Appendix 8

Air Quality
Impact Assessment

Prepared by Todoroski Air Sciences - August 2019

(Total No. of pages including blank pages = 134)

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AIR QUALITY IMPACT ASSESSMENT

BRANDY HILL QUARRY EXPANSION

Hanson Construction Material Pty Ltd

23 September 2019

Job Number 13050179B

Prepared by

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Air Quality Impact Assessment
Brandy Hill Quarry Expansion

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1 INTRODUCTION

Todoroski Air Sciences has prepared this report for RW Corkery & Co Pty Limited on behalf of Hanson Construction Materials (Hanson). The report presents an assessment of potential air quality impacts associated with the proposed expansion of the Brandy Hill Quarry located at Seaham, New South Wales (NSW) (hereafter referred to as the Project).

The Project is seeking to expand its current extraction limit from 700,000 tonnes per annum (tpa) to 1.5 million tonnes per annum (Mtpa). It is also proposed to receive 20,000tpa of concrete washout material from concrete batch plants in order to produce blended recycled aggregates and road base and to produce 15,000 cubic metres (m^3) of concrete from an on-site concrete batching plant (from Stage 4 of operations).

This air quality impact assessment has been prepared in general accordance with the NSW Environment Protection Authority (EPA) document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2017**).

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

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

1.1 Preamble

Todoroski Air Sciences have been commissioned to prepare an updated air quality assessment for the proposed expansion of the Brandy Hill Quarry. As part of this work, the *Brandy Hill Quarry Expansion Updated Air Quality Assessment* prepared by **Vipac Engineers & Scientists** (**2018**) (Vipac) and subsequent addendum reports have been reviewed along with the NSW EPA comments regarding the assessment.

Each of the comments raised by the NSW EPA in their review of the Vipac air quality assessment have been addressed, where applicable, in this assessment. **Appendix A** presents a summary of each of the NSW EPA comments with a reference to where they have been addressed in this report.

2 PROJECT BACKGROUND

2.1 Project setting

The Project site is located approximately 30 kilometres (km) north-northwest of Newcastle and approximately 14km northeast of Maitland. The site covers an area of approximately 554 hectares (ha) with the surrounding land use characterised as predominantly rural with dense bushland to the north.

Figure 2-1 presents the location of the Project and residential receptors assessed as discrete receptors in this assessment. The nearest residential receptors to the Project are located approximately 1.3km to the south of the existing processing area. The address of each residential receptor shown in **Table 2-1**.

Figure 2-2 presents a pseudo three-dimensional visualisation of the topography in the general vicinity of the Project. The topography consists of undulating hills sloping towards higher elevations to the northwest and lower flat terrain to the south.

Table 2-1: Residential receptor details

Receptor ID	Address
R1	122B Dunns Creek Road
R2	16 Uffington Road
R3	60 Green Wattle Creek Road
R4	34 Timber Top Road
R5	35 Timber Top Road
R6	36 Timber Top Road
R7	13 Mooghin Road
R8	14 Mooghin Road
R9	13 Giles Road
R10	13B Giles Road
R11	866 Clarence Town Road
R12	994 Clarence Town Road
R13	1034 Clarence Town Road
R14	1060 Clarence Town Road
R15	1094 Clarence Town Road
R16	1189 Clarence Town Road
R17	1203 Clarence Town Road

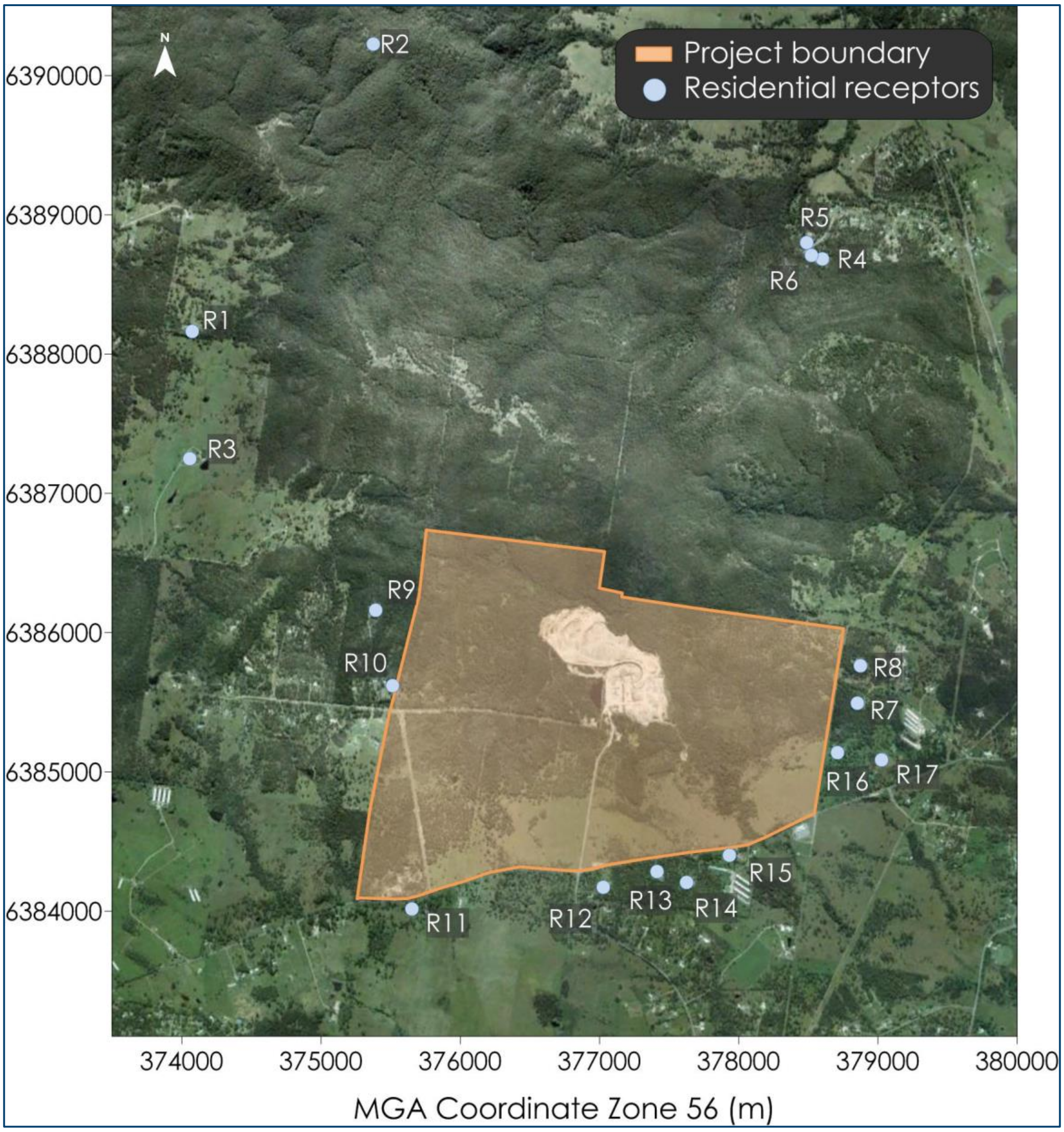


Figure 2-1: Project setting

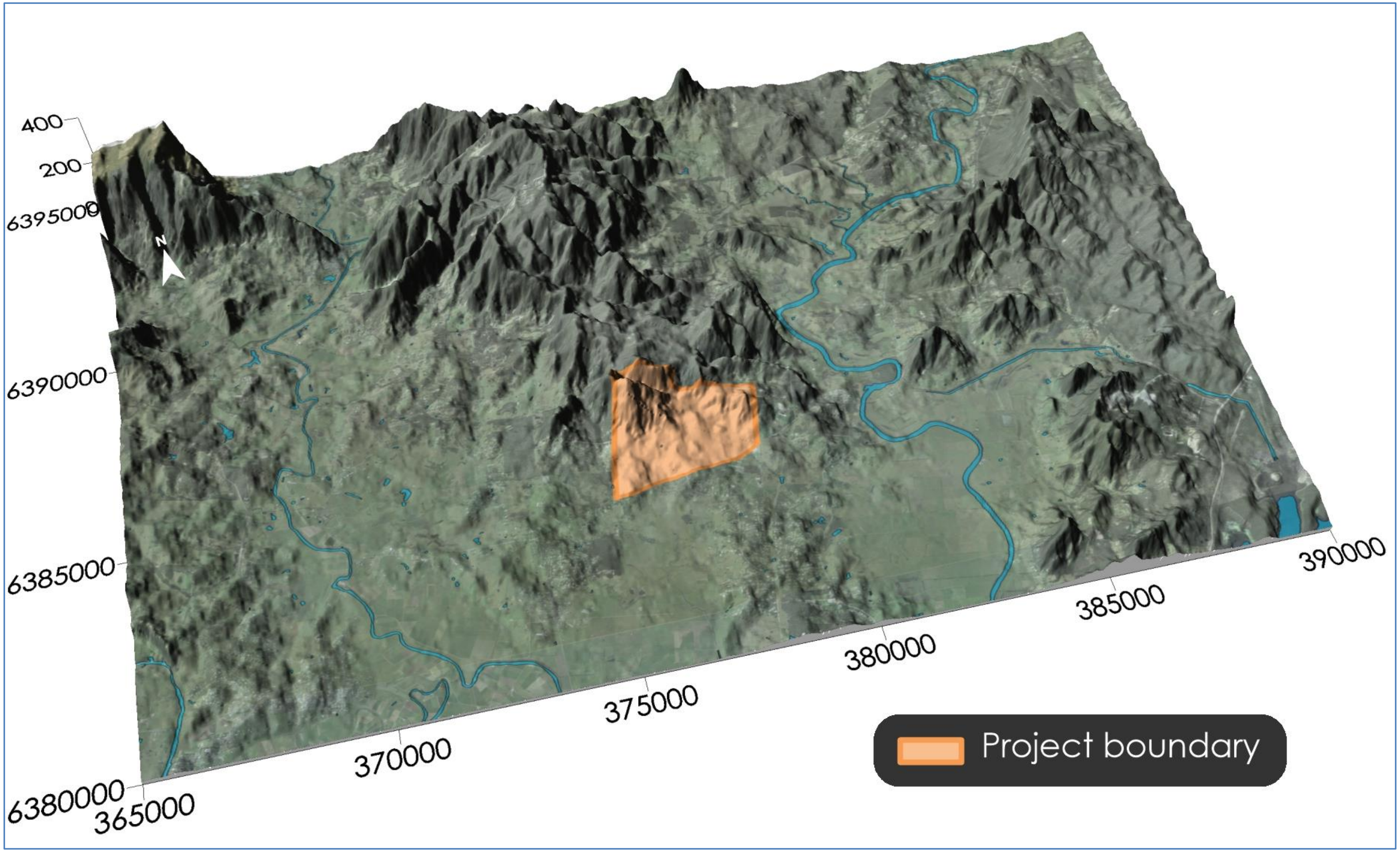


Figure 2-2: Representative visualisation of topography in the area surrounding the Project

2.2 Project description

The Project consists of an expansion of the existing quarry operation to extend the life of the quarry and increase the production limit to a rate of up to 1.5Mtpa.

In order to accommodate the proposed expansion, resource would be extracted from beneath part of the existing quarry infrastructure area and requires the existing plant infrastructure to be relocated approximately 500 metres (m) to the south of the current location.

The Project would be undertaken progressively in five stages (Stage 1 to Stage 5) to cover the extent of the quarry.

The hard rock resource would be extracted at the Project using the current extraction methods which include drill and blast to free and fracture the resource material. The material is then loaded to a haul truck by an excavator and transported to the fixed processing area. Material is then processed using a series of crushers and screens to produce a saleable product. The product material is stockpiled in designated areas before being dispatched from the site via road trucks.

Other key features for the Project include the processing of concrete washout material from concrete batch plants in order to produce blended recycled aggregates and road base and the establishment of an on-site concrete batch plant from Stage 4 which is expected to produce approximately 15,000m^3 of concrete each year.

The proposed operating hours of the Project are outlined below in **Table 2-2**.

Table 2-2: Proposed operating hours

Activity	Monday-Friday	Saturday	Sunday
Construction works	7am-6pm	7am-5pm	-
Blasting	9am-5pm	-	-
Load and Haul	5am-10pm	5am-10pm	-
Primary crusher	5am-10pm	5am-10pm	-
Secondary and tertiary crusher	24hr	24hr	24hr
Sales and despatch*	5am-10pm	5am-10pm	5am-10pm
Maintenance	24hr	24hr	24hr

*Night time despatch is proposed to occur on only 20 days per year

3 AIR QUALITY CRITERIA

3.1 Particulate Matter

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

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

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

3.1.1 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 goals for total impact relate to the total dust burden in the air and not just the dust from the Project. Consideration of background dust levels needs to be made when using these goals to assess potential impacts.

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

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

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

3.2 NSW Voluntary Land Acquisition and Mitigation Policy (VLAMP)

Part of the NSW VLAMP dated September 2018 describes the NSW Government's policy to provide landowners with the right to request or negotiate mitigation or land acquisition to address particulate matter impacts from state significant mining, petroleum and extractive industry developments.

Voluntary mitigation rights may apply per the VLAMP where, even with best practice management, the development contributes to exceedances of the criteria in **Table 3-2** at any residence on privately owned land or workplace. [1]

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

Table 3-2: Particulate matter mitigation criteria

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

Source: **NSW Government (2018)**

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

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

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

Table 3-3: Particulate matter acquisition criteria

Pollutant	Averaging period	Acquisition 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 Government (2018)**

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

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

3.3 Crystalline silica

Silica occurs in nature in a crystalline or amorphous form, and may be synthetically produced in amorphous forms. Silica is commonly found in soil and rocks, the most common form is quartz, followed by cristobalite and tridymite. The crystalline form of silica has potential to cause adverse health effects in humans. Occupational exposure to respirable crystalline silica has potential to result in silicosis (**NIOSH, 1974**).

Various jurisdictions have developed criteria for acceptable levels of exposure to crystalline silica. These include the Victorian criterion adopted from Californian reference exposure level values, and occupational standards. **Table 3-4** presents the Victorian impact assessment criteria (**VIC EPA, 2007**) which are the most stringent available standards for respirable crystalline silica and which are applied to the Project.

Table 3-4: Air quality criterion for respirable silica

Pollutant	Averaging period	Criterion (µg/m³)	Organisation
Respirable crystalline silica (as $PM_{2.5}$)	Annual	3	VIC EPA

Source: **VIC EPA (2007)**

3.4 Other air pollutants

Emissions of other air pollutants, namely nitrogen dioxide (NO_2), will also potentially arise from the blasting activities on-site. NO_2 is reddish-brown in colour (at high concentrations) with a characteristic odour and can irritate the lungs and lower resistance to respiratory infections such as influenza. NO_2 belongs to a family of reactive gases called nitrogen oxides (NO_X).

Table 3-5 summarises the air quality goals for NO_2 considered in this report.

Table 3-5: NSW EPA air quality impact assessment criteria of air toxics

Pollutant	Averaging period	Criterion
Nitrogen dioxide (NO_2)	1 hour	246µg/m³
	Annual	62µg/m³

Source: **NSW EPA (2017)**

It is noted that other air pollutants can also arise due to blasting activities. These pollutants are generally considered to be too low to generate any significant off-site pollutant concentrations relative to their respective criteria and have not been assessed further in this study.

4 EXISTING ENVIRONMENT

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

4.1 Local climatic conditions

Long-term climatic data from the closest Bureau of Meteorology (BoM) weather station at Paterson (TOCAL AWS) (Site No. 061250) were analysed to characterise the local climate in the proximity of the Project. Paterson (TOCAL AWS) weather station is located approximately 9.9km northwest of the Project.

Table 4-1 and **Figure 4-1** present a summary of data from the Paterson (TOCAL AWS) weather station collected over a 34 to 52 year period for the various meteorological parameters.

The data indicate that January is the hottest month with a mean maximum temperature of 30.0 degrees Celsius (°C) and July is the coldest month with a mean minimum temperature of 6.1°C.

Rainfall decreases during the middle of the year, with an annual average rainfall of 940.3 millimetres (mm) over 88.8 days. The data indicate that March is the wettest month with an average rainfall of 117.6mm over 9.2 days and August is the driest month with an average rainfall of 37.0mm over 5.0 days.

Relative humidity levels exhibit variability over the day and seasonal fluctuations. Mean 9am relative humidity ranges from 64% in September and October to 80% in March and May. Mean 3pm relative humidity levels range from 46% in August and September to 59% in June.

Wind speeds during the warmer months have a greater spread between the 9am and 3pm conditions compared to the colder months. Mean 9am wind speeds range from 5.5 kilometres per hour (km/h) in February to 13.3km/h in August. Mean 3pm wind speeds range from 11.3km/h in April to 17.9km/h in August.

Table 4-1: Monthly climate statistics summary – Paterson (TOCAL AWS) weather station

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature													
Mean max. temp. (°C)	30.0	29.0	27.1	24.3	20.8	17.8	17.5	19.4	22.5	25.1	26.9	29.2	24.1
Mean min. temp. (°C)	17.7	17.6	15.8	12.6	9.6	7.6	6.1	6.6	9.0	11.5	14.0	16.3	12.0
Rainfall													
Rainfall (mm)	106.8	115.3	117.6	86.5	68.9	78.2	38.7	37.0	48.0	66.3	83.5	81.7	940.3
No. of rain days	8.4	8.6	9.2	7.6	7.0	7.7	5.8	5.0	5.8	7.4	8.7	7.6	88.8
9am conditions													
Mean temp. (°C)	22.7	22.0	20.6	18.0	14.6	11.9	11.0	12.6	16.2	19.1	20.1	22.2	17.6
Mean R.H. (%)	74	79	80	77	80	78	76	69	64	64	69	69	73
Mean W.S. (km/h)	7.0	5.5	5.8	7.0	8.4	11.0	11.5	13.3	13.1	11.1	9.5	8.5	9.3
3pm conditions													
Mean temp. (°C)	28.3	27.4	25.7	23.0	19.7	16.8	16.4	18.3	20.9	23.3	25.1	27.5	22.7
Mean R.H. (%)	52	56	58	56	58	59	55	46	46	48	49	49	53
Mean W.S. (km/h)	14.6	12.3	11.6	11.3	11.4	13.8	15.0	17.9	17.8	16.5	16.5	16.1	14.6

Source: **Bureau of Meteorology (2019)**

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

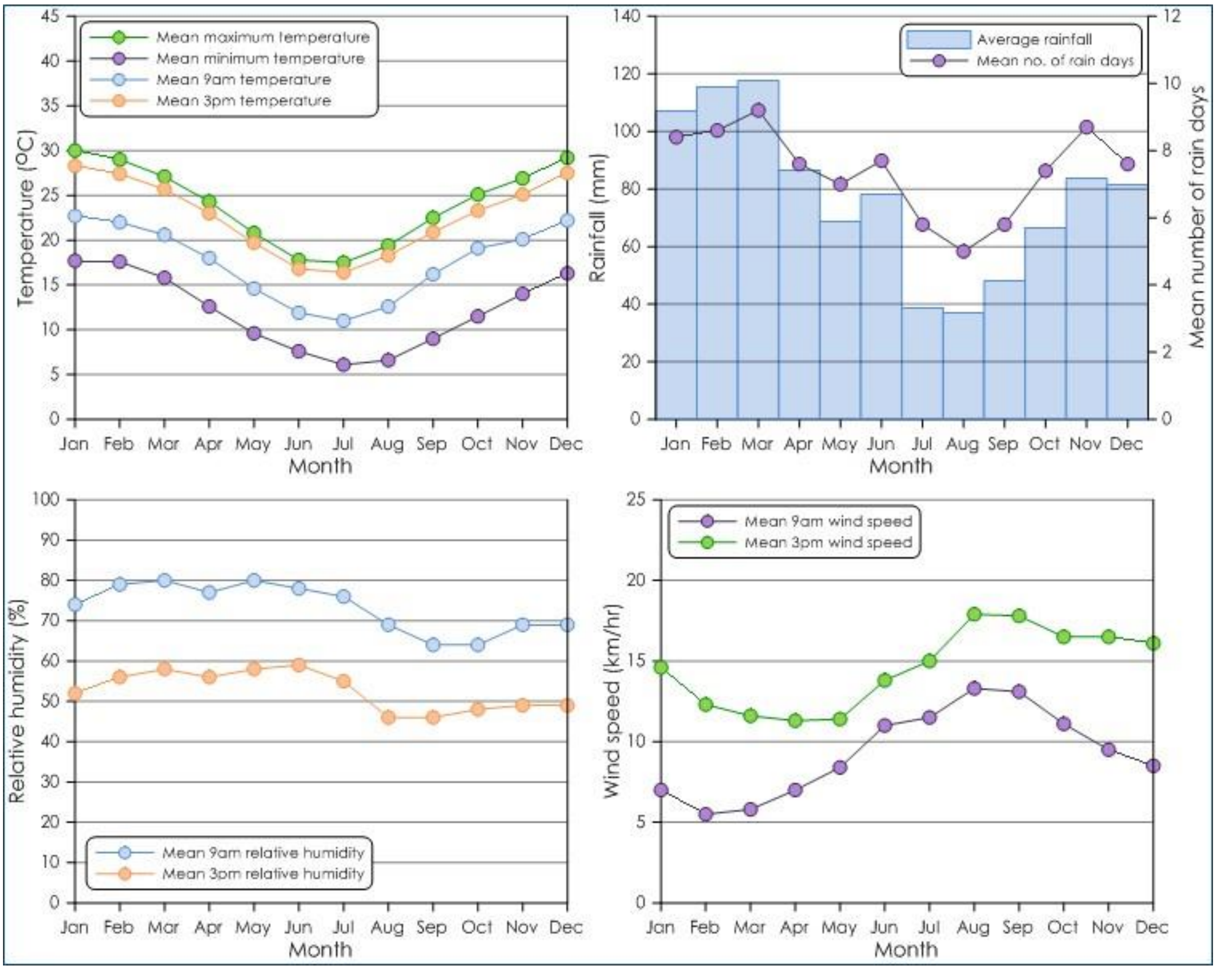


Figure 4-1: Monthly climate statistics summary – Patterson (TOCAL AWS) weather station

4.2 Local meteorological conditions

Annual and seasonal windroses for the Paterson (TOCAL AWS) weather station during the 2015 calendar period are presented in **Figure 4-2**.

The 2015 calendar year was selected as the meteorological year for the dispersion modelling based on an analysis of the long-term data trends in meteorological data recorded for the area as outlined in **Appendix B**.

On an annual basis, winds predominantly occur from the west-northwest and northwest and tend to flow on a northwest to southeast axis. In summer, winds tend to occur from the southeast quadrant. The autumn and winter wind distributions are similar to the annual distribution with winds predominantly occurring from the west-northwest and northwest. In winter there are fewer winds originating from the southeast quadrant. In spring, there is greater variability in wind directions which are more evenly distributed compared to the other seasons.

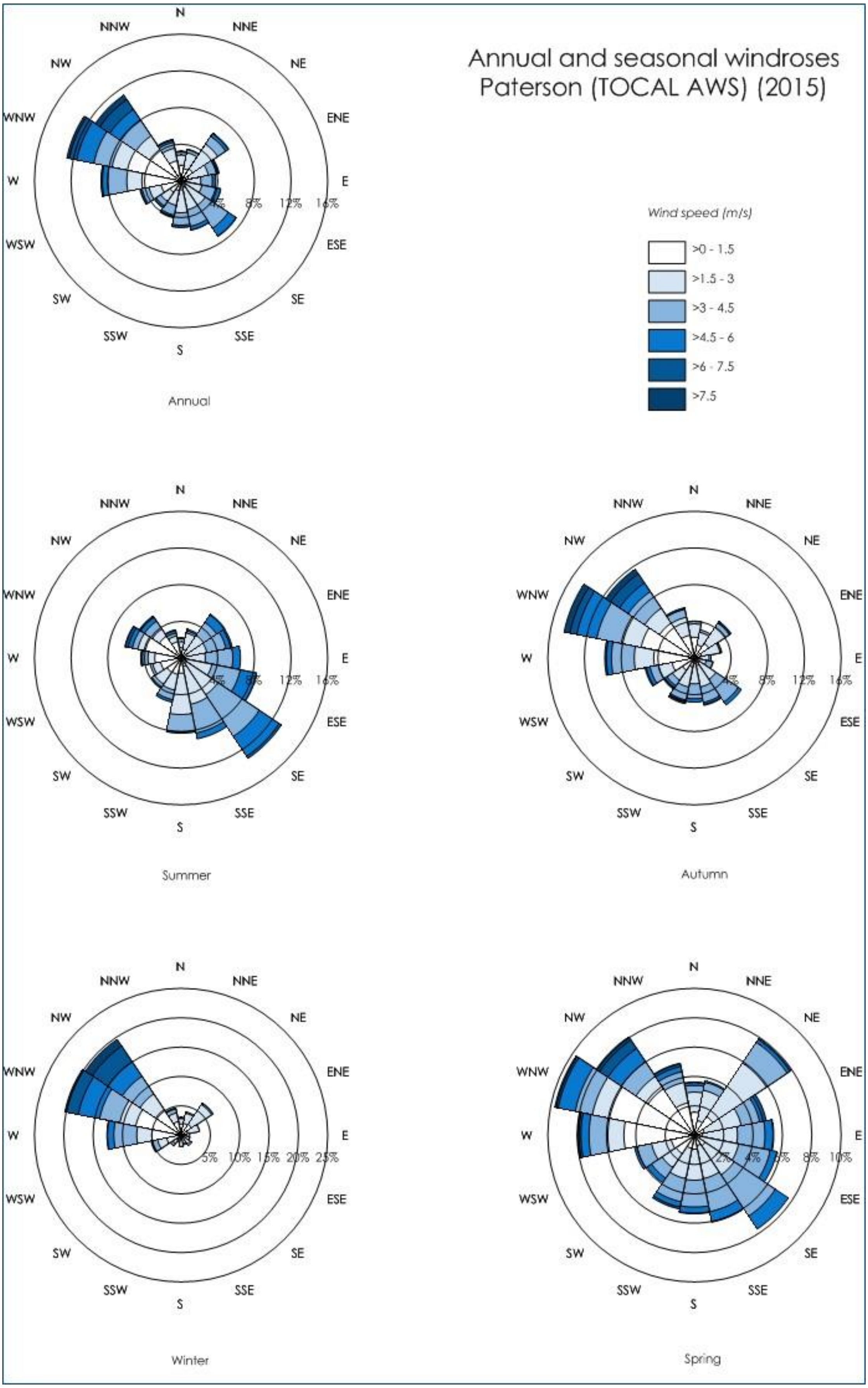


Figure 4-2 : Annual and seasonal windroses – Paterson (TOCAL AWS) weather station (2015)

4.3 Local air quality monitoring

The main sources of air pollutants in the area surrounding the Project include active quarrying, agricultural activities, emissions from anthropogenic activities such as motor vehicle exhaust, wood heater emissions and various agricultural activities.

4.3.1 Deposited dust monitoring

Deposited dust monitoring is conducted at the Project, the location of the deposited dust gauges is shown in **Figure 4-3**.

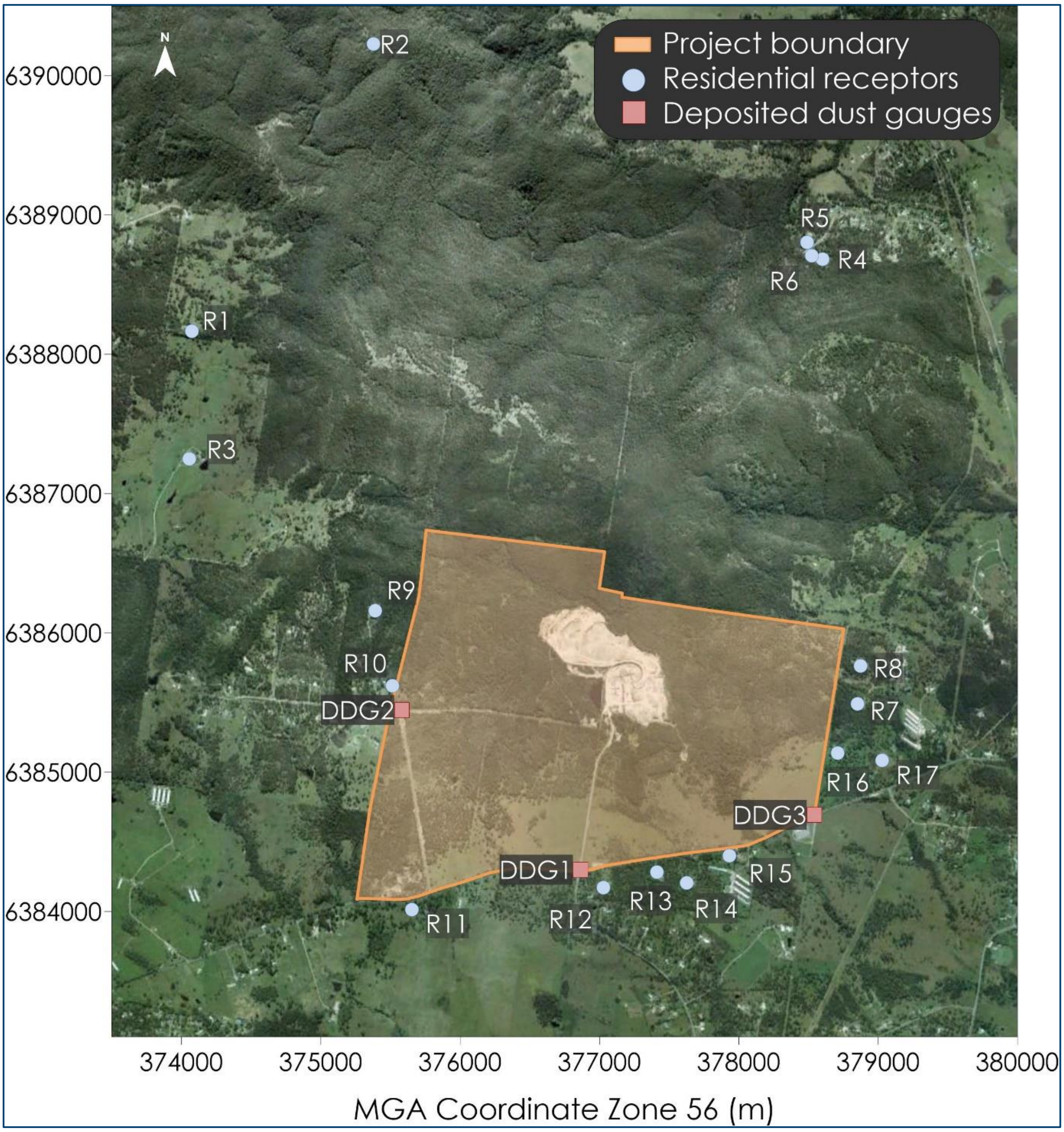


Figure 4-3: Deposited dust gauge locations

Table 4-2 presents the annual average deposited dust levels for the Project during 2011 to 2018. The results indicate that deposited dust levels are below the relevant criterion of 4g/m²/month and indicate that deposited dust levels are generally good in the vicinity of the Project.

Table 4-2: Annual average deposited dust monitoring data (g/m²/month)

Year	DDG1	DDG2	DDG3
2011-2012	3.1	0.4	1.1
2012-2013	3.1	0.6	1.9
2013-2014	2.3	0.5	1.4
2014-2015	1.4	0.5	0.6
2015-2016	0.8	0.6	1.2
2016-2017	1.5	0.7	2.9
2017-2018	3.0	1.6	2.3
Average	**2.2**	**0.7**	**1.6**

4.3.2 PM_{10} monitoring

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

The NSW OEH air quality monitors located at Beresfield and Wallsend which are 15.7km and 26.6km from the Project, respectively, and are taken to be generally representative of the background levels in the vicinity of the Project site.

A summary of the available PM_{10} monitoring data from Beresfield and Wallsend is presented in **Table 4-3**. Recorded 24-hour average PM_{10} concentrations are presented in **Figure 4-4.**

A review of **Table 4-3** indicates that the annual average PM_{10} concentrations from Beresfield and Wallsend were below the relevant criterion of 25µg/m³ each reviewed year. The maximum 24-hour average PM_{10} concentrations recorded at these stations exceeded the relevant criterion of 50µg/m³ on occasion during the review period. It can be seen from **Figure 4-4** that PM_{10} concentrations nominally peak in spring and summer with the warmer weather raising the potential for drier ground, elevating the occurrence of windblown dust, and increased pollen levels.

Table 4-3: Summary of PM_{10} levels from NSW OEH monitoring (µg/m³)

Year	Beresfield	Wallsend	Criterion
	Annual Average		
2014	19.4	16.9	**25**
2015	18.8	16.7	**25**
2016	19.1	16.6	**25**
2017	19.6	17.4	**25**
2018	21.6	19.4	**25**
	Maximum 24-hour Average		
2014	45.4	43.4	**50**
2015	**64.9**	**77.5**	**50**
2016	48.0	**65.5**	**50**
2017	49.4	47.9	**50**
2018	**149.1**	**136.5**	**50**

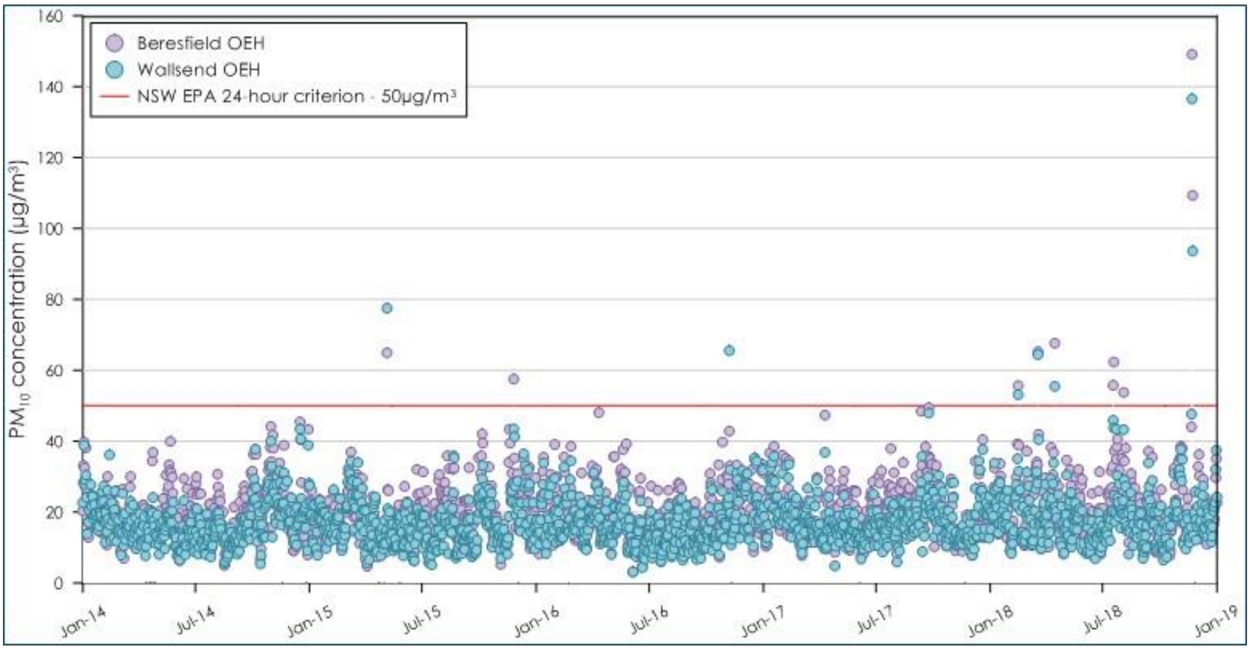
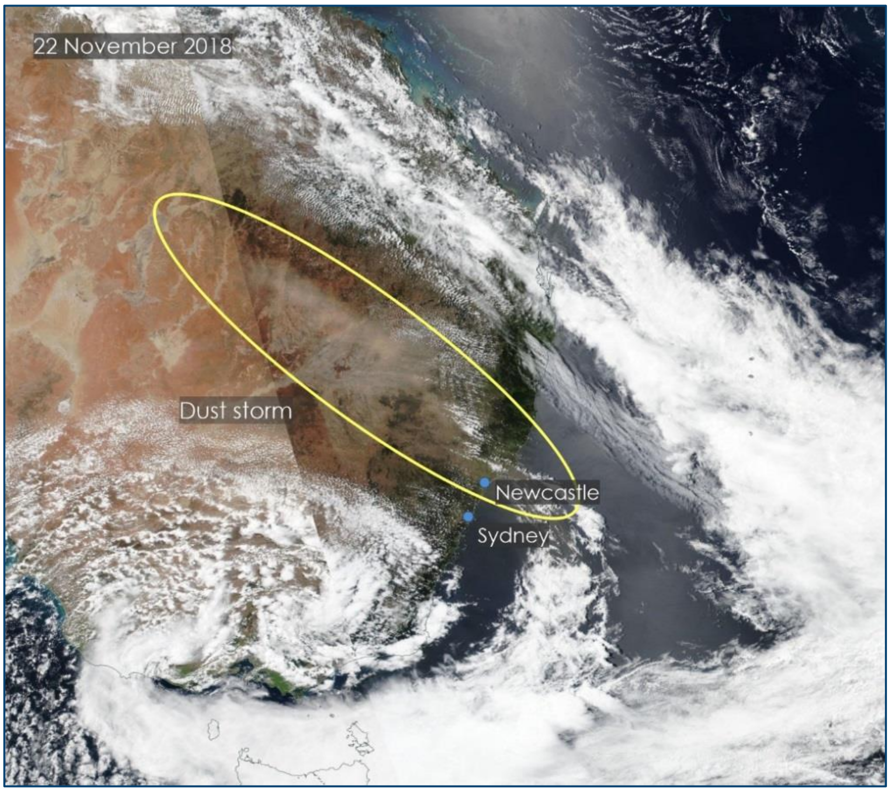


Figure 4-4: 24-hour average PM_{10} concentrations

High PM_{10} concentrations were recorded in November 2018 at the NSW OEH air quality monitors. An analysis into available satellite imagery (**NASA, 2019**) and other sources (**NSW OEH, 2018**) concludes elevated concentrations were due to a regional dust storm associated with a cold front which occurred on 22 November 2018. **Figure 4-5** presents satellite imagery showing the dust storm on 22 November 2018.



Source: **NASA (2019)**

Figure 4-5: Satellite imagery showing dust storm on 22 November 2018

4.3.3 $PM_{2.5}$ monitoring

A summary of the available $PM_{2.5}$ readings from the Beresfield and Wallsend monitors is presented in **Table 4-4**. The recorded 24-hour average $PM_{2.5}$ concentrations are presented in **Figure 4-6**.

Table 4-4 indicates that the annual average $PM_{2.5}$ concentrations from Beresfield and Wallsend monitors were below the relevant criterion of 8µg/m³ for each reviewed year with the exception of 2018 for Beresfield.

It can be seen from **Figure 4-6** that 24-hour average $PM_{2.5}$ concentrations are uniformly distributed throughout the year. The maximum 24-hour average $PM_{2.5}$ concentrations recorded at the Beresfield and Wallsend monitoring stations exceeded the relevant criterion of 25µg/m³ on three occasions at Beresfield and one occasion at Wallsend during the review period.

Table 4-4: Summary of $PM_{2.5}$ levels from NSW OEH monitoring (µg/m³)

Year	Beresfield	Wallsend	Criterion
	Annual Average		
2014	7.5	6.7	**8**
2015	7.3	7.3	**8**
2016	7.4	8.0	**8**
2017	7.6	7.3	**8**
2018	**8.7**	7.5	**8**
	Maximum 24-hour Average		
2014	19.0	18.0	**25**
2015	**25.9**	24.0	**25**
2016	**27.9**	**50.7**	**25**
2017	18.7	20.4	**25**
2018	24.9	20.2	**25**

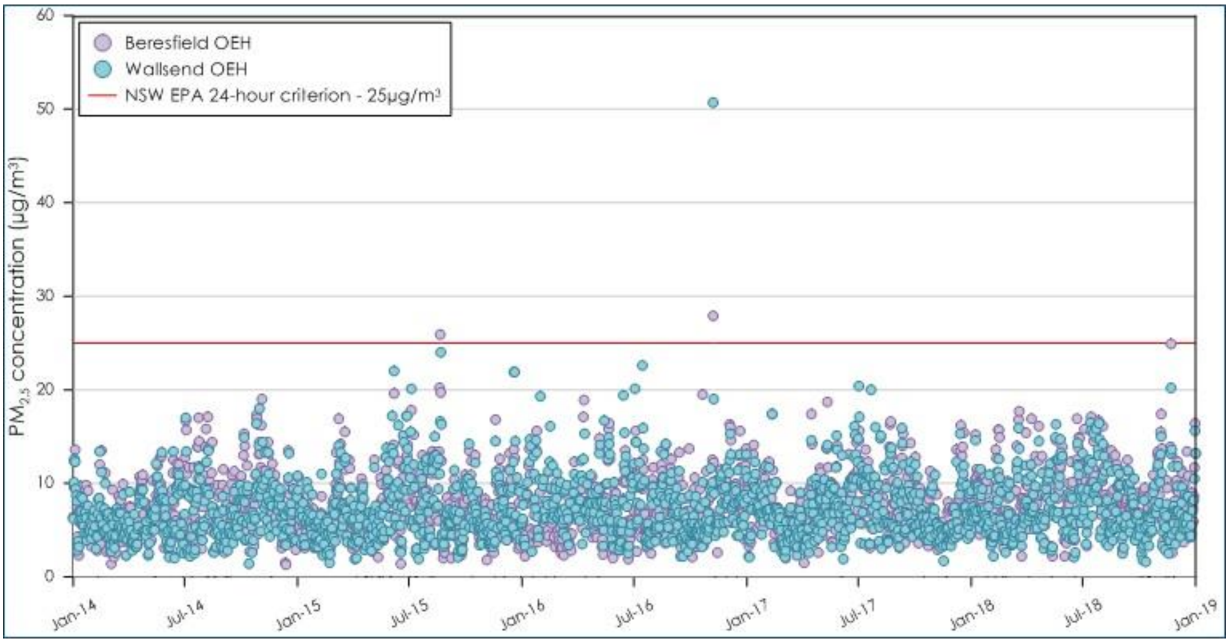


Figure 4-6: 24-hour average $PM_{2.5}$ concentrations

4.3.4 Rocky Hill Coal Project monitoring

The Rocky Hill Coal Project (RHCP) is located approximately 120km north of Newcastle in the Gloucester Basin. It is located in a rural area predominantly characterised by cattle grazing, bushland and low density residential similar to the area surrounding the Project site.

Baseline air quality monitoring for the RHCP includes two PM_{10} / $PM_{2.5}$ TEOM monitoring stations positioned to the north and south of the site.

As the TEOM monitoring stations are located in a similar setting and subject to similar conditions as the Project, the measured background levels have been reviewed in this assessment.

4.3.4.1 PM_{10} monitoring

A summary of the available PM_{10} monitoring data from RHCP is presented in **Table 4-5**. Recorded 24-hour average PM_{10} concentrations are presented in **Figure 4-7.**

A review of **Table 4-5** indicates that the annual average PM_{10} concentrations from RHCP were below the relevant criterion of 25µg/m^3 each reviewed year. It should be noted that annual periods which contain less than 75% data are excluded for estimating an annual average in **Table 4-5**.

The measured 24-hour average PM_{10} concentrations are below the relevant criterion of 50µg/m^3 with the exception of the South TEOM which recorded one period above 50µg/m^3 in 2013. Similar to the OEH monitors, a seasonal trend can be seen in **Figure 4-7** with PM_{10} concentrations peaking in spring and summer and decreasing during autumn and winter.

Table 4-5: Summary of PM_{10} levels from RHCP monitoring (µg/m^3)

Year	South TEOM	North TEOM	Criterion
		Annual Average	
2011	-	-	**25**
2012	9.3	10.8	**25**
2013	9.5	-	**25**
2014	9.8	9.4	**25**
2015	7.2	-	**25**
		Maximum 24-hour Average	
2011	36.7	33.6	**50**
2012	30.5	36.6	**50**
2013	**51.6**	47.9	**50**
2014	40.0	40.2	**50**
2015	26.5	-	**50**

Source: **Pacific Environment Limited (2016)**

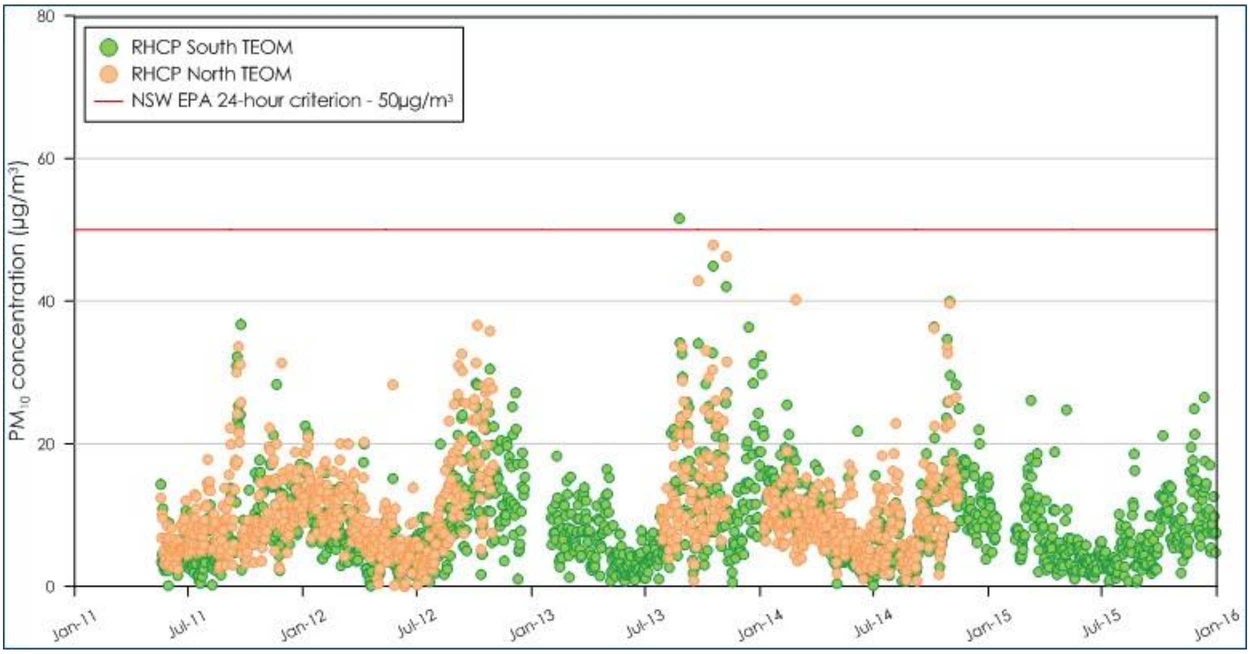


Figure 4-7: 24-hour average PM_{10} concentrations for RHCP

4.3.4.2 $PM_{2.5}$ monitoring

A summary of the available $PM_{2.5}$ readings from RHCP is presented in **Table 4-6**. The recorded 24-hour average $PM_{2.5}$ concentrations are presented in **Figure 4-8**.

Table 4-6 indicates that the annual average $PM_{2.5}$ concentrations from RHCP were below the relevant criterion of 8µg/m^3 each reviewed year. Annual periods which contain less than 75% data are excluded for estimating an annual average in **Table 4-6**.

The South TEOM and North TEOM recorded 24-hour average $PM_{2.5}$ concentrations above the relevant criterion of 25µg/m^3 on a number of occasions during the review period. It can be seen from **Figure 4-8** that the 24-hour average $PM_{2.5}$ concentrations follow a similar trend to the PM_{10} concentrations with peaks occurring in spring and summer.

Table 4-6: Summary of $PM_{2.5}$ levels from RHCP monitoring (µg/m³)

Year	South TEOM	North TEOM	Criterion
	Annual Average		
2011	-	-	**8**
2012	4.0	5.1	**8**
2013	3.9	-	**8**
2014	3.7	4.0	**8**
2015	2.5	-	**8**
	Maximum 24-hour Average		
2011	22.9	**25.1**	**25**
2012	20.6	22.3	**25**
2013	**42.8**	**32.7**	**25**
2014	**26.7**	**29.5**	**25**
2015	15.4	19.2	**25**

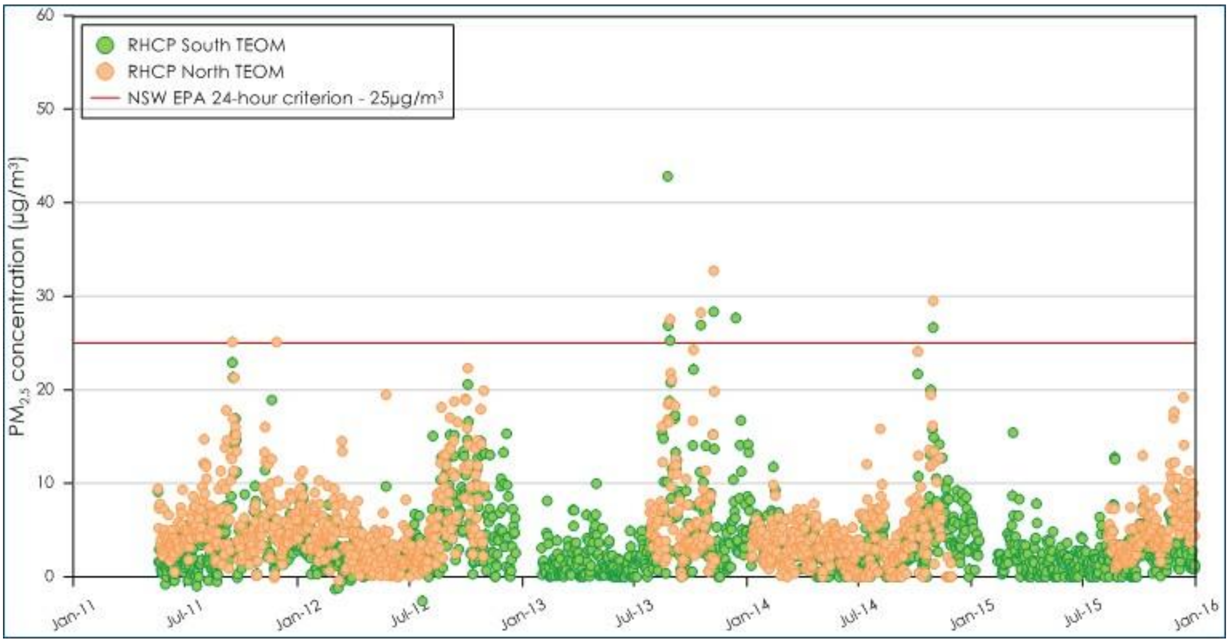


Figure 4-8: 24-hour average $PM_{2.5}$ concentrations for RHCP

4.3.5 Estimated background levels

As outlined above, there are no readily available site specific monitoring data, and therefore to assess the potential impacts associated with the Project against the relevant dust criteria outlined in **Section 3**, consideration of background dust levels needs to be applied. The background dust levels should be representative of the area surrounding the Project site.

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

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

The Wallsend monitoring site is located in a more urbanised setting which predominantly comprises residential with some nearby commercial and industrial sources.

The RHCP TEOMs are positioned furthest from the Project site, however are in a location considered most similar to the Project site and would expect to have similar background levels. It is noted the South TEOM is located in an entirely rural area whereas the North TEOM is located closer to the town of Gloucester and in the vicinity of Jacks Road which is considered a good match to the area surrounding the Project site. However, due to a lack of available data during 2015 for the North TEOM, this monitor cannot be used to estimate background levels for the assessment.

Of the available data, the Beresfield monitor provides a sufficient dataset for 2015 and would present a conservative estimate of background levels for the Project site to assess the cumulative impacts and thus has been selected for this assessment.

4.3.5.1 PM$_{2.5}$ and PM$_{10}$, concentrations

Annual average $PM_{2.5}$ and PM_{10} values from the Beresfield monitoring station for the 2015 calendar year were used to represent the background levels for the Project (see **Table 4-3** and **Table 4-4**).

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} and TSP concentrations and the measured PM_{10} levels.

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

Applying this relationship with the measured annual average PM_{10} concentration of 18.8µg/m^3 indicates an approximate annual average TSP concentration of 67.7µg/m^3.

4.3.5.3 Deposited dust levels

Annual average deposited dust levels have been estimated from the measured levels at the Project site. **Table 4-2** indicates the maximum average deposited dust level for each of the monitoring locations is 2.2g/m^2/month at DDG1 and has been used to represent the background level. We note that this value includes a contribution from the existing operations and is therefore a conservative estimate of background levels for the Project site.

4.3.5.4 Summary of background levels

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

- $PM_{2.5}$ concentrations – 7.3µg/m^3;
- PM_{10} concentrations – 18.8µg/m^3;
- TSP concentrations – 67.7µg/m^3; and,
- Deposited dust levels – 2.2g/m^2/month.

5 DISPERSION MODELLING APPROACH

5.1 Introduction

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

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

5.2 Modelling methodology

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

5.2.1 Meteorological modelling

TAPM was applied to the available data to generate a 3D upper air data file for use in CALMET. The centre of analysis for TAPM was 32deg39.5min south and 151deg41.5min east. The simulation involved an outer grid of 30 km, with three nested grids of 10 km, 3 km and 1 km with 35 vertical grid levels. The CALMET domain was run on a 15 x 15km area with 0.15 km grid resolution.

The 2015 calendar year was selected as the meteorological year for the dispersion modelling based on analysis of long-term data trends in meteorological data recorded for the area as outlined in **Appendix B**. Accordingly, the available meteorological data from three meteorological stations were included in the simulation. **Table 5-1** outlines the parameters used from each station.

Table 5-1: Surface observation stations used in modelling

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

WS = wind speed, WD= wind direction, CH = cloud height, CC = cloud cover, T = temperature, RH = relative humidity and 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	5
IEXTRP	-4
BIAS (NZ)	-1, -0.5, -0.25, 0, 0, 0, 0, 0
R1 and R2	8, 8
RMAX1 and RMAX2	12, 12

5.2.2 Meteorological modelling evaluation

The outputs from the CALMET modelling are evaluated using visual analysis of the wind fields and extracted data and also through a comparison of the CALMET generated data at locations with measured observational meteorological data within the modelling domain.

Figure 5-1 presents a visualisation of the wind field generated by CALMET for a single hour of the modelling period. The wind fields are seen to follow the terrain well and indicate the simulation produces realistic fine scale flow fields (such as terrain forced flows) in surrounding areas.

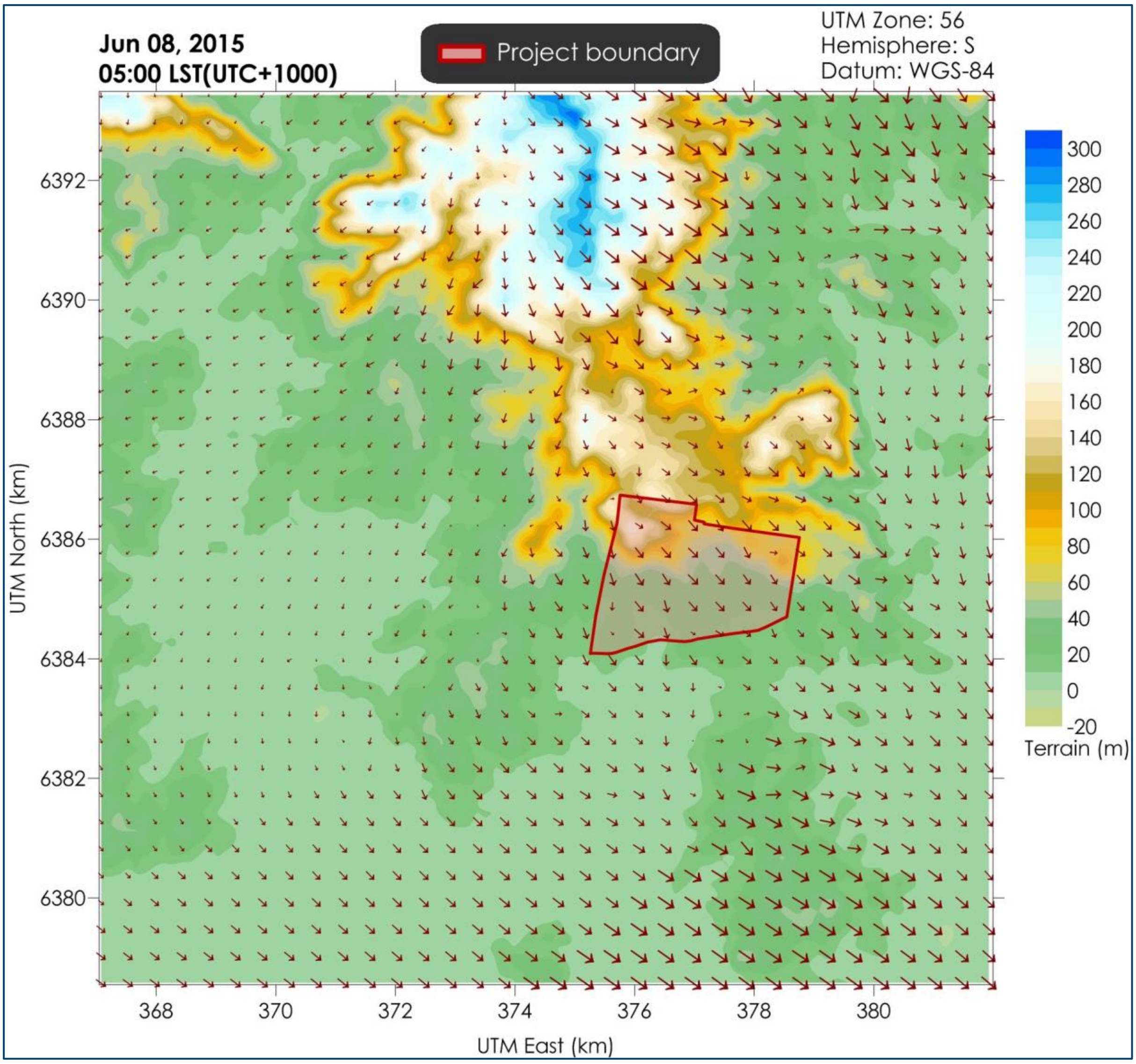


Figure 5-1: Representative snapshot of wind field for the Project

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

Figure 5-2 presents the annual and seasonal windroses from the CALMET data. Overall, the windroses generated in the CALMET modelling reflect the expected wind distribution patterns of the area as determined based on the available measured data and the expected terrain effects on the prevailing winds. **Figure 5-3** includes graphs of the temperature, wind speed, mixing height and stability classification over the modelling period and show sensible trends considered to be representative of the area.

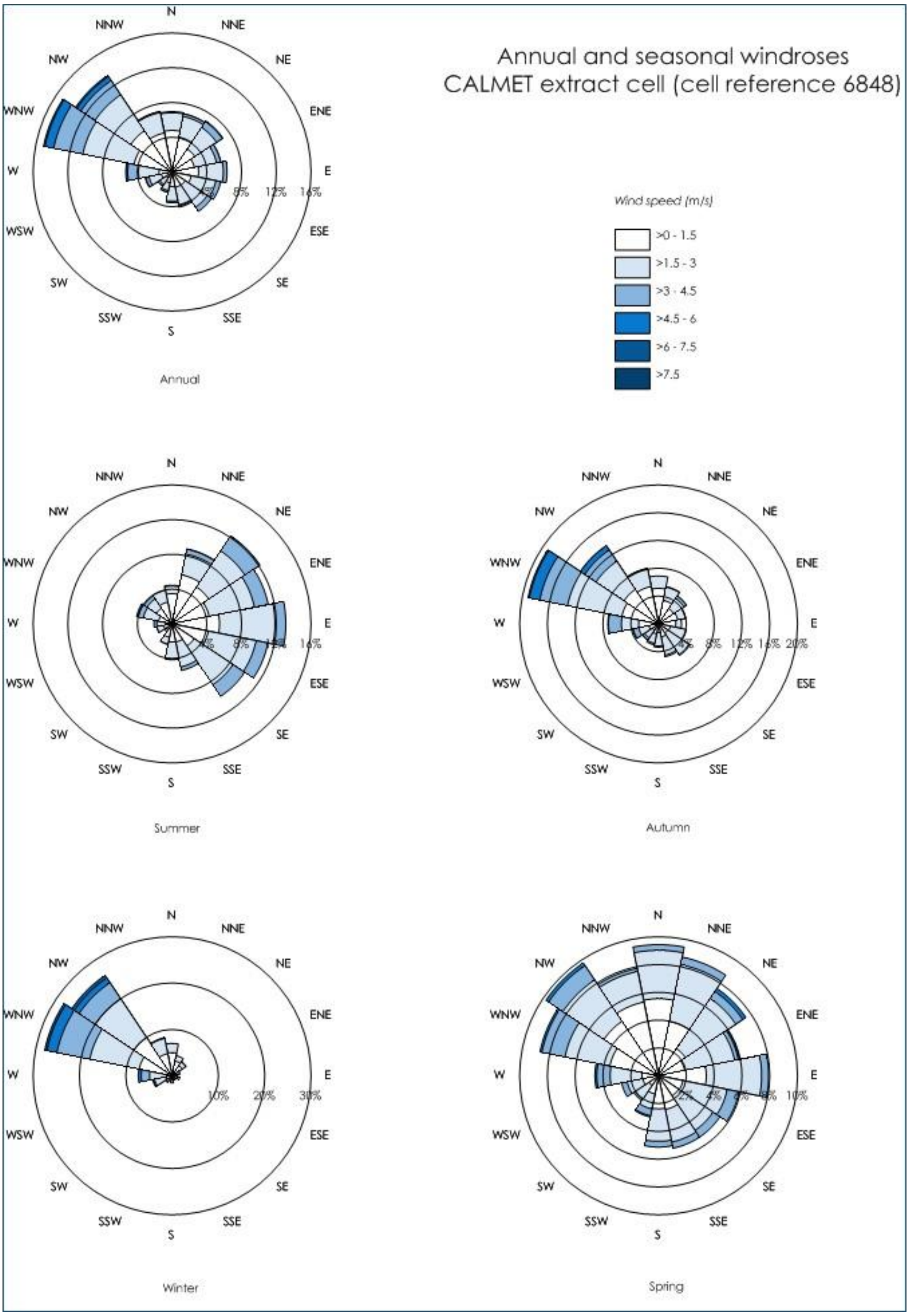


Figure 5-2: Annual and seasonal windroses from CALMET (Cell reference 6848)

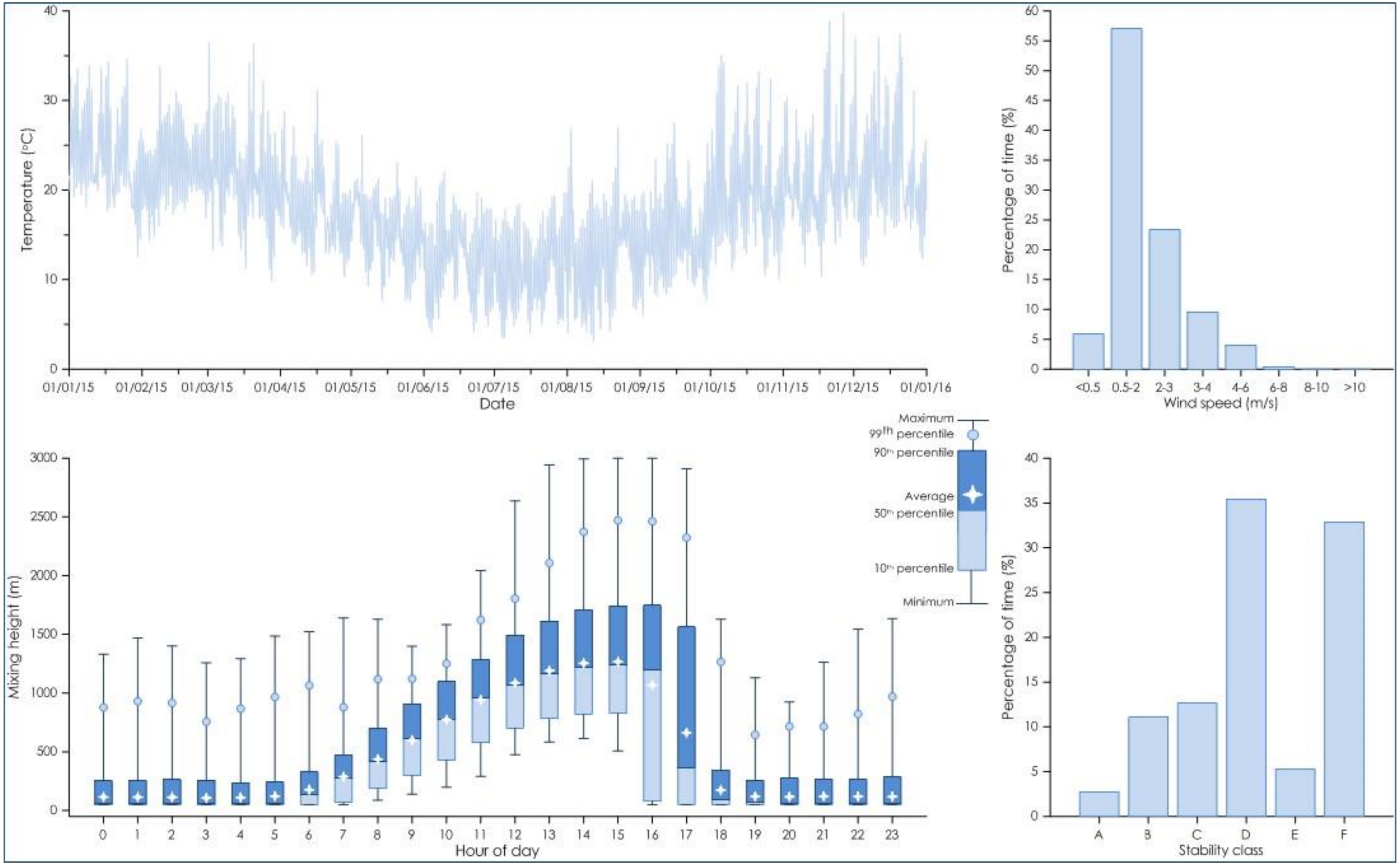


Figure 5-3: Meteorological analysis of CALMET (Cell Ref 6848)

To demonstrate the CALMET generated data are adequately representing the terrain and meteorological effects of the modelling domain, a comparison with actual measured observational data from a weather station located within the modelling domain is performed.

Measured observational data from the BoM Paterson (TOCAL AWS) weather station are used in the comparison, the location of the Paterson (TOCAL AWS) weather station relative to the Project site is shown in **Figure 5-4**.

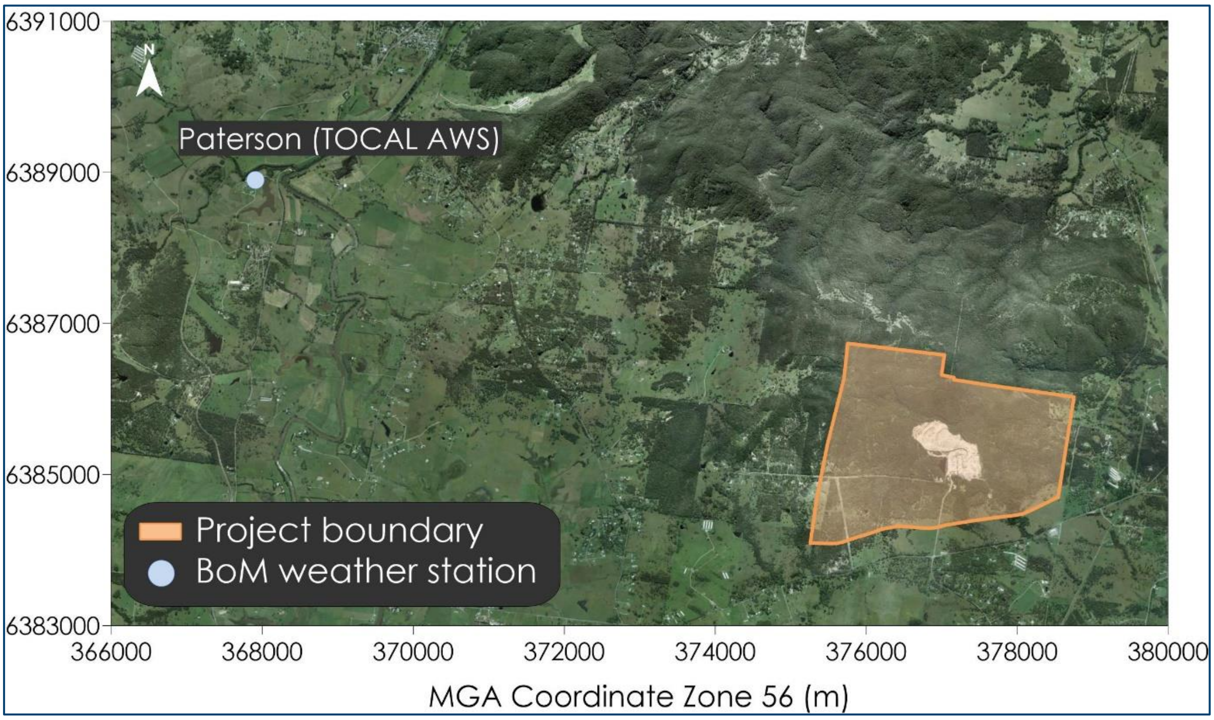


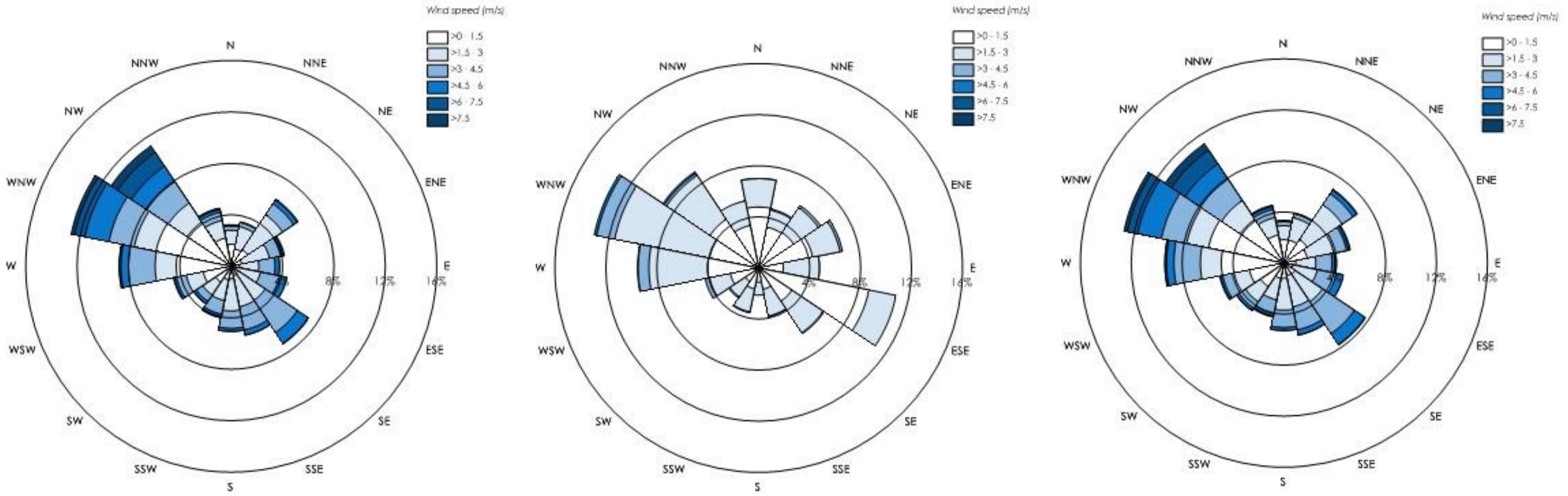
Figure 5-4: Location of weather station relative to the Project

An additional CALMET scenario is prepared with the observational data from the Paterson (TOCAL AWS) weather station excluded from the simulation to demonstrate how the CALMET model performs at this location.

Figure 5-5 presents the comparison of annual windroses for the Paterson (TOCAL AWS) weather station during the 2015 calendar period, the CALMET extract data at this location excluding observational data and including observational data from the Paterson (TOCAL AWS).

The windroses generated using CALMET, excluding and including observational data from Paterson (TOCAL AWS), are comparable to that of the annual windrose for the measured data at the Paterson (TOCAL AWS) weather station. The dominant wind flows from the west-northwest and northwest are well represented in both CALMET simulations noting that including the observational data better represents the measured conditions as expected.

Overall, the CALMET simulation excluding data suggests the modelling reflects the expected wind distribution patterns of the area and the expected terrain effects on the prevailing winds.



Observational data for Paterson (TOCAL AWS) | CALMET extract – excluding Paterson (TOCAL AWS) | CALMET extract – including Paterson (TOCAL AWS)

Figure 5-5: Comparison of annual windroses for Paterson (TOCAL AWS), CALMET extract excluding Paterson (TOCAL AWS) and CALMET extract including Paterson (TOCAL AWS)

5.3 Dispersion modelling

Dust emissions from each operational activity of the Project were represented by a series of volume sources and were included in the CALPUFF model via an hourly varying emission file. Meteorological conditions associated with dust generation (such as wind speed) and levels of dust generating activity were considered in calculating the hourly varying emission rate for each source.

It should be noted that as a conservative measure, the effect of the precipitation rate (rainfall) in reducing dust emissions has not been considered in this assessment.

5.4 Modelling scenarios

To identify potential worst-case operating scenarios for the Project, each of the activities associated with the different stages were analysed in regard to the quantity of material extracted and handled in each year, the location of the activity and the potential to generate dust at the receptor locations.

Six potential operating scenarios representing the different stages of the Project were investigated in detail to identify which would likely represent a worst-case operating scenario. These include:

- Current operations – This scenario represents the current approved operations with an annual production rate of 700,000tpa. This scenario provides a baseline of the dust emissions associated with the currently approved activities at the quarry and reflects dust levels currently experienced in the local community.

- Stage 1 – In this scenario, the western end of the quarry is initially expanded to the south and the annual production rate increases to 1.5Mtpa. Approximately 20,000tpa of concrete washout material from concrete batch plants is processed at the site to produce blended recycled aggregates and road base. For the purpose of this assessment processing of the concrete washout material is predicted to occur on a campaign basis over four campaigns a year. Construction of the amenity barrier would also occur in this stage using overburden generated from the extraction of the resource.

- Stage 2 – The quarry is expanded to the southwestern extent of the proposed expansion boundary in this stage with rehabilitation of the northwest extraction area commencing in this stage. The annual production rate is 1.5Mtpa and 20,000tpa of concrete washout material is processed at the site.

- Stage 3 – The quarry expands along the southern extraction boundary towards the existing processing area. The annual production rate is 1.5Mtpa and 20,000tpa of concrete washout material is processed at the site. Continued rehabilitation of the northwest extraction area occurs along with the clearing of the new processing and stockpile area to the south of the existing processing area.

- Stage 4 – The quarry extends the extraction area to the east in this stage to allow access to the resource material under the existing processing area. Processing activities have been relocated to the south of the existing processing area with a concrete batch plant established in this location capable of producing approximately 15,000m^3 of concrete each year. The annual production rate is 1.5Mtpa and 20,000tpa of concrete washout material is processed at the site with rehabilitation of the northwest extraction area.

- Stage 5 – the extraction at the quarry reaches the extent of the extraction area and progresses to lower depths. Similar to Stage 4, the annual production rate is 1.5Mtpa, 20,000tpa of concrete washout material is processed at the site with 15,000m^3 of concrete produced and rehabilitation continues in the northwest extraction area.

Indicative site layouts of the six operational scenarios representing the Project area are presented in **Figure 5-6** to **Figure 5-10**.

Figure 5-6: Indicative layout for the Current operations

Figure 5-7: Indicative layout for Stage 1

Figure 5-8: Indicative layout for Stage 2

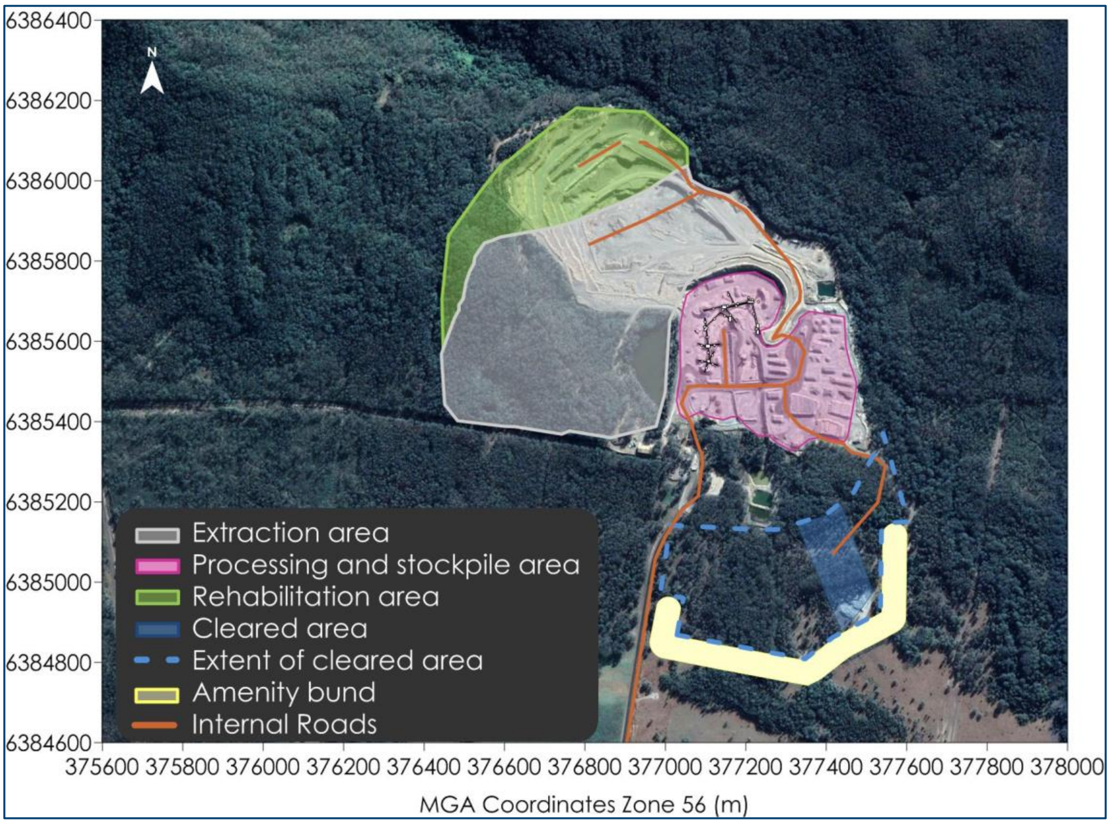


Figure 5-9: Indicative layout for Stage 3

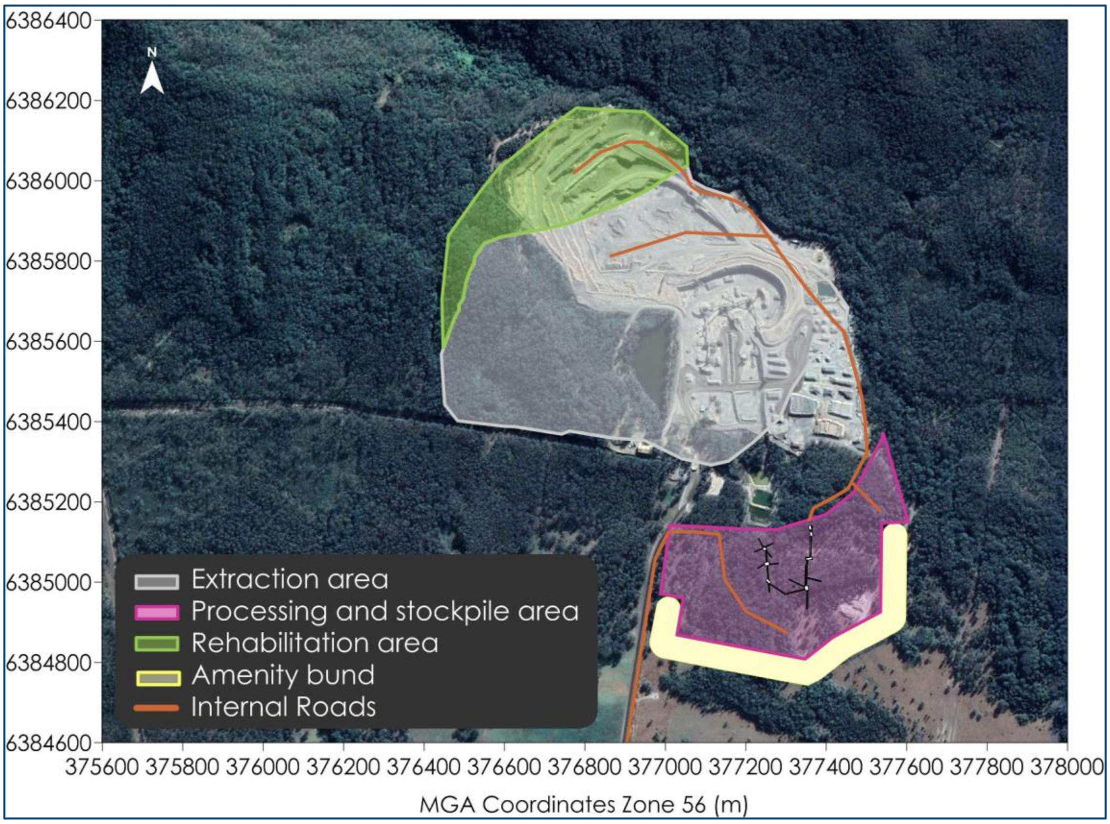


Figure 5-10: Indicative layout for Stage 4

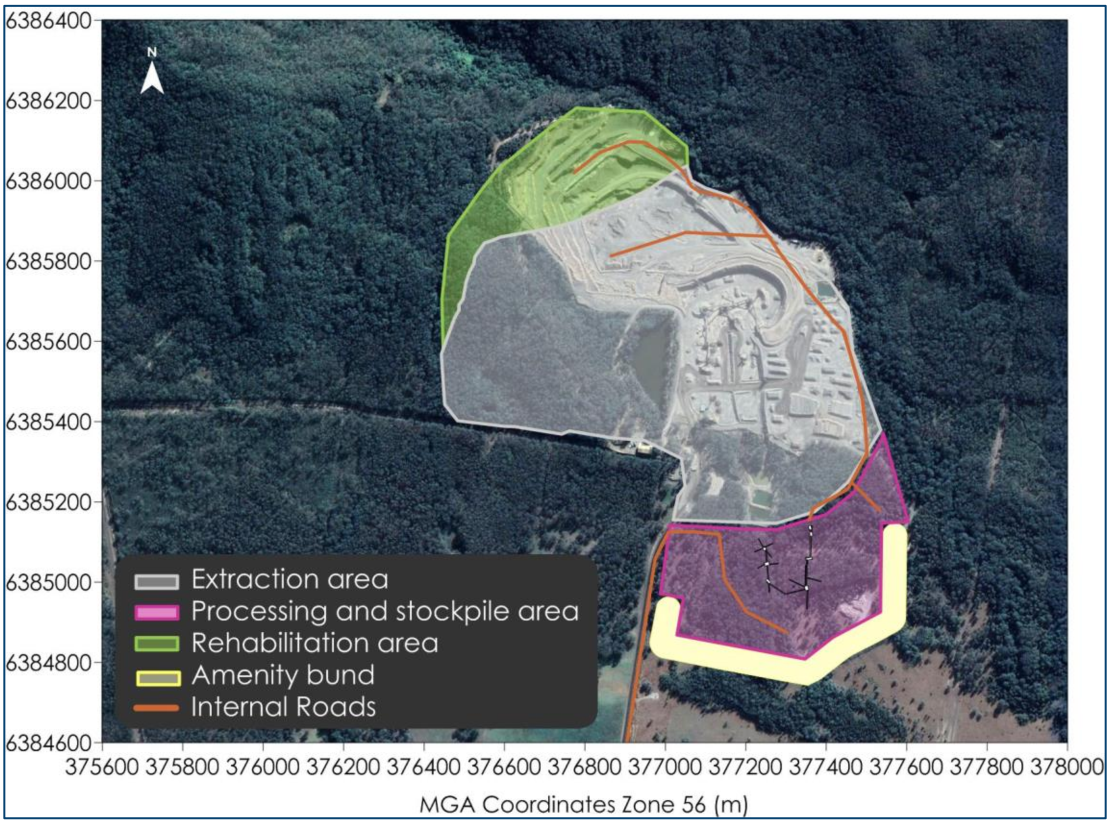


Figure 5-11: Indicative layout for Stage 5

5.5 Emission estimation

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

Dust emission estimates for each of the scenarios have been calculated by analysing the various types of dust generating activities taking place and utilising suitable emissions sourced from both locally developed and United States Environmental Protection Agency (US EPA) developed documentation.

The estimated annual dust emissions for activities associated with the operation of the Project for each of the scenarios are summarised in **Table 5-3**. Detailed calculations of the dust emission estimates are provided in **Appendix C**.

Table 5-3 Estimated annual dust emissions for the Project (kg/year)

Scenario	TSP emissions	PM_{10} emissions	$PM_{2.5}$ emissions
Current	129,777	50,379	8,377
Stage 1	160,375	56,889	8,428
Stage 2	161,569	57,322	8,482
Stage 3	168,377	60,708	8,989
Stage 4	174,893	62,814	9,037
Stage 5	174,893	62,814	9,037

Based on the estimated annual dust emissions set out in **Table 5-3**, the amount of dust generated in each stage increases as the stages progress as expected. The amount of dust estimated for the current operations is largely equivalent to the amount of dust generated in the proposed stages (at the increased production rate). It is noted that proposed additional dust mitigation and management measures which would be applied as part of the Project, are effective in reducing the overall dust generated. Further detail regarding the dust mitigation and management measures are outlined in **Section 7**.

For the purposes of this assessment, only four scenarios have been selected for dispersion modelling to represent the potential extent of worst-case impacts for the Project. These include the current operations, Stage 1, Stage 2 and Stage 4.

The current operations at the Project were selected as this scenario generates a significant amount of dust emissions compared to the proposed stages and would present a comparison of the approved operations against the proposed operations in the future stages.

Activity in Stage 1 is the first stage of the Project and includes the construction of the amenity bund and represents operational activities occurring close to nearest residential receptors to the south.

The Stage 2 and Stage 3 scenarios are considered similar, with Stage 2 the first stage to include rehabilitation.

Stage 4 and Stage 5 scenarios are also quite similar and include the new processing area and operation of the concrete batching plant. Extraction occurring in Stage 5 would occur at a lower depth compared to Stage 4 and hence is expected to show a reduced impact.

6 DISPERSION MODELLING RESULTS

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

6.1 Dust concentrations

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

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

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

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

Table 6-1 to **Table 6-4** present the predicted incremental and cumulative particulate dispersion modelling results at each of the assessed sensitive receptor locations for each of the modelled scenarios.

The total (cumulative) impact is defined as the modelling impact associated with the operation of the Project combined with the estimated ambient background levels in **Section 4.3.4**.

The total (cumulative) 24-hour average impacts are calculated differently to annual average impacts and have been addressed specifically in **Section 6.2**.

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

A comparison of the predicted dust impacts associated with the current operations with the proposed project stages indicates the dust levels experienced at assessed receptor locations would be comparable in the early stages and would only increase slightly in the latter stages of the Project.

Table 6-1: Dispersion modelling results for Current operations

Receptor ID	PM2.5 (µg/m³)		PM10 (µg/m³)		TSP (µg/m³)	DD (g/m²/mth)	PM2.5 (µg/m³)	PM10 (µg/m³)	TSP (µg/m³)	DD (g/m²/mth)
	Incremental						Cumulative			
	24-hr ave.	Ann. ave.	24-hr ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.
	Air quality impact criteria									
	-	-	-	-	-	2	8	25	90	4
R1	0.3	<0.1	1.5	0.1	0.2	<0.1	7.3	18.9	67.9	2.2
R2	0.2	<0.1	0.9	<0.1	<0.1	<0.1	7.3	18.9	67.8	2.2
R3	0.3	<0.1	1.5	0.2	0.3	<0.1	7.3	19.0	68.0	2.2
R4	0.3	<0.1	1.4	<0.1	<0.1	<0.1	7.3	18.9	67.8	2.2
R5	0.3	<0.1	1.4	<0.1	<0.1	<0.1	7.3	18.9	67.8	2.2
R6	0.3	<0.1	1.5	<0.1	<0.1	<0.1	7.3	18.9	67.8	2.2
R7	1.2	0.2	7.2	0.9	1.6	<0.1	7.5	19.7	69.3	2.3
R8	0.9	0.1	4.9	0.6	1.0	<0.1	7.4	19.4	68.7	2.2
R9	0.8	0.1	4.2	0.6	1.0	<0.1	7.4	19.4	68.7	2.2
R10	0.9	0.2	4.6	0.8	1.4	<0.1	7.5	19.6	69.1	2.2
R11	0.7	0.1	3.2	0.5	0.8	<0.1	7.4	19.3	68.5	2.2
R12	3.0	0.5	13.8	1.8	3.5	<0.1	7.8	20.6	71.2	2.3
R13	2.4	0.5	11.6	2.0	3.8	<0.1	7.8	20.8	71.4	2.3
R14	2.1	0.4	10.2	1.6	3.0	<0.1	7.7	20.4	70.6	2.2
R15	2.3	0.4	12.0	1.8	3.3	<0.1	7.7	20.6	71.0	2.3
R16	1.9	0.3	10.3	1.6	3.0	0.1	7.6	20.4	70.7	2.3
R17	1.4	0.2	7.3	1.1	2.0	<0.1	7.5	19.9	69.7	2.3

Table 6-2: Dispersion modelling results for Stage 1

Receptor ID	PM2.5 (µg/m³)		PM10 (µg/m³)		TSP (µg/m³)	DD (g/m²/mth)	PM2.5 (µg/m³)	PM10 (µg/m³)	TSP (µg/m³)	DD (g/m²/mth)
	Incremental						Cumulative			
	24-hr ave.	Ann. ave.	24-hr ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.
	Air quality impact criteria									
	-	-	-	-	-	2	8	25	90	4
R1	0.3	<0.1	1.5	0.2	0.3	<0.1	7.3	19.0	68.0	2.2
R2	0.2	<0.1	0.9	<0.1	0.1	<0.1	7.3	18.9	67.8	2.2
R3	0.3	<0.1	1.5	0.2	0.4	<0.1	7.3	19.0	68.1	2.2
R4	0.3	<0.1	1.4	<0.1	0.1	<0.1	7.3	18.9	67.8	2.2
R5	0.3	<0.1	1.4	<0.1	0.1	<0.1	7.3	18.9	67.8	2.2
R6	0.3	<0.1	1.5	<0.1	0.1	<0.1	7.3	18.9	67.8	2.2
R7	1.2	0.1	7.2	0.9	1.8	<0.1	7.4	19.7	69.5	2.3
R8	0.9	0.1	4.9	0.6	1.2	<0.1	7.4	19.4	68.8	2.3
R9	0.8	0.1	4.2	0.7	1.4	<0.1	7.4	19.5	69.0	2.3
R10	0.9	0.1	4.6	0.8	1.6	<0.1	7.4	19.6	69.3	2.3
R11	0.7	<0.1	3.2	0.5	0.9	<0.1	7.4	19.3	68.6	2.2
R12	3.0	0.5	13.8	1.8	4.1	<0.1	7.8	20.6	71.8	2.3
R13	2.4	0.5	11.6	2.3	4.9	0.1	7.8	21.1	72.6	2.3
R14	2.1	0.4	10.2	1.8	3.8	<0.1	7.7	20.6	71.5	2.3
R15	2.3	0.4	12.0	2.0	4.1	<0.1	7.7	20.8	71.8	2.3
R16	1.9	0.3	10.3	1.6	3.3	0.1	7.6	20.4	71.0	2.3
R17	1.4	0.2	7.3	1.1	2.2	<0.1	7.5	19.9	69.8	2.3

Table 6-3: Dispersion modelling results for Stage 2

Receptor ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/mth)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/mth)
	Incremental						Cumulative			
	24-hr ave.	Ann. ave.	24-hr ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.
	Air quality impact criteria									
	-	-	-	-	-	2	8	25	90	4
R1	0.3	<0.1	2.1	0.2	0.3	<0.1	7.3	19.0	68.0	2.2
R2	0.1	<0.1	1.0	<0.1	0.1	<0.1	7.3	18.9	67.8	2.2
R3	0.4	<0.1	2.3	0.2	0.4	<0.1	7.3	19.0	68.1	2.2
R4	0.2	<0.1	1.6	<0.1	0.1	<0.1	7.3	18.9	67.8	2.2
R5	0.2	<0.1	1.6	<0.1	0.1	<0.1	7.3	18.9	67.8	2.2
R6	0.2	<0.1	1.7	<0.1	0.1	<0.1	7.3	18.9	67.8	2.2
R7	1.2	0.2	8.1	0.9	1.8	<0.1	7.5	19.7	69.5	2.3
R8	0.8	0.1	5.1	0.6	1.2	<0.1	7.4	19.4	68.9	2.3
R9	0.8	0.1	5.3	0.7	1.4	<0.1	7.4	19.5	69.1	2.3
R10	0.9	0.1	5.1	0.9	1.8	<0.1	7.4	19.7	69.5	2.3
R11	0.6	<0.1	3.5	0.5	1.0	<0.1	7.4	19.3	68.7	2.2
R12	2.7	0.5	13.8	1.7	4.0	<0.1	7.8	20.5	71.7	2.3
R13	2.3	0.4	11.5	1.9	4.4	<0.1	7.7	20.7	72.1	2.3
R14	1.8	0.3	10.0	1.5	3.4	<0.1	7.6	20.3	71.1	2.3
R15	1.8	0.3	10.9	1.6	3.5	<0.1	7.6	20.4	71.2	2.3
R16	1.6	0.3	10.4	1.7	3.4	0.1	7.6	20.5	71.1	2.3
R17	1.2	0.2	7.5	1.1	2.2	<0.1	7.5	19.9	69.9	2.3

Table 6-4: Dispersion modelling results for Stage 4

Receptor ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/mth)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/mth)
	Incremental						Cumulative			
	24-hr ave.	Ann. ave.	24-hr ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.	Ann. ave.
	Air quality impact criteria									
	-	-	-	-	-	2	8	25	90	4
R1	0.2	<0.1	1.6	0.1	0.3	<0.1	7.3	18.9	67.9	2.2
R2	0.1	<0.1	0.9	<0.1	0.1	<0.1	7.3	18.9	67.8	2.2
R3	0.3	<0.1	1.9	0.2	0.4	<0.1	7.3	19.0	68.1	2.2
R4	0.2	<0.1	1.6	<0.1	0.1	<0.1	7.3	18.9	67.8	2.2
R5	0.2	<0.1	1.6	<0.1	0.1	<0.1	7.3	18.9	67.8	2.2
R6	0.2	<0.1	1.6	<0.1	0.1	<0.1	7.3	18.9	67.8	2.2
R7	1.1	0.1	6.8	0.8	1.7	<0.1	7.4	19.6	69.3	2.3
R8	0.8	<0.1	5.6	0.6	1.1	<0.1	7.4	19.4	68.8	2.3
R9	0.7	0.1	4.7	0.7	1.4	<0.1	7.4	19.5	69.1	2.3
R10	0.9	0.1	5.6	0.9	2.0	<0.1	7.4	19.7	69.7	2.3
R11	0.7	0.1	4.3	0.6	1.3	<0.1	7.4	19.4	69.0	2.2
R12	2.2	0.4	13.5	2.1	5.2	0.1	7.7	20.9	72.9	2.3
R13	3.0	0.6	18.2	3.2	7.8	0.2	7.9	22.0	75.4	2.4
R14	2.6	0.4	16.6	2.5	5.8	0.1	7.7	21.3	73.5	2.3
R15	2.5	0.5	16.3	2.9	6.7	0.2	7.8	21.7	74.3	2.4
R16	1.6	0.2	10.4	1.4	2.9	0.1	7.5	20.2	70.6	2.3
R17	1.0	0.2	6.8	1.0	2.0	<0.1	7.5	19.8	69.7	2.3

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

When assessing the total (cumulative) 24-hour average impacts based on model predictions an assessment of cumulative 24-hour average $PM_{2.5}$ and PM_{10} impacts was undertaken in accordance with Section 11.2 of the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA**, **2017**).

As shown in **Section 4.3**, the maximum measured 24-hour concentrations of $PM_{2.5}$ and PM_{10} have in the past exceeded or come close to the relevant criterion level on occasion.

As a result, the NSW EPA "Level 1 assessment – Maximum impact" approach of adding maximum background levels to maximum predicted levels from the Project would show levels above the criterion whether or not the Project was operating.

In such situations, the NSW EPA applies "Level 2 assessment - Contemporaneous impact and background" approach was applied to assess potential impacts. In simple terms, the contemporaneous assessment involves matching one year of ambient air quality monitoring data with meteorological data representing the same period.

The analysis has focussed on the assessment locations which represent the closest and most likely impacted receptor locations surrounding the Project.

Ambient (background) $PM_{2.5}$ and PM_{10} concentration data corresponding with the year of modelling (2015) from the NSW OEH monitoring site at Beresfield have been applied in this case to represent the prevailing background levels in the vicinity of the Project and at representative receptor locations surrounding the Project.

Table 6-5 provides a summary of the findings from the contemporaneous assessment at representative receptors for both $PM_{2.5}$ and PM_{10}. Detailed tables of the contemporaneous assessment results are provided in **Appendix E**.

The results indicate that the Project does not increase the number of days above the 24-hour average criterion at the assessed receptors for $PM_{2.5}$ and PM_{10}. Based on this result it can be inferred that the Project does not increase the number of days above the 24-hour average $PM_{2.5}$ and PM_{10} criterion at any of the receptor locations surrounding the Project.

Table 6-5: NSW EPA contemporaneous assessment - maximum number of additional days above 24-hour average criterion

Receptor ID	$PM_{2.5}$				PM_{10}			
	Current	Stage 1	Stage 2	Stage 4	Current	Stage 1	Stage 2	Stage 4
R10	0	0	0	0	0	0	0	0
R12	0	0	0	0	0	0	0	0
R13	0	0	0	0	0	0	0	0
R16	0	0	0	0	0	0	0	0

Time series plots of the predicted cumulative 24-hour average $PM_{2.5}$ and PM_{10} concentrations at a selected receptor, Receptor R12, for each of the modelling scenarios are presented in **Figure 6-1** to

Figure 6-4. The orange bars in the figures represent the predicted incremental levels due to the Project and the blue bars represent the applied background levels on the corresponding day.

It is clear from the figures that the Project has a small influence at the assessed receptor locations and in most cases would be difficult to discern beyond the expected background level.

6.3 Respirable crystalline silica

The assessment results show that a maximum incremental annual average $PM_{2.5}$ concentration level of 0.6µg/m^3 is predicted at the assessed receptor locations across all four scenarios. This level is due to the total dust from the Project and only a small portion of this dust would contain silica.

As the total level is five times below the VIC EPA criteria of 3µg/m^3 for respirable crystalline silica, the actual level from the Project would be significantly below the criteria and thus, the Project would not result in an unacceptable level of respirable crystalline silica in the ambient air at the residential receptor locations.

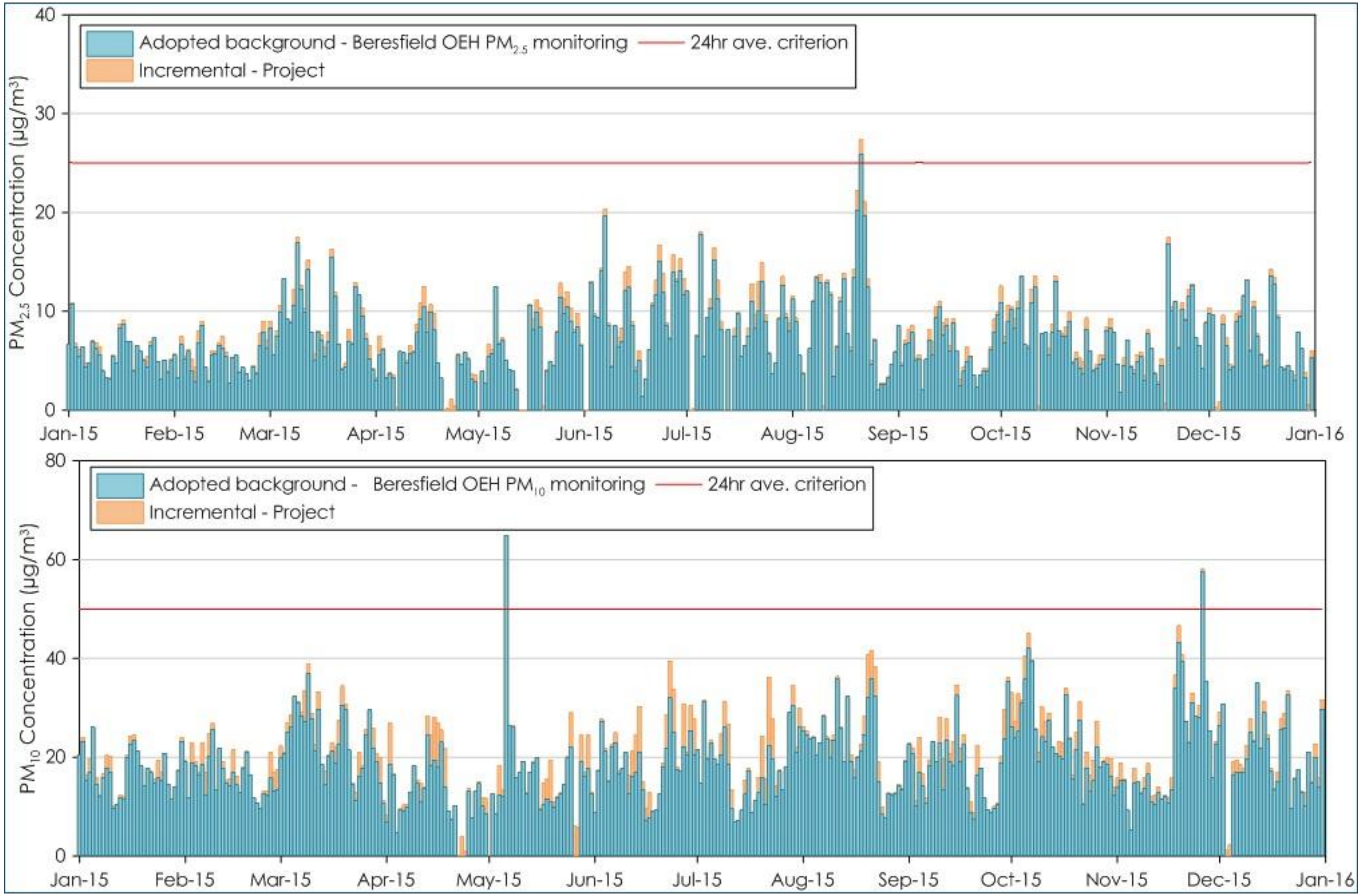


Figure 6-1: Time series plots of predicted cumulative 24-hour average $PM_{2.5}$ and PM_{10} concentrations for R12 - Current operations

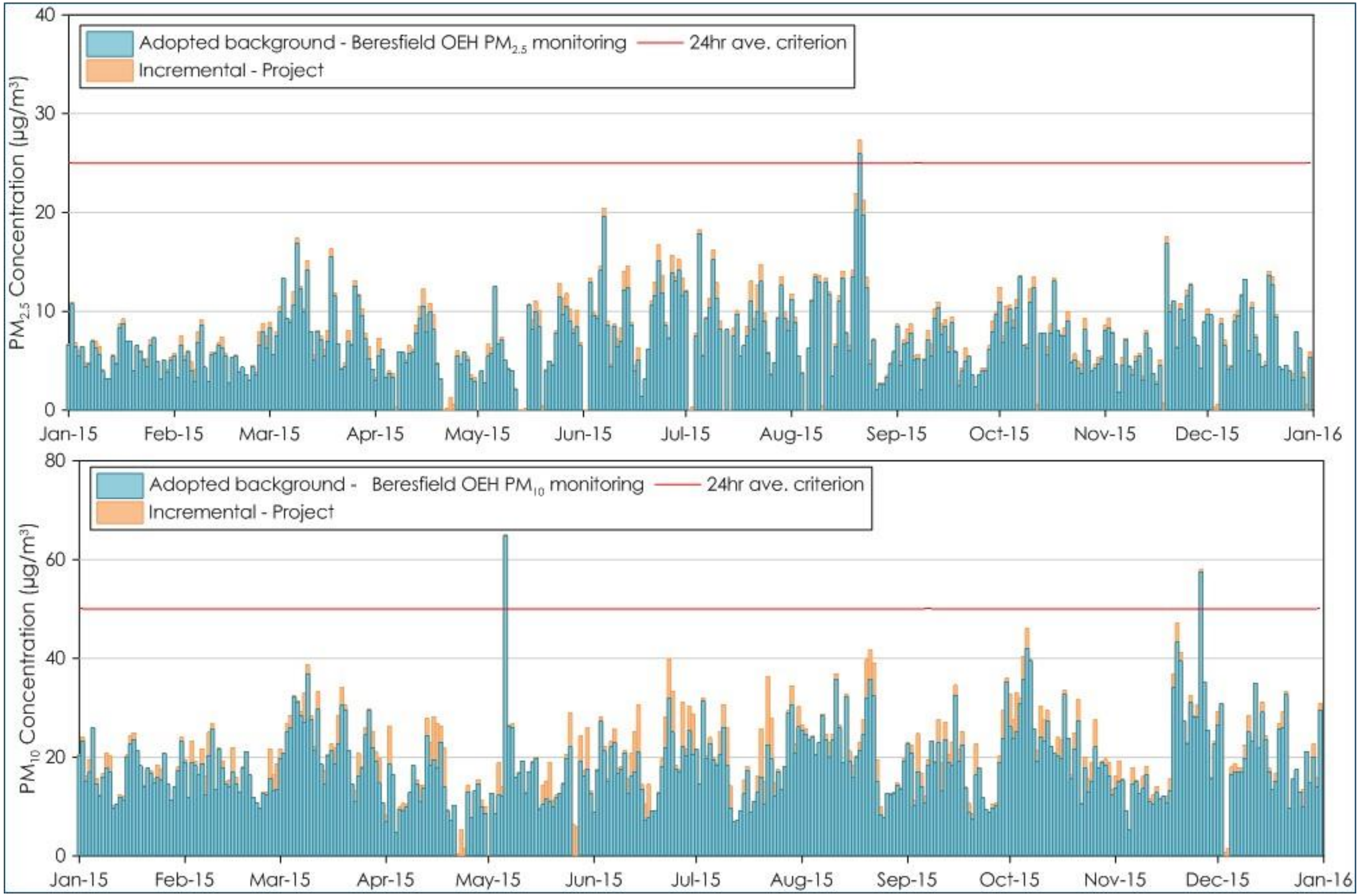


Figure 6-2: Time series plots of predicted cumulative 24-hour average $PM_{2.5}$ and PM_{10} concentrations for R12 – Stage 1

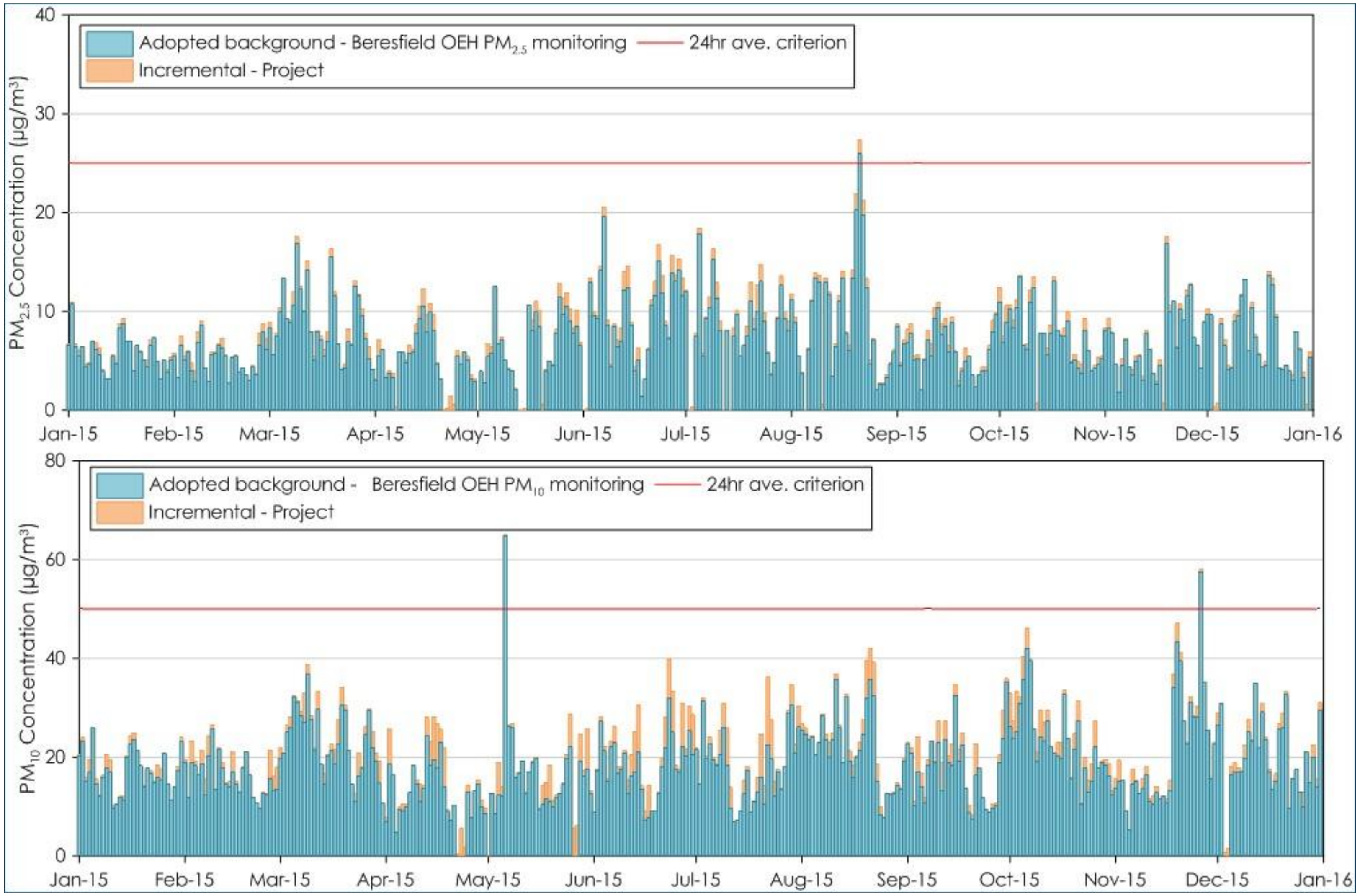


Figure 6-3: Time series plots of predicted cumulative 24-hour average $PM_{2.5}$ and PM_{10} concentrations for R12 – Stage 2

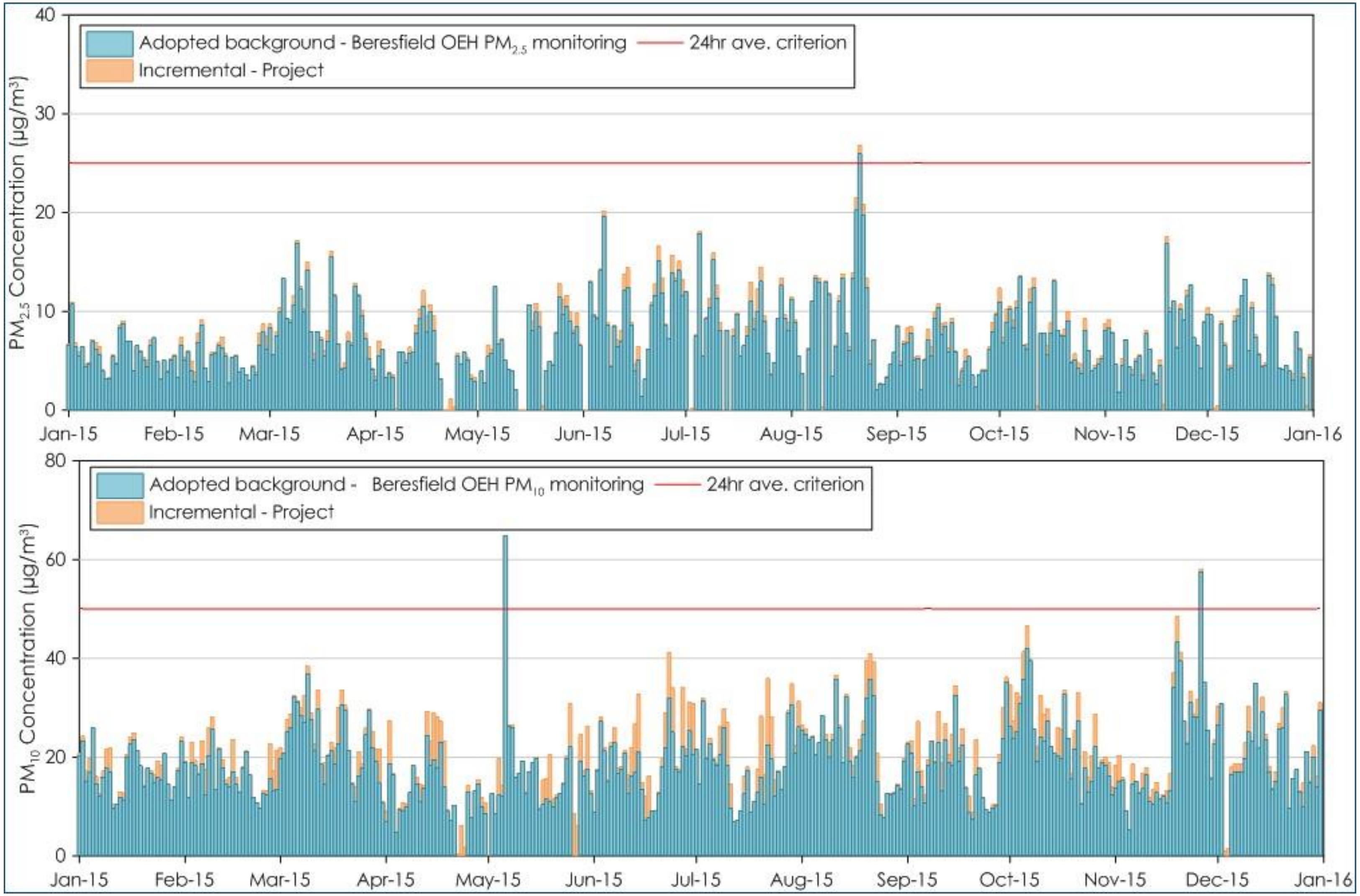


Figure 6-4: Time series plots of predicted cumulative 24-hour average $PM_{2.5}$ and PM_{10} concentrations for R12 – Stage 4

6.4 Assessment of impacts per VLAMP criteria

6.4.1 Summary of modelling predictions

The results in **Table 6-1** to **Table 6-4** indicate the highest maximum predicted level at the assessed receptors would be below the applicable VLAMP mitigation and acquisition criteria outlined in **Table 3-2** and **Table 3-3** respectively, for each modelled scenario.

6.4.2 Dust impacts on privately-owned land

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

The results show the cumulative annual average $PM_{2.5}$ predictions would have the most spatial extent at the criteria level concentrations, relative to any of the other assessed dust metrics, and hence cumulative annual average $PM_{2.5}$ represents the most impacting parameter in this case.

Figure 6-5 below presents an isopleth diagram for the predicted maximum cumulative annual average $PM_{2.5}$ level of 8µg/m^3 combined for all scenarios modelled. The purple shaded polygons in **Figure 6-5** represent approximately 25% of the land parcel closest to the Project.

The figure shows that the extent of the maximum cumulative annual average $PM_{2.5}$ for all scenarios would not extend over more than 25% of any privately-owned land parcels, and it can be concluded that the Project would not cause impact per this criterion for these privately-owned land parcels.

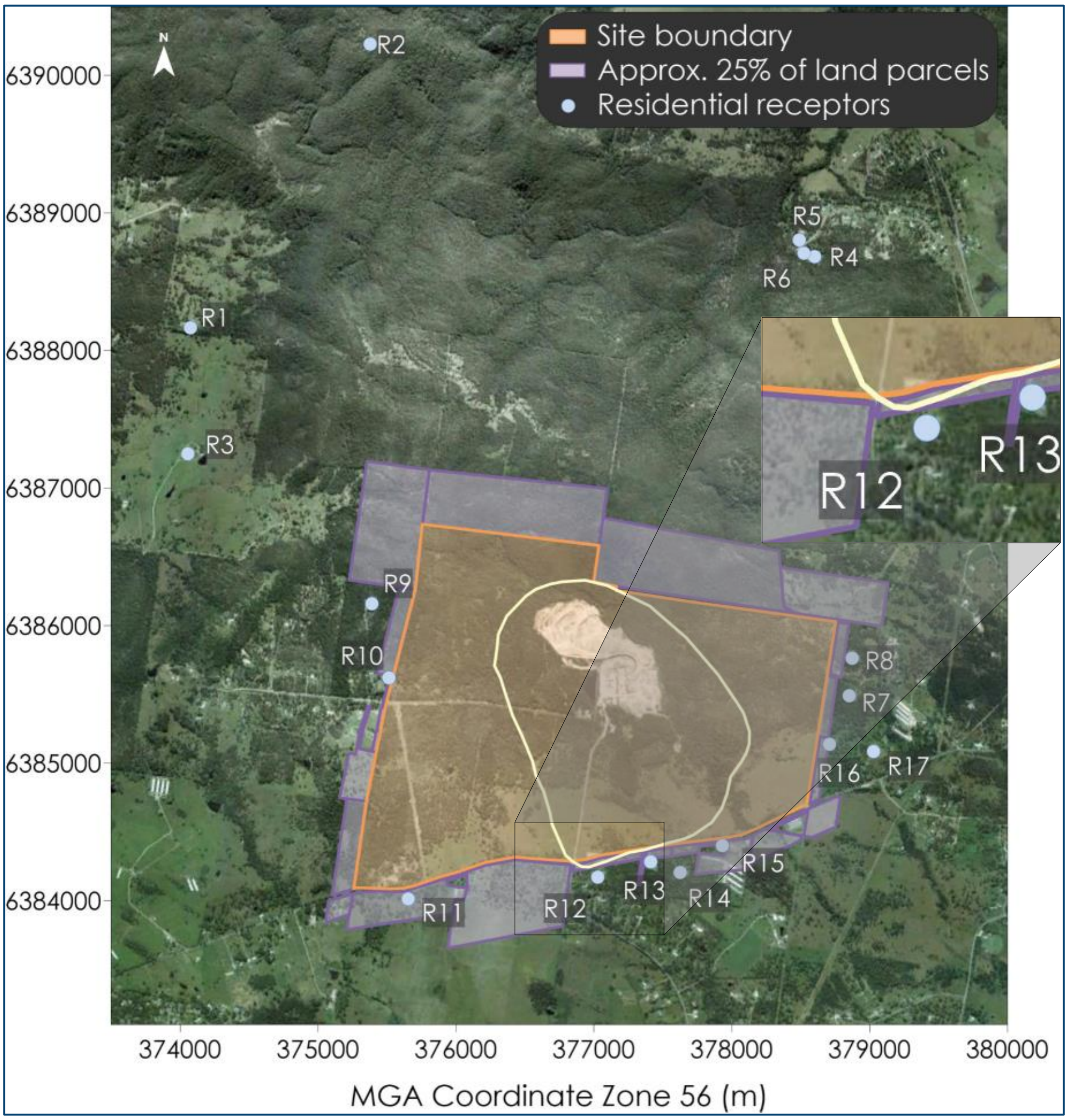


Figure 6-5: Predicted maximum cumulative annual average $PM_{2.5}$ level for 8µg/m³ for all scenarios combined

7 ASSESSMENT OF BLAST FUME EMISSIONS

7.1 Approach to assessment

7.1.1 Emission estimation

Blast fume emissions (NO_2) were estimated on the basis of emission levels presented in a CSIRO study of Hunter Valley blasts (**Attala et al., 2008**). Blast fume emissions can vary greatly depending on a number of factors but largely depend on the tendency of a particular blast (or holes within the shot) to generate significant NO_2 emissions. The assessment is based on the average measured level of emissions presented in the CSIRO study.

7.1.2 Dispersion modelling

Dispersion modelling of the potential blast fume emissions was conducted for each modelled scenario. The model setup was generally in accordance with the setup discussed in **Section 5**.

Blast emission sources were modelled in the approximate centre of the active pit during each modelling scenario. It is noted that the source location would vary; however, for the purposes of this assessment it is considered that the centre of the pit would provide a suitable indication of the potential impacts.

The model was set up to generate a blast during each hour of the day when blasting is permitted between 9:00am to 5:00pm.

7.2 Modelling predictions

The modelling predictions for each hour of blast were analysed to determine the period of maximum impact. Blasts occurring at 4:00pm were found to have the most potential for adverse blast fume impacts during each stage.

Figure 7-1 to **Figure 7-4** present the isopleth diagram for the predicted maximum incremental 1-hour average NO_2 level for all scenarios modelled for blasts occurring at 4:00pm. It should be noted that the isopleth diagram shows the maximum hourly extent of all potential blasts occurring at 4:00pm in a full year per the permitted blasting hour, and do not represent a single blast event.

The isopleth figures indicate that the incremental blast fume impacts are mostly contained within the site boundary and any potential for adverse impact at the surrounding residential receptors locations is unlikely to arise.

7.3 Blast fume management measures

The modelling predictions present the potential worst-case impacts associated with blasting under all of the potential weather conditions and hours when blasting is permitted to occur. It should be noted however, that the ultimate decision to blast on each occasion would be based on the consideration of a range of variables in conjunction with skilled and experienced operator judgement of the actual conditions at the time of the event.

The Project is expected to have blast management tools in place to indicate the potential extent of any impact at various times during the upcoming day, and allow the operator to select the least impacting time of the day at which to schedule the blast. The actual conditions leading up to the proposed time of blasting are evaluated as part of the final considerations in making the decision to initiate a blast.

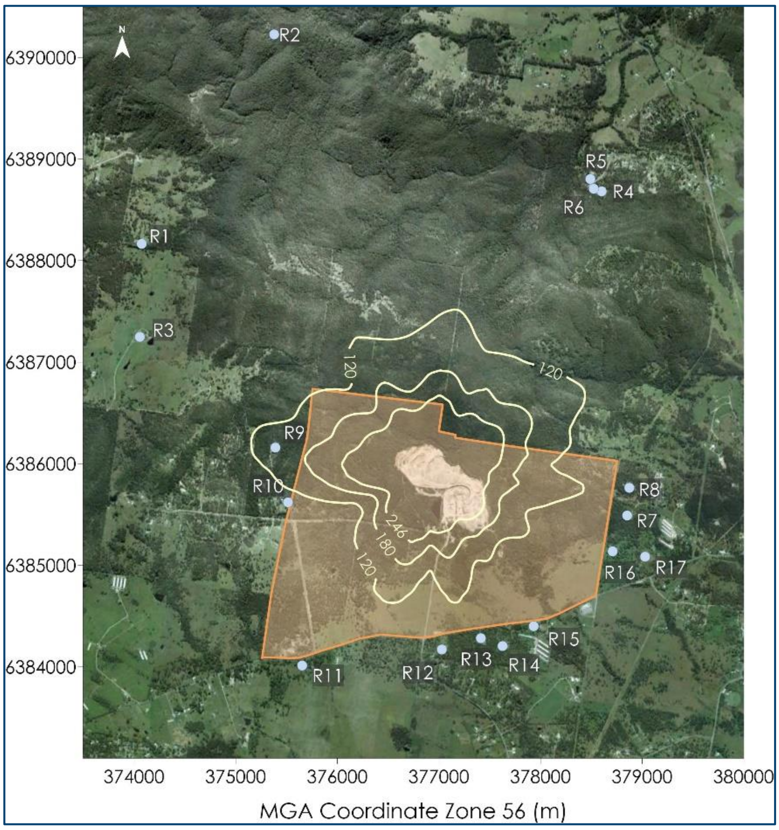


Figure 7-1: Predicted maximum 1-hour average NO_2 concentrations (µg/m³) from the Project – Current operations at 4:00PM

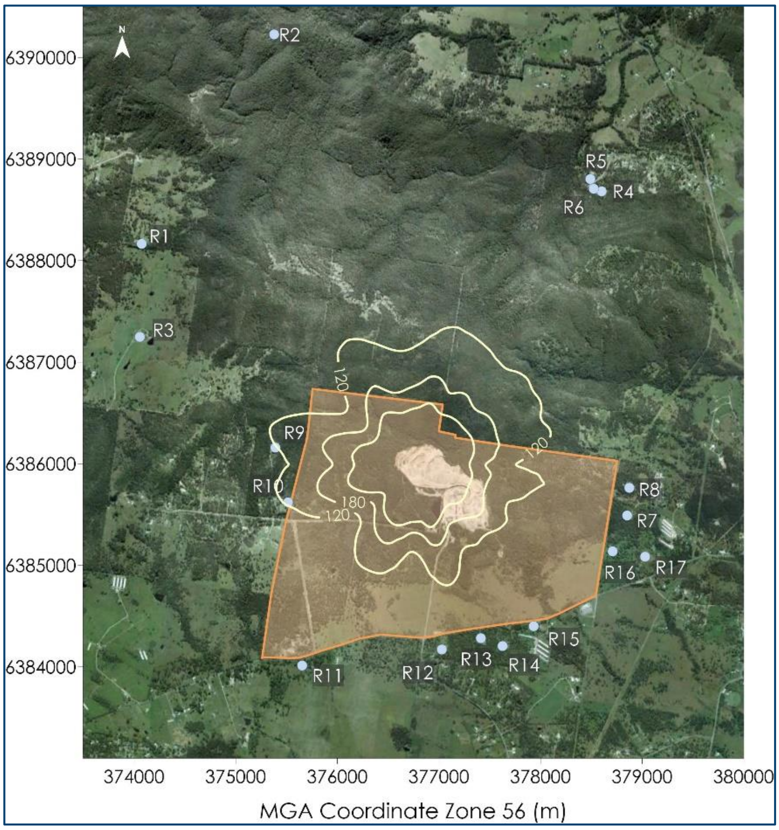


Figure 7-2: Predicted maximum 1-hour average NO_2 concentrations (µg/m³) from the Project – Stage 1 at 4:00PM

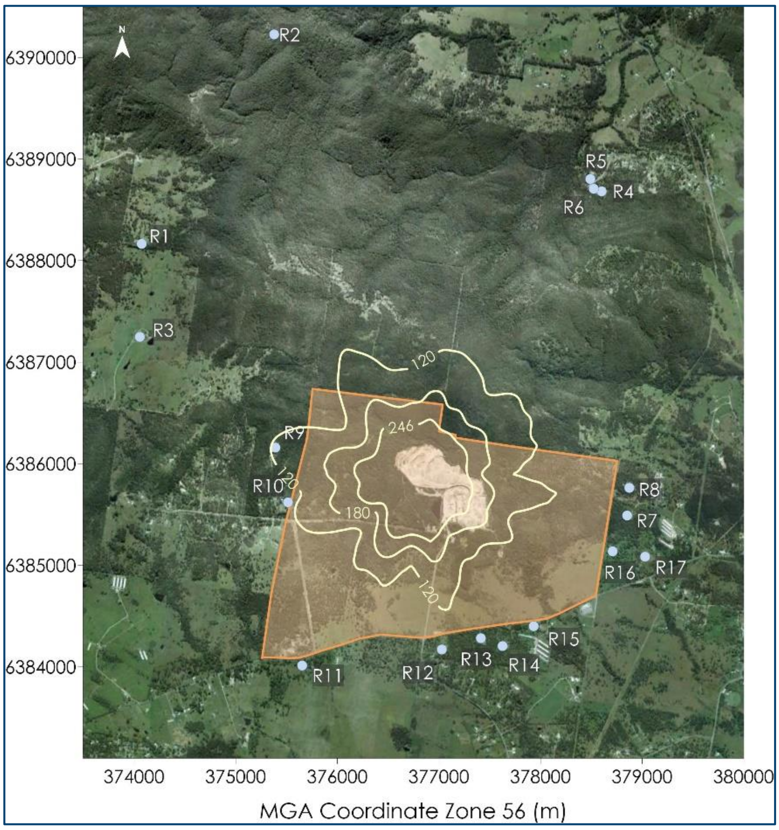


Figure 7-3: Predicted maximum 1-hour average NO_2 concentrations (µg/m³) from the Project – Stage 2 at 4:00PM

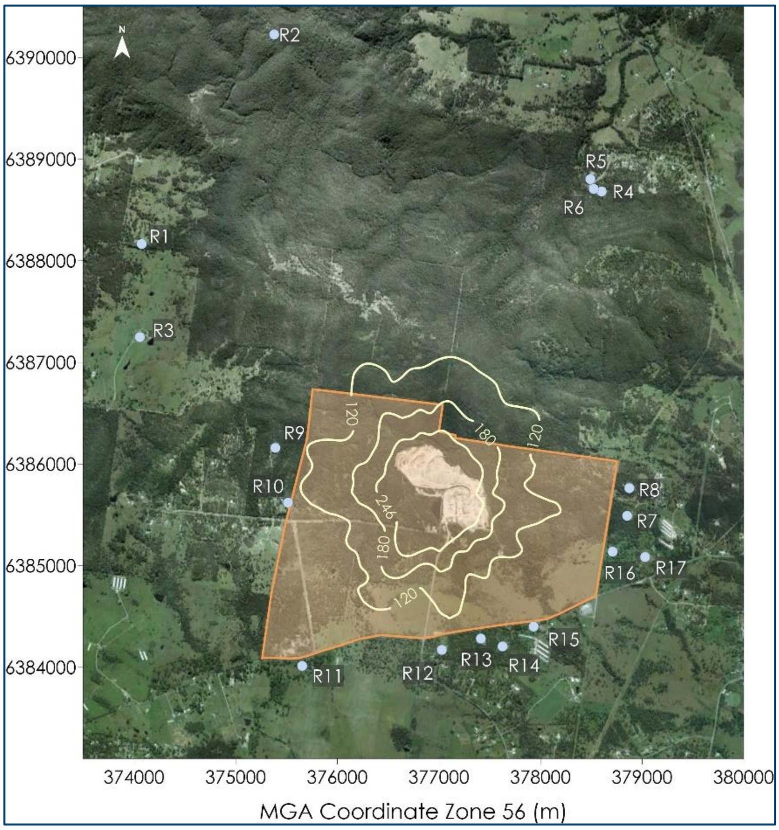


Figure 7-4: Predicted maximum 1-hour average NO_2 concentrations (µg/m³) from the Project – Stage 4 at 4:00PM

8 DUST MITIGATION AND MANAGEMENT

The air quality management strategy for the Project has considered a range of design features, physical dust mitigation and management measures that can be applied for the Project. This includes proactive and reactive management measures to assist with the day-to-day management of dust emissions from the site and to ensure that activities associated with the Project have a minimal effect on the surrounding environment and at the surrounding residential receptor locations.

8.1 Operational and physical mitigation

Operational and physical mitigation measures implemented at the Project are outlined in **Table 8-1**.

Where applicable these controls have been applied in the dust emission estimates shown in **Section 5.5** and **Appendix C**.

Table 8-1: Operational dust mitigation and management measures

Source	Mitigation Measure
General	Activities to be assessed during adverse weather conditions and modified as required (e.g. cease activity where reasonable levels of dust cannot be maintained using the available means).
	Weather forecast to be checked prior to undertaking material handling, processing or blasting.
	Engines of on-site vehicles and plant to be switched off when not in use.
	Vehicles and plant are to be fitted with appropriate pollution reduction devices where practicable.
	Vehicles are to be maintained and serviced according to manufacturer's specifications.
	Visual monitoring of activities is to be undertaken to identify visible dust plume generation.
	Construction of an earthen amenity barrier in Stage 1 to the south of the processing and stockpile area. Amenity barrier will be 18-20m high and stabilised with groundcover vegetation to minimise potential windblown dust emissions.
	Temporary amenity barriers will be constructed at strategic locations within the processing and stockpiling area at each stage of the Project.
Exposed areas/stockpiles	The extent of exposed surfaces and stockpiles is to be kept to a minimum.
	Disturbed areas within the Project site which are no longer required for operation will progressively be rehabilitated and stabilised with groundcover vegetation.
	Exposed areas and stockpiles are either to be covered or are to be dampened with water as far as is practicable to minimise the generation of visible dust emissions.
Material handling	Fixed crushing and screening equipment are to be enclosed and conveyor transfer points are to be partially enclosed after Stage 4 operations.
	Reduce drop heights from loading and handling equipment where practical.
	Dampen material when excessively dusty during handling.
Hauling activities	Internal hauling roads are to be covered with well graded materials to minimise the potential for dust emissions.
	Watering of hauling roads.
	Driveways and hardstand areas to be swept/cleaned regularly as required etc.
	Vehicle traffic is to be restricted to designated routes.
	Speed limits are to be enforced.
	Vehicle loads are to be covered when travelling off-site.

8.2 Reactive Management Strategy

Five triggers for reactive management would be applied by Hanson at the Project. These triggers are intended to assist with the day-to-day management of the operations and ensure the dust emissions generated from the operations are effectively managed. The reactive management triggers include:

- Continuous particulate matter monitoring equipment will be equipped with an internal alarm when dust levels are approaching or likely to approach criteria levels to alert quarry personnel to review and potentially modify operations with regard to dust generation.

- Exceedance of air quality criteria established through emissions monitoring. If the approved criteria has been exceeded then Hanson personnel will investigate the source of emissions and review and amend operations if necessary. Following a confirmed exceedance the DPIE and EPA will be notified.

- Predicted adverse weather conditions such as high winds and excessively dry periods would be considered as triggers for reactive management and operational activities will be modified to ensure compliance during these periods.

- Air quality complaints. All complaints will be investigated with a response provided to the complainant. Should the investigation result in additional monitoring, these results will be available for viewing by the complainant, on request.

- Extraordinary events or conditions such as bushfires, prescribed burning, dust storms, fire incidents or any other activity. During these conditions operational activities will be modified to limit air quality impacts, at the Hanson's discretion.

It is noted that the last three reactive management triggers are currently applied to the existing approved operations.

9 SUMMARY AND CONCLUSIONS

This report has assessed the potential air quality impacts associated with the proposed expansion of the Brandy Hill Quarry at Seaham, NSW.

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

The results indicate that for all assessed dust metrics, the Project would produce modest dust emissions with the predicted levels below the relevant criterion at the assessed residential receptor locations.

The assessment of impacts per the VLAMP criteria indicate the predicted dust levels would not extend over more than 25% of any privately-owned land parcels.

The site would apply appropriate dust management measures to ensure it minimises the potential occurrence of excessive air emissions from the site.

Overall, the assessment demonstrates that even using conservative assumptions, the Project can operate without causing any significant air quality impact at sensitive receptors in the surrounding environment.

10 REFERENCES

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Appendix A

Review of NSW EPA comments regarding previous assessment

Review of NSW EPA comments regarding previous assessment

As noted, this assessment seeks to review the existing air quality assessment and subsequent reports and present an updated standalone air quality assessment for the proposed expansion of the Brandy Hill Quarry.

Vipac Engineers & Scientists (**Vipac, 2018**) have previously prepared an air quality assessment for the proposed expansion of the Brandy Hill Quarry. Prior to this and subsequent from, the NSW EPA have raised potential issues with the air quality assessment, of which the majority of these are understood to have been adequately addressed.

To assist with the review of this assessment, for each of the issues raised by the NSW EPA relating to the previous air quality assessment have been addressed in this assessment or response provided to demonstrate how these have been addressed in this assessment.

The NSW EPA comments have been obtained from four different letters. A summary of each of the NSW EPA comments from each letter is outlined below in **Table A-1** to **Table A-4** along with a response and a reference to where the requirements are addressed in this report if applicable.

Table A-1: NSW EPA agency comments for air quality – letter dated April 2017

Issue	Comment	Response
Particulates criteria	The EPA requests the proponent revise the AQA to assess PM_{10} and $PM_{2.5}$ impacts against the *Approved Methods for Modelling and Assessment* of *Air Pollutants in NSW (2016).*	This assessment has been assessed against the relevant impact assessment criteria for the various pollutants. Refer to **Section 3** of this report.
Meteorological data	EPA requests the proponent provide evaluation to demonstrate that the prognostic model adequately captures the terrain and meteorological effects of the project area. The model setup should also be clearly detailed in the AQA	An evaluation of the meteorological modelling is presented in **Section 5.2.2**.
Emission estimation	The EPA requests the proponent provides all information and assumptions used in estimating emissions from the proposed operations. The scenarios assessed should be justified and include the worst case emissions over the life of the project.	**Section 5.3** and **Section 5.4** of this report describes the modelling scenarios and estimated emissions for the modelling scenarios. Detailed calculations of the dust emission estimates are provided in **Appendix C**.
PM_{10} impacts	Based on the predicted 24-hour average and annual average PM_{10} impacts at nearby sensitive receptors, EPA recommends additional mitigation measures for dust impacts should be included in the proposed project. Mitigation measures should include a reactive management strategy based on real time continuous PM_{10} monitoring at suitable location(s). It is the EPA's intention to require real time continuous PM_{10} monitoring as part of the environment protection licence requirements. Any additional mitigation measures identified should be included in the AQA.	Dust mitigation and management strategies for the Project are described in **Section 7** of this report. They include operational and physical mitigation measures and also a reactive management strategy.

Issue	Comment	Response
$PM_{2.5}$ impacts	EPA requests the proponent clarify the predicted impacts for 24-hour *average* $PM_{2.5}$ for the current and Stage 1 scenarios. The Approved Methods states "a *licensee must demonstrate that no additional exceedances of the impact assessment criteria will occur as* a *result of the proposed activity and that best management practices will be implemented to minimise emissions of air pollutants as far as is practical".* Where exceedances of EPA criteria *have* been identified, additional mitigation measures should be considered and assessed.	Predicted incremental impacts for 24-hour average $PM_{2.5}$ are presented in **Section 6.1**. Cumulative 24-hour average $PM_{2.5}$ impacts are assessed in **Section 6.2**. The predicted 24-hour average $PM_{2.5}$ impacts are below the relevant criterion of 25µg/m³ at all receptor locations for all assess scenarios.
Blast impacts on air quality	In consideration of the fact that the annual throughput of the facility is proposed to increase and the footprint of the quarry will also increase, it appears unlikely that blast requirements will remain the same. Table 5.1.1 in the EIS indicates there will be an increase in blast frequency. The EPA requests the proponent clarify the proposed blast requirements and assess potential blast impacts on nearby sensitive receptors.	Blast frequency has been assumed to occur at a rate of one blast per week. Refer to detailed calculations of the dust emission estimates are provided in **Appendix C** for blast parameters.

Table A-2: NSW EPA agency comments for air quality – letter dated October 2018

Issue	Comment	Response
Emission inventory	The emissions inventory does not provide sufficient information to adequately assess emission estimations, as required in Section 9.3 of the Approved Methods. The proponent must provide a full emissions inventory that includes as a minimum the following: list of all sources (items) assessed; the count of each plant item / transfer point; throughput per hour for each item; the final emission rate in grams per second per item; hours each item was modelled per day / year; type of emission point (i.e. point, volume, area).	Detailed calculations of the dust emission estimates are provided in **Appendix C**.
	The EPA notes that the 'drilling and blasting' annual emissions remain the same between current operations and each proposed stage, yet the extraction throughput increases from 0.7Mtpa to 1.5Mtpa. Explanation as to why the drilling and blasting emissions do not increase must be provided.	Drilling and blasting activities are assumed to have identical parameters for the different scenarios. This is based on a conservative assumption of a blast frequency of one blast per week. Regardless, the drilling and blasting represent less than 1% of the total dust emissions for the Project.
	The EPA notes that the 'wind erosion' annual emissions remain the same between current operations and each proposed stage, yet the extraction area varies per stage. For example, Table 14-4 of the assessment states the exposed area increases from 150,000 m² at Stage 1 to 340,000 m² for Stage 4. Explanation as to why the annual wind erosion emissions do not change must be provided.	The amount of exposed area for each of the difference scenarios have been revised. Detailed calculations of the dust emission estimates for wind erosion sources are provided in **Appendix C**. As noted in **Section 7** of this report, mitigation measures would be applied to manage potential dust emissions from exposed areas. This includes minimising the area exposed, progressive rehabilitation and applying water as a dust suppressant.

Issue	Comment	Response
	Clarification as to why crushing and screening emissions reduce between Stage 1 and Stage 2.	The estimated dust emissions for crushing and screening do not vary between the stages. The intensity of activity is identical in all stages. Detailed calculations of the dust emission estimates for crushing and screening sources are provided in **Appendix C**.
	The EPA cannot see in the assessment how emissions from the concrete batching plant, pug mill, concrete wash and pre-coating plant, among others, are calculated. All emission sources, including these, should be provided when providing the emissions inventory.	Detailed calculations of the dust emission estimates are provided in **Appendix C**. Dust emissions associated with the concrete batch plant in Stage 4 and processing concrete washout material are included. Negligible dust emissions are identified to arise from the pug mill and pre-coating plant activity and have not been included.
Meteorological and modelling assessment	The assessment uses meteorological and ambient monitoring data from the year 2013, however provides no justification for the selection of this year as being representative of long term trends over other years as required in Section 9.4.2 of the Approved Methods. The EPA requires that a detailed review and discussion of the meteorological and ambient monitoring data used in the model be provided, including the process used to select a year representative of long term trends over other assessed years.	Refer to **Appendix B** of this report. The 2015 calendar period is selected as the most representative year for the purposes of modelling in this assessment.
	The EPA notes in Table 14-4 the number of days with rainfall >0.25 mm is 216. Please confirm this number is correct and that this is reasonable when compared to long term trends.	An alternate dust emission factor for wind erosion from stockpiles has been applied in this assessment and the variable for rainfall is not required. The mean number of days of rain recorded at the Paterson (TOCAL AWS) is presented in **Table 4-1** of this report.
	The assessment compares TAPM data directly to the Paterson surface station data prior to the TAPM data being applied in CALMET. The proponent should compare CALMET data to surface observations to ensure that the setting selected in CALMET result in a meteorological dataset that is representation of local condition. Further, the assessment should review meteorological parameters such as mixing height and stability class using that CALMET data and not TAPM data for the same reason.	An evaluation of the meteorological modelling data is included in **Section 5.2.2** of this report. The evaluation includes a comparison of the observation data for the Paterson (TOCAL AWS) and the CALMET generated data at this location. **Figure 5-3** includes graphs of the temperature, wind speed, mixing height and stability classification over the modelling period.
	Further discussion and justification is required as to why the Paterson (Tocal) station was not included for data assimilation with observations in the TAPM run, however was deemed appropriate to be used as an assimilation station for 'nudging' the model.	Paterson (TOCAL AWS) was not included as observations in the TAPM simulation. The Paterson (TOCAL AWS) data was included as observations in the CALMET simulation.

Issue	Comment	Response
	Detailed confirmation and justification for CALMET and CALPUFF setting selection must be provided, including but not limited to the key model variable listed in Appendix A the document "Generic Guidance and Optimum Model Settings for the CALPUFF modelling system in the 'Approved Methods for the Modelling and Assessment of Air Pollutants in NSW" (NSW OEH, 2011) where relevant.	The seven critical parameters used in the CALMET modelling are presented in **Table 5-2**.
	Confirmation of the process used to transform the TAPM data to a format required for CALMET i.e. was CALTAPM used to process the data into a 3D.DAT.	CALTAPM was used to transform the TAPM generated 3D upper air file for use in CALMET.
Modelled results and the need for more controls for air quality	Provided the above technical issues can be satisfactorily resolved, the modelling is still predicting exceedances, particularly relevant is the exceedances to the PM_{10} 24-hour criteria. In our April 2017 submission the EPA advised that Approved Methods states "a *licensee must demonstrate that no additional exceedances* of *the impact assessment criteria will occur* as a *result* of *the proposed activity and that best management practices will be implemented to minimise emissions* of *air pollutants* as *far* as is *practical*"'. Where exceedances of EPA criteria have been identified, additional mitigation measures should be considered and assessed. The proponent needs to propose other control measures and then remodel these to determine likely impacts on emissions.	The modelling predictions presented in this report demonstrate the Project would not lead to any exceedances of the 24-hour average PM_{10} criteria. Refer to **Section 6.2** of this report.
Reactive management strategy	The EPA previously noted that mitigation measures should include a reactive management strategy based on real time continuous PM_{10} monitoring at suitable location(s). The EPA notes that the RTS document commits to an air quality reactive management strategy, but notes that the specifics of the strategy would be provided later within a detailed Air Quality Management Plan. While the EPA could assess an Air Quality Management Plan as part of an application for an environment protection licence, given the extent of submissions made in response to the proposal and given that additional work is necessary with regard to air, the EPA suggests that in the interests of transparency the proponent should detail the actions that will be taken, the most stringent of which might involve stopping identified operations, upon certain air quality triggers being exceeded.	A reactive management strategy for the Project is described in **Section 7** of this report.

Table A-3: NSW EPA agency comments for air quality – letter dated February 2019

Issue	Comment	Response
Meteorological data	The EPA recommends the proponent validates the CALMET data at the site of another meteorological station within the CALMET domain	Paterson (TOCAL AWS) was not included as observations in the TAPM simulation. The Paterson (TOCAL AWS) data was included as observations in the CALMET simulation. An additional CALMET simulation was conducted with the Paterson (TOCAL AWS) data excluded and an evaluation performed. Please refer to **Section 5.2.2** of this report.
Emission Estimation	The EPA recommends the proponent resolves the issues with the emissions inventory, including reviewing and providing calculation for emissions. Further, the scenarios assessed should be justified and include the worst-case emissions over the life of the Project. Peak daily emissions are to be modelled for each scenario. The AQIA should be revised accordingly.	Detailed calculations of the dust emission estimates are provided in **Appendix C**. Justification of the modelling scenarios selected is outlined in **Section 5.4** of this report. The approach used to estimate dust emissions involves the following; the Project emissions are calculated as an annual quantity following normal emissions estimation methods. The emissions are calculated in three categories, wind insensitive, wind sensitive and wind dependent. The total annual emissions are then distributed into every hour of the year according to the operating hours and the prevailing wind conditions. For this operation, the daily rate of activity would be relatively constant, and within the normal variability that will arise due to the prevailing weather effect, which are factored into the modelling.
PM_{10} impact	The dispersion modelling should include all days that had background exceedances. Results on these days should then be discussed within this context. Days where background exceeds the criterion should not be removed from the modelling set.	The modelling predictions presented in this report demonstrate the Project would not lead to any exceedances of the 24-hour average PM_{10} criteria. Refer to **Section 6.2** of this report. There is no adjustment made to the applied background data for the purposes of this assessment.

Issue	Comment	Response
Cumulative concentrations at the plots of vacant land were not provided	The revised assessment should provide cumulative 24-hour average PM_{10} and $PM_{2.5}$ results at the blocks of vacant land.	The modelling predictions presented in this report demonstrate the Project would not lead to any exceedances of the 24-hour average PM_{10} and $PM_{2.5}$ criteria at the assessed receptor locations. Associated isopleth diagrams of the dispersion modelling results area presented in **Appendix D**.
Emissions Inventory	*The EPA recommends that haul truck road emissions are reviewed to address the above issues and detailed calculations (including haul truck movements and VKT calculations) be provided. The level of watering proposed to be applied should be confirmed. Watering should only be modelled during hours when it will be implemented. Modelling should be revised using the updated emissions inventory.*	Detailed calculations of the dust emission estimates are provided in **Appendix C**. A control factor of 80% is applied to the hauling on unpaved surfaces. This control factor is based on watering on haul roads. Watering of the haul road surface would occur during the operational hours of the Project. Further detail on the applied control factor are provided in **Appendix C**.
Wind erosion of pits	*The EPA recommends pit wind erosion emissions should be reviewed and detailed calculations provided. Emissions should be reviewed to ensure there are no inconsistencies, and modelling should be revised accordingly. The proposed control for pit wind erosion should be explicitly stated and should be consistent with what is modelled.*	Detailed calculations of the dust emission estimates are provided in **Appendix C**.
Conveyors	*The EPA recommends that conveyor emission calculations should be reviewed, and detailed calculations provided*	Detailed calculations of the dust emission estimates are provided in **Appendix C**.
Product trucks	*The EPA recommends that product truck emission calculations should be reviewed, and detailed calculations provided.*	Detailed calculations of the dust emission estimates are provided in **Appendix C**.
Blasting and drilling	*The EPA recommends that the modelling is revised to model emissions from blasting and drilling as discrete events.*	The drilling and blasting represent less than 1% of the total dust emissions for the Project.
Mobile plant	*The EPA recommends that the emissions inventory is reviewed to include all sources of mobile plant emissions. Mobile plant emission calculations should be provided.*	Detailed calculations of the dust emission estimates are provided in **Appendix C**.

Table A-4: NSW EPA agency comments for air quality – letter dated July 2019

Issue	Comment	Response
Emission estimation	The EPA recommends the proponent resolves the issues with the emissions inventory provided in Attachment 2, including reviewing and providing calculations for the emissions from unpaved roads that could not be replicated. Peak daily emissions rates for the current stage should be revised. The AQIA should be revised accordingly.	Detailed calculations of the dust emission estimates are provided in **Appendix C**.

Issue	Comment	Response
PM_{10} impacts	Results of the revised dispersion modelling should include the concentration (background and incremental) at each receptor when there are exceedances.	Modelling prediction at the assessed receptor locations showing incremental and cumulative predictions are provided in **Section 6.1**.

Appendix B

Selection of Meteorological Year

Selection of meteorological year

A long-term analysis of the last five contiguous years of meteorological data from the nearest BoM weather station with suitable available data, Paterson (TOCAL AWS) weather station, is presented in **Table B-1**. The standard deviation of the last five years of meteorological data spanning 2014 to 2018 was analysed against the long-term measured wind speed, temperature and relative humidity spanning an approximate 34 to 52-year period recorded at this station.

The analysis indicates that 2014, 2015 and 2016 is closest to the long-term average for wind speed, 2014 and 2015 is closest to the long-term average for temperature and 2015 is closest to the long-term average for relative humidity. This analysis suggests 2015 would be considered as the most representative on the basis of long-term measured wind speed, temperature and relative humidity.

Table B-1: Statistical analysis results for Paterson (TOCAL AWS)

Year	Wind speed	Temperature	Relative humidity
2014	0.4	0.7	4.1
2015	0.4	0.7	2.5
2016	0.4	0.9	5.3
2017	0.5	1.1	6.0
2018	0.5	1.0	7.0

Figure B-1 shows the frequency distributions for wind speed, wind direction, temperature and relative humidity for the 2015 year compared with the mean and range of the 2014 to 2018 data set. The 2015 year data does not indicate any significant variation of the last five years of data.

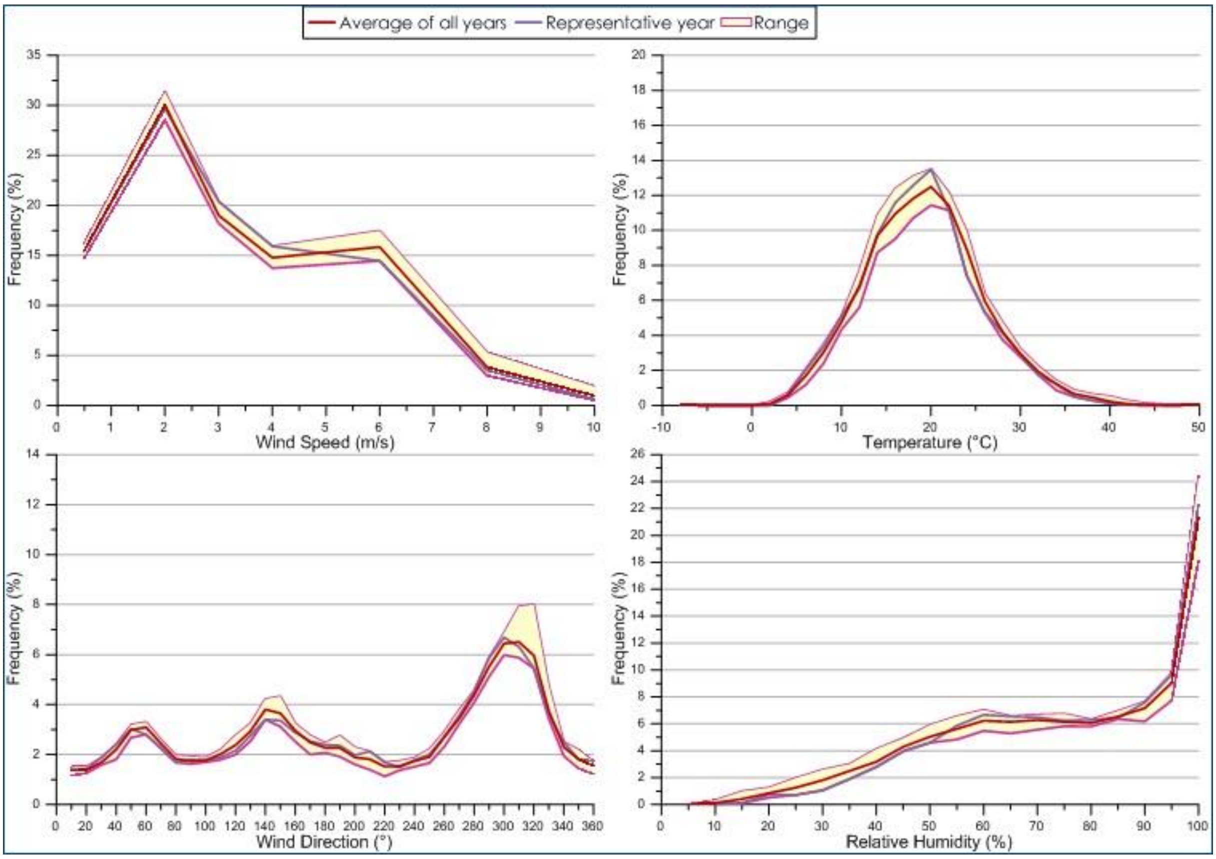

Figure B-1: Frequency distributions for wind speed, wind direction, temperature and relative humidity

Appendix C

Emission Calculations

Emission Calculation

The dust emissions from the Project have been estimated from the operational description of the proposed activities provided by the Hanson and have been combined with emissions factor equations and utilising suitable emission and load factors that relate to the quantity of dust emitted from particular activities based on intensity, the prevailing meteorological conditions and composition of the material being handled.

Emission factors and associated controls have been sourced from:

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

The emission factor equations used for each dust generating activity are outlined in **Table C-1** below. A detailed dust emission inventory for each of the scenarios considered in this assessment are presented in **Table C-2** to **Table C-7.**

Control factors included in Current operations scenario include:

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

Control factors included in the Project scenarios include:

- Hauling on unpaved surfaces – 80% control for watering of trafficked areas.
- Wind erosion - 50% control for watering of wind erosion areas
- Conveyer – 70% control for partially enclosed transfer points on the conveyor
- Unloading product material at processing stockpiles – 25% control for luffing stacker

Table C-1: Emission factor equations

Activity	Emission factor equation		
	TSP	PM_{10}	$PM_{2.5}$
Loading / emplacing material	$EF = 0.74 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$	$EF = 0.35 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$	$EF = 0.053 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$
Hauling on unsealed surfaces	$EF = \left(\frac{0.4536}{1.6093}\right) \times 4.9 \times (s/12)^{0.7} \times (1.1023 \times W/3)^{0.45} kg/VKT$	$EF = \left(\frac{0.4536}{1.6093}\right) \times 1.5 \times (s/12)^{0.9} \times (1.1023 \times W/3)^{0.45} kg/VKT$	$EF = \left(\frac{0.4536}{1.6093}\right) \times 0.15 \times (s/12)^{0.9} \times (1.1023 \times W/3)^{0.45} kg/VKT$
Hauling on sealed surfaces	$EF = 3.23 \times s.L.^{0.91} \times (1.1023 \times W)^{1.02} kg/VKT$	$EF = 0.62 \times s.L.^{0.91} \times (1.1023 \times W)^{1.02} kg/VKT$	$EF = 0.15 \times s.L.^{0.91} \times (1.1023 \times W)^{1.02} kg/VKT$
Drilling	$EF = 0.59 kg/hole$	$0.5 \times TSP$	$0.075 \times TSP$
Blasting	$EF = 0.00022\ x\ A^{1.5} kg/blast$	$0.52 \times TSP$	$0.03 \times TSP$
Crushing (controlled)	$EF = 0.0006\ kg/tonne$	$EF = 0.00027\ kg/tonne$	$EF = 0.00005\ kg/tonne$
Fine crushing (controlled)	$EF = 0.0015\ kg/tonne$	$EF = 0.0006\ kg/tonne$	$EF = 0.000035\ kg/tonne$
Screening (controlled)	$EF = 0.0011\ kg/tonne$	$EF = 0.00037\ kg/tonne$	$EF = 0.00000255\ kg/tonne$
Fine screening (controlled)	$EF = 0.0018\ kg/tonne$	$EF = 0.0011\ kg/tonne$	$EF = 0.000135\ kg/tonne$
Crushing (uncontrolled)	$EF = 0.0027\ kg/tonne$	$EF = 0.0012\ kg/tonne$	$0.075 \times TSP$
Screening (uncontrolled)	$EF = 0.0125\ kg/tonne$	$EF = 0.0043\ kg/tonne$	$0.075 \times TSP$
Conveyor transfer	$EF = 7\ x\ 10^{-5}\ kg/tonne$	$EF = 2.3\ x\ 10^{-5}\ kg/tonne$	$EF = 6.5\ x\ 10^{-6}\ kg/tonne$
Wind erosion on exposed areas, stockpiles	$EF = 850\ kg/ha/year$	$0.5 \times TSP$	$0.075 \times TSP$
Grading roads	$EF = 0.04 \times \left(\frac{S}{1.609}^{2.5}\right) km$	$0.6 \times TSP$	$0.031 \times TSP$

EF = emission factor, U = wind speed (m/s), M= moisture content (%), W = average weight of vehicle (tonne), VKT = vehicle kilometres travelled (km), A = area of blast (m^2), s = silt content (%), s.L. = silt loading (%), S = speed of graders (lm/h)

Table C-2: Dust Emissions Inventory – Current operations

Activity	TSP emission	PM10 emission	PM2.5 emission	Intensity	Units	EF TSP	EF PM10	EF PM2.5	Units	Var. 1	Units	Var. 2	Units	Size specific EF - TSP/PM10 /PM2.5	Units	Var. 3	Units	Var. 4	Units	Var. 5	Units
Excavator loading topsoil to haul truck	2	1	0	2,288	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling topsoil to stockpile	62	17	2	2,288	t/yr	0.108	0.031	0.003	kg/t	56	t/load	1.3	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	75	% Control
Emplacing topsoil at stockpile	2	1	0	2,288	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Loading topsoil material to haul truck	-	-	-	-	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling stockpile topsoil to rehabilitation site	-	-	-	-	t/yr	0.000	0.000	0.000	kg/t	56	t/load	0.0	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	75	% Control
Unloading topsoil material at rehabilitation site	-	-	-	-	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Drilling	920	460	69	1,560	holes/yr	0.59	0.30	0.04	kg/hole												
Blasting	490	255	15	52	blasts/yr	9	5	0.3	kg/blast	1,225	Area of blast in m^2										
Excavator loading hard rock to haul truck	674	319	48	700,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling hard rock to processing area	16,646	4,699	470	700,000	t/yr	0.095	0.027	0.003	kg/t	56	t/load	1.2	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	75	% Control
Loading hard rock to crusher	674	319	48	700,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle hard rock at crusher	67	32	5	70,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Crusher 1	1,890	840	142	700,000	t/yr	0.0027	0.0012	0.000203	kg/t												
Crusher 2	1,890	840	142	700,000	t/yr	0.0027	0.0012	0.0002	kg/t												
Crusher 3	1,134	504	85	420,000	t/yr	0.0027	0.0012	0.0002	kg/t												
Crusher 4	832	370	62	308,000	t/yr	0.0027	0.0012	0.0002	kg/t												
Crusher 5 (Fine)	347	139	8	231,000	t/yr	0.0015	0.0006	0.000035	kg/t												
Screen 1	8,750	3,010	656	700,000	t/yr	0.0125	0.0043	0.0009	kg/t												
Screen 2	8,750	3,010	656	700,000	t/yr	0.0125	0.0043	0.0009	kg/t												
Screen 3	5,250	1,806	394	420,000	t/yr	0.0125	0.0043	0.0009	kg/t												
Screen 4	3,850	1,324	289	308,000	t/yr	0.0125	0.0043	0.0009	kg/t												
Screen 5 (Fine)	416	254	31	231,000	t/yr	0.0018	0.0011	0.00014	kg/t												
Conveyor transferring between crushers and screens	49	16	5	700,000	t/yr	0.00007	0.00002	0.00001	kg/t												
Unloading product material at processing stockpile	674	319	48	700,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Loading product material to haul truck	674	319	48	700,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle product material at stockpile	67	32	5	70,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Transferring product material to main stockpile area	5,711	1,612	161	700,000	t/yr	0.033	0.009	0.001	kg/t	56	t/load	0.4	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	75	% Control
Unloading product material at main stockpile area	674	319	48	700,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Loading product material to road truck	674	319	48	700,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle product material at stockpile	67	32	5	70,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling product material offsite	18,703	5,279	528	700,000	t/yr	0.107	0.030	0.003	kg/t	33	t/load	1.1	km/trip	3.2/0.9/0.1	kg/VKT	8.0	S.C. in %	34	A.W. (t)	75	% Control
Hauling product material offsite (paved road)	10,874	2,087	505	700,000	t/yr	0.016	0.003	0.001	kg/t	33	t/load	2.1	km/trip	0.2/0.0/0.0	kg/VKT	2.0	S.L g/m2	34	A.W. (t)		
Loading overburden material to haul truck	58	28	4	60,480	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling overbuden material to stockpile	1,636	462	46	60,480	t/yr	0.108	0.031	0.003	kg/t	56	t/load	1.3	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	75	% Control
Hauling overbuden material for barrier construction	2,131	602	60	60,480	t/yr	0.141	0.040	0.004	kg/t	56	t/load	1.7	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	75	% Control
Unloading overburden material for barrier construction	58	28	4	60,480	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle overbuden material at barrier construction	58	28	4	60,480	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Unloading concrete washout at main stockpile area	-	-	-	-	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Loading concrete washout material to crusher	-	-	-	-	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle concrete washout material at crusher	-	-	-	-	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Crushing concrete washout material	-	-	-	-	t/yr	0.0006	0.00027	0.00005	kg/t												
Unloading concrete washout material at processing stock	-	-	-	-	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Concrete batch plant	No CBP in this scenario																				
Wind erosion - Cleared area	-	-	-	-	ha	850	425	64	kg/ha/yr												
Wind erosion - active extraction area	9,013	4,507	676	10.6	ha	850	425	64	kg/ha/yr												
Wind erosion - stockpile area	2,550	1,275	191	3.0	ha	850	425	64	kg/ha/yr												
Wind erosion - ammenity bund area	580	290	43	0.7	ha	850	425	64	kg/ha/yr												
Grading roads	20,626	12,375	639	31,926	km	0.6	0.4	0.02	kg/VKT	8	speed of graders in km/h										
Exhaust emissions	2,252	2,252	2,184																		
Total emissions (kg/yr)	**129,777**	**50,379**	**8,377**																		

Table C-3: Dust Emissions Inventory – Stage 1

Activity	TSP emission	PM10 emission	PM2.5 emission	Intensity	Units	EF TSP	EF PM10	EF PM2.5	Units	Var. 1	Units	Var. 2	Units	Size specific EF - TSP/PM10/ PM2.5	Units	Var. 3	Units	Var. 4	Units	Var. 5	Units
Excavator loading topsoil to haul truck	2	1	0	2,288	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling topsoil to stockpile	64	18	2	2,288	t/yr	0.140	0.040	0.004	kg/t	56	t/load	1.7	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Emplacing topsoil at stockpile	2	1	0	2,288	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Loading topsoil material to haul truck	-	-	-	-	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling stockpile topsoil to rehabilitation site	-	-	-	-	t/yr	0.000	0.000	0.000	kg/t	56	t/load	0.0	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Unloading topsoil material at rehabilitation site	-	-	-	-	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Drilling	920	460	69	1,560	holes/yr	0.59	0.30	0.04	kg/hole												
Blasting	490	255	15	52	blasts/yr	9	5	0.3	kg/bla	1,225	Area of blast in m^2										
Excavator loading hard rock to haul truck	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling hard rock to processing area	38,228	10,791	1,079	1,500,000	t/yr	0.127	0.036	0.004	kg/t	56	t/load	1.6	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Loading hard rock to crusher	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle hard rock at crusher	144	68	10	150,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Crusher 1	900	405	75	1,500,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 2	900	405	75	1,500,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 3	540	243	45	900,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 4	396	178	33	660,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 5 (Fine)	743	297	17	495,000	t/yr	0.0015	0.0006	0.000035	kg/t												
Screen 1	1,650	555	38	1,500,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 2	1,650	555	38	1,500,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 3	990	333	23	900,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 4	726	244	17	660,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 5 (Fine)	891	545	67	495,000	t/yr	0.0018	0.0011	0.000135	kg/t												
Conveyor transferring between crushers and screens	32	10	3	1,500,000	t/yr	0.00007	0.00002	0.00001	kg/t											70	% Control
Unloading product material at processing stockpile	1,083	512	78	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %							25	% Control
Loading product material to haul truck	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle product material at stockpile	144	68	10	150,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Transferring product material to main stockpile area	9,790	2,763	276	1,500,000	t/yr	0.033	0.009	0.001	kg/t	56	t/load	0.4	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Unloading product material at main stockpile area	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Loading product material to road truck	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle product material at stockpile	144	68	10	150,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling product material offsite	32,062	9,050	905	1,500,000	t/yr	0.107	0.030	0.003	kg/t	33	t/load	1.1	km/trip	3.2/0.9/0.1	kg/VKT	8.0	S.C. in %	34	A.W. (t)	80	% Control
Hauling product material offsite (paved road)	23,301	4,473	1,082	1,500,000	t/yr	0.016	0.003	0.001	kg/t	33	t/load	2.1	km/trip	0.2/0.0/0.0	kg/VKT	2.0	S.L g/m2	34	A.W. (t)		
Loading overburden material to haul truck	58	28	4	60,480	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling overbuden material to stockpile	1,699	480	48	60,480	t/yr	0.140	0.040	0.004	kg/t	56	t/load	1.7	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Hauling overbuden material for barrier construction	1,974	557	56	60,480	t/yr	0.163	0.046	0.005	kg/t	56	t/load	2.0	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Unloading overburden material for barrier construction	58	28	4	60,480	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle overbuden material at barrier construction	58	28	4	60,480	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Unloading concrete washout at main stockpile area	58	27	4	60,000	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Loading concrete washout material to crusher	58	27	4	60,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle concrete washout material at crusher	6	3	0	6,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Crushing concrete washout material	36	16	3	60,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Unloading concrete washout material at processing stock	58	27	4	60,000	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Concrete batch plant	No CBP in this scenario																				
Wind erosion - Cleared area	-	-	-	-	ha	850	425	64	kg/ha/yr												
Wind erosion - active extraction area	6,449	3,225	484	15.2	ha	850	425	64	kg/ha/yr											50	% Control
Wind erosion - stockpile area	1,275	638	96	3.0	ha	850	425	64	kg/ha/yr											50	% Control
Wind erosion - ammenity bund area	2,462	1,231	185	5.8	ha	850	425	64	kg/ha/yr											50	% Control
Grading roads	20,626	12,375	639	31,926	km	0.6	0.4	0.02	kg/VK	8	speed of graders in km/h										
Exhaust emissions	2,483	2,483	2,409																		
Total emissions (kg/yr)	**160,375**	**56,889**	**8,428**																		

Table C-4: Dust Emissions Inventory – Stage 2

Activity	TSP emission	PM10 emission	PM2.5 emission	Intensity	Units	EF TSP	EF PM10	EF PM2.5	Units	Var. 1	Units	Var. 2	Units	Size specific EF - TSP/PM10/ PM2.5	Units	Var. 3	Units	Var. 4	Units	Var. 5	Units
Excavator loading topsoil to haul truck	2	1	0	2,288	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling topsoil to stockpile	68	19	2	2,288	t/yr	0.149	0.042	0.004	kg/t	56	t/load	1.8	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Emplacing topsoil at stockpile	2	1	0	2,288	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Loading topsoil material to haul truck	2	1	0	2,288	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling stockpile topsoil to rehabilitation site	73	21	2	2,288	t/yr	0.160	0.045	0.005	kg/t	56	t/load	2.0	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Unloading topsoil material at rehabilitation site	2	1	0	2,288	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Drilling	920	460	69	1,560	holes/yr	0.59	0.30	0.04	kg/hole												
Blasting	490	255	15	52	blasts/yr	9	5	0.3	kg/blast	1,225	Area of blast in m^2										
Excavator loading hard rock to haul truck	1,445	683	103	1,500,000	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling hard rock to processing area	40,773	11,509	1,151	1,500,000	t/yr	0.136	0.038	0.004	kg/t	56	t/load	1.7	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Loading hard rock to crusher	1,445	683	103	1,500,000	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle hard rock at crusher	144	68	10	150,000	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Crusher 1	900	405	75	1,500,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 2	900	405	75	1,500,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 3	540	243	45	900,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 4	396	178	33	660,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 5 (Fine)	743	297	17	495,000	t/yr	0.0015	0.0006	0.000035	kg/t												
Screen 1	1,650	555	38	1,500,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 2	1,650	555	38	1,500,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 3	990	333	23	900,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 4	726	244	17	660,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 5 (Fine)	891	545	67	495,000	t/yr	0.0018	0.0011	0.000135	kg/t												
Conveyor transferring between crushers and screens	32	10	3	1,500,000	t/yr	0.00007	0.000	0.000	kg/t											70	% Control
Unloading product material at processing stockpile	1,083	512	78	1,500,000	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %							25	% Control
Loading product material to haul truck	1,445	683	103	1,500,000	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle product material at stockpile	144	68	10	150,000	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Transferring product material to main stockpile area	9,790	2,763	276	1,500,000	t/yr	0.033	0.009	0.001	kg/t	56	t/load	0.4	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Unloading product material at main stockpile area	1,445	683	103	1,500,000	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Loading product material to road truck	1,445	683	103	1,500,000	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle product material at stockpile	144	68	10	150,000	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling product material offsite	32,062	9,050	905	1,500,000	t/yr	0.107	0.030	0.003	kg/t	33	t/load	1.1	km/trip	3.2/0.9/0.1	kg/VKT	8.0	S.C. in %	34	A.W. (t)	80	% Control
Hauling product material offsite (paved road)	23,301	4,473	1,082	1,500,000	t/yr	0.016	0.003	0.001	kg/t	33	t/load	2.1	km/trip	0.2/0.0/0.0	kg/VKT	2.0	S.L g/m2	34	A.W. (t)		
Loading overburden material to haul truck	58	28	4	60,480	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling overbuden material to stockpile	1,802	509	51	60,480	t/yr	0.149	0.042	0.004	kg/t	56	t/load	1.8	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Hauling overbuden material for barrier construction	-	-	-	60,480	t/yr	0.000	0.000	0.000	kg/t	56	t/load	0.0	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Unloading overburden material for barrier construction	58	28	4	60,480	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle overbuden material at barrier construction	58	28	4	60,480	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Unloading concrete washout at main stockpile area	58	27	4	60,000	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Loading concrete washout material to crusher	58	27	4	60,000	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle concrete washout material at crusher	6	3	0	6,000	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Crushing concrete washout material	36	16	3	60,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Unloading concrete washout material at processing stock	58	27	4	60,000	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Concrete batch plant	No CBP in this scenario																				
Wind erosion - Cleared area	-	-	-	-	ha	850	425	64	kg/ha/yr												
Wind erosion - active extraction area	9,349	4,674	701	22.0	ha	850	425	64	kg/ha/yr											50	% Control
Wind erosion - stockpile area	1,275	638	96	3.0	ha	850	425	64	kg/ha/yr											50	% Control
Wind erosion - ammenity bund area	-	-	-	-	ha	850	425	64	kg/ha/yr												
Grading roads	20,626	12,375	639	31,926	km	0.6	0.4	0.0	kg/VKT	8	speed of graders in km/h										
Exhaust emissions	2,483	2,483	2,409																		
Total emissions (kg/yr)	**161,569**	**57,322**	**8,482**																		

Table C-5: Dust Emissions Inventory – Stage 3

Activity	TSP emission	PM10 emission	PM2.5 emission	Intensity	Units	EF TSP	EF PM10	EF PM2.5	Units	Var. 1	Units	Var. 2	Units	Size specific EF - TSP/PM10/ PM2.5	Units	Var. 3	Units	Var. 4	Units	Var. 5	Units
Excavator loading topsoil to haul truck	2	1	0	2,288	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling topsoil to stockpile	52	15	1	2,288	t/yr	0.114	0.032	0.003	kg/t	56	t/load	1.4	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Emplacing topsoil at stockpile	2	1	0	2,288	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Loading topsoil material to haul truck	2	1	0	2,288	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling stockpile topsoil to rehabilitation site	73	21	2	2,288	t/yr	0.160	0.045	0.005	kg/t	56	t/load	2.0	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Unloading topsoil material at rehabilitation site	2	1	0	2,288	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Drilling	920	460	69	1,560	holes/yr	0.59	0.30	0.04	kg/hole												
Blasting	490	255	15	52	blasts/yr	9	5	0.3	kg/blast	1,225	Area of blast in m^2										
Excavator loading hard rock to haul truck	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling hard rock to processing area	40,871	11,537	1,154	1,500,000	t/yr	0.136	0.038	0.004	kg/t	56	t/load	1.7	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Loading hard rock to crusher	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle hard rock at crusher	144	68	10	150,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Crusher 1	900	405	75	1,500,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 2	900	405	75	1,500,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 3	540	243	45	900,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 4	396	178	33	660,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 5 (Fine)	743	297	17	495,000	t/yr	0.0015	0.0006	0.000035	kg/t												
Screen 1	1,650	555	38	1,500,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 2	1,650	555	38	1,500,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 3	990	333	23	900,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 4	726	244	17	660,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 5 (Fine)	891	545	67	495,000	t/yr	0.0018	0.0011	0.000135	kg/t												
Conveyor transferring between crushers and screens	32	10	3	1,500,000	t/yr	0.00007	0.0000	0.000	kg/t											70	% Control
Unloading product material at processing stockpile	1,083	512	78	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %							25	% Control
Loading product material to haul truck	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle product material at stockpile	144	68	10	150,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Transferring product material to main stockpile area	9,790	2,763	276	1,500,000	t/yr	0.033	0.009	0.001	kg/t	56	t/load	0.4	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Unloading product material at main stockpile area	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Loading product material to road truck	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle product material at stockpile	144	68	10	150,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling product material offsite	32,062	9,050	905	1,500,000	t/yr	0.107	0.030	0.003	kg/t	33	t/load	1.1	km/trip	3.2/0.9/0.1	kg/VKT	8.0	S.C. in %	34	A.W. (t)	80	% Control
Hauling product material offsite (paved road)	23,301	4,473	1,082	1,500,000	t/yr	0.016	0.003	0.001	kg/t	33	t/load	2.1	km/trip	0.2/0.0/0.0	kg/VKT	2.0	S.L g/m2	34	A.W. (t)		
Loading overburden material to haul truck	58	28	4	60,480	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling overbuden material to stockpile	1,806	510	51	60,480	t/yr	0.149	0.042	0.004	kg/t	56	t/load	1.8	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Hauling overbuden material for barrier construction	-	-	-	60,480	t/yr	0.000	0.000	0.000	kg/t	56	t/load	0.0	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Unloading overburden material for barrier construction	58	28	4	60,480	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle overbuden material at barrier construction	58	28	4	60,480	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Unloading concrete washout at main stockpile area	58	27	4	60,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Loading concrete washout material to crusher	58	27	4	60,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle concrete washout material at crusher	6	3	0	6,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Crushing concrete washout material	36	16	3	60,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Unloading concrete washout material at processing stock	58	27	4	60,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Concrete batch plant	-	-	-	No CBP in this scenario																	
Wind erosion - Cleared area	2,550	1,275	191	3.00	ha	850	425	64	kg/ha/yr												
Wind erosion - active extraction area	13,521	6,761	1,014	31.8	ha	850	425	64	kg/ha/yr											50	% Control
Wind erosion - stockpile area	1,275	638	96	3.0	ha	850	425	64	kg/ha/yr											50	% Control
Wind erosion - ammenity bund area	-	-	-	-	ha	850	425	64	kg/ha/yr												
Grading roads	20,626	12,375	639	31,926	km	0.6	0.4	0.02	kg/VKT	8	speed of graders in km/h										
Exhaust emissions	2,483	2,483	2,409																		
Total emissions (kg/yr)	**168,377**	**60,708**	**8,989**																		

Table C-6: Dust Emissions Inventory – Stage 4

Activity	TSP emission	PM10 emission	PM2.5 emission	Intensity	Units	EF TSP	EF PM10	EF PM2.5	Units	Var. 1	Units	Var. 2	Units	Size specific EF - TSP/PM10/ PM2.5	Units	Var. 3	Units	Var. 4	Units	Var. 5	Units
Excavator loading topsoil to haul truck	2	1	0	2,288	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling topsoil to stockpile	96	27	3	2,288	t/yr	0.210	0.059	0.006	kg/t	56	t/load	2.6	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Emplacing topsoil at stockpile	2	1	0	2,288	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Loading topsoil material to haul truck	2	1	0	2,288	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling stockpile topsoil to rehabilitation site	108	30	3	2,288	t/yr	0.235	0.066	0.007	kg/t	56	t/load	2.9	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Unloading topsoil material at rehabilitation site	2	1	0	2,288	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Drilling	920	460	69	1,560	holes/yr	0.59	0.30	0.04	kg/hole												
Blasting	490	255	15	52	blasts/yr	9	5	0.3	kg/blast	1,225	Area of blast in m^2										
Excavator loading hard rock to haul truck	1,445	683	103	1,500,000	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling hard rock to processing area	58,737	16,580	1,658	1,500,000	t/yr	0.196	0.055	0.006	kg/t	56	t/load	2.4	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Loading hard rock to crusher	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle hard rock at crusher	144	68	10	150,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Crusher 1	900	405	75	1,500,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 2	900	405	75	1,500,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 3	540	243	45	900,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 4	396	178	33	660,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 5 (Fine)	743	297	17	495,000	t/yr	0.0015	0.0006	0.000035	kg/t												
Screen 1	1,650	555	38	1,500,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 2	1,650	555	38	1,500,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 3	990	333	23	900,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 4	726	244	17	660,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 5 (Fine)	891	545	67	495,000	t/yr	0.0018	0.0011	0.000135	kg/t												
Conveyor transferring between crushers and screens	32	10	3	1,500,000	t/yr	0.00007	0.0000	0.000	kg/t											70	% Control
Unloading product material at processing stockpile	1,083	512	78	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %							25	% Control
Loading product material to haul truck	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle product material at stockpile	144	68	10	150,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Transferring product material to main stockpile area	9,790	2,763	276	1,500,000	t/yr	0.033	0.009	0.001	kg/t	56	t/load	0.4	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Unloading product material at main stockpile area	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Loading product material to road truck	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle product material at stockpile	144	68	10	150,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling product material offsite	25,918	7,316	732	1,500,000	t/yr	0.086	0.024	0.002	kg/t	33	t/load	0.9	km/trip	3.2/0.9/0.1	kg/VKT	8.0	S.C. in %	34	A.W. (t)	80	% Control
Hauling product material offsite (paved road)	18,177	3,489	844	1,500,000	t/yr	0.012	0.002	0.001	kg/t	33	t/load	1.7	km/trip	0.2/0.0/0.0	kg/VKT	2.0	S.L g/m2	34	A.W. (t)		
Loading overburden material to haul truck	58	28	4	60,480	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Hauling overbuden material to stockpile	2,546	719	72	60,480	t/yr	0.210	0.059	0.006	kg/t	56	t/load	2.6	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Hauling overbuden material for barrier construction	-	-	-	60,480	t/yr	0.000	0.0000	0.000	kg/t	56	t/load	0.0	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Unloading overburden material for barrier construction	58	28	4	60,480	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle overbuden material at barrier construction	58	28	4	60,480	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Unloading concrete washout at main stockpile area	58	27	4	60,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Loading concrete washout material to crusher	58	27	4	60,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Rehandle concrete washout material at crusher	6	3	0	6,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Crushing concrete washout material	36	16	3	60,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Unloading concrete washout material at processing stock	58	27	4	60,000	t/yr	0.00096	0.000	0.0001	kg/t	0.81	ave. of $(WS/2.2)^{1.3}$	2.0	M.C. in %								
Concrete batch plant	956	478	72																		
Wind erosion - Cleared area	-	-	-	-	ha	850	425	64	kg/ha/yr												
Wind erosion - active extraction area	14,215	7,108	1,066	33.4	ha	850	425	64	kg/ha/yr											50	% Control
Wind erosion - stockpile area	1,275	638	96	3.0	ha	850	425	64	kg/ha/yr											50	% Control
Wind erosion - ammenity bund area	-	-	-	-	ha	850	425	64	kg/ha/yr												
Grading roads	20,626	12,375	639	31,926	km	0.6	0.4	0.02	kg/VKT	8	speed of graders in km/h										
Exhaust emissions	2,483	2,483	2,409																		
Total emissions (kg/yr)	**174,893**	**62,814**	**9,037**																		

Table C-7: Dust Emissions Inventory – Stage 5

Activity	TSP emission	PM10 emission	PM2.5 emission	Intensity	Units	EF TSP	EF PM10	EF PM2.5	Units	Var. 1	Units	Var. 2	Units	Size specific EF - TSP/PM10/ PM2.5	Units	Var. 3	Units	Var. 4	Units	Var. 5	Units
Excavator loading topsoil to haul truck	2	1	0	2,288	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Hauling topsoil to stockpile	96	27	3	2,288	t/yr	0.210	0.059	0.006	kg/t	56	t/load	2.6	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Emplacing topsoil at stockpile	2	1	0	2,288	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Loading topsoil material to haul truck	2	1	0	2,288	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Hauling stockpile topsoil to rehabilitation site	108	30	3	2,288	t/yr	0.235	0.066	0.007	kg/t	56	t/load	2.9	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Unloading topsoil material at rehabilitation site	2	1	0	2,288	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Drilling	920	460	69	1,560	holes/yr	0.59	0.30	0.04	kg/hole												
Blasting	490	255	15	52	blasts/yr	9	5	0.3	kg/blast	1,225	Area of blast in m^2										
Excavator loading hard rock to haul truck	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Hauling hard rock to processing area	58,737	16,580	1,658	1,500,000	t/yr	0.196	0.055	0.006	kg/t	56	t/load	2.4	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Loading hard rock to crusher	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Rehandle hard rock at crusher	144	68	10	150,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Crusher 1	900	405	75	1,500,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 2	900	405	75	1,500,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 3	540	243	45	900,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 4	396	178	33	660,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Crusher 5 (Fine)	743	297	17	495,000	t/yr	0.0015	0.0006	0.000035	kg/t												
Screen 1	1,650	555	38	1,500,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 2	1,650	555	38	1,500,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 3	990	333	23	900,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 4	726	244	17	660,000	t/yr	0.0011	0.00037	0.000025	kg/t												
Screen 5 (Fine)	891	545	67	495,000	t/yr	0.0018	0.0011	0.000135	kg/t												
Conveyor transferring between crushers and screens	32	10	3	1,500,000	t/yr	0.00007	0.0000	0.000	kg/t											70	% Control
Unloading product material at processing stockpile	1,083	512	78	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %							25	% Control
Loading product material to haul truck	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Rehandle product material at stockpile	144	68	10	150,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Transferring product material to main stockpile area	9,790	2,763	276	1,500,000	t/yr	0.033	0.009	0.001	kg/t	56	t/load	0.4	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Unloading product material at main stockpile area	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Loading product material to road truck	1,445	683	103	1,500,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Rehandle product material at stockpile	144	68	10	150,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Hauling product material offsite	25,918	7,316	732	1,500,000	t/yr	0.086	0.024	0.002	kg/t	33	t/load	0.9	km/trip	3.2/0.9/0.1	kg/VKT	8.0	S.C. in %	34	A.W. (t)	80	% Control
Hauling product material offsite (paved road)	18,177	3,489	844	1,500,000	t/yr	0.012	0.002	0.001	kg/t	33	t/load	1.7	km/trip	0.2/0.0/0.0	kg/VKT	2.0	S.L g/m2	34	A.W. (t)		
Loading overburden material to haul truck	58	28	4	60,480	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Hauling overbuden material to stockpile	2,546	719	72	60,480	t/yr	0.210	0.059	0.006	kg/t	56	t/load	2.6	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Hauling overbuden material for barrier construction	-	-	-	60,480	t/yr	0.000	0.0000	0.000	kg/t	56	t/load	0.0	km/trip	4.5/1.3/0.1	kg/VKT	8.0	S.C. in %	72	A.W. (t)	80	% Control
Unloading overburden material for barrier construction	58	28	4	60,480	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Rehandle overbuden material at barrier construction	58	28	4	60,480	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Unloading concrete washout at main stockpile area	58	27	4	60,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Loading concrete washout material to crusher	58	27	4	60,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Rehandle concrete washout material at crusher	6	3	0	6,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Crushing concrete washout material	36	16	3	60,000	t/yr	0.0006	0.00027	0.00005	kg/t												
Unloading concrete washout material at processing stock	58	27	4	60,000	t/yr	0.00096	0.0005	0.0001	kg/t	0.81	ave. of (WS/2.2)$^{1.3}$	2.0	M.C. in %								
Concrete batch plant	956	478	72																		
Wind erosion - Cleared area	-	-	-	-	ha	850	425	64	kg/ha/yr												
Wind erosion - active extraction area	14,215	7,108	1,066	33.4	ha	850	425	64	kg/ha/yr											50	% Control
Wind erosion - stockpile area	1,275	638	96	3.0	ha	850	425	64	kg/ha/yr											50	% Control
Wind erosion - ammenity bund area	-	-	-	-	ha	850	425	64	kg/ha/yr												
Grading roads	20,626	12,375	639	31,926	km	0.6	0.4	0.02	kg/VKT	8	speed of graders in km/h										
Exhaust emissions	2,483	2,483	2,409																		
Total emissions (kg/yr)	**174,893**	**62,814**	**9,037**																		

Haul Road Dust Control

The level of haul road dust control for the current operations is 75% and it is estimated that a control level up to 80% could be achieved with the Project. This level of haul road dust control would be achieved through a combination of:

- Watering of the haul road surface;
- Covered haul road with well graded materials; and,
- Regular maintenance (e.g. grading) of the road surface.

All these aspects would contribute to minimise dust emissions from this source.

To ensure the availability of sufficient water resources to achieve a level of dust control of 80% is available at the Project, calculations are made to estimate the water and haul truck requirements to this level of dust control.

The theoretical calculations of the control efficiency achieved by watering estimated based on the following empirical formula (**Buonicore and Davis, 1992**).

$$CE = 100 - \frac{0.8pdt}{i}$$

CE = average control efficiency (%)
p = potential average hourly daytime evaporation rate (mm/hr)
d = average hourly daytime traffic rate (/hr)
t = time between applications
i = application intensity (L/m^2)

Using the above formula, the typical water application intensity required to achieve an average control efficiency of 80% for the Project is estimated at 0.32 L/m^2 based on an annual evaporation rate of 0.4mm/hr from the Paterson (TOCAL AWS), an average traffic rate of 20 trips/hour and one hour between applications. One application per hour can be achieved using a single water cart, assuming an average operating speed of 40km/hr which would allow for reasonable down time for refilling.

Using the potential average hourly daytime evaporation rate for each month from the Paterson (TOCAL AWS) with haul road and traffic parameters based on the plans for each scenario included in the modelling, the estimated annual water requirements for haul road dust suppression to achieve a control level of 80% is shown in **Table C-8**.

Table C-8: Estimated water requirements for haul road control

Scenario	Control efficiency (%)	Average hourly traffic rate (/hr)	Time between applications	Annual water requirement (ML)
Stage 1	80	20	1	27.4
Stage 2	80	20	1	27.7
Stage 4	80	20	1	31.3

Appendix D

Isopleth Diagrams

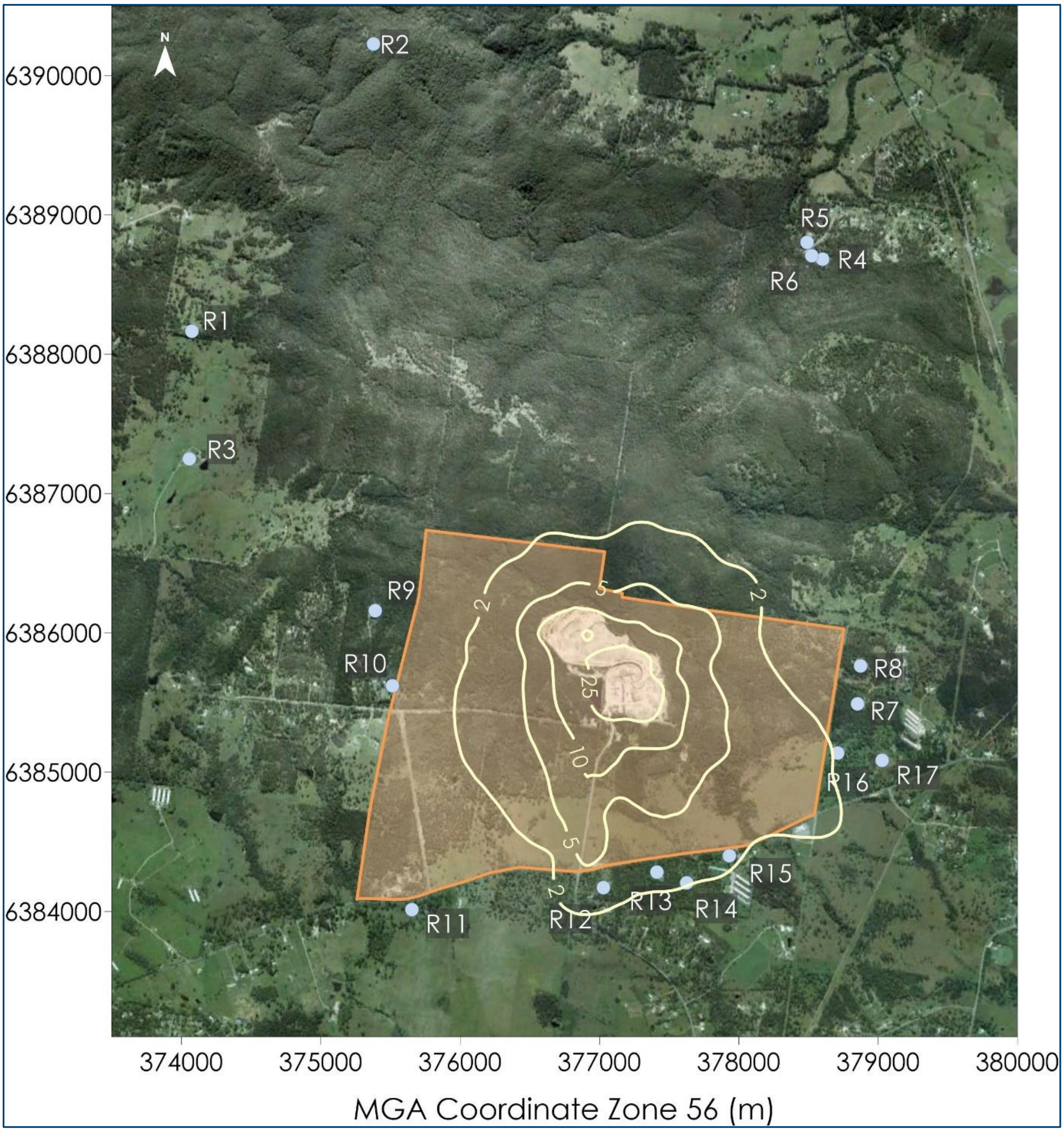

Figure D-1: Predicted incremental maximum 24-hour average $PM_{2.5}$ concentrations (µg/m³) – Current operation

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

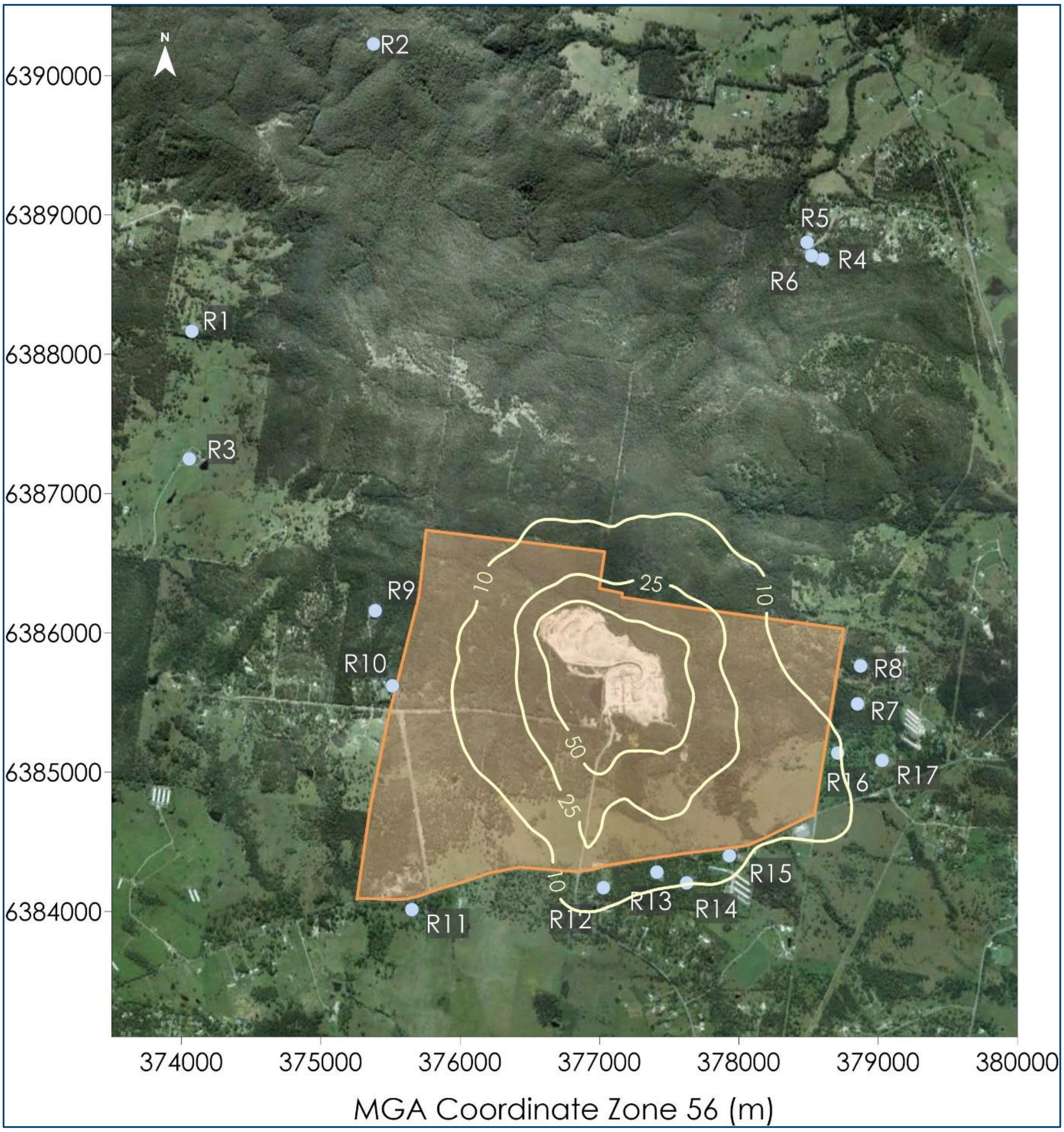

Figure D-3: Predicted incremental maximum 24-hour average PM_{10} concentrations (µg/m³) – Current operation

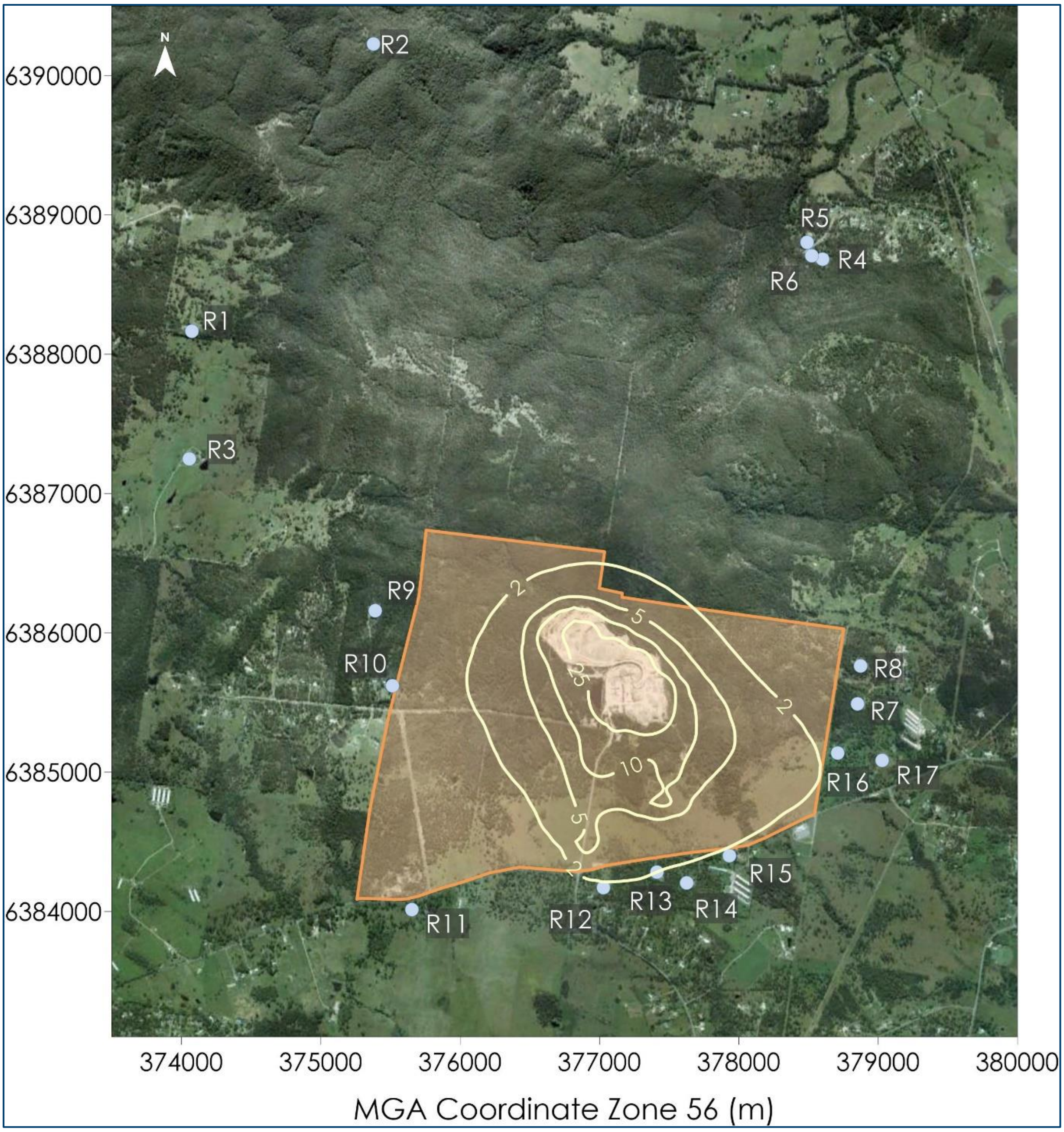

Figure D-4: Predicted incremental annual average PM_{10} concentrations (µg/m³) – Current operation

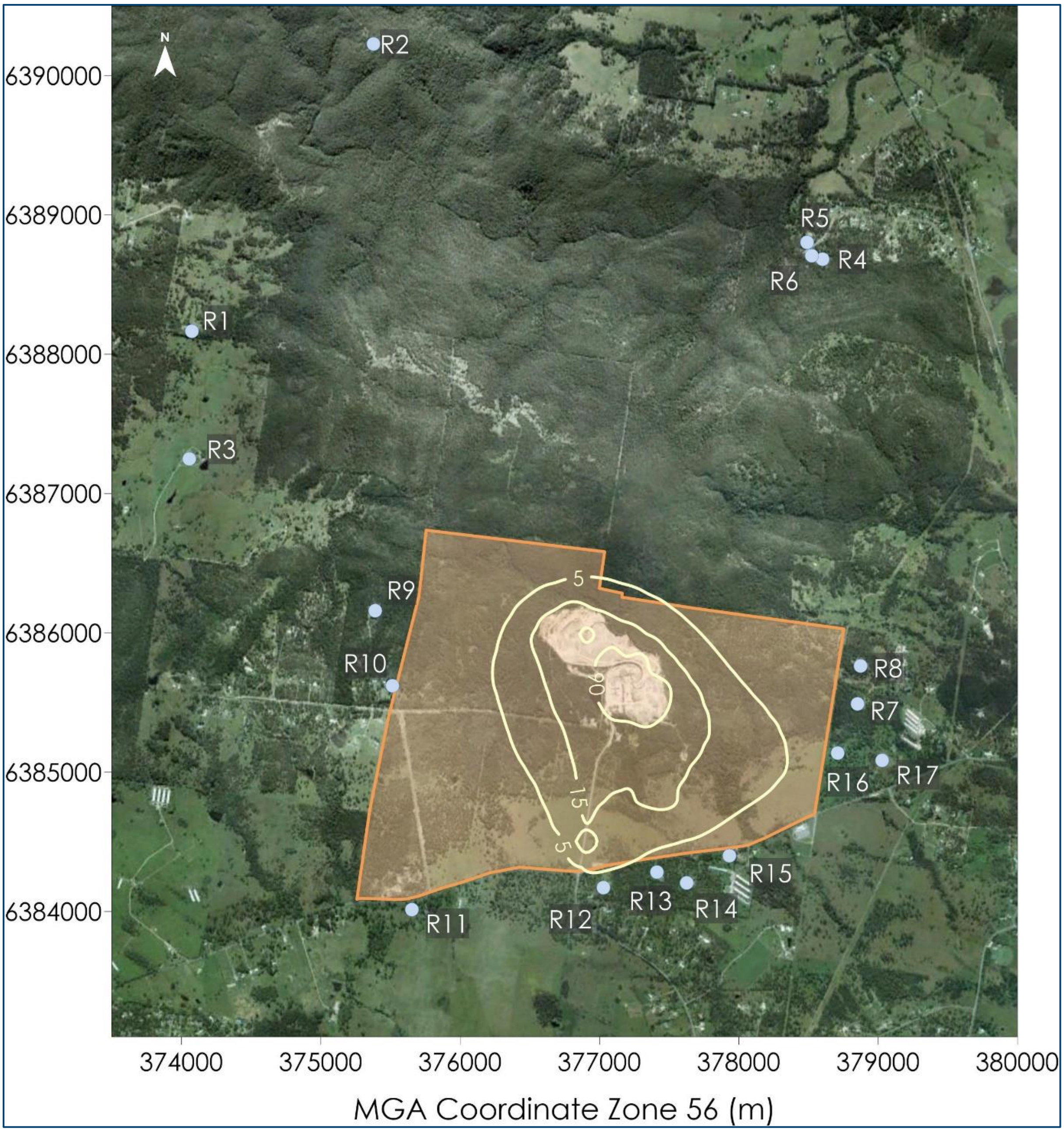

Figure D-5: Predicted incremental annual average TSP concentrations (µg/m³) – Current operation

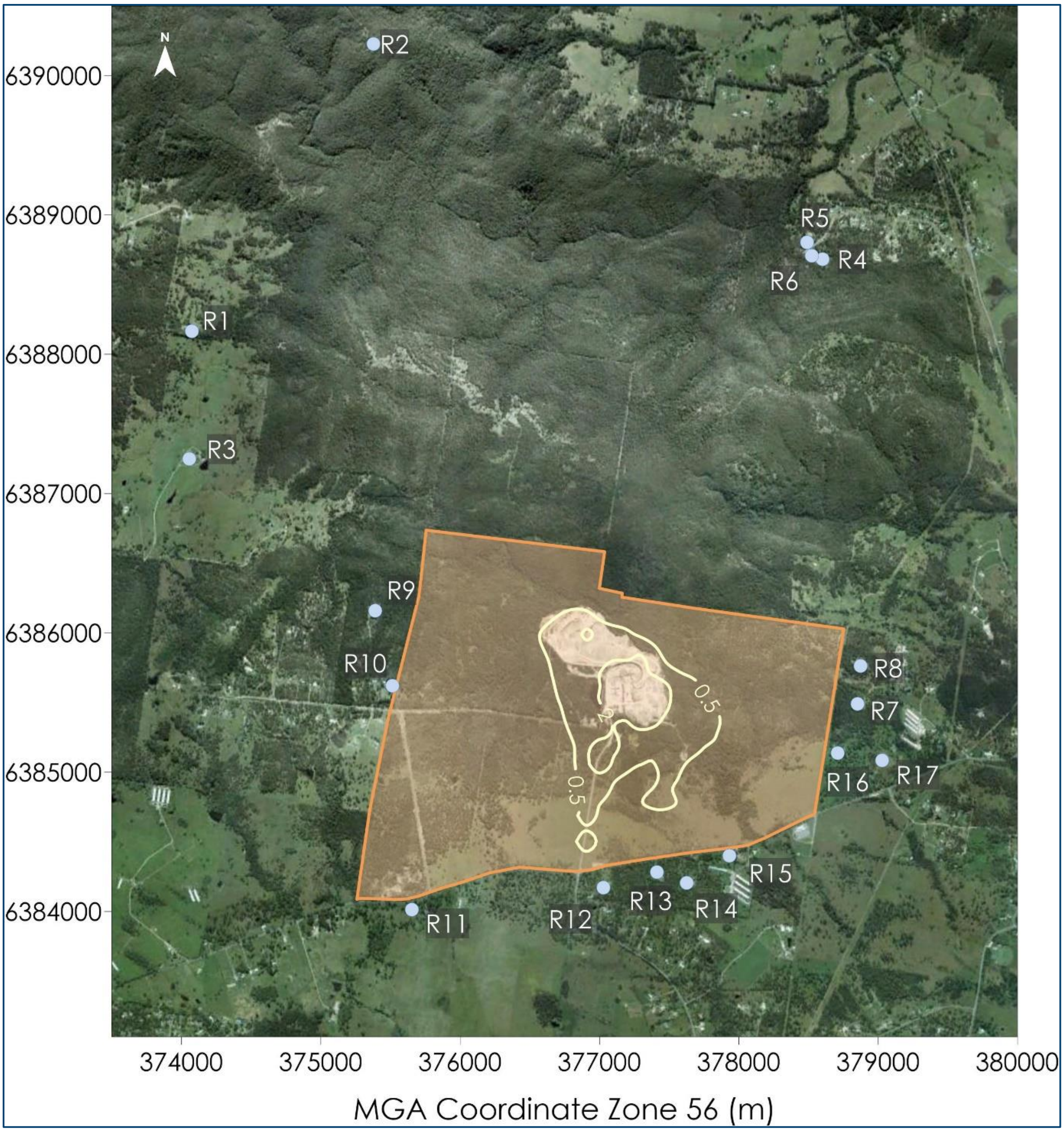

Figure D-6: Predicted incremental annual average dust deposition levels (g/m²/month) – Current operation

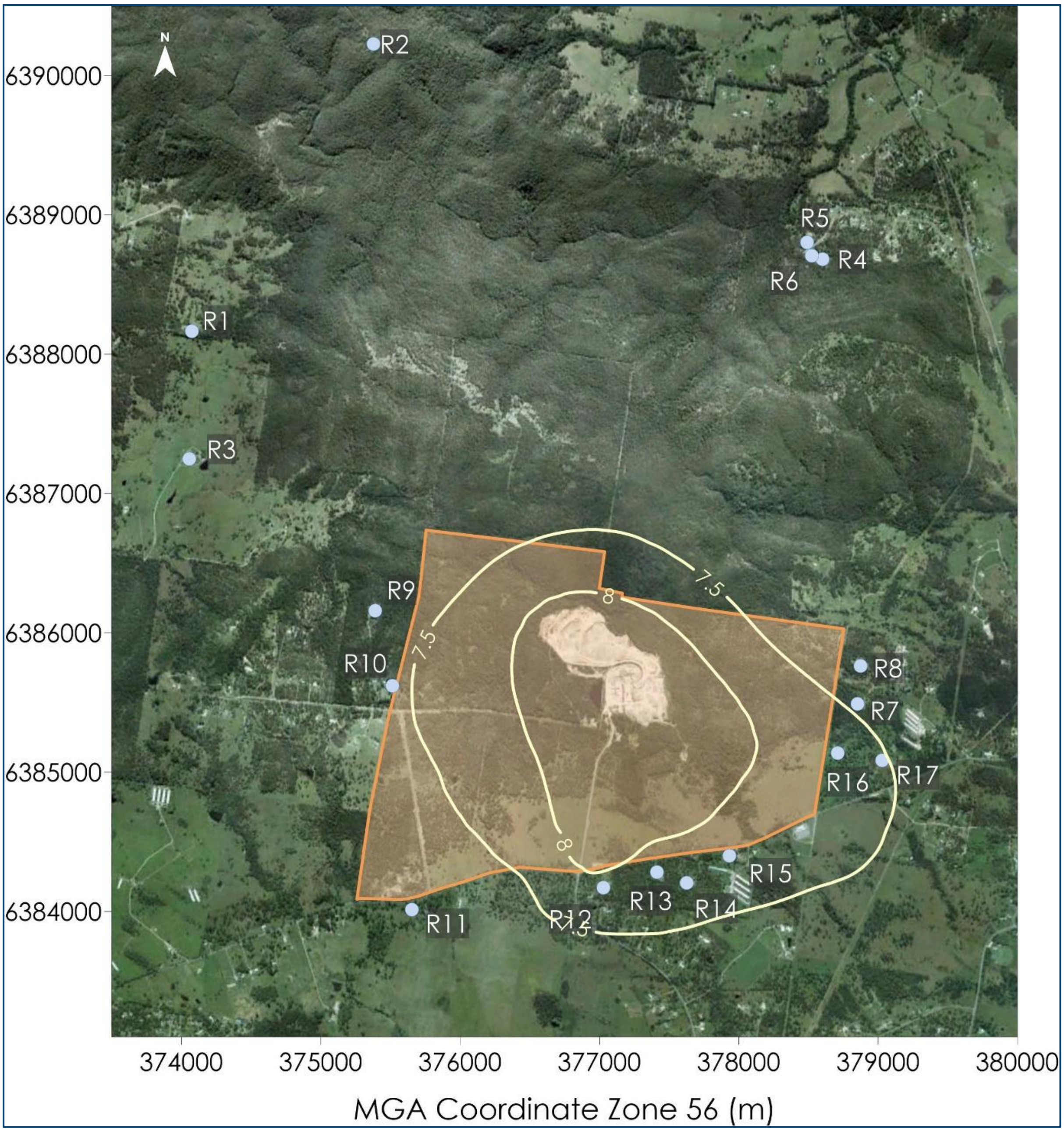

Figure D-7: Predicted cumulative annual average $PM_{2.5}$ concentrations (µg/m³) – Current operation

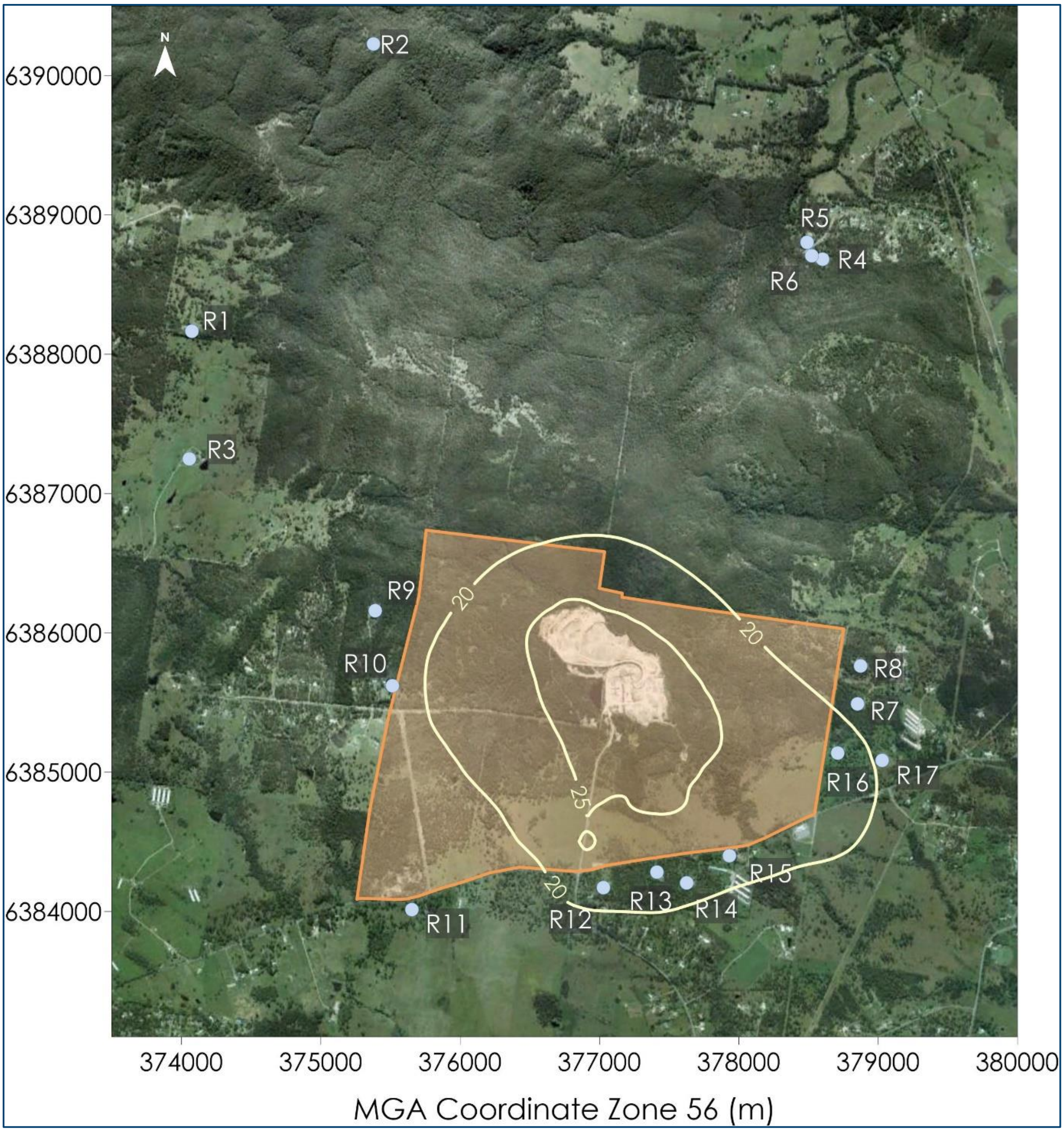

Figure D-8: Predicted cumulative annual average PM_{10} concentrations (µg/m³) – Current operation

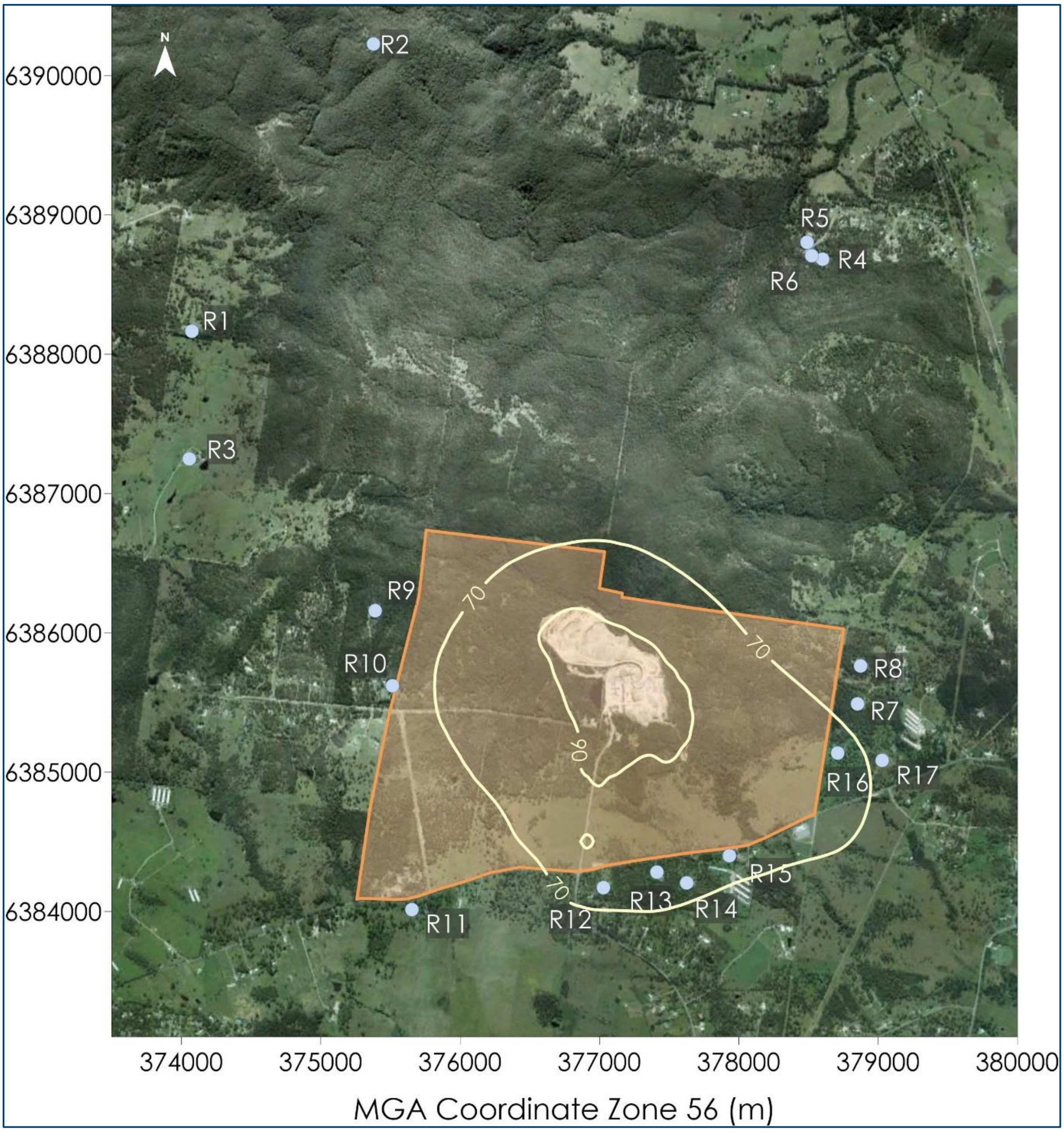

Figure D-9: Predicted cumulative annual average TSP concentrations (µg/m³) – Current operation

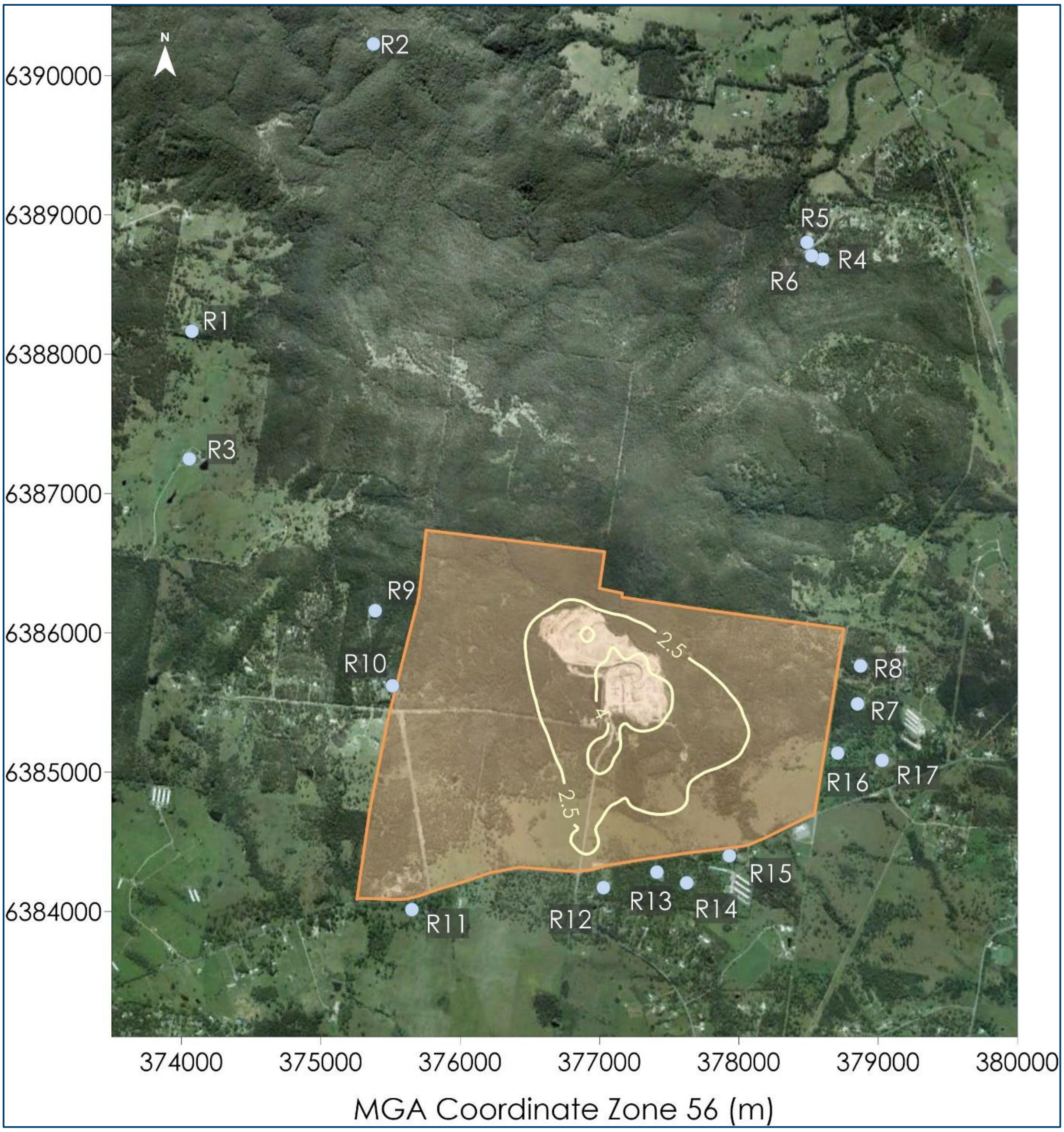

Figure D-10: Predicted cumulative annual average dust deposition levels (g/m²/month) – Current operation

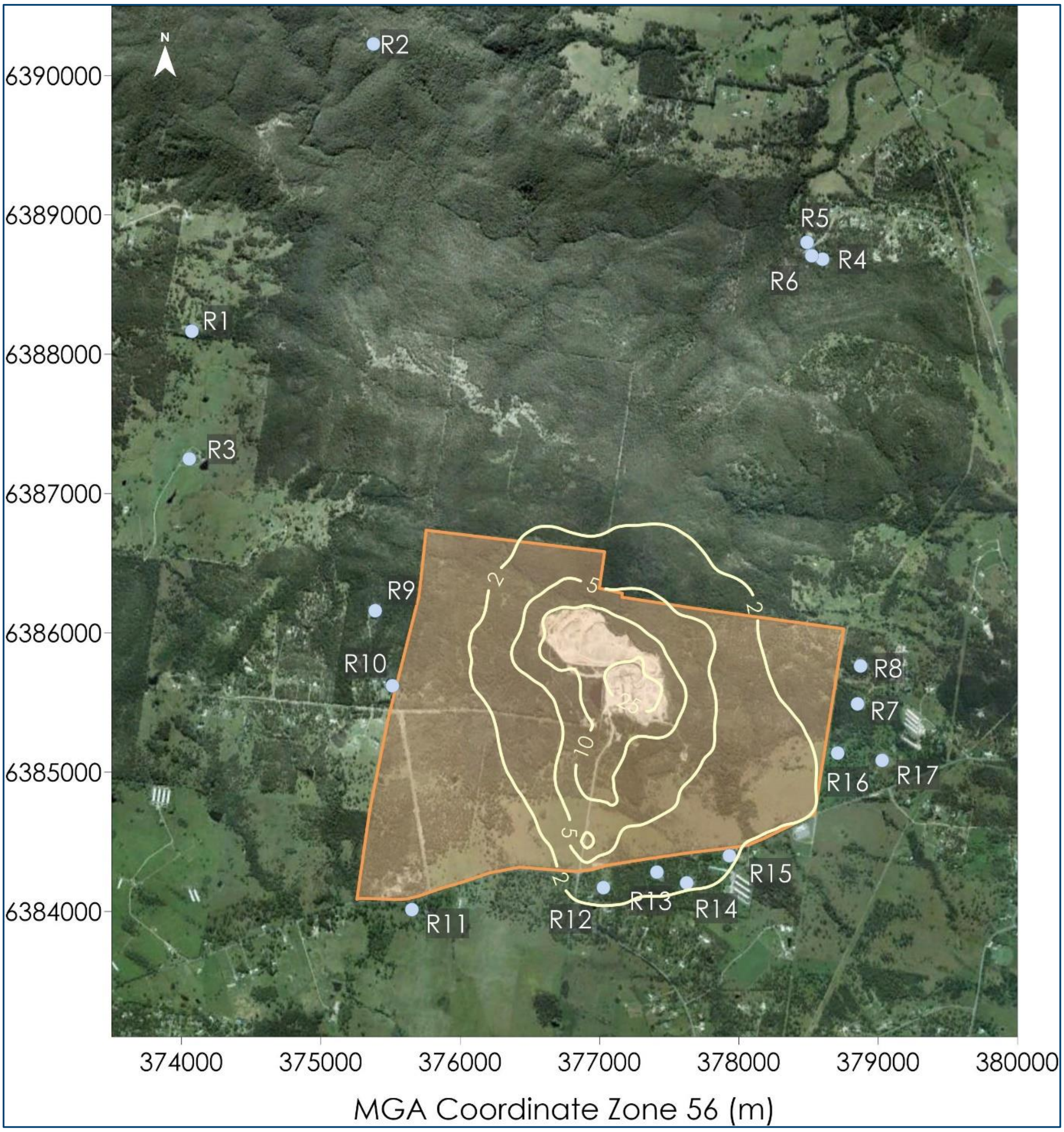

Figure D-11: Predicted incremental maximum 24-hour average $PM_{2.5}$ concentrations (µg/m³) – Stage 1

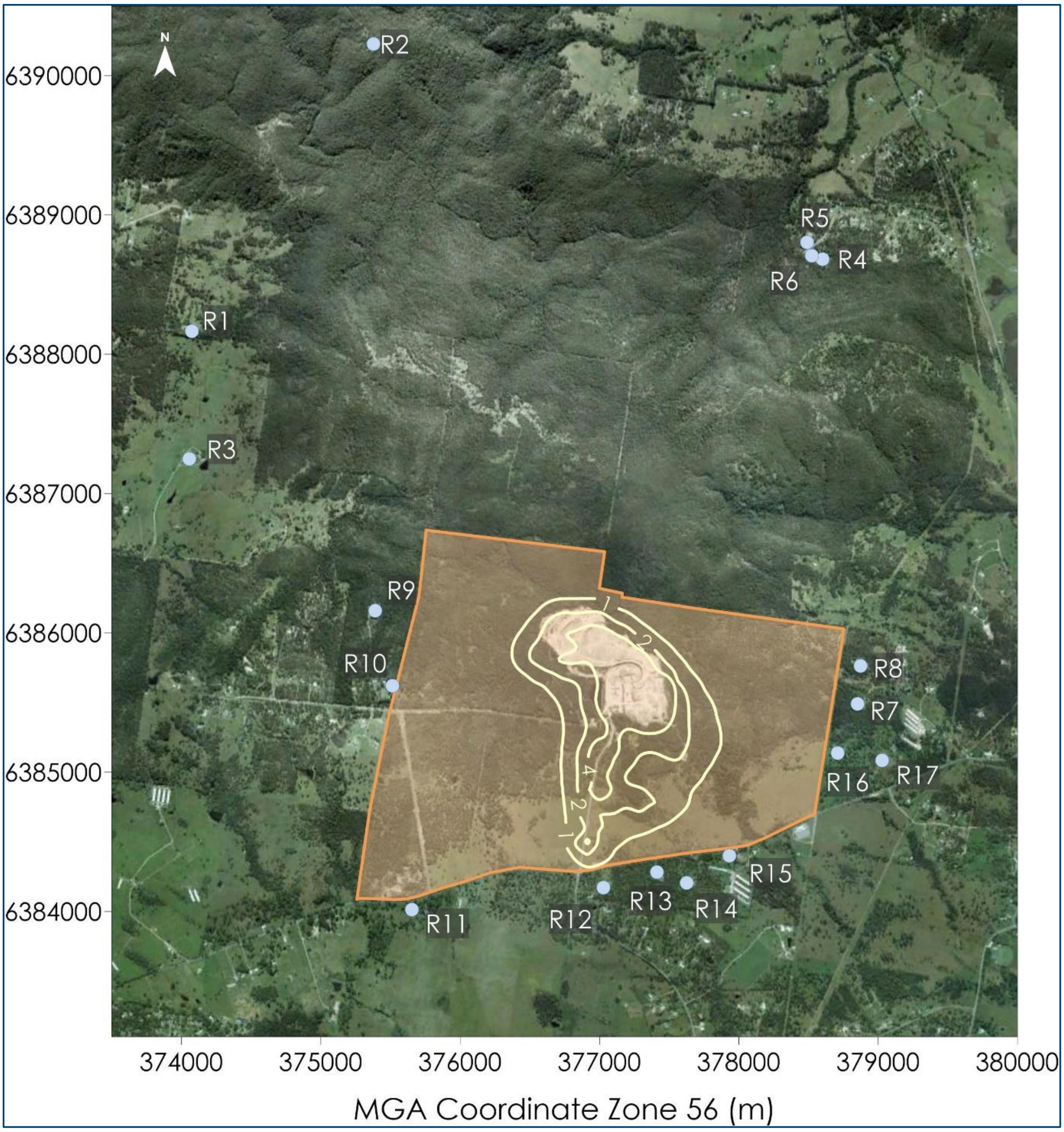

Figure D-12: Predicted incremental annual average $PM_{2.5}$ concentrations (µg/m³) – Stage 1

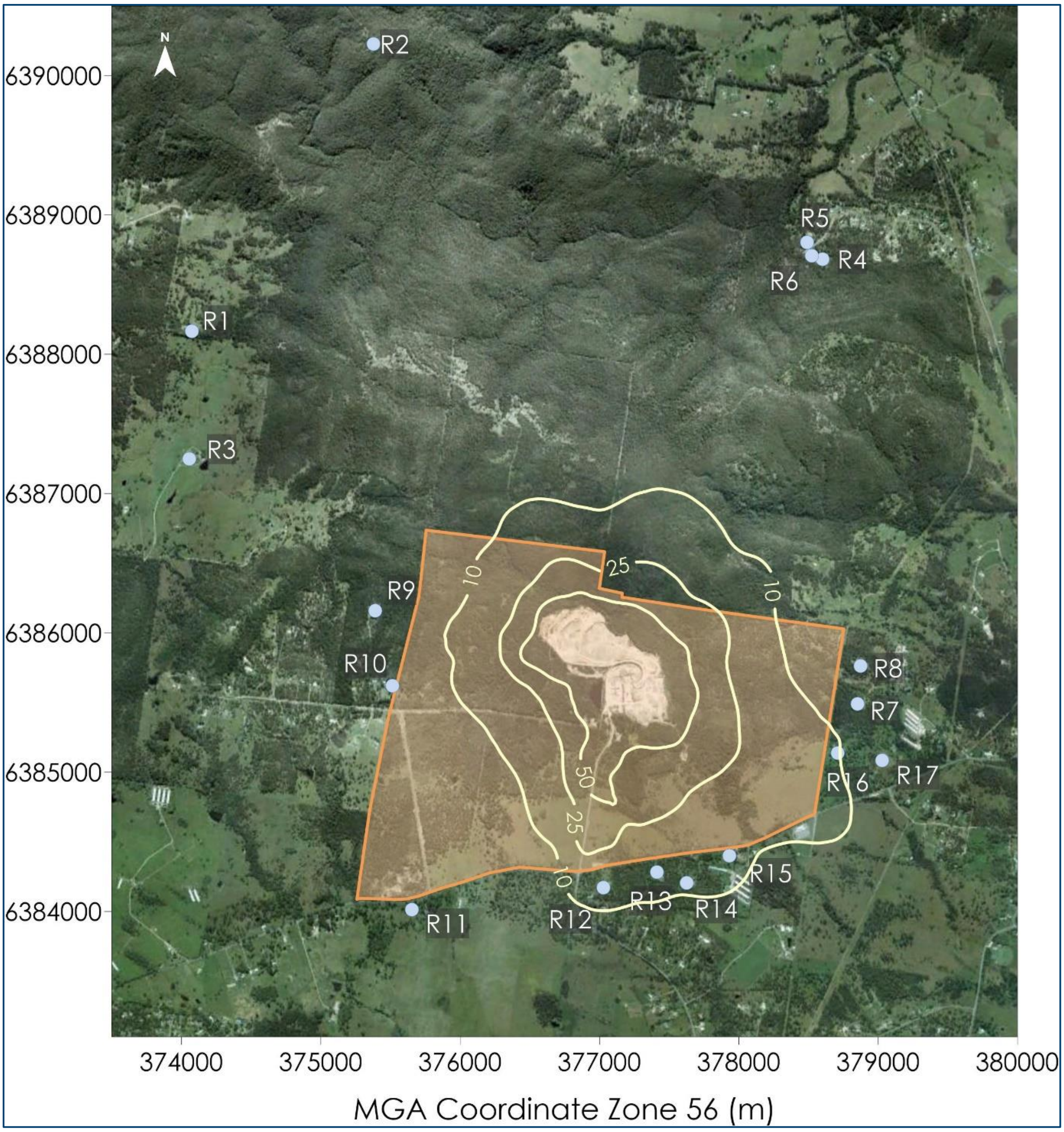

Figure D-13: Predicted incremental maximum 24-hour average PM_{10} concentrations (µg/m³) – Stage 1

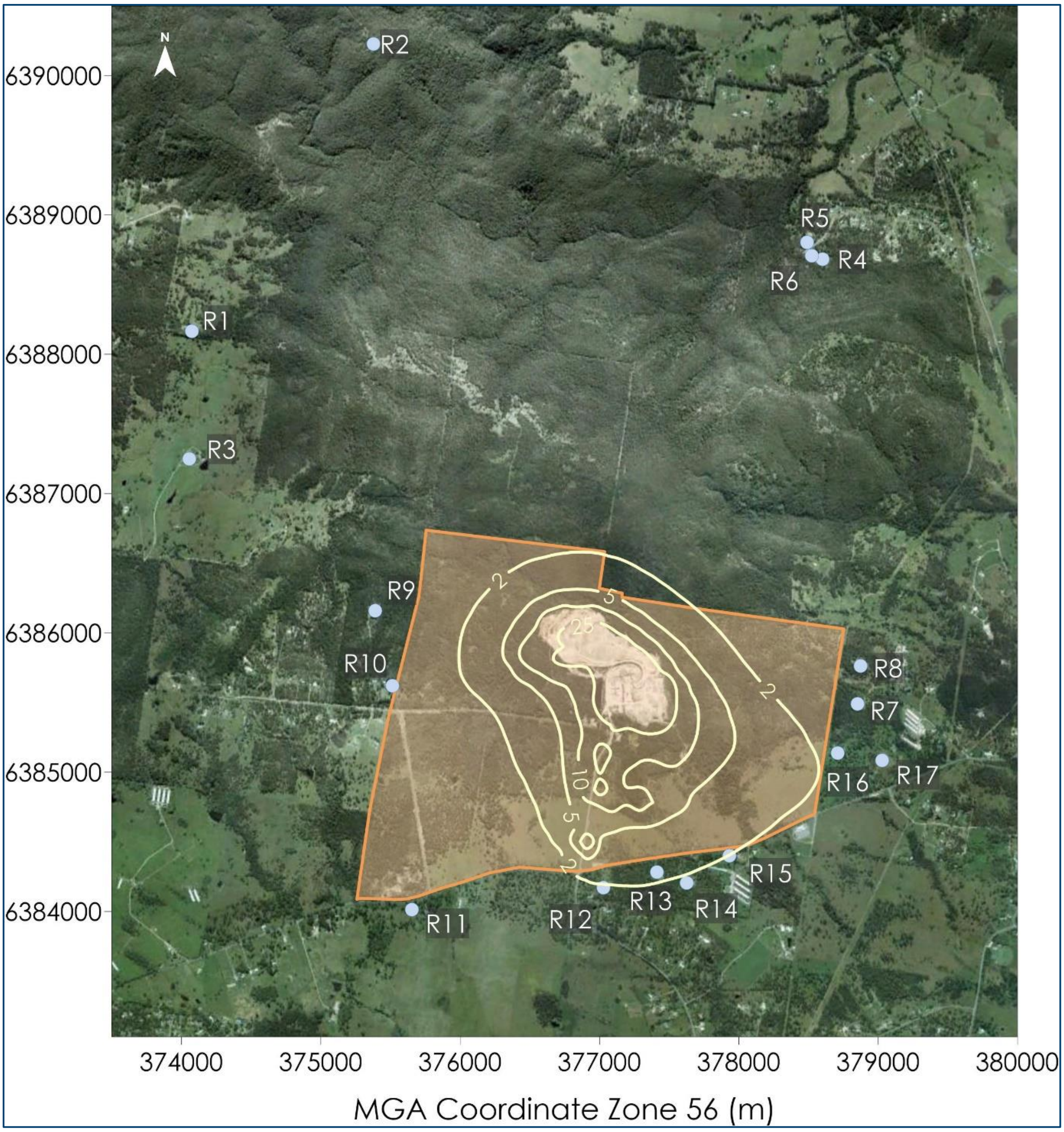

Figure D-14: Predicted incremental annual average PM_{10} concentrations (µg/m³) – Stage 1

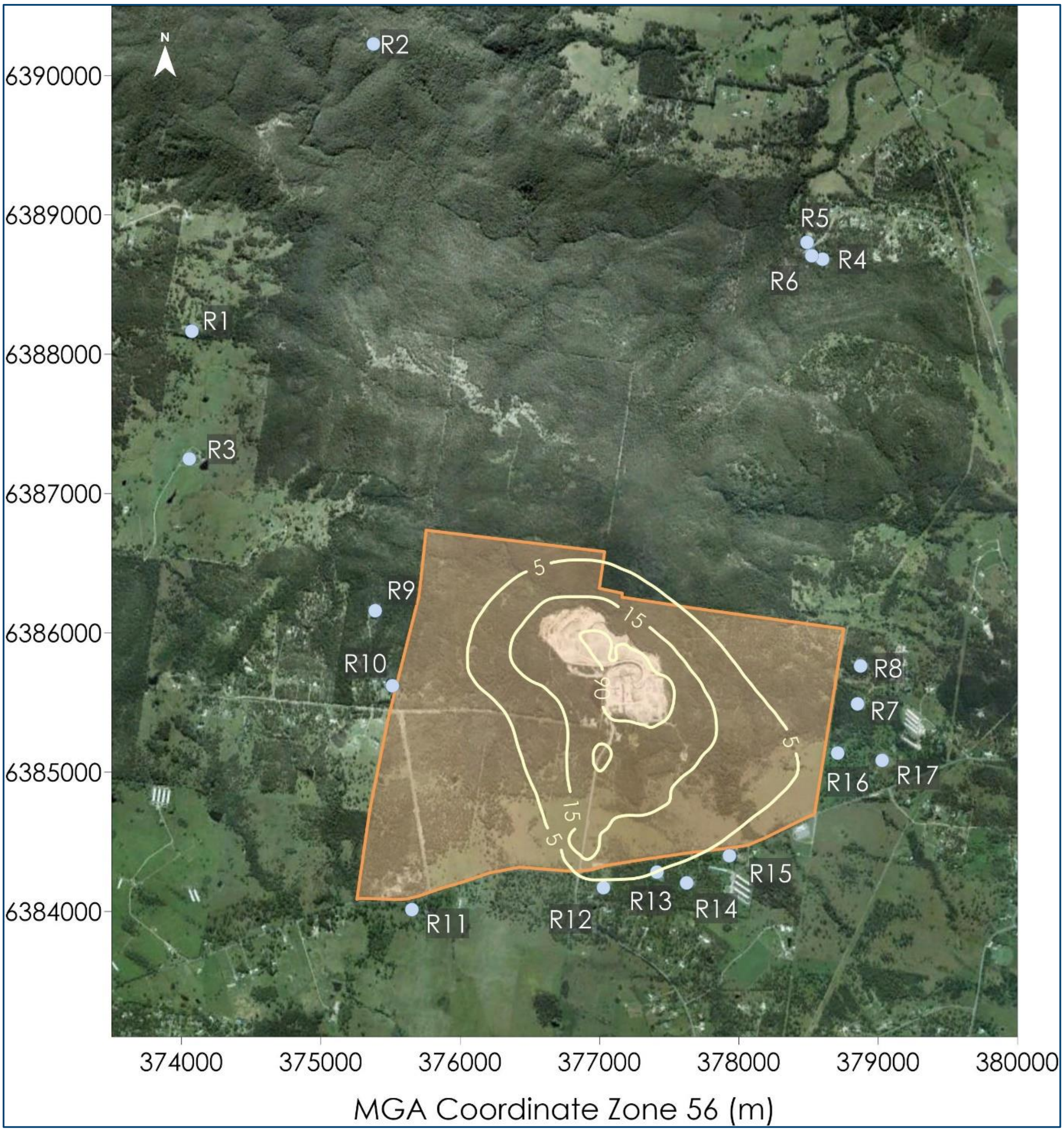

Figure D-15: Predicted incremental annual average TSP concentrations (µg/m³) – Stage 1

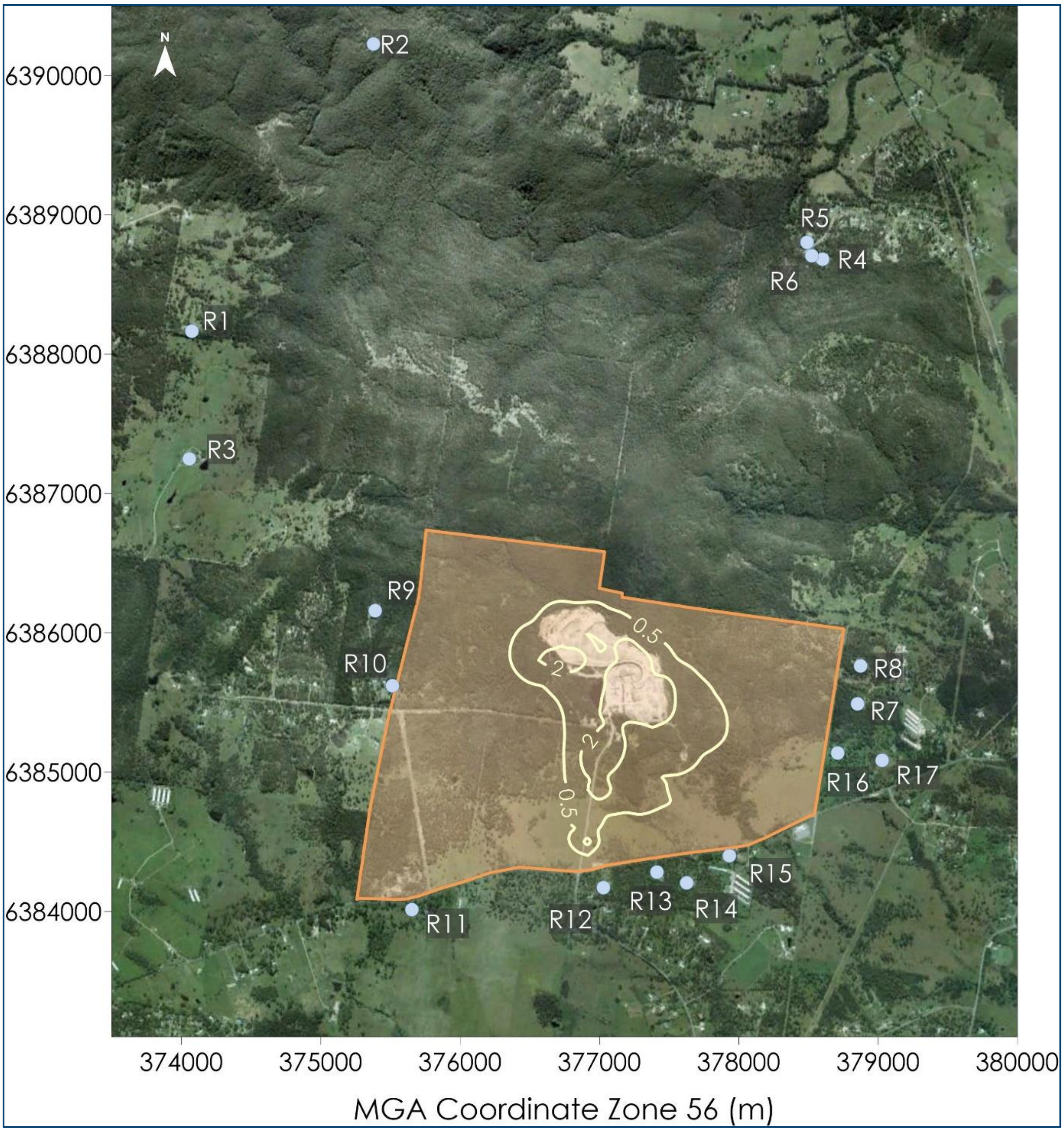

Figure D-16: Predicted incremental annual average dust deposition levels (g/m²/month) – Stage 1

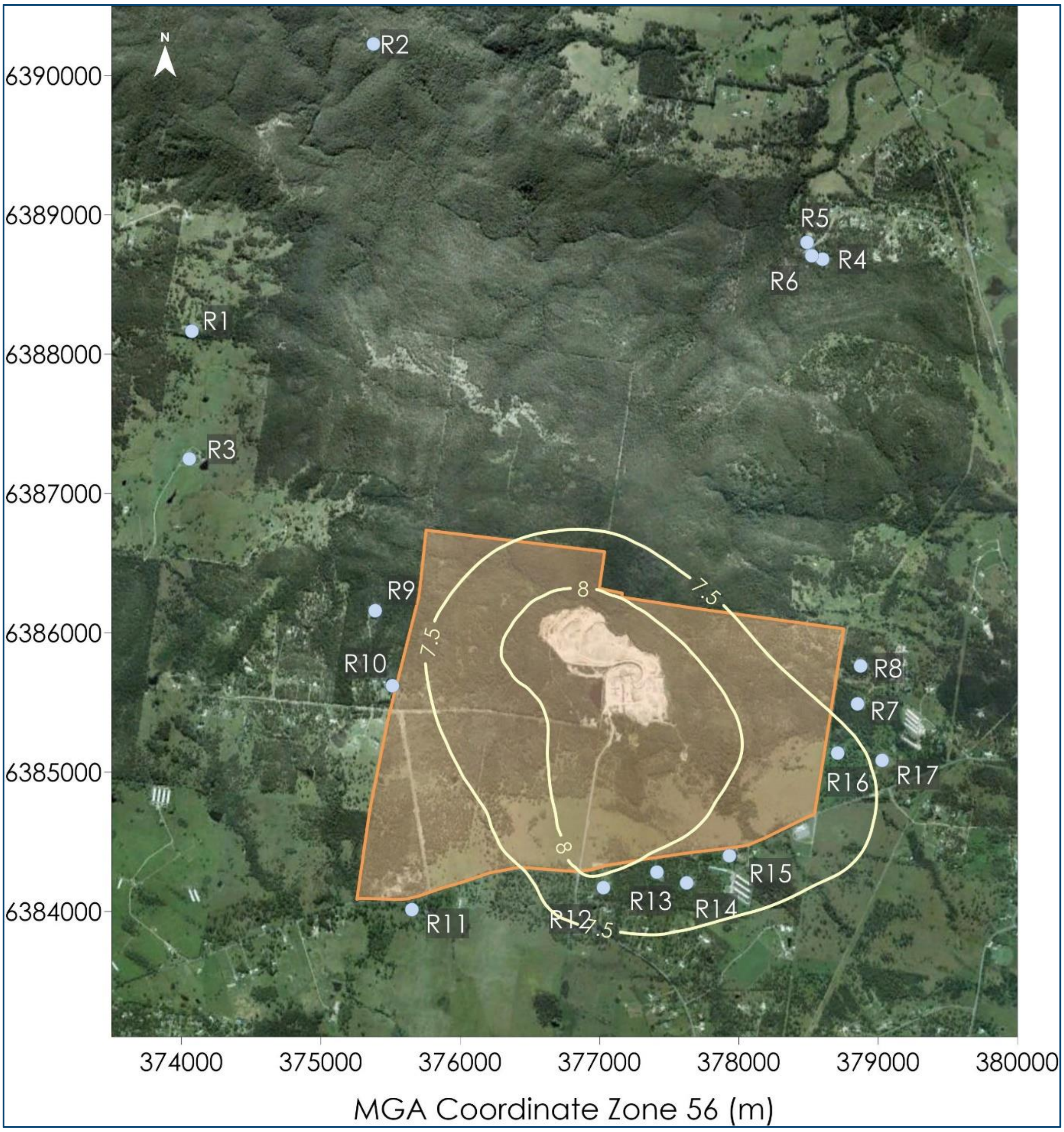

Figure D-17: Predicted cumulative annual average $PM_{2.5}$ concentrations (μg/m³) – Stage 1

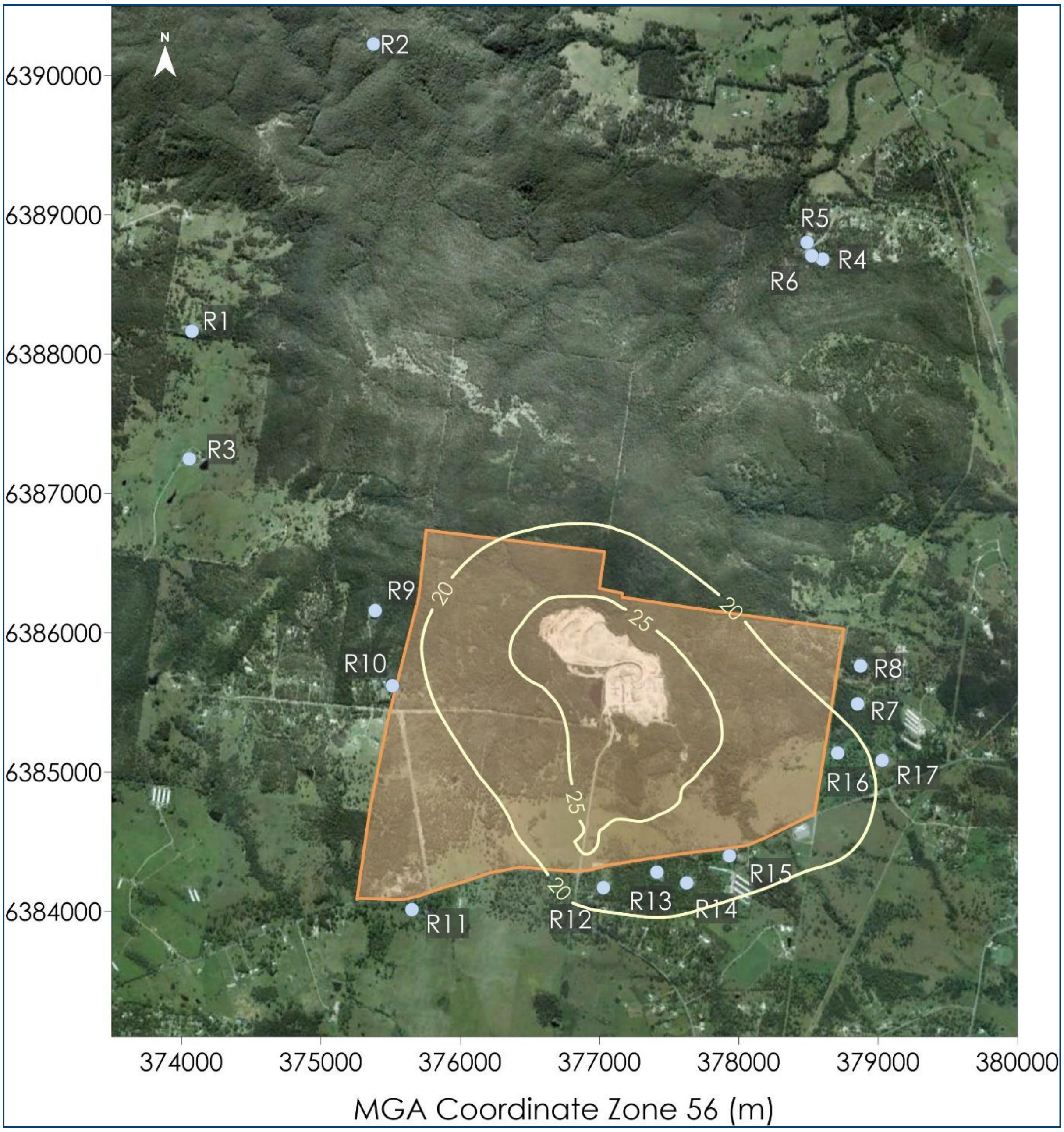

Figure D-18: Predicted cumulative annual average PM_{10} concentrations (μg/m³) – Stage 1

Figure D-19: Predicted cumulative annual average TSP concentrations (µg/m³) – Stage 1

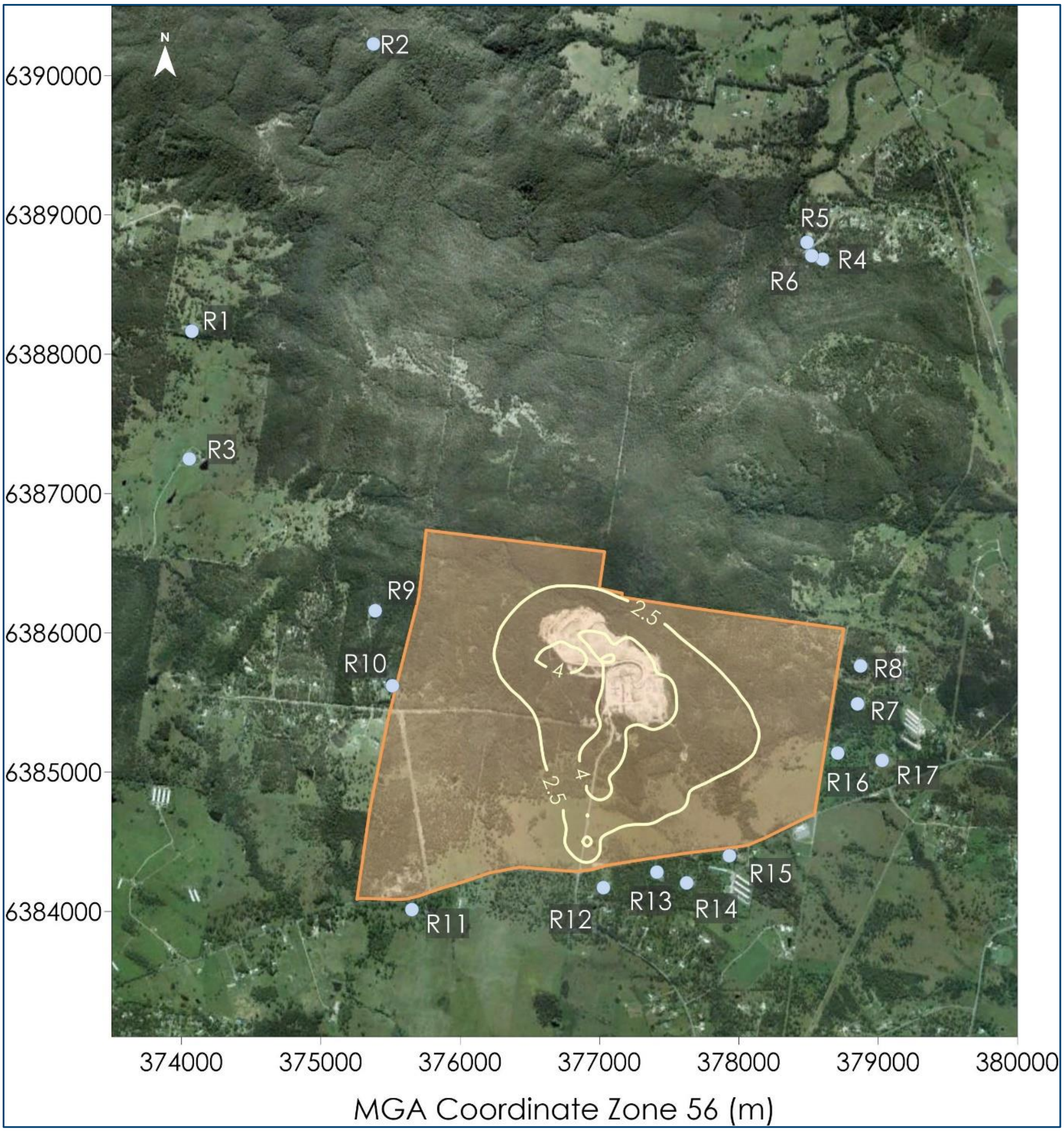

Figure D-20: Predicted cumulative annual average dust deposition levels (g/m²/month) – Stage 1

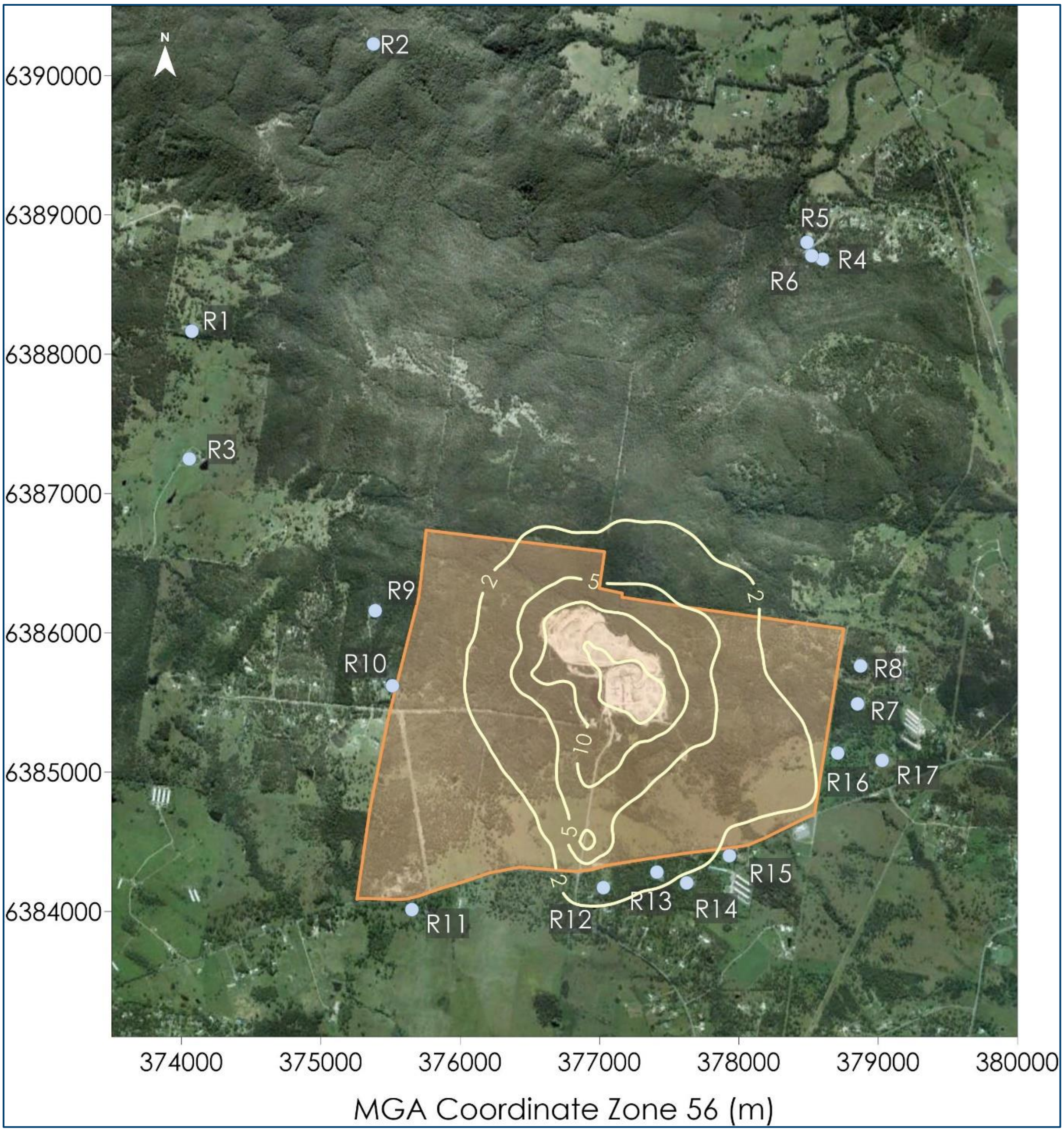

Figure D-21: Predicted incremental maximum 24-hour average $PM_{2.5}$ concentrations (µg/m³) – Stage 2

Figure D-22: Predicted incremental annual average $PM_{2.5}$ concentrations (µg/m³) – Stage 2

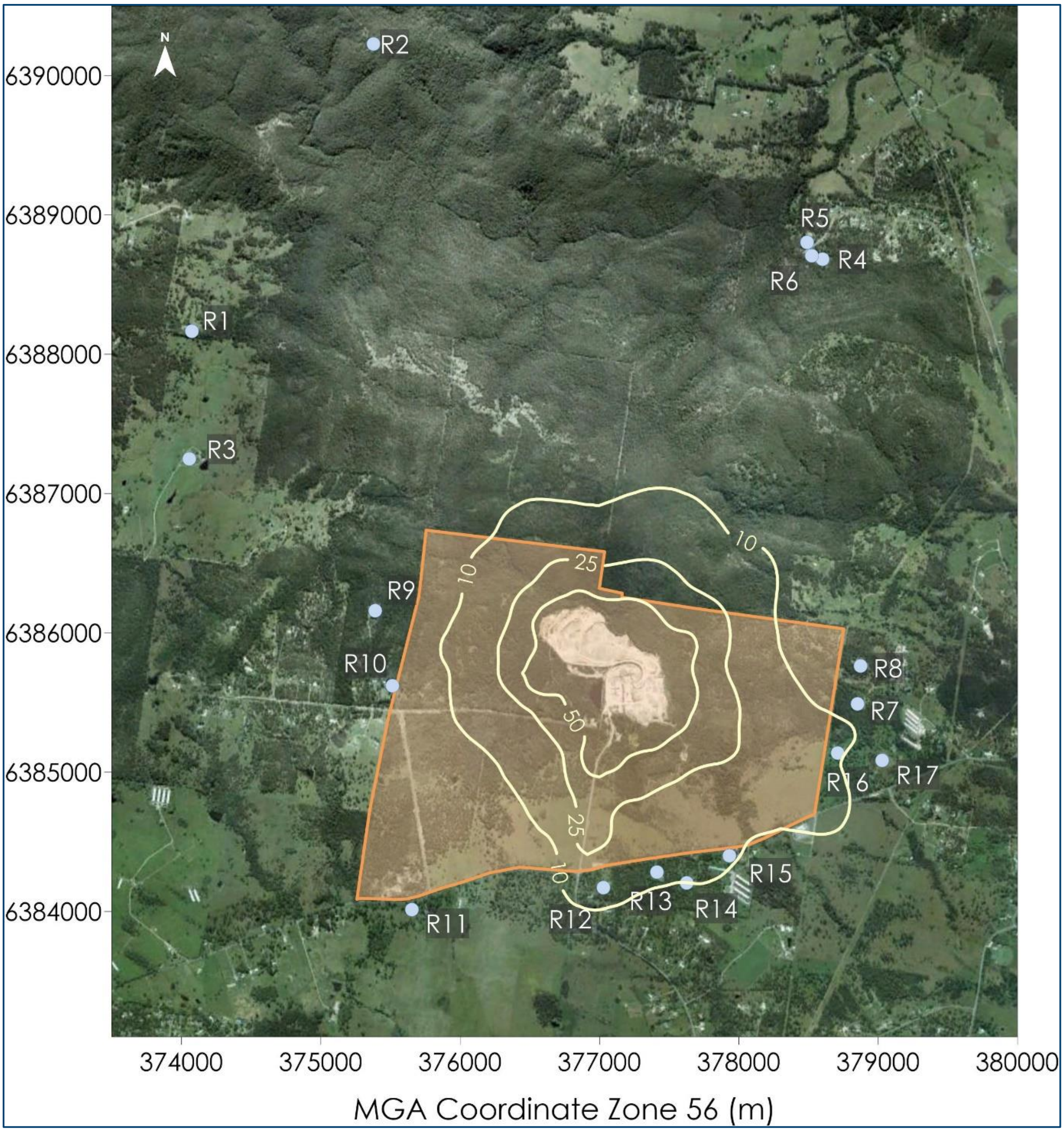

Figure D-23: Predicted incremental maximum 24-hour average PM_{10} concentrations (µg/m³) – Stage 2

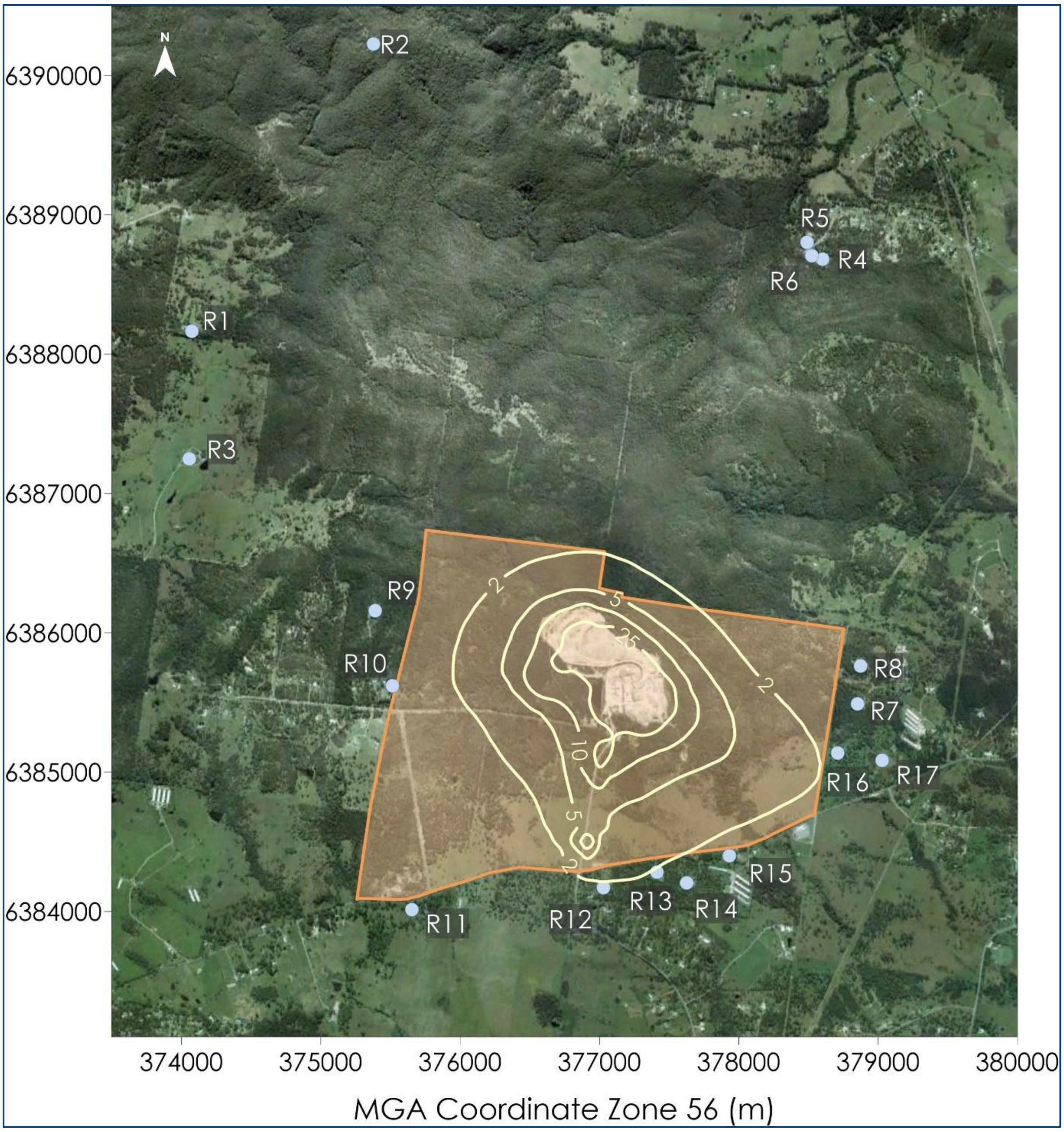

Figure D-24: Predicted incremental annual average PM_{10} concentrations (µg/m³) – Stage 2

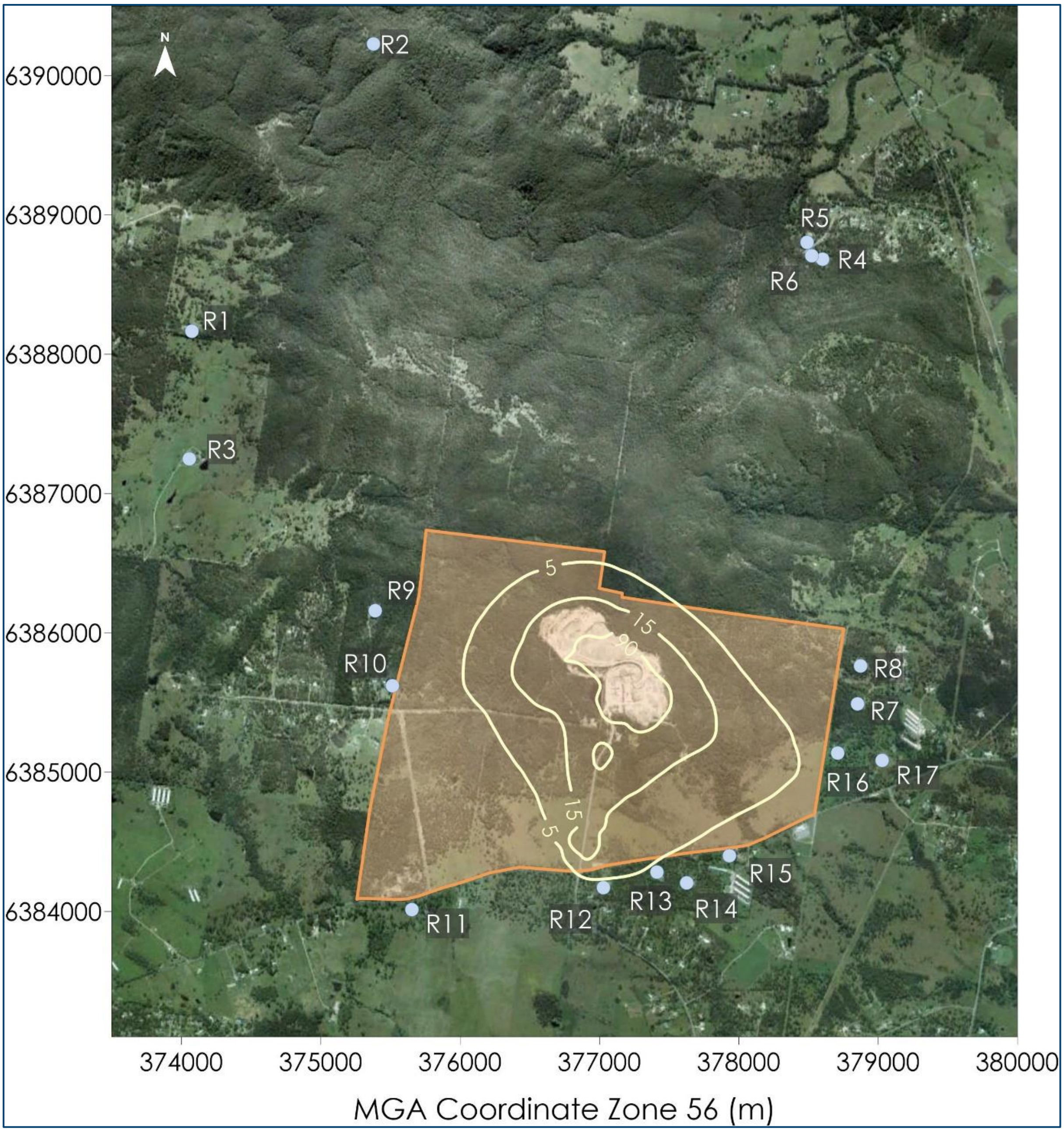

Figure D-25: Predicted incremental annual average TSP concentrations (µg/m³) – Stage 2

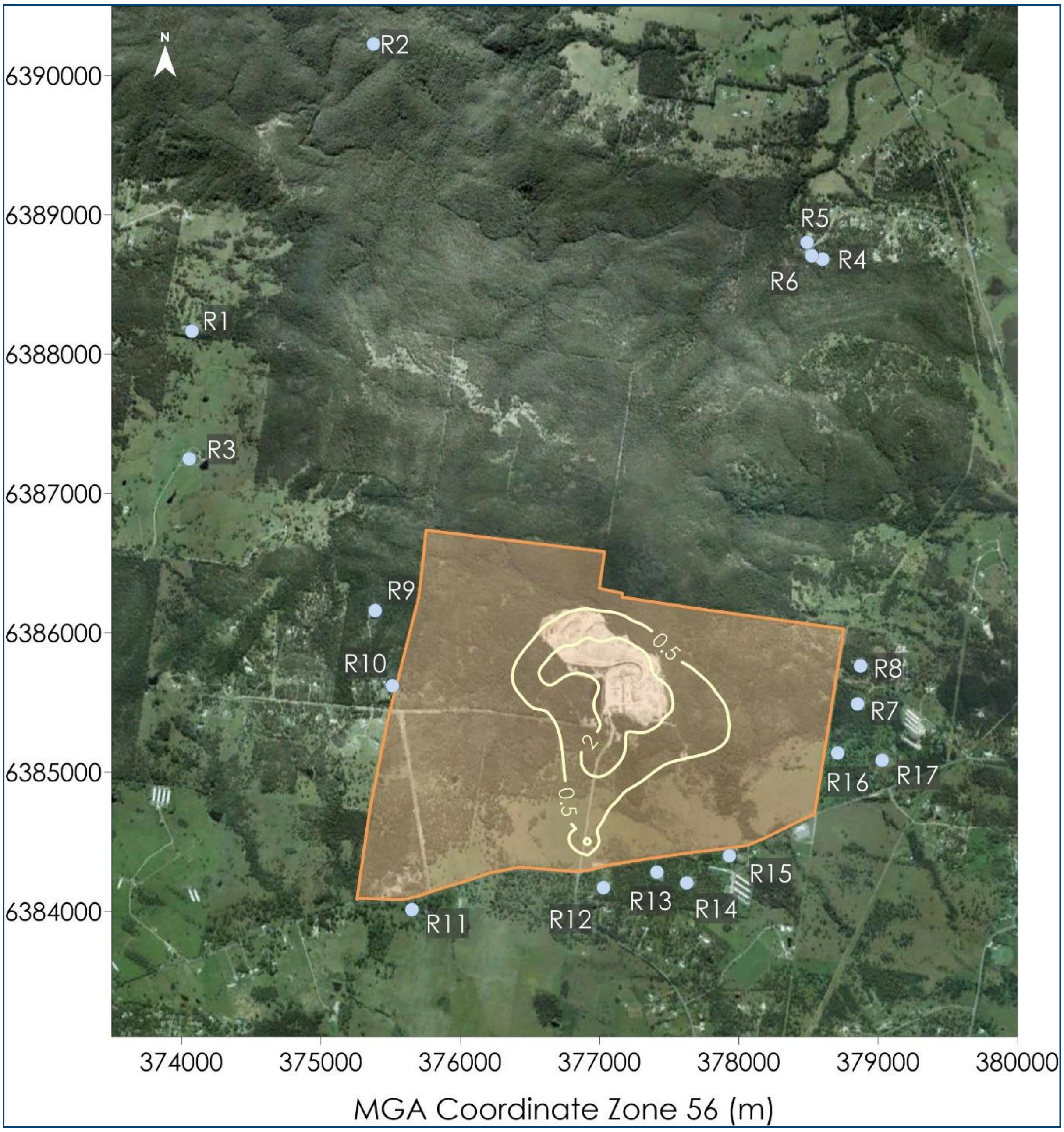

Figure D-26: Predicted incremental annual average dust deposition levels (g/m²/month) – Stage 2

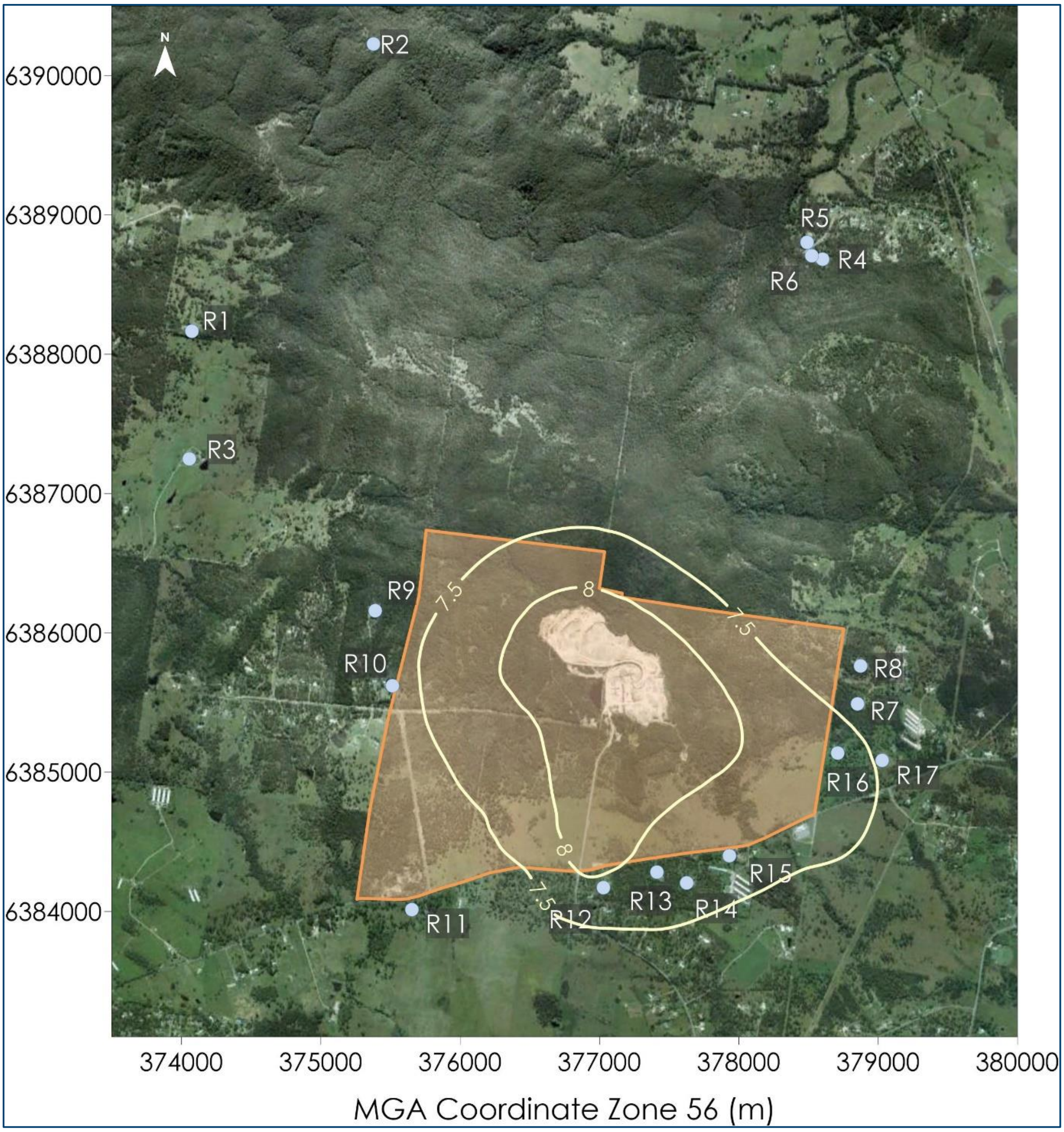

Figure D-27: Predicted cumulative annual average $PM_{2.5}$ concentrations (µg/m³) – Stage 2

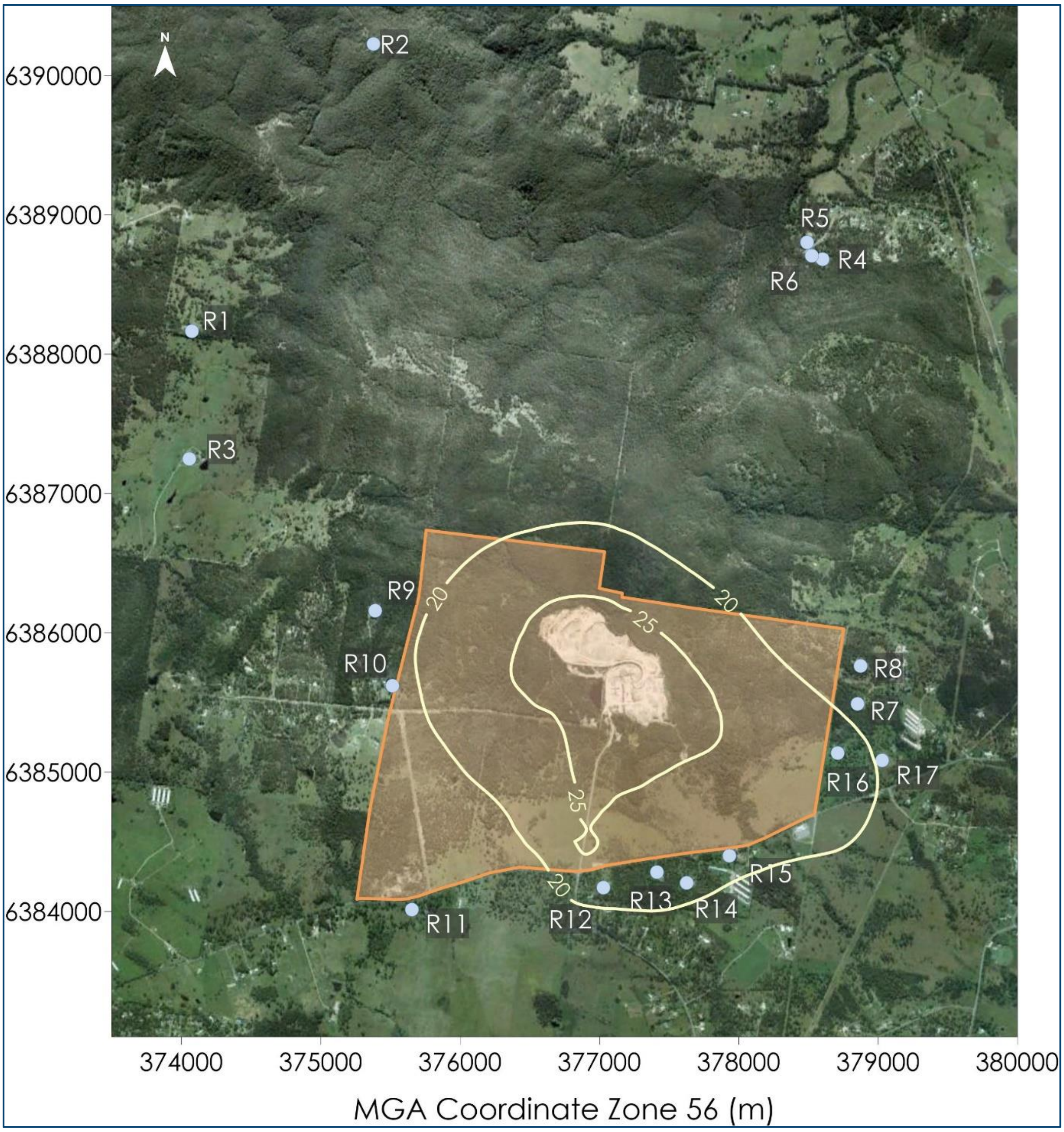

Figure D-28: Predicted cumulative annual average PM_{10} concentrations (µg/m³) – Stage 2

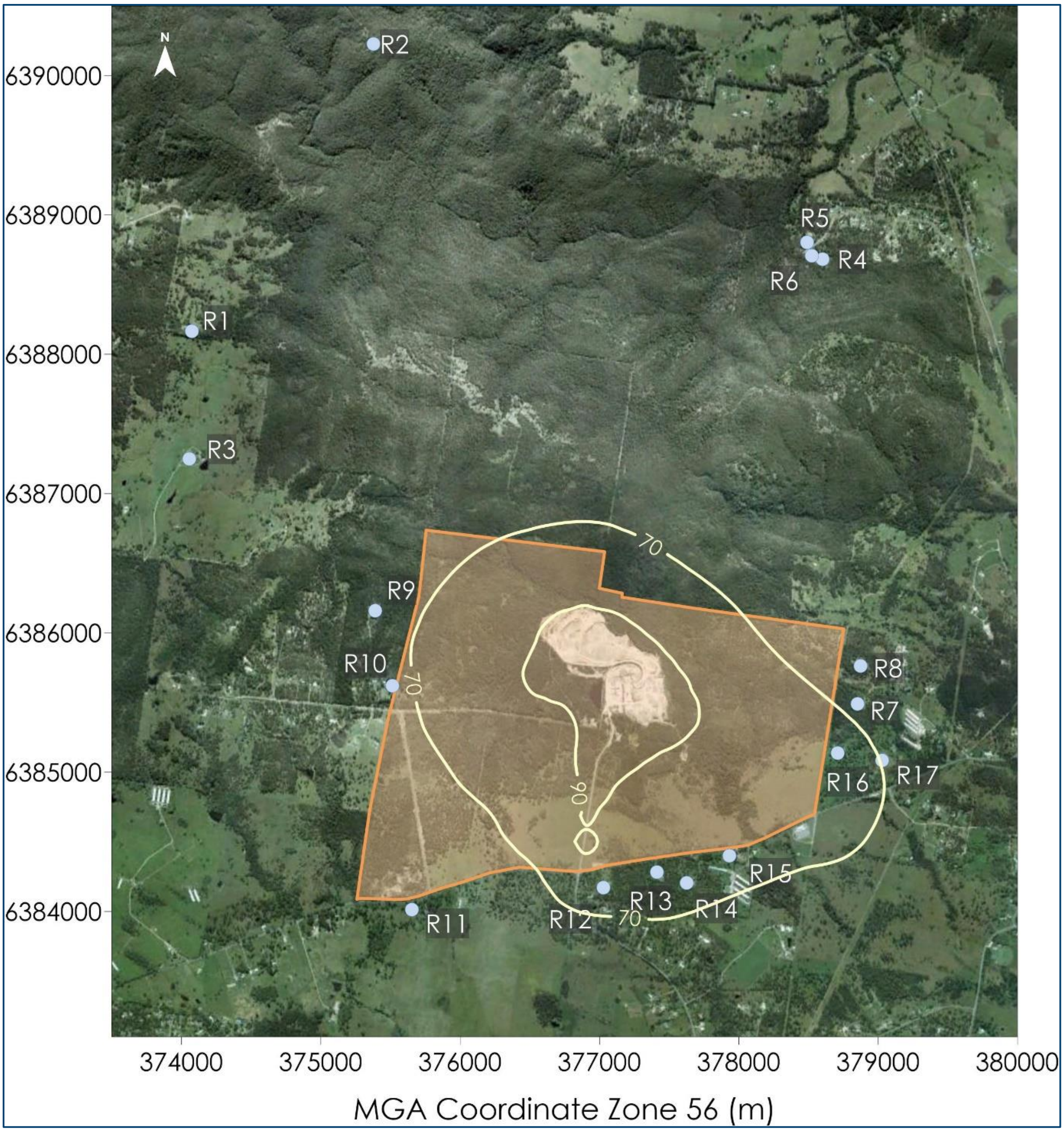

Figure D-29: Predicted cumulative annual average TSP concentrations (µg/m³) – Stage 2

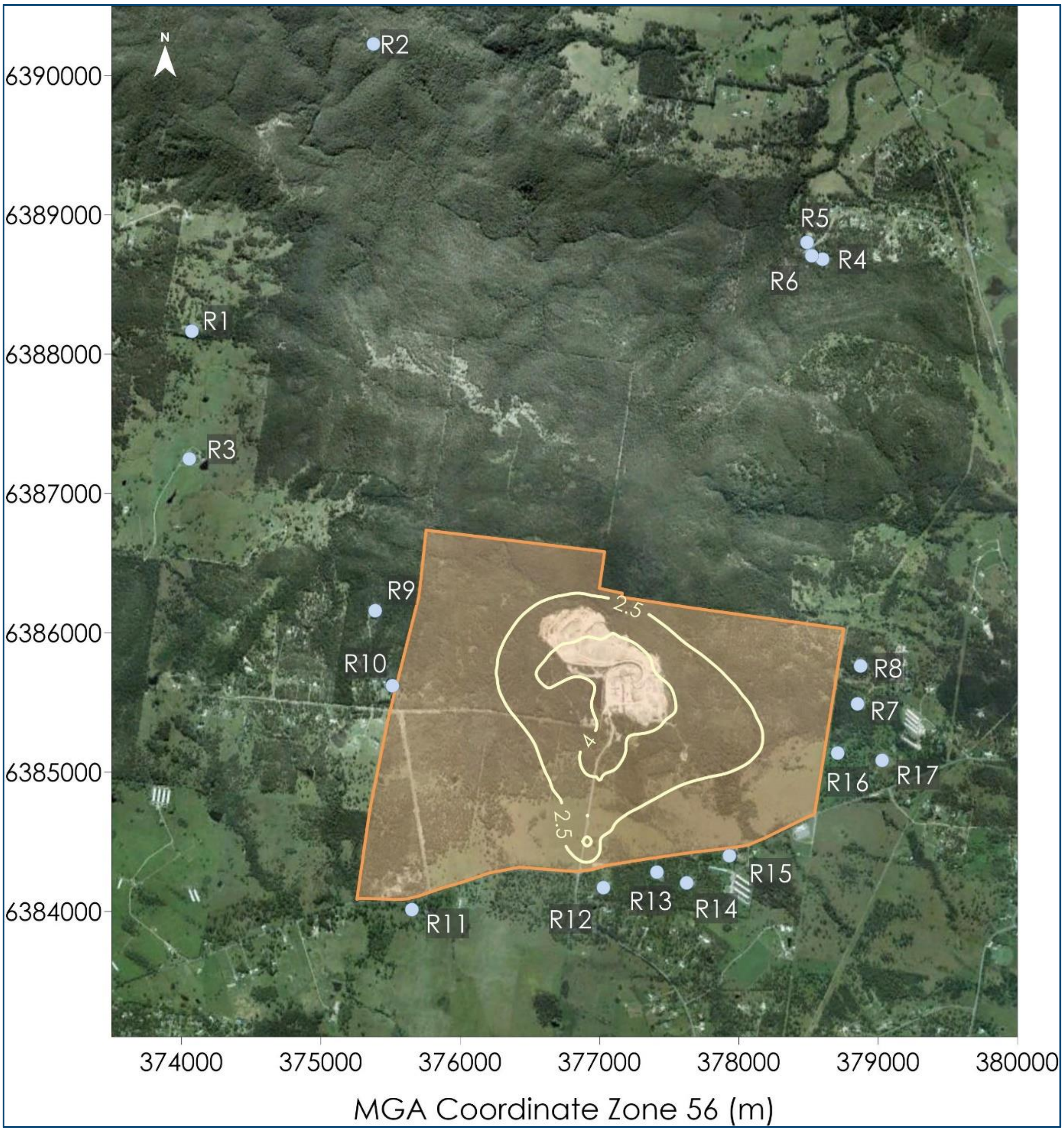

Figure D-30: Predicted cumulative annual average dust deposition levels (g/m²/month) – Stage 2

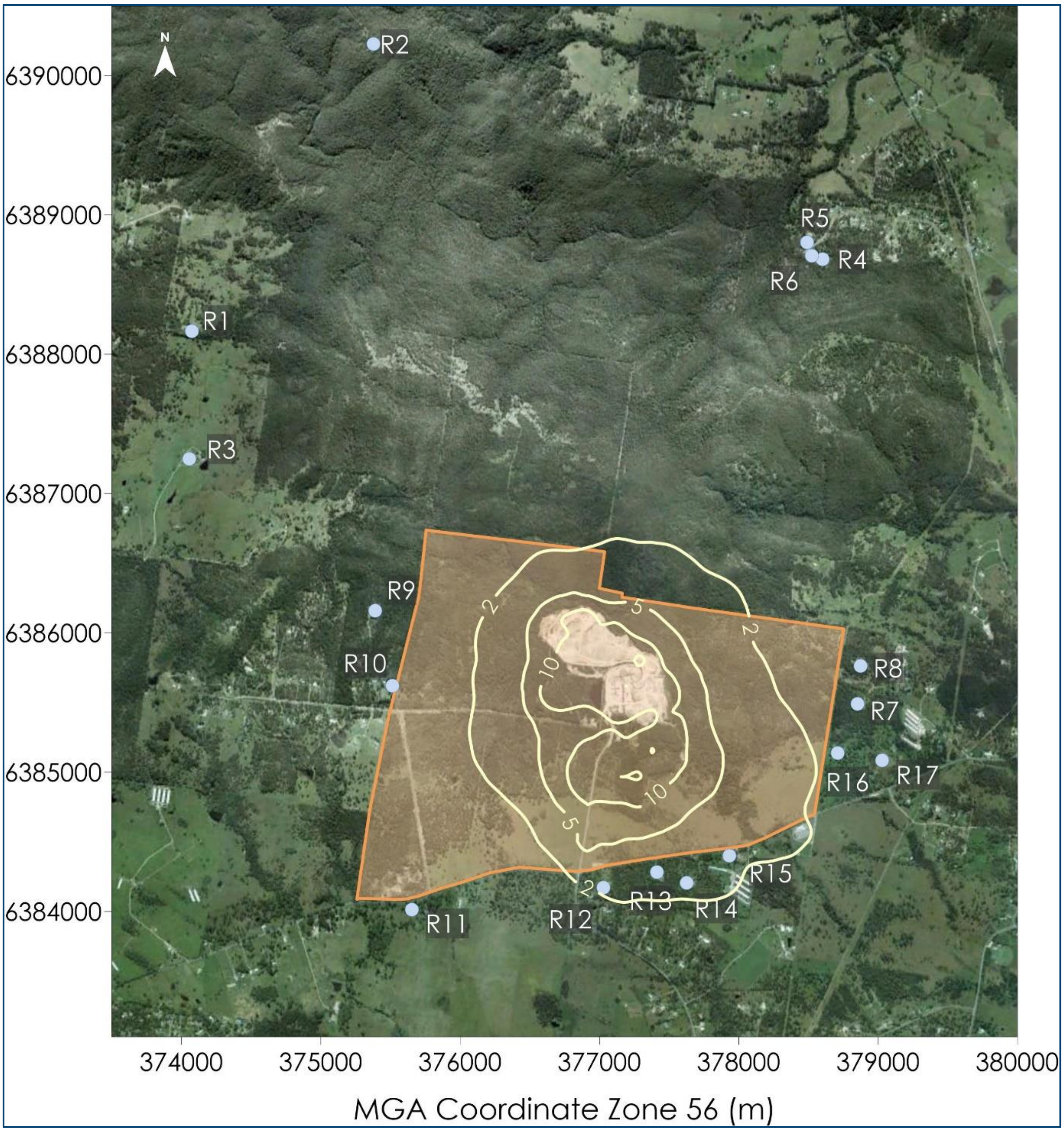

Figure D-31: Predicted incremental maximum 24-hour average $PM_{2.5}$ concentrations (µg/m³) – Stage 4

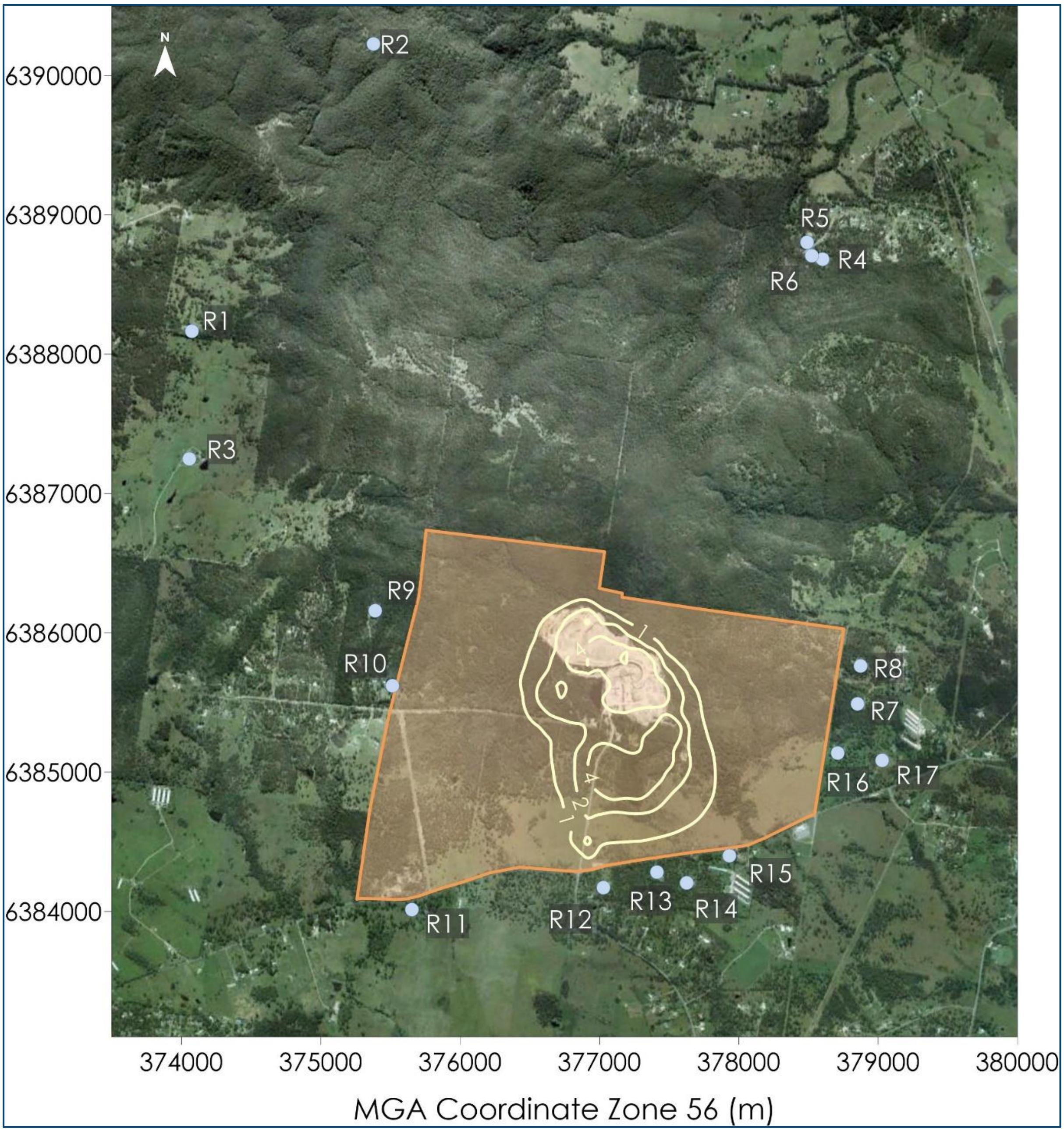

Figure D-32: Predicted incremental annual average $PM_{2.5}$ concentrations (µg/m³) – Stage 4

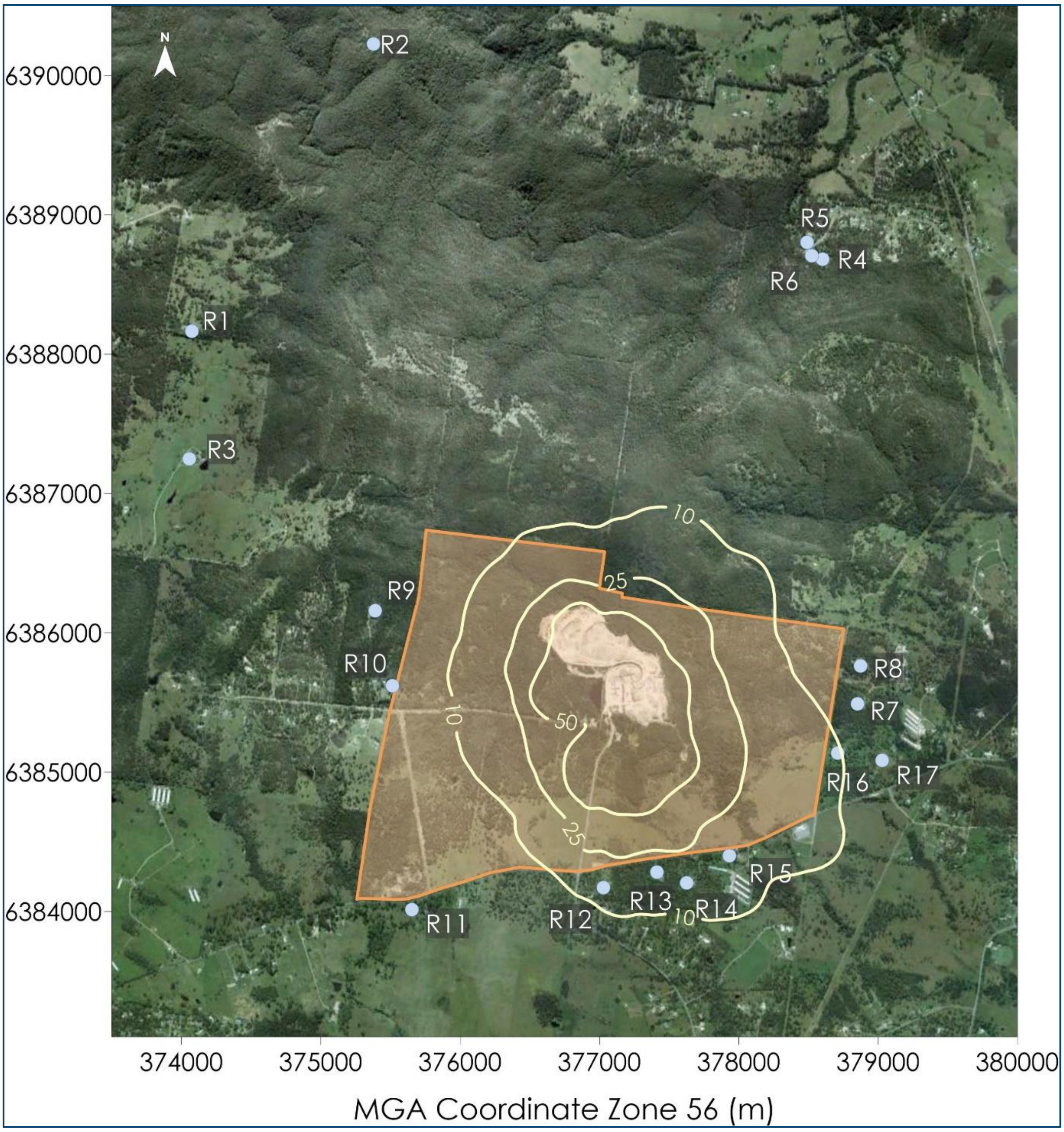

Figure D-33: Predicted incremental maximum 24-hour average PM_{10} concentrations (µg/m³) – Stage 4

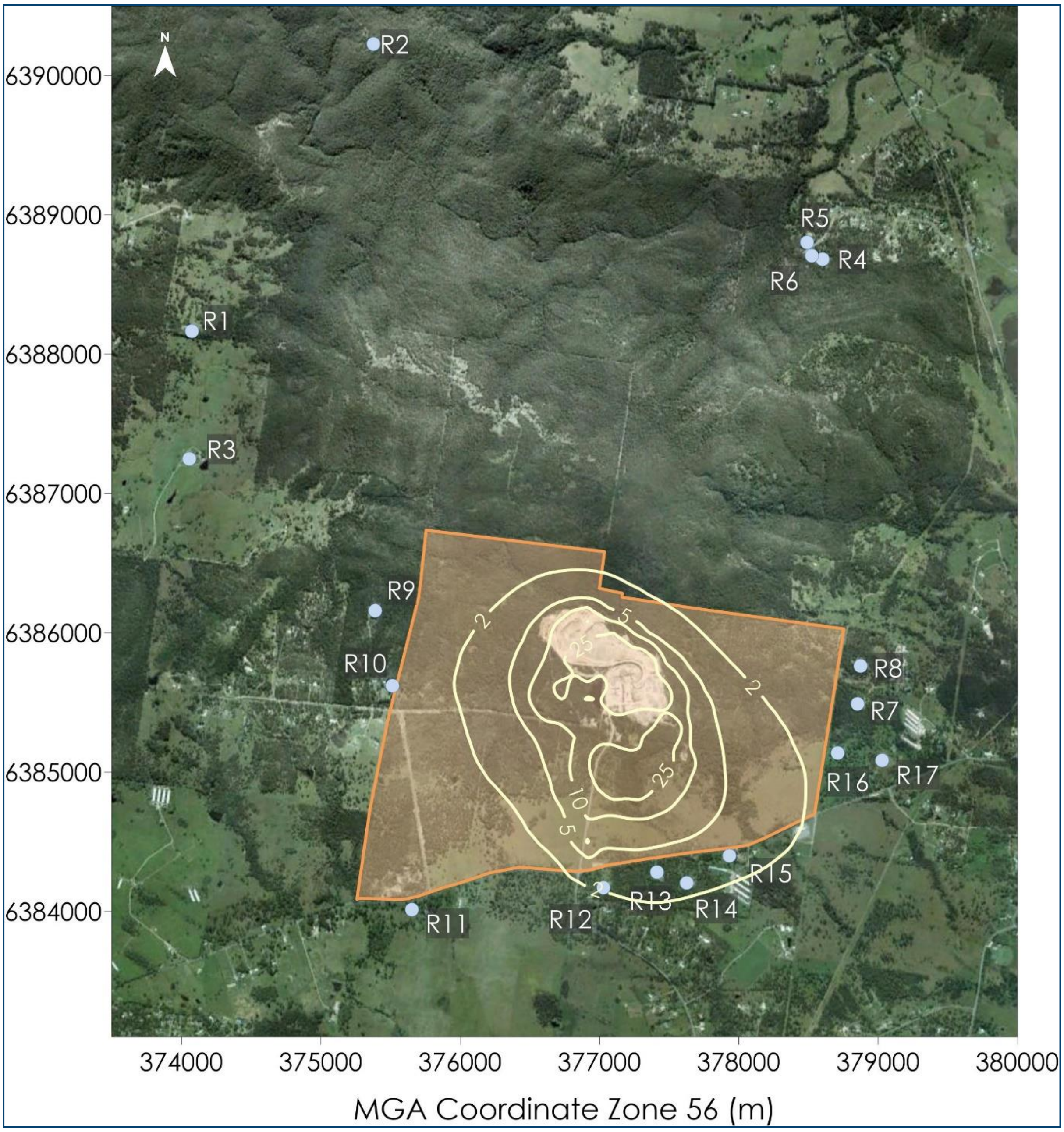

Figure D-34: Predicted incremental annual average PM_{10} concentrations (µg/m³) – Stage 4

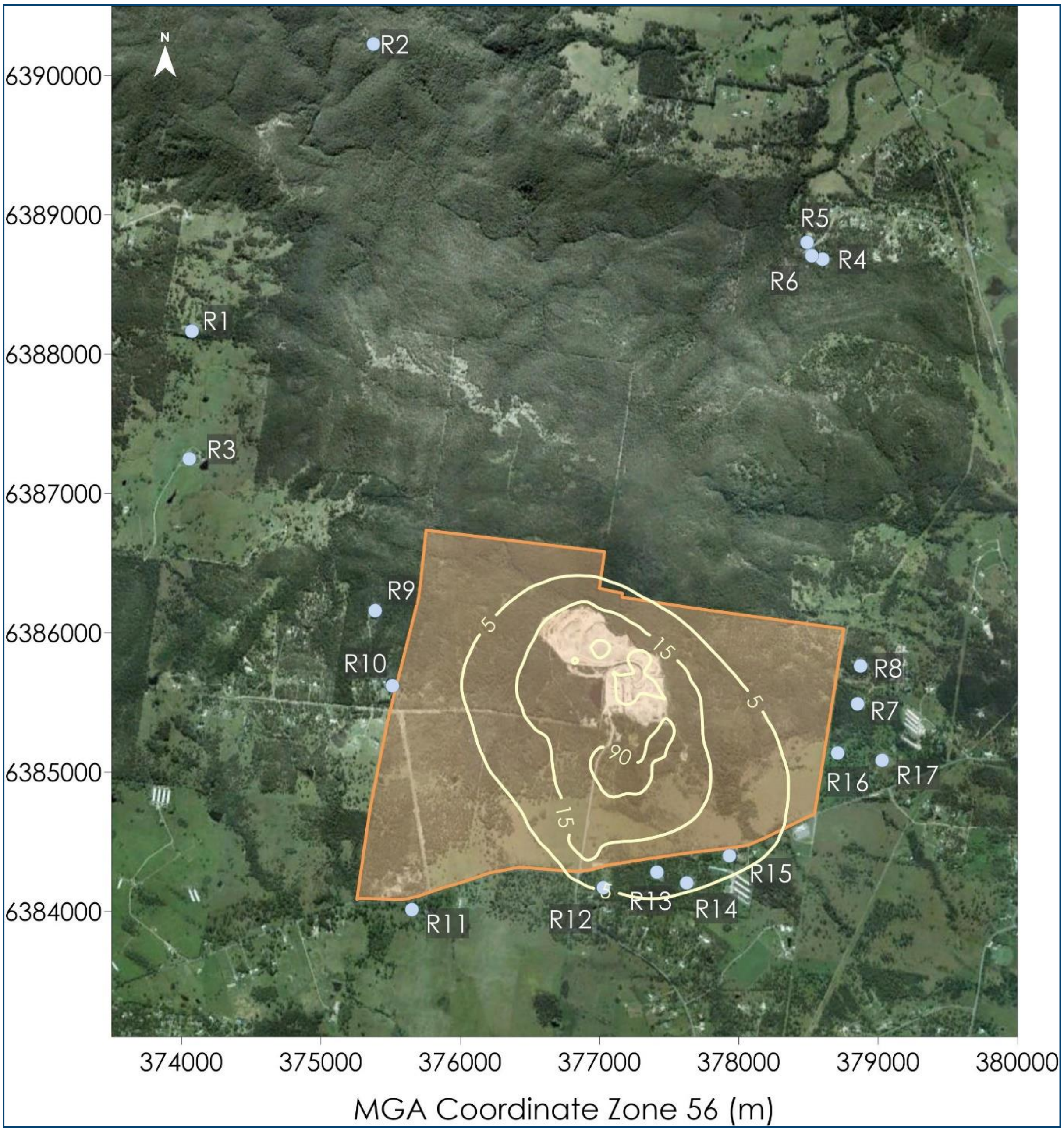

Figure D-35: Predicted incremental annual average TSP concentrations (µg/m³) – Stage 4

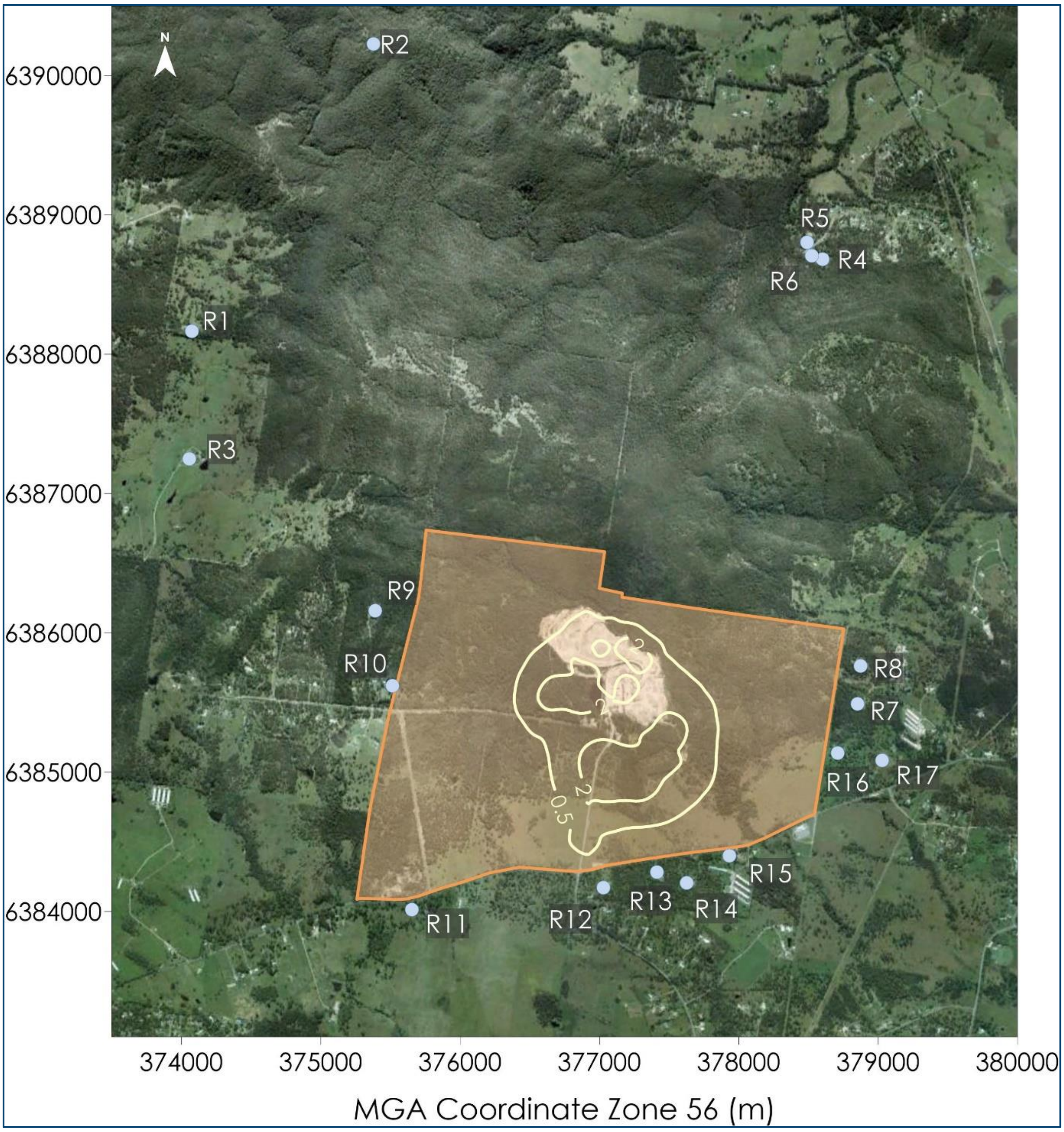

Figure D-36: Predicted incremental annual average dust deposition levels (g/m²/month) – Stage 4

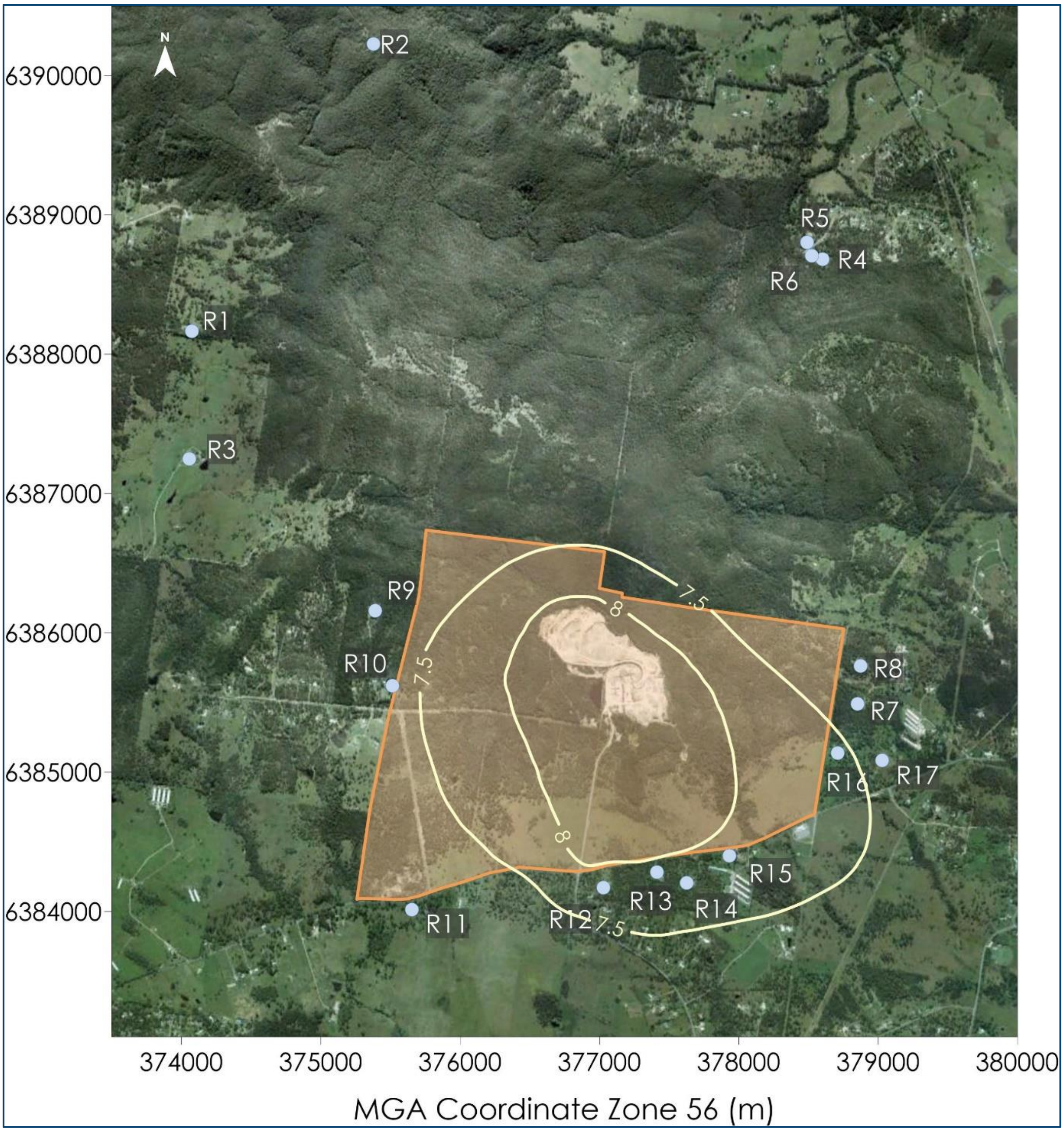

Figure D-37: Predicted cumulative annual average $PM_{2.5}$ concentrations (µg/m³) – Stage 4

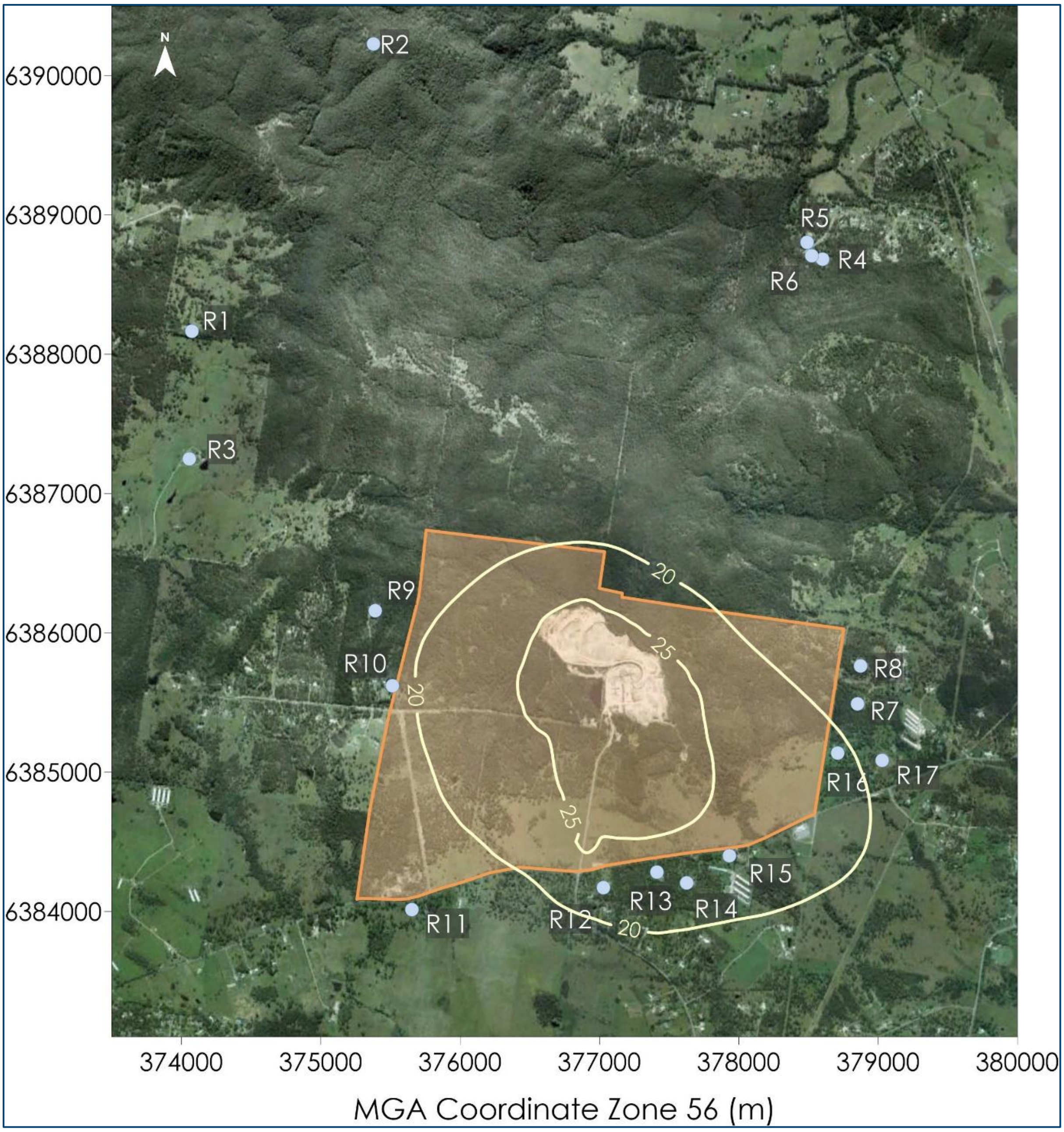

Figure D-38: Predicted cumulative annual average PM_{10} concentrations (µg/m³) – Stage 4

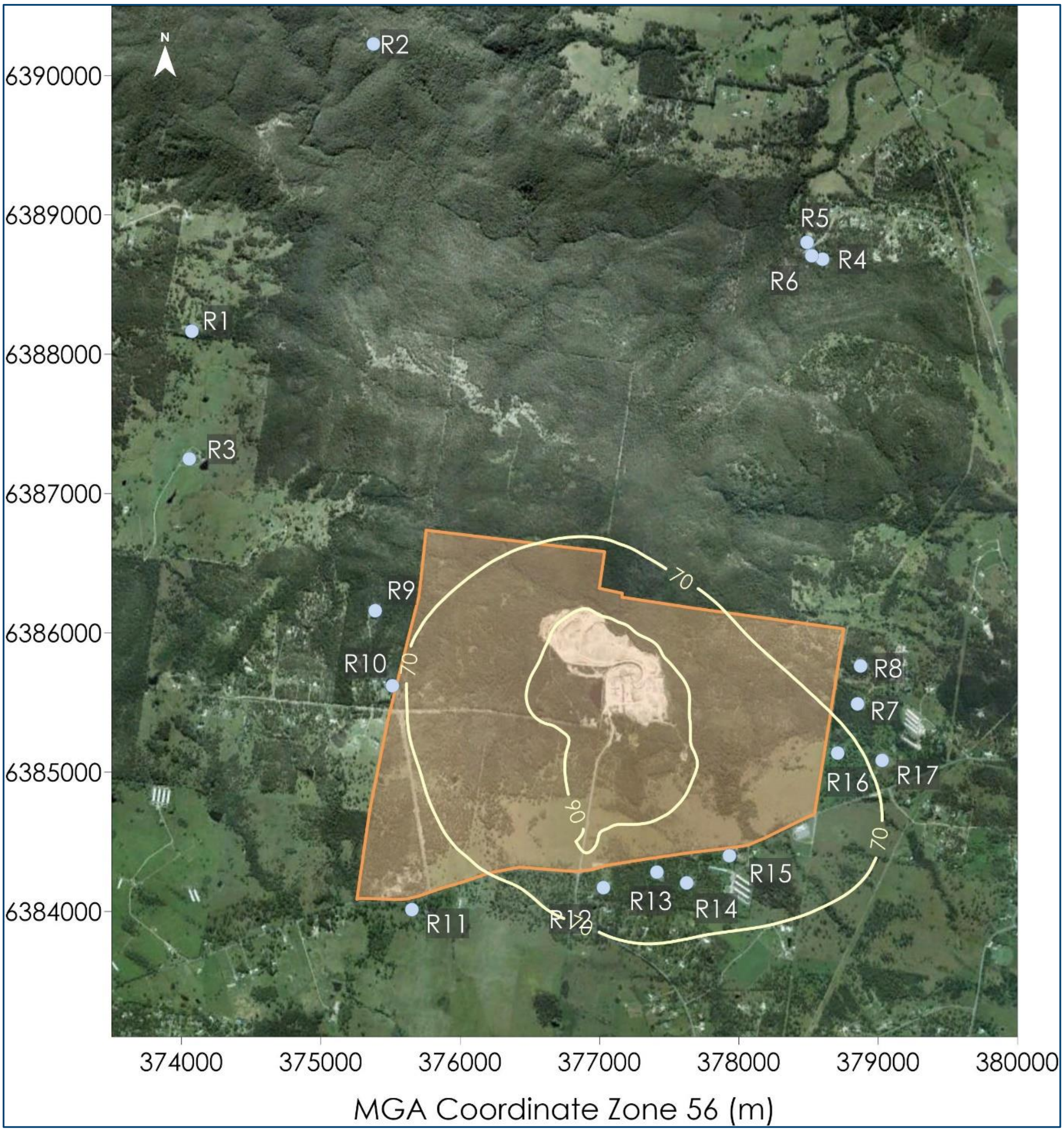

Figure D-39: Predicted cumulative annual average TSP concentrations (µg/m³) – Stage 4

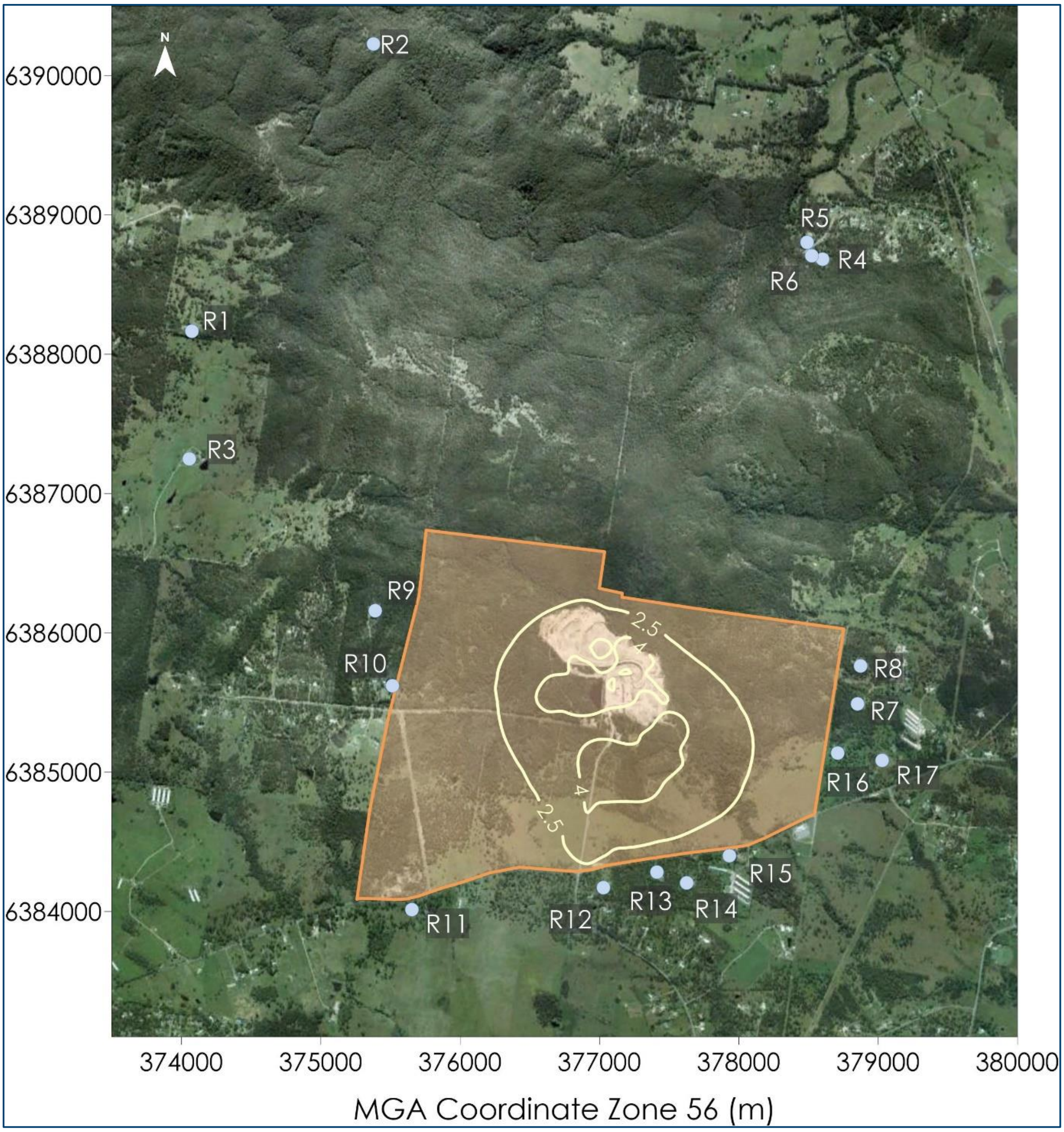

Figure D-40: Predicted cumulative annual average dust deposition levels (g/m²/month) – Stage 4

Appendix E

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

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

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

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

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

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

Tables E-1 to **E-32** assesses one receptor and shows the predicted maximum cumulative levels at selective representative receptors along the boundary of the Quarry for each modelling scenario. The left half of the table examines the cumulative impact during the periods of highest background levels and the right half of the table examines the cumulative impact during the periods of highest contribution from the project.

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

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

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

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

Table E-1: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R10, Current scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
21/08/2015	25.9	0.0	25.9				
20/08/2015	20.2	0.1	20.3	5/02/2015	5.9	0.9	6.8
22/08/2015	19.7	0.0	19.7	15/06/2015	8.6	0.9	9.5
7/06/2015	19.6	0.0	19.6	24/12/2015	4.5	0.9	5.4
5/07/2015	17.8	0.0	17.8	31/03/2015	4.1	0.9	5.0
9/03/2015	16.9	0.3	17.2	10/02/2015	4.3	0.8	5.1
19/11/2015	16.8	0.0	16.8	30/04/2015	2.9	0.8	3.7
19/03/2015	15.5	0.3	15.8	25/12/2015	3.9	0.8	4.7
9/07/2015	15.2	0.3	15.5	19/02/2015	5.5	0.8	6.3
23/06/2015	15.1	0.0	15.1	4/03/2015	9.9	0.7	10.6
12/03/2015	14.2	0.4	14.6	16/12/2015	5.6	0.7	6.3

Table E-2: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R12, Current scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
21/08/2015	25.9	1.5	27.4				
20/08/2015	20.2	2.0	22.2	22/07/2015	10	3.0	13.0
22/08/2015	19.7	1.4	21.1	14/06/2015	12.4	2.2	14.6
7/06/2015	19.6	0.7	20.3	20/08/2015	20.2	2.0	22.2
5/07/2015	17.8	0.2	18.0	2/04/2015	5.5	2.0	7.5
9/03/2015	16.9	0.6	17.5	19/05/2015	8.4	1.9	10.3
19/11/2015	16.8	0.6	17.4	15/04/2015	10.5	1.9	12.4
19/03/2015	15.5	0.8	16.3	16/04/2015	7.9	1.9	9.8
9/07/2015	15.2	1.3	16.5	24/06/2015	11.9	1.9	13.8
23/06/2015	15.1	1.6	16.7	10/07/2015	11.3	1.9	13.2
12/03/2015	14.2	0.9	15.1	23/07/2015	13	1.9	14.9

Table E-3: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R13, Current scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
21/08/2015	25.9	1.0	26.9				
20/08/2015	20.2	1.4	21.6	13/06/2015	12.1	2.4	14.5
22/08/2015	19.7	1.1	20.8	14/06/2015	12.4	2.4	14.8
7/06/2015	19.6	1.5	21.1	24/06/2015	11.9	2.1	14.0
5/07/2015	17.8	0.4	18.2	27/05/2015	10.5	1.9	12.4
9/03/2015	16.9	0.8	17.7	27/06/2015	13.9	1.9	15.8
19/11/2015	16.8	0.8	17.6	19/05/2015	8.4	1.9	10.3
19/03/2015	15.5	0.5	16.0	30/06/2015	11.6	1.9	13.5
9/07/2015	15.2	1.2	16.4	10/07/2015	11.3	1.8	13.1
23/06/2015	15.1	1.3	16.4	28/05/2015	9	1.8	10.8
12/03/2015	14.2	0.9	15.1	20/07/2015	11	1.8	12.8

Table E-4: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R16, Current scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
21/08/2015	**25.9**	0.0	**25.9**				
20/08/2015	20.2	0.3	20.5	21/06/2015	10.6	1.9	12.5
22/08/2015	19.7	0.0	19.7	1/07/2015	12	1.8	13.8
7/06/2015	19.6	0.1	19.7	20/06/2015	6.1	1.7	7.8
5/07/2015	17.8	0.7	18.5	21/05/2015	3.9	1.6	5.5
9/03/2015	16.9	0.2	17.1	28/06/2015	13	1.5	14.5
19/11/2015	16.8	0.2	17.0	24/05/2015	7.8	1.5	9.3
19/03/2015	15.5	0.6	16.1	26/06/2015	7.2	1.5	8.7
9/07/2015	15.2	0.4	15.6	19/07/2015	7.5	1.4	8.9
23/06/2015	15.1	0.0	15.1	6/03/2015	9.2	1.4	10.6
12/03/2015	14.2	0.0	14.2	14/08/2015	6.4	1.4	7.8

Table E-5: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R10, Current scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
6/05/2015	**64.9**	0.0	**64.9**				
26/11/2015	**57.5**	0.0	**57.5**				
19/11/2015	43.3	0.0	43.3	15/06/2015	13.5	4.6	18.1
6/10/2015	42.0	0.3	42.3	5/02/2015	16.3	4.6	20.9
7/10/2015	39.4	0.9	40.3	24/12/2015	17.4	4.4	21.8
20/11/2015	39.4	0.0	39.4	25/12/2015	12.9	4.3	17.2
9/03/2015	36.9	2.1	39.0	31/03/2015	10.6	4.3	14.9
11/08/2015	35.8	0.0	35.8	10/02/2015	13.5	4.1	17.6
21/08/2015	35.8	0.1	35.9	19/02/2015	21.0	4.0	25.0
5/10/2015	35.8	0.0	35.8	30/04/2015	8.6	3.8	12.4
30/09/2015	35.3	1.2	36.5	20/02/2015	16.3	3.6	19.9
27/11/2015	35.2	1.9	37.1	8/10/2015	25.7	3.6	29.3

Table E-6: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R12, Current scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
6/05/2015	**64.9**	0.0	**64.9**				
26/11/2015	**57.5**	0.5	**58.0**				
19/11/2015	43.3	3.3	46.6	22/07/2015	22.4	13.8	36.2
6/10/2015	42.0	3.1	45.1	14/06/2015	21.1	9.1	30.2
7/10/2015	39.4	0.3	39.7	16/04/2015	17.9	8.9	26.8
20/11/2015	39.4	1.4	40.8	20/08/2015	32.0	8.9	40.9
9/03/2015	36.9	1.9	38.8	24/06/2015	25.0	8.8	33.8
11/08/2015	35.8	0.5	36.3	27/06/2015	22.1	8.7	30.8
21/08/2015	35.8	5.8	41.6	15/04/2015	19.4	8.7	28.1
5/10/2015	35.8	4.7	40.5	19/05/2015	10.9	8.5	19.4
30/09/2015	35.3	0.7	36.0	20/07/2015	15.9	8.4	24.3
27/11/2015	35.2	0.0	35.2	10/07/2015	18.4	8.3	26.7

Table E-7: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R13, Current scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
6/05/2015	**64.9**	0.2	**65.1**				
26/11/2015	**57.5**	0.8	**58.3**				
19/11/2015	43.3	4.2	47.5	13/06/2015	16.9	11.6	28.5
6/10/2015	42.0	1.7	43.7	24/06/2015	25.0	11.4	36.4
7/10/2015	39.4	0.4	39.8	14/06/2015	21.1	10.9	32.0
20/11/2015	39.4	3.1	42.5	27/06/2015	22.1	10.0	32.1
9/03/2015	36.9	2.7	39.6	10/07/2015	18.4	9.8	28.2
11/08/2015	35.8	1.0	36.8	1/10/2015	26.1	9.2	35.3
21/08/2015	35.8	4.2	40.0	27/05/2015	-	9.1	9.1
5/10/2015	35.8	5.4	41.2	30/06/2015	20.5	9.0	29.5
30/09/2015	35.3	0.7	36.0	30/05/2015	17.6	9.0	26.6
27/11/2015	35.2	0.0	35.2	19/05/2015	10.9	8.8	19.7

Table E-8: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R16, Current scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
6/05/2015	64.9	3.7	68.6				
26/11/2015	57.5	0.4	57.9				
19/11/2015	43.3	0.8	44.1	21/06/2015	18.1	10.3	28.4
6/10/2015	42.0	1.1	43.1	1/07/2015	21.5	9.8	31.3
7/10/2015	39.4	1.6	41.0	20/06/2015	12.6	9.5	22.1
20/11/2015	39.4	1.0	40.4	21/05/2015	11.8	9.3	21.1
9/03/2015	36.9	0.8	37.7	28/06/2015	20.3	8.9	29.2
11/08/2015	35.8	1.9	37.7	24/05/2015	19.8	8.2	28.0
21/08/2015	35.8	0.1	35.9	14/08/2015	32.2	8.2	40.4
5/10/2015	35.8	1.1	36.9	26/06/2015	17.1	8.2	25.3
30/09/2015	35.3	1.2	36.5	6/03/2015	31.1	7.7	38.8
27/11/2015	35.2	0.0	35.2	26/08/2015	12.7	7.5	20.2

Table E-9: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R10, Stage 1 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
21/08/2015	25.9	0.0	25.9				
20/08/2015	20.2	0.1	20.3	15/06/2015	8.6	0.9	9.5
22/08/2015	19.7	0.0	19.7	31/03/2015	4.1	0.8	4.9
7/06/2015	19.6	0.0	19.6	30/04/2015	2.9	0.8	3.7
5/07/2015	17.8	0.0	17.8	5/02/2015	5.9	0.8	6.7
9/03/2015	16.9	0.2	17.1	11/06/2015	6.4	0.6	7.0
19/11/2015	16.8	0.0	16.8	17/05/2015	8.1	0.6	8.7
19/03/2015	15.5	0.2	15.7	19/02/2015	5.5	0.6	6.1
9/07/2015	15.2	0.3	15.5	8/10/2015	6.6	0.6	7.2
23/06/2015	15.1	0.0	15.1	29/04/2015	3.1	0.6	3.7
12/03/2015	14.2	0.3	14.5	14/10/2015	7.8	0.6	8.4

Table E-10: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R12, Stage 1 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
21/08/2015	25.9	1.4	27.3				
20/08/2015	20.2	1.7	21.9	22/07/2015	10.0	2.7	12.7
22/08/2015	19.7	1.5	21.2	14/06/2015	12.4	2.2	14.6
7/06/2015	19.6	0.8	20.4	20/07/2015	11.0	2.0	13.0
5/07/2015	17.8	0.5	18.3	13/06/2015	12.1	1.9	14.0
9/03/2015	16.9	0.6	17.5	15/04/2015	10.5	1.8	12.3
19/11/2015	16.8	0.7	17.5	16/04/2015	7.9	1.8	9.7
19/03/2015	15.5	0.8	16.3	27/06/2015	13.9	1.7	15.6
9/07/2015	15.2	1.0	16.2	23/07/2015	13.0	1.7	14.7
23/06/2015	15.1	1.6	16.7	30/06/2015	11.6	1.7	13.3
12/03/2015	14.2	0.9	15.1	2/04/2015	5.5	1.7	7.2

Table E-11: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R13, Stage 1 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
21/08/2015	**25.9**	1.2	**27.1**				
20/08/2015	20.2	1.5	21.7	13/06/2015	12.1	2.6	14.7
22/08/2015	19.7	1.4	21.1	14/06/2015	12.4	2.6	15.0
7/06/2015	19.6	1.9	21.5	24/06/2015	11.9	2.2	14.1
5/07/2015	17.8	0.6	18.4	23/04/2015	-	2.2	2.2
9/03/2015	16.9	0.7	17.6	27/05/2015	10.5	2.1	12.6
19/11/2015	16.8	0.8	17.6	28/05/2015	9.0	2.1	11.1
19/03/2015	15.5	0.7	16.2	20/07/2015	11.0	2.0	13.0
9/07/2015	15.2	1.3	16.5	10/07/2015	11.3	1.9	13.2
23/06/2015	15.1	1.6	16.7	30/06/2015	11.6	1.9	13.5
12/03/2015	14.2	0.9	15.1	7/06/2015	19.6	1.9	21.5

Table E-12: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R16, Stage 1 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
21/08/2015	**25.9**	0.0	**25.9**				
20/08/2015	20.2	0.2	20.4	21/06/2015	10.6	1.6	12.2
22/08/2015	19.7	0.0	19.7	1/07/2015	12.0	1.5	13.5
7/06/2015	19.6	0.1	19.7	20/06/2015	6.1	1.4	7.5
5/07/2015	17.8	0.6	18.4	21/05/2015	3.9	1.4	5.3
9/03/2015	16.9	0.1	17.0	26/06/2015	7.2	1.4	8.6
19/11/2015	16.8	0.1	16.9	28/06/2015	13	1.3	14.3
19/03/2015	15.5	0.5	16.0	24/05/2015	7.8	1.2	9.0
9/07/2015	15.2	0.3	15.5	14/08/2015	6.4	1.2	7.6
23/06/2015	15.1	0.0	15.1	19/07/2015	7.5	1.2	8.7
12/03/2015	14.2	0.0	14.2	6/03/2015	9.2	1.1	10.3

Table E-13: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R10, Stage 1 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
6/05/2015	**64.9**	0.0	**64.9**				
26/11/2015	**57.5**	0.0	**57.5**				
19/11/2015	43.3	0.0	43.3	15/06/2015	13.5	5.1	18.6
6/10/2015	42.0	0.5	42.5	31/03/2015	10.6	4.8	15.4
7/10/2015	39.4	0.4	39.8	30/04/2015	8.6	4.7	13.3
20/11/2015	39.4	0.0	39.4	5/02/2015	16.3	4.5	20.8
9/03/2015	36.9	1.5	38.4	8/10/2015	25.7	4.2	29.9
11/08/2015	35.8	0.0	35.8	19/02/2015	21.0	4.1	25.1
21/08/2015	35.8	0.1	35.9	22/11/2015	22.8	3.9	26.7
5/10/2015	35.8	0.0	35.8	11/06/2015	12.6	3.8	16.4
30/09/2015	35.3	1.6	36.9	14/10/2015	20.7	3.7	24.4
27/11/2015	35.2	2.4	37.6	29/04/2015	10.0	3.6	13.6

Table E-14: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R12, Stage 1 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
6/05/2015	**64.9**	0.0	**64.9**				
26/11/2015	**57.5**	0.4	**57.9**				
19/11/2015	43.3	3.9	47.2	22/07/2015	22.4	14.0	36.4
6/10/2015	42.0	4.0	46.0	20/07/2015	15.9	9.9	25.8
7/10/2015	39.4	0.3	39.7	14/06/2015	21.1	9.5	30.6
20/11/2015	39.4	1.8	41.2	16/04/2015	17.9	8.9	26.8
9/03/2015	36.9	1.7	38.6	27/06/2015	22.1	8.9	31.0
11/08/2015	35.8	1.0	36.8	15/04/2015	19.4	8.8	28.2
21/08/2015	35.8	5.9	41.7	23/07/2015	19.6	8.3	27.9
5/10/2015	35.8	4.6	40.4	24/06/2015	25.0	8.2	33.2
30/09/2015	35.3	0.6	35.9	13/06/2015	16.9	8.2	25.1
27/11/2015	35.2	0.0	35.2	30/05/2015	17.6	8.2	25.8

Table E-15: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R13, Stage 1 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
6/05/2015	**64.9**	0.3	**65.2**				
26/11/2015	**57.5**	1.0	**58.5**				
19/11/2015	43.3	4.5	47.8	13/06/2015	16.9	13.4	30.3
6/10/2015	42.0	2.4	44.4	24/06/2015	25.0	13.0	38.0
7/10/2015	39.4	0.4	39.8	14/06/2015	21.1	12.5	33.6
20/11/2015	39.4	3.4	42.8	30/05/2015	17.6	11.5	29.1
9/03/2015	36.9	2.6	39.5	23/04/2015	-	11.1	11.1
11/08/2015	35.8	1.8	37.6	10/07/2015	18.4	10.7	29.1
21/08/2015	35.8	5.7	41.5	27/05/2015	-	10.5	10.5
5/10/2015	35.8	6.2	42.0	27/06/2015	22.1	10.4	32.5
30/09/2015	35.3	0.7	36.0	28/05/2015	19.2	10.3	29.5
27/11/2015	35.2	0.0	35.2	20/07/2015	15.9	9.9	25.8

Table E-16: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R16, Stage 1 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
6/05/2015	64.9	3.8	68.7				
26/11/2015	57.5	0.4	57.9				
19/11/2015	43.3	0.7	44.0	21/06/2015	18.1	10.1	28.2
6/10/2015	42.0	0.9	42.9	20/06/2015	12.6	9.8	22.4
7/10/2015	39.4	1.4	40.8	1/07/2015	21.5	9.8	31.3
20/11/2015	39.4	0.9	40.3	21/05/2015	11.8	9.5	21.3
9/03/2015	36.9	0.7	37.6	28/06/2015	20.3	8.9	29.2
11/08/2015	35.8	2.1	37.9	26/06/2015	17.1	8.6	25.7
21/08/2015	35.8	0.1	35.9	14/08/2015	32.2	8.4	40.6
5/10/2015	35.8	1.1	36.9	24/05/2015	19.8	8.2	28.0
30/09/2015	35.3	1.1	36.4	26/08/2015	12.7	8.1	20.8
27/11/2015	35.2	0.0	35.2	6/03/2015	31.1	7.8	38.9

Table E-17: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R10, Stage 2 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
21/08/2015	25.9	0.0	25.9				
20/08/2015	20.2	0.1	20.3	31/03/2015	4.1	0.9	5.0
22/08/2015	19.7	0.0	19.7	30/04/2015	2.9	0.9	3.8
7/06/2015	19.6	0.0	19.6	15/06/2015	8.6	0.8	9.4
5/07/2015	17.8	0.0	17.8	5/02/2015	5.9	0.8	6.7
9/03/2015	16.9	0.3	17.2	19/02/2015	5.5	0.7	6.2
19/11/2015	16.8	0.0	16.8	10/02/2015	4.3	0.7	5.0
19/03/2015	15.5	0.2	15.7	11/06/2015	6.4	0.7	7.1
9/07/2015	15.2	0.3	15.5	24/12/2015	4.5	0.7	5.2
23/06/2015	15.1	0.0	15.1	14/10/2015	7.8	0.7	8.5
12/03/2015	14.2	0.3	14.5	22/11/2015	6.3	0.7	7.0

Table E-18: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R12, Stage 2 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
21/08/2015	25.9	1.5	27.4				
20/08/2015	20.2	1.7	21.9	22/07/2015	10.0	2.7	12.7
22/08/2015	19.7	1.5	21.2	14/06/2015	12.4	2.2	14.6
7/06/2015	19.6	1.0	20.6	13/06/2015	12.1	2.0	14.1
5/07/2015	17.8	0.5	18.3	20/07/2015	11.0	1.9	12.9
9/03/2015	16.9	0.6	17.5	16/04/2015	7.9	1.8	9.7
19/11/2015	16.8	0.7	17.5	30/06/2015	11.6	1.8	13.4
19/03/2015	15.5	0.8	16.3	15/04/2015	10.5	1.8	12.3
9/07/2015	15.2	1.1	16.3	27/06/2015	13.9	1.8	15.7
23/06/2015	15.1	1.6	16.7	30/05/2015	8.4	1.7	10.1
12/03/2015	14.2	0.9	15.1	24/06/2015	11.9	1.7	13.6

Table E-19: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R13, Stage 2 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
21/08/2015	25.9	1.0	26.9				
20/08/2015	20.2	1.3	21.5	13/06/2015	12.1	2.3	14.4
22/08/2015	19.7	1.1	20.8	14/06/2015	12.4	2.2	14.6
7/06/2015	19.6	1.8	21.4	23/04/2015	-	2.0	2.0
5/07/2015	17.8	0.6	18.4	27/05/2015	10.5	1.9	12.4
9/03/2015	16.9	0.6	17.5	24/06/2015	11.9	1.8	13.7
19/11/2015	16.8	0.7	17.5	7/06/2015	19.6	1.8	21.4
19/03/2015	15.5	0.6	16.1	28/05/2015	9.0	1.8	10.8
9/07/2015	15.2	1.2	16.4	27/06/2015	13.9	1.7	15.6
23/06/2015	15.1	1.3	16.4	30/06/2015	11.6	1.7	13.3
12/03/2015	14.2	0.8	15.0	30/05/2015	8.4	1.7	10.1

Table E-20: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R16, Stage 2 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
21/08/2015	25.9	0.0	25.9				
20/08/2015	20.2	0.2	20.4	21/06/2015	10.6	1.6	12.2
22/08/2015	19.7	0.0	19.7	1/07/2015	12.0	1.6	13.6
7/06/2015	19.6	0.1	19.7	20/06/2015	6.1	1.5	7.6
5/07/2015	17.8	0.7	18.5	21/05/2015	3.9	1.5	5.4
9/03/2015	16.9	0.2	17.1	26/06/2015	7.2	1.3	8.5
19/11/2015	16.8	0.1	16.9	28/06/2015	13	1.3	14.3
19/03/2015	15.5	0.5	16.0	24/05/2015	7.8	1.3	9.1
9/07/2015	15.2	0.4	15.6	6/03/2015	9.2	1.3	10.5
23/06/2015	15.1	0.1	15.2	14/08/2015	6.4	1.2	7.6
12/03/2015	14.2	0.0	14.2	26/08/2015	2.0	1.2	3.2

Table E-21: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R10, Stage 2 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
6/05/2015	64.9	0.0	64.9				
26/11/2015	57.5	0.0	57.5				
19/11/2015	43.3	0.0	43.3	31/03/2015	10.6	5.1	15.7
6/10/2015	42.0	0.4	42.4	30/04/2015	8.6	4.9	13.5
7/10/2015	39.4	0.4	39.8	15/06/2015	13.5	4.9	18.4
20/11/2015	39.4	0.0	39.4	19/02/2015	21.0	4.8	25.8
9/03/2015	36.9	2.2	39.1	5/02/2015	16.3	4.5	20.8
11/08/2015	35.8	0.0	35.8	8/10/2015	25.7	4.3	30.0
21/08/2015	35.8	0.1	35.9	22/11/2015	22.8	4.3	27.1
5/10/2015	35.8	0.0	35.8	11/06/2015	12.6	4.3	16.9
30/09/2015	35.3	1.6	36.9	23/02/2015	9.7	4.2	13.9
27/11/2015	35.2	2.7	37.9	14/10/2015	20.7	4.2	24.9

Table E-22: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R12, Stage 2 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
6/05/2015	**64.9**	0.0	**64.9**				
26/11/2015	**57.5**	0.4	**57.9**				
19/11/2015	43.3	3.7	47.0	22/07/2015	22.4	13.8	36.2
6/10/2015	42.0	4.1	46.1	14/06/2015	21.1	9.4	30.5
7/10/2015	39.4	0.3	39.7	16/04/2015	17.9	8.8	26.7
20/11/2015	39.4	1.9	41.3	27/06/2015	22.1	8.8	30.9
9/03/2015	36.9	1.7	38.6	20/07/2015	15.9	8.7	24.6
11/08/2015	35.8	1.1	36.9	15/04/2015	19.4	8.7	28.1
21/08/2015	35.8	6.1	41.9	24/06/2015	25.0	8.3	33.3
5/10/2015	35.8	4.5	40.3	13/06/2015	16.9	8.2	25.1
30/09/2015	35.3	0.6	35.9	30/05/2015	17.6	8.2	25.8
27/11/2015	35.2	0.0	35.2	30/06/2015	20.5	8.0	28.5

Table E-23: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R13, Stage 2 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
6/05/2015	**64.9**	0.3	**65.2**				
26/11/2015	**57.5**	0.8	**58.3**				
19/11/2015	43.3	3.5	46.8	13/06/2015	16.9	11.5	28.4
6/10/2015	42.0	1.5	43.5	14/06/2015	21.1	10.6	31.7
7/10/2015	39.4	0.3	39.7	24/06/2015	25.0	10.6	35.6
20/11/2015	39.4	3.0	42.4	30/05/2015	17.6	10.0	27.6
9/03/2015	36.9	2.2	39.1	23/04/2015	-	9.7	9.7
11/08/2015	35.8	1.7	37.5	27/06/2015	22.1	9.3	31.4
21/08/2015	35.8	4.5	40.3	27/05/2015	-	9.2	9.2
5/10/2015	35.8	5.1	40.9	10/07/2015	18.4	8.9	27.3
30/09/2015	35.3	0.6	35.9	28/05/2015	19.2	8.9	28.1
27/11/2015	35.2	0.0	35.2	7/06/2015	22.9	8.6	31.5

Table E-24: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R16, Stage 2 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
6/05/2015	64.9	4.1	69.0				
26/11/2015	57.5	0.4	57.9				
19/11/2015	43.3	0.8	44.1	20/06/2015	12.6	10.4	23.0
6/10/2015	42.0	1.0	43.0	1/07/2015	21.5	10.0	31.5
7/10/2015	39.4	1.4	40.8	21/06/2015	18.1	9.8	27.9
20/11/2015	39.4	1.0	40.4	21/05/2015	11.8	9.8	21.6
9/03/2015	36.9	0.7	37.6	28/06/2015	20.3	9.2	29.5
11/08/2015	35.8	2.3	38.1	26/08/2015	12.7	8.9	21.6
21/08/2015	35.8	0.1	35.9	14/08/2015	32.2	8.9	41.1
5/10/2015	35.8	1.2	37.0	26/06/2015	17.1	8.6	25.7
30/09/2015	35.3	1.2	36.5	6/03/2015	31.1	8.5	39.6
27/11/2015	35.2	0.0	35.2	24/05/2015	19.8	8.4	28.2

Table E-25: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R10, Stage 4 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
21/08/2015	25.9	0.0	25.9				
20/08/2015	20.2	0.1	20.3	24/12/2015	4.5	0.9	5.4
22/08/2015	19.7	0.0	19.7	30/04/2015	2.9	0.9	3.8
7/06/2015	19.6	0.0	19.6	31/03/2015	4.1	0.8	4.9
5/07/2015	17.8	0.0	17.8	17/05/2015	8.1	0.8	8.9
9/03/2015	16.9	0.3	17.2	15/06/2015	8.6	0.8	9.4
19/11/2015	16.8	0.0	16.8	11/06/2015	6.4	0.8	7.2
19/03/2015	15.5	0.2	15.7	5/02/2015	5.9	0.7	6.6
9/07/2015	15.2	0.3	15.5	20/02/2015	3.8	0.7	4.5
23/06/2015	15.1	0.0	15.1	10/02/2015	4.3	0.7	5.0
12/03/2015	14.2	0.4	14.6	18/10/2015	8.0	0.7	8.7

Table E-26: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R12, Stage 4 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
21/08/2015	25.9	0.9	26.8				
20/08/2015	20.2	1.3	21.5	22/07/2015	10.0	2.2	12.2
22/08/2015	19.7	1.2	20.9	20/07/2015	11.0	2.0	13.0
7/06/2015	19.6	0.6	20.2	14/06/2015	12.4	2.0	14.4
5/07/2015	17.8	0.2	18.0	27/06/2015	13.9	1.8	15.7
9/03/2015	16.9	0.3	17.2	13/06/2015	12.1	1.7	13.8
19/11/2015	16.8	0.7	17.5	16/04/2015	7.9	1.7	9.6
19/03/2015	15.5	0.5	16.0	30/06/2015	11.6	1.6	13.2
9/07/2015	15.2	0.7	15.9	15/04/2015	10.5	1.6	12.1
23/06/2015	15.1	1.4	16.5	19/05/2015	8.4	1.6	10.0
12/03/2015	14.2	0.8	15.0	4/09/2015	6.8	1.5	8.3

Table E-27: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R13, Stage 4 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
21/08/2015	**25.9**	1.5	**27.4**				
20/08/2015	20.2	1.8	22.0	14/06/2015	12.4	3.0	15.4
22/08/2015	19.7	1.8	21.5	13/06/2015	12.1	2.9	15.0
7/06/2015	19.6	2.2	21.8	24/06/2015	11.9	2.6	14.5
5/07/2015	17.8	0.6	18.4	23/04/2015	-	2.6	2.6
9/03/2015	16.9	0.7	17.6	28/05/2015	9.0	2.3	11.3
19/11/2015	16.8	0.9	17.7	16/04/2015	7.9	2.3	10.2
19/03/2015	15.5	0.7	16.2	10/07/2015	11.3	2.3	13.6
9/07/2015	15.2	1.4	16.6	27/05/2015	10.5	2.2	12.7
23/06/2015	15.1	1.9	17.0	20/07/2015	11.0	2.2	13.2
12/03/2015	14.2	1.1	15.3	30/06/2015	11.6	2.2	13.8

Table E-28: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – Receptor R16, Stage 4 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
21/08/2015	**25.9**	0.0	**25.9**				
20/08/2015	20.2	0.2	20.4	21/06/2015	10.6	1.6	12.2
22/08/2015	19.7	0.0	19.7	21/05/2015	3.9	1.3	5.2
7/06/2015	19.6	0.1	19.7	26/06/2015	7.2	1.3	8.5
5/07/2015	17.8	0.5	18.3	20/06/2015	6.1	1.2	7.3
9/03/2015	16.9	0.1	17.0	19/07/2015	7.5	1.2	8.7
19/11/2015	16.8	0.1	16.9	1/07/2015	12	1.1	13.1
19/03/2015	15.5	0.3	15.8	5/04/2015	3.7	1.0	4.7
9/07/2015	15.2	0.2	15.4	28/06/2015	13	1.0	14.0
23/06/2015	15.1	0.0	15.1	14/08/2015	6.4	1.0	7.4
12/03/2015	14.2	0.0	14.2	26/08/2015	2.0	1.0	3.0

Table E-29: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R10, Stage 4 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
6/05/2015	**64.9**	0.0	**64.9**				
26/11/2015	**57.5**	0.0	**57.5**				
19/11/2015	43.3	0.0	43.3	24/12/2015	17.4	5.6	23.0
6/10/2015	42.0	0.3	42.3	31/03/2015	10.6	5.2	15.8
7/10/2015	39.4	0.8	40.2	30/04/2015	8.6	5.0	13.6
20/11/2015	39.4	0.0	39.4	17/05/2015	10.4	4.9	15.3
9/03/2015	36.9	2.6	39.5	20/02/2015	16.3	4.8	21.1
11/08/2015	35.8	0.0	35.8	15/06/2015	13.5	4.8	18.3
21/08/2015	35.8	0.0	35.8	11/06/2015	12.6	4.7	17.3
5/10/2015	35.8	0.0	35.8	5/02/2015	16.3	4.5	20.8
30/09/2015	35.3	1.5	36.8	18/10/2015	23.8	4.5	28.3
27/11/2015	35.2	2.5	37.7	25/12/2015	12.9	4.3	17.2

Table E-30: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R12, Stage 4 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
6/05/2015	**64.9**	0.0	**64.9**				
26/11/2015	**57.5**	0.5	**58.0**				
19/11/2015	43.3	5.1	48.4	22/07/2015	22.4	13.5	35.9
6/10/2015	42.0	4.5	46.5	20/07/2015	15.9	12.3	28.2
7/10/2015	39.4	0.3	39.7	27/06/2015	22.1	12.0	34.1
20/11/2015	39.4	1.9	41.3	14/06/2015	21.1	11.6	32.7
9/03/2015	36.9	1.5	38.4	30/06/2015	20.5	10.4	30.9
11/08/2015	35.8	0.8	36.6	16/04/2015	17.9	10.3	28.2
21/08/2015	35.8	5.2	41.0	4/09/2015	17.0	10.2	27.2
5/10/2015	35.8	5.5	41.3	13/06/2015	16.9	9.7	26.6
30/09/2015	35.3	0.8	36.1	19/05/2015	10.9	9.5	20.4
27/11/2015	35.2	0.0	35.2	15/04/2015	19.4	9.5	28.9

Table E-31: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R13, Stage 4 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
6/05/2015	**64.9**	0.3	**65.2**				
26/11/2015	**57.5**	1.8	**59.3**				
19/11/2015	43.3	6.3	49.6	14/06/2015	21.1	18.2	39.3
6/10/2015	42.0	3.7	45.7	13/06/2015	16.9	18.1	35.0
7/10/2015	39.4	0.6	40.0	24/06/2015	25.0	17.0	42.0
20/11/2015	39.4	5.3	44.7	23/04/2015	-	16.4	16.4
9/03/2015	36.9	3.6	40.5	30/05/2015	17.6	15.4	33.0
11/08/2015	35.8	2.5	38.3	27/06/2015	22.1	14.8	36.9
21/08/2015	35.8	8.9	44.7	10/07/2015	18.4	14.7	33.1
5/10/2015	35.8	8.3	44.1	16/04/2015	17.9	14.5	32.4
30/09/2015	35.3	1.2	36.5	28/05/2015	19.2	14.2	33.4
27/11/2015	35.2	0.0	35.2	7/06/2015	22.9	14.0	36.9

Table E-32: Cumulative 24-hour average PM_{10} concentration (µg/m³) – Receptor R16, Stage 4 scenario

Ranked by Highest to Lowest Background Concentrations				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
6/05/2015	**64.9**	3.4	**68.3**				
26/11/2015	**57.5**	0.5	**58.0**				
19/11/2015	43.3	0.5	43.8	21/06/2015	18.1	10.4	28.5
6/10/2015	42.0	0.6	42.6	21/05/2015	11.8	9.0	20.8
7/10/2015	39.4	0.8	40.2	26/06/2015	17.1	8.5	25.6
20/11/2015	39.4	0.6	40.0	20/06/2015	12.6	8.5	21.1
9/03/2015	36.9	0.4	37.3	26/08/2015	12.7	7.4	20.1
11/08/2015	35.8	1.7	37.5	28/06/2015	20.3	7.3	27.6
21/08/2015	35.8	0.0	35.8	14/08/2015	32.2	7.3	39.5
5/10/2015	35.8	0.7	36.5	19/07/2015	12.8	7.3	20.1
30/09/2015	35.3	0.7	36.0	1/07/2015	21.5	7.2	28.7
27/11/2015	35.2	0.0	35.2	24/05/2015	19.8	6.3	26.1

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