APPENDIX H: AIR QUALITY IMPACT ASSESSMENT

AIR QUALITY IMPACT ASSESSMENT
DEEP CREEK QUARRY

Kleinfelder Australia Pty Ltd

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Job Number 20081163

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Air Quality Impact Assessment
Deep Creek Quarry

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1 INTRODUCTION

Todoroski Air Sciences has prepared this report for Ironstone Developments on behalf of Kleinfelder Australia Pty Ltd. The report presents an assessment of potential air quality impacts associated with the proposed Deep Creek Quarry at Limeburners Creek, New South Wales (NSW) (hereafter referred to as the Project).

The Project is seeking to develop a hard rock quarry to extract and process hard rock aggregate products, primarily rhyolite with wider resources comprising trachyte, arenite and quartz trachyte using standard drill and blast methods with processing via mobile plant. The proposed annual production rate is approximately 500,000 tonnes per annum (tpa).

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, 2017**).

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

- A background to the Project and description of the proposed site and 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, including potential diesel exhaust emissions associated with vehicles travelling on The Bucketts Way; 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 Project setting

The Project site is located approximately 5 kilometres (km) west-southwest of the township of Allworth in NSW on Lot 48 in DP 753178 and Lot 472 in DP 1162208. The area surrounding the Project site is predominately comprised of dense bushland with the Quarry Access Road located east of the Project where it joins The Bucketts Way.

Figure 2-1 presents the location of the Project and all of the identified receptors considered in this study. The key receptors are labelled, and **Appendix A** includes identification of all the receptors.

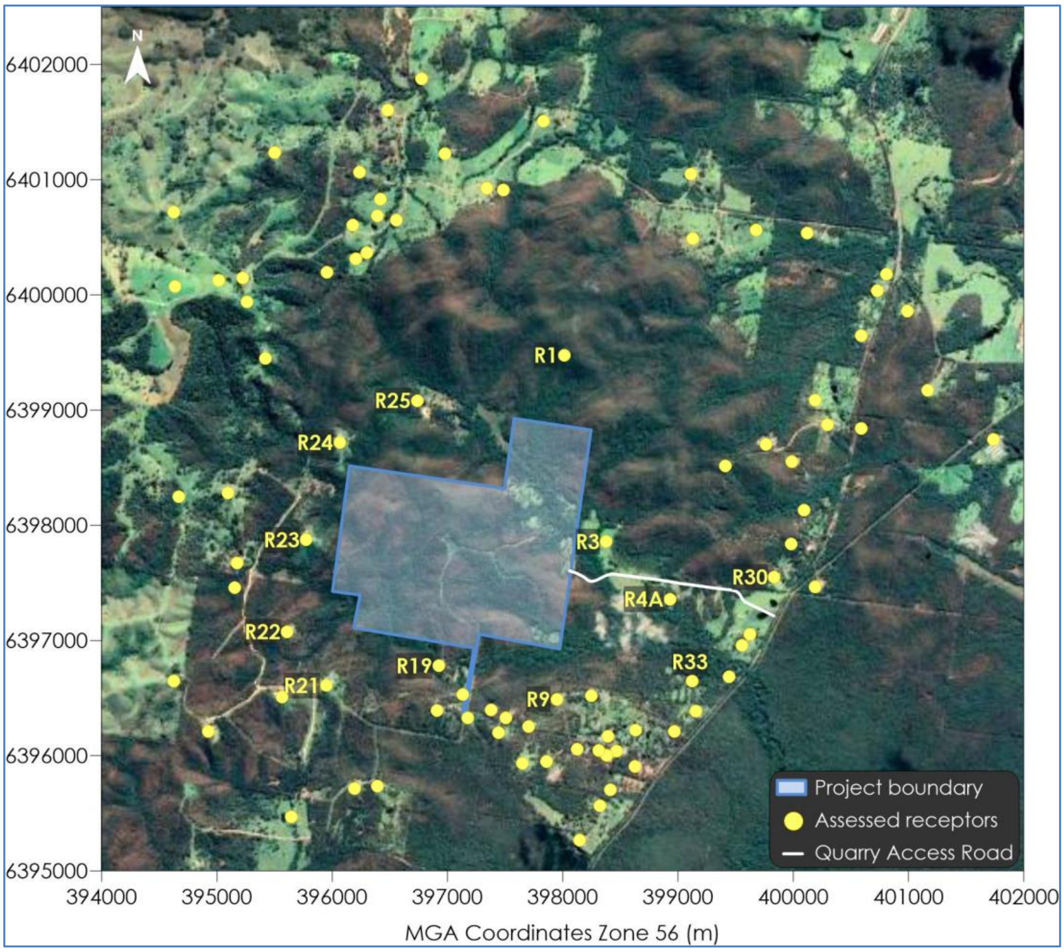

Figure 2-1: Project setting

Figure 2-2 presents a pseudo three-dimensional visualisation of the topography in the general vicinity of the Project. The Project site can be characterised as gently undulating with the Karuah River located approximately 4.6 kilometres (km) east of the site.

A specific focus of the assessment is on assessing potential impacts from road traffic emissions (i.e. mainly diesel emissions) associated with the project. This is because it is understood that receptor R30 has a sensitivity to these emissions. Due to this, the existing straight-line quarry access road has been significantly re-configured to a new route well away from R30. The new road alignment can be seen in **Figure 2-3**.

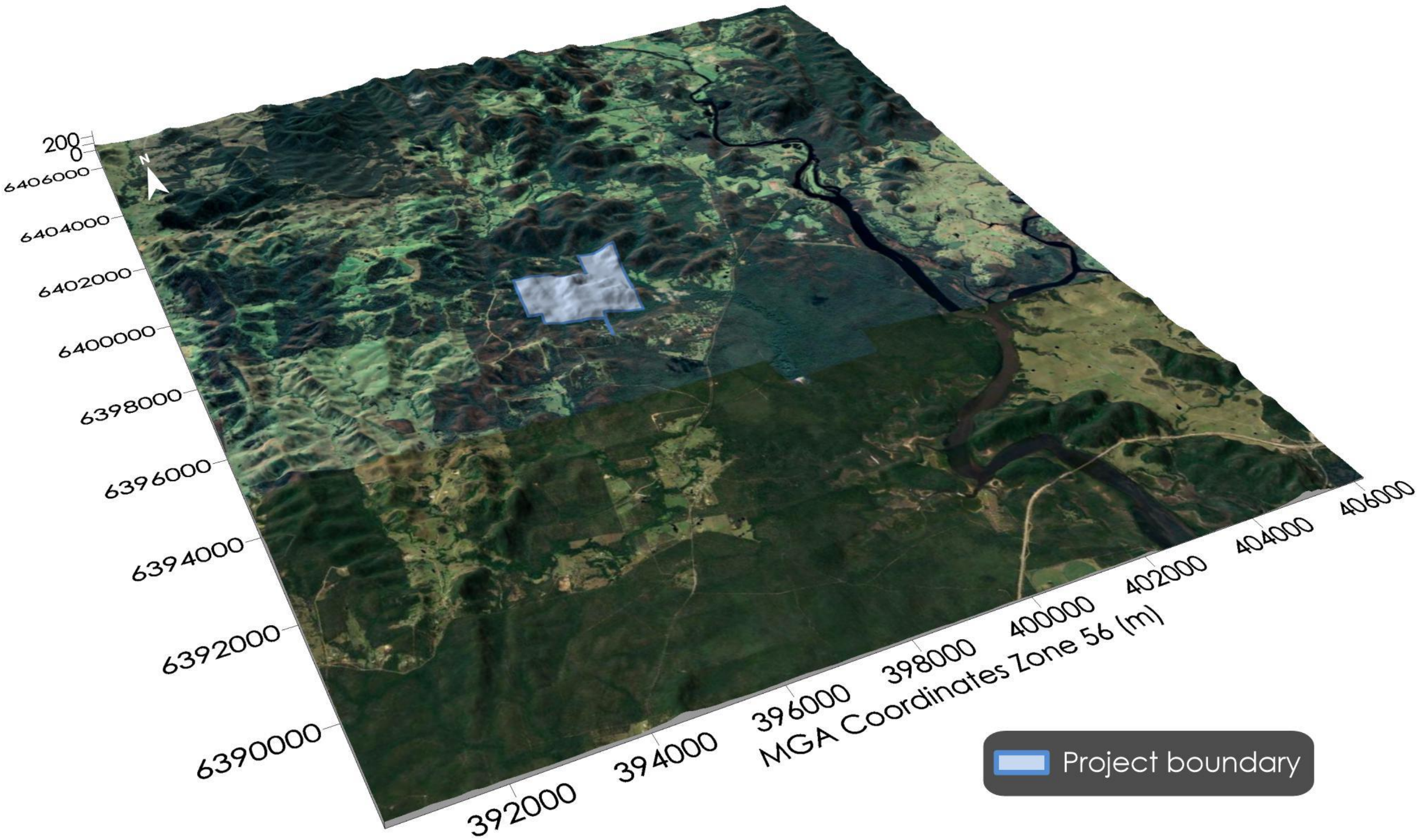

Figure 2-2: Representative visualisation of topography in the area surrounding the Project

2.2 Project description

The Project is seeking to develop a hard rock quarry to extract and process approximately 500,000tpa of hard rock aggregate products, primarily rhyolite with wider resources comprising trachyte, arenite and quartz trachyte. The Project would be undertaken progressively in four stages (Stage 1 to Stage 4).

The hard rock resource would be extracted at the Project site using the typical extraction methods which include standard drill and blast and free dig techniques. The material is loaded onto a haul truck by an excavator and transported to the mobile processing area located on the pit floor. Material is processed using a series of crushers and screens to produce a saleable product. The product material is transported and stockpiled in the designated product area before being dispatched via the new Quarry Access Road and The Bucketts Way.

Table 2-1 presents the proposed operating hours for the Project.

Table 2-1: Proposed operating hours

Activity	Monday to Friday	Saturday	Sunday[1]
Quarry operations	7:00am to 5:00pm	8:00am to 1:00pm	-
Loading and dispatch of trucks	6:00am to 6:00pm	8:00am to 1:00pm	-
Blasting	9:00am to 4:00pm	-	-

[1]No works on Sunday or public holidays

Figure 2-3 provides an indicative site layout of the Project.

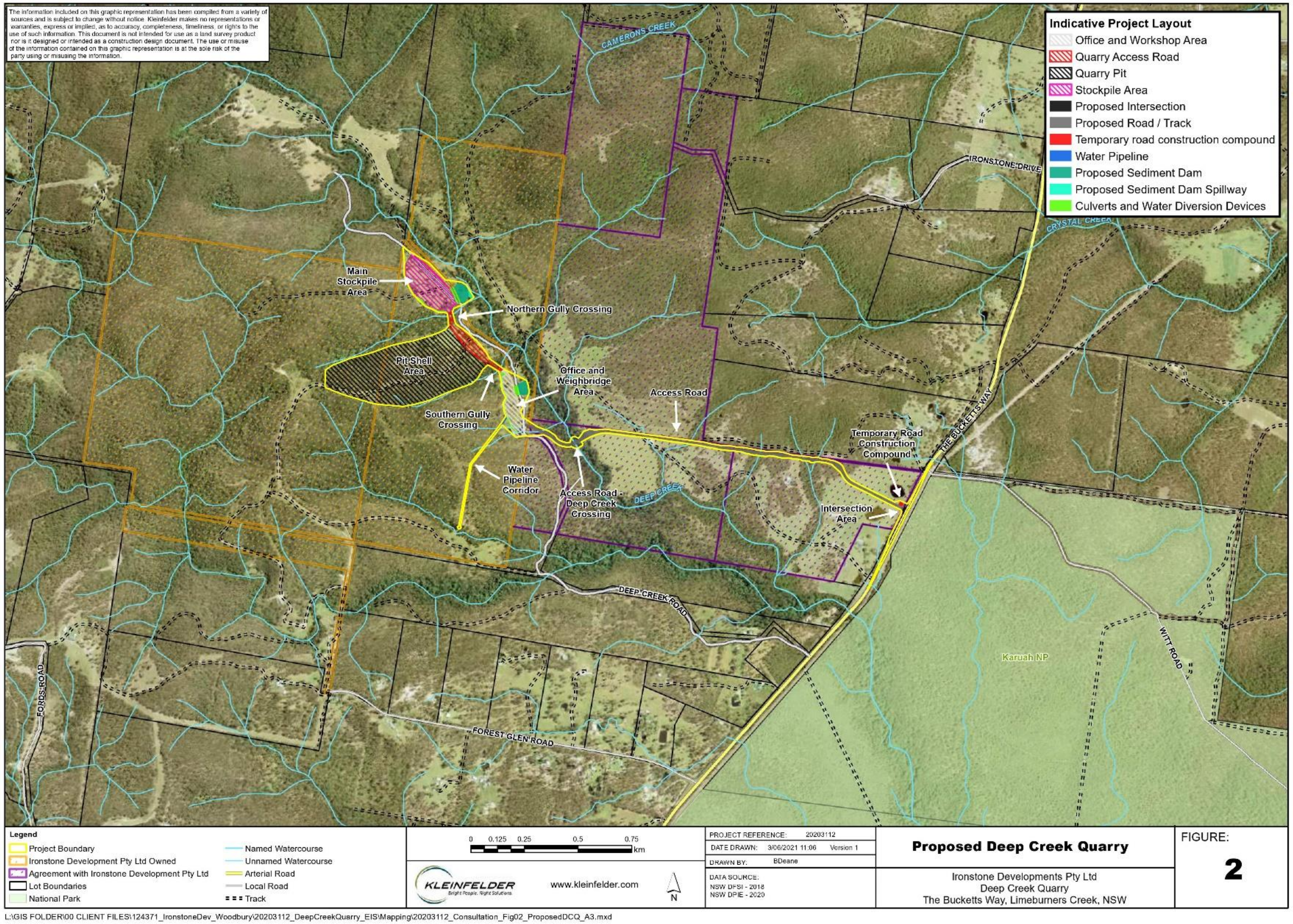

Figure 2-3: Site layout for the Project

3 STUDY REQUIREMENTS

The purpose of this report is to provide an assessment of the likely effects on air quality which may arise from the Project. The assessment presented in this report addresses planning and regulatory agency requirements, as set out below.

3.1 Secretary's Environmental Assessment Requirements

In preparing this Air Quality Impact Assessment, the Secretary's Environmental Assessment Requirements (SEARs) issued for the Project in February 2021 have been addressed and the key matters raised for consideration in the Air Quality Impact Assessment are outlined in **Table 3-1** along with a reference as to where the requirements are addressed in the report.

Table 3-1: Secretary's Environmental Assessment Requirements (SEAR Number SSD-11591659)

Aspect	Requirement	Section
Air Quality	A detailed assessment of potential construction and operational air quality impacts, in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW, and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10}, and having regard to the Voluntary Land Acquisition and Mitigation Policy.	This report
	An assessment of potential dust and other emissions generated from processing, operational activities and transportation of quarry products.	6 & 7
	Reasonable and feasible mitigation measures to minimise dust and emissions.	8
	Monitoring and management measures, in particular, real-time air quality Monitoring.	8

3.2 NSW EPA

This Air Quality Impact Assessment has been prepared in general accordance with the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2017**) and the specific requirements outlined therein as well as the SEARs requested by the NSW EPA as outlined in **Table 3-2**.

Table 3-2: NSW EPA agency comments for air quality (SEAR Number SSD-11591659)

Air quality		Section
Assessment Objective	Demonstrate the proposed project will incorporate and apply best management practice emission controls; and	8
	Demonstrate that the project will not cause violation of the project adopted air quality impact assessment criteria at any residential dwelling or other sensitive receptor.	7
Assessment Criteria	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).	4.4
Existing Environment	Provide a detailed description of the existing environment within the assessment domain, including: o geophysical form and land-uses; o location of all sensitive receptors; o local and regional prevailing meteorology.	2, 5, & Appendix A
Emissions Inventory	Provide a detailed description of the project and identify the key stages with regards to the potential for air emissions and impacts on the surrounding environment.	2
	Identify all sources of air emissions, including mechanically generated, combustion and transport related emissions likely to be associated with the proposed development.	6.3, 6.4 & Appendix C

Air quality		Section
Air Quality Emission Control Measures	Provide a detailed discussion of all proposed air quality emission control measures, including details of a reactive/predictive management system. The information provided must include: ○ explicit linkage of proposed emission controls to the site specific best practice determination assessment ○ timeframe for implementation of all identified emission controls; ○ key performance indicators for emission controls; ○ response mechanisms; ○ responsibilities for demonstrating and reporting achievement of KPIs; ○ record keeping and complaints response register;	8

3.3 MidCoast Council

This Air Quality Impact Assessment has been prepared in consideration of the input from MidCoast Council to the SEARs, outlined in **Table 3-3**.

Table 3-3: MidCoast Council input to the SEARs for air quality

Comments	Section
Assess in detail the potential construction and operational air quality impacts, in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*, and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10}, diesel and blast fume emissions.	This report
Detail reasonable and feasible mitigation measures, including evidence that there are no such measures available other than those proposed and provide details of monitoring and management measures.	8

4 AIR QUALITY CRITERIA

4.1 Particulate matter

Particulate matter consists of dust particles of varying size and composition. Air quality goals refer to measures of the total mass of all particles suspended in air defined as the Total Suspended Particulate matter (TSP). The upper size range for TSP is nominally taken to be 30 micrometres (µm) as in practice particles larger than 30 to 50µm will settle out of the atmosphere too quickly to be regarded as air pollutants.

Two sub-classes of TSP are also included in the air quality goals, namely PM_{10}, particulate matter with equivalent aerodynamic diameters of 10µm or less, and $PM_{2.5}$, particulate matter with equivalent aerodynamic diameters of 2.5µm or less.

Particulate matter, typically in the upper size range, that settles from the atmosphere and deposits on surfaces is characterised as deposited dust. The deposition of dust on surfaces may be considered a nuisance and can adversely affect the amenity of an area by soiling property in the vicinity.

4.2 Odour emissions

Odour emissions have some potential to arise from the diesel exhaust emissions of on-site plant equipment as well as vehicles travelling on and off site. These odorous emissions are generally considered to be too low to generate any significant off-site pollutant concentrations and have not been assessed further in this study.

4.3 Nitrogen dioxide

Nitrogen dioxide (NO_2) is reddish-brown in colour (at high concentrations) with a characteristic odour and can irritate the lungs and lower resistance to respiratory infections such as influenza. NO_2 belongs to a family of reactive gases called nitrogen oxides (NO_X). These gases form when fuel is burnt at high temperatures, mainly from motor vehicles, power generators and industrial boilers (**US EPA, 2011**).

For the Project, NO_2 from diesel powered equipment has been considered in this assessment. NO_2 may also be emitted from some blasts (i.e. blast fumes) under certain conditions, however due to the low frequency, relatively small scale nature of the blasts and material to be blasted the activity is considered to have a low potential of NO_2 generation. Blast fume emissions from hard-rock quarries can be easily managed so as to not cause any air impacts and thus have not been considered further.

4.4 NSW EPA impact assessment criteria

Table 4-1 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, 2017**).

The air quality goals for total impact 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 4-1: NSW EPA air quality impact assessment criteria

Pollutant	Averaging Period	Impact	Criterion
TSP	Annual	Total	90µg/m³
PM_{10}	Annual	Total	25µg/m³
	24 hour	Total	50µg/m³
$PM_{2.5}$	Annual	Total	8µg/m³
	24 hour	Total	25µg/m³
Deposited dust	Annual	Incremental	2 g/m²/month
		Total	4 g/m²/month
NO_2	1 hour	Total	246µg/m³
	Annual	Total	62µg/m³

Source: **NSW EPA, 2017**
µg/m³ = micrograms per cubic metre
g/m²/month = grams per square metre per month

4.5 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 rights may apply per the VLAMP where, even with best practice management, the development contributes to exceedances of the criteria in **Table 4-2** at any residence on privately owned land or workplace on privately owned land.[1]

Table 4-2: Particulate matter mitigation criteria

Pollutant	Averaging period	Mitigation criterion		Impact type
$PM_{2.5}$	Annual	8µg/m³*		Human health
$PM_{2.5}$	24 hour	25µg/m³**		Human health
PM_{10}	Annual	30µg/m³*		Human health
PM_{10}	24 hour	50µg/m³**		Human health
TSP	Annual	90µg/m³*		Amenity
Deposited dust	Annual	2 g/m²/month**	4 g/m²/month*	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.

Voluntary acquisition rights may apply per the VLAMP where, even with best practice management, the development contributes to exceedances of the criteria in **Table 4-3** at any residence on privately owned land, workplace on privately owned land or on more than 25% of any privately owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls (vacant land).

[1] Where any exceedance would be unreasonably detrimental to workers health or carrying out of the business at that workplace.

Table 4-3: Particulate matter acquisition criteria

Pollutant	Averaging period	Acquisition criterion		Impact type
$PM_{2.5}$	Annual	8 µg/m³*		Human health
$PM_{2.5}$	24 hour	25 µg/m³**		Human health
PM_{10}	Annual	30 µg/m³*		Human health
PM_{10}	24-hour	50 µg/m³**		Human health
TSP	Annual	90 µg/m³*		Amenity
Deposited dust	Annual	2 g/m²/month**	4 g/m²/month*	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 up to five allowable exceedances of the criteria over the life of the development.

4.6 Protection of the Environment Operations Act, 1997

The general obligations of the NSW *Protection of the Environment Operations Act, 1997* and the Regulations made under the Act (namely the NSW *Protection of the Environment Operations (Clean Air) Regulation, 2010*) would be followed for the Project. The Project would operate in accordance with the relevant regulatory framework for air quality to ensure compliance with this legislation.

5 EXISTING ENVIRONMENT

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

5.1 Local climatic conditions

Long-term climatic data from the closest Bureau of Meteorology (BoM) weather station at Williamtown RAAF (Site No. 061078) were analysed to characterise the local climate in the proximity of the Project. Williamtown RAAF is located approximately 27.4km north-northeast of the Project.

Table 5-1 and **Figure 5-1** present a summary of data from the Williamtown RAAF collected over a 59 to 70 year period for the various meteorological parameters.

The data indicate that January is the hottest month with a mean maximum temperature of 28.3 degrees Celsius (ºC) and July is the coldest month with a mean minimum temperature of 6.4ºC.

Rainfall decreases during the second half of the year, with an annual average rainfall of 1118.0 millimetres (mm) over 85.5 days. The data indicate that June is the wettest month with an average rainfall of 124.6mm over 8.4 days and September is the driest month with an average rainfall of 60.6mm over 5.6 days.

Relative humidity levels exhibit variability over the day and seasonal fluctuations. Mean 9am relative humidity ranges from 64% in October to 80% in June. Mean 3pm relative humidity levels range from 50% in August and September to 62% in February.

Wind speeds exhibit seasonal and diurnal variations with lower wind speed records for 9am and higher observations for 3pm conditions. Mean 9am wind speeds range from 10.2 kilometres per hour (km/h) in March to 16.8km/h in August. Mean 3pm wind speeds range from 15.8km/h in May to 23.5km/h in November and December.

Table 5-1: Monthly climate statistics summary – Williamtown RAAF

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature													
Mean max. temp. (ºC)	28.3	27.7	26.4	23.8	20.4	17.7	17.2	18.8	21.5	23.8	25.6	27.4	23.2
Mean min. temp. (ºC)	18.2	18.1	16.4	13.2	10.1	8.0	6.4	6.9	9.1	12.0	14.4	16.6	12.4
Rainfall													
Rainfall (mm)	98.3	117.8	120.7	109.8	108.6	124.6	70.3	73.2	60.6	73.5	81.9	77.5	1118.0
No. of rain days (≥1mm)	7.1	7.3	8.2	7.5	7.6	8.4	6.3	6.1	5.6	7.2	7.2	7.0	85.5
9am conditions													
Mean temp. (ºC)	23.0	22.5	21.2	18.2	14.3	11.6	10.5	12.2	15.7	18.8	20.5	22.2	17.6
Mean R.H. (%)	72	76	77	76	79	80	77	71	66	64	66	68	73
Mean W.S. (km/h)	11.9	10.6	10.2	11.4	13.7	15.9	16.4	16.8	15.3	14.4	14.4	12.9	13.7
3pm conditions													
Mean temp. (ºC)	26.5	26.1	24.9	22.5	19.3	16.8	16.2	17.6	20.0	21.9	23.8	25.6	21.8
Mean R.H. (%)	59	62	61	59	60	60	55	50	50	54	55	56	57
Mean W.S. (km/h)	21.9	20.6	18.9	17.2	15.8	17.5	18.7	20.9	22.0	22.5	23.5	23.5	20.2

Source: **Bureau of Meteorology, 2020 (February 2020)**

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

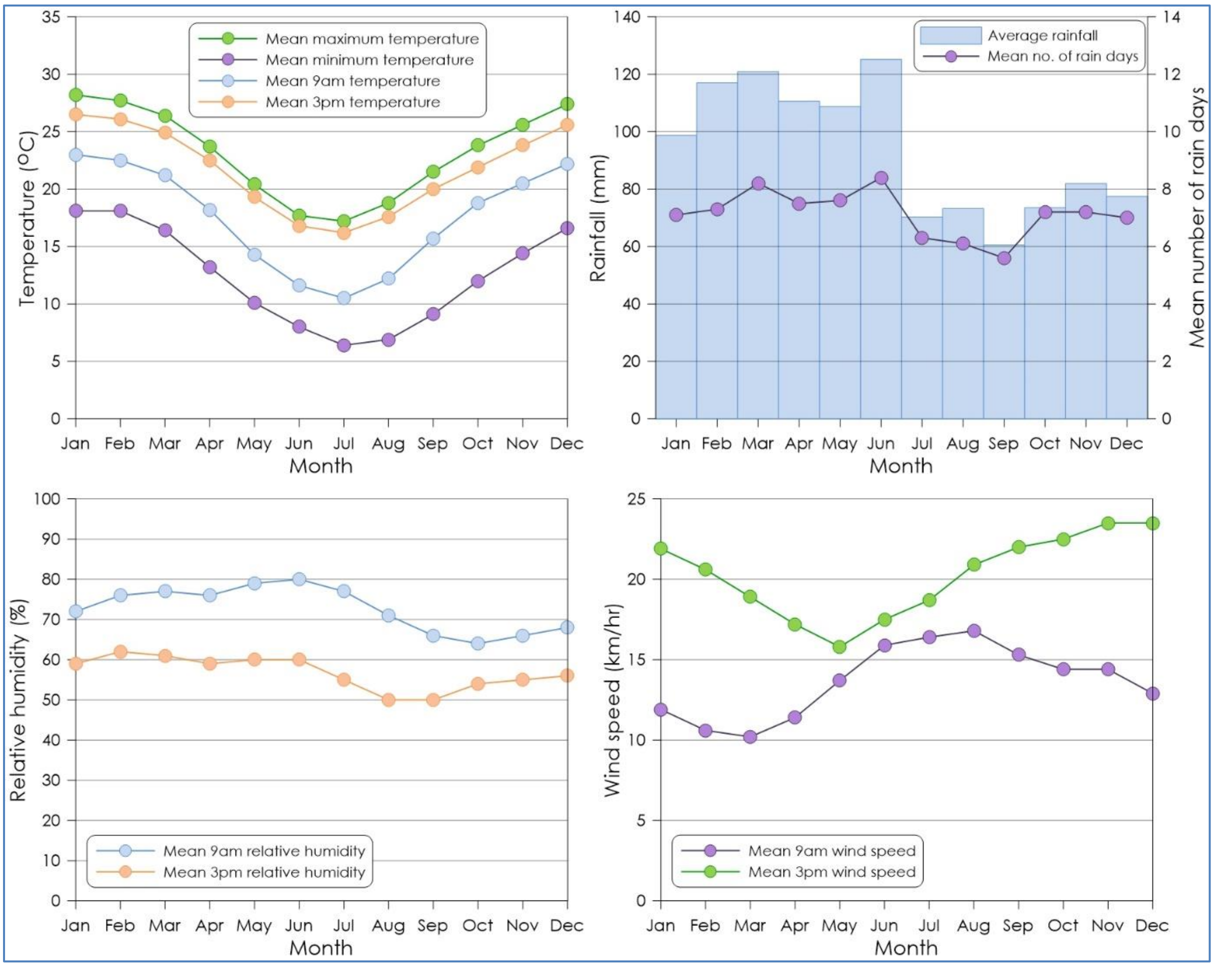

Figure 5-1: Monthly climate statistics summary – Williamtown RAAF

5.2 Local meteorological conditions

Annual and seasonal windroses for the Williamtown RAAF during the 2015 calendar period are presented in **Figure 5-2**.

The 2015 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 B**.

Analysis of the windroses shows that the annual wind directions are predominately from the west-northwest and northwest. In summer, winds from the northeast to the southeast are most frequent. The autumn windrose shows a similar distribution pattern as the annual windrose with the greatest winds from the west-northwest and northwest. During winter, winds from the west-northwest and northwest are most frequent. In spring wind directions are generally spread throughout all quadrants with winds predominately from the northwest, northeast and south.

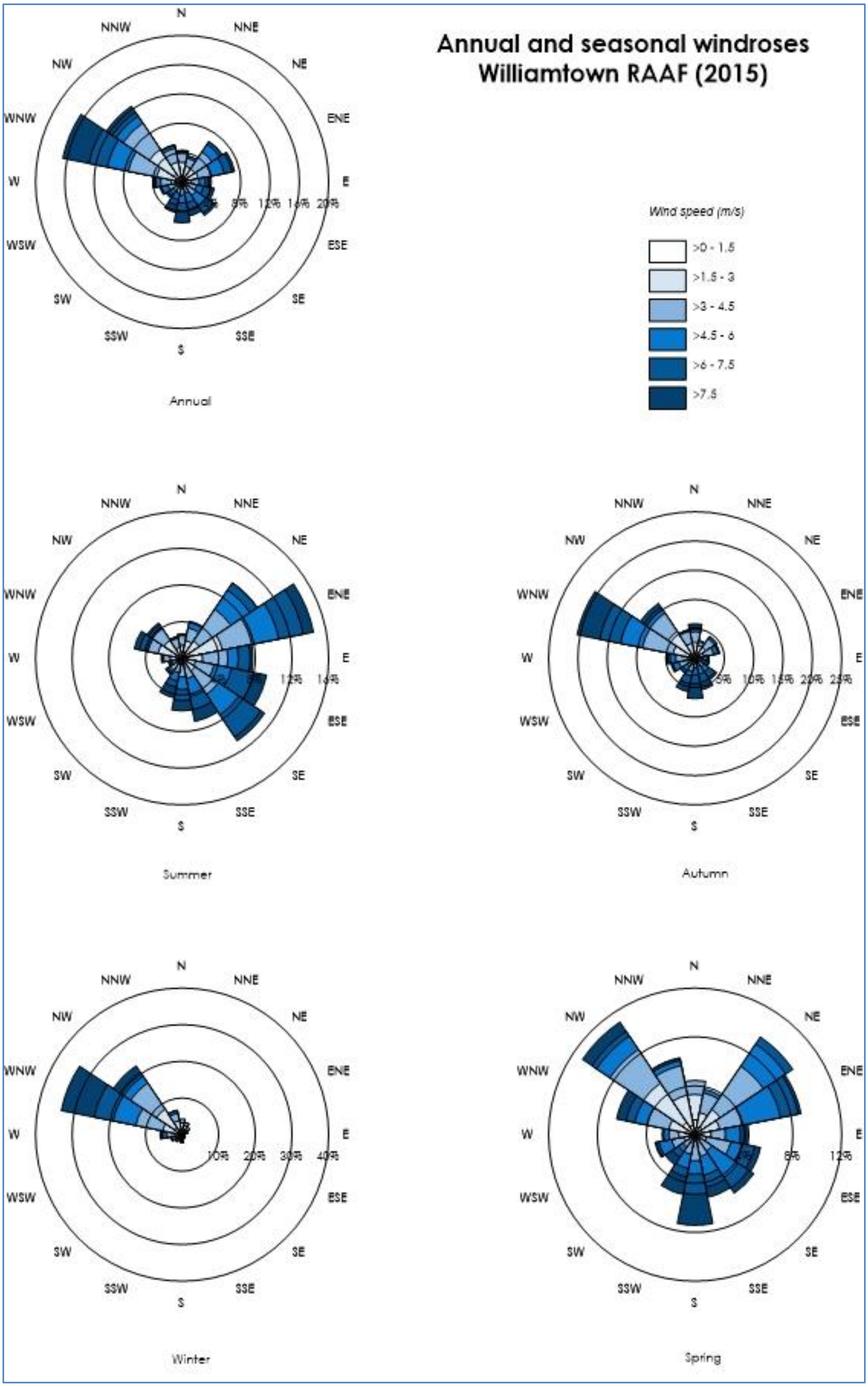

Figure 5-2 : Annual and seasonal windroses – Williamtown RAAF (2015)

5.3 Local air quality monitoring

The main sources of air pollutants in the area surrounding the Project would primarily include emissions from anthropogenic activities such as 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 Planning, Industry and Environment (DPIE) at Beresfield and Mayfield were used to characterise the background levels for the Project site.

It is to be noted that the Beresfield and Mayfield monitoring stations are located in generally more urban environments with potentially higher ambient air emissions sources originating from industrial and commercial operations as well as traffic emissions. The monitoring data are therefore expected to provide a conservative estimate of the underlying background levels in the locality of the Project.

5.3.1 PM_{10} monitoring

A summary of the available PM_{10} monitoring data from 2015 to 2020 for the Beresfield and Mayfield monitoring stations are presented in **Table 5-2**. Recorded 24-hour average PM_{10} concentrations are presented in **Figure 5-3**.

A review **Table 5-2** indicates that the annual average PM_{10} concentrations for the monitors were above the relevant criterion of 25µg/m^3 in 2019 at Beresfield and 2018 and 2019 at Mayfield. The maximum 24-hour average PM_{10} concentrations were found to exceed the relevant criterion of 50µg/m^3 for all years of the review period at both monitors except 2016 and 2017 at Beresfield.

Anomalously high PM_{10} concentrations recorded in November 2018 at the monitors have been attributed to state-wide dust storm events originating from the Victorian Mallee and Southern and Western NSW region (**NSW DPIE 2020a**). The high PM_{10} concentrations recorded at the monitors in November and December 2019 and January 2020 are attributed to wildfires and the drought period (**NSW DPIE 2019 & NSW DPIE 2020b**).

Table 5-2: Summary of PM_{10} levels from monitoring stations (µg/m³)

Year	Beresfield	Mayfield	Criterion
	Annual average		
2015	18.8	21.7	**25**
2016	19.1	22.6	**25**
2017	19.6	24.2	**25**
2018	21.6	**26.9**	**25**
2019	**25.9**	**30.8**	**25**
2020	18.5	23.0	**25**
Year	**Maximum 24-hour average**		**Criterion**
2015	**64.9**	**84.7**	**50**
2016	48.0	**84.1**	**50**
2017	49.4	**70.6**	**50**
2018	**149.1**	**135.6**	**50**
2019	**136.7**	**153.0**	**50**
2020	**77.7**	**96.2**	**50**

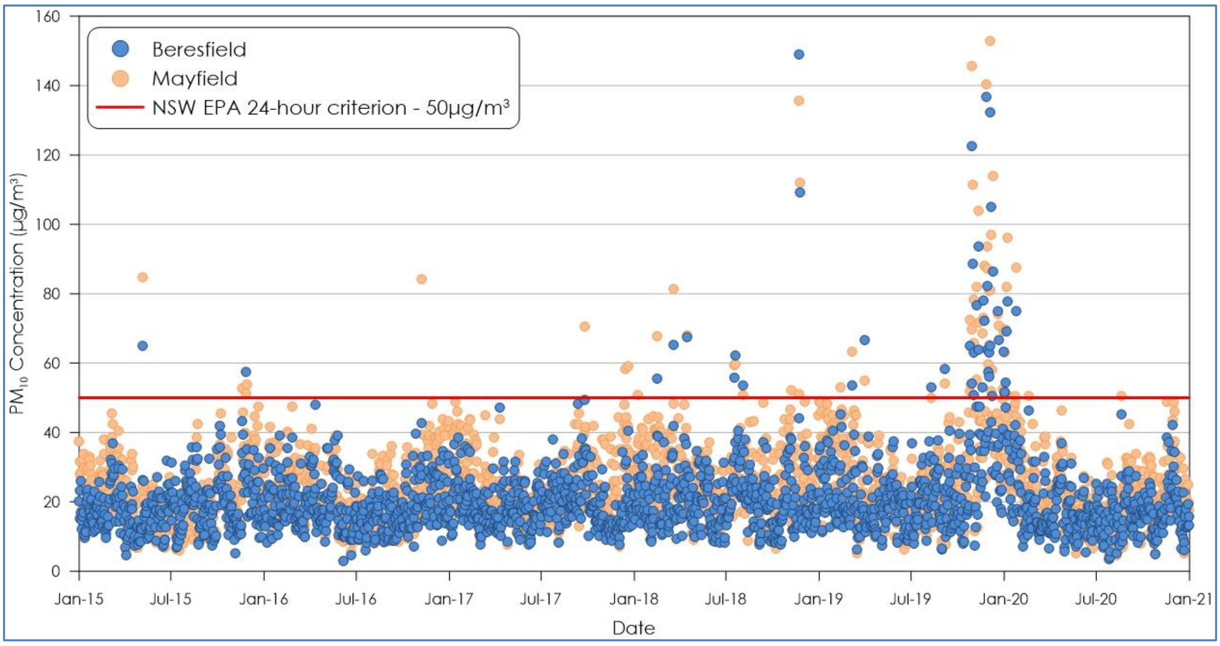

Figure 5-3: 24-hour average PM_{10} concentrations

5.3.2 $PM_{2.5}$ monitoring

A summary of the available data for the 2015 to 2020 for the Beresfield and Mayfield monitoring stations is presented in **Table 5-3**. Recorded 24-hour average $PM_{2.5}$ concentrations are presented in **Figure 5-4**.

Table 5-3 indicates that the annual average $PM_{2.5}$ concentrations for the monitoring station were above the relevant criterion of 8µg/m^3 during 2018 and 2019.

The maximum 24-hour average $PM_{2.5}$ concentrations were found to exceed the relevant criterion of 25µg/m^3 for all years of the review period except 2017 and 2018. Similar to the PM_{10} monitoring data, the mass bushfires affecting NSW in 2019 and 2020 are seen in the $PM_{2.5}$ monitoring data.

Table 5-3: Summary of $PM_{2.5}$ levels from Beresfield monitoring (µg/m³)

Year	Beresfield	Mayfield	Criterion
	Annual average		
2015	7.3	7.4	**8**
2016	7.4	7.4	**8**
2017	7.6	7.5	**8**
2018	**8.7**	**8.3**	**8**
2019	**12.1**	**11.2**	**8**
2020	7.7	7.6	**8**
Year	**Maximum 24-hour average**		**Criterion**
2015	**25.9**	**30.2**	**25**
2016	**27.9**	**57.9**	**25**
2017	18.7	18.8	**25**
2018	24.9	21.3	**25**
2019	**100.5**	**103.2**	**25**
2020	**49.7**	**61.9**	**25**

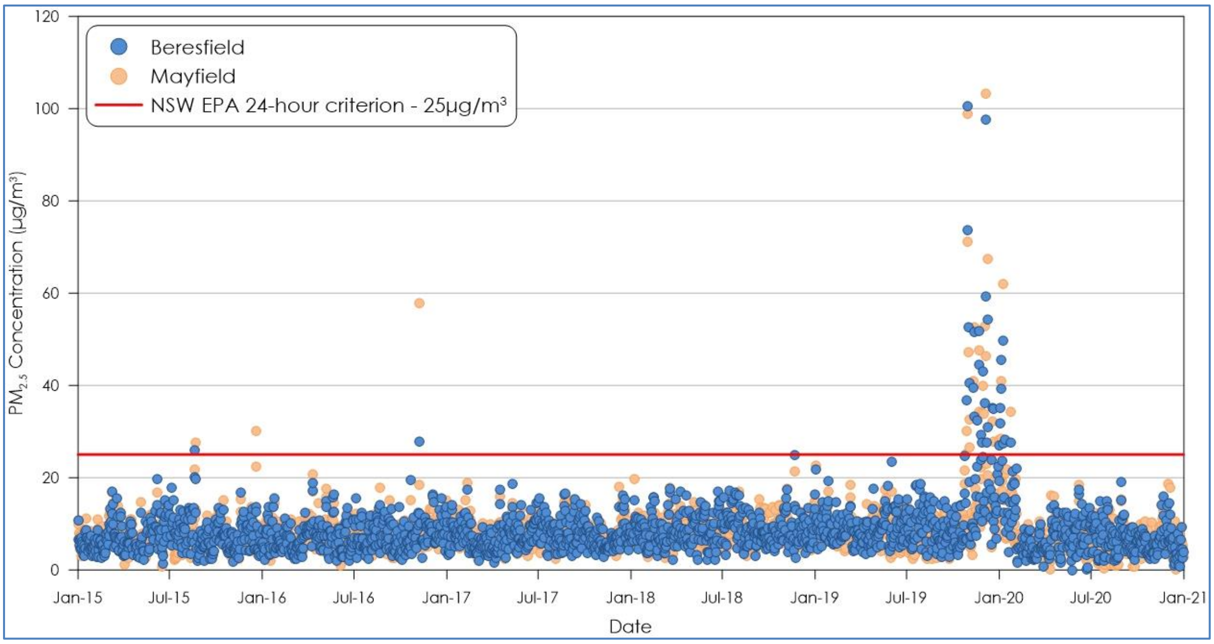

Figure 5-4: 24-hour average $PM_{2.5}$ concentrations

5.3.1 NO_2 monitoring

Figure 5-5 presents the daily maximum 1-hour average NO_2 monitoring data from the nearest NSW DPIE monitoring sites. The data show that the levels were well below the relevant criterion of 246µg/m^3 in 2015. A seasonal trend can be seen in the NO_2 monitoring data with elevated levels occurring in the cooler months compared to the warmer months.

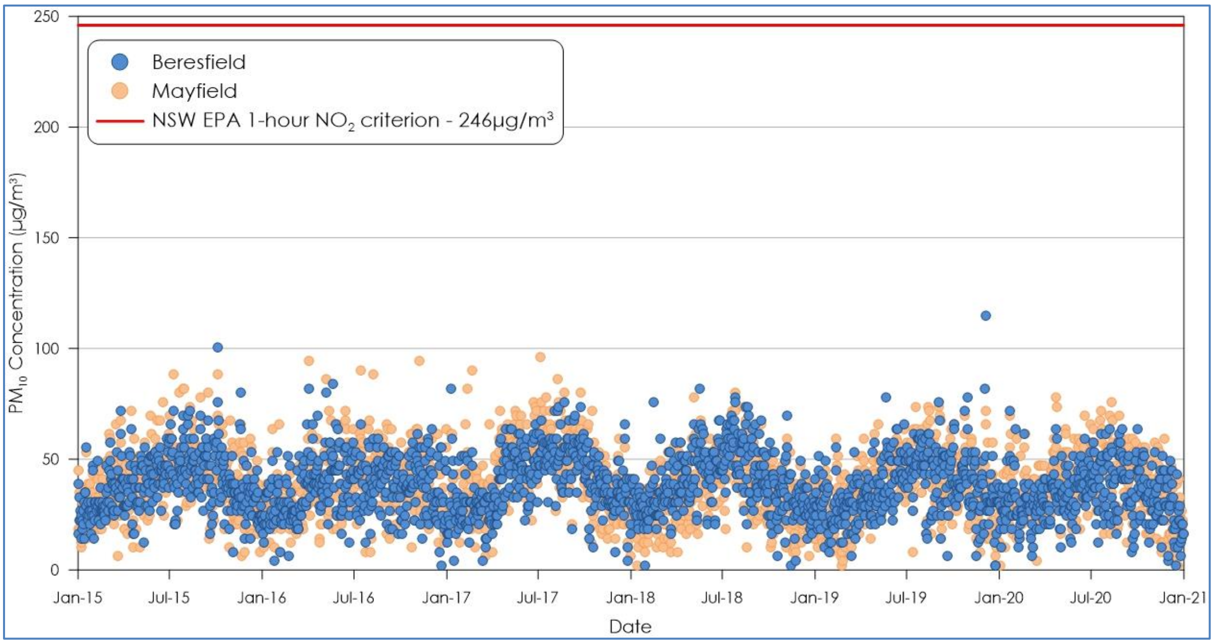

Figure 5-5: Daily maximum 1-hour average NO_2 concentrations

5.3.2 Estimated background levels

As outlined above, there are no readily available site specific monitoring data, and therefore to assess the potential impacts associated with the Project against the relevant dust criteria outlined in **Section 4**, consideration of background dust levels needs to be applied.

The measured background dust levels for the 2015 calendar year period correspond to the period selected for the meteorological modelling (as outlined in **Appendix B**) and is chosen to represent the background levels for the Project.

Of the ambient air quality monitors reviewed, the Beresfield monitoring site is the monitor located closest to the Project site. The Beresfield site is located in an urban residential development and near a motorway, railway line and other industrial sources which would contribute to the measured level at this monitor.

In the absence of available data, estimates of the annual average background TSP and deposited dust concentrations can be 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 dust deposition value of 4g/m^2/month. This assumption is based on the NSW EPA air quality impact criteria.

Applying this relationship with the measured annual average PM_{10} concentration of 18.8µg/m^3 indicates an approximate annual average TSP concentration and deposition value of 67.5µg/m^3 and 3.0g/m^2/month, respectively.

The background air quality levels applied in this assessment are summarised in **Table 5-4**.

Table 5-4: Summary of background levels

Pollutant	Averaging period	Background level	Units
TSP	Annual	67.5	µg/m^3
PM_{10}	24-hour	Daily varying	µg/m^3
	Annual	18.8	µg/m^3
$PM_{2.5}$	24-hour	Daily varying	µg/m^3
	Annual	7.3	µg/m^3
Deposited dust	Annual	3.0	g/m^2/month
NO_2	1-hour	100.5	µg/m^3
	Annual	39.1	µg/m^3

5.4 Local sources with cumulative impact potential

The Bucketts Way is located to the east of the Project and the proposed Hillview Hard Rock Quarry is located approximately 6.9km north of the Project.

The proposed Hillview Hard Rock Quarry has potential to generate similar air emissions (i.e. dust emission and diesel exhaust emissions) to the Project and may contribute to cumulative air pollutant levels in this locality.

The Hillview Hard Rock Quarry has a proposal to extract 600,000tpa over the first 5 years and 1.5 million tonnes per annum (Mtpa) for the remaining 20 years (**SLR, 2018**). The main air emissions from these operations would be dust generated from the quarrying activities and diesel emissions generated from the on-site vehicles and plant equipment and also trucks travelling on The Bucketts Way to and from the site.

Annual and seasonal windroses for the Williamtown RAAF presented in **Figure 5-2** indicate strong winds are generally experienced in the area with wind directions predominately coming from the northwest and west-northwest with varied winds from other directions throughout the year. Potential dust emissions from the Project and the Hillview Hard Rock Quarry will most likely be subject to similar wind. This means that it is unlikely for a single receptor to remain downwind of both operations for extended periods of time and overall, the prevailing dispersion conditions should allow for dust emissions from the Project and the Hillview Hard Rock Quarry to be reasonably well dispersed before reaching the receptor locations.

Furthermore, as the distance between the Hillview Hard Rock Quarry and the nearest receptors assessed as part of the Project is relatively large (~3km), the expected contribution from the Hillview Hard Rock Quarry extraction and processing activities to background dust levels would be difficult to discern from the existing background level. It is expected that the Hillview Hard Rock Quarry would apply suitable dust mitigation measures to ensure their contribution in the surrounding environment is minimised and hence, dust emissions for the Hillview Hard Rock Quarry have not been considered further in this study.

Diesel emissions from the trucks travelling along The Bucketts Way which access the Hillview Hard Rock Quarry have been considered in this assessment to determine any potential cumulative air quality impacts at receptors located along The Bucketts Way near to the Project.

6 DISPERSION MODELLING APPROACH

6.1 Introduction

The following sections are included to provide the reader with an understanding of the model and modelling approach applied for the assessment. 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 and applied to the quarrying activities for the Project. The model was setup 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**).

The CAL3QHCR roadway pollution dispersion model was used to estimate impacts associated with vehicles travelling on the Bucketts Way and the Quarry Access Road.

6.2 Modelling methodology

Modelling was undertaken using a combination of the CALPUFF Modelling System, CAL3QHCR and The Air Pollution Model (TAPM).

6.2.1 Meteorological modelling

The TAPM 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 TAPM modelling used is 32deg 30min south and 151deg 54.5min 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 initial domain of 30 x 30km grid with a 0.6km grid resolution and refined for a final domain of 10 x 10km with a 0.1km grid resolution. The available meteorological data for the 2015 calendar period from nearby BoM meteorological monitoring sites were included in the simulation. **Table 6-1** outlines the parameters used from the station.

Table 6-1: Surface observation stations

Weather Stations	Parameters						
	WS	WD	CH	CC	T	RH	SLP
Williamtown RAAF Weather Station (BoM) (Station No, 061078)	✓	✓	✓	✓	✓	✓	✓
Paterson (TOCAL AWS) (BoM) (Station No. 061250)	✓	✓			✓	✓	
Beresfield (NSW OEH)	✓	✓			✓	✓	

WS = wind speed, WD= wind direction, CH = cloud height, CC = cloud cover, T = temperature, RH = relative humidity, SLP = sea level pressure

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 6-1**.

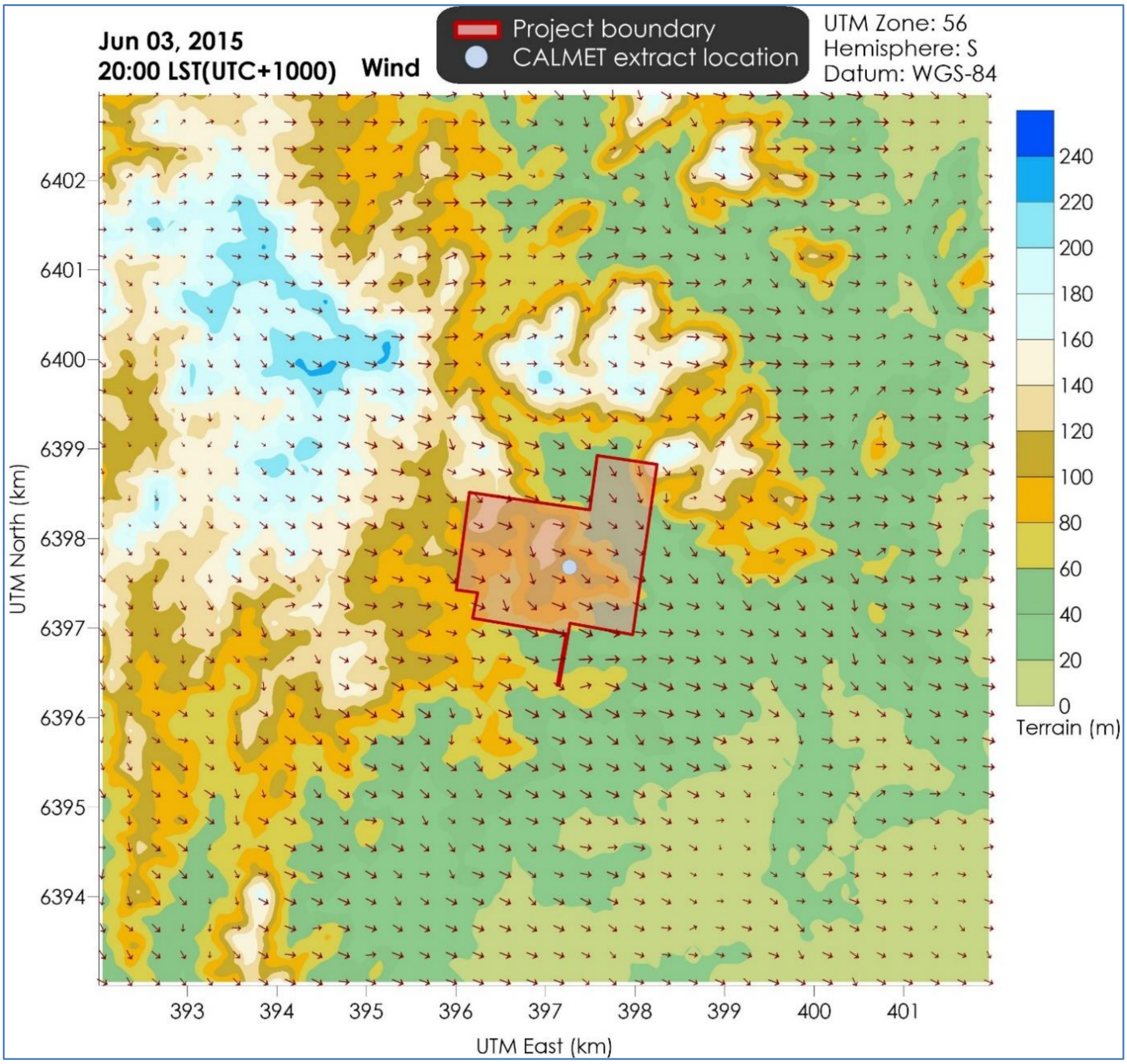

Figure 6-1: Representative 1-hour average snapshot of wind field for the Project

CALMET generated meteorological data were extracted from a point within the CALMET domain and are graphically represented in **Figure 6-2** and **Figure 6-3**.

Figure 6-2 presents the annual and seasonal windroses from the CALMET data. On an annual basis, winds predominantly occur from the west-northwest. In summer, winds tend to occur from the northeast quadrant. Autumn has a similar wind distribution to the annual wind distribution with dominant winds from the west-northwest. In winter, winds typically occur from the west-northwest with few winds from the other directions. In spring, winds predominantly occur from the north and west-northwest with varied winds in other directions.

Overall, the windroses generated in the CALMET modelling reflect the expected wind distribution patterns of the area as determined based on the expected terrain effects on the prevailing winds.

Figure 6-3 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.

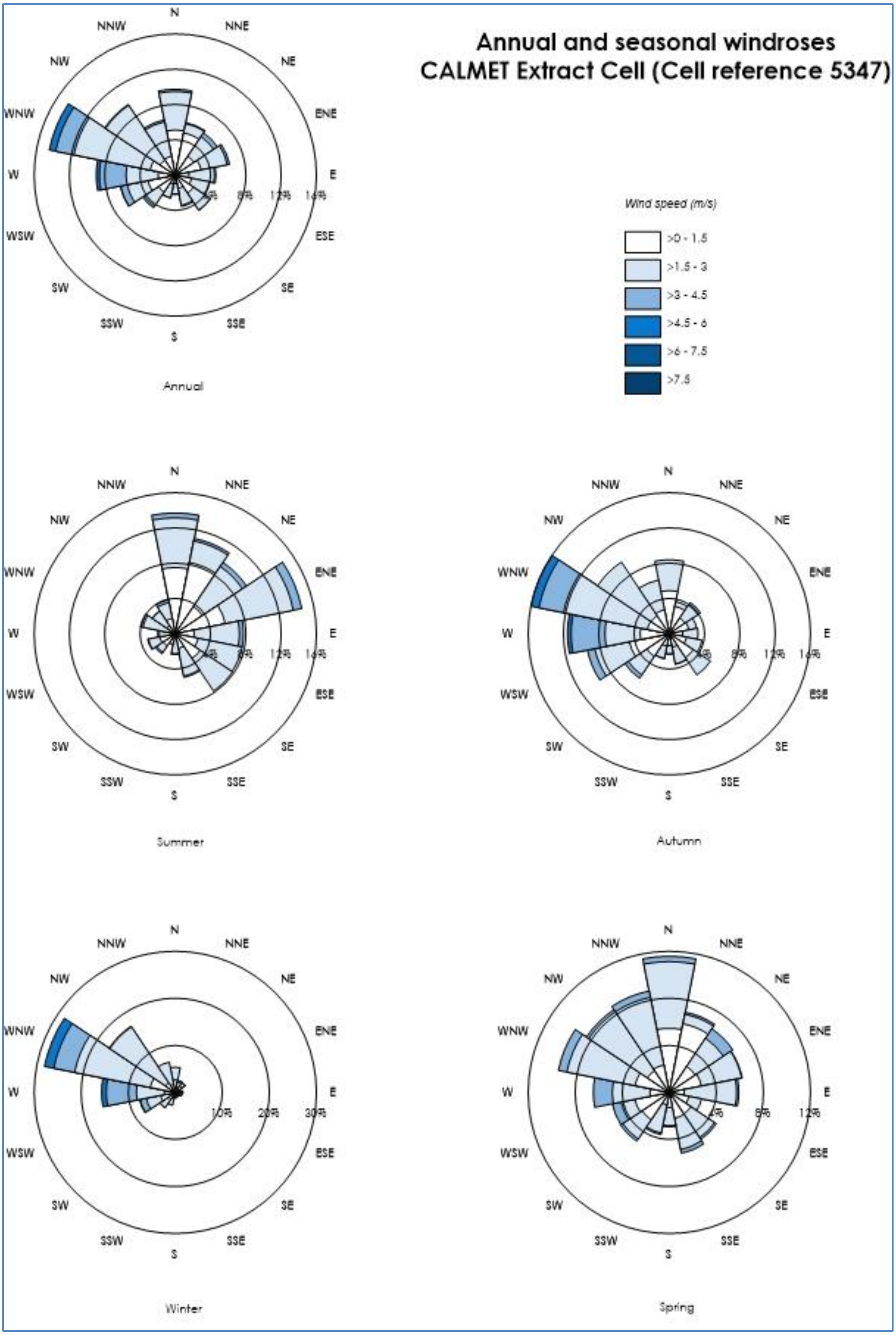

Figure 6-2: Annual and seasonal windroses from CALMET (Cell ref 5347)

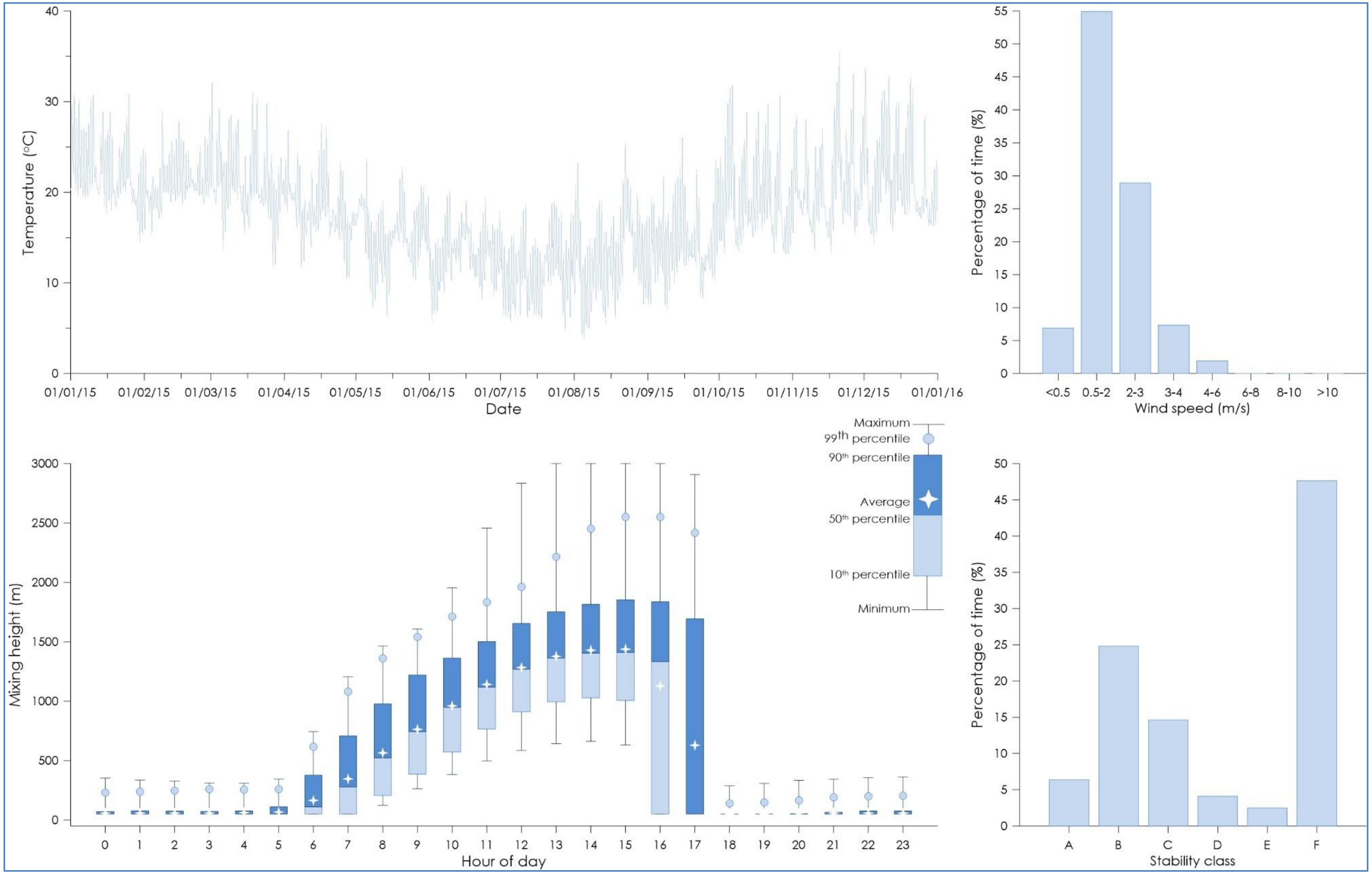

Figure 6-3: Meteorological analysis of CALMET (Cell Ref 5347)

6.3 Dispersion modelling

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.

Exhaust emissions from trucks travelling along The Bucketts Way and the Quarry Access Road were included in the CAL3QHCR model via an hourly varying emission file with CALMET generated data as described in the previous section.

6.4 Emission estimation

6.4.1 Dust emissions

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

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 average and peak TSP, PM_{10} and $PM_{2.5}$ emissions is presented in **Table 6-2**. Detailed calculations of the dust emission estimates are provided in **Appendix C**.

An average and a peak scenario have been assessed for the operation of the Project.

The average scenario is based on the proposed annual tonnage of 500,000tpa of hard rock aggregate extracted and processed at the site.

The peak scenario is based on the maximum amount of material handled on a daily basis (4,000 tonnes per day [tpd]). The maximum daily amount of material handled is assumed to apply every day of the modelling period (i.e. 365 days), regardless limited actual weekly workdays. This results in an estimated maximum annual tonnage in the modelling for the peak scenario of 1,460,000tpa (4,000tpd x 365 days).

The maximum annual tonnage is applied in the emission estimates to calculate an annual dust emission for the Project (average scenario), and the maximum daily tonnage to calculate 24-hour average dust emissions (peak scenario).

It is important to note that the actual annual emissions from the quarry would correspond with only the average scenario values, and the emissions in the peak scenario are used in the modelling only to ensure there is no underestimation of short-term impacts on any day of the year (given that any day could have peak activity).

Table 6-2: Summary of estimated dust emissions for the Project (kg/year)

Modelled Scenario	TSP Emissions	PM_{10} emissions	$PM_{2.5}$ emissions
Average scenario Total annual emissions – for annual average results	54,592	18,546	2,918
Peak scenario Total annual emissions – Peak daily scenario, modelled every day of the year	131,213	37,347	6,350

6.4.2 NO_X emissions

Vehicle exhaust emissions associated with diesel powered plant and equipment on-site have the potential to emit NO_X emissions. Vehicle exhaust emissions were estimated based on the power rating of the equipment and the emission standards from the *DieselNet United States Nonroad Diesel Engines guideline* (**DieselNet, 2017**).

A summary of the estimated annual NO_X emissions from the site is presented in **Table 6-3**.

Table 6-3: Summary of estimated diesel exhaust emissions for the Project (kg/year)

Pollutant	Emissions (kg/year)
NO_X	6,912

6.4.3 Road traffic emissions

An assessment of the potential air quality impacts associated with vehicles travelling along The Bucketts Way and the Quarry Access Road has been considered. This includes heavy vehicles associated with the proposed Hillview Hard Rock Quarry.

Daily traffic volumes for The Bucketts Way were obtained from the Transport for NSW (TfNSW) Traffic Volume Viewer station 05084 (**NSW RMS, 2021**) for 2010. For the modelling, the daily traffic volumes along The Bucketts Way were increased by 15% to account for any potential future increase in public traffic.

The Quarry Access Road is estimated to have a weekday traffic volume of 270 vehicle movements per day and a weekend (Saturday) traffic volume of 176 vehicle movements per day, which represents the expected vehicle activity associated with the Project.

As there were no available traffic data for the Hillview Hard Rock Quarry, a daily volume of 324 vehicle movements per day has been nominally adopted for the operating hours of that quarry based on the traffic profile for this Project.

Figure 6-4 and **Figure 6-5** present the hourly vehicle profiles for weekdays and weekends which were applied in the model for The Bucketts Way and the Quarry Access Road, respectively. It is to be noted that The Bucketts Way profile is inclusive of trucks travelling on-site and off-site for both Deep Creek Quarry and the Hillview Hard Rock Quarry. Peak traffic conditions can be observed during the morning and afternoon from approximately 6:00am to 9:00am and 3:00pm to 6:00pm, with higher vehicle counts shown during the weekend along The Bucketts Way.

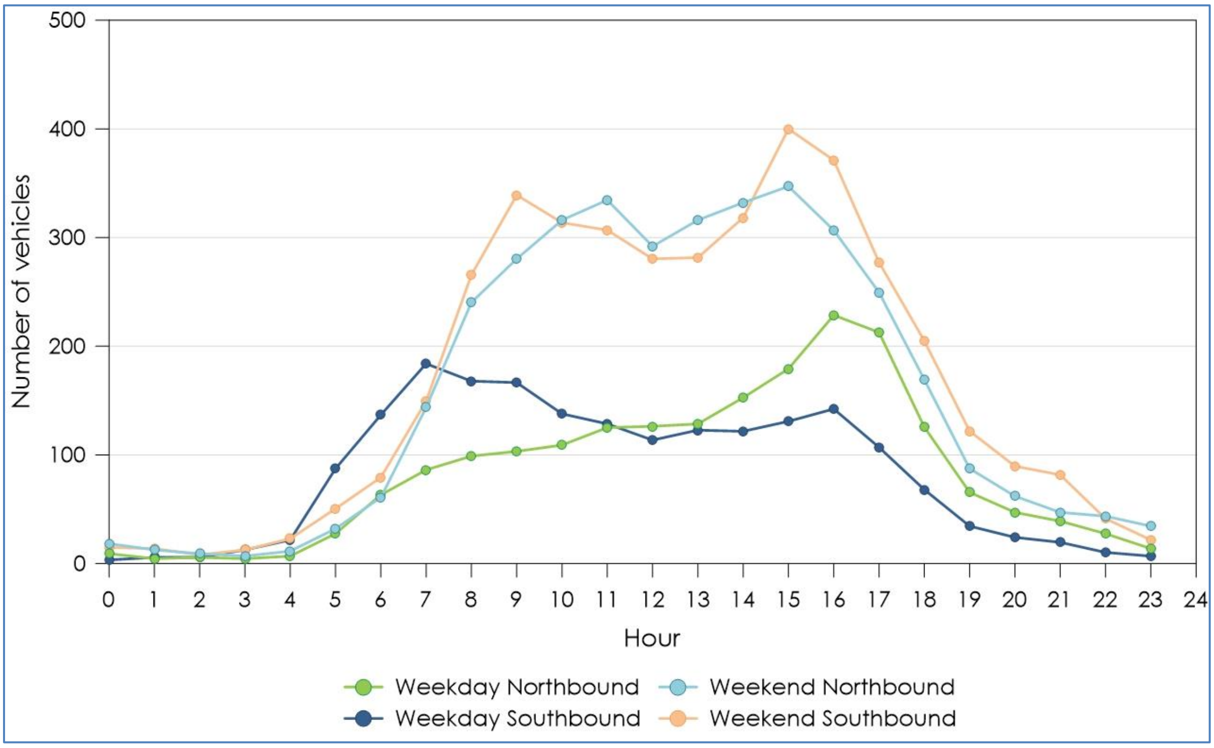

Figure 6-4: The Bucketts way hourly vehicle profile

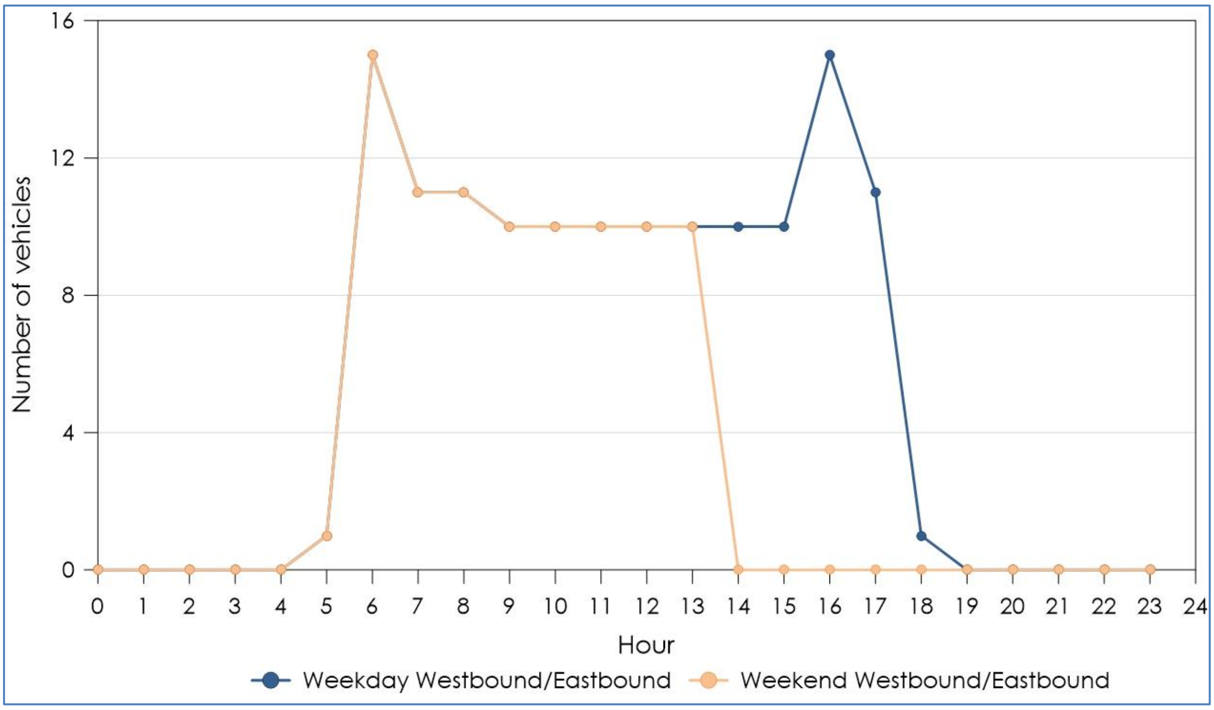

Figure 6-5: Quarry Access Road hourly vehicle profile

Hourly NO_x and PM_{10} emission rates for free-flowing traffic were obtained from the RMS Tool for Roadside Air Quality (TRAQ). **Table 6-4** summarises the settings used in TRAQ and **Table 6-5** outlines the estimated emission rates.

The traffic composition along The Bucketts Way was modelled at 12% heavy vehicles, as per the percentage of heavy vehicles from the RMS Traffic Volume Viewer station 05084.

Table 6-4: Summary of TRAQ settings

Parameter	The Bucketts Way	Quarry Access Road
Heavy vehicle percentage	12%	93%
Grade	Variable	Variable
Vehicle fleet	2021	2021
Local land use	Rural	Rural

Table 6-5: Free flow emissions factors (g/vehicle/km)

NOx	PM_{10}
0.2 to 1.5*	0.1 to 0.2*

*Varies according to gradient

$PM_{2.5}$ was conservatively assumed to be 92% of PM_{10} per the US EPA emission factors (**US EPA**, **2008**). As a conservative measure, NO_2 was assumed to be 50% of NO_X, whereas a value between 10% and 20% would be more realistic.

7 DISPERSION MODELLING RESULTS

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

7.1 Project 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 cumulative impact). The results show the predicted:

- Maximum 24-hour average $PM_{2.5}$ and PM_{10} concentrations;
- Annual average $PM_{2.5}$, PM_{10} 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 D**.

Table 7-1 presents the predicted incremental and cumulative particulate dispersion modelling results at selected key receptors, and **Appendix E** shows the complete results at all of the assessed receptor locations.

The results include particulate impacts from road traffic associated with the Project. A separate assessment of only the road traffic particulate and NO_2 is set out in **Section 7.5**

The cumulative (total) impact is defined as the modelling impact associated with the operation of the Project combined with the estimated ambient background levels in **Section 5.3.2**.

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 all of the assessed receptors are predicted to experience levels below the relevant criteria for each of the assessed dust metrics.

Table 7-1: Dust dispersion modelling results

Receptor ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/mth)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	TSP (µg/m³)	DD* (g/m²/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	0.8	<0.1	4.4	0.2	0.4	<0.1	7.3	19.0	67.9	3.0
R3	3.3	0.4	21.0	2.3	5.9	0.1	7.7	21.1	73.4	3.1
R9	0.6	<0.1	3.9	0.2	0.4	<0.1	7.3	19.0	67.9	3.0
R19	0.7	<0.1	4.6	0.2	0.5	<0.1	7.3	19.0	68.0	3.0
R21	0.4	<0.1	2.6	0.1	0.3	<0.1	7.3	18.9	67.8	3.0
R22	0.4	<0.1	2.3	0.1	0.3	<0.1	7.3	18.9	67.8	3.0
R23	0.6	<0.1	3.5	0.2	0.3	<0.1	7.3	19.0	67.8	3.0
R24	0.8	<0.1	4.6	0.2	0.4	<0.1	7.3	19.0	67.9	3.0
R25	1.3	<0.1	7.5	0.2	0.5	<0.1	7.3	19.0	68.0	3.0
R30	0.8	<0.1	5.4	0.4	0.8	<0.1	7.4	19.2	68.3	3.0
R33	0.9	<0.1	4.7	0.2	0.4	<0.1	7.3	19.0	67.9	3.0
R4A	1.9	0.2	11.2	1.0	2.7	<0.1	7.5	19.8	70.2	3.1

*Deposited dust

7.2 Assessment of Total (Cumulative) 24-hour average $PM_{2.5}$ and PM_{10} concentrations

The results for incremental 24-hour average $PM_{2.5}$ and PM_{10} concentrations indicate there are no predicted exceedances of the relevant criteria at the assessment locations for the assessed scenario.

When assessing the total (cumulative) 24-hour average impacts based on model predictions an assessment of cumulative 24-hour average $PM_{2.5}$ and PM_{10} 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**, **2017**). The Level 1 assessment matches the maximum predicted level with the maximum measured level for the period assessed and the Level 2 assessment involves matching one year of ambient air quality monitoring data with meteorological data representing the same period.

The monitoring data in **Section 5.3** show background levels are above the applicable criterion for $PM_{2.5}$ and PM_{10}, hence, a Level 2 assessment was conducted.

Table 7-2 provides a summary of the findings from the Level 2 assessments for selected receptors for both $PM_{2.5}$ and PM_{10}. The results in **Table 7-2** 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 PM_{10}. 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 PM_{10} criterion at any of the receptor locations surrounding the Project.

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

Table 7-2: NSW EPA contemporaneous assessment - maximum number of additional days above 24-hour average criterion

Receptor ID	$PM_{2.5}$	PM_{10}
R3	0	0
R4A	0	0
R19	0	0
R23	0	0
R24	0	0
R30	0	0

Time series plots of the predicted cumulative 24-hour average PM_{10} concentrations for the nearest receptor R19 is presented in **Figure 7-1**.

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 figure 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. It is to be noted that days with missing background data for PM_{10} have been substituted with the 70th percentile of the background monitoring data for the 2015 calendar period.

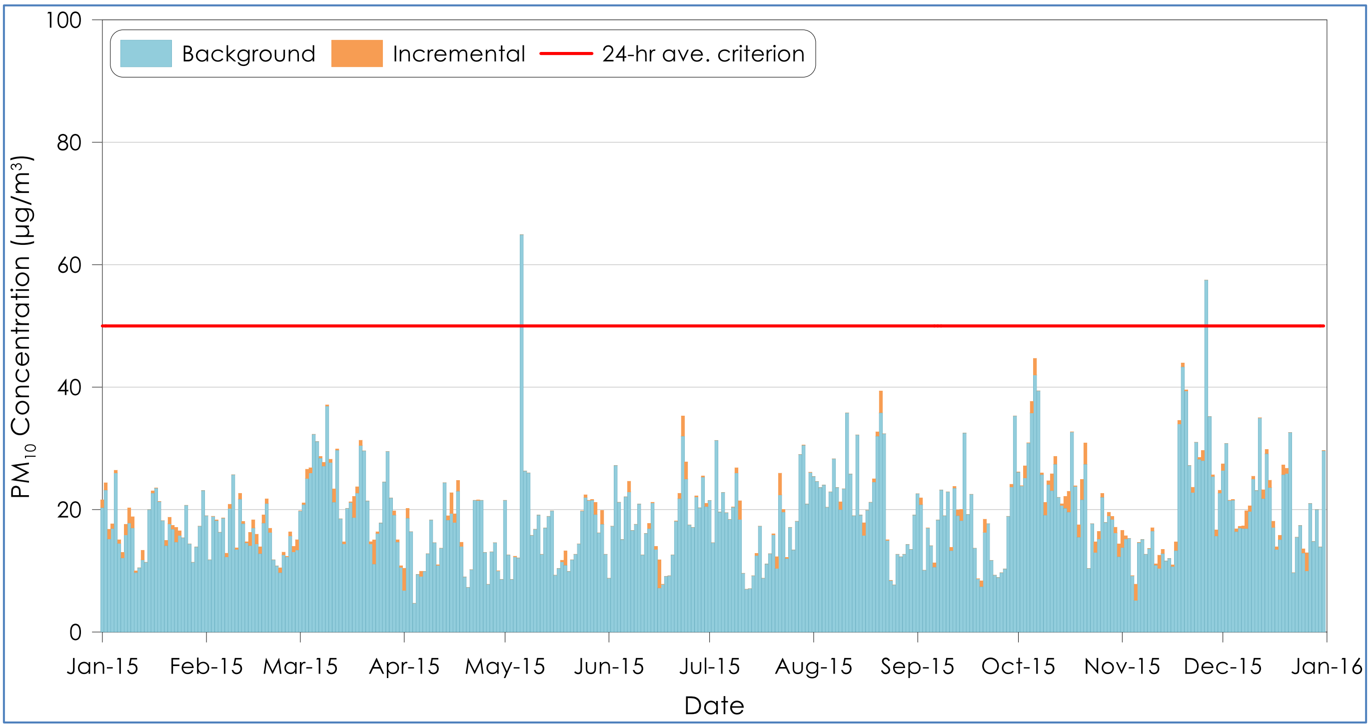

Figure 7-1: Time series plots of predicted cumulative 24-hour average PM_{10} concentrations for R19

7.3 Assessment of impacts per VLAMP criteria

7.3.1 Summary of modelling predictions

The results in **Table 7-1** 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 4-2** and **Table 4-3** respectively.

7.3.2 Dust impacts on 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 D**, the extent of the predicted maximum 24-hour average PM_{10} level of 50µg/m^3 would not extend over more than 25% of any privately-owned land parcels as a result of the Project, and as such the Project would not exceed this criterion.

7.4 Assessment of NO_2 concentration

Table 7-3 presents the predicted maximum impact from onsite vehicle and plant exhaust emissions for NO_2 at each of the assessed receptor locations. Isopleth diagrams of the predicted impact for maximum 1-hour average and annual average NO_2 concentrations are presented in **Appendix D**.

The cumulative (total) impact is defined as the modelling impact associated with the operation of the Project combined with the estimated ambient background levels in **Section 5.3.2**.

The results indicate the contribution from the Project at all the receptor locations would be well below the relevant criteria for NO_2.

Table 7-3: Predicted maximum impact at assessment locations (µg/m³)

Receptor ID	NO_2			
	Incremental		Cumulative	
	1-hr	Ann.ave.	1-hr	Ann.ave.
	Air quality impact criteria			
	-	-	246	62
R1	4.3	0.1	104.8	39.2
R2	1.5	0.0	102.0	39.1
R3	1.7	0.1	102.2	39.2
R4	1.1	0.0	101.6	39.1
R5	0.9	0.0	101.4	39.1
R6	2.5	0.0	103.0	39.1
R7	0.7	0.0	101.2	39.1
R8	0.7	0.0	101.2	39.1
R9	2.2	0.1	102.7	39.2
R10	4.3	0.1	104.8	39.2
R11	1.2	0.0	101.7	39.1
R12	0.8	0.0	101.3	39.1
R13	0.7	0.0	101.2	39.1
R14	1.9	0.0	102.4	39.1
R15	1.5	0.0	102.0	39.1
R16	2.1	0.0	102.6	39.1
R17	1.6	0.0	102.1	39.1
R18	1.6	0.0	102.1	39.1
R19	1.5	0.0	102.0	39.1
R20	1.9	0.0	102.4	39.1
R21	2.5	0.0	103.0	39.1
R22	3.7	0.1	104.2	39.2
R23	4.0	0.1	104.5	39.2
R24	4.4	0.1	104.9	39.2
R25	2.4	0.0	102.9	39.1
R26	1.4	0.0	101.9	39.1
R27	1.5	0.0	102.0	39.1
R28	1.0	0.0	101.5	39.1
R29	1.7	0.1	102.2	39.2
R30	1.1	0.0	101.6	39.1
R31	0.9	0.0	101.4	39.1
R32	1.4	0.1	101.9	39.2
R33	1.3	0.0	101.8	39.1
R34	1.0	0.0	101.5	39.1
R35	1.1	0.0	101.6	39.1
R36	1.3	0.0	101.8	39.1
R37	1.2	0.0	101.7	39.1
R38	1.1	0.0	101.6	39.1
R39	1.1	0.0	101.6	39.1
R40	1.0	0.0	101.5	39.1
R41	0.9	0.0	101.4	39.1
R42	1.9	0.0	102.4	39.1
R43	1.2	0.0	101.7	39.1
R44	2.1	0.0	102.6	39.1
R45	2.1	0.0	102.6	39.1
R46	2.0	0.0	102.5	39.1
R47	3.1	0.0	103.6	39.1
R48	3.0	0.0	103.5	39.1
R49	0.9	0.0	101.4	39.1
R50	0.7	0.0	101.2	39.1

Receptor ID	NO2			
	Incremental		Cumulative	
	1-hr	Ann.ave.	1-hr	Ann.ave.
	Air quality impact criteria			
	-	-	246	62
R51	0.7	0.0	101.2	39.1
R52	1.2	0.0	101.7	39.1
R53	0.6	0.0	101.1	39.1
R54	0.5	0.0	101.0	39.1
R55	1.7	0.0	102.2	39.1
R56	2.5	0.0	103.0	39.1
R57	2.4	0.0	102.9	39.1
R58	2.5	0.0	103.0	39.1
R59	2.5	0.0	103.0	39.1
R60	1.6	0.0	102.1	39.1
R61	1.1	0.0	101.6	39.1
R62	1.3	0.0	101.8	39.1
R63	1.4	0.0	101.9	39.1
R64	0.9	0.0	101.4	39.1
R65	0.9	0.0	101.4	39.1
R66	0.9	0.0	101.4	39.1
R67	0.8	0.0	101.3	39.1
R68	0.8	0.0	101.3	39.1
R69	0.7	0.0	101.2	39.1
R70	0.7	0.0	101.2	39.1
R71	0.4	0.0	100.9	39.1
R72	0.4	0.0	100.9	39.1
R73	0.6	0.0	101.1	39.1
R74	2.0	0.0	102.5	39.1
R75	2.3	0.0	102.8	39.1
R76	1.5	0.0	102.0	39.1
R77	0.9	0.0	101.4	39.1
R78	0.9	0.0	101.4	39.1
R79	0.7	0.0	101.2	39.1
R80	0.4	0.0	100.9	39.1
R81	0.5	0.0	101.0	39.1
R82	0.4	0.0	100.9	39.1
R84	2.2	0.1	102.7	39.2
R85	2.2	0.1	102.7	39.2
R86	2.2	0.1	102.7	39.2
R87	2.2	0.1	102.7	39.2
R4A	0.9	0.0	101.4	39.1

7.5 Assessment of road traffic emission concentrations

A specific assessment of road-going vehicle emissions has been conducted as we have been informed that R30 is sensitive to diesel emissions impacts. Noting that the Quarry Access Road has been moved to a new route well away from R30, and it can be seen in **Table 7-4** that the predicted impacts are very low. The table provides a summary of the predicted incremental and cumulative PM_{10}, $PM_{2.5}$ and NO_2 pollutant impacts due to traffic emissions from road trucks travelling on the Quarry Access Road and also all other vehicles travelling along The Bucketts Way, (including any additional new trucks and vehicles associated with the Project, and the proposed Hilview quarry).

The results in **Table 7-4** indicate the predicted levels associated with the Project are negligible.

The results most closely associated with harm, $PM_{2.5}$, are too low to be measurable, and would not result in any discernible effect on health at any of the receptors near any of the roads, including the quarry access road. The data show that emissions would not exceed any relevant criteria at the assessed receptor locations.

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

Table 7-4: Predicted incremental and cumulative impacts at R30 for truck and traffic emissions

Pollutant	Averaging period	Maximum incremental impact from vehicles on Quarry Access Road only	Maximum incremental impact from all vehicles (µg/m³)	Background (µg/m³)	Cumulative impact (µg/m³)	NSW EPA criterion (µg/m³)
PM_{10}	24-hour	0.005	0.07	-	-	**50**
	Annual	0.0008	0.022	18.8	18.8	**25**
$PM_{2.5}$	24-hour	0.005	0.06	-	-	**25**
	Annual	0.0007	0.020	7.3	7.3	**8**
NO_2	1-hour	0.15	1.02	100.5	101.7	**246**
	Annual	0.004	0.090	39.1	39.2	**62**

To assess the total cumulative 24-hour average $PM_{2.5}$ and PM_{10} impacts a Level 2 assessment was conducted. **Table 7-5** provides a summary of the findings for receptor R30 from road emissions for both $PM_{2.5}$ and PM_{10}. Detailed tables of the contemporaneous assessment results are provided in **Appendix F**.

The results indicate that the Project does not increase the number of days above the 24-hour average criterion at the assessed receptor for $PM_{2.5}$ and PM_{10}. 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 PM_{10} criterion at any of the receptor locations surrounding the Project.

Table 7-5: NSW EPA contemporaneous assessment - maximum number of additional days above 24-hour average criterion with road traffic emissions

Receptor ID	$PM_{2.5}$	PM_{10}
R30	0	0

8 DUST MITIGATION AND MANAGEMENT

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

Suggested reasonable and practicable dust mitigation measures for the Project are listed in **Table 8-1**.

Table 8-1: Potential operational 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 dust cannot be maintained using the available means).
	Weather forecast to be checked prior to undertaking material handling or processing.
	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 activities is to be undertaken to identify dust generation.
Exposed areas/stockpiles	The extent of exposed surfaces and stockpiles is to be kept to a minimum.
	Exposed areas and stockpiles are either to be covered or are to be dampened with water as far as is practicable if dust emissions are visible, or there is potential for dust emissions outside operating hours.
	Minimise dust generation by undertaking rehabilitation earthworks when topsoil and subsoil stockpiles are moist and/or wind speed is below 10 m/s.
Material handling	Reduce drop heights from loading and handling equipment where practical.
	Dampen material when excessively dusty during handling.
	Dust suppression on crushing and screening; water sprays as required to control fugitive dust emissions.
Hauling activities	Haul roads should be watered using water carts such that the road surface has sufficient moisture to minimise on-road dust generation but not so much as to cause mud/dirt track out to occur.
	Regularly inspect haul roads and maintain surfaces to remove potholes or depressions
	Driveways and hardstand areas to be swept/cleaned regularly as required etc.
	Vehicle traffic is to be restricted to designated routes.
	Speed limits are to be enforced.
	Vehicle loads are to be covered when travelling off-site.

The modelling predictions for the Project do not indicate any exceedance of the relevant pollutant impact assessment criteria at the residential receptors. Given this situation, there are no specific ambient air quality monitoring recommendation for Project at the residential receptors.

It is anticipated that the Project would develop a suitable Operational Environmental Management Plan for the site. The Operational Environmental Management Plan would include a specific chapter which outlines the measures to manage dust emissions at the site and include aspects such as key performance indicators, response mechanisms, and complaints management.

9 SUMMARY AND CONCLUSIONS

This report has assessed the potential air quality impacts associated with the proposed construction and operation of the Deep Creek Quarry.

Air dispersion modelling was used to predict the potential for off-site dust and vehicle emission impacts in the surrounding area due to the operation of the Project. The estimated emissions applied in the modelling are likely to be conservative and would overestimate the actual impacts.

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

Nevertheless, the site would apply appropriate air pollution management measures to ensure it minimises the potential occurrence of excessive air pollutant emissions from the site.

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

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Appendix A
Receptor Locations

Figure A-1: Location of receptors assessed in this study

Table A-1: List of receptors assessed in this study

ID	Easting	Northing	ID	Easting	Northing
R1	398013	6399476	R45	395151	6397456
R2	399409	6398516	R46	395173	6397673
R3	398376	6397858	R47	395094	6398281
R4	399554	6396956	R48	395421	6399446
R5	399124	6396648	R49	399125	6400486
R6	398247	6396521	R50	400189	6399086
R7	398632	6396220	R51	400298	6398874
R8	398394	6396167	R52	400590	6398840
R9	397947	6396490	R53	398146	6395264
R10	398122	6396054	R54	395642	6395471
R11	397702	6396251	R55	394925	6396210
R12	397860	6395949	R56	394626	6396650
R13	397651	6395932	R57	394667	6398249
R14	397505	6396329	R58	395258	6399939
R15	397442	6396202	R59	395221	6400146
R16	397380	6396399	R60	395955	6400197
R17	397175	6396328	R61	396302	6400366
R18	397131	6396531	R62	396203	6400311
R19	396923	6396780	R63	396176	6400606
R20	396909	6396393	R64	396391	6400687
R21	395948	6396609	R65	396556	6400651
R22	395608	6397075	R66	397339	6400924
R23	395773	6397873	R67	397485	6400909
R24	396063	6398719	R68	399110	6401051
R25	396736	6399083	R69	399680	6400562
R26	399764	6398700	R70	400122	6400536
R27	399987	6398550	R71	400730	6400037
R28	400093	6398133	R72	400592	6399649
R29	399980	6397836	R73	401165	6399172
R30	399835	6397551	R74	394634	6400073
R31	400188	6397465	R75	395015	6400125
R32	399623	6397051	R76	396238	6401064
R33	399442	6396686	R77	396419	6400831
R34	399155	6396387	R78	396980	6401226
R35	398969	6396212	R79	397829	6401508
R36	398625	6395905	R80	400811	6400178
R37	398465	6396039	R81	400992	6399858
R38	398380	6396002	R82	401737	6398744
R39	398312	6396048	R84	394627	6400717
R40	398415	6395703	R85	395500	6401238
R41	398322	6395568	R86	396483	6401605
R42	396389	6395734	R87	396776	6401875
R43	396194	6395717	R4A	398931	6397359
R44	395564	6396512			

Appendix B

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, Williamtown RAAF weather station, is presented in **Table A-1**.

The standard deviation of the latest five years of meteorological data spanning 2015 to 2019 was analysed against the available measured wind speed, temperature and relative humidity. The analysis indicates that 2015 dataset is closest to the mean for wind speed, temperature, and relative humidity. On the basis of a score weighting analysis, 2015 was found to be most representative.

Table B-1: Statistical analysis results for Williamtown RAAF

Year	Wind speed	Temperature	Relative humidity
2015	0.5	0.6	2.6
2016	0.7	0.8	4.4
2017	0.5	1.0	4.9
2018	0.6	0.8	5.1
2019	0.6	1.1	5.1

Figure A-1 shows the frequency distributions for wind speed, wind direction, temperature and relative humidity for the 2015 year compared with the mean of the 2015 to 2019 data set. The 2015 year data appear to be well aligned with the mean data.

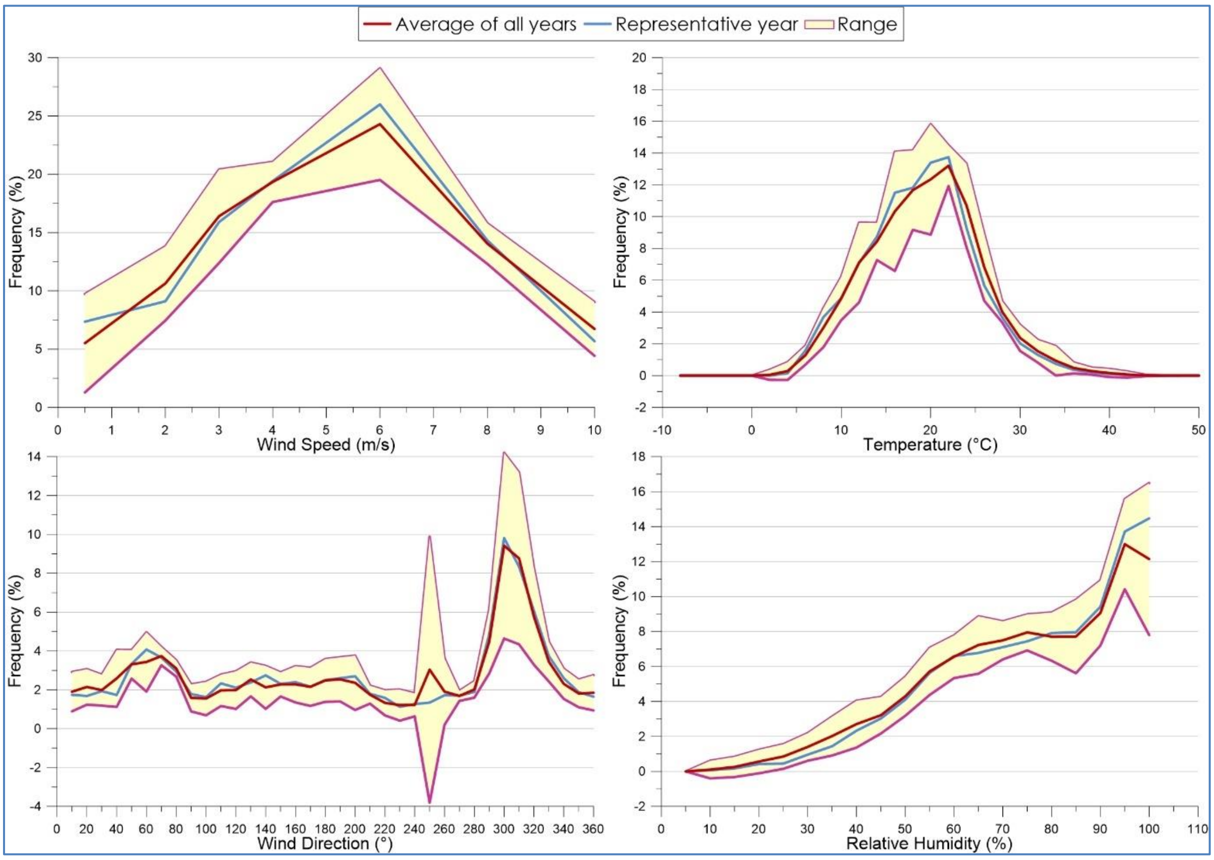

Figure B-1: Frequency distributions for wind speed, wind direction, temperature and relative humidity

Appendix C

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 C-1** below. A detailed dust emission inventory for the different scenarios is presented in **Table C-2** to **Table C-3.**

Control factors include the following:

- Hauling on unpaved surfaces – 75% control for watering of trafficked areas;
- Hauling on paved surfaces with 8.2g/m^2 silt loading – 50% control for watering and sweeping or flushing on trafficked areas;
- Wind erosion from exposed areas – 50% control for watering of exposed areas.

Table C-1: Emission factor equations

Activity	Emission factor equation		
	TSP	PM_{10}	$PM_{2.5}$
Loading / emplacing material	$EF = 0.74 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$	$EF = 0.35 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$	$EF = 0.053 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$
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	$EF = 3.23 \times s.L.^{0.91} \times (1.1023 \times W)^{1.02} kg/VKT$	$EF = 0.62 \times s.L.^{0.91} \times (1.1023 \times W)^{1.02} kg/VKT$	$EF = 0.15 \times s.L.^{0.91} \times (1.1023 \times W)^{1.02} kg/VKT$
Drilling overburden	0.59	$0.30 \times TSP$	$0.04 \times TSP$
Blasting overburden	$0.00022 \times A^{1.5}$	$0.52 \times TSP$	0.03
Tertiary crushing (controlled)	0.0006	0.00027	0.00005
Screening (controlled)	$EF = 0.0011\ kg/tonne$	$EF = 0.00037\ kg/tonne$	$EF = 0.000025\ kg/tonne$
Wind erosion on exposed areas, stockpiles	$EF = 850\ kg/ha/year$	$0.5 \times TSP$	$0.075 \times TSP$

A = horizontal area (m^2) with blasting depth ≤ 21m, EF = emission factor, U = wind speed (m/s), M = moisture content (%), s = silt content (%), s.L. = silt loading (g/m^2), W = average weight of vehicle (tonne), VKT = vehicle kilometres travelled (km).

Table C-2: Dust Emissions Inventory – Average Scenario

Activity - Average	TSP emission (kg/y)	PM10 emission (kg/y)	PM25 emission (kg/y)	Intensity	Units	EF - TSP	EF - PM10	EF - PM25	Units	Var 1	Units	Var 2	Units	Var 3 - TSP	Var 3 - PM10	Var 3 - PM25	Units	Var 4	Units	Var 5	Units	Var 6	Units
Excavator loading topsoil to haul truck	8	4	1	8,050	t/yr	0.00095	0.00045	0.00007	kg/t	0.80	ave of (ws/2.2)^1.3 m/s	2	M.C %										
Hauling topsoil to emplacement area (unpaved)	91	27	3	8,050	t/yr	0.045	0.013	0.001	kg/t	30	t/load	0.4	km/rt	3.6	1.1	0.11	kg/VKT	10.0	S.C %	30	ave weight (t)	75	C %
Unloading topsoil at emplacement area	8	4	1	8,050	t/yr	0.00095	0.00045	0.00007	kg/t	0.80	ave of (ws/2.2)^1.3 m/s	2	M.C %										
Drilling	1,928	964	145	3,267	holes/yr	0.59000	0.30	0.04	kg/hole														
Blasting	4,495	2,338	135	17	blasts/yr	264.441	137.509	7.933	kg/blast	11,305	blast area (m2)												
Excavator loading material to haul truck	476	225	34	500,000	t/yr	0.00095	0.00045	0.00007	kg/t	0.80	ave of (ws/2.2)^1.3 m/s	2	M.C %										
Hauling material to processing plant (unpaved)	5,668	1,673	167	500,000	t/yr	0.045	0.013	0.001	kg/t	30	t/load	0.4	km/rt	3.6	1.1	0.11	kg/VKT	10.0	S.C %	30	ave weight (t)	75	C %
Unloading material at processing plant	476	225	34	500,000	t/yr	0.00095	0.00045	0.00007	kg/t	0.80	ave of (ws/2.2)^1.3 m/s	2	M.C %										
Loading material to crusher/screen	476	225	34	500,000	t/yr	0.00095	0.00045	0.00007	kg/t	0.80	ave of (ws/2.2)^1.3 m/s	2	M.C %										
Crushing (controlled)	300	135	25	500,000	t/yr	0.00060	0.00027	0.00005	kg/t														
Screening (controlled)	550	185	13	500,000	t/yr	0.0011	0.00037	0.000025	kg/t														
Loading processed material to haul truck	476	225	34	500,000	t/yr	0.00095	0.00045	0.00007	kg/t	0.80	ave of (ws/2.2)^1.3 m/s	2	M.C %										
Hauling processed material to stockpile area (unpaved)	5,071	1,497	150	500,000	t/yr	0.041	0.012	0.001	kg/t	30	t/load	0.3	km/rt	3.6	1.1	0.11	kg/VKT	10.0	S.C %	30	ave weight (t)	75	C %
Hauling processed material to stockpile area (paved)	2,721	522	126	500,000	t/yr	0.011	0.002	0.001	kg/t	30	t/load	0.4	km/rt	0.78	0.15	0.04	kg/VKT	8.2	S.L (g/m2)	30	ave weight (t)	50	C %
Unload to stockpile	476	225	34	500,000	t/yr	0.00095	0.00045	0.00007	kg/t	0.80	ave of (ws/2.2)^1.3 m/s	2	M.C %										
Rehandle processed material	95	45	7	100,000	t/yr	0.00095	0.00045	0.00007	kg/t	0.80	ave of (ws/2.2)^1.3 m/s	2	M.C %										
Loading processed material to dispatch truck	476	225	34	500,000	t/yr	0.00095	0.00045	0.00007	kg/t	0.80	ave of (ws/2.2)^1.3 m/s	2	M.C %										
Hauling processed material onsite (paved)	10,377	1,992	482	500,000	t/yr	0.0415	0.00797	0.001928	kg/t	32	t/load	1.60	km/rt	0.83	0.16	0.04	kg/VKT	8.2	S.L (g/m2)	32	ave weight (t)	50	C %
Hauling processed material off the site (paved)	1,232	237	57	500,000	t/yr	0.0049	0.00095	0.000229	kg/t	32	t/load	0.19	km/rt	0.83	0.16	0.04	kg/VKT	8.2	S.L (g/m2)	32	ave weight (t)	50	C %
Hauling processed material off the site (paved)	1,781	342	83	500,000	t/yr	0.0036	0.00068	0.000165	kg/t	32	t/load	0.19	km/rt	0.60	0.12	0.03	kg/VKT	5.7	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	1,312	252	61	500,000	t/yr	0.0026	0.00050	0.000122	kg/t	32	t/load	0.19	km/rt	0.44	0.08	0.02	kg/VKT	4.1	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	948	182	44	500,000	t/yr	0.0019	0.00036	0.000088	kg/t	32	t/load	0.19	km/rt	0.32	0.06	0.01	kg/VKT	2.9	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	698	134	32	500,000	t/yr	0.0014	0.00027	0.000065	kg/t	32	t/load	0.19	km/rt	0.24	0.05	0.01	kg/VKT	2.1	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	505	97	23	500,000	t/yr	0.0010	0.00019	0.000047	kg/t	32	t/load	0.19	km/rt	0.17	0.03	0.01	kg/VKT	1.4	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	371	71	17	500,000	t/yr	0.0007	0.00014	0.000035	kg/t	32	t/load	0.19	km/rt	0.13	0.02	0.01	kg/VKT	1.0	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	269	52	12	500,000	t/yr	0.0005	0.00010	0.000025	kg/t	32	t/load	0.19	km/rt	0.09	0.02	0.004	kg/VKT	0.7	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	198	38	9	500,000	t/yr	0.0004	0.00008	0.000018	kg/t	32	t/load	0.19	km/rt	0.07	0.01	0.003	kg/VKT	0.5	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	143	27	7	500,000	t/yr	0.0003	0.00005	0.000013	kg/t	32	t/load	0.19	km/rt	0.05	0.01	0.002	kg/VKT	0.4	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	105	20	5	500,000	t/yr	0.0002	0.00004	0.000010	kg/t	32	t/load	0.19	km/rt	0.04	0.01	0.002	kg/VKT	0.3	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	76	15	4	500,000	t/yr	0.0002	0.00003	0.000007	kg/t	32	t/load	0.19	km/rt	0.03	0.005	0.001	kg/VKT	0.2	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	448	86	21	500,000	t/yr	0.0009	0.00017	0.000042	kg/t	32	t/load	1.52	km/rt	0.02	0.004	0.001	kg/VKT	0.1	S.L (g/m2)	32	ave weight (t)		
WE - exposed area	5,041	2,520	378	12	ha	850	425	64	kg/ha/year													50	C %
WE - rehabilitation	7,120	3,560	534	17	ha	850	425	64	kg/ha/year													50	C %
Exhaust emissions (road trucks)	17	17	17																				
Exhaust emissions (other plant and trucks)	162	162	157																				
Total TSP emissions (kg/yr.)	**54,592**	**18,546**	**2,918**																				

Table C-3: Dust Emissions Inventory – Peak Scenario

Activity - Peak	TSP emission (kg/y)	PM10 emission (kg/y)	PM25 emission (kg/y)	Intensity	Units	EF - TSP	EF - PM10	EF - PM25	Units	Var 1	Units	Var 2	Units	Var 3 - TSP	Var 3 - PM10	Var 3 - PM25	Units	Var 4	Units	Var 5	Units	Var 6	Units
Excavator loading topsoil to haul truck	8	4	1	8,050	t/yr	0.00095	0.00045	0.00007	kg/t	0.80	ave of (ws/2.2)^1.3 m/s	2	M.C %										
Hauling topsoil to emplacement area (unpaved)	91	27	3	8,050	t/yr	0.045	0.013	0.001	kg/t	30	t/load	0.4	km/rt	3.6	1.1	0.11	kg/VKT	10.0	S.C %	30	ave weight (t)	75	C %
Unloading topsoil at emplacement area	8	4	1	8,050	t/yr	0.00095	0.00045	0.00007	kg/t	0.80	ave of (ws/2.2)^1.3 m/s	2	M.C %										
Drilling	1,928	964	145	3,267	holes/yr	0.59000	0.30	0.04	kg/hole														
Blasting	4,495	2,338	135	17	blasts/yr	264.441	137.509	7.933	kg/blast	11,305	blast area (m2)												
Excavator loading material to haul truck	1,389	657	100	1,460,000	t/yr	0.00095	0.00045	0.00007	kg/t	0.80	ave of (ws/2.2)^1.3 m/s	2	M.C %										
Hauling material to processing plant (unpaved)	16,550	4,885	488	1,460,000	t/yr	0.045	0.013	0.001	kg/t	30	t/load	0.4	km/rt	3.6	1.1	0.11	kg/VKT	10.0	S.C %	30	ave weight (t)	75	C %
Unloading material at processing plant	1,389	657	100	1,460,000	t/yr	0.00095	0.00045	0.00007	kg/t	0.80	ave of (ws/2.2)^1.3 m/s	2	M.C %										
Loading material to crusher/screen	1,389	657	100	1,460,000	t/yr	0.00095	0.00045	0.00007	kg/t	0.80	ave of (ws/2.2)^1.3 m/s	2	M.C %										
Crushing (controlled)	876	394	73	1,460,000	t/yr	0.00060	0.00027	0.00005	kg/t														
Screening (controlled)	1,606	540	37	1,460,000	t/yr	0.0011	0.00037	0.000025	kg/t														
Loading processed material to haul truck	1,389	657	100	1,460,000	t/yr	0.00095	0.00045	0.00007	kg/t	0.80	ave of (ws/2.2)^1.3 m/s	2	M.C %										
Hauling processed material to stockpile area (unpaved)	14,808	4,371	437	1,460,000	t/yr	0.041	0.012	0.001	kg/t	30	t/load	0.3	km/rt	3.6	1.1	0.11	kg/VKT	10.0	S.C %	30	ave weight (t)	75	C %
Hauling processed material to stockpile area (paved)	15,888	3,050	738	1,460,000	t/yr	0.011	0.002	0.001	kg/t	30	t/load	0.4	km/rt	0.78	0.15	0.04	kg/VKT	8.2	S.L (g/m2)	30	ave weight (t)		
Unload to stockpile	1,389	657	100	1,460,000	t/yr	0.00095	0.00045	0.00007	kg/t	0.80	ave of (ws/2.2)^1.3 m/s	2	M.C %										
Rehandle processed material	278	131	20	292,000	t/yr	0.00095	0.00045	0.00007	kg/t	0.80	ave of (ws/2.2)^1.3 m/s	2	M.C %										
Loading processed material to dispatch truck	1,389	657	100	1,460,000	t/yr	0.00095	0.00045	0.00007	kg/t	0.80	ave of (ws/2.2)^1.3 m/s	2	M.C %										
Hauling processed material onsite (paved)	30,302	5,816	1,407	1,460,000	t/yr	0.0415	0.00797	0.001928	kg/t	32	t/load	1.60	km/rt	0.83	0.16	0.04	kg/VKT	8.2	S.L (g/m2)	32	ave weight (t)	50	C %
Hauling processed material off the site (paved)	3,598	691	167	1,460,000	t/yr	0.0049	0.00095	0.000229	kg/t	32	t/load	0.19	km/rt	0.83	0.16	0.04	kg/VKT	8.2	S.L (g/m2)	32	ave weight (t)	50	C %
Hauling processed material off the site (paved)	5,202	999	242	1,460,000	t/yr	0.0036	0.00068	0.000165	kg/t	32	t/load	0.19	km/rt	0.60	0.12	0.03	kg/VKT	5.7	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	3,830	735	178	1,460,000	t/yr	0.0026	0.00050	0.000122	kg/t	32	t/load	0.19	km/rt	0.44	0.08	0.02	kg/VKT	4.1	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	2,768	531	129	1,460,000	t/yr	0.0019	0.00036	0.000088	kg/t	32	t/load	0.19	km/rt	0.32	0.06	0.01	kg/VKT	2.9	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	2,038	391	95	1,460,000	t/yr	0.0014	0.00027	0.000065	kg/t	32	t/load	0.19	km/rt	0.24	0.05	0.01	kg/VKT	2.1	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	1,473	283	68	1,460,000	t/yr	0.0010	0.00019	0.000047	kg/t	32	t/load	0.19	km/rt	0.17	0.03	0.01	kg/VKT	1.4	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	1,085	208	50	1,460,000	t/yr	0.0007	0.00014	0.000035	kg/t	32	t/load	0.19	km/rt	0.13	0.02	0.01	kg/VKT	1.0	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	784	151	36	1,460,000	t/yr	0.0005	0.00010	0.000025	kg/t	32	t/load	0.19	km/rt	0.09	0.02	0.004	kg/VKT	0.7	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	577	111	27	1,460,000	t/yr	0.0004	0.00008	0.000018	kg/t	32	t/load	0.19	km/rt	0.07	0.01	0.003	kg/VKT	0.5	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	417	80	19	1,460,000	t/yr	0.0003	0.00005	0.000013	kg/t	32	t/load	0.19	km/rt	0.05	0.01	0.002	kg/VKT	0.4	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	307	59	14	1,460,000	t/yr	0.0002	0.00004	0.000010	kg/t	32	t/load	0.19	km/rt	0.04	0.01	0.002	kg/VKT	0.3	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	222	43	10	1,460,000	t/yr	0.0002	0.00003	0.000007	kg/t	32	t/load	0.19	km/rt	0.03	0.005	0.001	kg/VKT	0.2	S.L (g/m2)	32	ave weight (t)		
Hauling processed material off the site (paved)	1,308	251	61	1,460,000	t/yr	0.0009	0.00017	0.000042	kg/t	32	t/load	1.52	km/rt	0.02	0.004	0.001	kg/VKT	0.1	S.L (g/m2)	32	ave weight (t)		
WE - exposed area	5,041	2,520	378	12	ha	850	425	64	kg/ha/year													50	C %
WE - rehabilitation	7,120	3,560	534	17	ha	850	425	64	kg/ha/year													50	C %
Exhaust emissions (road trucks)	50	50	49																				
Exhaust emissions (other plant and trucks)	219	219	212																				
Total TSP emissions (kg/yr.)	**131,213**	**37,347**	**6,350**																				

Appendix D

Isopleth Diagrams

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

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

Figure D-3: Predicted incremental maximum 24-hour average PM_{10} concentrations (µg/m³)

Figure D-4: Predicted incremental annual average PM_{10} concentrations (µg/m³)

Figure D-5: Predicted incremental annual average TSP concentrations (µg/m³)

Figure D-6: Predicted incremental annual average dust deposition levels (g/m²/month)

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

Figure D-8: Predicted cumulative annual average PM_{10} concentrations (µg/m³)

Figure D-9: Predicted cumulative annual average TSP concentrations (µg/m³)

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

Figure D-11: Predicted incremental maximum 1-hour average NO_2 concentrations due to the Project (ug/m³)

Figure D-12: Predicted incremental annual average NO_2 concentrations due to the Project (ug/m³)

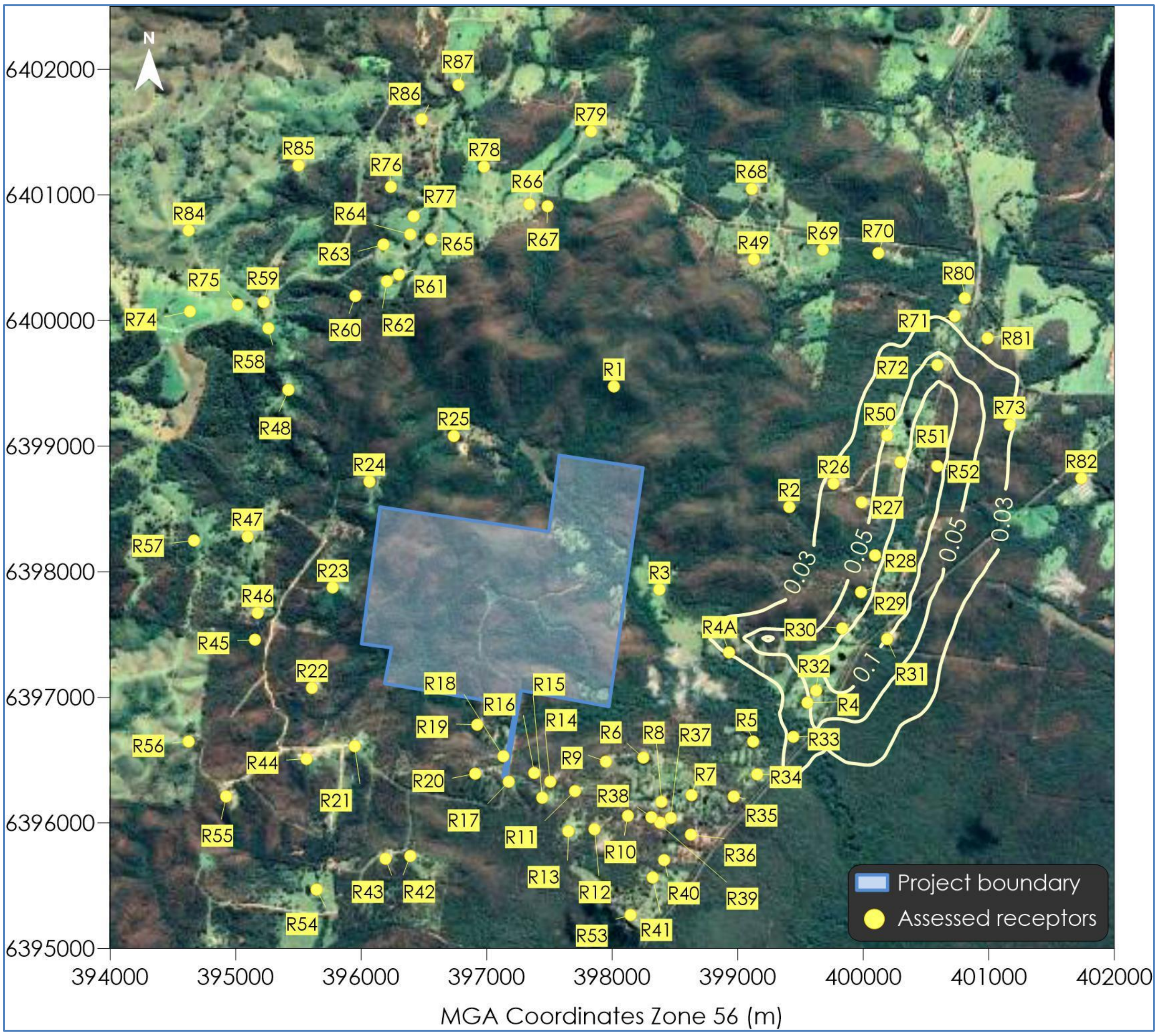

Figure D-13: Predicted incremental maximum 24-hour average $PM_{2.5}$ concentrations due to road traffic emissions from the Quarry Access Road and The Bucketts Way (ug/m³)

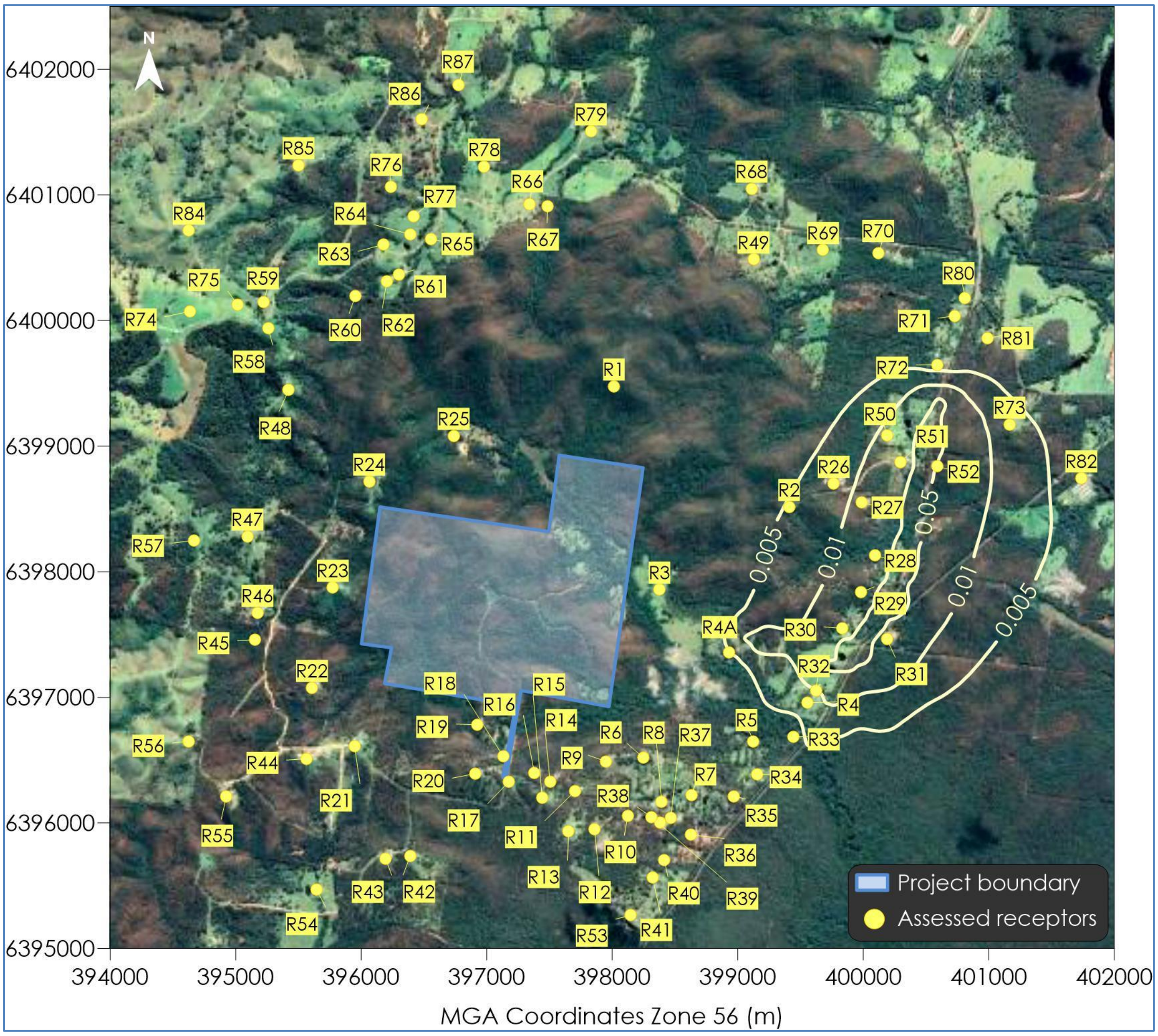

Figure D-14: Predicted incremental annual average $PM_{2.5}$ concentrations due to road traffic emissions from the Quarry Access Road and The Bucketts Way (ug/m³)

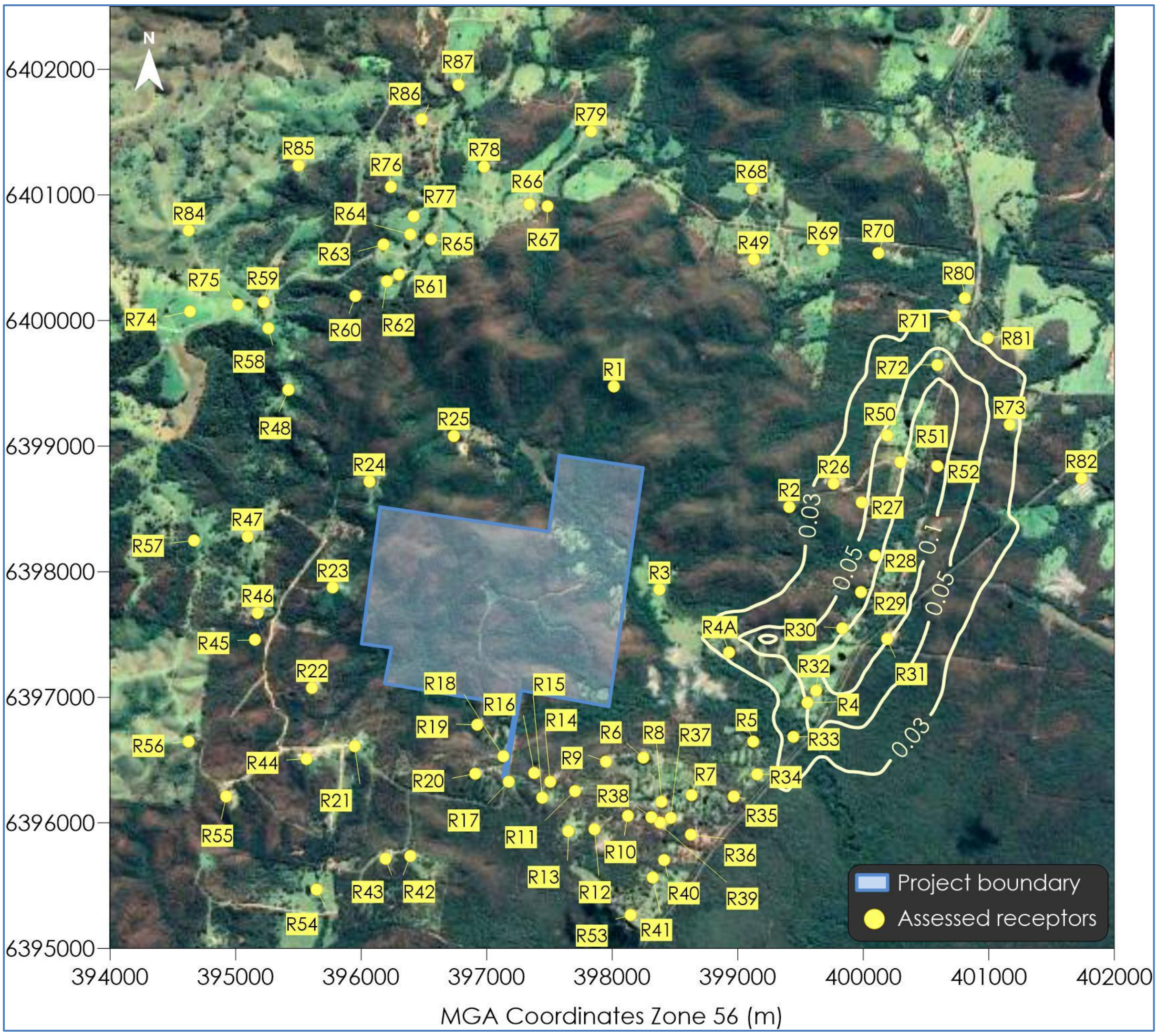

Figure D-15: Predicted incremental maximum 24-hour average PM_{10} concentrations due to road traffic emissions from the Quarry Access Road and The Bucketts Way (ug/m³)

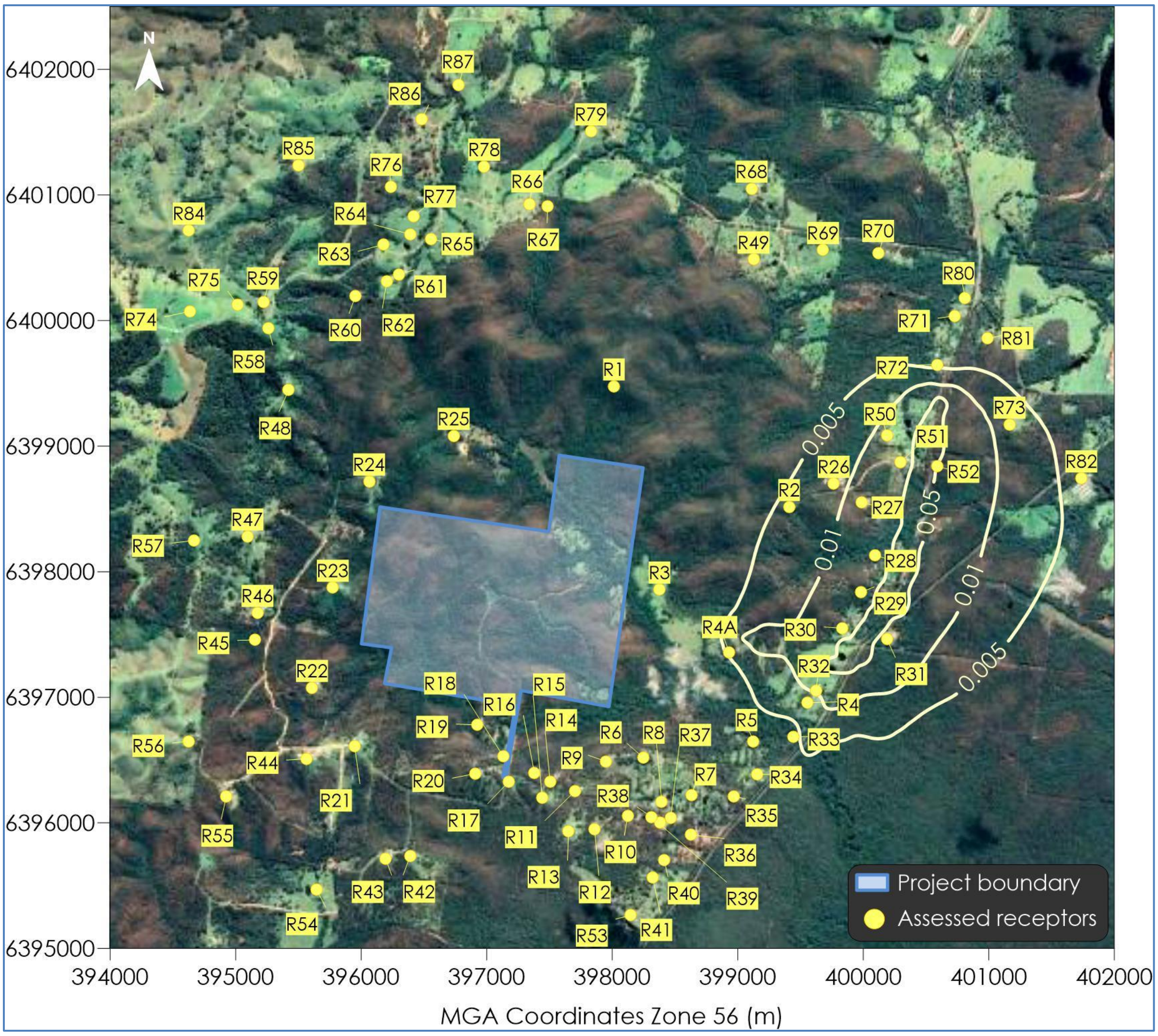

Figure D-16: Predicted incremental annual average PM_{10} concentrations due to road traffic emissions from the Quarry Access Road and The Bucketts Way (ug/m³)

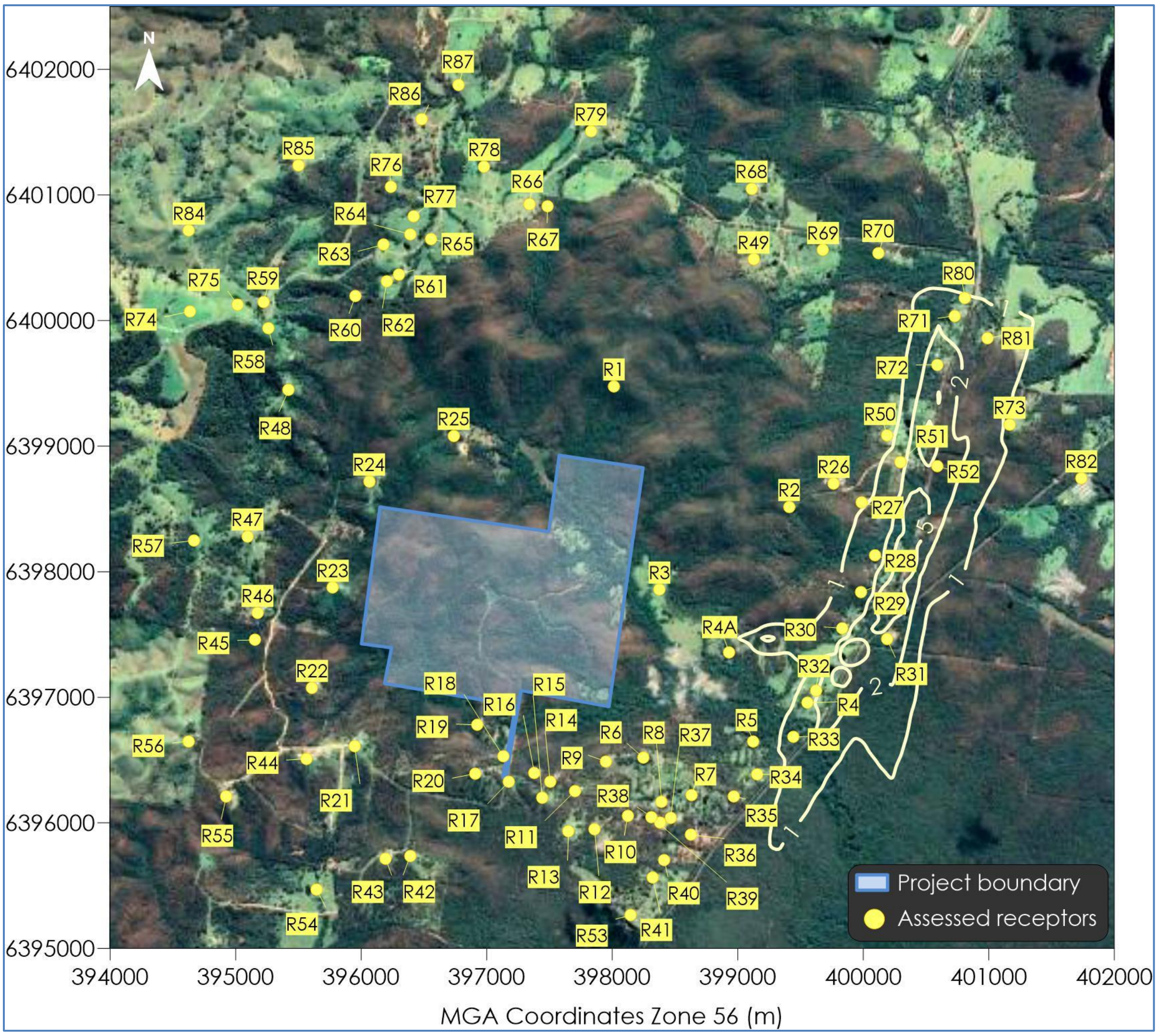

Figure D-17: Predicted incremental maximum 1-hour average NO_2 concentrations due to road traffic emissions from the Quarry Access Road and The Bucketts Way (ug/m³)

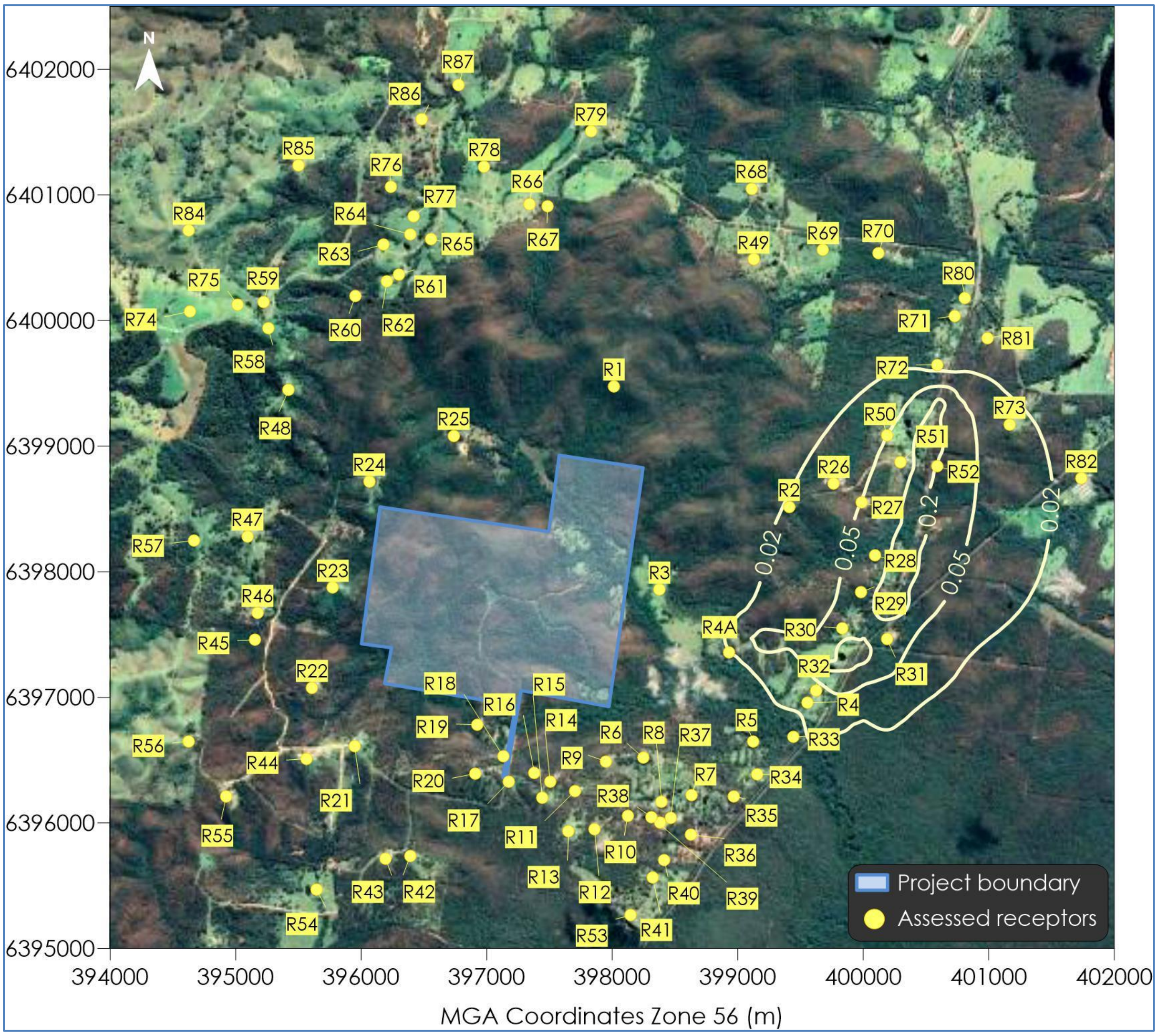

Figure D-18: Predicted incremental annual average NO_2 concentrations due to road traffic emissions from the Quarry Access Road and The Bucketts Way (ug/m³)

Appendix E

Project dust concentrations

Project particulate matter concentrations (TSP, PM_{10}, $PM_{2.5}$ and deposited dust)

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).

Table E-1 presents the predicted incremental and cumulative particulate dispersion modelling results at all receptor locations.

The cumulative (total) impact is defined as the modelling impact associated with the operation of the Project combined with the estimated ambient background levels in **Section 5.3.2**.

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 all of the assessed receptors are predicted to experience levels below the relevant criteria for each of the assessed dust metrics.

Table E-1: Dust dispersion modelling results

Receptor ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/mth)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	TSP (µg/m³)	DD* (g/m²/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	0.8	<0.1	4.4	0.2	0.4	<0.1	7.3	19.0	67.9	3.0
R2	0.7	<0.1	4.2	0.2	0.5	<0.1	7.3	19.0	68.0	3.0
R3	3.3	0.4	21.0	2.3	5.9	0.1	7.7	21.1	73.4	3.1
R4	1.1	<0.1	6.7	0.3	0.7	<0.1	7.4	19.1	68.2	3.0
R5	1.2	<0.1	6.5	0.2	0.4	<0.1	7.3	19.0	67.9	3.0
R6	0.7	<0.1	4.1	0.2	0.4	<0.1	7.3	19.0	67.9	3.0
R7	0.5	<0.1	2.7	<0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R8	0.5	<0.1	2.6	<0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R9	0.6	<0.1	3.9	0.2	0.4	<0.1	7.3	19.0	67.9	3.0
R10	0.4	<0.1	2.4	<0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R11	0.5	<0.1	2.7	0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R12	0.3	<0.1	1.9	<0.1	0.1	<0.1	7.3	18.9	67.6	3.0
R13	0.4	<0.1	1.9	<0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R14	0.5	<0.1	3.4	0.1	0.3	<0.1	7.3	18.9	67.8	3.0
R15	0.5	<0.1	3.0	0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R16	0.6	<0.1	3.8	0.1	0.3	<0.1	7.3	18.9	67.8	3.0
R17	0.6	<0.1	3.7	0.1	0.3	<0.1	7.3	18.9	67.8	3.0
R18	0.7	<0.1	4.1	0.2	0.4	<0.1	7.3	19.0	67.9	3.0
R19	0.7	<0.1	4.6	0.2	0.5	<0.1	7.3	19.0	68.0	3.0
R20	0.5	<0.1	3.2	0.2	0.3	<0.1	7.3	19.0	67.8	3.0
R21	0.4	<0.1	2.6	0.1	0.3	<0.1	7.3	18.9	67.8	3.0
R22	0.4	<0.1	2.3	0.1	0.3	<0.1	7.3	18.9	67.8	3.0
R23	0.6	<0.1	3.5	0.2	0.3	<0.1	7.3	19.0	67.8	3.0
R24	0.8	<0.1	4.6	0.2	0.4	<0.1	7.3	19.0	67.9	3.0
R25	1.3	<0.1	7.5	0.2	0.5	<0.1	7.3	19.0	68.0	3.0

Receptor ID	PM2.5 (µg/m³)		PM10 (µg/m³)		TSP (µg/m³)	DD (g/m²/mth)	PM2.5 (µg/m³)	PM10 (µg/m³)	TSP (µg/m³)	DD* (g/m²/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
R26	0.6	<0.1	3.1	0.2	0.3	<0.1	7.3	19.0	67.8	3.0
R27	0.5	<0.1	2.8	0.2	0.3	<0.1	7.3	19.0	67.8	3.0
R28	0.5	<0.1	2.9	0.2	0.4	<0.1	7.3	19.0	67.9	3.0
R29	0.8	<0.1	4.7	0.3	0.6	<0.1	7.3	19.1	68.1	3.0
R30	0.8	<0.1	5.4	0.4	0.8	<0.1	7.4	19.2	68.3	3.0
R31	0.7	<0.1	4.3	0.3	0.6	<0.1	7.3	19.1	68.1	3.0
R32	1.1	<0.1	6.6	0.3	0.8	<0.1	7.4	19.1	68.3	3.0
R33	0.9	<0.1	4.7	0.2	0.4	<0.1	7.3	19.0	67.9	3.0
R34	0.7	<0.1	3.9	0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R35	0.5	<0.1	2.6	<0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R36	0.4	<0.1	2.2	<0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R37	0.4	<0.1	2.4	<0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R38	0.4	<0.1	2.3	<0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R39	0.4	<0.1	2.4	<0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R40	0.3	<0.1	1.9	<0.1	0.1	<0.1	7.3	18.9	67.6	3.0
R41	0.3	<0.1	1.7	<0.1	0.1	<0.1	7.3	18.8	67.6	3.0
R42	0.4	<0.1	2.3	<0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R43	0.3	<0.1	2.1	<0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R44	0.3	<0.1	1.9	0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R45	0.4	<0.1	2.3	0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R46	0.4	<0.1	2.3	<0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R47	0.3	<0.1	1.9	<0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R48	0.6	<0.1	3.2	<0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R49	0.3	<0.1	1.6	<0.1	0.1	<0.1	7.3	18.8	67.6	3.0
R50	0.4	<0.1	2.0	<0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R51	0.4	<0.1	2.0	<0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R52	0.3	<0.1	1.9	<0.1	0.2	<0.1	7.3	18.9	67.7	3.0
R53	0.2	<0.1	1.2	<0.1	0.1	<0.1	7.3	18.8	67.6	3.0
R54	0.2	<0.1	1.5	<0.1	0.1	<0.1	7.3	18.9	67.6	3.0
R55	0.2	<0.1	1.3	<0.1	0.1	<0.1	7.3	18.9	67.6	3.0
R56	0.2	<0.1	0.9	<0.1	0.1	<0.1	7.3	18.9	67.6	3.0
R57	0.3	<0.1	1.5	<0.1	0.1	<0.1	7.3	18.9	67.6	3.0
R58	0.5	<0.1	2.4	<0.1	0.1	<0.1	7.3	18.9	67.6	3.0
R59	0.4	<0.1	1.9	<0.1	0.1	<0.1	7.3	18.9	67.6	3.0
R60	0.4	<0.1	2.2	<0.1	0.1	<0.1	7.3	18.9	67.6	3.0
R61	0.3	<0.1	1.6	<0.1	0.1	<0.1	7.3	18.9	67.6	3.0
R62	0.3	<0.1	1.6	<0.1	0.1	<0.1	7.3	18.9	67.6	3.0
R63	0.3	<0.1	1.4	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R64	0.2	<0.1	1.2	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R65	0.2	<0.1	1.1	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R66	0.3	<0.1	1.6	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R67	0.3	<0.1	1.6	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R68	0.2	<0.1	1.0	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R69	0.2	<0.1	1.1	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0

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
R70	0.2	<0.1	1.1	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R71	0.2	<0.1	0.9	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R72	0.2	<0.1	1.2	<0.1	0.1	<0.1	7.3	18.9	67.6	3.0
R73	0.2	<0.1	1.2	<0.1	0.1	<0.1	7.3	18.9	67.6	3.0
R74	0.3	<0.1	1.6	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R75	0.4	<0.1	1.9	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R76	0.2	<0.1	1.0	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R77	0.2	<0.1	1.0	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R78	0.2	<0.1	1.1	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R79	0.2	<0.1	1.0	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R80	0.2	<0.1	0.9	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R81	0.2	<0.1	1.0	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R82	0.1	<0.1	0.9	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R84	0.2	<0.1	1.2	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R85	0.1	<0.1	0.8	<0.1	<0.1	<0.1	7.3	18.8	67.6	3.0
R86	0.1	<0.1	0.6	<0.1	<0.1	<0.1	7.3	18.8	67.5	3.0
R87	0.1	<0.1	0.7	<0.1	<0.1	<0.1	7.3	18.8	67.5	3.0
R4A	1.9	0.2	11.2	1.0	2.7	<0.1	7.5	19.8	70.2	3.1

Appendix F

Further detail regarding 24-hour PM_{10} and $PM_{2.5}$ 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 PM_{10} impact assessment in accordance with the NSW EPA Approved Methods; refer to the worked example on Page 46 to 47 of the Approved Methods.

The background level is the ambient level at Beresfield monitoring station for $PM_{2.5}$ and PM_{10}.

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 F-1 to **Table F-14** assess selected receptor R3, R4A, R19, R23, R24 and R30 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/m^3 or above the PM_{10} criterion of 50µg/m^3 is in **bold red.**

Table F-1: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R3

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
21/08/2015	25.9	0.0	25.9				
20/08/2015	20.2	0.2	20.4	27/07/2015	4.8	3.3	8.1
22/08/2015	19.7	0.1	19.8	11/05/2015	4.0	3.1	7.1
7/06/2015	19.6	0.7	20.3	5/08/2015	8.6	3.0	11.6
5/07/2015	17.8	2.5	20.3	8/05/2015	7.1	3.0	10.1
9/03/2015	16.9	0.4	17.3	31/05/2015	6.5	3.0	9.5
19/11/2015	16.8	0.6	17.4	4/08/2015	3.7	2.9	6.6
19/03/2015	15.5	0.8	16.3	3/07/2015	8.6	2.9	11.5
9/07/2015	15.2	0.3	15.5	14/07/2015	8.6	2.8	11.4
23/06/2015	15.1	0.1	15.2	7/07/2015	9.3	2.8	12.1

Table F-2: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R3

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
6/05/2015	64.9	14.8	79.7				
26/11/2015	57.5	4.5	62.0				
19/11/2015	43.3	3.5	46.8	27/07/2015	18.1	21.0	39.1
6/10/2015	42.0	2.1	44.1	11/05/2015	19.1	20.5	39.6
7/10/2015	39.4	2.1	41.5	5/08/2015	20.4	20.3	40.7
20/11/2015	39.4	0.5	39.9	8/05/2015	26.0	18.7	44.7
9/03/2015	36.9	2.0	38.9	13/07/2015	7.1	18.7	25.8
11/08/2015	35.8	6.9	42.7	14/07/2015	9.2	18.7	27.9
21/08/2015	35.8	0.1	35.9	31/05/2015	12.7	18.3	31.0
5/10/2015	35.8	4.3	40.1	6/07/2015	19.5	17.9	37.4

Table F-3: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R4A

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
21/08/2015	**25.9**	0.2	**26.1**				
20/08/2015	20.2	0.4	20.6	12/05/2015	2.1	1.9	4.0
22/08/2015	19.7	0.3	20.0	31/05/2015	6.5	1.9	8.4
7/06/2015	19.6	0.9	20.5	12/07/2015	8.6	1.8	10.4
5/07/2015	17.8	1.6	19.4	10/05/2015	4.1	1.8	5.9
9/03/2015	16.9	0.3	17.2	9/06/2015	4.4	1.8	6.2
19/11/2015	16.8	0.4	17.2	25/07/2015	5.7	1.7	7.4
19/03/2015	15.5	0.3	15.8	4/06/2015	9.5	1.6	11.1
9/07/2015	15.2	0.6	15.8	9/05/2015	5.0	1.6	6.6
23/06/2015	15.1	0.4	15.5	4/07/2015	7.5	1.6	9.1

Table F-4: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R4A

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
6/05/2015	**64.9**	4.7	**69.6**				
26/11/2015	**57.5**	1.1	**58.6**				
19/11/2015	43.3	2.3	45.6	12/07/2015	7.0	11.2	18.2
6/10/2015	42.0	2.0	44.0	10/05/2015	16.8	10.8	27.6
7/10/2015	39.4	0.5	39.9	12/05/2015	12.7	10.4	23.1
20/11/2015	39.4	1.3	40.7	31/05/2015	12.7	9.3	22.0
9/03/2015	36.9	1.2	38.1	25/07/2015	17.1	8.9	26.0
11/08/2015	35.8	6.1	41.9	9/06/2015	17.6	8.9	26.5
21/08/2015	35.8	0.7	36.5	9/05/2015	15.8	8.5	24.3
5/10/2015	35.8	2.9	38.7	27/08/2015	12.3	8.3	20.6

Table F-5: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R19

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
21/08/2015	**25.9**	0.6	**26.5**				
20/08/2015	20.2	0.1	20.3	16/06/2015	3.9	0.7	4.6
22/08/2015	19.7	0.0	19.7	22/07/2015	10.0	0.6	10.6
7/06/2015	19.6	0.3	19.9	1/04/2015	3.0	0.6	3.6
5/07/2015	17.8	0.0	17.8	23/03/2015	4.3	0.6	4.9
9/03/2015	16.9	0.1	17.0	21/10/2015	9.0	0.6	9.6
19/11/2015	16.8	0.1	16.9	21/08/2015	**25.9**	0.6	**26.5**
19/03/2015	15.5	0.2	15.7	17/03/2015	5.4	0.6	6.0
9/07/2015	15.2	0.2	15.4	20/10/2015	7.5	0.5	8.0
23/06/2015	15.1	0.5	15.6	23/06/2015	15.1	0.5	15.6

Table F-6: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R19

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
6/05/2015	**64.9**	0.0	**64.9**				
26/11/2015	**57.5**	0.0	**57.5**				
19/11/2015	43.3	0.7	44.0	16/06/2015	7.2	4.6	11.8
6/10/2015	42.0	2.7	44.7	23/03/2015	11.1	3.9	15.0
7/10/2015	39.4	0.0	39.4	1/04/2015	6.8	3.6	10.4
20/11/2015	39.4	0.2	39.6	22/07/2015	22.4	3.6	26.0
9/03/2015	36.9	0.2	37.1	21/08/2015	35.8	3.6	39.4
11/08/2015	35.8	0.0	35.8	21/10/2015	27.4	3.5	30.9
21/08/2015	35.8	3.6	39.4	17/03/2015	18.7	3.5	22.2
5/10/2015	35.8	1.9	37.7	16/10/2015	19.6	3.4	23.0

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Table F-7: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R23

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
21/08/2015	25.9	0.0	25.9				
20/08/2015	20.2	0.4	20.6	15/06/2015	8.6	0.6	9.2
22/08/2015	19.7	0.0	19.7	31/03/2015	4.1	0.6	4.7
7/06/2015	19.6	0.0	19.6	18/10/2015	8.0	0.6	8.6
5/07/2015	17.8	0.0	17.8	14/04/2015	9.2	0.5	9.7
9/03/2015	16.9	0.1	17.0	14/10/2015	7.8	0.5	8.3
19/11/2015	16.8	0.0	16.8	18/05/2015	9.9	0.5	10.4
19/03/2015	15.5	0.1	15.6	8/10/2015	6.6	0.5	7.1
9/07/2015	15.2	0.3	15.5	28/10/2015	3.9	0.5	4.4
23/06/2015	15.1	0.0	15.1	11/09/2015	5.5	0.4	5.9

Table F-8: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R23

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
6/05/2015	64.9	0.0	64.9				
26/11/2015	57.5	0.0	57.5				
19/11/2015	43.3	0.0	43.3	18/10/2015	23.8	3.5	27.3
6/10/2015	42.0	0.1	42.1	15/06/2015	13.5	3.4	16.9
7/10/2015	39.4	0.0	39.4	31/03/2015	10.6	3.3	13.9
20/11/2015	39.4	0.0	39.4	14/04/2015	18.3	3.1	21.4
9/03/2015	36.9	0.6	37.5	14/10/2015	20.7	3.0	23.7
11/08/2015	35.8	0.0	35.8	18/05/2015	11.5	2.8	14.3
21/08/2015	35.8	0.0	35.8	8/10/2015	25.7	2.8	28.5
5/10/2015	35.8	0.0	35.8	11/09/2015	13.3	2.6	15.9

Table F-9: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R24

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
21/08/2015	25.9	0.0	25.9				
20/08/2015	20.2	0.1	20.3	16/03/2015	7.1	0.8	7.9
22/08/2015	19.7	0.0	19.7	3/04/2015	6.1	0.8	6.9
7/06/2015	19.6	0.0	19.6	2/05/2015	3.9	0.7	4.6
5/07/2015	17.8	0.0	17.8	30/09/2015	9.6	0.6	10.2
9/03/2015	16.9	0.2	17.1	19/09/2015	2.5	0.6	3.1
19/11/2015	16.8	0.0	16.8	14/06/2015	12.4	0.5	12.9
19/03/2015	15.5	0.2	15.7	20/07/2015	11.0	0.5	11.5
9/07/2015	15.2	0.0	15.2	29/06/2015	14.1	0.5	14.6
23/06/2015	15.1	0.0	15.1	23/08/2015	12.4	0.5	12.9

Table F-10: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R24

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
6/05/2015	64.9	0.0	64.9				
26/11/2015	57.5	0.0	57.5				
19/11/2015	43.3	0.0	43.3	3/04/2015	16.4	4.6	21.0
6/10/2015	42.0	0.0	42.0	16/03/2015	21.2	4.3	25.5
7/10/2015	39.4	0.4	39.8	2/05/2015	12.6	3.9	16.5
20/11/2015	39.4	0.0	39.4	30/09/2015	35.3	3.5	38.8
9/03/2015	36.9	0.8	37.7	19/09/2015	8.7	3.1	11.8
11/08/2015	35.8	0.0	35.8	14/06/2015	21.1	3.1	24.2
21/08/2015	35.8	0.0	35.8	21/03/2015	21.4	3.0	24.4
5/10/2015	35.8	0.0	35.8	20/07/2015	15.9	2.8	18.7

Table F-11: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R30

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
21/08/2015	**25.9**	0.0	**25.9**				
20/08/2015	20.2	0.0	20.2	11/05/2015	4.0	0.8	4.8
22/08/2015	19.7	0.0	19.7	13/07/2015	8.1	0.8	8.9
7/06/2015	19.6	0.1	19.7	14/07/2015	8.6	0.8	9.4
5/07/2015	17.8	0.4	18.2	5/08/2015	8.6	0.8	9.4
9/03/2015	16.9	0.0	16.9	27/07/2015	4.8	0.8	5.6
19/11/2015	16.8	0.1	16.9	13/08/2015	3.4	0.7	4.1
19/03/2015	15.5	0.1	15.6	4/08/2015	3.7	0.7	4.4
9/07/2015	15.2	0.0	15.2	6/07/2015	5.4	0.6	6.0
23/06/2015	15.1	0.0	15.1	31/05/2015	6.5	0.6	7.1

Table F-12: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R30

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
6/05/2015	**64.9**	2.5	**67.4**				
26/11/2015	**57.5**	0.4	**57.9**				
19/11/2015	43.3	0.6	43.9	13/07/2015	7.1	5.4	12.5
6/10/2015	42.0	0.2	42.2	11/05/2015	19.1	5.3	24.4
7/10/2015	39.4	0.1	39.5	14/07/2015	9.2	5.0	14.2
20/11/2015	39.4	0.0	39.4	5/08/2015	20.4	4.9	25.3
9/03/2015	36.9	0.2	37.1	27/07/2015	18.1	4.5	22.6
11/08/2015	35.8	1.2	37.0	13/08/2015	19.0	4.4	23.4
21/08/2015	35.8	0.0	35.8	6/07/2015	19.5	3.9	23.4
5/10/2015	35.8	0.7	36.5	4/08/2015	24.0	3.8	27.8

Table F-13: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R30 (Road Traffic Emissions)

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
21/08/2015	25.9	0.0	25.9				
20/08/2015	20.2	0.0	20.2	25/06/2015	8.6	0.0	8.6
22/08/2015	19.7	0.0	19.7	10/04/2015	4.8	0.0	4.8
7/06/2015	19.6	0.0	19.6	4/05/2015	5.4	0.0	5.4
5/07/2015	17.8	0.0	17.8	23/04/2015	8.6	0.0	8.6
9/03/2015	16.9	0.0	16.9	26/06/2015	7.2	0.0	7.2
19/11/2015	16.8	0.0	16.8	26/05/2015	9.7	0.0	9.7
19/03/2015	15.5	0.0	15.5	8/07/2015	10.3	0.0	10.3
9/07/2015	15.2	0.0	15.2	21/05/2015	3.9	0.0	3.9
23/06/2015	15.1	0.0	15.1	4/09/2015	6.8	0.0	6.8

Table F-14: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R30 (Road Traffic Emissions)

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
6/05/2015	64.9	0.0	64.9				
26/11/2015	57.5	0.0	57.5				
19/11/2015	43.3	0.0	43.3	25/06/2015	17.5	0.0	17.5
6/10/2015	42.0	0.0	42.0	10/04/2015	14.6	0.0	14.6
7/10/2015	39.4	0.0	39.4	4/05/2015	12.3	0.0	12.3
20/11/2015	39.4	0.0	39.4	23/04/2015	21.5	0.0	21.5
9/03/2015	36.9	0.0	36.9	26/06/2015	17.1	0.0	17.1
11/08/2015	35.8	0.0	35.8	26/05/2015	21.5	0.0	21.5
21/08/2015	35.8	0.0	35.8	8/07/2015	20.4	0.0	20.4
5/10/2015	35.8	0.0	35.8	21/05/2015	11.8	0.0	11.8