Appendix 8

Air Quality Impact Assessment

prepared by
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AIR QUALITY IMPACT ASSESSMENT AUSTEN QUARRY

Hy-Tec Industries Pty Ltd

19 January 2018

Job Number 17080725

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Air Quality Impact Assessment
Austen Quarry

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1 INTRODUCTION

Todoroski Air Sciences has prepared this report for RW Corkery & Co Pty Ltd on behalf of Hy-Tec Industries Pty Ltd. It provides an assessment of the potential air quality impacts associated with the proposed Austen Quarry (the Quarry) Extension Modification 1 (the proposed Modification).

This air quality 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**) and the *Generic Guidance and Optimum Model Settings for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia* (**TRC, 2011**)

To assess the potential air quality impacts associated with the proposed Modification this report incorporates the following aspects:

- Background and description of the Quarry.
- Review of the existing meteorological and air quality environment surrounding the Quarry site.
- Description of the dispersion modelling approach used to assess potential air quality impacts.
- Presentation of the predicted operational air quality levels in the surrounding environment.
- Discussion of the potential air quality impacts.

1.1 Proponent background

Hy-Tec Industries Pty Limited (Hy-Tec) is a fully owned subsidiary of Adelaide Brighton Ltd (Adelaide Brighton), a leading integrated construction materials and lime producing group of companies focused on the engineering, infrastructure and resource sectors. The group's principal activities are the production and marketing of clinker, cement and lime products, pre-mixed concrete and aggregates, and concrete products.

1.2 Existing approvals

The Austen Quarry is operated with the following development consent and licence:

- Development Consent SSD-6084 'Austen Quarry Extension' (Stage 2) issued by the Minister for Planning on 15 July 2015. Operations under SSD 6084 commenced on 15 September 2016 following the surrender of DA 103/94.
- Environment Protection Licence 12323 issued by the NSW Environment Protection Authority (EPA). This licence is renewed annually with the anniversary date being 1 July.

Development Consent DA 103/94 (Stage 1) issued by the Council of the City of Greater Lithgow (now Lithgow City Council) on 22 March 1995, was surrendered 15 September 2016.

1.3 Modification description

A description of the proposed Modification is outlined below:

- Increase the approved annual volume of Quarry products transported from the Quarry from the currently approved limit of 1.1 million tonnes per annum (Mtpa) to1.6Mtpa.
- Increase the daily maximum laden truck loads despatched from 250 to 300 loads per day.
- Increase the daily average laden truck loads despatched from 150 to 200 loads per day.
- Modify the permitted hours of operations to permit truck loading and transport activities to commence from 4:00am rather than the currently approved start time of 5:00am.
- A modification to the approved Extraction area boundary.
- A modification to the approved boundary of the Overburden Emplacement to remove the area no longer required to be disturbed for development of this emplacement.
- A modification to the wording of conditions relating to biodiversity offsetting obligations.

The component of the proposed Modification relevant to this assessment of air quality impacts is the proposed increase to the annual limit on Quarry product despatch from 1.1Mtpa to 1.6Mtpa and associated increase in daily laden truck movements.

1.3.1 Process description

The extraction of rhyolite is undertaken using conventional drill and blast, load and haul methods. Vegetation is first cleared by bulldozer and/or hydraulic excavator and stockpiled for placement over sections of the Quarry to be rehabilitated. Any available soil resources are then stripped and stockpiled for spreading over rehabilitated slopes of the overburden emplacement, or other areas of the Quarry to be rehabilitated.

Current blast sizes may vary according to the location within the extraction area but generally vary from 10 000 tonnes (t) through to approximately 100 000t (with an average of approximately 60 000t). Extraction is approved to a depth of 685m AHD.

The processing operations involve the use of a series of crushers and screens to crush and separate the rhyolite into various size aggregate and sand products and to blend some products to produce customised road pavement products.

Within the secondary processing area, the primary crushed rhyolite is reclaimed from the base of the primary feed stockpile, and conveyed to secondary and tertiary crushers to further reduce the size of the rock. Normally, the crushed rhyolite is conveyed to a screen deck where oversize rock is re-circulated and re-crushed to make products of 20mm size or smaller. All <14mm crushed rock that passes through the screens is conveyed to a vertical shaft impactor where this product is further shaped before being separated into smaller aggregate sizes. An air separator is used for the production of a sand product.

All products are loaded into road registered trucks within either the secondary processing area or the Yorkeys Creek stockpile area.

Figure 1-1 provides the proposed Quarry layout.

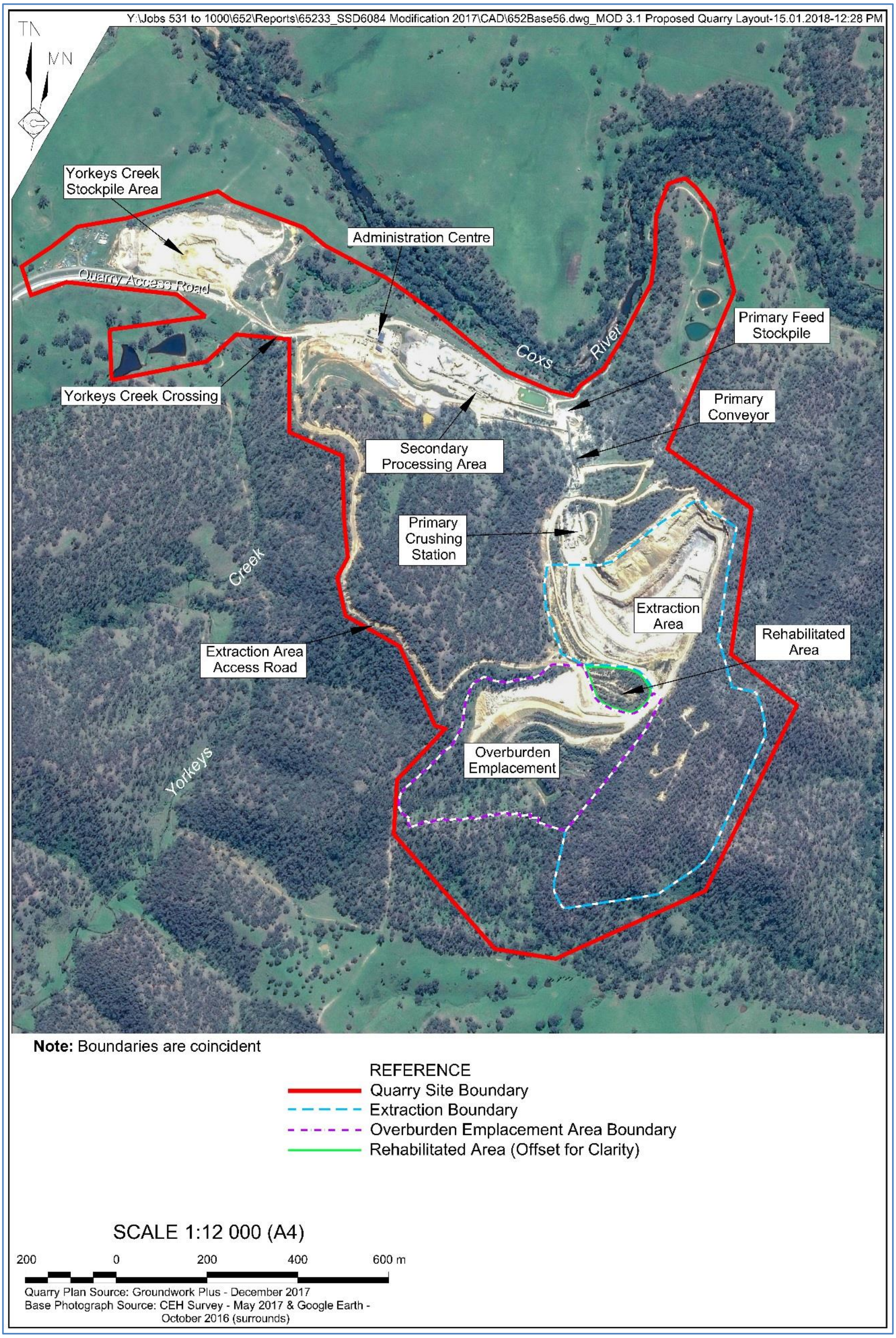

Figure 1-1: Proposed Quarry layout

1.3.2 Proposed operational hours

Table 1-1 outlines the proposed operational hours.

Table 1-1: Operational Hours

Activity	Operational Hours
Extraction operations Processing operations Overburden management Stockpile management	Monday to Friday: 6am – 10pm Saturday: 6am – 3pm
Blasting	Monday to Friday: 10am – 3pm
Loading and dispatch	Monday to Friday: 4am – 10pm Saturday: 5am – 3pm

2 QUARRY SETTING

The Quarry site is situated approximately 3.5 kilometres (km) south-southwest of the village of Hartley and approximately 10km south of Lithgow. The land on which the Quarry is located is considered rural and covers an area of approximately 144 hectares. The Quarry site consists of the following parcels of land, Lots 1 and 2 DP 1000511, Lot 31 DP 1009967 and Lot 4 DP 876394.

Figure 2-1 presents the location of the Quarry and the sensitive receptor locations assessed as discrete receptors in this study. The nearest privately owned residence to the Quarry is located at 781 Jenolan Caves Road, Good Forest, approximately 1,100 metres (m) to the southwest of the Quarry. The full list of sensitive receptors included in this assessment is provided in **Appendix A**.

Figure 2-2 presents a pseudo three-dimensional visualisation of the topography surrounding the Quarry location. The terrain immediately surrounding the Quarry site is rugged. The sensitive receptors from the east to northeast and west to southwest are typically at higher elevations than the operational areas of the Quarry. The extraction area and the overburden emplacement area are significantly elevated compared to the secondary processing area.

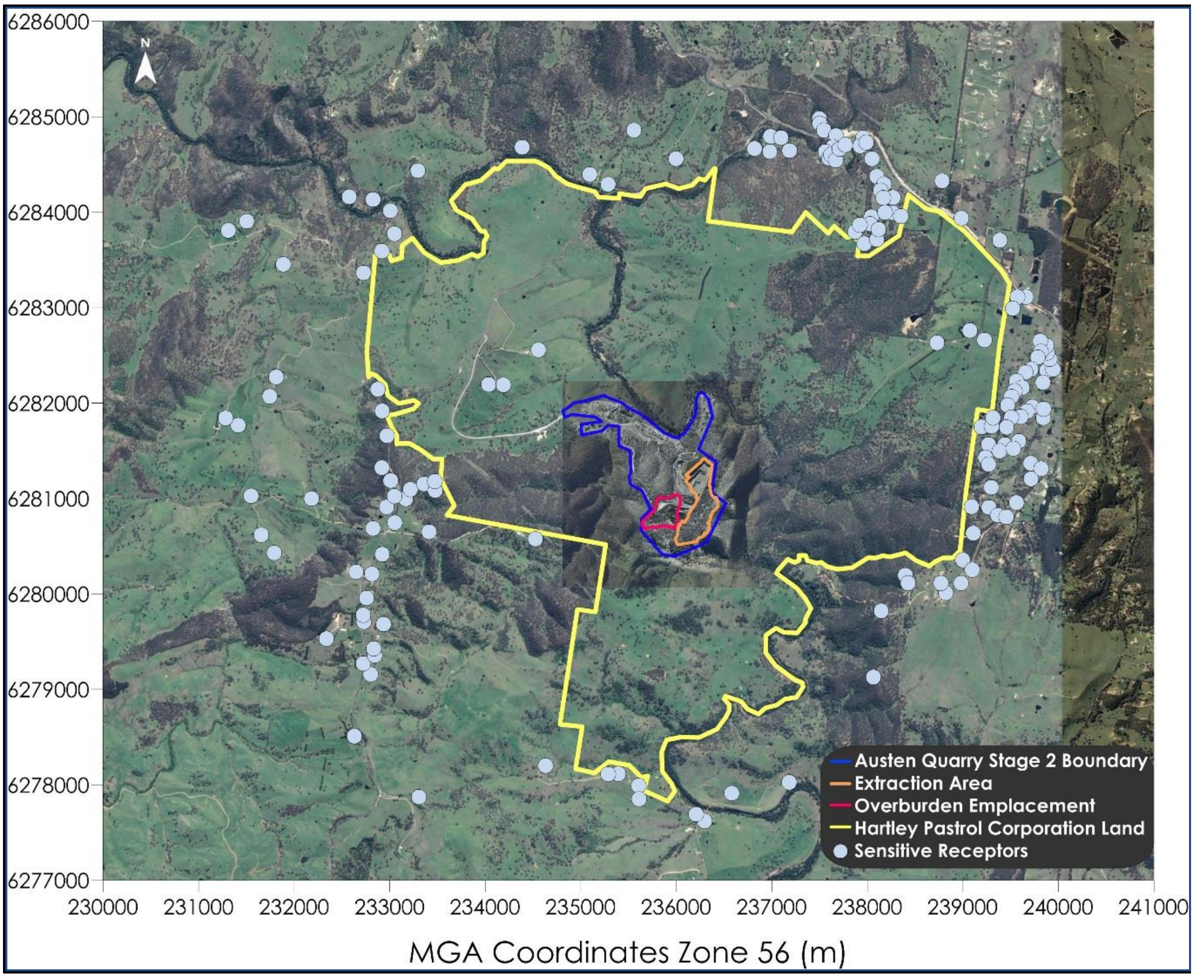

Figure 2-1: Quarry location

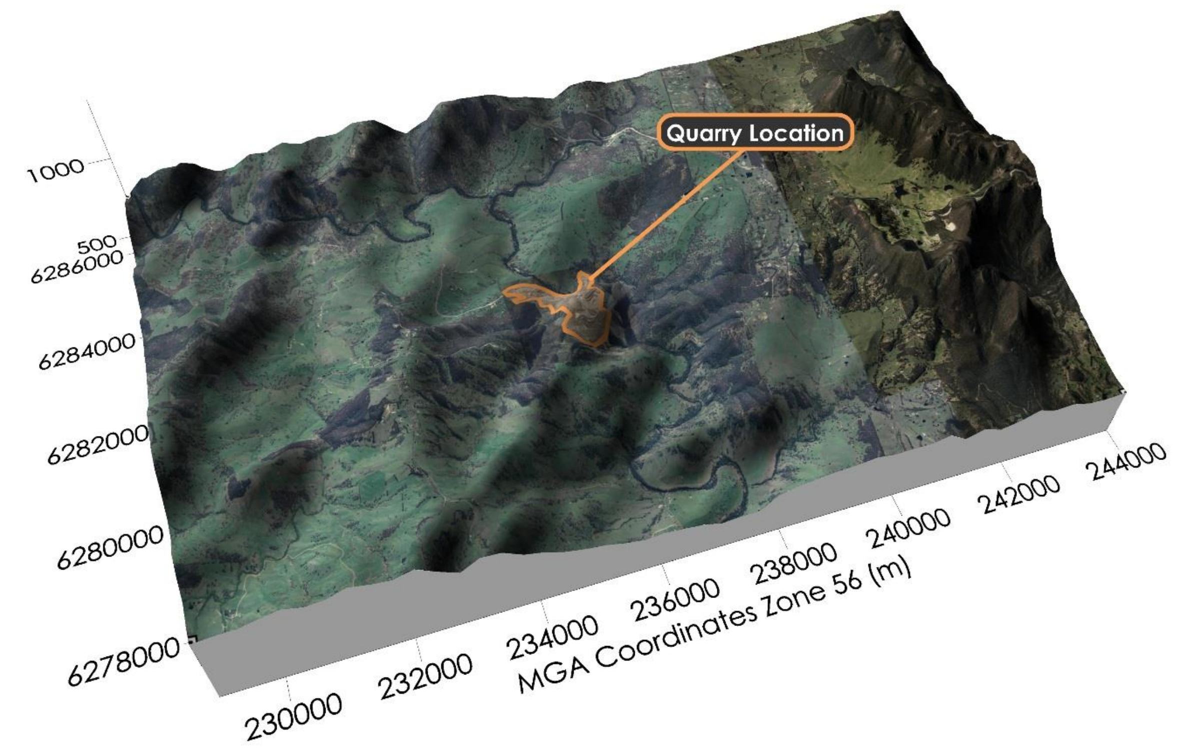

Figure 2-2: Representative view of topography surrounding the Quarry location

3 AIR QUALITY CRITERIA

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. The sub-sections below identify the potential air emissions generated by the Quarry and the applicable air quality criteria. The proposed Modification to increase the annual production intensity would increase the air emissions associated with Quarry's operation.

Particulate matter consists of dust particles of varying size and composition. The upper size range for Total Suspended Particulate matter (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 criteria, 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.

3.1 NSW EPA impact assessment criteria

Table 3-1 summarises the air quality goals that are relevant to this assessment as outlined in the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2017**).

The air quality criteria for particulates refers to the cumulative impact and not just the dust from the Quarry. Consideration of background dust levels needs to be made when using these criterion to assess potential impacts.

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

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

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

3.2 Quarry approval criteria

SSD-6084 provides air quality performance criteria for the Quarry site.

Environmental Compliance Condition 10, Project Approval (SSD-6084) require that all reasonable and feasible avoidance and mitigation measures are employed so that particulate matter emissions generated by Austen Quarry do not cause an exceedance of the criteria presented in **Table 3-2** at any residence on privately-owned land.

Table 3-2: Long term impact assessment criteria for particulate matter

Pollutant	Averaging period	Criterion	
PM_{10}	Annual	[a,d] 30µg/m³	
	24 hour	[b] 50µg/m³	
TSP	Annual	[a,d] 90µg/m³	
[c] Deposited dust	Annual	[b] 2g/m²/month	[a,d] 4g/m²/month

Source: Table 4 of Project Approval (SSD-6084)

a Cumulative impact (i.e. increase in concentrations due to the development plus background concentrations due to all other sources).
b 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.
c Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter - Deposited Matter - Gravimetric Method.
d Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents or any other activity agreed by the Secretary.
e "Reasonable and feasible avoidance measures" includes, but is not limited to, the operational requirements in conditions 11 and 12 to develop and implement an air quality management system that ensures operational responses to the risks of exceedance of the criteria.

3.3 Environmental Protection Licence operating conditions

Environmental Protection Licence (EPL) 12323 provides qualitative operating conditions and monitoring requirements for air pollution at the Quarry.

Condition O3 of EPL 12323 states:

O3 Dust

O3.1 The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.

EPL 12323 does not provide any specific concentration limits relating to air pollution.

3.4 NSW Voluntary Land Acquisition and Mitigation Policy (VLAMP)

The Draft NSW VLAMP dated November 2017 describes the NSW Department of Planning & Environment policy for voluntary mitigation and land acquisition to address impacts at privately-owned residences from State significant mining, petroleum and extractive industry developments. The following criteria apply for impacts associated with particulate matter with separate criteria that apply for noise-related impacts.

Voluntary mitigation rights may apply under the VLAMP where, even with best practice management, the development contributes to exceedances of the air quality criteria in **Table 3-3** at any residence or workplace. [1]

Table 3-3: 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	25µg/m³*		Human health
PM_{10}	24 hour	50µg/m³**		Human health
TSP	Annual	90µg/m³*		Amenity
Deposited dust	Annual	2g/m²/month**	4g/m²/month*	Amenity

Source: NSW Dept Planning & Environment (2017)

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

*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.

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

Table 3-4: Particulate matter acquisition criteria

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

Source: NSW Government (2017)
*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.

3.5 Adopted air quality assessment criteria

The NSW EPA criteria outlined in **Table 3-1** are the most stringent and have been applied for this assessment. It is expected that any approval of the proposed Modifications will include a modification to the air quality criteria to match **NSW EPA (2017)**.

Table 3-5: Adopted air quality impact assessment criteria for the proposed Modification

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

4 EXISTING ENVIRONMENT

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

4.1 Local climatic conditions

Long-term climatic data from the Bureau of Meteorology (BoM) weather station at Mount Boyce AWS (Site No. 063292) were used to characterise the local climate in the proximity of the Quarry. The Mount Boyce AWS is located approximately 12km southeast of the Quarry.

Table 4-1 and **Figure 4-1** present a summary of data from the Mount Boyce AWS collected over an approximate 19 to 26 year period for the various meteorological parameters.

The data indicate that January is the hottest month with a mean maximum temperature of 24.0 degrees Celsius (°C) and July as the coldest month with a mean minimum temperature of 2.5°C.

Rainfall generally peaks during the summer months and declines during winter. The data indicate that February is the wettest month with an average rainfall of 123.4 millimetres (mm) over 10.2 days and July is the driest month with an average rainfall of 42.2 mm over 6.5 days.

Humidity levels exhibit variability and seasonal flux across the year. Mean 9am humidity levels range from 69 per cent (%) in October to 86% in June. Mean 3pm humidity levels range from 54% in October to 72% in June.

Mean 9am wind speeds range from 11.2 kilometres per hour (km/h) in March to 18.8km/h in August. Mean 3pm wind speeds range from 13.9km/h in March to 21.3km/h in September.

Table 4-1: Monthly climate statistics summary – Mount Boyce AWS

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature													
Mean max. temp. (°C)	24.0	22.9	20.5	17.1	13.5	10.1	9.5	11.3	14.7	17.8	20.2	22.4	17.0
Mean min. temp. (°C)	13.3	13.2	11.4	8.7	6.1	3.8	2.5	3.0	5.4	7.5	9.9	11.5	8.0
Rainfall													
Rainfall (mm)	118.9	123.4	116.9	67.8	55.5	79.7	42.2	56.9	55.2	62.9	101.3	85.3	971.5
No. of rain days	11.1	10.2	10.2	7.5	6.3	7.9	6.5	6.2	6.7	7.7	11.8	10.0	102.1
9am conditions													
Mean temp. (°C)	16.4	15.7	13.8	11.8	8.8	6.0	4.8	6.0	9.0	11.8	13.1	15.2	11.0
Mean R.H. (%)	75.0	83.0	84.0	79.0	84.0	86.0	85.0	77.0	72.0	69.0	77.0	74.0	79.0
Mean W.S. (km/h)	11.7	11.4	11.2	12.5	14.4	16.7	17.3	18.8	18.5	17.1	14.3	13.5	14.8
3pm conditions													
Mean temp. (°C)	21.8	20.5	18.7	15.8	12.3	9.1	8.3	10.0	13.1	15.6	17.6	20.1	15.2
Mean R.H. (%)	58.0	66.0	65.0	63.0	69.0	72.0	69.0	59.0	56.0	54.0	61.0	57.0	62.0
Mean W.S. (km/h)	15.3	14.1	13.9	14.3	14.8	17.4	18.3	20.9	21.3	20.0	18.0	17.4	17.1

Source: **Bureau of Meteorology (August 2017)**

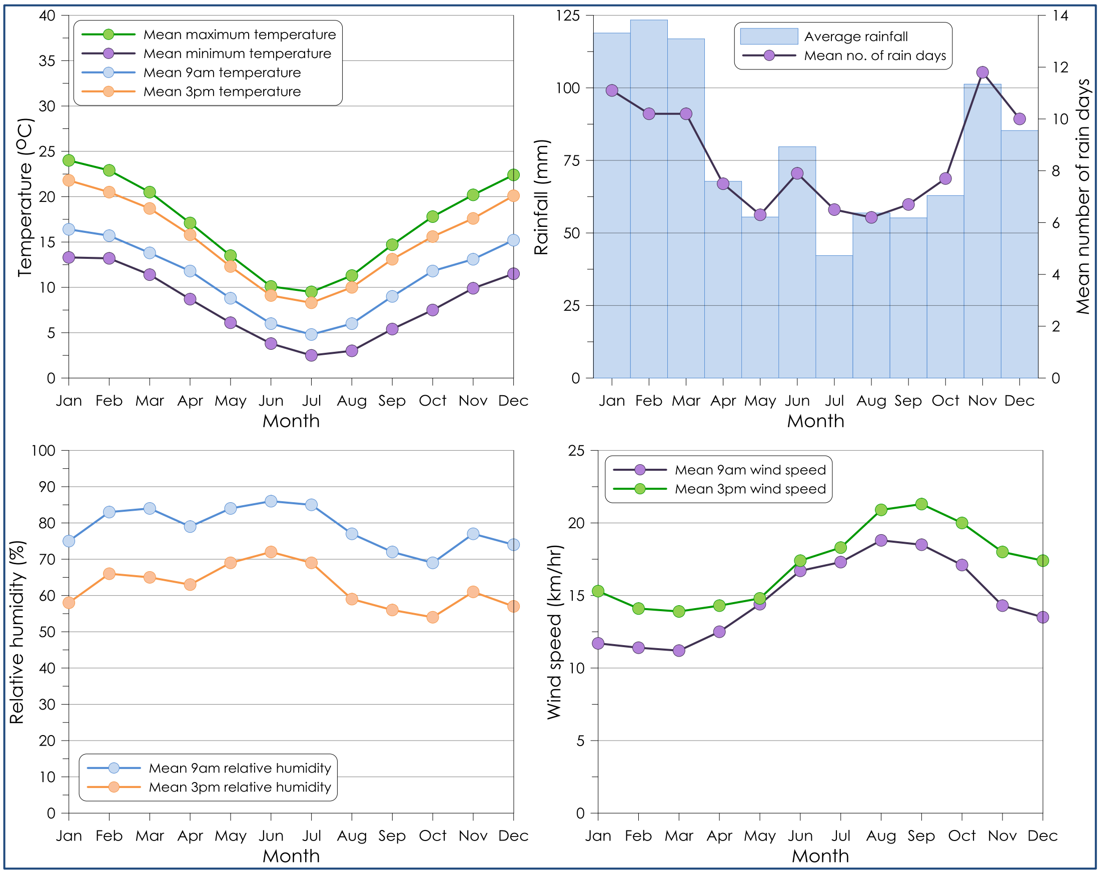

Figure 4-1: Monthly climate statistics summary – Mount Boyce AWS

4.2 Local meteorological conditions

Austen Quarry operates an on-site meteorological station (AQ Met Station) to assist with the ongoing environmental management of the operations. Long term climatic data were not available from the AQ Met Station, and as such the Mount Boyce Automatic Weather Station (AWS) data have been used to select a representative meteorological year for this assessment.

From a review of the latest five years of available data, the 2014 calendar period was found to be representative based on a long-term meteorological analysis of data collected from the Mount Boyce AWS. Details on the selection of the meteorological year are given in **Appendix B**.

Annual and seasonal windroses prepared from AQ Met Station data collected for the 2014 calendar year are presented in **Figure 4-2**.

The windroses indicate that on an annual basis winds from the west-southwest are predominant. High wind speeds occur from the west-southwest while very low wind speeds are predominant from the south-southwest and south. There are few winds from the north, east and southeast which is consistent with the expectations of the positioning of the meteorological station in relation to local terrain features.

During summer, winds are predominantly from the northeast sector. The autumn and spring wind distributions are similar to the annual pattern, typically dominated by strong winds from the west and west-southwest and winds from the east-northeast. In winter the distribution shows mostly high wind speeds from the west-southwest.

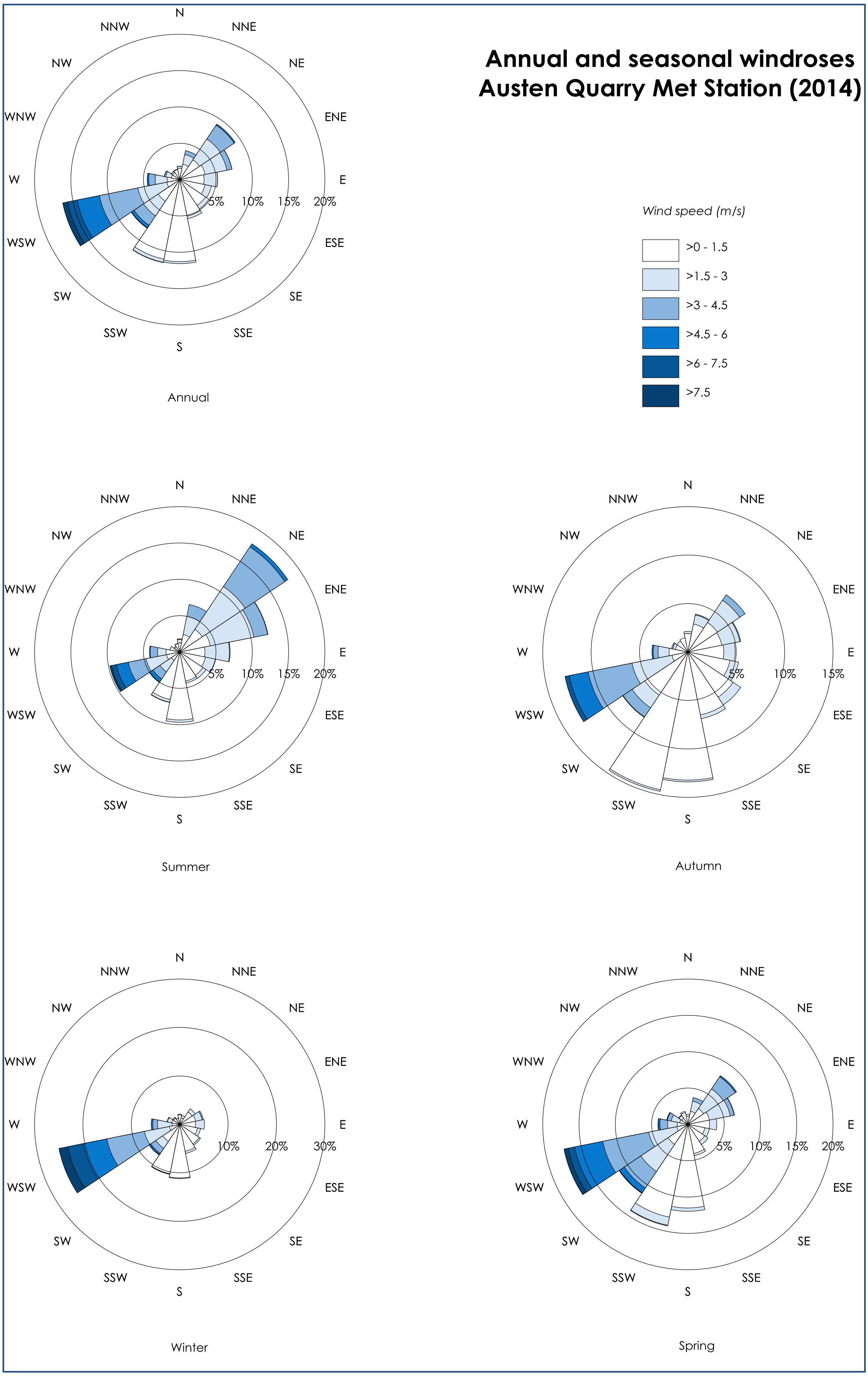

Figure 4-2: Annual and seasonal windroses for Austen Quarry (2014)

4.3 Ambient air quality

The main sources of particulate matter in the wider area around the Quarry include agricultural activities, emissions from local anthropogenic activities such as motor vehicle exhaust and domestic wood heaters.

This section reviews the ambient monitoring data collected from the NSW Office of Environment and Heritage (OEH) monitoring stations located at Tamworth, Wagga Wagga North and Merriwa and by Austen Quarry in the vicinity of the Quarry.

The location of ambient air quality monitoring stations in the vicinity of the Quarry are shown in **Figure 4-3**.

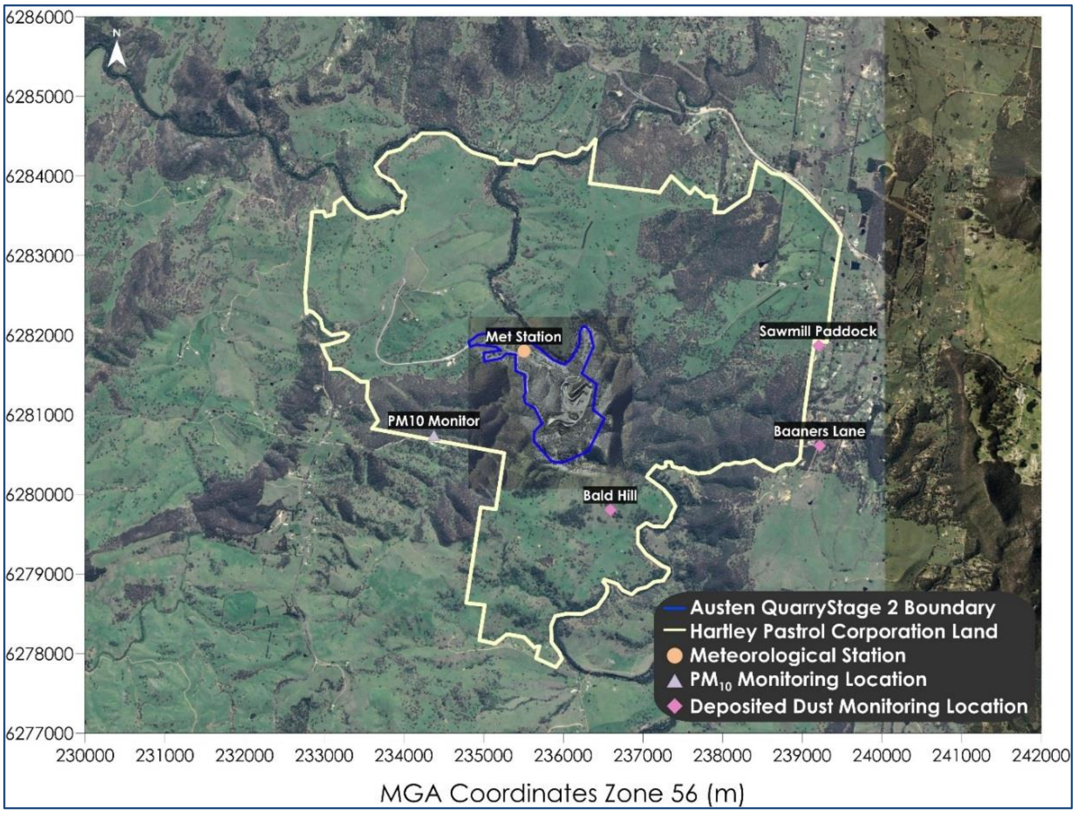

Figure 4-3: Monitoring locations

4.3.1 OEH PM_{10} monitoring

Table 4-2 presents a summary of the PM_{10} concentrations for the Tamworth, Wagga Wagga North and Merriwa monitoring stations from 2012 to 2016.

Annual average PM_{10} concentrations were below the relevant criterion of 25µg/m^3 for the period reviewed. The maximum 24-hour average PM_{10} concentrations recorded were found to exceed the NSW EPA 24-hour average goal of 50µg/m^3 during:

- 2012, 2014 and 2015 at Merriwa;
- 2012, 2014, 2015, and 2016 at Tamworth; and,
- all years at Wagga Wagga North.

Figure 4-4 presents the 24-hour average PM_{10} concentrations recorded at the Tamworth, Wagga Wagga North and Merriwa monitoring stations.

Table 4-2: Summary of PM_{10} levels at OEH monitoring sites (µg/m³)

Parameter	Year	Merriwa	Tamworth	Wagga Wagga North
Annual average (µg/m³)	2012	14.2	15.9	18.8
	2013	14.9	16.5	22.1
	2014	15.2	15.8	20.6
	2015	13.2	14.1	19.8
	2016	13.5	15.3	20.6
Maximum 24-hour average	2012	50.4	55.1	67.2
	2013	43.3	47.5	110.7
	2014	55.2	66.6	88.2
	2015	83	52.7	145.1
	2016	41.6	51.7	114.7
Number of days above criterion (50 µg/m³)	2012	1	1	1
	2013	0	0	15
	2014	3	1	14
	2015	1	1	7
	2016	0	1	16

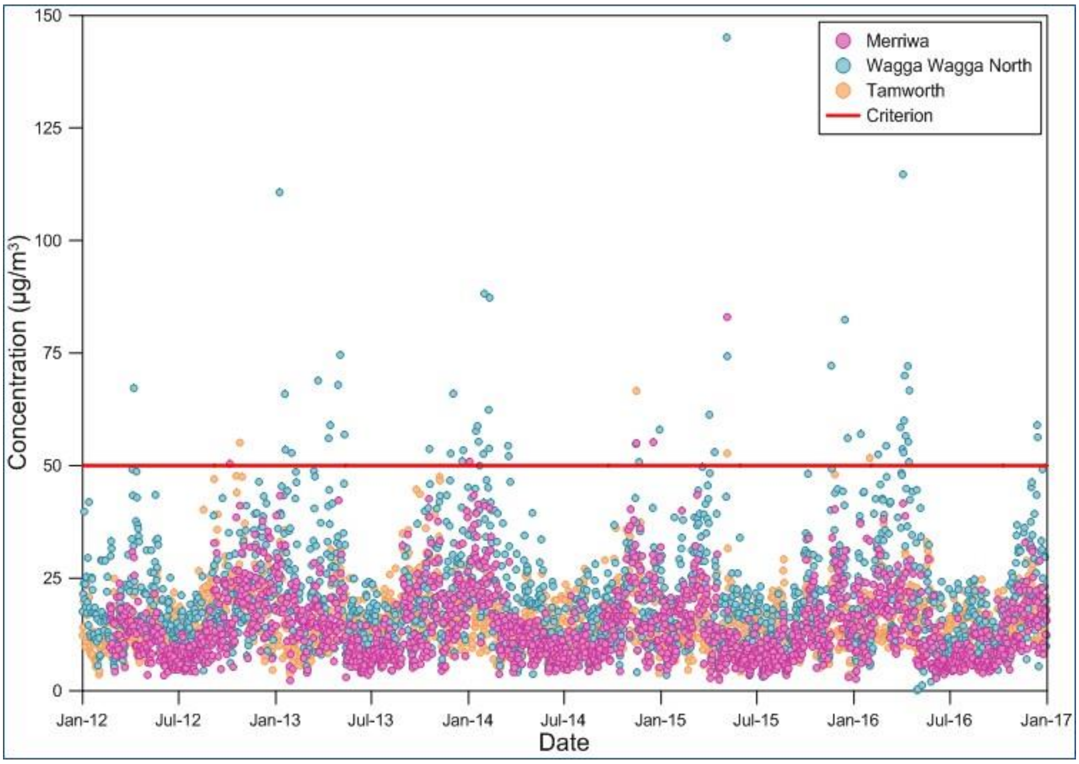

Figure 4-4: 24-hour average PM_{10} concentrations

4.3.2 OEH $PM_{2.5}$ monitoring

Table 4-3 presents a summary of the available $PM_{2.5}$ concentrations for the Tamworth and Wagga Wagga North monitoring stations from 2012 to 2016.

Annual average $PM_{2.5}$ concentrations were above the relevant criterion of 8µg/m^3 at Wagga Wagga North in 2012. The maximum 24-hour average $PM_{2.5}$ concentrations recorded were found to exceed the NSW EPA 24-hour average goal of 25µg/m^3 during 2013, 2014 and 2016 at Wagga Wagga North.

Figure 4-5 presents the 24-hour average $PM_{2.5}$ concentrations recorded at the Tamworth, Wagga Wagga North and Merriwa monitoring stations.

Table 4-3: Summary of $PM_{2.5}$ levels from OEH monitoring sites (µg/m^3)

Parameter	Year	Tamworth	Wagga Wagga North
Annual average (µg/m^3)	2012	-	8.6
	2013	-	8.0
	2014	-	7.5
	2015	-	7.6
	2016	-	7.4
Maximum 24-hour average	2012	-	23.2
	2013	-	29.9
	2014	-	27.6
	2015	-	24.2
	2016	17.6	28.1
Number of days above criterion (25 µg/m^3)	2012	-	0
	2013	-	3
	2014	-	2
	2015	-	0
	2016	0	2

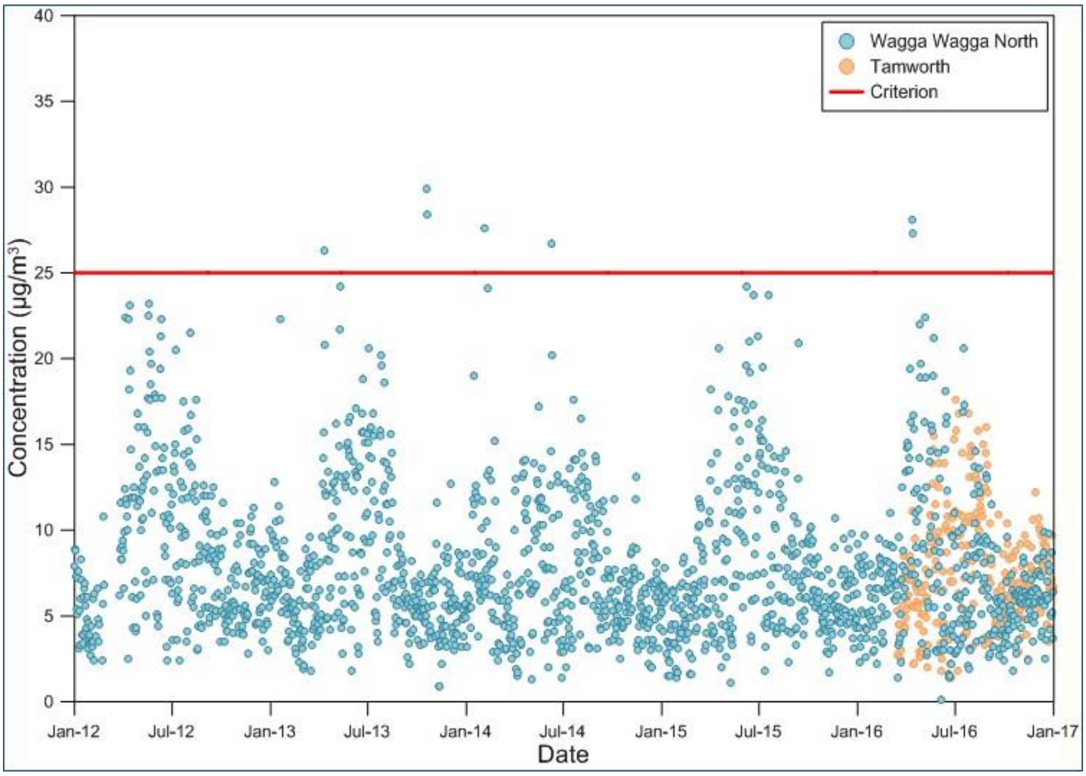

Figure 4-5: 24-hour average $PM_{2.5}$ concentrations

4.3.3 On-site & OEH PM_{10} monitoring data comparison

On-site monitoring data are limited for the Quarry and only available for the period 14 March 2017 to the 15 October 2017. The available data were compared with monitoring data from the NSW OEH monitoring stations located at Tamworth, Wagga Wagga North and Merriwa. These OEH stations were selected as they typically represent similar land uses to those in the vicinity of the Quarry site.

Figure 4-6 presents a comparison of the 24-hour average PM_{10} concentrations for the Quarry site and NSW OEH monitoring stations.

The OEH monitoring stations appear to follow similar trends to the Quarry site data. **Figure 4-6** indicates that data recorded at the Merriwa OEH station roughly aligns the best with the Quarry site monitoring data over the period analysed. Generally concentrations recorded at the Quarry site were slightly lower than that measured at Merriwa for the period analysed.

The Wagga Wagga North and Tamworth data tended to be slightly elevated compared with the Quarry site data and Merriwa data over the period analysed and may be due to the influence of localised sources.

Further analysis of the particulate monitoring is available in the *Austen Quarry Particulate Matter Monitoring Report* (**RWC, 2017b**).

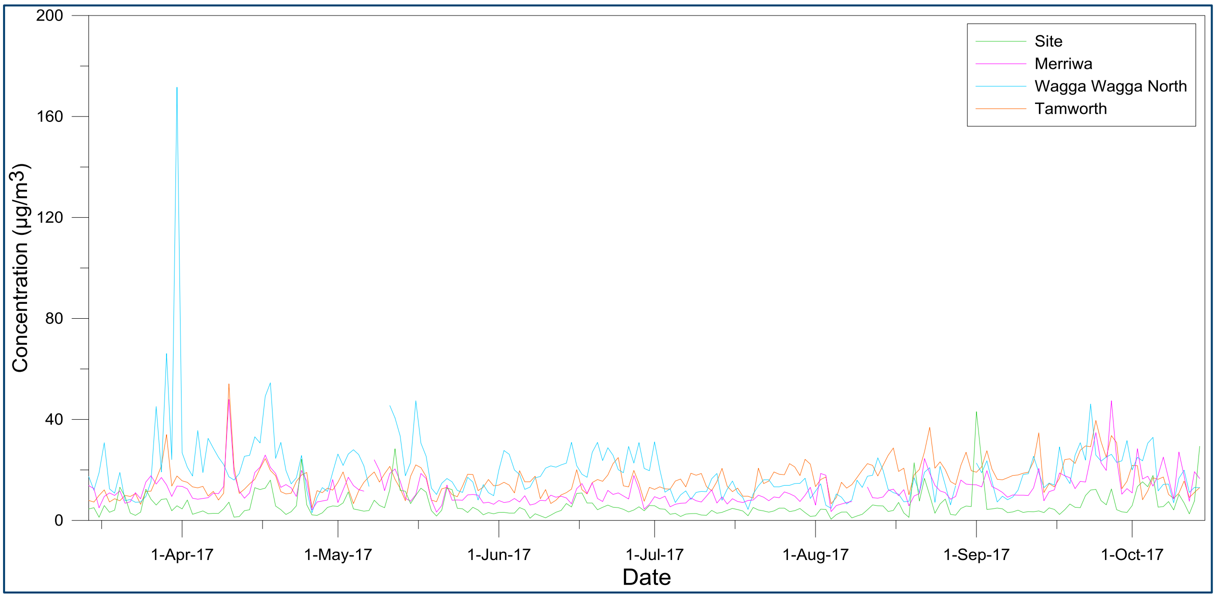

Figure 4-6: Comparison of site and OEH 24-hour average PM_{10} concentrations (14/3/2017 to 15/10/2017)

4.3.4 Deposited dust monitoring data

The Quarry operates three dust deposition monitoring locations, shown in **Figure 4-3**.

Table 4-4 provides a summary of the measured annual (financial year) average dust deposition data. All gauges recorded an annual average insoluble deposition level below the criterion of 4g/m^2/month.

Table 4-4: Summary of measured dust deposition – insoluble solids (g/m²/month)

Period (July-June)	Sawmill Paddock	Baaners Lane	Bald Hill
2011-2012	0.7	0.4	0.2

Period (July-June)	Sawmill Paddock	Baaners Lane	Bald Hill
2012-2013	1.1	0.8	0.6
2013-2014	1.2	0.8	0.7
2014-2015	1.1	0.4	0.7
2015-2016	1.6	0.7	0.6
2016-2017	1.1	0.7	0.8

4.3.5 Estimated background air quality levels

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

For annual average PM_{10}, data from the Merriwa, Tamworth and Wagga Wagga North monitors have been averaged to determine an appropriate annual background level. In correlation with the meteorological data set used, the 2014 year data set was selected to represent background concentrations at the Quarry site and surrounding sensitive receptors.

The Wagga Wagga North monitoring station was the only station which recorded $PM_{2.5}$ during the 2014 year. As such the Wagga Wagga North monitoring data have been adopted to quantify the existing ambient levels of air pollutants in this study. The adopted background level is considered conservative as this would include additional contribution from local sources near the Wagga Wagga North monitoring station.

4.3.5.2 TSP concentrations

In the absence of data, estimates of the annual average background TSP concentrations can be determined from a relationship between PM_{10}, TSP and the measured PM_{10} levels.

This relationship conservatively assumes that an annual average PM_{10} concentration of 25µg/m^3 corresponds to a TSP concentration of 90µg/m^3. This assumption is based on the NSW EPA air quality impact criteria.

Applying this relationship with the applied annual average PM_{10} concentration of 17.2µg/m^3 indicates an approximate annual average TSP concentration of 61.9µg/m^3.

4.3.5.3 Deposited dust

In correlation with the meteorological data set used, the 2014 year data set was selected to represent background concentrations at the Quarry site and surrounding sensitive receptors. The deposited dust level of 1.2 g/m^2/month from Sawmill Paddock was adopted as the background level for this assessment, as this monitor recorded the highest concentration of the three monitoring locations during the 2013-2014 and 2014-2015 periods.

Note that the adoption of this background level is conservative as this would include a contribution from the existing Quarry operations.

4.3.5.4 Summary of background pollutant concentrations

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

Table 4-5: Summary of background air quality levels

Pollutant	Averaging Period	Units	Value
PM_{10}	Annual	µg/m³	17.2
$PM_{2.5}$	Annual	µg/m³	7.5
TSP	Annual	µg/m³	61.9
Deposited dust	Annual	g/m²/month	1.2

Ambient (background) concentration data for PM_{10} and $PM_{2.5}$ from Merriwa and Wagga Wagga North respectively have been applied in the Level 2 contemporaneous assessment of 24-hour average impacts.

5 DISPERSION MODELLING APPROACH

5.1 Introduction

The following sections are included to provide the reader with an understanding of the model and the modelling approach applied for the assessment.

An air dispersion model is a complex simulation of how the prevailing weather conditions affect the way air pollutants travel and disperse in the atmosphere away from the pollutant sources. Such models are used to predict the potential air quality impacts of the Quarry on the surrounding environment.

For this assessment, the CALPUFF modelling suite is applied to dispersion modelling. The model was setup in general accordance with methods provided in the NSW EPA document *Generic Guidance and Optimum Model Settings for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia'* (**TRC Environmental Corporation [TRC]**, **2011**).

5.2 Modelling methodology

5.2.1 Meteorological modelling

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

The centre of analysis for TAPM was 33deg34.5min south and 150deg9.5min east (236000mE, 6281000mN). 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 domain. 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 20 x 20km area with a 0.4km grid resolution and refined for an inner domain on a 10 x 10km area with a 0.1km grid resolution.

The 2014 calendar year was selected as the meteorological year for the dispersion modelling based on analysis of long-term data trends in meteorological data recorded for the area. Further detail on the selection of the meteorological year is outlined in **Appendix B**. The available meteorological data for January 2014 to December 2014 from relevant on-site and BoM meteorological monitoring sites were included in the simulation. **Table 5-1** outlines the parameters used from each station.

Table 5-1: Surface observation stations

Weather Stations	Parameters						
	WS	WD	CH	CC	T	RH	SLP
Austen Quarry Met Station	✓	✓			✓	✓	✓
Mount Boyce AWS (BoM) (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 seven critical parameters used in the CALMET modelling are presented in **Table 5-2**.

Table 5-2: Seven critical parameters used in CALMET

Parameter	Value
TERRAD	10
IEXTRP	-4
BIAS (NZ)	-1, -0.5, -0.25, 0, 0, 0, 0, 0
R1 and R2	3.5, 3.5
RMAX1 and RMAX2	7,7

CALMET generated meteorological data were extracted from a point within the CALMET domain and are represented in **Figure 5-1** and **Figure 5-2**.

Figure 5-1 presents the annual and seasonal windroses from the CALMET data. The CALMET modelling results reflect the expected wind distribution patterns of the area based on consideration of the measured data and the expected terrain effects on the prevailing winds.

Figure 5-2 includes graphs of the temperature, wind speed, mixing height and stability classification over the modelling period and is consistent with the conditions expected to occur in the area.

It is considered that the CALMET modelling reflects the expected wind distribution patterns of the area as determined based on the available measured data and the expected terrain effects on the prevailing winds.

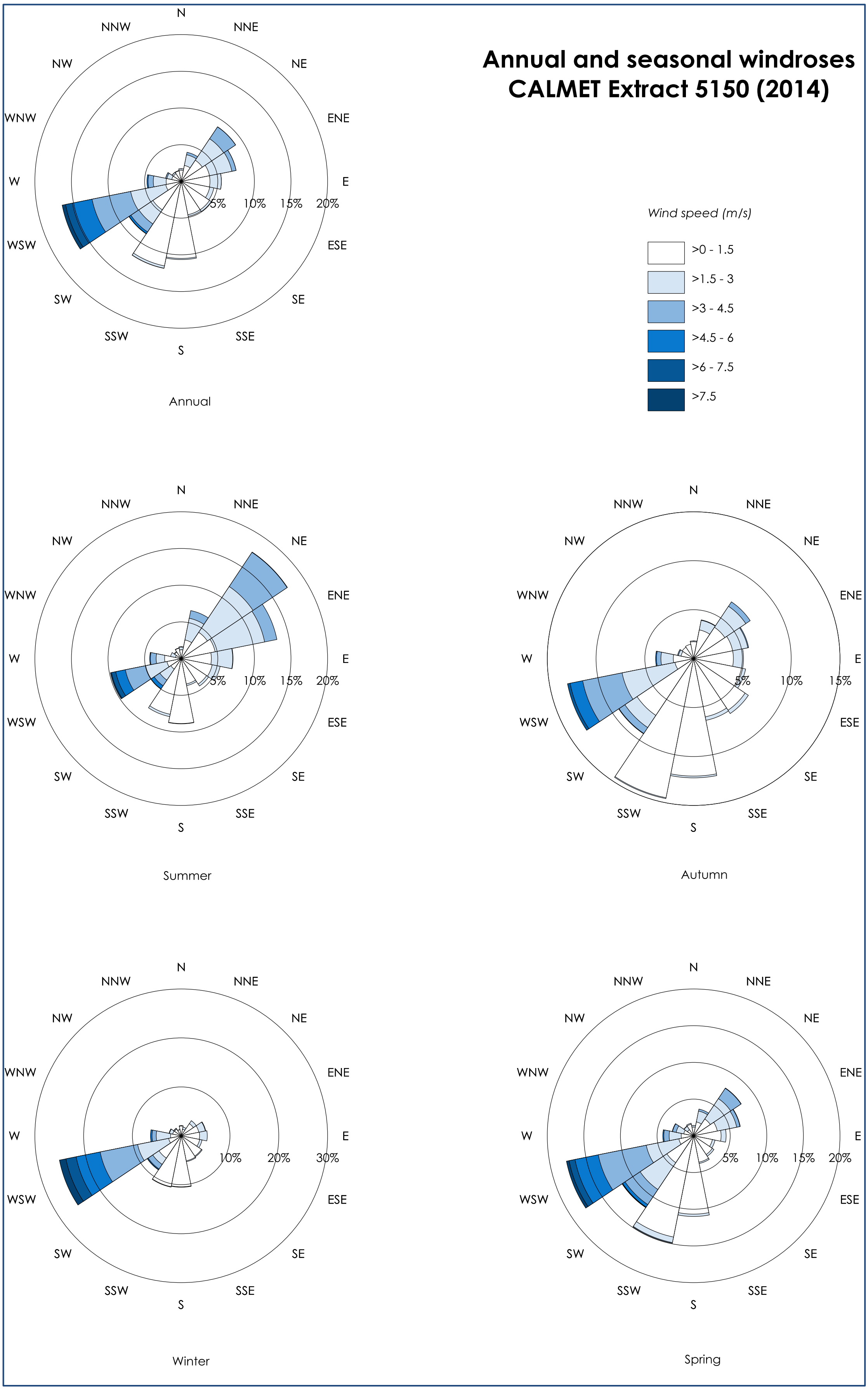

Figure 5-1: Windroses from CALMET extract (cell ref 5150)

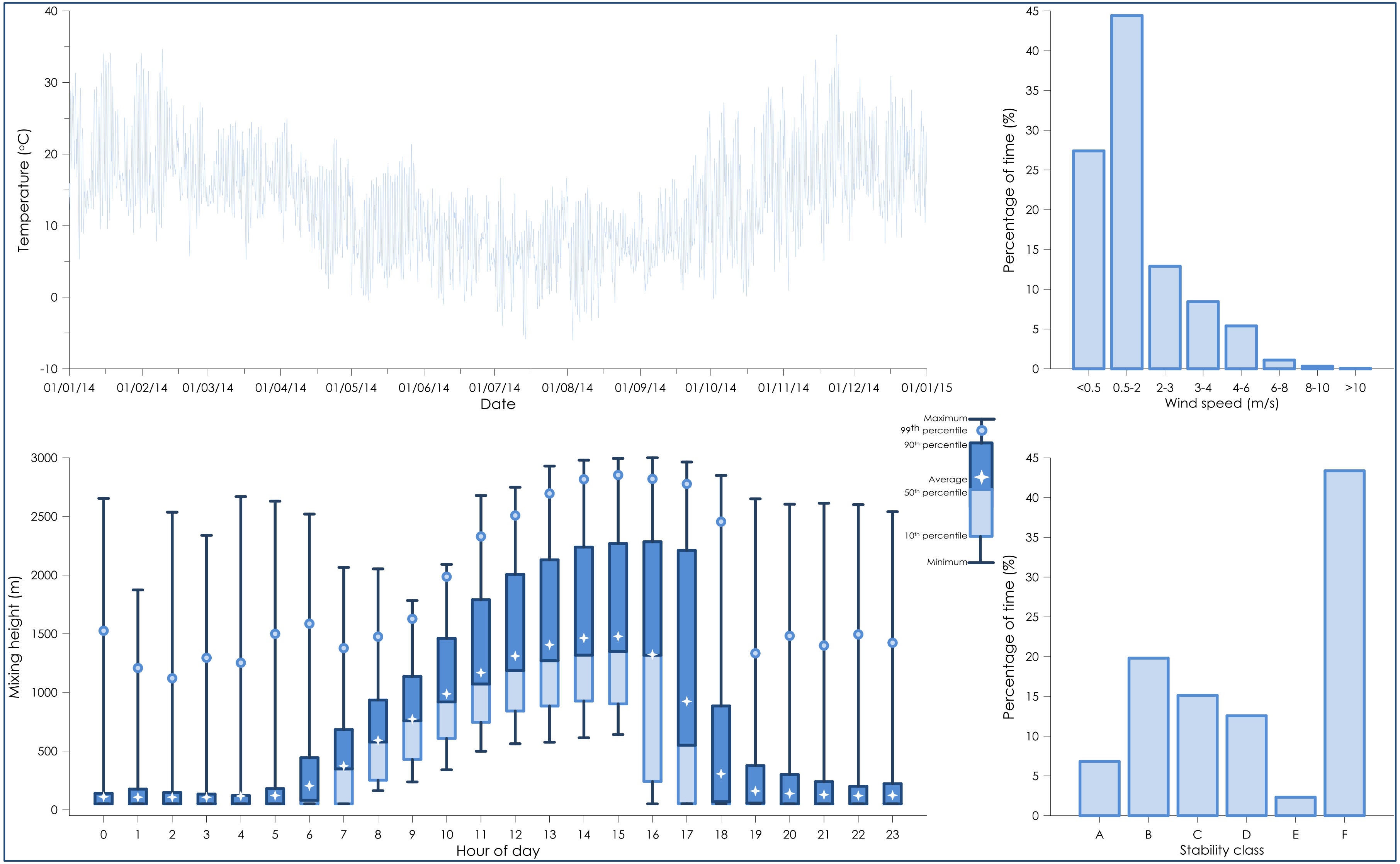

Figure 5-2: Meteorological analysis of CALMET extract (cell ref 5150)]

5.2.2 Dispersion modelling

The CALPUFF dispersion model, in conjunction with a CALMET generated meteorological data file, was applied to provide predictions of the ground level concentrations of dust based on the estimated emissions.

As such emissions from each activity were represented by a series of volume sources and were included in the CALPUFF model via an hourly varying emission file.

5.3 Emission estimation

5.3.1 Dust emission estimation

Activities associated with the proposed Modification have the potential to generate dust emissions from various activities including extraction, processing, handling and wind erosion of exposed areas. Movements of vehicles on the site (including excavators, dozers and trucks) may generate air emissions from the exhaust, brake wear and wheel generated dust when travelling on roads. **Table 5-3** provides a list of these activities and sources.

Dust emissions from the Quarry would increase as a result of the proposed Modification increasing the limit on Quarry product desptach from 1.1 million tonnes per annum to 1.6 million tonnes per annum.

Dust emission estimates for the proposed Modification have been calculated by analysing the various types of dust generating activities taking place and utilising suitable emission factors sourced from both locally developed (**NPI 2012 and 2014**) and US EPA developed documentation (**US EPA 1998** and **US EPA 2006**). The estimated dust emissions for activities associated with the proposed operation are presented in **Table 5-3**. Detailed calculations of the dust emission estimates are provided in the emissions inventory **Appendix C**.

Table 5-3: Estimated annual dust emission rate for the proposed Modification (kg/year)

Activity	TSP emissions	PM_{10} emissions	$PM_{2.5}$ emissions
Dozers removing vegetation in extraction area	16,701	4,008	1,800
Drilling in extraction area	8,925	4,641	268
Blasting in extraction areas	483	251	15
Overburden excavator loading to truck	144	69	5
Haul overburden to overburden emplacement	10,369	2,540	207
Dumping overburden at emplacement	144	69	5
Dozers on overburden	16,701	4,008	1,800
Excavator loading materials to truck	1,082	519	36
Hauling materials to primary crusher	56,425	13,824	1,129
Load materials to primary crusher	1,082	519	36
Primary crushing	4,320	1,944	136
Loading to screen	1,082	519	36
Primary screening	20,000	6,727	1,667
Conveying to primary feed stockpile	18	9	1
Unload to stockpile	1,082	519	36
Conveying to secondary processing area	21	11	2
Transfer to secondary crusher	1,039	499	35
Secondary crushing	4,147	1,866	131
Convey to secondary screen	8	4	1
Transfer to secondary screen	1,039	499	35
Secondary screening	19,200	6,458	1,600

Activity	TSP emissions	PM_{10} emissions	$PM_{2.5}$ emissions
Unload to stockpile (ballast/20mm)	312	150	10
Convey to tertiary crusher	8	4	1
Transfer to tertiary crusher	831	399	28
Tertiary crusher	3,318	1,493	105
Convey to secondary screen	8	4	1
Transfer to secondary screen	831	399	28
Secondary screening	15,363	5,167	1,280
Convey to quaternary crusher	8	4	1
Transfer to quaternary crusher	727	349	24
Quaternary crusher	2,903	1,306	91
Convey to tertiary screen	8	4	1
Transfer to tertiary screen	727	349	24
Tertiary screening	13,438	4,520	1,120
Unload to stockpile (14mm, 10mm, 7mm, 5mm)	416	199	14
Convey to air separator	8	4	1
Transfer to air separator	312	150	10
Air separator	5,760	1,937	480
Unload sand to stockpile	312	150	10
Load truck in secondary processing area	1,021	490	34
Hauling materials offsite	76,892	18,838	1,538
Load truck (fines)	61	29	2
Hauling fines to Yorkeys Creek stockpile area	2,696	660	54
Unload fines to Yorkeys creek stockpile	61	29	2
Load truck (fines)	55	26	2
Hauling fines offsite	1,941	476	39
Wind erosion	22,100	11,050	1,658
Grading roads	54	17	2
Total emissions	**314,178**	**97,709**	**15,539**

5.3.2 Potential diesel emissions

The emission factor equations used for the activities that involve diesel powered equipment include contributions from the diesel exhaust emissions of the equipment. The emission factor equations do not distinguish between the separate sources of emissions, as the mechanically generated emissions and the exhaust emissions combined were measured when deriving the equations.

The estimated emissions presented in **Table 5-3** include the contribution of exhaust emissions associated with the diesel powered equipment.

5.3.3 Potential blast fume emissions

Air quality impacts from blast fume emissions are rare, but are possible when there are unforeseeable complications with a blast that causes high levels of NO_2 or dust emission, and when this occurs during unfavourable air dispersion conditions.

The Quarry employs appropriate blast management measures outlined in a blast management plan to ensure that blasting activities are managed in a manner which would minimise the risk of impacts arising.

The potential effects from blasting activities are generally managed by scheduling the blast to times when there would be a low risk of impact, for example, when winds blow away from receptors. These conditions can be forecast by reviewing predictive meteorology. Blast operators make the final decision to blast based on the available information, including real-time conditions and available forecasts.

The decision of whether to initiate a blast at any given time will generally need to balance many potentially conflicting factors; for example water ingress will increase the risk of a high emissions event, thus waiting too long for ideal air dispersion conditions to occur may present an unacceptable level of risk and therefore the blast may be initiated under less than ideal weather conditions.

On the other hand, a dry blast with low scope for any degradation of the explosive over time or low potential to lead to any elevated emissions might be delayed if it appears that air dispersion conditions would soon improve significantly.

Occasionally safety concerns may also arise, and may require a blast to be detonated under less than ideal (environmental) conditions.

Overall, it is anticipated that with due care, potential blast impacts would be averted at the Quarry, it is recommended that the blast management plan is regularly reviewed to ensure best practice blast management.

5.3.4 Estimated greenhouse gas emissions

The primary source of greenhouse gas emissions from the Quarry would be direct emissions as a result of the combustion of diesel by on-site generators and mobile equipment and also, to a minor extent, emissions from blasting. Greenhouse gases would also be generated indirectly through the extraction and processing of raw materials to produce the diesel fuel consumed on the site.

Although carbon dioxide (CO_2) would be the principal gas produced, greenhouse gases emitted as a result of the operations may also include carbon monoxide (CO), methane (CH_4), oxides of nitrogen (NO_x), SO_2 and non-methane volatile organic compounds (NMVOCs).

To estimate the potential change in greenhouse gas emissions associated with the proposed Modification, it can be assumed that the proposed increase in annual production would see a proportional increase in the use of diesel. Based on this assumption, it can be estimated that potential greenhouse gas emissions may increase by approximately 45 per cent due to the proposed Modification.

Hy-Tec will continue to utilise mitigation measures set out in the ***Austen Quarry Air Quality Management Plan*** **(RWC, 2017a)** to minimise the generation of greenhouse gases emissions from the Quarry incorporating the proposed Modification and investigate ways to reduce overall greenhouse gas emissions from the operations.

6 DISPERSION MODELLING RESULTS

6.1 Dust concentrations

Figure 6-1 to **Figure 6-6** present pollutant concentration isopleths showing the spatial distribution of the predicted incremental impacts associated with the proposed Modification (alone) over the modelling domain for maximum 24-hour average $PM_{2.5}$ and PM_{10}, and annual average $PM_{2.5}$, PM_{10}, TSP and deposited dust (DD) levels.

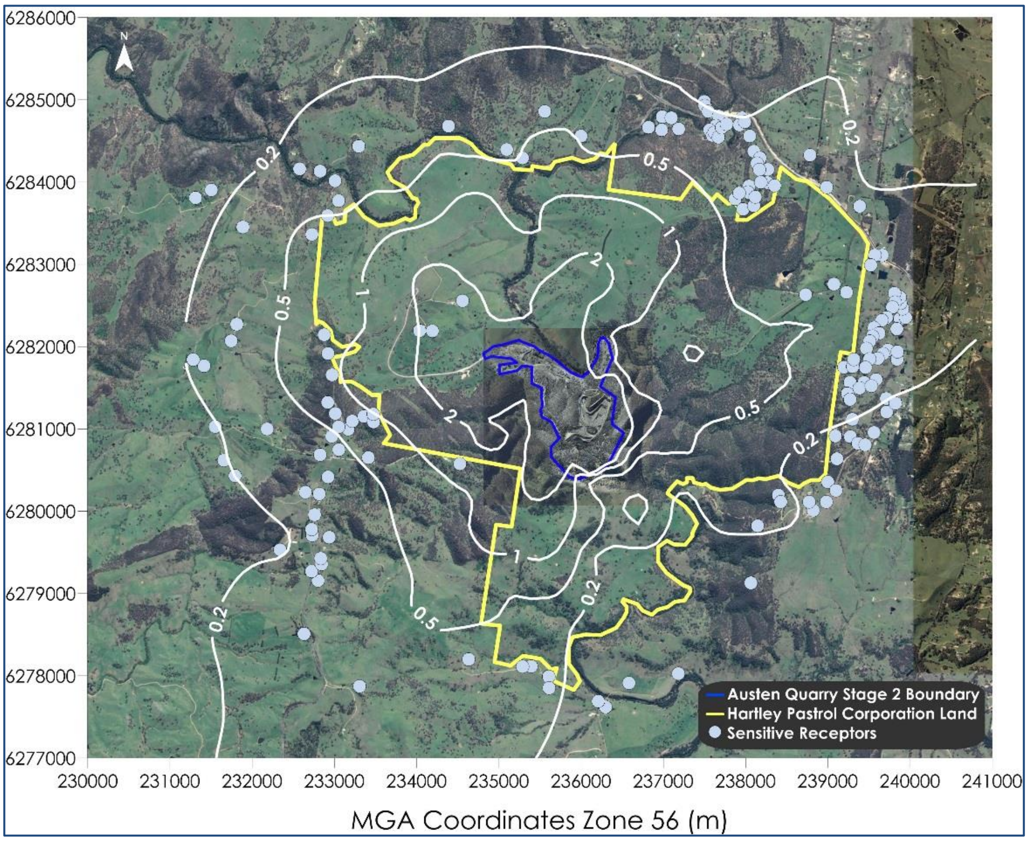

Figure 6-1: Predicted incremental maximum 24-hour average $PM_{2.5}$ concentrations (µg/m³)

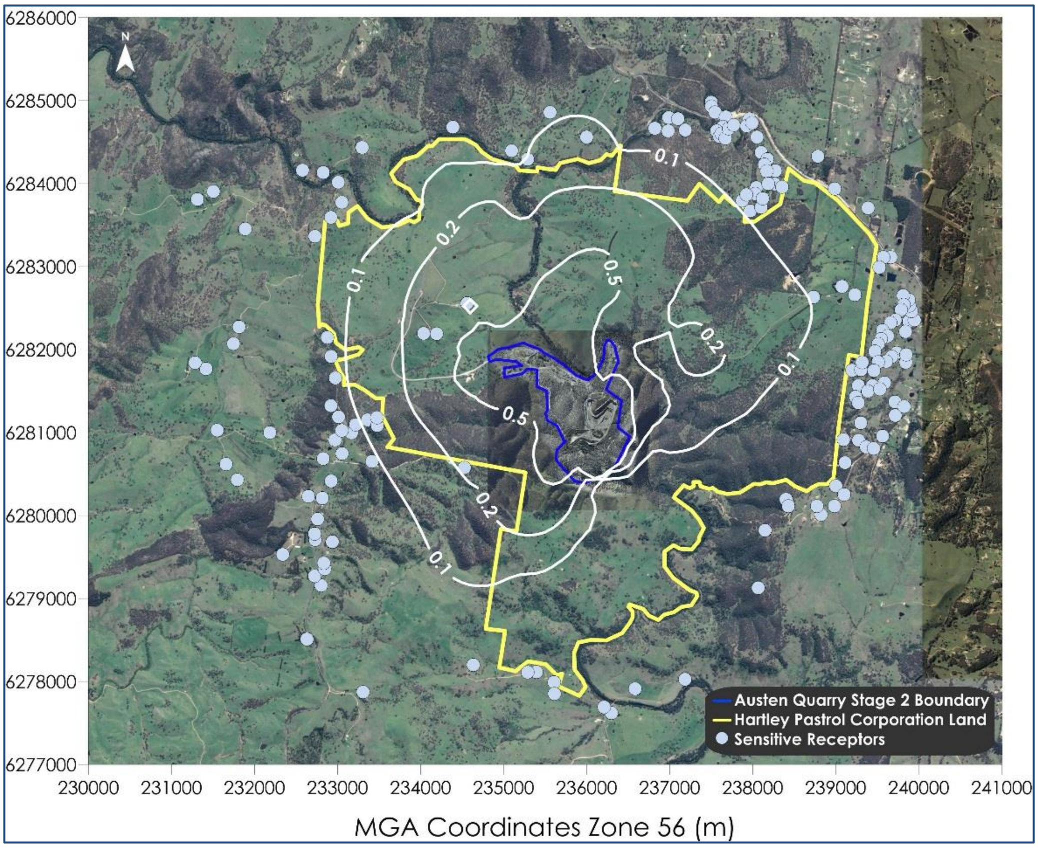

Figure 6-2: Predicted incremental annual average $PM_{2.5}$ concentrations (µg/m³)

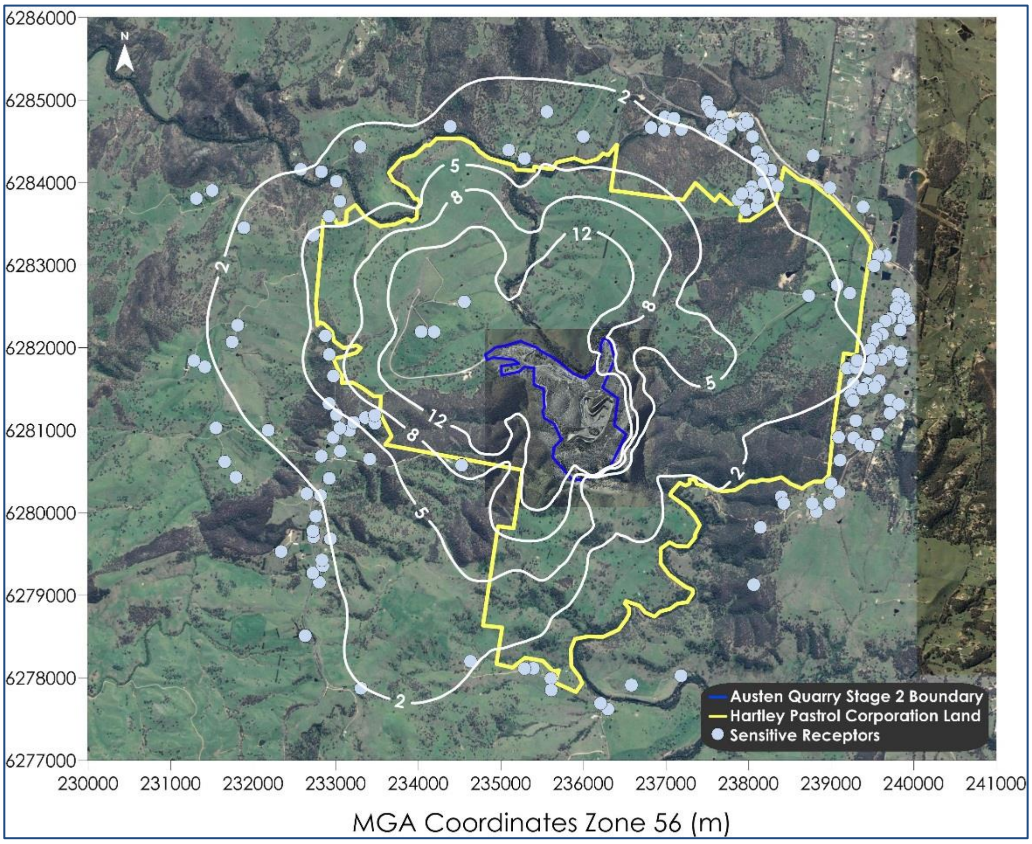

Figure 6-3: Predicted incremental maximum 24-hour average PM_{10} concentrations (µg/m³)

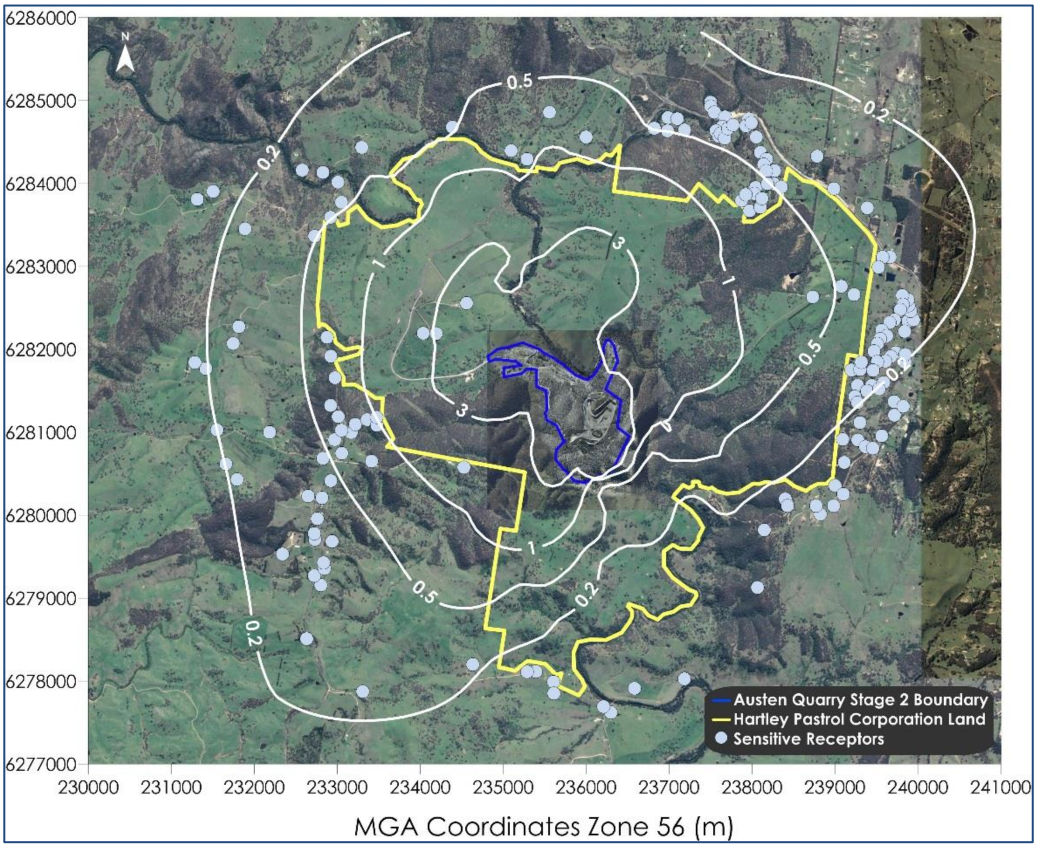

Figure 6-4: Predicted incremental annual average PM_{10} concentrations (µg/m³)

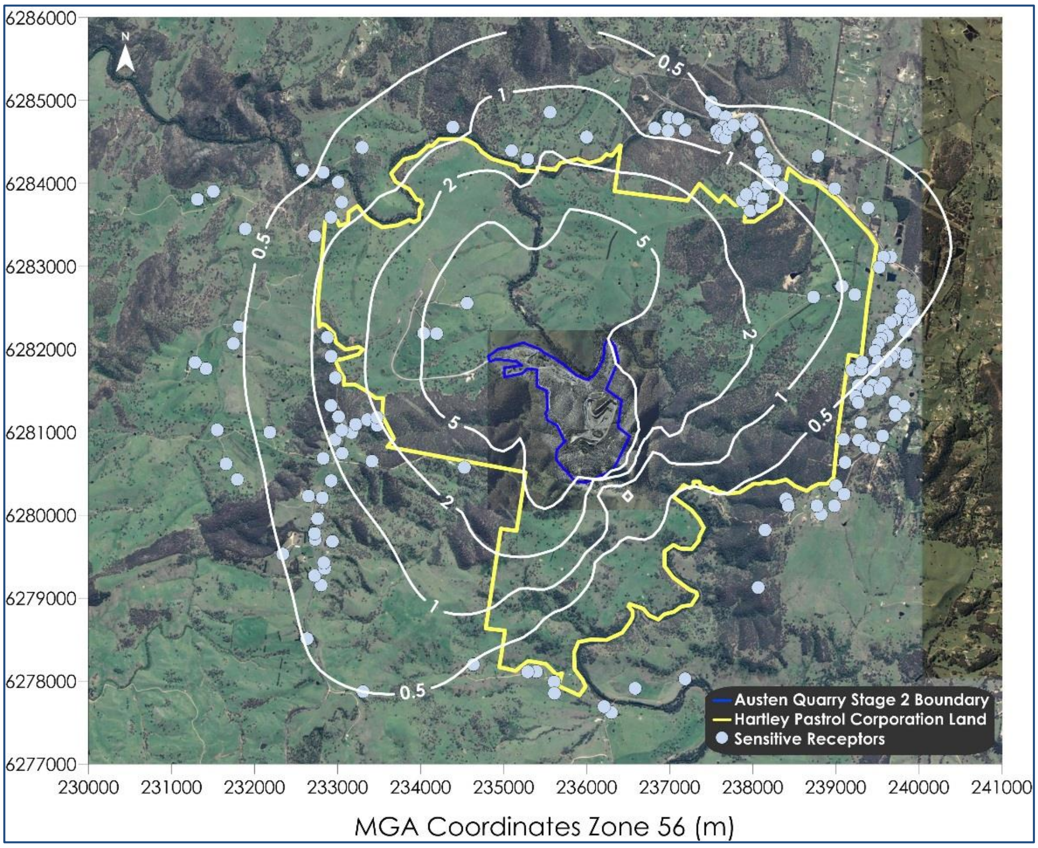

Figure 6-5: Predicted incremental annual average TSP concentrations (µg/m³)

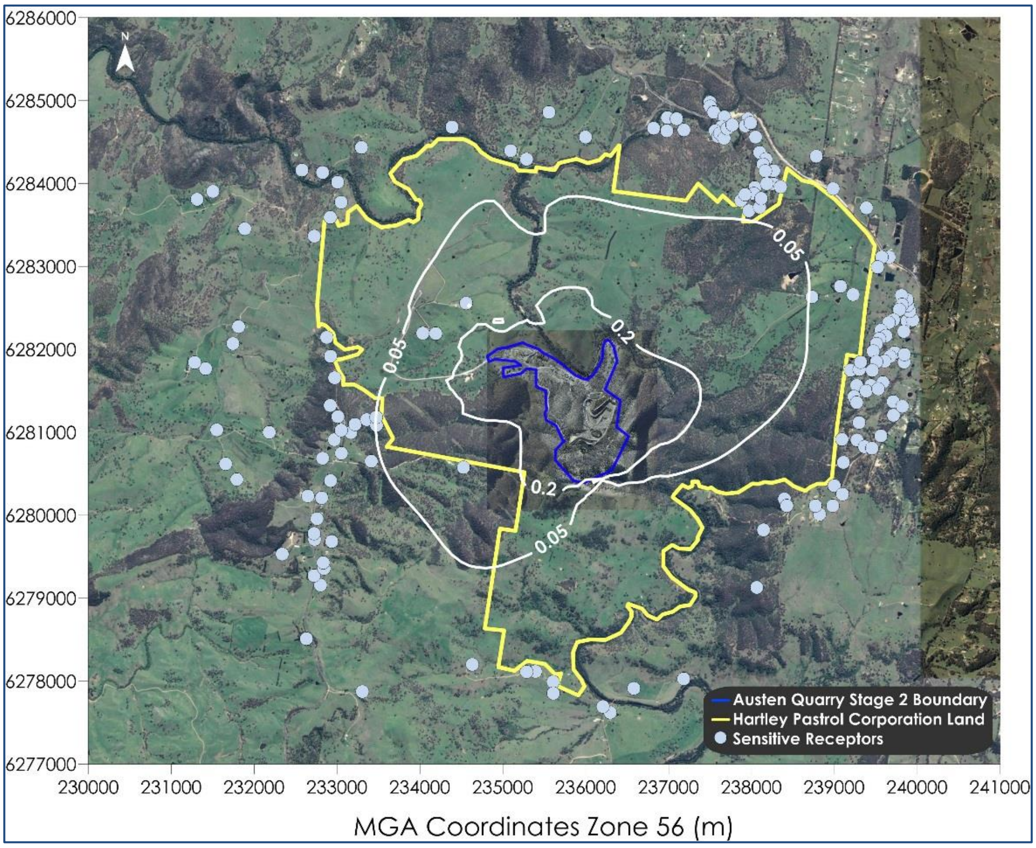

Figure 6-6: Predicted incremental annual average dust deposition levels (g/m²/month)

No exceedances of the criteria for $PM_{2.5}$, PM_{10}, TSP or dust deposition are predicted at any privately-owned residence due to emissions from the Quarry after the modified operation are taken into account.

A summary of the maximum cumulative annual average impacts at any privately-owned residence is shown in **Table 6-1**.

The predicted annual cumulative $PM_{2.5}$, PM_{10}, TSP and dust deposition levels based on applying the estimated background levels in **Section 4.3.4**. The modelling predictions indicate they would be below the relevant criteria at the assessed private sensitive receiver locations. The full list of sensitive receptor results is provided in **Appendix D**.

Table 6-1: Maximum annual particulate dispersion modelling results for privately-owned residence – Cumulative impact

Pollutant	Maximum incremental impact at privately-owned residence	Background concentration	Maximum cumulative impact at receptor	Criteria	Units
$PM_{2.5}$	0.2	7.5	7.7	8	µg/m³
PM_{10}	1.6	17.2	18.8	25	µg/m³
TSP	3.2	61.9	65.1	90	µg/m³
DD	0.1	1.2	1.3	4	g/m²/month

6.2 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 accordance with the methods outlined in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA**, **2017**).

As shown in **Section 4.3** maximum background level data available for this assessment have in the past exceeded or come close to criterion level on occasion. As a result, the Level 1 NSW EPA approach of adding maximum background levels to maximum predicted levels from the proposed Modification would show levels above the criterion whether or not the proposed Modification were operating.

In such situations, the NSW EPA applies a Level 2 contemporaneous assessment approach where the measured background levels are added to the day's corresponding predicted dust level from the proposed Modification. Ambient (background) PM_{10} and $PM_{2.5}$ concentration data corresponding with the year of modelling (2014) from the NSW OEH monitoring sites at Merriwa and Wagga Wagga North respectively have been applied in this case to represent the prevailing background levels in the vicinity of the proposed Modification and representative sensitive receptor locations.

Assessment of cumulative 24-hour average $PM_{2.5}$ and PM_{10} was therefore conducted per the NSW EPA Level 2 contemporaneous assessment method 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 proposed Modification

Table 6-2 provides a summary of the findings from the Level 2 assessment at representative receptor locations. The results in **Table 6-2** indicate that it is unlikely that cumulative impacts would arise at the assessed receptor locations due to the proposed Modification. Detailed tables of the assessment results are provided in **Appendix D**.

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

Receptor ID	PM_{10}	$PM_{2.5}$
32	0	0
61	0	0
84	0	0
92	0	0
111	0	0
124	0	0
130	0	0
158	0	0

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

The potential impacts due to the proposed Modification, extending over more than 25 per cent of any privately-owned land, have been evaluated using the predicted pollutant dispersion contours.

Figure 6-7 presents the extent of the maximum 24-hour average PM_{10} level (50µg/m³) due to the proposed Modification in isolation. The maximum 24-hour average PM_{10} level was found to have the greatest extent of any of the other assessed dust metrics and hence represents the most impacting parameter.

The isopleth in **Figure 6-7** indicates there is no privately-owned land parcels for which the relevant assessment criteria would be exceeded over more than 25 per cent of the land.

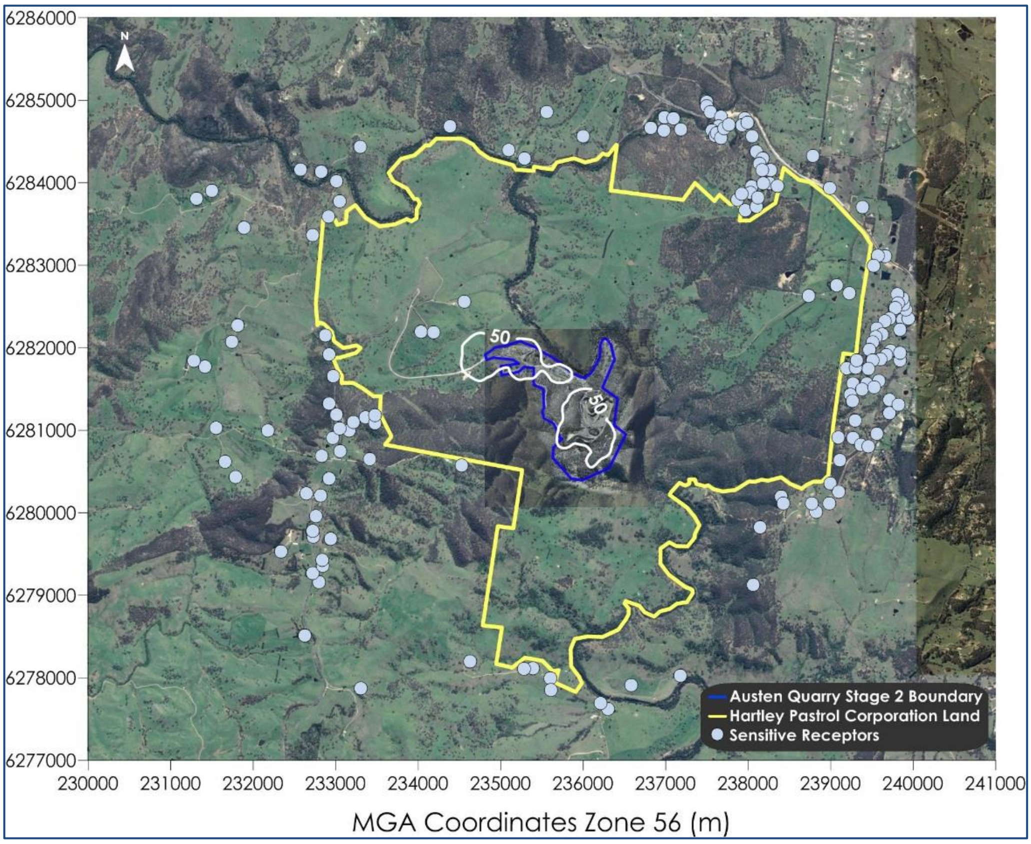

Figure 6-7: Predicted maximum 24-hour average PM_{10} level

7 AIR QUALITY MANAGEMENT

Assuming that the site will continue to operate in accordance with the ***Austen Quarry Air Quality Management Plan*** **(RWC, 2017a)**, no additional design of operational controls or mitigation measures are necessary to manage air quality at the Quarry.

Details of the following are included in the approved Air Quality Management Plan:

- Meteorological monitoring program;
- Dust monitoring program;
- Proactive management systems
- Reactive management systems;
- Incident management;
- Roles and responsibilities;
- Competence training;
- Documentation and reporting;
- Complaints handling; and the
- Plan review and improvement protocol.

The dust controls included in the air quality management plan are outlined in the following sections.

7.1 Design features

- *The Northern Ridge within the Quarry area will be retained.*
- *The primary crushing station is located within the purpose built depression within the extraction area below surrounding ground level. This location limits dust emissions and the distance haul trucks are required to travel from active faces.*
- *The primary conveyor between the Primary Crushing Station and secondary processing area reduces the distance haul trucks are required to travel.*
- *Conveyor transfer points are partially enclosed.*
- *The Quarry Access Road is sealed from Jenolan Caves Road to Yorkeys Creek.*

7.2 Operational controls and safeguards

- *Surface disturbance activities have been planned to limit the total surface disturbance at any one time.*
- *Progressive rehabilitation will include initial revegetation to provide a suitable groundcover that limits surface disturbance and the potential for dust lift-off.*

- *Dust mitigation is incorporated into processing equipment including sprays, covers and enclosures.*
- *During periods of extended dry weather and/or high winds, when dust emissions have the potential to occur as a result of quarrying activities, dust is managed through the use of a water truck to supress emissions.*
- *All other internal roads are surfaced with well graded materials to limit dust lift-off.*
- *Exposed areas that are not covered in gravel under dry and windy conditions would be watered (visible dust plumes being the trigger for this action).*
- *All vehicles travelling on internal unsealed roads are limited to a speed appropriate for the conditions and safety, i.e. less than 40km/hr.*
- *Load sizes would be limited to ensure product does not extend above truck sidewalls.*
- *Care would be taken to avoid spillage during loading.*
- *Dump heights from trucks, front-end loaders and conveyors would be minimised.*
- *As far as practicable, blasts would be scheduled to avoid higher wind conditions, especially when northerly, northwesterly or northeasterly winds prevail (which may result in a plume of particulate matter towards the most affected receiver to the southwest).*
- *Truck queuing, unnecessary idling of trucks and unnecessary trips would be reduced through logistical planning, where possible.*

7.3 Ambient air quality monitoring

The monitoring data presented in **Section 4.3** indicate that the Quarry has been generally in compliance with the NSW EPA air quality criteria. Where exceedances have occurred, these have typically been associated with other sources and not the Quarry activities.

Relative to the existing operations, the proposed Modification would lead to an increase in dust levels, however the increase would not be significant at any privately-owned residences.

This is supported by the air quality assessment for the proposed Modification, which predicts that there would be no exceedances of NSW EPA air quality impact assessment criteria at any privately-owned receptor due to the proposed Modification and background sources.

Given this situation and the demonstrated performance of existing operations, it is considered that the continued implementation of the approved Air Quality Management Plan would be suitable to manage potential air quality impacts from the proposed Modification and that no additional requirements for ambient air quality monitoring is recommended.

8 SUMMARY AND CONCLUSIONS

This report has assessed the potential worst-case air quality impacts associated with the proposed Austen Quarry Extension Modification 1.

The component of the proposed Modification relevant to this assessment of air quality impacts the proposed increase to the annual limit on Quarry product despatch from 1.1Mtpa to 1.6Mtpa and associated increase in daily laden truck movements. This increase in product despatch would result in an increase in the potential amount of dust generated from the operations and in turn would contribute to additional dust levels in the surrounding environment.

Air dispersion modelling using the CALPUFF model was used to predict the potential for off-site air quality impacts in the surrounding area due to the proposed Modification.

It is predicted that all assessed air pollutants attributable to the proposed Modification would be within the applicable assessment criteria at all privately-owned residences at all times, 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 quality management measures to ensure it minimises the potential occurrence of excessive air emissions from the site.

Overall, the assessment demonstrates that the proposed Modification can operate without causing any significant air quality impact in the surrounding environment at any time.

9 REFERENCES

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Appendix A

Sensitive Receptor Locations

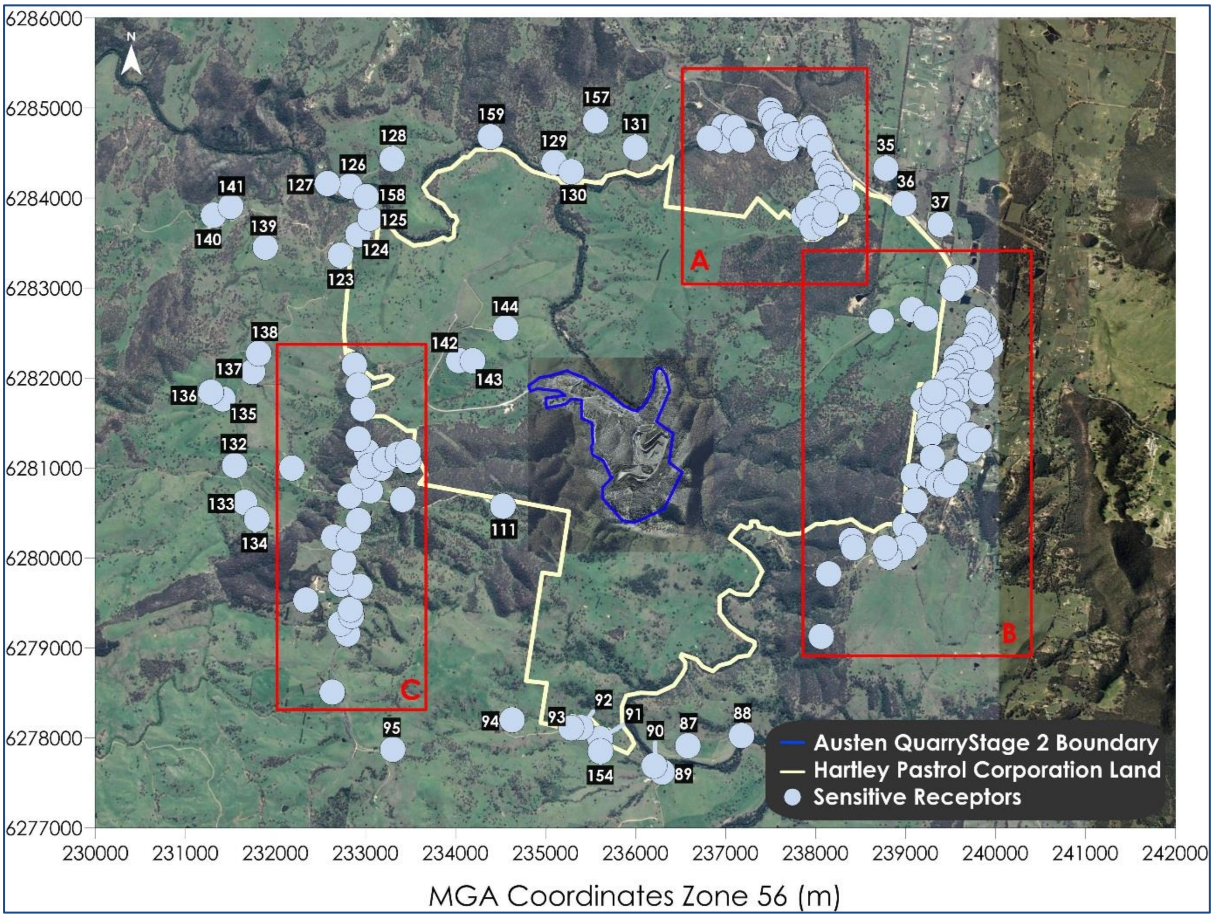

Figure A-1: Location of sensitive receptors

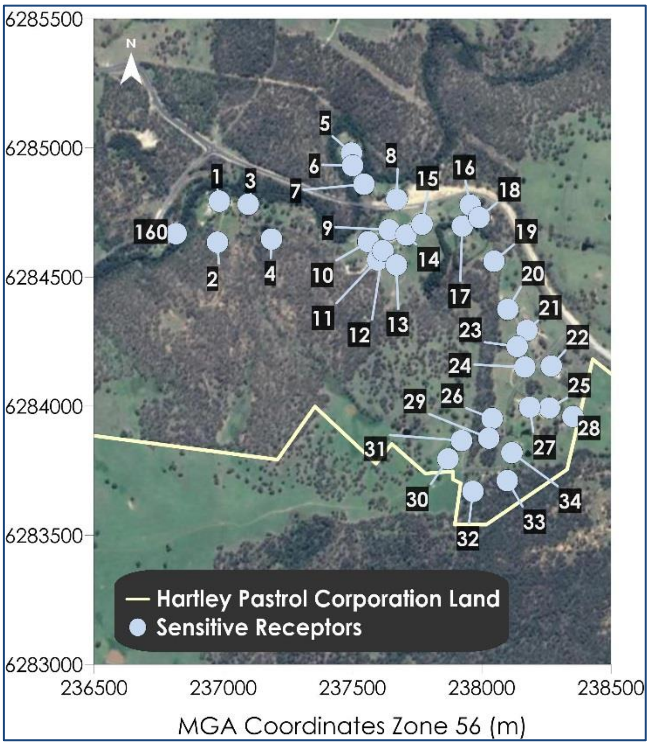

Figure A-2: Location of sensitive receptors Insert A

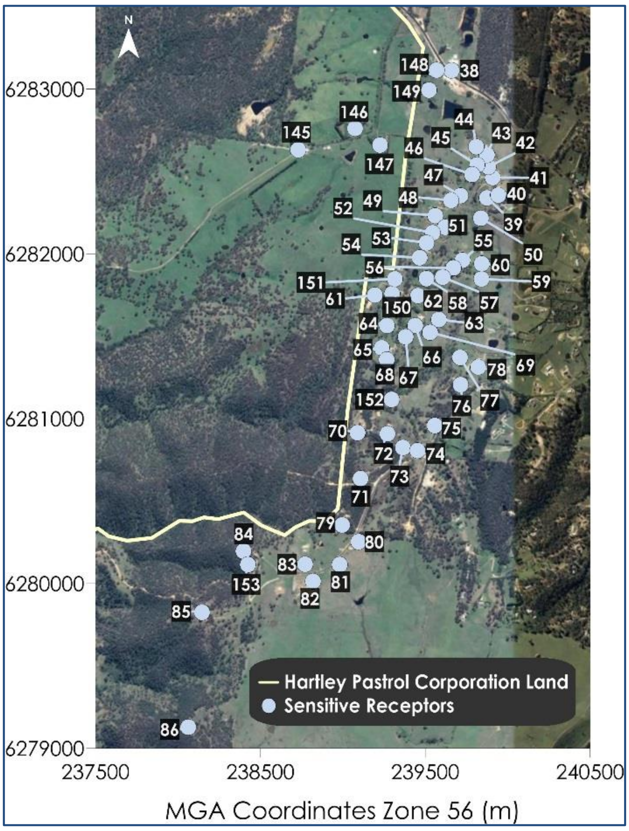

Figure A-3: Location of sensitive receptors Insert B

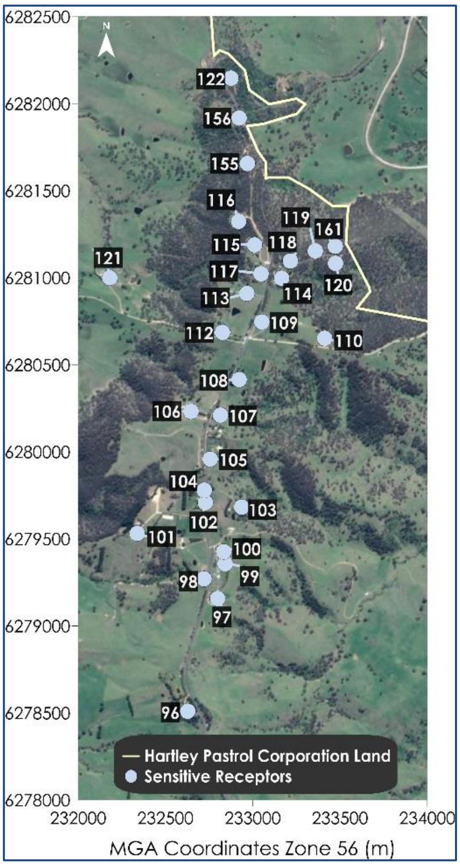

Figure A-4: Location of sensitive receptors Insert C

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

ID	Type	Easting	Northing	ID	Type	Easting	Northing
1	Private	236984	6284794	58	Private	239507	6281850
2	Private	236977	6284635	59	Private	239841	6281848
3	Private	237096	6284782	60	Private	239842	6281941
4	Private	237186	6284647	61	Private	239194	6281750
5	Private	237496	6284980	62	Private	239457	6281747
6	Private	237500	6284932	63	Private	239583	6281602
7	Private	237544	6284859	64	Private	239268	6281566
8	Private	237670	6284801	65	Private	239236	6281430
9	Private	237641	6284684	66	Private	239438	6281566
10	Private	237560	6284637	67	Private	239380	6281497
11	Private	237596	6284567	68	Private	239266	6281359
12	Private	237617	6284603	69	Private	239529	6281524
13	Private	237669	6284547	70	Private	239089	6280916
14	Private	237707	6284663	71	Private	239107	6280636
15	Private	237769	6284705	72	Private	239270	6280908
16	Private	237955	6284780	73	Private	239364	6280825
17	Private	237924	6284698	74	Private	239453	6280807
18	Private	237989	6284731	75	Private	239558	6280959
19	Private	238047	6284562	76	Private	239714	6281207
20	Private	238100	6284376	77	Private	239710	6281372
21	Private	238175	6284294	78	Private	239821	6281314
22	Private	238269	6284156	79	Private	238996	6280355
23	Private	238137	6284231	80	Private	239096	6280254
24	Private	238167	6284151	81	Private	238980	6280115
25	Private	238261	6283994	82	Private	238819	6280013
26	Private	238040	6283954	83	Private	238770	6280116
27	Private	238184	6283997	84	Private	238397	6280196
28	Private	238352	6283960	85	Private	238145	6279825
29	Private	238027	6283877	86	Private	238062	6279128
30	Private	237869	6283796	87	Private	236580	6277915
31	Private	237921	6283867	88	Private	237180	6278027
32	Private	237965	6283671	89	Private	236297	6277621
33	Private	238098	6283713	90	Private	236208	6277693
34	Private	238116	6283820	91	Private	235605	6277993
35	Private	238782	6284330	92	Private	235393	6278116
36	Private	238985	6283939	93	Private	235284	6278112
37	Private	239386	6283706	94	Private	234630	6278201
38	Private	239660	6283113	95	Private	233304	6277875
39	Private	239875	6282340	96	Private	232628	6278510
40	Private	239943	6282357	97	Private	232799	6279158
41	Private	239910	6282463	98	Private	232721	6279271
42	Private	239882	6282529	99	Private	232842	6279358
43	Private	239875	6282600	100	Private	232833	6279427
44	Private	239809	6282650	101	Private	232339	6279531
45	Private	239814	6282541	102	Private	232729	6279709
46	Private	239784	6282482	103	Private	232936	6279684
47	Private	239714	6282354	104	Private	232722	6279780
48	Private	239656	6282325	105	Private	232757	6279960
49	Private	239560	6282233	106	Private	232646	6280233
50	Private	239838	6282217	107	Private	232815	6280212
51	Private	239621	6282163	108	Private	232923	6280416
52	Private	239543	6282129	109	Private	233052	6280748
53	Private	239507	6282067	110	Private	233413	6280653
54	Private	239466	6281977	111	Private	234526	6280578
55	Private	239726	6281962	112	Private	232827	6280688
56	Private	239670	6281916	113	Private	232966	6280911
57	Private	239605	6281859	114	Private	233166	6280999

ID	Type	Easting	Northing	ID	Type	Easting	Northing
115	Private	233011	6281189	139	Private	231887	6283455
116	Private	232919	6281325	140	Private	231310	6283811
117	Private	233048	6281024	141	Private	231501	6283907
118	Private	233215	6281097	142	Quarry-owned	234035	6282196
119	Private	233359	6281155	143	Quarry-owned	234190	6282191
120	Private	233475	6281084	144	Quarry-owned	234556	6282560
121	Private	232180	6281000	145	Quarry-owned	238729	6282632
122	Private	232876	6282147	146	Quarry-owned	239074	6282761
123	Private	232724	6283366	147	Quarry-owned	239227	6282660
124	Private	232916	6283593	148	Private	239570	6283115
125	Private	233049	6283775	149	Private	239522	6282993
126	Private	232826	6284135	150	Private	239299	6281759
127	Private	232575	6284163	151	Private	239316	6281849
128	Private	233296	6284436	152	Private	239296	6281117
129	Private	235094	6284397	153	Private	238424	6280115
130	Private	235287	6284294	154	Private	235608	6277853
131	Private	235998	6284562	155	Private	232970	6281657
132	Private	231547	6281029	156	Private	232922	6281918
133	Private	231657	6280620	157	Private	235555	6284860
134	Private	231789	6280432	158	Private	233007	6284018
135	Private	231413	6281770	159	Private	234388	6284684
136	Private	231283	6281843	160	Private	236817	6284668
137	Private	231745	6282073	161	Private	233474	6281182
138	Private	231811	6282273				

Appendix B

Selection of Meteorological Year

Selection of meteorological year

The 2014 calendar year has been selected as the meteorological year for the dispersion modelling based on an analysis of long-term data trends in the recorded meteorological data and wind patterns which reflect those patterns experienced in other years.

A statistical analysis of long-term meteorological data from the nearest BoM weather station with suitable available data, Mount Boyce AWS, is presented in **Table B-1**. The standard deviation of five years of meteorological data spanning 2012 to 2016 was analysed against the long-term measured wind speed, temperature and relative humidity spanning an approximate 19-year period recorded at the station.

The analysis indicates that 2012 and 2013 is closest to the long-term average for wind speed, 2014 is the closest to the long-term average for temperature and 2015 is closest for relative humidity. The statistical analysis indicates that the years analysed do not deviate significantly from the long-term averages.

Therefore, based on this analysis it was determined that 2014 is generally representative of the long-term trends compared to other years and is thus suitable for the purpose of modelling.

Table B-1: Statistical analysis results of standard deviation from long-term meteorological data at Mount Boyce AWS

Year	Wind speed	Temperature	Relative humidity
2012	0.4	1.0	4.0
2013	0.4	0.8	4.5
2014	0.5	0.7	4.3
2015	0.6	0.9	3.1
2016	0.6	1.0	5.2

Annual and seasonal windroses prepared from data collected for the 2014 calendar year are presented in **Figure B-1**.

The windroses indicate that on an annual basis winds from the west and east-northeast are predominant. High wind speeds occur from the westerly and west-southwesterly directions.

During summer, winds are predominantly from the east-northeast sector. The autumn and spring wind distributions are similar to the annual pattern, typically dominated by strong winds from the west and west-southwest and winds from the east-northeast. In winter the distribution shows predominate high wind speeds from the west.

A five year annual and seasonal windrose for the Mount Boyce AWS spanning 2012 to 2016 is presented in **Figure B-2**. The windrose indicates little variation when compared to the individual year presented in **Figure B-1** for the 2014 period. This further suggests that the 2014 calendar year is representative of the available data and is a suitable period for modelling.

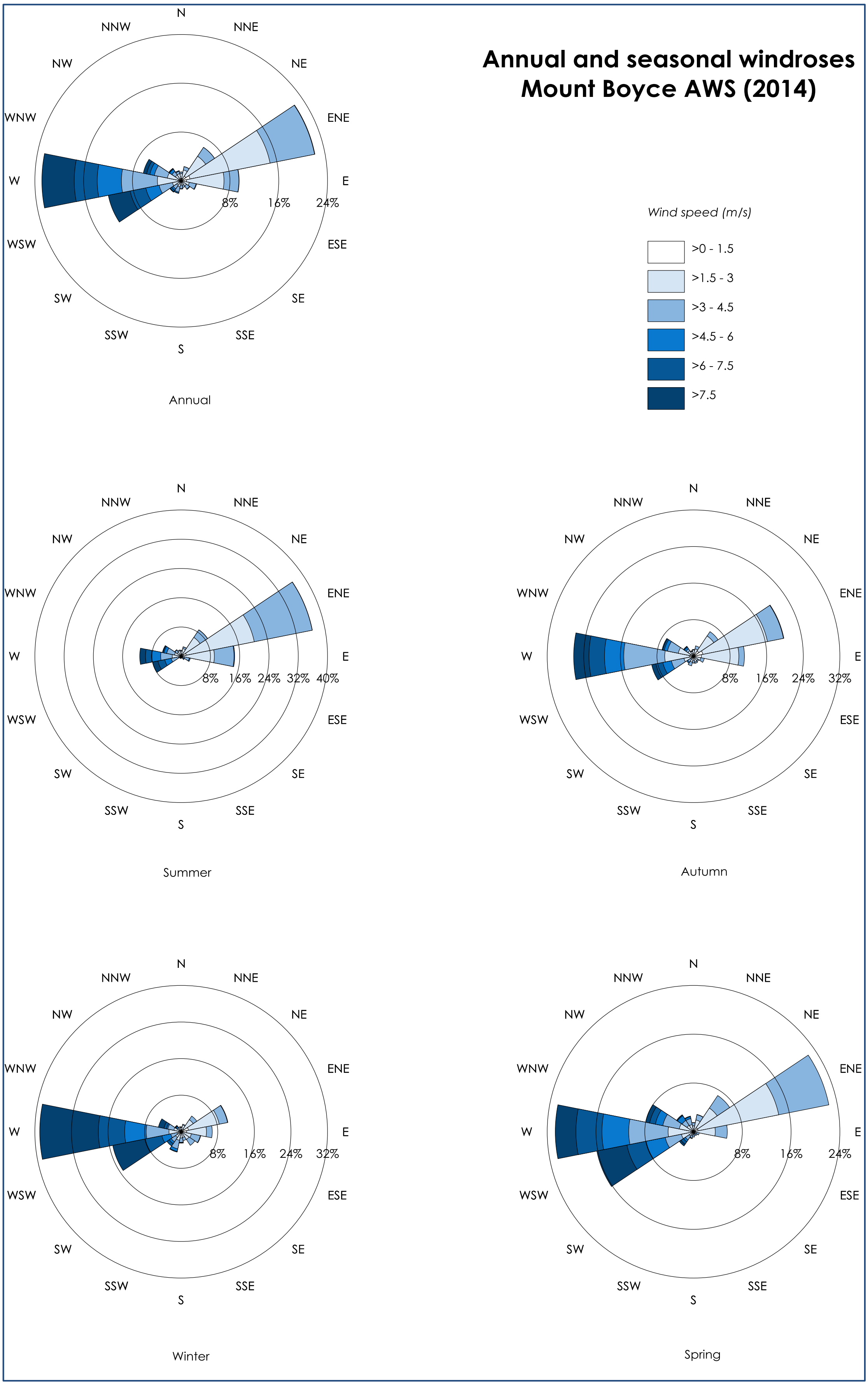

Figure B-1: Annual and seasonal windroses for Mount Boyce AWS (2014)

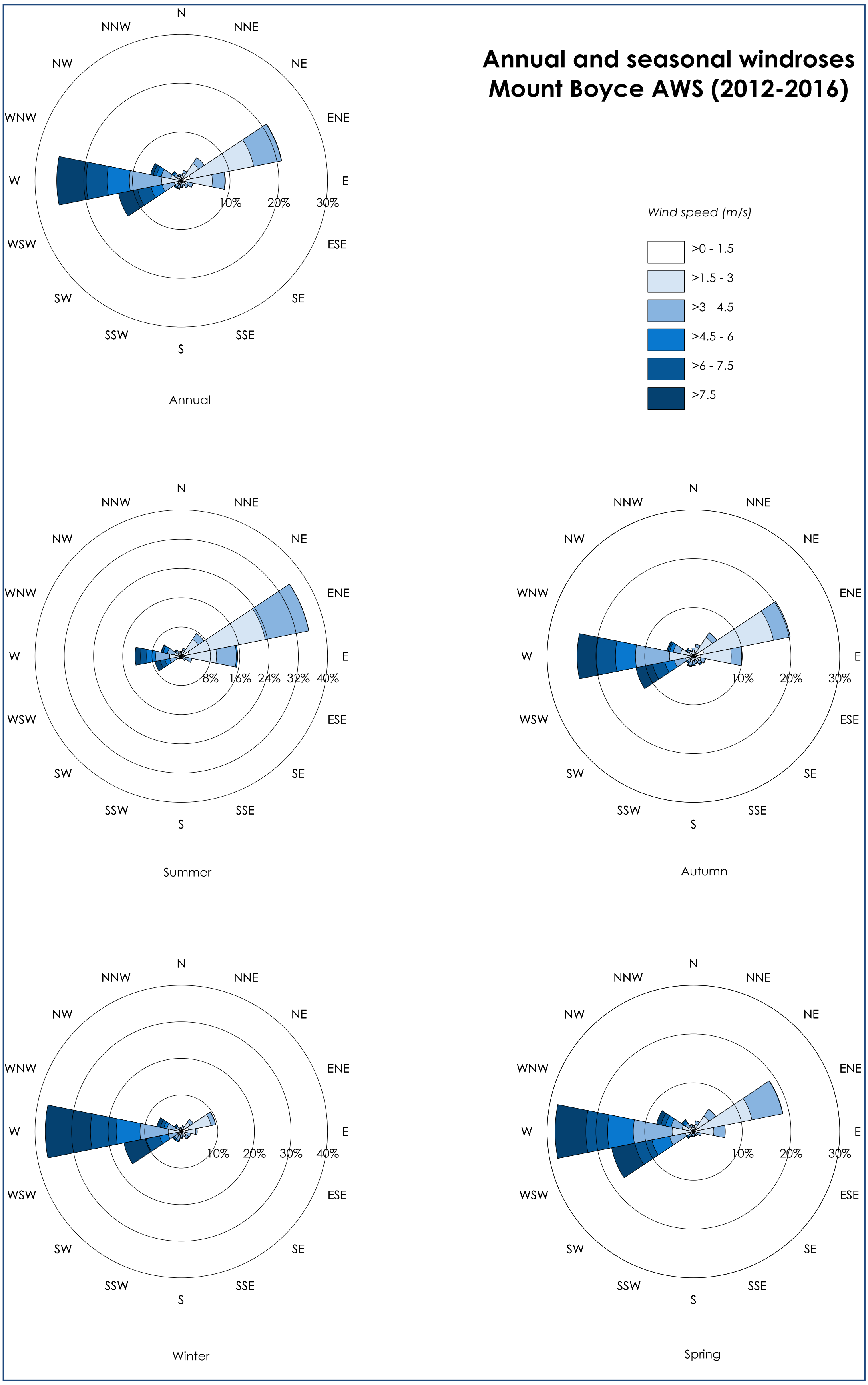

Figure B-2: Annual and seasonal windroses for Mount Boyce AWS (2012-2016)

Appendix C

Emissions Calculations

Quarry Activities

The dust emissions from the Quarry and Modification have been estimated from the operational description of the proposed activities provided by the Proponent and have been combined with emissions factor equations that relate to the quantity of dust emitted from particular activities based on intensity, the prevailing meteorological conditions and composition of the material being handled.

Emission factors and associated controls have been sourced from the National Pollutant Inventory Emission Estimation Technique Manuals (**NPI 2012** and **NPI 2014**) and US EPA AP42 Emission Factors (**US EPA 1998** and **US EPA 2006**)

Table C-1: Emission factor equations

Activity	Emission factor equation	Variable
Dozers	$EF_{TSP} = 2.6 \times \left(\frac{s^{1.2}}{M^{1.3}}\right) kg/hr\,/vehicle$	s = surface material silt content (%) M = moisture content (%)
Drilling	$EF_{TSP} = 0.59$ kg/hole	-
Blasting	$EF_{TSP} = 0.00022 \times A^{1.5}$ kg/blast	A = area blasted (m²)
Material handling	$EF_{TSP} = k \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$	K_{tsp} = 0.74 U = wind speed (m/s) M = moisture content (%)
Crushing	$EF_{TSP} = 0.0027$ kg/tonne	-
Screening	$EF_{TSP} = 0.0125$ kg/tonne	-
Hauling on unsealed surfaces	$EF_{TSP} = 0.2819 \times k \times \left(\frac{s}{12}\right)^{a} \times \left(\frac{W}{3}\right)^{b} kg/VKT$	k_{TSP} = 4.9 s = surface material silt content (%) W = average weight of vehicles (tonnes) a_{TSP} = 0.7 b_{TSP} = 0.45
Wind erosion/conveying	$EF_{TSP} = 850\, kg/ha\,/year$	-
Grading	$EF_{TSP} = 0.0034 \times S^{2.5}$ kg/VKT	S = vehicle speed (km/hr)

Table C-2: Emissions Inventory (TSP)

Activity	TSP emission (kg/y)	Intensity	Units	Emission Factor TSP	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Control
Dozers removing vegetation in extraction area	16,701	1,248	hours/year	13.4	kg/h	8.3	silt content in %	2	moisture content in %							
Drilling in extraction area	8,925	15,127	holes/year	0.59	kg/hole											
Blasting in extraction areas	483	38	blasts/year	13	kg/blast	1,500	Area of blast in square metres									
Overburden excavator loading to truck	144	212,364	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Haul overburden to overburden emplacement	10,369	212,364	tonnes/year	0.195	kg/t	37	tonnes/load	1.6	km/return trip	4.4556	kg/VKT	8.3	% silt content	65	Ave GMV (tonnes)	75% watercart
Dumping overburden at emplacement	144	212,364	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Dozers on overburden	16,701	1,248	hours/year	13.4	kg/h	8.3	silt content in %	2	moisture content in %							
Excavator loading materials to truck	1,082	1,600,000	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Hauling materials to primary crusher	56,425	1,600,000	tonnes/year	0.141	kg/t	64	tonnes/load	1.6	km/return trip	5.6425	kg/VKT	8.3	% silt content	110	Ave GMV (tonnes)	75% watercart
Load materials to primary crusher	1,082	1,600,000	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Primary crushing	4,320	1,600,000	tonnes/year	0.0027	kg/t											
Loading to screen	1,082	1,600,000	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Primary screening	20,000	1,600,000	tonnes/year	0.0125	kg/t											
Conveying to primary feed stockpile	18	0.072	ha	850	kg/ha/yr											70% enclosure
Unload to stockpile	1,082	1,600,000	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Conveying to secondary processing area	21	0.0825	ha	850	kg/ha/yr											70% enclosure
Transfer to secondary crusher	1,039	1,536,000	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Secondary crushing	4,147	1,536,000	tonnes/year	0.0027	kg/t											

Activity	TSP emission (kg/y)	Intensity	Units	Emission Factor TSP	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Control
Convey to secondary screen	8	0.009	ha	850	kg/ha/yr											
Transfer to secondary screen	1,039	1,536,000	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Secondary screening	19,200	1,536,000	tonnes/year	0.0125	kg/t											
Unload to stockpile (ballast/ 20mm)	312	460,800	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Convey to tertiary crusher	8	0.009	ha	850	kg/ha/yr											
Transfer to tertiary crusher	831	1,229,000	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Tertiary crusher	3,318	1,229,000	tonnes/year	0.0027	kg/t											
Convey to secondary screen	8	0.009	ha	850	kg/ha/yr											
Transfer to secondary screen	831	1,229,000	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Secondary screening	15,363	1,229,000	tonnes/year	0.0125	kg/t											
Convey to quaternary crusher	8	0.009	ha	850	kg/ha/yr											
Transfer to quaternary crusher	727	1,075,000	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Quaternary crusher	2,903	1,075,000	tonnes/year	0.0027	kg/t											
Convey to tertiary screen	8	0.009	ha	850	kg/ha/yr											
Transfer to tertiary screen	727	1,075,000	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Tertiary screening	13,438	1,075,000	tonnes/year	0.0125	kg/t											
Unload to stockpile (14mm, 10mm, 7mm, 5mm)	416	614,400	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Convey to air separator	8	0.009	ha	850	kg/ha/yr											
Transfer to air separator	312	460,800	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Air separator	5,760	460,800	tonnes/year	0.0125	kg/t											
Unload sand to stockpile	312	460,800	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							

Activity	TSP emission (kg/y)	Intensity	Units	Emission Factor TSP	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Control
Load truck in secondary processing area	1,021	1,510,000	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Hauling materials offsite	76,892	1,510,000	tonnes/year	0.204	kg/t	33	tonnes/load	1.7	km/return trip	3.9539	kg/VKT	8.3	% silt content	50	Ave GMV (tonnes)	75% watercart
Load truck (fines)	61	90,000	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Hauling fines to Yorkeys Creek stockpile area	2,696	90,000	tonnes/year	0.120	kg/t	33	tonnes/load	1.0	km/return trip	3.9539	kg/VKT	8.3	% silt content	50	Ave GMV (tonnes)	75% watercart
Unload fines to Yorkeys creek stockpile	61	90,000	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Load truck (fines)	55	81,000	tonnes/year	0.00068	kg/t	0.571	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							
Hauling fines offsite	1,941	81,000	tonnes/year	0.096	kg/t	33	tonnes/load	0.8	km/return trip	3.9539	kg/VKT	8.3	% silt content	50	Ave GMV (tonnes)	75% watercart
Wind erosion	22,100	52	ha	850	kg/ha/yr											50% water sprays
Grading roads	54	50	km/yr	1.08	kg/VKT	10	speed of graders in km/h									
Total emissions	**314,178**															

Appendix D

Modelling Predictions

Predicted impacts at receptors

Table D-1: Modelling predictions

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 Impact						Total impact			
	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									
	25	-	50	-	-	2	8	25	90	4
Privately-owned receptors										
1	0.3	0.1	1.9	0.4	0.7	0.0	7.6	17.6	62.6	1.2
2	0.3	0.1	2.3	0.5	0.9	0.0	7.6	17.7	62.8	1.2
3	0.2	0.1	1.8	0.4	0.6	0.0	7.6	17.6	62.5	1.2
4	0.3	0.1	2.1	0.4	0.8	0.0	7.6	17.6	62.7	1.2
5	0.2	0.0	1.4	0.3	0.5	0.0	7.5	17.5	62.4	1.2
6	0.2	0.0	1.4	0.3	0.5	0.0	7.5	17.5	62.4	1.2
7	0.2	0.0	1.5	0.3	0.5	0.0	7.5	17.5	62.4	1.2
8	0.2	0.0	1.5	0.3	0.6	0.0	7.5	17.5	62.5	1.2
9	0.2	0.1	1.7	0.4	0.7	0.0	7.6	17.6	62.6	1.2
10	0.2	0.1	1.7	0.4	0.7	0.0	7.6	17.6	62.6	1.2
11	0.3	0.1	1.9	0.4	0.8	0.0	7.6	17.6	62.7	1.2
12	0.3	0.1	1.8	0.4	0.7	0.0	7.6	17.6	62.6	1.2
13	0.3	0.1	1.9	0.4	0.8	0.0	7.6	17.6	62.7	1.2
14	0.2	0.1	1.6	0.4	0.7	0.0	7.6	17.6	62.6	1.2
15	0.2	0.0	1.5	0.4	0.6	0.0	7.5	17.6	62.5	1.2
16	0.2	0.0	1.4	0.3	0.6	0.0	7.5	17.5	62.5	1.2
17	0.2	0.0	1.5	0.4	0.6	0.0	7.5	17.6	62.5	1.2
18	0.2	0.0	1.4	0.3	0.6	0.0	7.5	17.5	62.5	1.2
19	0.2	0.1	1.6	0.4	0.7	0.0	7.6	17.6	62.6	1.2
20	0.3	0.1	1.8	0.4	0.8	0.0	7.6	17.6	62.7	1.2
21	0.3	0.1	1.9	0.4	0.8	0.0	7.6	17.6	62.7	1.2
22	0.3	0.1	1.9	0.4	0.9	0.0	7.6	17.6	62.8	1.2
23	0.3	0.1	1.9	0.5	0.9	0.0	7.6	17.7	62.8	1.2
24	0.3	0.1	2.0	0.5	0.9	0.0	7.6	17.7	62.8	1.2
25	0.3	0.1	2.0	0.5	1.0	0.0	7.6	17.7	62.9	1.2
26	0.3	0.1	2.3	0.6	1.1	0.0	7.6	17.8	63.0	1.2
27	0.3	0.1	2.1	0.5	1.0	0.0	7.6	17.7	62.9	1.2
28	0.3	0.1	1.9	0.5	1.0	0.0	7.6	17.7	62.9	1.2
29	0.4	0.1	2.3	0.6	1.2	0.0	7.6	17.8	63.1	1.2
30	0.4	0.1	2.6	0.7	1.4	0.0	7.6	17.9	63.3	1.2
31	0.4	0.1	2.5	0.6	1.3	0.0	7.6	17.8	63.2	1.2
32	0.4	0.1	2.6	0.7	1.4	0.0	7.6	17.9	63.3	1.2
33	0.4	0.1	2.3	0.6	1.2	0.0	7.6	17.8	63.1	1.2
34	0.4	0.1	2.2	0.6	1.2	0.0	7.6	17.8	63.1	1.2
35	0.3	0.0	1.5	0.3	0.7	0.0	7.5	17.5	62.6	1.2
36	0.2	0.1	1.5	0.4	0.7	0.0	7.6	17.6	62.6	1.2
37	0.2	0.1	1.7	0.3	0.7	0.0	7.6	17.5	62.6	1.2
38	0.4	0.1	1.7	0.4	0.7	0.0	7.6	17.6	62.6	1.2
39	0.4	0.0	1.5	0.3	0.5	0.0	7.5	17.5	62.4	1.2
40	0.4	0.0	1.4	0.3	0.5	0.0	7.5	17.5	62.4	1.2

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 Impact						Total impact			
	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									
	25	-	50	-	-	2	8	25	90	4
41	0.4	0.1	1.4	0.3	0.6	0.0	7.6	17.5	62.5	1.2
42	0.4	0.1	1.5	0.3	0.6	0.0	7.6	17.5	62.5	1.2
43	0.4	0.1	1.5	0.3	0.6	0.0	7.6	17.5	62.5	1.2
44	0.4	0.1	1.6	0.3	0.6	0.0	7.6	17.5	62.5	1.2
45	0.4	0.1	1.5	0.3	0.6	0.0	7.6	17.5	62.5	1.2
46	0.4	0.1	1.5	0.3	0.6	0.0	7.6	17.5	62.5	1.2
47	0.4	0.1	1.6	0.3	0.6	0.0	7.6	17.5	62.5	1.2
48	0.4	0.1	1.6	0.3	0.6	0.0	7.6	17.5	62.5	1.2
49	0.4	0.1	1.7	0.3	0.6	0.0	7.6	17.5	62.5	1.2
50	0.3	0.0	1.5	0.3	0.5	0.0	7.5	17.5	62.4	1.2
51	0.4	0.1	1.7	0.3	0.6	0.0	7.6	17.5	62.5	1.2
52	0.4	0.1	1.8	0.3	0.6	0.0	7.6	17.5	62.5	1.2
53	0.4	0.1	1.9	0.3	0.6	0.0	7.6	17.5	62.5	1.2
54	0.3	0.1	1.9	0.3	0.6	0.0	7.6	17.5	62.5	1.2
55	0.3	0.0	1.7	0.2	0.5	0.0	7.5	17.4	62.4	1.2
56	0.3	0.0	1.7	0.2	0.5	0.0	7.5	17.4	62.4	1.2
57	0.3	0.0	1.8	0.2	0.5	0.0	7.5	17.4	62.4	1.2
58	0.3	0.0	1.9	0.3	0.5	0.0	7.5	17.5	62.4	1.2
59	0.3	0.0	1.5	0.2	0.4	0.0	7.5	17.4	62.3	1.2
60	0.3	0.0	1.5	0.2	0.4	0.0	7.5	17.4	62.3	1.2
61	0.4	0.1	2.2	0.3	0.6	0.0	7.6	17.5	62.5	1.2
62	0.3	0.0	1.9	0.2	0.5	0.0	7.5	17.4	62.4	1.2
63	0.3	0.0	1.7	0.2	0.4	0.0	7.5	17.4	62.3	1.2
64	0.3	0.0	2.0	0.2	0.5	0.0	7.5	17.4	62.4	1.2
65	0.3	0.0	1.8	0.2	0.5	0.0	7.5	17.4	62.4	1.2
66	0.3	0.0	1.8	0.2	0.4	0.0	7.5	17.4	62.3	1.2
67	0.3	0.0	1.8	0.2	0.4	0.0	7.5	17.4	62.3	1.2
68	0.3	0.0	1.7	0.2	0.4	0.0	7.5	17.4	62.3	1.2
69	0.3	0.0	1.6	0.2	0.4	0.0	7.5	17.4	62.3	1.2
70	0.2	0.0	1.0	0.2	0.3	0.0	7.5	17.4	62.2	1.2
71	0.1	0.0	0.9	0.1	0.3	0.0	7.5	17.3	62.2	1.2
72	0.2	0.0	0.9	0.2	0.3	0.0	7.5	17.4	62.2	1.2
73	0.1	0.0	0.8	0.1	0.3	0.0	7.5	17.3	62.2	1.2
74	0.1	0.0	0.7	0.1	0.2	0.0	7.5	17.3	62.1	1.2
75	0.1	0.0	0.9	0.1	0.3	0.0	7.5	17.3	62.2	1.2
76	0.2	0.0	1.1	0.1	0.3	0.0	7.5	17.3	62.2	1.2
77	0.2	0.0	1.3	0.2	0.3	0.0	7.5	17.4	62.2	1.2
78	0.2	0.0	1.1	0.1	0.3	0.0	7.5	17.3	62.2	1.2
79	0.2	0.0	1.0	0.1	0.3	0.0	7.5	17.3	62.2	1.2
80	0.1	0.0	1.0	0.1	0.2	0.0	7.5	17.3	62.1	1.2
81	0.2	0.0	1.1	0.1	0.2	0.0	7.5	17.3	62.1	1.2
82	0.2	0.0	1.2	0.1	0.2	0.0	7.5	17.3	62.1	1.2
83	0.2	0.0	1.2	0.1	0.3	0.0	7.5	17.3	62.2	1.2
84	0.2	0.0	1.5	0.2	0.4	0.0	7.5	17.4	62.3	1.2
85	0.2	0.0	1.5	0.2	0.3	0.0	7.5	17.4	62.2	1.2

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 Impact						Total impact			
	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									
	25	-	50	-	-	2	8	25	90	4
86	0.1	0.0	0.9	0.1	0.2	0.0	7.5	17.3	62.1	1.2
87	0.1	0.0	0.4	0.1	0.1	0.0	7.5	17.3	62.0	1.2
88	0.1	0.0	0.3	0.0	0.1	0.0	7.5	17.2	62.0	1.2
89	0.1	0.0	0.4	0.1	0.1	0.0	7.5	17.3	62.0	1.2
90	0.1	0.0	0.5	0.1	0.1	0.0	7.5	17.3	62.0	1.2
91	0.2	0.0	1.1	0.1	0.2	0.0	7.5	17.3	62.1	1.2
92	0.3	0.0	1.4	0.1	0.2	0.0	7.5	17.3	62.1	1.2
93	0.3	0.0	1.5	0.1	0.3	0.0	7.5	17.3	62.2	1.2
94	0.3	0.0	2.2	0.2	0.5	0.0	7.5	17.4	62.4	1.2
95	0.4	0.0	2.0	0.2	0.5	0.0	7.5	17.4	62.4	1.2
96	0.3	0.0	1.7	0.3	0.5	0.0	7.5	17.5	62.4	1.2
97	0.3	0.0	1.8	0.3	0.6	0.0	7.5	17.5	62.5	1.2
98	0.3	0.0	1.7	0.3	0.6	0.0	7.5	17.5	62.5	1.2
99	0.3	0.0	1.8	0.3	0.6	0.0	7.5	17.5	62.5	1.2
100	0.3	0.0	1.8	0.3	0.6	0.0	7.5	17.5	62.5	1.2
101	0.2	0.0	1.3	0.3	0.5	0.0	7.5	17.5	62.4	1.2
102	0.2	0.0	1.7	0.3	0.6	0.0	7.5	17.5	62.5	1.2
103	0.3	0.1	2.0	0.4	0.7	0.0	7.6	17.6	62.6	1.2
104	0.2	0.0	1.7	0.3	0.6	0.0	7.5	17.5	62.5	1.2
105	0.2	0.0	1.8	0.4	0.7	0.0	7.5	17.6	62.6	1.2
106	0.3	0.0	1.9	0.4	0.7	0.0	7.5	17.6	62.6	1.2
107	0.3	0.1	2.0	0.4	0.8	0.0	7.6	17.6	62.7	1.2
108	0.3	0.1	2.4	0.5	0.9	0.0	7.6	17.7	62.8	1.2
109	0.4	0.1	3.2	0.6	1.1	0.0	7.6	17.8	63.0	1.2
110	0.6	0.1	4.0	0.7	1.4	0.0	7.6	17.9	63.3	1.2
111	1.4	0.2	9.3	1.6	3.2	0.1	7.7	18.8	65.1	1.3
112	0.4	0.1	2.6	0.5	0.9	0.0	7.6	17.7	62.8	1.2
113	0.5	0.1	3.3	0.6	1.1	0.0	7.6	17.8	63.0	1.2
114	0.6	0.1	4.2	0.7	1.3	0.0	7.6	17.9	63.2	1.2
115	0.7	0.1	4.7	0.6	1.2	0.0	7.6	17.8	63.1	1.2
116	0.7	0.1	5.1	0.6	1.2	0.0	7.6	17.8	63.1	1.2
117	0.6	0.1	3.8	0.6	1.2	0.0	7.6	17.8	63.1	1.2
118	0.7	0.1	4.9	0.8	1.4	0.0	7.6	18.0	63.3	1.2
119	0.9	0.1	6.1	0.9	1.7	0.0	7.6	18.1	63.6	1.2
120	0.9	0.1	6.0	1.0	1.9	0.1	7.6	18.2	63.8	1.3
121	0.3	0.0	2.2	0.3	0.6	0.0	7.5	17.5	62.5	1.2
122	0.7	0.1	5.8	0.7	1.2	0.0	7.6	17.9	63.1	1.2
123	0.6	0.1	5.3	0.5	0.8	0.0	7.6	17.7	62.7	1.2
124	0.5	0.1	4.4	0.5	0.8	0.0	7.6	17.7	62.7	1.2
125	0.4	0.1	3.3	0.5	0.8	0.0	7.6	17.7	62.7	1.2
126	0.3	0.0	2.1	0.3	0.5	0.0	7.5	17.5	62.4	1.2
127	0.2	0.0	1.9	0.3	0.4	0.0	7.5	17.5	62.3	1.2
128	0.3	0.1	2.5	0.4	0.7	0.0	7.6	17.6	62.6	1.2
129	0.5	0.1	3.6	0.7	1.3	0.0	7.6	17.9	63.2	1.2
130	0.5	0.1	3.9	0.8	1.5	0.0	7.6	18.0	63.4	1.2

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 Impact						Total impact			
	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									
	25	-	50	-	-	2	8	25	90	4
131	0.5	0.1	3.6	0.9	1.7	0.0	7.6	18.1	63.6	1.2
132	0.2	0.0	1.5	0.2	0.4	0.0	7.5	17.4	62.3	1.2
133	0.2	0.0	1.4	0.2	0.4	0.0	7.5	17.4	62.3	1.2
134	0.2	0.0	1.3	0.2	0.4	0.0	7.5	17.4	62.3	1.2
135	0.2	0.0	1.8	0.2	0.3	0.0	7.5	17.4	62.2	1.2
136	0.2	0.0	1.6	0.2	0.3	0.0	7.5	17.4	62.2	1.2
137	0.3	0.0	2.6	0.3	0.4	0.0	7.5	17.5	62.3	1.2
138	0.3	0.0	2.8	0.3	0.5	0.0	7.5	17.5	62.4	1.2
139	0.3	0.0	2.3	0.2	0.4	0.0	7.5	17.4	62.3	1.2
140	0.1	0.0	1.0	0.1	0.2	0.0	7.5	17.3	62.1	1.2
141	0.2	0.0	1.2	0.2	0.2	0.0	7.5	17.4	62.1	1.2
148	0.4	0.1	1.7	0.4	0.8	0.0	7.6	17.6	62.7	1.2
149	0.4	0.1	1.8	0.4	0.8	0.0	7.6	17.6	62.7	1.2
150	0.3	0.0	2.1	0.3	0.6	0.0	7.5	17.5	62.5	1.2
151	0.3	0.1	2.1	0.3	0.6	0.0	7.6	17.5	62.5	1.2
152	0.2	0.0	1.2	0.2	0.3	0.0	7.5	17.4	62.2	1.2
153	0.2	0.0	1.5	0.2	0.3	0.0	7.5	17.4	62.2	1.2
154	0.2	0.0	1.1	0.1	0.2	0.0	7.5	17.3	62.1	1.2
155	0.9	0.1	6.9	0.7	1.3	0.0	7.6	17.9	63.2	1.2
156	0.9	0.1	6.7	0.7	1.3	0.0	7.6	17.9	63.2	1.2
157	0.4	0.1	2.9	0.7	1.3	0.0	7.6	17.9	63.2	1.2
158	0.3	0.0	2.4	0.4	0.6	0.0	7.5	17.6	62.5	1.2
159	0.3	0.1	2.6	0.5	0.9	0.0	7.6	17.7	62.8	1.2
160	0.3	0.1	2.3	0.5	0.8	0.0	7.6	17.7	62.7	1.2
161	1.0	0.1	6.9	1.0	2.0	0.1	7.6	18.2	63.9	1.3
Quarry-owned Receptors										
142	2.0	0.3	17.3	2.5	5.2	0.1	7.8	19.7	67.1	1.3
143	2.4	0.3	23.1	3.2	7.0	0.1	7.8	20.4	68.9	1.3
144	3.2	0.5	27.5	5.2	12.3	0.2	8.0	22.4	74.2	1.4
145	0.4	0.1	2.2	0.6	1.2	0.0	7.6	17.8	63.1	1.2
146	0.4	0.1	2.0	0.5	1.0	0.0	7.6	17.7	62.9	1.2
147	0.5	0.1	1.9	0.4	0.9	0.0	7.6	17.6	62.8	1.2

Contemporaneous 24-hour PM_{10} and $PM_{2.5}$ assessment

Table D-2: 24-hour average PM_{10} concentration – Sensitive receptor location 32

Ranked by Highest to Lowest Background Concentration				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
17/12/2014	55.2	0.2	55.4	-	-	-	-
15/11/2014	55.0	0.5	55.5	-	-	-	-
3/01/2014	50.9	0.2	51.1	-	-	-	-
11/01/2014	43.4	0.1	43.5	19/05/2014	9.9	2.6	12.5
19/01/2014	41.4	0.0	41.4	8/07/2014	4.6	2.5	7.1
1/02/2014	41.1	0.0	41.1	2/07/2014	5.8	2.5	8.3
10/02/2014	40.6	0.0	40.6	3/07/2014	9.4	2.4	11.8
4/11/2014	40.3	0.3	40.6	21/05/2014	13.2	2.4	15.6
16/01/2014	39.4	0.0	39.4	2/09/2014	6.4	2.4	8.8
10/11/2014	37.9	0.0	37.9	1/10/2014	16.3	2.3	18.6
12/01/2014	36.9	0.0	36.9	18/09/2014	8.8	2.2	11.0
3/11/2014	36.6	0.0	36.6	17/06/2014	4.9	2.2	7.1
22/11/2014	36.1	0.3	36.4	14/10/2014	8.4	2.2	10.6

Table D-3: 24-hour average PM_{10} concentration – Sensitive receptor location 61

Ranked by Highest to Lowest Background Concentration				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
17/12/2014	55.2	0.1	55.3	-	-	-	-
15/11/2014	55.0	0.2	55.2	-	-	-	-
3/01/2014	50.9	0.1	51.0	-	-	-	-
11/01/2014	43.4	0.1	43.5	11/07/2014	6.5	2.2	8.7
19/01/2014	41.4	0.0	41.4	2/05/2014	10.1	1.6	11.7
1/02/2014	41.1	0.0	41.1	28/06/2014	11.2	1.5	12.7
10/02/2014	40.6	0.0	40.6	26/06/2014	9.6	1.4	11.0
4/11/2014	40.3	0.2	40.5	6/07/2014	5.5	1.2	6.7
16/01/2014	39.4	0.0	39.4	23/06/2014	7.2	1.2	8.4
10/11/2014	37.9	0.0	37.9	15/06/2014	7.3	1.1	8.4
12/01/2014	36.9	0.0	36.9	16/06/2014	7.5	1.1	8.6
3/11/2014	36.6	0.0	36.6	26/05/2014	10.9	1.1	12.0
22/11/2014	36.1	0.2	36.3	11/04/2014	10.5	1.1	11.6

Table D-4: 24-hour average PM_{10} concentration – Sensitive receptor location 84

Ranked by Highest to Lowest Background Concentration				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
17/12/2014	55.2	0.0	55.2	-	-	-	-
15/11/2014	55.0	0.2	55.2	-	-	-	-
3/01/2014	50.9	0.0	50.9	-	-	-	-
11/01/2014	43.4	0.1	43.5	25/06/2014	9.7	1.5	11.2
19/01/2014	41.4	0.0	41.4	10/07/2014	13.3	1.3	14.6
1/02/2014	41.1	0.0	41.1	1/06/2014	4.6	1.2	5.8
10/02/2014	40.6	0.0	40.6	13/06/2014	11.8	1.0	12.8
4/11/2014	40.3	0.2	40.5	27/06/2014	8.5	1.0	9.5
16/01/2014	39.4	0.0	39.4	27/05/2014	17.2	0.8	18.0
10/11/2014	37.9	0.0	37.9	28/03/2014	5.9	0.8	6.7
12/01/2014	36.9	0.0	36.9	6/10/2014	17.8	0.8	18.6
3/11/2014	36.6	0.0	36.6	24/09/2014	9.1	0.7	9.8
22/11/2014	36.1	0.2	36.3	10/05/2014	8.9	0.7	9.6

Table D-5: 24-hour average PM_{10} concentration – Sensitive receptor location 92

Ranked by Highest to Lowest Background Concentration				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
17/12/2014	55.2	0.0	55.2	-	-	-	-
15/11/2014	55.0	0.1	55.1	-	-	-	-
3/01/2014	50.9	0.3	51.2	-	-	-	-
11/01/2014	43.4	0.1	43.5	11/06/2014	9.1	1.4	10.5
19/01/2014	41.4	0.0	41.4	8/04/2014	13.3	1.1	14.4
1/02/2014	41.1	0.1	41.2	8/09/2014	7.1	1.0	8.1
10/02/2014	40.6	0.1	40.7	25/02/2014	13.8	0.9	14.7
4/11/2014	40.3	0.1	40.4	28/01/2014	18.8	0.9	19.7
16/01/2014	39.4	0.1	39.5	19/11/2014	27.8	0.9	28.7
10/11/2014	37.9	0.1	38.0	27/03/2014	4.1	0.9	5.0
12/01/2014	36.9	0.1	37.0	8/08/2014	18.5	0.8	19.3
3/11/2014	36.6	0.1	36.7	13/09/2014	13.8	0.8	14.6
22/11/2014	36.1	0.1	36.2	28/12/2014	9.5	0.8	10.3

Table D-6: 24-hour average PM_{10} concentration – Sensitive receptor location 111

Ranked by Highest to Lowest Background Concentration				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
17/12/2014	55.2	0.9	56.1	-	-	-	-
15/11/2014	55.0	1.5	56.5	-	-	-	-
3/01/2014	50.9	1.0	51.9	-	-	-	-
11/01/2014	43.4	1.5	44.9	6/06/2014	6.5	9.3	15.8
19/01/2014	41.4	1.1	42.5	31/05/2014	9.8	8.4	18.2
1/02/2014	41.1	2.5	43.6	30/08/2014	6.0	7.4	13.4
10/02/2014	40.6	1.3	41.9	24/12/2014	15.8	6.9	22.7
4/11/2014	40.3	3.0	43.3	9/06/2014	6.9	6.6	13.5
16/01/2014	39.4	2.4	41.8	12/08/2014	14.2	6.2	20.4
10/11/2014	37.9	1.4	39.3	21/10/2014	15.7	6.2	21.9
12/01/2014	36.9	0.9	37.8	27/03/2014	4.1	6.1	10.2
3/11/2014	36.6	1.5	38.1	3/08/2014	19.6	6.0	25.6
22/11/2014	36.1	1.4	37.5	19/08/2014	6.4	5.8	12.2

Table D-7: 24-hour average PM_{10} concentration – Sensitive receptor location 124

Ranked by Highest to Lowest Background Concentration				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
17/12/2014	55.2	0.0	55.2	-	-	-	-
15/11/2014	55.0	1.0	56.0	-	-	-	-
3/01/2014	50.9	0.1	51.0	-	-	-	-
11/01/2014	43.4	0.5	43.9	26/03/2014	10.5	4.4	14.9
19/01/2014	41.4	0.1	41.5	21/08/2014	8.8	3.4	12.2
1/02/2014	41.1	0.2	41.3	5/06/2014	10.9	3.3	14.2
10/02/2014	40.6	0.1	40.7	1/03/2014	8.8	3.1	11.9
4/11/2014	40.3	0.3	40.6	23/08/2014	8.8	3.1	11.9
16/01/2014	39.4	0.1	39.5	27/02/2014	22.5	2.8	25.3
10/11/2014	37.9	0.2	38.1	29/08/2014	8.2	2.8	11.0
12/01/2014	36.9	0.0	36.9	28/02/2014	3.7	2.6	6.3
3/11/2014	36.6	0.0	36.6	10/06/2014	8.0	2.5	10.5
22/11/2014	36.1	0.2	36.3	30/03/2014	16.5	2.3	18.8

Table D-8: 24-hour average PM_{10} concentration – Sensitive receptor location 130

Ranked by Highest to Lowest Background Concentration				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
17/12/2014	55.2	0.0	55.2	-	-	-	-
15/11/2014	55.0	0.8	55.8	-	-	-	-
3/01/2014	50.9	0.3	51.2	-	-	-	-
11/01/2014	43.4	0.1	43.5	22/07/2014	11.0	3.9	14.9
19/01/2014	41.4	0.1	41.5	7/06/2014	9.0	3.5	12.5
1/02/2014	41.1	0.2	41.3	11/05/2014	6.8	3.1	9.9
10/02/2014	40.6	0.1	40.7	20/07/2014	12.8	3.0	15.8
4/11/2014	40.3	0.3	40.6	27/09/2014	15.2	3.0	18.2
16/01/2014	39.4	0.2	39.6	17/04/2014	14.3	3.0	17.3
10/11/2014	37.9	0.1	38.0	16/04/2014	14.3	2.8	17.1
12/01/2014	36.9	0.1	37.0	12/06/2014	8.2	2.8	11.0
3/11/2014	36.6	0.0	36.6	21/11/2014	20.5	2.8	23.3
22/11/2014	36.1	2.3	38.4	13/05/2014	10.7	2.7	13.4

Table D-9: 24-hour average PM_{10} concentration – Sensitive receptor location 158

Ranked by Highest to Lowest Background Concentration				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
17/12/2014	55.2	0.0	55.2	-	-	-	-
15/11/2014	55.0	0.8	55.8	-	-	-	-
3/01/2014	50.9	0.1	51.0	-	-	-	-
11/01/2014	43.4	0.3	43.7	5/06/2014	10.9	2.4	13.3
19/01/2014	41.4	0.0	41.4	21/08/2014	8.8	2.3	11.1
1/02/2014	41.1	0.1	41.2	26/03/2014	10.5	2.2	12.7
10/02/2014	40.6	0.0	40.6	1/03/2014	8.8	2.1	10.9
4/11/2014	40.3	0.2	40.5	30/03/2014	16.5	1.9	18.4
16/01/2014	39.4	0.1	39.5	19/03/2014	28.6	1.9	30.5
10/11/2014	37.9	0.1	38.0	10/06/2014	8.0	1.9	9.9
12/01/2014	36.9	0.0	36.9	29/08/2014	8.2	1.9	10.1
3/11/2014	36.6	0.0	36.6	23/08/2014	8.8	1.8	10.6
22/11/2014	36.1	0.1	36.2	31/03/2014	15.1	1.6	16.7

Table D-10: 24-hour average $PM_{2.5}$ concentration – Sensitive receptor location 32

Ranked by Highest to Lowest Background Concentration				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
4/02/2014	27.6	0.0	27.6	-	-	-	-
9/06/2014	26.7	0.0	26.7	-	-	-	-
10/02/2014	24.1	0.0	24.1	2/09/2014	3.1	0.4	3.5
10/06/2014	20.2	0.0	20.2	2/07/2014	6.7	0.4	7.1
15/01/2014	19.0	0.0	19.0	19/05/2014	11.3	0.3	11.6
20/07/2014	17.6	0.1	17.7	8/07/2014	6.6	0.3	6.9
16/05/2014	17.2	0.2	17.4	1/10/2014	5.3	0.3	5.6
3/08/2014	16.5	0.1	16.6	5/10/2014	7.7	0.3	8.0
23/02/2014	15.2	0.0	15.2	6/05/2014	6.5	0.3	6.8
8/06/2014	14.6	0.1	14.7	21/05/2014	11.8	0.3	12.1
5/08/2014	14.5	0.2	14.7	3/07/2014	6.7	0.3	7.0
30/08/2014	14.3	0.1	14.4	22/05/2014	13.6	0.3	13.9

Table D-11: 24-hour average $PM_{2.5}$ concentration – Sensitive receptor location 61

Ranked by Highest to Lowest Background Concentration				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
4/02/2014	27.6	0.0	27.6	-	-	-	-
9/06/2014	26.7	0.0	26.7	-	-	-	-
10/02/2014	24.1	0.0	24.1	11/07/2014	4.3	0.4	4.7
10/06/2014	20.2	0.0	20.2	28/06/2014	1.4	0.3	1.7
15/01/2014	19.0	0.0	19.0	29/06/2014	3.2	0.3	3.5
20/07/2014	17.6	0.0	17.6	2/05/2014	6.3	0.3	6.6
16/05/2014	17.2	0.1	17.3	31/07/2014	8.2	0.3	8.5
3/08/2014	16.5	0.0	16.5	26/06/2014	2.9	0.3	3.2
23/02/2014	15.2	0.0	15.2	24/06/2014	3.5	0.3	3.8
8/06/2014	14.6	0.0	14.6	23/06/2014	4.7	0.2	4.9
5/08/2014	14.5	0.1	14.6	29/07/2014	12.8	0.2	13.0
30/08/2014	14.3	0.0	14.3	3/05/2014	1.3	0.2	1.5

Table D-12: 24-hour average $PM_{2.5}$ concentration – Sensitive receptor location 84

Ranked by Highest to Lowest Background Concentration				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
4/02/2014	27.6	0.0	27.6	-	-	-	-
9/06/2014	26.7	0.0	26.7	-	-	-	-
10/02/2014	24.1	0.0	24.1	25/06/2014	4.9	0.2	5.1
10/06/2014	20.2	0.0	20.2	10/07/2014	4.8	0.2	5.0
15/01/2014	19.0	0.0	19.0	1/06/2014	4.6	0.2	4.8
20/07/2014	17.6	0.0	17.6	27/06/2014	5.6	0.2	5.8
16/05/2014	17.2	0.1	17.3	13/06/2014	6.1	0.1	6.2
3/08/2014	16.5	0.1	16.6	27/05/2014	3.6	0.1	3.7
23/02/2014	15.2	0.0	15.2	6/10/2014	3.9	0.1	4.0
8/06/2014	14.6	0.0	14.6	28/03/2014	3.1	0.1	3.2
5/08/2014	14.5	0.0	14.5	24/09/2014	6.0	0.1	6.1
30/08/2014	14.3	0.0	14.3	2/07/2014	6.7	0.1	6.8

Table D-13: 24-hour average $PM_{2.5}$ concentration – Sensitive receptor location 92

Ranked by Highest to Lowest Background Concentration				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
4/02/2014	27.6	0.0	27.6	-	-	-	-
9/06/2014	26.7	0.0	26.7	-	-	-	-
10/02/2014	24.1	0.0	24.1	11/06/2014	10.7	0.3	11.0
10/06/2014	20.2	0.0	20.2	8/04/2014	6.3	0.2	6.5
15/01/2014	19.0	0.0	19.0	8/09/2014	4.3	0.2	4.5
20/07/2014	17.6	0.0	17.6	25/02/2014	9.0	0.2	9.2
16/05/2014	17.2	0.1	17.3	19/11/2014	4.4	0.2	4.6
3/08/2014	16.5	0.1	16.6	28/01/2014	6.3	0.2	6.5
23/02/2014	15.2	0.0	15.2	18/11/2014	3.6	0.1	3.7
8/06/2014	14.6	0.0	14.6	13/09/2014	11.1	0.1	11.2
5/08/2014	14.5	0.0	14.5	24/08/2014	9.2	0.1	9.3
30/08/2014	14.3	0.0	14.3	27/03/2014	2.5	0.1	2.6

Table D-14: 24-hour average $PM_{2.5}$ concentration – Sensitive receptor location 111

Ranked by Highest to Lowest Background Concentration				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
4/02/2014	27.6	0.3	27.9	-	-	-	-
9/06/2014	26.7	0.9	27.6	6/06/2014	9.0	1.4	10.4
10/02/2014	24.1	0.1	24.2	31/05/2014	7.8	1.1	8.9
10/06/2014	20.2	0.4	20.6	30/08/2014	14.3	1.1	15.4
15/01/2014	19.0	0.1	19.1	24/12/2014	6.4	1.0	7.4
20/07/2014	17.6	0.1	17.7	9/06/2014	26.7	0.9	27.6
16/05/2014	17.2	0.1	17.3	12/08/2014	6.9	0.9	7.8
3/08/2014	16.5	0.9	17.4	21/10/2014	4.4	0.9	5.3
23/02/2014	15.2	0.3	15.5	3/08/2014	16.5	0.9	17.4
8/06/2014	14.6	0.1	14.7	27/08/2014	9.1	0.9	10.0
5/08/2014	14.5	0.0	14.5	7/09/2014	5.9	0.9	6.8
30/08/2014	14.3	1.1	15.4	7/05/2014	13.9	0.8	14.7

Table D-15: 24-hour average $PM_{2.5}$ concentration – Sensitive receptor location 124

Ranked by Highest to Lowest Background Concentration				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
4/02/2014	27.6	0.0	27.6	-	-	-	-
9/06/2014	26.7	0.2	26.9	-	-	-	-
10/02/2014	24.1	0.0	24.1	26/03/2014	3.9	0.5	4.4
10/06/2014	20.2	0.3	20.5	5/06/2014	7.8	0.4	8.2
15/01/2014	19.0	0.0	19.0	21/08/2014	9.9	0.4	10.3
20/07/2014	17.6	0.1	17.7	23/08/2014	10.7	0.4	11.1
16/05/2014	17.2	0.0	17.2	1/03/2014	2.4	0.4	2.8
3/08/2014	16.5	0.1	16.6	29/08/2014	11.0	0.4	11.4
23/02/2014	15.2	0.0	15.2	27/02/2014	4.7	0.3	5.0
8/06/2014	14.6	0.2	14.8	28/02/2014	2.9	0.3	3.2
5/08/2014	14.5	0.1	14.6	30/03/2014	4.8	0.3	5.1
30/08/2014	14.3	0.2	14.5	4/04/2014	1.9	0.3	2.2

Table D-16: 24-hour average $PM_{2.5}$ concentration – Sensitive receptor location 130

Ranked by Highest to Lowest Background Concentration				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
4/02/2014	27.6	0.0	27.6	-	-	-	-
9/06/2014	26.7	0.1	26.8	-	-	-	-
10/02/2014	24.1	0.0	24.1	22/07/2014	11.8	0.5	12.3
10/06/2014	20.2	0.1	20.3	7/06/2014	12.6	0.4	13.0
15/01/2014	19.0	0.0	19.0	11/05/2014	6.8	0.4	7.2
20/07/2014	17.6	0.4	18.0	27/09/2014	7.2	0.4	7.6
16/05/2014	17.2	0.3	17.5	16/04/2014	13.1	0.4	13.5
3/08/2014	16.5	0.1	16.6	20/07/2014	17.6	0.4	18.0
23/02/2014	15.2	0.0	15.2	17/04/2014	14.0	0.4	14.4
8/06/2014	14.6	0.3	14.9	21/11/2014	5.7	0.3	6.0
5/08/2014	14.5	0.2	14.7	13/09/2014	11.1	0.3	11.4
30/08/2014	14.3	0.1	14.4	12/06/2014	7.7	0.3	8.0

Table D-17: 24-hour average $PM_{2.5}$ concentration – Sensitive receptor location 158

Ranked by Highest to Lowest Background Concentration				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
4/02/2014	27.6	0.0	27.6	-	-	-	-
9/06/2014	26.7	0.1	26.8	-	-	-	-
10/02/2014	24.1	0.0	24.1	5/06/2014	7.8	0.3	8.1
10/06/2014	20.2	0.2	20.4	21/08/2014	9.9	0.3	10.2
15/01/2014	19.0	0.0	19.0	30/03/2014	4.8	0.3	5.1
20/07/2014	17.6	0.1	17.7	26/03/2014	3.9	0.3	4.2
16/05/2014	17.2	0.0	17.2	1/03/2014	2.4	0.3	2.7
3/08/2014	16.5	0.1	16.6	29/08/2014	11.0	0.3	11.3
23/02/2014	15.2	0.0	15.2	23/08/2014	10.7	0.2	10.9
8/06/2014	14.6	0.2	14.8	4/04/2014	1.9	0.2	2.1
5/08/2014	14.5	0.0	14.5	19/03/2014	5.5	0.2	5.7
30/08/2014	14.3	0.1	14.4	10/06/2014	20.2	0.2	20.4