Appendix G – Air Quality Impact Assessment

AIR QUALITY IMPACT AND GREENHOUSE GAS ASSESSMENT

RAZORBACK QUARRY

Space Urban Pty Ltd

12 December 2022

Job Number 21061299

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Air Quality Impact and Greenhouse Gas Assessment

Razorback Quarry

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1 INTRODUCTION

Todoroski Air Sciences has prepared this air quality impact assessment report for Space Urban Pty Ltd on behalf of Plantation Pine Products Australia Pty Ltd (hereafter referred to as the Proponent). This report provides an assessment of the potential air quality impacts associated with the proposed Razorback Quarry located at Running Stream (hereafter referred to as the Project). It also provides an estimate of the emissions of greenhouse gas to the atmosphere due to 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**). The assessment forms part of the Environmental Impact Statement (EIS) prepared to accompany the application for the Project.

To assess the potential air quality impacts and greenhouse gas emissions associated with the Project, this report incorporates the following aspects:

- A background and description of the Project;
- An outline of the applicable criteria to assess air quality impacts from the Project;
- Review of the existing meteorological and air quality environment surrounding the Project site;
- Description of the dispersion modelling approach used to assess potential air quality impacts;
- Presentation of the predicted results and discussion of the potential air quality impacts and associated mitigation measures; and,
- An assessment of the potential greenhouse gas emissions associated with the Project.

2 PROJECT SETTING

The Project site is located at 39 Razorback Road, Running Stream, NSW, and covers an area of approximately 24.7 hectares (ha). The Project is in the Mid-Western Regional Government Area (LGA). The area surrounding the site is predominately comprised of rural land.

Figure 2-1 presents the location of the Project and the receptor locations assessed as discrete receptors. **Table 2-1** presents a summary of the receptor addresses used in this study. **Figure 2-2** presents the landownership in the vicinity of the Project.

Figure 2-3 presents a pseudo three-dimensional visualisation of the topography surrounding the Project location. The Project site is located in an area of relatively elevated terrain which runs from the south to the northeast compared to the surrounding area, with areas of lower terrain to the northwest, southeast and southwest.

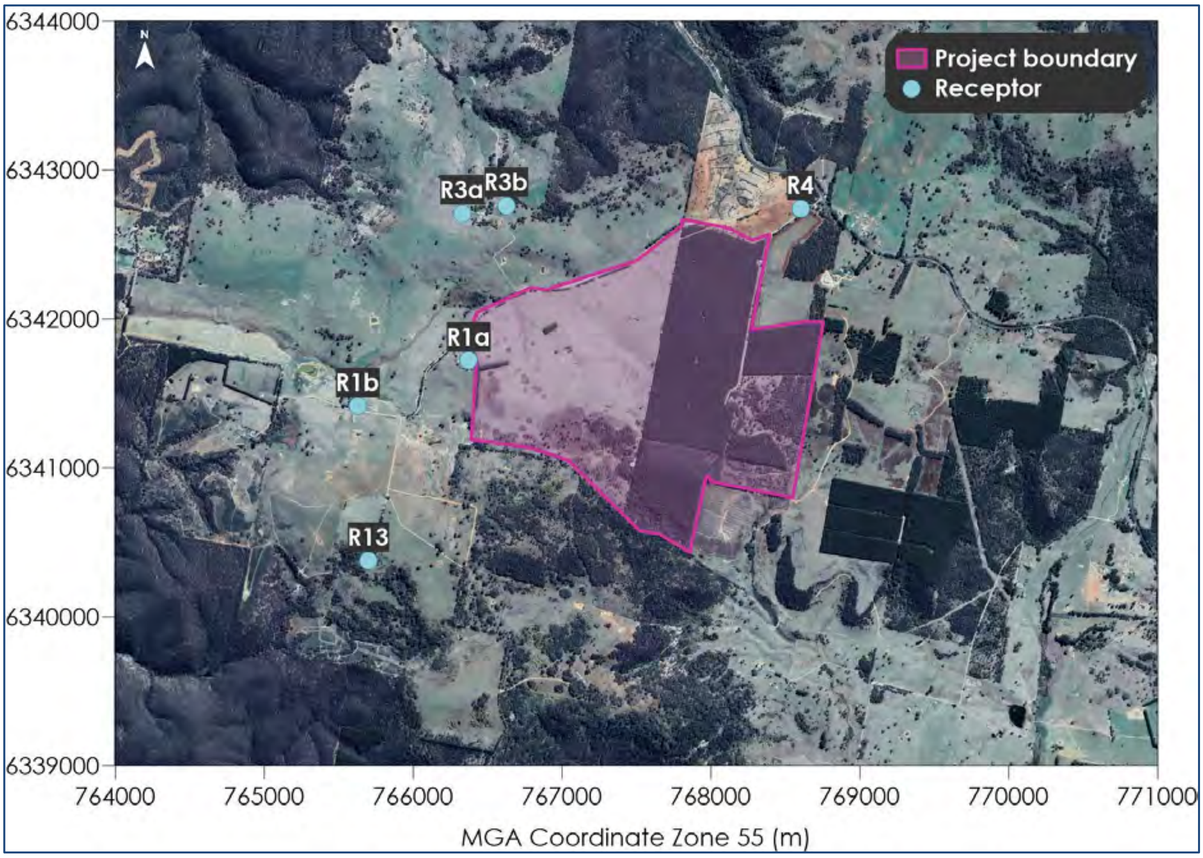

Figure 2-1: Project location

Table 2-1: Summary of discrete receptors

Receptor ID	Address/ description	Eastings	Northings
R1a	366 Razorback Road	766373	6341722
R1b	366 Razorback Road	765628	6341417
R3a	218 Razorback Road	766329	6342710
R3b	218 Razorback Road	766626	6342762
R4	82 Razorback Road	768603	6342742
R13	48 Berwick Road	765700	6340379

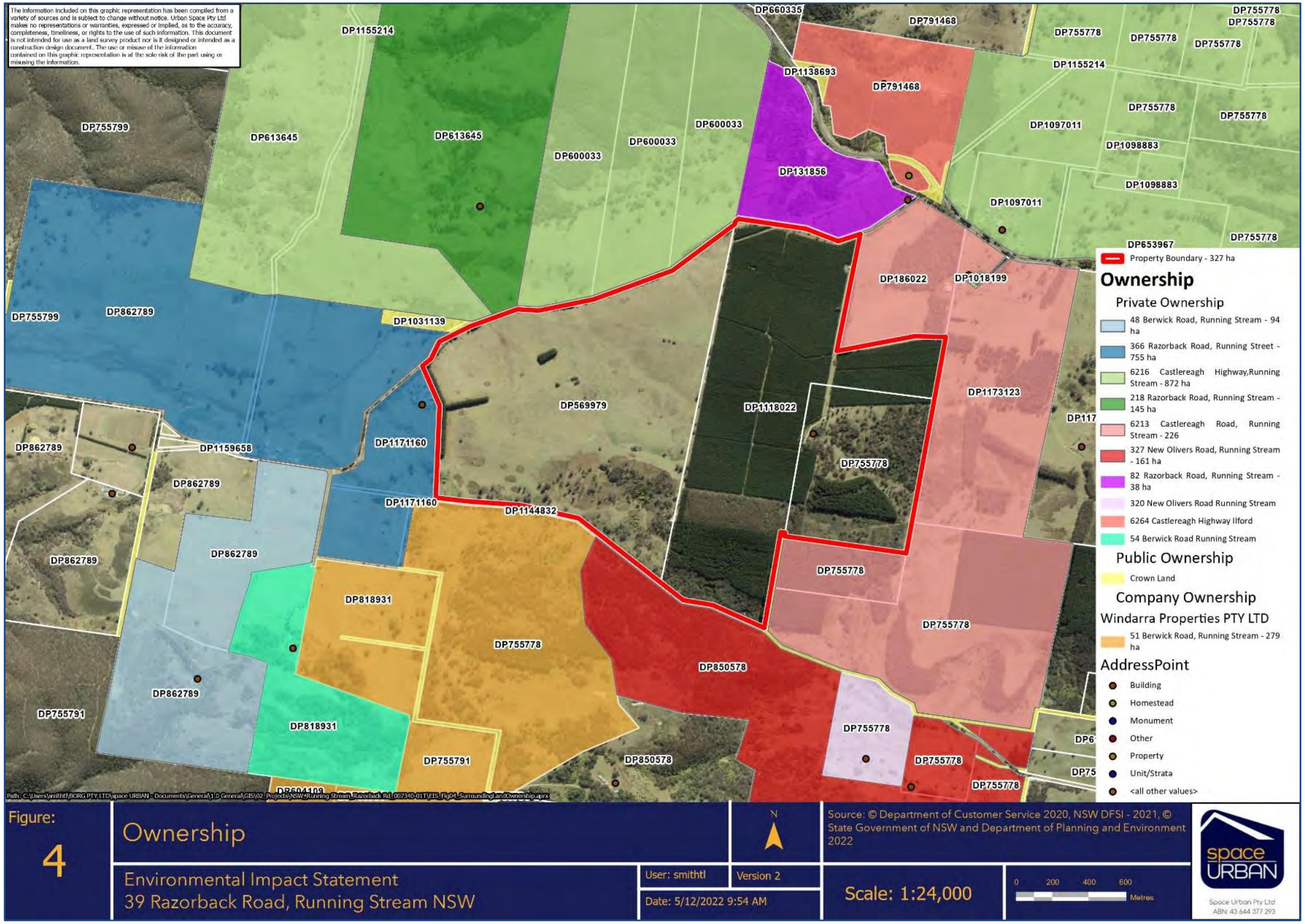

Figure 2-2: Land ownership

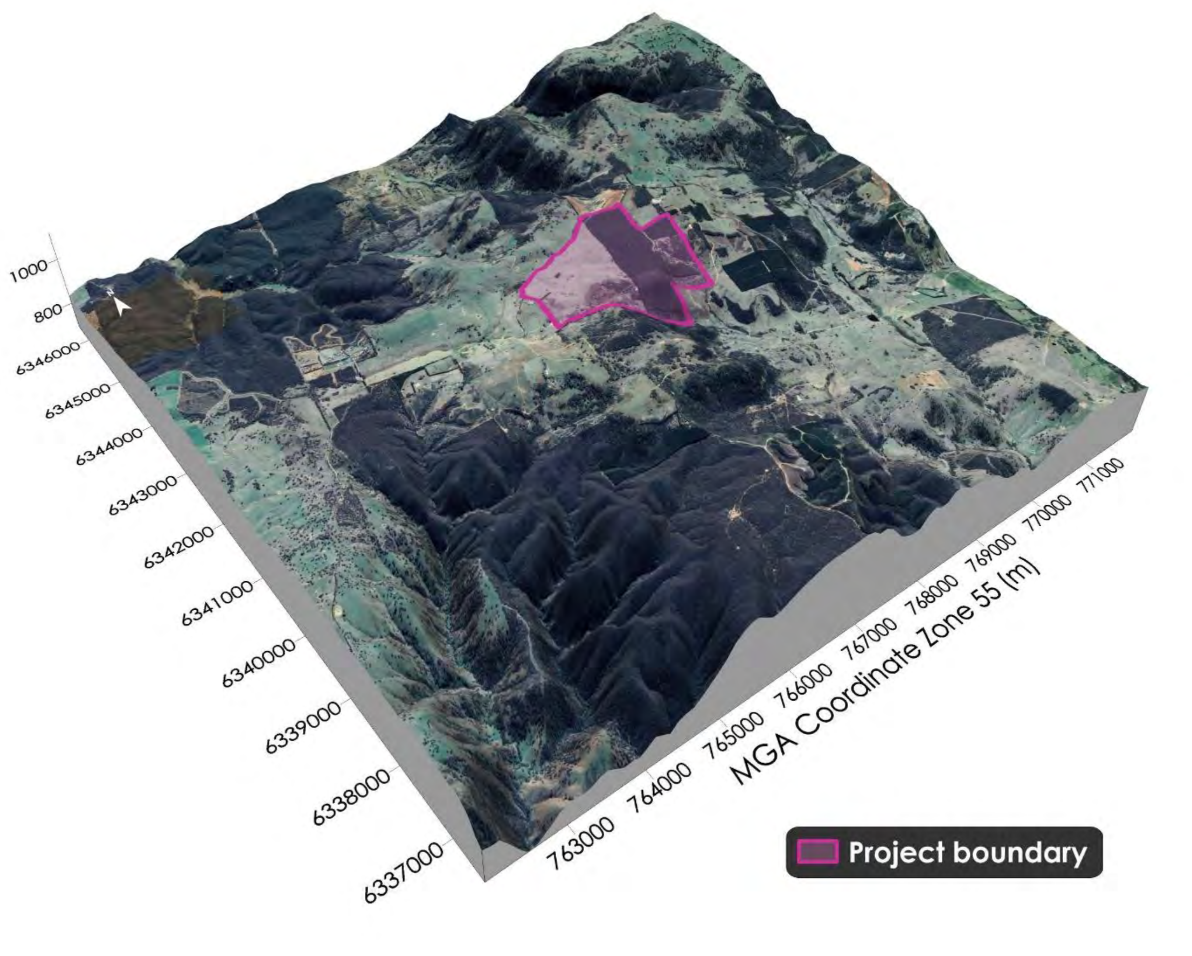

Figure 2-3: Representative view of topography surrounding the Project location

3 PROJECT DESCRIPTION

The Project involves the quarrying of up to 200,000 tonnes (t) of sand and gravel (decorative stone) per annum over a period of 30 years. Limited processing of extracted materials will occur onsite with the exception of a mobile screen to remove organic materials (e.g. sticks) and provide primary separation of the coarse pebble aggregates, finer gravels and the sand, silt and clays. The extract material would be trucked directly to consumers or third-party processing sites for use as sand in concrete and pebbles for decorative landscaping.

The maximum daily extraction rate will be 1,500 tonnes per day (tpd) to enable flexibility in transport and maximise campaign use of equipment. It should be noted that at 1,500tpd, the quarry would only need to operate for 2-3 days per week to meet the annual extraction limit. It is more likely the quarry would extract an average of less than 500tpd.

Figure 3-1 presents the proposed general Project arrangement including the staged extraction areas. Extraction from the quarry will be undertaken in 3 stages. Extraction areas would be progressively rehabilitated, returning the land to pasture and pine plantation with the potential future use of the facilities area for forestry related activities.

Table 3-1 outlines the operational hours for the Project.

Table 3-1: Operational hours for the Project

Activity	Hours of operation
Construction	7am to 6pm Monday to Friday 8am to 1pm Saturday No activity Sunday or public holidays
Extraction and haulage	7am to 6pm Monday to Friday 8am to 1pm Saturday No activity Sunday or public holidays

Project construction would occur over an estimated 12-week period and includes the following works:

- Bitumen sealing of Razorback Road to entrance of private haul road;
- Construction of private haul road;
- Construction of workshop and crib pad;
- Construction of the weigh bridge; and,
- Initial topsoil stripping and placement of topsoil stockpiles as a noise bund along the western boundary of the quarry.

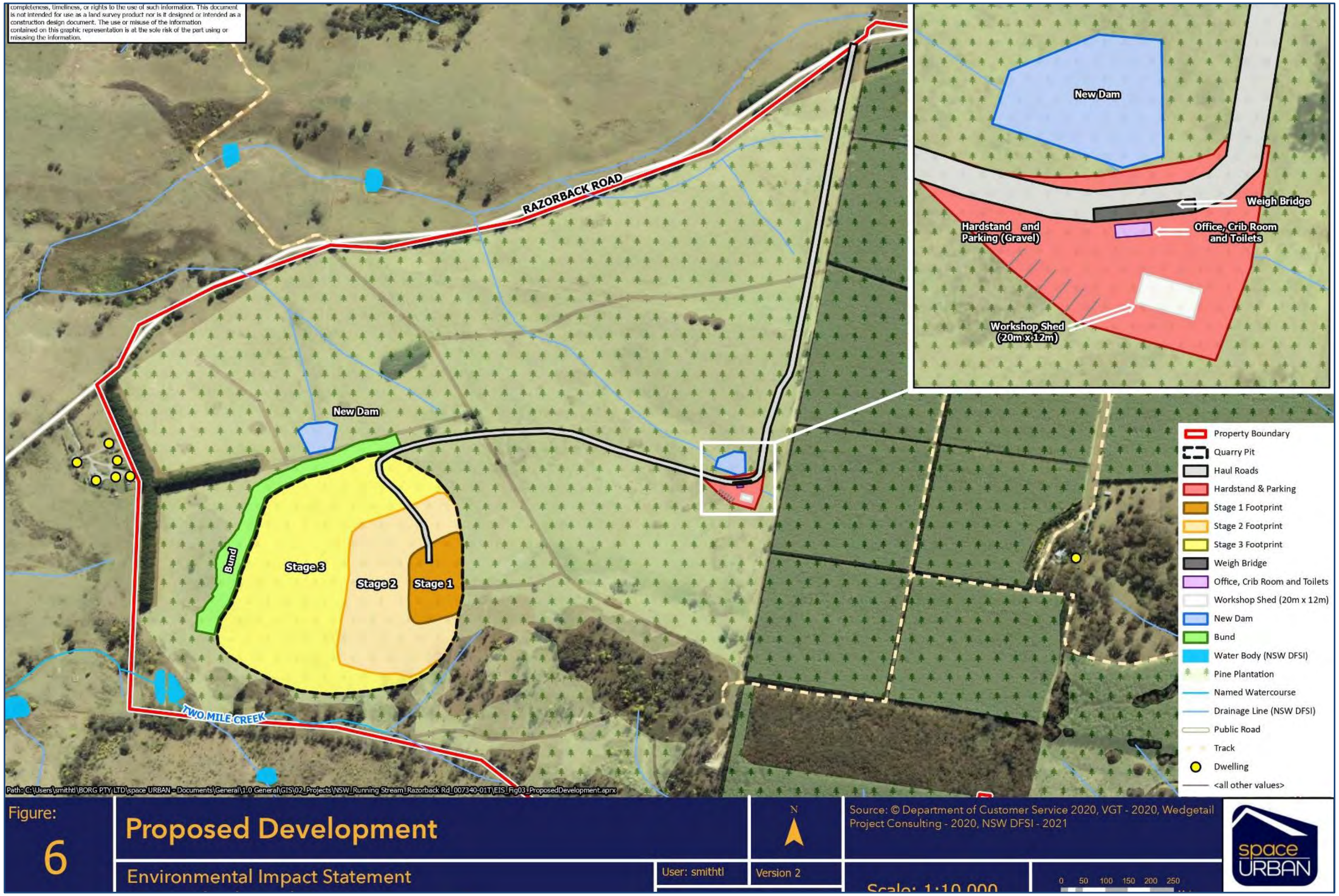

Figure 3-1: Proposed Project general arrangement

4 STATUTORY REQUIREMENTS

Table 4-1 outlines the relevant Planning Secretary's Environmental Assessment Requirements (SEAR's) and **Table 4-2** outlines the relevant NSW EPA requirements for this air quality impact assessment.

Table 4-1: SEAR's

Key issues	Section
Air – including an assessment of the likely air quality impacts of the development in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW. The assessment is to give particular attention to potential dust impacts on any nearby private receivers due to construction activities, the operation of the quarry and/or road haulage.	This report

Table 4-2: NSW EPA EIS Requirements

Air Quality requirements	Section
The EIS should include a detailed air quality impact assessment (AQIA). The AQIA should:	
1. Identify all potential discharges of fugitive and point source emissions of pollutants including dust for all stages of the proposal and assess the risk associated with those emissions. All processes that could result in air emissions must be identified and described. Sufficient detail to accurately communicate the characteristics and quantity of all emissions must be provided. Assessment of risk relates to environmental harm, risk to human health and amenity.	Section 8.3
2. Justify the level of assessment undertaken on the basis of risk factors, including but not limited to: a. proposal location; b. characteristics of the receiving environment; c. type and quantity of pollutants emitted.	Sections 2, 6 & 8.3
3. Describe the receiving environment in detail. The proposal must be contextualised within the receiving environment (local, regional and inter-regional as appropriate). The description must include but need not be limited to: a. meteorology and climate; b. topography; c. surrounding land-use; d. ambient air quality.	Sections 2 & 6
4. Include a consideration of 'worst case' emission scenarios and impacts at proposed emission limits.	Section 8.3
5. Account for cumulative impacts associated with existing emission sources as well as any currently approved developments linked to the receiving environment.	Sections 6.3.2 & 9.2
6. Include air dispersion modelling where there is a risk of adverse air quality impacts, or where there is sufficient uncertainty to warrant a rigorous numerical impact assessment. Air dispersion modelling must be conducted in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2005).	Section 8
7. Demonstrate the proposal's ability to comply with the relevant regulatory framework, specifically the Protection of the Environment Operations (POEO) Act (1997) and the POEO (Clean Air) Regulation (2010).	Section 5.3
8. Detail emissions control techniques/practices that will be employed by the proposal. Consideration should be given to dust management techniques where water is unavailable or limited and the development of a Trigger Action Response Plan (TARP).	Section 10

5 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 sub-sections below identify the potential air emissions generated by the Project and the applicable air quality criteria.

5.1 NSW EPA impact assessment criteria

Table 5-1 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 total impact relate to the total pollutant burden in the air and not just the pollutants from the Project. Consideration of background pollutant levels needs to be made when using these goals to assess potential impacts.

Table 5-1: Air quality impact assessment criteria

Pollutant	Averaging Period	Impact	Criterion	Application
Total Suspended Particulates (TSP)	Annual	Total	90 µg/m³	Sensitive receptors
Particulate matter ≤10µm (PM_{10})	Annual	Total	25 µg/m³	Sensitive receptors
	24 hour	Total	50 µg/m³	Sensitive receptors
Particulate matter ≤2.5µm ($PM_{2.5}$)	Annual	Total	8 µg/m³	Sensitive receptors
	24 hour	Total	25 µg/m³	Sensitive receptors
Deposited dust	Annual	Incremental	2 g/m²/month	Sensitive receptors
		Total	4 g/m²/month	Sensitive receptors

µg/m³ = micrograms per cubic metre
g/m²/month = grams per square metre per month

5.2 NSW Voluntary Land Acquisition and Mitigation Policy

Part of the NSW Voluntary Land Acquisition and Mitigation Policy (VLAMP) dated September 2018 describes the NSW Government's policy for voluntary mitigation and land acquisition to address particulate matter impacts from state significant mining, petroleum and extractive industry developments.

Voluntary mitigation and acquisition rights may apply per the VLAMP where, even with best practice management, the development contributes to exceedances of the criteria in **Table 5-2**. The mitigation criteria apply at any residence on privately owned land or workplace, where any exceedance would be unreasonably detrimental to workers health or carrying out of the business. The acquisition criteria apply at any residence on privately owned land, workplace or on more than 25 per cent of any privately owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls (vacant land).

Table 5-2: Particulate matter mitigation criteria

Pollutant	Averaging period	Mitigation criterion	Acquisition criterion	Impact type
$PM_{2.5}$	Annual	8µg/m³*	8µg/m³*	Human health
$PM_{2.5}$	24 hour	25µg/m³#	25µg/m³^	Human health
PM_{10}	Annual	25µg/m³*	25µg/m³*	Human health
PM_{10}	24 hour	50µg/m³#	50µg/m³^	Human health
TSP	Annual	90µg/m³*	90µg/m³*	Amenity

Pollutant	Averaging period	Mitigation criterion		Acquisition criterion		Impact type
$PM_{2.5}$	Annual	8µg/m³*		8µg/m³*		Human health
$PM_{2.5}$	24 hour	25µg/m³#		25µg/m³^		Human health
Deposited dust	Annual	2g/m²/mth#	4g/m²/mth*	2g/m²/mth^	4g/m²/mth*	Amenity

Source: NSW Government (2018)

*Cumulative impact (i.e. increase in concentration due to the development plus background concentrations due to all other sources).

#Incremental impact (i.e. increase in concentrations due to the development alone), with zero allowable exceedances of the criteria over the life of the development.

^Incremental impact (i.e. increase in concentrations due to the development alone), with up to five allowable exceedances of the criteria over the life of the development.

5.3 Protection of the Environment Operations Act 1979

The Protection of the Environment (POEO) Act 1997 (**NSW Government, 2022b**) and the POEO Clean Air Regulation 2021 (**NSW Government, 2022a**) apply to extractive activities. The Project would operate in accordance with the relevant regulatory framework for air quality to ensure compliance with this legislation.

6 EXISTING ENVIRONMENT

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

6.1 Local climatic conditions

Long-term climatic data from the Bureau of Meteorology (BoM) weather station at Nullo Mountain Automatic Weather Station (AWS) (Site No. 062100) were used to characterise the local climate in the proximity of the Project. The Nullo Mountain AWS is located approximately 50 kilometres (km) northeast of the Project.

Table 6-1 and **Figure 6-1** present a summary of data from the Nullo Mountain AWS collected over an approximate 18-to-31-year period for the various meteorological parameters.

The data indicate that January is the hottest month with a mean maximum temperature of 24.3 degrees Celsius (°C) and July is the coldest month with a mean minimum temperature of 2.5°C.

Rainfall exhibits variability and seasonal fluctuations across the year with an annual average rainfall of 950.0 millimetres (mm) over 90.5 days. The data indicate that March is the wettest month with an average rainfall of 108.3 millimetres (mm) over 8.9 days and May is the driest month with an average rainfall of 54.7mm over 6.2 days.

Humidity levels exhibit variability and seasonal flux across the year. Mean 9am humidity levels range from 70 per cent (%) in October to 85% in June. Mean 3pm humidity levels range from 54% in October to 74% in June.

Mean 9am wind speeds range from 15.0 kilometres per hour (km/h) in April, May and December to 16.2km/h in August. Mean 3pm wind speeds range from 12.9km/h in April and May to 15.6km/h in September.

Table 6-1: Monthly climate statistics summary – Nullo Mountain AWS

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature													
Mean max. temp. (°C)	24.3	22.8	20.1	16.8	12.9	9.6	9.3	10.9	14.3	17.5	20.0	22.5	16.8
Mean min. temp. (°C)	13.8	13.2	11.5	8.6	5.7	3.4	2.5	3.0	5.6	7.9	10.1	11.9	8.1
Rainfall													
Rainfall (mm)	100.8	99.4	108.3	57.8	54.7	73.7	67.6	56.6	72.1	70.1	98.7	90.6	950.0
No. of rain days (≥1mm)	8.3	8.0	8.9	5.6	6.2	8.3	7.8	6.6	6.8	7.3	8.6	8.1	90.5
9am conditions													
Mean temp. (°C)	17.2	16.3	14.3	12.3	9.1	6.2	5.2	6.5	9.4	12.1	13.8	15.9	11.5
Mean R.H. (%)	75	82	83	78	81	85	84	76	72	70	73	73	78
Mean W.S. (km/h)	15.6	15.9	15.5	15.0	15.0	15.5	15.1	16.2	15.9	15.6	15.7	15.0	15.5
3pm conditions													
Mean temp. (°C)	22.3	20.9	18.6	15.7	11.8	8.6	8.0	9.8	13.0	15.6	17.7	20.4	15.2
Mean R.H. (%)	56	64	64	62	68	74	71	60	56	54	58	56	62
Mean W.S. (km/h)	14.8	14.5	13.9	12.9	12.9	13.9	13.9	15.0	15.6	15.5	14.9	14.6	14.4

Source: **Bureau of Meteorology, 2022**

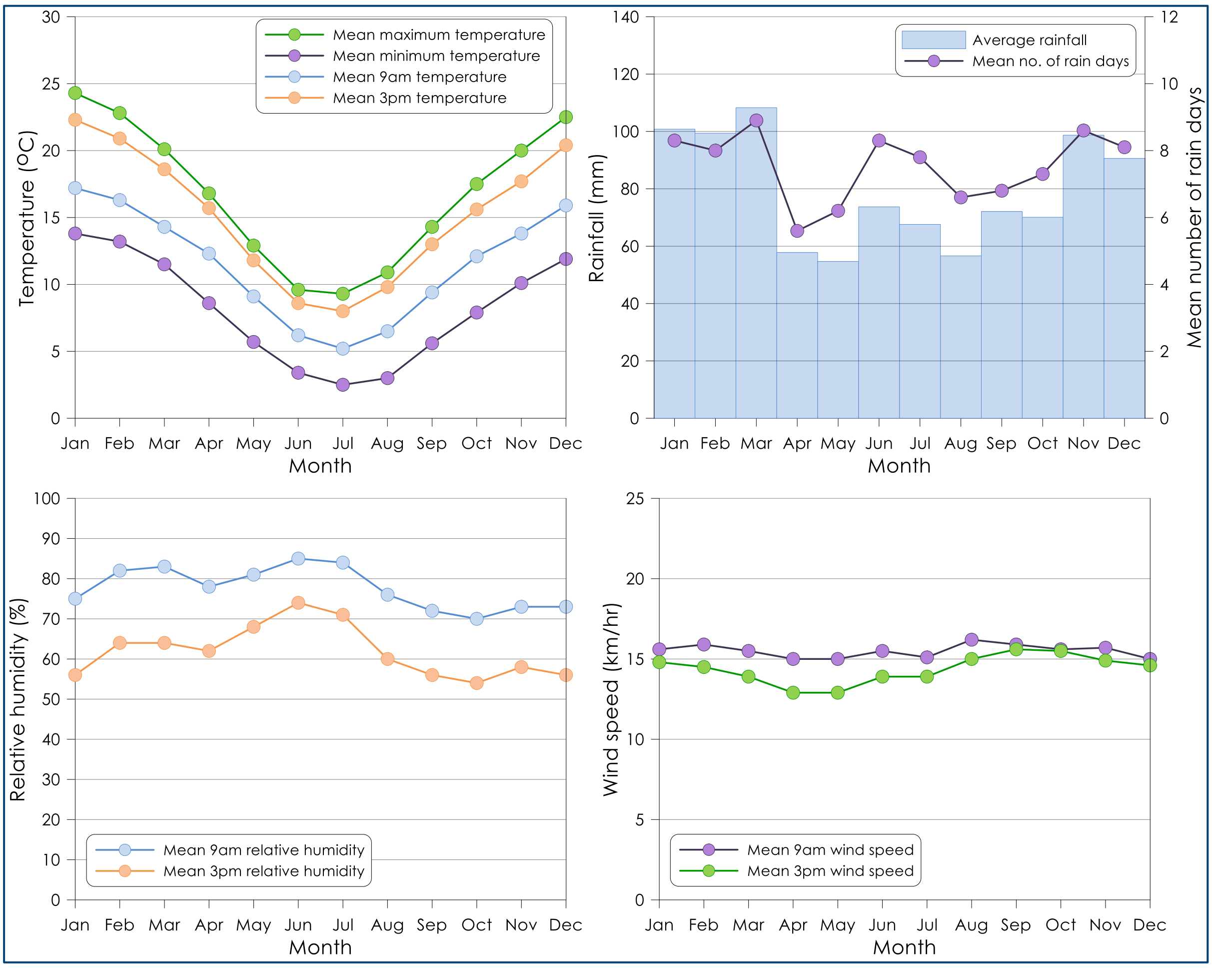

Figure 6-1: Monthly climate statistics summary – Nullo Mountain AWS

6.2 Local meteorological conditions

The Nullo Mountain AWS has been used to represent local meteorological conditions that would be experienced at the Project site. Annual and seasonal windroses prepared from data collected for the 2021 calendar year are presented in **Figure 6-2**.

The 2021 calendar year was selected as the meteorological year for the dispersion modelling based on analysis of long-term data trends in meteorological data recorded for the area, as outlined in **Appendix A**.

Analysis of the windroses shows that on an annual basis, winds range from the west to east-southeast. During summer, winds are predominately from the east-southeast. The autumn wind distribution shows the greatest percentage of winds from the north-northeast and northeast. In winter the highest percentage of winds come from the northwest sector. During spring, winds are predominately from the east-southeast and west to northwest sectors.

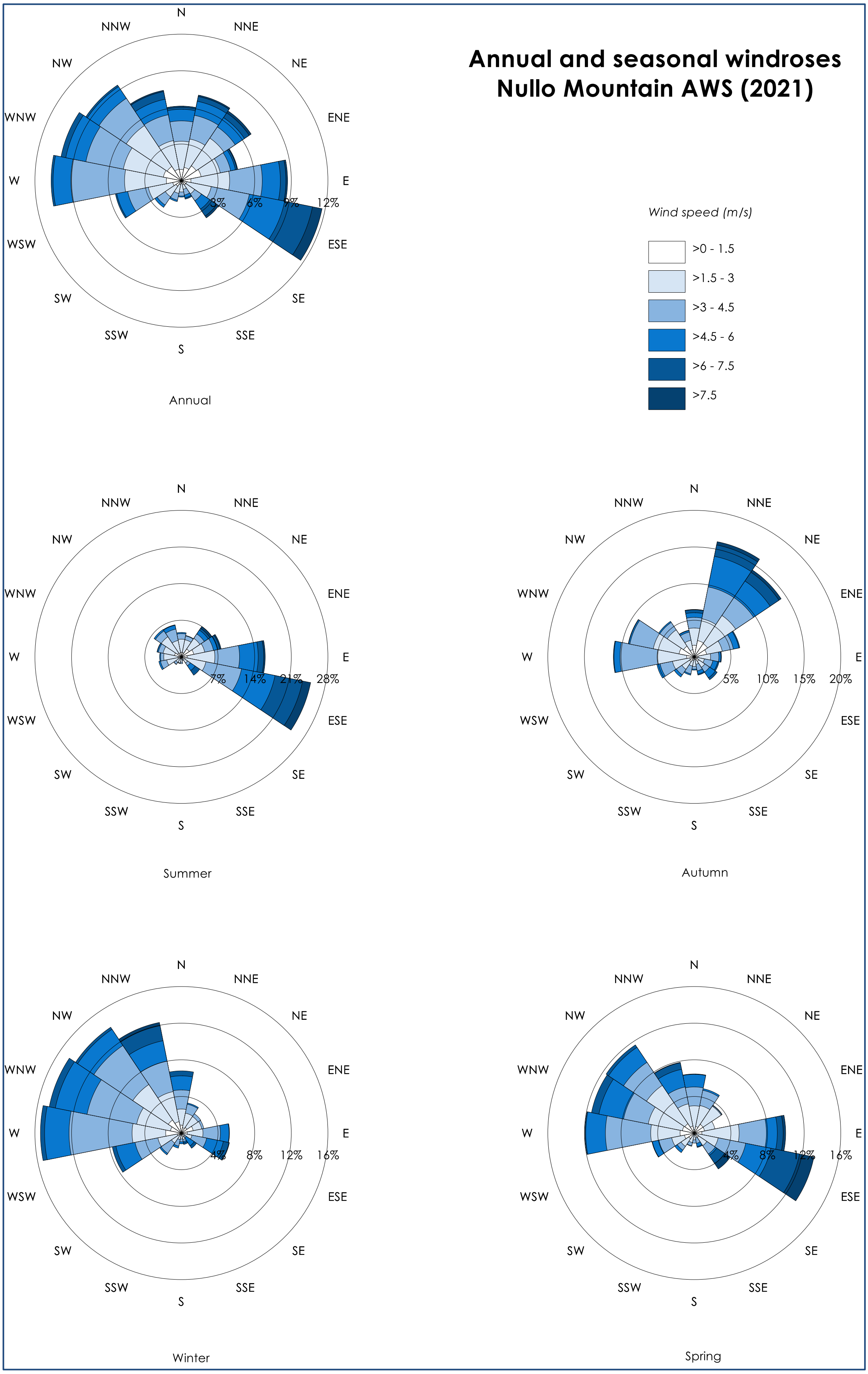

Figure 6-2: Annual and seasonal windroses for Nullo Mountain AWS (2021)

6.3 Ambient air quality

The main sources of air pollutants in the area surrounding the Project include emissions from local anthropogenic activities (such as motor vehicle exhaust and domestic wood heaters), agricultural activities, and industrial activities.

This section reviews the available ambient air quality monitoring data sourced from the nearest NSW Department of Planning and Environment (DPE) ambient air quality monitoring station at Bathurst which is located approximately 50km southwest of the Project.

6.3.1 NSW DPE Monitoring

The available PM_{10} monitoring data have been reviewed and are summarised in **Table 6-2**. Recorded 24-hour average PM_{10} concentrations are presented graphically in **Figure 6-3**.

A review of **Table 6-2** indicates that the annual average PM_{10} concentrations at Bathurst were below the relevant criterion of 25µg/m^3 for the period reviewed, with the exception of 2019.

The maximum 24-hour average PM_{10} concentrations recorded exceed the relevant criterion of 50µg/m^3 at times during the review period. It is noted that there was a significant increase in the frequency of 24-hour average PM_{10} exceedances in 2019 and 2020, predominately due to smoke associated with the 2019/2020 bushfires.

Table 6-2: Summary of PM_{10} levels from NSW DPE Bathurst

Year	Annual average (µg/m^3)	Maximum 24-hour average (µg/m^3)	Number of days above criterion (50 µg/m^3)
Criterion	**25**	**50**	-
2017	14.1	49.9	0
2018	18.8	**274.1**	8
2019	**27.4**	**296.6**	40
2020	17.0	**320.4**	14
2021	11.3	29.2	0

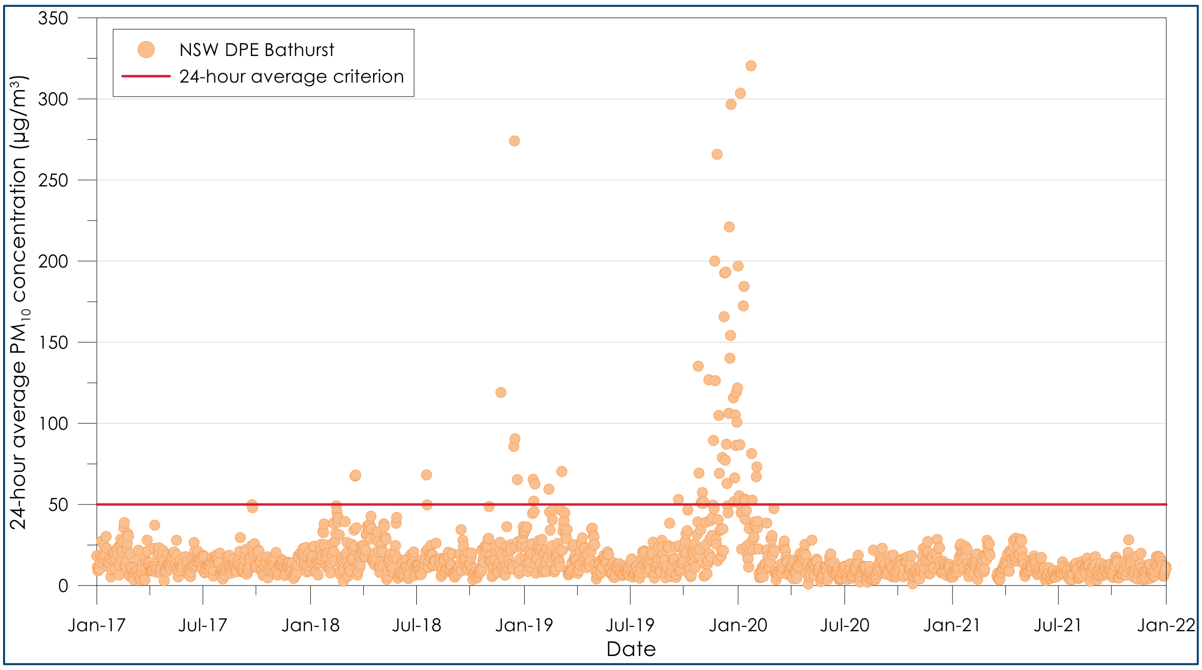

Figure 6-3: 24-hour average PM_{10} concentrations – NSW DPE Bathurst

The available $PM_{2.5}$ monitoring data from the NSW DPE Bathurst air quality monitoring station have been reviewed and are summarised in **Table 6-3**. Recorded 24-hour average $PM_{2.5}$ concentrations are presented graphically in **Figure 6-4**.

A review of **Table 6-3** indicates that the annual average $PM_{2.5}$ concentrations at Bathurst were below the relevant criterion of 8µg/m^3 during the period reviewed, with the exception of 2019.

The maximum 24-hour average $PM_{2.5}$ concentrations recorded exceed the relevant criterion of 25µg/m^3 at times during the review period. Similar to the PM_{10} monitoring data, there was a significant increase in the frequency of 24-hour average $PM_{2.5}$ exceedances in 2019 and 2020, predominately due to smoke associated with the 2019/2020 bushfires.

Table 6-3: Summary of $PM_{2.5}$ levels from NSW DPE Bathurst

Year	Annual average (µg/m³)	Maximum 24-hour average (µg/m³)	Number of days above criterion (25 µg/m³)
Criterion	**8**	**25**	-
2017	6.1	17.5	0
2018	7.0	**40.5**	2
2019	**11.3**	**199.5**	24
2020	7.6	**207.3**	13
2021	5.1	13.8	0

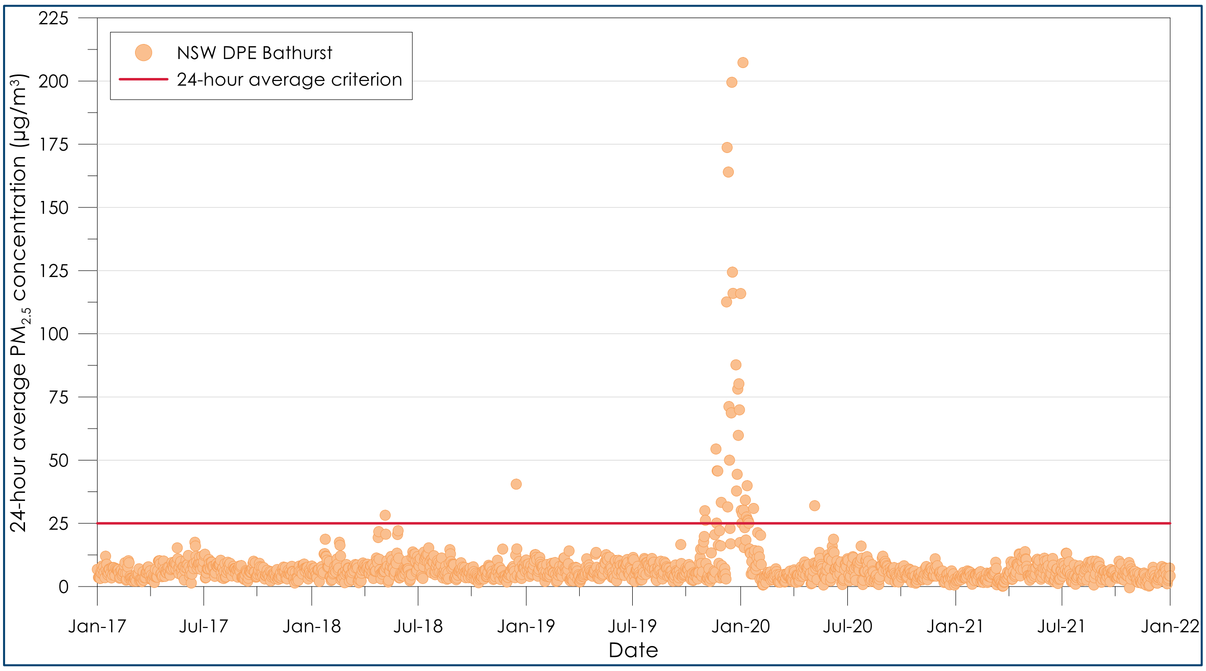

Figure 6-4: 24-hour average $PM_{2.5}$ concentrations – NSW DPE Bathurst

6.3.2 Estimated background air quality levels

The air quality monitoring data from the NSW DPE Bathurst monitoring station have been used to represent background concentrations at the Project site.

The annual average background PM_{10} and $PM_{2.5}$ levels of 15.3µg/m^3 and 6.5µg/m^3 respectively were estimated from the average of the recorded annual levels for the 2017 to 2021 period excluding 2019 (which was significantly impacted by bushfires).

An assessment of cumulative 24-hour average $PM_{2.5}$ and PM_{10} impacts using daily varying background levels was undertaken in accordance with the methods outlined in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA**, **2022**). In correlation with the meteorological data set used, the 2021 calendar year was used for the 24-hour average contemporaneous assessment.

In the absence of available data, estimates of the annual average background TSP concentrations have been determined from a relationship between PM_{10}, TSP and deposited dust concentrations and the measured PM_{10} levels.

This relationship assumes that an annual average PM_{10} concentration of 25µg/m^3 corresponds to a TSP concentration of 90µg/m^3 and a deposited dust concentration of 4g/m^2/month. This assumption is based on the NSW EPA air quality impact criteria. Applying this relationship with the applied annual average PM_{10} concentration of 15.3µg/m^3 indicates an approximate annual average TSP concentration of 55.1µg/m^3 and an approximate annual average deposited dust concentration of 2.4g/m^2/month.

A summary of the background concentrations applied in this assessment are outlined in **Table 6-4.**

Table 6-4: Summary of background pollutant concentrations

Pollutant	Averaging Period	Units	Concentration
TSP	Annual	µg/m³	55.1
PM_{10}	Annual	µg/m³	15.3
	24 Hour	µg/m³	Daily varying
$PM_{2.5}$	Annual	µg/m³	6.5
	24 Hour	µg/m³	Daily varying
Deposited dust	Annual	g/m²/month	2.4

7 POTENTIAL CONSTRUCTION DUST EMISSIONS

The Project requires the construction of various infrastructure and associated facilities. The construction activities associated with the Project have the potential to generate dust emissions.

Potential construction dust emissions will be primarily generated from material handling, vehicle movements, and windblown dust from exposed areas. The operation of construction vehicles and plant will also generate exhaust emissions.

The potential particulate impacts due to these activities is difficult to accurately quantify on any given day due to the short sporadic periods of dust generating activity which may occur over the construction time frame. The sources of construction dust are temporary in nature and will only occur during the approximate 12-week construction period.

The total amount of dust generated from the construction process is unlikely to be significant given the nature of the activities. Given that the activities would occur for a limited period, no significant or prolonged effect at any off-site receptor is predicted to arise due to the construction activity.

To ensure dust generation is controlled during the construction activities and the potential for off-site impacts are reduced, appropriate (operational and physical) mitigation measures in **Table 7-1** will be implemented as necessary.

Table 7-1: Construction dust mitigation measures

Source	Mitigation measure
General	Activities to be assessed during adverse weather conditions and modified as required (e.g. cease activity where reasonable levels of visible dust cannot be maintained).
	Engines of on-site vehicles and plant to be switched off when not in use.
	Vehicles and plant are to be fitted with pollution reduction devices where practicable.
	Vehicles are to be maintained and serviced according to manufacturer's specifications.
	Visual monitoring of construction activities is to be undertaken to identify dust generation.
Hauling material	Active unsealed haul roads are to be kept watered.
	Construction vehicle traffic is to be restricted to designated routes.
	Construction speed limits are to be enforced.
	Vehicle loads are to be covered when travelling off-site.
	Shaker grid to be established near exit point from the site onto Razorback Road to minimise mud/ dirt track out.
	The section of Razorback Road fronting the site and leading to Castlereagh Highway will be sealed.
Material handling	Drop heights from loading and handling equipment are to be reduced as much as practical.
Exposed areas / stockpiles	The extent of exposed surfaces and stockpiles is to be kept to a minimum.
	Exposed areas and stockpiles are to be dampened with water as far as is practicable if dust emissions are visible.
	Disturbed areas are to be rehabilitated as soon as practicable after completion of works.

8 DISPERSION MODELLING APPROACH

8.1 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 model is an advanced "puff" model which can deal with the effects of complex local terrain on the dispersion meteorology over the entire modelling domain in a three-dimensional, hourly varying time step. CALPUFF is an air dispersion model approved by NSW EPA for use in air quality impact assessments. The model setup used is in general accordance with 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**).

8.2 Modelling methodology

8.2.1 Meteorological modelling

The meteorological modelling methodology applied a 'hybrid' approach which includes a combination of prognostic model data from The Air Pollution Model (TAPM) with surface observations from surrounding weather stations for input in the CALMET model.

The centre of analysis for TAPM was 33deg 2min south and 149deg 51.5min east. The simulation involved an outer grid of 30km, with three nested grids of 10km, 3km and 1km with 35 vertical grid levels. The CALMET domain was run on an outer domain with a 50 x 50km area with a 1.0km grid resolution and an inner domain with a 10 x 10km area with a 0.1km grid resolution.

The 2021 calendar year was selected as the meteorological year for the dispersion modelling based on analysis of long-term data trends in meteorological data recorded for the area. Further detail on the selection of the meteorological year is outlined in **Appendix A**. Accordingly, the available meteorological data for January 2021 to December 2021 from the Nullo Mountain, Bathurst Airport and Marrangaroo (Defence) BoM monitoring sites were included in the simulation.

The seven critical parameters used in the CALMET modelling are presented in **Table 8-1**.

Table 8-1: Seven critical parameters used in CALMET

Parameter	Outer domain value	Inner domain value
TERRAD	10	10
IEXTRP	-4	-4
BIAS (NZ)	-1, -0.5, -0.3, 0, 0, 0, 0, 0	-1, -0.5, -0.3, 0, 0, 0, 0, 0
R1 and R2	10,10	2,2
RMAX1 and RMAX2	20,20	5,5

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

Figure 8-1 presents a visualisation of the wind field generated by CALMET for a single hour of the modelling period. The wind fields are seen to follow the terrain well and indicate the simulation produces realistic fine scale flow fields (such as terrain forced flows) in surrounding areas.

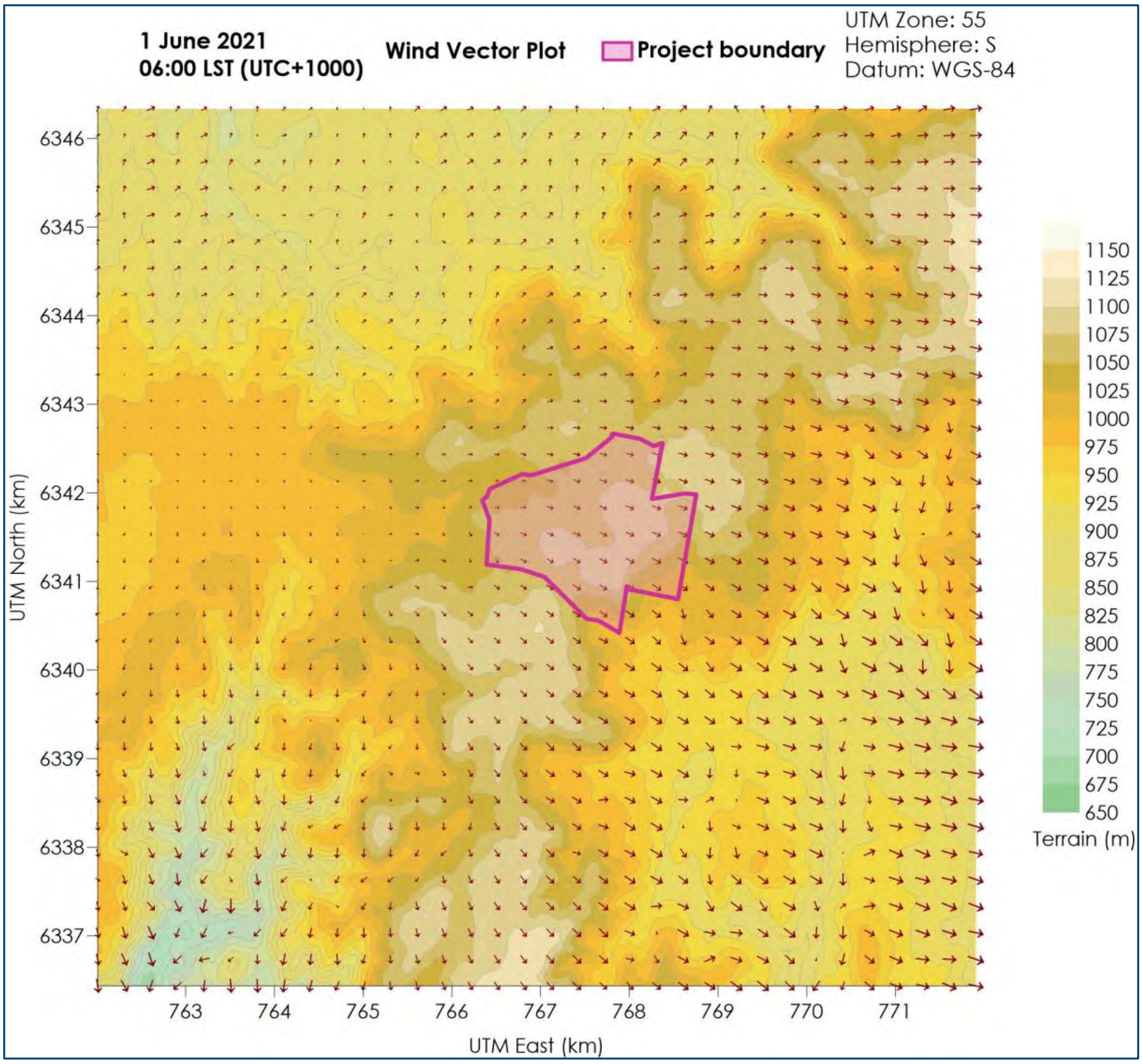

Figure 8-1: Example of the wind field for one of the 8,760 hours of the year that are modelled

CALMET generated meteorological data were extracted from a point within the CALMET domain and are represented in **Figure 8-2** and **Figure 8-3**.

Figure 8-2 presents the annual and seasonal windroses from the CALMET data.

Figure 8-3 includes graphs of the temperature, wind speed, mixing height and stability classification over the modelling period and is consistent with the conditions expected to occur in the area.

It is considered that the CALMET modelling reflects 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.

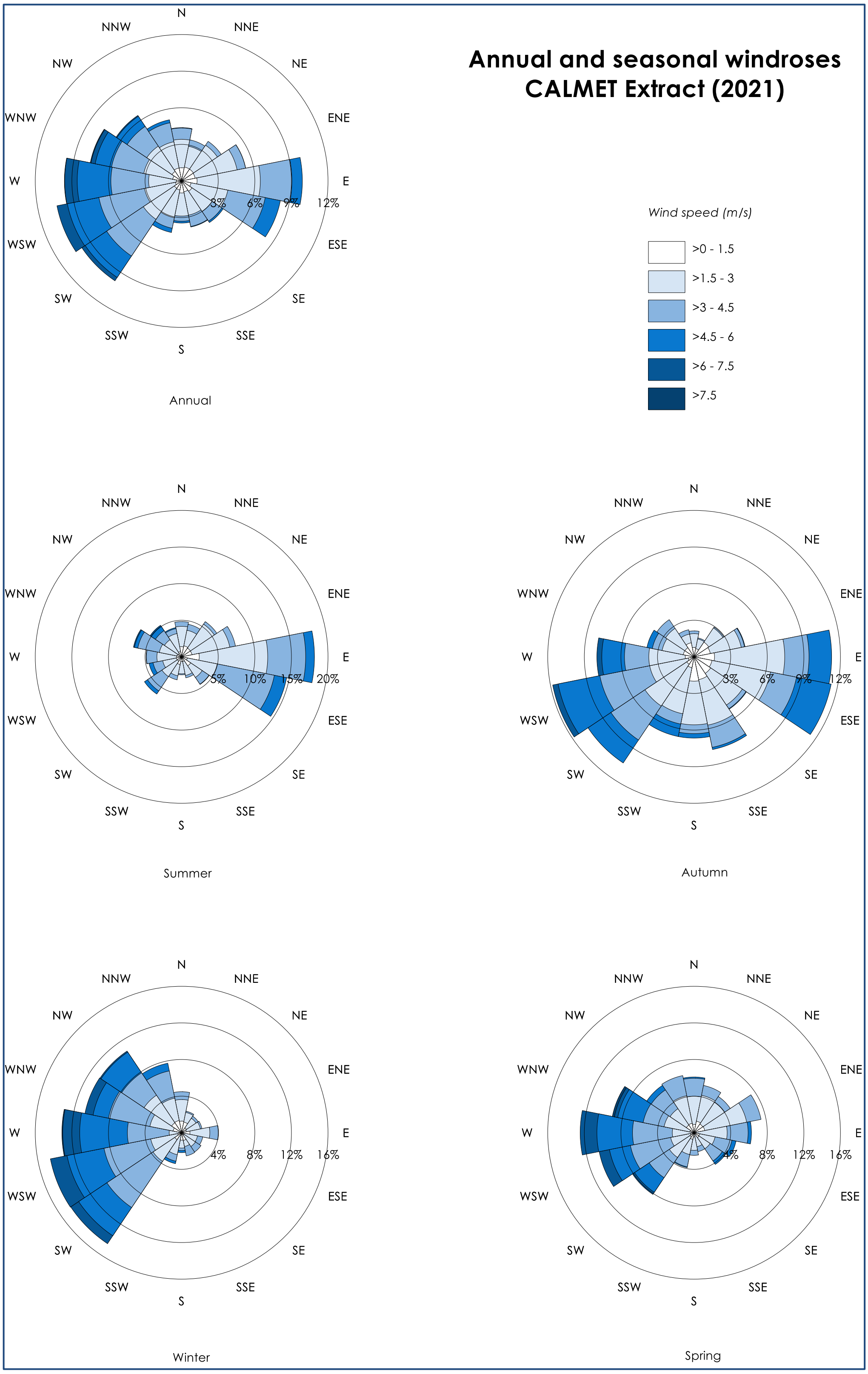

Figure 8-2: Windroses from CALMET extract (cell ref 5050)

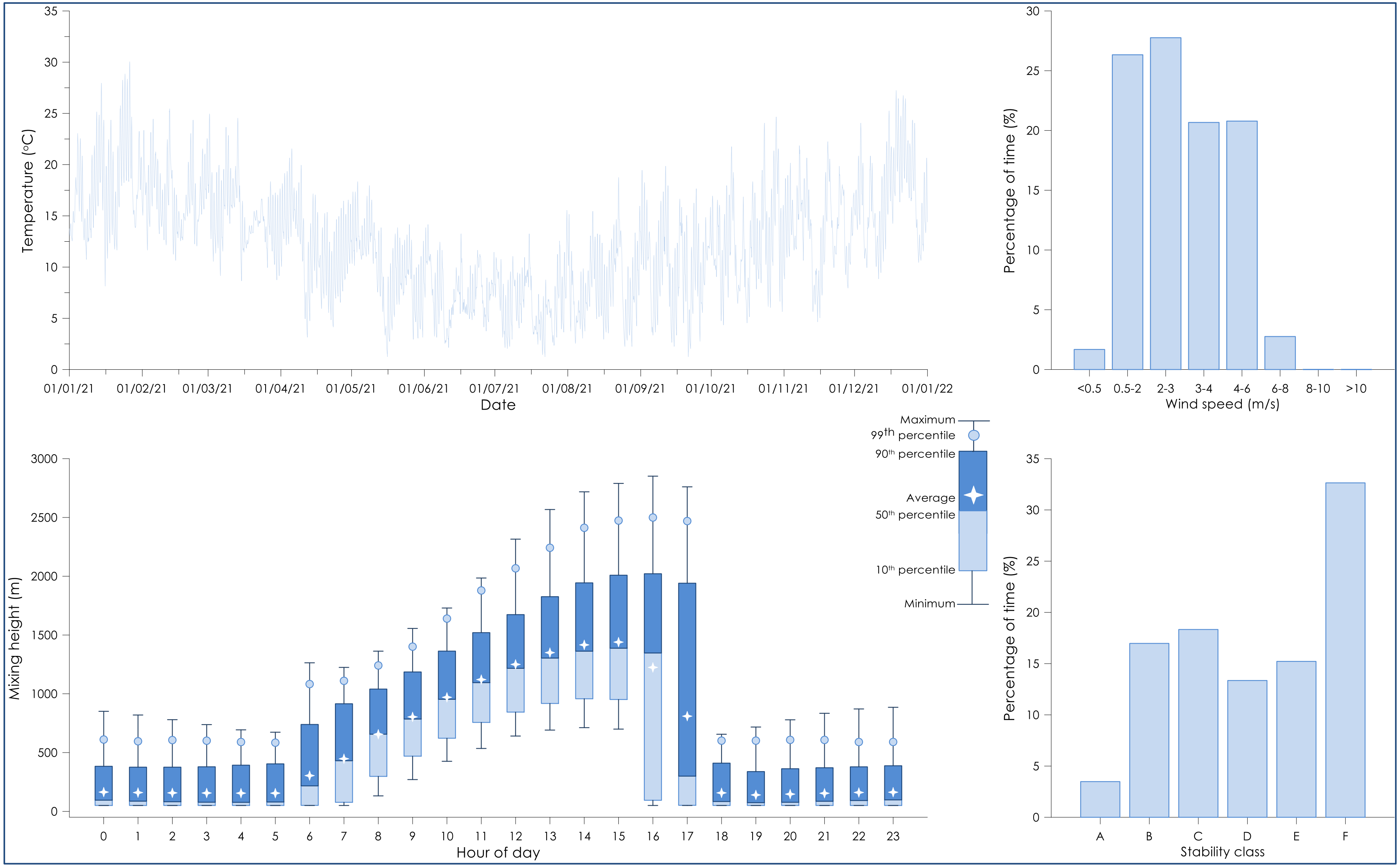

Figure 8-3: Meteorological analysis of CALMET extract (cell ref 5050)

8.2.2 Dispersion modelling

Air dispersion modelling of the key air emission sources was conducted to predict potential air quality impacts from the Project.

Fugitive dust emissions associated with 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.

8.3 Emissions estimation

For the modelled scenarios, dust emission estimates have been calculated by analysing the various types of dust generating activities taking place and utilising suitable emission factors sourced from both locally developed and US EPA developed documentation.

Activities associated with operation of the Project have the potential to generate dust emissions from various activities including - extraction activities, loading/unloading of material, vehicles travelling on-site, and windblown dust generated from exposed areas.

Stage 3 is considered to be the worst-case operating stage with regard to potential air quality impacts due to the proximity of the extraction area to the nearest residences and largest potential exposed area.

Two scenarios have been modelled for Stage 3;

- the annual scenario which considers the maximum annual material extraction rate of 200,000t per year; and
- the peak scenario which considers the maximum daily material extraction rate of 1,500tpd (which equates to an annual rate of 547,500t per year).

Detailed calculations of the dust emission estimates are provided in **Appendix B**.

The estimated fugitive dust emissions for activities associated with the Project are presented in **Table 8-2**.

Table 8-2: Estimated annual TSP emission rate for fugitive emissions

Activity	TSP emissions	
	Annual scenario (kg/year)	Peak scenario (kg/year)
Bulldozer to strip topsoil/subsoil	10,497	13,287
Loading topsoil/subsoil to haul truck	195	247
Hauling topsoil/subsoil to stockpile (unpaved)	1,132	1,433
Unloading topsoil/subsoil to stockpile	195	247
Bulldozer to strip burden	10,572	13,382
Loading burden to haul truck	196	249
Hauling burden to bund area (unpaved)	760	962
Unloading burden at stockpile	196	249
FEL shaping stockpiles	391	495
Bulldozer for breaking up materials	18,745	23,726
Loading material to mobile screen	348	953
Screening	2,500	6,844
Unloading materials from screen	348	953
Loading materials to truck	348	953
Truck haulage of materials offsite (unpaved)	15,996	43,788
Wind erosion (exposed areas)	8,798	8,798
Wind erosion (Stage 1 area - partial rehabilitation)	850	850
Diesel exhaust emission	646	945
Total emissions	**72,714**	**118,360**

9 DISPERSION MODELLING RESULTS

The dispersion model predictions for each of the annual and peak 24-hour scenarios are presented in this section. The results presented include those for the operation in isolation (incremental impact) and cumulative impacts with background levels.

9.1 Dust modelling predictions

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 (cumulative) impact). The results show the predicted:

- Maximum 24-hour average $PM_{2.5}$ and PM_{10} concentrations (peak scenario); and
- Annual average $PM_{2.5}$, PM_{10}, TSP and dust (insoluble solids) deposition concentrations (annual scenario).

It is important to note that when assessing impacts per the maximum 24-hour average levels, the predictions are based on the highest predicted 24-hour average concentrations modelled at each grid (or discrete receptor) point in the modelling domain. At each point, this is the worst day (i.e. a 24-hour period) in the annual modelling period. The predictions thus do not represent just one particular day, but a combination of all of the worst-case days at every point. Thus, the extent of the predicted impacts is a large overestimation of what would occur on any single day.

Associated isopleth diagrams of the dispersion modelling results are presented in **Appendix C**. **Table 9-1** present the predicted incremental particulate dispersion modelling results at each of the assessed sensitive receptor locations.

The results in **Table 9-1** below indicate the Project would be below the relevant incremental criteria at all the assessed existing receptor locations for both the annual and peak daily scenarios. Therefore, it is determined that the operation of the Project would not lead to any unacceptable level of environmental harm or impact in the surrounding area.

Table 9-1: Incremental particulate dispersion modelling results for sensitive receptors

Receptor ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average
	NSW EPA Air Quality Impact Criteria					
	25	-	50	-	-	2
R1a	8.3	0.6	22.8	1.8	5.2	0.1
R1b	1.4	0.1	4.4	0.4	1.1	0.0
R3a	1.3	0.0	3.9	0.2	0.4	0.0
R3b	1.8	0.0	5.8	0.1	0.4	0.0
R4	1.5	0.0	5.3	0.2	0.4	0.0
R13	2.9	0.1	8.6	0.2	0.4	0.0

The cumulative (total) impact is the impact associated with the operation of the Project and the ambient background levels in **Section 6.3.2**. The predicted cumulative annual average $PM_{2.5}$, PM_{10}, TSP and dust deposition levels due to the Project are shown in **Table 9-2**.

Cumulative 24-hour average $PM_{2.5}$ and PM_{10} impacts are considered in detail in **Section 9.2**.

The results in **Table 9-2** below indicate that the predicted levels would be below the relevant annual average criteria for each of the assessed dust metrics at the assessed receptor locations.

Table 9-2: Cumulative annual average particulate dispersion modelling results for sensitive receptors

Receptor ID	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	NSW EPA Air Quality Impact Criteria			
	8	25	90	4
R1a	7.1	17.1	60.3	2.5
R1b	6.6	15.7	56.2	2.4
R3a	6.5	15.5	55.5	2.4
R3b	6.5	15.4	55.5	2.4
R4	6.5	15.5	55.5	2.4
R13	6.6	15.5	55.5	2.4

9.2 Assessment of Cumulative 24-hour average $PM_{2.5}$ and PM_{10} Concentrations

An assessment of cumulative 24-hour average $PM_{2.5}$ and PM_{10} impacts was undertaken in accordance with the methods outlined in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA**, **2022**).

The NSW EPA applies a Level 2 contemporaneous assessment approach where the measured background levels are added to the day's corresponding predicted dust level from the Project. Ambient $PM_{2.5}$ and PM_{10} concentration data corresponding with the year of modelling (2021 calendar year) from the NSW DPE monitoring sites at Bathurst has been applied in this case to represent the prevailing background levels in the vicinity of the Project and representative sensitive receptor locations.

The analysis has focused on the R1a privately-owned receptor location which represent the closest and most likely impacted receptor locations surrounding the Project.

Table 9-3 provides a summary of the findings from the Level 2 assessment at the most impacted representative receptor location. Detailed tables of the assessment results are provided in **Appendix D**.

The results in **Table 9-3** indicate that the Project will not increase the number of days above the 24-hour average criterion at the most impacted receptor, and thus meets the EPA cumulative impact assessment criteria at all receptors at all times.

Table 9-3: NSW EPA contemporaneous assessment - maximum number of additional days above 24-hour average criterion

Receptor ID	$PM_{2.5}$	PM_{10}
R1a	0	0

Time series plots of the predicted cumulative 24-hour average $PM_{2.5}$ and PM_{10} concentrations for R1a are presented in **Figure 9-1**.

The blue bars show the existing background levels and the orange bars in the figures show the predicted additional levels due to the Project above background levels (i.e. the orange sections of the bars indicate the amount of increased dust). The top of the orange bar indicates the predicted future cumulative level associated with Project and background combined.

The results indicate that the predicted $PM_{2.5}$ and PM_{10} levels would not result in any additional days of exceedance of the cumulative 24-hour average $PM_{2.5}$ and PM_{10} criteria due to the operation of the Project. The data shows that generally, impacts from the Project at R1a are greater during the summer and autumn periods which corresponds to the windrose plots in **Figure 8-2** which indicate a significant proportion of east/east-southeast wind directions during these periods and hence R1a would be downwind for a significant proportion of the time during these periods.

The assessment of 24-hour average $PM_{2.5}$ and PM_{10} levels is conservative as it considers that the maximum daily extraction rate of 1,500tpd occurs for every day of the year whereas the typical Project extraction rates would in reality be more like 500tpd (i.e. three times lower than modelled).

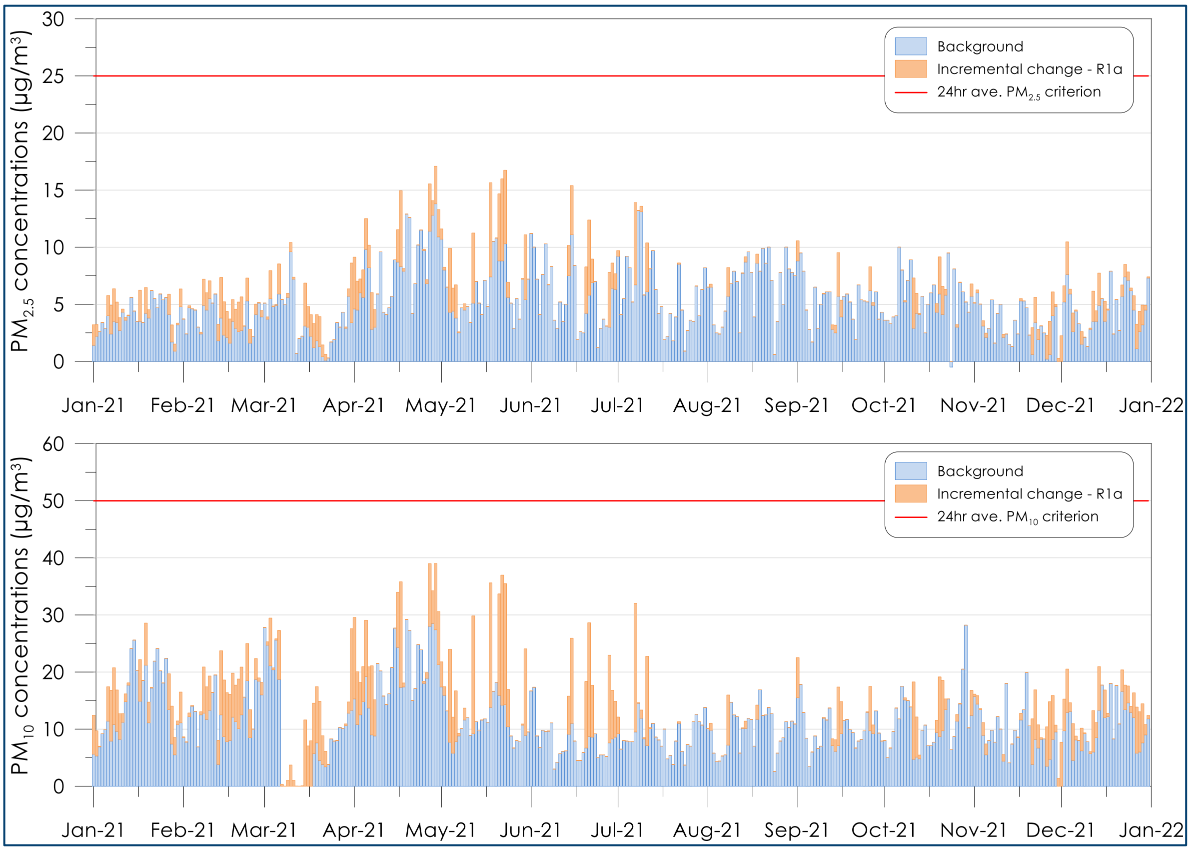

Figure 9-1: Time series plots of predicted cumulative 24-hour average $PM_{2.5}$ and PM_{10} concentrations for R1a

9.3 Assessment of impacts per VLAMP criteria

9.3.1 Summary of modelling predictions

The results in **Table 9-1** and **Table 9-2** indicate the highest maximum predicted level at the assessed privately-owned receptors would be below the applicable VLAMP mitigation and acquisition criteria outlined in **Table 5-2**.

9.3.2 Dust impacts on more than 25 per cent of privately-owned land

As required by the VLAMP, the potential impacts due to the Project, extending over more than 25% of any privately-owned land, have been evaluated using the predicted pollutant dispersion contours.

The results at the criteria level concentrations show the maximum 24-hour average PM_{10} predictions would have the most spatial extent, relative to any of the other assessed dust metrics and hence 24-hour average PM_{10} represents the most impacting parameter.

Based on the isopleth diagrams in **Appendix C** and in **Figure 9-2**, the extent of the predicted maximum 24-hour average PM_{10} level of 50µg/m³ would not extend over more than 25% of any privately-owned land parcels, and it can be concluded that the Project would not exceed this criterion.

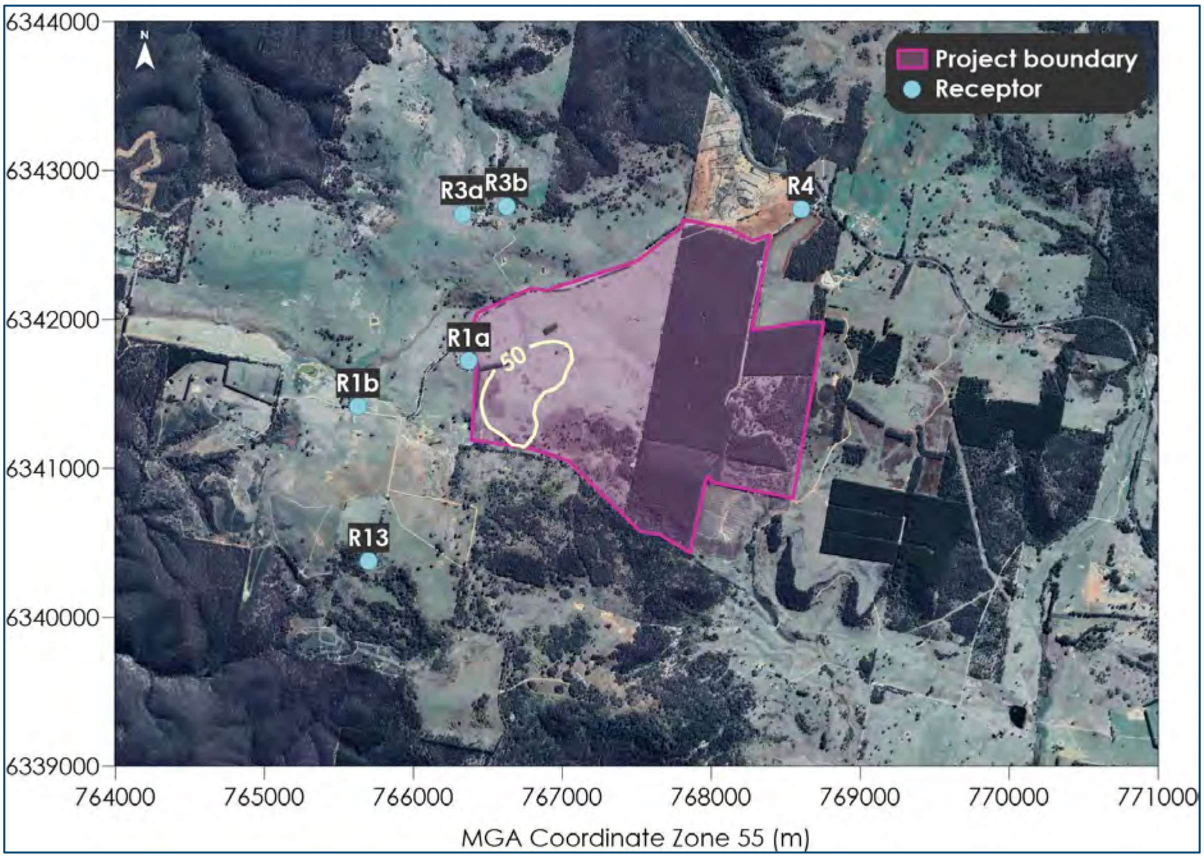

Figure 9-2: Predicted maximum 24-hour average PM_{10} concentrations due to emissions from the Project (µg/m³)

10 MITIGATION AND MANAGEMENT

The site will consider the possible range of air quality mitigation measures that are feasible and can be applied to achieve a standard of extraction operation consistent with current best practice for the control of dust emissions from mines in NSW, as outlined in the NSW EPA document, *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining*, prepared by Katestone Environmental (**Katestone Environmental, 2010**).

A summary of the key air quality controls, which would be applied for the Project, is shown in **Table 10-1**.

Table 10-1: Potential air quality controls

Activity	Control
General	Develop a trigger action response plan (TARP) to manage dust. Modify activities during adverse meteorological conditions. Modify activities during periods of high visible dust. Conduct visual inspections of dust generation. All equipment will be maintained and operated in a proper and efficient manner.
Hauling	Regular watering unpaved roads using water cart. Enforce site speed limit of 20km/hr. Shut down engines when vehicles are idle over prolonged periods. Loads leaving the site are watered and covered. Shaker grid used to minimise dirt track out as vehicle exit the site. The section of Razorback Road fronting the site and leading to Castlereagh Highway will be sealed.
Loading/unloading material	Minimise drop heights. Water spray used where required on loading/unloading activities.
Wind erosion on exposed surfaces	Shaping of stockpiles/emplacements where practical to avoid strong wind flows and smooth gradients to reduce turbulence at surface. Restrict ground disturbance as much as practical. Rehabilitation of disturbed surfaces by revegetation as soon as practical. Watering of exposed areas as required.

11 GREENHOUSE GAS ASSESSMENT

The National Greenhouse Accounts (NGA) Factors published by the Department of Climate Change, Energy, the Environment and Water defines three scopes (Scope 1, 2 and 3) for different emission categories based on whether the emissions generated are from "direct" or "indirect" sources.

Scope 1 emissions encompass the direct sources from the Project defined as:

> "*...from sources within the boundary of an organisation and as a result of that organisation's activities*" (**Department of Climate Change, Energy, the Environment and Water, 2022b**).

Scope 2 and 3 emissions occur due to the indirect sources from the Project as:

> "*...emissions generated in the wider economy as a consequence of an organisation's activities but which are physically produced by the activities of another organisation*" (**Department of Climate Change, Energy, the Environment and Water, 2022b**).

Scope 3 emissions are often not directly controlled by the operation. These emissions are understood to be considered in the Scope 1 emissions from other various organisations related to the Project.

Scope 3 emissions also arise from various other sources indirectly associated with the operation of the Project such as emissions generated by employees travelling to and from the site. The relatively minor individual contributions, that are difficult to accurately quantify due to the diversity and nature of the sources, have not been considered further in this assessment.

11.1 Emission sources

Scope 1 GHG emission sources identified from the operation of the Project are based the on-site combustion of diesel fuel. It is noted that site power would come from an onsite diesel generator rather than electricity from the grid and that the weighbridge would likely be solar powered.

Scope 3 emissions have been identified as resulting from the purchase of diesel and the transport of product material to customers.

Estimated quantities of materials that have the potential to emit GHG emissions associated with Scope 1 and 2 emissions for the Project have been summarised in **Table 11-1** below. These estimates are based on the proposed annual use of diesel for the Project as provided by the Proponent.

Table 11-1: Summary of annual quantities of materials estimated for the Project

Type	Annual quantity for proposed Project	Units
Diesel	240	kL

Note: kL = kilolitres

Scope 3 emissions associated with the transport of the product materials from the Project site have been estimated based on an average distance for proposed customers along with the assumed maximum annual production of the Project (200,000tpa). The average fuel consumption of 53.1L/100km for articulated trucks is applied (**ABS, 2022**) with an estimated return travel distance of 149km. **Table 11-2** summarises the estimated diesel fuel required to transport the product material.

Table 11-2: Estimated diesel fuel required to transport product material

Distance (km)	Amount of material transported (tpa)	Payload (t)	Estimated travel distance (km)	Fuel (kL)
149	200,000	32	930,000	494

11.2 Emission factors

To quantify the amount of carbon dioxide equivalent (CO_2-e) material generated from the Project, emission factors obtained from the NGA 2022 Factors (**Department of Climate Change, Energy, the Environment and Water, 2022b**) are summarised in **Table 11-3**.

Table 11-3: Summary of emission factors

Type	Energy content factor (GJ/kL)	Emission factor (kg CO_2-e/GJ)				Scope
		CO_2	CH_4	N_2O	Total	
Diesel	38.6	69.9	0.1	0.2	70.2	1
					17.3	3
Transport of product (Heavy duty vehicles – diesel – Euro IV)	38.6	69.9	0.1	0.2	70.2	3

Note: CO_2 = Carbon Dioxide, CH_4 = Methane and N_2O = Nitrous Oxide

11.3 Summary of greenhouse gas emissions

Table 11-4 summarises the estimated annual CO_2-e emissions due to the Project.

Table 11-4: Summary of CO_2-e emissions for the Project (t CO_2-e)

Type	Scope 1	Scope 2	Scope 3
Diesel	650.3	-	160.3
Transport of product	-	-	1,341.4
Total	**650.3**	**0.0**	**1,501.6**

11.4 Contribution of greenhouse gas emissions

Table 11-5 summarises the emissions associated with the Project based on Scopes 1, 2 and 3.

Table 11-5: Summary of CO_2-e emissions per scope (t CO_2-e)

Period	Scope 1	Scope 2	Scope 3
Annual	650.3	0.0	1,501.6

The estimated annual greenhouse emissions for Australia for the year to March 2022 was 487.1 million tonnes of carbon dioxide equivalent (Mt CO_2-e) (**Department of Climate Change, Energy, the Environment and Water, 2022a**). In comparison, the estimated annual average greenhouse emission for the Project is 0.002Mt CO_2-e (Scope 1 and 3). Therefore, the annual contribution of greenhouse emissions from the Project in comparison to the Australian greenhouse emissions for the year to March 2022 period is estimated to be approximately 0.0004 per cent (%).

At a state level, the estimated greenhouse emissions for NSW in the 2020 period was 132.4Mt CO_2-e (**Department of Climate Change, Energy, the Environment and Water, 2022c**). The annual contribution of greenhouse emissions from the Project in comparison to the NSW greenhouse emissions for the 2019 period is estimated to be approximately 0.002%.

The estimated GHG emissions generated are based on approximated quantities of materials and where applicable, generic emission factors and provides a reasonable approximation of the potential GHG emissions for the purpose of this assessment.

11.5 Greenhouse gas management

The Project would utilise various mitigation measures to minimise the overall generation of GHG emissions. Some examples of GHG mitigation and management practices that would be applied during construction and operation of the Project include:

- Investigating ways to reduce energy consumption throughout the life of the project and reviewing energy efficient alternatives;
- Regular maintenance of equipment and plant;
- Ensure plant and equipment are switched off when not in use;
- Monitoring the consumption of fuel and regularly maintaining diesel powered equipment to ensure operational efficiency; and,
- Source consumable materials from environmentally sustainable sources.

12 SUMMARY AND CONCLUSIONS

This report has assessed the potential worst-case air quality impacts associated with the proposed Razorback Quarry at Running Stream, NSW.

Air dispersion modelling using the CALPUFF model was used, with generally conservative assumptions to predict the potential for off-site air quality impacts in the surrounding area due to the Project.

It is predicted that the operation of the Project would comply with the assessment criteria for all assessed air pollutants and therefore would not lead to any unacceptable level of environmental harm or impact in the surrounding area.

The estimated annual average greenhouse gas emission is calculated to be approximately 0.0004% of the Australian greenhouse gas emissions for the year to March 2022 period and approximately 0.002% of the NSW greenhouse gas emissions for the 2020 period.

The proposed Project includes design controls to minimise the generation and impact of air pollutants and the site would apply appropriate management measures to ensure it minimises the potential occurrence of excessive air emissions from the site.

Overall, the assessment demonstrates that the operation of the Project would not cause any unacceptable air quality impact to the surrounding environment.

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Appendix A

Selection of Meteorological Year

Selection of meteorological year

The 2021 calendar year has been selected as the meteorological year for the dispersion modelling based on an analysis of the latest five years of meteorological data and long-term climatic data.

A statistical analysis of the latest five years of meteorological data from the nearest BoM weather station with suitable available data, Nullo Mountain AWS, is presented in **Table A-1**. The standard deviation of five years of meteorological data spanning 2017 to 2021 was analysed against the long-term wind speed, temperature and relative humidity data.

The analysis indicates that 2021 is closest to the average for wind speed, 2021 is the closest to the average for temperature, 2020 is closest for relative humidity and 2018 is the closest for rainfall. It is noted that the 2021 year was second closest for relative humidity and rainfall.

Therefore, based on this analysis it was determined that 2021 is generally representative of the long-term trends and is thus suitable for the purpose of modelling.

Table A-1: Statistical analysis results of standard deviation from long-term meteorological data at Nullo Mountain AWS

Year	Wind speed	Temperature	Relative humidity	Rainfall
2017	0.58	0.92	5.08	29.5
2018	0.49	0.95	6.72	19.9
2019	0.53	1.32	8.11	64.1
2020	0.48	0.69	2.99	33.3
2021	0.47	0.59	3.67	28.2

Appendix B

Emissions Calculations

Emissions calculations

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 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.

Emission factors and associated control factors have been sourced from:

- National Pollutant Inventory Emission estimation technique manuals (**NPI, 2012 & 2014**);
- United States (US) EPA AP42 Emission Factors (**US EPA, 1998 & 2006**);
- Office of Environment and Heritage document, NSW Coal Mining Benchmarking Study: International Best Practise Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining, prepared by Katestone Environmental (**Katestone Environmental, 2010**).

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

Table B-1: Emission factor equations

Activity	Emission factor equation	Variable
Dozers	$EF_{TSP} = 2.6 \times \left(\frac{s^{1.2}}{M^{1.3}}\right) kg/hr/vehicle$	s = surface material silt content (%) M = moisture content (%)
Material handling/ loading/ unloading	$EF_{TSP} = k \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$	k_{tsp} = 0.74 U = wind speed (m/s) M = moisture content (%)
Hauling on unsealed surfaces	$EF_{TSP} = 0.2819 \times k \times \left(\frac{s}{12}\right)^{a} \times \left(\frac{1.1023 \times W}{3}\right)^{b} kg/VKT$	k_{TSP} = 4.9 s = surface material silt content (%) W = average weight of vehicles (tons) a_{TSP} = 0.7 b_{TSP} = 0.45 75% control factor for watering applied
Wind erosion	$EF_{TSP} = 850\, kg/ha/year$	50% control factor for watering applied 60% control factor applied for secondary rehabilitation
Screening	$EF_{TSP} = 0.0125\ kg/t$	-

Table B-2: Emissions inventory – Annual operating scenario

ACTIVITY	TSP emission (kg/y)	PM10 emission (kg/y)	PM25 emission (kg/y)	Intensity	Units	Emission Factor - TSP	Emission Factor - PM10	Emission Factor - PM25	Units	Var. 1	Units	Var. 2	Units	Var. 3	Units	Var. 4 - TSP	Var. 4 - PM10	Var. 4 - PM25	Units	Var. 5	Units	Control %
Bulldozer to strip topsoil/subsoil	10,497	2,555	1,050	627	hrs/yr	16.74	4.07	1.67	kg/hr	10	silt content %	2	moisture content %									
Loading topsoil/subsoil to haul truck	195	92	9	112,000	t/yr	0.0017	0.0008	0.0001	kg/t	1.5	mean WS m/s/2.2 ^1.3	2	moisture content %									
Hauling topsoil/subsoil to stockpile (unpaved)	1,132	288	29	112,000	t/yr	0.040	0.010	0.001	kg/t	40	t/load	0.6	km/trip	4.8	silt content %	2.695	0.687	0.069	kg/VKT	50	Ave GMV (tonnes)	75
Unloading topsoil/subsoil to stockpile	195	92	9	112,000	t/yr	0.0017	0.0008	0.0001	kg/t	1.5	mean WS m/s/2.2 ^1.3	2	moisture content %									
Bulldozer to strip burden	10,572	2,574	1,057	632	hrs/yr	16.74	4.07	1.67	kg/hr	10	silt content %	2	moisture content %									
Loading burden to haul truck	196	93	9	112,800	t/yr	0.0017	0.0008	0.0001	kg/t	1.5	mean WS m/s/2.2 ^1.3	2	moisture content %									
Hauling burden to bund area (unpaved)	760	194	19	112,800	t/yr	0.027	0.007	0.001	kg/t	40	t/load	0.4	km/trip	4.8	silt content %	2.695	0.687	0.069	kg/VKT	50	Ave GMV (tonnes)	75
Unloading burden at stockpile	196	93	9	112,800	t/yr	0.0017	0.0008	0.0001	kg/t	1.5	mean WS m/s/2.2 ^1.3	2	moisture content %									
FEL shaping stockpiles	391	185	19	224,800	t/yr	0.0017	0.0008	0.0001	kg/t	1.5	mean WS m/s/2.2 ^1.3	2	moisture content %									
Bulldozer for breaking up materials	18,745	4,563	1,874	1,120	hrs/yr	16.74	4.07	1.67	kg/hr	10	silt content %	2	moisture content %									
Loading material to mobile screen	348	165	16	200,000	t/yr	0.0017	0.0008	0.0001	kg/t	1.5	mean WS m/s/2.2 ^1.3	2	moisture content %									
Screening	2,500	860	250	200,000	t/yr	0.0125	0.0043	0.0013	kg/t													
Unloading materials from screen	348	165	16	200,000	t/yr	0.0017	0.0008	0.0001	kg/t	1.5	mean WS m/s/2.2 ^1.3	2	moisture content %									
Loading materials to truck	348	165	16	200,000	t/yr	0.0017	0.0008	0.0001	kg/t	1.5	mean WS m/s/2.2 ^1.3	2	moisture content %									
Truck haulage of materials offsite (unpaved)	15,996	4,077	408	200,000	t/yr	0.320	0.082	0.008	kg/t	32	t/load	4.2	km/trip	4.8	silt conten	2.437	0.621	0.062	kg/VKT	40	Ave GMV (tonnes)	75
Wind erosion (exposed areas)	8,798	4,399	660	21	ha	850	425	64	kg/ha/yr													50
Wind erosion (Stage 1 area - partial rehabilitation)	850	425	64	3	ha	850	425	64	kg/ha/yr													60
Diesel exhaust emission	646	646	627																			
Total	**72,714**	**21,631**	**6,143**																			

Table B-3: Emissions inventory – Peak 24-hour operating scenario

ACTIVITY	TSP emission (kg/y)	PM10 emission (kg/y)	PM25 emission (kg/y)	Intensity	Units	Emission Factor - TSP	Emission Factor - PM10	Emission Factor - PM25	Units	Var. 1	Units	Var. 2	Units	Var. 3	Units	Var. 4 - TSP	Var. 4 - PM10	Var. 4 - PM25	Units	Var. 5	Units	Control %
Bulldozer to strip topsoil/subsoil	13,287	3,235	1,329	794	hrs/yr	16.74	4.07	1.67	kg/hr	10	silt content %	2	moisture content %									
Loading topsoil/subsoil to haul truck	247	117	12	141,765	t/yr	0.0017	0.0008	0.0001	kg/t	1.5	mean WS m/s/2.2 ^1.3	2	moisture content %									
Hauling topsoil/subsoil to stockpile (unpaved)	1,433	365	37	141,765	t/yr	0.040	0.010	0.001	kg/t	40	t/load	0.6	km/trip	4.8	silt content %	2.695	0.687	0.069	kg/VKT	50	Ave GMV (tonnes)	75
Unloading topsoil/subsoil to stockpile	247	117	12	141,765	t/yr	0.0017	0.0008	0.0001	kg/t	1.5	mean WS m/s/2.2 ^1.3	2	moisture content %									
Bulldozer to strip burden	13,382	3,258	1,338	800	hrs/yr	16.74	4.07	1.67	kg/hr	10	silt content %	2	moisture content %									
Loading burden to haul truck	249	118	12	142,778	t/yr	0.0017	0.0008	0.0001	kg/t	1.5	mean WS m/s/2.2 ^1.3	2	moisture content %									
Hauling burden to bund area (unpaved)	962	245	25	142,778	t/yr	0.027	0.007	0.001	kg/t	40	t/load	0.4	km/trip	4.8	silt content %	2.695	0.687	0.069	kg/VKT	50	Ave GMV (tonnes)	75
Unloading burden at stockpile	249	118	12	142,778	t/yr	0.0017	0.0008	0.0001	kg/t	1.5	mean WS m/s/2.2 ^1.3	2	moisture content %									
FEL shaping stockpiles	495	234	23	284,544	t/yr	0.0017	0.0008	0.0001	kg/t	1.5	mean WS m/s/2.2 ^1.3	2	moisture content %									
Bulldozer for breaking up materials	23,726	5,776	2,373	1,418	hrs/yr	16.74	4.07	1.67	kg/hr	10	silt content %	2	moisture content %									
Loading material to mobile screen	953	451	45	547,500	t/yr	0.0017	0.0008	0.0001	kg/t	1.5	mean WS m/s/2.2 ^1.3	2	moisture content %									
Screening	6,844	2,354	684	547,500	t/yr	0.0125	0.0043	0.0013	kg/t													
Unloading materials from screen	953	451	45	547,500	t/yr	0.0017	0.0008	0.0001	kg/t	1.5	mean WS m/s/2.2 ^1.3	2	moisture content %									
Loading materials to truck	953	451	45	547,500	t/yr	0.0017	0.0008	0.0001	kg/t	1.5	mean WS m/s/2.2 ^1.3	2	moisture content %									
Truck haulage of materials offsite (unpaved)	43,788	11,160	1,116	547,500	t/yr	0.320	0.082	0.008	kg/t	32	t/load	4.2	km/trip	4.8	silt conten	2.437	0.621	0.062	kg/VKT	40	Ave GMV (tonnes)	75
Wind erosion (exposed areas)	8,798	4,399	660	21	ha	850	425	64	kg/ha/yr													50
Wind erosion (Stage 1 area - partial rehabilitation)	850	425	64	3	ha	850	425	64	kg/ha/yr													60
Diesel exhaust emission	945	945	917																			
Total	**118,360**	**34,218**	**8,747**																			

Appendix C

Isopleth Diagrams

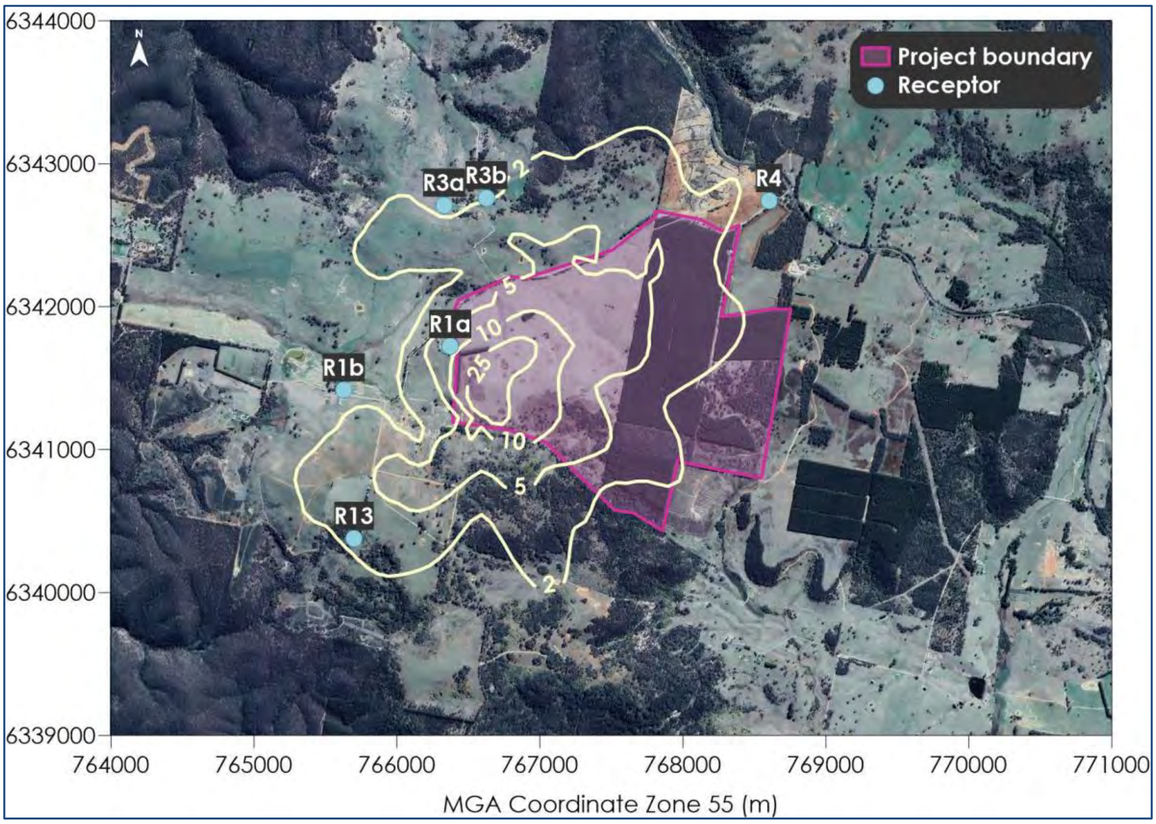

Figure C-1: Predicted incremental maximum 24-hour average $PM_{2.5}$ concentrations (µg/m³)

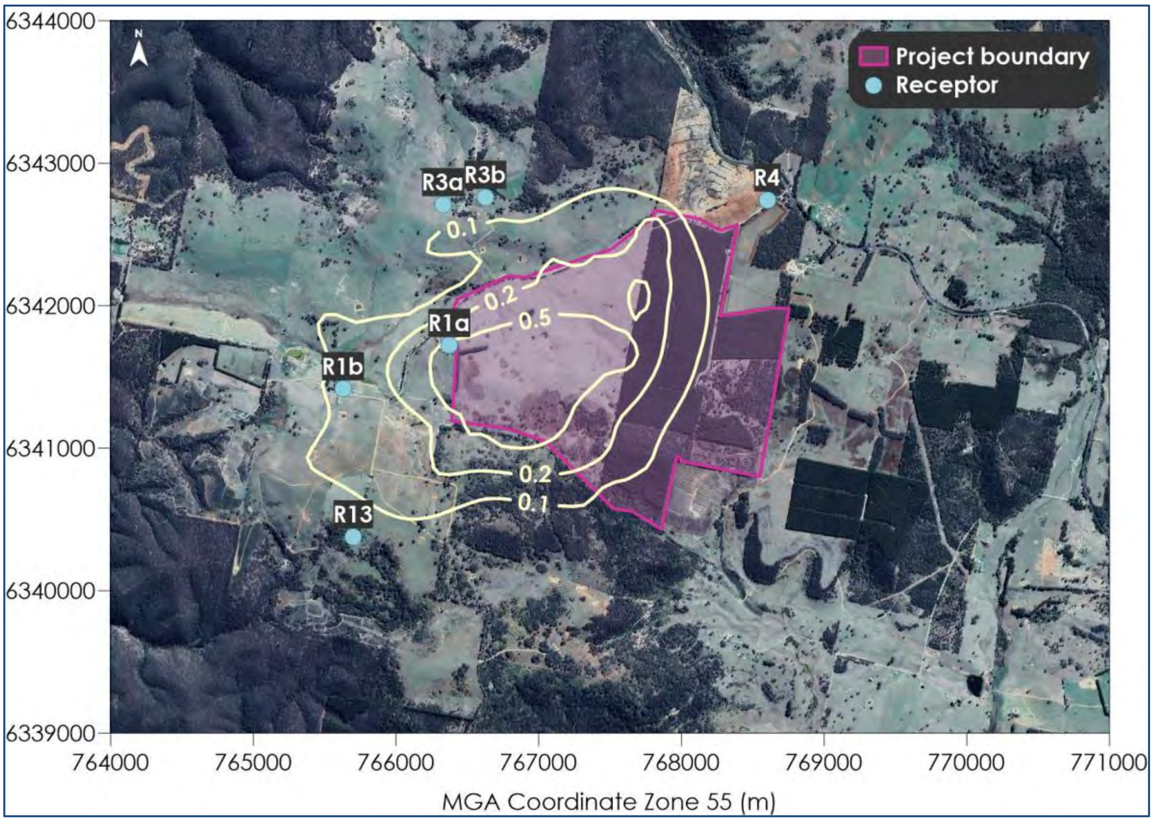

Figure C-2: Predicted incremental annual average $PM_{2.5}$ concentrations (µg/m³)

Figure C-3: Predicted cumulative annual average $PM_{2.5}$ concentrations (µg/m³)

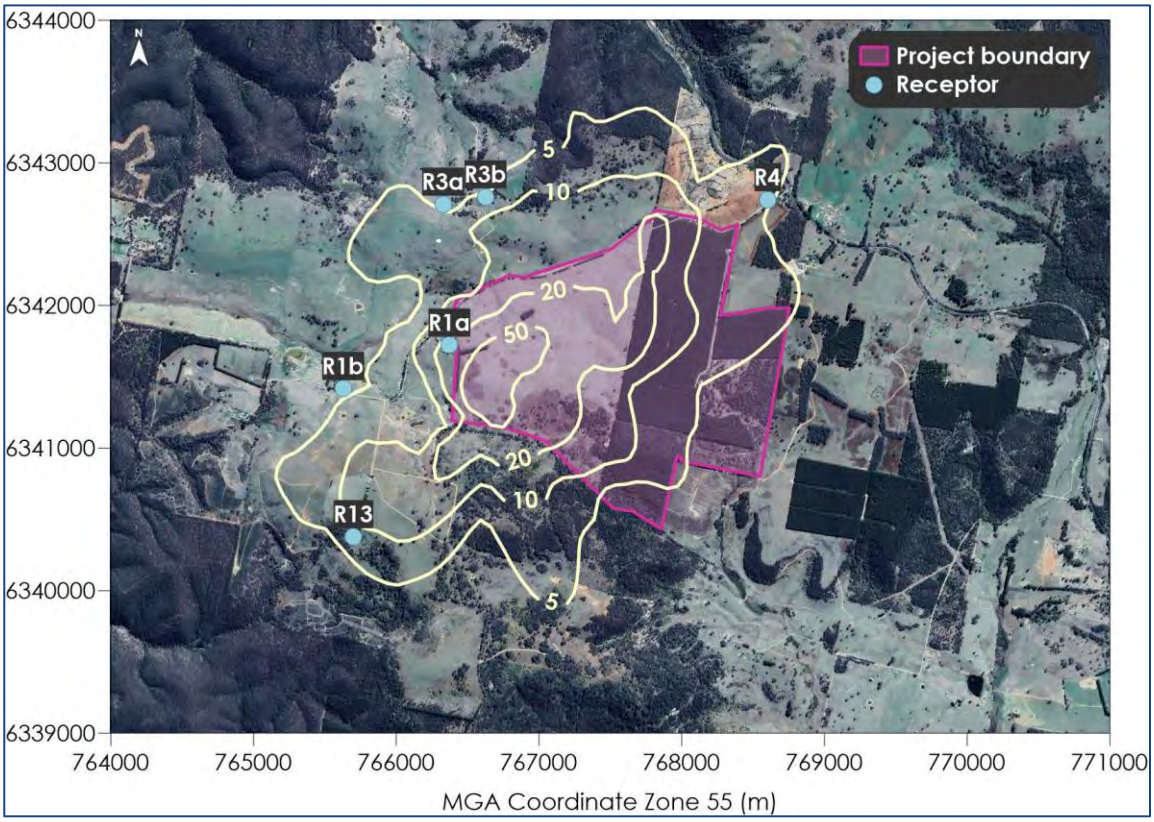

Figure C-4: Predicted incremental maximum 24-hour average PM_{10} concentrations (µg/m³)

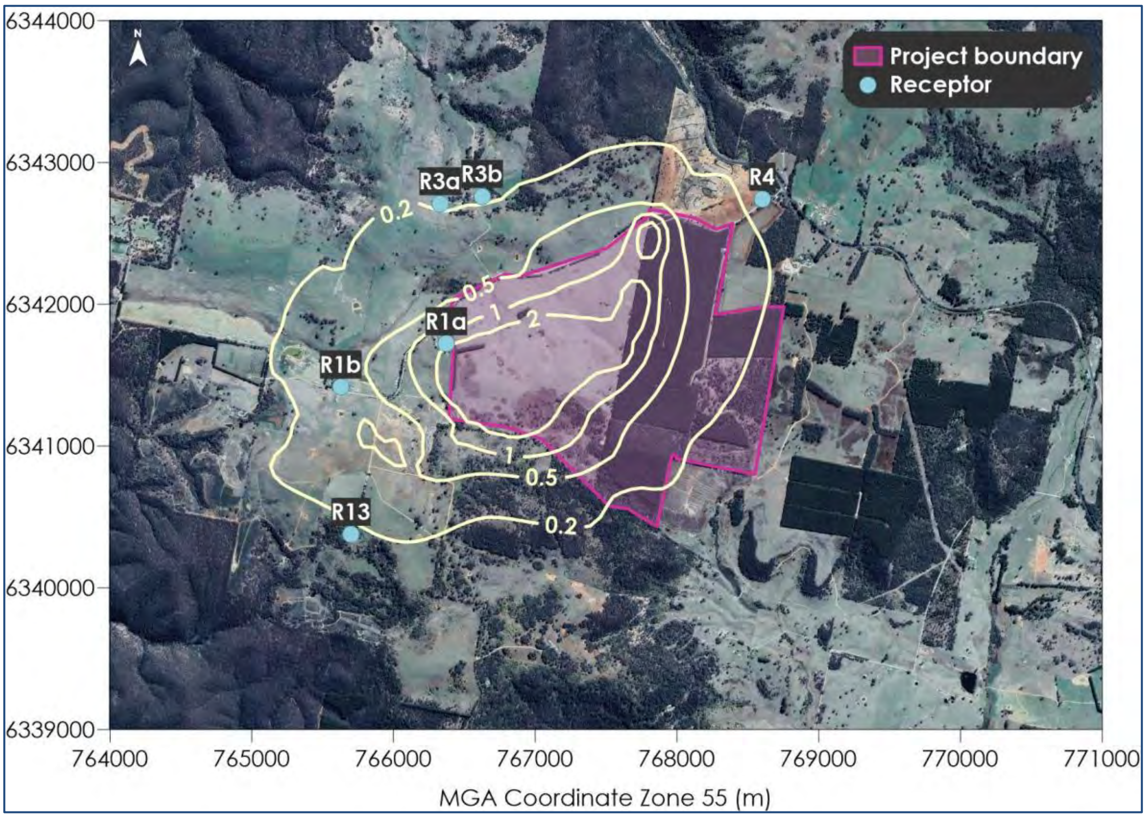

Figure C-5: Predicted incremental annual average PM_{10} concentrations (µg/m³)

Figure C-6: Predicted cumulative annual average PM_{10} concentrations (µg/m³)

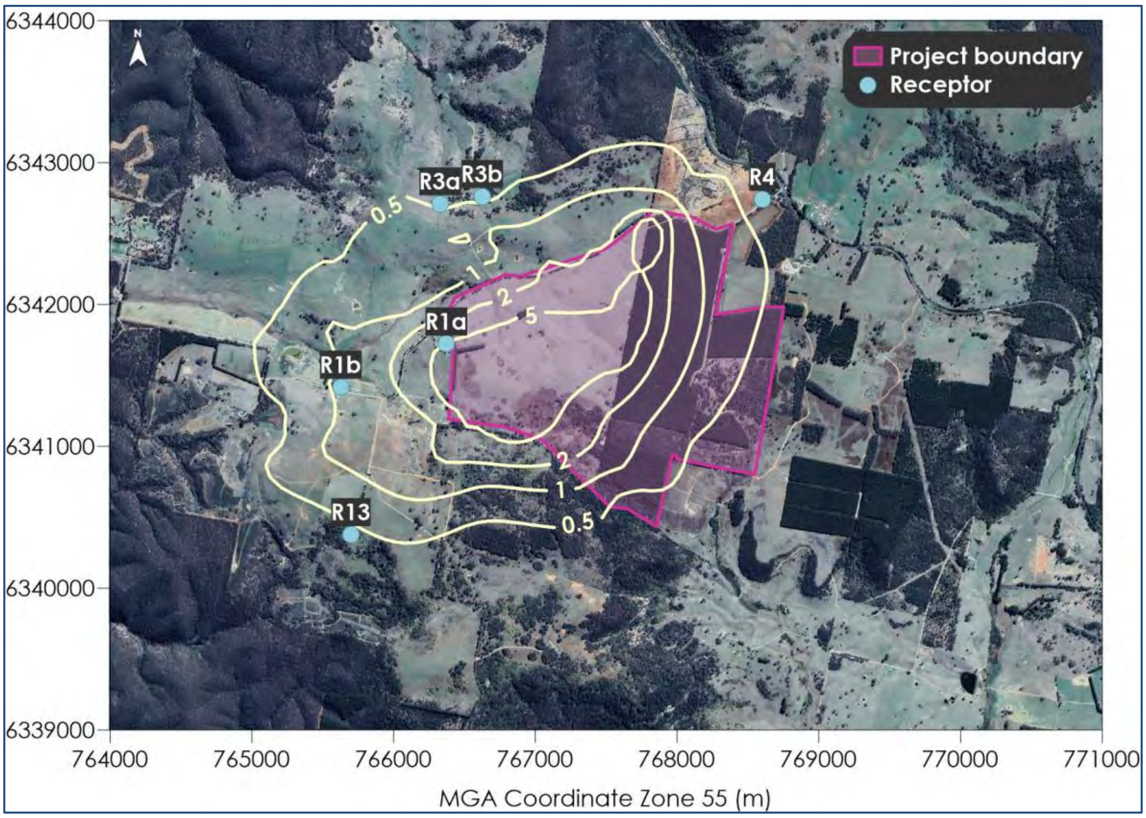

Figure C-7: Predicted incremental annual average TSP concentrations (µg/m³)

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

Figure C-9: Predicted incremental annual average dust deposition levels (g/m²/month)

Figure C-10: Predicted cumulative annual average dust deposition levels (g/m²/month)

Appendix D

Further detail regarding 24-hour $PM_{2.5}$ and PM_{10} analysis

Further detail regarding 24-hour average $PM_{2.5}$ and PM_{10} analysis

The analysis below provides a cumulative 24-hour $PM_{2.5}$ and a 24-hour PM_{10} 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 DPE Bathurst monitoring station.

The Project 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.

Each table assesses one 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. Any value above the $PM_{2.5}$ criterion of 25µg/m^3 or above the PM_{10} criterion of 50µg/m^3 is in **bold red.**

Tables D-1 to **D-2** show the predicted maximum cumulative levels at the assessed most impacted receptor location surrounding the Project.

Table D-1: 24-hour average PM_{10} concentration (µg/m³) – R1a

Ranked by Highest to Lowest Predicted Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Project increment	Total cumulative 24-hr average level	Date	Measured background level	Project increment	Total cumulative 24-hr average level
19/04/2021	29.2	0.0	29.2	22/05/2021	14.2	22.8	37.0
28/04/2021	28.5	5.7	34.2	07/07/2021	9.5	22.5	32.0
29/10/2021	28.2	0.0	28.2	18/05/2021	13.8	21.8	35.6
27/04/2021	28.0	11.0	39.0	23/05/2021	14.3	21.2	35.5
01/03/2021	27.8	0.0	27.8	12/05/2021	9.2	20.6	29.8
15/04/2021	27.7	0.0	27.7	21/06/2021	8.7	19.9	28.6
29/04/2021	27.4	11.6	39.0	17/04/2021	17.3	18.5	35.8
20/04/2021	27.3	0.0	27.3	21/05/2021	15.9	17.8	33.7
15/01/2021	25.6	0.0	25.6	04/05/2021	7.7	16.3	24.0
05/03/2021	25.6	0.2	25.8	11/07/2021	7.1	15.7	22.8

Table D-2: 24-hour average $PM_{2.5}$ concentration (µg/m³) – R1a

Ranked by Highest to Lowest Predicted Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Project increment	Total cumulative 24-hr average level	Date	Measured background level	Project increment	Total cumulative 24-hr average level
29/04/2021	13.8	3.3	17.1	18/05/2021	7.4	8.3	15.7
08/07/2021	13.2	0.0	13.2	07/07/2021	6.7	7.2	13.9
09/07/2021	13.1	0.5	13.6	22/05/2021	8.8	7.2	16.0
19/04/2021	12.9	0.0	12.9	17/04/2021	8.3	6.6	14.9
28/04/2021	12.8	1.3	14.1	21/06/2021	5.8	6.6	12.4
20/04/2021	12.6	0.0	12.6	23/05/2021	10.3	6.4	16.7
24/04/2021	11.5	0.0	11.5	12/05/2021	5.1	6.1	11.2
27/04/2021	11.4	4.1	15.5	21/05/2021	8.8	5.9	14.7
01/06/2021	11.2	0.0	11.2	30/05/2021	5.4	5.7	11.1
15/06/2021	11.1	4.3	15.4	04/05/2021	4.3	5.6	9.9