Mount Thorley Operations 2014

3

Environmental Impact Statement

Prepared for Mt Thorley Operations Pty Limited | June 2014

VOLUME 3 — Appendices G to J

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Appendix G — Air quality and greenhouse gas study

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AIR QUALITY AND GREENHOUSE GAS ASSESSMENT
MOUNT THORLEY OPERATIONS 2014

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12 June 2014

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Air Quality and Greenhouse Gas Assessment Mount Thorley Operations 2014

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EXECUTIVE SUMMARY

This assessment investigates the potential air quality effects and calculates the greenhouse gas emissions that may arise as a result of the proposed modifications to the Mount Thorley Operations. The Mount Thorley Operations is located in the Hunter Valley, NSW and is operated by Coal & Allied on behalf of Mount Thorley Joint Venture. The mine currently operates under Development Consent No. DA 34/95.

The assessment is prepared in general accordance with the applicable regulatory requirements and guidelines and forms part of the environmental impact statement prepared for the development application. Environmental impacts are assessed against relevant criteria developed as benchmarks set to protect the overall health and amenity of the general community.

The existing environmental condition of the area is typical of the Hunter Valley region with common wind flows aligned along a northwest to southeast flow. The ambient air quality in the area is generally fair considering the various industrial and commercial activities of the region.

The assessment has focused on three indicative mine plan years chosen to represent a range of potential impacts over the life of the mining operation with reference to surrounding operations in the area which would also contribute to dust emissions in each year. Air dispersion modelling with the CALPUFF modelling suite is utilised in conjunction with estimated emission rates for air pollutants generated by the various activities. Best practice mitigation and management measures are considered to ameliorate any potential adverse air quality impacts and respond to government and community concerns regarding the regional air quality in the Hunter Valley.

The assessment predicts potential dust impacts at mine-owned assessment locations, two privately owned assessment locations in Warkworth, and the Warkworth community hall. These three non-mine owned properties are within the area encompassed by the acquisition zone of neighbouring mines (although not all properties are explicitly identified). All of the affected properties would also be afforded acquisition rights should the proposal proceed.

The assessment indicates that adverse air quality impacts are unlikely from diesel combustion and whilst blasting has potential to lead to impacts in the late afternoon periods, this would be averted with appropriate management measures that prevent blasting under impacting conditions.

The calculated annual greenhouse gas emissions for the MTO is 0.472Mt CO_2-e and is equivalent to approximately 0.1 per cent and 0.3 per cent of the total Australian and NSW greenhouse gas emissions respectively.

Overall the assessment indicates that whilst adverse air quality impacts may arise at a small number of assessment locations due to the proposal, these can be managed and mitigated effectively.

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1 INTRODUCTION

Mount Thorley Operations (MTO) is an open cut coal mine approximately 10.5 kilometres (km) south-west of Singleton in the Hunter Valley, NSW. The mine is operated by Coal & Allied on behalf of Mount Thorley Joint Venture (MTJV). The site currently operates under Development Consent No. DA 34/95 (the development consent) issued by the then Minister for Planning on 22 June 1996 under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

Immediately to the north is Warkworth Mine. Since 2004, the two mines have integrated at an operational level and are known as Mount Thorley Warkworth (MTW), with a single management team responsible for all the operations. Equipment, personnel, water, rejects and coal preparation are all shared between the mines. The MTW operations involve an existing operation of approximately 1,300 persons, which includes full-time personnel and a small number of short-term contractors. Ownership of the two mines remains separate.

Mining activities approved under DA 34/95 have mostly been completed with the exception of Loders Pit and Abbey Green North Pit (AGN) with rehabilitation well-progressed on the east of the site. Run-of-mine (ROM) coal from MTO is transported to either the MTO or Warkworth Mine coal preparation plant (CPP) for processing. Extraction of coal from other pits has been completed; overburden emplacement is ongoing. Product coal from the CPPs is transported via conveyor to the Mount Thorley Coal Loader (MTCL). Coal loaded onto trains at the MTCL is transported to the Port of Newcastle for export.

The MTO 2014 (the proposal) seeks an approval under Part 4, Division 4.1 of the EP&A Act to complete mining and rehabilitation activities within the current limits of approval.

1.1 Project description

MTO has approval to mine until 22 June 2017 under its development consent. The proposal seeks a 21 year development consent period from the date of any approval. If approval is granted in 2015, operations at MTO are forecast to continue to the end of 2035, an 18 year extension over the current approval. The proposal seeks a continuation of all aspects of MTO as it presently operates and extends or alters them, including:

- mining in Loders Pit and AGN Pit. Mining in Loders Pit is expected to be completed in approximately 2020. Mining in AGN Pit is yet to commence; however, it is anticipated to take approximately two years and be completed before 2022;
- transfer of overburden between MTO and Warkworth Mine to assist in rehabilitation and development of the final landform;
- maintain existing extraction rate of 10 million tonnes per year (Mtpa) of ROM coal;
- maintain and upgrade to the integrated MTW water management system (WMS), including:
  - upgrade to the approved discharge point and rate of discharge into Loders Creek from 100Ml/d to 300Ml/d via the Hunter River Salinity Trading Scheme (HRSTS);

  - ability to transfer and accept mine water from neighbouring operations (ie Bulga Coal Complex, Wambo Mine, Warkworth Mine and Hunter Valley Operations);
  - increase in the storage capacity of the southern out-of-pit (SOOP) dam from 1.6 giga litres (GL) to 2.2GL
- maintain and upgrade to the integrated MTW tailings management:
  - including use of the northern part of Loders Pit as a TSF after completion of mining; and
  - Wall lift to Centre Ramp Tailings Facility to approximately RL150
- upgrade to the MTO CPP to facilitate an increase in maximum throughput to 18Mtpa with the ability to receive this coal from Warkworth Mine;
- acknowledge all approved interactions with Bulga Coal Complex; and
- continuation of coal transfer between Warkworth Mine and MTO and transportation of coal via the MTCL to Port of Newcastle.
- All activities, including coal extraction will be within disturbance areas approved under the existing development consent.

The proposal is shown in **Figure 1-1**.

1.2 Report purpose

This air quality impact and greenhouse gas assessment has been prepared in general accordance with the Secretary's Requirements and the New South Wales (NSW) Environment Protection Authority (EPA) document "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" (**NSW DEC, 2005**). The assessment forms part of the environmental impact statement prepared in support of the development application for the proposal.

The assessment investigates the potential for adverse air quality impacts occurring at surrounding assessment locations as a result of the proposal. Air dispersion modelling is utilised in conjunction with estimated emission rates of air pollutants and the consideration of mitigation measures in ameliorating any potential air quality impacts.

This report comprises of:

- A review of the existing environment surrounding the proposal;
- A description of the dispersion modelling approach used to assess potential impacts;
- The results of the dispersion modelling;
- A discussion of the potential air quality impacts as a result of the proposal;
- An estimation of the greenhouse gas emissions generated; and
- Measures to avoid or mitigate potential air quality impacts.

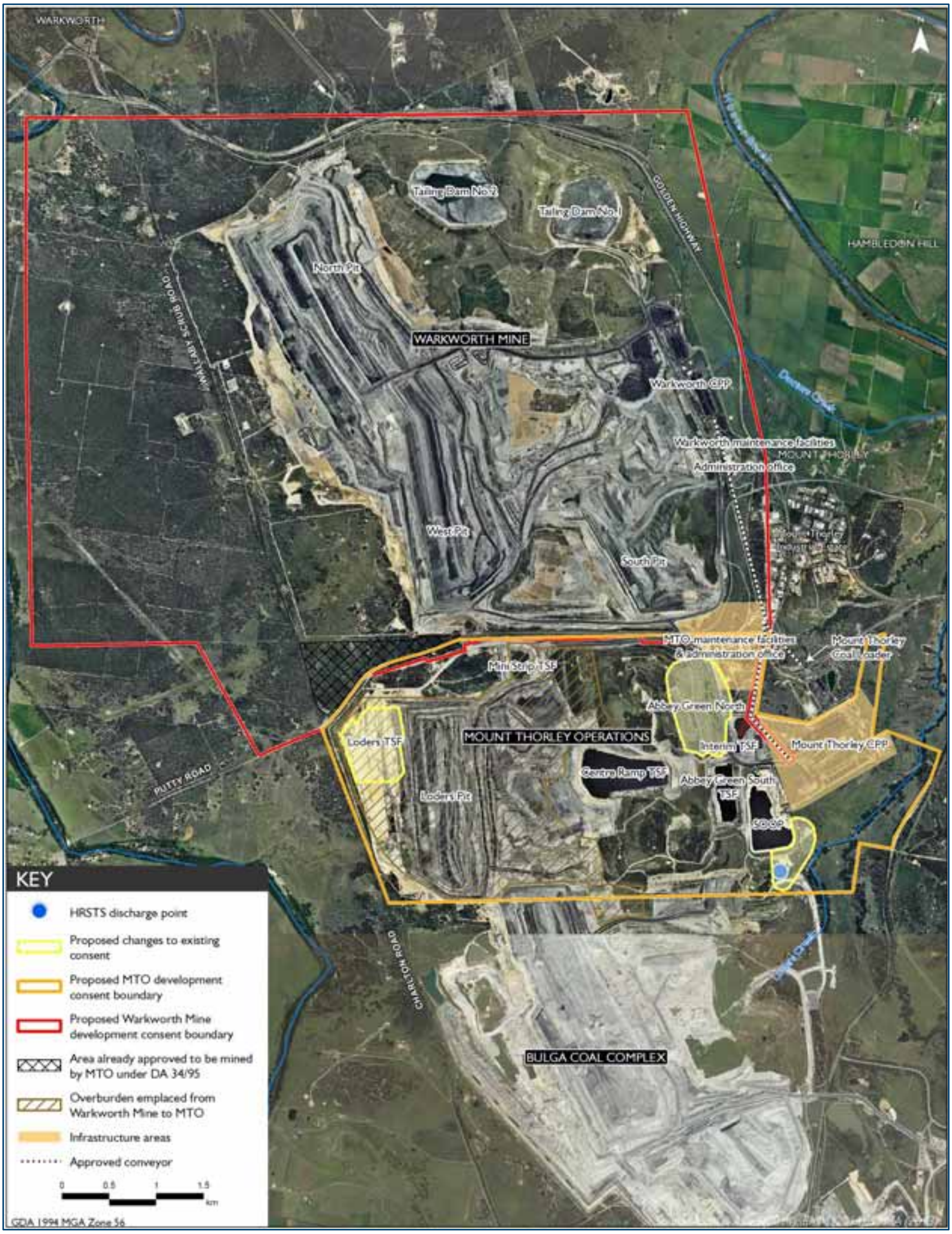

Figure 1-1: The proposal

2 LOCAL SETTING

The area surrounding MTO is comprised of various open cut coal mining operations, agriculture, forest, national park and rural residential areas.

Figure 2-1 presents the location of the proposal in relation to the neighbouring coal mining operations and the assessment locations of relevance to this study. **Appendix A** provides a detailed list of all the assessment locations considered in this report.

Figure 2-2 presents a three-dimensional (3D) visualisation of the topography in the vicinity of MTO. The surrounding topography is characterised by the steep escarpment to the west and south which forms part of the Wollemi National Park and the Pokolbin State Forest respectively. To the north and east, the terrain is generally open to form the Hunter Valley. In the general vicinity of MTO, the terrain is typical of grassland and woodland with moderately hilly terrain. The complex terrain features of the surrounding area have a significant effect on the local wind distribution patterns.

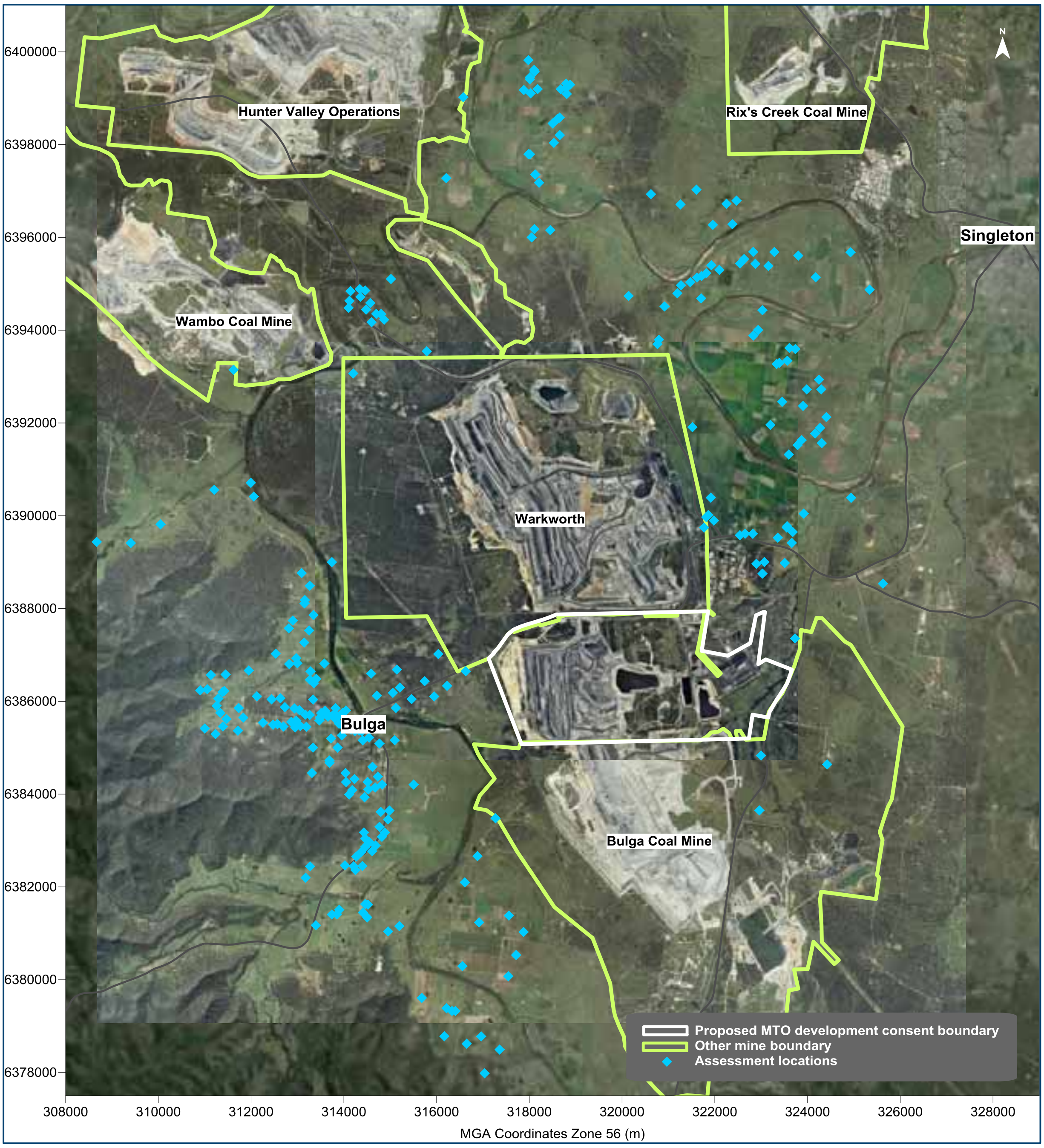

Figure 2-1: Proposal setting

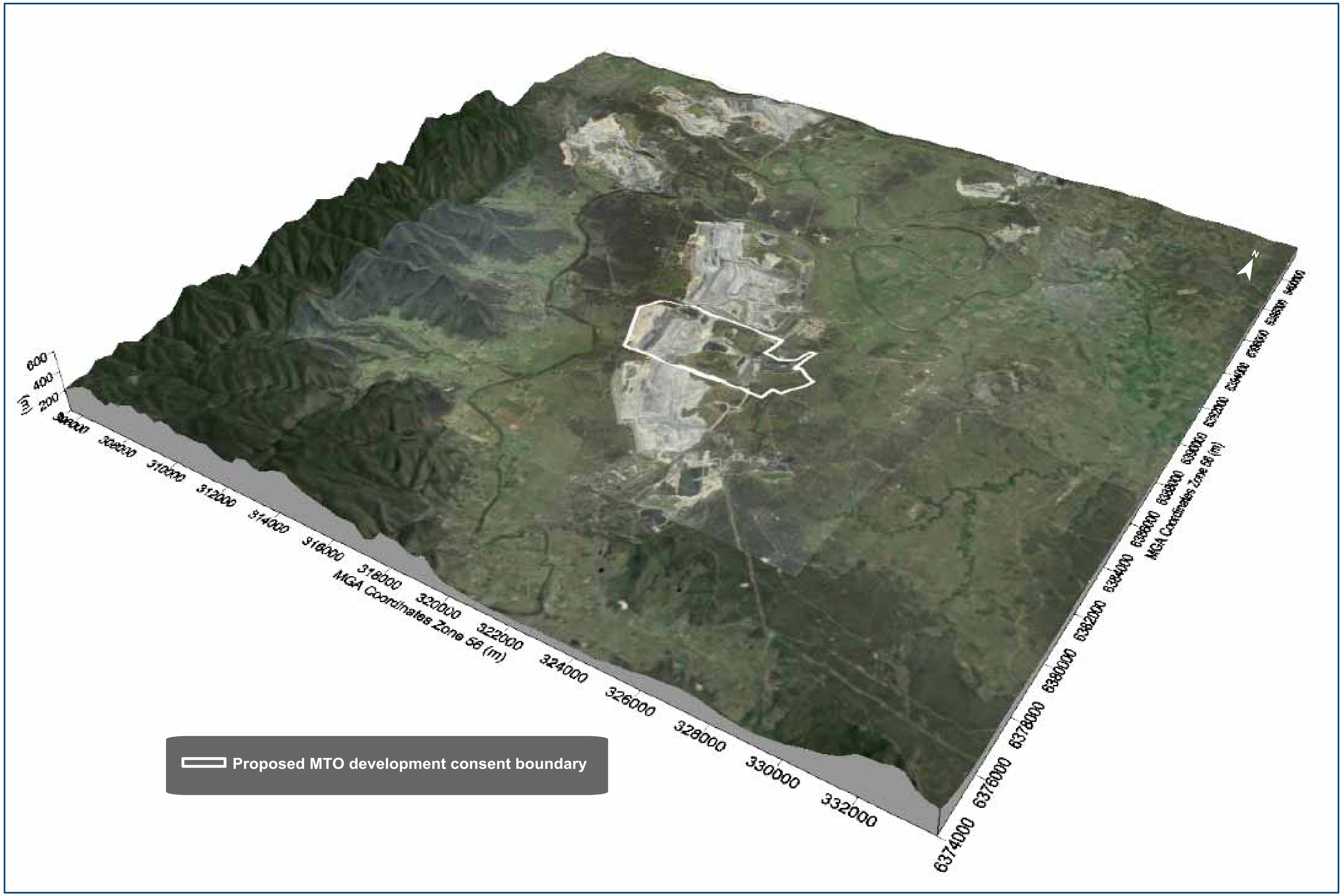

Figure 2-2: Topography surrounding the proposal

3 AIR QUALITY ASSESSMENT CRITERIA

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. The sections below identify the potential air emissions generated by the proposal and the applicable air quality criteria.

3.1 Particulate matter

Particulate matter refers to particles of varying size and composition. The air quality goals relevant to this assessment refer to three classes of particulate matter based on the sizes of the particles. The first class is referred to as Total Suspended Particulate matter (TSP) which measures the total mass of all particles suspended in air. The upper size range for TSP is nominally taken to be 30 micrometres (µm) as in practice, particles larger than 30 to 50µm settle out of the atmosphere too quickly to be regarded as air pollutants.

The second and third class are sub-classes of TSP, namely PM_{10}, particulate matter with aerodynamic diameters of 10µm or less, and $PM_{2.5}$, particulate matter with aerodynamic diameters of 2.5µm or less.

Mining activities generate particles in all the above size categories. The great majority of the particles generated are due to the abrasion or crushing of rock and coal and general disturbance of dusty material. These particulate emissions will be generally larger than 2.5µm as these fine sub-2.5µm particles are usually generated through combustion processes or as secondary particles formed from chemical reactions rather than through mechanical processes that dominate emissions on mine sites.

Combustion particulates can be more harmful to human health as the particles have the ability to penetrate deep into the human respiratory system as they are small and can be comprised of acidic and carcinogenic substances.

A study of the particle size distribution from mine dust sources in 1986 conducted by the State Pollution Control Commission (SPCC) found that of approximately 120 samples showed $PM_{2.5}$ comprised 4.7 per cent of the TSP, and PM_{10} comprised 39.1 per cent of the TSP in the samples (**SPCC, 1986**). The emissions of $PM_{2.5}$ occurring from mining activities are small in comparison to the total dust emissions and in practice, the concentrations of $PM_{2.5}$ in the vicinity of mining dust sources are likely to be low.

3.1.1 NSW EPA impact assessment criteria

Table 3-1 summarises the air quality goals that are relevant to this study as outlined in the NSW EPA document "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" (**NSW DEC, 2005**). The air quality goals for total impact relate to the total dust burden in the air and not just the dust from the proposal. 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	90µg/m^3
PM_{10}	Annual	Total	30µg/m^3
	24 hour	Total	50µg/m^3
Deposited dust	Annual	Incremental	2g/m^2/month
		Total	4g/m^2/month

Source: **NSW DEC, 2005**

The criterion for 24-hour average PM_{10} originates from the National Environment Protection Measure (NEPM) goals (**NEPC, 1988**). These goals apply to the population as a whole, and are not recommended to be applied to "hot spots" such as locations near industry, busy roads or mining. However, in the absence of alternative measures, NSW EPA does apply the criteria to assess the potential for impacts to arise at such locations.

The NEPM permits five days annually above the 24-hour average PM_{10} criterion to allow for bush fires and similar events. Similarly, it is normally the case that days, where ambient dust levels are affected by such events, are excluded from assessment as per the NSW EPA criterion.

It is important to note the Mining SEPP non-discretionary standard for air quality is a PM_{10} annual average criterion of 30µg/m^3 and a key matter for consideration.

3.1.2 NSW Planning & Infrastructure private residential property acquisition criterion for particulate matter

While the NSW EPA applies the maximum 24-hour average PM_{10} level in any year to assess the potential for impacts from a project, the NSW Planning & Infrastructure (P&I) in contemporary planning approvals has invoked requirements for acquisition and negotiated agreements with private residential landowners if there are systemic exceedances of the NSW EPA criterion. In the context of impact assessments for approval of new projects and modifications to existing projects, this is interpreted to mean where the NSW EPA criterion is exceeded on more than five days in any year (a 98.6 percentile level of compliance). This P&I criterion and other relevant criteria are outlined in **Table 3-2**.

Table 3-2: P&I private residential property acquisition criteria for particulate matter

Pollutant	Averaging Period	Impact	Criterion
TSP	Annual	Total	90µg/m^3
PM_{10}	Annual	Total	30µg/m^3
	24 hours	Incremental	50µg/m^3
Deposited dust	Annual	Incremental	2g/m^2/month
		Total	4g/m^2/month

3.1.3 $PM_{2.5}$ concentrations

The NSW EPA currently does not have impact assessment criteria for $PM_{2.5}$ concentrations; however the National Environment Protection Council (NEPC) has released a variation to the NEPM (**NEPC, 2003**) to include advisory reporting standards for $PM_{2.5}$ (see **Table 3-3**).

The advisory reporting standards for $PM_{2.5}$ are a maximum 24-hour average of 25µg/m^3 and an annual average of 8µg/m^3, and as with the NEPM goals, apply to the average, or general exposure of a population, rather than to "hot spot" locations.

Table 3-3: Advisory standard for $PM_{2.5}$ concentrations

Pollutant	Averaging Period	Criterion
$PM_{2.5}$	24 hours	25µg/m^3
	Annual	8µg/m^3

Source: **NEPC, 2003**

3.2 Other air pollutants

Emissions of other air pollutants will also potentially arise from mining operations such as the diesel powered equipment used on-site. Emissions from diesel powered equipment generally include carbon monoxide (CO), nitrogen dioxide (NO_2) and other pollutants, such as sulphur dioxide (SO_2).

CO is colourless, odourless and tasteless and generated from the incomplete combustion of fuels when carbon molecules are only partially oxidised. It can reduce the capacity of blood to transport oxygen in humans resulting in symptoms of headache, nausea and fatigue.

NO_2 is reddish-brown in colour (at high concentrations) with a characteristic odour and can irritate the lungs and lower resistance to respiratory infections such as influenza. NO_2 belongs to a family of reactive gases called nitrogen oxides (NO_X). These gases form when fuel is burned at high temperatures, mainly from motor vehicles, power generators and industrial boilers (**USEPA 2011**). NO_X may also be generated by blasting activities. It is important to note that when formed, NO_2 is generally a small fraction of the total NO_X generated.

Sulphur dioxide (SO_2) is a colourless, toxic gas with a pungent and irritating smell. It commonly arises in industrial emissions due to the sulphur content of the fuel. SO_2 can have impacts upon human health and the habitability of the environment for flora and fauna. SO_2 emissions are a precursor to acid rain, which can be an issue in the northern hemisphere; however it is not known to have any widespread impact in NSW, and is generally only associated with large industrial activities. Due to its potential to impact on human health, sulphur is actively removed from fuel to prevent the release and formation of SO_2. The sulphur content of Australian diesel is controlled to a low level by national fuel standards. Therefore the emissions of SO_2 generated from diesel powered equipment at mine sites are generally considered to be too low to generate any significant off-site pollutant concentrations and have not been assessed further in this study.

Table 3-4 summarises the air quality goals for CO and NO_2 assessed in this report.

Table 3-4: NSW EPA air quality impact assessment criteria of air toxics

Pollutant	Averaging period	Criterion
Carbon monoxide (CO)	15 minute	100mg/m²
	1 hour	30mg/m²
	8 hour	10mg/m²
Nitrogen dioxide (NO_2)	1 hour	246µg/m³
	Annual	62µg/m³

Source: **NSW DEC, 2005**

4 EXISTING ENVIRONMENT

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

4.1 Local climate

Long term climate data collected at the nearest Bureau of Meteorology (BoM) station, Jerrys Plains Post Office (Station Number 061086), are summarised in **Table 4-1** and **Figure 4-1**. Climatic parameters have been collected from the Jerrys Plains Post Office over a 45 to 128 year period. These data assist in characterising the local climatic conditions based on the long term meteorological parameters. The Jerrys Plains Post Office is located approximately 20km northwest of Warkworth Mine.

The data indicates that January is the hottest month with a mean maximum temperature of 31.7°C and July is the coldest month with a mean minimum temperature of 3.8°C.

Relative humidity levels exhibit variability over the day and seasonal fluctuations. Mean 9am relative humidity levels range from 59 per cent in October to 80 per cent in June. Mean 3pm relative humidity levels vary from 42 per cent in October – December to 54 per cent in June.

Rainfall peaks during the summer months and declines during winter. The data show January is the wettest month with an average rainfall of 77.7mm over 6.4 days and August is the driest month with an average rainfall of 36.1mm over 5.2 days.

Wind speeds during the warmer months have a greater spread between the 9am and 3pm conditions compared to the colder months. The mean 9am wind speeds range from 8.6km/h in April to 11.7km/h in September. The mean 3pm wind speeds vary from 11.0km/h in May to 14.7km/h in September.

Table 4-1: Monthly climate statistics summary – Jerrys Plains Post Office

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature												
Mean max. temperature (°C)	31.7	30.9	28.9	25.3	21.3	18.0	17.4	19.4	22.9	26.2	29.1	31.2
Mean min. temperature (°C)	17.2	17.1	15.0	11.0	7.4	5.3	3.8	4.4	7.0	10.3	13.2	15.7
Rainfall												
Rainfall (mm)	77.7	73.1	59.1	44.0	40.7	48.1	43.4	36.1	41.7	51.9	61.9	67.5
Mean No. of rain days (≥1mm)	6.4	6.0	5.8	4.9	4.9	5.5	5.2	5.2	5.2	5.8	6.2	6.3
9am conditions												
Mean temperature (°C)	23.4	22.7	21.2	18.0	13.6	10.6	9.4	11.4	15.3	19.0	21.1	23.0
Mean relative humidity (%)	67	72	72	72	77	80	78	71	65	59	60	61
Mean wind speed (km/h)	9.6	9.0	8.8	8.6	9.0	9.4	10.6	11.0	11.7	10.9	10.5	9.9
3pm conditions												
Mean temperature (°C)	29.8	28.9	27.2	24.1	20.1	17.1	16.4	18.2	21.2	24.2	26.9	29.0
Mean relative humidity (%)	47	50	49	49	52	54	51	45	43	42	42	42
Mean wind speed (km/h)	13.2	13.0	12.4	11.3	11.0	11.5	13.0	14.3	14.7	14.1	14.2	14.2

Source: **Bureau of Meteorology, 2014**

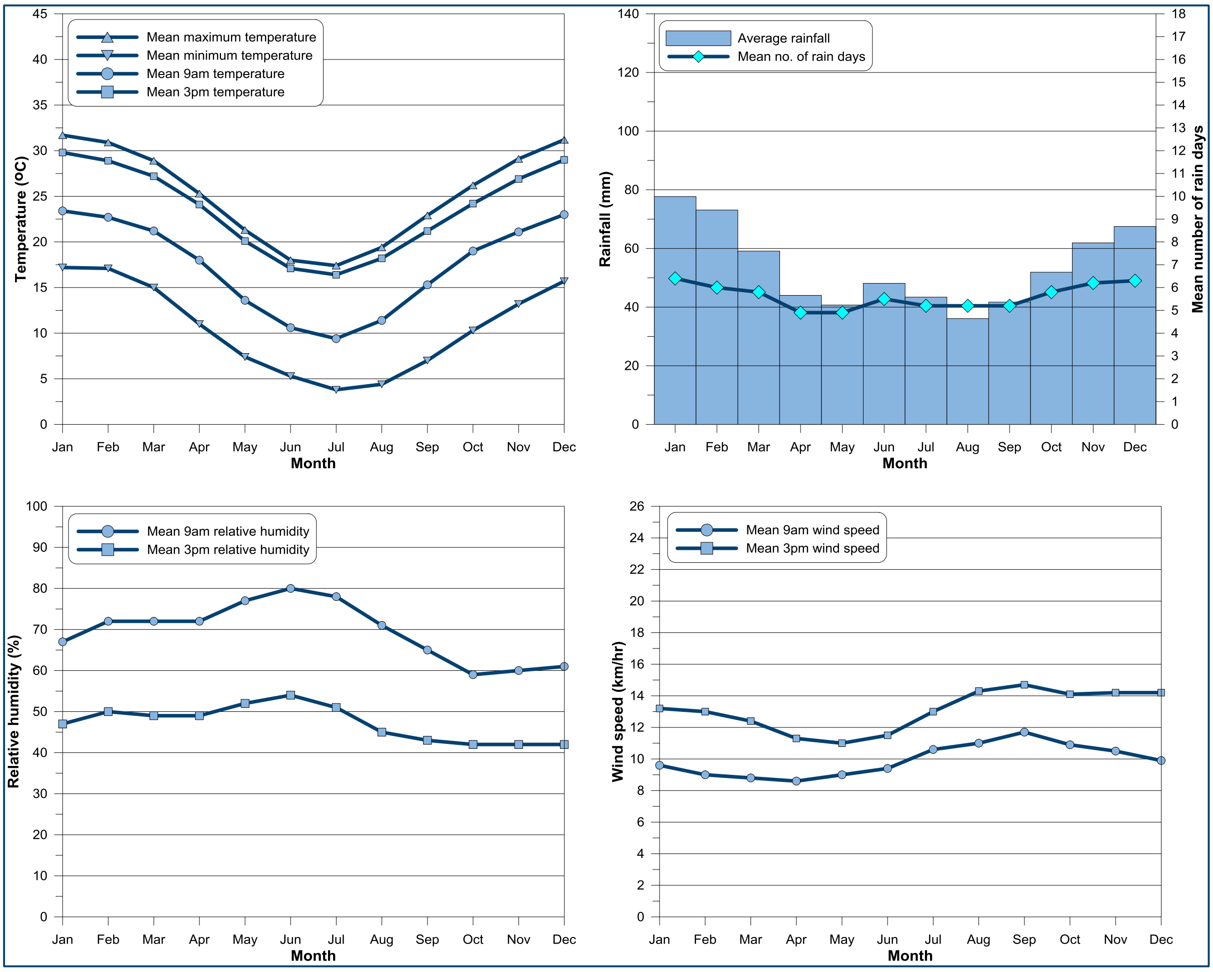

Figure 4-1: Monthly climate statistics summary – Jerrys Plains Post Office

4.2 Local meteorological conditions

MTW operate the Charlton Ridge meteorological station to assist with environmental management of site operations. The location of this station is shown in **Figure 4-2**.

Annual and seasonal windroses prepared from the available data collected for the 2012 period are presented in **Figure 4-3**.

Analysis of the windroses shows that the most common winds on an annual basis are from the south-southeast and south. Very few winds originate from the northeast and southwest sectors. In the summertime the wind predominately occurs from the south-southeast. The autumn distribution is similar to the annual distribution pattern. During winter, winds from the south-southeast and northwest dominate the distribution with some winds from the south. In the spring time, the majority of winds are from the south-southeast with varied winds from east-southeast, south and northwest.

Figure 4-2: Charlton Ridge meteorological station

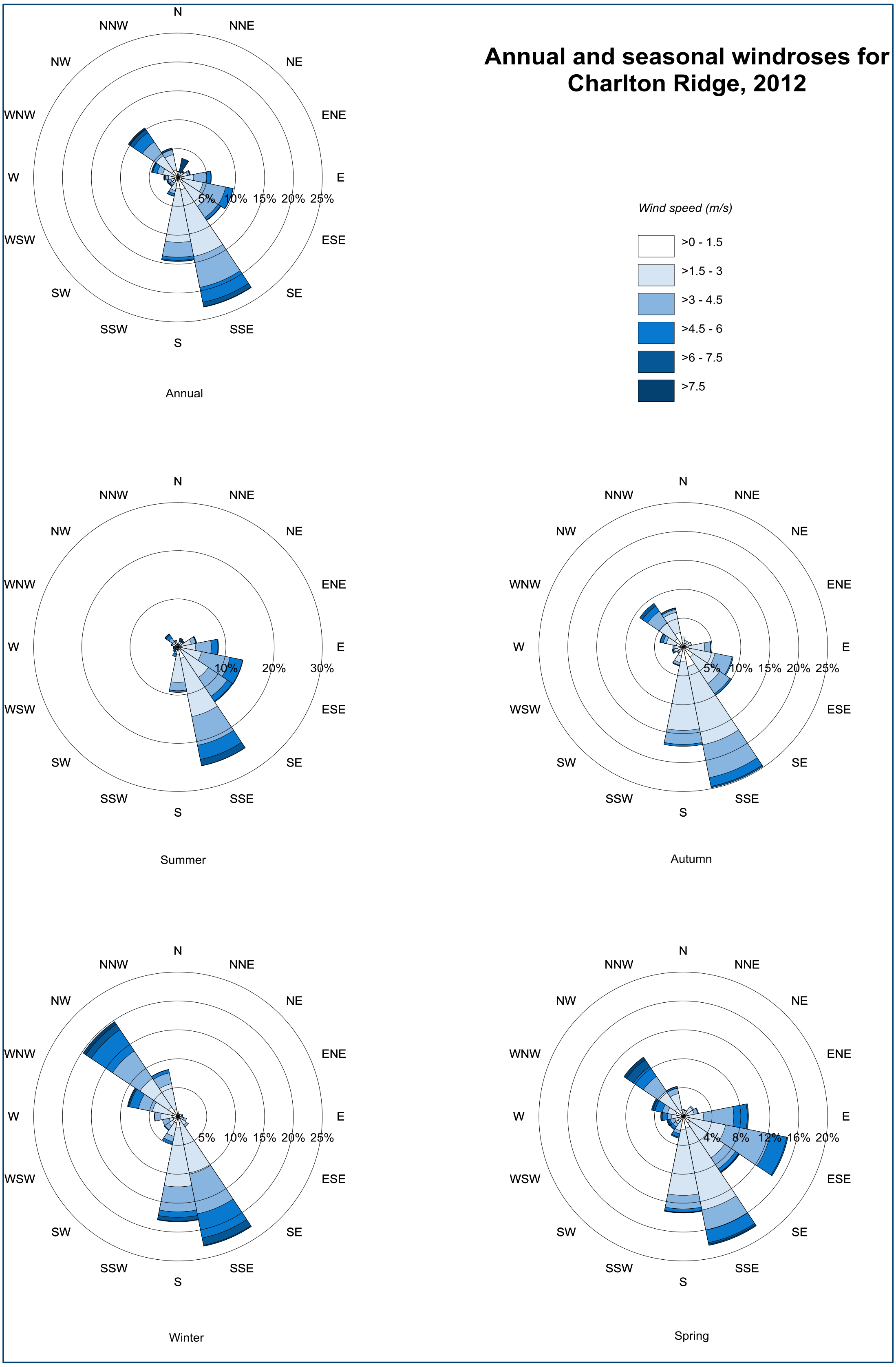

Figure 4-3: Annual and seasonal windroses for Charlton Ridge weather station (2012)

4.3 Ambient air quality

The main sources of particulate matter in the wider area include active mining, agricultural activities, emissions from local anthropogenic activities such as motor vehicle exhaust and domestic wood heaters, urban activity and various other commercial and industrial activities. Other pollutant emissions considered in the study include NO_2 and CO, which can potentially arise from mining operations such as the diesel powered equipment used on site and methane flaring operations, and power generation, including the Liddell, Bayswater and Redbank power stations. This section reviews the ambient monitoring data collected from a number of ambient monitoring locations in the vicinity of MTO.

The air quality monitors reviewed in this assessment include 12 Tapered Element Oscillating Microbalances (TEOMs), 11 High Volume Air Samplers (HVAS) measuring either TSP or PM_{10}, 13 dust deposition gauges and three NO_2 monitors surrounding MTO.

Table 4-2 lists the monitoring stations reviewed in this section which includes data from surrounding mining operations and the NSW EPA stations. **Figure 4-4** shows the approximate location of each of the monitoring stations reviewed in this assessment. **Appendix B** provides a summary of the mining operations monitoring data reviewed in this assessment.

Table 4-2: Summary of ambient monitoring stations

Monitoring site ID	Type	Monitoring data review period
Bulga	TEOM	January 2010 – December 2013
Wallaby Scrub Road	TEOM	January 2010 – December 2013
Warkworth	TEOM	January 2010 – December 2013
Knodlers Lane	TEOM	November 2011 – December 2013
Maison Dieu	TEOM	January 2010 – December 2013
MTIE	TEOM	January 2010 – December 2013
Bulga (NSW EPA)	TEOM	August 2011 – March 2014
Warkworth (NSW EPA)	TEOM	December 2011 – March 2014
Maison Dieu (NSW EPA)	TEOM	March 2011 – March 2014
Singleton NW (NSW EPA)	TEOM	July 2011 – March 2014
Singleton (NSW EPA)	TEOM	December 2010 – March 2014
Mt Thorley (NSW EPA)	TEOM	July 2011 – March 2014
MTO PM10	HVAS – PM_{10}	January 2012 – December 2013
WML PM10	HVAS – PM_{10}	August 2012 – December 2013
Knodlers Lane PM10	HVAS – PM_{10}	January 2012 – December 2013
Long Point PM10	HVAS – PM_{10}	Jan-Feb 2012 – Oct-Dec 2013
MTIE PM10	HVAS – PM_{10}	January 2012 – February 2013
Loders Creek PM10	HVAS – PM_{10}	March 2013 – December 2013
MTO TSP	HVAS – TSP	January 2012 – December 2013
WML TSP	HVAS – TSP	January 2012 – December 2013
Warkworth TSP	HVAS – TSP	January 2012 – December 2013
Long Point TSP	HVAS – TSP	October 2013 – December 2013
Loders Creek TSP	HVAS – TSP	March 2013 – December 2013
DW21A	Dust gauge	January 2012 – December 2013
Warkworth	Dust gauge	January 2012 – December 2013
DL30	Dust gauge	January 2012 – December 2013
DL22	Dust gauge	January 2012 – December 2013
Knodlers Lane	Dust gauge	January 2012 – December 2013
DL21	Dust gauge	January 2012 – December 2013

Monitoring site ID	Type	Monitoring data review period
DL14	Dust gauge	January 2012 – December 2013
D122	Dust gauge	January 2012 – December 2013
DW15	Dust gauge	January 2012 – December 2013
DW20A	Dust gauge	January 2012 – December 2013
DW14	Dust gauge	January 2012 – December 2013
D125	Dust gauge	January 2012 – December 2013
D124	Dust gauge	January 2012 – December 2013
Beresfield (NSW EPA)	NO_2 monitor	January 2008 – January 2014
Muswellbrook (NSW EPA)	NO_2 monitor	November 2011 – January 2014
Singleton (NSW EPA)	NO_2 monitor	November 2011 – January 2014

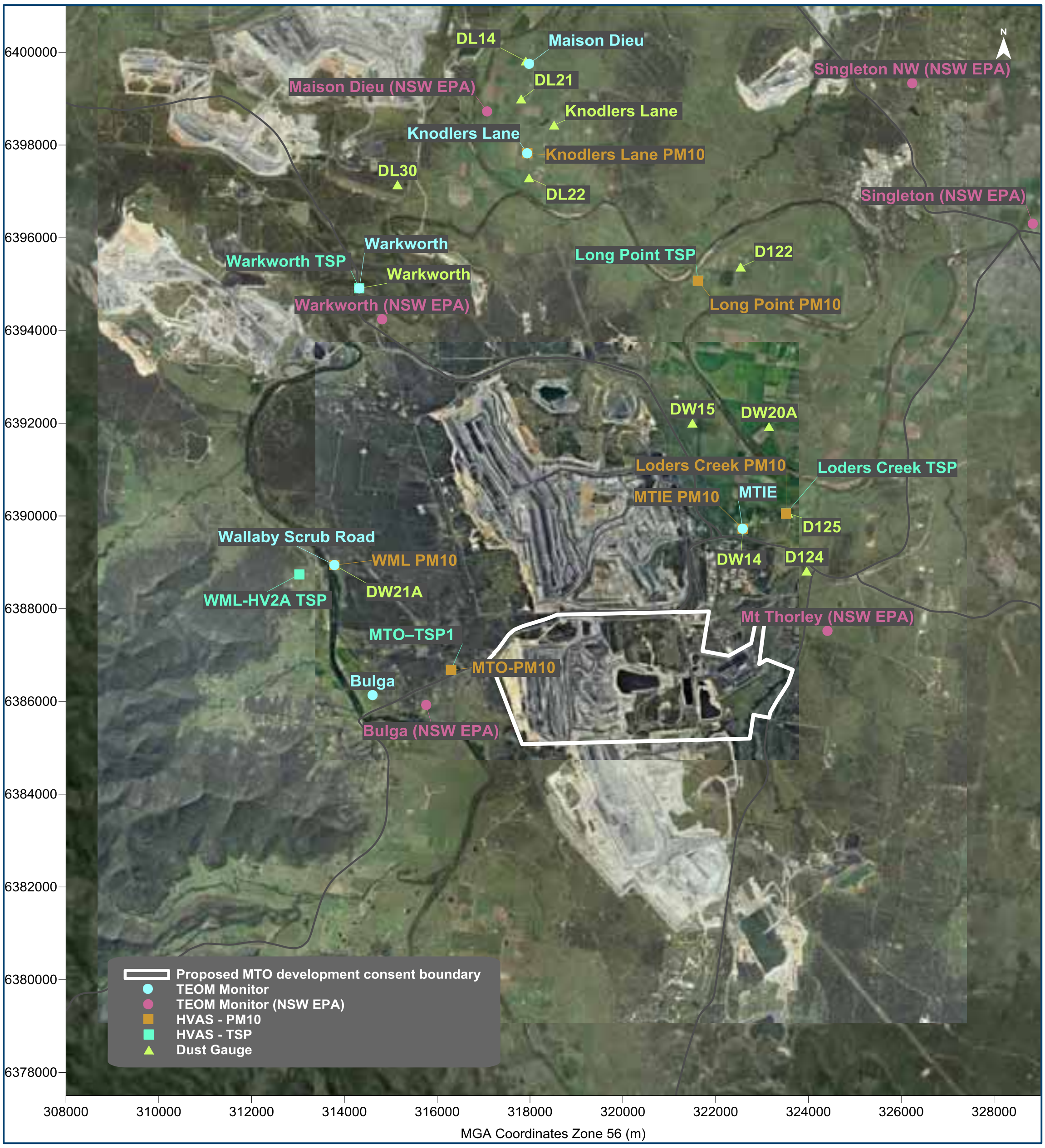

Figure 4-4: Monitoring locations

4.3.1 PM_{10} monitoring - TEOMs

Ambient PM_{10} monitoring using TEOMs is conducted by MTW and Hunter Valley Operations and NSW EPA at various locations surrounding MTO. The location of each of these monitors is shown in **Figure 4-4**. The monitoring data includes all emission sources in the vicinity of MTO.

4.3.1.1 MTW and Hunter Valley Operations

A summary of the available data collected from MTW and Hunter Valley Operations monitors from January 2010 to December 2013 is presented in **Table 4-3**. Recorded 24-hour average PM_{10} concentrations are presented in **Figure 4-5**.

Table 4-3 indicates that the annual average PM_{10} concentrations for each of the monitoring stations were below the relevant criterion of 30µg/m^3 and that the maximum 24-hour average PM_{10} concentrations were on occasion above 50µg/m^3 on days during the monitoring period. Further details regarding individual elevated days of dust concentrations are described in the Annual Environmental Management Report (Annual Review) for the mining operations.

It can be seen from **Figure 4-5** that PM_{10} concentrations are nominally highest in the spring and summer months with the warmer weather raising the potential for drier ground elevating the occurrence of windblown dust, bushfires and pollen levels.

The yellow shaded band in **Figure 4-5** represents the period containing the data used to make the assessment of cumulative impacts. It can be seen that this period has the highest baseline PM_{10} levels in Bulga village and does not contain the anomalous high peaks that occurred during the bushfire period in late 2013 or the relatively low levels that occurred in Bulga village in 2013.

Table 4-3: Summary of PM_{10} levels from MTW and Hunter Valley Operations TEOM monitoring (µg/m^3)

	2010	2011	2012	2013
	Annual average			
Bulga	12.8	12.9	14.3	13.3
Knodlers Lane[(1)]	-	9.2	18.1	18.9
Wallaby Scrub Road	13.4	13.0	16.6	15.9
Maison Dieu	17.1	18.2	21.4	21.5
MTIE	22.2	19.9	24.9	27.5
Warkworth	11.2	13.7	16.5	18.2
	Maximum 24-hour average			
Bulga	39.5	42.8	56.1	78.8
Knodlers Lane[(1)]	-	15.6	56.3	62.1
Wallaby Scrub Road	45.6	54.0	46.0	72.0
Maison Dieu	77.0	64.7	76.0	74.7
MTIE	85.0	76.0	77.0	103.0
Warkworth	32.0	44.6	41.2	58.0

[(1)]Data available from November 2011

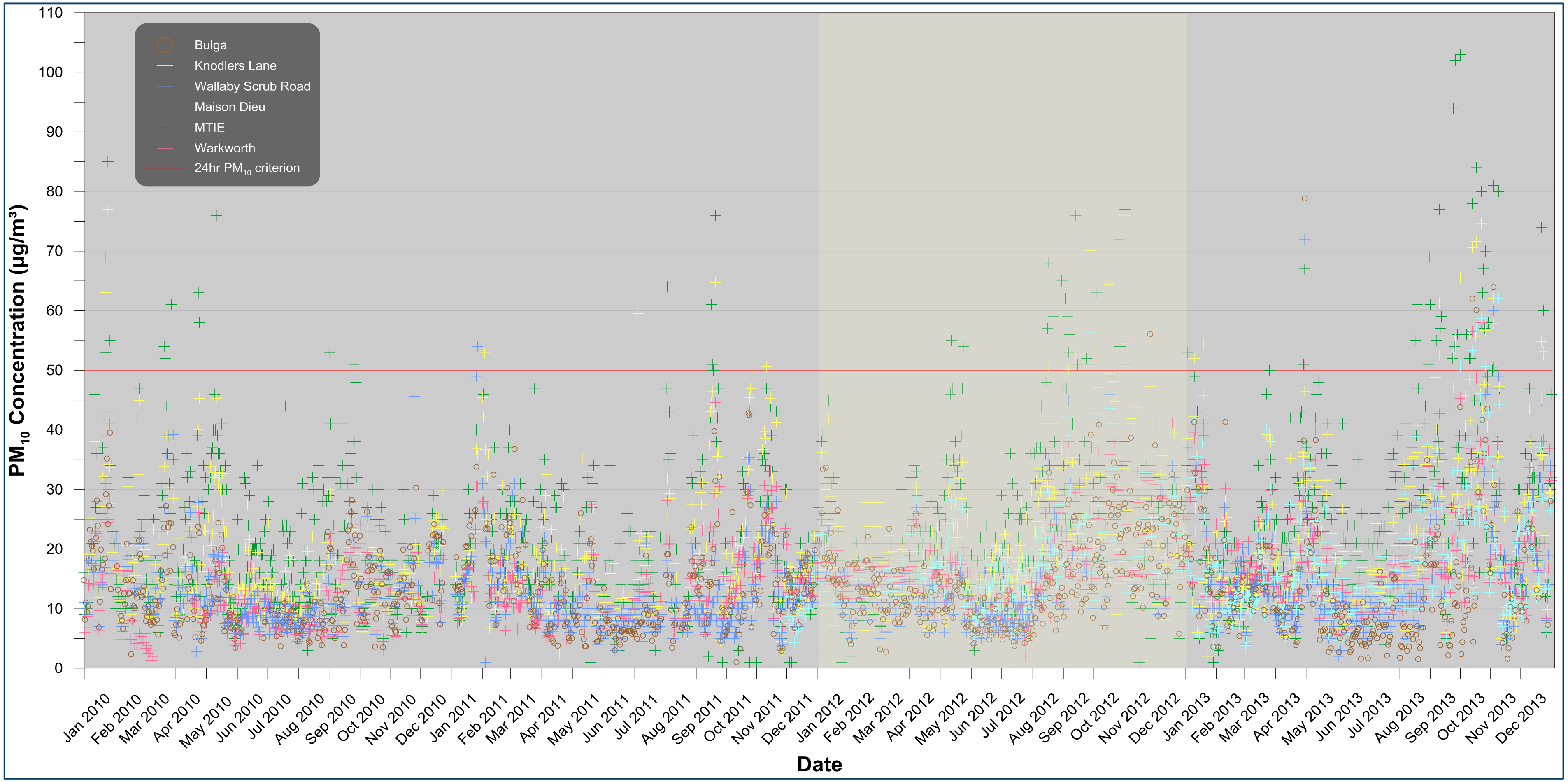

Figure 4-5: TEOM 24-hour average PM_{10} concentrations at MTW and Hunter Valley Operations monitors

4.3.1.2 NSW EPA

A summary of the available data from the NSW EPA monitoring stations is presented in **Table 4-4**. Recorded 24-hour average PM_{10} concentrations are presented in **Figure 4-6**.

A review of **Table 4-4** indicates that the annual average PM_{10} concentrations for each monitoring station were below the relevant criterion on 30µg/m^3. The maximum 24-hour average PM_{10} concentrations recorded at these stations were found to exceed the relevant criterion of 50µg/m^3 at times during the review period.

Figure 4-6 shows a relatively similar trend to the MTW and Hunter Valley Operations TEOM station data (shown in **Figure 4-5**). Variation between the monitoring data sites are largely attributed to the proximity of these monitors to various dust sources located in the surrounding area.

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

	2010	2011	2012	2013	2014(1)
	Annual average				
Bulga(2)	-	16.8	18.7	19.2	23.9
Singleton(3)	20.0	19.8	22.3	23.3	21.4
Maison Dieu(4)	-	22.1	25.8	25.8	23.7
Singleton NW(5)	-	24.8	25.9	25.9	20.0
Mount Thorley(5)	-	22.5	24.8	24.7	19.0
Warkworth(6)	-	19.7	21.1	21.5	28.4
	Maximum 24-hour average				
Bulga(2)	-	41.6	55.1	88.4	54.3
Singleton(3)	32.8	60.5	63.6	62.7	45.3
Maison Dieu(4)	-	78.3	87.7	84.2	53.1
Singleton NW(5)	-	72.2	85.2	91.7	45.4
Mount Thorley(5)	-	58.5	88.7	88.3	46.1
Warkworth(6)	-	26	49.9	65.4	67.9

(1)Data available till March 2014
(2)Data available from August 2011
(3)Data available from December 2010
(4)Data available from March 2011
(5)Data available from July 2011
(6)Data available from December 2011

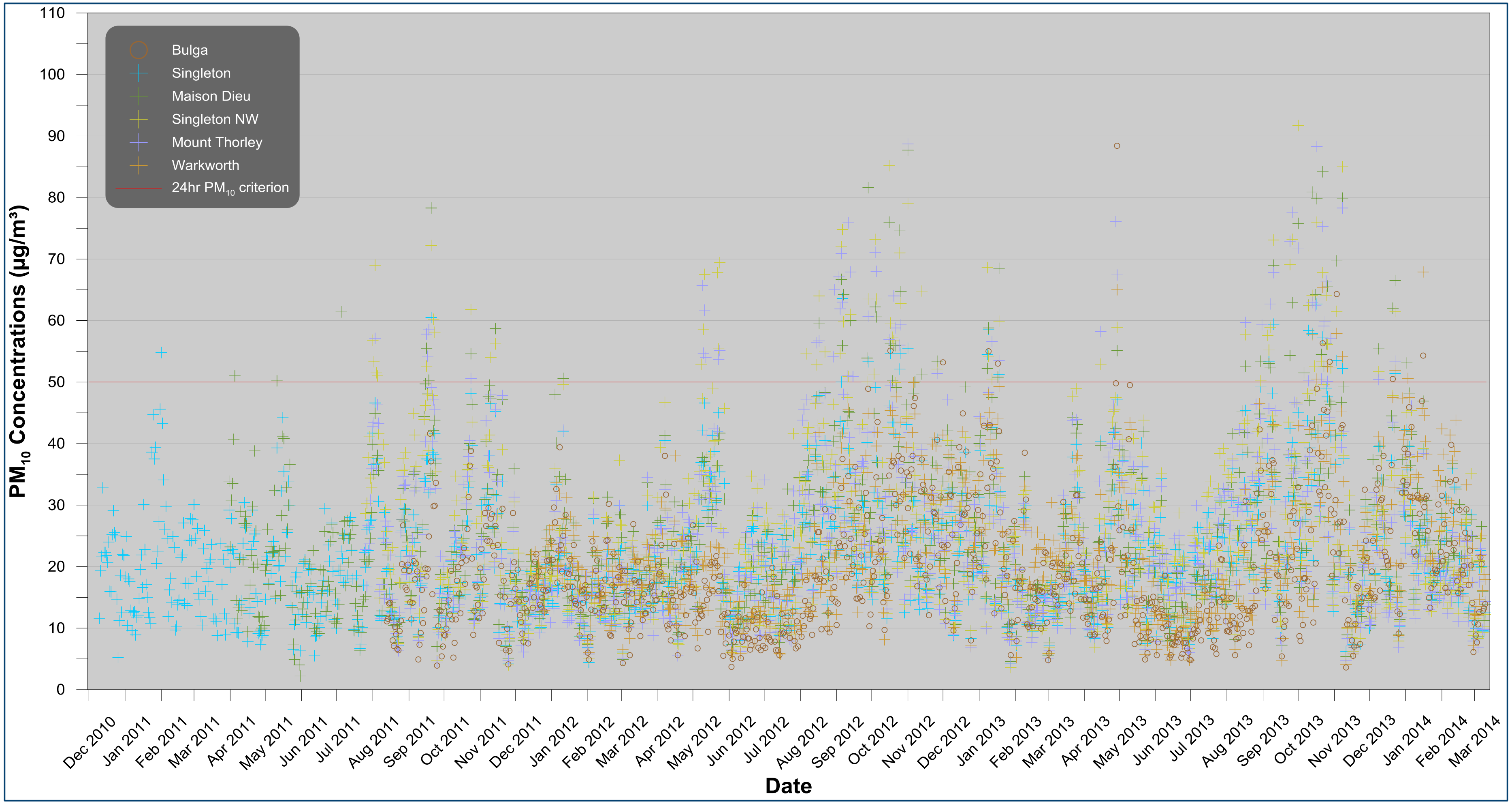

Figure 4-6: TEOM 24-hour average PM_{10} concentrations at NSW EPA monitors

4.3.2 PM_{10} monitoring - HVAS

A summary of the PM_{10} levels from the six HVAS monitoring stations is presented in **Table 4-5**. Recorded 24-hour average PM_{10} concentrations are presented in **Figure 4-7**. The data in **Table 4-5** indicate that the annual average PM_{10} concentrations for each of the monitoring stations were below the relevant criterion of 30µg/m³ for the years reviewed. The maximum 24-hour average concentrations exceed the relevant criterion of 50µg/m³ at these monitors and this can generally be attributed to events such as bushfires, dust storms, localised sources and dust emissions as a result of mining activity. Further details regarding individual elevated days of dust concentrations are described in the Annual Review for the mining operations.

The seasonal trends in PM_{10} concentrations can be seen in **Figure 4-7**, elevated days tend to occur in the warmer months with regional events indicated by most monitors showing elevated levels over the same period.

Table 4-5: Summary of PM_{10} levels from HVAS monitoring (µg/m³)

	Annual average		Maximum 24-hour average	
	2012	2013	2012	2013
Loders Creek PM10[(1)]	-	26.6	-	74
MTIE PM10[(2)]	27.9	21.1	98	58
MTO PM10	17.3	17.4	54	67
WML PM10[(3)]	17.5	13.5	43	47
Knodlers Lane PM10	20.8	24.9	59	84
Long Point PM10[(4)]	8.7	21.4	16	45

(1) Data available from March 2013
(2) Data available till February 2013
(3) Data available from August 2012
(4) Data available from Jan to Feb 2012 and Oct to Dec 2013

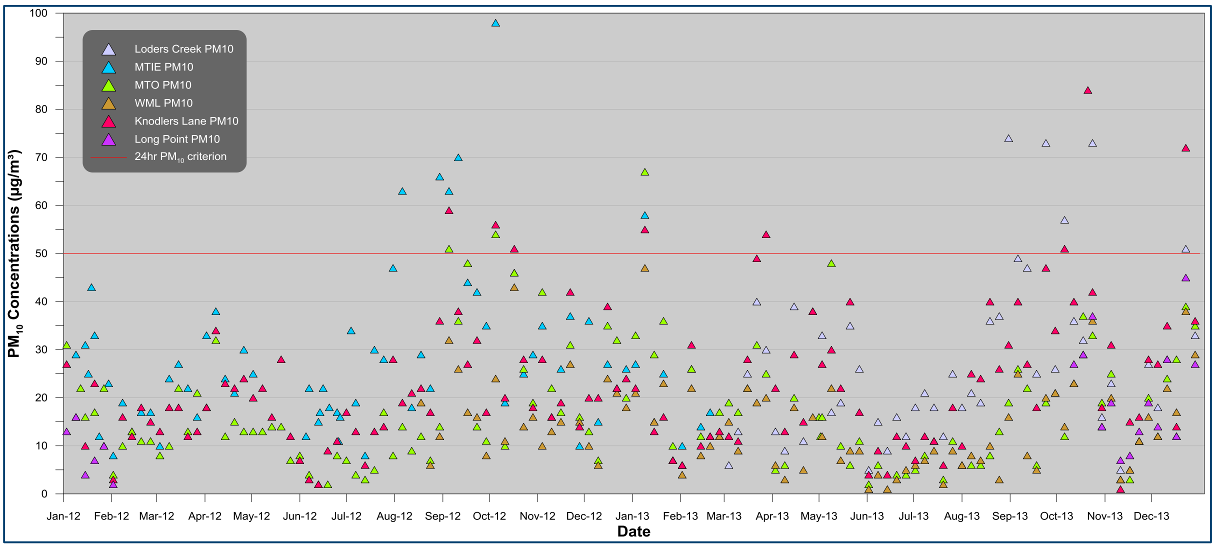

Figure 4-7: HVAS 24-hour average PM_{10} concentrations

4.3.3 TSP monitoring

TSP monitoring data are available from the five HVAS monitors surrounding MTO (see **Figure 4-4**). A summary of the results collected between January 2012 and December 2013 at these stations is shown in **Table 4-6**. Recorded 24-hour average TSP concentrations are presented in **Figure 4-8**.

The monitoring data presented in **Table 4-6** indicate that the annual average TSP concentrations for each monitoring station were less than the criterion of 90µg/m³. **Figure 4-8** shows that the recorded 24-hour average TSP concentrations at each monitor are generally consistent and follow a similar trend. The Loders Creek monitor shows slightly higher concentrations compared with the other monitoring locations and may be influenced by local sources.

Table 4-6: Summary of annul average TSP levels from HVAS monitoring (µg/m³)

	2012	2013
Loders Creek TSP(1)	-	71.6
MTO TSP	58.0	56.1
WML TSP	46.4	41.9
Warkworth TSP	50.7	55.7
Long Point TSP(2)	-	61.9

(1)Data available from March 2013

(2)Data available from October 2013

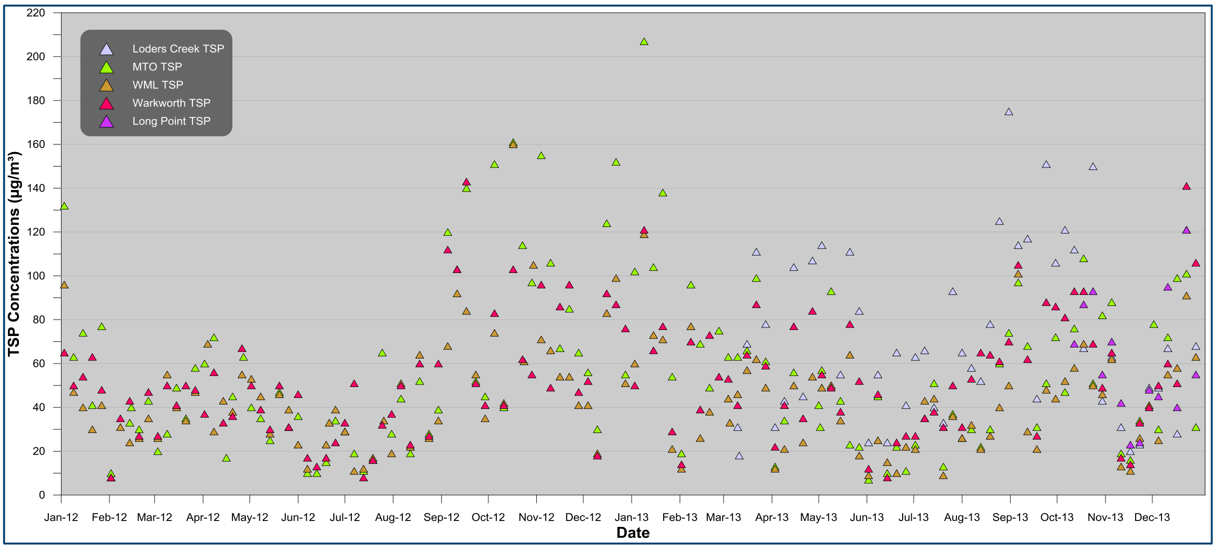

Figure 4-8: HVAS 24-hour average TSP concentrations

4.3.4 Dust deposition monitoring

The location of the dust deposition monitoring sites reviewed in this assessment are shown in **Figure 4-4**. **Table 4-7** summarises the annual average deposition levels at each gauge during 2012 and 2013.

Field notes accompanying the monitoring indicate that some of the samples were contaminated with materials such as bird droppings, insects or plant matter. This is a relatively common occurrence for this type of monitoring, and accordingly, contaminated samples have been excluded from the reported annual average results.

All gauges recorded an annual average insoluble deposition level below the criterion of 4g/m^2/month and in general, the air quality in terms of dust deposition is considered good.

Table 4-7: Annual average dust deposition (g/m²/month)

	2012	2013
DW21A	2.5	2.4
Warkworth	3.4	3.3
DL30	2.9	2.6
DL22	2.1	1.9
Knodlers Lane	1.3	1.1
DL21	3.0	2.3
DL14	2.2	1.8
D122	2.3	1.6
DW15	3.9	3.1
DW20A	1.2	1.4
DW14	2.1	2.8
D125	1.7	1.9
D124	2.0	1.7

4.3.5 Nitrogen dioxide

Figure 4-9 presents the maximum daily 1-hour average NO_2 concentrations from the Beresfield, Muswellbrook and Singleton NSW EPA monitoring sites from 2008 to January 2014. As shown in **Figure 4-9**, the Muswellbrook and Singleton monitoring sites were commissioned in November 2011 and data are only available after this date for these locations.

Ambient air quality monitoring data collected at these locations would include emissions from sources such as the Liddell, Bayswater and Redbank power stations, methane gas flaring operations at mining operations as well as other various combustion sources.

The monitoring data recorded are well below the NSW EPA 1-hour average goal of 246µg/m^3 during this period at all of the monitors. The data in **Figure 4-9** indicate that levels of NO_2 are relatively low compared to the criterion level and show a seasonal fluctuation.

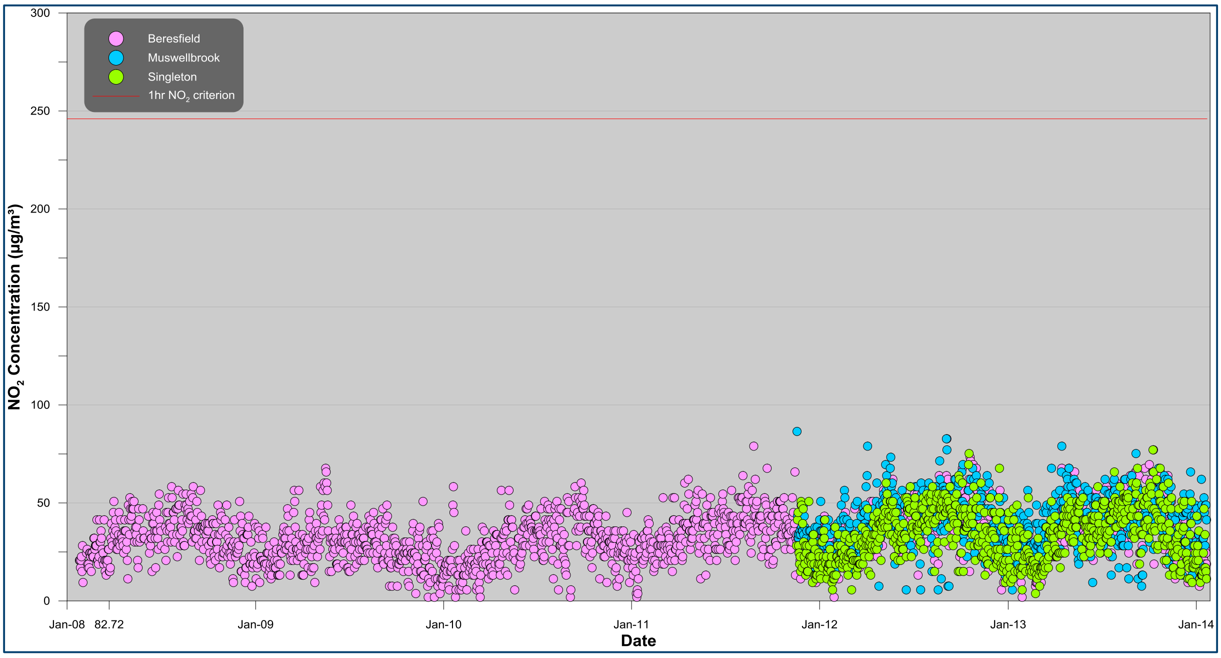

Figure 4-9: Daily 1-hour maximum NO_2 concentrations – Beresfield, Muswellbrook and Singleton

4.3.6 Carbon monoxide

The NSW EPA monitoring sites at Beresfield, Muswellbrook and Singleton do not record ambient concentrations of CO. Combustion activities are the cause of CO emissions and spatially there is very little such activity in the area apart from power generation, motor vehicles and wood heaters. Therefore, ambient concentrations of CO are expected to be low.

Ambient air quality goals for CO are set at higher concentration levels than NO_2 goals. Based on the NO_2 monitoring data which are low compared to the goals, and consideration of the typical mix of ambient pollutant levels, the indication is that ambient levels of CO would similarly also be well below the air quality goals.

5 MODELLING SCENARIOS

The assessment considers three indicative mine plan years (Year 3, 9 and 14) chosen to represent a range of potential impacts over the life of the proposal by reference to the location of the operations and the potential to generate dust in each year.

Indicative mine plans for each of the respective years are presented in **Figure 5-1**.

The indicative Year 3 mine plan shows MTO and the Warkworth Mine continuing the general progression of the mines in a westerly direction. With ROM extraction occurring at both MTO and Warkworth Mine. Some of the overburden generated from Warkworth Mine is hauled through the proposed underpass beneath Putty Road to MTO. The approved emplacement and subsequent rehabilitation at the Common Boundary Landform development along the southern boundary of MTO with Bulga Mine Complex will be undertaken and completed. The rehabilitation works will continue to progress from east to west as the landform is completed.

The indicative Year 9 mine plan shows mining at MTO is completed and overburden material from Warkworth Mine continues to be emplaced into the Loders Pit void. It is expected that AGN will commence mining in 2018 or 2019 and be completed within approximately two years before becoming a tailings storage facility (TSF) as approved. For modelling purposes and to ensure a worst case scenario is captured the assessment has conservatively assumed that mining in AGN is still taking place in 2023, however in practice it is likely to be completed and being used as a TSF before 2023. The mining of AGN will have required the removal of some areas of existing northern vegetation which will have been re-established in non-tailings areas by this stage. The MTO emplacement areas will be progressively rehabilitated with the advancement of completed landform from east to west.

The indicative Year 14 mine plan shows mining reaching near to its westernmost extent in Warkworth Mine. The MTO area is almost completely rehabilitated with remaining activities consisting of the operation of the MTO CPP and the final void being used for tailings storage.

The air quality environment in the vicinity of Bulga village and for the receptors generally to the west and south west of the proposal is likely to improve beyond Year 14. This arises as the dust emissions from the other mines in the area show reductions in emissions and/ or move further away from the assessment locations.

The emissions reductions beyond Year 14 occur as mining activity/ footprints reduce and also as some of the mines' consents expire. It should however be noted that all of the neighbouring mines were included in the modelling assessment for Year 14 (even those without a consent or known plans to operate at this time).

Dust emissions and impacts from the Bulga Coal Mine would progressively reduce at the majority of the assessment locations as the proposed operation moves to the east (away from assessment locations) and its emissions and footprint reduce over time.

During all indicative years extracted ROM coal is hauled to and processed at either the Warkworth Mine or MTO CPPs. Completed overburden emplacement areas are progressively rehabilitated commensurate with the mine progression.

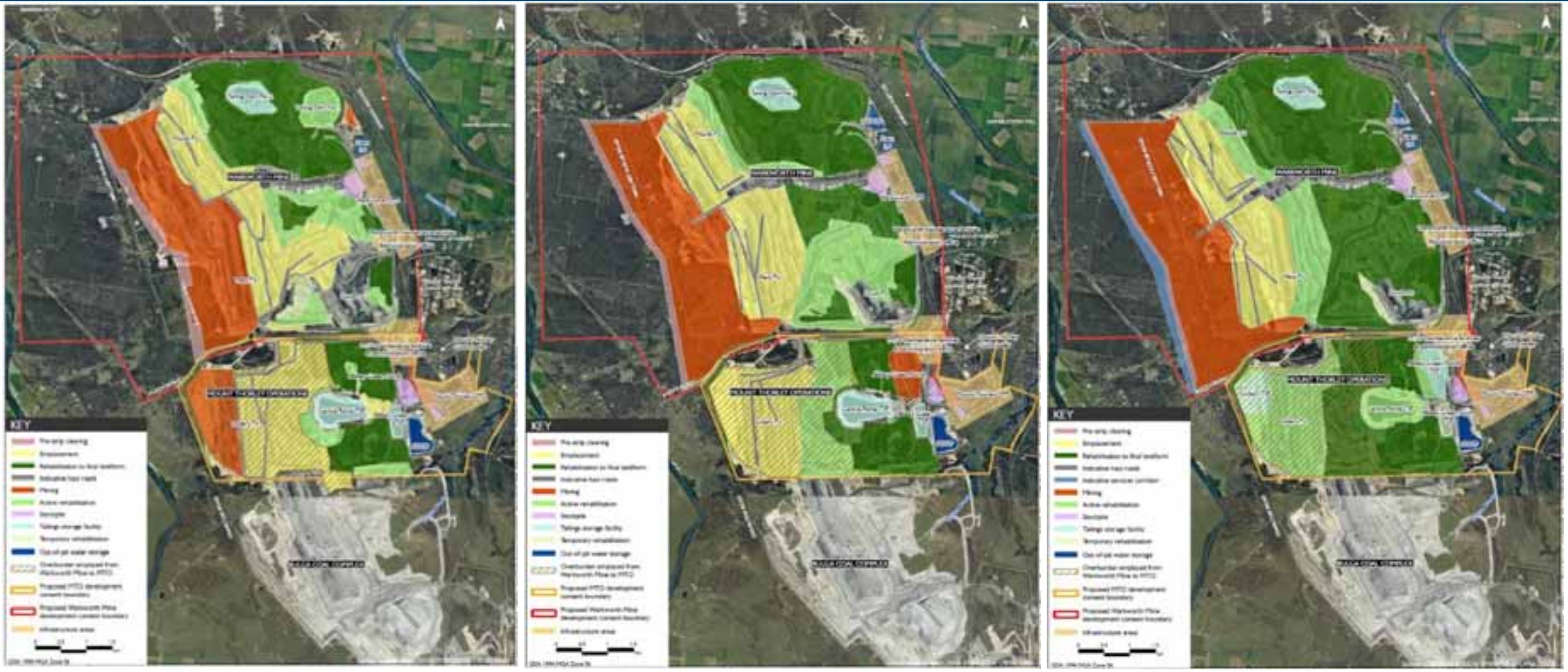

Figure 5-1: Indicative Year 3, 9 and 11 mine plans for the proposal

5.1 Emission estimation

5.1.1 The proposal

For each of the three indicative years selected to represent the key stages over the life of the proposal, the rate of dust emission has been calculated by analysing the various types of dust generating activities taking place in each year and applying suitable emission factors.

The emission factors applied are considered the most applicable and representative factor available for calculating the dust generation rates for the proposed activities. The emission factors were sourced mainly from studies supported by the US EPA and from Australian studies and site specific data where possible. Total dust emissions from all significant dust generating activities for the proposal are presented in **Table 5-1**. Detailed emission inventories and emission estimation calculations are presented in **Appendix C**.

The estimated dust emissions presented in **Table 5-1** reflect the application of best practice dust mitigation currently being implemented at MTW in accordance with its Air Quality Management Plan (AQMP) and Pollution Reduction Program (PRP) (refer to **Section 6**). The dust control measures are described in the following section.

Table 5-1: Estimated emission for the proposal (kg of TSP)

Activity	Year 3	Year 9	Year 14
OB - Drilling	3,827	-	-
OB - Blasting	98,214	-	-
OB - Dragline	227,330	-	-
OB - Loading OB to haul truck	71,694	-	-
OB - Hauling to emplacement area – from MTO	617,750	-	-
OB - Hauling to emplacement area - from Warkworth	149,803	615,215	-
OB - Emplacing at area	111,814	82,384	-
OB - Dozers in pit	222,959	-	-
OB - Dozers on dump and rehab	89,626	99,642	-
CL - Drilling	279	-	-
CL - Blasting	3,979	-	-
CL - Dozers ripping/pushing/clean-up	48,714	-	-
CL - Loading ROM coal to haul truck	202,661	-	-
CL - Hauling ROM to hopper - Mt Thorley CPP	134,122	-	-
CL - Hauling Warkworth ROM to hopper - Mt Thorley CPP	81,541	161,979	188,301
CPP - Unloading ROM to hopper - Mt Thorley CPP	30,399	-	-
CPP - Unloading Warkworth ROM to hopper - Mt Thorley CPP	29,300	51,877	63,048
CPP - Rehandle ROM at hopper - Mt Thorley CPP	11,940	10,375	12,610
CPP - Dozer pushing ROM coal - Mt Thorley CPP	42,997	42,997	42,997
CPP - Dozer pushing Product coal - Mt Thorley CPP	13,593	13,593	13,593
CPP - Loading Product coal to stockpile - Mt Thorley CPP	580	504	612
CPP - Loading Product coal to train - Mt Thorley CPP	232	202	245
CPP - Loading rejects - Mt Thorley CPP	335	238	331
CPP - Hauling rejects - Mt Thorley CPP	12,908	9,169	63,846
CPP - Hauling rejects from Warkworth - Mt Thorley CPP	22,193	20,131	46,582
CPP - Unloading rejects - Mt Thorley CPP	742	686	726
CPP - Conveying to train load out from Mt Thorley CPP	318	318	318
WE - Overburden emplacement areas - Mt Thorley	705,978	492,801	-
WE - Open pit - Mt Thorley	520,144	-	-

Activity	Year 3	Year 9	Year 14
WE - ROM stockpiles - Mt Thorley	30,748	20,901	20,901
WE - Product stockpiles - Mt Thorley	24,743	24,743	24,743
Grading roads	22,157	22,157	22,157
ABBEY GREEN NORTH*			
Drilling overburden	-	5,900	-
Blasting overburden	-	31,300	-
Dozers on overburden dumps	-	54,500	-
Dozers on overburden assisting excavators	-	55,400	-
Loading overburden to trucks	-	50,500	-
Hauling overburden to waste dump	-	720,000	-
Unloading overburden to waste dump	-	50,500	-
Dozers working on coal	-	5,690	-
Loading coal to trucks	-	169,000	-
Hauling coal to the MTCPP	-	78,900	-
Unloading coal to hopper	-	25,000	-
Re-handle coal at the ROM hopper	-	2,500	-
Loading coal to stockpiles	-	1,130	-
Loading coal to trains	-	791	-
WE - Waste emplacement 1	-	258,000	-
WE - Waste emplacement 2	-	63,900	-
WE - Pit	-	278,000	-
WE - ROM stockpile	-	2,580	-
WE - Product stockpile	-	875	-
Grading roads	-	1,120	-
Total	**3,533,619**	**3,525,498**	**501,011**

OB – overburden, CL – coal, CPP – coal preparation plant, WE – wind erosion
*PAEHolmes (2009)

5.1.2 Other mining operations

In addition to the estimated dust emissions from the proposal, emissions from all nearby approved mining operations were also modelled, per their current consent (or current proposed project), to assess potential cumulative dust effects. Emissions estimates from these sources were derived from information provided in the air quality assessments available in the public domain at the time of modelling. These estimates are likely to be conservative, as in many cases, mines do not continually operate at the maximum extraction rates assessed in their respective environmental assessments. This is evident when examining Reviews for coal mines in the Hunter Valley that typically show that the mines actual rate of activity is below the approved level of activity. **Table 5-2** summarises the emissions adopted in this assessment for each of the nearby mining operations.

Table 5-2: Estimated emissions from nearby mining operations (kg of TSP)

Mining operation	Year 3	Year 9	Year 14
Warkworth Mine[(1)]	9,756,076	11,966,083	13,027,625
Bulga Coal Mine[(2)]	10,004,386	7,762,460	6,736,792
Wambo Coal Mine[(3)]	4,186,080	4,186,080	4,186,080
Hunter Valley Operations[(4)]	9,029,790	7,568,834	7,568,834
Rix's Creek Coal Mine[(5)(6)]	3,396,250	6,113,250	2,173,600

[(1)]Todoroski Air Sciences (2014)
[(2)]Pacific Environment Limited (2013)
[(3)]Holmes Air Sciences (2003)
[(4)]Holmes Air Sciences (2008)
[(5)] Holmes Air Sciences (1994)
[(6)]AECOM (2013)

It is noted that only a Preliminary Environmental Assessment (**AECOM, 2013**) has been lodged at this stage for the Rix's Creek Mine Continuation of Mining Project, and not a full environmental assessment. Estimates of the potential dust emissions included in the cumulative assessment have been made based on the indicative production rate of this project.

Further, it is noted that consents for some mining operations would expire at some stage during the proposal. However to assess potential worst case cumulative dust effects, it has been assumed that these operations would continue until the end of the proposal. This also adds considerable conservatism to the model predictions.

Emissions from nearby mining operations would contribute to the background level of dust in the area surrounding the proposal, and these emissions were explicitly included in the modelling assessment. Additionally, there would be numerous smaller or very distant sources that contribute to the total background dust level. Modelling these sources explicitly is impractical; however, the residual level of dust due to all other such non-modelled sources has been included in the cumulative results, and the method for doing this is discussed further in **Section 7**.

6 DUST MITIGATION AND MANAGEMENT

6.1 Dust management

MTO and Warkworth Mine have integrated their management of air quality and operate per an integrated MTW AQMP.

The possible range of air quality mitigation measures that are feasible and can be applied to achieve a standard of mine operation consistent with current best practice for the control of dust emissions from coal mines in NSW has been carefully considered in the implementation of such measures at MTW.

The measures applied to MTW reflect those outlined in the recent NSW EPA document, "*NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining*", prepared by Katestone Environmental (**Katestone, 2010**), and also imposed on mines in the current NSW EPA PRP's that relate to haul road emissions, and dust mitigation in response to adverse weather conditions. Dust management practices are in place at MTO that also respond to government and community concerns regarding the impacts of mining on regional air quality in the Hunter Valley.

These measures include implementation of best practice management techniques to reduce dust, and staff guidance for the visual identification and hence control of dust. Other measures include alarms based on monitoring to manage potentially rising dust levels and to help prevent or reduce potential impacts. Operational measures such as enforcing a cessation of particular operations during periods of high dust provide additional assistance in reducing the potential dust impacts.

MTW utilises meteorological forecast data to guide the day to day planning of mining operations. These systems identify potentially adverse conditions that may arise over the coming day, giving MTW time to prepare in advance means to mitigate dust appropriately.

The NSW EPA has also placed a PRP on the MTO Environment Protection Licence which requires identification and assessment of the practicality of implementing further best practice measures. The best practice controls currently implemented were considered in this assessment. Where applicable these controls have been applied in the dust emission estimates as shown in **Appendix C**.

The operation of dust mitigation and management measures commensurate with best practice is a key aspect of MTO operations. An outline of such measures is set out in the air quality chapter in the main body of the EIS, and the overall approach is detailed in the air quality and greenhouse gas management plan. This is available on the company's website: http://www.riotintocoalaustralia.com.au/documents/MTW_Air_Quality_and_Greenhouse_Gas_Management_(Approved_31Jan2013).pdf . It should be noted that attainment of best practice requires ongoing improvement and thus the current best practice mitigation and dust management measures are likely to improve over time, as they are regularly reviewed and updated through the management plan framework.

6.2 Monitoring network

The MTW air quality monitoring network, is illustrated in **Figure 4-4**. The network of monitors surround the mine operation and are positioned in areas representative of the surrounding assessment locations.

This network is augmented by ambient air quality monitoring stations operated by the NSW EPA and provide an extensive network of stations from which to measure ambient air quality.

Air quality monitoring at MTW is supplemented with portable real-time PM_{10} monitoring and visual surveillance to support the reactive air quality management system. The monitors are portable to enable relocation as mining and seasonal conditions change. These monitors are aimed for use as a warning tool for mine operations and provide advance warning of degrading air quality which serves to prompt appropriate actions. Visual surveillance monitoring is also used in the network to assist with identification of problem dust sources, informing a management response and verifying the effectiveness of controls implemented.

7 DISPERSION MODELLING APPROACH

7.1 Introduction

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

For this assessment the CALPUFF modelling suite is applied to dispersion modelling. The CALPUFF model is an advanced "puff" model that can deal with the effects of complex local terrain on the dispersion meteorology over the entire modelling domain in a 3D, hourly varying time step. CALPUFF is an air dispersion model approved by NSW EPA for use in air quality impact assessments. The model setup used is in general accordance with methods provided in the NSW EPA document "*Generic Guidance and Optimum Model Setting for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia*" (**TRC**, **2011**).

7.2 Modelling methodology

Modelling was undertaken using a combination of the CALPUFF Modelling System and 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.

TAPM is a prognostic air model used to simulate the upper air data for CALMET input. The meteorological component of TAPM is an incompressible, non-hydrostatic, primitive equation model with a terrain-following vertical coordinate for 3D simulations. The model predicts the flows important to local scale air pollution, such as sea breezes and terrain induced flows, against a background of larger scale meteorology provided by synoptic analysis.

CALMET is a meteorological model that uses the geophysical information and observed/simulated surface and upper air data as inputs and develops wind and temperature fields on a three-dimensional gridded modelling domain.

CALPUFF is a transport and dispersion model that advects "puffs" of material emitted from modelled sources, simulating dispersion processes along the way. It typically uses the 3D meteorological field generated by CALMET.

CALPOST is a post processor used to process the output of the CALPUFF model and produce tabulations that summarise the results of the simulation.

7.2.1 Meteorological modelling

The TAPM model was applied to the available data to generate a 3D upper air data file for use in CALMET. The centre of analysis for the TAPM modelling used is 32deg38min south and 151deg5min east. The simulation involved four nesting grids of 30km, 10km, 3km and 1km with 35 vertical grid levels.

CALMET modelling used a nested approach where the 3D wind field from the coarser grid outer domain is used as the initial (or starting) field for the finer grid inner domains. This approach has several advantages over modelling a single domain. Observed surface wind field data from the near field as well as from far field monitoring sites can be included in the model to generate a more representative 3D wind field for the modelled area. Off domain terrain features for the finer grid domain can be allowed to take effect within the finer domain, as would occur in reality, also the coarse scale wind flow fields give a better set of starting conditions with which to operate the finer grid run.

The CALMET initial domain was run on a 150 x 150km grid with a 3km grid resolution and refined for a second domain on a 50 x 50km grid with a 1km grid resolution and further refined for a final domain on a 30 x 30km grid with a 0.3km grid resolution.

The available meteorological data for January 2012 to December 2012 from ten nearby meteorological monitoring sites were included in the simulation. The 2012 calendar year was chosen as a representative meteorological year based on a long-term meteorological analysis.

Table 7-1 outlines the parameters used from each station. The 3D upper air data was sourced from TAPM output. Further detail regarding input variables are presented in **Appendix D**.

Table 7-1: Surface observation stations

Weather station	Parameters
Charlton Ridge Weather Station	Wind speed, wind direction, temperature, humidity.
Cheshunt Weather Station	Wind speed, wind direction, temperature, humidity.
HVO Corp Weather Station	Wind speed, wind direction, temperature, humidity.
Cessnock Airport Automatic Weather Station (BoM) (Station No. 061260)	Wind speed, wind direction, temperature, humidity, sea level pressure.
Merriwa (Roscommon) Weather Station (BoM) (Station No, 061287)	Wind speed, wind direction, temperature, humidity, sea level pressure, cloud height, cloud amount.
Murrurundi Gap Automatic Weather Station (BoM) (Station No. 061392)	Wind speed, wind direction, temperature, humidity, sea level pressure, cloud height, cloud amount.
Paterson (Tocal) Automatic Weather Station (BoM) (Station No. 061250)	Wind speed, wind direction, temperature, humidity.
Scone Airport Automatic Weather Station (BoM) (Station No. 061363)	Wind speed, wind direction, temperature, humidity, sea level pressure.
Williamtown RAAF (BoM) (Station No. 061078)	Wind speed, wind direction, temperature, humidity, sea level pressure, cloud height, cloud amount.
Nullo Mountain Automatic Weather Station (BoM) (Station No. 062100)	Wind speed, wind direction, temperature, humidity.

Local land use and detailed topographical information including local mine topography was included in the simulation to produce realistic fine scale flow fields (such as terrain forced flows) in surrounding areas, as shown in **Figure 7-1**.

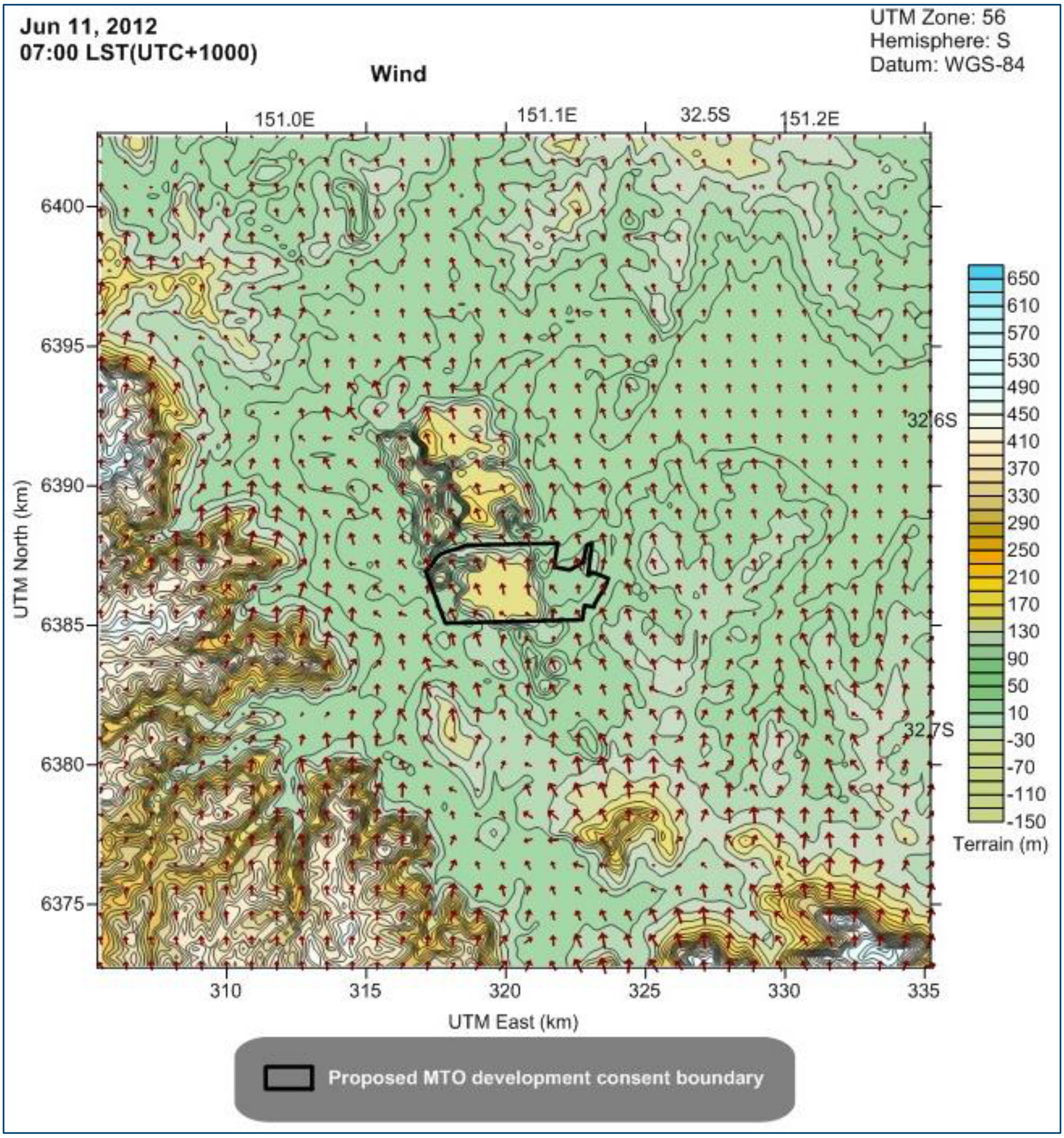

Figure 7-1: Representative snapshot of wind field for the proposal

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

Figure 7-2 presents annual and seasonal windroses extracted from one central point in the CALMET domain. On an annual basis, winds from the south-southeast are most frequent. During summer, winds from the south-southeast dominate the distribution with a spread of winds from the southeast quadrant. The autumn wind distribution shows the majority of winds originating from the south-southeast and south with some winds from the northwest. In winter, winds from the northwest are the most predominant. In spring, the wind distribution is more varied compared to the other seasons with winds from the northwest and southeast quadrants.

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. This is evident as the windroses based on the CALMET data also compare well with the windroses generated with the measured data, as presented in **Figure 4-3**.

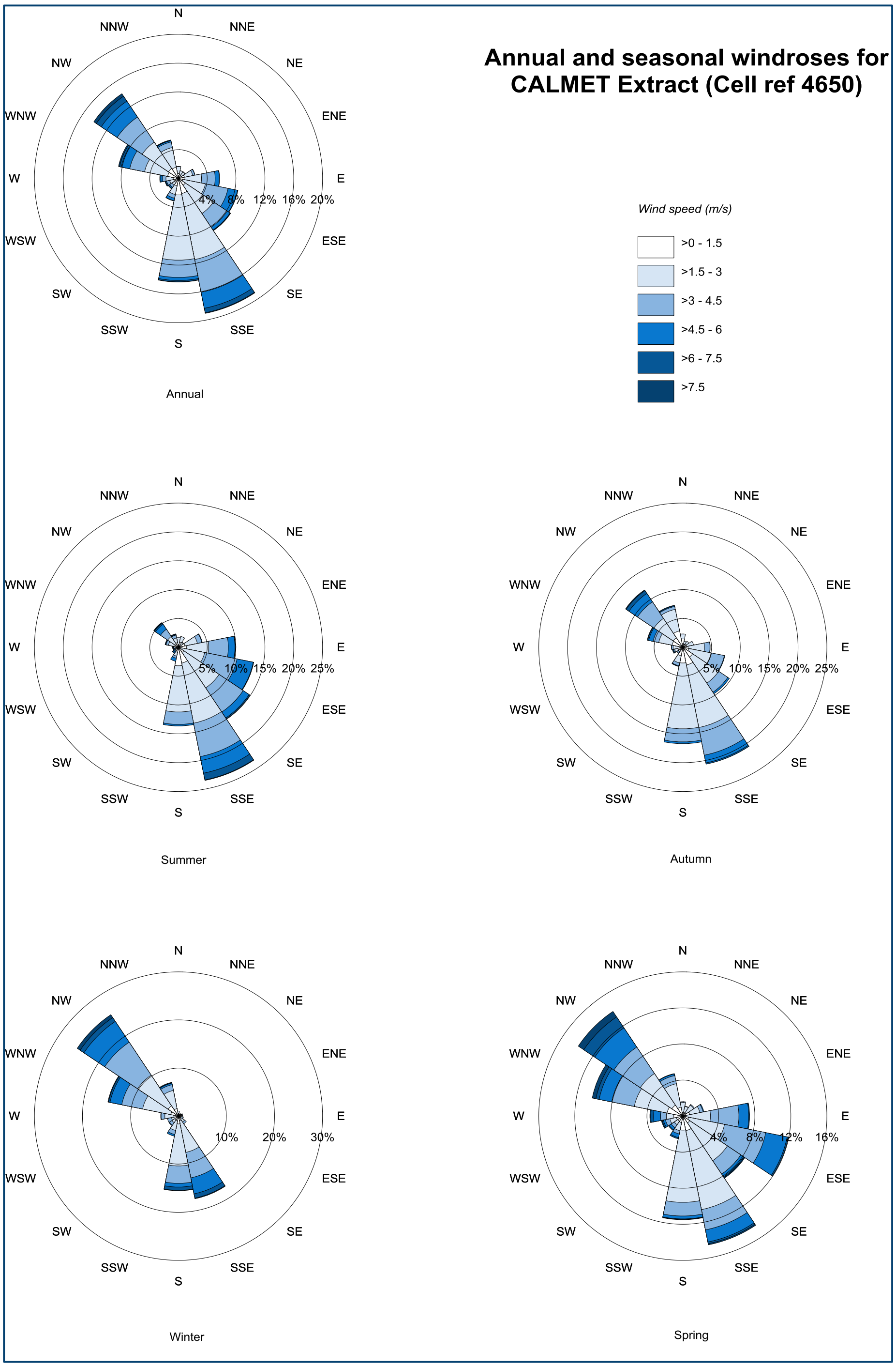

Figure 7-2: Windroses from CALMET extract (Cell ref 4650)

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

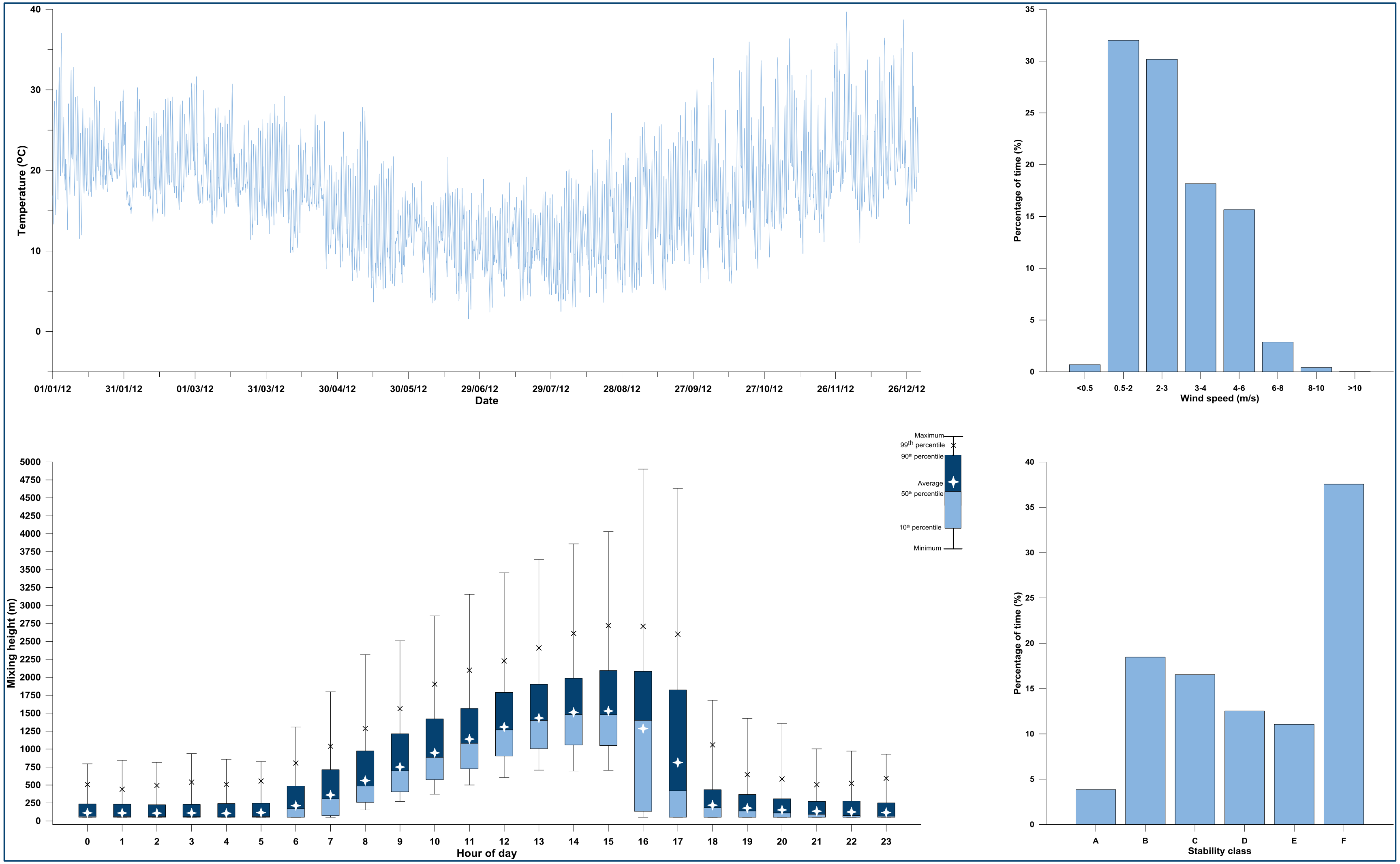

Figure 7-3: Meteorological analysis of CALMET extract (Cell ref 4650)

7.2.2 Dispersion modelling

CALPUFF modelling is based on the application of three particle size categories fine particulates, coarse matter and rest. The distribution of particles for each particle size category was derived from measurements in the **SPCC (1986)** study and is presented in **Table 7-2**.

Emissions from each activity in **Table 5-1** were represented by a series of volume sources and 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.

Table 7-2: Distribution of particles

Particle category	Size range	Distribution[1]
Fine particulates	0 to 2.5 µm	4.68% of TSP
Coarse matter	2.5 to 10 µm	34.4% of TSP
Rest	10 to 30 µm	60.92% of TSP

[1] Particle distribution sourced from **SPCC (1986)**

Each particle-size category is modelled separately and later combined to predict short term and long term average concentrations for $PM_{2.5}$, PM_{10}, and TSP. Dust deposition was predicted using the proven dry deposition algorithm within the CALPUFF model. Particle deposition is expressed in terms of atmospheric resistance through the surface layer, deposition layer resistance and gravitational settling (**Slinn and Slinn, 1980** and **Pleim et al., 1984**). Gravitational settling is a function of the particle size and density, simulated for spheres by the Stokes equation (**Gregory, 1973**).

CALPUFF is capable of tracking the mass balance of particles emitted into the modelling domain. For each hour CALPUFF tracks the mass emitted, the amount deposited, the amounts remaining in the surface mixed layer or the air above the mixed layer, and the amount advected out of the modelling domain. The versatility to address both dispersion and deposition algorithms in CALPUFF, combined with the 3D meteorological and land use field generally result in a more accurate model prediction compared to other Gaussian plume models (**Pfender et al 2006**).

8 ACCOUNTING FOR BACKGROUND DUST LEVELS

Other significant dust generating sources surrounding the proposal were explicitly included in the model, including Warkworth, Bulga, Wambo, Hunter Valley Operations and Rix's Creek coal mines. These mining operations are the nearest significant operations and variously contribute to particulate matter concentrations near the proposal. **Section 5** outlines how dust emissions from these sources have been accounted for in the modelling to assess cumulative effects.

Other dust generating activities in the surrounding area would also contribute to existing dust levels and an allowance for this contribution as well as contributions from other non-modelled dust sources is included in the assessment.

The contribution to the prevailing background dust levels of other non-modelled dust sources was estimated by modelling the past (known) mining activities (including Warkworth, Bulga, Wambo, Hunter Valley Operations and Rix's Creek coal mines) during January 2012 to December 2012 and comparing model predictions with the actual measured data from the corresponding monitoring stations. The average difference between the measured and predicted PM_{10}, TSP and deposited dust levels from each of the monitoring points was considered to be the contribution from other non-modelled dust sources, and was added to the future predicted values to account for the background dust levels (not already in the model and due to the numerous non-modelled dust sources).

This approach is preferable to modelling the proposal alone and adding a single constant background level at all points across the modelling domain to estimate cumulative impacts. This is because the approach includes modelling of other major sources (ie mines) that more reliably represent the higher dust levels near such sources, and also accounts for the seasonal and time varying changes in the background levels that arise from these major dust sources. In addition, to account for any underestimation from not including every source (as it's not possible to do that reasonably), the relatively smaller contribution arising from the other non-modelled dust sources, as determined above, was added to the results to obtain the most accurate predictions of future cumulative impacts across the modelled domain.

Using the approach described above, the estimated annual average contribution from other non-modelled dust sources in the surrounding area was found to be:

- PM_{10} – 6.9µg/m^3;
- TSP – 23.1µg/m^3; and,
- Deposited dust – 1.7g/m^2/month.

It is important that the above values are not confused with measured background levels, background levels excluding only the proposal, or the change in existing levels as a result of the proposal. The values above are not background levels in that sense, but are the residual, small amount of the background dust that is not accounted for directly in the air dispersion modelling.

To account for background levels when assessing total (cumulative) 24-hour average PM_{10} impacts, the mine only incremental levels are added to the total measured ambient dust levels (per the NSW EPA contemporaneous assessment guidance). Further details regarding the total cumulative 24-hour average PM_{10} impacts are provided in **Section 8.5**.

Predicted incremental (proposal alone) and total (cumulative) concentrations and dust deposition levels for short and long term averaging periods are presented in tabular format as well as contour plots in the following section of this report.

9 DISPERSION MODELLING RESULTS

The dispersion model predictions for each of the indicative mine plan years are presented in this section. The results show the estimated maximum 24-hour average and annual average $PM_{2.5}$ concentrations, maximum 24-hour and annual average PM_{10} concentrations, annual average TSP concentrations and annual average dust (insoluble solids) deposition (DD) rates for the proposal operating in isolation (the incremental impact) and with other sources (the total (cumulative) impact).

It is important to note that when assessing impacts for a maximum 24-hour average PM_{10} concentration; the predictions show the highest modelled predicted 24-hour average PM_{10} concentrations that occur at each point within the modelling domain for the worst day (a 24-hour period) over the one year modelling period. When assessing the total (cumulative) 24-hour average PM_{10} impacts based on model predictions, challenges arise as the predicted impacts are often overestimated by the model's inability to consider spatial and temporal variability in reality. Furthermore, the difficulties associated with identification and quantification of emissions from non-modelled sources over the 24-hour period result in additional complications. The potential 24-hour average PM_{10} impacts need to be calculated differently to annual average impacts and therefore the predicted total (cumulative) impacts for maximum 24-hour average PM_{10} concentrations have been addressed specifically in **Section 8.5**.

Each of the potential assessment locations shown in **Figure 2-1** and listed in **Appendix A** were assessed individually as discrete receptors with the predicted results presented in tabular form for each of the indicative mine plan years.

For sources not explicitly included in the model, and to fully account for all cumulative dust levels, the unaccounted fractions of background dust levels (which arise from the other non-modelled sources) as described in **Section 7**, were added to the model predictions with the results presented in the following sections for each of the indicative mine plan years.

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

9.1 Year 3 results

Table 9-1 presents the model predictions at each of the assessment locations. The values presented in bold indicate predicted values above the relevant criteria. The assessment locations highlighted in grey are identified as mine-owned assessment locations, and those highlighted in orange are privately-owned assessment locations already in the acquisition zone for other mine operations.

Figure E-1 to **Figure E-9** in **Appendix E** present isopleth diagrams of the predicted modelling results for each of the assessed pollutants in Year 3.

Table 9-1: Modelling predictions for Year 3 of the proposal

Assessment location ID	$PM_{2.5}$ (μg/m³)		PM_{10} (μg/m³)		TSP (μg/m³)	DD (g/m²/month)	PM_{10} (μg/m³)	TSP (μg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
1	1	0	4	1	1	0.02	10	28	1.80
2	1	0	4	1	1	0.02	10	29	1.81
3	1	0	4	1	1	0.02	10	29	1.83
4	1	0	4	1	1	0.02	10	29	1.83
5	1	0	4	1	1	0.02	10	29	1.83
6	1	0	4	1	1	0.02	10	29	1.83
7	1	0	4	1	1	0.02	10	29	1.84
8	1	0	5	1	1	0.03	11	29	1.86
9	1	0	4	1	1	0.02	10	29	1.86
10	1	0	5	1	2	0.03	11	30	1.85
11**	1	0	10	1	2	0.06	14	36	2.03
12	1	0	6	1	1	0.04	11	31	1.92
13	1	0	7	1	2	0.05	12	31	1.89
14	1	0	6	1	2	0.04	12	31	1.94
15	1	0	6	1	2	0.04	12	31	1.95
16	1	0	6	1	2	0.06	12	32	1.92
17	1	0	8	1	3	0.07	12	32	1.92
18	1	0	6	1	2	0.04	12	32	1.96
19	1	0	8	1	3	0.08	12	33	1.93
20	1	0	7	1	2	0.04	12	32	1.97
21	1	0	7	1	3	0.07	12	33	1.94
22	1	0	6	1	2	0.04	12	32	1.97
23	1	0	5	1	1	0.03	12	32	1.95
24	1	0	9	2	3	0.08	13	33	1.95
25	2	0	15	2	3	0.08	13	34	1.98
26	1	0	6	1	2	0.04	12	32	1.98
27	1	0	11	2	3	0.09	13	33	1.96
28	1	0	4	1	1	0.02	11	31	1.91
29	1	0	11	2	3	0.09	13	33	1.96
30	1	0	8	1	3	0.07	13	33	1.97
31	1	0	8	2	3	0.07	13	33	1.97
32	1	0	10	2	3	0.09	13	34	1.96
33	1	0	8	1	2	0.06	13	33	1.99
34	2	0	15	2	3	0.09	13	34	1.98
35	1	0	8	2	3	0.07	13	34	1.98
36	1	0	6	1	2	0.04	12	33	1.98
37	1	0	11	2	3	0.10	13	34	1.97
38	1	0	7	1	2	0.04	13	33	1.99
39	1	0	7	1	2	0.05	13	33	1.99
40	1	0	7	1	2	0.05	13	34	2.00
41	1	0	4	1	1	0.02	11	31	1.91
42	2	0	12	2	3	0.10	14	35	1.99
43	1	0	7	1	2	0.05	13	33	2.00

Assessment location ID	PM2.5 (µg/m³)		PM10 (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM10 (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
44	1	0	7	1	2	0.05	13	34	2.00
45	1	0	5	1	1	0.03	12	32	1.97
46	1	0	7	1	2	0.05	13	34	2.01
47	1	0	8	1	2	0.05	13	34	2.01
48	1	0	8	1	3	0.06	14	35	2.02
49	1	0	8	1	2	0.05	13	34	2.01
50	1	0	7	1	2	0.05	13	34	2.01
51	2	0	17	2	4	0.12	16	39	2.10
52	1	0	6	1	2	0.04	13	33	1.99
53	1	0	7	1	2	0.05	13	34	2.01
54	1	0	5	0	1	0.02	11	31	1.90
55	1	0	8	2	3	0.06	14	35	2.03
56	1	0	7	1	2	0.05	13	34	2.01
57	1	0	7	1	2	0.05	13	34	2.02
58	1	0	9	2	3	0.07	14	36	2.03
59	1	0	8	1	2	0.05	14	35	2.02
60	1	0	8	1	2	0.05	14	35	2.02
61	1	0	5	0	1	0.02	11	31	1.90
62	1	0	8	1	2	0.05	14	35	2.03
63	1	0	9	1	3	0.06	14	36	2.04
64	1	0	9	1	3	0.06	14	36	2.04
65	1	0	9	2	3	0.06	14	36	2.04
66	1	0	8	1	2	0.05	14	35	2.03
67	1	0	5	0	0	0.01	10	28	1.81
68	1	0	9	2	3	0.06	14	36	2.04
69	1	0	8	1	2	0.05	14	35	2.04
70	1	0	4	0	0	0.01	10	28	1.81
71	1	0	9	1	2	0.05	14	36	2.04
72	1	0	9	1	2	0.05	14	36	2.04
73	1	0	8	1	2	0.04	14	35	2.02
74	1	0	6	1	1	0.02	12	31	1.91
75	1	0	9	1	2	0.05	14	36	2.04
76	1	0	6	1	1	0.02	12	33	1.97
77	1	0	9	1	2	0.07	**32**	68	2.91
78	1	0	9	1	2	0.11	**32**	69	3.40
79**	1	0	10	1	2	0.07	**32**	68	2.88
80	1	0	5	0	1	0.01	11	29	1.84
81	2	0	17	3	6	0.17	17	41	2.14
82	1	0	6	1	1	0.02	12	32	1.94
83**	1	0	10	1	2	0.07	**32**	67	2.85
84	1	0	5	0	1	0.01	11	30	1.86
86	1	0	9	1	2	0.04	14	36	2.05
87	3	0	21	3	6	0.16	17	41	2.17
89	1	0	5	0	1	0.01	11	30	1.86

Assessment location ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
90	1	0	10	1	2	0.07	30	65	2.88
91**	1	0	10	1	2	0.08	30	65	2.92
92**	1	0	5	0	1	0.01	11	31	1.88
93	1	0	11	1	2	0.09	30	65	3.04
94**	1	0	11	1	2	0.07	30	64	2.91
95	2	0	13	2	3	0.06	16	39	2.11
96**	2	0	11	1	2	0.09	30	64	3.02
97	3	1	25	4	7	0.20	19	45	2.25
98	3	0	26	4	7	0.17	19	45	2.25
99**	2	0	12	1	2	0.10	30	65	3.20
100	3	1	20	4	7	0.20	19	45	2.21
101	3	1	24	4	8	0.22	20	46	2.28
102	2	0	12	1	2	0.10	30	65	3.26
103**	1	0	8	1	1	0.02	14	35	2.00
104	4	1	31	5	9	0.26	22	49	2.38
105	1	0	11	1	2	0.08	30	64	3.05
106	4	1	31	6	11	0.33	23	52	2.45
107	5	1	41	7	13	0.40	25	56	2.59
108	4	1	36	8	14	0.47	26	57	2.60
109**	2	0	16	2	4	0.15	**59**	**122**	**5.19**
110	6	1	49	9	17	0.52	28	62	2.73
111	1	0	4	0	0	0.01	10	28	1.83
112	9	2	**67**	15	28	0.91	**37**	79	3.16
113**	1	0	5	0	1	0.01	11	31	1.95
114	2	0	15	1	1	0.04	26	55	2.79
115**	1	0	8	1	1	0.02	19	45	2.45
116	1	0	6	1	1	0.04	21	47	2.43
117	1	0	6	1	1	0.02	21	47	2.58
118	1	0	6	1	1	0.03	21	47	2.53
118	1	0	6	1	1	0.03	21	47	2.53
119	1	0	5	1	1	0.03	21	46	2.41
120	1	0	4	0	1	0.02	18	42	2.38
121	1	0	4	1	1	0.02	19	43	2.43
122	1	0	4	0	1	0.02	18	41	2.34
123	1	0	4	1	1	0.02	18	42	2.37
124	1	0	4	0	1	0.02	18	41	2.32
125	1	0	5	1	1	0.03	23	50	2.36
126	1	0	6	1	2	0.03	**36**	73	2.59
127	0	0	4	1	1	0.01	18	40	2.14
128	1	0	5	1	1	0.02	25	53	2.33
129	1	0	5	1	1	0.02	21	47	2.25
130	1	0	5	1	1	0.02	20	45	2.21
131	1	0	9	1	3	0.05	28	60	2.47
133	0	0	4	0	1	0.01	16	38	2.08

Assessment location ID	PM2.5 (µg/m³)		PM10 (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM10 (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
134	1	0	5	1	1	0.02	19	43	2.17
135	2	0	18	3	5	0.10	28	60	2.65
136	2	0	18	3	5	0.10	28	60	2.63
137	1	0	5	1	1	0.02	18	41	2.14
138	2	0	16	2	4	0.08	28	61	2.61
139	1	0	5	1	1	0.02	19	42	2.16
140	2	0	17	3	5	0.10	26	57	2.58
141	0	0	4	0	1	0.01	15	36	2.03
142	1	0	5	1	1	0.02	17	40	2.12
143	1	0	5	1	1	0.02	17	39	2.10
144	1	0	10	3	4	0.08	23	51	2.43
145**	2	1	14	4	7	0.20	**36**	76	3.07
146	1	0	9	2	4	0.07	23	50	2.40
147	1	0	8	1	1	0.03	17	39	2.09
148	1	0	9	2	3	0.05	21	47	2.30
149	1	0	10	2	3	0.05	21	46	2.32
150	1	0	8	1	2	0.04	20	45	2.25
151**	1	0	9	2	3	0.06	24	53	2.52
152	1	0	7	1	1	0.02	16	38	2.06
153	1	0	8	1	2	0.04	19	44	2.24
154**	1	0	7	1	2	0.04	19	44	2.22
155	1	0	5	1	1	0.02	15	36	2.02
156	1	0	5	1	1	0.02	15	35	2.01
157	1	0	5	1	1	0.02	14	35	2.00
158	1	0	10	1	1	0.03	27	58	3.59
160	1	0	6	0	1	0.02	18	42	2.48
161	1	0	6	0	1	0.02	17	40	2.33
162	1	0	6	0	1	0.02	17	41	2.35
163	1	0	5	0	1	0.02	17	39	2.25
165	1	0	6	1	1	0.03	21	47	2.43
167	0	0	4	0	1	0.01	14	35	1.99
168	0	0	3	0	1	0.01	14	35	1.97
169	1	0	4	0	1	0.01	15	36	2.03
170	0	0	4	0	1	0.01	15	36	2.00
172	1	0	5	1	1	0.01	16	38	2.07
173	1	0	5	1	1	0.01	16	38	2.06
174	1	0	5	0	1	0.01	15	36	2.01
175	1	0	4	0	1	0.01	14	35	2.00
176	1	0	4	0	1	0.01	14	35	1.99
177	1	0	5	0	1	0.01	14	34	1.98
178	1	0	4	0	1	0.01	14	34	1.95
179	1	0	4	0	1	0.01	13	33	1.95
180	1	0	7	1	1	0.02	14	35	2.00
181	1	0	7	1	1	0.02	15	36	2.02

Assessment location ID	PM2.5 (µg/m³)		PM10 (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM10 (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
182	1	0	7	1	1	0.02	14	35	2.01
183	1	0	8	1	1	0.02	15	37	2.04
184	1	0	6	1	1	0.02	14	35	2.02
185	1	0	7	1	1	0.02	15	36	2.03
186	1	0	7	1	1	0.02	15	36	2.04
187	1	0	7	1	1	0.02	15	36	2.03
188	1	0	5	1	1	0.02	15	36	2.03
189**	1	0	6	1	2	0.03	18	41	2.15
190	1	0	8	1	2	0.04	20	45	2.25
191	1	0	7	1	1	0.02	16	37	2.06
192	1	0	8	1	1	0.03	16	39	2.09
193	0	0	2	0	0	0.00	8	25	1.74
194**	0	0	3	0	0	0.01	9	26	1.77
195**	1	0	4	0	0	0.01	9	27	1.79
196**	1	0	4	0	0	0.01	9	27	1.77
197	0	0	3	0	0	0.01	9	26	1.76
198**	0	0	2	0	0	0.01	8	26	1.75
199	0	0	1	0	0	0.00	8	24	1.72
200	0	0	2	0	0	0.00	8	25	1.73
201	0	0	2	0	0	0.00	8	25	1.73
202	0	0	2	0	0	0.00	8	25	1.73
203	0	0	2	0	0	0.00	8	25	1.73
204	0	0	2	0	0	0.00	8	25	1.73
205	0	0	2	0	0	0.00	8	25	1.73
206	0	0	2	0	0	0.00	8	25	1.73
207	0	0	2	0	0	0.00	8	25	1.73
208	0	0	3	0	0	0.00	8	25	1.74
209**	3	0	20	3	5	0.18	**32**	67	2.84
210	1	0	9	1	3	0.06	14	35	2.03
211	1	0	9	2	3	0.06	14	36	2.04
215	1	0	8	1	3	0.07	13	33	1.98
217	1	0	5	1	1	0.03	11	30	1.89
218	1	0	4	1	1	0.03	10	29	1.82
219	1	0	4	1	1	0.02	10	29	1.81
220	1	0	4	1	1	0.02	10	29	1.82
221	1	0	3	0	1	0.01	10	28	1.80
222	1	0	3	0	1	0.01	10	28	1.81
223	1	0	4	0	1	0.02	10	28	1.83
224	1	0	3	0	1	0.02	10	29	1.84
225	1	0	4	1	1	0.03	11	30	1.89
226	1	0	4	1	1	0.03	11	30	1.91
227	1	0	4	1	1	0.03	11	30	1.91
228	1	0	4	1	1	0.03	11	30	1.92
229	1	0	5	1	1	0.03	11	31	1.94

Assessment location ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
230	1	0	4	1	1	0.03	11	31	1.93
231	1	0	5	1	1	0.03	12	31	1.94
234	1	0	5	0	1	0.01	11	30	1.88
235	1	0	5	0	1	0.01	11	30	1.87
236	1	0	6	1	1	0.02	12	31	1.91
237	1	0	5	0	1	0.01	11	30	1.86
238	1	0	5	0	1	0.01	11	30	1.87
243	1	0	5	0	1	0.01	10	29	1.83
244	0	0	4	0	1	0.01	17	39	2.20
245	1	0	4	0	1	0.02	17	39	2.20
246	0	0	4	0	1	0.01	16	38	2.15
247	0	0	4	0	1	0.01	16	38	2.14
248	1	0	5	0	1	0.01	14	35	1.99
249	1	0	4	0	1	0.01	14	34	1.97
250	0	0	4	0	1	0.01	13	33	1.93
251	0	0	4	0	1	0.01	13	32	1.92
252	1	0	6	1	1	0.02	12	32	1.93
253	1	0	5	1	1	0.03	12	31	1.95
254	1	0	5	0	1	0.01	11	31	1.90
255	1	0	7	1	3	0.07	12	33	1.93
256	1	0	5	0	1	0.02	17	39	2.21
257	0	0	4	0	1	0.01	17	39	2.17
258	1	0	5	0	1	0.02	17	39	2.24
259	1	0	6	1	1	0.03	21	46	2.51
260	1	0	5	0	1	0.02	18	41	2.35
261	1	0	6	0	1	0.02	18	42	2.43
262	1	0	6	1	2	0.03	**34**	69	2.54
263	1	0	8	1	1	0.02	16	38	2.07
264	2	0	12	1	2	0.11	**31**	66	3.41
265	1	0	6	1	1	0.02	21	46	2.57
266	1	0	5	1	1	0.04	10	29	1.88
267	0	0	3	1	1	0.03	10	28	1.83
268	0	0	3	1	1	0.03	9	27	1.80
269**	1	0	9	1	2	0.05	12	32	1.96
270**	1	0	9	1	2	0.06	15	36	2.04
271**	1	0	6	1	1	0.02	**44**	88	3.00
903	1	0	4	0	1	0.01	10	29	1.82
904	0	0	3	0	0	0.01	9	27	1.77
905	0	0	3	0	0	0.00	9	26	1.75
909	1	0	4	0	0	0.01	10	28	1.80
911	0	0	3	0	0	0.00	9	26	1.76
915	1	0	11	3	5	0.08	23	52	2.46
917	1	0	4	0	0	0.01	10	28	1.80
918	1	0	4	0	0	0.01	10	28	1.81

Assessment location ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
919	1	0	5	1	1	0.03	12	32	1.96
920	1	0	8	1	2	0.05	14	35	2.03
921	1	0	4	1	1	0.02	11	30	1.90
922	1	0	3	0	1	0.01	10	29	1.85
923	0	0	2	0	0	0.00	8	25	1.74
926	0	0	3	0	0	0.00	8	26	1.75
927a	1	0	3	0	0	0.01	9	27	1.77
927b	1	0	3	0	0	0.01	9	27	1.77
927c	1	0	4	0	0	0.01	9	27	1.78
927d	0	0	2	0	0	0.00	8	26	1.75
927e	0	0	2	0	0	0.00	9	26	1.75
927f	0	0	2	0	0	0.00	9	26	1.75
927g	0	0	2	0	0	0.00	8	25	1.73
927h	0	0	2	0	0	0.00	8	25	1.74
927i	0	0	2	0	0	0.00	8	25	1.74
927j	0	0	2	0	0	0.00	8	25	1.74
928	1	0	4	0	0	0.01	9	27	1.78
929	1	0	4	0	0	0.01	10	28	1.80
932	1	0	6	1	1	0.02	15	37	2.03
936	1	0	4	0	0	0.01	9	27	1.79
937a	1	0	6	1	1	0.02	16	37	2.06
937b	1	0	6	1	1	0.02	15	37	2.04
937c	1	0	6	1	1	0.01	15	36	2.01
937d	1	0	6	1	1	0.02	15	37	2.04
937e	1	0	6	1	1	0.02	15	37	2.04
941**	2	0	12	1	2	0.10	30	65	3.27

*Advisory NEPM reporting standard applicable to the population as a whole

**Other mine owned property

9.1.1 Predicted maximum 24-hour and annual average $PM_{2.5}$ concentrations

Figure E-1 and **Figure E-2** show the predicted maximum 24-hour average and annual average $PM_{2.5}$ concentrations for Year 3 due to emissions from the proposal. The results in **Table 9-1** indicate that all assessment locations are predicted to experience a maximum 24-hour average and annual average concentration below the advisory reporting standards of 25µg/m³ and 8µg/m³, respectively in Year 3.

9.1.2 Predicted maximum 24-hour and annual average PM_{10} concentrations

Figure E-3 shows the predicted maximum 24-hour average PM_{10} concentrations for Year 3 due to emissions from the proposal. The results in **Table 9-1** indicate that all assessment locations with the exception of assessment location 112 are predicted to experience maximum 24-hour average PM_{10} concentrations below the relevant criterion of 50µg/m³ in Year 3.

An analysis of the number of days that the P&I acquisition criterion of 50µg/m^3 would be exceeded at this assessment location is presented in **Table 9-2**. The analysis indicates that assessment location 112 would experience levels systemically above the criterion (eg on more than five days).

Table 9-2: Analysis of Year 3 – maximum 24-hour average PM_{10} concentrations

Assessment location ID	Number of days over 50µg/m^3
112	**6**

Results for the total (cumulative) impact for maximum 24-hour average PM_{10} concentrations are discussed in **Section 9.5**.

Figure E-4 shows the predicted annual average PM_{10} concentrations for Year 3 due to emissions from the proposal. **Figure E-5** shows the predicted total impact from the proposal and other sources. The results in **Table 9-1** indicate that assessment locations 77, 78, 79, 83, 109, 112, 126, 145, 209, 262, 264 and 271 are predicted to experience annual average PM_{10} concentrations above the relevant criterion of 30µg/m^3 in Year 3. All assessment locations are mine-owned with the exception of assessment locations 77, 102 and 264. Assessment locations 77 and 102 are in the acquisition zone under the current development consent.

It is noted that assessment locations 209 and 271 are largely unaffected by activity from the proposal. These locations would be influenced by other dust sources in the area as indicated by the low incremental predictions due to the proposal in **Table 9-1**.

9.1.3 Predicted annual average TSP concentrations

Figure E-6 shows the predicted annual average TSP concentrations for Year 3 due to emissions from the proposal. **Figure E-7** shows the predicted total impact from the proposal and other sources. The results in **Table 9-1** indicate that all assessment locations are predicted to experience annual average TSP concentrations below the relevant criterion of 90µg/m^3 in Year 3, with the exception of assessment location 109. Assessment location 109 is a mine-owned property.

9.1.4 Predicted annual average dust deposition levels

Figure E-8 shows the predicted annual average dust deposition levels for Year 3 due to emissions from the proposal. **Figure E-9** shows the predicted total impact from the proposal and other sources.

The results in **Table 9-1** indicate that all of the assessment locations are predicted to experience incremental annual average dust deposition levels below the relevant criterion of 2g/m^2/month in Year 3. All of the assessment locations with the exception of assessment location 109 are predicted to experience total annual average dust deposition levels below the relevant criterion of 4g/m^2/month in Year 3 from the proposal and other sources. Assessment location 109 is a mine-owned property.

9.2 Year 9 results

Table 9-3 presents the model predictions at each of the assessment locations, the values presented in bold indicate predicted values above the relevant criteria. The assessment locations highlighted in grey are identified as mine-owned assessment locations, and those highlighted in orange are privately-owned assessment locations already in the acquisition zone for other mine operations.

Figure E-10 to **Figure E-18** in **Appendix E** present isopleth diagrams of the predicted modelling results for each of the assessed pollutants in Year 9.

Table 9-3: Modelling predictions for Year 9 of the proposal

Assessment location ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
1	1	0	4	1	1	0.02	10	28	1.79
2	1	0	4	1	1	0.02	10	28	1.79
3	1	0	4	1	1	0.02	10	28	1.81
4	1	0	3	0	1	0.02	10	28	1.81
5	1	0	4	1	1	0.02	10	28	1.81
6	1	0	4	1	1	0.02	10	28	1.81
7	1	0	3	0	1	0.02	10	28	1.81
8	1	0	4	1	1	0.02	10	29	1.83
9	1	0	4	0	1	0.02	10	28	1.83
10	1	0	5	1	1	0.03	11	29	1.83
11**	1	0	8	1	2	0.06	15	37	2.06
12	1	0	5	1	1	0.03	11	30	1.88
13	1	0	5	1	2	0.04	11	31	1.87
14	1	0	5	1	1	0.03	11	30	1.89
15	1	0	5	1	1	0.03	11	30	1.90
16	1	0	5	1	2	0.05	12	31	1.89
17	1	0	6	1	2	0.06	12	32	1.91
18	1	0	5	1	1	0.03	11	30	1.91
19	1	0	7	1	2	0.06	12	33	1.92
20	1	0	5	1	1	0.03	11	31	1.92
21	1	0	6	1	2	0.05	12	32	1.91
22	1	0	5	1	1	0.03	11	31	1.92
23	1	0	4	1	1	0.03	11	30	1.90
24	1	0	7	1	2	0.07	13	33	1.93
25	1	0	10	1	2	0.06	14	35	2.01
26	1	0	5	1	1	0.03	12	31	1.92
27	1	0	8	1	2	0.07	13	34	1.96
28	1	0	4	0	1	0.02	11	30	1.87
29	1	0	8	1	2	0.07	13	34	1.97
30	1	0	7	1	2	0.05	12	32	1.93
31	1	0	7	1	2	0.06	12	33	1.93
32	1	0	8	1	2	0.07	13	34	1.95
33	1	0	7	1	2	0.04	12	32	1.93

Assessment location ID	PM2.5 (µg/m³)		PM10 (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM10 (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
34	1	0	10	1	2	0.07	14	35	2.01
35	1	0	7	1	2	0.06	13	33	1.94
36	1	0	5	1	1	0.03	12	31	1.93
37	1	0	8	1	2	0.07	13	34	1.97
38	1	0	5	1	1	0.03	12	31	1.93
39	1	0	6	1	2	0.04	12	32	1.93
40	1	0	6	1	2	0.04	12	32	1.94
41	1	0	4	0	1	0.01	11	30	1.87
42	1	0	9	1	3	0.07	13	34	1.96
43	1	0	6	1	2	0.04	12	32	1.94
44	1	0	6	1	2	0.04	12	32	1.94
45	1	0	4	1	1	0.02	11	31	1.91
46	1	0	6	1	2	0.04	12	32	1.94
47	1	0	6	1	2	0.04	12	33	1.95
48	1	0	6	1	2	0.05	13	33	1.95
49	1	0	6	1	2	0.04	13	33	1.95
50	1	0	5	1	2	0.04	12	32	1.94
51	2	0	13	2	3	0.10	17	40	2.16
52	1	0	5	1	1	0.03	12	32	1.93
53	1	0	5	1	2	0.04	12	33	1.95
54	1	0	4	0	1	0.01	11	30	1.87
55	1	0	6	1	2	0.05	13	33	1.96
56	1	0	5	1	2	0.04	12	33	1.95
57	1	0	5	1	2	0.04	13	33	1.95
58	1	0	6	1	2	0.05	13	34	1.97
59	1	0	5	1	2	0.04	13	33	1.95
60	1	0	5	1	2	0.04	13	33	1.95
61	1	0	4	0	1	0.01	11	30	1.87
62	1	0	6	1	2	0.04	13	33	1.96
63	1	0	6	1	2	0.04	13	34	1.97
64	1	0	6	1	2	0.04	13	34	1.96
65	1	0	6	1	2	0.05	13	34	1.97
66	1	0	6	1	2	0.04	13	34	1.96
67	1	0	4	0	0	0.01	10	28	1.80
68	1	0	6	1	2	0.05	13	34	1.97
69	1	0	6	1	2	0.04	13	34	1.96
70	1	0	3	0	0	0.01	10	28	1.79
71	1	0	6	1	2	0.04	13	34	1.97
72	1	0	6	1	2	0.04	13	34	1.97
73	1	0	6	1	1	0.03	13	33	1.95
74	1	0	5	0	1	0.01	11	30	1.88
75	1	0	6	1	2	0.04	13	34	1.97
76	1	0	5	1	1	0.02	12	31	1.91
77	1	0	8	1	2	0.08	**36**	75	3.15

Assessment location ID	PM$_{2.5}$ (µg/m³)		PM$_{10}$ (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM$_{10}$ (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
78	1	0	6	1	2	0.09	**55**	**110**	**4.86**
79**	1	0	8	1	2	0.07	**35**	73	3.09
80	1	0	4	0	0	0.01	10	29	1.82
81	2	0	12	2	4	0.13	16	40	2.08
82	1	0	5	0	1	0.01	12	31	1.90
83**	1	0	8	1	2	0.07	**34**	71	3.03
84	1	0	5	0	1	0.01	11	29	1.84
86	1	0	7	1	2	0.03	13	34	1.98
87	1	0	10	2	4	0.11	16	39	2.08
89	1	0	4	0	1	0.01	11	29	1.84
90	1	0	9	1	2	0.07	**32**	68	3.06
91**	1	0	9	1	2	0.08	**32**	69	3.12
92**	1	0	4	0	1	0.01	11	30	1.85
93	1	0	9	1	2	0.09	**33**	69	3.30
94**	1	0	9	1	2	0.08	**31**	67	3.08
95	1	0	8	1	2	0.04	15	37	2.02
96**	1	0	9	1	2	0.09	**31**	67	3.23
97	1	0	12	2	5	0.14	18	42	2.14
98	1	0	11	2	4	0.12	18	42	2.12
99**	1	0	10	1	2	0.10	**32**	68	3.44
100	2	0	14	3	5	0.15	19	44	2.15
101	2	0	12	3	5	0.16	19	44	2.17
102	1	0	10	1	2	0.10	**31**	67	3.46
103**	1	0	6	1	1	0.02	13	33	1.94
104	2	0	13	3	6	0.17	20	46	2.22
105	1	0	8	1	2	0.07	28	61	2.94
106	2	0	16	4	7	0.22	22	50	2.30
107	2	0	15	4	7	0.25	22	50	2.36
108	2	1	20	4	9	0.29	28	61	2.52
109**	2	0	14	2	3	0.11	**35**	75	3.64
110	2	1	19	5	9	0.34	25	56	2.48
111	1	0	3	0	0	0.01	10	28	1.83
112	3	1	29	7	15	0.53	**34**	72	2.82
113**	1	0	4	0	1	0.01	11	30	1.94
114	1	0	9	1	2	0.04	22	49	2.57
115**	1	0	6	1	1	0.02	18	42	2.33
116	1	0	8	1	2	0.06	20	45	2.32
117	1	0	8	1	2	0.04	19	44	2.44
118	1	0	9	1	2	0.05	19	44	2.40
118	1	0	9	1	2	0.05	19	44	2.40
119	1	0	10	2	2	0.06	19	44	2.30
120	1	0	8	1	2	0.03	17	40	2.27
121	1	0	8	1	2	0.04	18	41	2.31
122	1	0	7	1	2	0.03	17	39	2.24

Assessment location ID	PM2.5 (µg/m³)		PM10 (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM10 (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
123	1	0	8	1	2	0.03	17	40	2.27
124	1	0	7	1	2	0.03	17	39	2.23
125	2	0	13	2	4	0.06	20	44	2.20
126	2	0	14	3	4	0.07	23	49	2.26
127	1	0	8	1	2	0.03	17	39	2.08
128	2	0	14	2	3	0.05	19	44	2.17
129	2	0	14	2	3	0.04	18	41	2.13
130	2	0	13	2	2	0.04	17	40	2.10
131	3	1	21	4	6	0.09	24	53	2.28
133	1	0	10	1	2	0.02	16	37	2.03
134	1	0	12	1	2	0.03	17	39	2.08
135	6	1	44	9	14	0.20	30	62	2.59
136	5	1	42	8	13	0.19	29	60	2.56
137	1	0	10	1	2	0.03	16	38	2.06
138	4	1	32	6	10	0.15	27	57	2.47
139	1	0	10	1	2	0.03	16	39	2.07
140	5	1	40	7	12	0.17	27	57	2.50
141	1	0	9	1	1	0.02	16	36	1.99
142	1	0	9	1	2	0.03	16	37	2.05
143	1	0	9	1	2	0.02	16	37	2.03
144	3	0	21	4	6	0.09	21	46	2.30
145**	4	1	33	7	12	0.27	**41**	85	3.12
146	3	0	19	3	5	0.08	20	45	2.26
147	2	0	15	2	2	0.03	16	37	2.02
148	2	0	17	3	4	0.07	19	43	2.18
149	3	0	23	3	5	0.08	19	44	2.22
150	2	0	16	2	4	0.06	18	41	2.13
151**	3	0	22	3	6	0.12	23	51	2.42
152	2	0	13	1	2	0.03	15	36	2.00
153	2	0	17	2	4	0.06	18	41	2.14
154**	2	0	16	2	3	0.06	17	40	2.12
155	1	0	11	1	1	0.02	14	35	1.98
156	1	0	10	1	1	0.02	14	34	1.97
157	1	0	10	1	1	0.02	14	34	1.96
158	1	0	6	1	1	0.04	24	53	3.25
160	1	0	7	1	1	0.03	17	40	2.36
161	1	0	7	1	1	0.03	17	39	2.25
162	1	0	7	1	1	0.03	17	39	2.26
163	1	0	7	1	1	0.03	17	38	2.19
165	1	0	9	1	2	0.06	19	44	2.32
167	1	0	6	1	1	0.01	15	35	1.96
168	1	0	5	1	1	0.01	15	35	1.95
169	1	0	7	1	1	0.02	15	36	1.99
170	1	0	6	1	1	0.01	15	36	1.97

Assessment location ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
172	1	0	8	1	2	0.02	15	36	2.02
173	1	0	8	1	2	0.02	15	36	2.01
174	1	0	7	1	1	0.02	14	35	1.97
175	1	0	7	1	1	0.02	14	35	1.97
176	1	0	6	1	1	0.01	14	34	1.96
177	1	0	6	1	1	0.01	14	34	1.95
178	1	0	5	1	1	0.01	14	35	1.94
179	1	0	6	1	1	0.01	14	34	1.93
180	1	0	11	1	1	0.02	14	34	1.96
181	2	0	12	1	2	0.02	14	35	1.98
182	2	0	12	1	1	0.02	14	34	1.97
183	2	0	13	1	2	0.02	14	35	1.99
184	2	0	12	1	2	0.02	14	34	1.97
185	2	0	12	1	2	0.03	14	35	1.98
186	2	0	12	1	2	0.03	14	35	1.99
187	1	0	11	1	2	0.03	14	35	1.99
188	1	0	10	1	2	0.03	14	35	1.98
189**	2	0	13	2	3	0.05	16	38	2.06
190	2	0	16	2	4	0.06	18	41	2.13
191	2	0	14	1	2	0.03	15	36	2.00
192	2	0	15	1	2	0.03	15	37	2.02
193	0	0	2	0	0	0.00	8	25	1.74
194**	0	0	2	0	0	0.01	9	26	1.78
195**	0	0	3	0	0	0.01	9	27	1.80
196**	0	0	3	0	0	0.01	9	27	1.78
197	0	0	2	0	0	0.01	9	26	1.76
198**	0	0	2	0	0	0.00	8	26	1.75
199	0	0	1	0	0	0.00	8	25	1.72
200	0	0	2	0	0	0.00	8	25	1.73
201	0	0	2	0	0	0.00	8	25	1.73
202	0	0	1	0	0	0.00	8	25	1.73
203	0	0	1	0	0	0.00	8	25	1.73
204	0	0	2	0	0	0.00	8	25	1.73
205	0	0	2	0	0	0.00	8	25	1.73
206	0	0	2	0	0	0.00	8	25	1.73
207	0	0	2	0	0	0.00	8	25	1.73
208	0	0	2	0	0	0.00	8	25	1.74
209**	2	0	12	3	4	0.14	**35**	72	2.92
210	1	0	6	1	2	0.04	13	34	1.96
211	1	0	6	1	2	0.04	13	34	1.97
215	1	0	7	1	2	0.05	12	32	1.93
217	1	0	4	1	1	0.03	11	29	1.86
218	1	0	4	1	1	0.02	10	29	1.81
219	1	0	4	1	1	0.02	10	28	1.80

Assessment location ID	PM2.5 (µg/m³)		PM10 (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM10 (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
220	1	0	4	0	1	0.02	10	28	1.80
221	1	0	3	0	1	0.01	9	27	1.79
222	1	0	3	0	1	0.01	9	27	1.79
223	1	0	3	0	1	0.01	10	28	1.81
224	1	0	3	0	1	0.01	10	28	1.82
225	1	0	4	0	1	0.02	10	29	1.86
226	1	0	4	1	1	0.02	10	29	1.87
227	1	0	4	1	1	0.02	11	29	1.87
228	1	0	4	1	1	0.02	11	29	1.88
229	1	0	4	1	1	0.03	11	30	1.89
230	1	0	4	1	1	0.02	11	30	1.89
231	1	0	4	1	1	0.03	11	30	1.90
234	1	0	4	0	1	0.01	11	29	1.85
235	1	0	4	0	1	0.01	10	29	1.84
236	1	0	5	0	1	0.01	11	30	1.87
237	1	0	4	0	1	0.01	10	29	1.83
238	1	0	5	0	1	0.01	11	29	1.85
243	1	0	3	0	0	0.01	10	29	1.82
244	1	0	7	1	1	0.03	17	38	2.13
245	1	0	7	1	1	0.03	17	38	2.14
246	1	0	6	1	1	0.03	16	38	2.10
247	1	0	7	1	1	0.03	17	38	2.10
248	1	0	6	1	1	0.02	14	34	1.96
249	1	0	5	1	1	0.01	14	35	1.95
250	1	0	6	0	1	0.01	15	35	1.94
251	1	0	7	0	1	0.01	14	34	1.92
252	1	0	5	0	1	0.01	11	31	1.89
253	1	0	4	1	1	0.03	11	30	1.90
254	1	0	5	0	1	0.01	11	30	1.86
255	1	0	6	1	2	0.05	12	32	1.91
256	1	0	6	1	1	0.03	16	38	2.16
257	1	0	7	1	1	0.03	17	38	2.12
258	1	0	6	1	1	0.03	16	38	2.18
259	1	0	9	1	2	0.05	19	43	2.37
260	1	0	7	1	1	0.03	17	39	2.26
261	1	0	7	1	1	0.03	17	40	2.32
262	2	0	14	3	4	0.06	22	48	2.25
263	2	0	14	1	2	0.03	15	36	2.01
264	1	0	10	1	2	0.11	**32**	68	3.58
265	1	0	8	1	2	0.04	19	44	2.43
266	0	0	4	1	1	0.04	11	29	1.89
267	0	0	2	0	1	0.03	10	28	1.84
268	0	0	2	0	1	0.02	10	28	1.80
269**	1	0	7	1	1	0.05	13	33	1.99

Assessment location ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
270**	1	0	7	1	2	0.05	15	38	2.08
271**	1	0	4	1	1	0.02	**46**	**92**	3.08
903	1	0	3	0	0	0.01	10	28	1.81
904	0	0	3	0	0	0.00	9	26	1.77
905	0	0	3	0	0	0.00	8	26	1.75
909	1	0	3	0	0	0.01	9	27	1.79
911	0	0	3	0	0	0.00	9	26	1.76
915	3	1	23	4	6	0.10	21	47	2.33
917	1	0	3	0	0	0.01	10	28	1.79
918	1	0	3	0	0	0.01	10	28	1.80
919	1	0	4	1	1	0.02	11	31	1.91
920	1	0	6	1	2	0.04	13	33	1.96
921	1	0	4	0	1	0.01	11	29	1.86
922	0	0	3	0	1	0.01	10	28	1.83
923	0	0	2	0	0	0.00	8	25	1.75
926	0	0	2	0	0	0.00	8	26	1.75
927a	0	0	3	0	0	0.00	9	27	1.77
927b	0	0	3	0	0	0.00	9	26	1.77
927c	0	0	3	0	0	0.00	9	27	1.77
927d	0	0	2	0	0	0.00	8	25	1.75
927e	0	0	2	0	0	0.00	8	26	1.75
927f	0	0	2	0	0	0.00	8	26	1.75
927g	0	0	2	0	0	0.00	8	25	1.73
927h	0	0	2	0	0	0.00	8	25	1.74
927i	0	0	2	0	0	0.00	8	25	1.74
927j	0	0	2	0	0	0.00	8	25	1.74
928	0	0	3	0	0	0.01	9	27	1.78
929	1	0	3	0	0	0.01	9	27	1.79
932	1	0	11	1	2	0.03	14	35	1.99
936	1	0	3	0	0	0.01	9	27	1.78
937a	1	0	8	1	2	0.02	15	36	2.00
937b	1	0	8	1	1	0.02	15	35	1.99
937c	1	0	7	1	1	0.02	14	35	1.97
937d	1	0	11	1	2	0.02	15	35	1.99
937e	1	0	11	1	2	0.02	14	35	1.99
941**	1	0	10	1	2	0.10	**31**	67	3.46

*Advisory NEPM reporting standard applicable to the population as a whole
**Other mine owned property

9.2.1 Predicted maximum 24-hour and annual average $PM_{2.5}$ concentrations

Figure E-10 and **Figure E-11** show the predicted maximum 24-hour average and annual average $PM_{2.5}$ concentrations for Year 9 due to emissions from the proposal. The results in **Table 9-3** indicate that all assessment locations are predicted to experience a maximum 24-hour average and annual average concentrations below the advisory reporting standards of 25µg/m³ and 8µg/m³, respectively in Year 9.

9.2.2 Predicted maximum 24-hour and annual average PM_{10} concentrations

Figure E-12 shows the predicted maximum 24-hour average PM_{10} concentrations for Year 9 due to emissions from the proposal. The results in **Table 9-3** indicate that all assessment locations are predicted to experience maximum 24-hour average PM_{10} concentrations below the relevant criterion of 50µg/m^3 in Year 9.

Results for the total (cumulative) impact for maximum 24-hour average PM_{10} concentrations are discussed in **Section 9.5**.

Figure E-13 shows the predicted annual average PM_{10} concentrations for Year 9 due to emissions from the proposal. **Figure E-14** shows the predicted total impact from the proposal and other sources. The results in **Table 9-3** indicate that assessment locations 77, 78, 79, 83, 90, 91, 93, 94, 96, 99, 102, 109, 112, 145, 209, 264, 271 and 941 are predicted to experience annual average PM_{10} concentrations above the relevant criterion of 30µg/m^3 in Year 9. All assessment locations are mine-owned with the exception of assessment locations 77, 102 and 264. Assessment locations 77 and 102 are in the acquisition zone under the current development consent.

It is noted that assessment locations 145, 209 and 271 are largely unaffected by activity from the proposal. These locations would be influenced by other dust sources in the area as indicated by the incremental predictions due to the proposal in **Table 9-3**.

9.2.3 Predicted annual average TSP concentrations

Figure E-15 shows the predicted annual average TSP concentrations for Year 9 due to emissions from the proposal. **Figure E-16** shows the predicted total impact from the proposal and other sources. The results in **Table 9-3** indicate that assessment locations 78 and 271 are predicted to experience annual average TSP concentrations above the relevant criterion of 90µg/m^3 in Year 9. Assessment locations 78 and 271 are mine-owned properties.

It is noted that assessment location 271 is largely unaffected by activity from the proposal. This location would be influenced by other dust sources in the area as indicated by the incremental predictions due to the proposal in **Table 9-3**.

9.2.4 Predicted annual average dust deposition levels

Figure E-17 shows the predicted annual average dust deposition levels for Year 9 due to emissions from the proposal. **Figure E-18** shows the predicted total impact from the proposal and other sources.

The results in **Table 9-3** indicate that all assessment locations are predicted to experience incremental annual average dust deposition levels below the relevant criterion of 2g/m^2/month in Year 9. Assessment location 78 is predicted to experience total annual average dust deposition levels above the relevant criterion of 4g/m^2/month in Year 9 from the proposal and other sources. Assessment location 78 is a mine-owned property.

9.3 Year 14 results

Table 9-4 presents the model predictions at each of the assessment locations, the values presented in bold indicate predicted values above the relevant criteria. The assessment locations highlighted in grey are identified as mine-owned assessment locations, and those highlighted in orange are privately-owned assessment locations already in the acquisition zone for other mine operations.

Figure E-19 to **Figure E-27** in **Appendix E** present isopleth diagrams of the predicted modelling results for each of the assessed pollutants in Year 14.

Table 9-4: Modelling predictions for Year 14 of the proposal

Assessment location ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
1	0	0	0	0	0	0.00	9	27	1.77
2	0	0	0	0	0	0.00	9	27	1.78
3	0	0	0	0	0	0.00	9	27	1.79
4	0	0	0	0	0	0.00	9	27	1.79
5	0	0	0	0	0	0.00	9	27	1.79
6	0	0	0	0	0	0.00	9	27	1.79
7	0	0	0	0	0	0.00	9	27	1.80
8	0	0	0	0	0	0.00	10	28	1.81
9	0	0	0	0	0	0.00	10	28	1.81
10	0	0	1	0	0	0.00	10	28	1.81
11**	0	0	0	0	0	0.00	14	36	2.06
12	0	0	1	0	0	0.00	10	29	1.85
13	0	0	1	0	0	0.00	11	29	1.84
14	0	0	1	0	0	0.00	10	29	1.86
15	0	0	1	0	0	0.00	10	29	1.87
16	0	0	1	0	0	0.00	11	30	1.85
17	0	0	1	0	0	0.00	11	30	1.86
18	0	0	1	0	0	0.00	10	29	1.87
19	0	0	1	0	0	0.00	11	31	1.87
20	0	0	1	0	0	0.00	11	29	1.88
21	0	0	1	0	0	0.00	11	30	1.86
22	0	0	1	0	0	0.00	11	29	1.88
23	0	0	1	0	0	0.00	10	29	1.88
24	0	0	1	0	0	0.00	12	31	1.87
25	0	0	1	0	0	0.00	13	34	1.97
26	0	0	1	0	0	0.00	11	30	1.89
27	0	0	1	0	0	0.00	12	32	1.92
28	0	0	1	0	0	0.00	10	29	1.86
29	0	0	1	0	0	0.00	12	32	1.92
30	0	0	1	0	0	0.00	11	30	1.88
31	0	0	1	0	0	0.00	11	31	1.87
32	0	0	1	0	0	0.00	12	31	1.89
33	0	0	1	0	0	0.00	11	30	1.89

Assessment location ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
34	0	0	1	0	0	0.00	13	33	1.97
35	0	0	1	0	0	0.00	11	31	1.88
36	0	0	1	0	0	0.00	11	30	1.89
37	0	0	1	0	0	0.00	12	32	1.92
38	0	0	1	0	0	0.00	11	30	1.89
39	0	0	1	0	0	0.00	11	30	1.89
40	0	0	1	0	0	0.00	11	30	1.90
41	0	0	1	0	0	0.00	10	29	1.86
42	0	0	1	0	0	0.00	12	32	1.88
43	0	0	1	0	0	0.00	11	30	1.90
44	0	0	1	0	0	0.00	11	30	1.90
45	0	0	1	0	0	0.00	11	30	1.89
46	0	0	1	0	0	0.00	11	31	1.90
47	0	0	1	0	0	0.00	11	31	1.90
48	0	0	1	0	0	0.00	12	31	1.90
49	0	0	1	0	0	0.00	12	31	1.90
50	0	0	1	0	0	0.00	11	31	1.90
51	0	0	1	0	0	0.01	15	38	2.12
52	0	0	1	0	0	0.00	11	31	1.90
53	0	0	1	0	0	0.00	12	31	1.90
54	0	0	1	0	0	0.00	10	29	1.87
55	0	0	1	0	0	0.00	12	31	1.91
56	0	0	1	0	0	0.00	12	31	1.91
57	0	0	1	0	0	0.00	12	31	1.91
58	0	0	1	0	0	0.00	12	32	1.91
59	0	0	1	0	0	0.00	12	31	1.91
60	0	0	1	0	0	0.00	12	31	1.91
61	0	0	1	0	0	0.00	11	29	1.87
62	0	0	1	0	0	0.00	12	32	1.91
63	0	0	1	0	0	0.00	12	32	1.91
64	0	0	1	0	0	0.00	12	32	1.91
65	0	0	1	0	0	0.00	12	32	1.91
66	0	0	1	0	0	0.00	12	32	1.91
67	0	0	0	0	0	0.00	10	28	1.81
68	0	0	1	0	0	0.00	12	32	1.92
69	0	0	1	0	0	0.00	12	32	1.92
70	0	0	0	0	0	0.00	10	28	1.81
71	0	0	1	0	0	0.00	12	32	1.92
72	0	0	1	0	0	0.00	12	32	1.92
73	0	0	1	0	0	0.00	12	32	1.92
74	0	0	1	0	0	0.00	11	30	1.88
75	0	0	1	0	0	0.00	12	32	1.93
76	0	0	1	0	0	0.00	11	31	1.91
77	0	0	1	0	0	0.01	**35**	75	3.19

Assessment location ID	PM2.5 (µg/m³)		PM10 (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM10 (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
78	0	0	1	0	0	0.01	**57**	**117**	**5.15**
79**	0	0	1	0	0	0.01	**34**	72	3.10
80	0	0	0	0	0	0.00	10	29	1.83
81	0	0	1	0	0	0.01	14	35	1.94
82	0	0	1	0	0	0.00	11	31	1.90
83**	0	0	1	0	0	0.00	**33**	69	2.99
84	0	0	0	0	0	0.00	11	30	1.85
86	0	0	1	0	0	0.00	12	33	1.93
87	0	0	1	0	0	0.00	14	35	1.94
89	0	0	0	0	0	0.00	11	30	1.85
90	0	0	1	0	0	0.00	29	63	2.92
91**	0	0	1	0	0	0.01	30	65	2.99
92**	0	0	0	0	0	0.00	11	30	1.87
93	0	0	1	0	0	0.01	30	65	3.10
94**	0	0	1	0	0	0.01	28	61	2.89
95	0	0	1	0	0	0.00	13	34	1.95
96**	0	0	1	0	0	0.01	28	61	2.98
97	0	0	1	0	0	0.00	15	37	1.97
98	0	0	1	0	0	0.00	15	37	1.97
99**	0	0	1	0	0	0.01	28	61	3.07
100	0	0	1	0	0	0.01	16	39	1.99
101	0	0	1	0	0	0.01	16	39	1.99
102	0	0	1	0	0	0.01	26	59	3.03
103**	0	0	1	0	0	0.00	13	33	1.94
104	0	0	1	0	0	0.01	17	40	2.01
105	0	0	1	0	0	0.01	23	52	2.68
106	0	0	1	0	0	0.01	20	46	2.08
107	0	0	1	0	0	0.01	19	43	2.07
108	0	0	2	0	0	0.01	30	65	2.43
109**	0	0	1	0	0	0.01	23	52	2.81
110	0	0	2	0	0	0.01	23	51	2.19
111	0	0	1	0	0	0.00	10	28	1.86
112	0	0	2	0	1	0.01	**43**	90	2.88
113**	0	0	1	0	0	0.00	11	31	2.01
114	0	0	1	0	0	0.01	20	45	2.46
115**	0	0	1	0	0	0.00	18	43	2.46
116	0	0	2	0	1	0.01	17	40	2.22
117	0	0	2	0	0	0.01	17	40	2.36
118	0	0	2	0	0	0.01	17	40	2.31
118	0	0	2	0	0	0.01	17	40	2.31
119	0	0	2	0	1	0.01	16	39	2.21
120	0	0	2	0	0	0.01	15	36	2.21
121	0	0	2	0	0	0.01	15	37	2.24
122	0	0	2	0	0	0.01	14	35	2.17

Assessment location ID	PM2.5 (µg/m³)		PM10 (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM10 (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
123	0	0	2	0	0	0.01	15	36	2.20
124	0	0	2	0	0	0.01	14	35	2.16
125	0	0	4	1	1	0.02	16	39	2.11
126	1	0	4	1	1	0.02	19	43	2.16
127	0	0	2	0	0	0.01	14	34	2.01
128	0	0	3	1	1	0.01	16	38	2.09
129	0	0	3	0	1	0.01	15	36	2.05
130	0	0	3	0	1	0.01	14	35	2.04
131	1	0	5	1	2	0.03	20	46	2.16
133	0	0	2	0	0	0.01	13	32	1.97
134	0	0	3	0	1	0.01	14	34	2.02
135	1	0	11	3	5	0.07	21	47	2.34
136	1	0	10	3	4	0.07	20	46	2.31
137	0	0	3	0	1	0.01	13	34	2.00
138	1	0	8	2	3	0.05	20	46	2.27
139	0	0	3	0	1	0.01	14	34	2.01
140	1	0	10	3	4	0.07	19	44	2.27
141	0	0	2	0	0	0.00	12	32	1.94
142	0	0	3	0	1	0.01	13	33	1.99
143	0	0	3	0	0	0.01	13	33	1.98
144	1	0	9	2	3	0.04	16	39	2.12
145**	2	0	13	2	3	0.06	22	50	2.37
146	1	0	9	2	3	0.04	16	38	2.09
147	0	0	3	0	1	0.01	13	33	1.95
148	1	0	10	1	2	0.03	14	36	2.03
149	1	0	11	1	2	0.03	14	36	2.04
150	1	0	9	1	2	0.02	14	35	2.00
151**	1	0	6	1	2	0.03	15	37	2.10
152	0	0	3	0	1	0.01	12	32	1.94
153	1	0	9	1	2	0.02	14	34	2.00
154**	1	0	8	1	1	0.02	14	34	1.99
155	0	0	2	0	0	0.00	12	31	1.92
156	0	0	2	0	0	0.00	12	31	1.92
157	0	0	2	0	0	0.00	12	31	1.91
158	0	0	1	0	0	0.01	22	50	3.15
160	0	0	2	0	0	0.01	15	37	2.29
161	0	0	2	0	0	0.01	14	35	2.18
162	0	0	2	0	0	0.01	14	35	2.19
163	0	0	2	0	0	0.01	14	34	2.11
165	0	0	2	0	1	0.01	17	40	2.22
167	0	0	2	0	0	0.00	12	31	1.91
168	0	0	2	0	0	0.00	12	31	1.90
169	0	0	3	0	0	0.00	12	31	1.94
170	0	0	2	0	0	0.00	12	31	1.92

Assessment location ID	PM2.5 (µg/m³)		PM10 (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM10 (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
172	0	0	3	0	0	0.01	13	32	1.96
173	0	0	3	0	0	0.01	12	32	1.96
174	0	0	2	0	0	0.00	12	31	1.93
175	0	0	2	0	0	0.00	12	31	1.92
176	0	0	1	0	0	0.00	12	31	1.91
177	0	0	1	0	0	0.00	11	31	1.90
178	0	0	1	0	0	0.00	11	30	1.89
179	0	0	1	0	0	0.00	11	30	1.88
180	0	0	2	0	0	0.00	12	31	1.91
181	0	0	2	0	0	0.01	12	31	1.92
182	0	0	2	0	0	0.00	12	31	1.92
183	0	0	2	0	0	0.01	12	31	1.93
184	0	0	3	0	0	0.01	12	31	1.92
185	0	0	3	0	0	0.01	12	31	1.93
186	0	0	3	0	1	0.01	12	31	1.93
187	0	0	3	0	1	0.01	12	31	1.93
188	1	0	5	0	1	0.01	12	32	1.92
189**	1	0	7	1	1	0.01	13	33	1.96
190	1	0	9	1	2	0.02	14	35	2.00
191	0	0	3	0	1	0.01	12	32	1.94
192	0	0	3	0	1	0.01	13	32	1.94
193	0	0	0	0	0	0.00	8	25	1.75
194**	0	0	0	0	0	0.00	9	26	1.78
195**	0	0	0	0	0	0.00	9	27	1.80
196**	0	0	0	0	0	0.00	9	27	1.79
197	0	0	0	0	0	0.00	9	26	1.76
198**	0	0	0	0	0	0.00	8	26	1.75
199	0	0	0	0	0	0.00	8	24	1.72
200	0	0	0	0	0	0.00	8	25	1.73
201	0	0	0	0	0	0.00	8	25	1.73
202	0	0	0	0	0	0.00	8	25	1.73
203	0	0	0	0	0	0.00	8	25	1.73
204	0	0	0	0	0	0.00	8	25	1.73
205	0	0	0	0	0	0.00	8	25	1.73
206	0	0	0	0	0	0.00	8	25	1.73
207	0	0	0	0	0	0.00	8	25	1.73
208	0	0	0	0	0	0.00	8	25	1.74
209**	0	0	3	0	1	0.01	26	55	2.38
210	0	0	1	0	0	0.00	12	32	1.91
211	0	0	1	0	0	0.00	12	32	1.92
215	0	0	1	0	0	0.00	11	31	1.88
217	0	0	1	0	0	0.00	10	28	1.83
218	0	0	1	0	0	0.00	10	28	1.79
219	0	0	0	0	0	0.00	9	27	1.78

Assessment location ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
220	0	0	0	0	0	0.00	9	27	1.79
221	0	0	0	0	0	0.00	9	27	1.78
222	0	0	0	0	0	0.00	9	27	1.78
223	0	0	0	0	0	0.00	9	27	1.79
224	0	0	0	0	0	0.00	9	27	1.80
225	0	0	0	0	0	0.00	10	28	1.83
226	0	0	0	0	0	0.00	10	28	1.84
227	0	0	0	0	0	0.00	10	28	1.85
228	0	0	0	0	0	0.00	10	28	1.85
229	0	0	1	0	0	0.00	10	29	1.86
230	0	0	1	0	0	0.00	10	29	1.86
231	0	0	1	0	0	0.00	10	29	1.87
234	0	0	0	0	0	0.00	10	29	1.86
235	0	0	0	0	0	0.00	10	29	1.85
236	0	0	1	0	0	0.00	11	30	1.88
237	0	0	0	0	0	0.00	10	29	1.84
238	0	0	0	0	0	0.00	10	29	1.85
243	0	0	0	0	0	0.00	10	29	1.83
244	0	0	2	0	0	0.01	13	34	2.06
245	0	0	2	0	0	0.01	14	34	2.07
246	0	0	2	0	0	0.01	13	33	2.03
247	0	0	2	0	0	0.01	13	33	2.02
248	0	0	2	0	0	0.00	12	31	1.91
249	0	0	1	0	0	0.00	11	30	1.90
250	0	0	1	0	0	0.00	11	30	1.87
251	0	0	1	0	0	0.00	11	29	1.86
252	0	0	1	0	0	0.00	11	31	1.89
253	0	0	1	0	0	0.00	10	29	1.87
254	0	0	1	0	0	0.00	11	30	1.87
255	0	0	1	0	0	0.00	11	30	1.86
256	0	0	2	0	0	0.01	14	34	2.08
257	0	0	2	0	0	0.01	13	34	2.05
258	0	0	2	0	0	0.01	14	34	2.11
259	0	0	2	0	1	0.01	16	39	2.29
260	0	0	2	0	0	0.01	14	35	2.19
261	0	0	2	0	0	0.01	15	36	2.25
262	1	0	4	1	1	0.02	18	42	2.15
263	0	0	3	0	1	0.01	12	32	1.94
264	0	0	1	0	0	0.01	26	58	3.08
265	0	0	2	0	0	0.01	17	40	2.35
266	0	0	0	0	0	0.00	10	29	1.87
267	0	0	0	0	0	0.00	10	28	1.82
268	0	0	0	0	0	0.00	9	27	1.79
269**	0	0	0	0	0	0.00	13	33	1.98

Assessment location ID	PM2.5 (µg/m³)		PM10 (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM10 (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	25	8	50	-	-	2	30	90	4
270**	0	0	1	0	0	0.00	15	37	2.09
271**	0	0	1	0	0	0.00	46	92	3.09
903	0	0	0	0	0	0.00	10	29	1.83
904	0	0	0	0	0	0.00	9	27	1.77
905	0	0	0	0	0	0.00	8	26	1.75
909	0	0	0	0	0	0.00	10	28	1.80
911	0	0	0	0	0	0.00	9	26	1.76
915	1	0	10	2	3	0.05	16	39	2.14
917	0	0	0	0	0	0.00	10	28	1.81
918	0	0	0	0	0	0.00	10	28	1.81
919	0	0	1	0	0	0.00	11	30	1.89
920	0	0	1	0	0	0.00	12	32	1.91
921	0	0	1	0	0	0.00	10	29	1.86
922	0	0	0	0	0	0.00	10	28	1.83
923	0	0	0	0	0	0.00	8	25	1.75
926	0	0	0	0	0	0.00	8	26	1.75
927a	0	0	0	0	0	0.00	9	27	1.78
927b	0	0	0	0	0	0.00	9	27	1.77
927c	0	0	0	0	0	0.00	9	27	1.78
927d	0	0	0	0	0	0.00	8	25	1.75
927e	0	0	0	0	0	0.00	8	26	1.75
927f	0	0	0	0	0	0.00	8	26	1.76
927g	0	0	0	0	0	0.00	8	25	1.74
927h	0	0	0	0	0	0.00	8	25	1.74
927i	0	0	0	0	0	0.00	8	25	1.74
927j	0	0	0	0	0	0.00	8	25	1.75
928	0	0	0	0	0	0.00	9	27	1.78
929	0	0	0	0	0	0.00	10	28	1.80
932	0	0	2	0	1	0.01	12	32	1.93
936	0	0	0	0	0	0.00	9	27	1.79
937a	0	0	2	0	0	0.01	12	32	1.95
937b	0	0	2	0	0	0.01	12	32	1.94
937c	0	0	2	0	0	0.00	12	31	1.92
937d	0	0	2	0	0	0.01	12	32	1.93
937e	0	0	2	0	0	0.01	12	32	1.93
941**	0	0	1	0	0	0.01	26	58	3.03

*Advisory NEPM reporting standard applicable to the population as a whole
**Other mine owned property

9.3.1 Predicted maximum 24-hour and annual average $PM_{2.5}$ concentrations

Figure E-19 and **Figure E-20** show the predicted maximum 24-hour average and annual average $PM_{2.5}$ concentrations for Year 14 due to emissions from the proposal. The results in **Table 9-4** indicate that all assessment locations are predicted to experience a maximum 24-hour average and annual average concentrations below the advisory reporting standard of 25µg/m³ and 8µg/m³ in Year 14.

9.3.2 Predicted maximum 24-hour and annual average PM_{10} concentrations

Figure E-21 shows the predicted maximum 24-hour average PM_{10} concentrations for Year 14 due to emissions from the proposal. The results in **Table 9-4** indicate that all assessment locations are predicted to experience maximum 24-hour average PM_{10} concentrations below the relevant criterion of 50µg/m³ in Year 14.

Results for the total (cumulative) impact for maximum 24-hour average PM_{10} concentrations are discussed in **Section 9.5**.

Figure E-22 shows the predicted annual average PM_{10} concentrations for Year 14 due to emissions from the proposal. **Figure E-23** shows the predicted total impact from the proposal and other sources. The results in **Table 9-4** indicate that assessment locations 77, 78, 79, 83, 112 and 271 are predicted to experience annual average PM_{10} concentrations above the relevant criterion of 30µg/m³ in Year 14. All assessment locations are mine-owned with the exception of assessment location 77. Assessment locations 77 is in the acquisition zone under the current development consent.

It is noted that assessment location 271 is largely unaffected by activity from the proposal. This location would be influenced by other dust sources in the area as indicated by the incremental predictions due to the proposal in **Table 9-4**.

9.3.3 Predicted annual average TSP concentrations

Figure E-24 shows the predicted annual average TSP concentrations for Year 14 due to emissions from the proposal. **Figure E-25** shows the predicted total impact from the proposal and other sources. The results in **Table 9-4** indicate that all assessment locations with the exception of assessment locations 78 and 271 are predicted to experience annual average TSP concentrations below the relevant criterion of 90µg/m³ in Year 14. Assessment locations 78 and 271 are mine-owned properties.

It is noted that assessment location 271 is largely unaffected by activity from the proposal. This location would be influenced by other dust sources in the area as indicated by the incremental predictions due to the proposal in **Table 9-4**.

9.3.4 Predicted annual average dust deposition levels

Figure E-26 shows the predicted annual average dust deposition levels for Year 14 due to emissions from the proposal. **Figure E-27** shows the predicted total impact from the proposal and other sources. The results in **Table 9-4** indicate that all assessment locations are predicted to experience incremental annual average dust deposition levels below the relevant criterion of 2g/m²/month in Year 14. Assessment location 78 is predicted to experience total annual average dust deposition levels above the relevant criterion of 4g/m²/month in Year 14 from the proposal and other sources. Assessment location 78 is a mine-owned property.

9.4 Summary of results

Table 9-5 summarises the assessment locations where impacts are predicted to exceed relevant assessment criteria. The assessment locations highlighted in grey are identified as mine-owned assessment locations, and those highlighted in orange are privately-owned assessment locations already in the acquisition zone for other mine operations.

Cumulative 24-hour PM_{10} impacts are assessed specifically in **Section 9.5**.

As shown, all assessment locations where predicted impacts exceed assessment criteria are mine-owned properties with the exception of assessment location 77, 102 and 246 which are privately-owned. Assessment locations 77 and 102 are in the acquisition zone for other mine operations.

It is noted that assessment locations 145, 209 and 271 are largely unaffected by activity from the proposal. These locations would be influenced by other dust sources in the area.

Table 9-5: Summary of modelled predictions where predicted impacts exceed assessment criteria

Assessment location ID	PM_{10}			TSP	DD	
	Incremental 24-hour average		Total annual average	Total annual average	Incremental annual average	Total annual average
	Criterion 50µg/m³		Criterion 30µg/m³	Criterion 90µg/m³	Criterion 2g/m²/month	Criterion 4g/m²/month
	Year of impact (level of impact - µg/m³)	No. of days above 50µg/m³	Year of impact (level of impact - µg/m³)		Year of impact (level of impact - g/m²/month)	
77			Year 3 (32) Year 9 (36) Year 14 (35)			
78			Year 3 (32) Year 9 (55) Year 14 (57)	Year 9 (110) Year 14 (117)		Year 9 (4.9) Year 14 (5.2)
79*			Year 3 (32) Year 9 (35) Year 14 (34)			
83*			Year 3 (32) Year 9 (34) Year 14 (33)			
90			Year 9 (32)			
91*			Year 9 (32)			
93			Year 9 (33)			
94*			Year 9 (31)			
96*			Year 9 (31)			
99*			Year 9 (32)			
102			Year 3 (31) Year 9 (31)			
109*			Year 3 (61) Year 9 (35)	Year 3 (125)		Year 3 (5.3)
112	Year 3 (67)	6	Year 3 (37) Year 9 (34) Year 14 (43)			
145*			Year 3 (36) Year 9 (41)			
209*			Year 3 (32) Year 9 (35)			
264			Year 3 (31) Year 9 (32)			
271*			Year 3 (44)	Year 9 (92)		

Assessment location ID	PM$_{10}$			TSP	DD	
	Incremental 24-hour average		Total annual average	Total annual average	Incremental annual average	Total annual average
	Criterion 50µg/m^3		Criterion 30µg/m^3	Criterion 90µg/m^3	Criterion 2g/m^2/month	Criterion 4g/m^2/month
	Year of impact (level of impact - µg/m^3)	No. of days above 50µg/m^3	Year of impact (level of impact - µg/m^3)		Year of impact (level of impact - g/m^2/month)	
			Year 9 (46) Year 14 (46)	Year 14 (92)		
941*			Year 9 (31)			

*Other mine owned property

9.5 Assessment of total (cumulative) 24-hour average PM$_{10}$ concentrations

9.5.1 Introduction

The NSW EPA contemporaneous assessment method was applied to examine the potential maximum (cumulative) 24-hour average PM$_{10}$ impacts for the proposal.

The analysis described in this section focusses on locations at which the data required to conduct this assessment are available and represent the assessment locations surrounding MTO. The locations are five monitoring stations where suitable ambient monitoring data is available. The monitoring data collected at these sites cover the contemporaneous modelling period. The assessment of cumulative impacts uses the monitoring data from the closest monitor.

Figure 9-1 shows the location of each of these monitors in relation to MTO and surrounding assessment locations.

Generally, these monitoring locations are representative of the most impacted receptors in the surrounding assessment locations as they are typically located closer to the mining activity and hence are likely to experience greater impacts. The predicted cumulative 24-hour average PM$_{10}$ levels assessed at the monitor locations can therefore be considered a reasonable, conservative measure of the potential 24-hour average PM$_{10}$ impacts that may arise across the representative assessment locations.

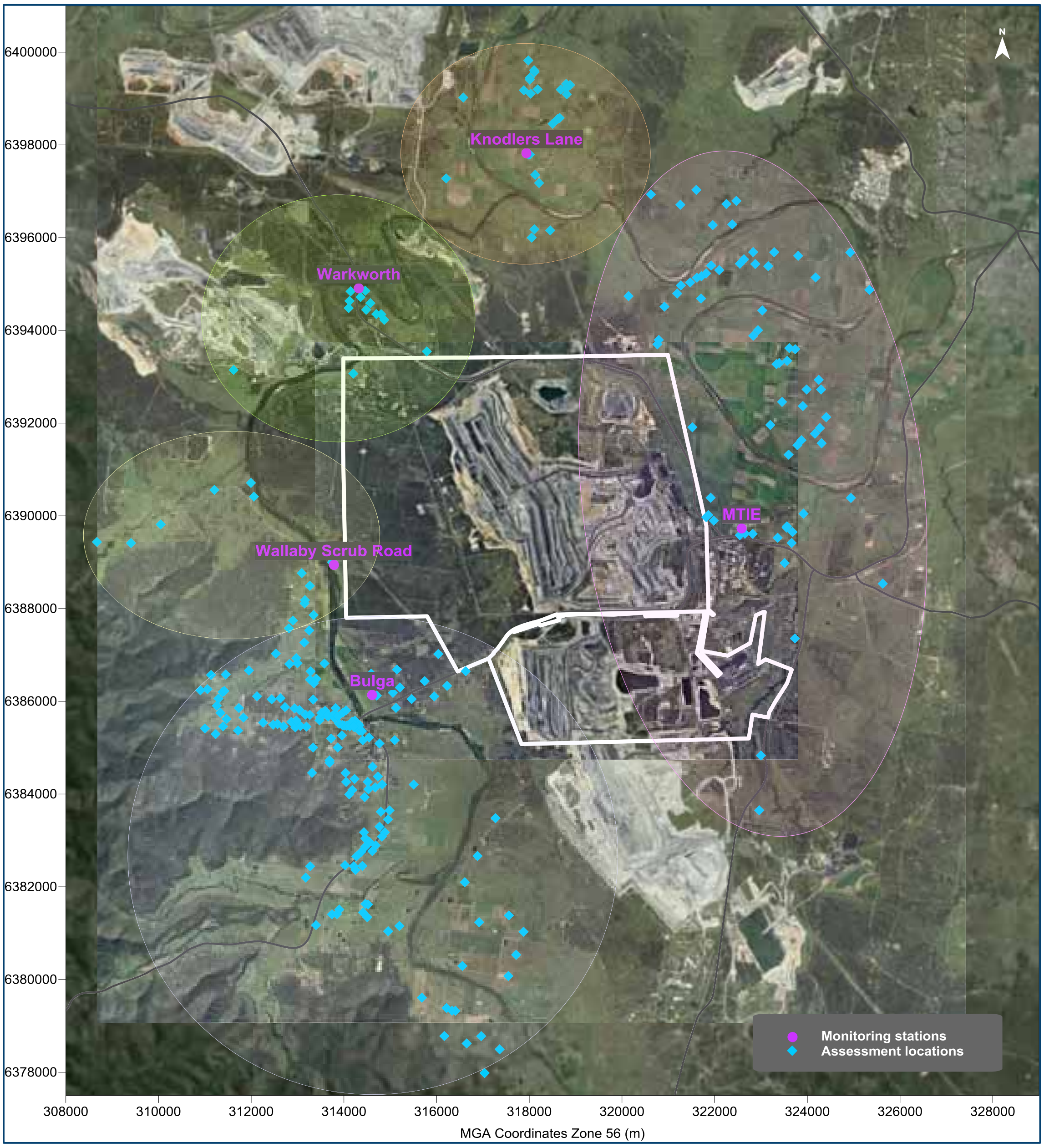

Figure 9-1: Locations available for contemporaneous cumulative impact assessment

9.5.2 Contemporaneous assessment per NSW EPA Approved Methods

An assessment of cumulative 24-hour average PM_{10} impacts was undertaken in accordance with the methods outlined in Section 11.2 of the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW DEC**, **2005**). The "Level 2 assessment - Contemporaneous impact and background approach" was applied to assess potential impacts.

As shown in **Section 4**, maximum background levels have in the past reached levels near to the 24-hour average PM_{10} criterion level (depending on the monitoring location and time). As a result, the screening Level 1 NSW EPA approach of adding maximum background levels to maximum predicted proposal only levels would show levels above the criterion.

In such situations, the NSW EPA approach applies a more thorough Level 2 assessment whereby the measured background level on a given day is added contemporaneously with the corresponding proposal only level predicted using the same day's weather data. This method factors into the assessment the spatial and temporal variation in background levels affected by the weather and existing sources of dust in the area on a given day. However, even with a detailed Level 2 approach, any air dispersion modelling has limitations (as described in **Section 8**) in predicting short term impacts which may arise many years into the future, and these limitations need to be understood when interpreting the results.

Ambient (background) dust concentration data for January 2012 to December 2012 from the TEOM stations have been applied in the Level 2 contemporaneous 24-hour average PM_{10} assessment and represent the prevailing measured background levels in the vicinity of Warkworth Mine and surrounding assessment locations.

This period was chosen as it contains meteorological data that if representative for this area, and also as it contains the highest baseline PM_{10} levels measured in Bulga village, but does not contain the anomalous high peaks that occurred during the bushfire period in late 2013 or the relatively low levels that occurred in Bulga village in 2013. The use of this data is likely to result in a generally conservative estimate (ie an overestimate) of the potential cumulative air quality impacts which may be predicted to occur in this area.

As the existing mine was operational during 2012, it would have contributed to the measured levels of dust in the area on some occasions. Due to this it is important to account for these existing activities in the cumulative assessment. Modelling of the actual mining scenario for the 2012 period (in which the weather and background dust data were collected) was conducted to determine the existing contribution to the measured levels of dust. The results were applied in the cumulative assessment to minimise potential double counting of existing mine emissions (as they would occur in both the measured data and in the predicted levels), and thus to make a more reliable prediction of the likely cumulative total dust level.

As the proposal interacts with Warkworth Mine, future Warkworth Mine activities were included as part of the total cumulative assessment of likely future impacts.

Table 9-6 provides a summary of the findings of the contemporaneous assessment at each monitoring location. Detailed tables of the full assessment results are provided in **Appendix F**.

Table 9-6: NSW EPA contemporaneous assessment - maximum number of additional days above 24-hour average criterion depending on background level at monitoring sites

Location	Year 3	Year 9	Year 14
Bulga	0	0	0
Wallaby Scrub Road	0	0	0
Warkworth	1	6	4
Knodlers Lane	0	2	1
MTIE	0	3	0

The results in **Table 9-6** indicate that it is unlikely that cumulative impacts would arise at the assessment locations near the Bulga and Wallaby Scrub Road monitoring locations during the years assessed.

There is potential for cumulative impacts to arise near the Warkworth, Knodlers Lane and MTIE monitoring stations. The potential risk of cumulative impacts at the Knodlers Lane and MTIE monitors is relatively low with only two and three additional days, respectively, of predicted impact above the relevant criterion in Year 9 and only one day for Knodlers Lane in Year 14.

The potential risk of cumulative impacts near the Warkworth monitor is greater with one, six and four additional days predicted to exceed the relevant criterion in Year 3, 9 and 14, respectively. These impacts are as would be expected when analysing the predicted results and isopleth figures in **Appendix E**. The figures show that the prevailing winds would transport material along the mine pit and project dust northwards. As the mine progresses westwards, the impacts to the north of the mine move closer to Warkworth, as represented in the indicative mine plan years assessed.

9.6 Consideration of cumulative $PM_{2.5}$ impacts

There are currently no criteria applicable for $PM_{2.5}$ particulate impact assessment in NSW, however there are NEPM advisory reporting standards that apply to the exposure of the population as a whole, as assessed by monitoring at suitable NEPM "performance monitoring sites"", which are positioned away from "hot spots' such as industry, main roads and other sources of pollution. Compliance with the NEPM standards is assessed by monitoring at such sites, and therefore the NEPM criteria would not generally apply in the near proximity to coal mines, or near to other potentially large sources of particulate emissions.

Despite the absence of suitable criteria, this assessment quantifies the approximate levels of $PM_{2.5}$ that may arise as a result of the proposal.

There are no reliable $PM_{2.5}$ background monitoring data collected at the proposal with which to conduct an accurate technical assessment of impacts and therefore it is necessary to make an approximate assessment to consider 24-hour average $PM_{2.5}$ levels.

The lack of $PM_{2.5}$ data at the proposal is not unusual (such data is rare), but it is an impediment to making an accurate calculation of the likely total $PM_{2.5}$ level in the area. This is especially so in this case as it is known that particulate levels from coal mine emissions contain a relatively small fraction of $PM_{2.5}$ material (approximately 4.7% of TSP from mining– refer to **Section 4.1** and **Section 8.2.2**). This means that in the modelling, where all major mine sources of dust are accounted for, the residual, unaccounted portion of $PM_{2.5}$, for example due to non-mining sources such as wood smoke and other such sources may comprise a significant portion of total $PM_{2.5}$ levels in the environment.

In other words ambient $PM_{2.5}$ levels are likely to be governed by many minor non-mining background sources such as wood heaters and motor vehicles which cannot be reasonably modelled in small populations and rural areas, and there is little $PM_{2.5}$ monitoring data available with which to make a detailed assessment.

The nearest available $PM_{2.5}$ data is collected at the Upper Hunter Air Quality Monitoring Network station at Singleton. This data was examined in the absence of site specific data and is presented in **Figure 9-2**. The graph includes a moving average trend line on a 25 point basis and shows a trend of increasing $PM_{2.5}$ levels in the winter and reduced levels in the summer.

A peak in wintertime $PM_{2.5}$ levels in Singleton is shown. It is unlikely that this arises from mining activity as mining produces a relatively steady level of particulate emissions over the year. It can be reasonably inferred that the increase winter levels of $PM_{2.5}$ may be largely due to urban sources of fine particulate matter such as wood heaters, and that these sources appear to govern the population exposure to $PM_{2.5}$ in this area.

Examination of the available $PM_{2.5}$ measurement data for Singleton shows that during 2012, the annual average $PM_{2.5}$ level is approximately 8µg/m³ and the 70th percentile 24-hour average maximum levels are approximately 9.6µg/m³. Maximum 24-hour average levels are below 25 µg/m³.

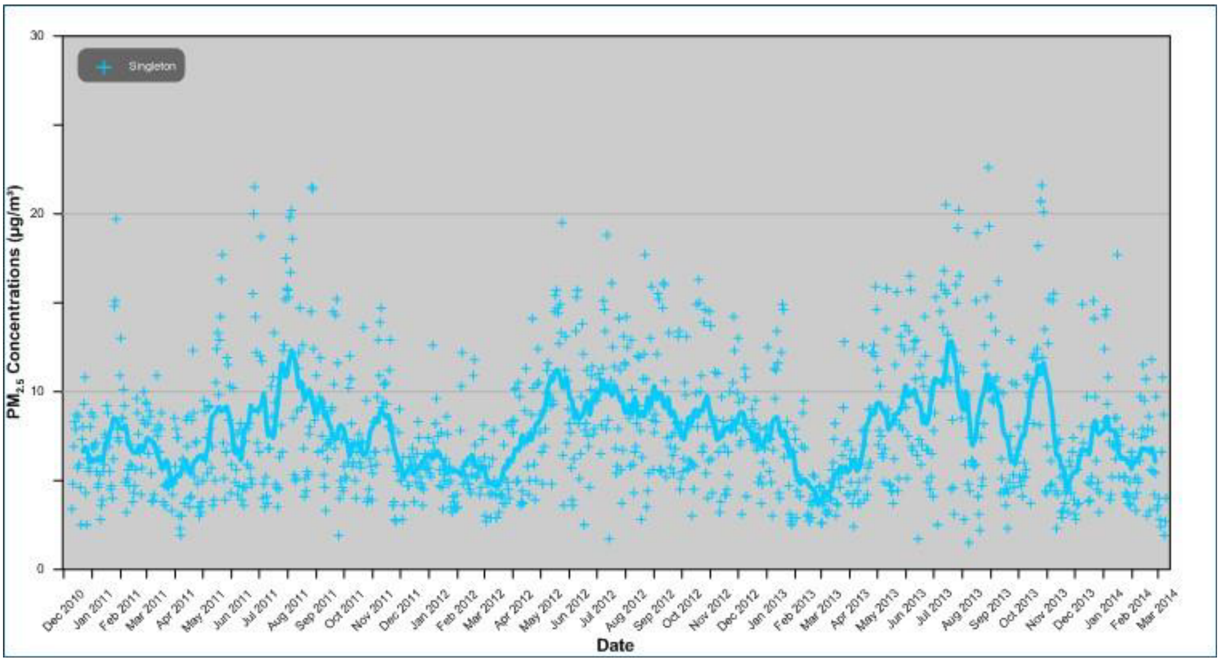

Figure 9-2: Measured $PM_{2.5}$ levels in Singleton

However, as the $PM_{2.5}$ levels in Singleton would be influenced by urban sources of fine particle emissions such as wood heaters, motor vehicles and other combustions sources potentially to a larger extent than the sparsely populated rural receptors surrounding MTO.

This is reflected in the recent CSIRO study (**CSIRO, 2013**) that characterises fine particulate matter in the Hunter Valley region. This study found that wood burning activities in winter make up an average of 62 per cent of the $PM_{2.5}$ in Muswellbrook and 38 per cent of the $PM_{2.5}$ in Singleton.

The monitoring data in Camberwell shows lower levels of $PM_{2.5}$ than are measured in Muswellbrook and Singleton, less of a winter peak, and the location is close to coal mining activity.

On the basis of the available information it would be reasonable to assume that the underlying background levels of $PM_{2.5}$ at the proposal site would be significantly lower than the levels in Singleton, given that wood heaters, people and cars are more widely spaced and, therefore, the likely level has been estimated to be approximately 5µg/m³ on an annual average basis and 9µg/m³ on a 70th percentile 24-hour basis.

Examination of the incremental (mine alone) results for annual and 24-hour $PM_{2.5}$ shown in the tables in **Section 9**, reveals that if these levels were added to the assumed annual average background levels or the 70th percentile 24-hour maximum levels, then no assessment location (predicted to comply with the criteria for other pollutants) would experience $PM_{2.5}$ level above the NEPM advisory reporting standards.

Therefore, the indication is that $PM_{2.5}$ would not appear to be a limiting issue for air quality impacts from the proposal, and that air impacts, including $PM_{2.5}$, would be effectively managed through the existing framework for air quality impact assessment and regulation overseen by NSW EPA and P&I.

The recently released Upper Hunter Air Particles Action Plan (**NSW EPA, 2013**), by the NSW EPA provides additional information about air quality and the actions underway to improve air quality in the Upper Hunter. The action plan has a strong focus on reducing $PM_{2.5}$ levels in the region and outlines 18 actions of which include a dust stop program for coal mining operations, reducing emissions from diesel powered equipment and improving local government wood smoke management in the urban settlements. MTW is actively participating in these relevant actions to assist with the reduction in $PM_{2.5}$ levels from the operation.

10 ASSESSMENT OF DIESEL EMISSIONS

10.1 Preamble

It is generally considered that the quantity of emissions generated from diesel powered equipment used for mining activity is too low to generate any significant off-site concentrations. This is due to consideration of the relatively small individual sources, the generally large distance between the sources and assessment locations, and the generally widely spread distribution of sources across the mine site.

Recent analysis by NSW EPA indicates that a large amount of diesel fuel is used in mining and, consequently, that there may be potential for impacts to arise due to the emissions from diesel powered equipment used during operations.

It is noted that the available data do not indicate any likely issues in this regard. For example, NO_2 is a significant pollutant emitted from the combustion of diesel, yet NO_2 levels at the monitoring stations in the Hunter Valley are low relative to the criteria.

Also, fine particulate (ie $PM_{2.5}$) is a significant pollutant emitted from diesel combustion. However the recent CSIRO study (**CSIRO, 2013**) found that wood burning in winter made up an average of 62 per cent of the $PM_{2.5}$ in Muswellbrook and 38 per cent of the $PM_{2.5}$ in Singleton. Secondary sulphate and industry aged sea salt made the highest contribution during summer months, sulphate levels were found to be comparable to other Australian locations. Vehicle and industry sources comprised of approximately 8 per cent and 17 per cent in Muswellbrook and Singleton, respectively.

Whilst these data may not indicate any issue related to diesel combustion, it is recognised that the locations at which this data was collected are some distance away from coal mines. Thus an assessment of potential impacts from diesel combustion was conducted for the proposal to determine whether any risk may arise. It should be noted that emissions of fine particulate from diesel combustion in mining equipment is generally already included within the assessment of mine dust presented in **Section 8**.

10.2 Approach to assessment

10.2.1 Emission estimation

Emissions from diesel powered equipment were estimated on the basis of manufacturer's data. It is noted that manufacturer's equipment performance specifications were typically categorised on the basis of the US EPA federal tier standards of emissions for diesel equipment (**Dieselnet**, **2012**).

Emissions for certain plant included non-methane-hydrocarbon (NMHC) and NO_x emissions as a single value. For the purpose of this assessment it has been conservatively assumed that the total emission (NHMC and NO_x) comprises NO_2.

The various types of diesel powered mining equipment to be used under the proposal were identified (see **Table 10-1**). Plant hours of operation were based on assumed plant availability and utilisation rates for the specific equipment type, conservatively assuming that all operational plant operates at full power for 20 per cent of the time.

The emission rates used in the modelling are considered conservative and likely to overestimate actual emissions from mining equipment.

Table 10-1: Summary of diesel powered equipment and associated emissions

Equipment type	Number of equipment			CO (g/KWh)	NMHC + NOx / NOx (g/KWh)
	Year 3	Year 9	Year 14		
3600 Excavator	2	-	-	3.5	6.4
Dozer	5	3	-	3.5	3.5
RTD	1	1	-	3.5	6.4
Drill	1	-	-	3.5	6.4
Grader	2	2	2	3.5	4.0
Watercart	1	1	1	1.3	9.2
795 Truck	0	5	3	3.5	6.4
830E Truck	20	10	4	0.8	8.7
789 Truck	6	2	4	11.4	9.2

10.2.2 Dispersion modelling

Dispersion modelling of the diesel powered equipment was conducted for each indicative mine plan year. Modelled sources were described as point sources and incremental impacts due to the proposal were added to the ambient background level to assess potential impacts.

The NO_2 monitoring data presented in **Section 4** shows that the maximum measured 1-hour average NO_2 background level at the Singleton monitor during 2012 was 75.2µg/m^3. In lieu of any data for the site, per the Victorian EPA approach[1], the 70th percentile level of 41.4µg/m^3 obtained from the Singleton data was used as a constant background level contributing to the total cumulative impact predictions. The annual average NO_2 background level at the Singleton monitor during 2012 was 16.9µg/m^3.

It is noted that the background levels measured in Singleton are likely to be higher than the levels for the majority of assessment locations because there are many densely positioned sources of NO_X in Singleton, such as motor vehicles. The measured levels would also include some contribution of emissions arising from the existing operations and thus are considered to be even more conservative and likely to overestimate actual levels.

The conversion of NO_X to NO_2 was estimated using an empirical equation for estimating the oxidation rate of NO in power plant plumes developed by **Janssen et al. (1988)**. This method is outlined in the Approved Methods **(DEC 2005)** and is used to calculate the ratio of NO_2 to NO_X as determined by the atmospheric conditions and distance from the maximum recorded level to the source.

The separation distance from the sources to the maximum predicted 1-hour and annual average ground-level concentrations was taken to be the nominal distance from the centroid of all NOx sources to the nearest likely affected assessment locations. Applying conservative A and α constant values, the ratio of NO_2 to NO_X at receptors due to the diesel powered equipment was calculated to be approximately 15%.

[1]The Victorian Government's State Environment Protection Policy (Air Quality Management), **SEPP (2001)** states at Part B, 3(b) *"Proponents required to include background data where no appropriate hourly background data exists must add the 70th percentile of one year's observed hourly concentrations as a constant value to the predicted maximum concentration from the model simulation. In cases where a 24-hour averaging time is used in the model, the background data must be based on 24-hour averages. "*.

10.3 Modelling predictions

Figure G-1 to **Figure G-6** in **Appendix G** present isopleth diagrams of the predicted modelling results for the assessed 1-hour average and annual average NO_2 concentrations.

Table 10-2 presents the model predictions at each of the assessment locations with background levels included. The assessment locations highlighted in grey are identified as mine-owned assessment locations, and those highlighted in orange are privately-owned assessment locations already in the acquisition zone under the development consent.

Table 10-2: Predicted NO_2 concentrations for each indicative mine plan year

Assessment locations ID	Year 3		Year 9		Year 14	
	1-hour average	Annual average	1-hour average	Annual average	1-hour average	Annual average
1	45	17	43	17	42	17
2	46	17	43	17	42	17
3	46	17	43	17	43	17
4	46	17	43	17	43	17
5	46	17	43	17	43	17
6	46	17	43	17	43	17
7	46	17	43	17	42	17
8	46	17	44	17	43	17
9	46	17	43	17	43	17
10	47	17	44	17	43	17
11*	45	17	43	17	42	17
12	48	17	44	17	43	17
13	47	17	44	17	43	17
14	49	17	45	17	43	17
15	49	17	45	17	43	17
16	50	17	45	17	44	17
17	47	17	44	17	43	17
18	49	17	45	17	43	17
19	47	17	44	17	43	17
20	49	17	45	17	43	17
21	51	17	46	17	44	17
22	48	17	44	17	43	17
23	46	17	44	17	43	17
24	48	17	44	17	43	17
25	46	17	43	17	42	17
26	48	17	44	17	43	17
27	47	17	44	17	43	17
28	46	17	43	17	42	17
29	47	17	44	17	43	17
30	54	17	47	17	45	17
31	53	17	47	17	45	17
32	48	17	44	17	43	17
33	52	17	46	17	44	17
34	46	17	43	17	43	17
35	54	17	47	17	45	17
36	47	17	44	17	43	17
37	48	17	44	17	43	17

Assessment locations ID	Year 3		Year 9		Year 14	
	1-hour average	Annual average	1-hour average	Annual average	1-hour average	Annual average
38	48	17	44	17	43	17
39	49	17	45	17	43	17
40	49	17	45	17	43	17
41	46	17	43	17	42	17
42	51	17	46	17	45	17
43	48	17	45	17	43	17
44	49	17	45	17	43	17
45	47	17	44	17	43	17
46	49	17	45	17	43	17
47	49	17	45	17	43	17
48	50	17	45	17	43	17
49	50	17	45	17	43	17
50	49	17	45	17	43	17
51	46	17	43	17	42	17
52	48	17	44	17	43	17
53	49	17	45	17	43	17
54	45	17	43	17	42	17
55	50	17	45	17	43	17
56	49	17	45	17	43	17
57	49	17	45	17	43	17
58	51	17	45	17	43	17
59	50	17	45	17	43	17
60	50	17	45	17	43	17
61	45	17	43	17	42	17
62	50	17	45	17	43	17
63	51	17	45	17	43	17
64	51	17	45	17	43	17
65	51	17	45	17	43	17
66	50	17	45	17	43	17
67	45	17	43	17	42	17
68	51	17	45	17	43	17
69	50	17	45	17	43	17
70	45	17	43	17	42	17
71	50	17	45	17	43	17
72	50	17	46	17	43	17
73	50	17	45	17	43	17
74	46	17	43	17	42	17
75	51	17	46	17	43	17
76	48	17	44	17	43	17
77	44	17	43	17	42	17
78	44	17	43	17	42	17
79*	44	17	43	17	42	17
80	45	17	43	17	42	17
81	50	17	45	17	44	17
82	47	17	44	17	42	17
83*	43	17	43	17	42	17
84	45	17	43	17	42	17
86	51	17	46	17	43	17

Assessment locations ID	Year 3		Year 9		Year 14	
	1-hour average	Annual average	1-hour average	Annual average	1-hour average	Annual average
87	51	17	46	17	44	17
89	46	17	43	17	42	17
90	43	17	43	17	42	17
91*	44	17	43	17	42	17
92*	46	17	43	17	42	17
93	44	17	43	17	42	17
94*	43	17	43	17	42	17
95	53	17	47	17	44	17
96*	44	17	43	17	42	17
97	51	17	45	17	44	17
98	54	17	46	17	44	17
99*	44	17	43	17	42	17
100	50	17	44	17	44	17
101	51	17	45	17	44	17
102	44	17	43	17	42	17
103*	48	17	44	17	42	17
104	53	17	45	17	44	17
105	44	17	43	17	42	17
106	53	17	44	17	44	17
107	56	17	45	17	44	17
108	50	17	45	17	45	17
109*	45	17	43	17	42	17
110	57	17	46	17	45	17
111	45	17	42	17	42	17
112	60	17	49	17	47	17
113*	46	17	43	17	42	17
114	43	17	42	17	42	17
115*	51	17	44	17	42	17
116	43	17	42	17	42	17
117	43	17	42	17	42	17
118	43	17	42	17	42	17
118	43	17	42	17	42	17
119	43	17	42	17	42	17
120	43	17	42	17	42	17
121	43	17	42	17	42	17
122	43	17	42	17	42	17
123	43	17	42	17	42	17
124	43	17	42	17	42	17
125	43	17	43	17	42	17
126	44	17	43	17	43	17
127	44	17	43	17	42	17
128	44	17	43	17	43	17
129	43	17	43	17	43	17
130	43	17	43	17	43	17
131	45	17	44	17	43	17
133	43	17	43	17	42	17
134	43	17	43	17	43	17
135	47	17	45	17	44	17

Assessment locations ID	Year 3		Year 9		Year 14	
	1-hour average	Annual average	1-hour average	Annual average	1-hour average	Annual average
136	47	17	45	17	44	17
137	43	17	43	17	42	17
138	47	17	45	17	43	17
139	43	17	43	17	42	17
140	47	17	46	17	44	17
141	43	17	42	17	42	17
142	43	17	43	17	43	17
143	43	17	43	17	43	17
144	46	17	44	17	44	17
145*	49	17	47	17	45	17
146	46	17	44	17	44	17
147	45	17	43	17	43	17
148	45	17	44	17	44	17
149	46	17	45	17	44	17
150	45	17	44	17	43	17
151*	48	17	45	17	45	17
152	45	17	43	17	43	17
153	45	17	44	17	44	17
154*	45	17	43	17	43	17
155	44	17	43	17	42	17
156	44	17	43	17	42	17
157	44	17	43	17	42	17
158	43	17	42	17	42	17
160	43	17	42	17	42	17
161	43	17	42	17	42	17
162	43	17	42	17	42	17
163	43	17	42	17	42	17
165	43	17	42	17	42	17
167	43	17	42	17	42	17
168	43	17	42	17	42	17
169	43	17	42	17	42	17
170	43	17	42	17	42	17
172	43	17	43	17	43	17
173	43	17	43	17	43	17
174	43	17	42	17	42	17
175	43	17	42	17	42	17
176	43	17	42	17	42	17
177	43	17	42	17	42	17
178	44	17	42	17	42	17
179	44	17	42	17	42	17
180	45	17	43	17	43	17
181	45	17	43	17	43	17
182	45	17	43	17	43	17
183	45	17	43	17	43	17
184	44	17	43	17	43	17
185	44	17	43	17	43	17
186	44	17	43	17	43	17
187	44	17	43	17	43	17

Assessment locations ID	Year 3		Year 9		Year 14	
	1-hour average	Annual average	1-hour average	Annual average	1-hour average	Annual average
188	45	17	43	17	43	17
189*	45	17	43	17	43	17
190	45	17	44	17	43	17
191	45	17	43	17	43	17
192	45	17	43	17	43	17
193	43	17	42	17	42	17
194*	43	17	42	17	42	17
195*	45	17	43	17	42	17
196*	46	17	43	17	42	17
197	44	17	42	17	42	17
198*	43	17	42	17	42	17
199	43	17	42	17	42	17
200	43	17	42	17	42	17
201	43	17	42	17	42	17
202	43	17	42	17	42	17
203	43	17	42	17	42	17
204	43	17	42	17	42	17
205	43	17	42	17	42	17
206	43	17	42	17	42	17
207	43	17	42	17	42	17
208	44	17	42	17	42	17
209*	48	17	44	17	43	17
210	51	17	45	17	43	17
211	51	17	46	17	43	17
215	54	17	47	17	45	17
217	47	17	44	17	43	17
218	46	17	43	17	42	17
219	45	17	43	17	42	17
220	46	17	43	17	43	17
221	45	17	43	17	42	17
222	45	17	43	17	42	17
223	46	17	43	17	42	17
224	45	17	43	17	42	17
225	46	17	43	17	42	17
226	46	17	43	17	42	17
227	46	17	43	17	43	17
228	46	17	43	17	42	17
229	46	17	44	17	43	17
230	45	17	43	17	43	17
231	46	17	43	17	43	17
234	45	17	43	17	42	17
235	45	17	43	17	42	17
236	46	17	43	17	42	17
237	45	17	43	17	42	17
238	46	17	43	17	42	17
243	45	17	43	17	42	17
244	43	17	42	17	42	17
245	43	17	42	17	42	17

Assessment locations ID	Year 3		Year 9		Year 14	
	1-hour average	Annual average	1-hour average	Annual average	1-hour average	Annual average
246	43	17	42	17	42	17
247	43	17	42	17	42	17
248	43	17	42	17	42	17
249	43	17	42	17	42	17
250	44	17	42	17	42	17
251	43	17	42	17	42	17
252	47	17	44	17	42	17
253	47	17	44	17	43	17
254	46	17	43	17	42	17
255	50	17	45	17	44	17
256	42	17	42	17	42	17
257	43	17	42	17	42	17
258	43	17	42	17	42	17
259	43	17	42	17	42	17
260	43	17	42	17	42	17
261	43	17	42	17	42	17
262	44	17	43	17	43	17
263	45	17	43	17	43	17
264	44	17	43	17	42	17
265	43	17	42	17	42	17
266	44	17	42	17	42	17
267	43	17	42	17	42	17
268	43	17	42	17	42	17
269*	46	17	43	17	42	17
270*	45	17	43	17	42	17
271*	44	17	43	17	42	17
903	45	17	43	17	42	17
904	45	17	43	17	42	17
905	44	17	43	17	42	17
909	45	17	43	17	42	17
911	44	17	43	17	42	17
915	46	17	44	17	44	17
917	45	17	43	17	42	17
918	45	17	43	17	42	17
919	47	17	44	17	43	17
920	50	17	45	17	43	17
921	45	17	43	17	42	17
922	44	17	43	17	42	17
923	43	17	42	17	42	17
926	44	17	42	17	42	17
927a	44	17	43	17	42	17
927b	44	17	43	17	42	17
927c	44	17	43	17	42	17
927d	43	17	42	17	42	17
927e	43	17	42	17	42	17
927f	43	17	42	17	42	17
927g	43	17	42	17	42	17
927h	43	17	42	17	42	17

Assessment locations ID	Year 3		Year 9		Year 14	
	1-hour average	Annual average	1-hour average	Annual average	1-hour average	Annual average
927i	43	17	42	17	42	17
927j	43	17	42	17	42	17
928	45	17	43	17	42	17
929	45	17	43	17	42	17
932	46	17	45	17	44	17
936	45	17	43	17	42	17
937a	44	17	43	17	42	17
937b	44	17	42	17	42	17
937c	44	17	42	17	42	17
937d	44	17	43	17	42	17
937e	44	17	43	17	42	17
941*	44	17	43	17	42	17

*Other mine owned property

10.4 Results

10.4.1 Analysis of NO_2 modelling

The modelling predictions in **Table 10-2** indicate that in Year 3, 9 and 14 all assessment locations are predicted to experience maximum 1-hour average and annual average NO_2 concentrations below the relevant criterion of 246µg/m^3 and 63µg/m^3, respectively.

10.4.2 Other diesel powered plant impacts

The ambient air quality goals for CO are set at higher concentration levels than the NO_2 goals. Based on the NO_2 monitoring data which are low compared to the goals, and consideration of the typical mix of ambient pollutant levels and associated emissions of CO, the indication is that predictions of CO would be well below the air quality goals and do not require further consideration.

11 ASSESSMENT OF BLAST FUME EMISSIONS

11.1 Preamble

Air quality impacts of blast operations at MTO are managed under MTW's Blast Management Plan (BMP) MTW-10-ENVMP-SITE-060. The purpose of the BMP is to ensure that blasting operations comply with all relevant requirements particularly noise, overpressure, vibration, blast fume and dust effects.

The BMP applies a blasting permissions flowchart to guide operators on the suitability of various factors including the current weather conditions for blasting. The BMP takes into consideration meteorological factors such as wind speed and direction which can affect the scale of potential blast impacts at assessment locations.

A predictive blast system is also used, to schedule blast events to the least-risk time of the day where feasible. This approach minimises the risk of any off-site impact occurring, and is based on hourly forecast weather conditions that may affect the dispersion of blast emissions.

11.2 Approach to assessment

11.2.1 Emission estimation

Blast fume emissions (NO_2) were estimated on the basis of emission levels presented in a CSIRO study into 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 to generate NO_2 emissions. The assessment is based on the measured level of emissions presented in the CSIRO study.

11.2.2 Dispersion modelling

Dispersion modelling of the potential blast fume emissions was conducted for the Year 3 indicative mine plan year. The model setup was generally in accordance with the setup discussed in **Section 6**. Blast emission sources were modelled in the centre of the active pit location. 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, and considering weather conditions and the existing blast permissions. In other words the model was programmed to halt a blast based on the weather condition if that is what the blasting permissions would require.

As a comparison, modelling of blasts during each hour of the day without consideration of the blasting permissions was also conducted to determine the suitability of these permissions.

11.3 Modelling predictions

Figure H-1 to **Figure H-9** in **Appendix H** present isopleth diagrams of the predicted modelling results for the assessed maximum 1-hour average NO_2 concentrations during each potential blast hour of each year. It should be noted that the isopleth diagrams show the maximum hourly extent of all potential blasts in all daytime hours in a full year per the blast permissions, and do not represent a single blast event.

The isopleth diagrams indicate that based on the potential blast hours in each day, blasts occurring at 4:00pm and 5:00pm have the potential to result in adverse blast fume impacts. This indicates that the meteorological conditions during these periods may at times be unfavourable for blasting and the most case should be taken if conducting blasting at these times.

The decision to blast under such conditions is based on skilled and experienced operator judgement of the actual prevailing weather conditions, forecast weather conditions and the expected nature of potential plume travel towards the nearest assessment locations. It is not reasonably possible to incorporate the human decision making element of the blast permissions into a computer model, thus it is considered likely that the potential late evening impacts that are predicted in the modelling would not arise in practice, due to the benefit of the actual human intervention that occurs.

An examination of the blast impact isopleth diagrams shown in **Figure H-1** to **Figure H-9** in **Appendix H** was conducted to analyse any potential issues of compliance with the NO_2 criterion of 246µg/m^3, 1-hour average. The red isopleths show the impact that could hypothetically occur if blasting occurred without any regard to the blast permissions (on every hour of the day) and the light blue isopleths show the potential impact if the blast permissions that apply are adhered to.

The results indicate that whilst the blast permissions take into account the location of the blast in reference to the surrounding assessment locations, the prevailing meteorological conditions in which blasts are not permitted occur infrequently and the modelling results show little difference.

11.4 Conclusions

Overall, it is noticeable that during the middle daytime hours no impacts due to blasting fume emissions are predicted to occur. During these times, the blast permissions have a relatively small effect in mitigating impacts (largely as there would not be any appreciable impact to mitigate).

However, in the early evening, when there is potential for impacts to arise off-site, the results show that application of the blasting permissions would avert such potential impacts for most assessment locations.

It is noted that in this regard MTW have implemented a predictive management system to aid with management of blasting operations. Such a system uses actual conditions for each blast to predict the potential impact which may occur. The prediction is made on the basis of forecast weather data, allowing operators to schedule a blast to the time of least impact over the course of the upcoming day. In effect the system updates the blasting permissions for each individual blast on the basis of predicted impact. The system thus deals with the spatially and time varying weather and terrain influences and is generally more reliable than relying on a fixed set of wind speed and wind direction restrictions.

Overall, it is anticipated that with due care, potential blast impacts would be averted.

12 PARTICULATE MATTER HEALTH EFFECTS

12.1 Introduction

The following section is a summarised excerpt of private correspondence from Environmental Risk Sciences Pty Ltd to Todoroski Air Sciences.

Detailed reviews of the available studies that relate to health effects associated with exposure to particulates are available from various sources (**NEPC 2010, USEPA 2009**, **Anderson et al. 2004, WHO 2003, OEHHA 2002**). Particulate matter is comprised of a diverse range of substances, with varying morphological, chemical, physical and thermodynamic properties, across a large size range. Particulates can be derived from natural sources such as crustal dust, pollen, sea salts and moulds, and anthropogenic (human) activities including combustion and industrial processes. Secondary particulate matter is formed via atmospheric reactions of primary gaseous emissions. The most significant contributors to secondary particulates include nitrogen oxides, ammonia, sulfur oxides, and certain organic gases (emitted from vehicles, combustion, agriculture, industry and biogenic sources).

Particulate matter comprises particles which can remain suspended in the air for extended periods, and is typically classified by particle size.

12.2 Particulate size

The size of particulates is important as it determines how far from an emission source the particulates may be present in air (with larger particulates settling out first and smaller particles remaining airborne for greater distances) but also the potential for adverse effects to occur as a result of exposure.

The common measures of particulate matter that are considered in the assessment of air quality and health risks are previously outlined in **Section 4.1** with more detail in regard to health as follows:

- TSP refers to all particulate with an equivalent aerodynamic particle size below approximately 50µm diameter. Larger particles (termed "inspirable", comprise particles around 10µm and larger) that may cause nuisance and would deposit out of the air (measured as deposited dust) closer to the source. Such particles, if inhaled are mostly trapped in the upper respiratory system[2] and do not reach the lungs. Finer particles (smaller than 10µm, termed "respirable") tend to be of more concern as these particles can penetrate into the lungs. As only a fraction of TSP material is harmful to human health, it is a measure of nuisance impact, not health impact.
- PM_{10}, particulate matter below 10µm in diameter, $PM_{2.5}$, particulate matter below 2.5µm in diameter and PM_1, particulate matter below 1µm in diameter. These particles are small and have the potential to penetrate beyond the nose and upper respiratory system, with the smaller particles able to penetrate into the lower respiratory tract[3] and lungs which may result in adverse health effects (**OEHHA, 2002**).

[2] The upper respiratory tract comprises the mouth, nose, throat and trachea. Larger particles are mostly trapped by the cilia and mucosa and swept to the back of the throat and swallowed.

[3] The lower respiratory tract comprises the smaller bronchioles and alveoli, the area of the lungs where gaseous exchange takes place. The alveoli have a very large surface area and absorption of gases occurs rapidly with subsequent transport to the blood and the rest of the body. Small particles can reach these areas, be dissolved by fluids and absorbed.

Monitoring for PM_{10} is the most commonly applied metric in local and regional air quality monitoring program. Smaller particulates such as $PM_{2.5}$ and PM_1 are generally of most significance with respect to evaluating health effects as a higher proportion of these particles penetrate into the lungs; however, monitoring for such particulate matter is technically challenging and thus is not widely established. Thus PM_{10} monitoring serves as a defacto method of measuring $PM_{2.5}$ (**WHO, 2005**).

Apart from small aerodynamic diameter factors such as the hygroscopicity, electrostatic charge, and characteristics of the human respiratory system including airway structure and geometry, as well as depth, rate and mode of breathing (eg nasal vs. oral/nasal) affect the extent of particulate penetration and deposition into the lung.

A significant amount of research has been conducted on the health effects of particulates with causal effects relationships identified for exposure to $PM_{2.5}$. A more limited body of evidence suggests an association between exposure to larger particles, PM_{10} and adverse effects (**USEPA, 2009 and WHO, 2003**).

12.3 Particulates composition

Evaluation of size alone in regard to particle health impacts is difficult as particle size may not be independent of chemical composition. Certain particulate size fractions tend to contain certain chemical components, such as crustal materials in the coarse particle fraction (PM_{10} or larger) or metals in fine particulates (<$PM_{2.5}$). In addition, different sources of particulates may emit other pollutants in addition to particulate matter. For example, combustion sources, the dominant particulate source in urban areas, emit predominantly fine particulates as well as gaseous pollutants such as ozone, nitrogen dioxide, carbon monoxide and sulfur dioxide, all of which have independent health effects.

There is strong evidence (**WHO, 2003**) to conclude that fine particles (<2.5μm, $PM_{2.5}$) are more hazardous than coarse particles, primarily on the basis of studies conducted in urban air environments where there is a higher proportion of fine particulates present from fuel combustion sources, rather than from crustal origins. Studies indicate that particles generated from fossil fuel combustion may be a significant contributor to adverse health outcomes. Amongst the characteristics found to be contributing to these outcomes are high organic carbon content, metal content, presence of Poly-cyclic Aromatic Hydrocarbons (PAHs), other organic components, endotoxin and both small (<2.5μm) and extremely small size (<100nm) particulate (**USEPA 2009, WHO 2006a**, **WHO 2003**).

This does not mean that the coarse fraction of PM_{10} is not harmful, however, it appears to be a less critical source (**WHO, 2003 and USEPA, 2009**).

The observed health effects are derived from studies conducted in urban areas, whereas the actual health impacts from particulate matter in a specific location would be affected by the specific characteristics of the mix of particulate matter at the location.

Reviews of the currently available information have not been able to identify any single physical or chemical property of particles that is responsible for the array of adverse health outcomes reported in epidemiological studies (**USEPA, 2009 and WHO, 2003**). Hence, WHO (**WHO, 2006b**) and NEPC (**NEPC, 2010**) concluded that the evidence at present cannot support an indicator for a standard that is more specific than size fraction alone.

As a consequence, the potential for adverse health effects is assumed to apply equally for all sources and composition of particulates at this time.

12.4 Health effects

Adverse health effects associated with exposure to particulate matter have been primarily derived from population-based epidemiological studies. It is difficult to obtain reliable measures of $PM_{2.5}$, hence much of data considered in the studies is based on ambient PM_{10} data measured in urban areas.

Short term exposure (days to weeks) and long term exposure (years) to PM_{10} has been linked to adverse health effects.

Mortality effects relate to the increase in the number of deaths due to existing (underlying) respiratory or cardiovascular diseases that have been associated with exposure to PM_{10} or $PM_{2.5}$ in population-based epidemiological studies.

Morbidity effects relate to a wide range of health indicators used to define illness or the severity of illness associated with exposure to PM_{10} or $PM_{2.5}$, primarily related to the respiratory and cardiovascular system (**USEPA, 2009 and Morawska et al., 2004**) and include:

- Aggravation of existing respiratory and cardiovascular disease (as indicated by increased hospital admissions and emergency room visits, school absences, work loss days, and restricted activity days);
- Changes in cardiovascular risk factors such as blood pressure;
- Changes in lung function and increased respiratory symptoms (including asthma);
- Changes to lung tissues and structure; and
- Altered respiratory defence mechanisms.

These effects are commonly used as measures of population exposure to particulate matter in community epidemiological studies. While there is general agreement on the mortality effects associated with exposure to particulate matter, it is noted that there is less agreement on the wide range of morbidity indicators.

12.5 Summary of health effects

The following table presents a summary of the adverse effects associated with exposure to particulate matter in generally large cities and the susceptible populations identified (relevant to the health endpoint).

Table 12-1: Summary of potential adverse health effects from exposure to particulate matter in cities

Health-effect	Susceptible group	Comments
Short term		
Mortality	Elderly, infants, persons with chronic cardiopulmonary disease, influenza or asthma	Causal relationship has been identified for exposure to PM_{10} and $PM_{2.5}$.
Hospitalisation rates (respiratory and cardiovascular effects)	Elderly, infants, persons with chronic cardiopulmonary disease, pneumonia, influenza or asthma	Reflects substantive health impacts in terms of illness, discomfort, treatment costs, work or school time lost.
Increased respiratory symptoms	Most consistently observed in people with asthma, and children	For most, effects are transient with minimal overall health consequences. May result in some short term absence from work or school due to illness.
Decreased lung function	Observed in both children and adults	For most, effects seem to be small and transient.
Long term		
Increased mortality rates, reduced survival times, chronic cardiopulmonary disease, reduced lung function, lung cancer	Observed in population-wide epidemiological studies, including adults, children and infants. All chronically exposed are potentially affected	Long-term repeated exposure appears to increase the risk of cardiopulmonary disease and mortality. May also result in lower lung function.

12.6 Considerations relevant to mining

Table 12-1 relates to studies of human exposure to particulate matter in generally large cities, where a larger portion of the particulates are in the fine fraction that would penetrate into the lung, and also where a greater portion of the particulate matter is from combustion sources, and thus carries with it other individually toxic substances that are damaging to human health.

It is important to understand that the majority of particulate emissions from mining are dust which originates from the soil. Due to the extreme forces required at the micro level to break down a particle of dust into smaller particles in the fine fraction, mining techniques used at coal mines generally cannot breakdown rock, coal or soil material into these very fine fractions. As a result emissions from mines are predominantly in the coarse size fraction which would not penetrate as deeply into the lung, or carry additional toxic combustion substances. On average it has been measured that approximately 5 per cent of the total dust (TSP) from mining is in the $PM_{2.5}$ size fraction, and approximately 12 per cent of PM_{10} from mining is in the $PM_{2.5}$ fraction (**SPCC, 1986**).

In contrast, in the urban areas in which the majority of the health studies have been conducted, approximately 50 per cent of the PM_{10} is comprised of particles in the $PM_{2.5}$ size range, and most of these are from combustion.

It needs to be understood that rural populations are simply too small for conclusive epidemiological studies to be conducted in those areas, and insufficient alternative data is available for rural areas to identify specific issues that health experts can agree on. Therefore, as a matter of precaution, the findings for urban areas (as shown in **Table 12-1**) are extrapolated to cover rural areas in order to have a basis for managing exposure to particulate matter for rural populations.

This is not to say that particulate emissions from mining are harmless. Mining emissions include a component of particles in the PM_{10} and $PM_{2.5}$ range and this would include fine combustion particles from diesel equipment.

In the context of health impacts in rural areas, it needs to be noted that in many rural areas domestic wood smoke is a key issue of health impact. Wood smoke warrants close attention in any evaluation of health impact as it can be a significant, highly localised source of toxic pollution in the winter period for rural communities and individuals.

The recent studies by CSIRO (**CSIRO, 2013**) into the composition of particulate matter in the Hunter Valley found that a key source of fine particulate is wood smoke. As has occurred in many rural towns, NSW EPA has launched an initiative to target particulates in the Hunter Valley (**NSW EPA, 2013**), and a key action relates to management of wood smoke in the urban areas.

In this regard it is also important to interpret emission inventory data, such as NPI data and data from NSW EPA's air emissions inventory for the Greater Metropolitan Region (GMR) in NSW in the correct context. For example, if one compares mine dust emissions with those from wood heaters based on only the inventory data, one would see that the two produce roughly the same amount of $PM_{2.5}$ emissions. However, it would be wrong to conclude that mines and wood heaters have similar health impacts on the residential population. Unlike coal mines, wood heaters are located inside living rooms and their chimneys are closer to residents than coal mines, which means the air that the population breathes will be affected by wood heater emissions to a much greater degree.

It also needs to be noted that health should be considered in terms of risk of adverse impacts to individuals residing in a specific location, but also in regard to the impacts on the whole community. In the Hunter Valley, the community includes mine workers, and to maintain overall population health it is reasonable to also minimise mine staff exposure to pollutants that may be harmful, or to situations that may be dangerous.

13 GREENHOUSE GAS ASSESSMENT

13.1 Introduction

Dynamic interactions between the atmosphere and surface of the earth create the unique climate that enables life on earth. Solar radiation from the sun provides the heat energy necessary for this interaction to take place, with the atmosphere acting to regulate the complex equilibrium. A large part of this regulation occurs from the "greenhouse effect" with the absorption and reflection of the solar radiation dependent on the composition of specific greenhouse gases in the atmosphere.

Over the last century, the composition and concentration of greenhouse gases in the atmosphere has increased due to increased anthropogenic activity. Climatic observations indicate that the average pattern of global weather is changing as a result. The measured increase in global average surface temperatures indicate an unfavourable and unknown outcome if the rate of release of greenhouse gas emissions remain at the current rate.

This assessment aims to estimate the predicted emissions of greenhouse gases (GHG) to the atmosphere due to the proposal and to provide a comparison of the direct emissions from the proposal at the state and national level.

13.2 Greenhouse gas inventory

The National Greenhouse Accounts (NGA) Factors document published by the Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education (DIICSRTE) defines three scopes (Scope 1, 2 and 3) for different emission categories based on whether the emissions generated are from "direct" or "indirect" sources.

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

"*...from sources within the boundary of an organisation as a result of that organisation's activities*" (**DIICSRTE, 2013a**).

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

"*...emissions generated in the wider economy as a consequence of an organisation's activities (particularly from its demand for goods and services), but which are physically produced by the activities of another organisation*" (**DIICSRTE, 2013a**).

For the purpose of this assessment, emissions generated in all three scopes defined above provide a suitable approximation of the total GHG emissions generated from the proposal.

Scope 3 emissions can often result in a significant component of the total emissions inventory; however, these emissions are often not directly controlled by the proposal. These emissions are understood to be considered in the Scope 1 emissions from other various organisations related to the proposal. The primary contribution of the Scope 3 emissions from the proposal occurs from the transportation of the product coal and from the end use of the product coal.

Scope 3 emissions also have the potential to arise from a greater number of sources associated with the operation of the proposal. As these are often difficult to quantify due to the diversity of sources and relatively minor individual contributions, they have not been considered in this assessment.

13.2.1 Emission sources

Scope 1 and 2 GHG emission sources identified from the operation of the proposal are the on-site combustion of diesel fuel, petrol fuel, petroleum based greases and oils, explosives, emissions of methane from the exposed coal seams, gaseous fuels and on-site consumption of electricity.

Scope 3 emissions have been identified as resulting from the purchase of diesel, petrol, petroleum based greases and oils, electricity for use on-site, the transport of product to its final destination and the final use of the product.

Estimated quantities of materials that have the potential to emit GHG emissions associated with Scope 1 and 2 emissions for the proposal have been summarised in **Table 13-1** below. These estimates are based on a conservative upper limit of the assumed maximum production throughout the life of the proposal. The assessment provides a reasonable worst case approximation of the potential GHG emissions for the purpose of this assessment.

Table 13-1: Summary of quantities of materials estimated for the proposal

Period	ROM coal (tonnes)	Diesel (kL)	Petrol (kL)	Grease/oils/lubes (kL)	Electricity (kWh)	Explosives (t)	LPG (kL)	Acetylene (m^3)
Annual	10,000,000	64,850	69	480	99,832	37,580	0.11	710.35
Total	50,000,000	324,248	347	2,399	499,158	187,902	1.0	3,552

Scope 3 emissions for the transport and final use of the coal may have the potential to vary in the future depending on the market situation at the time. These assumptions include emission factors for the transport modes of rail and shipping and the associated average weighted distance travelled for the export coal.

13.2.2 Emission factors

To quantify the amount of carbon dioxide equivalent (CO_2-e) material generated from the proposal, emission factors obtained from the NGA Factors (**DIICSRTE, 2013a**) and other sources as required and are summarised in **Table 13-2**.

Table 13-2: Summary of emission factors

Type	Energy content factor	Emission factor			Units	Scope	Source
		CO_2	CH_4	N_2O			
Diesel	38.6	69.2	0.2	0.5	kg CO_2-e/GJ	1	Table 4 (**DIICSRTE, 2013a**)
		5.3				3	Table 40 **DIICSRTE, 2013a**)
Petrol	34.2	66.7	0.6	2.3	kg CO_2-e/GJ	1	Table 4 (**DIICSRTE, 2013a**)
		5.3				3	Table 40 (**DIICSRTE, 2013a**)
Grease/oils/lubes	38.8	27.9			kg CO_2-e/GJ	1	Table 3 (**DIICSRTE, 2013a**)
		5.3				3	Table 40 (**DIICSRTE, 2013a**)
Electricity		0.87			kg CO_2-e/kWh	2	Table 5 (**DIICSRTE, 2013a**)

Type	Energy content factor	Emission factor			Units	Scope	Source
		CO_2	CH_4	N_2O			
		0.19				3	Table 41 (**DIICSRTE, 2013a**)
Explosives(1)		0.18			t CO_2-e/tonne	1	Table 4 (**DCC, 2008**)
LPG	25.7	1.547			kg CO_2-e/GJ	1	Proponent
Acetylene	0.0393	0.002			t CO_2-e/m^3	1	Proponent
Fugitive emissions		0.045			kg CO_2-e/t ROM	1	Table 7 (**DIICSRTE, 2013a**)
Rail		16.66			t CO_2-e/Mt-km	3	Proponent
Ship – Handy		5.422			t CO_2-e/Mt-km	3	Proponent
Ship – Panamax		3.459			t CO_2-e/Mt-km	3	Proponent
Ship – Bulk Carrier		2.090			t CO_2-e/Mt-km	3	Proponent
Thermal coal(2)	29	88.2	0.03	0.2	kg CO_2-e/GJ	3	Table 1 (**DIICSRTE, 2013a**)

(1)Assumes all explosives considered as Heavy ANFO
(2)Assumes type of coal is anthracite

Product coal is transported to the Port of Newcastle by rail and then transferred to coal loaders before being shipped to its final destination. The approximate rail distance is taken to be 166km (return distance). The approximate shipping distance of 13,000km (return distance) is based predominately on destinations in the Asian market.

The emissions generated from the end use of coal produced by the proposal have assumed that 5 per cent of the product coal is consumed at the Redbank power station and the remaining quantity is assumed to be used in power generation and steel manufacturing. As it is difficult to estimate emissions from power stations in other countries, this assessment has assumed the emissions generated would be equivalent to those generated from a power station in NSW. For the product coal used in steel manufacture we have taken a mass balance approach and assumed that all the carbon used will be converted to CO_2, where in reality some of the carbon would be captured in the steel. This approach is very conservative; however, in the absence of specific data, it has been adopted for this assessment.

13.3 Summary of greenhouse gas emissions

Table 13-3 summarises the estimated annual CO_2-e emissions due to the operation of the proposal.

Table 13-3: Summary of CO_2-e emissions for the proposal (t CO_2-e)

		Annual	Total
Fugitive emissions	Scope 1	203,163	1,015,823
Diesel	Scope 1	174,973	874,866
	Scope 3	13,267	66,335
Petrol	Scope 1	165	827
	Scope 3	13	63
Grease/oil/lubes	Scope 1	519	2,597
	Scope 3	99	493
Electricity	Scope 2	86,854	434,268
	Scope 3	18,968	94,840
Explosives	Scope 1	6,764	33,822
LPG	Scope 1	4.3	21.3
Acetylene	Scope 1	0.06	0.28
Transport via rail	Scope 3	18,391	91,955
Transport via ship	Scope 3	248,288	1,241,441
Final use of product – power supply	Scope 3	9,424,427	47,122,136

		Annual	Total
Final use of product – steel	Scope 3	12,191,667	60,958,333

13.4 Contribution of greenhouse gas emissions

Table 13-4 summarises the emissions associated with the proposal based on Scopes 1, 2 and 3.

Table 13-4: Summary of CO2-e emissions per scope (t CO_2-e)

Period	Scope 1	Scope 2	Scope 3
Annual	385,591	86,854	21,915,119
Total	**1,927,957**	**434,268**	**109,575,596**

The estimated annual greenhouse emissions for Australia for the period October 2012 to September 2013 was 567.5 Mt CO_2-e (**DoE, 2014**). In comparison, the conservative estimated annual average greenhouse emission over the 21-year life of the proposal is 0.472Mt CO_2-e (Scope 1 and 2). Therefore, the annual contribution of greenhouse emissions from the proposal in comparison to the Australian greenhouse emissions for the period October 2012 to September 2013 is conservatively estimated to be approximately 0.1 per cent.

At a state level, the estimated greenhouse emissions for NSW in the 2010-11 period was 159 Mt CO_2-e (**DIICSRTE, 2013b**). The annual contribution of greenhouse emissions from the proposal in comparison to the NSW greenhouse emissions for the 2010-11 period is conservatively estimated to be approximately 0.3 per cent.

The estimated greenhouse gas emissions generated in all three scopes are based on approximated quantities of materials and where applicable generic emission factors. Therefore, the estimated emissions for the proposal are considered conservative.

13.5 Greenhouse gas management

The proposal will continue to utilise various mitigation measures to minimise the overall generation of greenhouse gas emissions. The proposal's climate change programme has objectives in four key areas delivered through ongoing integration into existing business processes:

- Supporting research and promotion of technologies that reduce carbon dioxide emission from the use of coal;
- The improved use of energy at operations, projects and supply chain;
- Designing future projects with energy efficiency and climate change risks considered; and
- Raising awareness amongst stakeholders that climate change is an issues that requires us all to change how we currently operate.

Research programme funding is provided for the COAL21 Fund, the Australian Coal Association Research Programme (ACARP) and the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC) to support and develop the research of low emissions coal technologies.

The bulk consumption of diesel is monitored and reported monthly with the on-site fuel management system monitoring the quantity of fuel dispensed from tanks and service trucks through metering. Vehicles and plant equipment are fitted with identification tags to assist in tracking diesel consumption; the regular maintenance of diesel equipment ensures operational efficiency.

The total site electricity consumption is monitored and reported monthly with significant infrastructure and equipment such as the CPPs, draglines and electric rope shovels fitted with various meters to monitor electricity consumption.

MTW have developed and implemented energy efficiency performance metrics for fuel and electricity consumption which are tracked monthly against internal targets.

Waste is managed across the site in accordance with an appropriate waste management procedure. Waste management contributes to energy efficiency through measures such as planning when purchasing items to avoid or minimise waste with preference is given to products that are recyclable and reusable over ones that are not; consideration of minimum of packaging or packaging which is reusable or recyclable; and segregating waste to facilitate maximum reuse or recycling.

14 CONCLUSION

The study has identifies the potential air quality impacts that may arise from the proposal. The assessment utilises air dispersion modelling and focuses on potential dust impacts from the proposal in isolation (incrementally) and cumulatively with other nearby mines and background levels of dust. The assessment also investigates the potential air quality impacts associated with diesel fuel combustion, blast fume emissions and calculates potential greenhouse gas emissions.

The dispersion modelling predictions show that 18 assessment locations may experience levels above the relevant criterion for certain dust metrics due to the proposal.

Of these 18 potentially affected assessment locations, 15 are mine owned properties. The other three are identified as assessment locations 77, 102 and 264. Location 102 is the Warkworth community hall, and the remaining two assessment locations are privately owned residences in Warkworth. All three of these properties would lie within the area encompassed by the acquisition zone of neighbouring mines, but it should be noted that assessment location 264 is newly identified and does not appear in the explicit list of affected properties. In any case, all three of these potentially affected, non-mine owned properties would be afforded acquisition rights should the proposal proceed.

The assessment of cumulative 24-hour average PM_{10} concentrations found that impacts may potentially occur near the Warkworth, Knodlers Lane and MTIE monitoring locations. Of these locations, the potential risk of cumulative impacts is greatest near the Warkworth monitor as would be expected given the prevailing wind conditions in the area are likely to transport material from the operation towards this location as it progresses in a westerly direction.

An indicative cumulative 24-hour average $PM_{2.5}$ assessment reveals that no assessment location (predicted to comply with the criteria for other pollutants) would experience $PM_{2.5}$ level above the NEPM advisory reporting standards.

The assessment of diesel emissions shows that in the assessed years, all assessment locations are predicted to experience NO_2 concentrations below the relevant criterion.

The investigation into potential blast impacts found that the area of potential risk would shift towards the west over time with the progression of the proposal. With the current blast management practices, it is anticipated that any potential blast impacts can be adverted.

The greenhouse gas assessment conservatively calculates the annual Scope 1 and Scope 2 emission generated from the proposal to be 0.472Mt CO_2-e. Relative to the annual greenhouse gas emissions from Australian and NSW, it is estimated the proposal would contribute approximately 0.1 per cent and 0.3 per cent respectively.

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Appendix A
Assessment locations

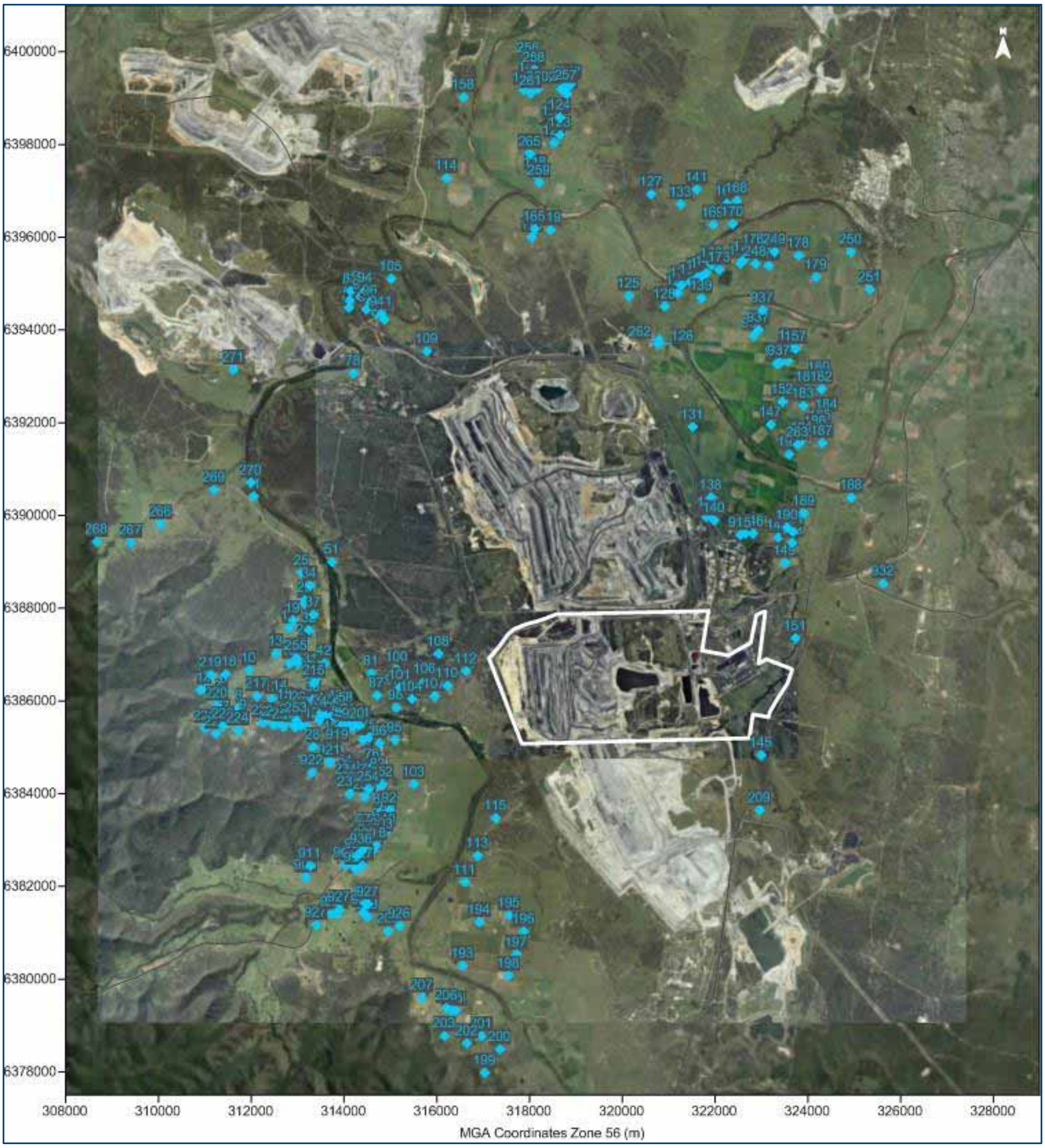

Figure A-1: Location of assessment locations assessed in this study

Table A-1: List of assessment locations assessed in this study

ID	X	Y	NAME
1	310903	6386238	JUDITH LESLIE
2	311055	6386261	SHAYNE AARON CURRIE
3	311295	6386059	PAUL TEMPLE VINES JESSOP
4	311336	6385751	GRAEME O'BRIEN & SUSANN FLORENCE O'BRIEN
5	311384	6386200	TREVOR HALTON MCTAGGART
6	311422	6386223	DOUGLAS KEITH PARTRIDGE
7	311470	6385618	DARRAL KEITH MARGERY & ANNETTE GAYE MARGERY
8	311735	6385855	LAURENCE FLETCHER & MARGARET ANN FLETCHER
9	311832	6385649	DONALD BRUCE ROSER
10	311950	6386665	PAKA INVESTMENTS PTY LIMITED
11**	312058	6390414	WAMBO MINING CORPORATION
12	312442	6386044	RONALD ALEXANDER CORINO
13	312532	6387028	ILARIO FRANCISCO CIRCOSTA & MARIA ANGELA CIRCOSTA
14	312632	6386066	KARIN MARGARET HUNT
15	312729	6385875	WILLIAM LINDSAY GORDON SLANEY
16	312822	6386804	LEONA ANN WILLIAMS
17	312814	6387573	GEORGE DAVID LIANOS
18	312935	6385847	BARRY JOHN ANDERSON & MELISSA GAI ANDERSON
19	312900	6387741	DENIS CYRIL MAIZEY
20	313041	6385812	GREGORY WILLIAM BANKS & MARION ELIZABETH BANKS
21	312998	6386821	GREGORY WILLIAM BANKS
22	313169	6385713	ELIZABETH MACKENZIE
23	313193	6385453	PETER JASON KOLATCHEW & HEIDI KOLATCHEW
24	313145	6387267	RONALD GARRY BAILEY
25	313091	6388764	WARKWORTH MINING LIMITED
26	313266	6385706	BARBARA GAE HARRISON & TREVOR ERIC HARRISON
27	313151	6388111	WARKWORTH MINING LIMITED
28	313335	6385003	HUBERT GEORGE UPWARD
29	313160	6388183	ILARIO FRANCISCO CIRCOSTA
30	313270	6386465	DAMIEN MICHAEL HANSON
31	313281	6386646	GREGORY MALCOLM CABAN
32	313252	6387528	PAUL MARK DUNN
33	313338	6386039	IAN NORRIS BARTHOLOMEW
34	313265	6388491	ALLAN CLYDE LEPISTO
35	313406	6386485	LAWRENCE MALCOLM CABAN
36	313473	6385589	RAYMOND CARL POWELL & CHRISTINE THERESE SHANNON
37	313345	6387861	GREGORY PAUL CROWE
38	313489	6385650	CHRISTOPHER LEONARD PRICE & LESLEY PRICE
39	313511	6385747	FERDINANDO FAMELI & JOELLE FAMELI
40	313595	6385794	MARGARET PLAYER & JOHN MACLACHLAN PLAYER
41	313690	6384726	HUBERT GEORGE UPWARD
42	313580	6386816	MARK ANTHONY LANCASTER
43	313658	6385668	DAVID JOHN BENSON
44	313658	6385708	BARRY FOGWELL
45	313725	6385198	ADAM CHARLES CAMERON
46	313798	6385640	DAVID JAMES GOLDSTEIN & VANESSA AMY GOLDSTEIN
47	313793	6385729	PHILIP ADAMTHWAITE
48	313823	6385853	BRETT JAMES GALLAGHER
49	313872	6385678	DEON PIERRE JANSE VAN RENSBURG
50	313898	6385517	SCOTT JAMES PRINGLE & LEANNE PRINGLE

ID	X	Y	NAME
51	313744	6389001	WARKWORTH MINING LIMITED
52	313956	6385265	STEWART JAMES MITCHELL & MARIE CLARE MITCHELL
53	313965	6385488	ROBERT MCLAUGHLIN
54	314037	6384456	CHRISTOPHER STANLEY NEVILLE & ELIZABETH ANN NEVILLE
55	313981	6385757	ROBERT JOHN EVANS
56	314005	6385480	LEONARD WALTER MCLACHLAN
57	314055	6385470	PAUL WILLIAM HARRIS
58	314046	6385804	DAVID ANDREW GREGORY
59	314088	6385479	WARKWORTH MINING LIMITED
60	314128	6385459	DAVID SAUNDERS
61	314231	6384325	DARRELL STANLEY KAIZER
62	314225	6385443	PATRICK JOHN MAGIN
63	314229	6385540	PETER JAMES COOKE
64	314242	6385504	DUSKO DRAGICEVIC
65	314239	6385584	GORDON KEITH GRAINGER
66	314258	6385447	MICHAEL VIVIAN BENDALL
67	314434	6383176	MICHAEL SHANE DAWSON & SUZANA DAWSON
68	314306	6385515	WARKWORTH MINING LIMITED
69	314329	6385371	WARKWORTH MINING LIMITED
70	314462	6383042	PETER FRANCIS RITCHIE AND FIONA JENNIFER RITCHIE
71	314354	6385377	ROBERT IAN HEDLEY
72	314392	6385359	FRANCIS HENRY TURNBULL
73	314407	6385160	PHILLIP JOSEPH REID
74	314514	6384263	RONALD GUY GODYN & ANNE-MARIE GODYN
75	314546	6385220	LINDSAY ROBERT SMITH
76	314618	6384591	THE STATE OF NEW SOUTH WALES
77	314103	6394482	WILLIAM JOSEPH KELLY
78	314203	6393069	WARKWORTH MINING LIMITED
79**	314121	6394634	WAMBO MINING CORPORATION LIMITED
80	314769	6383296	DIMITRIOUS VIKAS & JOY MARY VIKAS
81	314590	6386597	JOHN CHARLES MULALLY & PETER EDWIN MCMAUGH & GARRETT JOHN BURKE
82	314734	6384379	DONALD JAMES WALTERS
83**	314144	6394841	XSTRATA COAL PTY LIMITED
84	314796	6383618	MARY VERONICA THOMPSON
86	314767	6385091	THE STATE OF NEW SOUTH WALES
87	314711	6386122	MILLER POHANG COAL COMPANY PTY LTD
89	314951	6383454	BRYAN DUDLEY MEDHURST
90	314344	6394886	COAL & ALLIED OPERATIONS PTY LIMITED
91**	314359	6394718	WAMBO COAL PTY LTD
92**	314985	6383647	SAXONVALE COAL PTY LIMITED
93	314481	6394444	COAL & ALLIED OPERATIONS PTY LIMITED
94**	314463	6394855	WAMBO COAL PTY LTD
95	315097	6385163	MILLER POHANG COAL COMPANY
96**	314571	6394587	WAMBO MINING CORPORATION PTY LIMITED
97	315058	6386183	WARKWORTH MINING LIMITED
98	315125	6385857	MILLER POHANG COAL COMPANY
99**	314699	6394352	WAMBO COAL PTY LTD
100	315144	6386684	MILLER POHANG COAL COMPANY PTY LTD
101	315208	6386297	MILLER POHANG COAL COMPANY
102	314800	6394348	BRIAN EDWARD KENNEDY & JOHN GRIFFITHS

ID	X	Y	NAME
103**	315505	6384205	SAXONVALE COAL PTY. LIMITED
104	315463	6386048	MILLER POHANG COAL COMPANY
105	315017	6395104	COAL & ALLIED OPERATIONS PTY LIMITED
106	315742	6386435	MILLER POHANG COAL COMPANY
107	315949	6386105	MILLER POHANG COAL COMPANY PTY LIMITED
108	316037	6387020	MILLER POHANG COAL COMPANY PTY LIMITED
109**	315789	6393545	XSTRATA COAL (NSW) PTY LIMITED
110	316226	6386333	MILLER POHANG COAL COMPANY PTY LIMITED
111	316609	6382098	WALLACE RUSSELL
112	316629	6386649	MILLER POHANG COAL COMPANY PTY LIMITED
113**	316882	6382664	SAXONVALE COAL PTY LIMITED
114	316208	6397277	COAL & ALLIED OPERATIONS PTY LIMITED
115**	317271	6383479	SAXONVALE COAL PTY. LIMITED
116	318052	6396001	COAL & ALLIED OPERATIONS PTY LIMITED
117	317982	6397794	PHILLIP & COLLEEN ALGIE
118	318128	6397356	ROBERT ALGIE
118	318128	6397356	ROBERT ALGIE
119	318452	6396156	COAL & ALLIED OPERATIONS PTY LIMITED
120	318504	6398457	R & J WENHAM
121	318530	6398039	JULIE & GREGORY ERNST
122	318608	6398554	STEPHEN EDWARDS
123	318658	6398205	N & G NELSON
124	318655	6398582	STEPHEN EDWARDS
125	320142	6394738	COAL & ALLIED OPERATIONS PTY LIMITED
126	320764	6393699	PETER GLEN STUART
127	320624	6396932	NOEL & ELAINE RILEY
128	320916	6394511	PETER & DAPHNE WELSH
129	321192	6394796	COAL & ALLIED OPERATIONS PTY LIMITED
130	321271	6394970	FRANK & JOANNE VENTRA
131	321519	6391910	WARKWORTH MINING LIMITED
133	321261	6396710	COAL & ALLIED OPERATIONS PTY LIMITED
134	321472	6395034	LUCIANO CHARLES GATT
135	321816	6389971	WARKWORTH MINING LIMITED
136	321862	6390017	WARKWORTH MINING LIMITED
137	321617	6395135	COAL & ALLIED OPERATIONS PTY LIMITED
138	321914	6390390	WARKWORTH MINING LIMITED
139	321707	6394686	KEVIN DENNIS
140	321981	6389895	WARKWORTH MINING LIMITED
141	321604	6397030	WARREN AND LESLEY BARRY
142	321715	6395167	COAL & ALLIED OPERATIONS PTY LIMITED
143	321817	6395230	COAL & ALLIED OPERATIONS PTY LIMITED
144	322654	6389614	CAROL ANNE DYSON
145**	322998	6384833	SAXONVALE COAL PTY. LIMITED
146	322820	6389611	PAUL HENRY RUSSELL
147	323200	6391960	WARKWORTH MINING LIMITED
148	323360	6389527	DOROTHY CLARE RUSSELL
149	323510	6388982	IAN BULMER HEDLEY
150	323560	6389775	KEITH DAVID ISAAC AND SHARON ANN ISAAC
151**	323731	6387355	BULGA COAL MANAGEMENT PTY LIMITED
152	323454	6392457	GRAHAM EDWIN BERRY

ID	X	Y	NAME
153	323662	6389415	THOMAS WILLIAM KERMODE & KATHLEEN MAY KERMODE
154**	323680	6389650	BULGA COAL MANAGEMENT PTY LIMITED
155	323565	6393343	KEITH GEORGE BERRY
156	323610	6393617	ROBERT O'HARA
157	323739	6393594	ROBERT O'HARA
158	316576	6399021	COAL & ALLIED OPERATIONS PTY LIMITED
160	317883	6399178	ELIZABETH BOWMAN
161	318010	6399448	WYOMING HOLSTEINS PTY LTD
162	318011	6399407	WYOMING HOLSTEINS PTY LTD
163	318114	6399572	WYOMING HOLSTEINS PTY LTD
165	318110	6396180	COAL & ALLIED
167	322254	6396725	NATHAN JAMES LAING
168	322468	6396793	STUART FRANCIS NICHOL WRIGHT AND PAMELA LYNN WRIGHT
169	321959	6396271	HAROLD DOUGLAS HOBDEN
170	322379	6396285	JOHN MARCHEFF
172	321925	6395400	JOHN STUART GOUGH AND LYNETTE JEAN GOUGH
173	322099	6395301	JOHN STUART GOUGH AND LYNETTE JEAN GOUGH
174	322545	6395438	COLIN RAYMOND NEAL AND MARGARET ANNE NEAL
175	322633	6395534	BRADLEY JOHN HALTER
176	322830	6395688	MICHAEL RAYMOND MAPP AND SHIRLEY MAREE MAPP
177	323156	6395384	DELANEY
178	323801	6395607	CRAIG IAN FLISSINGER AND CATHERINE ANNE FLISSINGER
179	324177	6395141	TICKALARA PTY. LIMITED
180	324246	6392934	MOORE
181	323983	6392725	DAVID CHARLES VASSALLO AND SHEREE ANN VASSALLO
182	324296	6392725	ROBERT FRANCIS HOLSTEIN AND ANDREA TERRY HOLSTEIN
183	323903	6392368	HALL
184	324407	6392127	CAMPBELL STUART BALL AND GAIL AGNES BALL
185	324272	6391894	LEONARD DALE FRANKS
186	324164	6391772	LEONARD DALE FRANKS
187	324308	6391565	HEUSTON PTY LTD
188	324940	6390387	WALDOCK
189**	323916	6390047	BULGA COAL MANAGEMENT PTY LIMITED
190	323552	6389746	KEITH DAVID ISAAC AND SHARON ANN ISAAC
191	323873	6391630	ROBERT JOHN VIDLER AND CORAL MAY VIDLER
192	323595	6391320	O'HARA R & J
193	316558	6380293	ROBERT KENNEDY
194**	316918	6381236	SAXONVALE COAL PTY LIMITED
195**	317561	6381382	SAXONVALE COAL PTY LIMITED
196**	317877	6381030	SAXONVALE COAL PTY LIMITED
197	317716	6380532	ROBERT KENNEDY
198**	317549	6380075	SAXONVALE COAL PTY LIMITED
199	317036	6377983	ADRIAN GARTON
200	317360	6378494	KARREN ANNE MCCRAW
201	316963	6378778	RICHARD JAMES OWENS
202	316649	6378621	RICHARD JAMES OWENS
203	316167	6378781	GRAPEMEN HOLDINGS PTY LIMITED
204	316407	6379326	ESSLEMONT FAMILY HOLDINGS PTY LIMITED
205	316333	6379327	VICTORIA ANN FOSTER
206	316214	6379385	THEO POULOS

ID	X	Y	NAME
207	315682	6379608	JOHN STEPHEN TULLOCH
208	314955	6381041	CYBELE GENEVIEVE ORTON
209**	322962	6383649	SAXONVALE COAL PTY LIMITED
210	314178	6385559	MERIA VIOLET FORD
211	314331	6385481	MIKE DEAN SILK
215	313354	6386390	
217	312125	6386110	
218	311450	6386578	
219	311134	6386568	
220	311258	6385905	
221	311001	6385414	
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224	311716	6385367	
225	312256	6385540	
226	312474	6385495	
227	312569	6385509	
228	312698	6385457	
229	312866	6385557	
230	312952	6385439	
231	313060	6385467	
234	314048	6384261	
235	314181	6384088	
236	314679	6384143	
237	314116	6383992	
238	314448	6383932	
243	314883	6383176	
244	318808	6399092	
245	318679	6399194	
246	318795	6399314	
247	318879	6399292	
248	322876	6395431	
249	323284	6395685	
250	324927	6395679	
251	325339	6394874	
252	314827	6384207	
253	312973	6385584	
254	314529	6384103	
255	312973	6386930	ILARIO FRANCISCO CIRCOSTA & MARIA ANGELA CIRCOSTA
256	317979	6399821	BRUCE ERIC MOXEY
257	318793	6399221	ROBERT JOHN ALGIE
258	318104	6399611	WYOMING HOLSTEINS PTY LTD
259	318211	6397178	ROBERT JOHN ALGIE
260	318180	6399198	WYOMING HOLSTEINS PTY LTD
261	318030	6399106	WYOMING HOLSTEINS PTY LTD
262	320794	6393794	PETER GLEN STUART
263	323786	6391522	JOHN KLASEN
264	314870	6394227	GEORGE ROBERT MILLER
265	318014	6397793	PHILLIP JOHN ALGIE
266	310048	6389815	RONALD WAYNE FENWICK

ID	X	Y	NAME
267	309407	6389413	KENNETH MAX BROSI & CORAL MAUDE BROSI
268	308672	6389436	KENNETH MAX BROSI
269**	311206	6390559	WAMBO MINING CORPORATION PTY LIMITED
270**	311995	6390710	WAMBO MINING CORPORATION PTY LIMITED
271**	311622	6393146	WAMBO MINING CORPORATION PTY LIMITED
903	314821	6383080	ADAM JOHN BAKER
904	314024	6382465	ALLAN MARK BRASINGTON, JUDITH ANNE BRASINGTON
905	313176	6382198	CAMERON MICHAEL TURNER, MELISSA JAYNE HARRIS
909	314611	6382770	EMANUEL VICTOR VASSALLO
911	313271	6382442	GARY DALE HARRIS
915	322542	6389581	JASON CYRIL RUMBEL, REBECCA RUTH RUMBEL
917	314549	6382967	JOHN ROBERT LAMB
918	314686	6382893	JOSEPH VASSALLO, DORIS VASSALLO
919	313866	6385003	KENNETH NEIL CAMERON
920	314208	6385455	LINDSAY GORDON HARRIS, JILLIAN MAY FERGUSON
921	313692	6384676	MELANIE CABAN, KEIRAN LIONEL CABAN
922	313313	6384456	MELANIE EVELYN UPWARD
923	314505	6381343	MICHELLE MARIA BRENNAN
926	315197	6381155	PAUL WILLIAM MACKAY, SUZANNE ELIZABETH MACKAY
927a	314213	6382445	PHILLIP JOHN GUNTER, LEONA MARY GUNTER
927b	314251	6382364	
927c	314400	6382451	
927d	314414	6381446	
927e	314462	6381631	
927f	314521	6381618	
927g	313398	6381173	
927h	313742	6381405	
927i	313851	6381411	
927j	313902	6381509	
928	314270	6382655	SARAH ELIZABETH PURSER, STIRLING OWEN KEAYES
929	314462	6382864	SIMON JAMES BEAVIS
932	325626	6388538	STEPHEN DENNIS TIPPING
936	314376	6382753	THOMAS CHARLES JACKSON, SUSAN GAI JACKSON
937a	322832	6393883	TREVOR KEITH BERRY, GRAHAM EDWIN BERRY
937b	322935	6394004	
937c	323028	6394431	
937d	323333	6393272	
937e	323391	6393295	
941**	314808	6394346	XSTRATA COAL PTY LIMITED

**Other mine owned property

Appendix B
Monitoring Data

Table B-1: TEOM Monitoring data

Date	Bulga	Knodlers Lane	Maison Dieu	MTIE	Wallaby Scrub Road	Warkworth	Date	Bulga	Knodlers Lane	Maison Dieu	MTIE	Wallaby Scrub Road	Warkworth
1/01/2012	ND	ND	20	21	16	15	1/01/2013	22	21	26	19	25	28
2/01/2012	ND	ND	18	27	21	18	2/01/2013	19	34	31	34	ND	22
3/01/2012	ND	12	17	21	20	20	3/01/2013	30	32	39	53	33	37
4/01/2012	ND	14	17	19	22	14	4/01/2013	ND	17	21	ND	ND	20
5/01/2012	26	22	36	38	25	21	5/01/2013	21	15	18	21	26	21
6/01/2012	33	ND	ND	39	ND	ND	6/01/2013	ND	16	21	15	ND	29
7/01/2012	18	11	16	16	13	15	7/01/2013	18	13	16	21	28	21
8/01/2012	19	13	19	22	20	15	8/01/2013	14	10	11	13	ND	14
9/01/2012	34	ND	30	26	31	24	9/01/2013	ND	32	42	35	ND	40
10/01/2012	18	ND	17	22	16	ND	10/01/2013	41	42	52	49	ND	39
11/01/2012	15	ND	20	25	13	ND	11/01/2013	33	23	27	32	40	33
12/01/2012	19	ND	42	45	23	ND	12/01/2013	ND	29	36	30	34	33
13/01/2012	17	ND	26	32	18	ND	13/01/2013	ND	36	6	43	ND	ND
14/01/2012	23	ND	29	28	22	18	14/01/2013	30	15	30	30	35	ND
15/01/2012	18	ND	24	31	19	20	15/01/2013	9	6	10	5	10	ND
16/01/2012	15	ND	13	22	13	12	16/01/2013	18	12	14	18	22	12
17/01/2012	15	7	11	32	15	14	17/01/2013	27	24	31	33	32	29
18/01/2012	19	11	17	26	20	17	18/01/2013	ND	38	ND	ND	ND	31
19/01/2012	14	8	13	18	13	15	19/01/2013	ND	46	54	ND	41	39
20/01/2012	15	ND	16	ND	13	15	20/01/2013	27	26	31	25	26	34
21/01/2012	27	ND	23	43	20	20	21/01/2013	10	12	13	18	13	12
22/01/2012	15	14	24	23	13	17	22/01/2013	20	13	15	19	23	22
23/01/2012	12	ND	15	18	11	19	23/01/2013	16	16	2	30	17	ND
24/01/2012	17	ND	ND	12	16	14	24/01/2013	13	16	18	14	15	ND
25/01/2012	14	ND	ND	1	11	14	25/01/2013	17	15	18	16	20	19
26/01/2012	9	ND	ND	12	9	13	26/01/2013	13	7	8	6	14	13
27/01/2012	10	ND	ND	10	10	12	27/01/2013	16	10	11	12	ND	15
28/01/2012	15	ND	ND	15	16	15	28/01/2013	7	7	9	7	10	11
29/01/2012	11	ND	ND	6	11	12	29/01/2013	4	4	4	1	6	7
30/01/2012	14	ND	ND	10	14	12	30/01/2013	6	6	7	10	8	10
31/01/2012	17	ND	ND	17	15	16	31/01/2013	18	17	10	ND	21	22
1/02/2012	ND	ND	13	11	13	13	1/02/2013	ND	18	23	6	ND	24
2/02/2012	5	4	7	8	6	7	2/02/2013	12	17	18	19	ND	19
3/02/2012	4	4	5	2	5	5	3/02/2013	4	7	7	3	6	6
4/02/2012	7	ND	9	5	8	8	4/02/2013	9	12	15	17	10	11
5/02/2012	9	ND	15	15	11	14	5/02/2013	13	17	16	17	14	17
6/02/2012	17	ND	18	15	17	17	6/02/2013	13	13	15	16	ND	15
7/02/2012	18	ND	26	ND	17	22	7/02/2013	13	10	12	12	ND	14
8/02/2012	8	ND	15	18	17	12	8/02/2013	13	12	15	18	16	19
9/02/2012	17	ND	19	21	ND	17	9/02/2013	21	20	25	23	27	26
10/02/2012	13	ND	18	17	13	16	10/02/2013	41	22	29	21	ND	30
11/02/2012	12	ND	17	18	14	ND	11/02/2013	ND	21	25	23	ND	24
12/02/2012	9	ND	15	16	10	12	12/02/2013	7	11	13	20	10	10
13/02/2012	14	ND	11	15	16	11	13/02/2013	6	10	11	8	9	13
14/02/2012	13	ND	18	13	14	13	14/02/2013	8	8	9	8	12	15
15/02/2012	10	ND	12	8	12	13	15/02/2013	11	11	13	14	12	13
16/02/2012	9	ND	11	11	10	12	16/02/2013	8	8	8	12	11	20
17/02/2012	13	ND	6	13	14	14	17/02/2013	8	7	10	11	9	12
18/02/2012	18	ND	18	22	17	18	18/02/2013	10	9	10	10	12	14
19/02/2012	18	ND	28	22	22	24	19/02/2013	9	12	13	21	12	15
20/02/2012	22	ND	24	21	20	17	20/02/2013	12	12	12	14	ND	18
21/02/2012	13	ND	13	14	14	14	21/02/2013	ND	12	15	16	14	21
22/02/2012	8	ND	9	12	8	9	22/02/2013	11	12	13	13	14	18

Date	Bulga	Knodlers Lane	Maison Dieu	MTIE	Wallaby Scrub Road	Warkworth	Date	Bulga	Knodlers Lane	Maison Dieu	MTIE	Wallaby Scrub Road	Warkworth
23/02/2012	13	ND	19	15	ND	17	23/02/2013	13	14	15	14	16	21
24/02/2012	17	ND	12	ND	17	13	24/02/2013	5	7	8	7	9	10
25/02/2012	13	ND	12	15	15	17	25/02/2013	12	9	10	ND	18	15
26/02/2012	15	ND	11	9	13	14	26/02/2013	14	10	12	ND	16	18
27/02/2012	11	ND	13	15	11	14	27/02/2013	17	12	14	13	20	20
28/02/2012	14	ND	17	18	ND	14	28/02/2013	15	12	14	7	17	19
29/02/2012	16	ND	24	ND	17	19	1/03/2013	ND	ND	15	13	12	16
1/03/2012	13	ND	28	21	15	19	2/03/2013	ND	3	4	ND	4	4
2/03/2012	15	ND	22	21	16	19	3/03/2013	ND	4	6	ND	6	6
3/03/2012	3	ND	4	5	5	7	4/03/2013	ND	10	13	10	15	16
4/03/2012	10	ND	10	7	13	10	5/03/2013	14	12	15	15	20	21
5/03/2012	16	ND	ND	18	15	15	6/03/2013	14	ND	13	11	17	16
6/03/2012	8	ND	12	14	11	11	7/03/2013	11	9	12	12	14	18
7/03/2012	11	ND	18	20	16	17	8/03/2013	15	10	ND	18	14	12
8/03/2012	10	ND	13	15	10	10	9/03/2013	12	10	ND	14	13	15
9/03/2012	3	ND	8	17	6	6	10/03/2013	10	10	10	14	12	14
10/03/2012	9	13	15	21	11	14	11/03/2013	13	11	12	24	14	15
11/03/2012	10	14	19	19	13	17	12/03/2013	13	12	13	14	14	16
12/03/2012	23	17	22	22	21	18	13/03/2013	12	11	13	15	15	17
13/03/2012	14	17	15	21	16	16	14/03/2013	14	12	16	19	19	15
14/03/2012	12	11	ND	17	14	ND	15/03/2013	20	19	22	34	22	25
15/03/2012	11	15	13	24	14	17	16/03/2013	16	18	19	ND	15	16
16/03/2012	ND	13	20	21	16	17	17/03/2013	19	19	24	24	21	21
17/03/2012	16	12	15	ND	ND	13	18/03/2013	17	21	24	28	15	17
18/03/2012	8	12	14	12	9	11	19/03/2013	13	16	20	27	16	17
19/03/2012	11	13	15	12	14	14	20/03/2013	10	14	18	21	13	14
20/03/2012	ND	9	10	11	10	12	21/03/2013	9	9	10	24	13	13
21/03/2012	8	11	14	20	13	15	22/03/2013	14	18	24	21	15	20
22/03/2012	8	10	12	16	12	14	23/03/2013	21	40	39	46	25	27
23/03/2012	8	15	17	16	7	17	24/03/2013	13	17	15	14	15	12
24/03/2012	17	27	26	30	20	21	25/03/2013	9	26	24	ND	12	16
25/03/2012	10	18	20	21	14	16	26/03/2013	21	35	39	50	24	ND
26/03/2012	9	15	16	21	13	17	27/03/2013	ND	30	38	35	ND	30
27/03/2012	12	12	14	13	15	16	28/03/2013	ND	ND	21	ND	20	21
28/03/2012	11	13	14	17	16	16	29/03/2013	19	38	28	30	22	20
29/03/2012	9	10	11	11	12	15	30/03/2013	10	10	14	16	12	14
30/03/2012	11	16	20	17	11	16	31/03/2013	12	15	17	24	14	16
31/03/2012	10	21	21	21	12	16	1/04/2013	10	21	23	32	9	15
1/04/2012	10	ND	14	19	14	15	2/04/2013	10	15	17	25	9	14
1/04/2012	13	22	22	32	16	17	3/04/2013	9	15	16	16	10	15
2/04/2012	12	14	16	23	13	14	4/04/2013	8	17	19	19	8	13
3/04/2012	ND	20	21	32	15	17	5/04/2013	6	11	13	10	7	10
4/04/2012	ND	20	20	25	23	24	6/04/2013	9	8	11	13	9	12
5/04/2012	12	12	12	34	18	18	7/04/2013	6	10	12	20	6	10
6/04/2012	13	11	11	16	13	15	7/04/2013	8	10	12	22	10	11
7/04/2012	26	28	30	33	27	24	8/04/2013	9	10	11	17	12	12
8/04/2012	24	27	31	29	26	27	9/04/2013	6	12	12	22	8	14
9/04/2012	10	16	17	20	11	13	10/04/2013	5	7	5	12	8	10
10/04/2012	9	16	21	21	10	12	11/04/2013	9	10	11	21	10	15
11/04/2012	8	16	15	23	9	10	12/04/2013	10	12	13	25	10	15
12/04/2012	ND	9	12	15	9	11	13/04/2013	14	20	20	22	12	21
13/04/2012	12	13	12	21	14	13	14/04/2013	10	17	19	27	13	20
14/04/2012	10	15	19	18	12	13	15/04/2013	16	27	35	42	19	25
15/04/2012	17	22	26	27	17	21	16/04/2013	6	12	14	15	9	13

Date	Bulga	Knodlers Lane	Maison Dieu	MTIE	Wallaby Scrub Road	Warkworth	Date	Bulga	Knodlers Lane	Maison Dieu	MTIE	Wallaby Scrub Road	Warkworth
16/04/2012	12	14	17	19	13	24	17/04/2013	6	14	16	15	9	ND
17/04/2012	8	16	16	21	10	9	18/04/2013	ND	14	16	ND	11	12
18/04/2012	6	6	7	8	6	11	19/04/2013	7	15	19	23	7	12
19/04/2012	ND	6	6	13	9	ND	20/04/2013	4	16	19	5	6	7
20/04/2012	7	ND	16	19	11	14	21/04/2013	4	10	12	10	7	11
21/04/2012	9	13	19	23	13	20	22/04/2013	8	19	25	32	9	17
22/04/2012	13	20	23	28	16	20	23/04/2013	17	16	22	31	9	12
23/04/2012	10	18	23	23	14	15	24/04/2013	13	ND	10	29	ND	13
24/04/2012	6	14	17	22	8	14	25/04/2013	17	25	28	42	16	20
25/04/2012	7	13	14	20	11	9	26/04/2013	10	26	31	43	12	18
26/04/2012	12	17	21	ND	13	16	27/04/2013	19	30	36	38	20	24
27/04/2012	16	17	20	22	18	15	28/04/2013	38	34	36	51	32	28
28/04/2012	16	21	24	27	19	16	29/04/2013	79	38	47	67	72	51
29/04/2012	10	18	20	26	13	17	30/04/2013	25	24	28	32	28	30
30/04/2012	14	17	9	24	17	16	1/05/2013	21	28	32	37	26	26
1/05/2012	15	15	17	26	14	15	2/05/2013	ND	ND	19	25	14	18
2/05/2012	13	15	18	21	14	16	3/05/2013	14	20	23	29	13	17
3/05/2012	9	10	15	10	10	12	4/05/2013	20	22	34	33	24	25
4/05/2012	ND	15	14	18	13	14	5/05/2013	19	34	34	35	23	24
5/05/2012	8	13	14	29	6	11	6/05/2013	ND	14	17	25	11	16
6/05/2012	10	20	18	25	ND	11	7/05/2013	11	ND	ND	27	15	22
7/05/2012	10	20	8	35	11	14	8/05/2013	ND	15	10	21	ND	15
8/05/2012	10	19	24	32	11	11	9/05/2013	26	18	18	30	19	23
9/05/2012	12	22	30	ND	12	15	10/05/2013	38	25	25	42	40	35
10/05/2012	12	ND	29	47	ND	16	11/05/2013	25	29	31	46	29	35
11/05/2012	15	31	31	46	17	19	12/05/2013	23	13	13	23	14	12
12/05/2012	12	28	28	55	12	17	13/05/2013	ND	ND	32	48	19	23
13/05/2012	10	25	34	47	13	18	14/05/2013	5	10	12	16	8	8
14/05/2012	8	16	24	35	9	12	15/05/2013	6	16	21	22	10	10
15/05/2012	ND	21	30	34	ND	13	16/05/2013	10	17	23	36	14	12
16/05/2012	14	24	28	38	17	18	17/05/2013	6	10	16	28	10	12
17/05/2012	16	17	22	30	14	16	18/05/2013	6	16	19	23	9	10
18/05/2012	13	22	24	33	13	19	19/05/2013	7	12	13	26	10	9
19/05/2012	15	25	29	43	17	16	20/05/2013	13	21	32	29	16	13
20/05/2012	14	28	32	35	15	16	21/05/2013	12	27	29	36	14	18
21/05/2012	14	18	ND	31	16	16	22/05/2013	ND	32	39	41	14	20
22/05/2012	12	27	29	39	18	17	23/05/2013	3	6	7	13	5	5
23/05/2012	15	27	35	47	15	15	24/05/2013	6	8	11	ND	9	8
24/05/2012	14	29	38	54	19	20	25/05/2013	3	8	9	10	5	7
25/05/2012	7	10	11	14	8	10	26/05/2013	6	9	11	25	8	10
26/05/2012	9	13	15	13	12	10	27/05/2013	11	18	23	34	14	16
27/05/2012	7	13	14	27	6	7	28/05/2013	6	10	11	14	7	13
28/05/2012	12	24	26	ND	12	16	29/05/2013	9	13	14	27	11	12
29/05/2012	7	ND	14	12	ND	10	30/05/2013	10	ND	19	ND	11	16
30/05/2012	8	11	12	13	8	12	31/05/2013	9	15	16	17	10	13
31/05/2012	9	13	14	14	11	16	1/06/2013	10	18	21	19	ND	13
1/06/2012	7	7	9	19	8	12	2/06/2013	3	5	7	7	2	6
2/06/2012	6	7	8	11	6	11	3/06/2013	5	8	12	24	3	9
3/06/2012	4	5	5	6	4	5	4/06/2013	8	12	18	31	3	11
4/06/2012	4	6	5	3	5	5	5/06/2013	9	12	14	26	10	11
5/06/2012	6	8	8	10	8	7	6/06/2013	11	18	27	41	12	14
6/06/2012	9	8	10	9	10	9	7/06/2013	6	15	20	22	12	11
7/06/2012	6	7	9	18	ND	8	8/06/2013	9	11	13	27	10	15
8/06/2012	6	9	10	11	8	10	9/06/2013	10	11	11	21	11	13

Date	Bulga	Knodlers Lane	Maison Dieu	MTIE	Wallaby Scrub Road	Warkworth	Date	Bulga	Knodlers Lane	Maison Dieu	MTIE	Wallaby Scrub Road	Warkworth
9/06/2012	9	10	10	15	10	10	10/06/2013	7	9	11	18	10	13
10/06/2012	9	14	15	22	10	12	11/06/2013	4	6	7	24	6	7
11/06/2012	5	7	9	5	5	7	12/06/2013	8	9	10	21	9	10
12/06/2012	7	8	9	11	7	7	13/06/2013	3	6	7	10	6	6
13/06/2012	ND	9	9	10	ND	8	14/06/2013	3	6	7	10	6	5
14/06/2012	12	10	10	19	16	ND	15/06/2013	4	7	9	14	7	6
15/06/2012	8	15	19	16	11	13	16/06/2013	5	10	10	13	8	6
16/06/2012	8	13	14	24	9	10	17/06/2013	6	12	11	20	10	8
17/06/2012	6	8	9	8	8	6	18/06/2013	5	9	11	24	7	8
18/06/2012	7	14	13	ND	8	8	19/06/2013	6	13	ND	19	7	9
19/06/2012	5	9	13	ND	6	8	20/06/2013	6	13	ND	21	8	11
20/06/2012	6	13	17	10	8	10	21/06/2013	7	18	20	35	12	14
21/06/2012	8	17	ND	19	11	10	22/06/2013	7	10	14	17	9	10
22/06/2012	10	14	19	16	15	10	23/06/2013	5	10	13	16	5	7
23/06/2012	6	9	11	9	6	6	24/06/2013	2	12	11	18	5	6
24/06/2012	8	10	16	11	9	9	25/06/2013	4	6	ND	26	8	9
25/06/2012	10	10	20	22	11	9	26/06/2013	11	13	17	18	12	13
26/06/2012	6	17	21	18	7	12	27/06/2013	8	10	13	6	7	8
27/06/2012	8	8	10	10	8	9	28/06/2013	4	7	8	12	6	ND
28/06/2012	ND	10	9	17	6	9	29/06/2013	4	ND	7	6	5	ND
29/06/2012	12	14	20	19	15	ND	30/06/2013	8	10	11	7	4	ND
30/06/2012	6	11	10	14	7	8	1/07/2013	2	13	11	20	5	ND
1/07/2012	8	17	20	29	10	9	2/07/2013	4	9	10	21	9	ND
2/07/2012	5	12	11	20	8	6	3/07/2013	5	8	9	15	8	6
3/07/2012	7	9	14	16	9	8	4/07/2013	9	14	16	ND	11	11
4/07/2012	9	17	23	21	9	10	5/07/2013	6	14	14	20	10	10
5/07/2012	7	16	23	24	8	11	6/07/2013	6	14	16	20	13	9
6/07/2012	6	9	12	11	7	7	7/07/2013	6	12	16	22	9	10
7/07/2012	6	15	19	10	8	13	8/07/2013	8	15	17	26	12	12
8/07/2012	13	16	20	26	16	12	9/07/2013	10	19	24	24	11	15
9/07/2012	12	10	12	20	14	12	10/07/2013	5	13	16	17	ND	11
10/07/2012	7	12	15	36	7	13	11/07/2013	7	13	16	21	10	14
11/07/2012	5	6	7	12	6	8	12/07/2013	7	13	17	23	9	11
12/07/2012	8	12	15	31	8	12	13/07/2013	16	10	13	18	13	18
13/07/2012	4	9	9	11	7	7	14/07/2013	14	12	14	24	15	15
14/07/2012	4	6	6	9	7	6	15/07/2013	11	19	22	ND	14	15
15/07/2012	6	7	7	8	10	5	16/07/2013	5	ND	16	23	8	12
16/07/2012	8	11	15	11	11	9	17/07/2013	7	11	14	4	9	ND
17/07/2012	6	13	16	29	5	10	18/07/2013	7	11	14	24	9	ND
18/07/2012	ND	14	18	22	7	11	19/07/2013	7	12	15	19	10	12
19/07/2012	ND	12	17	25	8	11	20/07/2013	2	9	9	23	6	11
20/07/2012	7	18	21	26	10	11	21/07/2013	4	12	11	27	8	8
21/07/2012	8	16	28	25	11	13	22/07/2013	5	14	15	35	8	9
22/07/2012	7	13	19	17	9	10	23/07/2013	5	10	12	12	7	10
23/07/2012	6	9	13	10	8	10	24/07/2013	9	14	22	30	9	11
24/07/2012	4	8	9	13	6	5	25/07/2013	16	19	23	35	19	17
25/07/2012	6	10	16	18	8	2	26/07/2013	10	18	25	36	14	16
26/07/2012	ND	19	26	27	12	7	27/07/2013	15	17	26	33	16	16
27/07/2012	5	12	14	25	7	9	28/07/2013	15	13	18	32	18	16
28/07/2012	5	10	12	18	9	6	29/07/2013	11	16	21	33	15	19
29/07/2012	10	12	18	17	12	8	30/07/2013	ND	18	26	39	14	15
30/07/2012	5	6	15	36	6	11	31/07/2013	ND	12	14	17	10	11
31/07/2012	7	8	30	ND	10	14	1/08/2013	ND	11	12	21	8	10
1/08/2012	6	15	17	15	12	9	2/08/2013	2	16	28	28	ND	13

Date	Bulga	Knodlers Lane	Maison Dieu	MTIE	Wallaby Scrub Road	Warkworth	Date	Bulga	Knodlers Lane	Maison Dieu	MTIE	Wallaby Scrub Road	Warkworth
2/08/2012	6	10	14	18	8	8	3/08/2013	4	13	15	26	11	12
3/08/2012	8	16	23	36	11	12	4/08/2013	4	13	16	26	12	10
4/08/2012	8	18	23	31	11	13	5/08/2013	7	22	29	34	17	19
5/08/2012	13	22	32	37	15	13	6/08/2013	7	29	34	32	14	18
6/08/2012	12	18	25	ND	24	16	7/08/2013	5	22	30	41	16	17
7/08/2012	11	17	28	28	12	13	8/08/2013	ND	5	6	10	5	6
8/08/2012	12	23	34	33	15	11	9/08/2013	3	10	ND	21	8	10
9/08/2012	10	19	30	37	16	13	10/08/2013	6	18	21	20	13	10
10/08/2012	10	14	23	44	15	12	11/08/2013	4	18	23	27	11	12
11/08/2012	7	12	20	33	12	11	12/08/2013	7	23	31	ND	11	15
12/08/2012	10	15	24	18	17	12	13/08/2013	ND	23	22	27	11	13
13/08/2012	13	17	24	28	27	20	14/08/2013	6	34	35	37	11	ND
14/08/2012	14	22	32	36	26	16	15/08/2013	5	16	22	34	8	11
15/08/2012	15	30	41	48	26	15	16/08/2013	ND	ND	36	ND	18	18
16/08/2012	15	20	31	57	21	15	17/08/2013	21	39	47	55	27	27
17/08/2012	33	33	50	68	35	32	18/08/2013	6	20	23	39	12	12
18/08/2012	12	17	30	34	27	14	19/08/2013	7	41	36	61	14	16
19/08/2012	9	11	15	24	20	8	20/08/2013	2	10	16	47	7	11
20/08/2012	16	19	29	37	23	18	21/08/2013	4	18	19	29	15	10
21/08/2012	14	23	30	23	22	15	22/08/2013	3	26	19	29	12	10
22/08/2012	17	28	41	59	28	24	23/08/2013	7	29	24	32	15	11
23/08/2012	17	20	30	38	26	22	24/08/2013	10	12	17	27	15	12
24/08/2012	6	9	9	19	36	8	25/08/2013	7	23	21	30	11	13
25/08/2012	8	14	18	24	25	12	26/08/2013	12	22	29	41	17	15
26/08/2012	10	12	18	23	11	8	27/08/2013	17	ND	34	44	19	21
27/08/2012	12	15	20	27	28	12	28/08/2013	19	11	28	ND	ND	20
28/08/2012	12	14	20	19	20	12	29/08/2013	35	33	37	21	ND	37
29/08/2012	20	27	34	34	29	26	30/08/2013	28	37	46	51	34	34
30/08/2012	14	25	37	65	23	19	31/08/2013	ND	25	36	69	20	23
31/08/2012	11	17	31	47	26	19	1/09/2013	21	21	29	61	25	23
1/09/2012	9	12	18	34	10	10	2/09/2013	17	18	20	15	20	20
2/09/2012	12	19	25	30	19	13	3/09/2013	10	13	15	21	15	17
3/09/2012	17	18	26	62	25	16	4/09/2013	18	14	18	24	20	18
4/09/2012	18	25	35	47	23	21	5/09/2013	17	30	ND	33	28	22
5/09/2012	28	42	ND	59	37	33	6/09/2013	22	ND	49	ND	ND	32
6/09/2012	28	39	50	53	45	38	7/09/2013	18	36	40	55	25	27
7/09/2012	18	ND	55	56	31	26	8/09/2013	24	27	37	40	28	35
8/09/2012	15	30	23	24	31	17	9/09/2013	22	29	35	38	28	31
9/09/2012	13	15	22	23	20	15	10/09/2013	ND	53	61	77	36	43
10/09/2012	16	ND	35	41	19	20	11/09/2013	4	22	29	57	16	ND
11/09/2012	25	40	41	ND	30	ND	12/09/2013	10	27	30	59	12	16
12/09/2012	25	35	19	42	28	30	13/09/2013	11	19	22	35	21	17
13/09/2012	20	ND	52	76	ND	30	14/09/2013	9	17	21	31	18	18
14/09/2012	12	12	19	25	19	15	15/09/2013	ND	11	11	25	13	17
15/09/2012	14	20	23	51	19	22	16/09/2013	9	9	12	9	ND	15
16/09/2012	17	21	23	26	17	20	17/09/2013	ND	5	6	5	ND	6
17/09/2012	ND	24	31	35	31	31	18/09/2013	ND	19	12	17	ND	8
18/09/2012	9	ND	21	21	13	16	19/09/2013	2	18	17	21	ND	15
19/09/2012	11	10	14	ND	16	11	20/09/2013	4	25	26	44	ND	17
20/09/2012	20	22	26	ND	24	20	21/09/2013	4	14	17	16	ND	13
21/09/2012	11	24	28	45	16	23	22/09/2013	8	17	19	27	ND	16
22/09/2012	15	19	26	38	17	17	23/09/2013	6	33	29	52	ND	22
23/09/2012	12	24	26	29	18	13	24/09/2013	16	47	53	94	ND	28
24/09/2012	ND	25	32	52	16	18	25/09/2013	11	24	27	54	ND	22

Date	Bulga	Knodlers Lane	Maison Dieu	MTIE	Wallaby Scrub Road	Warkworth	Date	Bulga	Knodlers Lane	Maison Dieu	MTIE	Wallaby Scrub Road	Warkworth
25/09/2012	ND	25	27	ND	ND	20	26/09/2013	11	54	55	102	ND	26
26/09/2012	24	16	22	ND	29	27	27/09/2013	18	22	27	37	ND	20
27/09/2012	22	29	41	34	25	27	28/09/2013	10	33	29	56	ND	21
28/09/2012	39	56	70	51	44	37	29/09/2013	14	27	35	37	ND	27
29/09/2012	14	19	28	37	14	16	30/09/2013	16	27	27	39	ND	24
30/09/2012	8	17	25	24	10	13	1/10/2013	44	51	66	103	ND	45
1/10/2012	13	16	21	31	16	17	2/10/2013	2	21	13	31	ND	10
2/10/2012	18	11	14	ND	16	ND	3/10/2013	4	20	16	32	ND	19
3/10/2012	28	ND	33	28	24	15	4/10/2013	8	20	21	25	ND	14
4/10/2012	19	43	53	63	22	25	5/10/2013	6	25	20	31	ND	11
5/10/2012	21	47	53	73	20	29	7/10/2013	9	46	41	39	ND	18
6/10/2012	41	27	33	26	41	36	8/10/2013	13	31	33	56	ND	26
8/10/2012	16	ND	21	34	ND	18	9/10/2013	12	17	20	19	ND	17
9/10/2012	18	18	22	32	20	ND	10/10/2013	10	26	28	25	ND	16
10/10/2012	17	19	21	28	18	17	11/10/2013	26	48	56	52	ND	34
11/10/2012	20	23	28	26	20	18	12/10/2013	35	38	42	52	ND	37
12/10/2012	10	ND	23	21	13	14	13/10/2013	17	31	34	36	ND	26
13/10/2012	7	12	16	20	10	7	14/10/2013	62	53	71	78	ND	57
14/10/2012	15	13	17	24	13	12	15/10/2013	4	13	14	21	ND	13
15/10/2012	11	13	17	20	12	12	16/10/2013	11	25	33	45	ND	15
16/10/2012	14	21	26	25	15	15	17/10/2013	12	ND	56	ND	ND	ND
17/10/2012	28	48	64	ND	33	27	18/10/2013	60	57	72	84	ND	49
18/10/2012	ND	44	49	ND	46	36	19/10/2013	35	31	36	40	ND	33
19/10/2012	26	19	26	31	31	ND	20/10/2013	30	27	30	35	ND	34
20/10/2012	27	33	41	38	28	31	21/10/2013	29	25	27	16	ND	29
21/10/2012	30	41	48	49	33	34	22/10/2013	ND	46	46	45	ND	38
22/10/2012	34	34	46	35	30	26	23/10/2013	ND	59	75	80	ND	58
23/10/2012	24	41	45	30	26	38	24/10/2013	42	42	43	63	ND	35
24/10/2012	16	21	23	25	18	18	25/10/2013	26	28	26	67	31	31
25/10/2012	32	29	9	41	30	26	26/10/2013	36	37	48	57	33	37
26/10/2012	26	50	56	42	27	30	27/10/2013	38	51	57	70	46	50
27/10/2012	27	49	62	72	33	38	28/10/2013	24	24	27	22	24	25
28/10/2012	22	14	20	54	22	19	29/10/2013	44	36	41	49	47	36
29/10/2012	23	18	22	24	24	26	30/10/2013	ND	43	ND	58	ND	37
30/10/2012	16	13	18	34	17	15	31/10/2013	17	13	15	15	17	14
31/10/2012	19	23	26	29	21	23	1/11/2013	16	14	15	17	20	18
1/11/2012	27	29	34	38	28	25	2/11/2013	24	16	17	16	24	22
2/11/2012	28	55	76	77	29	35	3/11/2013	ND	33	31	50	23	33
3/11/2012	23	27	31	51	29	26	4/11/2013	64	58	62	81	60	50
4/11/2012	16	13	15	18	20	19	5/11/2013	31	22	23	23	27	26
5/11/2012	23	20	27	28	ND	24	6/11/2013	22	21	19	21	21	19
6/11/2012	ND	19	25	ND	ND	ND	7/11/2013	28	20	19	29	28	19
7/11/2012	30	34	41	41	ND	40	8/11/2013	ND	35	38	38	35	38
8/11/2012	39	34	42	40	ND	35	9/11/2013	ND	62	36	80	49	ND
9/11/2012	16	18	24	11	17	16	10/11/2013	ND	44	47	47	31	30
10/11/2012	12	12	14	ND	14	14	11/11/2013	15	17	17	19	16	20
11/11/2012	13	15	17	14	20	16	12/11/2013	ND	4	5	4	4	4
12/11/2012	14	12	12	ND	17	16	13/11/2013	4	7	8	7	7	ND
13/11/2012	22	17	ND	ND	20	ND	14/11/2013	5	9	15	18	8	ND
14/11/2012	ND	31	44	33	33	29	15/11/2013	12	26	25	ND	19	16
15/11/2012	24	19	23	27	29	28	16/11/2013	ND	ND	18	ND	18	14
16/11/2012	24	21	26	1	27	28	17/11/2013	6	10	9	5	7	7
17/11/2012	17	17	21	22	20	22	18/11/2013	2	13	13	7	5	5
18/11/2012	13	11	14	10	17	15	19/11/2013	3	6	6	6	6	6

Date	Bulga	Knodlers Lane	Maison Dieu	MTIE	Wallaby Scrub Road	Warkworth	Date	Bulga	Knodlers Lane	Maison Dieu	MTIE	Wallaby Scrub Road	Warkworth
19/11/2012	17	13	14	10	20	23	20/11/2013	6	9	11	13	9	8
20/11/2012	10	20	23	21	13	16	21/11/2013	10	10	9	12	16	13
21/11/2012	15	ND	20	18	20	20	22/11/2013	12	12	12	16	16	17
22/11/2012	23	25	29	25	ND	23	23/11/2013	5	11	12	12	ND	ND
23/11/2012	27	33	31	34	32	33	24/11/2013	ND	ND	ND	ND	7	ND
24/11/2012	23	22	23	27	29	24	25/11/2013	9	11	9	16	13	ND
25/11/2012	24	ND	20	15	29	32	26/11/2013	10	20	16	17	13	ND
26/11/2012	21	27	23	33	29	ND	27/11/2013	16	21	7	18	20	13
27/11/2012	56	36	47	5	34	ND	28/11/2013	26	22	20	23	26	17
28/11/2012	18	22	24	28	ND	21	29/11/2013	ND	23	26	30	20	21
29/11/2012	12	12	13	10	15	16	30/11/2013	15	24	24	30	21	18
30/11/2012	23	16	17	14	26	24	1/12/2013	10	13	13	14	15	13
1/12/2012	ND	ND	25	25	ND	23	2/12/2013	9	10	10	12	13	12
2/12/2012	37	27	30	32	41	31	3/12/2013	9	9	9	14	15	12
3/12/2012	24	16	18	15	24	20	4/12/2013	14	10	ND	12	17	12
4/12/2012	12	10	11	11	12	15	5/12/2013	20	25	28	21	24	21
5/12/2012	9	15	21	27	9	16	6/12/2013	10	ND	13	36	13	20
6/12/2012	17	25	16	47	18	23	7/12/2013	8	11	14	13	13	9
7/12/2012	29	25	33	ND	30	29	8/12/2013	24	20	23	30	22	19
8/12/2012	25	25	26	28	29	27	9/12/2013	24	23	29	24	27	22
9/12/2012	25	32	36	28	30	29	10/12/2013	ND	ND	44	47	31	34
10/12/2012	21	24	27	25	ND	32	11/12/2013	ND	28	38	38	21	22
11/12/2012	9	14	15	21	10	ND	12/12/2013	20	27	34	35	24	23
12/12/2012	11	19	17	14	12	12	13/12/2013	23	23	26	32	29	25
13/12/2012	11	9	8	13	13	18	14/12/2013	ND	23	29	28	29	32
14/12/2012	16	12	12	21	20	16	15/12/2013	ND	19	23	32	19	22
15/12/2012	25	18	ND	22	28	27	16/12/2013	18	13	17	21	22	20
16/12/2012	28	23	ND	25	ND	26	17/12/2013	13	12	12	21	18	20
17/12/2012	19	25	ND	23	25	27	18/12/2013	ND	13	14	18	19	16
18/12/2012	ND	ND	27	25	ND	28	19/12/2013	12	15	13	30	16	ND
19/12/2012	33	25	ND	30	34	41	20/12/2013	ND	15	14	32	21	ND
20/12/2012	22	16	9	17	ND	27	21/12/2013	ND	37	36	37	32	ND
21/12/2012	26	29	40	32	32	ND	22/12/2013	ND	45	55	74	45	38
22/12/2012	28	24	28	27	33	26	23/12/2013	ND	28	36	36	30	29
23/12/2012	24	17	19	22	30	25	24/12/2013	ND	53	53	60	34	38
24/12/2012	19	15	19	30	23	22	25/12/2013	12	13	22	22	17	21
25/12/2012	ND	22	30	26	ND	20	26/12/2013	ND	13	15	12	14	14
26/12/2012	6	ND	ND	5	ND	ND	27/12/2013	ND	7	7	6	8	8
27/12/2012	14	12	14	11	15	17	28/12/2013	7	9	10	13	14	12
28/12/2012	19	16	18	28	17	17	29/12/2013	ND	13	13	14	19	17
29/12/2012	17	19	23	22	17	20	30/12/2013	ND	29	30	31	28	37
30/12/2012	27	19	23	20	17	25	31/12/2013	28	26	30	30	34	33
31/12/2012	20	14	18	18	17	20							

Table B-1: HVAS PM_{10} Monitoring data

Date	Loders Creek	MTIE	MTO	WML	Knodlers Lane	Long Point
3/01/2012	-	-	31	-	27	13
9/01/2012	-	29	-	-	16	16
12/01/2012	-	-	22	-	-	-
15/01/2012	-	31	16	-	10	4
17/01/2012	-	25	-	-	-	-
19/01/2012	-	43	-	-	-	-
21/01/2012	-	33	17	-	23	7
24/01/2012	-	12	-	-	-	-
27/01/2012	-	10	22	-	10	10
30/01/2012	-	23	-	-	-	-
2/02/2012	-	8	4	-	3	2
8/02/2012	-	19	10	-	16	-
14/02/2012	-	13	13	-	12	-
20/02/2012	-	17	11	-	18	-
26/02/2012	-	17	11	-	15	-
3/03/2012	-	10	8	-	13	-
9/03/2012	-	24	10	-	18	-
15/03/2012	-	27	22	-	18	-
21/03/2012	-	22	13	-	12	-
27/03/2012	-	16	21	-	13	-
2/04/2012	-	33	18	-	18	-
8/04/2012	-	38	32	-	34	-
14/04/2012	-	24	12	-	23	-
20/04/2012	-	21	15	-	22	-
26/04/2012	-	30	13	-	24	-
2/05/2012	-	25	13	-	20	-
8/05/2012	-	-	13	-	22	-
14/05/2012	-	-	14	-	16	-
20/05/2012	-	-	14	-	28	-
26/05/2012	-	-	7	-	12	-
1/06/2012	-	-	8	-	7	-
5/06/2012	-	12	-	-	-	-
7/06/2012	-	22	4	-	3	-
13/06/2012	-	15	2	-	2	-
14/06/2012	-	17	-	-	-	-
16/06/2012	-	22	-	-	-	-
19/06/2012	-	-	2	-	9	-
20/06/2012	-	18	-	-	-	-
25/06/2012	-	17	8	-	11	-
26/06/2012	-	11	-	-	-	-
27/06/2012	-	16	-	-	-	-
1/07/2012	-	-	7	-	17	-
4/07/2012	-	34	-	-	-	-
7/07/2012	-	19	4	-	13	-
13/07/2012	-	8	3	-	6	-
19/07/2012	-	30	5	-	13	-
25/07/2012	-	28	17	-	14	-
31/07/2012	-	47	8	-	28	-
6/08/2012	-	63	14	-	19	-
12/08/2012	-	18	9	-	21	-
18/08/2012	-	29	12	19	22	-
24/08/2012	-	22	7	6	17	-
30/08/2012	-	66	14	12	36	-
5/09/2012	-	63	51	32	59	-
11/09/2012	-	70	36	26	38	-
17/09/2012	-	44	48	17	27	-
23/09/2012	-	42	14	16	32	-

Date	Loders Creek	MTIE	MTO	WML	Knodlers Lane	Long Point
29/09/2012	-	35	11	8	17	-
5/10/2012	-	98	54	24	56	-
11/10/2012	-	19	10	11	20	-
17/10/2012	-	46	46	43	51	-
23/10/2012	-	25	26	14	28	-
29/10/2012	-	29	19	16	18	-
4/11/2012	-	35	42	10	28	-
10/11/2012	-	16	22	13	16	-
16/11/2012	-	26	17	15	19	-
22/11/2012	-	37	31	27	42	-
28/11/2012	-	10	16	15	14	-
4/12/2012	-	36	13	10	20	-
10/12/2012	-	15	7	6	20	-
16/12/2012	-	27	35	24	39	-
22/12/2012	-	22	32	21	22	-
28/12/2012	-	26	20	18	24	-
3/01/2013	-	27	33	21	22	-
9/01/2013	-	58	67	47	55	-
15/01/2013	-	15	29	15	13	-
21/01/2013	-	25	36	23	16	-
27/01/2013	-	7	10	7	7	-
2/02/2013	-	10	6	4	6	-
8/02/2013	-	26	26	22	31	-
14/02/2013	-	14	12	8	10	-
20/02/2013	-	17	12	10	12	-
26/02/2013	-	12	17	12	13	-
4/03/2013	6	-	19	15	12	-
10/03/2013	13	-	17	9	11	-
16/03/2013	25	-	22	22	28	-
22/03/2013	40	-	31	19	49	-
28/03/2013	30	-	25	20	54	-
3/04/2013	13	-	5	6	22	-
9/04/2013	9	-	6	3	13	-
15/04/2013	39	-	20	18	29	-
21/04/2013	11	-	-	5	15	-
27/04/2013	38	-	-	16	38	-
1/05/2013	-	-	16	-	-	-
2/05/2013	-	-	12	-	-	-
3/05/2013	33	-	16	12	27	-
9/05/2013	17	-	48	22	30	-
15/05/2013	19	-	10	7	22	-
21/05/2013	35	-	6	9	40	-
27/05/2013	26	-	11	9	17	-
2/06/2013	5	-	2	1	4	-
8/06/2013	15	-	6	4	9	-
14/06/2013	9	-		1	4	-
20/06/2013	16	-	4	3	12	-
26/06/2013	12	-	4	5	10	-
2/07/2013	18	-	5	6	7	-
8/07/2013	21	-	8	7	12	-
14/07/2013	18	-	11	9	11	-
20/07/2013	12	-	3	2	6	-
26/07/2013	25	-	11	9	18	-
1/08/2013	18	-	6	6	10	-
7/08/2013	21	-	6	8	25	-
13/08/2013	19	-	6	7	24	-
19/08/2013	36	-	8	10	40	-
25/08/2013	37	-	13	3	26	-

Date	Loders Creek	MTIE	MTO	WML	Knodlers Lane	Long Point
31/08/2013	74	-	19	16	31	-
6/09/2013	49	-	26	25	40	-
12/09/2013	47	-	22	8	27	-
18/09/2013	25	-	6	5	18	-
24/09/2013	73	-	19	20	47	-
30/09/2013	26	-	21	21	34	-
6/10/2013	57	-	12	14	51	-
12/10/2013	36	-	23	23	40	27
18/10/2013	32	-	37	29	-	29
21/10/2013	-	-	-	-	84	-
24/10/2013	73	-	33	36	42	37
30/10/2013	16	-	19	14	18	14
5/11/2013	23	-	25	20	31	19
11/11/2013	5	-	3	3	1	7
17/11/2013	5	-	3	5	15	8
23/11/2013	11	-	11	11	16	13
29/11/2013	27	-	20	16	28	19
5/12/2013	18	-	12	12	27	14
11/12/2013	28	-	24	22	35	28
17/12/2013	12	-	28	17	14	12
23/12/2013	51	-	39	38	72	45
29/12/2013	33	-	35	29	36	27

Table B-1: HVAS TSP Monitoring data

Date	Loders Creek	MTO	WML	Warkworth	Long Point
3/01/2012	-	132	96	65	-
9/01/2012	-	63	47	50	-
15/01/2012	-	74	40	54	-
21/01/2012	-	41	30	63	-
27/01/2012	-	77	41	48	-
2/02/2012	-	10	8	8	-
8/02/2012	-	-	31	35	-
14/02/2012	-	33	24	43	-
15/02/2012	-	40	-	-	-
20/02/2012	-	30	26	27	-
26/02/2012	-	43	35	47	-
3/03/2012	-	20	26	27	-
9/03/2012	-	28	55	50	-
15/03/2012	-	49	40	41	-
21/03/2012	-	35	34	50	-
27/03/2012	-	58	47	48	-
2/04/2012	-	60	-	37	-
4/04/2012	-	-	69	-	-
8/04/2012	-	72	29	56	-
14/04/2012	-	-	43	33	-
16/04/2012	-	17	-	-	-
20/04/2012	-	45	38	36	-
26/04/2012	-	-	55	67	-
27/04/2012	-	63	-	-	-
2/05/2012	-	40	53	50	-
8/05/2012	-	35	45	39	-
14/05/2012	-	25	28	30	-
20/05/2012	-	47	46	50	-
26/05/2012	-	31	39	31	-
1/06/2012	-	36	23	46	-
7/06/2012	-	10	12	17	-

Date	Loders Creek	MTO	WML	Warkworth	Long Point
13/06/2012	-	10	-	13	-
19/06/2012	-	15	23	17	-
21/06/2012	-	-	33	-	-
25/06/2012	-	34	39	24	-
1/07/2012	-	29	29	33	-
7/07/2012	-	19	11	51	-
13/07/2012	-	11	12	8	-
19/07/2012	-	16	17	16	-
25/07/2012	-	65	-	32	-
26/07/2012	-	-	34	-	-
31/07/2012	-	28	19	37	-
6/08/2012	-	44	51	50	-
12/08/2012	-	19	22	23	-
18/08/2012	-	52	64	60	-
24/08/2012	-	28	26	27	-
30/08/2012	-	39	34	60	-
5/09/2012	-	120	68	112	-
11/09/2012	-	103	92	103	-
17/09/2012	-	140	84	143	-
23/09/2012	-	52	55	51	-
29/09/2012	-	45	35	41	-
5/10/2012	-	151	74	83	-
11/10/2012	-	40	42	41	-
17/10/2012	-	161	160	103	-
23/10/2012	-	114	-	62	-
24/10/2012	-	-	61	-	-
29/10/2012	-	97	-	55	-
30/10/2012	-	-	105	-	-
4/11/2012	-	155	71	96	-
10/11/2012	-	106	66	49	-
16/11/2012	-	67	54	86	-
22/11/2012	-	85	54	96	-
28/11/2012	-	65	41	47	-
4/12/2012	-	56	41	52	-
10/12/2012	-	30	19	18	-
16/12/2012	-	124	83	92	-
22/12/2012	-	152	99	87	-
28/12/2012	-	55	51	76	-
3/01/2013	-	102	60	50	-
9/01/2013	-	207	119	121	-
15/01/2013	-	104	73	66	-
21/01/2013	-	138	71	77	-
27/01/2013	-	54	21	29	-
2/02/2013	-	19	12	14	-
8/02/2013	-	96	77	70	-
14/02/2013	-	69	26	39	-
20/02/2013	-	49	38	73	-
26/02/2013	-	75	-	54	-
4/03/2013	-	63	44	53	-
5/03/2013	-	-	33	-	-
10/03/2013	31	63	46	41	-
11/03/2013	18	-	-	-	-
16/03/2013	69	66	57	64	-
22/03/2013	111	99	62	87	-
28/03/2013	78	61	49	59	-
3/04/2013	31	13	12	22	-
9/04/2013	43	34	21	41	-
15/04/2013	104	56	50	77	-

Date	Loders Creek	MTO	WML	Warkworth	Long Point
21/04/2013	45	-	24	35	-
27/04/2013	107	-	54	84	-
1/05/2013	-	41	-	-	-
2/05/2013	-	31	-	-	-
3/05/2013	114	57	49	55	-
9/05/2013	50	93	50	49	-
15/05/2013	55	43	34	38	-
21/05/2013	111	23	64	78	-
27/05/2013	84	22	18	52	-
2/06/2013	24	7	9	12	-
8/06/2013	55	45	25	46	-
14/06/2013	24	10	15	8	-
20/06/2013	65	22	10	24	-
26/06/2013	41	11	22	27	-
2/07/2013	63	23	21	27	-
8/07/2013	66	35	43	35	-
14/07/2013	40	51	44	38	-
20/07/2013	33	13	9	31	-
26/07/2013	93	37	36	50	-
1/08/2013	65	26	26	31	-
7/08/2013	58	30	32	53	-
13/08/2013	52	22	21	65	-
19/08/2013	78	30	27	64	-
25/08/2013	125	60	40	61	-
31/08/2013	175	74	50	70	-
6/09/2013	114	97	101	105	-
12/09/2013	117	68	29	62	-
18/09/2013	44	31	21	27	-
24/09/2013	151	51	48	88	-
30/09/2013	106	72	44	86	-
6/10/2013	121	47	52	81	-
12/10/2013	112	76	58	93	69
18/10/2013	67	108	69	93	87
24/10/2013	150	51	50	69	93
30/10/2013	43	82	46	49	55
5/11/2013	63	88	62	65	70
11/11/2013	31	19	13	17	42
17/11/2013	20	16	11	14	23
23/11/2013	23	34	26	33	24
29/11/2013	49	-	41	40	48
2/12/2013	-	78	-	-	-
5/12/2013	49	30	25	50	45
11/12/2013	67	72	55	60	95
17/12/2013	28	99	58	51	40
23/12/2013	121	101	91	141	121
29/12/2013	68	31	63	106	55

Appendix C

Emission Calculation

MTO Continuation 2014 - Emission Calculation

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

Emission factors and associated controls have been sourced from the US EPA AP42 Emission Factors (**US EPA, 1985 and Updates**), the State Pollution Control Commission document "*Air Pollution from Coal Mining and Related Developments*" (**SPCC, 1983**), the National Pollutant Inventory document "Emission Estimation Technique Manual for Mining, Version 3.1" (**NPI, 2012**) and the NSW EPA document, "*NSW Coal Mining Benchmarking Study: International Best Practise Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining*", prepared by Katestone Environmental (**Katestone, 2010**).

The emission factor equations used for each dust generating activity are outlined in **Table C-1** below. Detailed emission inventories for each modelled year are presented in **Table C-2** to **Table C-6**.

Table C-1: Emission factor equations

Activity	Emission factor equation	Variables	Control	Source
Drilling (overburden/coal)	$EF = 0.59\ kg/hole$	-	70% - water sprays	US EPA, 1985 NPI, 2012
Blasting (overburden/coal)	$EF = 0.00022\ \times A^{1.5}\ kg/blast$	A = area to be blasted (m^2)	-	US EPA, 1985
Loading / emplacing overburden	$EF = k\ \times 0.0016\ \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right)\ kg/tonne$	Ktsp = 0.74 U = wind speed (m/s) M = moisture content (%)	-	NPI, 2012
Dragline	$EF =\ 0.0046\ \times d^{1.1}/M^{1.3}\ \ kg/m^3$	d = drop height (m) M = moisture content (%)	-	US EPA, 1985
Hauling on unsealed surfaces	$EF = \left(\frac{0.4536}{1.6093}\right) \times\ k\ \times\ (s/12)^{0.7} \times\ (1.1023\ \times M/3)^{0.45}\ kg/VKT$	S = silt content (%) M = average vehicle gross mass (tonnes)	80% - watering of trafficked areas	US EPA, 1985
Dozers on overburden	$EF = 2.6\ \times\ \frac{s^{1.2}}{M^{1.3}}\ kg/hour$	S = silt content (%) M = moisture content (%)	-	US EPA, 1985
Dozers on coal	$EF = 35.6\ \times\ \frac{s^{1.2}}{M^{1.4}}\ kg/hour$	S = silt content (%) M = moisture content (%)	-	US EPA, 1985
Loading / emplacing coal	$EF = \frac{0.58}{M^{1.2}}\ kg/tonne$	M = moisture content (%)	85% - enclosed dump hopper and water sprays	US EPA, 1985
Loading product coal to stockpile	$EF = k\ \times 0.0016\ \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right)\ kg/tonne$	Ktsp = 0.74 U = wind speed (m/s) M = moisture content (%)	25% - variable height stacker	US EPA, 1985
Wind erosion on exposed areas / stockpiles	$EF = 0.4\ kg/ha\ /hour$	-	50% - water sprays, interim rehabilitation	SPCC, 1983
Grading roads	$EF = 0.0034\ \times\ s^{2.5}\ kg/VKT$	S = speed of grader (km/hr)	-	US EPA, 1985

Table C-2: Emission inventory – Year 3

ACTIVITY	TSP emission (kg/y) - Uncontrolled	TSP emission (kg/y) - Controlled	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units
Mt Thorley																		
OB - Dozers stripping topsoil	-	-	-	hours/year	16.7	kg/h	10	silt content in %	2	moisture content in %								
OB - Drilling	12,757	3,827	21,623	holes/year	0.59	kg/hole											70	% Control
OB - Blasting	98,214	98,214	86	blasts/year	1143	kg/blast	30,000	Area of blast in square metres										
OB - Dragline	227,330	227,330	7,154,857	bcm/year	0.032	kg/m^3	7	drop height in m	2	moisture content in %								
OB - Loading OB to haul truck	71,694	71,694	42,296,002	tonnes/year	0.00170	kg/t	1.432	average of (wind speed/2.2)^1.3 ir	2	moisture content in %								
OB - Hauling to emplacement area	3,088,748	617,750	42,296,002	tonnes/year	0.073	kg/t	240	tonnes/load	6.0	km/return trip	2.9	kg/VKT	1.8	% silt content	275	Ave GMV (tonnes)	80	% Control
OB - Hauling to emplacement area - from Warkworth	749,015	149,803	23,669,300	tonnes/year	0.032	kg/t	240	tonnes/load	2.6	km/return trip	2.9	kg/VKT	1.8	% silt content	275	Ave GMV (tonnes)	80	% Control
OB - Emplacing at area	111,814	111,814	65,965,302	tonnes/year	0.00170	kg/t	1.432	average of (wind speed/2.2)^1.3 ir	2	moisture content in %								
OB - Dozers in pit	222,959	222,959	13,323	hours/year	16.7	kg/h	10	silt content in %	2	moisture content in %								
OB - Dozers on dump and rehab	89,626	89,626	5,355	hours/year	16.7	kg/h	10	silt content in %	2	moisture content in %								
CL - Drilling	929	279	9,294	holes/year	0.10	kg/hole											70	% Control
CL - Blasting	3,979	3,979	18	blasts/year	220	kg/blast	10,000	Area of blast in square metres										
CL - Dozers ripping/pushing/clean-up	48,714	48,714	1,416	hours/year	34.4	kg/h	8	silt content in %	7	moisture content in %								
CL - Loading ROM coal to haul truck	202,661	202,661	3,609,604	tonnes/year	0.056	kg/t	7	moisture content in %										
CL - Hauling ROM to hopper - Mt Thorley CHPP	670,612	134,122	3,609,604	tonnes/year	0.186	kg/t	190	tonnes/load	13.0	km/return trip	2.7	kg/VKT	1.8	% silt content	234	Ave GMV (tonnes)	80	% Control
CL - Hauling Warkworth ROM to hopper - Mt Thorley CHPP	407,704	81,541	3,479,068	tonnes/year	0.117	kg/t	190	tonnes/load	8.2	km/return trip	2.7	kg/VKT	1.8	% silt content	234	Ave GMV (tonnes)	80	% Control
CHPP - Unloading ROM to hopper - Mt Thorley CHPP	202,661	30,399	3,609,604	tonnes/year	0.056	kg/t	7	moisture content in %									85	% Control
CHPP - Unloading Warkworth ROM to hopper - Mt Thorley	195,332	29,300	3,479,068	tonnes/year	0.056	kg/t	7	moisture content in %									85	% Control
CHPP - Rehandle ROM at hopper - Mt Thorley CHPP	79,599	11,940	1,417,734	tonnes/year	0.056	kg/t	7	moisture content in %									85	% Control
CHPP - Dozer pushing ROM coal - Mt Thorley CHPP	42,997	42,997	1,250	hours/year	34.4	kg/h	8	silt content in %	7	moisture content in %								
CHPP - Dozer pushing Product coal - Mt Thorley CHPP	13,593	13,593	1,250	hours/year	10.9	kg/h	5	silt content in %	11	moisture content in %								
CHPP - Loading Product coal to stockpile - Mt Thorley CHP	773	580	4,962,070	tonnes/year	0.00016	kg/t	1.432	average of (wind speed/2.2)^1.3 ir	11	moisture content in %							25	% Control
CHPP - Loading Product coal to train - Mt Thorley CHPP	773	232	4,962,070	tonnes/year	0.00016	kg/t	1.432	average of (wind speed/2.2)^1.3 ir	11	moisture content in %							70	% Control
CHPP - Loading rejects - Mt Thorley CHPP	335	335	1,881,767	tonnes/year	0.00018	kg/t	1.432	average of (wind speed/2.2)^1.3 ir	10	moisture content in %								
CHPP - Hauling rejects - Mt Thorley CHPP	64,542	12,908	1,881,767	tonnes/year	0.034	kg/t	190	tonnes/load	2.4	km/return trip	2.7	kg/VKT	1.8	% silt content	234	Ave GMV (tonnes)	80	% Control
CHPP - Hauling rejects from Warkworth - Mt Thorley CHPP	110,967	22,193	2,283,733	tonnes/year	0.049	kg/t	190	tonnes/load	3.4	km/return trip	2.7	kg/VKT	1.8	% silt content	234	Ave GMV (tonnes)	80	% Control
CHPP - Unloading rejects - Mt Thorley CHPP	742	742	4,165,500	tonnes/year	0.00018	kg/t	1.432	average of (wind speed/2.2)^1.3 ir	10	moisture content in %								
CHPP - Conveying to train load out from Mt Thorley CHPP	1,060	318	0.3	ha	3,504	kg/ha/year											70	% Control
WE - Overburden emplacement areas - Mt Thorley	1,411,955	705,978	403.0	ha	3,504	kg/ha/year											50	% Control
WE - Open pit - Mt Thorley	520,144	520,144	148.4	ha	3,504	kg/ha/year												
WE - ROM stockpiles - Mt Thorley	61,495	30,748	17.6	ha	3,504	kg/ha/year											50	% Control
WE - Product stockpiles - Mt Thorley	49,486	24,743	14.1	ha	3,504	kg/ha/year											50	% Control
Grading roads	22,157	22,157	36,000	km	0.62	kg/VKT	8	speed of graders in km/h										
Total TSP emissions (kg/yr)	**8,785,368**	**3,533,619**																

Table C-3: Emission inventory – Year 9

ACTIVITY	TSP emission (kg/y) - Uncontrolled	TSP emission (kg/y) - Controlled	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units
Mt Thorley																		
OB - Dozers stripping topsoil	-	-	-	hours/year	16.7	kg/h	10	silt content in %	2	moisture content in %								
OB - Drilling	-	-	-	holes/year	0.59	kg/hole											70	% Control
OB - Blasting	-	-	-	blasts/year	1143	kg/blast	30,000	Area of blast in square metres										
OB - Dragline	-	-	-	bcm/year	0.032	kg/m^3	7	drop height in m	2	moisture content in %								
OB - Loading OB to haul truck	-	-	-	tonnes/year	0.00170	kg/t	1.432	average of (wind speed/2.2)^1.3	2	moisture content in %								
OB - Hauling to emplacement area	-	-	-	tonnes/year	0.000	kg/t	240	tonnes/load	-	km/return trip	2.9	kg/VKT	1.8	% silt content	275	Ave GMV (tonnes)	80	% Control
OB - Hauling to emplacement area - from Warkworth	3,076,074.2	615,215	48,602,834	tonnes/year	0.063	kg/t	240	tonnes/load	5.2	km/return trip	2.9	kg/VKT	1.8	% silt content	275	Ave GMV (tonnes)	80	% Control
OB - Emplacing at area	82,384.0	82,384	48,602,834	tonnes/year	0.00170	kg/t	1.432	average of (wind speed/2.2)^1.3	2	moisture content in %								
OB - Dozers in pit	-	-	-	hours/year	16.7	kg/h	10	silt content in %	2	moisture content in %								
OB - Dozers on dump and rehab	99,642.2	99,642	5,954	hours/year	16.7	kg/h	10	silt content in %	2	moisture content in %								
CL - Drilling	-	-	-	holes/year	0.10	kg/hole											70	% Control
CL - Blasting	-	-	-	blasts/year	220	kg/blast	10,000	Area of blast in square metres										
CL - Dozers ripping/pushing/clean-up	-	-	-	hours/year	34.4	kg/h	8	silt content in %	7	moisture content in %								
CL - Loading ROM coal to haul truck	-	-	-	tonnes/year	0.056	kg/t	7	moisture content in %										
CL - Hauling ROM to hopper - Mt Thorley CHPP	-	-	-	tonnes/year	0.000	kg/t	190	tonnes/load	-	km/return trip	2.7	kg/VKT	1.8	% silt content	234	Ave GMV (tonnes)	80	% Control
CL - Hauling Warkworth ROM to hopper - Mt Thorley CHPP	809,892.5	161,979	6,159,861	tonnes/year	0.131	kg/t	190	tonnes/load	9.2	km/return trip	2.7	kg/VKT	1.8	% silt content	234	Ave GMV (tonnes)	80	% Control
CHPP - Unloading ROM to hopper - Mt Thorley CHPP	-	-	-	tonnes/year	0.056	kg/t	7	moisture content in %									85	% Control
CHPP - Unloading Warkworth ROM to hopper - Mt Thorley	345,844.8	51,877	6,159,861	tonnes/year	0.056	kg/t	7	moisture content in %									85	% Control
CHPP - Rehandle ROM at hopper - Mt Thorley CHPP	69,169.0	10,375	1,231,972	tonnes/year	0.056	kg/t	7	moisture content in %									85	% Control
CHPP - Dozer pushing ROM coal - Mt Thorley CHPP	42,997.2	42,997	1,250	hours/year	34.4	kg/h	8	silt content in %	7	moisture content in %								
CHPP - Dozer pushing Product coal - Mt Thorley CHPP	13,592.9	13,593	1,250	hours/year	10.9	kg/h	5	silt content in %	11	moisture content in %								
CHPP - Loading Product coal to stockpile - Mt Thorley CHPP	672.0	504	4,311,903	tonnes/year	0.00016	kg/t	1.432	average of (wind speed/2.2)^1.3	11	moisture content in %							25	% Control
CHPP - Loading Product coal to train - Mt Thorley CHPP	672.0	202	4,311,903	tonnes/year	0.00016	kg/t	1.432	average of (wind speed/2.2)^1.3	11	moisture content in %							70	% Control
CHPP - Loading rejects - Mt Thorley CHPP	238.0	238	1,336,690	tonnes/year	0.00018	kg/t	1.432	average of (wind speed/2.2)^1.3	10	moisture content in %								
CHPP - Hauling rejects - Mt Thorley CHPP	45,847.0	9,169	1,336,690	tonnes/year	0.034	kg/t	190	tonnes/load	2.4	km/return trip	2.7	kg/VKT	1.8	% silt content	234	Ave GMV (tonnes)	80	% Control
CHPP - Hauling rejects from Warkworth - Mt Thorley CHPP	100,656.3	20,131	2,515,442	tonnes/year	0.040	kg/t	190	tonnes/load	2.8	km/return trip	2.7	kg/VKT	1.8	% silt content	234	Ave GMV (tonnes)	80	% Control
CHPP - Unloading rejects - Mt Thorley CHPP	686.0	686	3,852,132	tonnes/year	0.00018	kg/t	1.432	average of (wind speed/2.2)^1.3	10	moisture content in %								
CHPP - Conveying to train load out from Mt Thorley CHPP	1,059.6	318	0.3	ha	3,504	kg/ha/year											70	% Control
WE - Overburden emplacement areas - Mt Thorley	985,601.6	492,801	281.3	ha	3,504	kg/ha/year											50	% Control
WE - Open pit - Mt Thorley	-	-	-	ha	3,504	kg/ha/year												
WE - ROM stockpiles - Mt Thorley	41,802.7	20,901	11.9	ha	3,504	kg/ha/year											50	% Control
WE - Product stockpiles - Mt Thorley	49,486.3	24,743	14.1	ha	3,504	kg/ha/year											50	% Control
Grading roads	22,156.8	22,157	36,000	km	0.62	kg/VKT	8	speed of graders in km/h										
Abbey Green North																		
Drilling overburden	5,900	5,900																
Blasting overburden	31,300	31,300																
Dozers on overburden dumps	54,500	54,500																
Dozers on overburden assisting excavators	55,400	55,400																
Loading overburden to trucks	50,500	50,500																
Hauling overburden to waste dump	720,000	720,000																
Unloading overburden to waste dump	50,500	50,500																
Dozers working on coal	5,690	5,690																
Loading coal to trucks	169,000	169,000																
Hauling coal to the MTCPP	78,900	78,900																
Unloading coal to hopper	25,000	25,000																
Re-handle coal at the ROM hopper	2,500	2,500																
Loading coal to stockpiles	1,130	1,130																
Loading coal to trains	791	791																
WE - Waste emplacement 1	258,000	258,000																
WE - Waste emplacement 2	63,900	63,900																
WE - Pit	278,000	278,000																
WE - ROM stockpile	2,580	2,580																
WE - Product stockpile	875	875																
Grading roads	1,120	1,120																
Total TSP emissions (kg/yr)	**7,644,061**	**3,525,498**																

Table C-3: Emission inventory – Year 14

ACTIVITY	TSP emission (kg/y) - Uncontrolled	TSP emission (kg/y) - Controlled	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units
Mt Thorley																		
OB - Dozers stripping topsoil	-	-	-	hours/year	16.7	kg/h	10	silt content in %	2	moisture content in %								
OB - Drilling	-	-	-	holes/year	0.59	kg/hole											70	% Control
OB - Blasting	-	-	-	blasts/year	1143	kg/blast	30,000	Area of blast in square metres										
OB - Dragline	-	-	-	bcm/year	0.032	kg/m^3	7	drop height in m	2	moisture content in %								
OB - Loading OB to haul truck	-	-	-	tonnes/year	0.00170	kg/t	1.432	average of (wind speed/2.2)^1.3 i	2	moisture content in %								
OB - Hauling to emplacement area	-	-	-	tonnes/year	0.000	kg/t	240	tonnes/load	-	km/return trip	2.9	kg/VKT	1.8	% silt conter	275	Ave GMV (tonnes	80	% Control
OB - Hauling to emplacement area - from Warkworth	-	-	-	tonnes/year	0.000	kg/t	240	tonnes/load	-	km/return trip	2.9	kg/VKT	1.8	% silt conter	275	Ave GMV (tonnes	80	% Control
OB - Emplacing at area	-	-	-	tonnes/year	0.00170	kg/t	1.432	average of (wind speed/2.2)^1.3 i	2	moisture content in %								
OB - Dozers in pit	-	-	-	hours/year	16.7	kg/h	10	silt content in %	2	moisture content in %								
OB - Dozers on dump and rehab	-	-	-	hours/year	16.7	kg/h	10	silt content in %	2	moisture content in %								
CL - Drilling	-	-	-	holes/year	0.10	kg/hole											70	% Control
CL - Blasting	-	-	-	blasts/year	220	kg/blast	10,000	Area of blast in square metres										
CL - Dozers ripping/pushing/clean-up	-	-	-	hours/year	34.4	kg/h	8	silt content in %	7	moisture content in %								
CL - Loading ROM coal to haul truck	-	-	-	tonnes/year	0.056	kg/t	7	moisture content in %										
CL - Hauling ROM to hopper - Mt Thorley CHPP	-	-	-	tonnes/year	0.000	kg/t	190	tonnes/load	-	km/return trip	2.7	kg/VKT	1.8	% silt conter	234	Ave GMV (tonnes	80	% Control
CL - Hauling Warkworth ROM to hopper - Mt Thorley CHPP	941,504.3	188,301	7,486,365	tonnes/year	0.126	kg/t	190	tonnes/load	8.8	km/return trip	2.7	kg/VKT	1.8	% silt conter	234	Ave GMV (tonnes	80	% Control
CHPP - Unloading ROM to hopper - Mt Thorley CHPP	-	-	-	tonnes/year	0.056	kg/t	7	moisture content in %									85	% Control
CHPP - Unloading Warkworth ROM to hopper - Mt Thorley CHPP	420,321.3	63,048	7,486,365	tonnes/year	0.056	kg/t	7	moisture content in %									85	% Control
CHPP - Rehandle ROM at hopper - Mt Thorley CHPP	84,064.3	12,610	1,497,273	tonnes/year	0.056	kg/t	7	moisture content in %									85	% Control
CHPP - Dozer pushing ROM coal - Mt Thorley CHPP	42,997.2	42,997	1,250	hours/year	34.4	kg/h	8	silt content in %	7	moisture content in %								
CHPP - Dozer pushing Product coal - Mt Thorley CHPP	13,592.9	13,593	1,250	hours/year	10.9	kg/h	5	silt content in %	11	moisture content in %								
CHPP - Loading Product coal to stockpile - Mt Thorley CHPP	816.7	612	5,240,456	tonnes/year	0.00016	kg/t	1.432	average of (wind speed/2.2)^1.3 i	11	moisture content in %							25	% Control
CHPP - Loading Product coal to train - Mt Thorley CHPP	816.7	245	5,240,456	tonnes/year	0.00016	kg/t	1.432	average of (wind speed/2.2)^1.3 i	11	moisture content in %							70	% Control
CHPP - Loading rejects - Mt Thorley CHPP	331.5	331	1,861,472	tonnes/year	0.00018	kg/t	1.432	average of (wind speed/2.2)^1.3 i	10	moisture content in %								
CHPP - Hauling rejects - Mt Thorley CHPP	319,232.0	63,846	1,861,472	tonnes/year	0.171	kg/t	190	tonnes/load	12.0	km/return trip	2.7	kg/VKT	1.8	% silt conter	234	Ave GMV (tonnes	80	% Control
CHPP - Hauling rejects from Warkworth - Mt Thorley CHPP	232,907.8	46,582	2,214,306	tonnes/year	0.105	kg/t	190	tonnes/load	7.4	km/return trip	2.7	kg/VKT	1.8	% silt conter	234	Ave GMV (tonnes	80	% Control
CHPP - Unloading rejects - Mt Thorley CHPP	725.8	726	4,075,778	tonnes/year	0.00018	kg/t	1.432	average of (wind speed/2.2)^1.3 i	10	moisture content in %								
CHPP - Conveying to train load out from Mt Thorley CHPP	1,059.6	318	0.3	ha	3,504	kg/ha/year											70	% Control
WE - Overburden emplacement areas - Mt Thorley	-	-	-	ha	3,504	kg/ha/year											50	% Control
WE - Open pit - Mt Thorley	-	-	-	ha	3,504	kg/ha/year												
WE - ROM stockpiles - Mt Thorley	41,802.7	20,901	11.9	ha	3,504	kg/ha/year											50	% Control
WE - Product stockpiles - Mt Thorley	49,486.3	24,743	14.1	ha	3,504	kg/ha/year											50	% Control
Grading roads	22,156.8	22,157	36,000	km	0.62	kg/VKT	8	speed of graders in km/h										
Total TSP emissions (kg/yr)	**2,171,816**	**501,011**																

Appendix D

CALMET/CALPUFF Input Variables

Table D-1: CALMET input variables

Parameter	Value
Terrain radius of influence (TERRAD)	10km
Vertical extrapolation of surface wind observations (IEXTRP)	-4
Layer dependent weighting factor of surface vs. upper air wind observations (BIAS [NZ])	-1,-0.5,-0.25,0,0,0,0,0
Weighting parameter for Step 1 wind field vs. Observations	R1 = 2.5km, R2 = 2.5km
Maximum radius of influence for meteorological stations in Layer 1 and layers aloft	RMAX1=1.0km, RMAX2=1.0km

Table D-2: CALPUFF input variables

Parameter	Used option	Value
Aqueous phase transformation modelled?	No	0
Boundary conditions modelled?	No	0
CGRUP (Species groups)	PM2.5, PM10 and TSP	-
Chemical transformation	Not modelled	0
Dry deposition modelled?	Yes	1
Gravitational settling (plume tilt) modelled?	No	0
Horizontal size of puff (m) beyond which time-dependent dispersion equations (Heffter) are used to determine sigma-y and sigma-z	Default	550
Individual source conditions saved?	No	0
Maximum length of a slug (met. grid units)	Default	1
Maximum mixing height	Default	3000
Maximum number of sampling steps for one puff/slug during one time step	-	60
Maximum number of slugs/puffs release from one source during one time step	-	60
Maximum sigma z allowed to avoid numerical problem in calculating virtual time or distance	Default	5.00E+06
Maximum travel distance of a puff/slug during one sampling step	Default	1
Method used to compute dispersion coefficients?	Internally calculated sigma v, sigma w using micrometeorological variables	2
Method used for lagrangian timescale for Sigma-y	Draxler default 617.284	0
Method used to compute turbulence sigma-v & sigma-w using micrometeorological variables	Standard CALPUFF subroutines	1
Minimum mixing height	Default	50
Minimum sigma y for a new puff/slug	Default	1
Minimum sigma z for a new puff/slug	Default	1
Minimum turbulence velocities sigma-v and sigma-w for each stability class over land and over water	Default	-
Near-field puffs modelled as elongated slugs?	No	0
Plume path coefficients for each stability class	Default	-
Potential temperature gradient for stable classes E, F	Default	-
Puff splitting allowed?	No	0
Range of land use categories for which urban dispersion is assumed	Default	-
Slug - to - puff transition criterion factor	Default	10
Stability class used to determine plume growth rates for puffs above the boundary layer	Default	5
Sub grid-scale complex terrain	Not Modelled	0
Switch for using Heffter equation for sigma-z	Default(Not use Heffter)	0
Terrain adjustment method	Default(Partial plume path adjustment)	3
Vegetation state in unirrigated areas	Default(Active and unstressed)	1
Vertical dispersion constant for stable conditions	Default	0.01
Vertical distribution used in the near field	Default (Gaussian)	1
Wet removal modelled?	No	0
Wind speed classes	Default	-
Wind speed profile power-law exponents for stabilities	Default	-

Appendix E

Isopleth Diagrams – Dust emissions

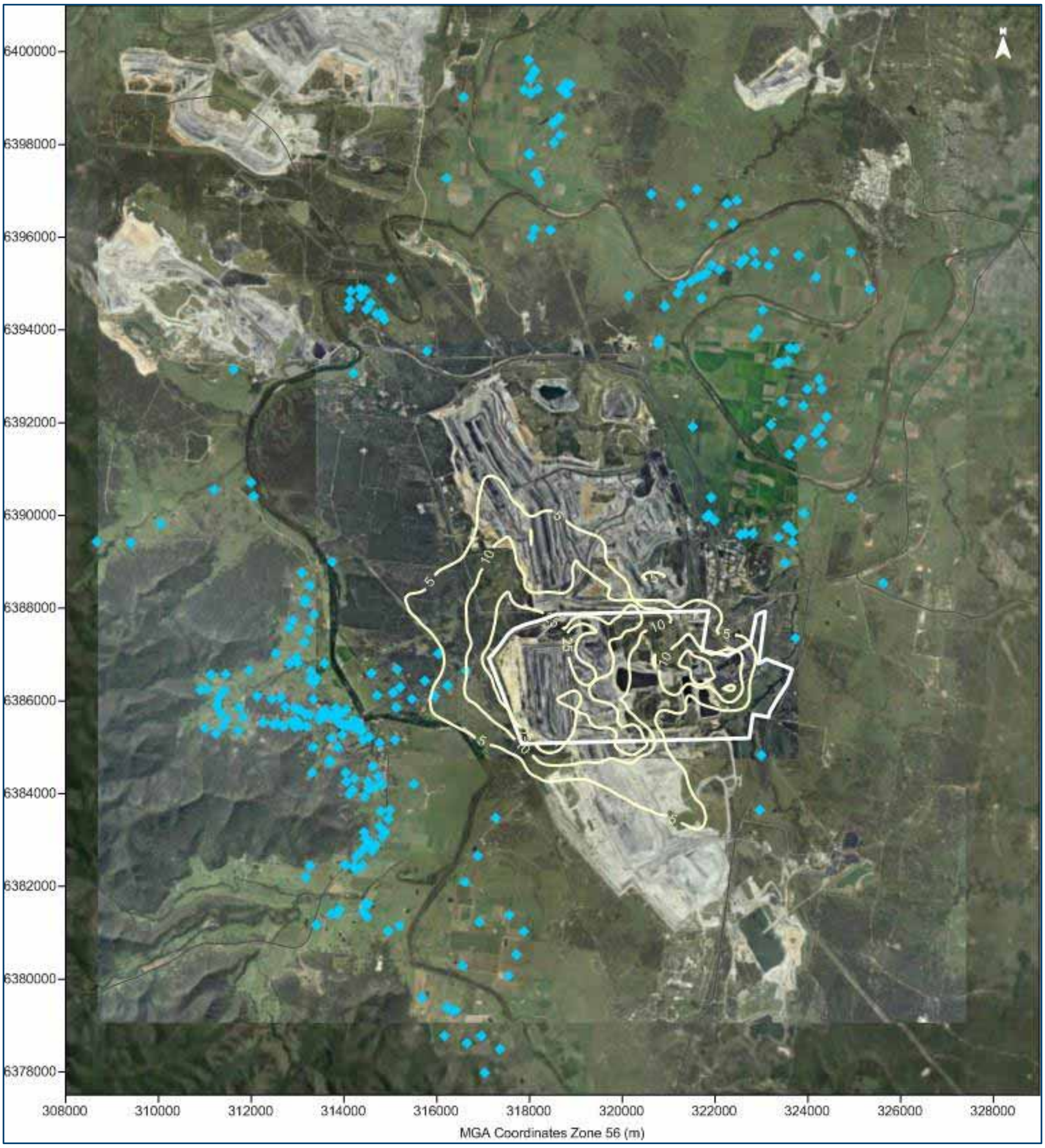

Figure E-1: Predicted maximum 24-hour average $PM_{2.5}$ concentrations due to emissions from the proposal in Year 3 (µg/m³)

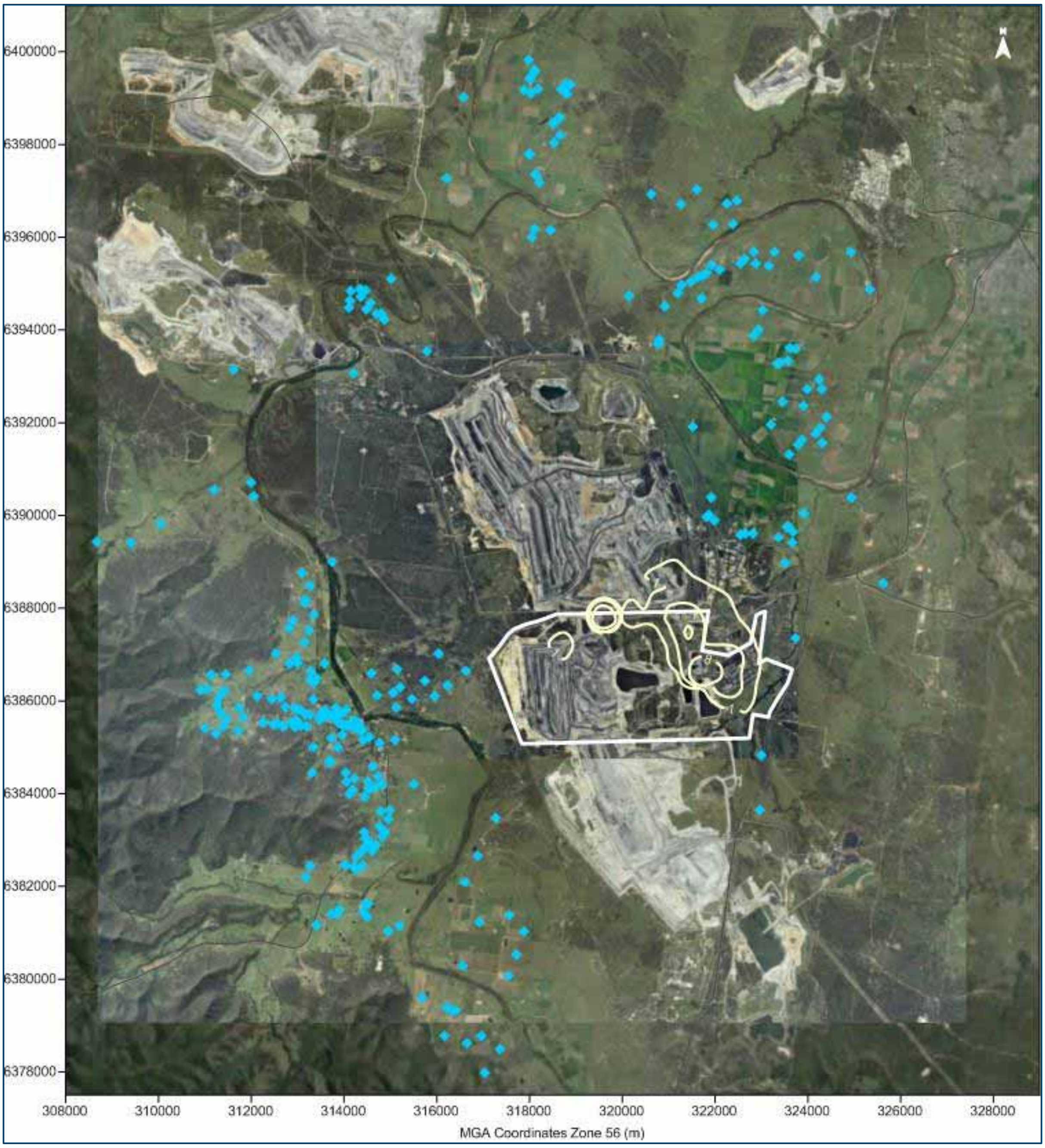

Figure E-2: Predicted annual average $PM_{2.5}$ concentrations due to emissions from the proposal in Year 3 (µg/m³)

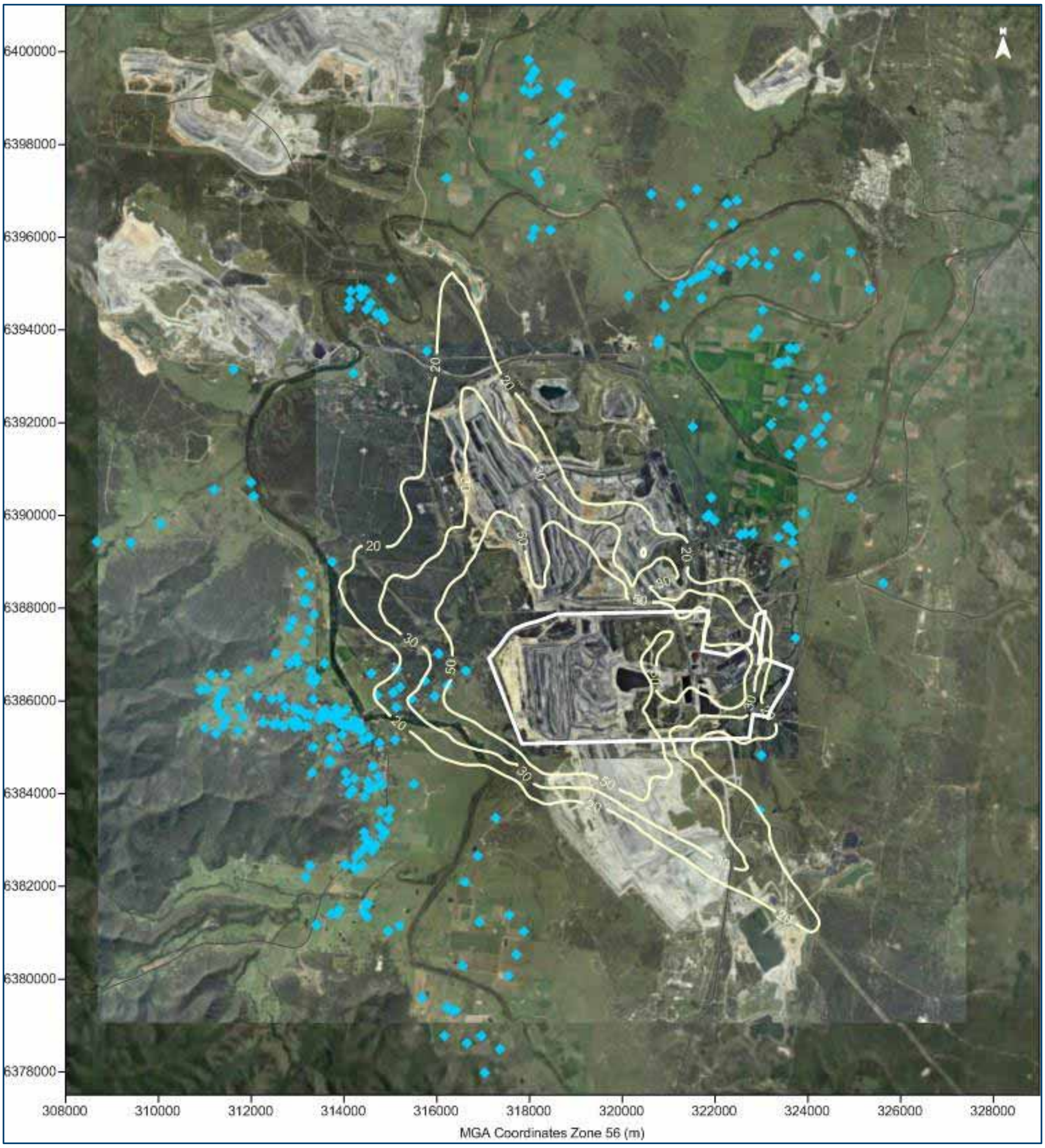

Figure E-3: Predicted maximum 24-hour average PM_{10} concentrations due to emissions from the proposal in Year 3 (µg/m³)

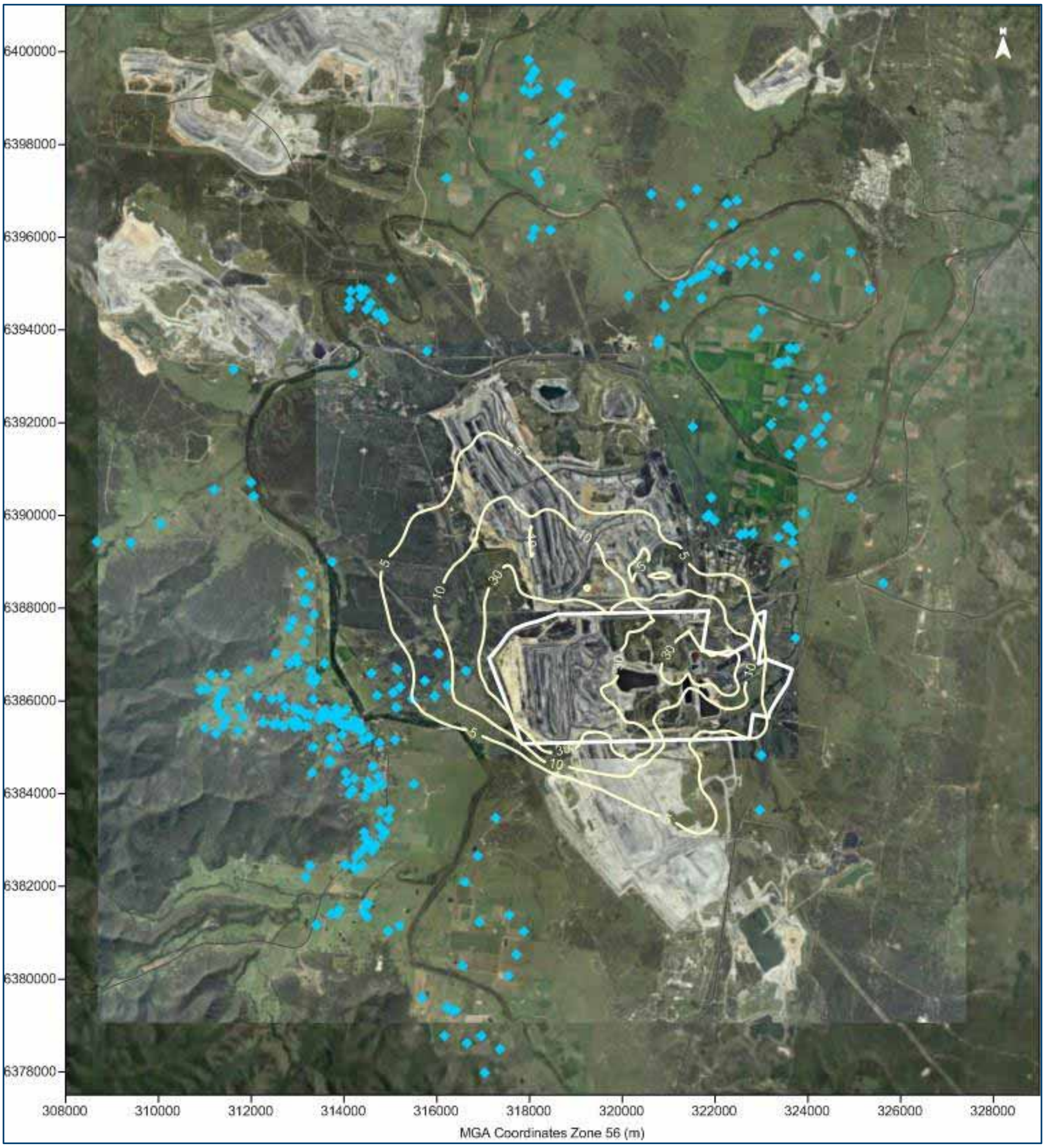

Figure E-4: Predicted annual average PM_{10} concentrations due to emissions from the proposal in Year 3 (µg/m³)

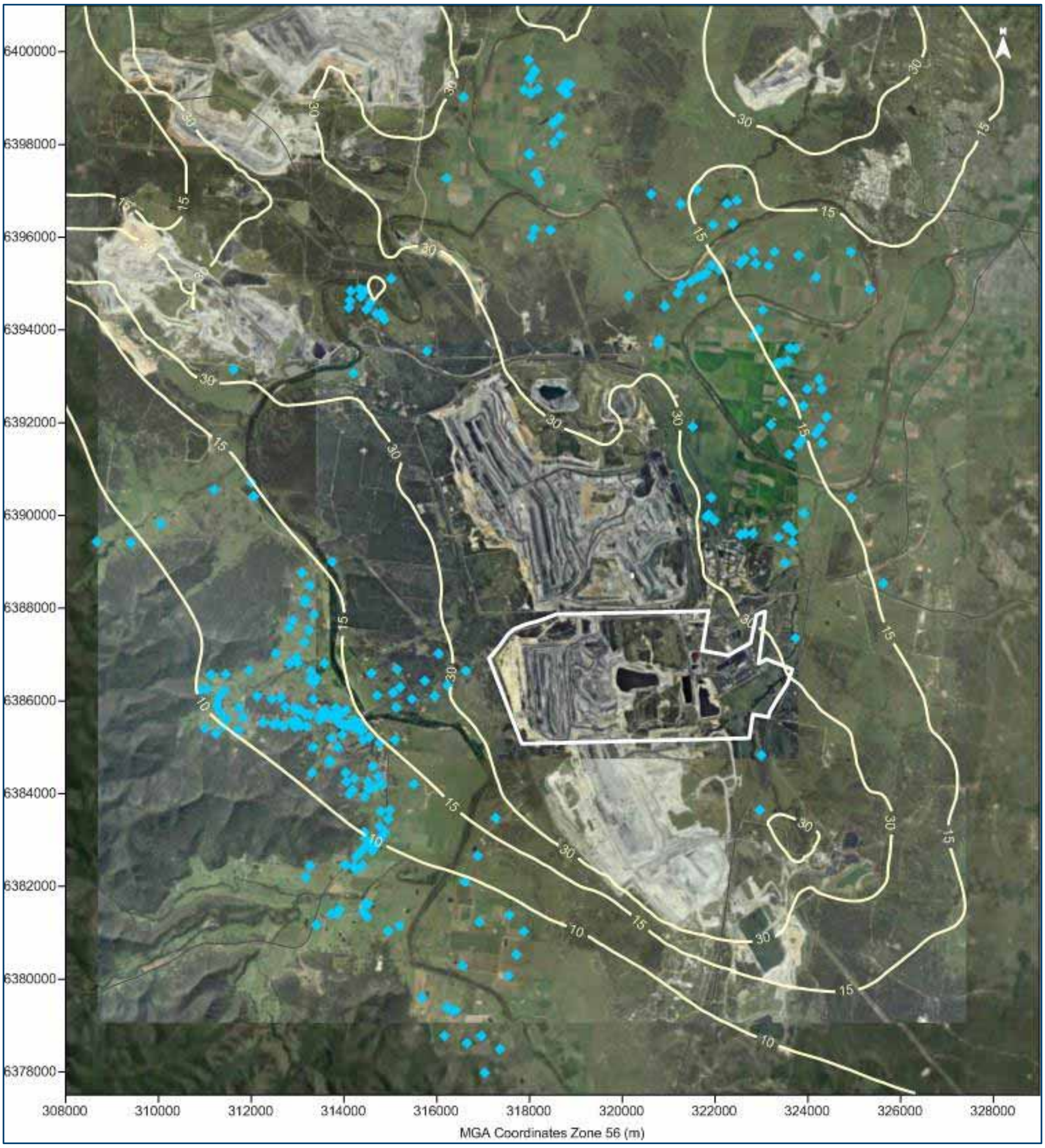

Figure E-5: Predicted annual average PM_{10} concentrations due to emissions from the proposal and other sources in Year 3 (µg/m³)

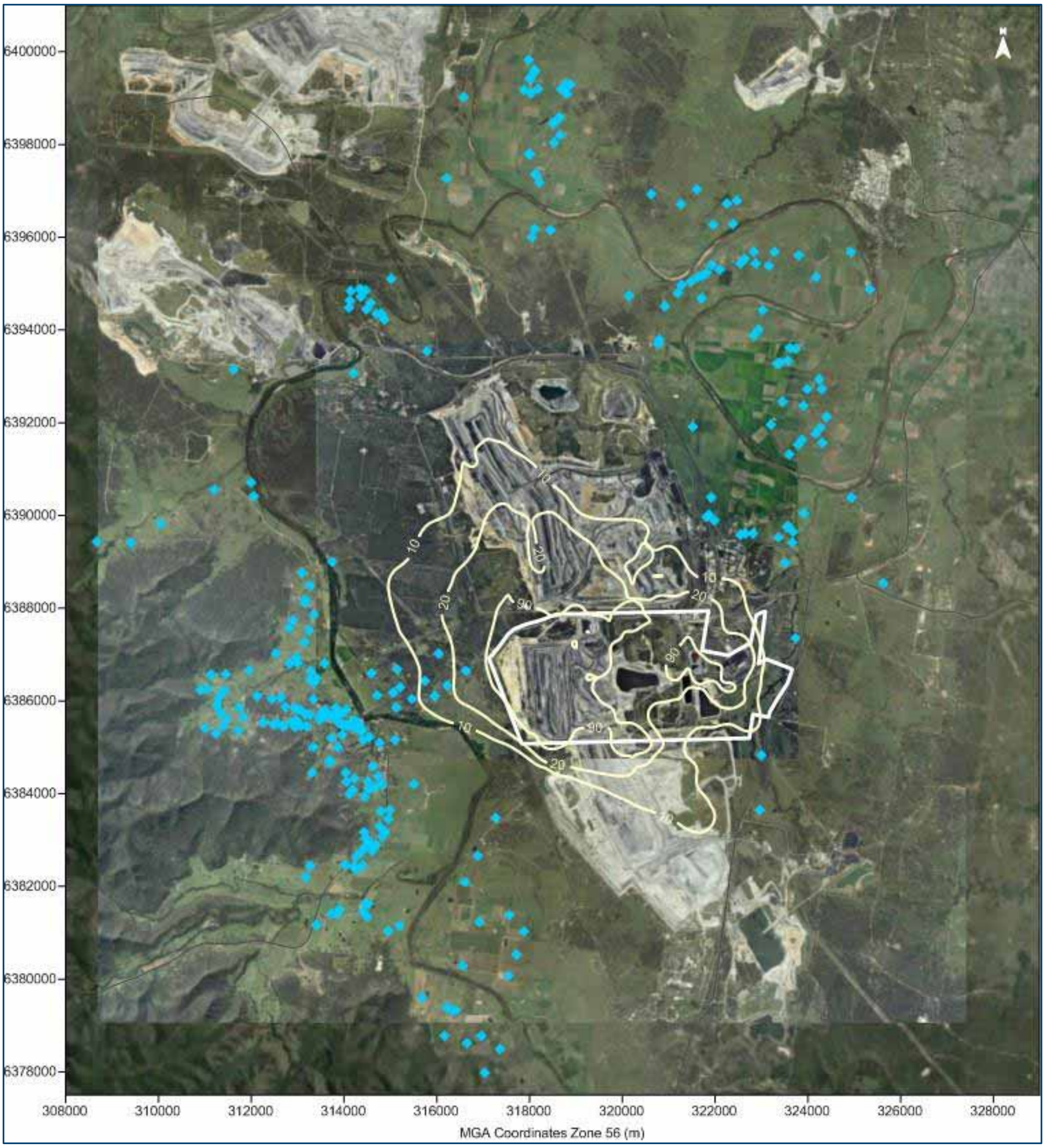

Figure E-6: Predicted annual average TSP concentrations due to emissions from the proposal in Year 3 (µg/m³)

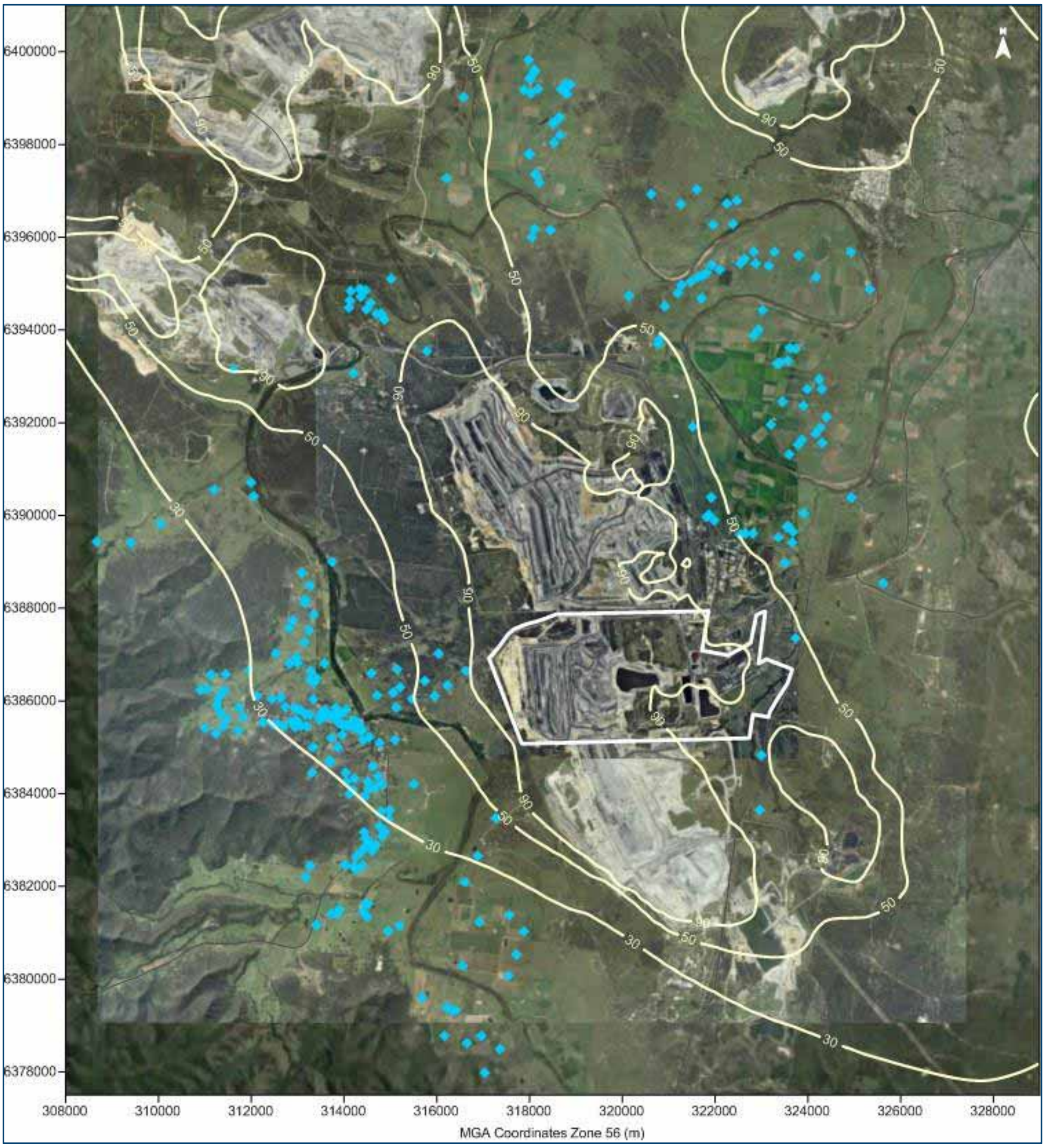

Figure E-7: Predicted annual average TSP concentrations due to emissions from the proposal and other sources in Year 3 (µg/m³)

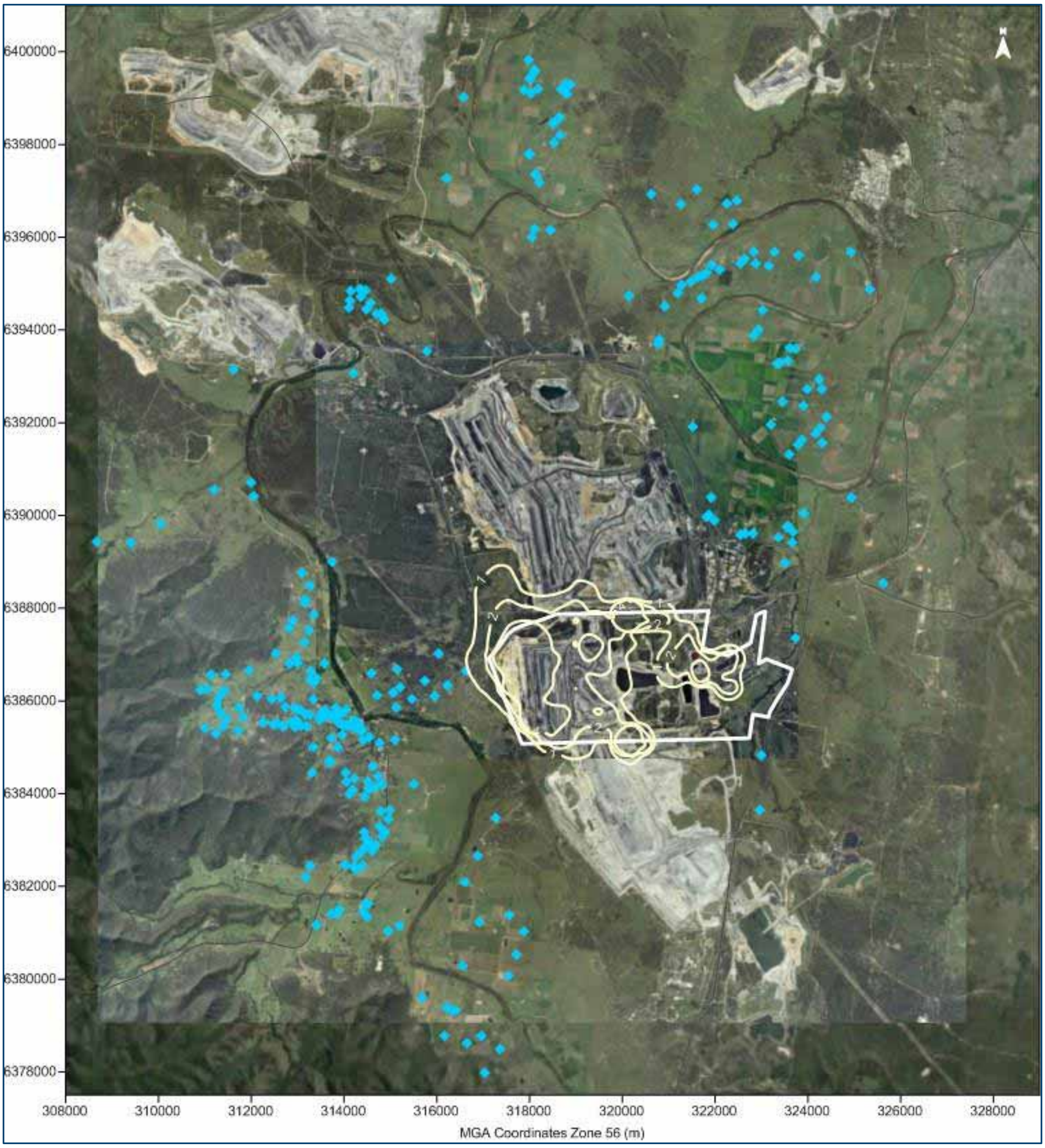

Figure E-8: Predicted annual average dust deposition levels due to emissions from the proposal in Year 3 (g/m²/month)

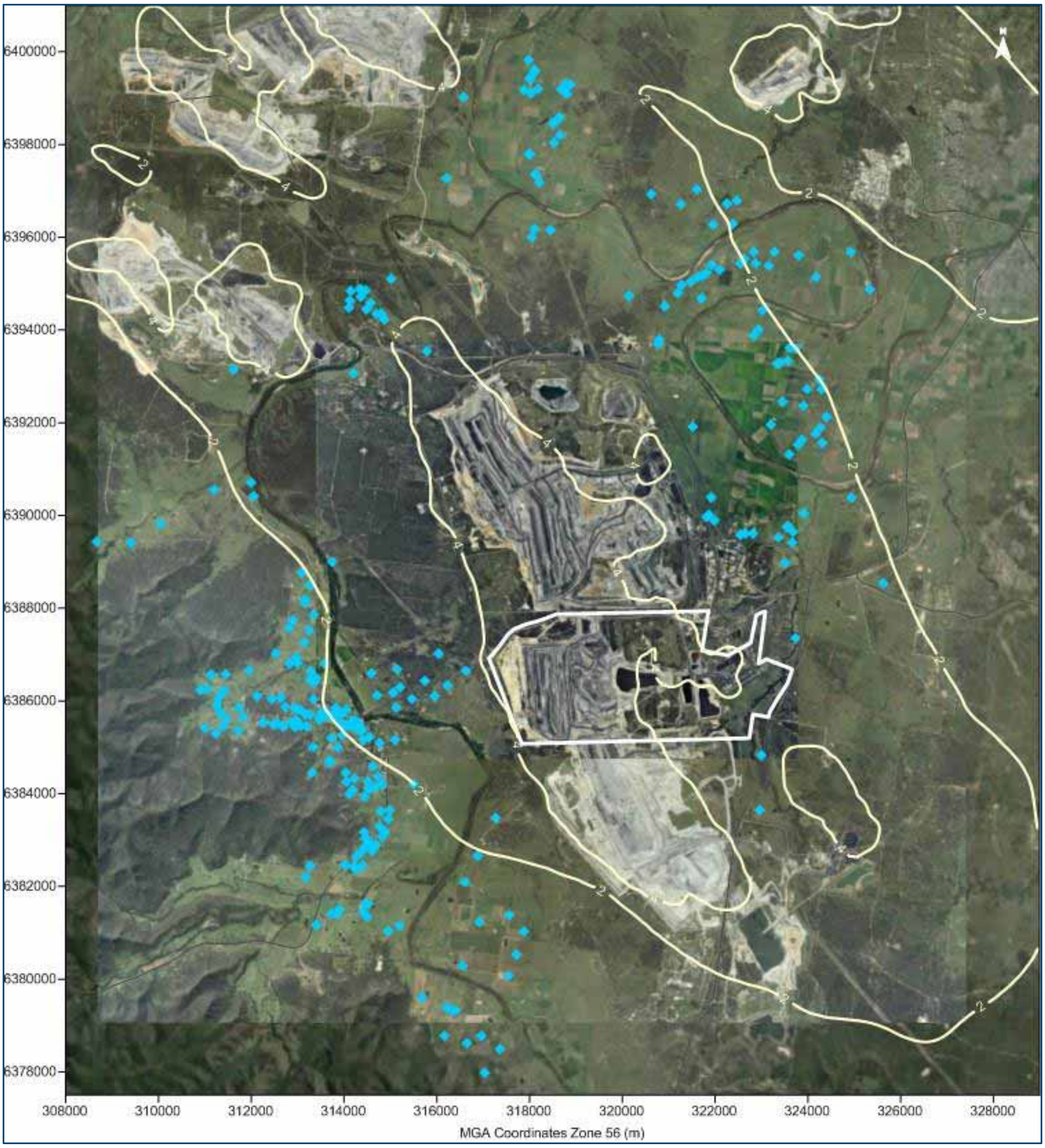

Figure E-9: Predicted annual average dust deposition levels due to emissions from the proposal and other sources in Year 3 (g/m²/month)

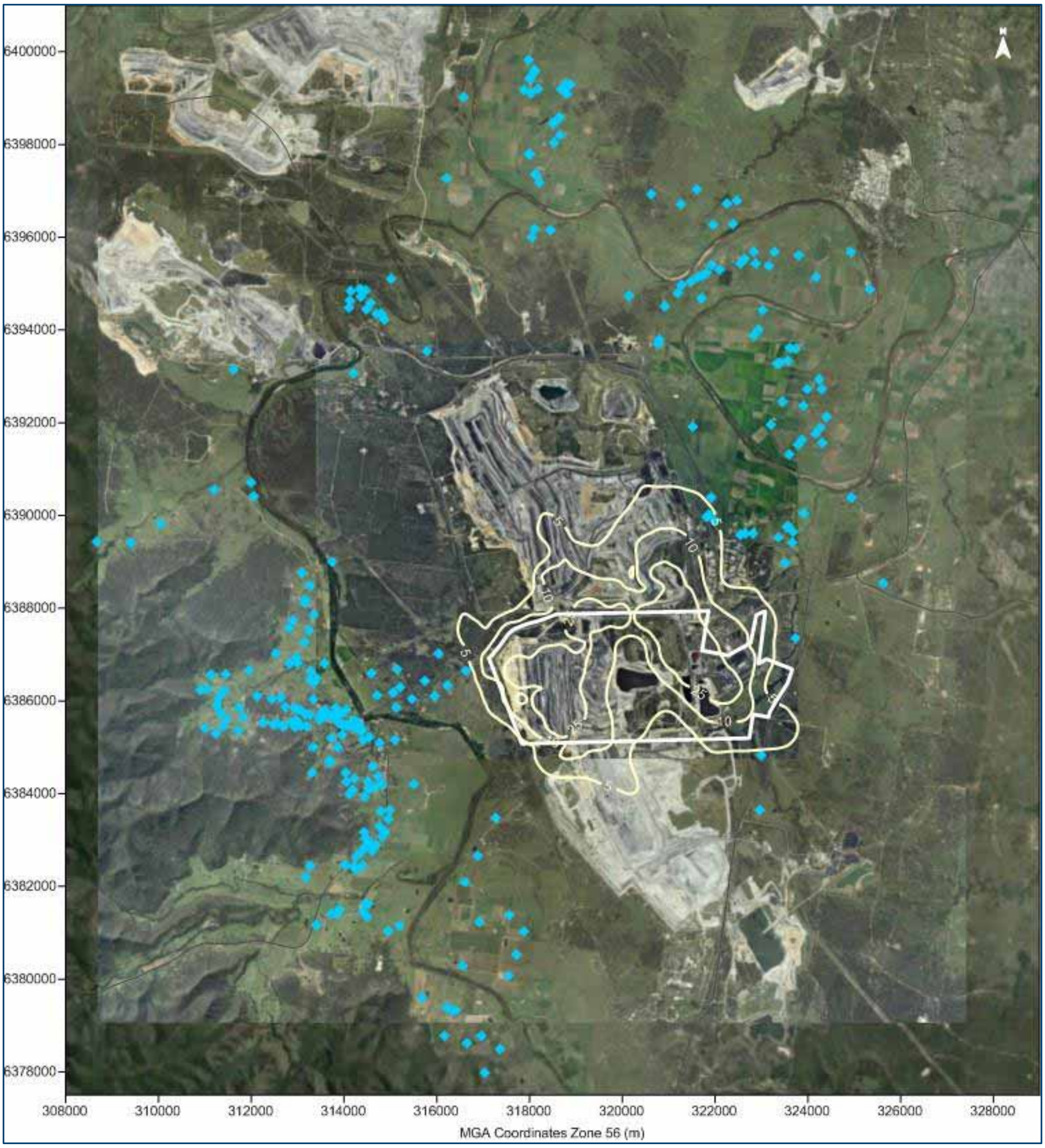

Figure E-10: Predicted maximum 24-hour average $PM_{2.5}$ concentrations due to emissions from the proposal in Year 9 (µg/m³)

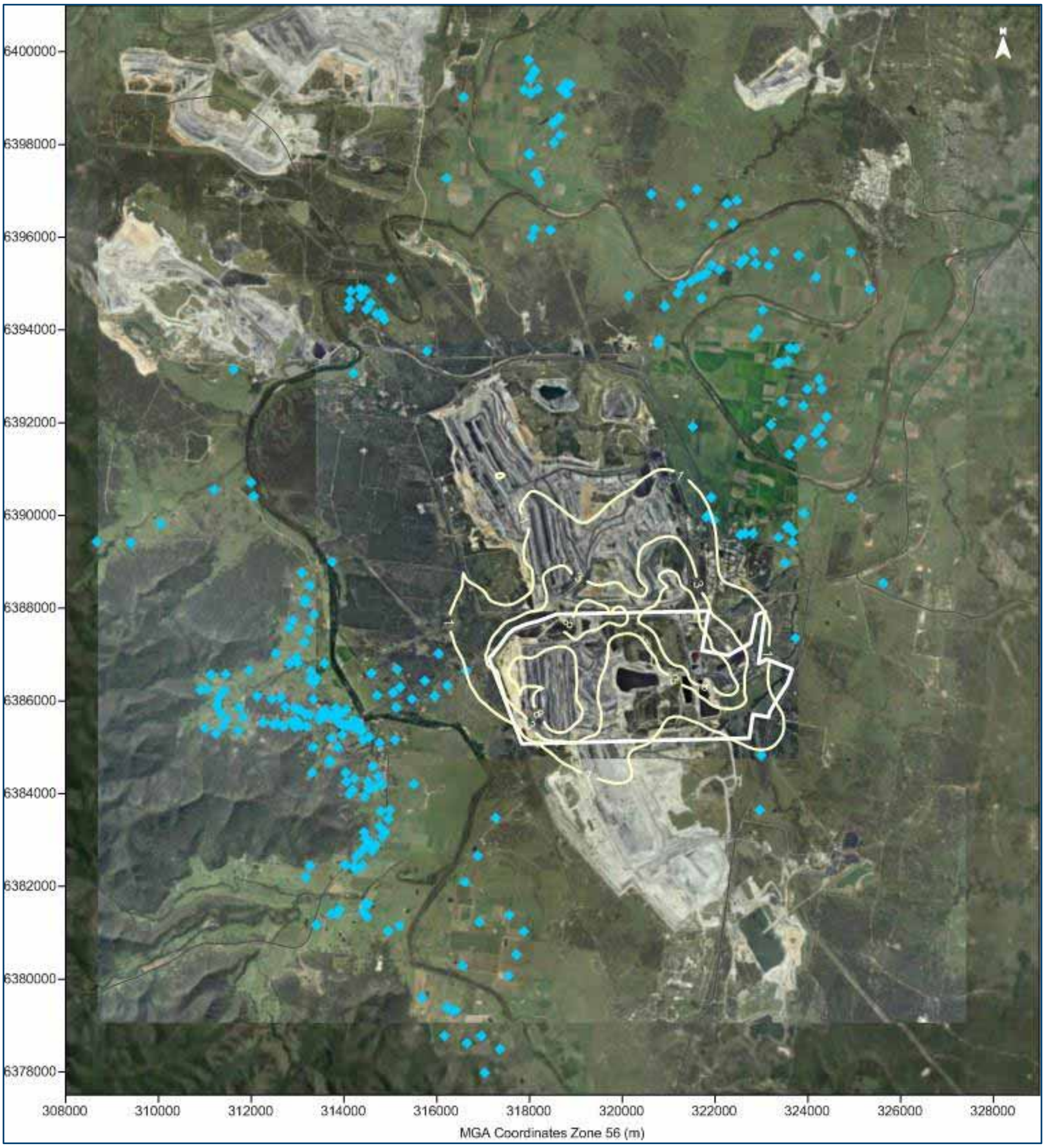

Figure E-11: Predicted annual average $PM_{2.5}$ concentrations due to emissions from the proposal in Year 9 (µg/m³)

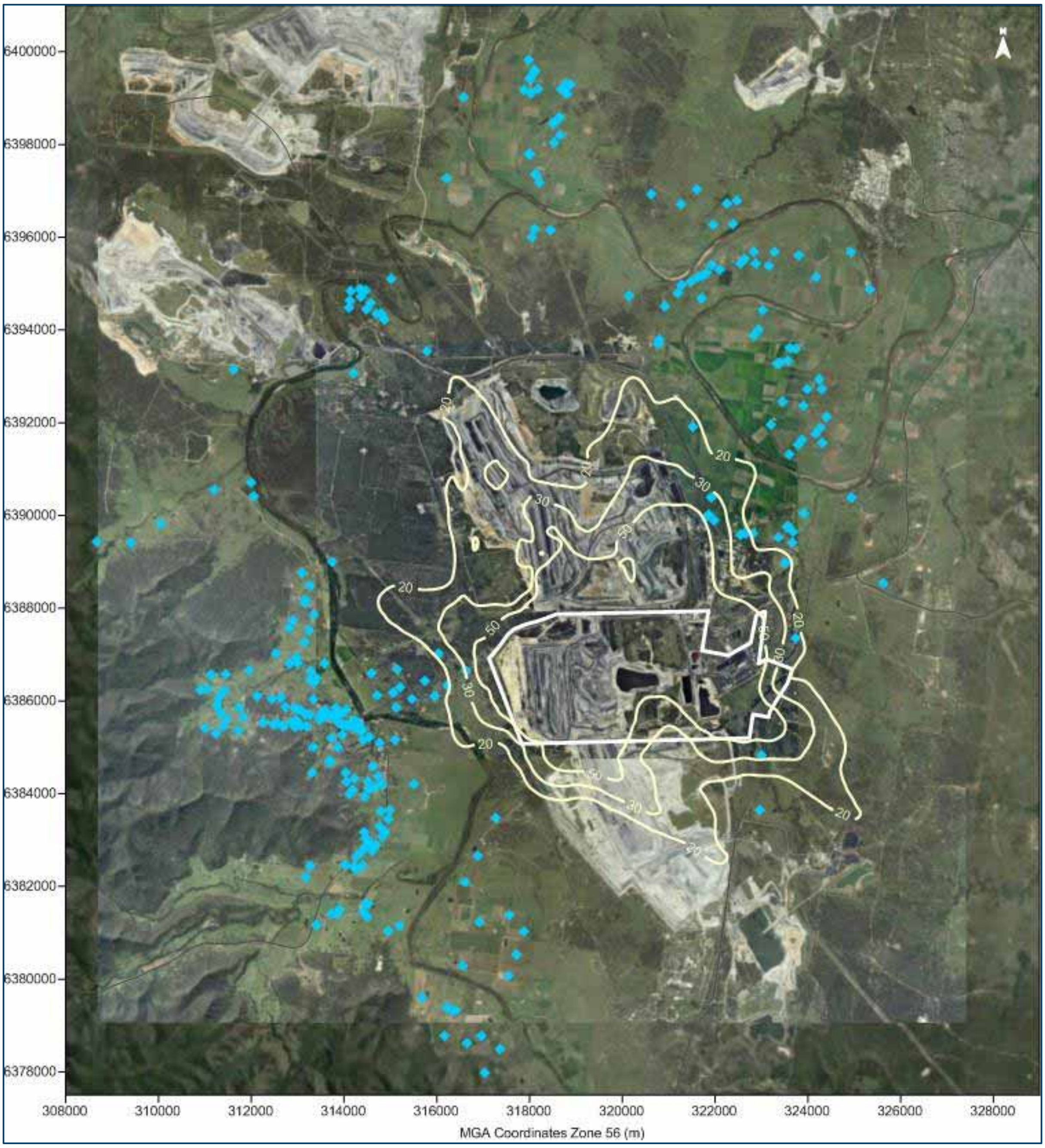

Figure E-12: Predicted maximum 24-hour average PM_{10} concentrations due to emissions from the proposal in Year 9 ($\mu g/m^3$)

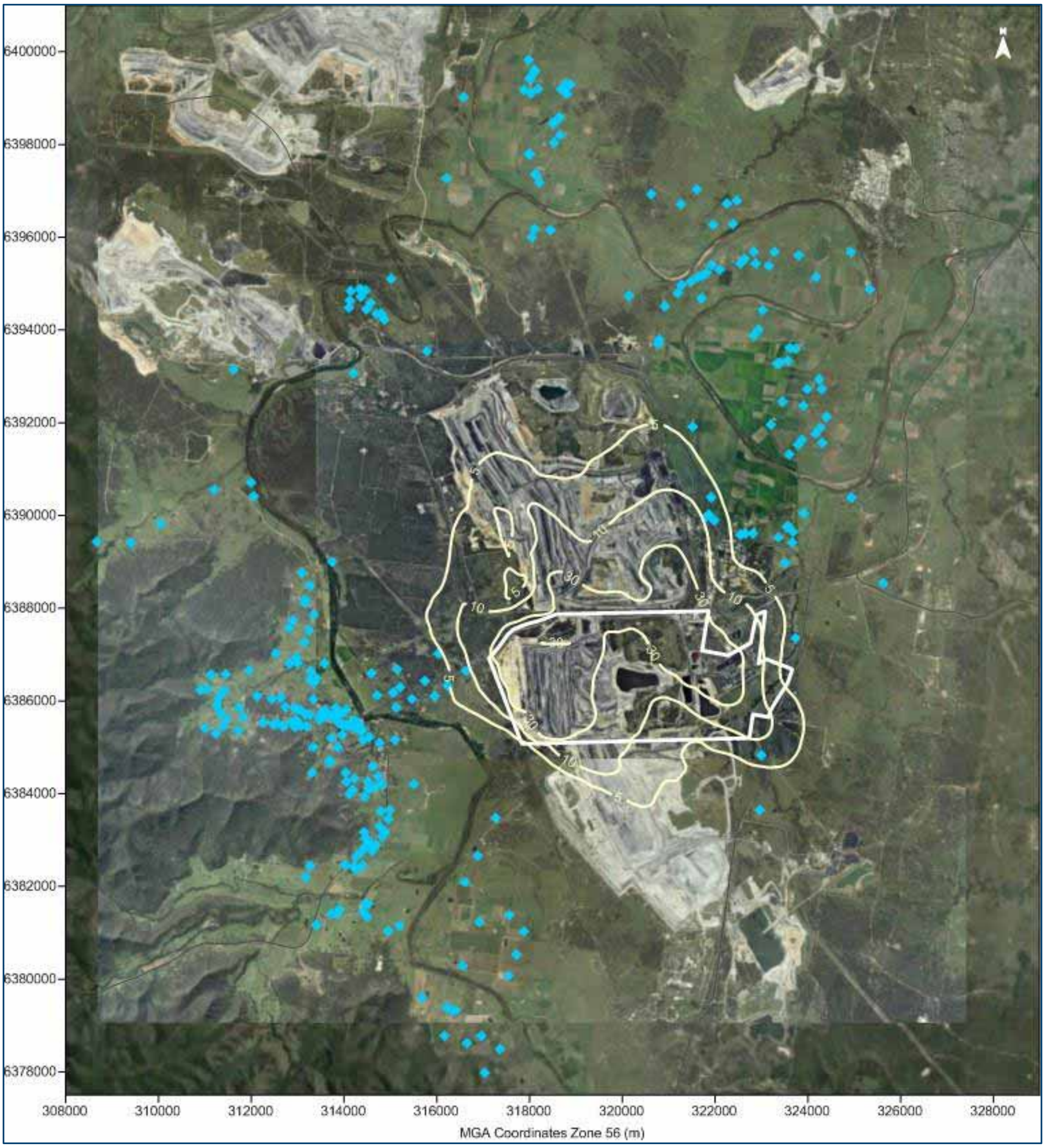

Figure E-13: Predicted annual average PM_{10} concentrations due to emissions from the proposal in Year 9 ($\mu g/m^3$)

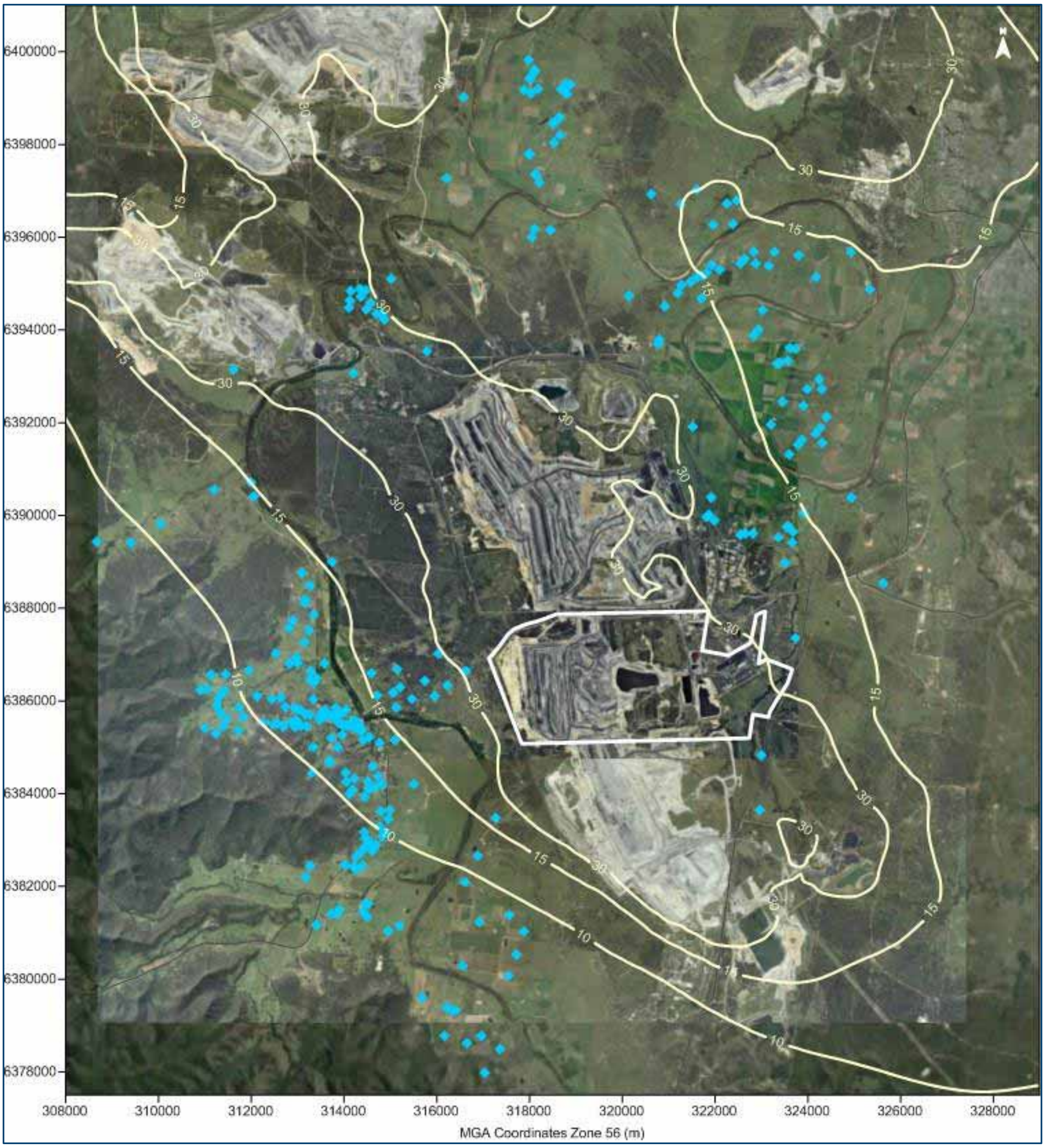

Figure E-14: Predicted annual average PM_{10} concentrations due to emissions from the proposal and other sources in Year 9 ($\mu g/m^3$)

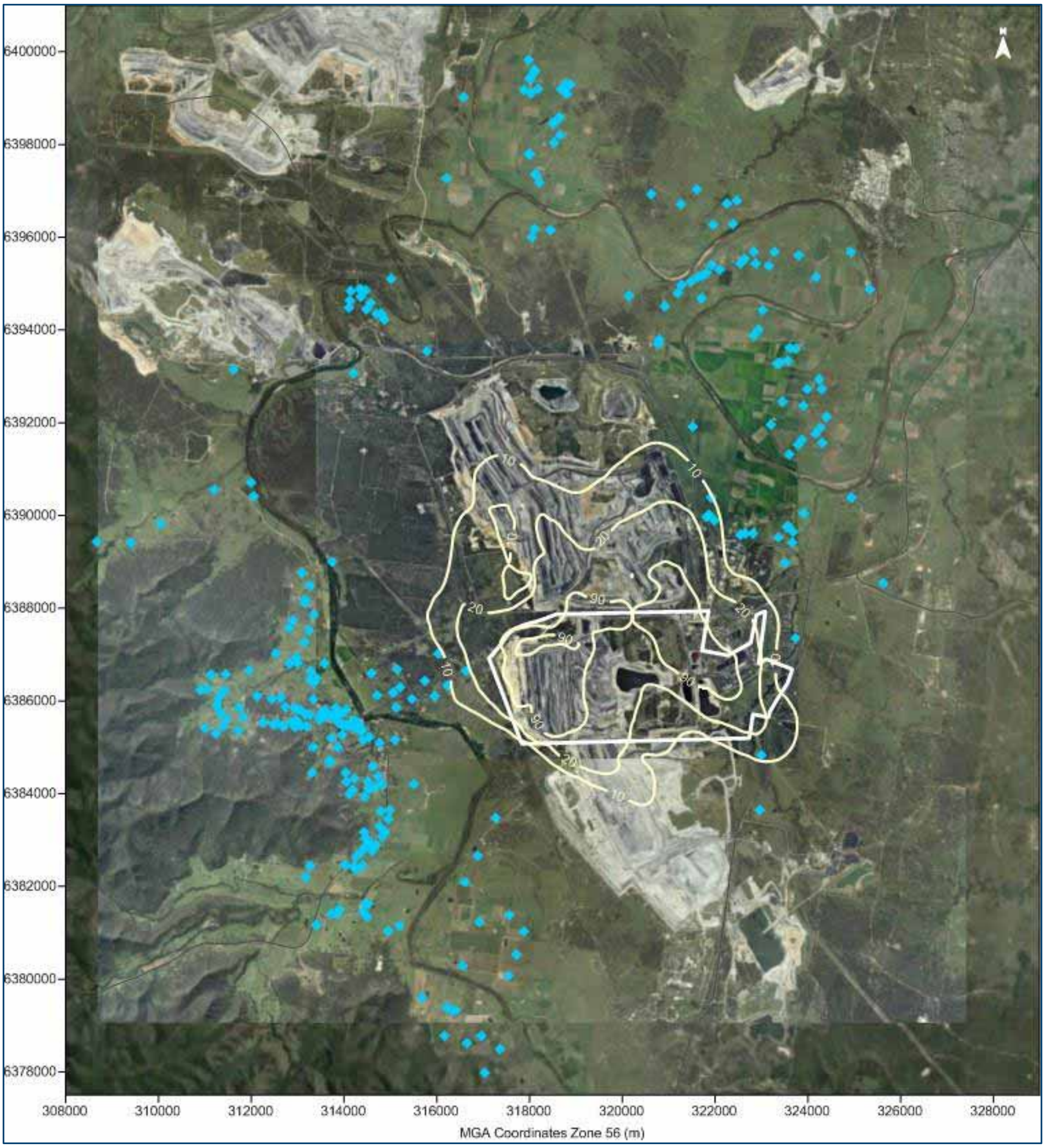

Figure E-15: Predicted annual average TSP concentrations due to emissions from the proposal in Year 9 (µg/m³)

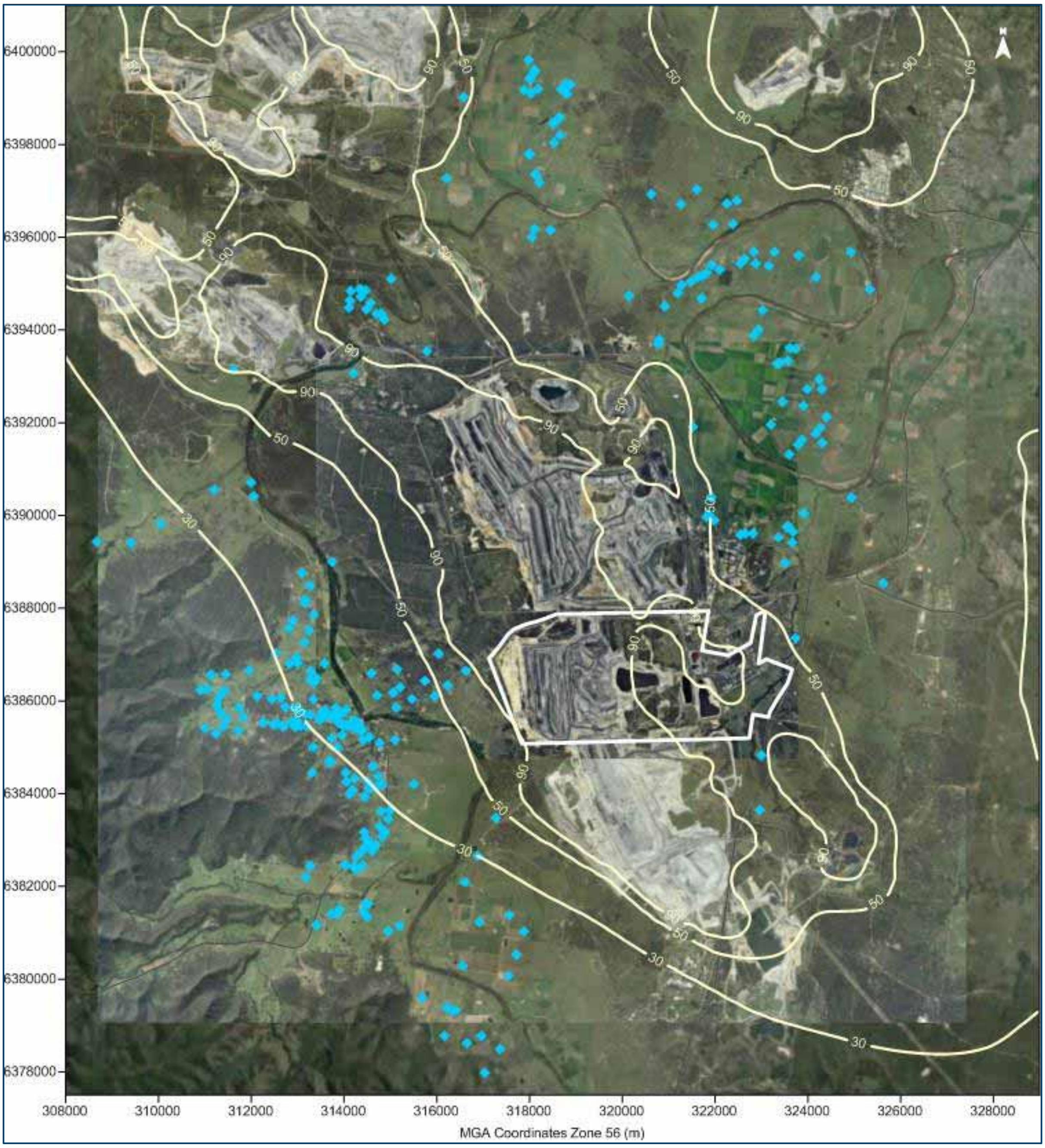

Figure E-16: Predicted annual average TSP concentrations due to emissions from the proposal and other sources in Year 9 (µg/m³)

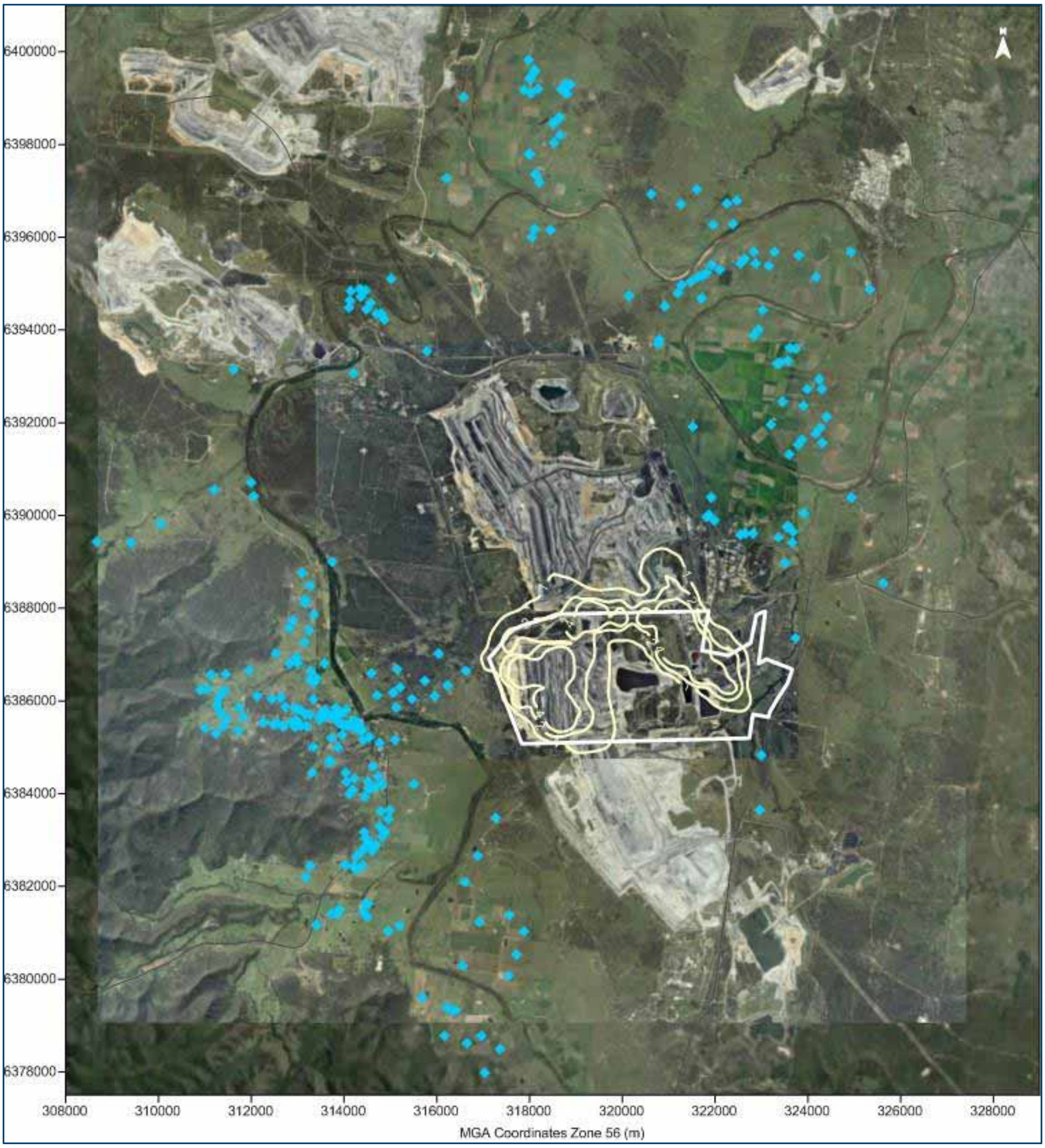

Figure E-17: Predicted annual average dust deposition levels due to emissions from the proposal in Year 9 (g/m²/month)

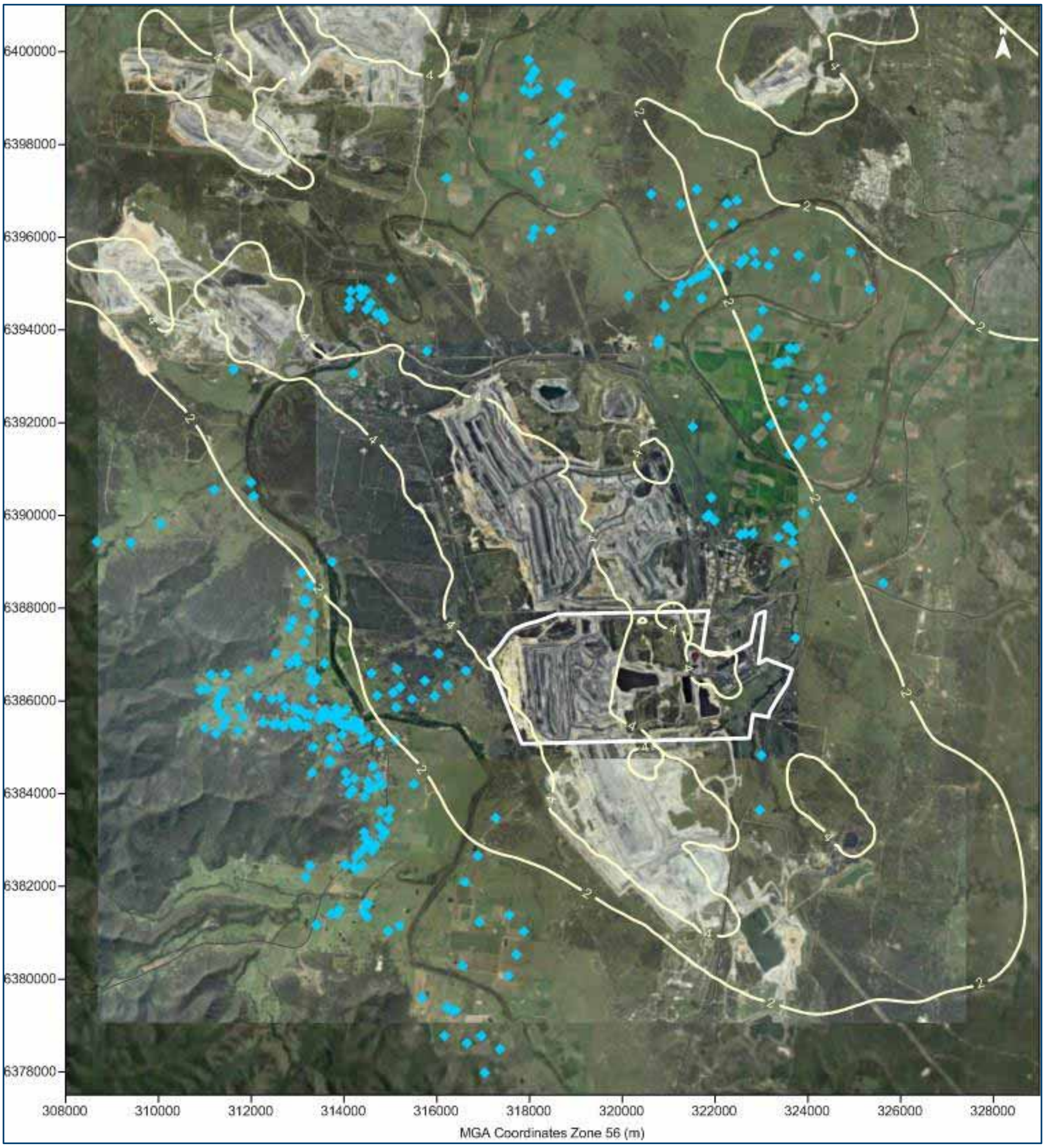

Figure E-18: Predicted annual average dust deposition levels due to emissions from the proposal and other sources in Year 9 (g/m²/month)

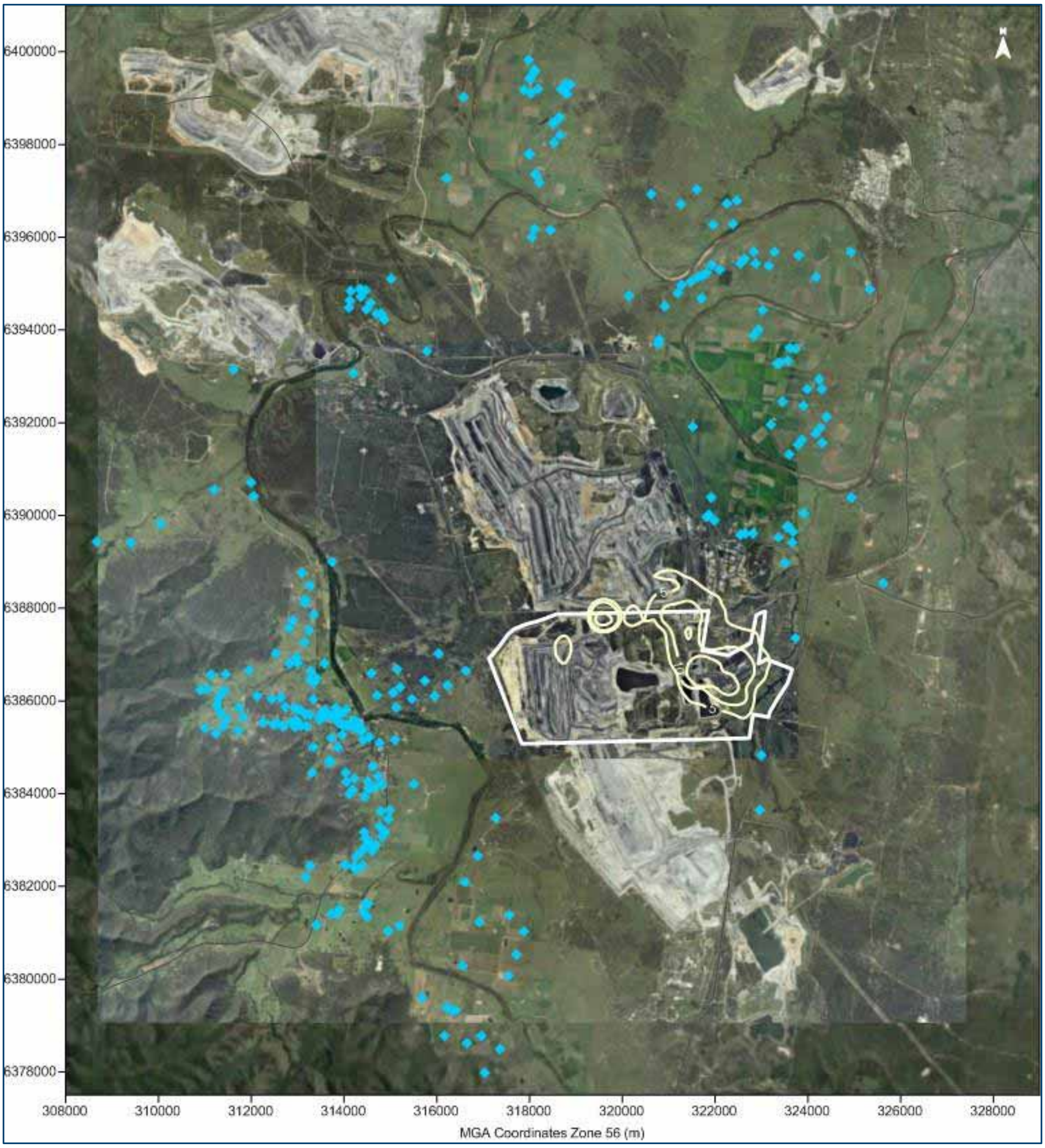

Figure E-19: Predicted maximum 24-hour average $PM_{2.5}$ concentrations due to emissions from the proposal in Year 14 (µg/m³)

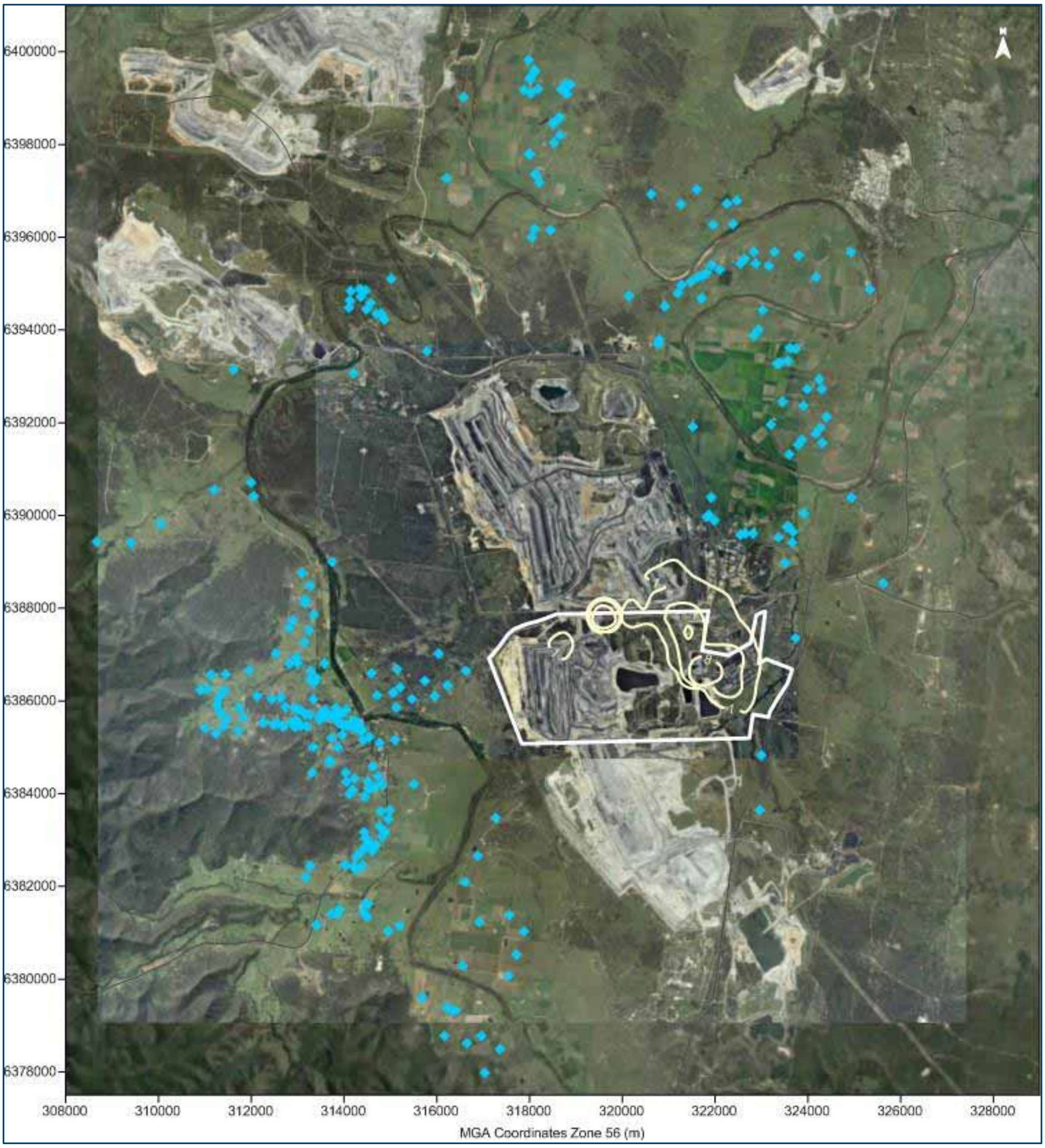

Figure E-20: Predicted annual average $PM_{2.5}$ concentrations due to emissions from the proposal in Year 14 (µg/m³)

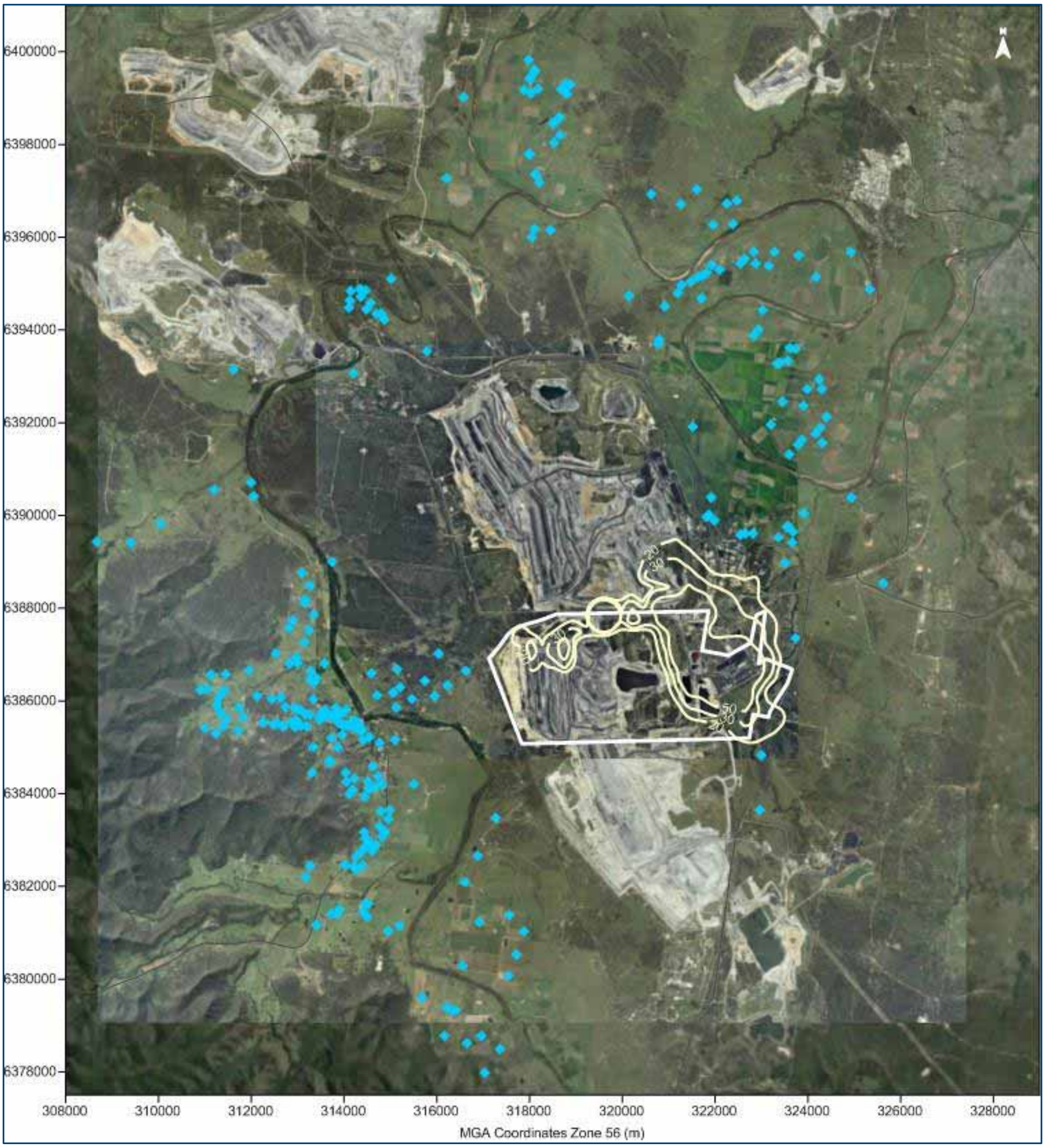

Figure E-21: Predicted maximum 24-hour average PM_{10} concentrations due to emissions from the proposal in Year 14 (µg/m³)

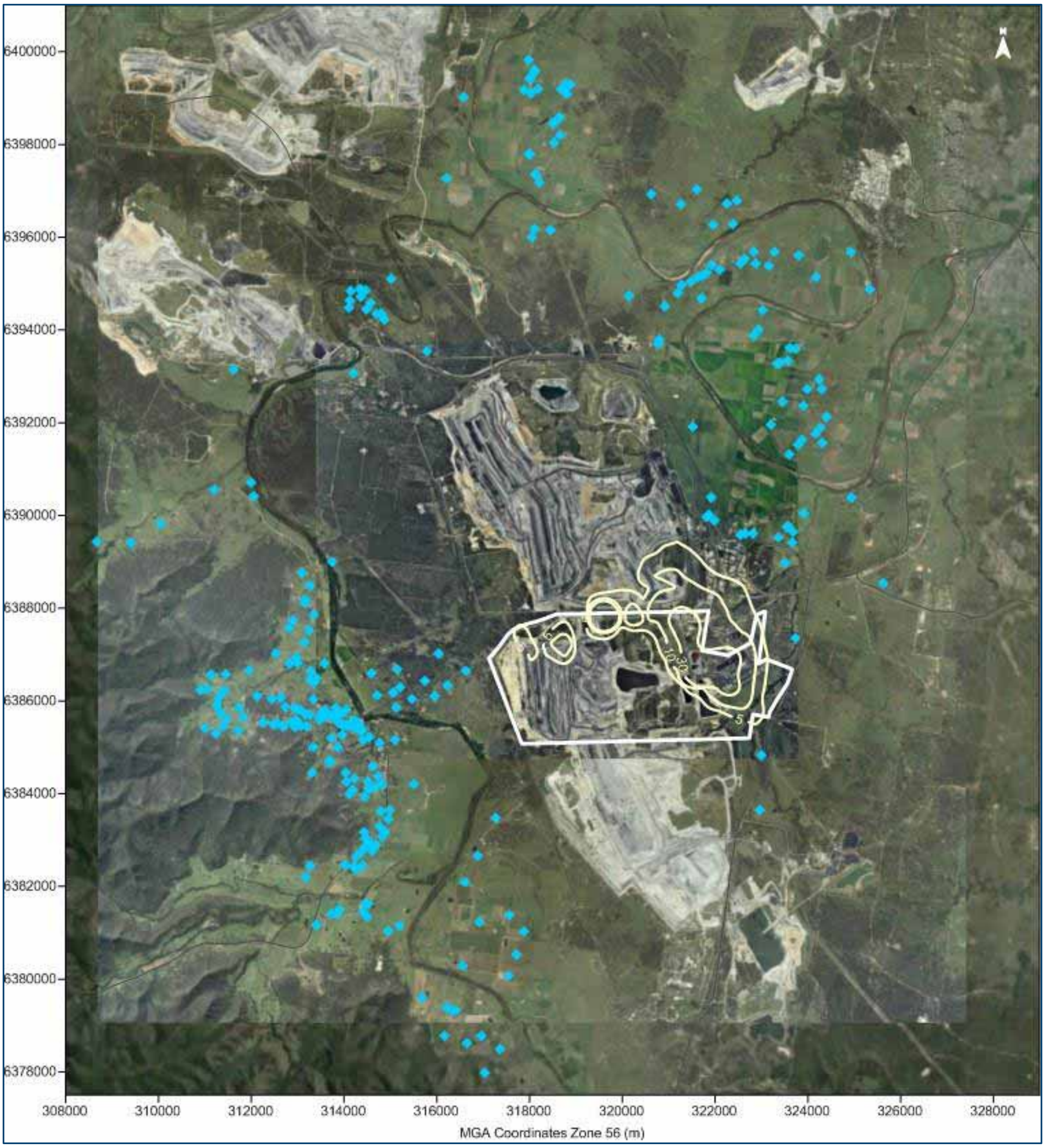

Figure E-22: Predicted annual average PM_{10} concentrations due to emissions from the proposal in Year 14 (µg/m³)

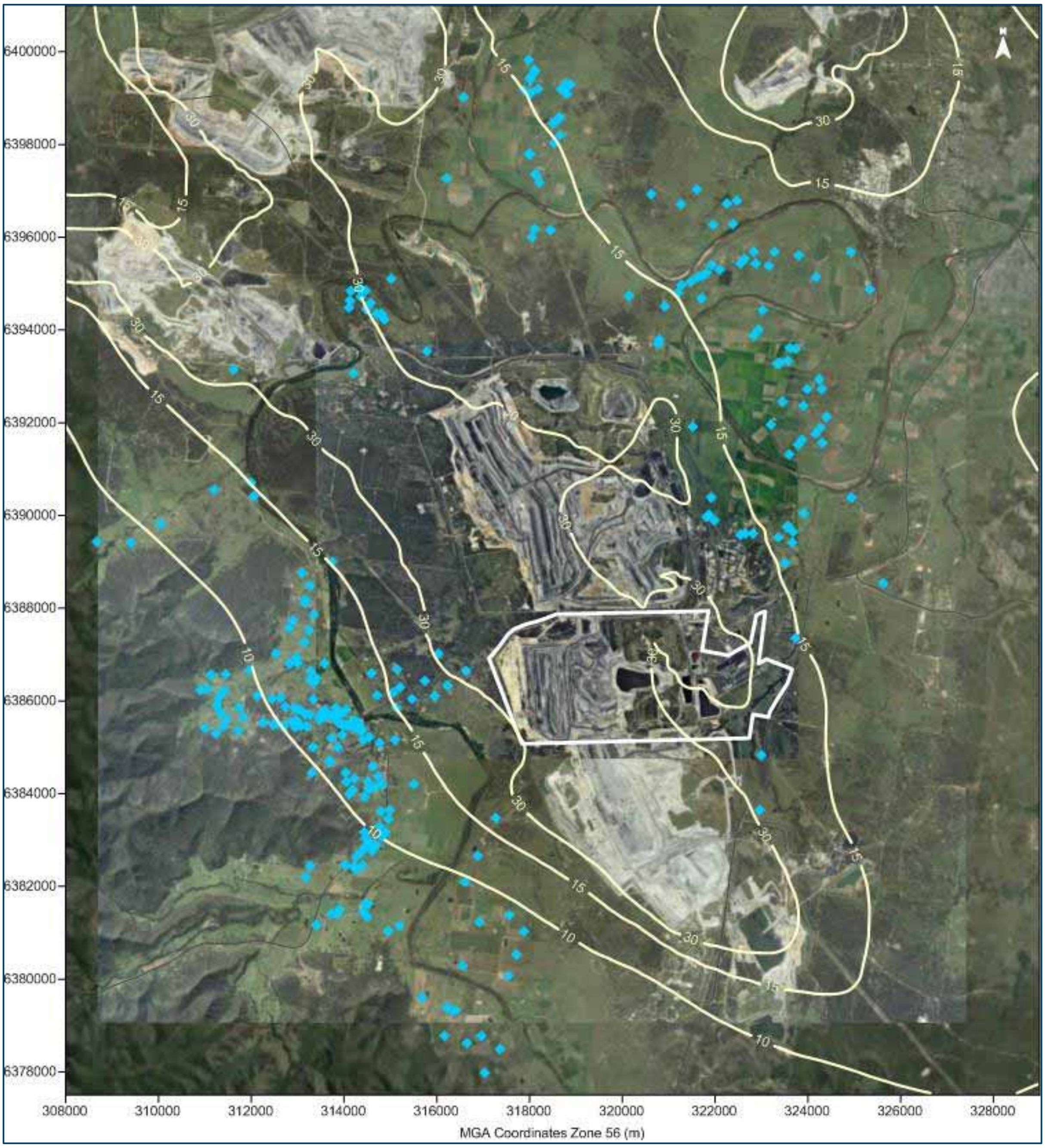

Figure E-23: Predicted annual average PM_{10} concentrations due to emissions from the proposal and other sources in Year 14 (µg/m³)

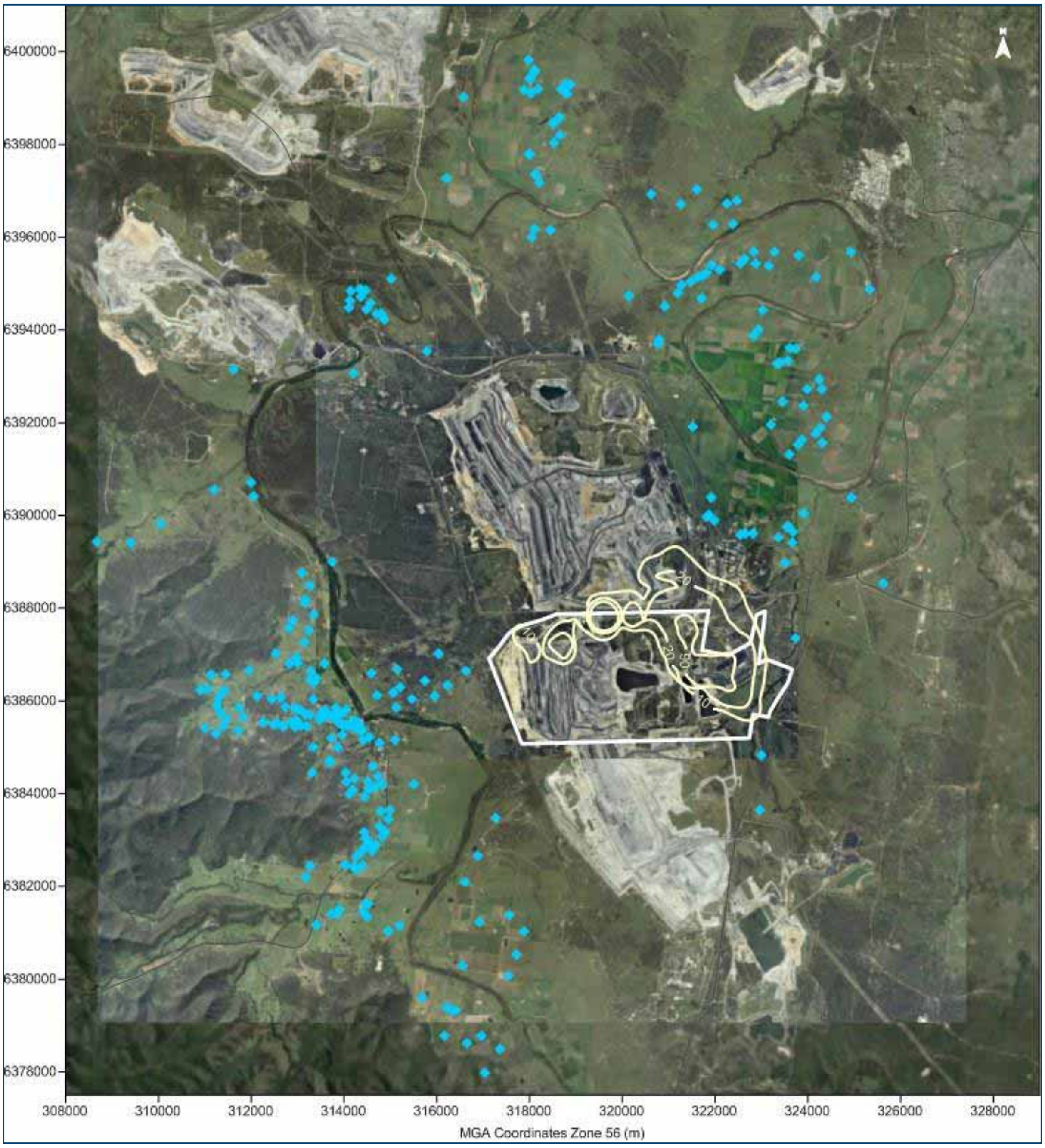

Figure E-24: Predicted annual average TSP concentrations due to emissions from the proposal in Year 14 (µg/m³)

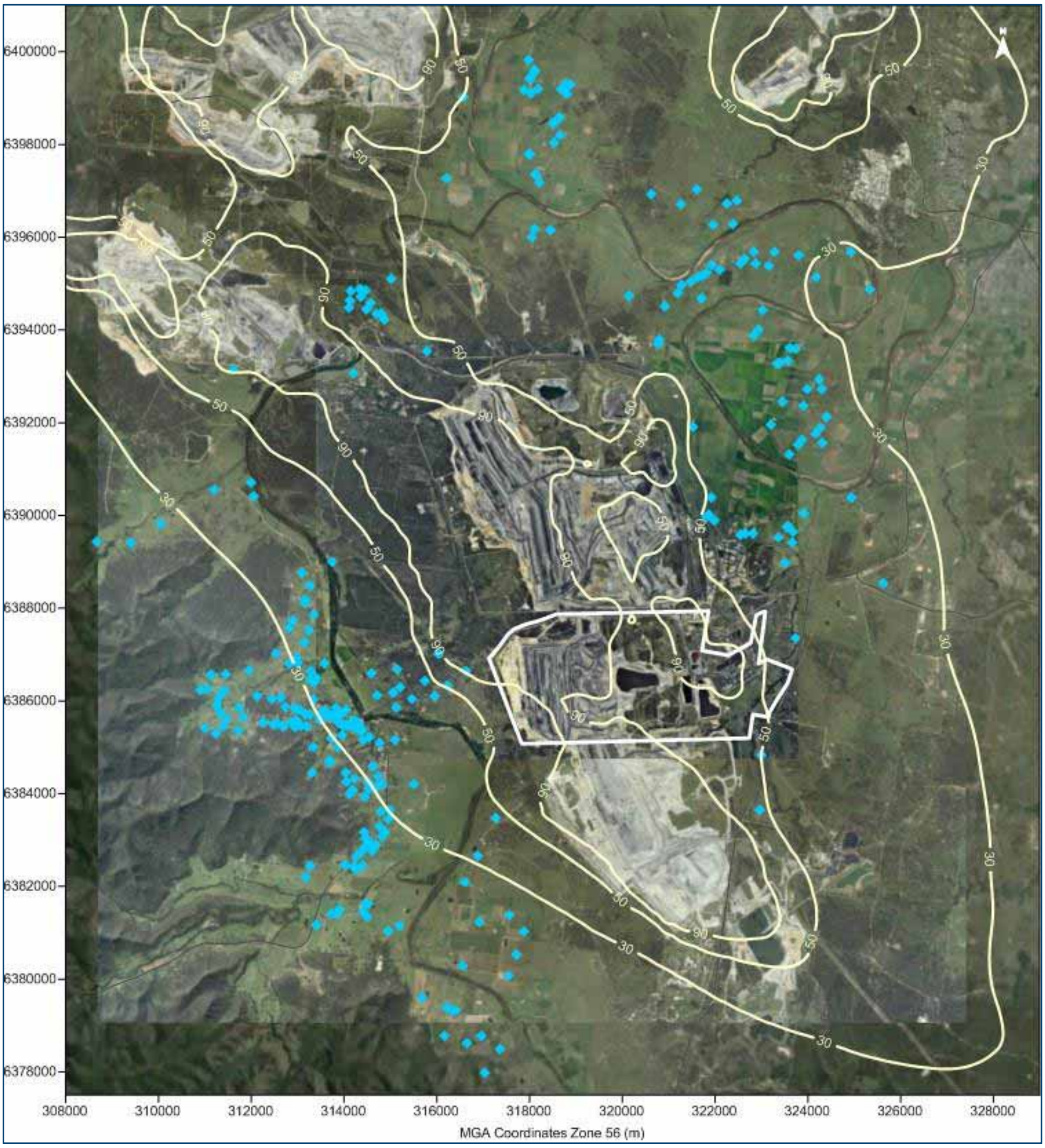

Figure E-25: Predicted annual average TSP concentrations due to emissions from the proposal and other sources in Year 14 (µg/m³)

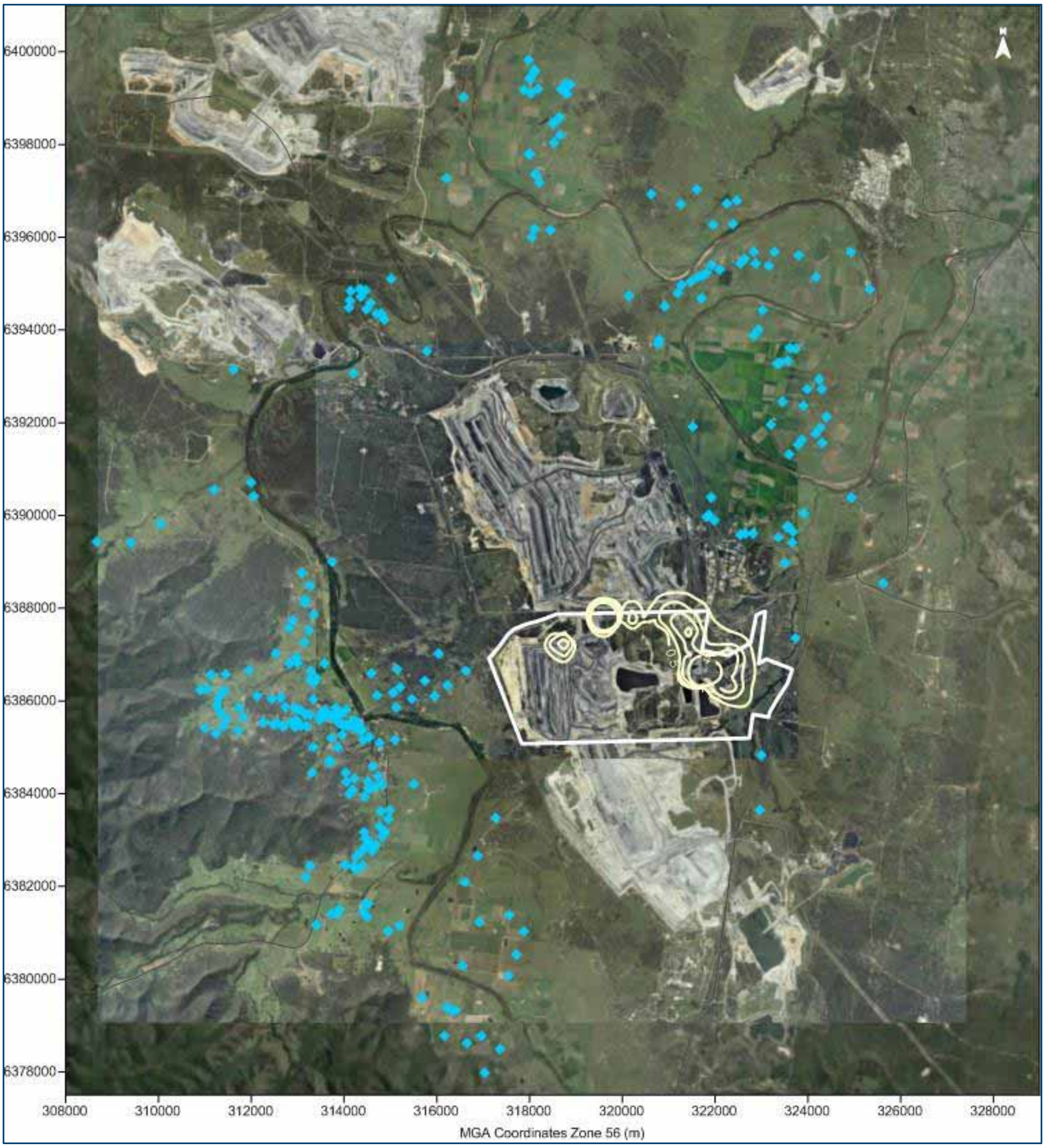

Figure E-26: Predicted annual average dust deposition levels due to emissions from the proposal in Year 14 (g/m²/month)

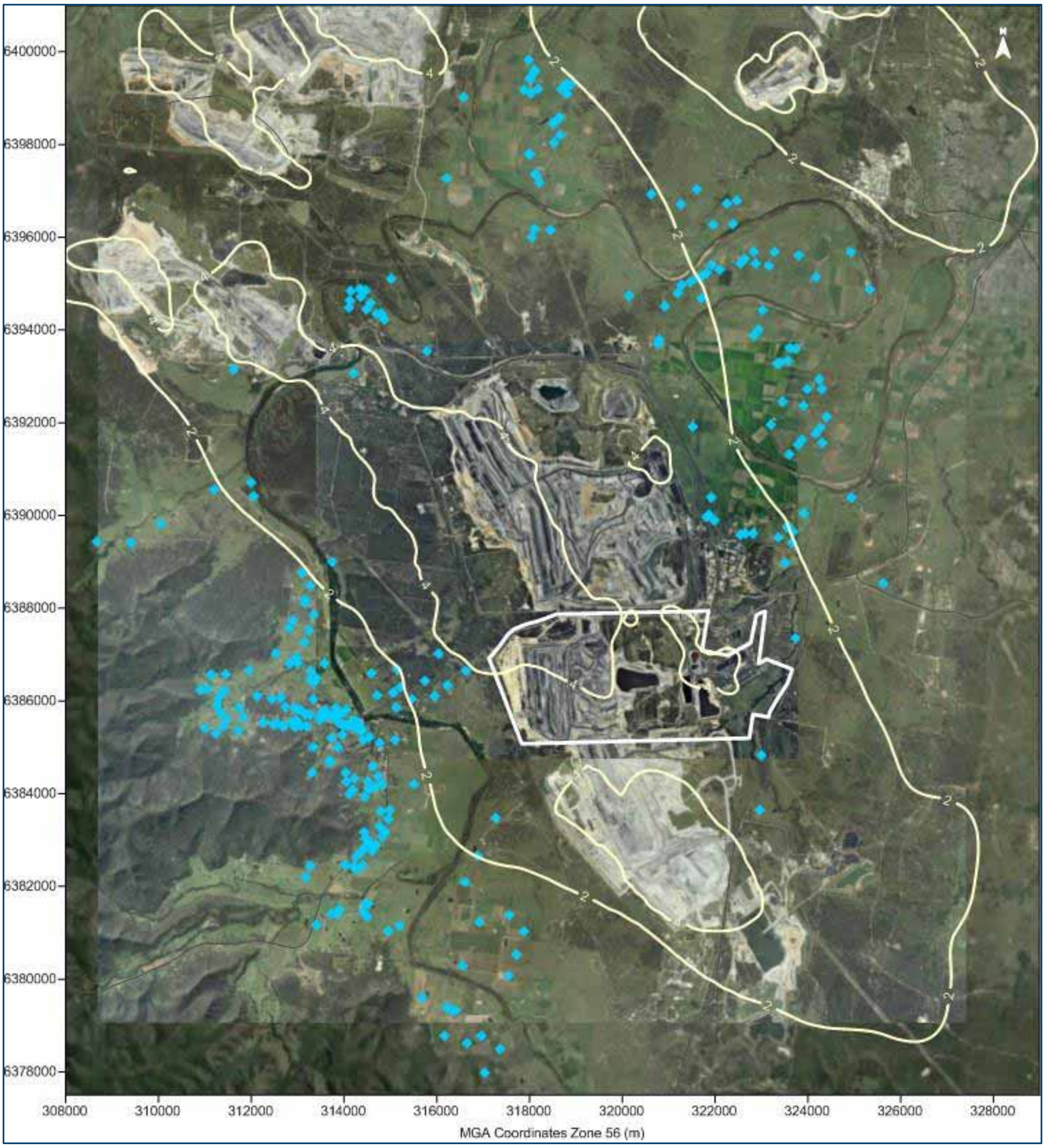

Figure E-27: Predicted annual average dust deposition levels due to emissions from the proposal and other sources in Year 14 (g/m²/month)

Appendix F

Further detail regarding 24-hour PM_{10} analysis

Table F-1: Bulga – Year 3

PM_{10} 24-hour average (µg/m³)							
Date	**Background**	**Predicted increment**	**Total**	**Date**	**Background**	**Highest predicted increment**	**Total**
27/11/2012	56.1	-0.7	55.4	14/06/2012	ND	5.2	5.2
7/10/2012	40.9	-4.1	36.8	4/03/2012	9.8	4.3	14.2
29/09/2012	39.2	0.0	39.2	16/03/2012	ND	3.0	3.0
8/11/2012	38.7	0.3	39.0	22/04/2012	9.1	2.9	12.1
2/12/2012	37.4	-1.9	35.6	15/10/2012	11.4	2.6	14.0
22/10/2012	34.5	0.0	34.5	21/03/2012	8.3	2.0	10.3
9/01/2012	33.7	1.4	35.0	17/05/2012	13.7	1.9	15.5
6/01/2012	33.4	0.0	33.4	14/04/2012	12.1	1.8	13.9
18/08/2012	32.8	0.0	32.8	2/05/2012	15.3	1.7	17.0
19/12/2012	32.6	-0.9	31.6	25/05/2012	14.0	1.7	15.7

ND – No data

Table F-2: Wallaby Scrub Road – Year 3

PM_{10} 24-hour average (µg/m³)							
Date	**Background**	**Predicted increment**	**Total**	**Date**	**Background**	**Highest predicted increment**	**Total**
18/10/2012	46.0	-7.0	39.0	8/06/2012	ND	7.9	7.9
7/09/2012	45.0	0.0	45.0	14/06/2012	ND	7.0	7.0
29/09/2012	44.0	0.0	44.0	1/04/2012	14.0	5.1	19.1
7/10/2012	41.0	0.5	41.5	8/07/2012	8.0	4.2	12.2
2/12/2012	41.0	1.2	42.2	22/04/2012	13.0	3.8	16.8
6/09/2012	37.0	0.0	37.0	3/09/2012	19.0	3.8	22.8
25/08/2012	36.0	0.1	36.1	22/02/2012	8.0	3.8	11.8
18/08/2012	35.0	0.0	35.0	3/04/2012	13.0	3.4	16.4
27/11/2012	34.0	-3.9	30.1	4/05/2012	10.0	3.0	13.0
19/12/2012	34.0	-2.0	32.0	8/04/2012	27.0	2.9	29.9

ND – No data

Table F-3: Warkworth – Year 3

PM_{10} 24-hour average (µg/m³)							
Date	**Background**	**Predicted increment**	**Total**	**Date**	**Background**	**Highest predicted increment**	**Total**
19/12/2012	41.2	2.1	43.3	10/12/2012	31.7	19.0	50.7
7/11/2012	40.0	-0.4	39.6	11/12/2012	ND	11.4	11.4
7/09/2012	38.0	0.0	38.0	28/03/2012	15.9	11.3	27.2
23/10/2012	37.8	3.1	40.9	1/02/2012	12.9	11.3	24.2
27/10/2012	37.6	-0.8	36.8	13/06/2012	6.7	10.7	17.4
29/09/2012	37.3	0.0	37.3	2/06/2012	12.2	10.2	22.4
7/10/2012	36.3	1.2	37.5	5/01/2012	21.2	9.9	31.1
18/10/2012	35.9	-1.5	34.4	2/01/2012	17.8	9.2	27.0
8/11/2012	35.3	0.9	36.2	13/01/2012	ND	9.2	9.2
2/11/2012	34.7	0.5	35.2	3/01/2012	19.5	9.1	28.6

ND – No data

Table F-4: Knodlers Lane – Year 3

PM$_{10}$ 24-hour average (µg/m³)							
Date	**Background**	**Predicted increment**	**Total**	**Date**	**Background**	**Highest predicted increment**	**Total**
29/09/2012	56.3	0.0	56.3	2/06/2012	6.7	4.4	11.1
2/11/2012	54.5	0.0	54.5	1/03/2012	ND	3.1	3.1
26/10/2012	49.7	0.1	49.8	18/04/2012	16.0	3.0	19.0
27/10/2012	48.7	0.4	49.0	11/03/2012	14.0	3.0	17.0
17/10/2012	47.7	0.0	47.7	7/01/2012	10.5	3.0	13.5
6/10/2012	47.1	0.4	47.4	11/11/2012	14.9	2.5	17.4
18/10/2012	43.6	0.2	43.8	9/02/2012	ND	2.4	2.4
5/10/2012	42.8	0.0	42.8	14/11/2012	31.0	2.4	33.3
6/09/2012	42.3	0.0	42.3	24/01/2012	ND	2.3	2.3
21/10/2012	41.1	0.4	41.5	3/01/2012	12.0	2.2	14.2

ND – No data

Table F-5: MTIE – Year 3

PM$_{10}$ 24-hour average (µg/m³)							
Date	**Background**	**Predicted increment**	**Total**	**Date**	**Background**	**Highest predicted increment**	**Total**
2/11/2012	77.0	1.3	78.3	15/06/2012	19.0	9.1	28.1
14/09/2012	76.0	-2.1	73.9	17/07/2012	11.0	7.4	18.4
6/10/2012	73.0	-0.1	72.9	29/06/2012	17.0	6.4	23.4
27/10/2012	72.0	0.9	72.9	21/05/2012	35.0	5.6	40.6
18/08/2012	68.0	-0.7	67.3	21/08/2012	37.0	5.6	42.6
31/08/2012	65.0	-3.0	62.0	8/05/2012	35.0	5.3	40.3
5/10/2012	63.0	0.7	63.7	4/05/2012	10.0	5.3	15.3
4/09/2012	62.0	1.0	63.0	29/07/2012	18.0	5.1	23.1
23/08/2012	59.0	-1.6	57.4	27/09/2012	ND	5.1	5.1
6/09/2012	59.0	-12.1	46.9	22/08/2012	23.0	5.0	28.0

ND – No data

Table F-6: Bulga – Year 9

PM$_{10}$ 24-hour average (µg/m³)							
Date	**Background**	**Predicted increment**	**Total**	**Date**	**Background**	**Highest predicted increment**	**Total**
27/11/2012	56.1	-1.7	54.4	14/06/2012	ND	14.8	14.8
7/10/2012	40.9	-6.0	34.9	8/06/2012	5.9	12.8	18.7
29/09/2012	39.2	0.0	39.2	22/04/2012	9.1	12.3	21.5
8/11/2012	38.7	2.8	41.5	4/03/2012	9.8	11.8	21.6
2/12/2012	37.4	-1.9	35.5	16/03/2012	ND	10.8	10.8
22/10/2012	34.5	0.0	34.5	3/04/2012	11.9	9.2	21.1
9/01/2012	33.7	-0.4	33.3	17/05/2012	13.7	9.1	22.8
6/01/2012	33.4	0.3	33.7	14/04/2012	12.1	8.9	21.0
18/08/2012	32.8	0.0	32.8	30/10/2012	16.3	8.2	24.5
19/12/2012	32.6	-3.8	28.8	15/10/2012	11.4	8.0	19.4

ND – No data

Table F-7: Wallaby Scrub Road – Year 9

PM10 24-hour average (µg/m³)							
Date	**Background**	**Predicted increment**	**Total**	**Date**	**Background**	**Highest predicted increment**	**Total**
18/10/2012	46.0	-4.8	41.2	8/06/2012	ND	16.9	16.9
7/09/2012	45.0	0.0	45.0	3/09/2012	19.0	16.7	35.7
29/09/2012	44.0	0.0	44.0	8/07/2012	8.0	11.3	19.3
7/10/2012	41.0	3.8	44.8	22/04/2012	13.0	11.1	24.1
2/12/2012	41.0	3.3	44.3	1/04/2012	14.0	10.2	24.2
6/09/2012	37.0	0.0	37.0	4/05/2012	10.0	10.0	20.0
25/08/2012	36.0	0.0	36.0	13/01/2012	18.0	9.7	27.7
18/08/2012	35.0	0.0	35.0	19/02/2012	22.0	8.6	30.6
27/11/2012	34.0	-0.6	33.4	20/04/2012	9.0	8.3	17.3
19/12/2012	34.0	1.1	35.1	6/10/2012	20.0	7.6	27.6

ND – No data

Table F-8: Warkworth – Year 9

PM10 24-hour average (µg/m³)							
Date	**Background**	**Predicted increment**	**Total**	**Date**	**Background**	**Highest predicted increment**	**Total**
19/12/2012	41.2	-11.5	29.7	10/12/2012	31.7	56.3	88.0
7/11/2012	40.0	0.2	40.2	11/12/2012	ND	50.1	50.1
7/09/2012	38.0	0.0	38.0	12/06/2012	6.6	45.7	52.3
23/10/2012	37.8	14.9	52.7	17/04/2012	23.7	44.6	68.3
27/10/2012	37.6	-2.2	35.4	12/08/2012	10.6	41.9	52.5
29/09/2012	37.3	0.0	37.3	11/06/2012	11.5	38.5	50.0
7/10/2012	36.3	-1.7	34.6	10/07/2012	12.0	38.0	50.0
18/10/2012	35.9	-15.5	20.4	21/07/2012	10.5	35.5	46.0
8/11/2012	35.3	-0.6	34.7	6/07/2012	11.0	34.5	45.5
2/11/2012	34.7	0.8	35.5	7/03/2012	17.1	34.0	51.1

ND – No data

Table F-9: Knodlers Lane – Year 9

PM10 24-hour average (µg/m³)							
Date	**Background**	**Predicted increment**	**Total**	**Date**	**Background**	**Highest predicted increment**	**Total**
29/09/2012	56.3	0.0	56.3	1/05/2012	17.1	3.2	20.3
2/11/2012	54.5	0.8	55.3	9/06/2012	8.6	3.2	11.8
26/10/2012	49.7	0.9	50.6	27/10/2012	48.7	3.2	51.8
27/10/2012	48.7	3.2	51.8	28/05/2012	12.6	2.9	15.5
17/10/2012	47.7	0.0	47.7	30/04/2012	18.1	2.7	20.9
6/10/2012	47.1	0.1	47.2	24/09/2012	24.3	2.2	26.4
18/10/2012	43.6	-0.1	43.5	26/06/2012	10.0	2.2	12.2
5/10/2012	42.8	0.1	42.8	9/07/2012	15.9	2.2	18.1
6/09/2012	42.3	0.0	42.3	31/07/2012	6.0	2.1	8.1
21/10/2012	41.1	0.3	41.4	30/03/2012	16.1	2.0	18.1

Table F-10: MTIE – Year 9

PM$_{10}$ 24-hour average ($\mu g/m^3$)							
Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
2/11/2012	77.0	5.2	82.2	26/07/2012	18.0	10.4	28.4
14/09/2012	76.0	-2.8	73.2	22/09/2012	45.0	10.1	55.1
6/10/2012	73.0	0.0	73.0	31/07/2012	36.0	9.4	45.4
27/10/2012	72.0	2.3	74.3	30/07/2012	17.0	9.2	26.2
18/08/2012	68.0	-3.5	64.5	10/03/2012	21.0	8.7	29.7
31/08/2012	65.0	-4.6	60.4	24/05/2012	47.0	8.6	55.6
5/10/2012	63.0	-9.1	53.9	5/05/2012	18.0	8.3	26.3
4/09/2012	62.0	2.0	64.0	3/07/2012	20.0	7.3	27.3
23/08/2012	59.0	-6.0	53.0	13/09/2012	42.0	7.3	49.3
6/09/2012	59.0	-13.6	45.4	11/07/2012	36.0	7.1	43.1

Table F-11: Bulga – Year 14

PM$_{10}$ 24-hour average ($\mu g/m^3$)							
Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
27/11/2012	56.1	-3.0	53.1	4/03/2012	9.8	18.9	28.7
7/10/2012	40.9	-10.7	30.1	14/06/2012	ND	18.9	18.9
29/09/2012	39.2	0.0	39.2	8/06/2012	5.9	17.0	22.9
8/11/2012	38.7	3.3	42.0	30/10/2012	16.3	16.6	32.8
2/12/2012	37.4	-5.6	31.8	20/09/2012	10.8	15.3	26.1
22/10/2012	34.5	0.0	34.4	17/05/2012	13.7	14.8	28.5
9/01/2012	33.7	-3.2	30.4	16/03/2012	ND	14.7	14.7
6/01/2012	33.4	0.3	33.7	22/04/2012	9.1	14.2	23.3
18/08/2012	32.8	0.0	32.8	3/04/2012	11.9	11.1	23.0
19/12/2012	32.6	-8.3	24.2	20/04/2012	ND	10.9	10.9

ND – No data

Table F-12: Wallaby Scrub Road – Year 14

PM$_{10}$ 24-hour average ($\mu g/m^3$)							
Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
18/10/2012	46.0	-13.4	32.6	8/06/2012	ND	23.3	23.3
7/09/2012	45.0	0.0	45.0	22/04/2012	13.0	18.5	31.5
29/09/2012	44.0	0.0	44.0	3/09/2012	19.0	17.7	36.7
7/10/2012	41.0	4.9	45.9	4/05/2012	10.0	16.1	26.1
2/12/2012	41.0	4.6	45.6	8/07/2012	8.0	15.2	23.2
6/09/2012	37.0	0.0	37.0	20/04/2012	9.0	13.2	22.2
25/08/2012	36.0	0.0	36.0	13/01/2012	18.0	12.5	30.5
18/08/2012	35.0	0.0	35.0	1/04/2012	14.0	12.3	26.3
27/11/2012	34.0	-4.3	29.7	30/10/2012	17.0	11.9	28.9
19/12/2012	34.0	-1.8	32.2	27/04/2012	13.0	10.7	23.7

ND – No data

Table F-13: Warkworth – Year 14

PM$_{10}$ 24-hour average (µg/m³)							
Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
19/12/2012	41.2	-12.4	28.8	6/06/2012	6.9	65.4	72.3
7/11/2012	40.0	-1.1	38.9	10/12/2012	31.7	57.3	89.0
7/09/2012	38.0	0.0	38.0	11/12/2012	ND	45.0	45.0
23/10/2012	37.8	-1.4	36.4	26/06/2012	9.1	37.2	46.3
27/10/2012	37.6	-2.2	35.4	5/07/2012	9.8	37.1	46.9
29/09/2012	37.3	0.0	37.3	21/07/2012	10.5	35.1	45.6
7/10/2012	36.3	-0.8	35.5	11/06/2012	11.5	34.1	45.6
18/10/2012	35.9	-17.1	18.8	21/02/2012	13.7	33.1	46.8
8/11/2012	35.3	-0.9	34.4	12/08/2012	10.6	32.5	43.1
2/11/2012	34.7	2.8	37.5	11/04/2012	12.3	31.9	44.2

ND – No data

Table F-14: Knodlers Lane – Year 14

PM$_{10}$ 24-hour average (µg/m³)							
Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
29/09/2012	56.3	0.0	56.4	27/10/2012	48.7	4.1	52.8
2/11/2012	54.5	0.3	54.8	20/07/2012	12.1	3.5	15.6
26/10/2012	49.7	0.3	50.0	31/07/2012	6.0	1.4	7.4
27/10/2012	48.7	4.1	52.8	7/10/2012	27.3	1.1	28.5
17/10/2012	47.7	0.0	47.7	1/11/2012	28.9	1.0	29.9
6/10/2012	47.1	0.2	47.3	10/01/2012	ND	0.9	0.9
18/10/2012	43.6	-0.1	43.5	28/05/2012	12.6	0.9	13.5
5/10/2012	42.8	0.1	42.9	20/05/2012	25.0	0.9	25.9
6/09/2012	42.3	0.0	42.3	15/09/2012	11.6	0.7	12.4
21/10/2012	41.1	-0.1	41.0	6/12/2012	24.7	0.6	25.3

ND – No data

Table F-15: MTIE – Year 14

PM$_{10}$ 24-hour average (µg/m³)							
Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
2/11/2012	77.0	-0.1	76.9	2/06/2012	19.0	1.6	20.6
14/09/2012	76.0	-9.9	66.1	31/05/2012	13.0	1.4	14.4
6/10/2012	73.0	-0.4	72.6	8/10/2012	34.0	1.2	35.2
27/10/2012	72.0	0.3	72.3	16/09/2012	51.0	0.9	51.9
18/08/2012	68.0	-4.0	64.0	30/05/2012	12.0	0.8	12.8
31/08/2012	65.0	-12.2	52.8	4/02/2012	5.0	0.8	5.8
5/10/2012	63.0	-9.7	53.3	12/02/2012	16.0	0.8	16.8
4/09/2012	62.0	-6.2	55.8	1/05/2012	24.0	0.7	24.7
23/08/2012	59.0	-7.9	51.1	14/03/2012	17.0	0.7	17.7
6/09/2012	59.0	-16.1	42.9	13/03/2012	21.0	0.7	21.7

Appendix G

Isopleth Diagrams – Diesel emissions

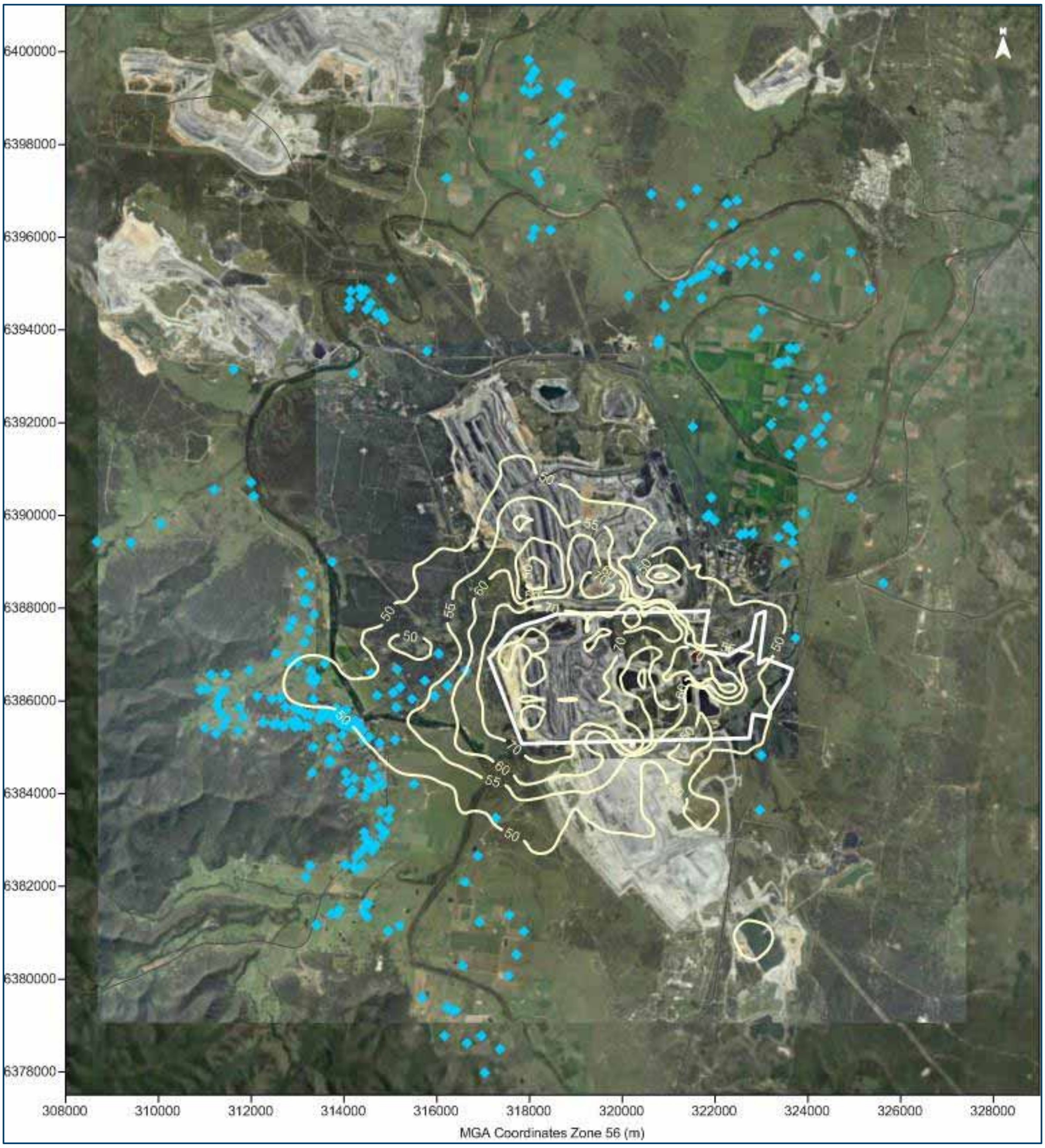

Figure G-1: Predicted 1-hour average NO_2 concentrations due to emissions from the proposal in Year 3 (µg/m³)

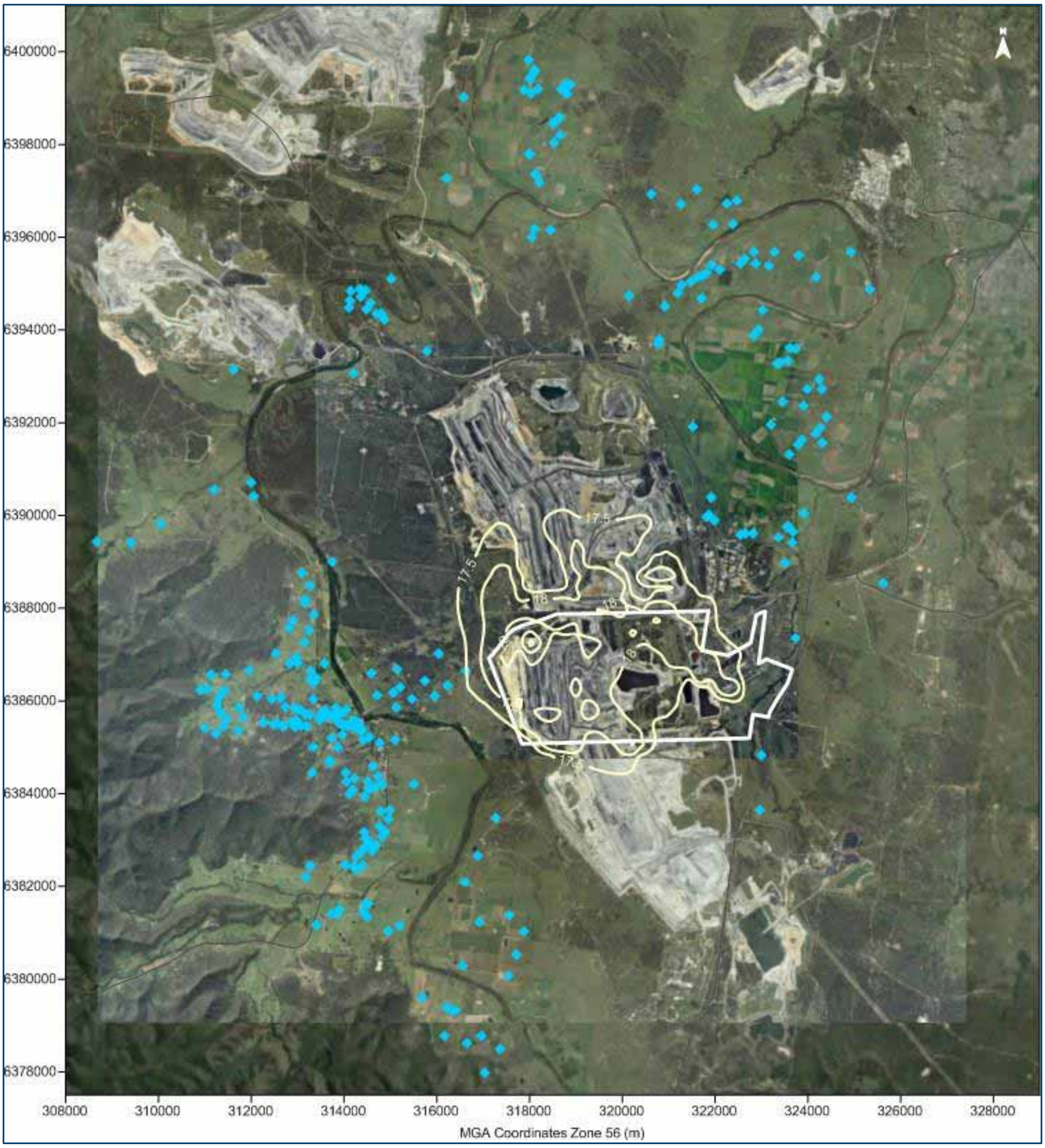

Figure G-2: Predicted annual average NO_2 concentrations due to emissions from the proposal in Year 3 (µg/m³)

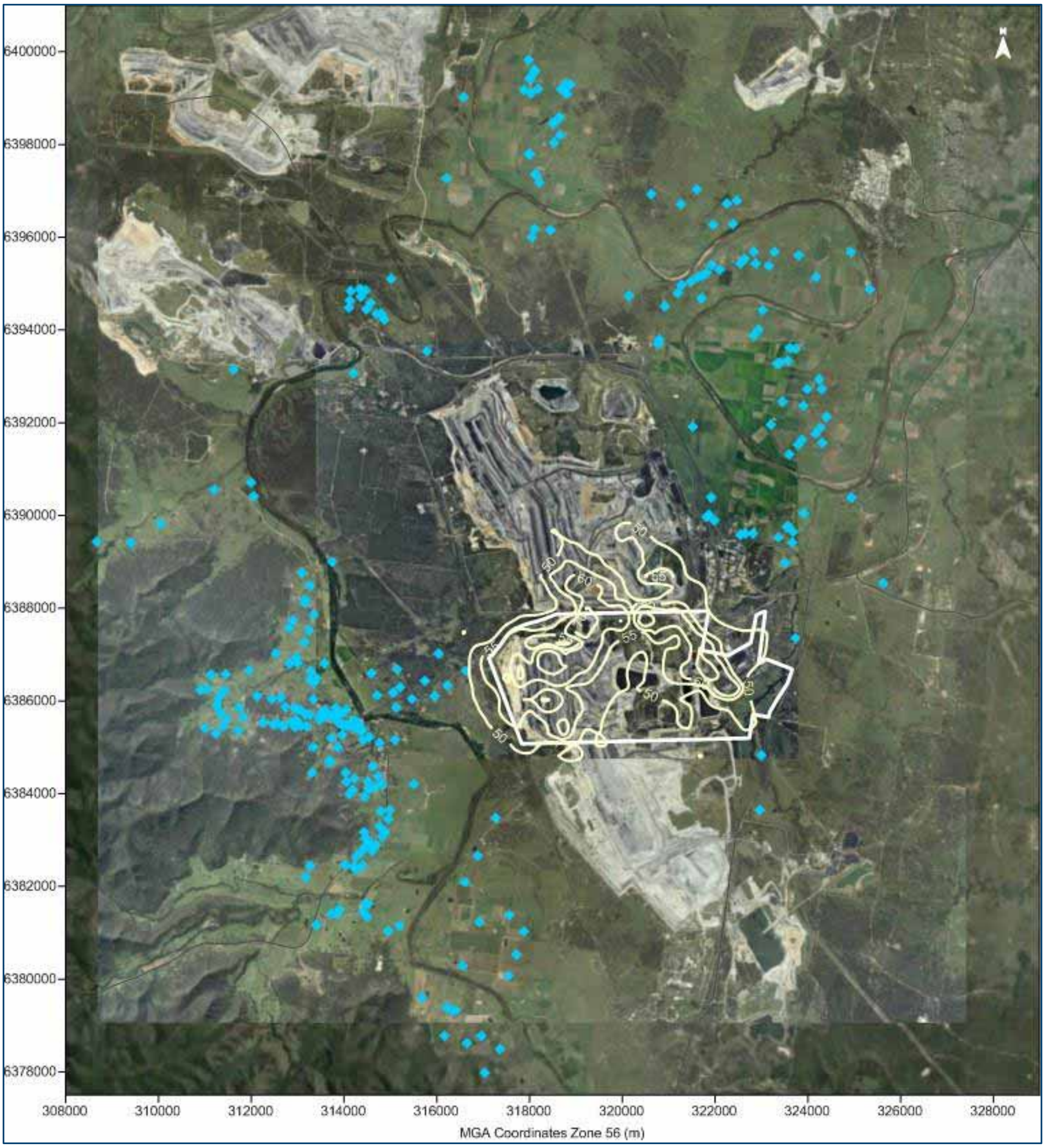

Figure G-3: Predicted 1-hour average NO_2 concentrations due to emissions from the proposal in Year 9 (µg/m³)

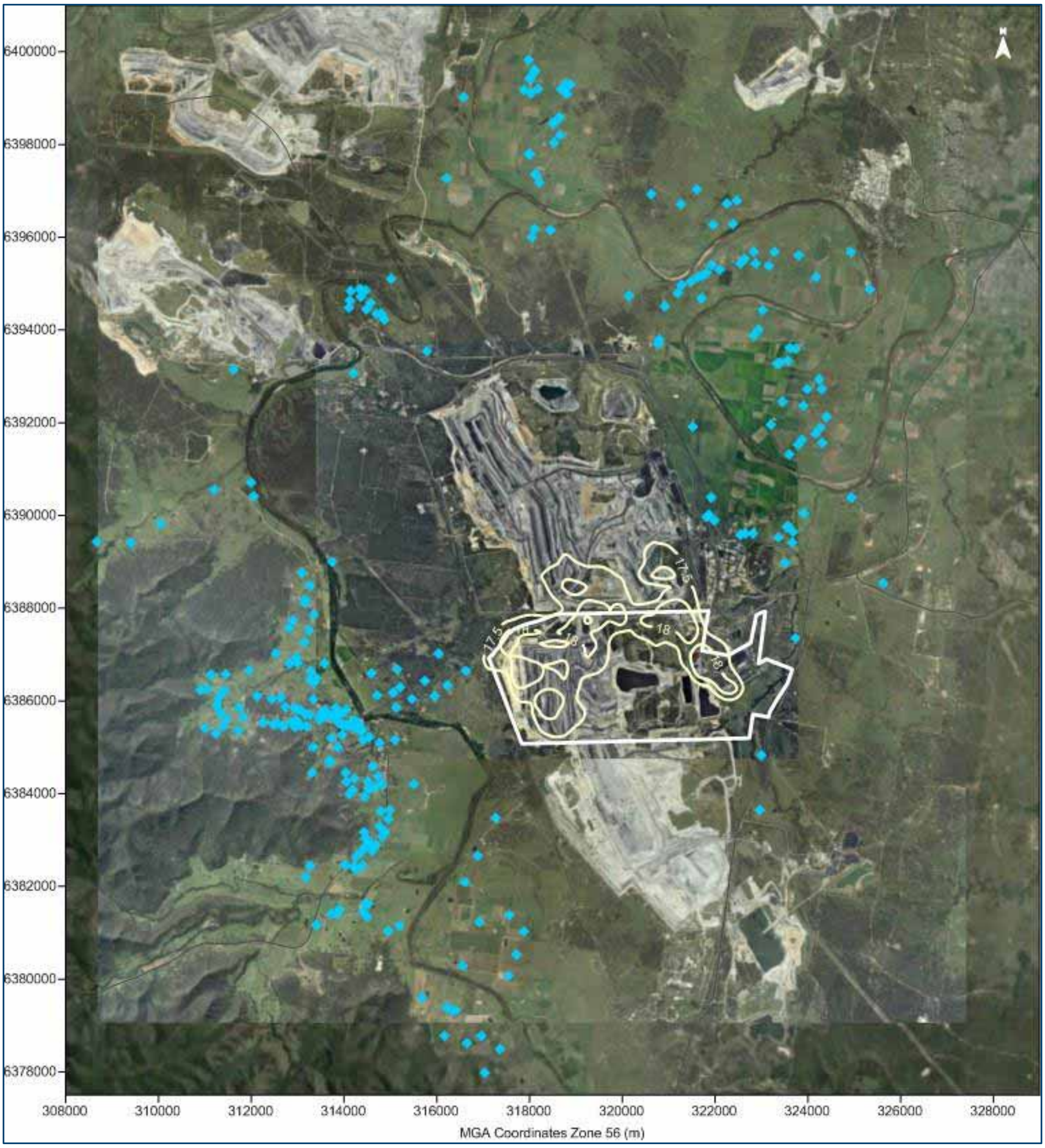

Figure G-4: Predicted annual average NO_2 concentrations due to emissions from the proposal in Year 9 (µg/m³)

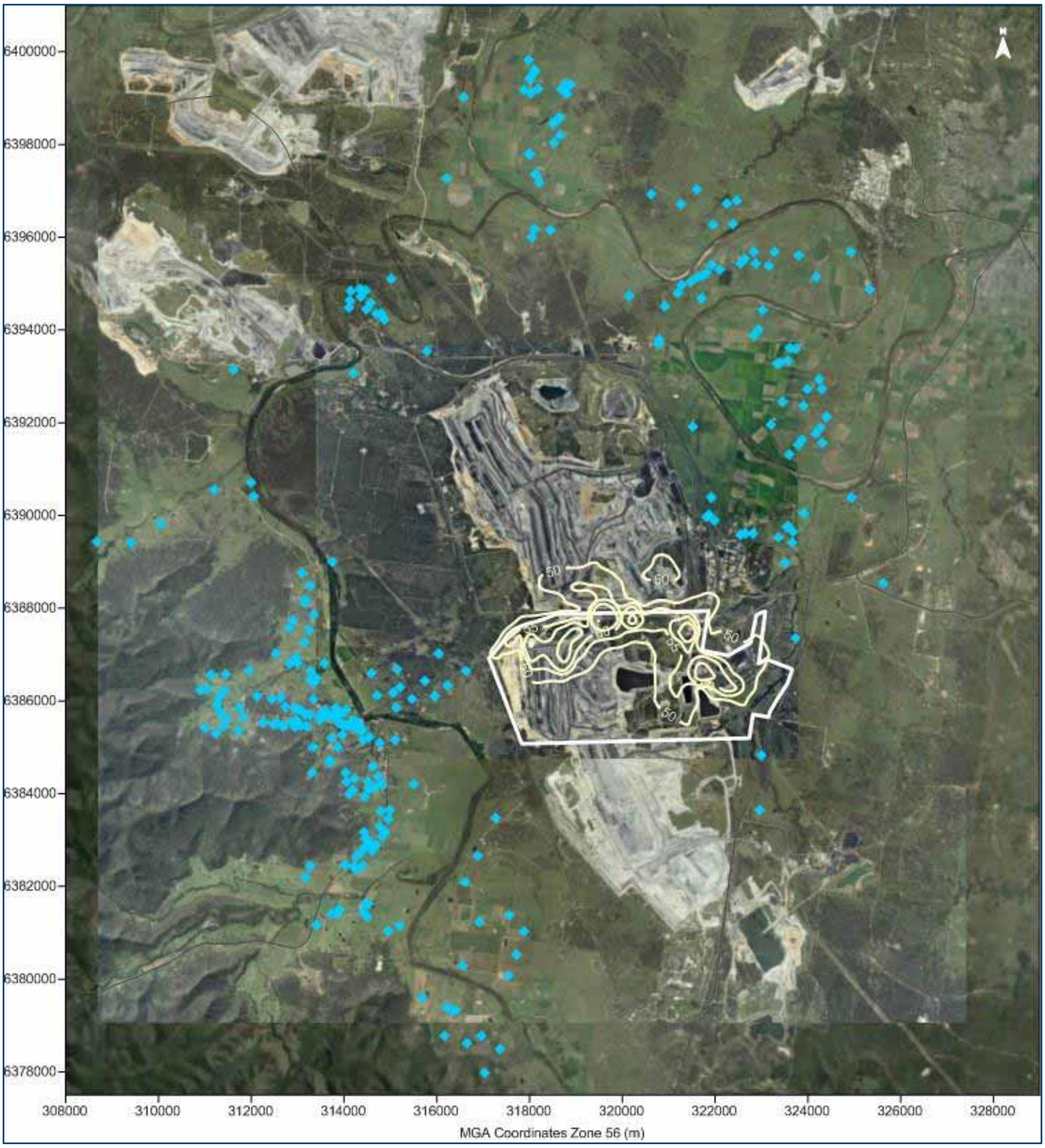

Figure G-5: Predicted 1-hour average NO_2 concentrations due to emissions from the proposal in Year 14 (µg/m³)

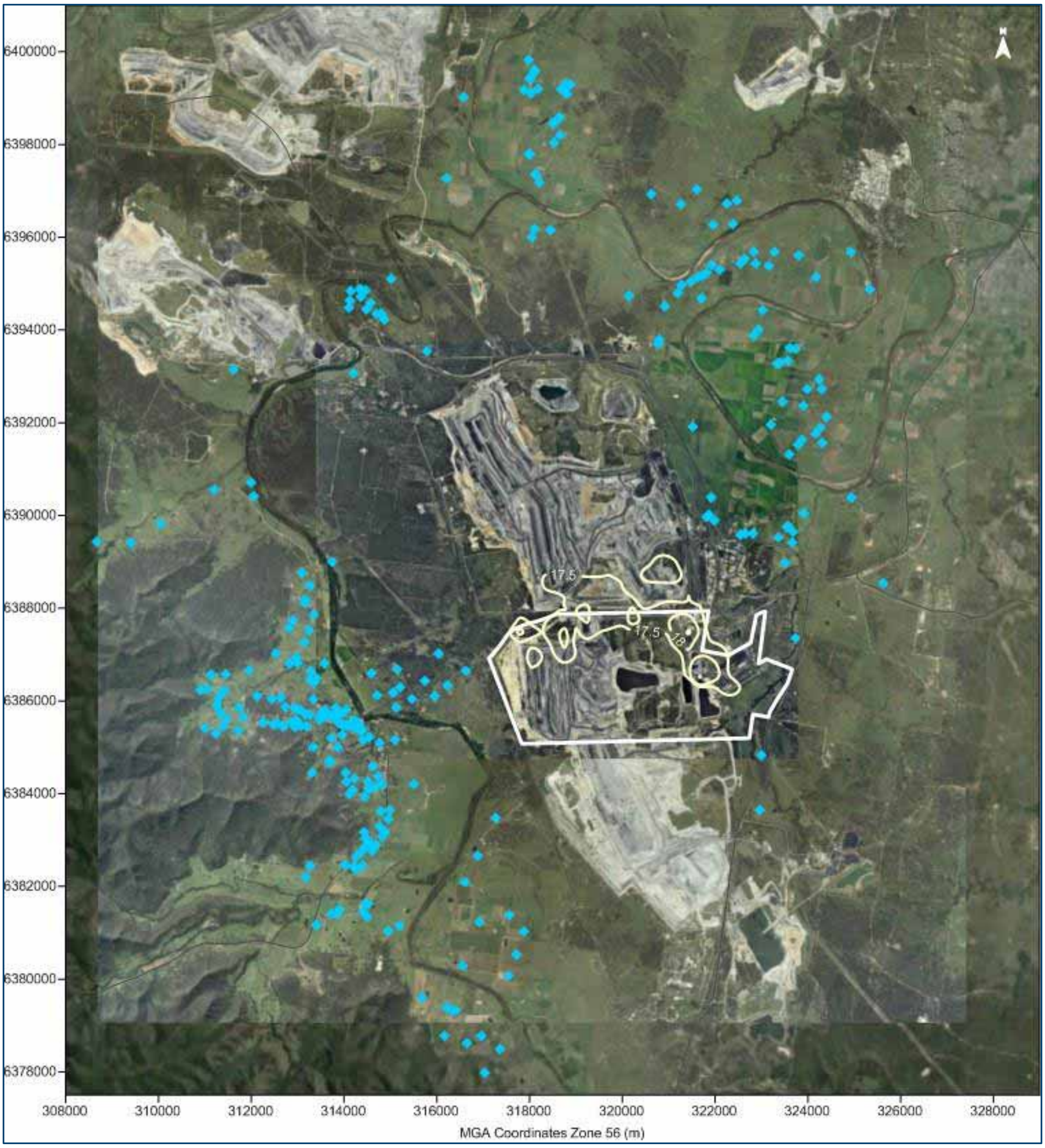

Figure G-6: Predicted annual average NO_2 concentrations due to emissions from the proposal in Year 14 (µg/m³)

Appendix H

Isopleth Diagrams – Blast emissions

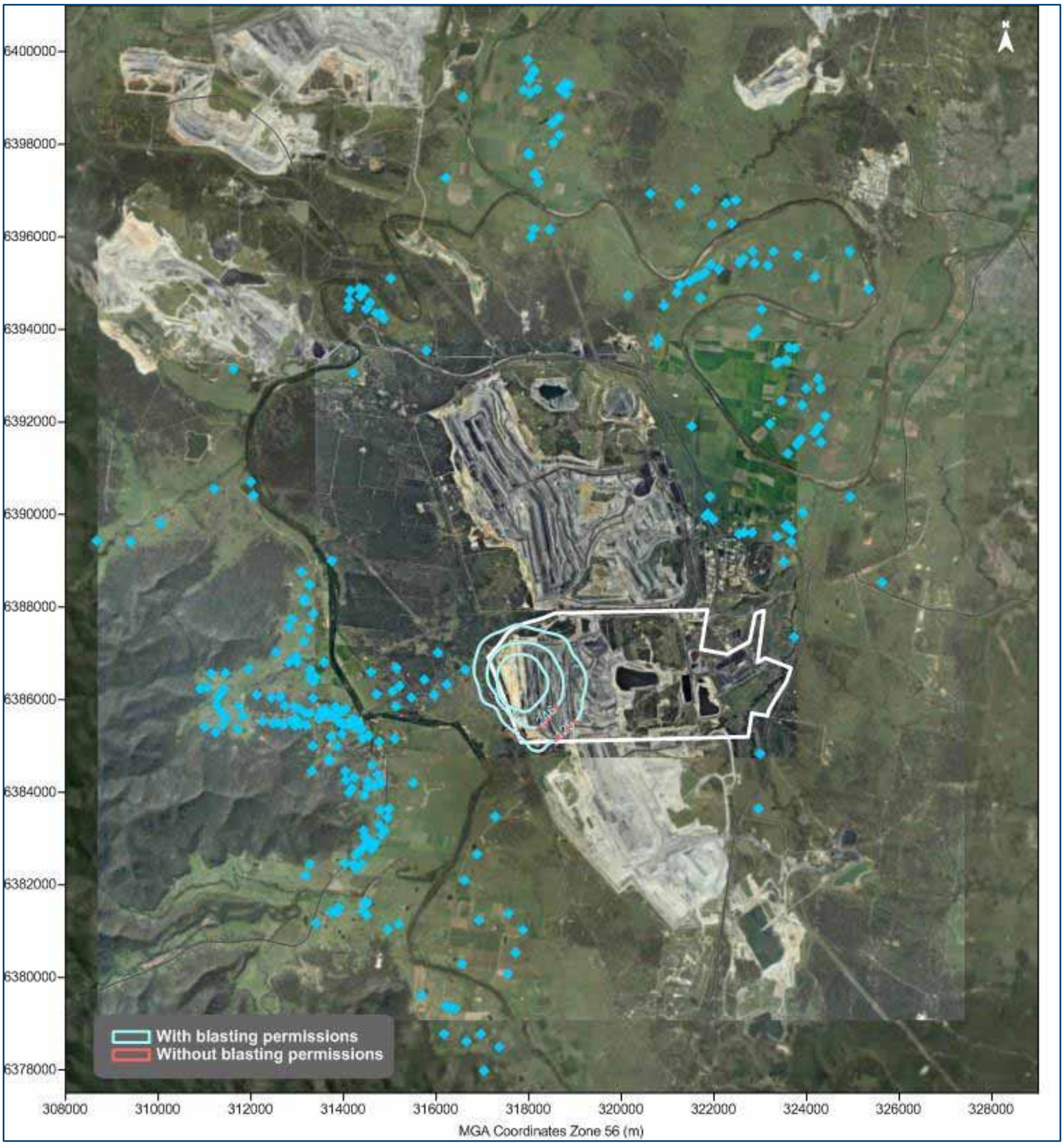

Figure H-1: Predicted maximum 1-hour average blast emissions from the proposal in Year 3 – 09:00 (NO_2 concentrations µg/m³)

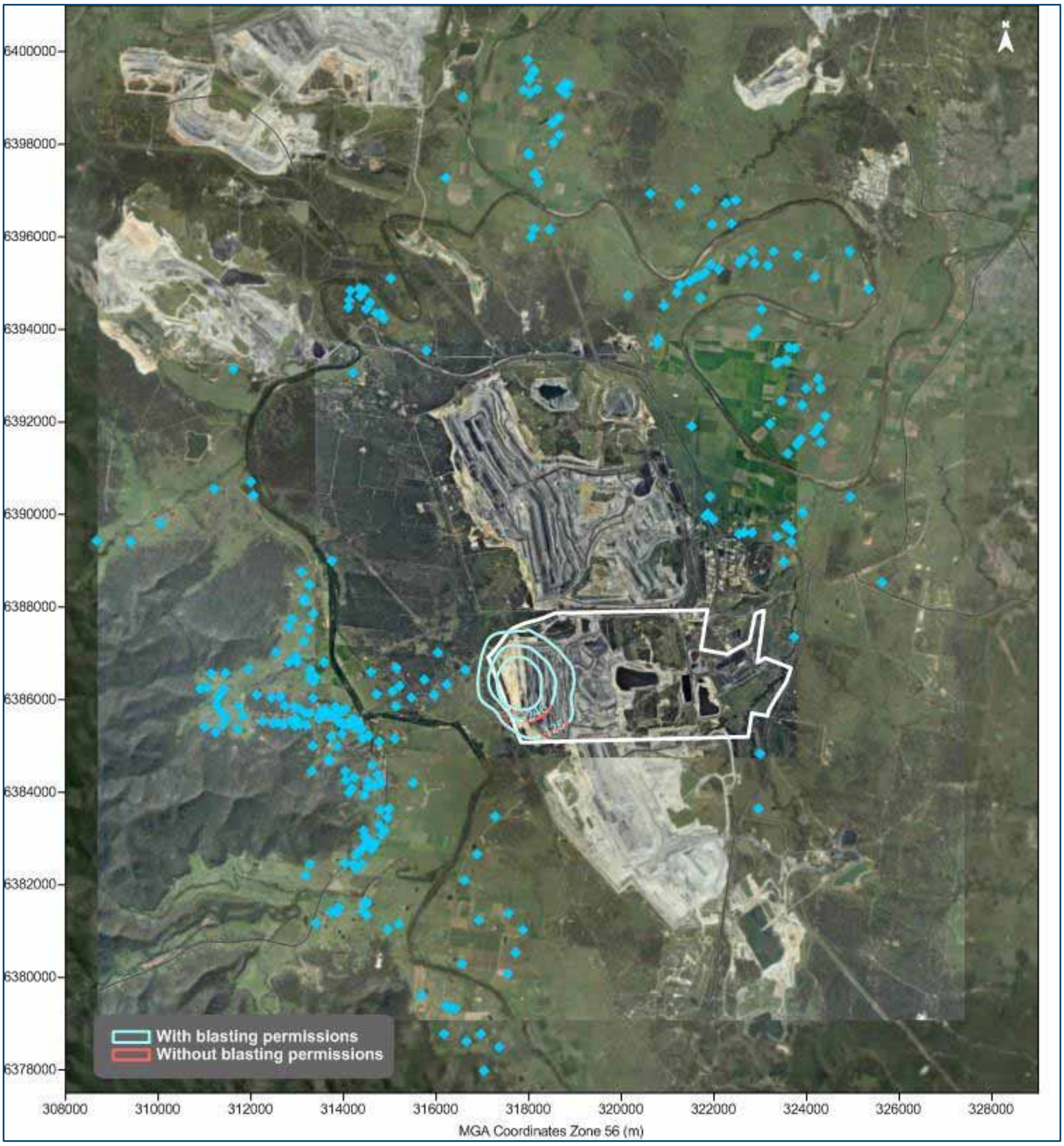

Figure H-2: Predicted maximum 1-hour average blast emissions from the proposal in Year 3 – 10:00 (NO_2 concentrations µg/m³)

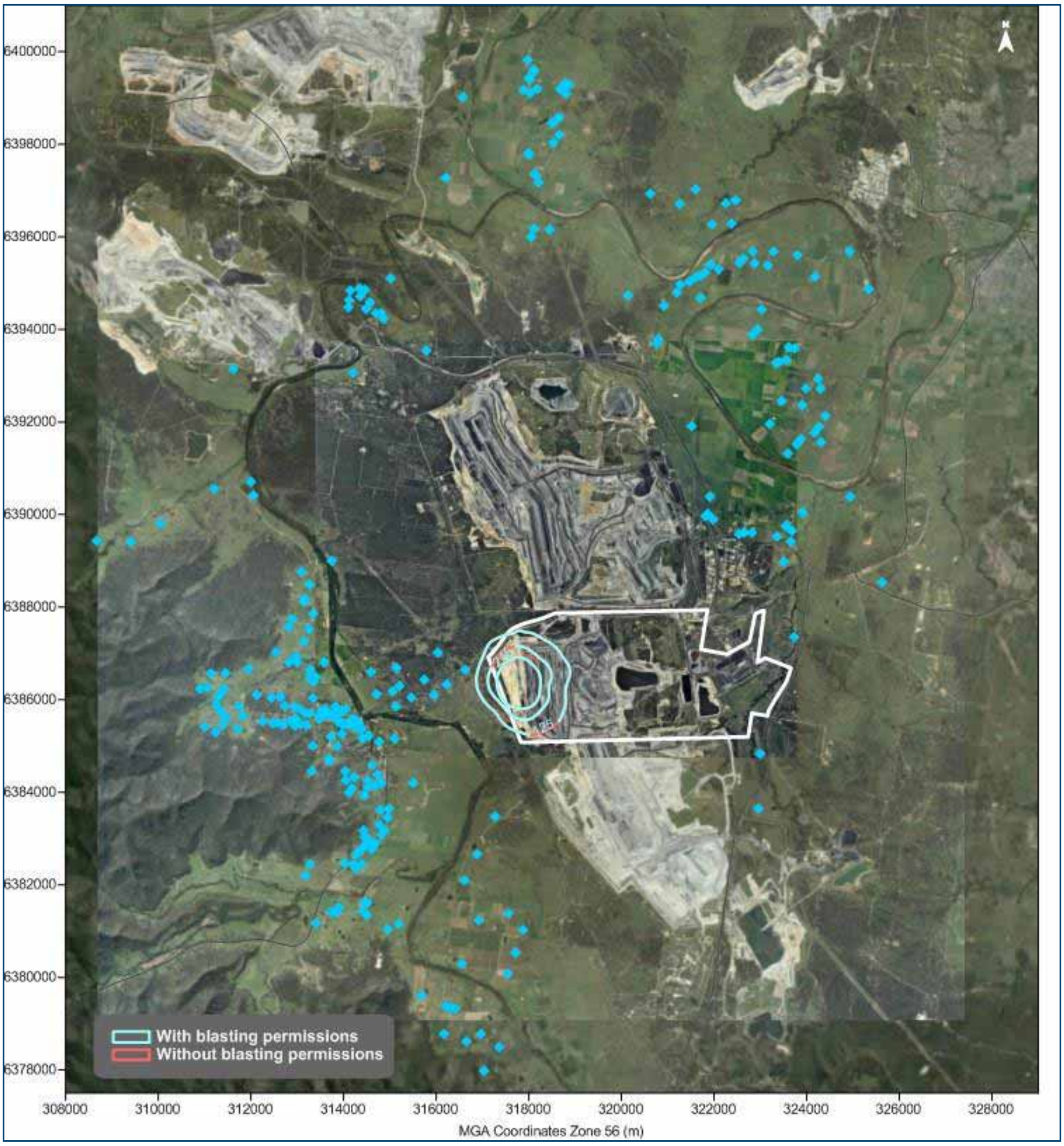

Figure H-3: Predicted maximum 1-hour average blast emissions from the proposal in Year 3 – 11:00 (NO_2 concentrations µg/m³)

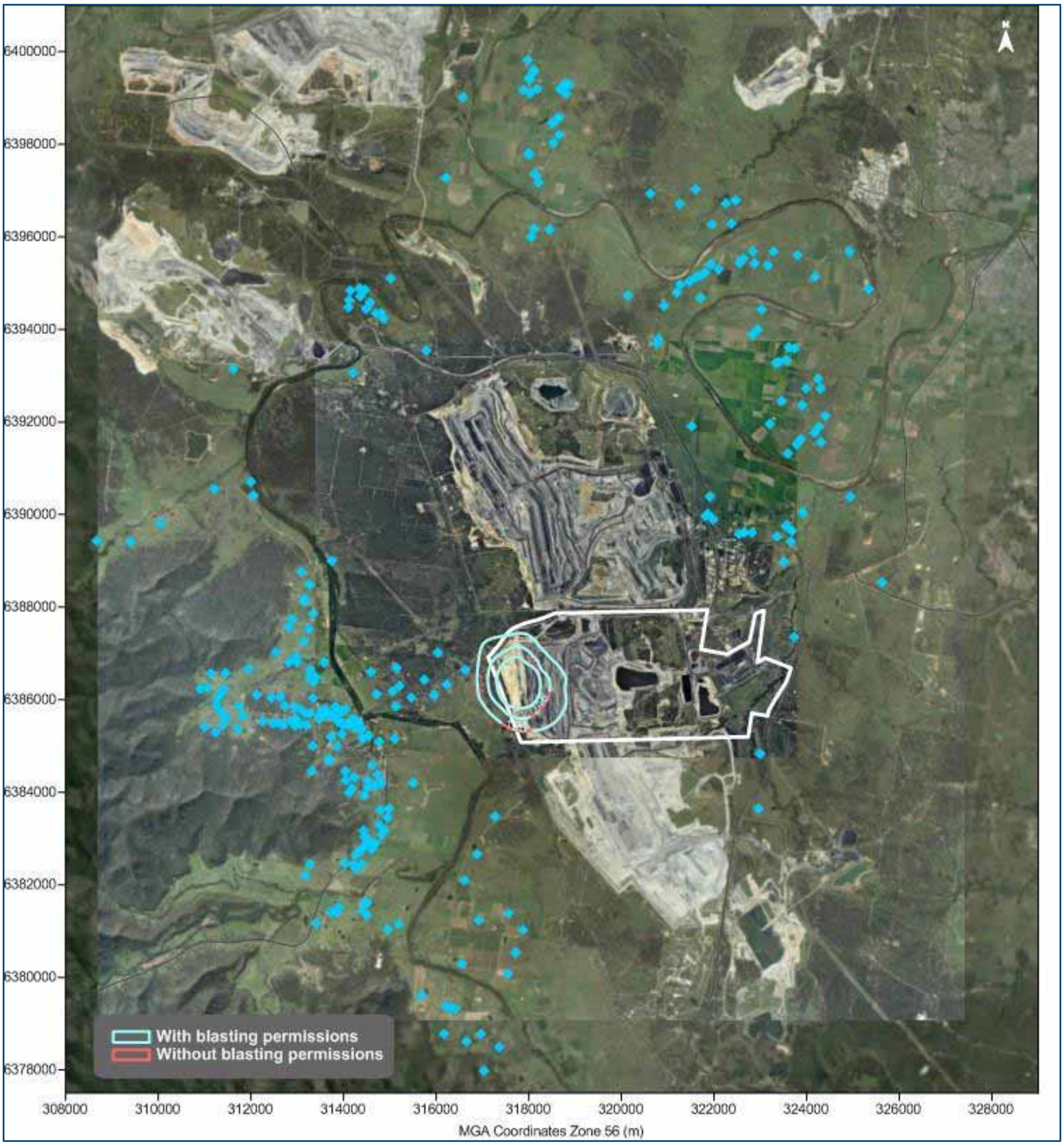

Figure H-4: Predicted maximum 1-hour average blast emissions from the proposal in Year 3 – 12:00 (NO_2 concentrations µg/m³)

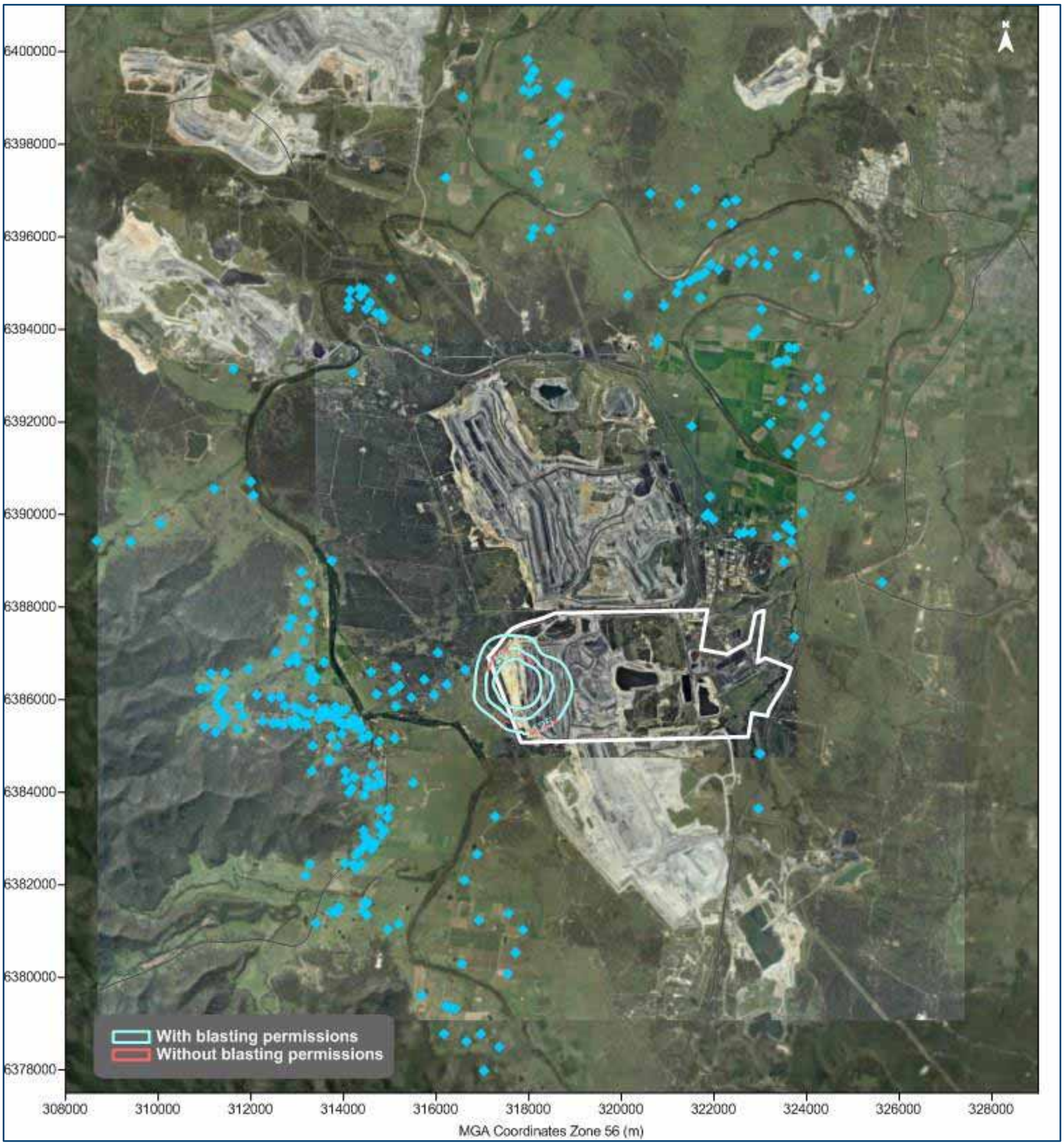

Figure H-5: Predicted maximum 1-hour average blast emissions from the proposal in Year 3 – 13:00 (NO_2 concentrations µg/m³)

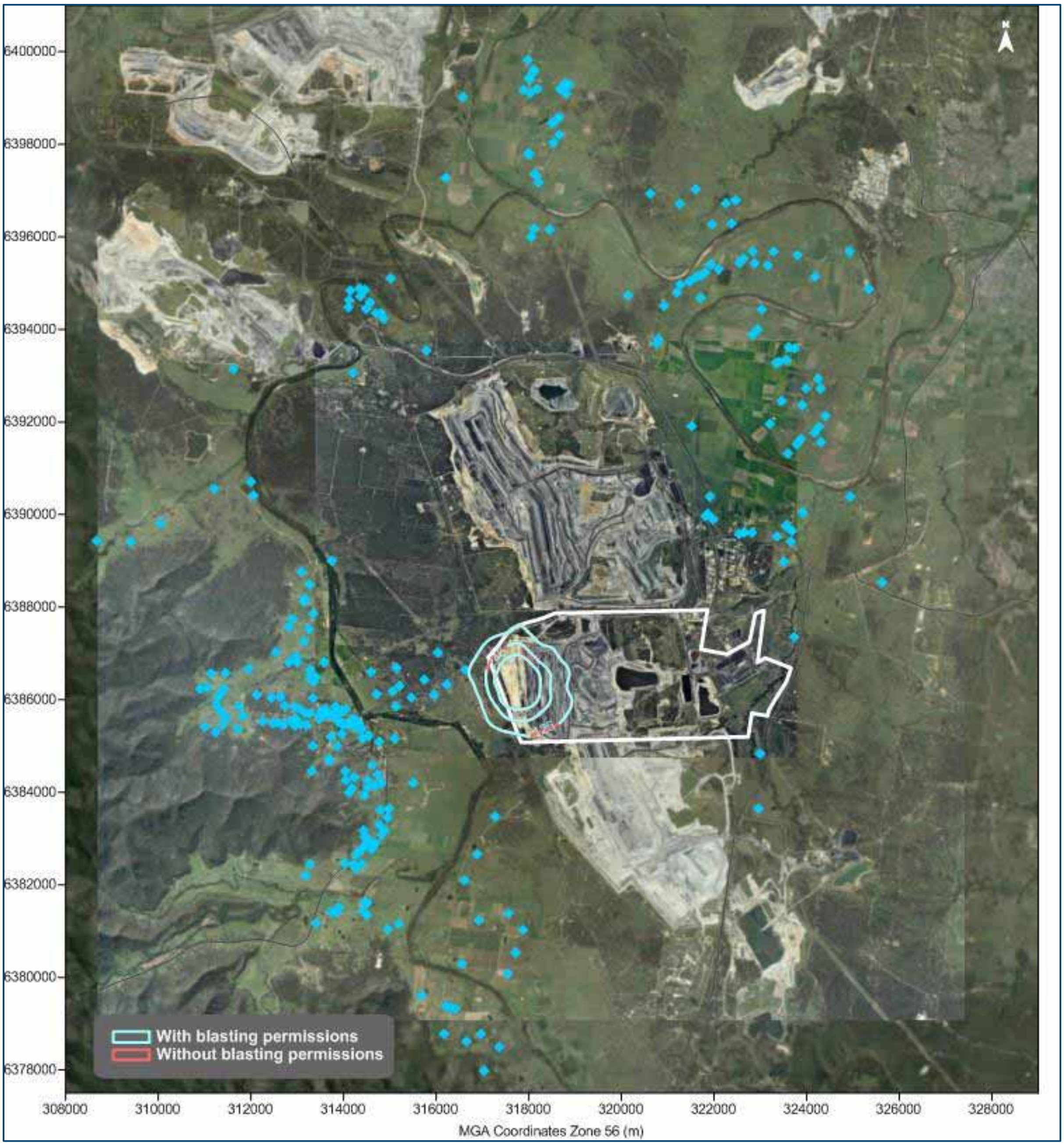

Figure H-6: Predicted maximum 1-hour average blast emissions from the proposal in Year 3 – 14:00 (NO_2 concentrations µg/m³)

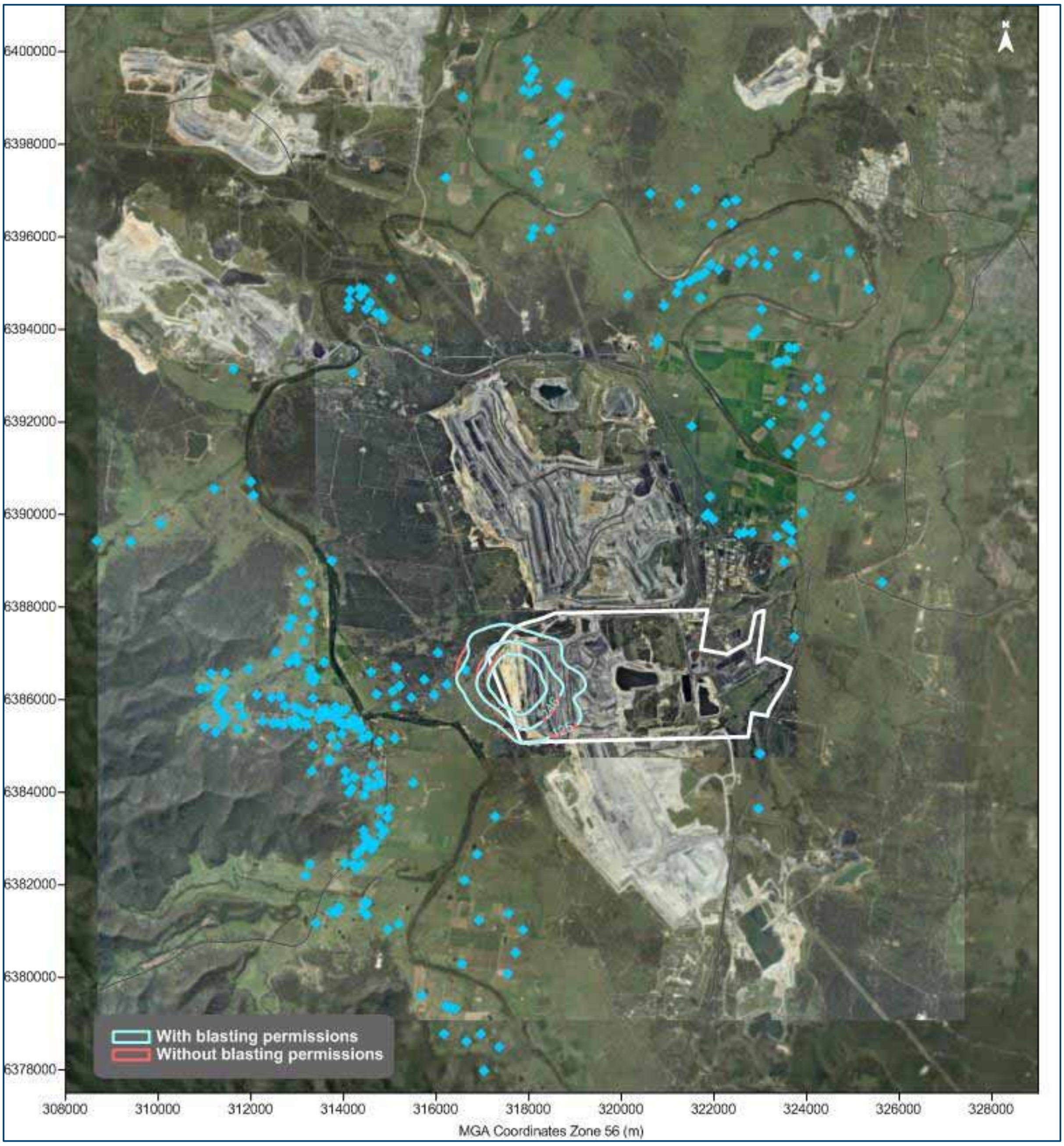

Figure H-7: Predicted maximum 1-hour average blast emissions from the proposal in Year 3 – 15:00 (NO_2 concentrations µg/m³)

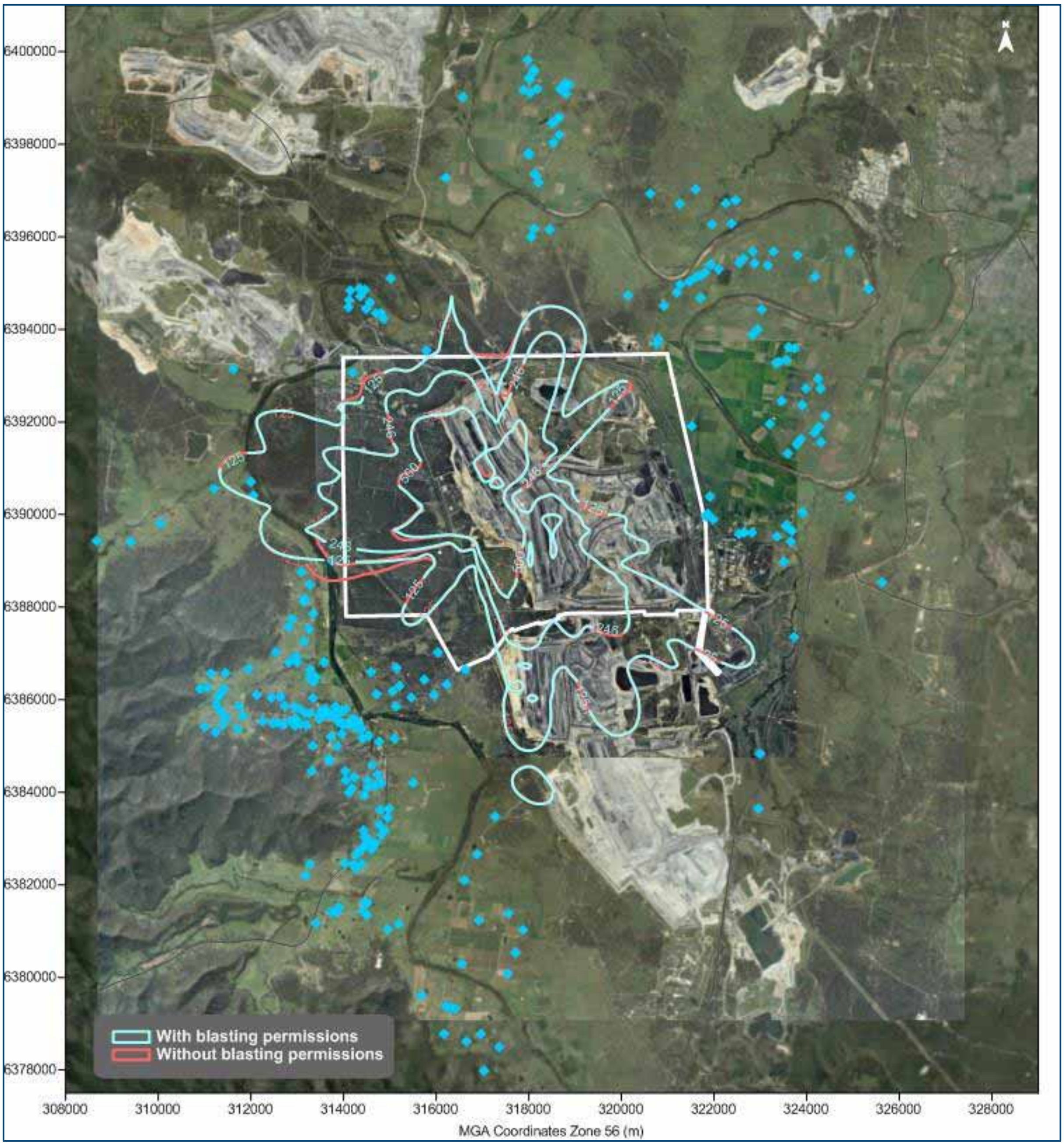

Figure H-8: Predicted maximum 1-hour average blast emissions from the proposal in Year 3 – 16:00 (NO_2 concentrations µg/m³)

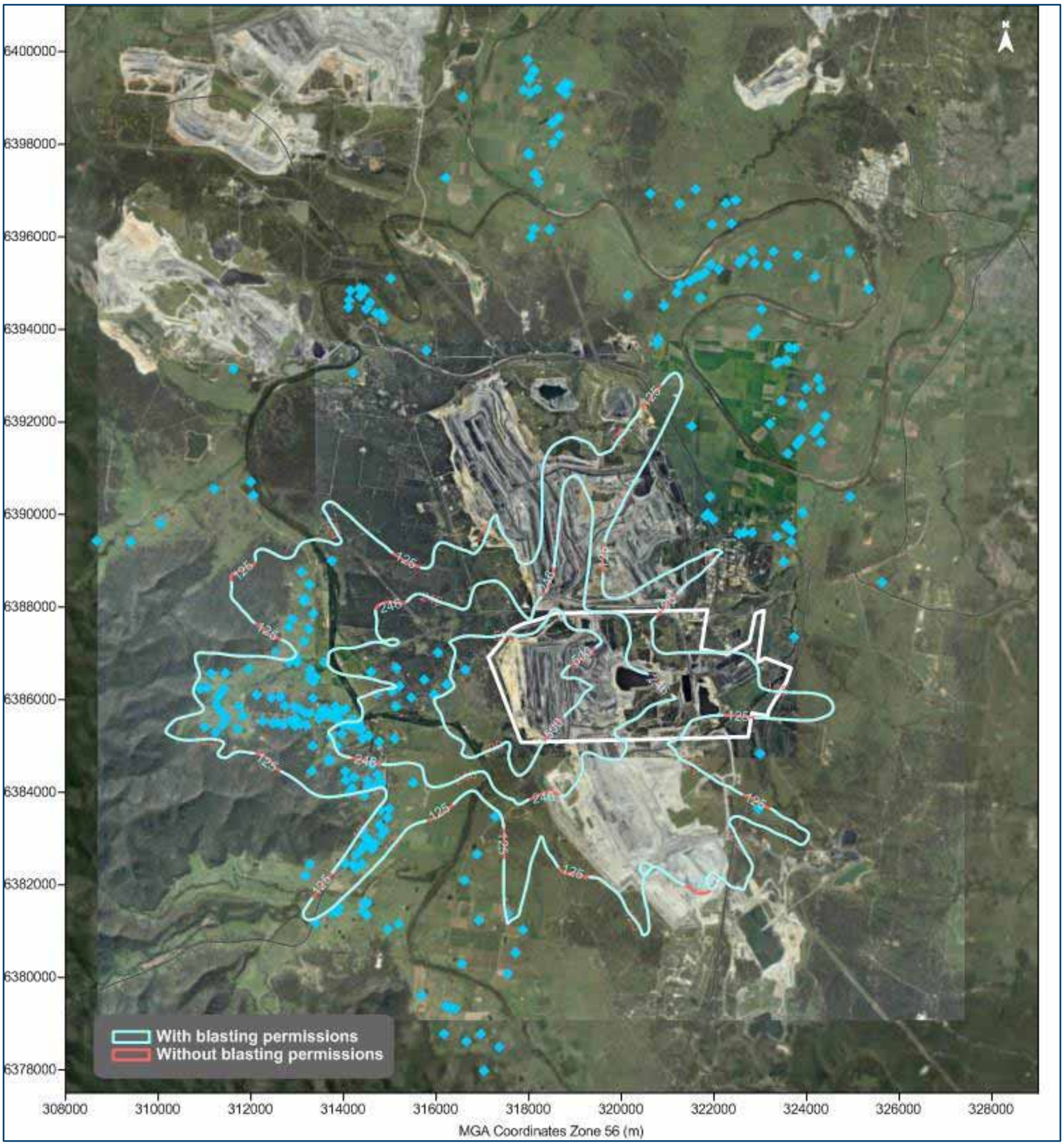

Figure H-9: Predicted maximum 1-hour average blast emissions from the proposal in Year 3 – 17:00 (NO_2 concentrations µg/m³)