AIR QUALITY IMPACT ASSESSMENT

BARK & TIMBER PROCESSING AND LANDSCAPE SUPPLIES PRODUCTION FACILITY IN OBERON

Borg Plantations Pty Ltd

18 February 2019

Job Number 18090874A

Prepared by

Todoroski Air Sciences Pty Ltd

Suite 2B, 14 Glen Street

Eastwood, NSW 2122

Phone: (02) 9874 2123

Fax: (02) 9874 2125

Email: info@airsciences.com.au

Air Quality Impact Assessment
Bark & Timber Processing and Landscape Supplies Production Facility in Oberon

DOCUMENT CONTROL

Report Version	Date	Prepared by	Reviewed by
DRAFT - 001	12/02/2019	P Henschke	A Todoroski
FINAL - 001	18/02/2019	P Henschke	

EXECUTIVE SUMMARY

This assessment investigates the potential air quality impacts arising from the construction and operation of the proposed bark-timber processing and landscape supplies production facility located to the north of Oberon in New South Wales.

This assessment is prepared in accordance with the applicable regulatory requirements and guidelines and forms part of the environmental assessment prepared for the proposed bark-timber processing and landscape supplies production facility application.

The prevailing wind flows in the area surrounding the proposed facility are influenced by the local topography. The nearest ambient air quality data, which are collected at Bathurst, indicate that air quality is generally good and is typically below the relevant New South Wales Environment Protection Authority goals with the exception of occasional short-term (24-hour average) particulate matter less than 10 micrometres in diameter (PM_{10}) levels, as occurs at most locations across the state.

Potential construction dust emissions associated with the Project are temporary in nature and will only occur during the three month construction period. The total amount of dust generated from the construction process is unlikely to be significant given the nature of the activities and no significant or prolonged effect at any off-site receptor is predicted to arise.

A worst-case operating scenario is modelled to represent the potential likely worst-case air quality impacts for the Project. Air dispersion modelling with the CALPUFF modelling suite is utilised in conjunction with estimated emission rates for the air pollutants generated by the various activities associated with the Project. The modelling takes into account other air emissions sources in the vicinity of the Project with potential to generate dust emissions and contribute to the cumulative impacts in the area and includes various timber manufacturing facilities and a wood waste processing operation.

The assessment predicts potential dust levels generated by the operation of the Project would comply with the applicable assessment criteria at the assessed sensitive receptors and therefore would not lead to any unacceptable level of environmental harm or impact in the surrounding area.

To ensure activities associated with the Project have a minimal effect on the surrounding environment, operational and physical mitigation measures are recommended to be implemented where feasible and reasonable.

TABLE OF CONTENTS

LIST OF APPENDICES

Appendix A – Selection of Meteorological Year
Appendix B – Emissions Inventory
Appendix C – Isopleth Diagrams
Appendix D – Further detail regarding 24-hour $PM_{2.5}$ and PM_{10} analysis

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

Todoroski Air Sciences has prepared this report for Jackson Environment and Planning Pty Ltd on behalf of Borg Plantations Pty Ltd (hereafter referred to as the Proponent). The report presents an assessment of potential air quality impacts associated with the construction and operation of the proposed bark-timber processing and landscape supplies production facility located to the north of Oberon in New South Wales (NSW) (hereafter referred to as the Project).

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

- A background and description of the Project;
- A review of the existing meteorological and air quality environment surrounding the Project;
- A description of the dispersion modelling approach used to assess potential air quality impacts; and,
- Presentation of the predicted results and a discussion of the potential air quality impacts.

2 PROJECT BACKGROUND

2.1 Project setting

The proposed Project site is located at 26 Endeavour Street, Oberon, on a vacant lot within an existing industrial precinct. The land use in the surrounding area is characterised by predominantly agricultural land to the north and east, with the residential areas of Oberon to the south of the industrial precinct in which the Project is located.

Figure 2-1 presents the location of the Project and nearby sensitive receptors considered in this study. The nearest sensitive receptors are located approximately 600 metres (m) to the south of the Project.

Figure 2-1: Project site overview

Figure 2-2 presents a pseudo three-dimensional visualisation of the topography in the general vicinity of the Project area. The Project site is situated in a relatively flat zone which is surrounded by areas of higher elevation with Lake Oberon located to the south.

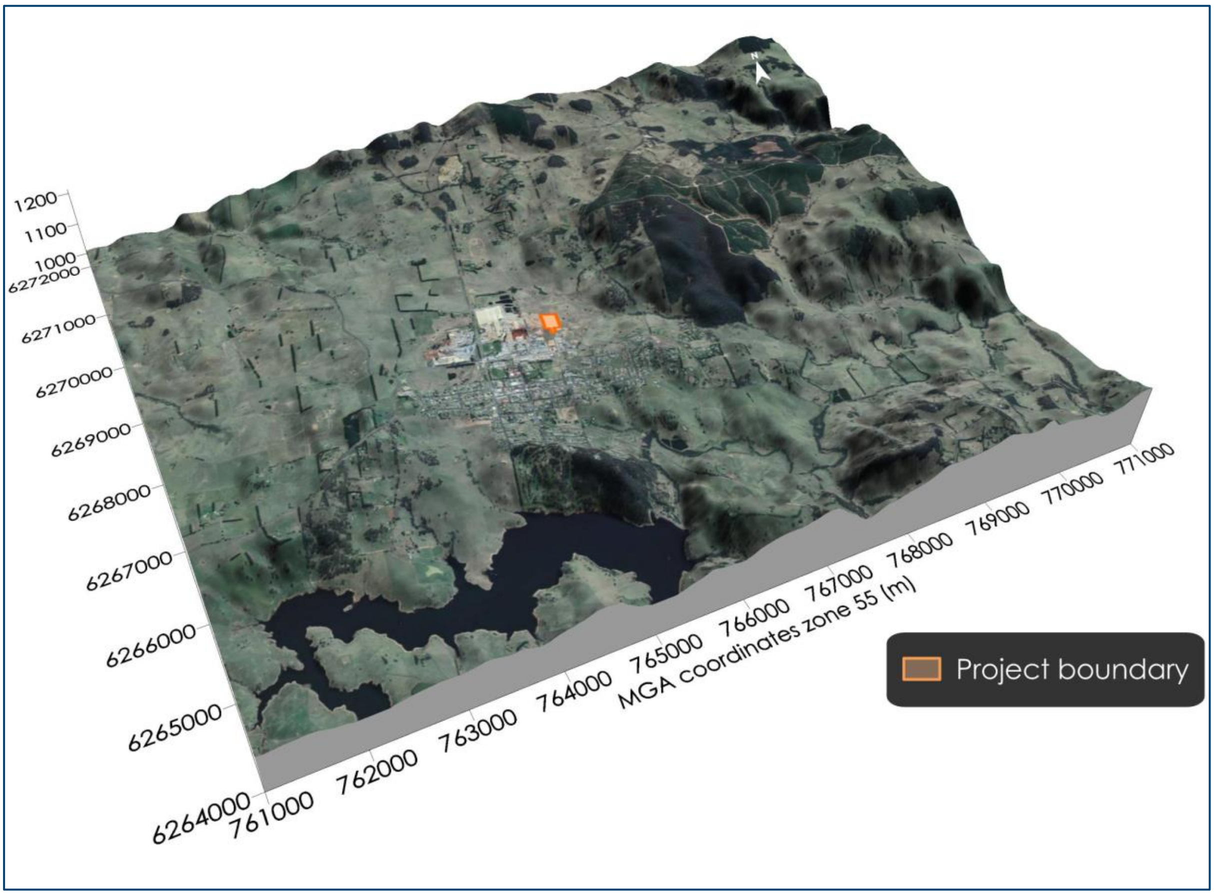

Figure 2-2: Representative visualisation of topography in the area surrounding the Project

2.2 Project description

The Project seeks to process up to 99,000 tonnes per annum (tpa) of pine bark, sawdust, clean (heat treated) pallets and clean untreated timbers into landscape materials with a focus on quality horticultural mulches for gardens and landscaping.

Processing of feedstock is expected to include mulching via grinders and shredders, with screening by a trommel for sizing processed material. No composting will take place on site.

Pallets and timbers will be delivered to Oberon from Borg's other facilities and may include timbers from other sources. Material will be unloaded into a designated waste tipping and inspection area. Regular sampling will take place following a quality assurance program and quality control measures to guarantee that the recovered products are adequate. Concrete block bays will be used for storage of the processed landscaping materials.

The facility's proposed operation hours are 7:00am to 6:00pm Monday to Friday, and 8:00am to 1:00pm on Saturdays. It is proposed to accept deliveries of pine bark and timber and to despatch finished product from the site on a 24-7 schedule. The site will not be open for processing on Sundays and on public holidays.

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

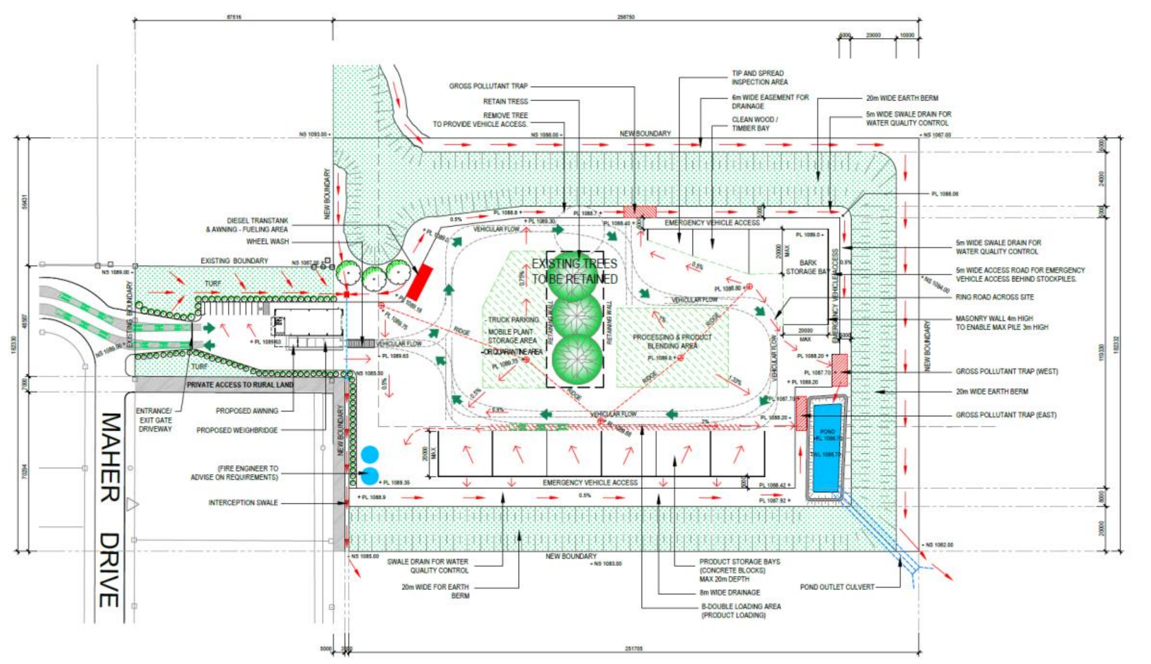

Figure 2-3: Indicative site layout

3 STUDY REQUIREMENTS

The purpose of this report is to provide an assessment of the maximum likely effects on air quality that may arise due to the construction and operations of 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 issued for the Project in November 2018 have been addressed. The key matters raised for consideration in this 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 No. 1238)

Specific Issue	General requirements	Section
Air quality – including:	A description of all potential sources of air and odour emissions;	6.3
	An air quality impact assessment in accordance with relevant Environment Protection Authority guidelines; and,	This report
	A description and appraisal of air quality impact mitigation, management and monitoring measures.	8

3.2 NSW Environmental Protection Authority

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 in **Table 3-2** along with a reference as to where the requirements are addressed in the report.

Table 3-2: NSW EPA agency comments for air quality (SEAR No. 1238)

Air quality	Section
Identify all potential discharges of fugitive and point source emissions of pollutants and odour for all stages of the proposal and assess the risk associated with those emissions. All processes that could result in air emissions, including dust, must be identified and described. Sufficient detail to accurately communicate the characteristics and quantity of all emissions must be provided and an assessment of risk, relating to environmental harm, risk to human health and amenity, must be undertaken.	2 & 6
Justify the level of assessment undertaken on the basis of risk factors, including but not limited to: a) Proposal location; b) Characteristics of the receiving environment; and c) Type and quantity of pollutants emitted.	2, 5 & 6
Describe the receiving environment in detail. The proposal must be contextualised within the receiving environment (local, regional and inter-regional as appropriate). The description must include but need not be limited to: a) Meteorology and climate; b) Topography; c) Surrounding land-use; receptors; and d) Ambient air quality.	5
Include a consideration of 'worst case' emission scenarios and potential impacts at neighbouring industry and residential receivers.	6.3
Account for cumulative impacts associated with existing emission sources (including the adjacent Borg MDF factory and ANL yard) as well as any currently approved developments linked to the receiving environment.	6.3
Include air dispersion modelling where there is a risk of adverse air quality impacts, or where there is sufficient uncertainty to warrant a rigorous numerical impact assessment. Air dispersion modelling must be conducted in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2017).*	This report

Air quality	Section
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)*. Detail emission control techniques/practices that will be employed by the proposal and benchmark these techniques/practices against best practice emission control and management.	7 & 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.

4.1.1 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 dust burden in the air and not just the dust from the Project. Consideration of background dust 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	2g/m²/month
		Total	4g/m²/month

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

4.2 Odour

4.2.1 Introduction

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

NSW legislation prohibits emissions which cause offensive odour to occur at any off-site receptor. Offensive odour is evaluated in the field by authorised officers, who are obliged to consider the odour in the context of its receiving environment, frequency, duration, character etc. and to determine whether the odour would interfere with the comfort and repose of the normal person unreasonably. In this context, the concept of offensive odour is applied to operational facilities and relates to actual emissions in the air.

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

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

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

For activities with potential to release significant odour it may be necessary to predict the likely odour impact that may arise. This is done by using air dispersion modelling which can calculate the level of dilution of odours emitted from the source at the point that such odour reaches surrounding receptors. This approach allows the air dispersion model to produce results in terms of odour units.

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

4.2.2 Complex Mixtures of Odorous Air Pollutants

Table 4-2 presents the assessment criteria as outlined in the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2017**). This criterion has been refined to take into account the population densities of specific areas and is based on a 99th percentile of dispersion model predictions calculated as 1-second averages (nose-response time).

Table 4-2: Impact assessment criteria for complex mixtures of odorous air pollutants (nose-response-time average, 99th percentile)

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

Source: NSW EPA, 2017

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

4.3 Protection of the Environment Operations Act 1997

The general obligations of the *Protection of the Environment Operations Act, 1997* and the Regulations made under the Act (namely the *Protection of the Environment Operations (Clean Air) Regulation, 2010*) would be followed at the Project and the Project would be operated 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 Bathurst Airport AWS (Automatic weather station) (Site No. 063291) were analysed to characterise the local climate in the proximity of the Project. The Bathurst Airport AWS is located approximately 37 kilometres (km) northwest of the Project.

Table 5-1 and **Figure 5-1** present a summary of data from the Bathurst Airport AWS collected over an 18 to 27 year period for the various meteorological parameters.

The data indicate that January is the hottest month with a mean maximum temperature of 28.7 degrees Celsius (°C) and July is the coldest month with a mean minimum temperature of 0.8°C.

Rainfall is higher during the warmer months of the year and declines during the colder months, with an annual average rainfall of 607.6 millimetres (mm) over 69.9 days. The data indicate that December is the wettest month with an average rainfall of 74.2mm over 7.0 days and May is the driest month with an average rainfall of 32.5mm over 4.5 days.

Relative humidity is higher during the colder months of the year. Mean 9am relative humidity ranges from 66% in December to 91% in June. Mean 3pm relative humidity levels range from 40% in December and January to 64% in June.

Wind speeds decrease slightly in the colder months and are highest during spring. Mean 9am wind speeds range from 8.1 kilometres per hour (km/h) in May to 12.5km/h in September and October. Mean 3pm wind speeds range from 15.9km/h in May to 21.0km/h in September.

Table 5-1: Monthly climate statistics summary – Bathurst Airport AWS

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature													
Mean max. temp. (°C)	28.7	27.6	24.8	20.9	16.3	12.6	12.0	13.8	17.1	20.4	23.7	26.6	20.4
Mean min. temp. (°C)	13.7	13.5	10.7	6.5	3.0	1.9	0.8	1.2	3.6	6.2	9.4	11.7	6.9
Rainfall													
Rainfall (mm)	58.5	57.3	55.7	33.1	32.5	39.3	42.0	40.1	47.0	52.8	64.3	74.2	607.6
No. of rain days (≥1mm)	5.8	5.5	5.2	4.0	4.5	6.3	6.4	6.0	5.5	6.4	7.3	7.0	69.9
9am conditions													
Mean temp. (°C)	19.4	18.2	15.3	12.4	8.0	5.2	4.4	6.0	9.9	13.5	15.6	18.1	12.2
Mean R.H. (%)	67	75	78	78	88	91	90	84	77	69	71	66	78
Mean W.S. (km/h)	10.7	10.1	9.0	8.6	8.1	8.8	9.1	10.9	12.5	12.5	11.8	10.8	10.2
3pm conditions													
Mean temperature (°C)	26.8	25.6	23.4	19.5	15.2	11.5	10.8	12.5	15.6	18.7	21.6	24.7	18.8
Mean R.H. (%)	40	46	44	44	54	64	62	53	50	47	47	40	49
Mean W.S. (km/h)	18.6	17.7	17.3	16.6	15.9	16.6	17.3	20.1	21.0	19.9	19.4	19.5	18.3

Source: Bureau of Meteorology, 2018

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

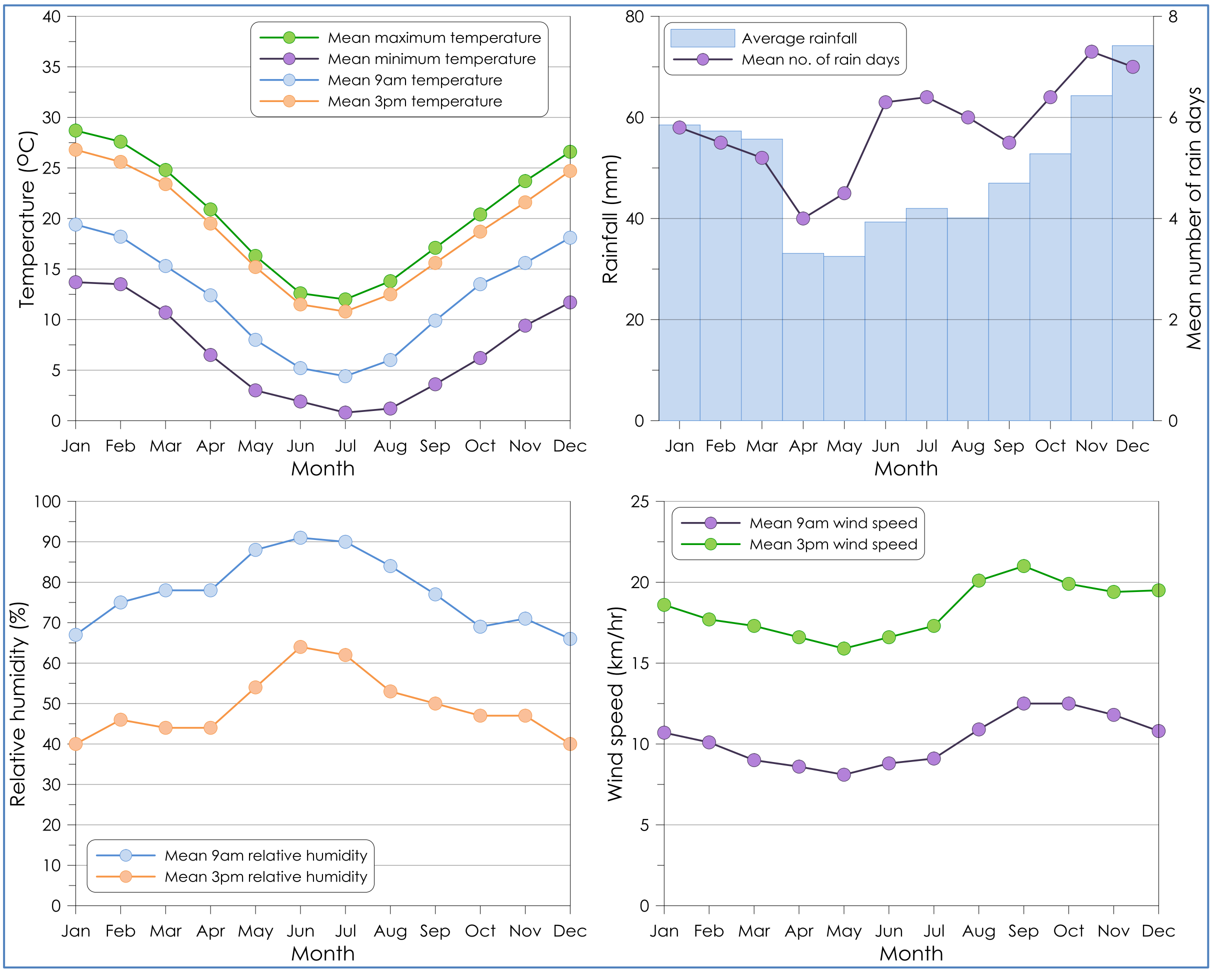

Figure 5-1: Monthly climate statistics summary – Bathurst Airport AWS

5.2 Local meteorological conditions

Annual and seasonal windroses for the Borg Plantations Pty Ltd weather station during the 2017 calendar period are presented in **Figure 5-2**.

The 2017 calendar year was selected as the meteorological year for the dispersion modelling based on analysis of meteorological data recorded for the area and other parameters as outlined in **Appendix A**.

On an annual basis, the winds predominantly arise from the west-northwest and from the east to the southeast. In summer, winds are predominantly from the west-northwest and the east. In autumn, winds from the east to the southeast are the most frequent. During winter, winds typically arise from the west-northwest to the west-southwest and from the southeast. Spring has a similar wind distribution to summer, with frequent winds from the east.

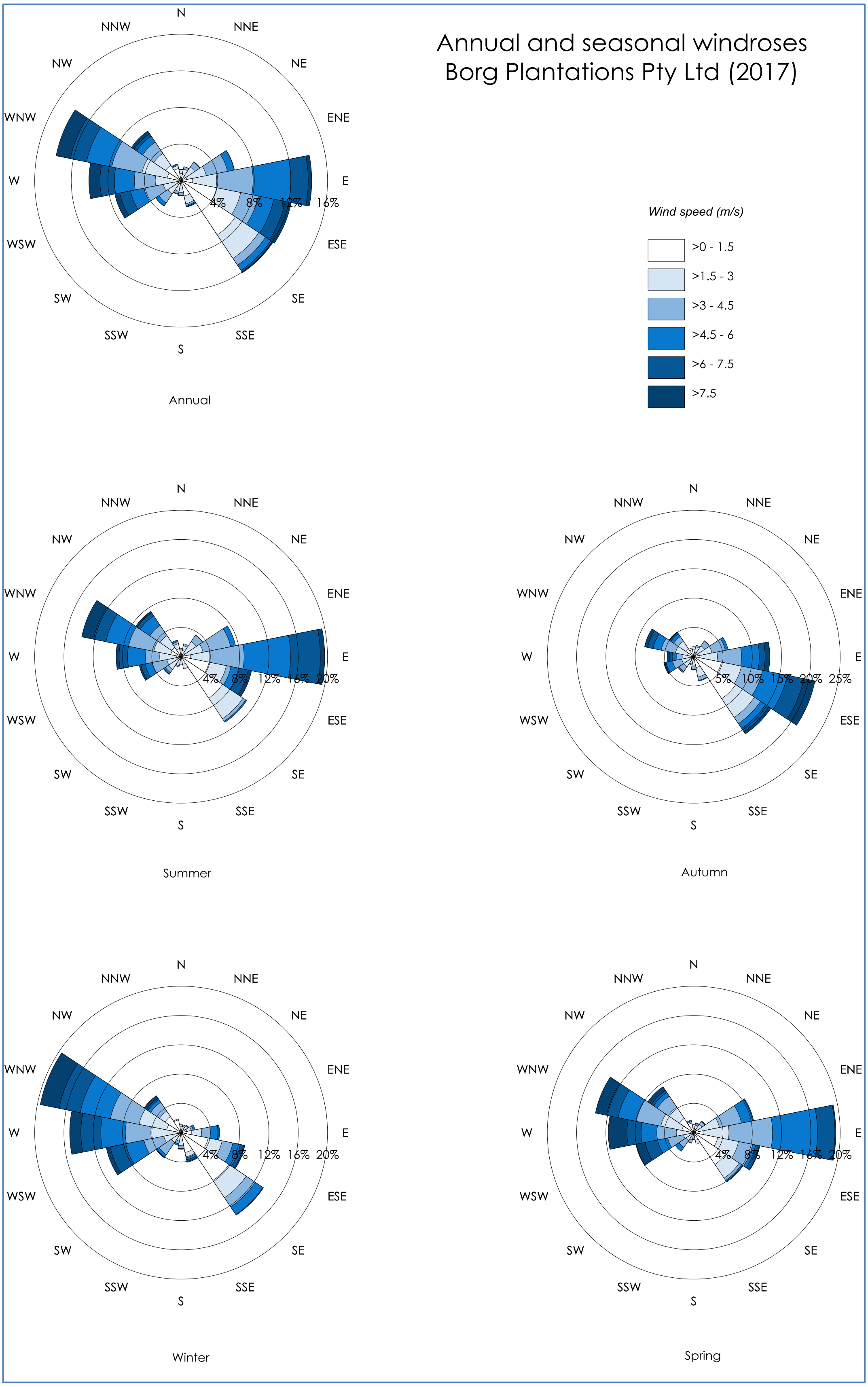

Figure 5-2: Annual and seasonal windroses – Borg Plantations Pty Ltd weather station (2017)

5.3 Local air quality monitoring

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

Ambient air quality monitoring data for the Project site are not available. Therefore the available data from the nearest air quality monitors operated by the NSW Office of Environment and Heritage (OEH) were used to quantify the existing background level for assessed pollutants at the Project site.

The NSW OEH air quality monitor at Bathurst is approximately 42.1km northwest of the site.

5.3.1 PM_{10} monitoring

A summary of the available data from the Bathurst monitoring station from 2013 to 2017 is presented in **Table 5-2**. Recorded 24-hour average PM_{10} concentrations are presented in **Figure 5-3**.

A review of **Table 5-2** indicates that the annual average PM_{10} concentrations for the Bathurst monitoring station were below the relevant criterion of 25µg/m^3 during the review period. The maximum 24-hour average PM_{10} concentration recorded at the station was found to exceed the relevant criterion of 50µg/m^3 on occasion during the review period.

It can be seen from **Figure 5-3** that PM_{10} concentrations are nominally highest in the spring and summer months with the warmer weather raising the potential for drier ground elevating the occurrence of windblown dust, bushfires and increased pollen levels.

Table 5-2: Summary of PM_{10} levels from Bathurst (µg/m^3)

Year	Bathurst	Criterion
	Annual average	
2013	15.1	**25**
2014	14.6	**25**
2015	13.4	**25**
2016	13.3	**25**
2017	14.1	**25**
	Maximum 24-hour average	
2013	**145.0**	**50**
2014	42.8	**50**
2015	**94.6**	**50**
2016	34.1	**50**
2017	49.9	**50**

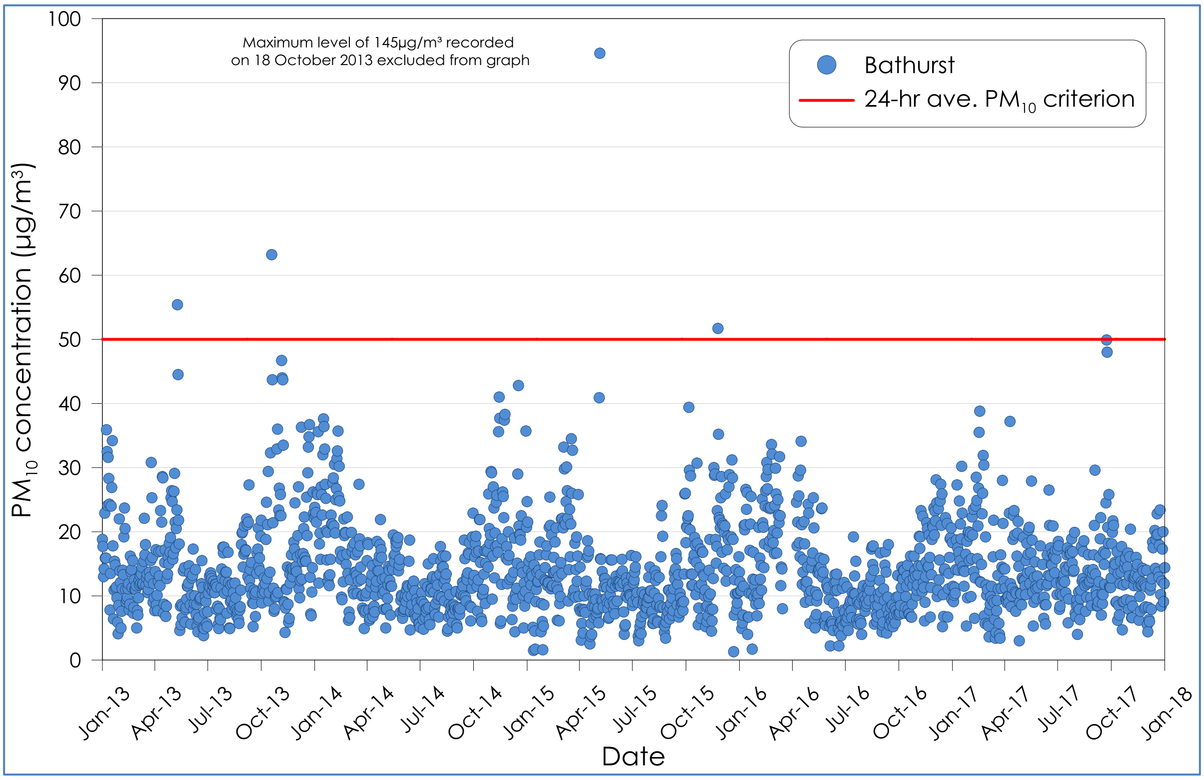

Figure 5-3: 24-hour average PM_{10} concentrations

5.3.2 $PM_{2.5}$ monitoring

A summary of the $PM_{2.5}$ readings from the Bathurst monitoring station is presented in **Table 5-3**. The recorded 24-hour average $PM_{2.5}$ concentrations are presented in **Figure 5-4**.

Data were only available for 2017 and indicate that $PM_{2.5}$ levels were below the annual average criterion of 8µg/m³ during this period and that the maximum 24-hour average levels were also below the criterion of 25µg/m³.

It can be seen from **Figure 5-4** that $PM_{2.5}$ concentrations are higher in the cooler months compared to the warmer months, which may be attributed to the contribution of wood smoke emitted by wood heaters and other combustion sources.

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

Year	Bathurst	Criterion
	Annual average	
2017	6.1	**8**
	Maximum 24-hour average	
2017	17.5	**25**

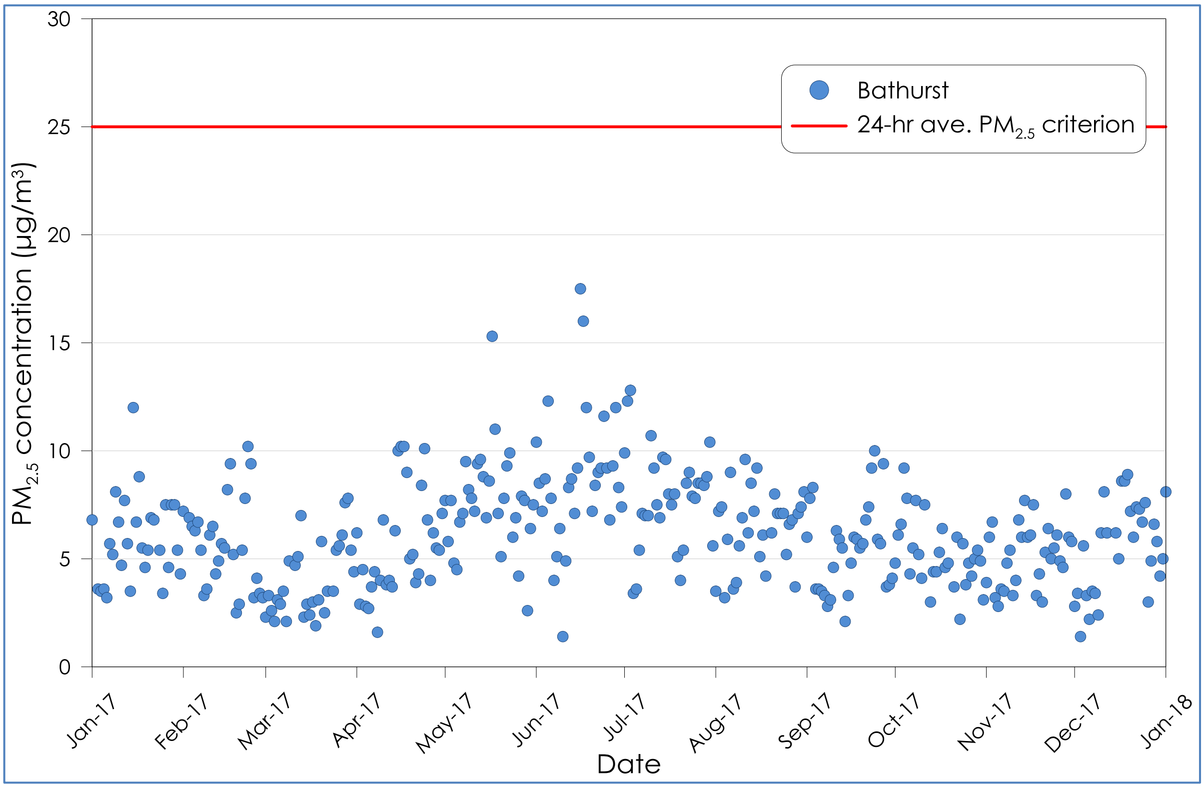

Figure 5-4: 24-hour average $PM_{2.5}$ concentrations

5.3.3 Estimated background dust levels

5.3.3.1 PM_{10} and $PM_{2.5}$ concentrations

As outlined above, there are no readily available site specific monitoring data, and therefore, the background dust levels around the Project site were estimated to be similar to those recorded at the Bathurst monitoring site.

Annual average PM_{10} and $PM_{2.5}$ values from the Bathurst monitoring station, for the 2017 calendar period were used to represent the background levels for the Project (see **Table 5-2** and **Table 5-3**). The 2017 calendar period corresponds to the period of meteorological modelling used in this assessment.

The background levels for air quality data at the Project site would likely be lower than in the urban environments of Bathurst.

5.3.3.2 TSP and Deposited dust

In the absence of 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 25 µg/m^3 corresponds to a TSP concentration of 90 µg/m^3 and a dust deposition value of 4 g/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 14.1 µg/m^3 indicates an approximate annual average TSP concentration and deposition value of 50.8 µg/m^3 and 2.3 g/m^2/month, respectively.

5.3.3.3 Summary of background dust levels

The annual average background air quality levels applied in this assessment are as follows:

- $PM_{2.5}$ concentrations – 6.1 µg/m^3;
- PM_{10} concentrations – 14.1 µg/m^3;
- TSP concentrations – 50.8 µg/m^3; and,
- Deposited dust levels – 2.3 g/m^2/month.

6 ASSESSMENT OF POTENTIAL CONSTRUCTION DUST EMISSIONS

The establishment of the Project would involve the construction of the associated infrastructure. This construction activity has the potential to generate dust emissions.

Potential construction dust emissions will be primarily generated due to material handling, vehicle movements, windblown dust generated from exposed areas and stockpiles. Exhaust emissions will be from the operation of construction vehicles and plant.

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

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

To ensure dust generation is controlled during the construction activities and the potential for off-site impacts is reduced, appropriate (operational and physical) mitigation measures will be implemented as necessary. Suggested dust mitigation measures to apply during construction are outlined in **Table 6-1**.

Table 6-1: Suggested construction dust mitigation measures

Source	Mitigation measure
General	Activities to be assessed during adverse weather conditions and modified as required (e.g. cease activity where reasonable levels of visible dust cannot be maintained).
	Engines of on-site vehicles and plant to be switched off when not in use.
	Vehicles and plant are to be fitted with pollution reduction devices where practicable.
	Vehicles are to be maintained and serviced according to manufacturer's specifications.
	Visual monitoring of construction activities is to be undertaken to identify dust generation.
Hauling material/ vehicle movements	Any hardstand on-site to be swept/cleaned regularly as required etc.
	Construction vehicle traffic is to be restricted to designated routes.
	Construction speed limits are to be enforced.
	Vehicle loads are to be covered when travelling off-site.
Material handling	Drop heights from loading and handling equipment are to be reduced as much as practical.
Exposed areas / stockpiles	The extent of exposed surfaces and stockpiles is to be kept to a minimum.
	Exposed areas and stockpiles are either to be covered or are to be dampened with water as far as is practicable if dust emissions are visible.

7 DISPERSION MODELLING APPROACH

7.1 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 "puff" air dispersion model which can deal with the effects of complex local terrain on the dispersion meteorology over the entire modelling domain in a three-dimensional, hourly varying time step. The model setup used is in general accordance with methods provided in the NSW EPA document *Generic Guidance and Optimum Model Setting for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia'* (**TRC, 2011**).

7.2 Modelling methodology

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

7.2.1 Meteorological modelling

TAPM was applied to the available data to generate a 3D upper air data file for use in CALMET. The centre of analysis for TAPM was 33deg41.5min south and 149deg51.5min 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 modelling used a nested approach where the 3D wind field from the coarser grid outer domain is used as the initial guess (or starting) field for the finer grid inner domains. This approach has several advantages over modelling a single domain. Observed surface wind field data from the near field as well as from far field monitoring sites can be included in the model to generate a more representative 3D wind field for the modelled area. Off domain terrain features for the finer grid domain can be allowed to take effect within the finer domain, as would occur in reality. Also, the coarse scale wind flow fields give a better set of starting conditions with which to operate the finer grid run.

The CALMET outer domain was run on a 50 x 50km area with a 1.0km grid resolution, refined for a second domain on a 30 x 30km area with a 0.6km grid and refined for a final domain on a 10 x 10km area with a 0.1km grid resolution.

The available meteorological data for January 2017 to December 2017 from relevant meteorological monitoring sites were included in the simulation. **Table 7-1** outlines the parameters used from each station.

Table 7-1: Surface observation stations

Weather Stations	Parameters						
	WS	WD	CH	CC	T	RH	SLP
Borg Plantations Pty Ltd Weather Station	✓	✓			✓	✓	
Bathurst Airport AWS (Station No. 063291)	✓	✓	✓	✓	✓	✓	✓
Bathurst (NSW OEH)	✓	✓			✓	✓	
Mount Boyce AWS (Station No. 063292)	✓	✓	✓	✓	✓	✓	✓

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

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

Figure 7-1 presents a visualisation of the wind field generated by CALMET for a single hour of the modelling period. The wind fields are seen to follow the terrain well and indicate the simulation produces realistic fine scale flow fields (such as terrain forced flows) in surrounding areas.

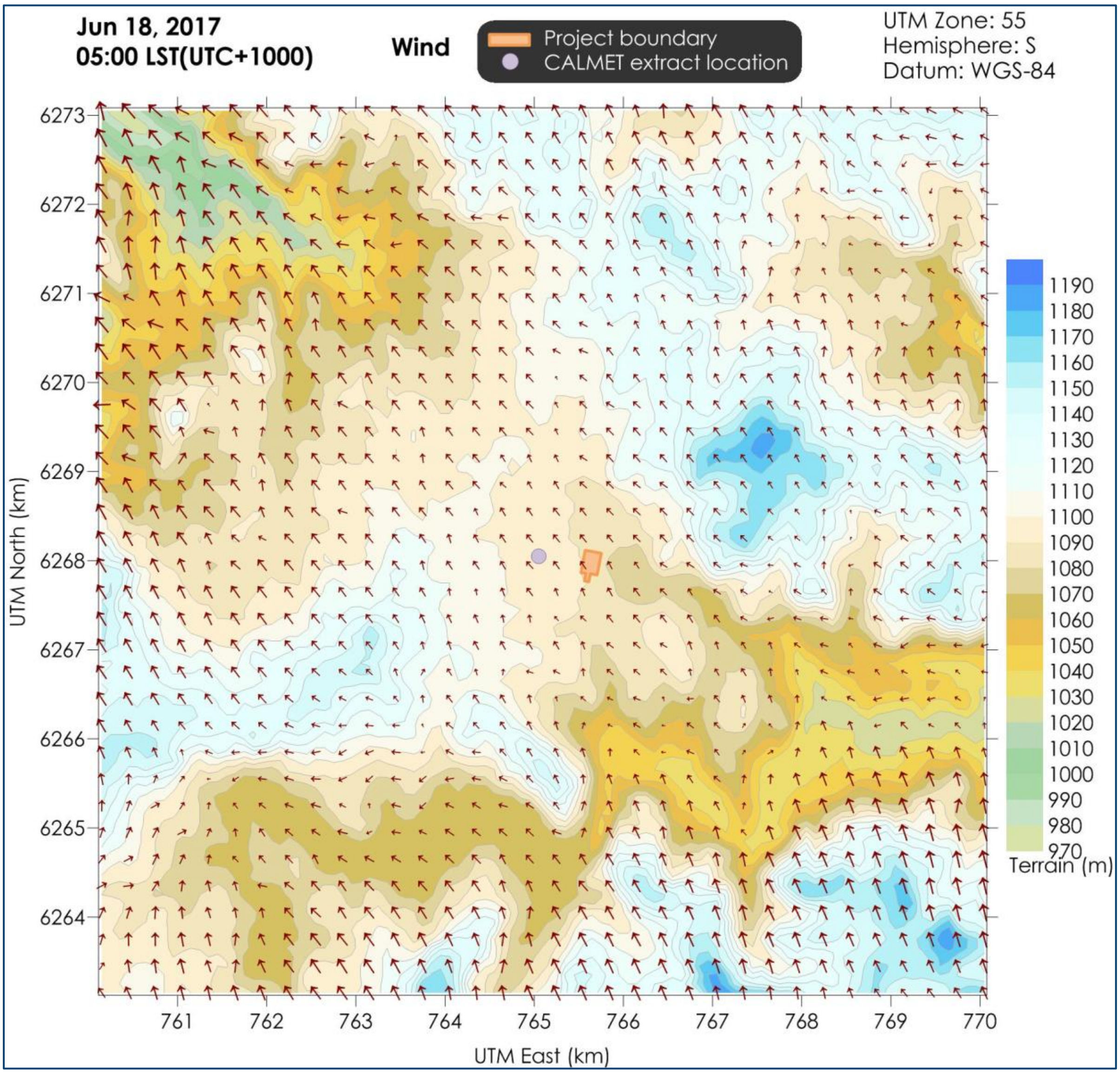

Figure 7-1: Example of the wind field for one of the 8,760 hours of the year that are modelled

CALMET generated meteorological data were extracted from a point within the CALMET domain and are graphically represented in **Figure 7-2** and **Figure 7-3**.

Figure 7-2 presents the annual and seasonal windroses from the CALMET data. Overall, the windroses generated in the CALMET modelling reflect the expected wind distribution patterns of the area as determined based on the available measured data and the expected terrain effects on the prevailing winds.

Figure 7-3 includes graphs of the temperature, wind speed, mixing height and stability classification over the modelling period and show sensible trends considered to be representative of the area.

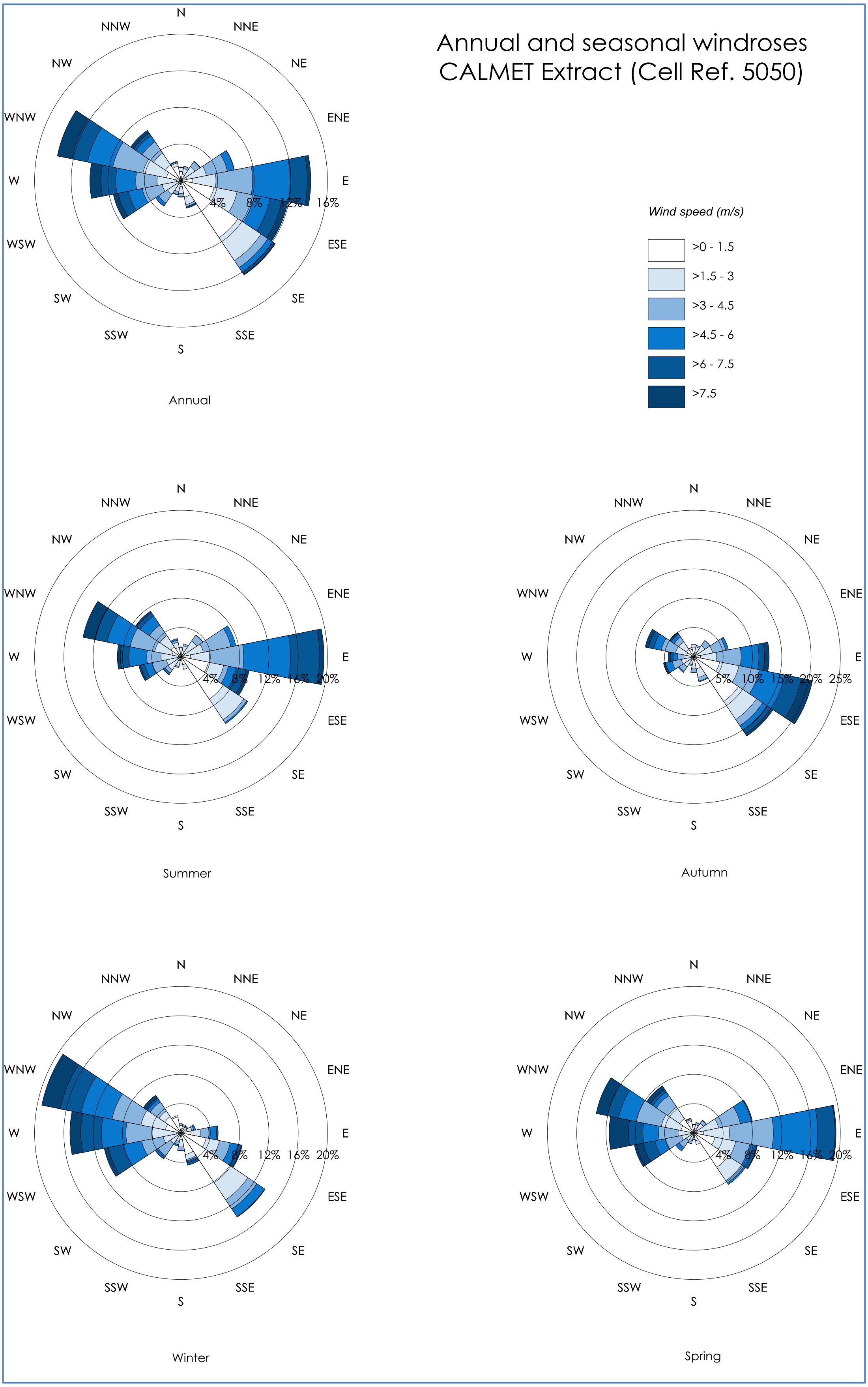

Figure 7-2: Annual and seasonal windroses from CALMET (Cell reference 5050)

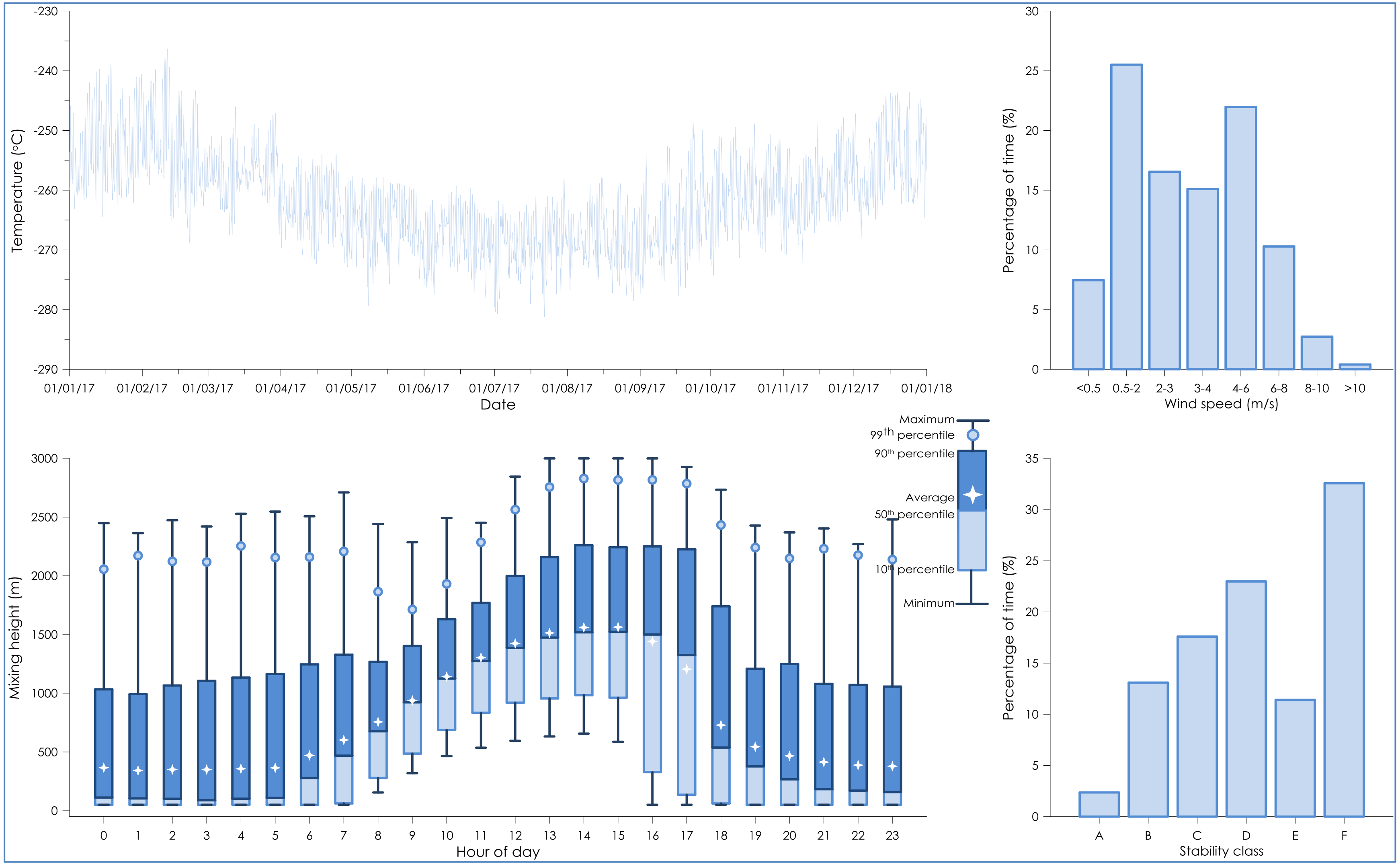

Figure 7-3: Meteorological analysis of CALMET (Cell Ref 5050)

7.2.2 Dispersion modelling

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.

7.3 Emission estimation

7.3.1 Dust emissions

The significant dust generating activities associated with the construction and operation of the Project are identified as: loading/unloading of material, processing (grinding and shredding) material, screening material, vehicles travelling on-site, and windblown dust generated from stockpiles. The on-site vehicle and plant equipment also have the potential to generate particulate emissions from the diesel exhaust.

Dust emission estimates for the Project have been calculated by analysing the various types of dust generating activities taking place and utilising suitable emission factors sourced from US EPA developed documentation (**US EPA, 1985 and Updates**).

The estimated dust emissions for activities associated with the operation are presented in **Table 7-2**. Detailed calculations of the dust emission estimates are provided in **Appendix B**.

Table 7-2: Estimated annual emissions for the Project

Activity	TSP emission	PM_{10} emission	$PM_{2.5}$ emission
Hauling bulk residual bark to stockpile	974	278	28
Hauling bulk used pallets to stockpile	450	128	13
Hauling bulk sawdust to stockpile	162	46	5
Unloading material to stockpile	219	104	16
Loading material to crusher	219	104	16
Processing material	267	119	20
Screening material	1,238	426	93
Unloading processed material to stockpile	219	104	16
Rehandling processed material at stockpiles	219	104	16
Loading processed material to haul truck	219	104	16
Hauling timber mulch offsite	3,225	919	92
Hauling metal material offsite	2	1	0.1
Hauling residual waste material to landfill	7	2	0.2
Wind erosion - whole site	4,080	2,040	306
Exhaust emissions	50	50	48
Total emissions (kg/yr)	**11,552**	**4,527**	**683**

7.3.2 Other surrounding sources

Other surrounding sources in the vicinity of the Project with potential to generate dust emissions and contribute to the cumulative impacts in the area include various timber manufacturing facilities and a wood waste processing operation.

The identified existing timber manufacturing facilities include Borg Manufacturing Timber Panels Processing Facility, Woodchem, Structaflor and Highland Pine Products. Modelling parameters and sources of TSP and PM_{10} from the timber manufacturing facilities have been sourced from the *Air Quality Impact Assessment Revised Borg Manufacturing Timber Panels Processing Facility Expansion* (**Todoroski Air Sciences, 2017**).

Table 7-3 presents a summary of the estimated emissions applied for the timber product manufacturing facilities.

Table 7-3: Summary of emissions for timber product manufacturing facilities

Source ID	TSP (g/s)	PM_{10} (g/s)	Source ID	TSP (g/s)	PM_{10} (g/s)
Borg Manufacturing			**Borg Manufacturing**		
EPA4	0.054	0.049	Old Jeldwen Point 21	0.033	0.033
EPA5	0.068	0.056	Old Jeldwen Point 22	0.092	0.092
EPA7	0.94	0.94	E1	0.0053	0.0053
EPA8	0.88	0.88	E2	0.0038	0.0038
EPA9	0.66	0.56	E3	0.035	0.035
EPA10	0.69	0.58	E4	0.056	0.056
EPA11	1.3	0.026	E5	0.072	0.072
EPA12a	0.026	0.025	E7	0.0038	0.0038
EPA12b	0.098	0.087	E8	0.076	0.076
EPA12c	0.055	0.055	E9	0.031	0.031
EPA12d	0.06	0.043	E10	0.031	0.031
EPA12e	0.055	0.055	E12	1.26	0.7
EPA17	1.2	1	E13	0.036	0.036
New Combined Stack	0.84	0.82	E14	0.028	0.028
A3-1	0.069	0.069	E15	0.049	0.049
A3-2	0.069	0.069	E16	0.0038	0.0038
A2-1	0.056	0.056	E18	0.014	0.014
A2-2	0.056	0.056	E19	0.63	0.63
EPA6	0.07	0.052	Baghouse for particle board sander	0.17	0.054
EPA3	0.0074	0.0074	**Woodchem**		
EPA1	0.18	0.034	Catalytic oxidizer	0.0072	0.0072
EPA13a	0.035	0.033	Batch reactor stack	0.0008	0.0008
EPA13b	0.031	0.031	**Structaflor**		
EPA13c	0.043	0.038	Roof vent	0.084	0.071
EPA13d	0.067	0.055	Roof vent	0.067	0.067
EPA13e	0.23	0.22	Roof vent	0.078	0.053
EPA2	0.02	0.02	Core Dryer Stack 125	3.3	3
Conti Fibre Transport Cyclone	0.05	0.048	Surface Dryer Stack 105	0.94	0.65
EPA18a	0.064	0.064	Cyclones	0.033	0.016
EPA18b	0.037	0.037	Cyclones	0.032	0.0096
EPA18c	0.057	0.057	**Highland Pine Products**		
EPA18d	0.03	0.03	S2 Boiler Stack	3.3	2.2
EPA18e	0.045	0.045	S1 Planer Mill Cyclone	0.0013	0.0027
EPA19	3.22	0.39	S2 Baghouse	0.054	0.047
Old Jeldwen Point 20	0.062	0.062	S2 Chip Bin Cyclone	0.003	0.003

The wood waste processing operation is operated by Australian Native Landscapes (ANL) and is located approximately 300m to the southwest of the Project site. It is understood the facility has a processing capacity of approximately 65,000tpa as outlined in its Statement of Environmental Effects (**R.W. Corkery, 2005**).

The modelled activities at the facility include the transport of raw wood products, processing of material and storage on-site. A summary of the estimated annual dust emissions associated with the wood waste processing operation is presented in **Table 7-4**.

Table 7-4: Summary of annual emissions for the existing wood mulching operation

Activity	TSP emission	PM_{10} emission	$PM_{2.5}$ emission
Total emissions (kg/yr)	8,025	3,331	503

7.3.3 Odour emissions

The Project proposes to accept feedstock materials from the Borg MDF Manufacturing Facility, other Borg facilities and timbers from other sources with the feedstock material subject to initial screening with unwanted material or contaminated loads removed and disposed lawfully off-site.

The processing activities at the Project do not include any form of composting or similar such activities with potential to generate any significant odours, hence no adverse odour would be associated with the proposed activity.

Overall the potential for odorous material and odour emissions would be negligible and thus odour has not been further assessed.

8 DISPERSION MODELLING RESULTS

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 that were modelled at each point within the modelling domain for the worst day (i.e. a 24-hour period) in the one year long modelling period. The predictions do not represent just one particular day, but a combination of days and is an overestimation of what would actually occur.

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

8.1 Dust concentrations

Table 8-1 presents the predicted incremental particulate dispersion modelling results at each of the assessed sensitive receptor locations. The results show minimal incremental effects would arise at the sensitive receptor locations due to the Project.

Table 8-1: Particulate dispersion modelling results for sensitive receptor – Incremental impact

Receptor ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average
	Air quality impact criteria					
	-	-	-	-	-	2
R1	0.1	<0.01	0.4	<0.1	0.1	<0.01
R2	0.2	0.01	1.1	0.1	0.2	0.03
R3	0.1	0.01	0.9	<0.1	0.1	0.01
R4	0.2	0.01	1.1	<0.1	0.1	0.01
R5	0.2	0.01	1.6	0.1	0.1	0.01
R6	0.2	<0.01	1.1	<0.1	0.1	<0.01
R7	0.2	0.01	1.2	<0.1	0.1	<0.01
R8	0.2	0.01	1.2	<0.1	0.1	<0.01
R9	0.2	0.01	1.3	<0.1	0.1	<0.01
R10	0.2	0.01	1.0	<0.1	0.1	<0.01
R11	0.2	0.01	1.2	<0.1	0.1	<0.01
R12	0.2	0.01	1.0	0.1	0.1	0.01
R13	0.2	0.01	0.9	0.1	0.2	0.01
R14	0.1	0.01	0.9	0.1	0.2	0.01
R15	0.1	0.01	0.9	0.1	0.2	0.01
R16	0.1	0.02	1.0	0.1	0.2	0.01
R17	0.1	<0.01	0.3	<0.1	<0.1	<0.01
R18	<0.1	<0.01	0.2	<0.1	<0.1	<0.01

Receptor ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average
	Air quality impact criteria					
	-	-	-	-	-	2
R19	<0.1	<0.01	0.3	<0.1	<0.1	<0.01
R20	0.1	0.01	0.7	0.1	0.1	0.01
R21	<0.1	<0.01	0.2	<0.1	<0.1	<0.01
R22	<0.1	<0.01	0.2	<0.1	<0.1	<0.01
R23	<0.1	<0.01	0.2	<0.1	<0.1	<0.01
R24	<0.1	<0.01	0.3	<0.1	<0.1	<0.01
R25	<0.1	<0.01	0.2	<0.1	<0.1	<0.01
R26	0.1	0.01	0.6	0.1	0.1	0.01
R27	0.1	0.01	0.8	0.1	0.2	0.01
R28	0.1	0.01	0.8	0.1	0.2	0.01
R29	0.1	0.01	0.5	0.1	0.1	0.01
R30	0.1	<0.01	0.6	<0.1	0.1	<0.01
R31	0.1	<0.01	0.4	<0.1	<0.1	<0.01
R32	0.1	<0.01	0.4	<0.1	<0.1	<0.01
R33	0.1	<0.01	0.3	<0.1	<0.1	<0.01
R34	0.1	<0.01	0.4	<0.1	<0.1	<0.01
R35	0.1	<0.01	0.4	<0.1	<0.1	<0.01
R36	0.1	<0.01	0.4	<0.1	<0.1	<0.01
R37	0.1	0.01	0.7	0.1	0.1	0.01

The cumulative (total) impact is defined as the modelling impact associated with the operation of the Project combined with the other existing sources and the estimated ambient background levels in **Section 5.3.3**. The predicted cumulative annual average $PM_{2.5}$, PM_{10}, TSP and dust deposition levels due to the Project with the estimated background levels are presented in **Table 8-2**.

Cumulative 24-hour $PM_{2.5}$ and PM_{10} impacts are considered in detail in **Section 7.2**.

The results in **Table 8-2** indicate that all of the assessed sensitive receptors are predicted to experience levels below the relevant criteria for each of the assessed dust metrics.

Table 8-2: Particulate dispersion modelling results for sensitive receivers – Cumulative impact

Receptor ID	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Annual average			
	Air quality impact criteria			
	8	25	90	4
R1	6.1	15.7	53.1	2.3
R2	6.1	23.7	64.0	2.3
R3	6.1	16.1	53.9	2.3
R4	6.1	16.0	53.9	2.3
R5	6.1	16.3	54.0	2.3
R6	6.1	15.3	52.5	2.3
R7	6.1	15.4	52.6	2.3
R8	6.1	15.5	52.7	2.3
R9	6.1	15.7	53.0	2.3
R10	6.1	15.3	52.6	2.3
R11	6.1	15.7	53.0	2.3
R12	6.1	15.7	53.0	2.3
R13	6.1	15.8	53.3	2.3
R14	6.1	15.7	53.2	2.3
R15	6.1	15.7	53.2	2.3
R16	6.1	15.7	53.2	2.3
R17	6.1	15.3	52.6	2.3
R18	6.1	15.6	52.9	2.3
R19	6.1	18.9	57.2	2.3
R20	6.1	18.6	57.5	2.3
R21	6.1	14.7	51.9	2.3
R22	6.1	14.7	51.8	2.3
R23	6.1	14.6	51.7	2.3
R24	6.1	14.8	51.9	2.3
R25	6.1	14.8	51.9	2.3
R26	6.1	15.3	52.7	2.3
R27	6.1	15.7	53.2	2.3
R28	6.1	15.8	53.5	2.3
R29	6.1	15.5	53.0	2.3
R30	6.1	15.5	53.0	2.3
R31	6.1	14.6	51.6	2.3
R32	6.1	15.0	52.3	2.3
R33	6.1	15.1	52.4	2.3
R34	6.1	15.2	52.6	2.3
R35	6.1	15.3	52.7	2.3
R36	6.1	15.3	52.7	2.3
R37	6.1	18.2	56.9	2.3

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

An assessment of total (cumulative) 24-hour average $PM_{2.5}$ and PM_{10} impacts was undertaken in general accordance with the methods outlined in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2017**).

A Level 1 contemporaneous assessment approach where the maximum measured background level is added to the maximum predicted dust level from the Project and other sources has been applied to assess cumulative $PM_{2.5}$ impacts.

A Level 2 contemporaneous assessment approach where the measured background levels are added to the days corresponding predicted dust level from the Project and other sources has been applied to assess cumulative PM_{10} impacts.

Ambient (background) $PM_{2.5}$ and PM_{10} concentration data corresponding with the year of modelling (2017) from the NSW OEH monitoring site at Bathurst have been applied in this case to represent the prevailing background levels in the vicinity of the Project and representative sensitive receptor locations.

Assessment of cumulative 24-hour average $PM_{2.5}$ and PM_{10} was conducted in accordance with the NSW EPA Level 1 and Level 2 contemporaneous assessment methods as outlined in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2017**) to examine the potential maximum total (cumulative) 24-hour average $PM_{2.5}$ and PM_{10} impacts for the Project.

Table 8-3 provides a summary of the findings from the Level 2 assessment at representative receptor locations for both PM_{10} and $PM_{2.5}$. Detailed tables of the assessment results are provided in **Appendix D**.

The results indicate that the Project does not increase the number of days above the 24-hour average criterion at the assessed receptors.

Table 8-3: NSW EPA contemporaneous assessment - maximum number of additional days above 24-hour average criterion

Receptor ID	$PM_{2.5}$	PM_{10}
R5	0	0
R20	0	0
R24	0	0
R28	0	0
R30	0	0

Time series plots of the predicted cumulative 24-hour average PM_{10} concentrations for R5 and R20 are presented in **Figure 8-1** and **Figure 8-2**.

The orange bars in the figures represent the contribution from the Project, the blue bars represent the contribution from the modelled existing sources and the purple bars represent the background levels from Bathurst. It is clear from the figures that the Project has a relatively small influence at the receptor locations.

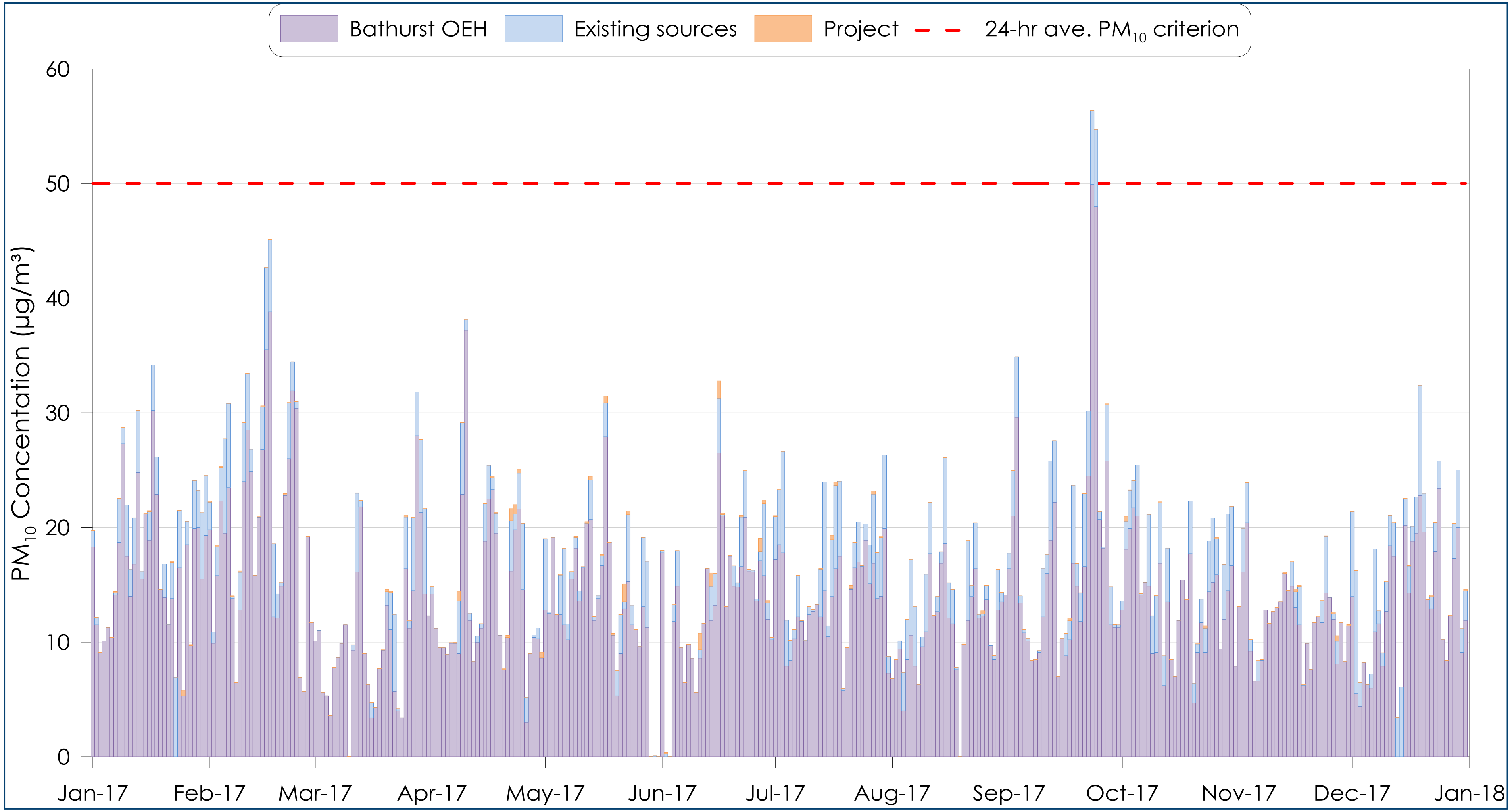

Figure 8-1: Time series plots of predicted cumulative 24-hour average PM_{10} concentrations for R5

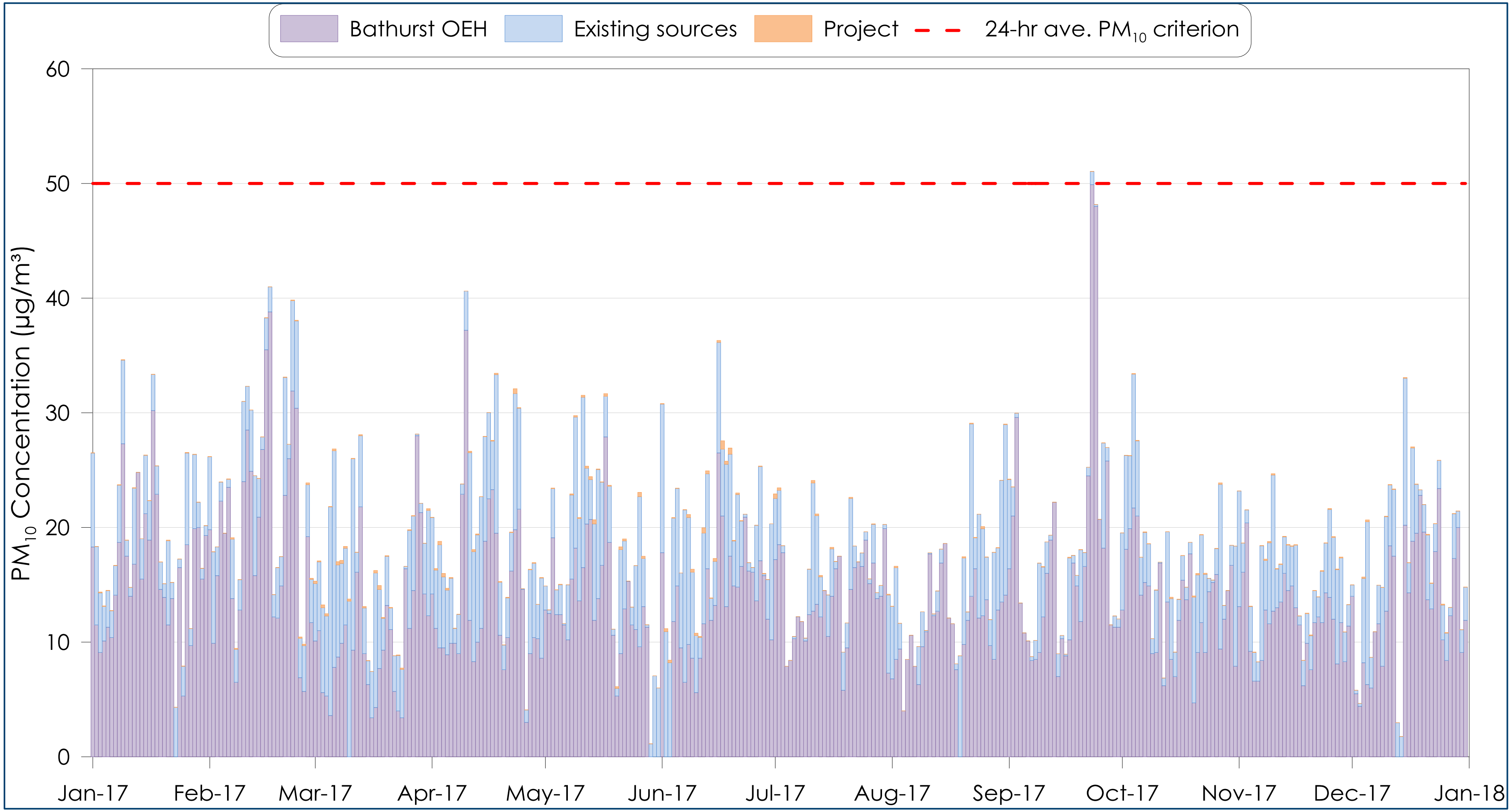

Figure 8-2: Time series plots of predicted cumulative 24-hour average PM_{10} concentrations for R20

9 DUST MITIGATION AND MANAGEMENT

The proposed operations at the Project have the potential to generate dust emissions.

To ensure activities associated with the Project have a minimal effect on the surrounding environment and at sensitive receptor locations, it is recommended that appropriate operational and physical mitigation measures should be implemented where feasible and reasonable as outlined in **Table 9-1**.

Table 9-1: Potential operational dust mitigation options

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.
Hauling activities	Any hardstand on-site or public roads 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.

10 SUMMARY AND CONCLUSIONS

This report has assessed the potential air quality impacts associated with the operation of the Borg Plantations bark-timber processing and landscape supplies production facility.

Air dispersion modelling was used to predict the potential for off-site dust impacts in the surrounding area due to the operation of the Project. The estimated emissions of dust 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 construction and operation of the Project would comply with the applicable assessment criteria at the sensitive 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 dust management measures to ensure it minimises the potential occurrence of excessive air emissions from the site.

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

11 REFERENCES

Bureau of Meteorology (2018)

Climate Averages Australia, Bureau of Meteorology website.

Katestone Environmental Pty Ltd (2010)

"NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining", Katestone Environmental Pty Ltd prepared for DECCW, 2010.

NSW EPA (2017)

"Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales", NSW EPA, January 2017

NSW DEC (2006)

"Technical Framework Assessment and Management of Odour from Stationary Sources in NSW", Department of Environment and Conservation (DEC) NSW, November 2006.

R.W. Corkery (2005)

"Statement of Environmental Effects Organic Material Processing and Handling Facility 7 Endeavour Street, Oberon", prepared for Australian Native Landscapes Pty Ltd for R.W. Corkery & Company Pty Limited.

Todoroski Air Sciences (2017)

"Air Quality Impact Assessment Revised Borg Manufacturing Timber Panels Processing Facility Expansion", prepared for Borg Manufacturing Pty Ltd by Todoroski Air Sciences, February 2017.

TRC (2011)

"Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia", Prepared for the NSW Office of Environment and Heritage by TRC Environmental Corporation.

US EPA (1985 and update)

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

Appendix A
Selection of Modelling Year

Selection of modelling year

Summary

Only limited recent local meteorological data are available for the assessment. In general, it is preferable to use local meteorological data in a case like this, as any year to year bias in the local data is likely to be smaller than the likely bias between the local and more distant data.

However, an analysis of the available data (from Bathurst Airport, approximately 37 kilometres (km) northwest) was conducted to evaluate whether any significant non-representative bias may arise in the assessment due using the available local data for 2017.

It is also noted that $PM_{2.5}$ monitoring data are only available for 2017, and this was a consideration when deciding to use the 2017 local data.

Analysis of available data

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

For each year of meteorological data from 2013 to 2017 the standard deviation from the long-term data set (collected over an 18 to 27 year period at the station) was determined for the measured wind speed temperature and relative humidity.

The analysis indicates that 2013 is closest to the long-term average for wind speed. 2013 and 2014 are the closest to the long-term average for temperature and 2015 for relative humidity.

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

Year	Wind speed	Temperature	Relative humidity
2013	0.31	0.95	5.80
2014	0.38	0.96	6.59
2015	0.39	1.01	4.87
2016	0.40	1.05	5.63
2017	0.39	1.50	6.34

The analysis shows that of the last five years, 2017 is not an outlier year in terms of deviation from the long term mean wind speed and relative humidity. On this basis, a further more detailed analysis of 2017 against the last five years of data was performed to confirm if there may be any potential for significant bias to arise.

Figure A-1 shows the frequency distributions for wind speed, wind direction, temperature and relative humidity of the 2017 year compared with the mean of the 2013 to 2017 data set. The 2017 year data appear to be aligned reasonably well with the mean data. It is noted that the temperature tends to be below the mean, however this tends to result in a greater occurrence of calm, poor dispersion conditions, and is thus unlikely to cause any underestimation.

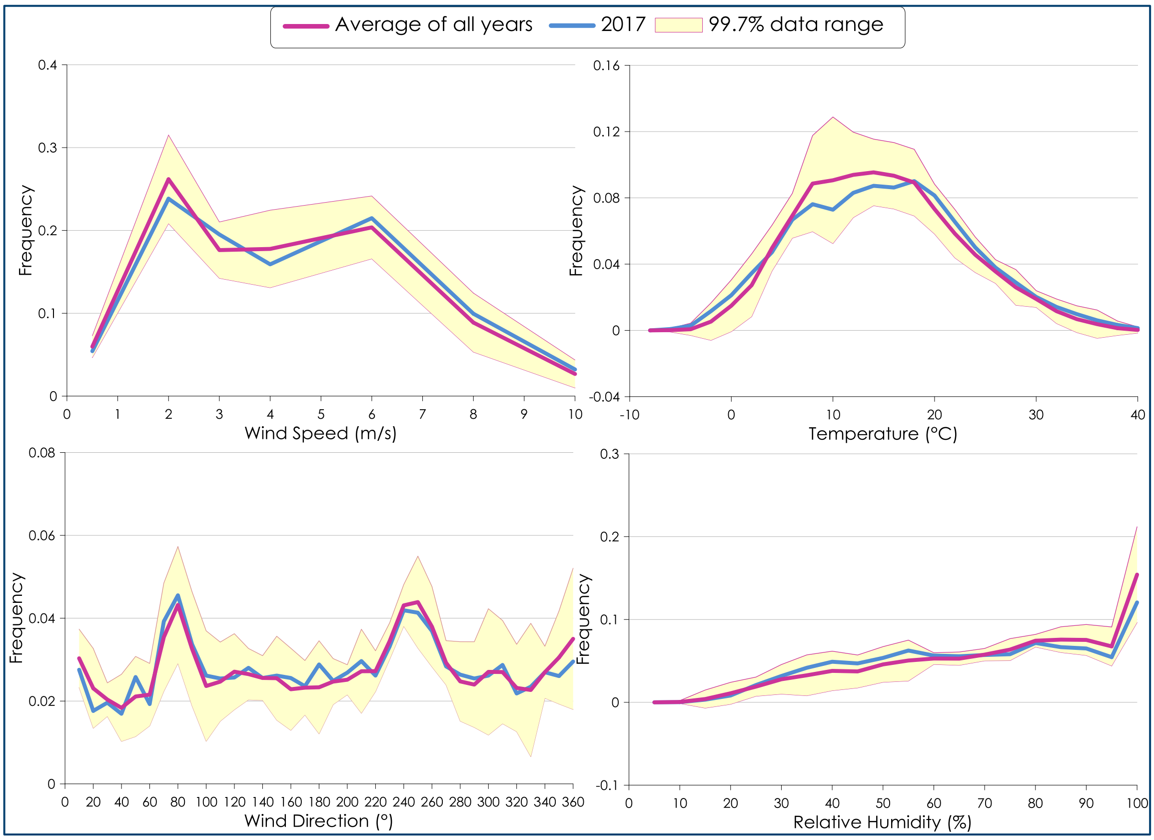

Figure A-1: Frequency distributions for wind speed, wind direction, temperature and relative humidity

On this basis, there is no reason to consider that 2017 is not a suitably representative year for modelling, using the local Project data.

We note that when conducting an air quality impact assessment the underlying background air quality levels are needed to assess potential cumulative impacts. The availability of ambient air quality monitoring data affects the estimation of the existing background level. A summary of the available ambient air quality monitoring for the Project for 2013 to 2017 is shown in **Table A-2**.

Table A-2: Available annual average PM_{10} and $PM_{2.5}$ levels from Bathurst ($\mu g/m^3$)

Year	Bathurst	
	PM_{10}	$PM_{2.5}$
2013	15.1	N/A
2014	14.6	N/A
2015	13.4	N/A
2016	13.3	N/A
2017	14.1	6.1

N/A – Not available

Ambient PM_{10} air quality monitoring data are available for all years and $PM_{2.5}$ air quality monitoring data only available for 2017.

Appendix B
Emission Calculation

Emission Calculation

The production schedule and site plan designs provided by the Proponent have been combined with emissions factor equations that relate to the quantity of dust emitted from particular activities based on intensity, the prevailing meteorological conditions and composition of the material being handled.

Emission factors and associated controls have been sourced from:

- United States (US) EPA AP42 Emission Factors (**US EPA, 1985 and Updates**); and,
- Office of Environment and Heritage document, "NSW Coal Mining Benchmarking Study: International Best Practise Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining", prepared by Katestone Environmental (**Katestone Environmental, 2010**).

The emission factor equations used for each dust generating activity are outlined in **Table B-1** below. Detailed emission inventory for the modelled year is presented in **Table B-2.**

Control factors include the following:

- Hauling on unpaved surfaces – 75% control for watering of trafficked areas.

Table B-1: Emission factor equations

Activity	Emission factor equation		
	TSP	PM_{10}	$PM_{2.5}$
Loading / emplacing material	$EF = 0.74 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$	$EF = 0.35 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$	$EF = 0.053 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$
Hauling on unsealed surfaces	$EF = \left(\frac{0.4536}{1.6093}\right) \times 4.9 \times (s/12)^{0.7} \times (1.1023 \times M/3)^{0.45}\ kg/VKT$	$EF = \left(\frac{0.4536}{1.6093}\right) \times 1.5 \times (s/12)^{0.9} \times (1.1023 \times M/3)^{0.45}\ kg/VKT$	$EF = \left(\frac{0.4536}{1.6093}\right) \times 0.15 \times (s/12)^{0.9} \times (1.1023 \times M/3)^{0.45}\ kg/VKT$
Processing material	$EF = 0.0027\ kg/tonne$	$EF = 0.0012\ kg/tonne$	$0.075 \times TSP$
Screening material	$EF = 0.0125\ kg/tonne$	$EF = 0.0043\ kg/tonne$	$0.075 \times TSP$
Wind erosion on exposed areas, stockpiles	$EF = 850\ kg/ha/year$	$0.5 \times TSP$	$0.075 \times TSP$

EF = emission factor, U = wind speed (m/s), M = moisture content (%), s = silt content (%), VKT = vehicle kilometres travelled (km).

Table B-2: Emissions inventory

ACTIVITY	TSP emission	PM10 emission	PM2.5 emission	Intensity	Units	Emission Factor TSP	Emission Factor PM10	Emission Factor PM2.5	Units	Var. 1	Units	Var. 2	Units	Var 3. TSP/PM10/PM 2.5 EF-TSP	Units	Var. 4	Units	Var. 5	Units	Var. 6	Units
Hauling bulk residual bark to stockpile	974	278	28	64,350	t/y	0.076	0.022	0.002	kg/t	40	t/load	0.65	km/return trip	3.7/1.1/0.1	kg/VKT	8.4	S.C. %	43	t	75	%
Hauling bulk used pallets to stockpile	450	128	13	29,700	t/y	0.076	0.022	0.002	kg/t	40	t/load	0.65	km/return trip	3.7/1.1/0.1	kg/VKT	8.4	S.C. %	43	t	75	%
Hauling bulk sawdust to stockpile	162	46	5	4,950	t/y	0.164	0.047	0.005	kg/t	12	t/load	0.65	km/return trip	2.4/0.7/0.1	kg/VKT	8.4	S.C. %	17	t	75	%
Unloading material to stockpile	219	104	16	99,000	t/y	0.00222	0.001	0.0002	kg/t	1.87	ave. of (WS/2.2)^1.3	2	M.C. %								
Loading material to crusher	219	104	16	99,000	t/y	0.00222	0.001	0.0002	kg/t	1.87	ave. of (WS/2.2)^1.3	2	M.C. %								
Processing material	267	119	20	99,000	t/y	0.0027	0.001	0.0002	kg/t												
Screening material	1,238	426	93	99,000	t/y	0.0125	0.004	0.0009	kg/t												
Unloading processed material to stockpile	219	104	16	99,000	t/y	0.00222	0.001	0.0002	kg/t	1.87	ave. of (WS/2.2)^1.3	2	M.C. %								
Rehandling processed material at stockpiles	219	104	16	99,000	t/y	0.00222	0.001	0.0002	kg/t	1.87	ave. of (WS/2.2)^1.3	2	M.C. %								
Loading processed material to haul truck	219	104	16	99,000	t/y	0.00222	0.001	0.0002	kg/t	1.87	ave. of (WS/2.2)^1.3	2	M.C. %								
Hauling timber mulch offsite	3,225	919	92	98,357	t/y	0.165	0.047	0.005	kg/t	12	t/load	0.65	km/return trip	2.4/0.7/0.1	kg/VKT	8.4	S.C. %	17	t	75	%
Hauling metal material offsite	2	1	0.1	149	t/y	0.084	0.024	0.002	kg/t	32	t/load	0.65	km/return trip	3.3/0.9/0.1	kg/VKT	8.4	S.C. %	33	t	75	%
Hauling residual waste material to landfill	7	2	0.2	495	t/y	0.076	0.022	0.002	kg/t	40	t/load	0.65	km/return trip	3.7/1.1/0.1	kg/VKT	8.4	S.C. %	43	t	75	%
Wind erosion - whole site	4,080	2,040	306	4.8	ha	850	425	64	a/year												
Exhaust emissions	50	50	48																		
Total TSP emissions (kg/yr)	**11,552**	**4,527**	**683**																		

Appendix C
Isopleth Diagrams

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

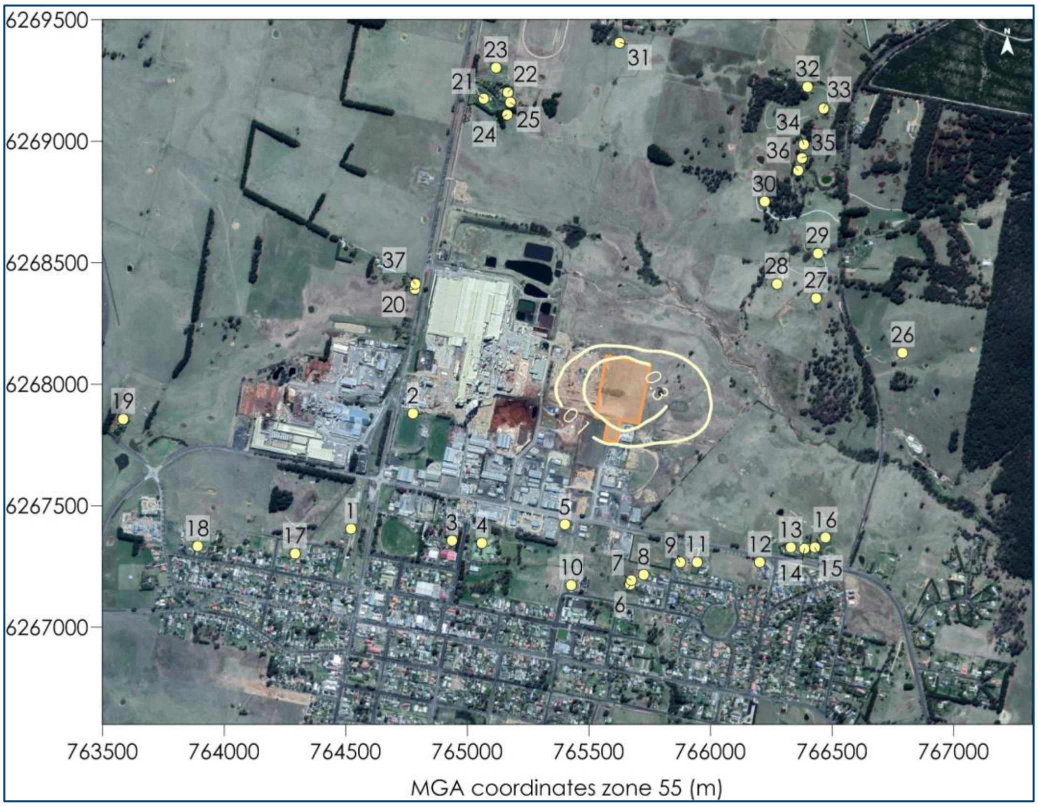

Figure C-2: Predicted incremental annual average $PM_{2.5}$ concentrations (µg/m³)

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

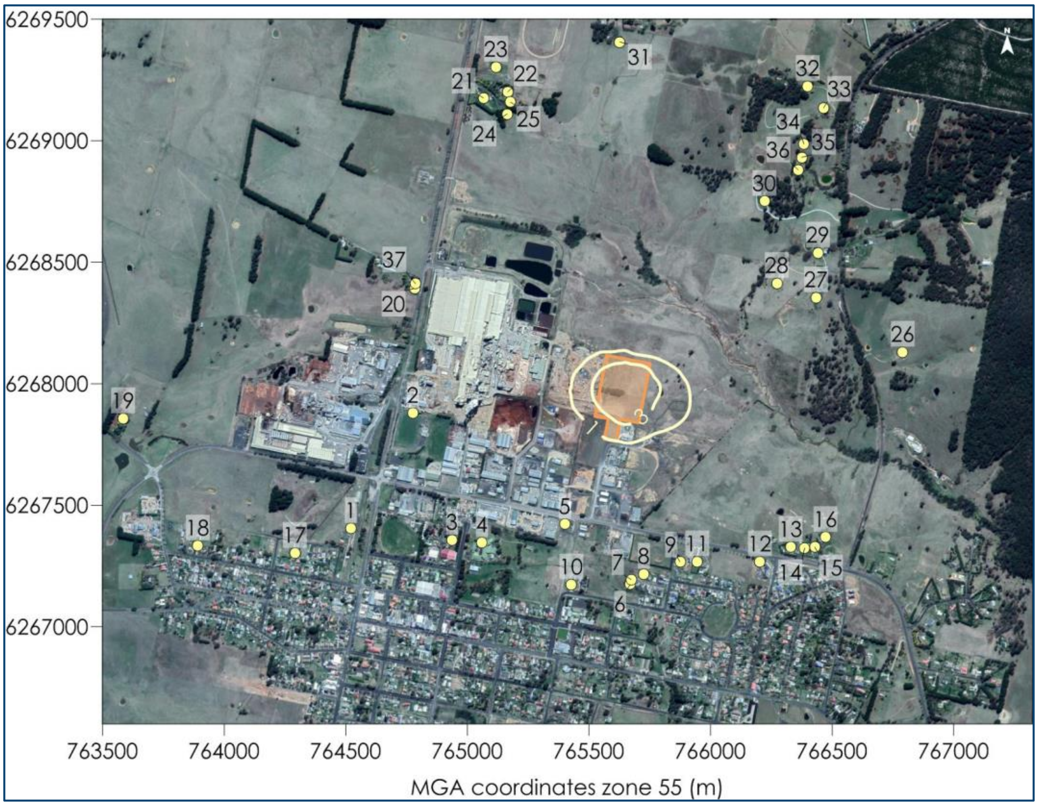

Figure C-4: Predicted incremental annual average PM_{10} concentrations (µg/m³)

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

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

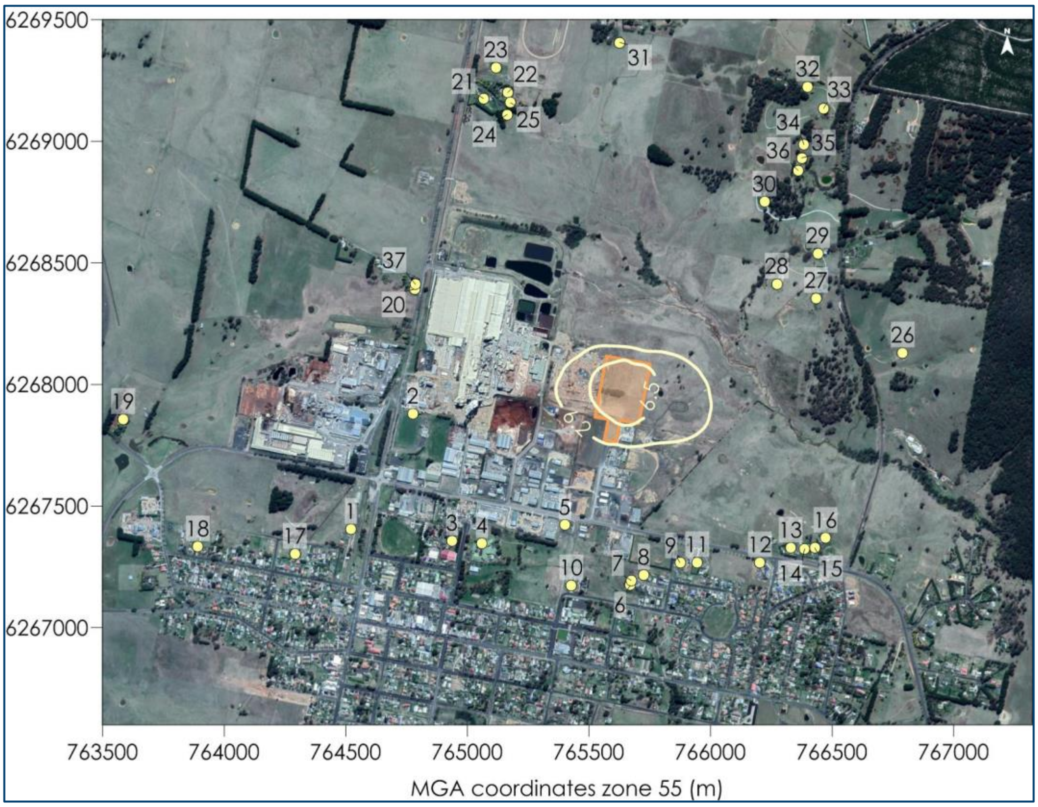

Figure C-7: Predicted cumulative annual average $PM_{2.5}$ concentrations (µg/m³)

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

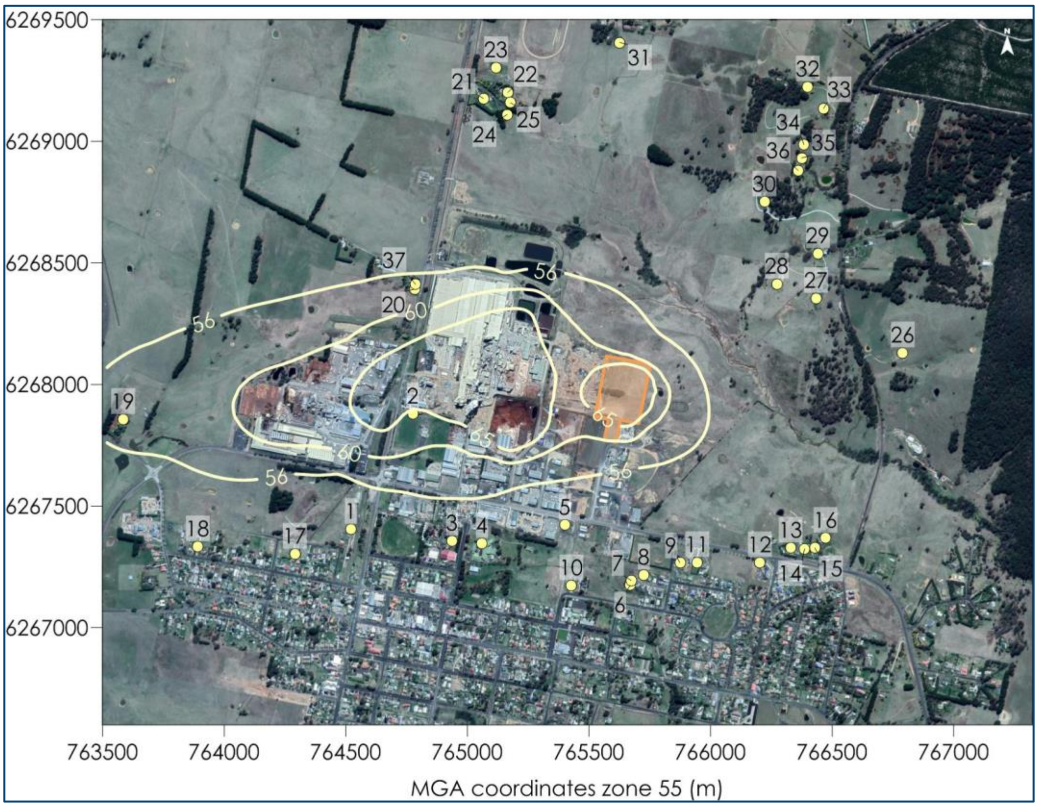

Figure C-9: Predicted cumulative annual average TSP concentrations (µg/m³)

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

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

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

The analysis below provides a cumulative 24-hour $PM_{2.5}$ and a 24-hour PM_{10} impact assessment in accordance with the NSW EPA Approved Methods; refer to the worked example on Page 46 to 47 of the Approved Methods.

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

The existing sources include the contribution from the other surrounding sources.

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.

For the Level 2 assessment, each table assesses one receiver. 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.**

Tables D-1 shows predicted maximum $PM_{2.5}$ cumulative levels at each assessed receptor based on a Level 1 assessment.

Tables D-2 to **D-6** show the predicted maximum PM_{10} cumulative levels at each assessed receptor based on a Level 2 assessment.

TODOROSKI AIR SCIENCES | info@airsciences.com.au | 02 9874 2123

Table D-1: Cumulative 24-hour average $PM_{2.5}$ concentrations (µg/m³)

Receptor ID	Maximum measured background level	Maximum predicted increment	Total cumulative 24-hr average level
R5	17.5	0.2	18.0
R20	17.5	0.1	17.7
R24	17.5	0.04	17.6
R28	17.5	0.1	17.7
R30	17.5	0.1	17.7

Table D-2: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R5

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level + Existing sources	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level + Existing sources	Predicted increment	Total cumulative 24-hr average level
23/09/2017	**56.4**	0.0	**56.4**				
24/09/2017	**54.7**	0.0	**54.7**				
17/02/2017	45.1	0.0	45.1	22/05/2017	13.5	1.6	15.1
16/02/2017	42.6	0.0	42.6	16/06/2017	31.3	1.5	32.8
10/04/2017	38.1	0.0	38.1	11/06/2017	9.4	1.4	10.8
3/09/2017	34.9	0.0	34.9	27/06/2017	17.9	1.2	19.0
23/02/2017	34.4	0.0	34.4	14/06/2017	14.9	1.1	16.0
17/01/2017	34.2	0.0	34.2	22/04/2017	20.6	1.1	21.6
11/02/2017	33.4	0.0	33.5	8/04/2017	13.6	0.9	14.4
19/12/2017	32.4	0.0	32.4	23/04/2017	21.2	0.8	22.0
28/03/2017	31.8	0.0	31.8	17/05/2017	30.9	0.6	31.5
16/06/2017	31.3	1.5	32.8	25/01/2017	5.3	0.5	5.8

Table D-3: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R20

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level + Existing sources	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level + Existing sources	Predicted increment	Total cumulative 24-hr average level
23/09/2017	**51.0**	0.0	**51.0**				
24/09/2017	48.2	0.0	48.2	17/06/2017	26.8	0.7	27.6
17/02/2017	41.0	0.0	41.0	19/06/2017	26.4	0.5	26.9
10/04/2017	40.6	0.0	40.6	12/06/2017	19.5	0.5	20.0
23/02/2017	39.8	0.1	39.8	23/04/2017	31.7	0.4	32.1
16/02/2017	38.3	0.0	38.3	1/07/2017	22.5	0.4	22.9
24/02/2017	38.0	0.1	38.1	26/05/2017	22.7	0.4	23.1
16/06/2017	36.1	0.2	36.3	14/05/2017	20.3	0.4	20.7
9/01/2017	34.6	0.0	34.6	18/03/2017	14.6	0.3	14.9
4/10/2017	33.4	0.1	33.4	3/04/2017	18.5	0.3	18.8
17/01/2017	33.4	0.0	33.4	7/03/2017	16.7	0.3	17.0

Table D-4: 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 + Existing sources	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level + Existing sources	Predicted increment	Total cumulative 24-hr average level
23/09/2017	50.0	0.0	50.0	1/07/2017	17.9	0.3	18.2
24/09/2017	48.0	0.0	48.0	7/06/2017	7.6	0.2	7.9
17/02/2017	39.0	0.0	39.0	11/07/2017	13.6	0.2	13.8
10/04/2017	37.4	0.0	37.4	10/05/2017	16.6	0.2	16.8
16/02/2017	35.6	0.0	35.6	11/03/2017	14.5	0.2	14.6
23/02/2017	32.1	0.0	32.2	27/06/2017	17.5	0.2	17.7
24/02/2017	30.5	0.0	30.5	2/06/2017	0.8	0.2	1.0
17/01/2017	30.5	0.0	30.5	5/06/2017	16.4	0.2	16.6
3/09/2017	29.7	0.0	29.7	27/07/2017	18.1	0.2	18.3
11/02/2017	29.6	0.0	29.6	5/03/2017	4.9	0.2	5.1

Table D-5: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R28

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level + Existing sources	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level + Existing sources	Predicted increment	Total cumulative 24-hr average level
23/09/2017	49.9	0.0	49.9	16/05/2017	17.7	0.8	18.5
24/09/2017	49.5	0.0	49.5	15/07/2017	14.0	0.8	14.8
10/04/2017	39.5	0.3	39.8	30/06/2017	10.4	0.7	11.1
17/02/2017	39.0	0.0	39.0	26/06/2017	19.5	0.7	20.2
16/02/2017	35.7	0.0	35.7	7/05/2017	14.3	0.6	14.9
11/02/2017	35.4	0.0	35.5	17/09/2017	11.5	0.6	12.1
23/02/2017	35.0	0.2	35.1	30/08/2017	13.9	0.6	14.5
3/09/2017	33.0	0.0	33.0	22/08/2017	17.2	0.6	17.8
28/03/2017	31.3	0.0	31.3	6/06/2017	12.8	0.5	13.4
17/01/2017	31.2	0.0	31.2	10/05/2017	14.7	0.5	15.3

Table D-6: 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 + Existing sources	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level + Existing sources	Predicted increment	Total cumulative 24-hr average level
24/09/2017	**50.6**	0.0	**50.6**				
23/09/2017	49.9	0.0	49.9	26/09/2017	25.7	0.6	26.3
10/04/2017	40.1	0.0	40.1	16/05/2017	19.7	0.5	20.2
17/02/2017	38.8	0.0	38.8	19/08/2017	5.4	0.4	5.8
16/02/2017	35.5	0.0	35.6	30/06/2017	12.7	0.4	13.0
23/02/2017	35.5	0.0	35.5	26/06/2017	19.3	0.3	19.7
11/02/2017	30.9	0.0	30.9	17/09/2017	11.3	0.3	11.6
12/02/2017	30.7	0.1	30.7	1/08/2017	8.3	0.3	8.6
17/01/2017	30.5	0.0	30.5	14/04/2017	11.9	0.2	12.1
24/02/2017	30.4	0.0	30.4	30/05/2017	8.9	0.2	9.1
3/09/2017	30.1	0.0	30.1	10/05/2017	14.6	0.2	14.8