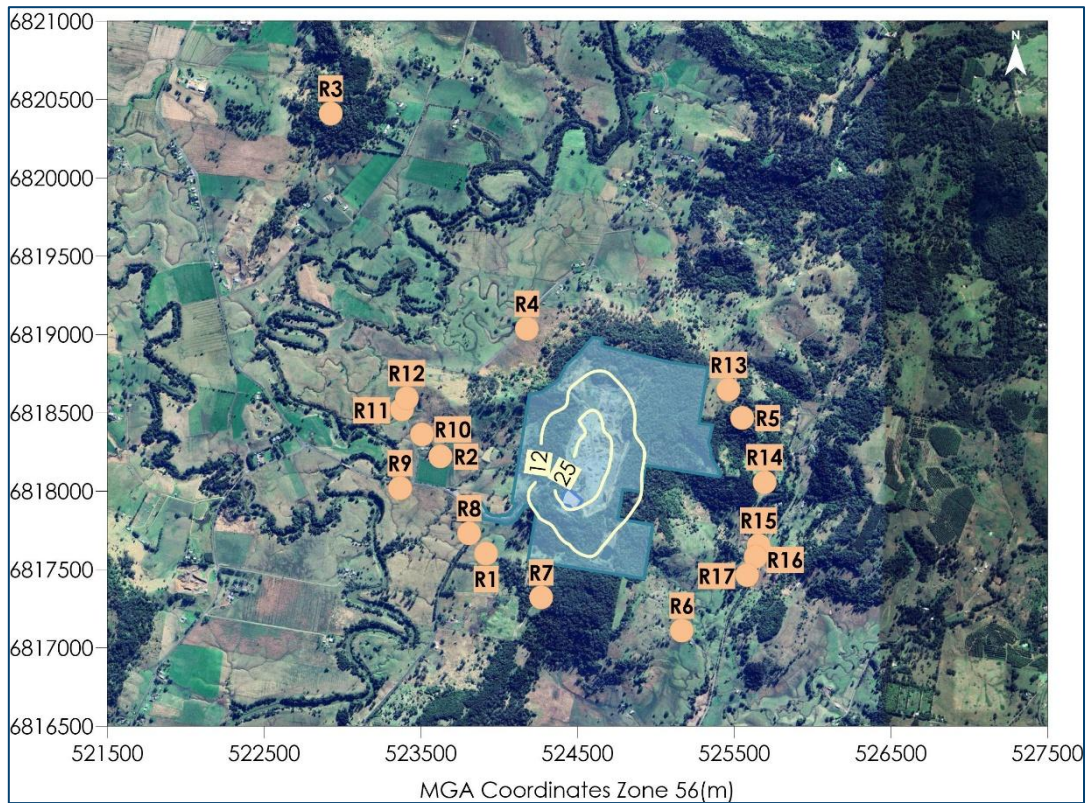


Figure C-8: Predicted cumulative annual average PM₁₀ concentrations (µg/m³)

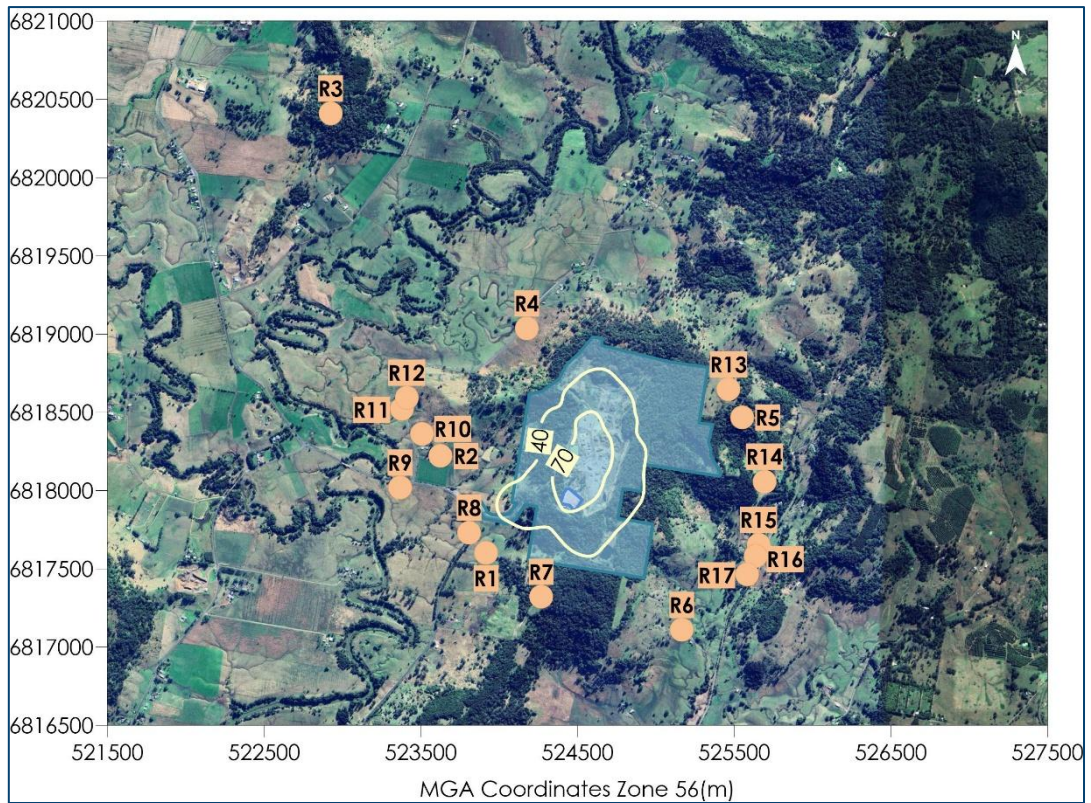


Figure C-9: Predicted cumulative annual average TSP concentrations ($\mu\text{g}/\text{m}^3$)

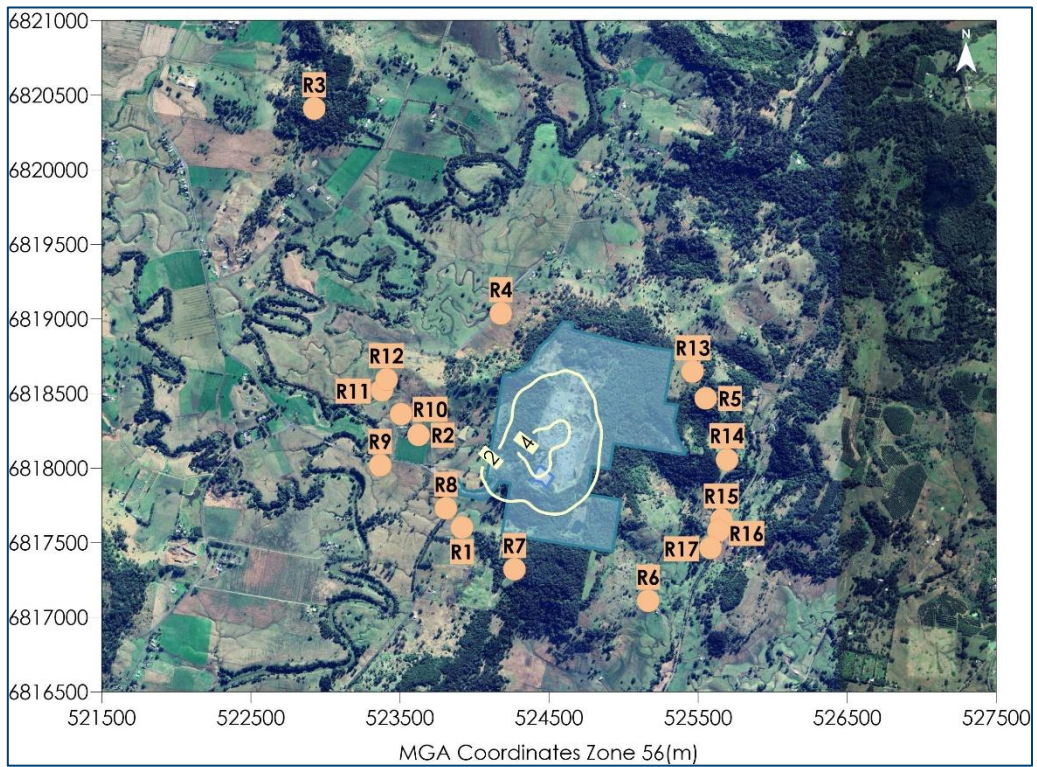


Figure C-10: Predicted cumulative annual average dust deposition levels ($\text{g}/\text{m}^2/\text{month}$)

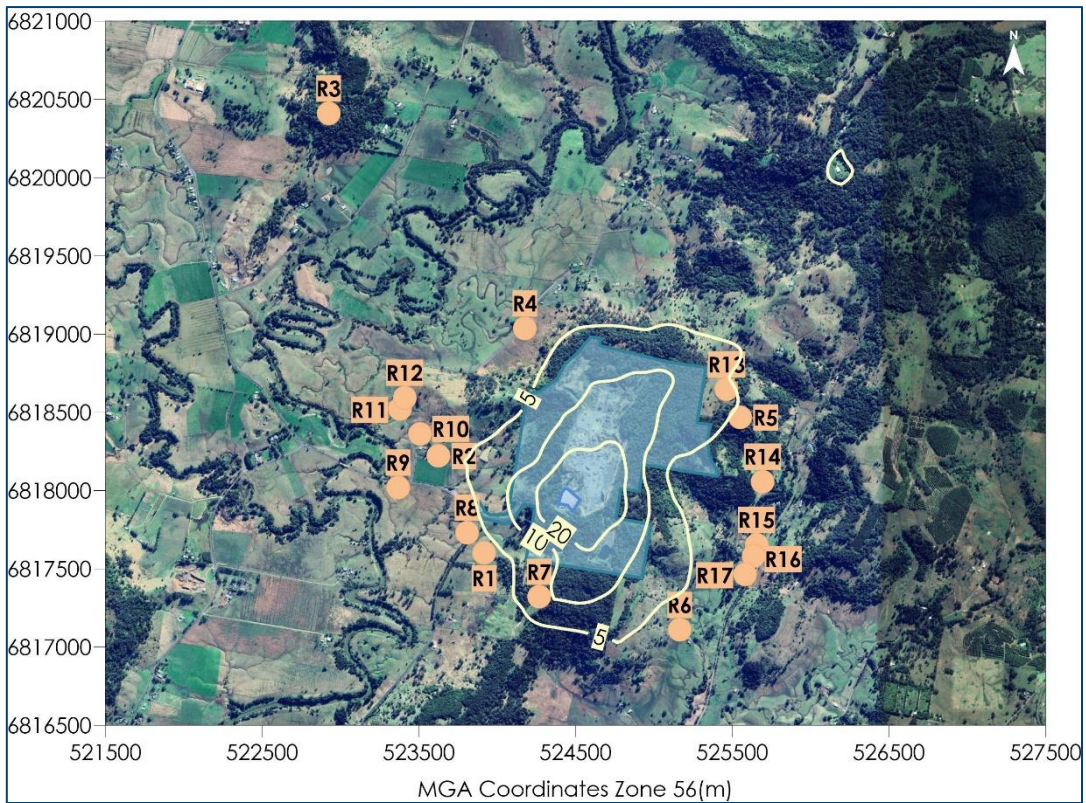


Figure C-11: Predicted incremental maximum 1-hour average NO₂ concentrations due to the Project

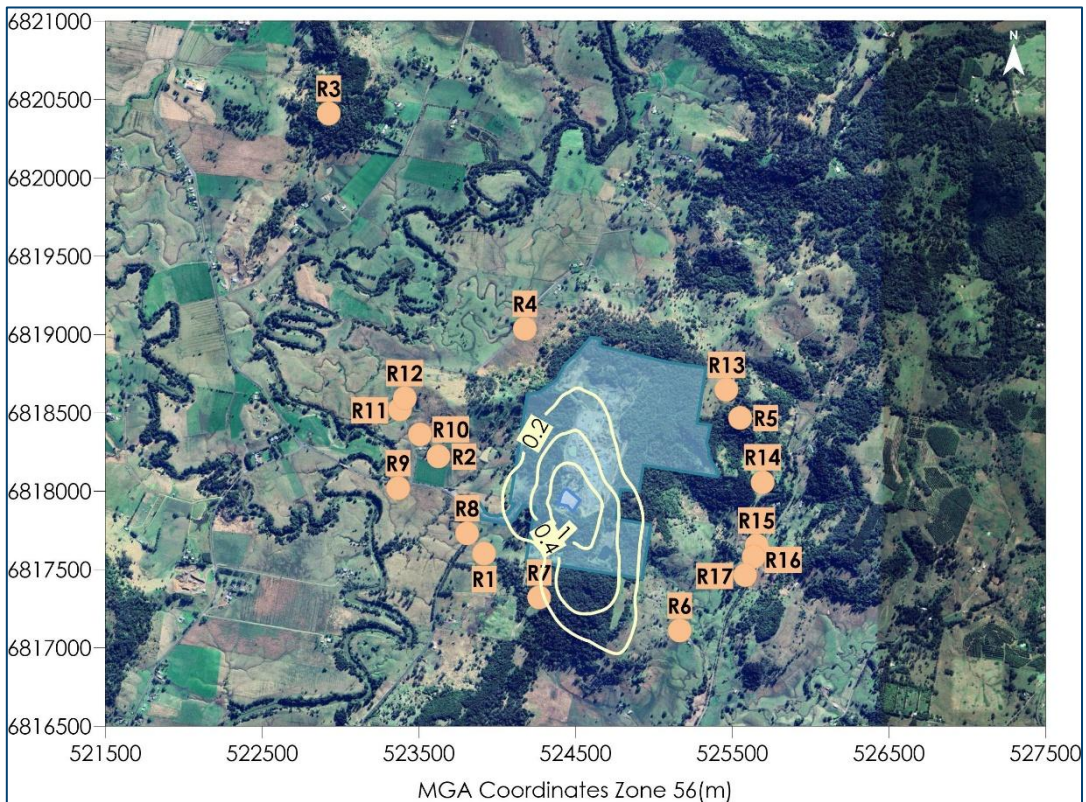


Figure C-12: Predicted incremental annual average NO₂ concentrations due to the Project

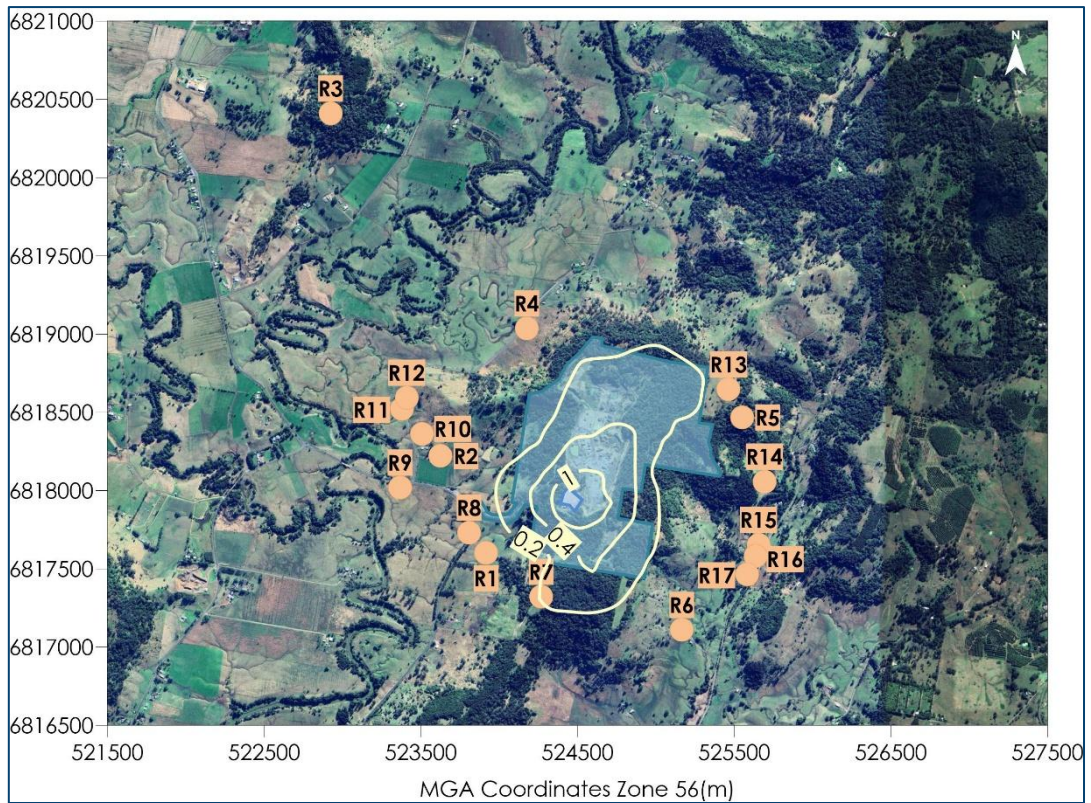


Figure C-13: Predicted incremental maximum 1-hour average SO₂ concentrations due to the Project

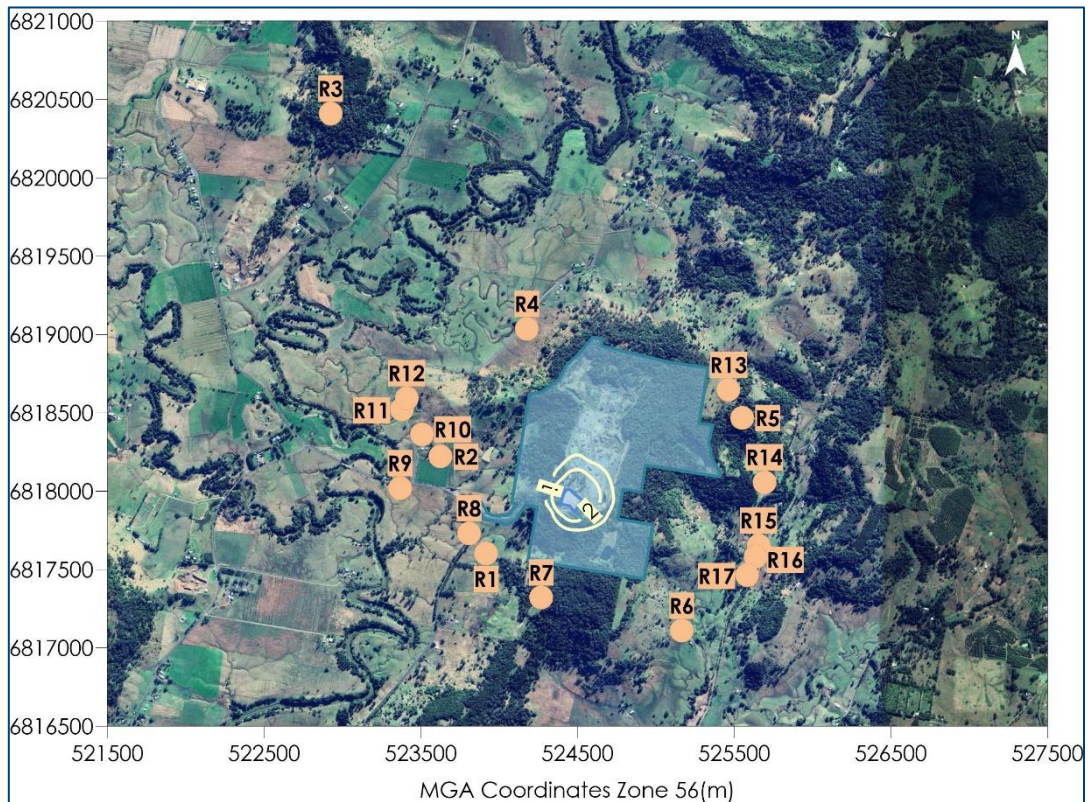


Figure C-14: Predicted incremental 99th percentile nose-response average ground level odour concentrations

Appendix D

Further detail regarding 24-hour PM_{2.5} and PM₁₀ analysis



Further detail regarding 24-hour average PM_{2.5} and PM₁₀ analysis

The analysis below provides a cumulative 24-hour PM_{2.5} and PM₁₀ impact assessment in accordance with the NSW EPA Approved Methods; refer to the worked example on Page 50 to 51 of the Approved Methods.

The background level is the ambient level at the Coffs Harbour monitoring station.

The predicted increment is the predicted level to occur at the receptor due to the Project.

The total is the sum of the background level and the predicted level. The totals may have minor discrepancies due to rounding.

Table D-1 to **Table D-4** assesses the selected receptors and shows the predicted maximum cumulative levels at the selected receptor.

The left half of the table examines the cumulative impact during the periods of highest background levels and the right half of the table examines the cumulative impact during the periods of highest contribution from the project.

The **green** shading represents days ranked per the highest background level but below the criteria.

The **blue** shading represents days ranked per the highest predicted increment level but below the criteria.

The **orange** shading represents days where the measured background level is already over the criteria.

Any value above the PM_{2.5} criterion of 25µg/m³ or above the PM₁₀ criterion of 50µg/m³ is in **bold red**.

Table D-1: Cumulative 24-hour average PM₁₀ concentration (µg/m³) – Receptor R1

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
8/10/2021	26.0	0.9	26.9	1/07/2021	4.9	7.3	12.2
15/10/2021	25.6	1.0	26.6	3/07/2021	4.7	7.0	11.7
10/10/2021	25.0	3.6	28.6	10/11/2021	10.1	6.3	16.4
2/03/2021	23.5	1.3	24.8	30/06/2021	8.4	6.2	14.6
16/01/2021	23.0	1.1	24.1	11/08/2021	9.7	6.1	15.8
12/09/2021	22.7	1.6	24.3	20/08/2021	10.9	6.1	17.0
9/10/2021	22.2	4.3	26.5	28/09/2021	8.4	5.8	14.2
30/10/2021	20.6	0.2	20.8	2/07/2021	5.2	5.8	11.0
1/09/2021	20.3	3.7	24.0	18/10/2021	11.5	5.8	17.3
16/04/2021	19.8	2.1	21.9	5/11/2021	6.6	5.6	12.2

Table D-2: Cumulative 24-hour average PM₁₀ concentration (µg/m³) – Receptor R7

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
8/10/2021	26.0	1.1	27.1	1/07/2021	4.9	10.5	15.4
15/10/2021	25.6	1.0	26.6	30/06/2021	8.4	8.0	16.4
10/10/2021	25.0	4.0	29.0	11/05/2021	10.0	7.8	17.8
2/03/2021	23.5	0.6	24.1	24/06/2021	6.4	7.2	13.6
16/01/2021	23.0	1.1	24.1	3/07/2021	4.7	6.8	11.5
12/09/2021	22.7	1.7	24.4	5/11/2021	6.6	6.8	13.4
9/10/2021	22.2	2.0	24.2	26/06/2021	7.5	6.4	13.9
30/10/2021	20.6	0.2	20.8	2/07/2021	5.2	6.2	11.4
1/09/2021	20.3	1.5	21.8	12/05/2021	7.3	5.9	13.2
16/04/2021	19.8	1.2	21.0	3/06/2021	10.1	5.4	15.5



Table D-3: Cumulative 24-hour average PM_{2.5} concentration (µg/m³) – Receptor R1

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
1/09/2021	12.6	1.0	13.6	3/07/2021	2.4	1.7	4.1
12/09/2021	11.4	0.4	11.8	1/07/2021	2.1	1.7	3.8
27/06/2021	10.4	0.8	11.2	30/06/2021	4.0	1.6	5.6
31/08/2021	10.2	1.0	11.2	10/11/2021	4.1	1.5	5.6
8/05/2021	10.1	0.9	11.0	20/08/2021	5.7	1.5	7.2
10/10/2021	9.9	0.9	10.8	11/08/2021	4.1	1.4	5.5
21/08/2021	9.7	1.1	10.8	18/10/2021	4.5	1.4	5.9
16/04/2021	9.4	0.5	9.9	28/09/2021	2.7	1.4	4.1
25/04/2021	9.3	1.0	10.3	2/07/2021	1.4	1.3	2.7
20/09/2021	9.0	0.7	9.7	5/11/2021	2.0	1.3	3.3

Table D-4: Cumulative 24-hour average PM_{2.5} concentration (µg/m³) – Receptor R7

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
1/09/2021	12.6	0.4	13.0	1/07/2021	2.1	1.7	3.8
12/09/2021	11.4	0.7	12.1	11/05/2021	3.8	1.5	5.3
27/06/2021	10.4	0.3	10.7	24/06/2021	1.4	1.5	2.9
31/08/2021	10.2	0.8	11.0	29/09/2021	4.6	1.5	6.1
8/05/2021	10.1	0.5	10.6	30/06/2021	4.0	1.4	5.4
10/10/2021	9.9	1.1	11.0	26/11/2021	2.1	1.4	3.5
21/08/2021	9.7	1.0	10.7	3/07/2021	2.4	1.4	3.8
16/04/2021	9.4	0.2	9.6	7/11/2021	3.3	1.3	4.6
25/04/2021	9.3	0.5	9.8	5/11/2021	2.0	1.3	3.3
20/09/2021	9.0	0.6	9.6	10/11/2021	4.1	1.2	5.3

