Appendix 3

Air Quality and Greenhouse Gas Assessments

South East Open Cut Project

&

Modification to the Existing ACP Consent

AIR QUALITY IMPACT ASSESSMENT

ASHTON SOUTH EAST OPEN CUT MINE

Wells Environmental Services for Ashton Coal Operations Limited

Job No: 2886

23 October 2009

A PEL Company

PROJECT TITLE:	**ASHTON SOUTH EAST OPEN CUT MINE**
JOB NUMBER:	**2886**
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1 INTRODUCTION

This report has been prepared by PAEHolmes on behalf of Wells Environmental Services for Ashton Coal Operations Limited (ACOL). This report assesses the likely air quality impacts of the proposed Ashton South East Open Cut coal mining project (hereafter referred to as SEOC) located in the Hunter Valley, New South Wales. The proposed SEOC will operate over a period of 7 years and will include open cut and underground mining, processing facilities, soil, waste and product emplacement areas, a conveyor system and associated infrastructure.

In summary, this report provides information on the following:

- Relevant air quality goals;
- Meteorological and climatic conditions in the area;
- A discussion of the existing air quality conditions in the area;
- The methods used to estimate dust emissions from the proposed mine;
- The expected dispersion and dust fallout patterns due to emissions from the mine and a comparison with the Department of Environment and Climate Change (DECC) assessment criteria;
- Mitigation and monitoring; and
- Greenhouse gas assessment.

2 LOCAL SETTING AND PROJECT DESCRIPTION

The SEOC is located in the Hunter Valley region of New South Wales approximately 12 km north-west of Singleton and 30 km south-east of Muswellbrook (see **Figure 2.** for mine location). The site is surrounded by other mining operations including Ravensworth East, Ravensworth West, Narama, Mount Owen, Integra North Open Cut, HVO South, HVO North, Rixs Creek, Glendell and Ashton North East Open Cut.

Air quality impacts have been assessed at the properties identified on **Figure 2.**. Locations of sensitive receptors (i.e. residences) are identified by a small dot. **Appendix** presents details of land ownership and a map with all receptors identified.

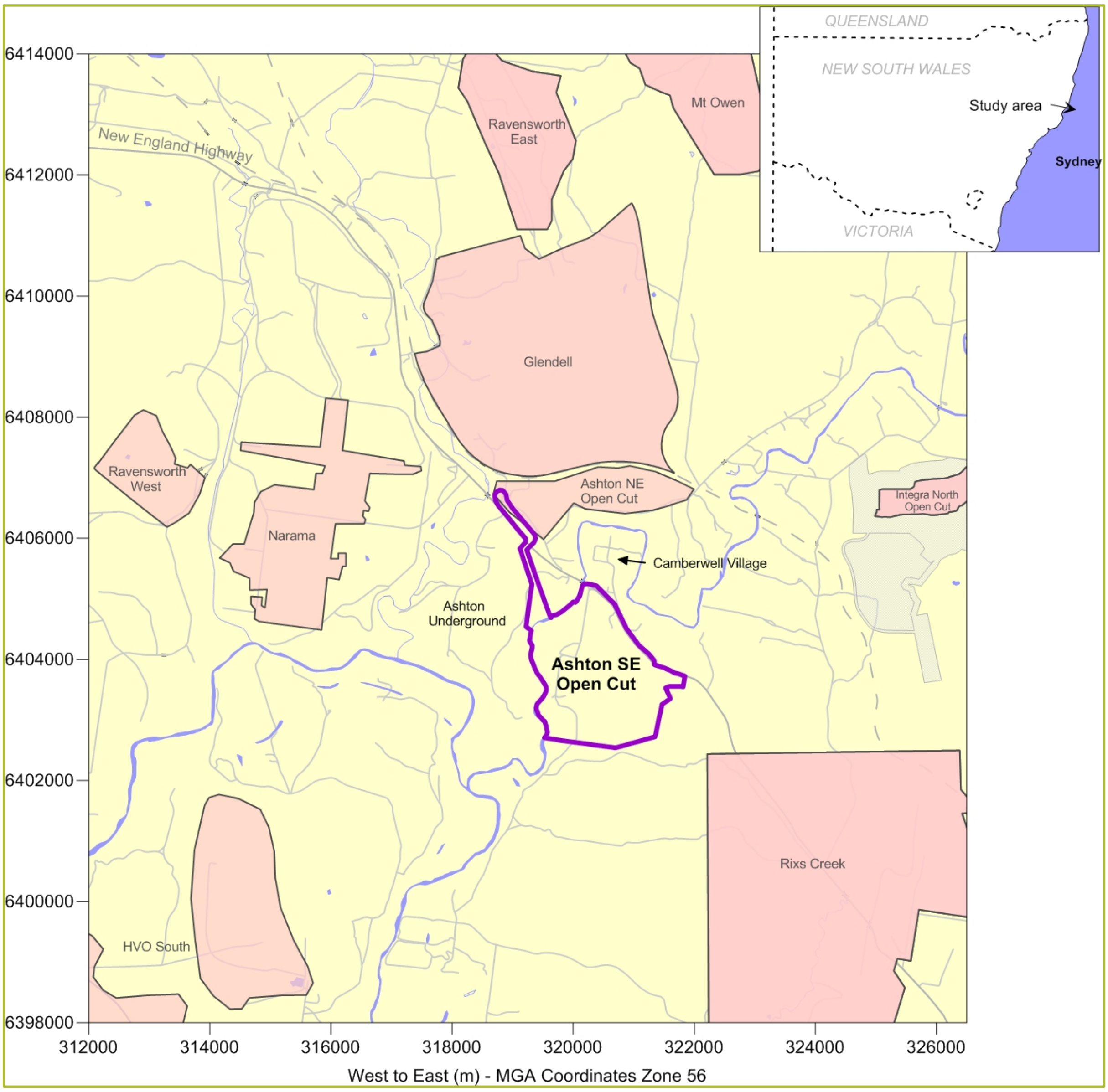

Figure 2.: Project Location

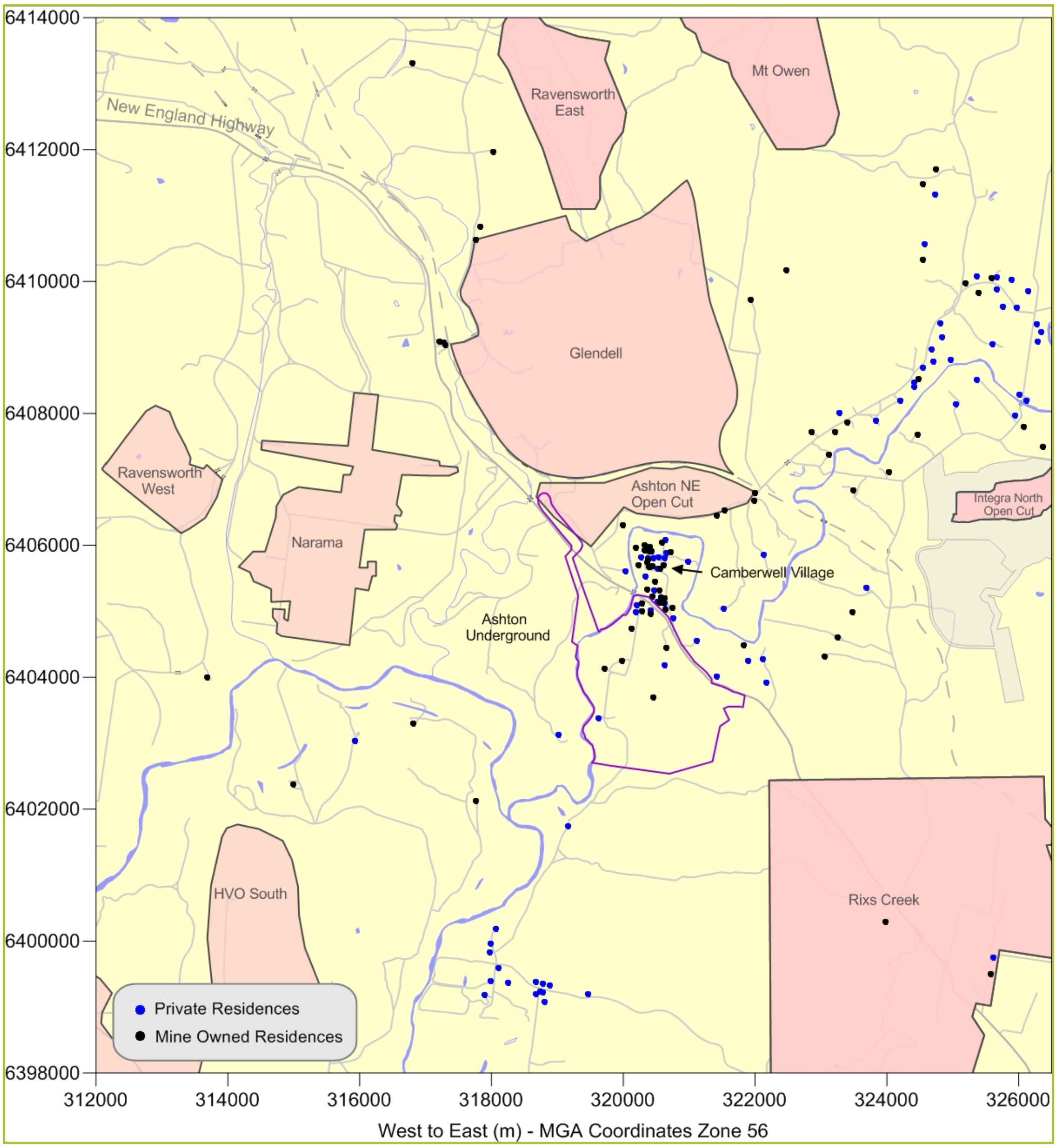

Figure 2.: Location of Discrete Receptors

3 THE PROJECT

The SEOC project comprises the following key elements:

- One open cut coal mine (the SEOC) producing up to 3.6Mtpa of ROM coal.
- Underground coal mining producing up to 5Mtpa of ROM coal.
- Demolition of existing structures within the footprint of the project.
- Environmental bund adjacent to the New England Highway blended into the out-of-pit emplacement and final landform.
- Free draining, stable final landform sympathetic to the surrounding topography.
- Rehabilitation of the final landform to a combination of woodland and grazing lands including in-spoil creek alignments.
- Final void in south eastern corner, to be used for tailings storage for the existing approved underground operations.
- ROM pad, stockpiles and crushers with a conveyor to transport the ROM coal to the existing ACP CPP.
- Conveyor and bridge over New England Highway.
- Conveyor and gantry over Glennies Creek.
- Piping between SEOC and ACP CPP to transfer water and coal reject.
- New office and workshop facilities, bathhouse and administration buildings located east of the SEOC and south of the New England Highway.
- New access road from New England Highway to the office and workshop facilities.
- Power supply and water supply infrastructure.
- The diversion of Energy Australia power lines and relocation of telecommunication lines.
- Staged 1 in 100 year event designed flood levee and associated flood mitigation works around ROM pad and along the western pit edge parallel with Glennies Creek.
- Water storage dam east of the SEOC.
- Enhancement of the Glennies Creek riparian corridor and revegetation of other cleared lands.

The SEOC Project occupies an area of approximately 300ha. Mining will commence in the north of the SEOC area via a box cut and progress to the south. Initially overburden will be emplaced out of pit along the northern boundary of the open cut forming an environmental bund adjacent to the New England Highway. In-pit emplacement of overburden will commence as soon as feasible.

The environmental bund will be integrated with the in-pit emplacement reaching maximum height in approximately 1 to 2 years. Rehabilitation of the environmental bund will commence progressively following its construction with a view to have the bund and northern face of the emplacement in a vegetated state within 12 months of its emplacement.

The SEOC will advance to the south over a period of 7 years, extracting up to 3.6Mt of ROM coal per annum, creating approximately 2.4Mtpa of product coal.

The current underground mining operations extract coal at a rate of 3Mtpa. ACOL seek approval to increase this amount to 5Mtpa of ROM coal to account for low yields and flexibility. Underground mining would operate 24 hours per day, 7 days per week. ROM coal will be transported via an underground conveyor system and will be unloaded at the existing coal processing plant.

The mining method utilised will be primarily truck and excavator with a haul back system to maximise in-pit backfill of overburden. Variations including throw blasting and dozer push may also be used. The final void will be located in the south-eastern corner and filled with coarse and fine washery reject material. It is anticipated that the final void will be used for approximately 6-7 years after the completion of mining for storage of tailings from the approved underground operations.

The SEOC offices, workshop and associated facilities are located east of the SEOC. Access to the facilities will be from a new intersection with the New England Highway. ROM coal will be hauled from the coal face to the ROM coal facility located west of the SEOC and east of Glennies Creek by truck along the haul roads within and adjacent to the open cut.

The SEOC project will be operated as part of the ACP and utilize the coal handling, preparation and loading facilities, and other office and surface facilities approved by the Ashton development consent (DA) 309-11-2001-i in 2002. In order to allow the effective integration and combined operation of the SEOC with the existing ACP an application to modify the existing ACP development consent under Section 75W of the EP&A Act 1979 has been made. ACOL seeks to modify the existing ACP development consent in the following manner:

- Increase the throughput of the existing ACP coal handling and preparation plant (CHPP) and rail loading facilities to cater for approximately 8.6Mtpa of ROM coal.
- Modification of the existing CHPP facilities to allow the receipt of coal from the SEOC.
- Disposal of coal tailings from the existing underground coal mine in the SEOC final void.
- Increase the coal extraction rate to 5.0Mtpa of ROM coal in the existing underground coal mine to provide operational flexibility.
- Associated modifications to the conditions of (DA) 309-11-2001-i to facilitate the above changes.

4 AIR QUALITY CRITERIA

In its modelling and assessment methodology, New South Wales Department of Environment and Climate Change (NSW DECC) specifies air quality assessment criteria relevant for assessing impacts from mining (**NSW DEC, 2005**). The assessment criteria are summarised in **Table 4.**, **Table 4.** and **Table 4.**.

These criteria are consistent with the National Environment Protection Measures for Ambient Air Quality (referred to as the Ambient Air-NEPMs (**NEPC, 1998**). However, the NSW DECC's criteria include averaging periods which are not included in the Air-NEPMs and references to other, non-NEPM, measures of air quality, namely total suspended particulate matter (TSP) (see **Table 4.**) and the insoluble component of deposited dust (see **Table 4.**).

Table 4.: NSW DECC Impact Assessment Criteria

Pollutant	Averaging period	Concentration	
		Parts per hundred million (pphm)	$\mu g/m^3$
PM_{10}	1-day	-	50*
	annual	-	30
SO_2	10 minutes	25	712
	1-hour	20	570
	1-day	8	228
	1-year	2	60
NO_2	1-hour	12	246
	1-year	3	62
		Parts per million (ppm)	**mg/m^3**
CO	15 minutes	87	100
	1-hour	25	30
	8-hours	9	10

* Non-cumulative for purposes of impact assessment

Table 4.: NSW DECC Assessment Criteria for TSP

Pollutant	Averaging period	Concentration
TSP	Annual	90 $\mu g/m^3$

Table 4.: NSW DECC Amenity Based Criteria for Dust Fallout

Pollutant	Averaging period	Maximum increase in deposited dust	Maximum allowable dust deposition
Deposited dust (insoluble)	Annual	2 g/m^2/month	4 g/m^2/month

In May 2003, NEPC released a variation to the NEPM (**NEPC, 2003**) to include advisory reporting standards for $PM_{2.5}$. The advisory reporting standards for $PM_{2.5}$ are a maximum 24-hour average of 25 $\mu g/m^3$ and an annual average of 8 $\mu g/m^3$. However, there is no time line for compliance. The goal was to gather sufficient data nationally to facilitate the review of the Air Quality NEPM which is currently underway. The variation includes a protocol setting out monitoring and reporting requirements for particles as $PM_{2.5}$.

At this stage, the advisory reporting $PM_{2.5}$ standards are not part of the NSW DECC assessment criteria and while predictions have been made as to the likely contribution that emissions from the Project would make to ambient $PM_{2.5}$ concentrations, these predictions have not been used to assess impacts against the proposed advisory standard. Predictions of $PM_{2.5}$ concentrations are provided in **Appendix** .

The low sulphur content of Australian diesel, in combination with the fact that mining equipment that is widely dispersed over mine sites, is such that the sulphur dioxide (SO_2) goals would not be exceeded, even in mining operations that use large quantities of diesel. For this reason, no detailed study is required to demonstrate that emissions of SO_2 from the Project would not significantly affect ambient SO_2 concentrations. Similarly, NO_x and CO emissions from the Project activities are too small and too widely dispersed to require a detailed modelling assessment.

Thus, the focus of the study is on the potential effects of PM emissions.

5 EXISTING ENVIRONMENT

This section describes the dispersion meteorology, local climatic conditions and existing air quality in the area. The existing air quality conditions will be influenced to some degree by the existing operations of the Ashton coal mine.

5.1 Dispersion Meteorology

The Gaussian dispersion model used for this assessment requires information about the dispersion characteristics of the area. In particular, data are required on wind speed, wind direction, atmospheric stability class[1] and mixing height[2].

The DECC have listed requirements for meteorological data that are used for air dispersion modelling in their *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (**NSW DEC, 2005**). The requirements are as follows:

- Data must span at least one year;
- Data must be at least 90% complete; and,
- Data must be representative of the area in which emissions are modelled.

ACOL operates two weather stations around the project; the repeater weather station on a ridge between the mine and Camberwell Village and also Site 1 weather station located in Camberwell Village. **Figure 5.** shows the location of these sites. Both weather stations collect 10-minute records of temperature, wind speed, wind direction and sigma-theta (a measure of the fluctuation of the horizontal wind direction). For the purposes of this assessment, data from the repeater weather station will be used as they are representative of the prevailing weather conditions that most influence air dispersion.

Data between July 2007 and June 2008 from the repeater site were available for this assessment. The available data contain all the parameters necessary to determine stability class and prepare windroses for analysis. There were 8,781 hourly records available which satisfies the DECC's requirement of 90% data recovery in the year.

Annual and seasonal windroses have been prepared using the on-site meteorological data and are shown in **Figure 5.** for the repeater site. The most common winds are from the west-northwest, and

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[1] In dispersion modelling, stability class is used to categorise the rate at which a plume will disperse. In the Pasquill-Gifford stability class assignment scheme, as used in this study, there are six stability classes A through to F. Class A relates to unstable conditions such as might be found on a sunny day with light winds. In such conditions plumes will spread rapidly. Class F relates to stable conditions, such as occur when the sky is clear, the winds are light and an inversion is present. Plume spreading is slow in these circumstances. The intermediate classes B, C, D and E relate to intermediate dispersion conditions.

[2] The term mixing height refers to the height of the turbulent layer of air near the earth's surface into which ground-level emissions will be rapidly mixed. A plume emitted above the mixed-layer will remain isolated from the ground until such time as the mixed-layer reaches the height of the plume. The height of the mixed-layer is controlled mainly by convection (resulting from solar heating of the ground) and by mechanically generated turbulence as the wind blows over the rough ground.

the east-southeast. This pattern of winds is evident in most seasons to various degrees, however west-north westerlies are less apparent in summer and east-south easterlies are less apparent in winter. Calm periods (that is, winds less than or equal to 0.5 metres per second [m/s]) occurred 6.2% of the time annually. The mean wind speed from the 2007/2008 data was 2.8 m/s.

To assess dispersion, it is necessary to have data available on atmospheric stability. A stability class was calculated for each hour of the meteorological data using sigma-theta according to the method recommended by the United States Environmental Protection Agency (US EPA) (**US EPA, 1985**). **Table 5.** shows the frequency of occurrence of the stability categories expected in the area.

Table 5.: Frequency of occurrence of stability classes in the study area

Stability Class	Repeater weather station data (June 2007 to July 2008)
A	0.6
B	1.2
C	5.6
D	47.3
E	25.9
F	19.4
Total	100

The most common stability class in the area was determined to be neutral D class stability.

Joint wind speed, wind direction and stability class frequency tables for the repeater weather station data are provided in **Appendix** .

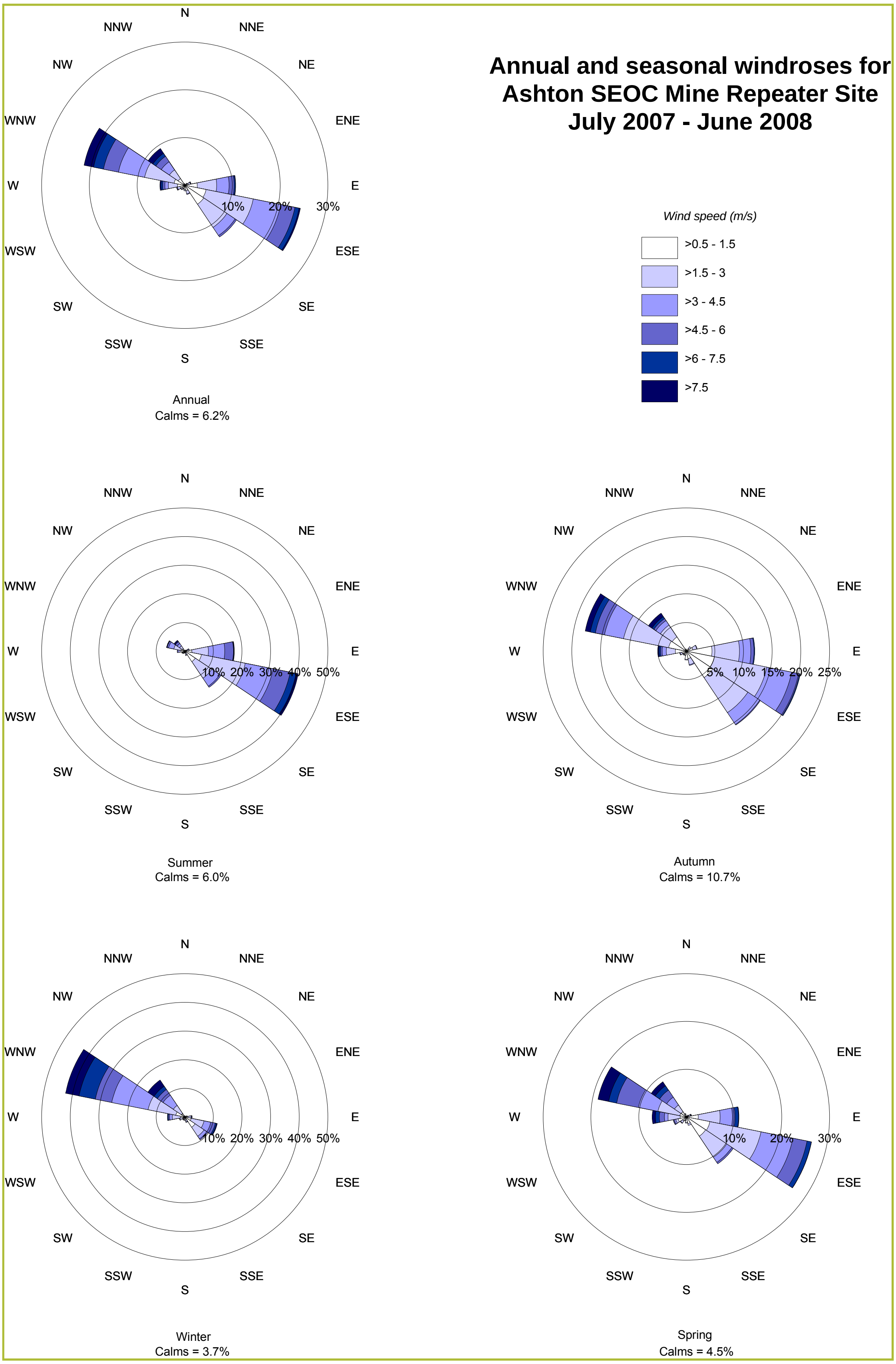


Figure 5.: Annual and seasonal windroses for Ashton SEOC Repeater Site (July 2007 – June 2008)

5.2 Local Climatic Conditions

The Bureau of Meteorology collects climatic information at Singleton, approximately 20 km to the south-east of the project. A range of climatic information collected from the Singleton site is presented in **Table 5.** (**Bureau of Meteorology, 2008**).

Table 5.: Climate Information for Singleton Water Board Monitoring Station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
9 am Mean Dry-bulb and Wet-bulb Temperatures (ºC) and Relative Humidity (%)													
Dry-bulb	22.0	21.0	19.2	16.8	13.0	10.0	9.1	10.8	14.6	18.4	19.3	21.1	16.3
Humidity	76	83	84	82	85	84	83	76	71	66	69	73	78
3 pm Mean Dry-bulb and Wet-bulb Temperatures (ºC) and Relative Humidity (%)													
Dry-bulb	29.0	28.3	26.3	24.1	19.9	17.1	16.8	18.8	21.8	24.6	25.8	27.9	23.4
Humidity	49	52	54	51	60	57	54	44	43	43	46	47	50
Mean Maximum Temperature (ºC)													
Mean	30.6	29.6	27.7	25.4	21.1	18.3	18.0	20.1	23.1	26.0	27.6	29.7	24.8
Mean Minimum Temperature (°C)													
Mean	17.3	17.2	15.2	11.1	8.6	5.6	4.8	5.0	8.0	10.7	13.5	15.9	11.1
Rainfall (mm)													
Mean	70.2	107.6	75.1	38.3	37.8	31.7	38.8	27.6	44.1	32.8	59.2	86.6	645.4
Raindays (Number)													
Mean	7.4	7.5	7.3	3.9	5.5	4.6	4.7	4.2	5.8	5.0	7.6	6.8	70.3

Climate averages for Station: 061371, Singleton Water Board, Commenced: 1991; Last record: 2002; Latitude (deg S): -33.57; Longitude (deg E): 151.16; State: NSW. Source: **Bureau of Meteorology, 2008** *website.*

Temperature data from **Table 5.** indicate that the warmest month is January and the coolest is July with the mean daily maximum temperatures of 30.6 and 18.0°C respectively. The mean daily minimum temperature follows the same pattern with the warmest month being January and the coolest being July with mean daily minimum temperatures of 17.3 and 4.8°C respectively.

Over the year, rain falls on an average of 70.3 days and the months with the highest and lowest monthly average rainfalls are February (107.6 mm) and August (27.6 mm) respectively. The warmer months typically have more rain days than the cooler months.

5.3 Existing Air Quality

5.4 Introduction

Air quality standards and goals refer to pollutant levels that include the contribution from specific projects and existing sources. To fully assess impacts against all the relevant air quality standards and goals (see **Section 4**) it is necessary to have information or estimates on existing dust concentration and deposition levels in the area in which the Project is likely to contribute to these levels. It is important to note that the existing air quality conditions (that is, background conditions) will be influenced to some degree by the existing mining operations.

Dust concentration and dust deposition (PM_{10} and Total Suspended Particulate Matter (TSP)) is monitored in the study area. The locations of the monitoring sites are shown in **Figure 5.**. There are five high volume air samplers (HVAS) measuring TSP, seven Tapered Element Oscillating Microbalance (TEOMs) measuring PM_{10} and 13 dust deposition gauges (DDG). The following sections discuss the monitoring results for the period 2004 to mid 2009.

5.5 Dust concentrations

5.5.1 PM_{10} concentrations

Figure 5. shows the locations of the TEOMs used to monitor PM_{10} concentrations. All TEOMs are located within approximately 3km of the mining site with the closest being less than 1km from the site. The TEOMs record daily 24-hour average concentrations and these results are presented in **Figure 5.**. It should be noted that TEOM site 8 was in operation from February 2007.

Generally, the annual rolling averages show that all sites fall below the annual average assessment criterion of 30 $\mu g/m^3$. TEOM site 4 however, recorded levels above the criterion in 2004. Generally, the monitoring results at these locations are influenced by existing Ashton North East Open Cut (NEOC) operations which would be expected as the monitoring network was specifically devised to monitor emissions from that mine. It should also be noted that sites closer to the existing NEOC such as TEOM sites 1 and 8, show generally higher PM_{10} annual average concentrations than those sites further away such as sites 7 and 3. Sites 1 and 8 are also located within the north-west and south-east prevailing wind directions (refer to **Figure 5.** and **Figure 5.**).

A summary of the recorded annual average data is presented in **Table 5.** for the period 2004 to mid 2009. As in **Figure 5.**, the results show that all sites recorded levels below the DECC criterion of 30 $\mu g/m^3$ from 2004 to 2008, with the exception of Site 4 in 2004 that recoded a concentration of 36.8 $\mu g/m^3$. Data shown in **bold red** indicate levels above the DECC criteria of 30 $\mu g/m^3$.

Table 5.: Annual average PM_{10} concentration at each TEOM monitoring site ($\mu g/m^3$)

TEOM Site	2004	2005	2006	2007	2008	2009	Annual
1	23.8	24.5	27.6	27.5	25.9	26.3	25.9
2	23.5	25.2	27.0	23.4	18.2	18.4	22.6
3	25.2	21.8	24.7	24.1	22.5	24.6	23.8
4	**36.8**	24.6	24.7	23.9	23.1	27.1	26.7
7	25.6	21.1	23.4	23.7	21.5	23.0	23.1
8	-	-	-	24.5	25.1	24.6	24.7

Figure 5. shows the locations of the HVAS's used to monitor TSP concentrations. All HVAS's are located within approximately 3km of the mining site. The HVAS's record 24-hour average concentrations every sixth day and these results are presented in **Figure 5.**. A summary of the results is presented in **Table 5.** for the four sites between 2004 and mid 2009. It should be noted that TEOM site 8 was in operation from January 2007.

The annual average TSP concentration for each of the four sites has generally been below the DECC's 90 $\mu g/m^3$ criterion. However, each of the sites recorded levels above the annual TSP criterion in at least one year.TSP levels that are notably above the criterion were recorded between 2006 and 2008 at Site 1. This site is located closest to the existing NEOC mine in Camberwell Village, and is also aligned on the prevailing wind direction axis relative to the NEOC. HVAS sites 2, 3 and 8 show TSP concentrations below the criterion.

The average for all sites is 87.4 $\mu g/m^3$ which is below the DECC's 90 $\mu g/m^3$ criterion. Data shown in **bold red** indicate levels above the DECC criteria of 90 $\mu g/m^3$.

Table 5.: Annual average TSP concentration at each HVAS monitoring site ($\mu g/m^3$)

HVAS Site	2004	2005	2006	2007	2008	2009	Annual

1	72.9	**90.1**	**103.9**	**103.4**	**99.9**	89.2	**93.2**
2	79.7	**94.7**	86.1	78.6	75.3	83.6	83.0
3	**102.2**	87.5	81.7	88.6	**92.3**	**94.2**	**91.1**
8	-	-	-	83.6	80.4	83.2	82.4

5.6 Dust Deposition

Figure 5. shows the locations of the 11 dust deposition gauges analysed in this assessment. The monthly data are presented in **Appendix** , and the annual averages summarised in **Table 5.**. Data shown in **bold red** indicate levels above of the DECC criteria of 4 µg/m^3.

Table 5.: Dust deposition data (insoluble solids) – 2003 to 2008 (g/m^2/month)

Gauge	2004	2005	2006	2007	2008	2009	Average
DG2	3.4	3.3	2.3	3.8	**5.5**	**4.1***	3.7
DG4	3.3	2.2	2.7	3.7	**5.4**	4.6*	3.7
DG5	2.0	2.7	2.5	2.1	2.6	4.5*	2.7
DG6	2.2	2.5	2.9	3.1	2.9	3.5*	2.8
DG7	3.0	3.4	**5.0**	**4.4**	3.6	3.9*	3.9
DG8	2.6	2.7	3.4	3.0	3.1	3.0*	3.0
DG9	3.2	3.0	3.9	3.7	3.1	3.5*	3.4
DG10	2.9	3.2	3.0	3.0	**4.3**	2.3*	3.1
DG11	1.9	1.9	2.3	2.9	2.8	2.7*	2.4
DG13	**7.1**	3.8	**4.7**	3.7	4.0	**6.1***	**4.9**
DG14	-	-	3.2*	2.0	2.5	2.3*	2.5
Average of all data							**3.2**

** Less than 6 months of valid data available*
+ Contamination from bird dropping, grazing material, irrigation etc.

It is clear from the monitoring results presented in **Table 5.**, that there are some sites which exceed the 4 g/m^2/month DECC criterion. Notable, DG13 recorded levels above the criterion in three years. DG13 is in the prevailing wind direction relative to the existing NEOC mine, which may contribute to the dust at this site.

Measurements at deposition gauges are heavily influenced by local dust producing activities, and this can be seen in the large variation in levels over small distances. For example, DG14 and DG7 are both located within Camberwell Village. DG14 has reported levels below 4 g/m^2/month for the entire monitoring period while DG7, which is approximately 600 m south-east of DG7, exceeds this level in two years. The annual average for all sites is 3.2 g/m^2/month which complies with the DECC's criterion of 4 g/m^2/month.

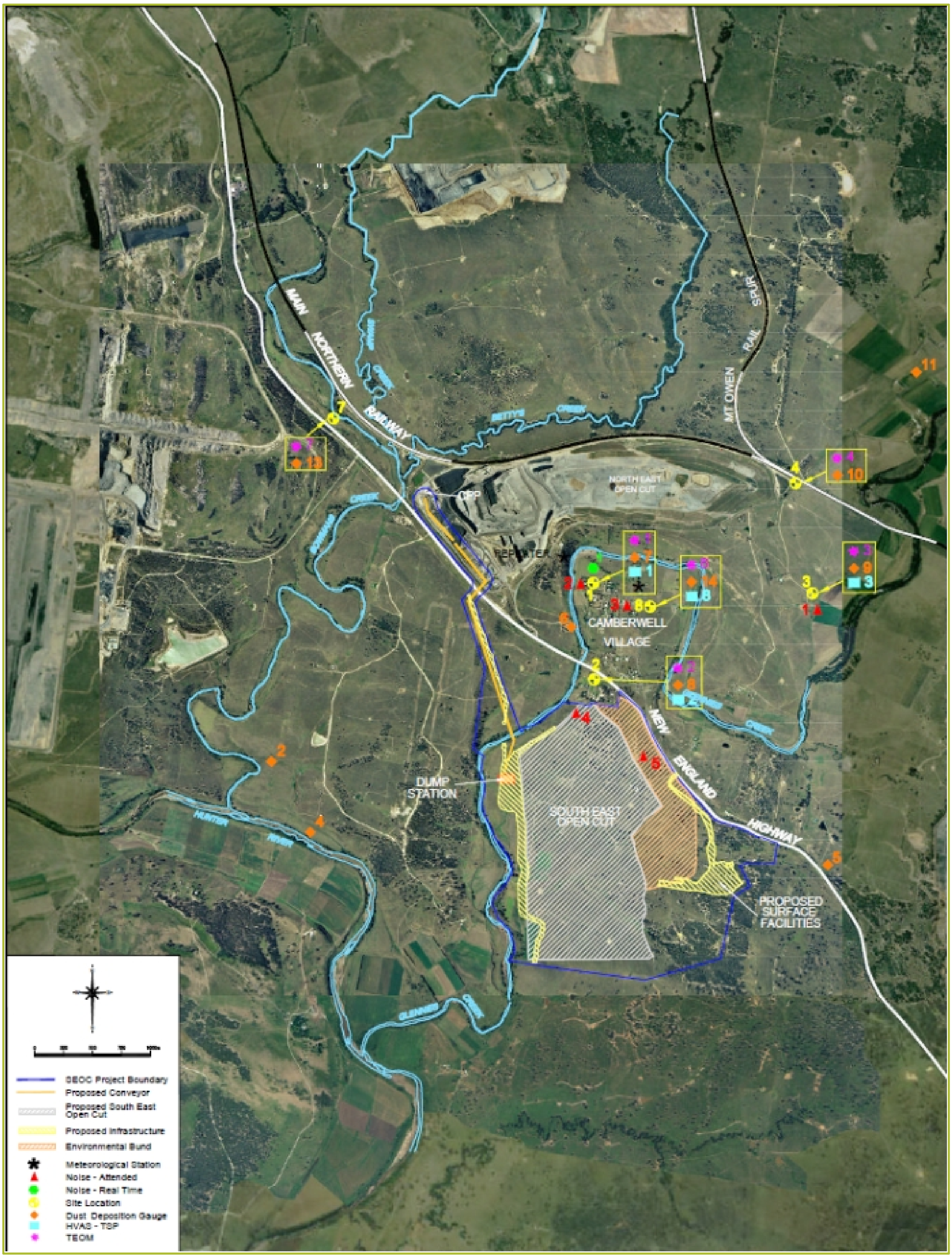


Figure 5.: Location of monitoring stations

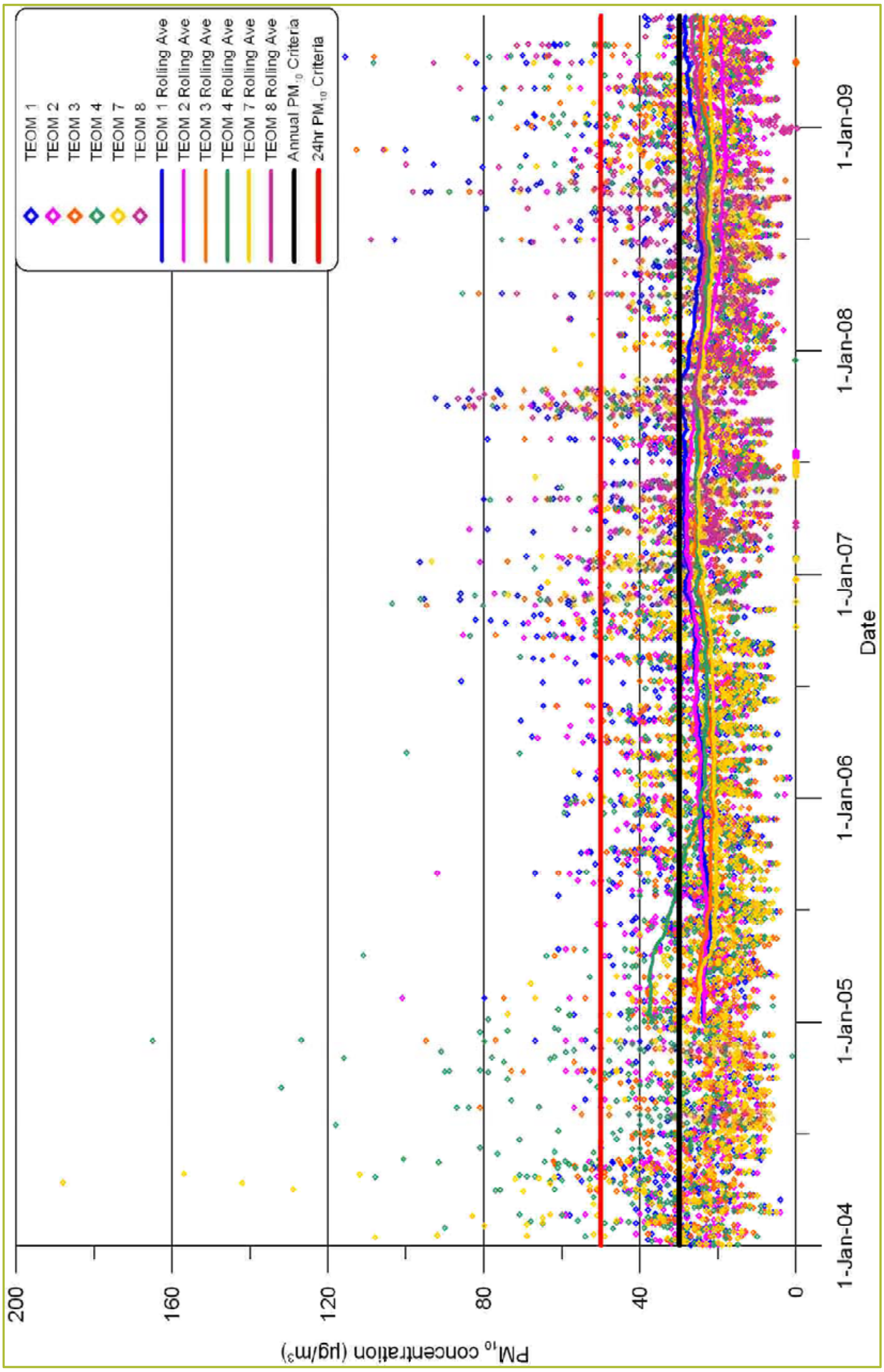


Figure 5.: TEOM PM_{10} concentrations

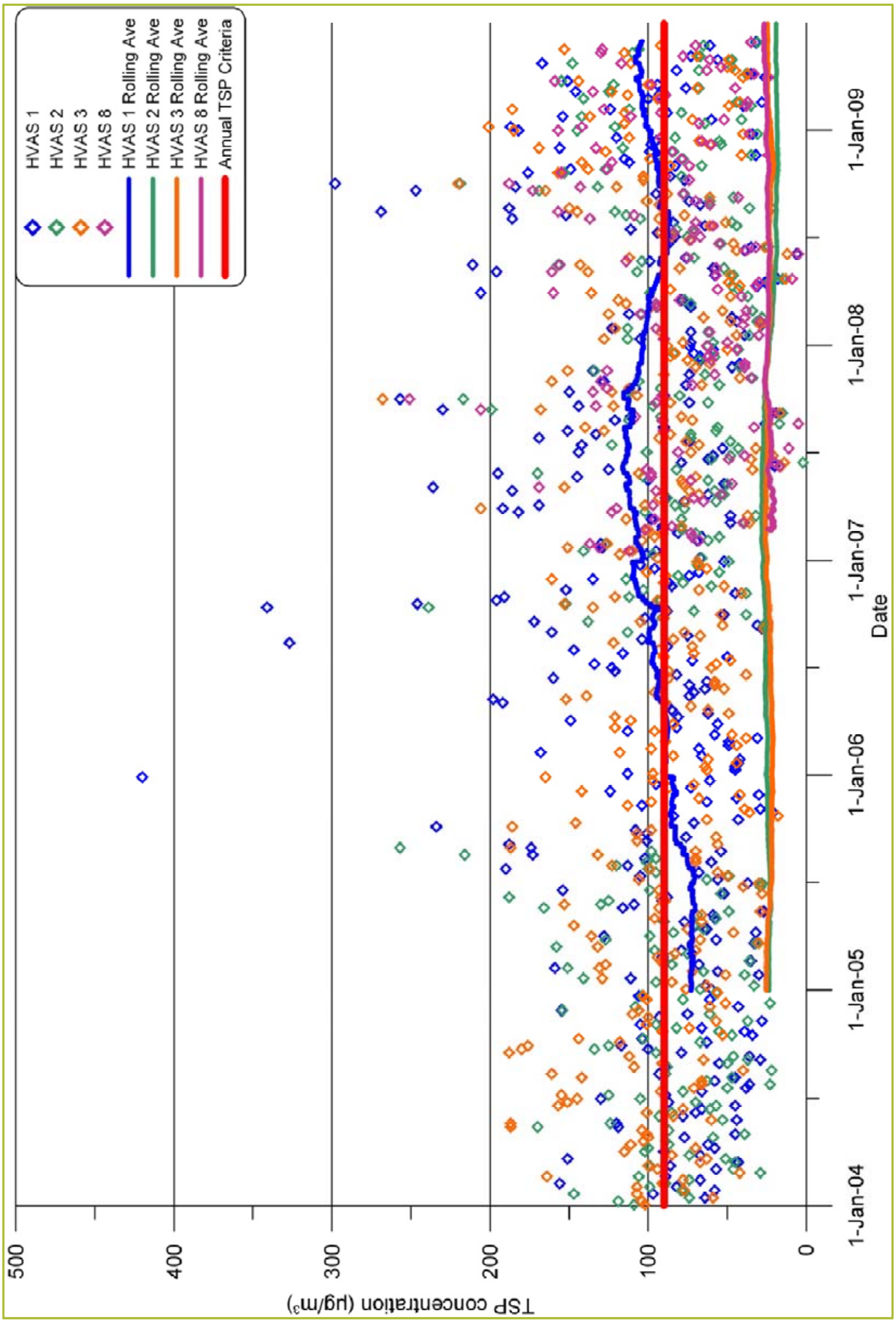


Figure 5.: HVAS TSP concentrations

6 APPROACH TO ASSESSMENT

In August 2005, DECC published guidelines for the assessment of air pollution sources using dispersion models (**NSW DEC, 2005**). The guidelines specify how assessments based on the use of air dispersion models should be undertaken. They include guidelines for the preparation of meteorological data to be used in dispersion models, the way in which emissions should be estimated and the relevant air quality criteria for assessing the significance of predicted concentration and deposition rates from the proposal. The approach taken in this assessment follows as closely as possible to the approaches suggested by the guidelines.

This section is provided so that technical reviewers can appreciate how the modelling of different particle size categories was carried out.

The model used was a modified version of the US EPA ISCST3 model (ISCMOD). ISCST3 is fully described in the user manual and the accompanying technical description (**US EPA, 1995a**).

The ISCST3 model has a tendency to overestimate short-term (24-hour) PM_{10} concentrations (**Holmes *et al.*, 2007**). To overcome this difficulty the modelling algorithms were modified to create ISCMOD. ISCMOD is identical to ISC except that the horizontal plume spreading dispersion curves have been modified to adopt the recommendations of the American Meteorological Society's (AMS) expert panel on dispersion curves (**Hanna, 1977**) and the suggestions made by **Arya (1999)**. The suggested changes were recommended because, as the AMS panel notes, the original horizontal dispersion curves relate to an averaging time of three minutes and they recommend that these be adjusted to the one hour curves required by ISC. The change involves increasing the horizontal plume widths by a factor of 1.82 $(60 \text{ minutes} / 3 \text{ minute})^{0.2}$. The modifications improve the performance of the model in predicting 24-hour concentrations and make almost no difference to the annual average predictions.

A similar adjustment has been applied to account for the local surface roughness being different at the sites compared with the site where the original curves were developed. The sites have been taken to have a surface roughness of 0.3m compared with 0.03m for the original curves. The adjustment leads to an increase in the horizontal and vertical curves by a factor of $(0.3 \text{ m}/ 0.03 \text{ m})^{0.2}$ namely 1.6.

The modelling has been based on the use of three particle-size categories (0 to 2.5μm - referred to as $PM_{2.5}$, 2.5 to 10μm - referred to as CM (coarse matter) and 10 to 30μm - referred to as the Rest). Emission rates of TSP have been calculated using emission factors developed both within NSW and by the US EPA (see **Section 7**).

The distribution of particles has been derived from measurements published by the SPCC **(SPCC, 1986)**. The distribution of particles in each particle size range is:

- $PM_{2.5}$ (FP) is 4.7% of the TSP;
- $PM_{2.5\text{-}10}$ (CM) is 34.4% of TSP; and
- $PM_{10\text{-}30}$ (Rest) is 60.9% of TSP.

Modelling was done using three ISC source groups with each group corresponding to a particle size category. Each source in the group was assumed to emit at the full TSP emission rate and to deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mean of the limits of the particle size range, except for the $PM_{2.5}$ group, which was assumed to have a particle size of 1 μm. The predicted concentration in the three plot output files for each group were then combined according to the weightings in the dot points above to determine the concentration of PM_{10} and TSP.

The ISC model also has the capacity to take into account dust emissions that vary in time, or with meteorological conditions. This has proved particularly useful for simulating emissions on mining operations where wind speed is an important factor in determining the rate at which dust is generated.

Estimates of emissions for each source were developed on an hourly time step taking into account the activities that would take place at that location. Thus, for each source, for each hour, an emission rate was determined which depended upon the level of activity and the wind speed. It is important to do this in the ISC model to ensure that long-term average emission rates are not combined with worst-case dispersion conditions which are associated with light winds. Light winds at a mine site would correspond with periods of low dust generation because wind erosion and other wind dependent emissions rates will be low. Light winds also correspond with periods of poor dispersion. If these measures are not taken into account, the model has the potential to significantly overstate impacts.

Operations were represented by a series of volume sources located according to the location of activities for the modelled scenarios (as shown on **Figure 7.** to **Figure 7.**). These correspond to operations as they are envisaged to occur in Year 1 (Fiscal Years 2010 – 2011), Year 3 (2012 – 2013), Year 5 (2014 – 2015) and Year 7 (2016 – 2017).

Dust concentrations and deposition rates have been predicted in the vicinity of the Project for the three stages of the proposed mining operations that were modelled. The local terrain has been taken into consideration for the modelling.

The modelling has been performed using the meteorological data discussed in **Section 5** and the dust emission estimates from **Section 7**. As an example, an ISCMOD input file is provided in **Appendix** .

All activities have been modelled for 24 hours per day, with the exception of topsoil removal, drilling of overburden, and grading, which have been assumed to occur between the hours of 7am and 7pm, and the blasting of overburden, which has been assumed to occur between the hours of 9am and 5pm only. **Section 7** provides details of dust emissions and allocation of sources for each activity.

Underground mining of ROM coal has a current approved extraction rate of approximately 3Mtpa. Ashton proposes to maintain this rate of production for the initial year of operation and subsequently to ramp up underground production to 5Mtpa. Therefore, an extraction rate of 3Mtpa of underground ROM coal was modelled in the first year and an extraction rate of 5Mtpa was modelled in years 3, 5 and 7.

To assess the air quality impacts of the proposed mining operations alone, the activities associated with the Project have been modelled in isolation. Contour plots were created and also the results at specific receptor locations were examined in order to assess the contribution mining activities to local air quality. Model predictions were then compared to the DECC criteria for deposited dust and 24-hour PM_{10} that are taken to be project specific criteria for assessing potential impacts.

For assessment of the cumulative impacts of the proposed mining operations, a separate set of model results have been presented which consider the contribution of other mines in the area as well as other local sources of dust. The Project model results were added to predicted annual average TSP, PM_{10} and dust deposition due to emissions from other mines. In addition, the contribution of other non-modelled mines and dust sources in the area was included through the use of a constant background level for annual average TSP, PM_{10} and dust deposition.

Modelled sources associated with mines other than the Project have been considered in three classes as follows:

1. Wind erosion sources
2. Wind sensitive sources
3. Wind insensitive sources

The mines other than the Project that were individually modelled for the assessment are presented in **Figure 2.**.

Uniform background levels were used across the modelling domain to account for the dust from sources that were not modelled. Section **7.4** outlines how these background levels were derived.

7 ESTIMATES OF EMISSIONS OF PARTICULATE MATTER

7.1 Introduction

This section discusses the calculation of the particulate emissions applied in the assessment. Emissions have been calculated for the following:

- The open-cut and underground operations from the Project
- Approved operations at other mines in the area

7.2 Emissions from open cut and underground mining operations for the Project

The operation of the mine has been analysed and estimates of dust emissions for the individual activities and operations for both open cut and underground mining operations have been made. Emission factors developed both locally and by the US EPA, have been applied to estimate the amount of dust produced by each activity. The emission factors applied are considered to be the most reliable or up-to-date methods for determining dust generation rates. The mining plans for the Project have been analysed and detailed emissions inventories have been prepared for five scenarios.

- Year 1 (Fiscal year 2010 – 2011);
- Year 3 (Fiscal year 2012 – 2013);
- Year 5 (Fiscal year 2014 – 2015); and
- Year 7 (Fiscal year 2016 – 2017).

The detailed calculations are provided in **Appendix** .

Appendix provides information on the equations used, the basic assumptions about material properties (e.g. moisture content, silt content etc), information on the way in which equipment would be used to undertake different mining operations and the quantities of materials that would be handled in each operation. **Figure 7.** to **Figure 7.** show the general progression of mining and associated activities over the life of the Project together with numbered locations that represent dust sources assumed in the modelling. The activities that are associated with each of the numbered locations are identified in **Appendix** .

Table 7. presents the emission estimates for each year modelled. Detailed emission estimates are provided in **Appendix** .

Table 7.: Summary of estimated TSP emissions from the Project (kg/y)

ACTIVITY	Year 1	Year 3	Year 5	Year 7
Topsoil Removal - Dozers/Excavators stripping topsoil	2,039	2,039	2,039	-
Topsoil removal - Sh/Ex/FELs loading topsoil	804	2,260	2,612	-
Topsoil removal - Hauling topsoil to emplacement area	10,378	35,270	49,189	-
Topsoil removal - Emplacing topsoil at emplacement area	804	2,260	2,612	-
OB - Drilling	11,943	11,943	11,943	11,943
OB - Blasting	21,825	21,825	21,825	21,825
OB - Excavator loading OB to haul truck	73,685	72,761	72,761	37,092
OB - Hauling to emplacement areas	669,098	1,080,725	1,146,313	342,042
OB - Emplacing at emplacement areas	73,685	72,761	72,761	37,092
OB - Dozers on OB	11,967	11,967	11,967	11,967
CL - Dozers ripping/pushing/clean-up	48,852	48,852	48,852	48,852
CL - Sh/Ex/FELs loading open pit coal to trucks	164,392	173,881	192,072	63,051
CL - Hauling open pit coal to ROM pad	63,065	55,587	78,946	28,795
CL - Unloading ROM to ROM stockpiles	20,496	21,679	23,947	7,861
CL - Loading ROM directly to hopper to be crushed	49,318	52,164	57,622	18,915
CL - Loading from stockpile to crusher using FELs	115,075	121,717	134,450	44,136
CL - Crushing ROM	7,906	8,362	9,237	3,032
CL - ROM hopper unloading coal to conveyor 1	29,280	30,970	34,210	11,230
CL - Conveyor to CHPP	993	993	993	993
CL - Unloading to transfer point 1	640	677	747	245
CL - Unloading to transfer point 2	640	677	747	245
CL - Unloading to transfer point 3	640	677	747	245
CL - Unloading to transfer point 4	640	677	747	245
CL - Unloading to transfer point 5	640	677	747	245
CL - Unloading to CHPP	914	967	1,068	351
CL - Unloading underground coal to CHPP	30,000	50,000	50,000	50,000
CL- Handle coal at CHPP (100%)	1,850	2,527	2,629	1,911
CL- Rehandle coal at CHPP (+10%)	185	253	263	191
CL - Loading product coal to trains	1,134	1,492	1,513	1,161
CL - Loading rejects and tailings to haul trucks	473	-	-	-
CL - Hauling rejects and tailings to NEOC voids	21,348	-	-	-
Cl - Unloading rejects and tailings to NEOC voids	473	-	-	-
WE - OB dump area	63,773	139,810	128,947	114,230
WE - Open pit	58,517	51,859	99,864	97,762
WE - ROM stockpiles	10,232	10,232	10,232	10,232
WE - Product stockpiles	3,504	3,504	3,504	3,504
WE - Dam construction	1,051	-	-	-
Grading roads	43,132	43,132	43,132	43,132
Upcast Vent	31,536	31,536	31,536	31,536
TOTAL TSP (kg)	**1,646,925**	**2,166,712**	**2,350,776**	**1,044,064**

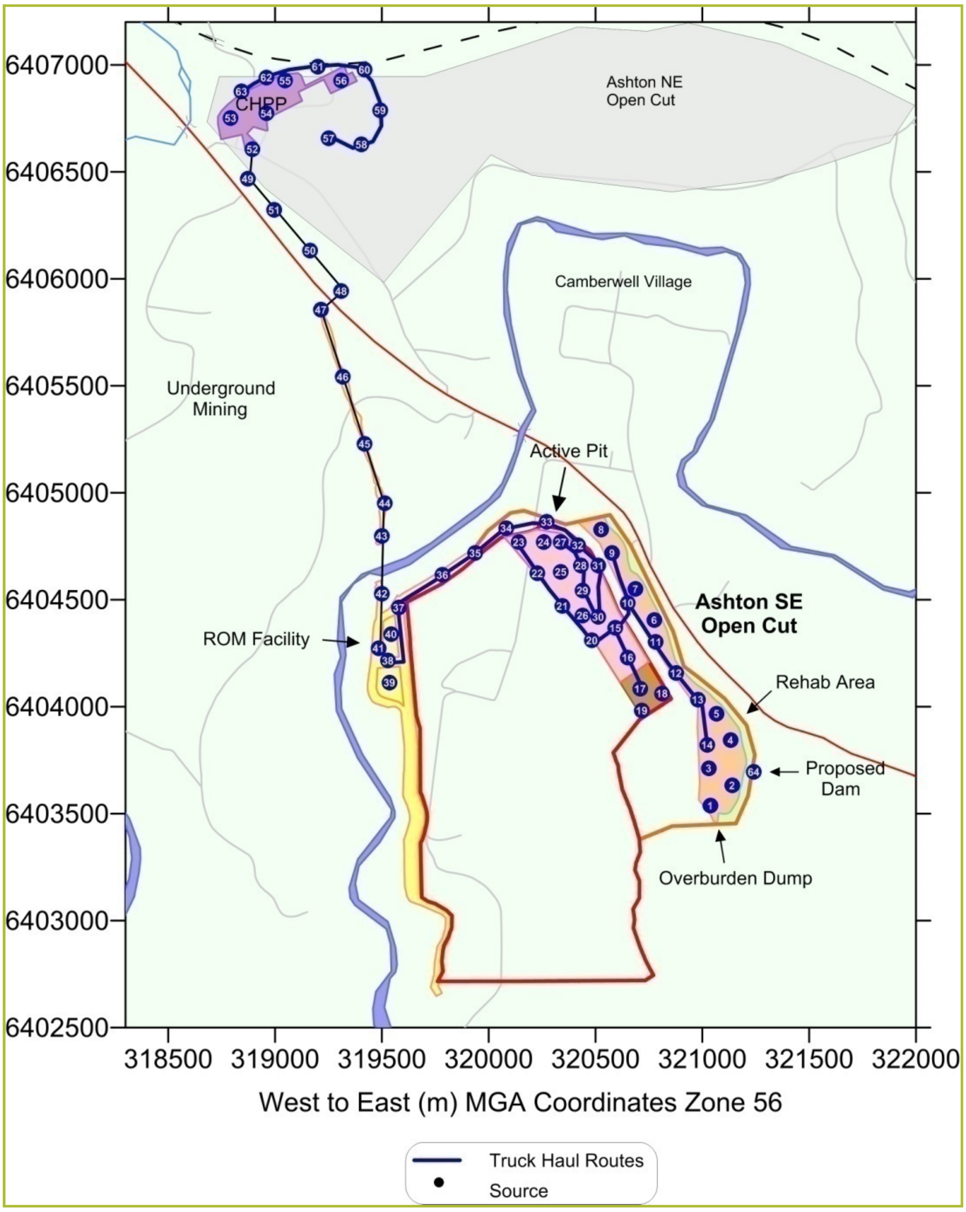


Figure 7.: Modelling sources locations – Year 1 (2010 -2011)

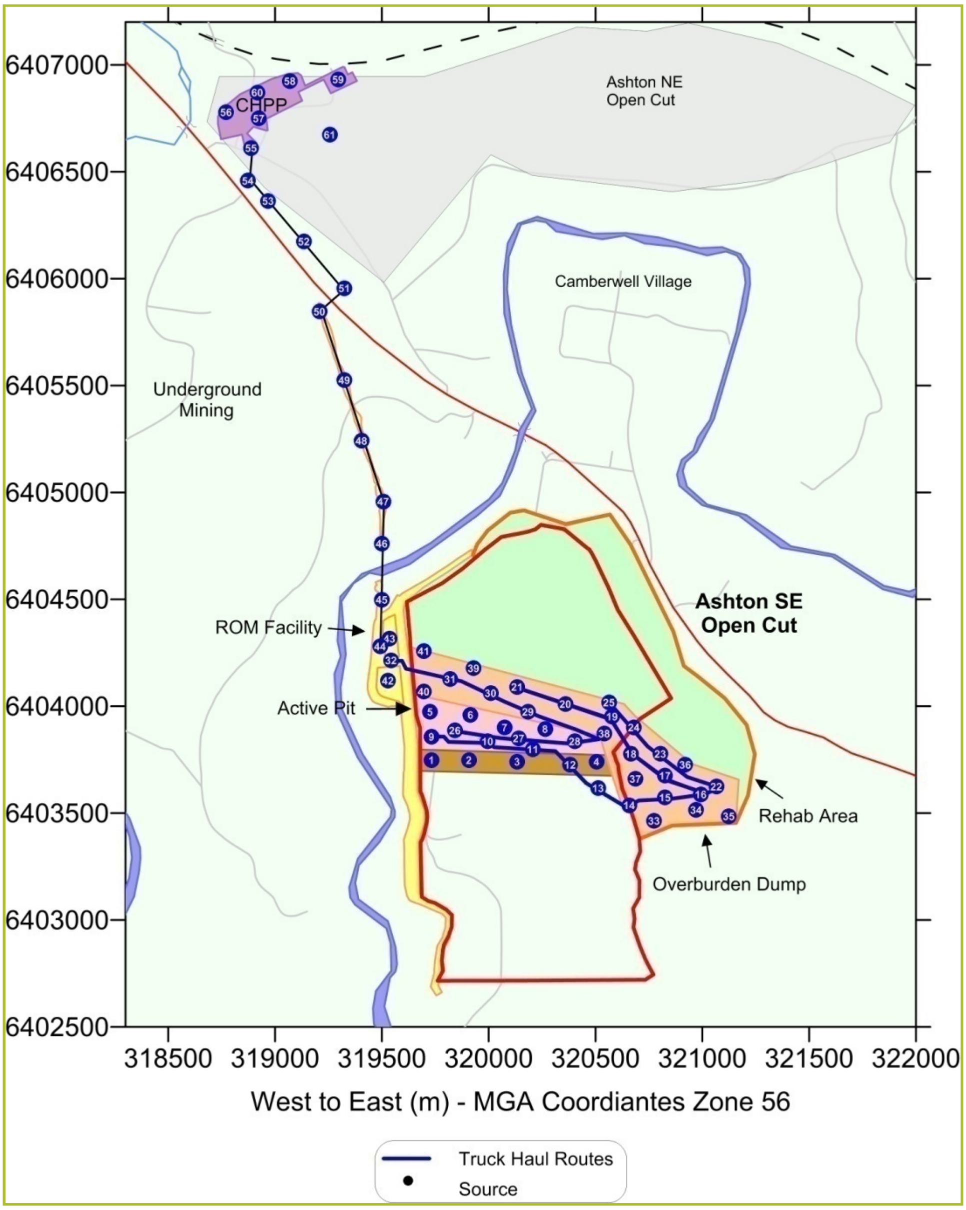


Figure 7.: Modelling sources locations – Year 3 (2012 – 2013)

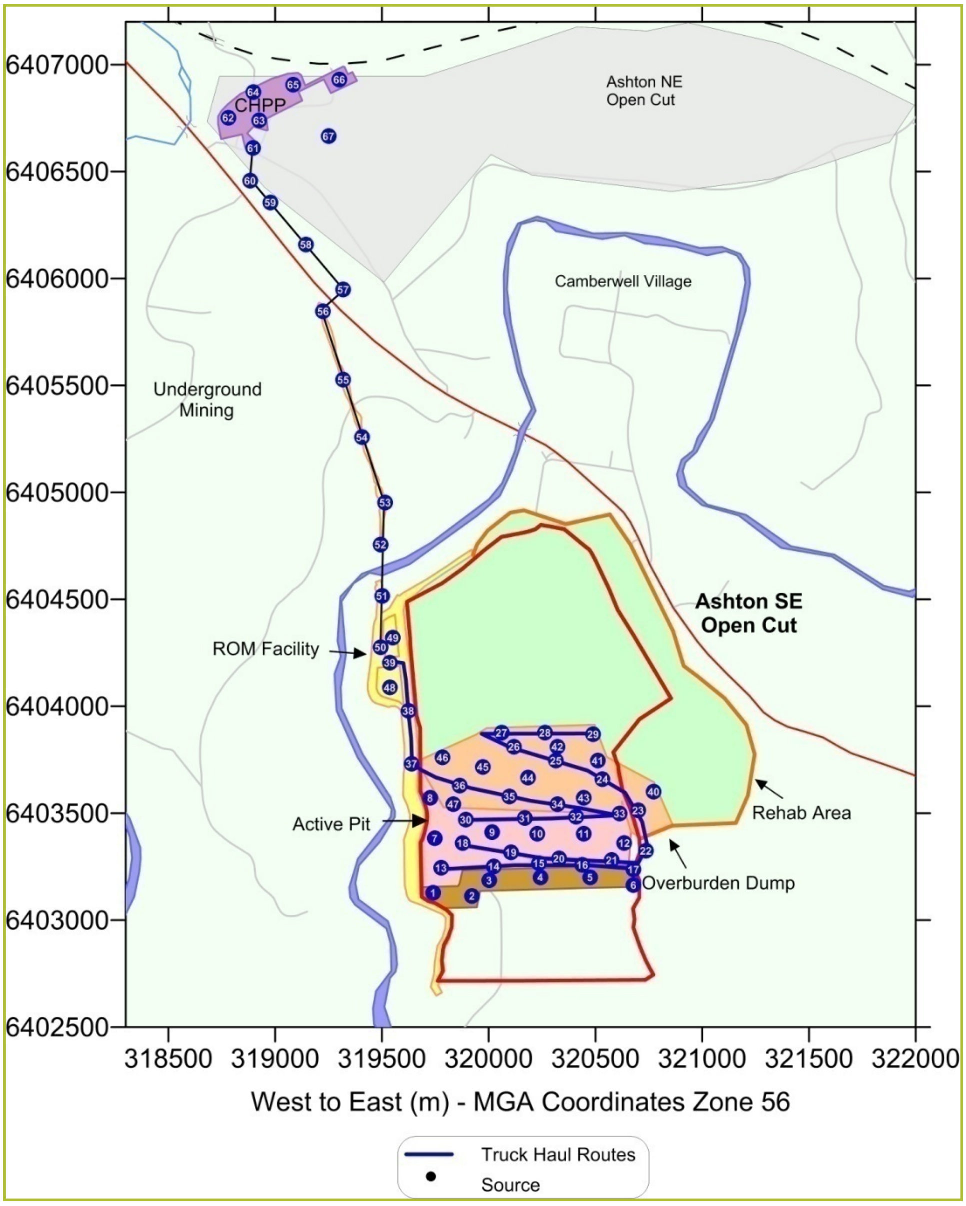


Figure 7.: Modelling sources locations – Year 5 (2014 – 2015)

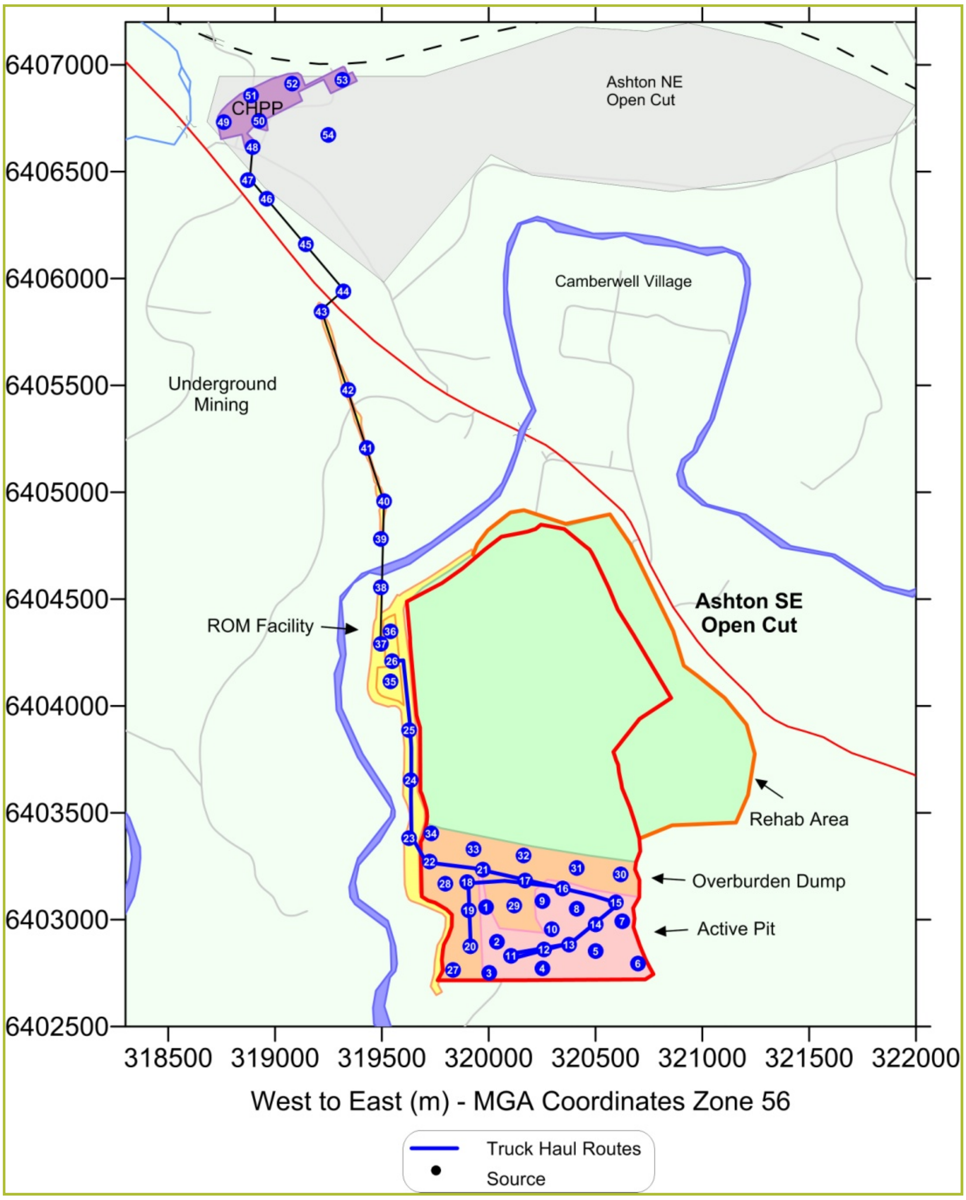


Figure 7.: Modelling sources locations – Year 7 (2016 – 2017)

7.3 Emissions from neighbouring mines

To assess total cumulative dust levels, the emissions from the SEOC, other neighbouring mines and residual background levels have been calculated and modelled. This section outlines the calculation of emissions from other mines as applied in the modelling.

The dust inventories used in the modelling include estimates of emissions from other approved operations at nearby mines. The locations of the nearby mines are shown in **Figure 2.**.

The estimated emissions for the neighbouring mines have been taken from the relevant EIS documents for following mines:

- Integra North Open Cut (Year 1 and Year 3 only) (**URS, 2009**)
- Ravensworth East (Year 1, Year 3 and Year 5 only) (**Holmes Air Sciences, 2003**)
- Mt Owen (all years) (**Holmes Air Sciences, 2006**)
- Glendell (all years) (**Holmes Air Sciences, 2007a**)
- Narama (Year 1, Year 3 and Year 5 only) (**Holmes Air Sciences, 2005**)
- HVO South (**Holmes Air Sciences, 2007b**)
- Rixs Creek (**Holmes Air Sciences, 1994**)
- Ashton North East Open Cut (NEOC) (Year 1 - July to October only)(**Holmes Air Sciences, 2003**)
- Ravensworth West (Year 1 only) (Year 1 - July to October only) (**ERM, 1997)**

Where data were not available for the precise years of the Project, data were interpolated or extrapolated from the available previously calculated emissions data. **Table 7.** presents a summary of the estimated emissions apportioned to other mines.

In the cumulative modelling work, each neighbouring mine has been treated as a small number of volume sources. These have been located at the apparent points of major emission as estimated from the known locations of the pits and/or major dust sources on the mine or facility.

Sources have been considered in three classes covering all dust emission sources for which there are emission factor equations for open cut mines.

1. Wind erosion sources where emissions vary with the hourly average wind speed according to the cube of the wind speed.
2. Loading and dumping operations where emissions vary as wind speed is raised to the power of 1.3.
3. All other sources where emissions are assumed to be independent of wind speed.

For neighbouring mines, the proportion of emissions in each of these categories has been assumed to be:

- 0.732 for emissions independent of wind speed;
- 0.135 for emissions that depend on wind speed (such as loading and dumping); and
- 0.133 for wind erosion sources.

These factors are based on a detailed analysis of mine dust inventories undertaken as part of the Mt Arthur North EIS (**URS, 2000**), and have subsequently been accepted as appropriate and routinely applied to subsequent air quality impact assessments for mining operations.

Table 7.: Summary of estimated TSP dust emissions from other mines (kg/y)

Mine	TSP Emissions			
	Year 1	Year 3	Year 5	Year 7
Integra North Open Cut - WI	809,563	412,873	-	-
Integra North Open Cut - WS	155,259	79,181	-	-
Integra North Open Cut - WE	144,169	73,525	-	-
Ravensworth East - WI	3,887,806	3,678,529	3,626,209	3,626,209
Ravensworth East - WS	745,607	705,471	695,437	695,437
Ravensworth East - WE	692,349	655,080	645,763	645,763
Mt Owen - WI	3,495,439	3,466,087	3,267,218	3,457,507
Mt Owen - WS	670,358	664,729	626,590	663,084
Mt Owen - WE	622,475	617,248	581,833	615,720
Glendell - WI	1,978,416	2,564,493	2,658,698	2,544,376
Glendell - WS	379,422	491,821	509,887	487,962
Glendell - WE	352,321	456,690	473,467	453,108
Narama - WI	996,450	911,040	455,520	-
Narama - WS	191,100	174,720	87,360	-
Narama - WE	177,450	162,240	81,120	-
HVO South - WI	7,783,809	8,016,772	7,924,869	6,858,371
HVO South - WS	1,492,785	1,537,463	1,519,838	1,315,304
HVO South - WE	1,386,158	1,427,644	1,411,278	1,221,354
Rixs Creek - WI	2,332,636	2,385,955	2,439,273	2,479,263
Rixs Creek - WI	447,355	457,580	467,806	475,475
Rixs Creek - WI	415,401	424,896	434,391	441,513
Ashton NEOC WI	191,521	-	-	-
Ashton NEOC WS	56,617	-	-	-
Ashton NEOC WE	20,036	-	-	-
Ravensworth West -WI	857,163	-	-	-
Ravensworth West -WS	158,083	-	-	-
Ravensworth West -WE	155,741	-	-	-

Notes:
WI = Wind insensitive emissions;
WS = Wind sensitive emissions;
WE = Wind erosion emissions

7.4 Estimated emissions from distant mines and other sources

Other sources, in addition to the Project and other mines identified in **Section 7.3**, will contribute to dust in the area. Estimating the background allowance for distant mines and the dust from other closer non-mining sources is complicated and depends on local land use and the associated emission sources, as well as climate, soil type, farming practice etc.

For annual average TSP, PM_{10} and dust deposition the following constant values have been used in the modelling predictions:

- 27 $\mu g/m^3$ for annual average TSP;
- 2 $\mu g/m^3$ for annual average PM_{10}; and
- 0.5 g/m^2/month for annual average dust deposition.

Historically, a value of 10 $\mu g/m^3$ has been used to account for non-modelled sources of TSP. A study for Hunter Valley Operations **(Holmes Air Sciences, 2007)** examined model predictions and measurements and found that the non-modelled contribution to annual average TSP levels could be higher than 10 $\mu g/m^3$, at around 27 $\mu g/m^3$. It is believed that the explanation for the higher non-modelled TSP contribution is that TSP measurements are dominated by localised activities with a high coarse particle fraction. The same argument applies to dust deposition measurements. From an air dispersion modelling perspective it is not possible to account for all localised activities, such as ploughing of fields, cattle grazing, farming activities and the like. A revision to the assumed TSP uniform constant background TSP level was therefore considered to be appropriate and a figure of 27 $\mu g/m^3$ has been used instead of 10 $\mu g/m^3$. 0.5 g/m^2/month for dust deposition is the default value used to dust deposition as consistent with mining studies over many years in the Hunter Valley (see **Holmes Air Sciences, 2007**).

By contrast, particles in the PM_{10} size range remain in the atmosphere for much longer than the coarse fraction of TSP and so travel much further. The result is a more uniform distribution of PM_{10} concentration.

To estimate the background PM_{10} concentration to apply in the modelling, a simple comparison of annual average PM_{10} model predictions was conducted (i.e. for all modelled sources but without background levels added) with the available annual average PM_{10} monitoring data at TEOM sites 1, 2 ,3 and 8 (see **Figure 5.**).

Table 7.: Comparison of model predictions with previous monitoring data

TEOM station	Model prediction for July 2007 to June 2008 without background levels added* (μg/m^3)	Comparison with July 2007 to June 2008 monitoring data (μg/m^3)	
		Data	**Difference**
1	34	25	9
2	17	19	-2
3	26	23	3
8	31	24	7

Table 7. shows that the model, without background levels added, over-predicts annual average PM_{10} levels at TEOM sites 1, 3 and 8. However, the model under predicts by 2μg/m^3 at TEOM site 2 which is located in Camberwell Village (see **Figure 5.**).

Therefore, a uniform background level of 2 μg/m^3 has been applied across the entire modelling domain to ensure that the model plus background does not under-predict the dust levels particularly at Camberwell Village.

This is a conservative approach which is likely to result in an over-prediction of annual average dust levels.

8 ASSESSMENT OF IMPACTS – PARTICULATE MATTER

8.1 Assessment Criteria

The air quality criteria used for identifying which properties are likely to experience air quality impacts are those specified in the NSW DECC's modelling guidelines as interpreted by recent Conditions of Consent for mines in NSW.

The criteria are:

- 50 $\mu g/m^3$ for 24-hour average PM_{10} for the Project considered alone;
- 30 $\mu g/m^3$ for annual average PM_{10} due to the Project and other sources;
- 90 $\mu g/m^3$ for annual average TSP concentrations due to the Project alone and other sources;
- 2 g/m^2/month for annual average deposition (insoluble solids) due to the Project considered alone; and
- 4 g/m^2/month for annual average predicted cumulative deposition (insoluble solids) due to the Project and other source levels.

Similar predictions for 24-hour and annual average $PM_{2.5}$ concentrations for the Project by itself and the Project considered with the effects of other mines are provided in **Appendix** .

Following practice established in recent Conditions of Consent, with the exception of the 2 g/m^2/month goal and the 24-hour PM_{10}, the assessment criteria are interpreted to be cumulative assessment criteria.

The following sections provide a summary of the affected residences and at what stage the effects are predicted to occur.

8.2 Assessment Approach

8.2.1 Annual average concentrations

For the annual average concentrations, dust concentrations and deposition rates for the selected years of assessment have been presented as isopleth diagrams showing the following:

1. Predicted annual average PM_{10} concentration.
2. Predicted annual average TSP concentration.
3. Predicted annual average dust deposition.

It is important to note that the isopleth figures are presented to provide a visual representation of the predicted impacts. To produce the isopleths it is necessary to make interpolations, and as a result the isopleths will not always match exactly with predicted impacts at any specific location. The actual predicted impacts at the sensitive receptors are presented in tabular form (see **Section 8.3.2** to **Section 8.3.5**).

8.2.2 24-hour average PM_{10} concentrations

The 24-hour PM_{10} criterion of 50 $\mu g/m^3$ is interpreted as being applicable to the Project when considered in isolation (at the 98.6th percentile), while in recent Conditions of Consent, the US EPA 24-hour PM_{10} standard of 150 $\mu g/m^3$ has been taken to be the cumulative criterion (at the 99th

percentile). The application of the 24-hour PM_{10} criteria applies in this way when the mine can demonstrate that it will or does employ best-practice dust control measures including the use of real-time monitoring and reactive dust measures. It is important to the note that it is not possible to accurately predict the cumulative PM_{10} 24-hour average using dispersion modelling as it is highly influenced by other sources in the area, and events such as bushfires, dust storms, etc., therefore cumulative PM_{10} 24-hour average predictions have not been included in the assessment.

For the 24-hour average PM_{10} predictions due to the Project on its own, a table of the predicted impacts at the nearby receptors due to the Project alone has been presented for each year of the assessment (see **Section 8.4**). For those receptors where the impact assessment criterion of 50 $\mu g/m^3$ is predicted to be exceeded, an assessment of the number of days in the year above the criteria has also been presented.

8.2.3 Interpretation of impacts at sensitive receptors

The predicted impacts at the sensitive receptors have been summarised in tabular form for each year (see **Section 8.3.2** to **Section 8.3.5**). The locations of neighbouring residences are shown in **Figure 2.**

For the assessment of predicted impacts at the sensitive receptors due to the Project alone, all receptors that are predicted to experience particulate matter deposition above the NSW DECC's assessment criteria are highlighted in the tabulated results.

The assessment of cumulative impacts is focussed on identification of all residences that would be materially affected by the proposed SOEC operations, however residences affected by other activities are also tabulated for completeness. For example, **Figure 8.** shows an isopleth of the predicted annual average PM_{10} concentrations due to the Project and other mines and sources in Year 1. The applicable assessment criteria of 30 $\mu g/m^3$ is highlighted. Any sensitive receptor within the 30 $\mu g/m^3$ isopleth is predicted to experience an exceedance of the annual average PM_{10} criteria. In **Figure 8.** there is a clearly defined area of influence around SOEC where the Project is likely to contribute to the impacts. Similarly, there are separate areas of influence around the other mines that were modelled. The isopleths were used to guide identification of the receptors where the SEOC would influence dust levels, and these receptors are highlighted in the tables as experiencing an exceedance of the criteria[a]. While there are other receptors in the tables that show predicted impacts above the criteria, these are likely to be the result of other activities and are unlikely to be influenced substantially by the Project, as such, these receptors are not considered any further in the assessment.

In addition, it should be noted that the following sensitive receptors would not exist in the stated year or subsequent years, as mining would occur at these locations:

- Year 1
  - One private residence (126); and
  - Five residences owned by mining companies or other entities (122, 123, 125, 127 and 128).
- Year 5
  - One private residence (129).

[a] As noted in **Section 8.2.1**, the isopleths do not always match exactly with the actual predicted impacts. The final assessment has been made on the actual predicted impacts, not the isopleths.

Whilst the predicted impacts at these locations have been included in the predicted impacts tables in **Section 8.3.2** to **Section 8.3.5**, no further discussion on the predicted impacts at these locations has been presented.

8.3 Annual average PM_{10}, TSP and dust deposition predictions

8.3.1 Introduction

Section 8.3.2 to **Section 8.3.5** present the predicted annual average impacts at the private residences and those owned by mining companies for each year assessed.

It should be noted that of the criteria that are used to assess impacts, namely 24-hour PM_{10}, annual average PM_{10}, annual average TSP and annual average deposition, only two are applicable for the Project considered in isolation. These are the 50 $\mu g/m^3$ 24-hour PM_{10} goal, which, for projects committing to best practice dust controls, should not be exceeded by the project in isolation (the results for 24-hour average PM_{10} concentrations are presented in **Section 8.4**) and the annual 2 g/m^2/month deposition limit for insoluble solids. The value of examining the effects of the Project by itself for the other parameters is that this allows the extent to which the Project contributes to the cumulative impacts to be quantified. This is useful when deciding the extent to which the Project contributes to exceedances that may arise due to the combined effect with all sources of dust.

The residences that are predicted to exceed the criteria are identified in the subsequent sections for each year of the proposed operations that was assessed. **Section 8.5** presents a summary of the impacted residences.

8.3.2 Year 1

Figure 8. to **Figure 8.** show the predicted annual average PM_{10} and TSP concentrations and dust deposition levels for operations in Year 1 showing the effects of the Project by itself and the Project in combination with other sources.

Table 8. presents the predicted dust concentration results for all receptors in the vicinity of the Project and highlights in bold those values above the relevant project specific criteria or cumulative criteria where the SEOC is expected to influence air quality. The table should be read in conjunction with **Section 8.2.3** (Interpretation of impacts at sensitive receptors).

In summary for Year 1, the following receptors where criteria are exceeded have been identified:

- Annual average deposition above 2 g/m^2/month due to the Project considered in isolation – One private residence (51) – see **Figure 8.**.
- Annual average PM_{10} above 30 $\mu g/m^3$ due to the Project and other mines and other sources – Sixteen private residences (23, 024A, 024B, 26, 30, 32, 34, 35, 46, 50, 51, 52, 117, 119, 120, 121) and nineteen residences owned by mining companies or other entities (21, 22, 25, 27, 28, 29, 33, 36, 36, 38, 39, 40, 41, 43, 44, 45, 47, 49 and 115) - see **Figure 8.**.
- Annual average TSP above 90 $\mu g/m^3$ due to the Project and other mines and other sources – One private residence (51) and one residence owned by mining companies or other entities (115) – see **Figure 8.**.
- Annual average dust deposition above 4 g/m^2/month due to the Project and other mines and other sources – One private residence (35) and four residences owned by mining companies or other entities (36, 36, 43 and 115) – see **Figure 8.**.

Table 8.: Summary of predicted annual average air quality impacts for Year 1

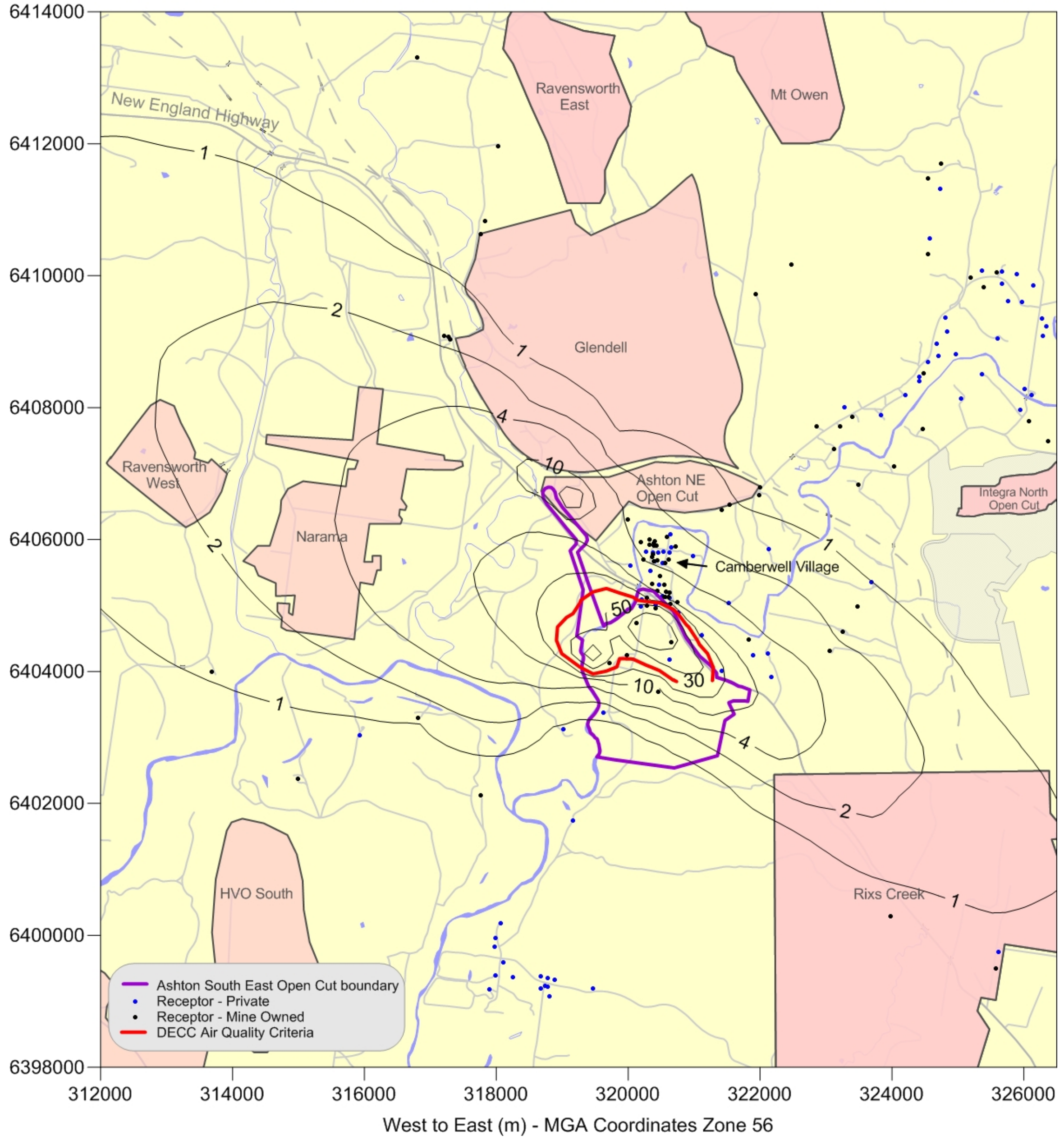
ID	Year 1 – Project alone			Year 1 - Project and other sources		
	PM_{10} (µg/m³)	TSP (µg/m³)	Dust deposition (g/m²/month)	PM_{10} (µg/m³)	TSP (µg/m³)	Dust deposition (g/m²/month)
	Assessment criteria					
	N/A	*N/A*	*2*	*30*	*90*	*4*
Private residences						
2	8	9	0.2	29	56	1.7
8	9	10	0.2	29	57	1.6
11	6	7	0.1	28	56	1.8
18	5	5	0.1	29	57	2.2
23	3	3	0.1	**36**	66	3.4
024A	3	3	0.1	**37**	66	3.5
024B	4	4	0.1	**33**	62	2.8
26	4	4	0.1	**32**	61	2.8
30	3	4	0.1	**35**	65	3.3
32	3	4	0.1	**34**	64	3.1
34	3	3	0.1	**38**	68	3.7
35	2	3	0.1	**40**	72	**4.2**
46	22	29	1.0	**41**	73	2.2
50	25	30	1.1	**42**	73	2.2
51	45	57	**2.6**	**62**	**100**	3.6
52	3	3	0.1	**36**	65	3.3
63	0	0	0.0	31	58	1.5
64	0	0	0.0	29	56	1.4
65	0	0	0.0	27	53	1.3
66	0	0	0.0	26	52	1.3
067A	0	0	0.0	22	48	1.3
067B	0	0	0.0	24	50	1.3
68	0	0	0.0	19	45	1.2
069A[a]	0	0	0.0	20	46	1.5
70	0	0	0.0	19	45	1.4
71	0	0	0.0	18	44	1.3
072B	0	0	0.0	20	47	1.2
072	0	0	0.0	20	47	1.2
73	0	0	0.0	17	43	1.2
74	0	0	0.0	17	43	1.2
75	0	0	0.0	17	43	1.1
76	0	0	0.0	18	44	1.3
77	0	0	0.0	19	45	1.4
78	0	0	0.0	20	46	1.5
80[a]	0	0	0.0	19	46	1.5
81	1	1	0.0	39	68	2.4
83	7	8	0.4	24	51	1.5
084A	5	5	0.2	22	49	1.4
084B	7	7	0.4	22	49	1.4
100A[b]	0	0	0.0	39	67	2.0
100B[b]	0	0	0.0	38	66	1.9
100C	0	0	0.0	36	63	1.7
100D	0	0	0.0	34	62	1.6
101A[b]	0	0	0.0	33	61	1.8
111[b]	1	1	0.0	29	56	1.9
114[b]	4	4	0.1	27	54	2.0
117	3	3	0.1	**35**	64	3.2
119	13	16	0.5	**32**	61	1.8
120	15	19	1.1	**33**	62	2.2
121	21	25	1.7	**37**	67	2.6
126[c]	68	94	7.1	84	136	8.0
129	1	1	0.0	20	46	1.1
130A	1	1	0.0	21	47	1.2
130B	0	0	0.0	22	48	1.1
131	0	0	0.0	24	51	1.6

ID	Year 1 – Project alone			Year 1 - Project and other sources		
	PM_{10} ($\mu g/m^3$)	TSP ($\mu g/m^3$)	Dust deposition ($g/m^2/month$)	PM_{10} ($\mu g/m^3$)	TSP ($\mu g/m^3$)	Dust deposition ($g/m^2/month$)
	Assessment criteria					
	N/A	***N/A***	***2***	***30***	***90***	***4***
132	0	0	0.0	24	51	1.6
133	0	0	0.0	24	51	1.5
137A	0	0	0.0	25	52	1.7
137B	0	0	0.0	26	53	1.8
137C	0	0	0.0	25	52	1.7
139	0	0	0.0	24	51	1.6
144	0	0	0.0	24	51	1.6
145	0	0	0.0	24	51	1.6
146	0	0	0.0	24	50	1.6
151	6	7	0.2	28	56	1.9
162	0	0	0.0	36	64	1.9
163	0	0	0.0	26	53	1.3
164	0	0	0.0	35	64	1.6
182A	0	0	0.0	24	51	1.5
182B	0	0	0.0	26	53	1.9
184A	0	0	0.0	23	50	1.5
184B	0	0	0.0	24	51	1.6
184C	0	0	0.0	25	52	1.7
187	1	1	0.0	17	43	0.8
197[b]	0	0	0.0	21	47	1.6
198[b]	0	0	0.0	31	60	3.3
217	1	1	0.0	30	60	2.7
Mine-owned residences						
1	11	13	0.3	30	58	1.6
3	8	9	0.2	29	56	1.7
4	7	8	0.2	28	56	1.8
5	7	8	0.2	28	56	1.7
6	8	10	0.2	29	57	1.7
7	9	10	0.2	29	57	1.6
10	6	6	0.1	28	56	1.9
12	8	9	0.2	28	56	1.7
13	7	8	0.2	28	56	1.8
17	5	5	0.1	29	57	2.2
21	4	4	0.1	**33**	62	2.9
22	3	4	0.1	**35**	64	3.1
25	4	4	0.1	**33**	62	2.9
27	4	4	0.1	**32**	61	2.7
28	3	4	0.1	**33**	62	2.9
29	3	4	0.1	**34**	64	3.1
31	4	4	0.1	30	59	2.5
33	3	3	0.1	**38**	68	3.7
36	3	3	0.1	**41**	72	**4.3**
36	3	3	0.1	**40**	71	**4.1**
38	3	3	0.1	**39**	69	3.8
39	3	3	0.1	**39**	69	3.8
40	3	3	0.1	**39**	70	4.0
41	3	3	0.1	**38**	69	3.8
43	3	3	0.1	**41**	72	**4.2**
44	3	4	0.1	**38**	69	3.8
45	33	44	2.0	**50**	88	3.1
47	34	43	1.8	**52**	87	2.9
49	17	21	0.7	**35**	65	1.9
069B	0	0	0.0	19	45	1.3
079A	0	0	0.0	29	56	1.9
079B	0	0	0.0	19	45	1.4
079C	0	0	0.0	19	46	1.5
101B	0	0	0.0	35	62	1.8

ID	Year 1 – Project alone			Year 1 - Project and other sources		
	PM_{10} ($\mu g/m^3$)	TSP ($\mu g/m^3$)	Dust deposition (g/m^2/month)	PM_{10} ($\mu g/m^3$)	TSP ($\mu g/m^3$)	Dust deposition (g/m^2/month)
	Assessment criteria					
	N/A	*N/A*	*2*	*30*	*90*	*4*
115	4	4	0.2	**65**	**103**	**7.6**
118	8	10	0.2	29	56	1.7
122[c]	134	205	15.4	150	248	16.3
123 [c]	146	180	9.5	162	222	10.4
125 [c]	26	33	1.8	43	75	2.7
127 [c]	42	66	5.7	59	108	6.6
128 [c]	7	10	0.6	24	52	1.5
153	1	1	0.0	16	41	0.7
159A	1	1	0.0	29	55	1.6
159B	1	1	0.0	28	55	1.5
159C	1	1	0.0	29	55	1.6
159D	1	1	0.0	29	56	1.7
159E	0	0	0.0	34	62	1.9
159F	0	0	0.0	34	61	1.8
159G	0	0	0.0	32	59	1.7
160A	1	1	0.0	28	57	2.2
160B	2	2	0.0	23	51	1.8
160C	2	2	0.1	21	47	1.5
160D	0	0	0.0	34	61	1.6
161A	1	1	0.0	41	69	2.3
161B	0	0	0.0	44	74	2.8
161C	6	6	0.2	24	51	1.6
161D	0	0	0.0	40	69	2.7
166	0	0	0.0	44	74	1.8
168	0	0	0.0	55	91	2.6
181A	1	1	0.0	20	46	1.2
181B	0	0	0.0	21	48	0.9
181C	0	0	0.0	20	45	1.0
189	2	2	0.0	25	51	0.9
190	2	2	0.0	25	50	0.9
191	2	2	0.0	25	51	0.9
192	0	0	0.0	16	42	0.8
193	0	0	0.0	18	43	0.8
194A	0	0	0.0	81	123	6.5
194B	0	0	0.0	55	84	2.6
195	0	0	0.0	29	56	1.9
196	0	0	0.0	21	47	1.4
199	0	0	0.0	34	63	3.8
200	0	0	0.0	43	73	4.8
218A	1	1	0.0	107	152	6.5
218B	0	0	0.0	21	48	1.9
218C	1	1	0.0	43	76	5.0

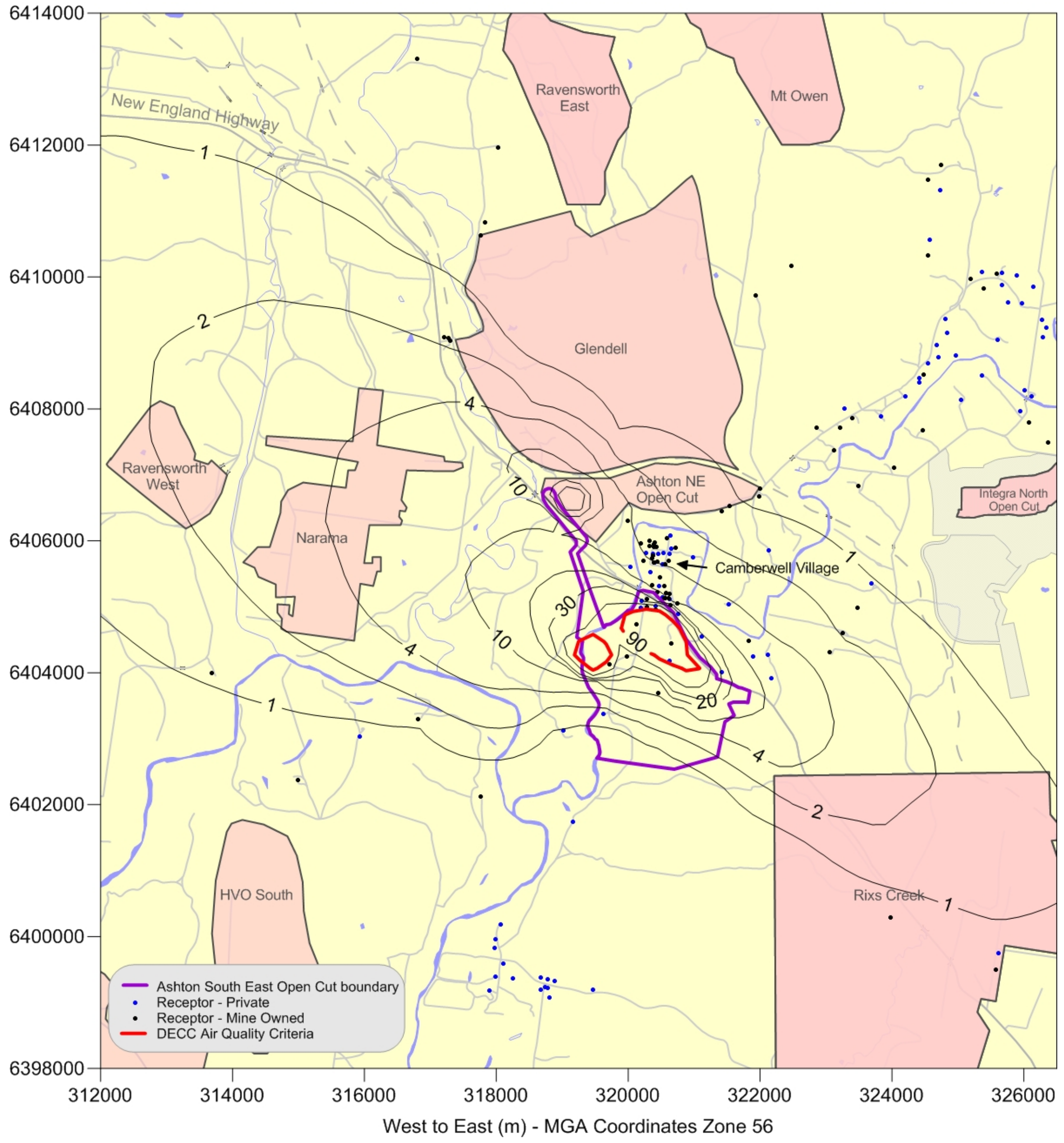
Notes:

a. These residences have Acquisition Right agreements with Glendell Mine.
b. These residences have Acquisition Right agreements with Mt Owen Mine.
c. These residences would not exist as mining would occur at the location.



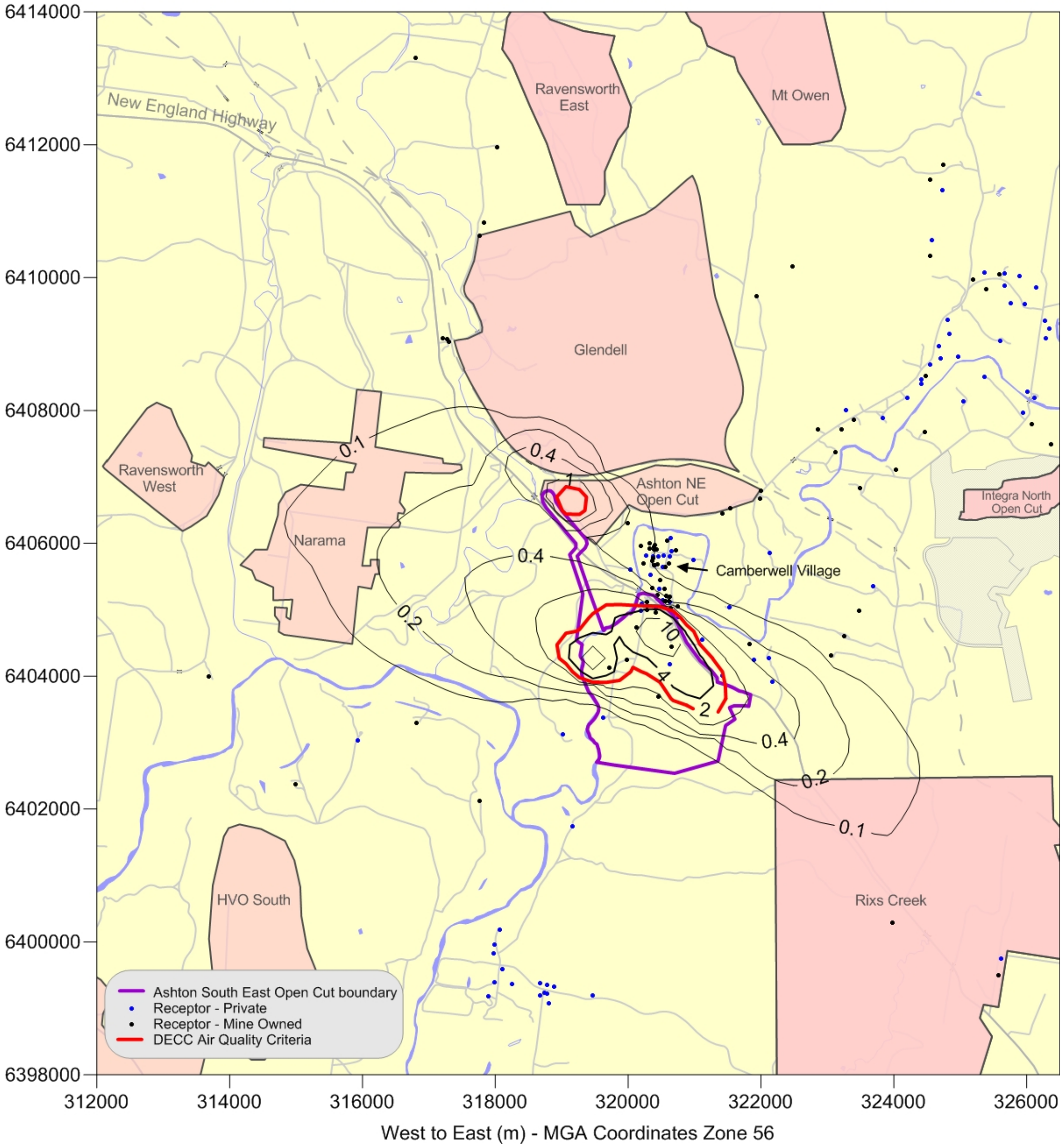
Species: PM$_{10}$	Averaging Time: Annual	Percentile: Maximum	Scenario: Year 1 Project only	Location: Ashton SEOC
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** N/A	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average PM$_{10}$ concentration due to emissions from the Project in Year 1



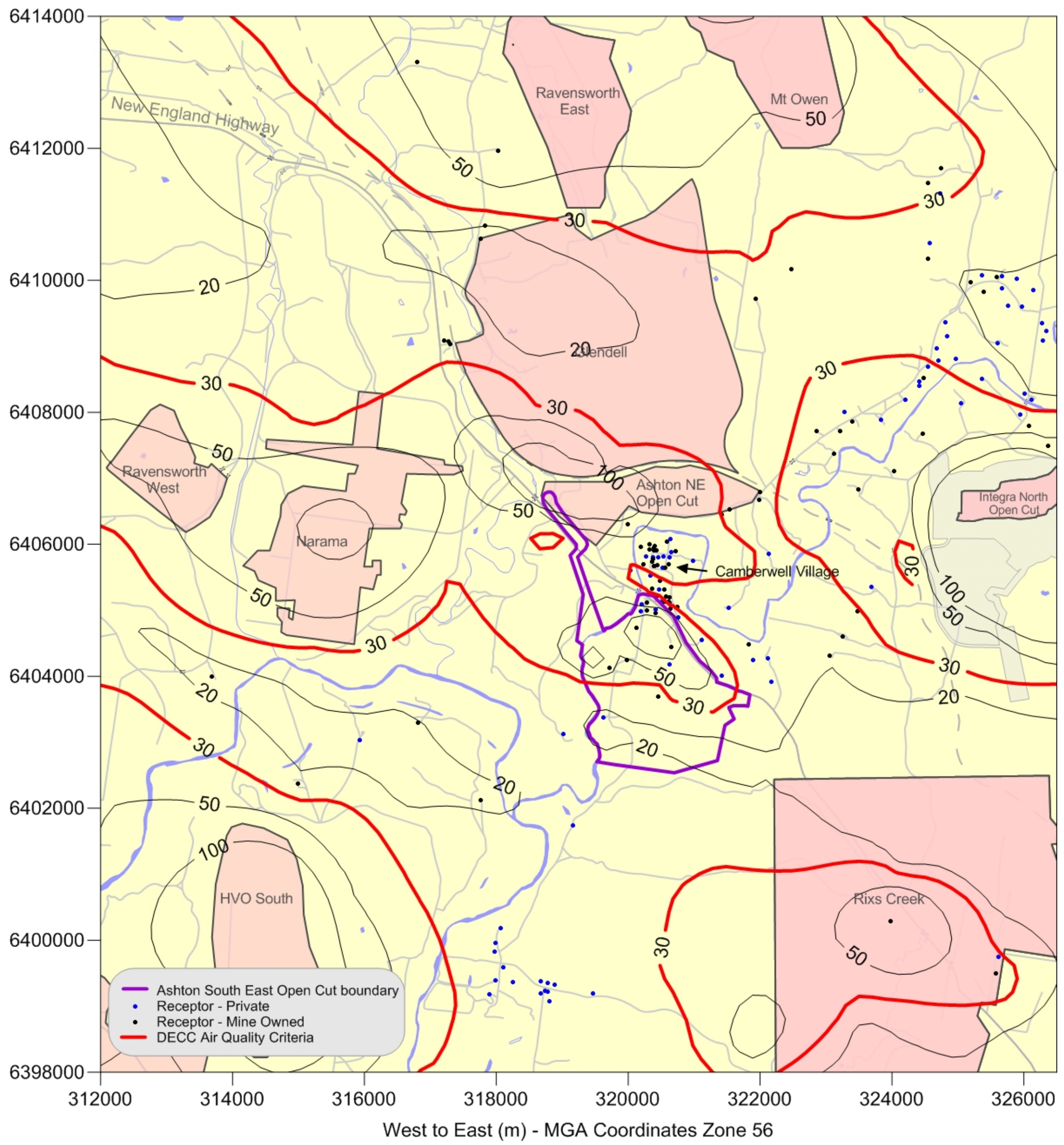
Species: TSP	Averaging Time: Annual	Percentile: Maximum	Scenario: Year 1 Project only	Location: Ashton SEOC
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** N/A	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average TSP concentration due to emissions from the Project in Year 1



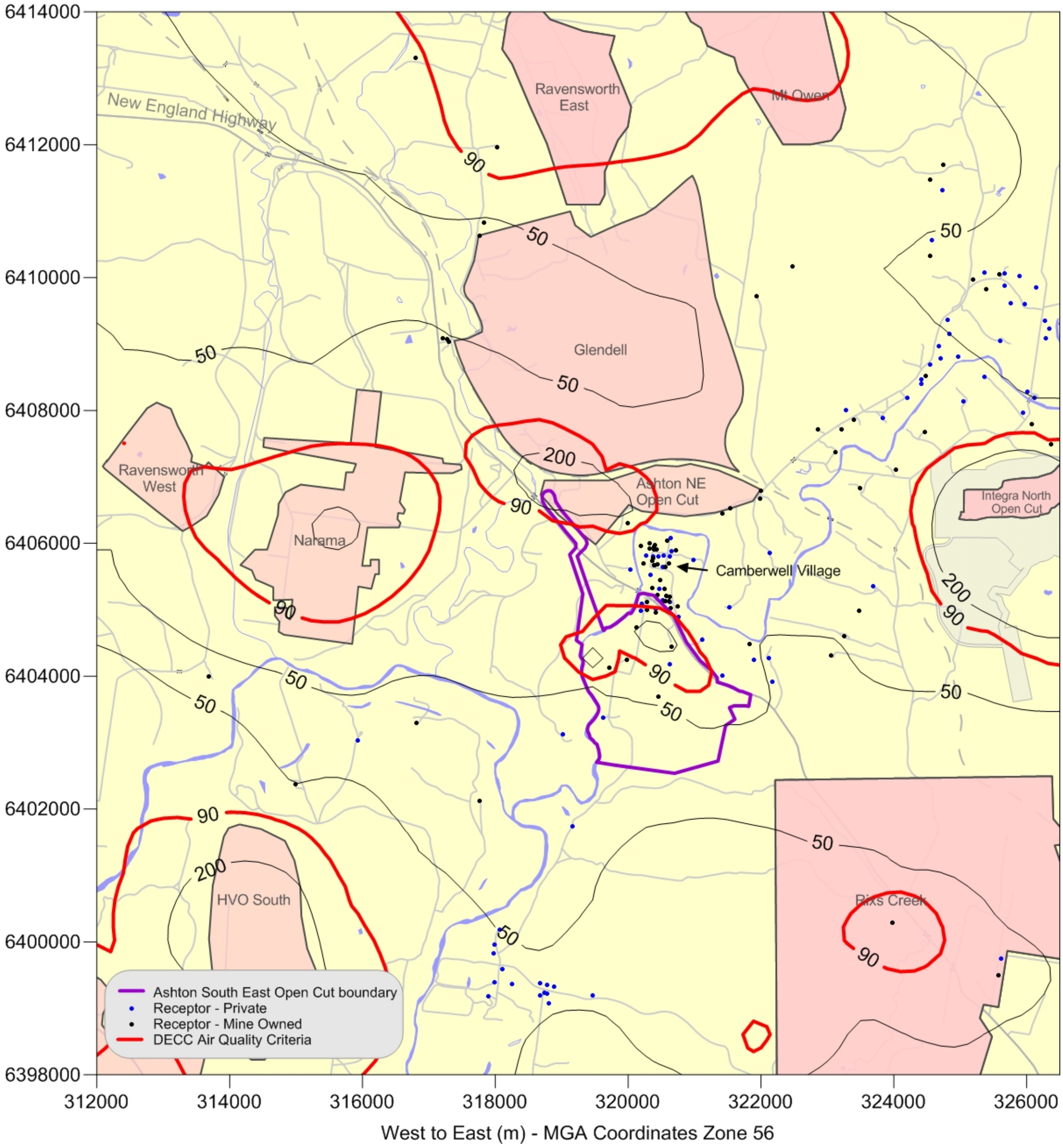
Species: Dust deposition	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Year 1 Project only	**Location:** Ashton SEOC
Model Used: ISCMOD	**Units:** $g/m^2/month$	**Assessment criteria:** NSW DECC = 2 $g/m^2/month$ (Shown as red line)	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average dust deposition concentration due to emissions from the Project in Year 1



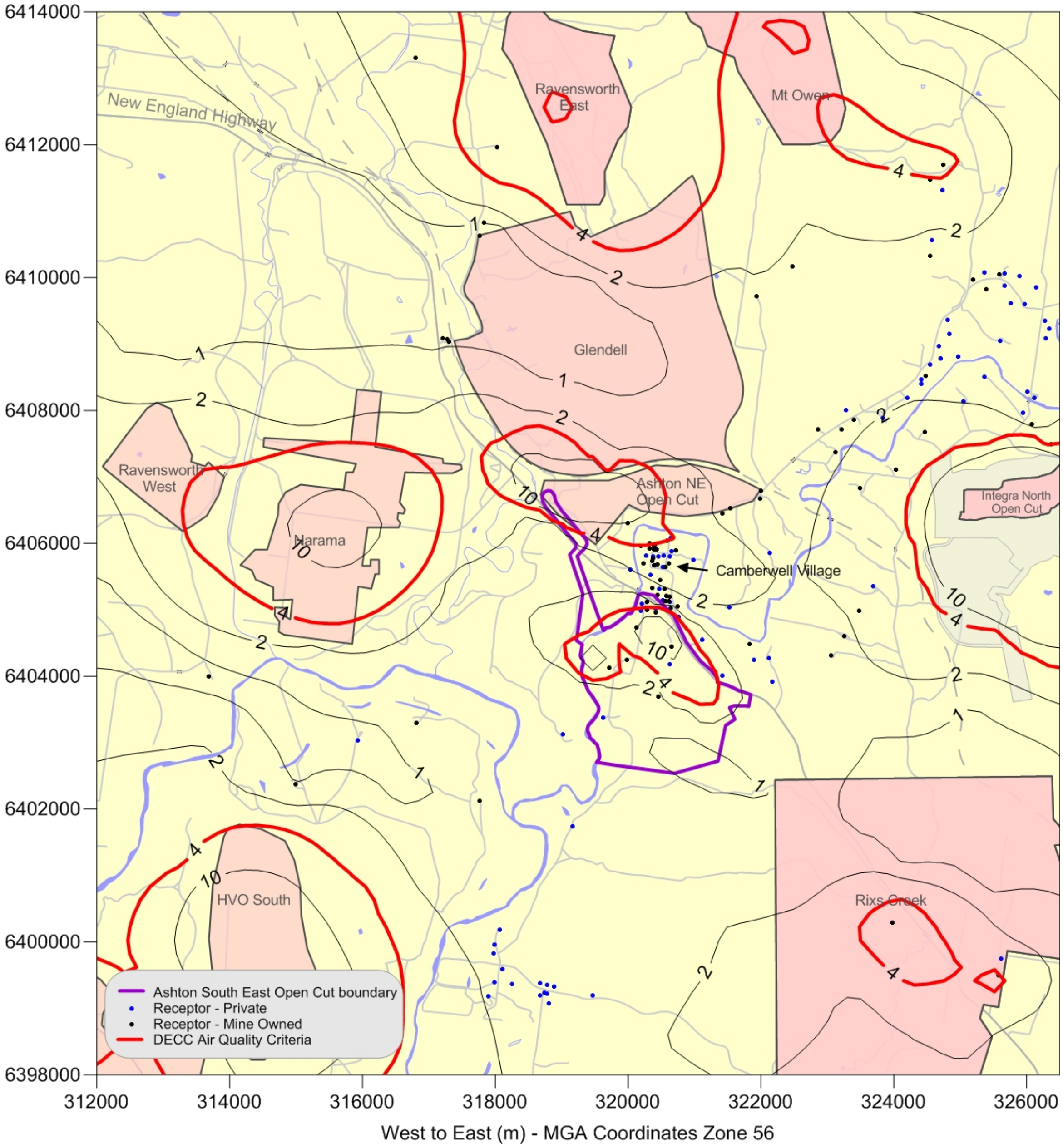
Species: PM PM_{10}	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Year 1 Project and other sources	**Location:** Ashton SEOC
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** NEPM = 30 µg/m^3 (Shown as red line)	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average PM_{10} concentration due to emissions from the Project and other sources in Year 1



Species: TSP	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Year 1 Project and other sources	**Location:** Ashton SEOC
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** NEPM = 90 µg/m^3 (Shown as red line)	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average TSP concentration due to emissions from the Project and other sources in Year 1



Species: Dust deposition	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Year 1 Project and other sources	**Location:** Ashton SEOC
Model Used: ISCMOD	**Units:** g/m²/month	**Assessment criteria:** NSW DECC = 4 g/m²/month (Shown as red line)	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average dust deposition concentration due to emissions from the Project and other sources in Year 1

8.3.3 Year 3

Figure 8. to **Figure 8.** show the predicted PM_{10} and TSP concentrations and dust deposition levels for operations in Year 3 showing the effects of the Project by itself and the Project in combination with other sources.

Table 8. presents the predicted dust concentrations results for all receptors in the vicinity of the Project and highlights in bold those values above the relevant project specific criteria or cumulative criteria where the SEOC is expected to influence air quality. The table should be read in conjunction with **Section 8.2.3** (Interpretation of impacts at sensitive receptors*)*.

In summary for Year 3 the following receptors where criteria are exceeded have been identified:

- Annual average deposition above 2 g/m^2/month due to the Project considered in isolation – no residences affected – see **Figure 8.**.
- Annual average PM_{10} above 30 $\mu g/m^3$ due to the Project and other mines and other sources – Two private residences (121 and 129) - see **Figure 8.**.
- Annual average TSP above 90 $\mu g/m^3$ due to the Project and other mines and other sources – no residences affected – see **Figure 8.**.
- Annual average dust deposition above 4 g/m^2/month due to the Project and other mines and other sources – no residences affected – see **Figure 8.**.

Table 8.. Summary of predicted annual average air quality impacts for Year 3

ID	Year 3 – Project alone			Year 3 - Project and other sources		
	PM_{10} (µg/m^3)	TSP (µg/m^3)	Dust deposition (g/m^2/month)	PM_{10} (µg/m^3)	TSP (µg/m^3)	Dust deposition (g/m^2/month)
	Assessment criteria					
	N/A	*N/A*	*2*	*30*	*90*	*4*
Private residences						
2	7	8	0.1	20	46	0.9
8	7	8	0.1	20	46	0.9
11	6	7	0.1	18	44	0.9
18	5	6	0.1	17	43	0.9
23	5	5	0.2	16	41	0.9
024A	5	5	0.2	16	42	0.9
024B	5	5	0.1	16	42	0.9
26	5	5	0.1	16	42	0.9
30	5	5	0.2	16	42	0.9
32	5	5	0.2	16	42	0.9
34	4	5	0.2	15	41	0.9
35	4	5	0.2	15	41	0.9
46	9	10	0.2	22	49	1.0
50	10	11	0.2	23	50	1.0
51	12	13	0.3	26	53	1.1
52	5	5	0.2	16	42	0.9
63	0	1	0.0	14	40	1.0
64	0	0	0.0	13	39	0.9
65	0	0	0.0	13	38	0.9
66	0	0	0.0	12	38	0.9
067A	0	0	0.0	12	37	0.8
067B	0	0	0.0	12	37	0.8
68	0	0	0.0	11	36	0.8
069A[a]	0	0	0.0	14	40	1.2
70	0	0	0.0	13	39	1.1
71	0	0	0.0	12	38	1.0
072B	1	1	0.0	11	36	0.8
072	1	1	0.0	11	36	0.8
73	0	0	0.0	12	37	1.0
74	0	0	0.0	12	37	0.9
75	0	0	0.0	11	37	0.9
76	0	0	0.0	12	38	1.0
77	0	0	0.0	14	40	1.2
78	0	0	0.0	14	40	1.3
80[a]	0	0	0.0	13	39	1.1
81	2	2	0.0	15	41	1.1
83	9	10	0.3	21	47	1.1
084A	7	8	0.3	19	45	1.0
084B	10	11	0.5	22	48	1.2
100A[b]	1	1	0.0	22	49	1.8
100B[b]	1	1	0.0	18	45	1.4
100C	1	1	0.0	16	42	1.1
100D	1	1	0.0	16	42	1.1
101A[b]	1	1	0.0	25	53	2.5
111[b]	2	3	0.1	13	39	0.9
114[b]	5	6	0.1	16	42	0.9
117	4	5	0.2	15	41	0.9
119	8	9	0.2	21	48	1.0
120	11	12	0.3	24	51	1.1
121	21	25	1.1	**34**	64	1.9
126[c]	63	89	3.4	79	131	4.3
129	12	13	0.5	**33**	61	1.7
130A	5	5	0.1	29	56	1.6
130B	1	1	0.0	25	51	1.3
131	0	0	0.0	27	54	1.8
132	0	0	0.0	27	54	1.8

ID	Year 3 – Project alone			Year 3 - Project and other sources		
	PM_{10} (μg/m³)	TSP (μg/m³)	Dust deposition (g/m²/month)	PM_{10} (μg/m³)	TSP (μg/m³)	Dust deposition (g/m²/month)
	Assessment criteria					
	N/A	*N/A*	*2*	*30*	*90*	*4*
133	0	0	0.0	27	54	1.7
137A	0	0	0.0	29	56	2.0
137B	0	0	0.0	30	57	2.2
137C	0	0	0.0	29	56	2.0
139	0	0	0.0	27	54	1.8
144	0	0	0.0	27	54	1.8
145	0	0	0.0	27	54	1.8
146	0	0	0.0	27	54	1.8
151	6	6	0.1	18	44	0.9
162	1	1	0.0	14	40	1.0
163	1	1	0.0	11	37	0.8
164	1	1	0.0	12	37	0.8
182A	0	0	0.0	27	54	1.7
182B	0	0	0.0	30	57	2.3
184A	0	0	0.0	26	53	1.7
184B	0	0	0.0	28	55	1.9
184C	0	0	0.0	28	55	2.0
187	3	3	0.0	21	47	0.9
197[b]	0	0	0.0	13	39	1.1
198[b]	0	0	0.0	25	53	3.0
217	3	3	0.2	33	63	2.7
Mine-owned residences						
1	8	8	0.2	21	47	0.9
3	7	8	0.1	20	46	0.9
4	6	7	0.1	19	45	0.9
5	6	7	0.1	19	45	0.9
6	7	8	0.1	20	46	0.9
7	7	8	0.1	20	46	0.9
10	6	6	0.1	18	44	0.9
12	7	7	0.1	19	45	0.9
13	6	7	0.1	19	45	0.9
17	5	6	0.1	17	43	0.9
21	5	5	0.1	16	42	0.9
22	5	5	0.2	16	42	0.9
25	5	5	0.1	16	42	0.9
27	5	5	0.1	16	42	0.9
28	5	5	0.1	16	42	0.9
29	5	5	0.2	16	42	0.9
31	5	5	0.1	17	42	0.9
33	4	5	0.2	15	41	0.9
36	4	5	0.2	15	41	0.9
36	5	5	0.2	16	42	0.9
38	5	5	0.2	16	42	0.9
39	5	5	0.2	16	42	0.9
40	5	5	0.2	16	42	0.9
41	5	5	0.2	16	42	0.9
43	5	5	0.2	16	42	0.9
44	5	5	0.2	16	42	0.9
45	10	11	0.2	23	50	1.0
47	10	12	0.2	24	51	1.1
49	8	9	0.2	22	48	1.0
069B	0	0	0.0	12	38	1.0
079A	1	1	0.0	34	65	3.3
079B	0	0	0.0	12	38	1.0
079C	0	0	0.0	14	40	1.2
101B	1	1	0.0	24	52	2.3
115	6	7	0.4	17	43	1.1
118	7	8	0.2	20	46	0.9

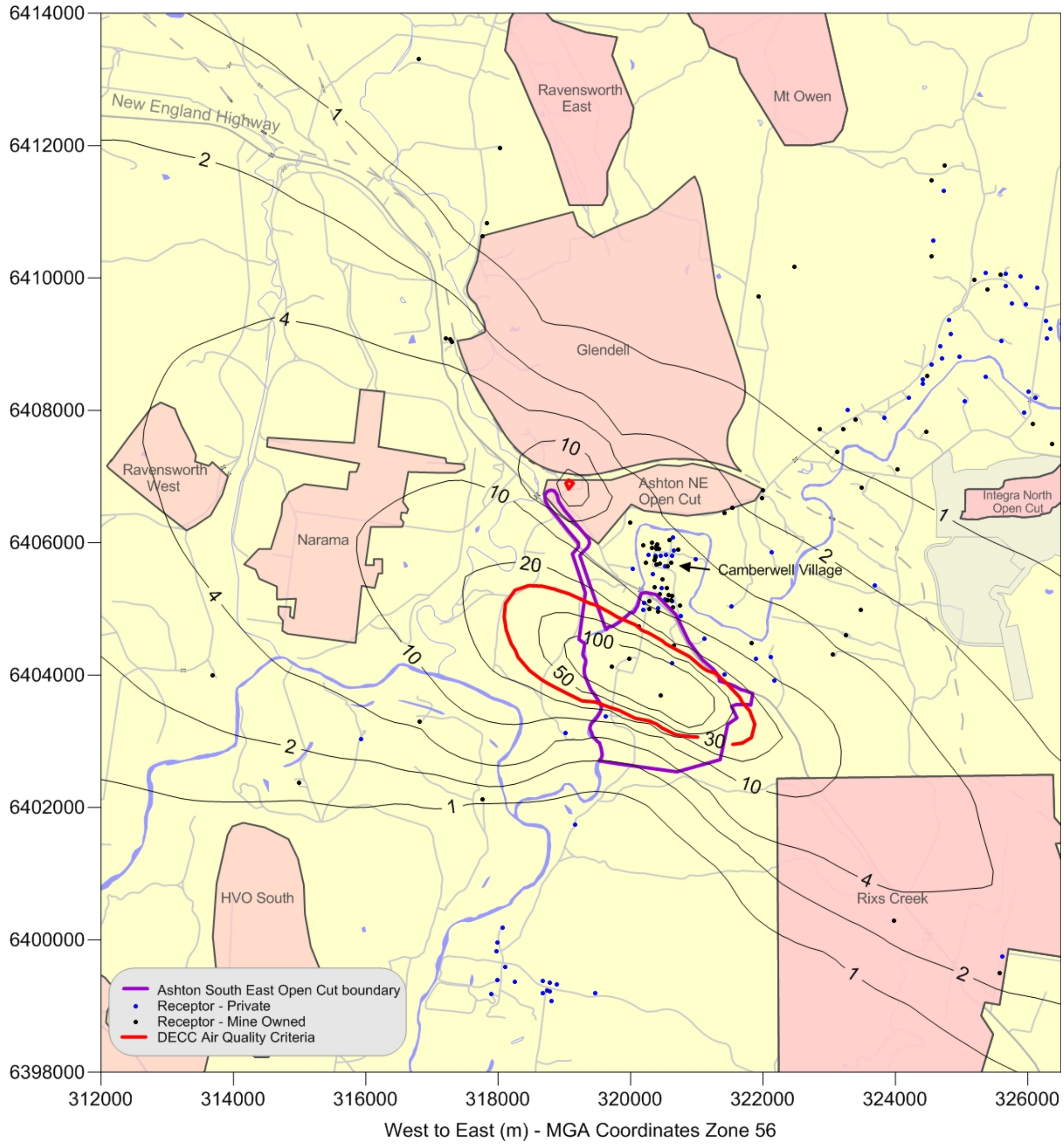
ID	Year 3 – Project alone			Year 3 - Project and other sources		
	PM_{10} (µg/m³)	TSP (µg/m³)	Dust deposition (g/m²/month)	PM_{10} (µg/m³)	TSP (µg/m³)	Dust deposition (g/m²/month)
	Assessment criteria					
	N/A	*N/A*	*2*	*30*	*90*	*4*
122[c]	21	26	0.7	36	66	1.5
123[c]	25	29	0.7	40	69	1.6
125[c]	165	218	12.0	182	262	13.1
127[c]	269	369	29.3	288	414	30.5
128[c]	527	908	88.1	545	952	89.1
153	3	3	0.1	18	43	0.8
159A	2	2	0.0	15	41	1.1
159B	2	2	0.0	15	41	1.2
159C	2	2	0.0	14	40	1.0
159D	2	2	0.0	14	39	0.9
159E	1	1	0.0	20	47	1.9
159F	1	1	0.0	24	52	2.4
159G	1	1	0.0	24	52	2.5
160A	2	3	0.1	14	40	0.9
160B	3	4	0.1	14	39	0.9
160C	4	5	0.1	14	40	0.9
160D	1	1	0.0	15	41	1.1
161A	1	1	0.0	18	45	1.5
161B	1	1	0.0	20	47	1.8
161C	7	8	0.2	19	45	1.0
161D	1	1	0.0	19	45	1.5
166	1	1	0.0	12	37	0.9
168	1	1	0.0	12	38	0.9
181A	4	4	0.1	26	52	1.5
181B	1	1	0.0	24	52	1.0
181C	1	1	0.0	23	49	1.2
189	3	3	0.0	26	53	1.6
190	3	3	0.0	26	53	1.6
191	3	3	0.0	26	53	1.6
192	1	1	0.0	34	61	1.6
193	1	1	0.0	33	60	1.6
194A	0	0	0.0	28	55	1.2
194B	0	0	0.0	23	49	0.9
195	1	1	0.0	16	43	1.0
196	0	0	0.0	12	38	0.9
199	0	0	0.0	27	56	3.4
200	0	0	0.0	37	67	4.5
218A	3	3	0.2	104	147	5.8
218B	1	2	0.1	24	51	2.1
218C	2	2	0.1	48	81	5.3

Notes:

a. These residences have Acquisition Right agreements with Glendell Mine.

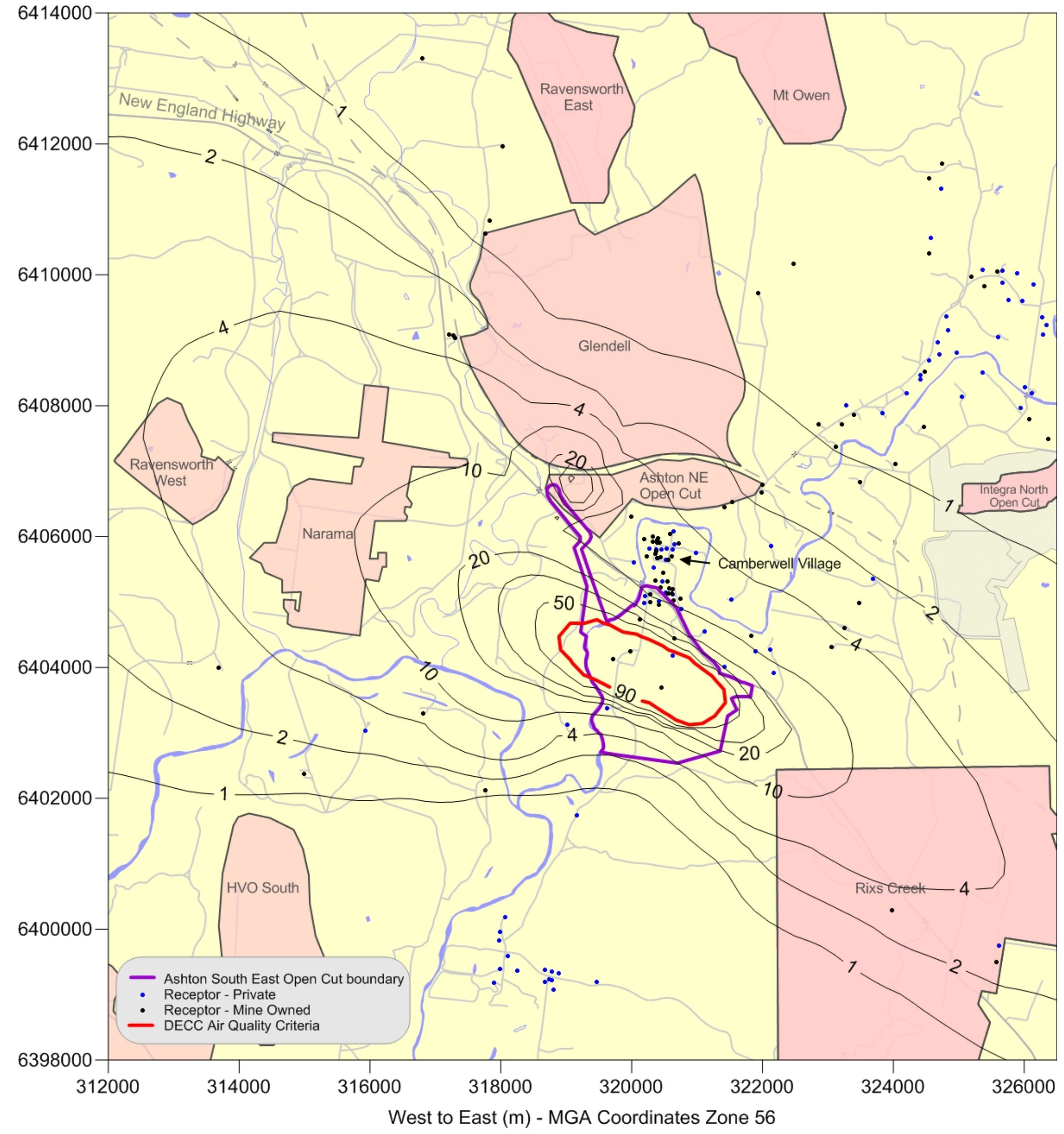
b. These residences have Acquisition Right agreements with Mt Owen Mine.

c. These residences would not exist as mining would occur at the location.



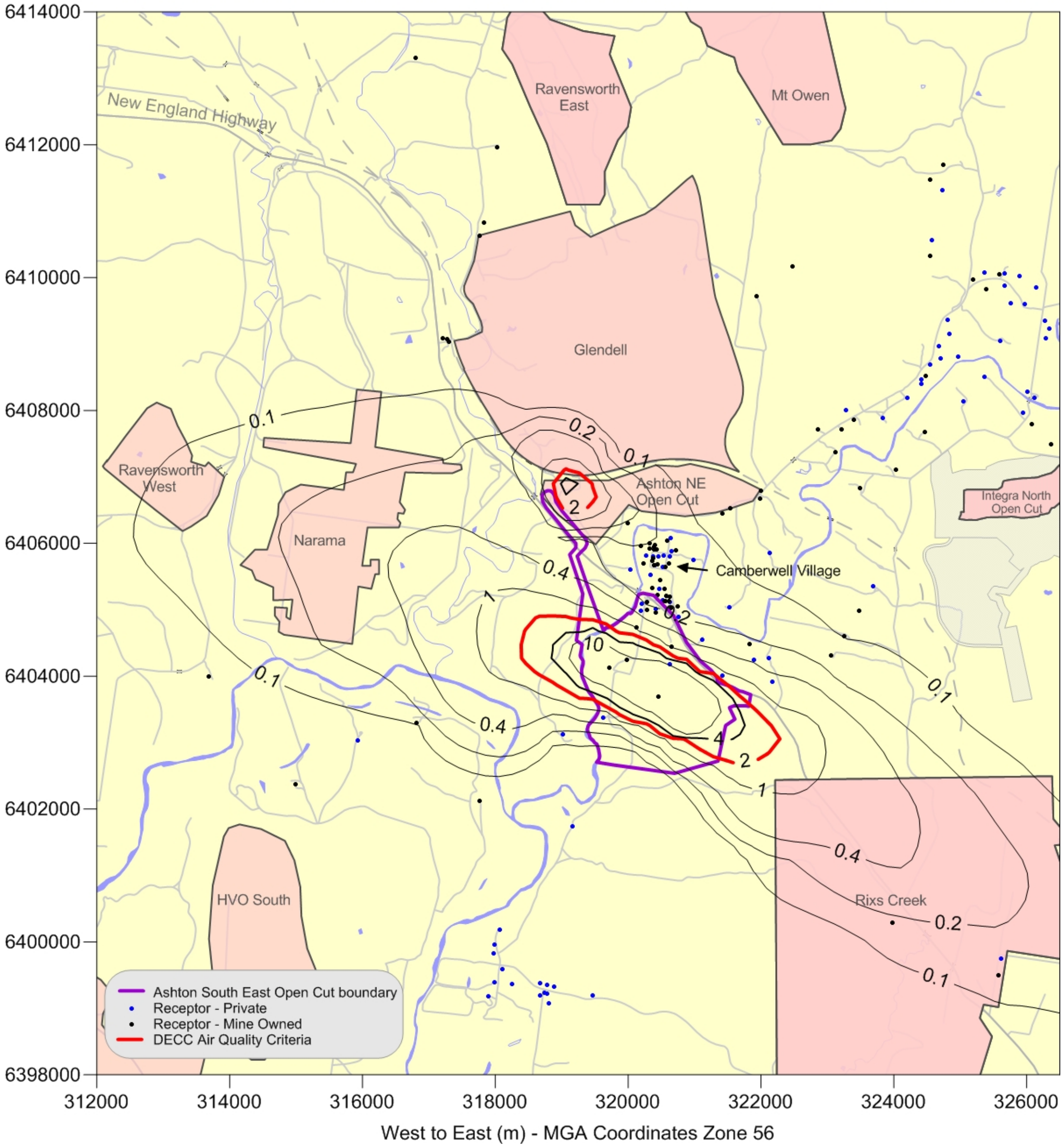
Species: PM$_{10}$	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Year 3 Project only	**Location:** Ashton SEOC
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** N/A	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average PM$_{10}$ concentration due to emissions from the Project in Year 3



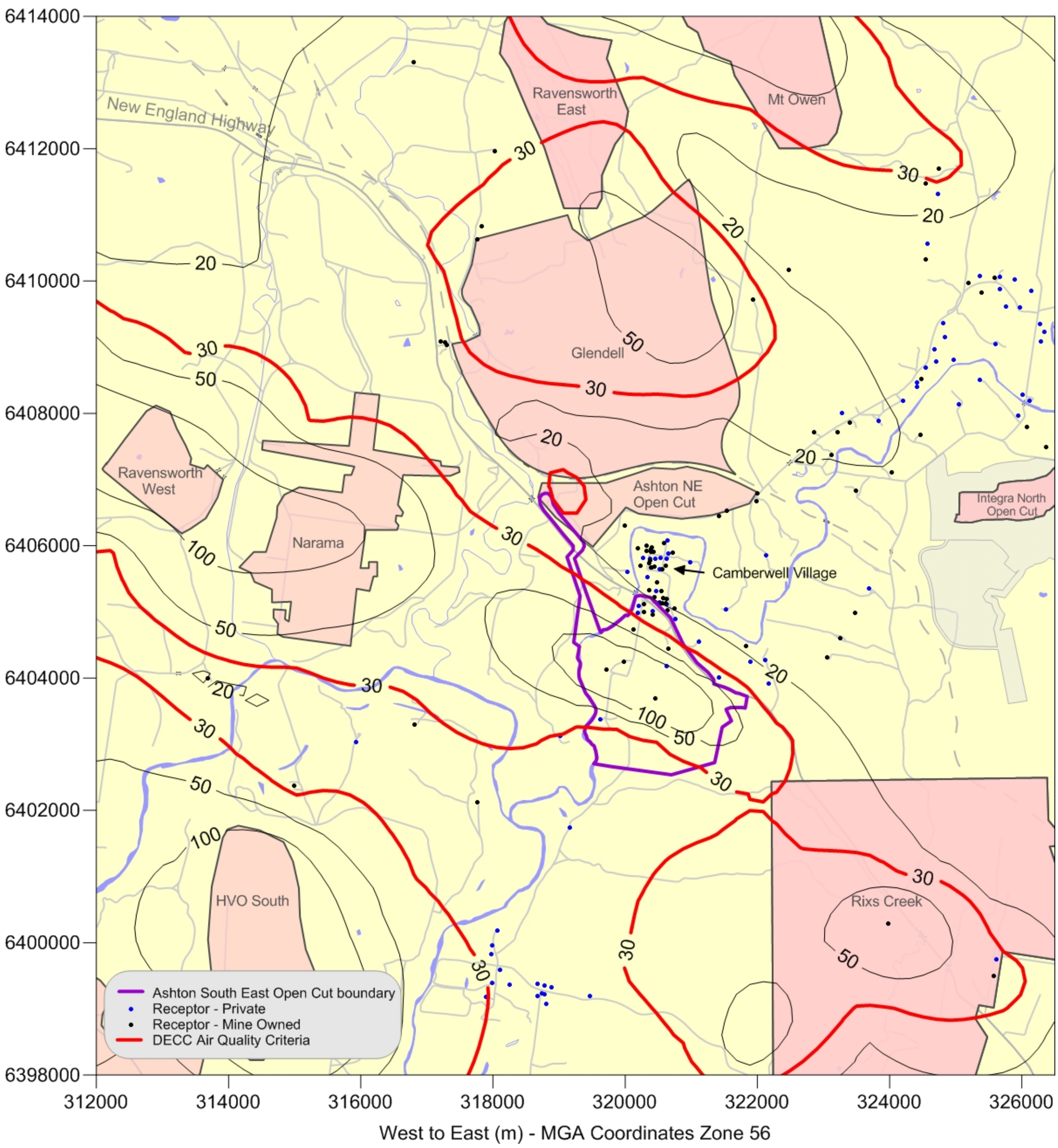
Species: TSP	Averaging Time: Annual	Percentile: Maximum	Scenario: Year 3 Project only	Location: Ashton SEOC
Model Used: ISCMOD	**Units:** $\mu g/m^3$	**Assessment criteria:** N/A	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average TSP concentration due to emissions from the Project in Year 3



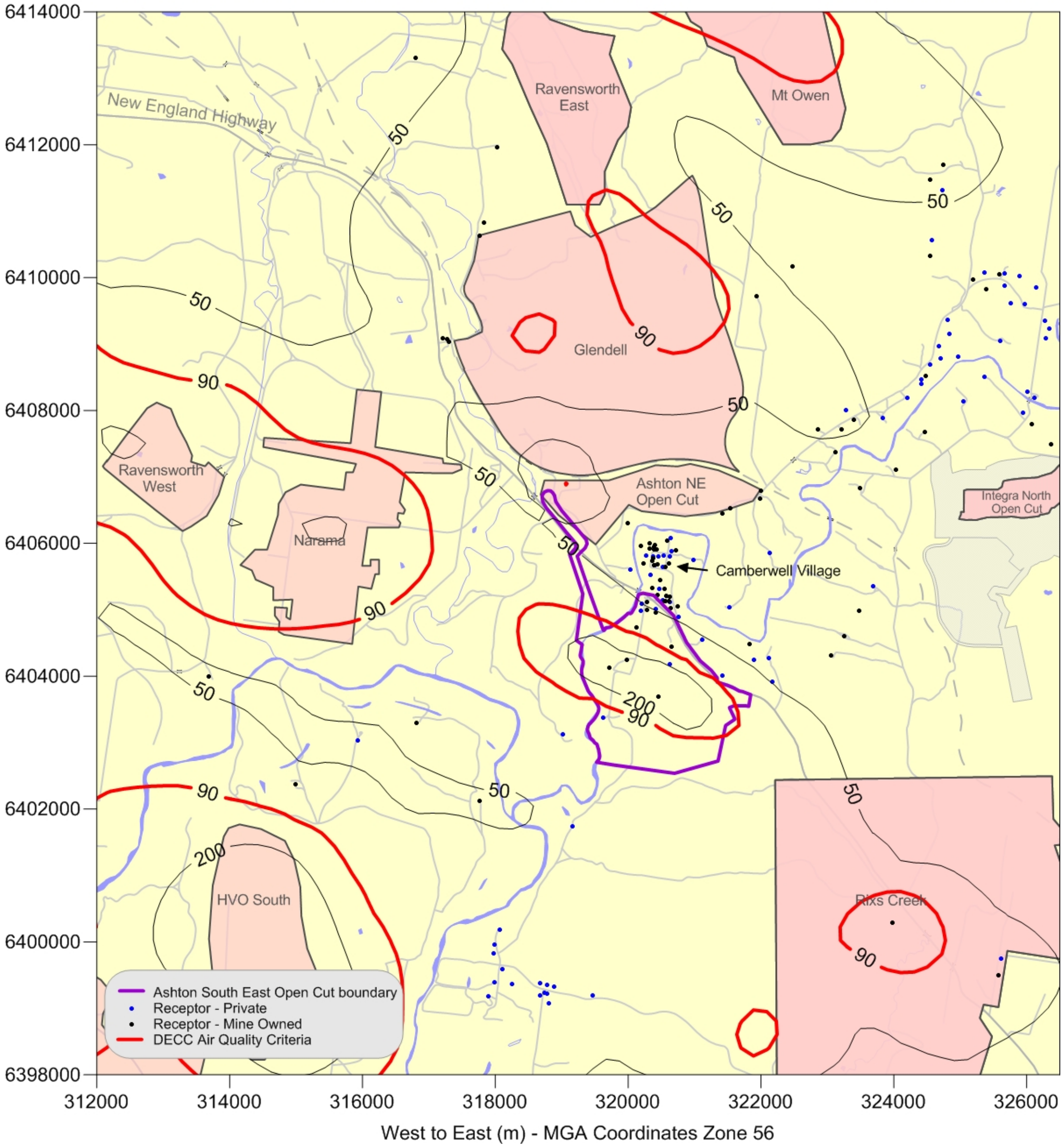
Species: Dust deposition	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Year 3 Project only	**Location:** Ashton SEOC
Model Used: ISCMOD	**Units:** g/m^2/month	**Assessment criteria:** NSW DECC = 2 g/m^2/month (Shown as red line)	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average dust deposition concentration due to emissions from the Project in Year 3



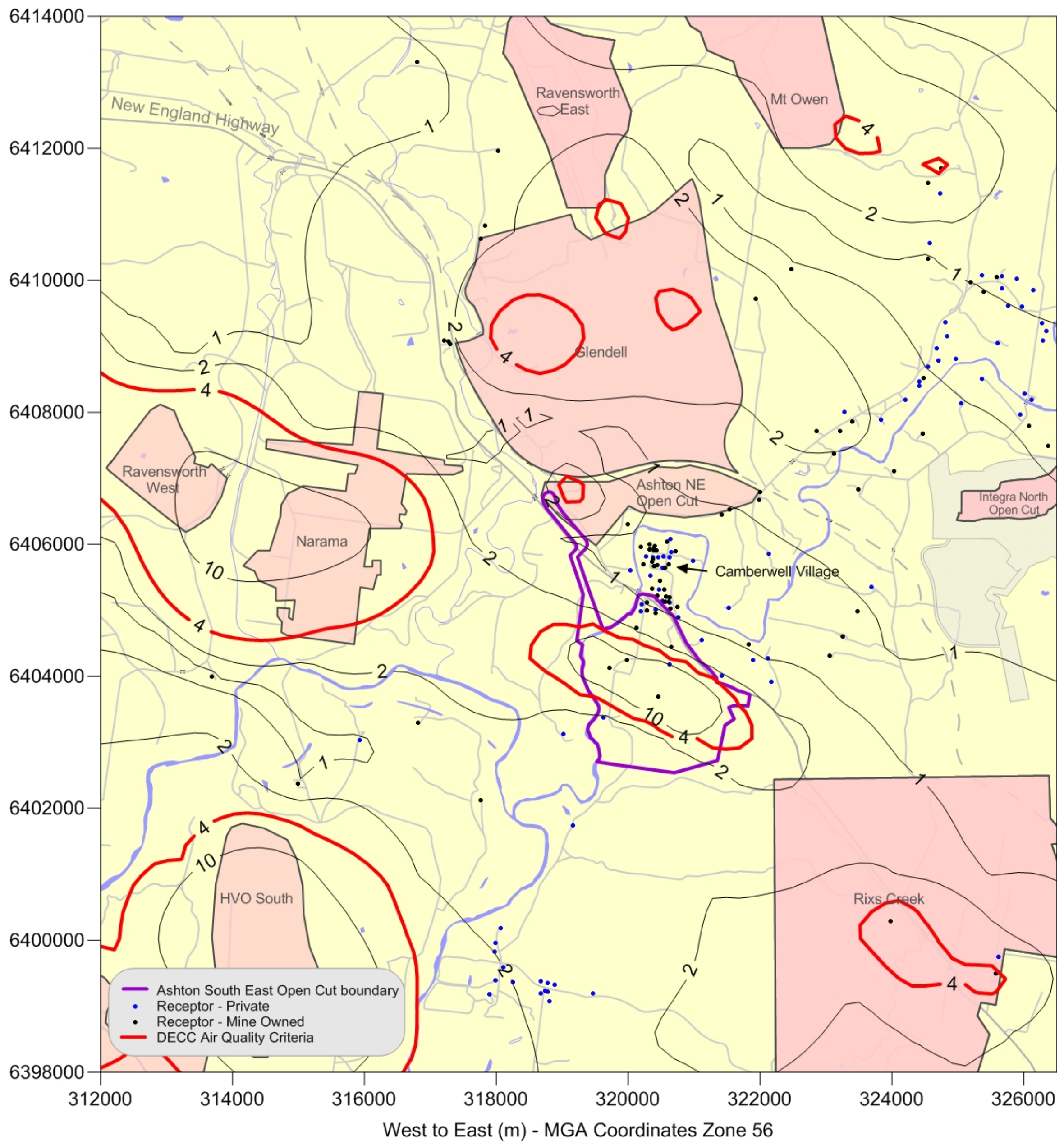
Species: PM_{10}	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Year 3 Project and other sources	**Location:** Ashton SEOC
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** NEPM = 30 µg/^{m3} (Shown as red line)	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average PM_{10} concentration due to emissions from the Project and other sources in Year 3



Species: TSP	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Year 3 Project and other sources	**Location:** Ashton SEOC
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** NEPM = 90 µg/m^3 (Shown as red line)	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average TSP concentration due to emissions from the Project and other sources in Year 3



Species: Dust deposition	Averaging Time: Annual	Percentile: Maximum	Scenario: Year 3 Project and other sources	Location: Ashton SEOC
Model Used: ISCMOD	**Units:** g/m²/month	**Assessment criteria:** NSW DECC = 4 g/m²/month (Shown as red line)	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average dust deposition concentration due to emissions from the Project and other sources in Year 3

8.3.4 Year 5

Figure 8. to **Figure 8.** show the predicted PM_{10} and TSP concentrations and dust deposition levels for operations in Year 5 showing the effects of the Project by itself and the Project in combination with other sources.

Table 8. presents the predicted dust concentrations results for all receptors in the vicinity of the Project and highlights in bold those values above the relevant project specific criteria or cumulative criteria where the SEOC is expected to influence air quality. The table should be read in conjunction with **Section 8.2.3** (Interpretation of impacts at sensitive receptors).

In summary for Year 5 the following receptors where criteria are exceeded have been identified:

- Annual average deposition above 2 g/m^2/month due to the Project considered in isolation – no residences affected – see **Figure 8.**.
- Annual average PM_{10} above 30 $\mu g/m^3$ due to the Project and other mines and other sources – One private residence (130A) – see **Figure 8.**.
- Annual average TSP above 90 $\mu g/m^3$ due to the Project and other mines and other sources – no residences affected – see **Figure 8.**.
- Annual average dust deposition above 4 g/m^2/month due to the Project and other mines and other sources – no residences affected – see **Figure 8.**.

Table 8.. Summary of predicted annual average air quality impacts for Year 5

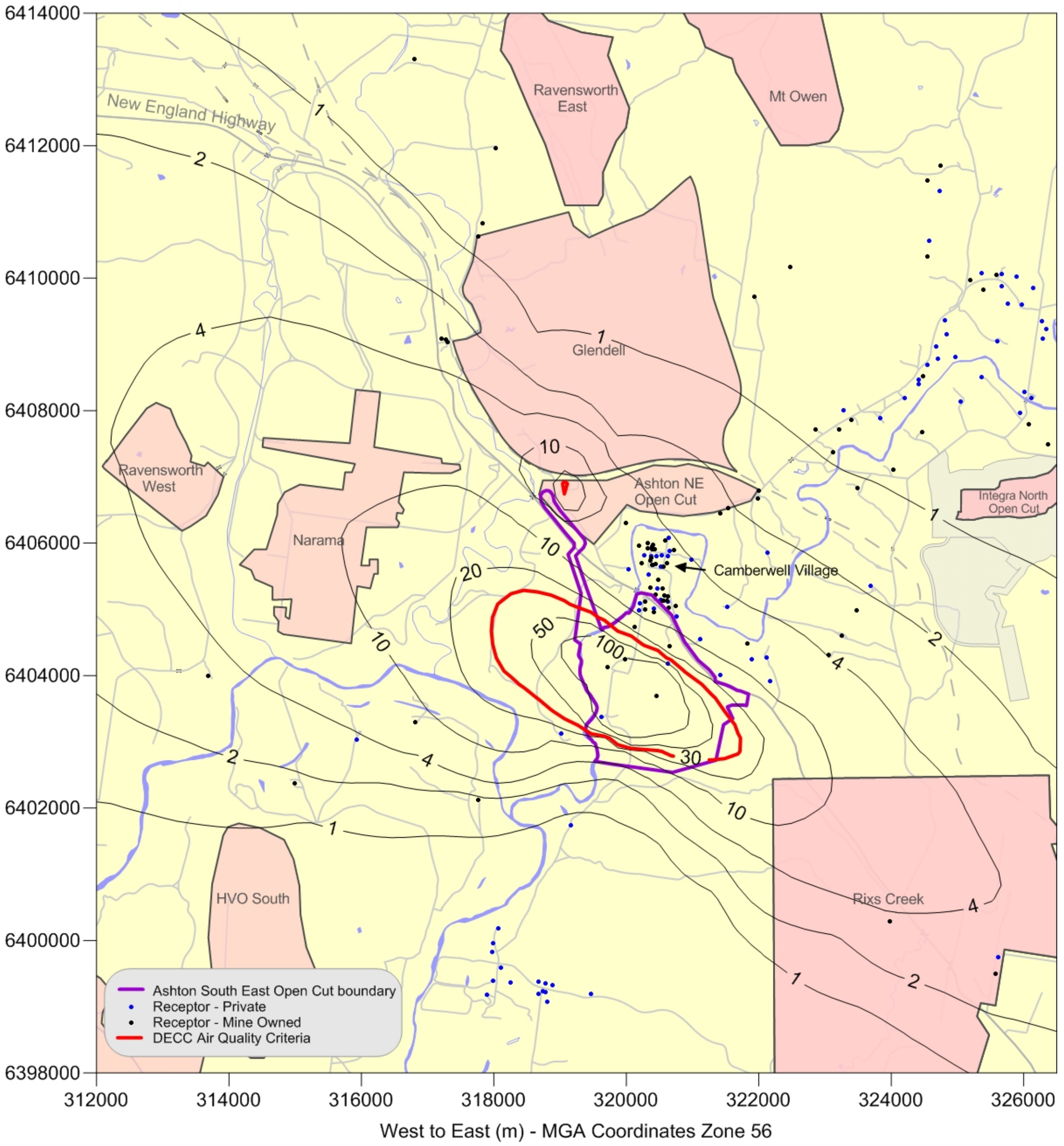
ID	Year 5 – Project alone			Year 5 - Project and other sources		
	PM_{10} (µg/m³)	TSP (µg/m³)	Dust deposition (g/m²/month)	PM_{10} (µg/m³)	TSP (µg/m³)	Dust deposition (g/m²/month)
	Assessment criteria					
	N/A	*N/A*	*2*	*30*	*90*	*4*
Private residences						
2	6	7	0.1	14	40	0.7
8	6	7	0.1	14	40	0.7
11	5	6	0.1	13	39	0.7
18	5	5	0.1	12	38	0.7
23	4	5	0.2	11	37	0.7
024A	5	5	0.2	11	37	0.7
024B	5	5	0.1	12	37	0.7
26	5	5	0.1	12	37	0.7
30	5	5	0.2	11	37	0.7
32	4	5	0.2	11	37	0.7
34	4	5	0.2	11	37	0.7
35	4	5	0.2	11	36	0.7
46	7	8	0.1	15	41	0.7
50	7	8	0.1	15	41	0.7
51	8	9	0.2	17	43	0.8
52	5	5	0.2	11	37	0.7
63	0	1	0.0	17	42	1.3
64	0	0	0.0	16	42	1.2
65	0	0	0.0	17	43	1.3
66	0	0	0.0	16	42	1.2
067A	0	0	0.0	18	44	1.3
067B	0	0	0.0	17	43	1.3
68	0	0	0.0	16	42	1.3
069A[a]	0	0	0.0	24	51	2.2
70	0	0	0.0	22	49	1.9
71	0	0	0.0	20	46	1.7
072B	1	1	0.0	14	40	1.1
072	1	1	0.0	14	40	1.1
73	0	0	0.0	18	44	1.5
74	0	0	0.0	18	44	1.5
75	0	0	0.0	17	43	1.4
76	0	0	0.0	20	46	1.7
77	0	0	0.0	22	48	1.9
78	0	0	0.0	24	51	2.1
80[a]	0	0	0.0	23	50	2.1
81	2	2	0.0	11	36	0.9
83	7	8	0.2	15	41	0.8
084A	6	7	0.2	13	39	0.8
084B	8	9	0.3	16	42	0.9
100A[b]	1	1	0.0	16	42	1.3
100B[b]	1	1	0.0	16	42	1.2
100C	1	1	0.0	16	42	1.2
100D	1	1	0.0	16	42	1.2
101A[b]	1	1	0.0	17	43	1.4
111[b]	2	2	0.1	9	35	0.7
114[b]	5	5	0.1	11	37	0.7
117	4	4	0.2	11	36	0.7
119	7	8	0.1	15	41	0.7
120	8	9	0.2	16	43	0.8
121	14	16	0.6	23	50	1.2
126[c]	27	35	1.1	37	70	1.7
129[c]	145	170	9.6	159	210	10.4
130A	15	16	0.5	**31**	57	1.3
130B	1	1	0.0	20	46	1.0
131	0	0	0.0	24	51	1.6
132	0	0	0.0	24	51	1.6

ID	Year 5 – Project alone			Year 5 - Project and other sources		
	PM10 (µg/m³)	TSP (µg/m³)	Dust deposition (g/m²/month)	PM10 (µg/m³)	TSP (µg/m³)	Dust deposition (g/m²/month)
	Assessment criteria					
	N/A	*N/A*	*2*	*30*	*90*	*4*
133	0	0	0.0	24	51	1.6
137A	0	0	0.0	25	52	1.8
137B	0	0	0.0	26	53	1.9
137C	0	0	0.0	25	52	1.8
139	0	0	0.0	24	51	1.6
144	0	0	0.0	24	51	1.6
145	0	0	0.0	24	51	1.6
146	0	0	0.0	24	51	1.6
151	5	5	0.1	12	37	0.7
162	1	1	0.0	15	40	1.1
163	1	1	0.0	15	41	1.2
164	1	1	0.0	14	40	1.1
182A	0	0	0.0	25	51	1.5
182B	0	0	0.0	26	53	1.9
184A	0	0	0.0	23	50	1.5
184B	0	0	0.0	25	51	1.7
184C	0	0	0.0	25	52	1.8
187	4	4	0.1	18	44	0.8
197[b]	0	0	0.0	25	53	2.6
198[b]	0	0	0.0	44	77	5.7
217	3	3	0.2	33	64	3.0
Mine-owned residences						
1	7	7	0.1	15	40	0.7
3	6	7	0.1	14	40	0.7
4	6	6	0.1	13	39	0.7
5	6	6	0.1	13	39	0.7
6	6	7	0.1	14	40	0.7
7	6	7	0.1	14	40	0.7
10	5	6	0.1	13	38	0.7
12	6	6	0.1	14	39	0.7
13	5	6	0.1	13	39	0.7
17	5	5	0.1	12	38	0.7
21	5	5	0.1	12	37	0.7
22	5	5	0.2	11	37	0.7
25	5	5	0.1	12	37	0.7
27	5	5	0.1	12	37	0.7
28	5	5	0.1	12	37	0.7
29	5	5	0.2	11	37	0.7
31	4	5	0.1	12	37	0.7
33	4	5	0.2	11	36	0.7
36	4	5	0.2	11	37	0.7
36	5	5	0.2	11	37	0.7
38	5	5	0.2	11	37	0.7
39	5	5	0.2	11	37	0.7
40	5	5	0.2	11	37	0.7
41	5	5	0.2	11	37	0.7
43	5	5	0.2	11	37	0.8
44	4	5	0.2	11	37	0.7
45	8	9	0.2	16	42	0.7
47	8	9	0.2	16	42	0.7
49	7	7	0.1	15	40	0.7
069B	0	0	0.0	21	47	1.8
079A	1	1	0.0	25	53	2.4
079B	0	0	0.0	22	48	1.9
079C	0	0	0.0	24	51	2.1
101B	1	1	0.0	17	43	1.4
115	6	6	0.4	12	38	0.9
118	6	7	0.1	14	40	0.7

ID	Year 5 – Project alone			Year 5 - Project and other sources		
	PM$_{10}$ ($\mu g/m^3$)	TSP ($\mu g/m^3$)	Dust deposition (g/m^2/month)	PM$_{10}$ ($\mu g/m^3$)	TSP ($\mu g/m^3$)	Dust deposition (g/m^2/month)
	Assessment criteria					
	N/A	*N/A*	*2*	*30*	*90*	*4*
122[c]	15	17	0.4	24	51	1.0
123[c]	14	16	0.4	23	50	1.0
125[c]	97	123	5.5	108	159	6.1
127[c]	216	301	22.8	227	338	23.4
128[c]	504	879	83.3	516	916	84.0
153	3	3	0.1	16	41	0.7
159A	2	2	0.0	12	38	1.1
159B	2	2	0.0	13	39	1.3
159C	2	2	0.0	10	35	0.7
159D	2	2	0.0	10	35	0.7
159E	1	1	0.0	19	46	1.9
159F	1	1	0.0	18	44	1.6
159G	1	1	0.0	20	47	1.9
160A	2	2	0.1	10	35	0.7
160B	3	3	0.1	10	35	0.7
160C	4	4	0.1	11	36	0.7
160D	1	1	0.0	16	42	1.2
161A	1	1	0.0	17	44	1.7
161B	1	1	0.0	16	42	1.3
161C	6	7	0.2	13	39	0.7
161D	1	1	0.0	15	40	1.2
166	1	1	0.0	14	39	1.0
168	1	1	0.0	13	39	1.0
181A	6	6	0.2	21	47	1.0
181B	2	2	0.0	22	49	1.0
181C	1	1	0.0	19	45	0.9
189	3	3	0.0	20	46	1.2
190	3	3	0.0	20	46	1.2
191	3	3	0.0	20	46	1.2
192	1	1	0.0	37	65	1.7
193	1	1	0.0	36	64	1.4
194A	0	0	0.0	122	172	9.6
194B	0	0	0.0	64	94	2.9
195	1	1	0.0	24	52	2.1
196	0	0	0.0	23	49	2.0
199	0	0	0.0	50	85	6.6
200	0	0	0.0	45	76	4.5
218A	4	4	0.2	103	146	6.2
218B	2	2	0.1	22	49	2.0
218C	3	3	0.2	49	83	5.8

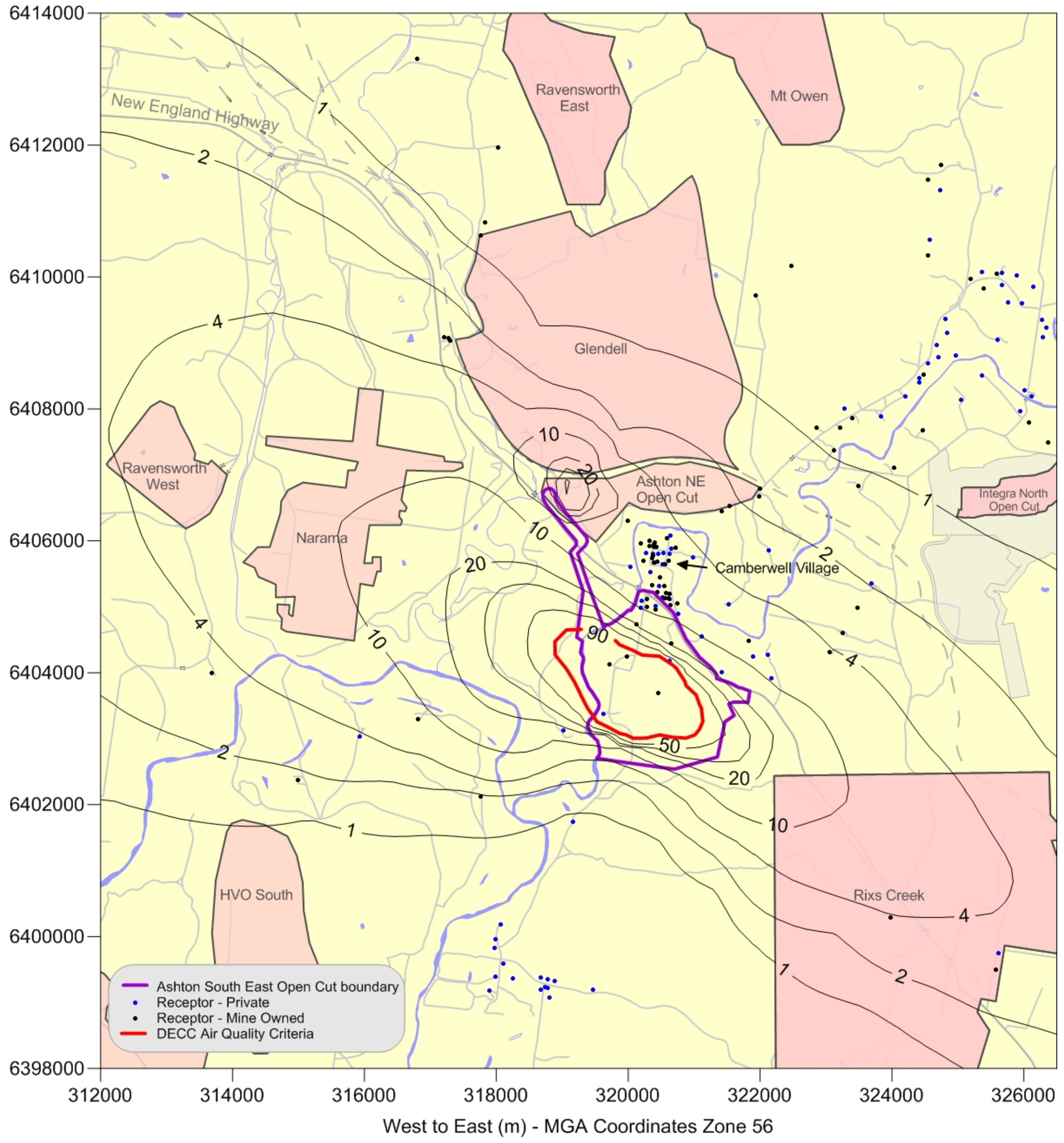
Notes:

a. These residences have Acquisition Right agreements with Glendell Mine.
b. These residences have Acquisition Right agreements with Mt Owen Mine.
c. These residences would not exist as mining would occur at the location.



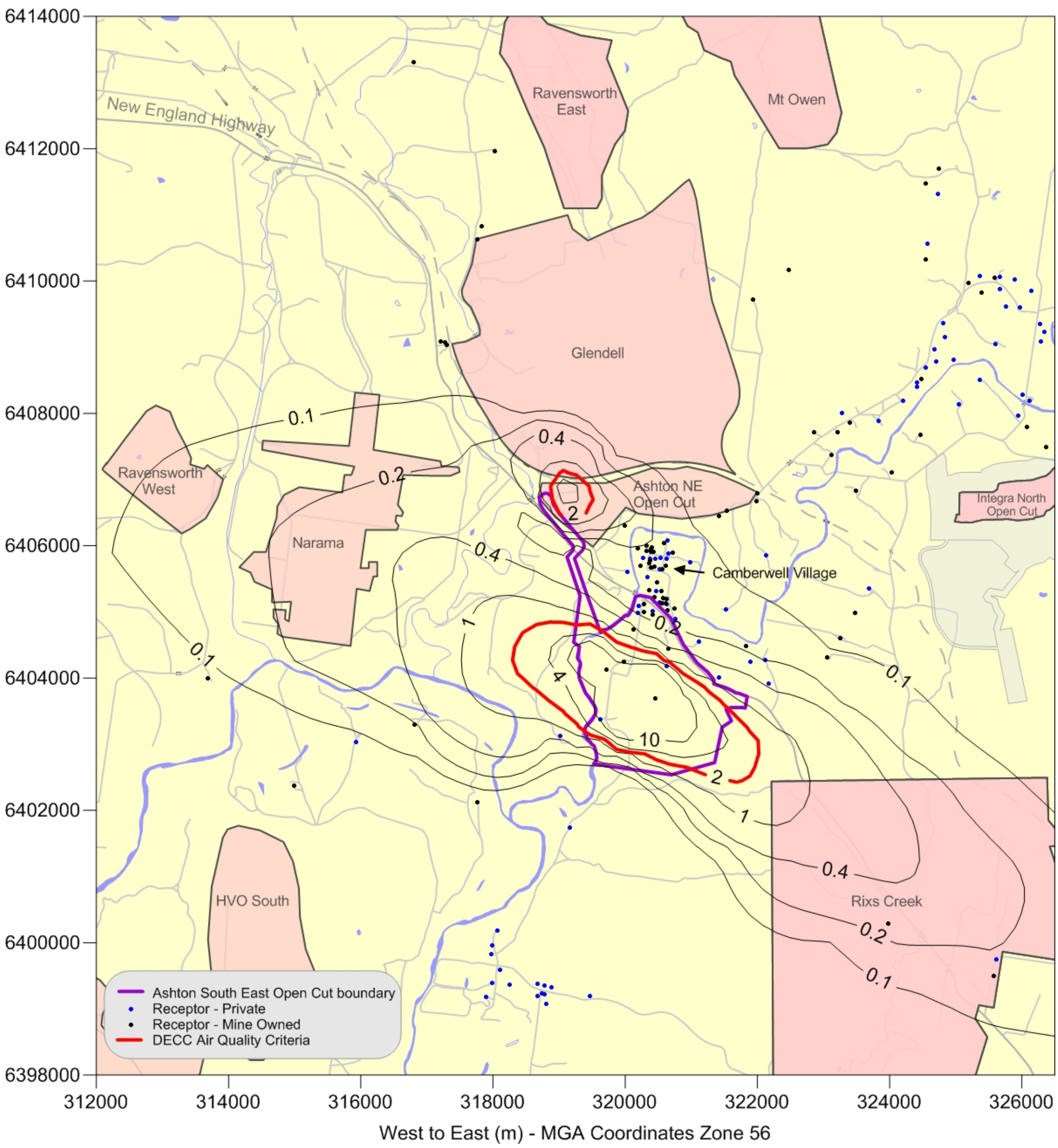
Species:	Averaging Time:	Percentile:	Scenario:	Location:
PM_{10}	Annual	Maximum	Year 5 Project only	Ashton SEOC
Model Used:	**Units:**	**Assessment criteria:**	**Met Data:**	**Plot:**
ISCMOD	$\mu g/m^3$	N/A	Repeater Station 2007-2008	F Triffett

Figure 8.: Predicted annual average PM_{10} concentration due to emissions from the Project in Year 5



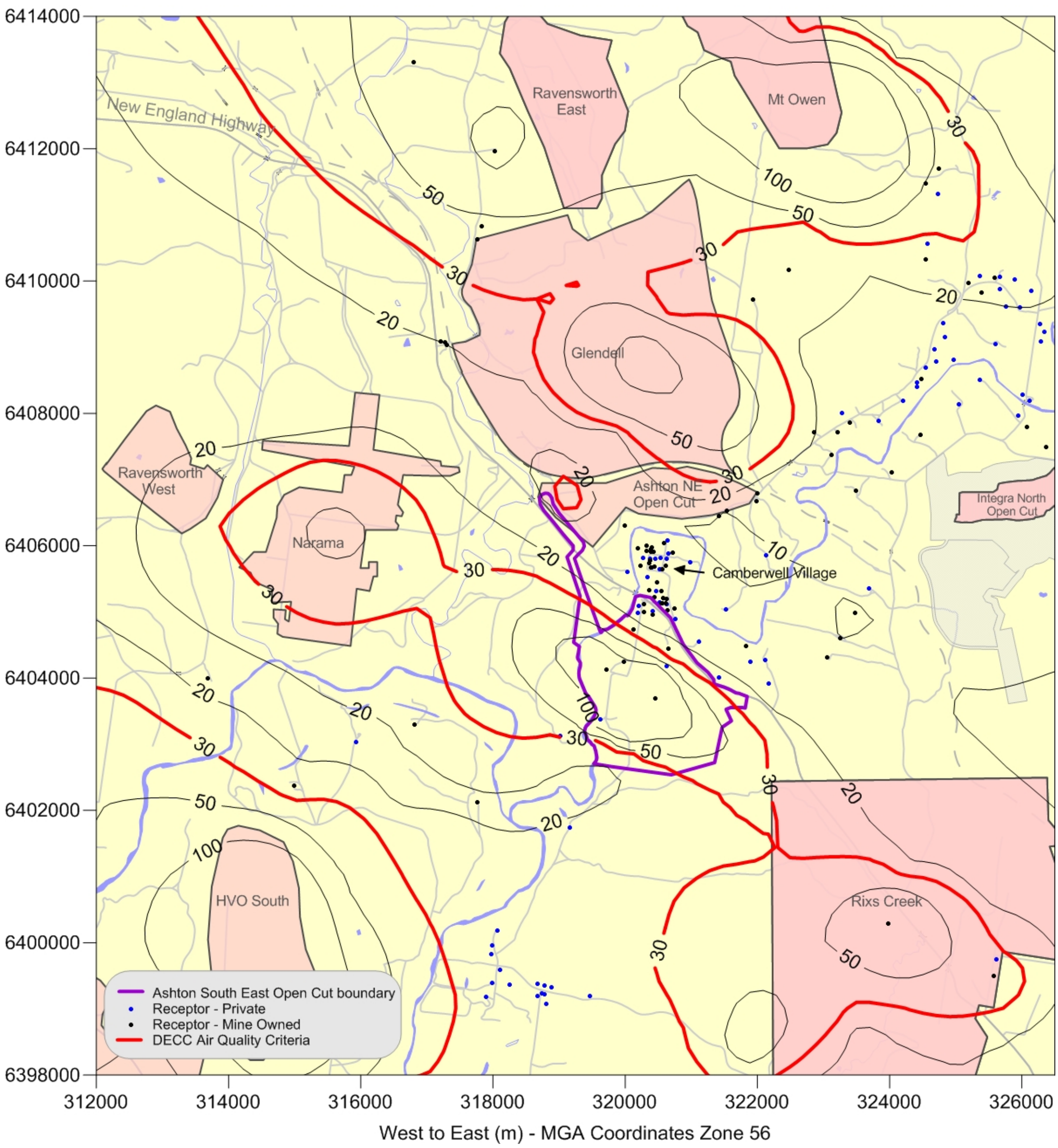
Species: TSP	Averaging Time: Annual	Percentile: Maximum	Scenario: Year 5 Project only	Location: Ashton SEOC
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** N/A	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average TSP concentration due to emissions from the Project in Year 5



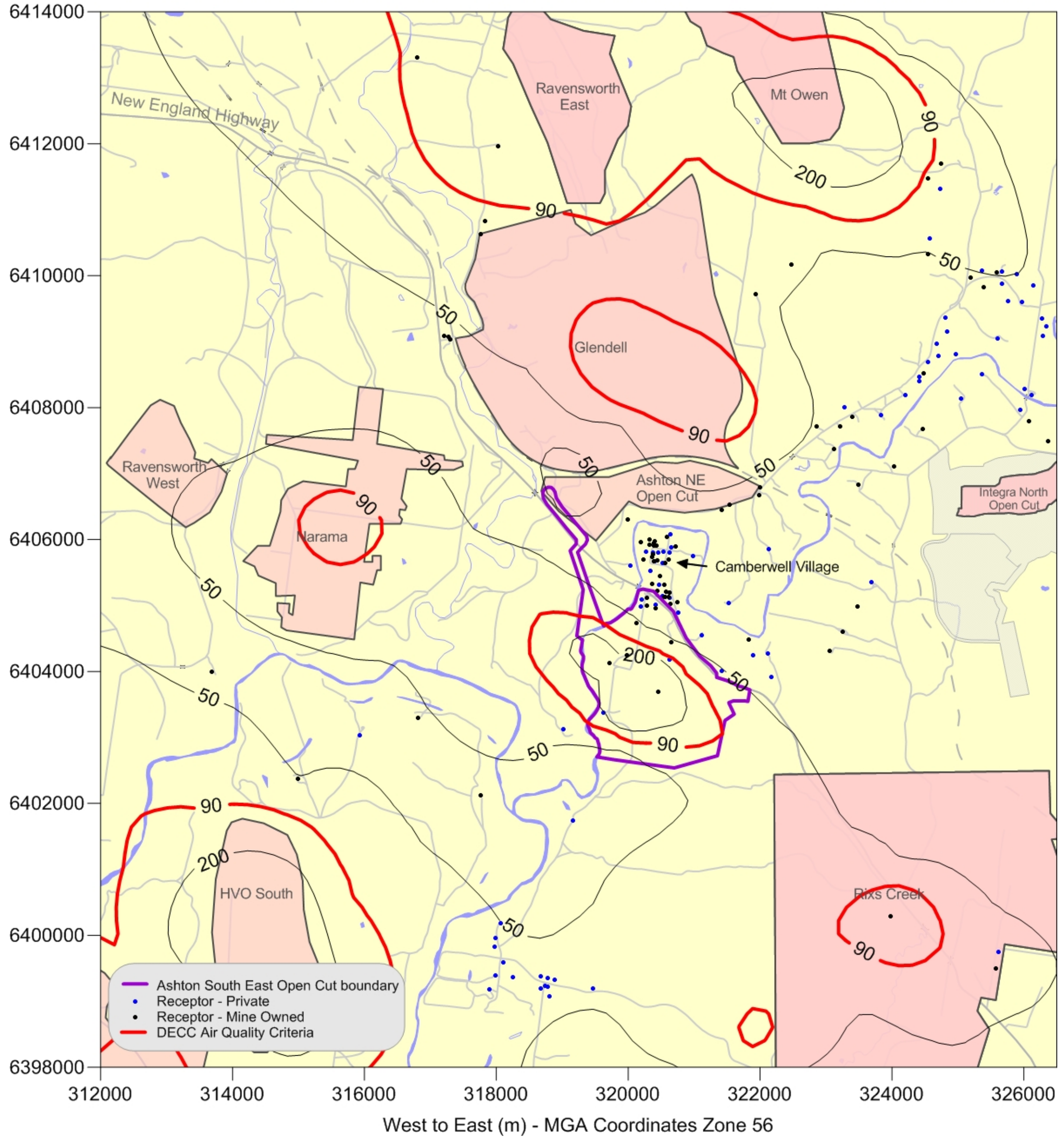
Species: Dust deposition	Averaging Time: Annual	Percentile: Maximum	Scenario: Year 5 Project only	Location: Ashton SEOC
Model Used: ISCMOD	**Units:** $g/m^2/month$	**Assessment criteria:** NSW DECC = 2 $g/m^2/month$ (Shown as red line)	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average dust deposition concentration due to emissions from the Project in Year 5



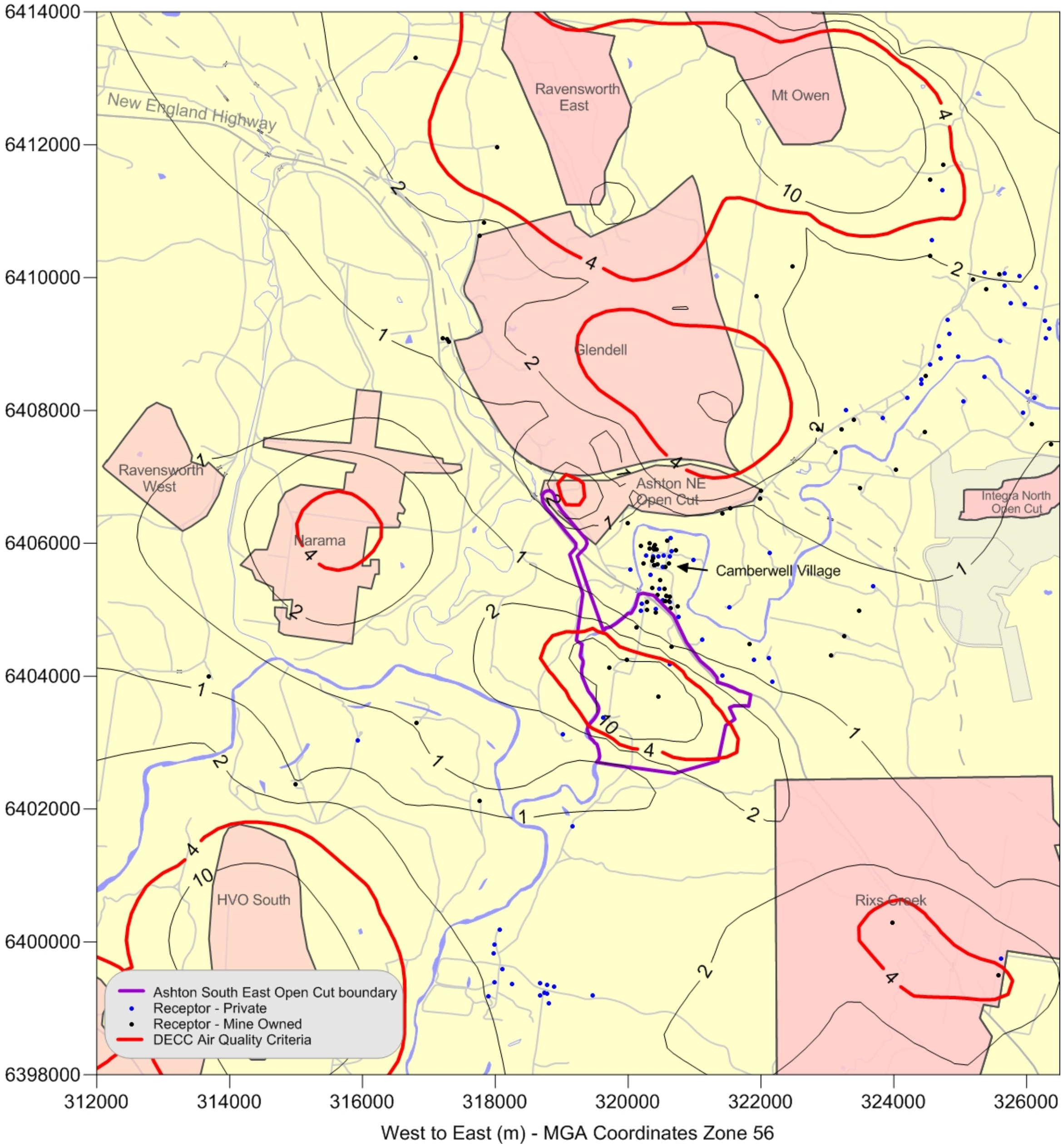
Species: PM_{10}	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Year 5 Project and other sources	**Location:** Ashton SEOC
Model Used: ISCMOD	**Units:** $\mu g/m^3$	**Assessment criteria:** NEPM = 30 $\mu g/^{m3}$ (Shown as red line)	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average PM_{10} concentration due to emissions from the Project and other sources in Year 5



Species: TSP	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Year 5 Project and other sources	**Location:** Ashton SEOC
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** NEPM = 90 µg/m^3 (Shown as red line)	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average TSP concentration due to emissions from the Project and other sources in Year 5



Species: Dust deposition	Averaging Time: Annual	Percentile: Maximum	Scenario: Year 5 Project and other sources	Location: Ashton SEOC
Model Used: ISCMOD	**Units:** $g/m^2/month$	**Assessment criteria:** NSW DECC = 4 $g/m^2/month$ (Shown as red line)	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average dust deposition concentration due to emissions from the Project and other sources in Year 5

8.3.5 Year 7

Figure 8. to **Figure 8.** show the predicted PM_{10} and TSP concentrations and dust deposition levels for operations in Year 7 showing the effects of the Project by itself and the Project in combination with other sources. These figures provide only a visual representation of the predicted concentrations, refer to **Table 8.** for the actual modelled values at specific receptor locations.

Table 8. presents the predicted dust concentration results for all receptors in the vicinity of the Project and highlights in bold those values above the relevant project specific criteria or cumulative criteria where the SEOC is expected to influence air quality. The table should be read in conjunction with **Section 8.2.3** (Interpretation of impacts at sensitive receptors).

In summary for Year 7 the following receptors where criteria are exceeded have been identified:

- Annual average deposition above 2 g/m^2/month due to the Project considered in isolation – no residences affected – see **Figure 8.**.
- Annual average PM_{10} above 30 $\mu g/m^3$ due to the Project and other mines and other sources – One private residence (130A) - see **Figure 8.**.
- Annual average TSP above 90 $\mu g/m^3$ due to the Project and other mines and other sources – no residences affected – see **Figure 8.**.
- Annual average dust deposition above 4 g/m^2/month due to the Project and other mines and other sources – no residences affected – see **Figure 8.**.

Table 8.. Summary of predicted annual average air quality impacts for Year 7

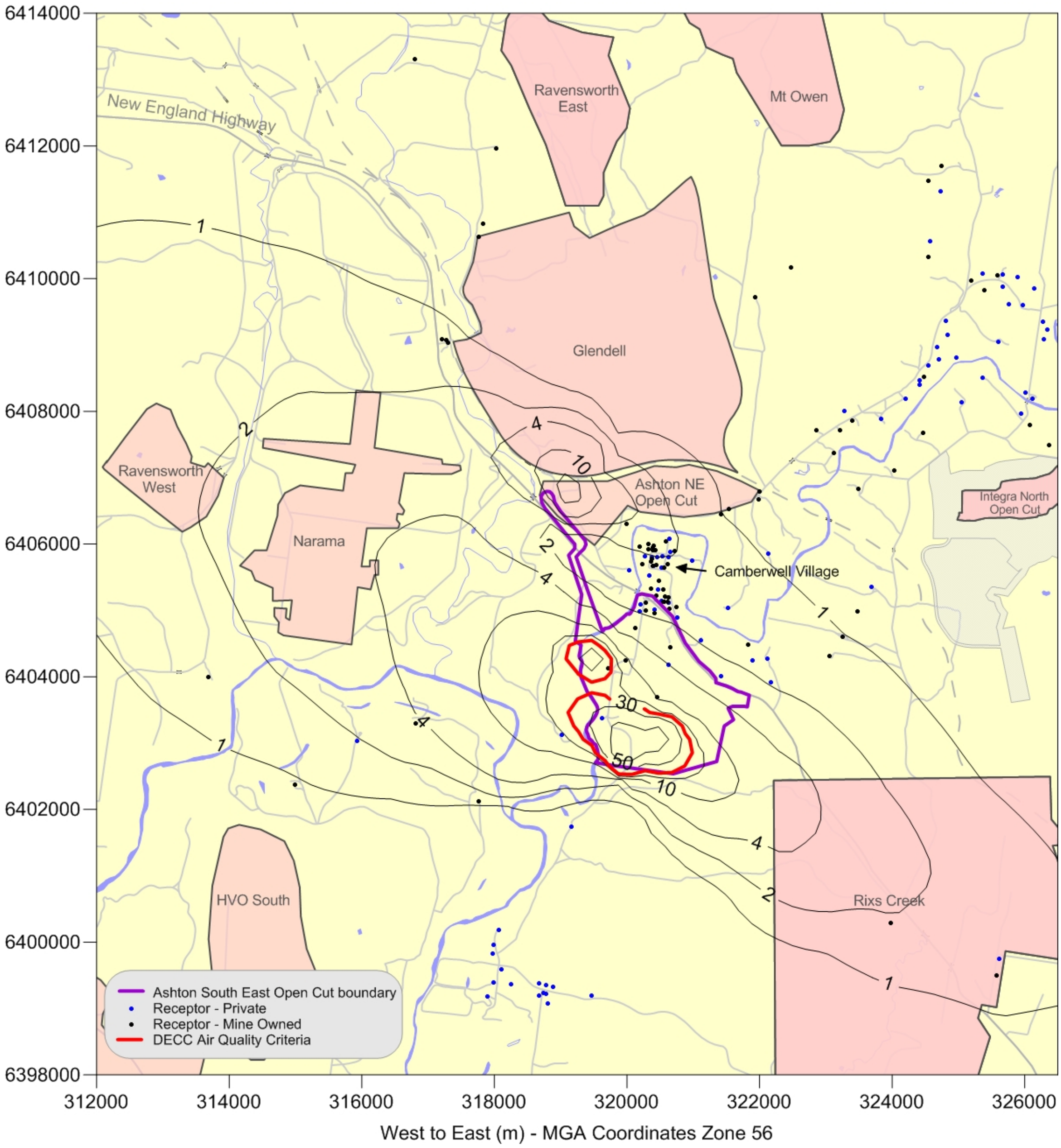
ID	Year 7 – Project alone			Year 7 - Project and other sources		
	PM10 (µg/m³)	TSP (µg/m³)	Dust deposition (g/m²/month)	PM10 (µg/m³)	TSP (µg/m³)	Dust deposition (g/m²/month)
	Assessment criteria					
	N/A	*N/A*	*2*	*30*	*90*	*4*
Private residences						
2	2	2	0.0	9	34	0.6
8	2	2	0.0	9	34	0.6
11	2	2	0.0	8	34	0.6
18	2	2	0.1	8	33	0.6
23	2	2	0.1	8	34	0.7
024A	2	2	0.1	8	34	0.7
024B	2	2	0.1	8	33	0.6
26	2	2	0.1	8	33	0.6
30	2	2	0.1	8	34	0.7
32	2	2	0.1	8	34	0.6
34	2	2	0.1	8	34	0.7
35	2	3	0.2	8	34	0.7
46	2	2	0.0	9	34	0.6
50	2	2	0.0	9	34	0.6
51	2	2	0.0	9	35	0.6
52	2	2	0.1	8	34	0.7
63	0	0	0.0	17	43	1.3
64	0	0	0.0	16	42	1.3
65	0	0	0.0	17	43	1.3
66	0	0	0.0	16	42	1.3
067A	0	0	0.0	17	43	1.3
067B	0	0	0.0	17	43	1.3
68	0	0	0.0	16	42	1.3
069A[a]	0	0	0.0	24	52	2.2
70	0	0	0.0	22	49	2.0
71	0	0	0.0	20	46	1.7
072B	0	0	0.0	14	39	1.1
072	0	0	0.0	14	40	1.1
73	0	0	0.0	18	44	1.6
74	0	0	0.0	18	44	1.5
75	0	0	0.0	17	43	1.4
76	0	0	0.0	20	47	1.8
77	0	0	0.0	22	49	2.0
78	0	0	0.0	24	51	2.2
80[a]	0	0	0.0	24	51	2.2
81	1	1	0.0	11	36	1.0
83	2	2	0.1	9	34	0.6
084A	2	2	0.1	8	33	0.6
084B	2	2	0.1	9	34	0.6
100A[b]	0	0	0.0	16	42	1.3
100B[b]	0	0	0.0	16	43	1.4
100C	0	0	0.0	16	43	1.4
100D	0	0	0.0	17	43	1.4
101A[b]	0	0	0.0	16	42	1.4
111[b]	1	1	0.0	9	35	0.9
114[b]	1	2	0.1	8	33	0.6
117	2	2	0.1	8	33	0.7
119	2	2	0.0	9	34	0.6
120	2	2	0.0	9	34	0.6
121	3	3	0.1	10	36	0.6
126[c]	4	4	0.1	13	38	0.7
129	83	117	8.8	96	155	9.5
130A	20	23	1.4	**33**	62	2.0
130B	0	1	0.0	19	45	1.0
131	0	0	0.0	22	49	1.5
132	0	0	0.0	23	49	1.5

ID	Year 7 – Project alone			Year 7 - Project and other sources		
	PM_{10} (µg/m³)	TSP (µg/m³)	Dust deposition (g/m²/month)	PM_{10} (µg/m³)	TSP (µg/m³)	Dust deposition (g/m²/month)
	Assessment criteria					
	N/A	*N/A*	*2*	*30*	*90*	*4*
133	0	0	0.0	23	49	1.5
137A	0	0	0.0	23	49	1.6
137B	0	0	0.0	23	50	1.7
137C	0	0	0.0	23	49	1.6
139	0	0	0.0	22	49	1.5
144	0	0	0.0	22	49	1.5
145	0	0	0.0	22	49	1.5
146	0	0	0.0	22	48	1.5
151	1	2	0.0	8	33	0.6
162	0	0	0.0	15	40	1.2
163	0	0	0.0	15	41	1.2
164	0	0	0.0	14	39	1.1
182A	0	0	0.0	23	50	1.5
182B	0	0	0.0	24	50	1.8
184A	0	0	0.0	21	48	1.4
184B	0	0	0.0	22	49	1.5
184C	0	0	0.0	23	49	1.6
187	2	2	0.1	15	41	0.8
197[b]	0	0	0.0	27	55	2.8
198[b]	0	0	0.0	45	77	5.6
217	1	1	0.1	29	59	2.6
Mine-owned residences						
1	2	2	0.0	9	34	0.6
3	2	2	0.0	9	34	0.6
4	2	2	0.1	8	34	0.6
5	2	2	0.0	8	34	0.6
6	2	2	0.0	9	34	0.6
7	2	2	0.0	9	34	0.6
10	2	2	0.1	8	34	0.6
12	2	2	0.0	9	34	0.6
13	2	2	0.0	8	34	0.6
17	2	2	0.1	8	33	0.6
21	2	2	0.1	8	34	0.6
22	2	2	0.1	8	34	0.7
25	2	2	0.1	8	33	0.6
27	2	2	0.1	8	33	0.6
28	2	2	0.1	8	33	0.6
29	2	2	0.1	8	34	0.6
31	2	2	0.1	8	33	0.6
33	2	2	0.1	8	34	0.7
36	2	3	0.2	8	34	0.7
36	2	3	0.2	8	34	0.7
38	2	2	0.1	8	34	0.7
39	2	2	0.1	8	34	0.7
40	2	3	0.2	8	34	0.7
41	2	2	0.1	8	34	0.7
43	2	3	0.2	9	34	0.7
44	2	2	0.1	8	34	0.7
45	2	2	0.0	9	34	0.6
47	2	2	0.0	9	34	0.6
49	2	2	0.0	9	34	0.6
069B	0	0	0.0	21	48	1.8
079A	0	0	0.0	37	68	4.2
079B	0	0	0.0	22	49	1.9
079C	0	0	0.0	24	51	2.2
101B	0	0	0.0	15	42	1.4
115	4	5	0.3	10	36	0.9
118	2	2	0.0	9	34	0.6

ID	Year 7 – Project alone PM10 (µg/m³)	TSP (µg/m³)	Dust deposition (g/m²/month)	Year 7 - Project and other sources PM10 (µg/m³)	TSP (µg/m³)	Dust deposition (g/m²/month)
	Assessment criteria					
	N/A	*N/A*	*2*	*30*	*90*	*4*
122[c]	3	3	0.1	11	36	0.6
123[c]	3	3	0.1	11	36	0.6
125[c]	10	12	0.8	19	47	1.4
127[c]	36	56	5.9	46	91	6.5
128[c]	9	11	0.5	20	47	1.1
153	1	1	0.0	13	38	0.7
159A	1	1	0.0	20	49	2.6
159B	1	1	0.0	23	52	3.0
159C	1	1	0.0	12	39	1.3
159D	1	1	0.0	10	36	0.9
159E	0	0	0.0	14	41	1.3
159F	0	0	0.0	15	41	1.3
159G	0	0	0.0	15	42	1.4
160A	1	1	0.0	9	34	0.8
160B	1	1	0.0	8	33	0.7
160C	1	1	0.0	8	33	0.6
160D	0	0	0.0	17	43	1.3
161A	0	0	0.0	14	40	1.3
161B	0	0	0.0	13	39	1.2
161C	2	2	0.1	8	33	0.6
161D	0	0	0.0	14	40	1.2
166	0	0	0.0	14	39	1.1
168	0	0	0.0	13	38	1.0
181A	3	4	0.2	16	42	0.8
181B	1	1	0.0	19	46	0.9
181C	1	1	0.0	17	43	0.9
189	1	1	0.0	20	47	1.2
190	1	1	0.0	20	47	1.3
191	1	1	0.0	20	47	1.3
192	0	0	0.0	39	67	1.9
193	0	0	0.0	38	66	1.8
194A	0	0	0.0	88	130	6.7
194B	0	0	0.0	57	86	2.6
195	0	0	0.0	25	52	2.1
196	0	0	0.0	23	50	2.1
199	0	0	0.0	50	84	6.3
200	0	0	0.0	43	74	4.2
218A	2	2	0.2	103	146	5.9
218B	1	1	0.1	21	48	2.1
218C	1	1	0.1	45	79	5.3

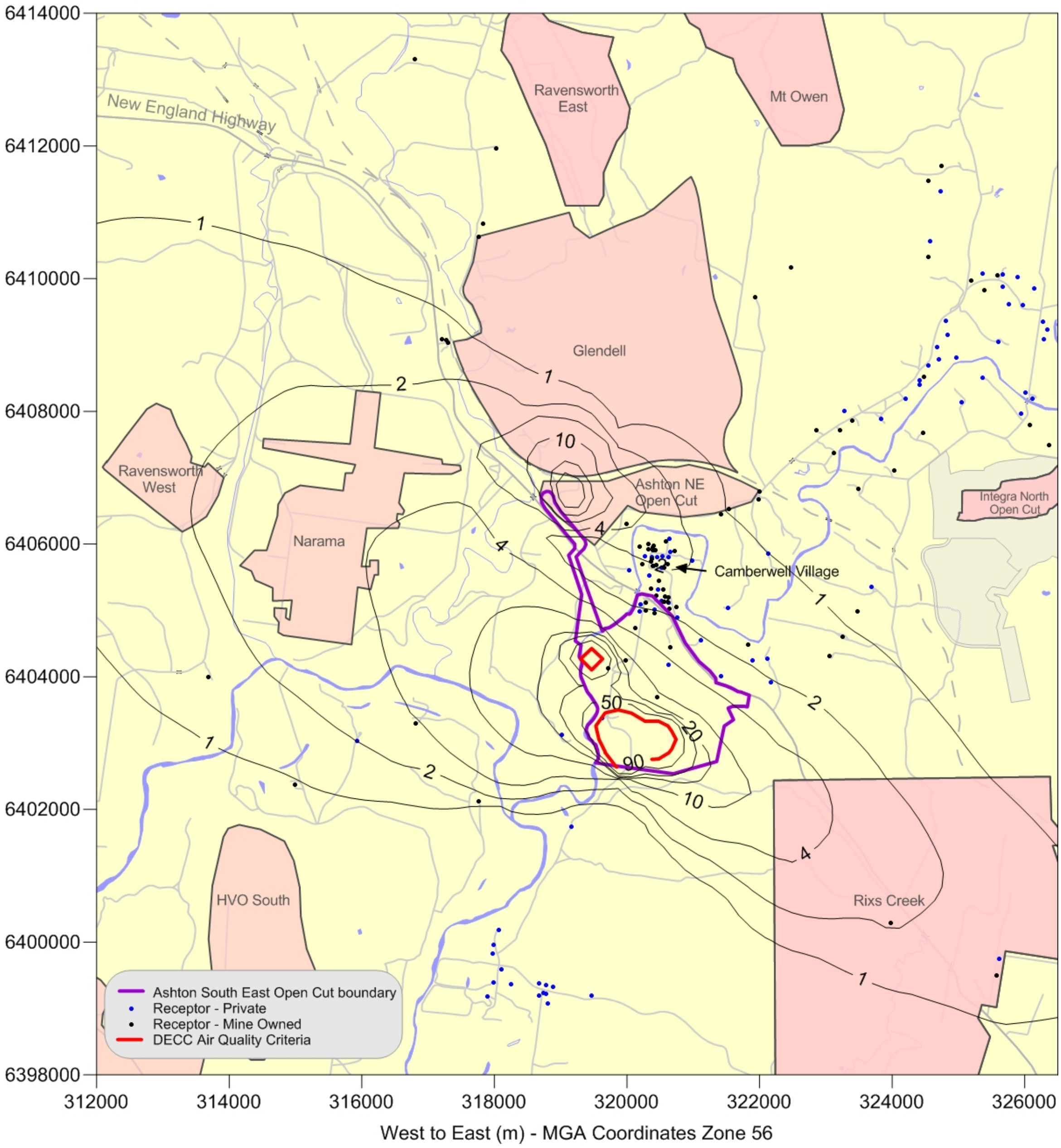
Notes:

a. These residences have Acquisition Right agreements with Glendell Mine.
b. These residences have Acquisition Right agreements with Mt Owen Mine.
c. These residences would not exist as mining would occur at the location.



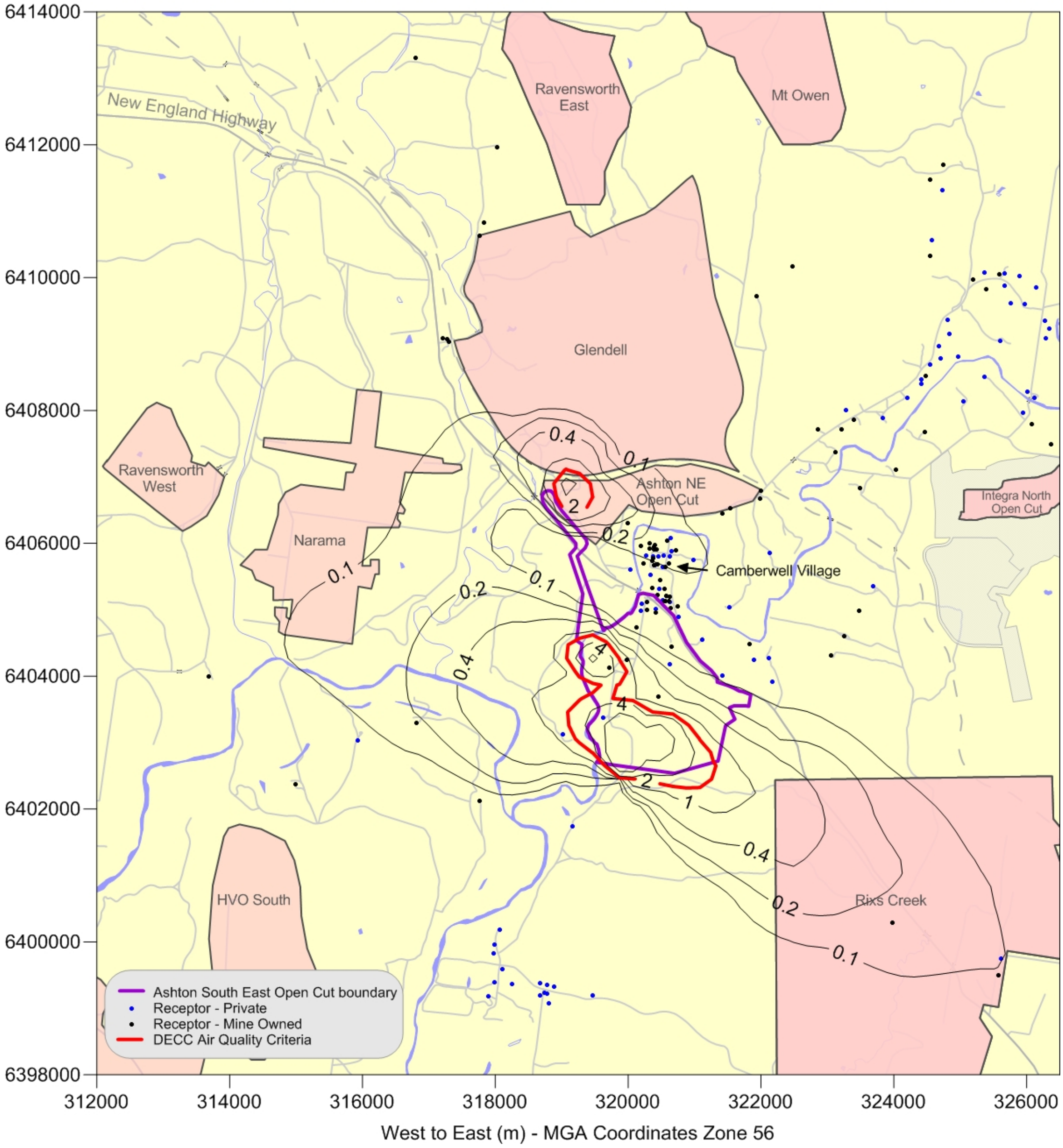
Species:	Averaging Time:	Percentile:	Scenario:	Location:
PM_{10}	Annual	Maximum	Year 7 Project only	Ashton SEOC
Model Used:	**Units:**	**Assessment criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	N/A	Repeater Station 2007-2008	F Triffett

Figure 8.: Predicted annual average PM_{10} concentration due to emissions from the Project in Year 7



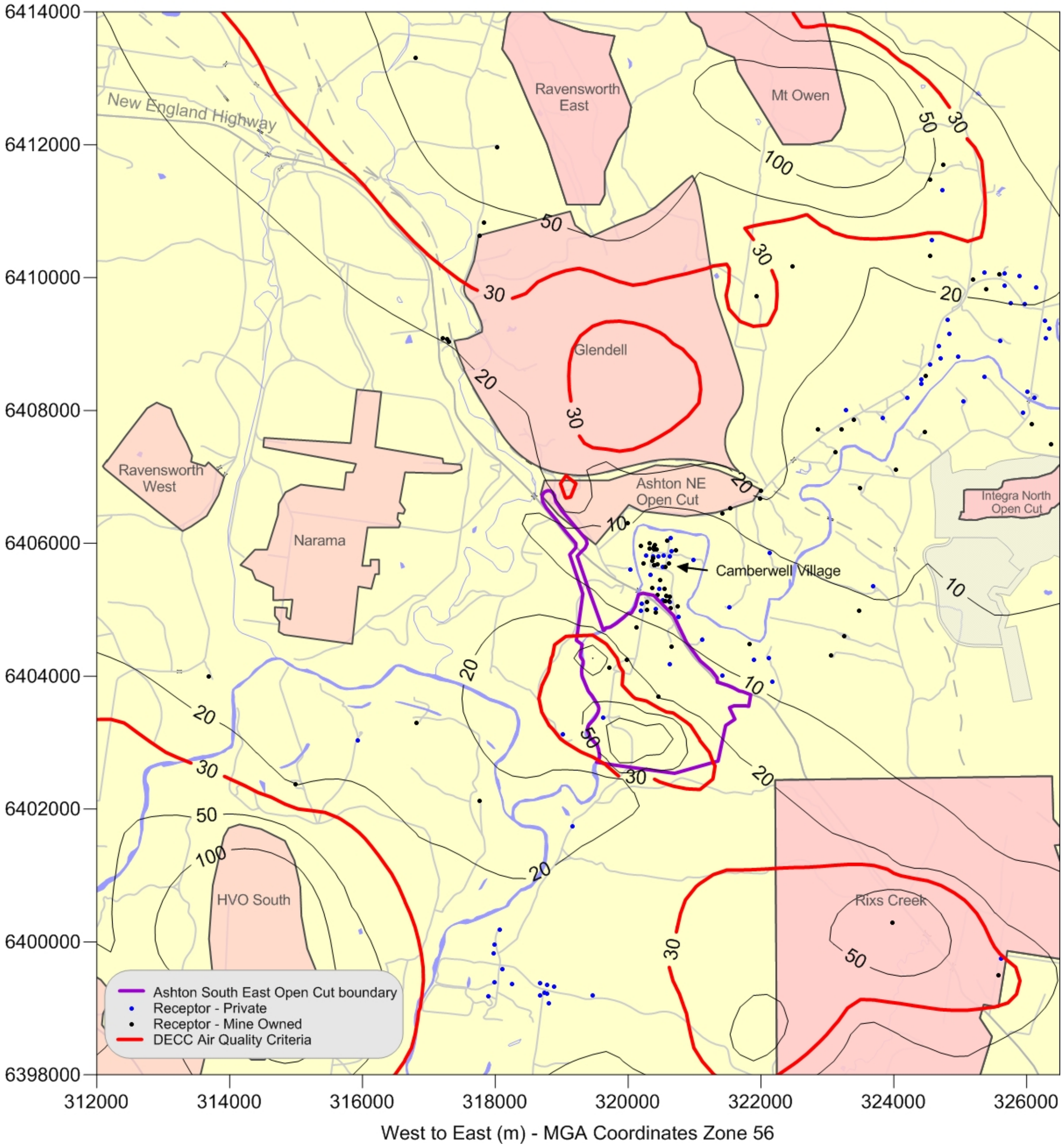
Species: TSP	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Year 7 Project only	**Location:** Ashton SEOC
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** N/A	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average TSP concentration due to emissions from the Project in Year 7



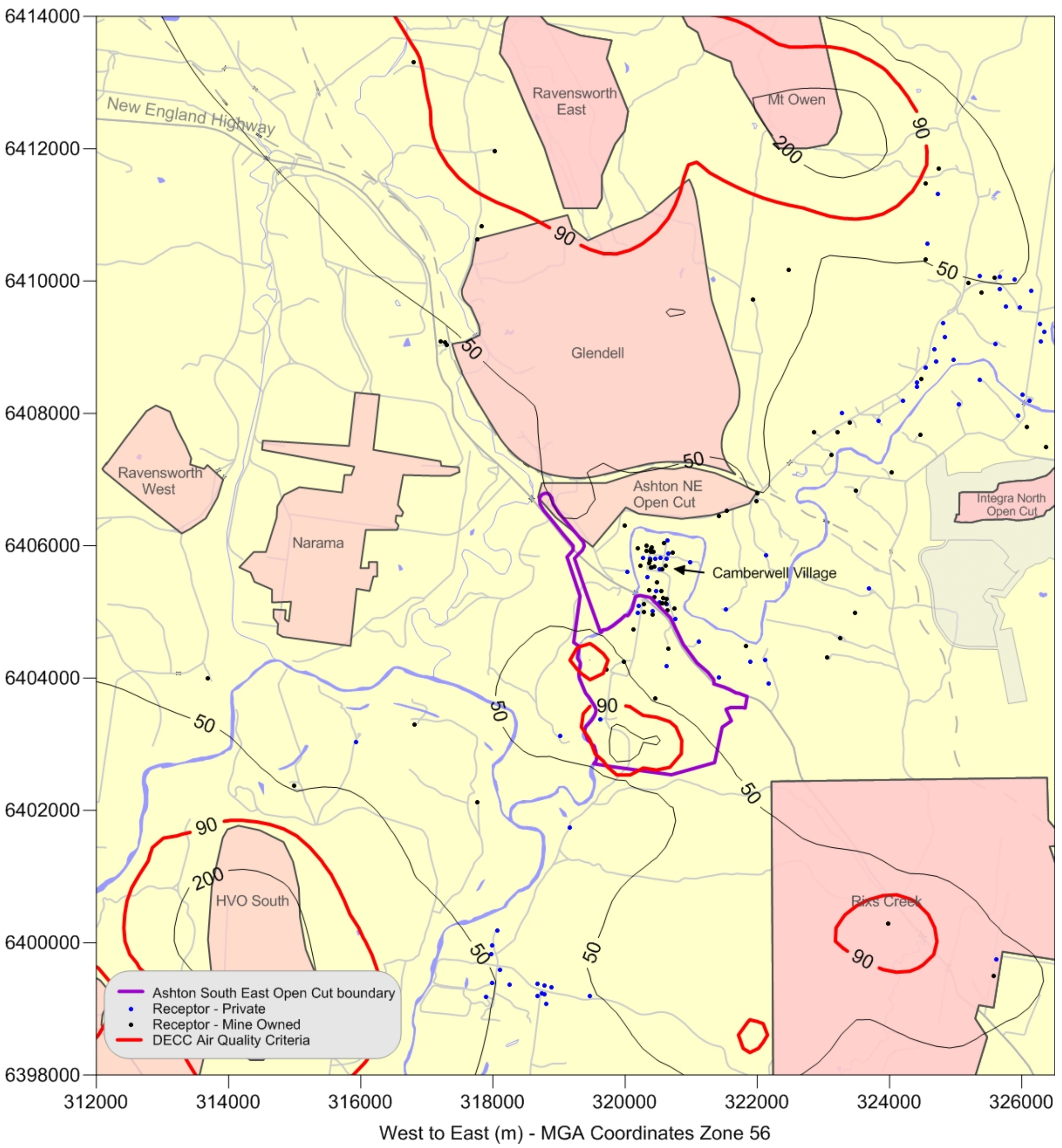
Species: Dust deposition	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Year 7 Project only	**Location:** Ashton SEOC
Model Used: ISCMOD	**Units:** g/m^2/month	**Assessment criteria:** NSW DECC = 2 g/m^2/month (Shown as red line)	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average dust deposition concentration due to emissions from the Project in Year 7



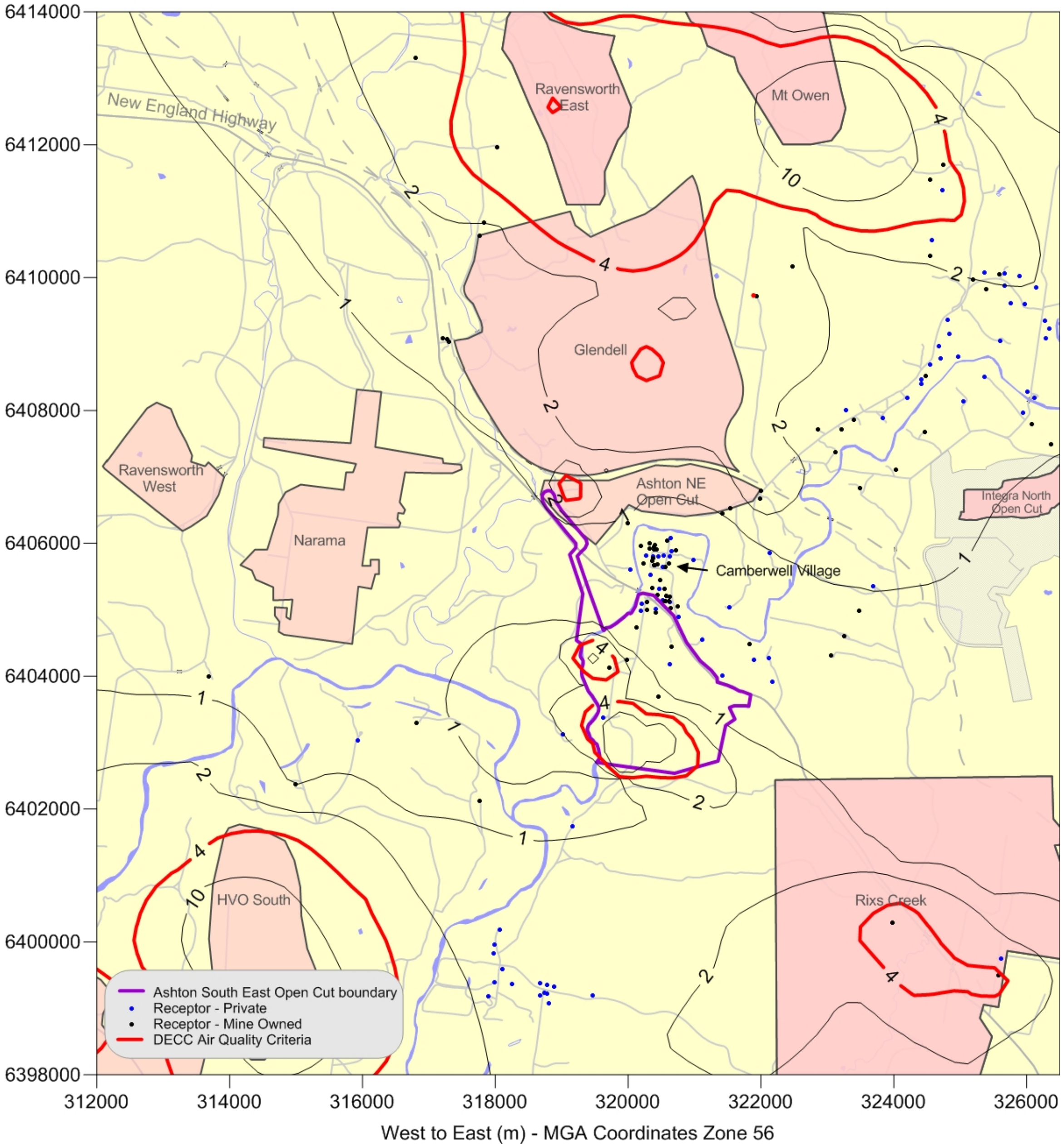
Species: PM_{10}	Averaging Time: Annual	Percentile: Maximum	Scenario: Year 7 Project and other sources	Location: Ashton SEOC
Model Used: ISCMOD	**Units:** $\mu g/m^3$	**Assessment criteria:** NEPM = 30 $\mu g/^{m3}$ (Shown as red line)	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average PM_{10} concentration due to emissions from the Project and other sources in Year 7



Species: TSP	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Year 7 Project and other sources	**Location:** Ashton SEOC
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** NEPM = 90 µg/m^3 (Shown as red line)	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average TSP concentration due to emissions from the Project and other sources in Year 7



Species: Dust deposition	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Year 7 Project and other sources	**Location:** Ashton SEOC
Model Used: ISCMOD	**Units:** g/m^2/month	**Assessment criteria:** NSW DECC = 4 g/m^2/month (Shown as red line)	**Met Data:** Repeater Station 2007-2008	**Plot:** F Triffett

Figure 8.: Predicted annual average dust deposition concentration due to emissions from the Project and other sources in Year 7

8.4 24-hour average PM_{10} concentrations

Table 8. presents the predicted maximum 24-hour PM_{10} concentrations at the residences. Values that are above the assessment criterion are highlighted **bold red**.

As discussed in **Section 8.2**, recent Conditions of Consent (for example, Integra North Open Cut) have required acquisition of properties if the 24-hour average PM_{10} concentration is exceeded more than five times per year (i.e. the 98.6th percentile), due to emissions from the Project alone.

Table 8. summarises the number of days predicted to exceed the 24-hour average PM_{10} concentration at the *private* residences and highlights in **bold red** those predicted to experience more than five days per above the criteria.

Table 8.. Summary of maximum predicted 24-hour average PM_{10} concentrations ($\mu g/m^3$)

ID	Year 1	Year 3	Year 5	Year 7
	Assessment criteria = 50 $\mu g/m^3$			
	Private Residences			
2	**88**	**73**	**92**	22
8	**89**	**68**	**91**	22
11	**70**	**61**	**78**	20
18	**51**	**54**	**57**	16
23	44	49	**63**	19
024A	40	47	**59**	19
024B	47	50	**65**	18
26	46	48	**57**	16
30	40	44	**51**	16
32	37	45	48	15
34	43	48	**61**	20
35	36	43	**55**	20
46	**139**	**81**	**96**	23
50	**163**	**76**	**80**	19
51	**254**	**88**	**88**	20
52	41	45	**56**	18
63	6	12	12	3
64	5	12	12	3
65	5	11	10	3
66	6	13	13	3
067A	5	9	9	3
067B	5	10	10	3
68	5	13	14	4
069A[a]	4	8	8	2
70	4	9	9	3
71	4	10	10	3
072B	7	14	14	5
072	6	15	15	5
73	5	13	13	4
74	5	13	14	4
75	5	14	14	4
76	4	11	11	3
77	4	10	10	3
78	4	9	8	3
80[a]	4	7	7	2
81	21	46	43	9
83	**68**	**123**	**109**	28
084A	**53**	**108**	**98**	22
084B	**75**	**129**	**101**	34
100A[b]	8	16	16	4
100B[b]	7	15	14	4
100C	6	14	14	4
100D	6	13	13	4
101A[b]	7	13	13	4
111[b]	27	44	41	9
114[b]	**77**	**84**	**84**	14
117	37	**55**	**56**	18
119	**183**	**95**	**97**	23
120	**155**	**142**	**140**	21
121	**194**	**202**	**162**	43

ID	Year 1	Year 3	Year 5	Year 7
	Assessment criteria = 50 µg/m³			
129[c]	24	**120**	-	-
130A	20	**82**	**171**	**133**
130B	7	14	21	12
131	3	7	9	4
132	3	7	8	4
133	3	7	8	3
137A	4	7	9	3
137B	4	7	8	3
137C	4	7	9	3
139	3	7	8	3
144	3	7	8	4
145	3	7	8	3
146	3	6	7	3
151	**56**	**51**	**53**	14
162	7	18	18	5
163	6	16	16	4
164	7	14	15	5
182A	4	9	10	4
182B	3	6	8	2
184A	4	7	8	4
184B	4	6	7	3
184C	4	6	7	3
187	14	44	**52**	24
197[b]	3	6	7	2
198[b]	2	6	6	2
217	9	20	24	10
Mine owned residences				
1	**113**	**80**	**98**	23
3	**86**	**72**	**92**	22
4	**78**	**69**	**88**	22
5	**76**	**67**	**88**	22
6	**87**	**70**	**92**	22
7	**89**	**69**	**92**	22
10	**67**	**61**	**81**	20
12	**78**	**65**	**82**	21
13	**68**	**62**	**70**	19
17	**60**	**55**	**71**	19
21	47	**51**	**67**	18
22	48	**51**	**66**	19
25	46	48	**59**	17
27	45	48	**56**	16
28	42	47	**52**	16
29	41	45	**51**	16
31	40	48	**51**	15
33	44	49	**61**	20
36	36	43	**54**	20
36	34	41	47	17
38	37	42	51	18
39	37	42	49	17
40	35	42	48	17
41	35	42	48	16
43	33	40	47	16
44	31	42	45	17
45	**184**	**85**	**101**	24
47	**203**	**84**	**88**	21
49	**120**	**75**	**78**	20
069B	4	8	8	2
079A	8	16	16	5
079B	4	7	7	2
079C	4	8	7	2
101B	8	15	14	4
115	29	37	41	22
118	**104**	**83**	**91**	22
122[c]	**532**[d]	**166**[d]	-	-
123 [c]	**566**[d]	**184**[d]	-	-
125 [c]	**136**[d]	**563**[d]	-	-
127 [c]	**283**[d]	**614**[d]	-	-
128 [c]	**56**[d]	**1326**[d]	-	-
153	16	41	40	11
159A	14	28	28	9
159B	12	27	28	9

ID	Year 1	Year 3	Year 5	Year 7
	Assessment criteria = 50 µg/m³			
159C	15	32	39	11
159D	18	33	40	11
159E	10	19	18	5
159F	8	15	15	4
159G	8	13	14	4
160A	20	**53**	**52**	12
160B	25	**51**	**54**	17
160C	29	**63**	**52**	21
160D	6	13	13	4
161A	13	28	28	6
161B	11	25	26	6
161C	**57**	**108**	**96**	27
161D	8	21	21	5
166	7	12	13	5
168	10	12	13	4
181A	20	**64**	**69**	31
181B	12	23	31	14
181C	10	25	41	22
189	19	26	26	9
190	19	26	26	9
191	19	26	26	9
192	7	10	10	4
193	6	9	9	4
194A	4	7	7	3
194B	4	6	6	2
195	5	11	13	4
196	3	6	7	2
199	2	7	7	2
200	2	6	6	2
218A	10	26	33	13
218B	7	15	19	7
218C	8	21	21	10

Notes:

[a] These residences have Acquisition Right agreements with Glendell Mine.
[b] These residences have Acquisition Right agreements with Mt Owen Mine.
[c] This residence would not exist by Year 5 due to mining.

Table 8.: Number of days 24-hour average PM_{10} concentrations are predicted to exceed 50 µg/m^3 due to Project alone at private residences only

ID	Owner	Year 1	Year 3	Year 5	Year 7
		No. of days above criteria			
2	Ninness	**13**	**9**	**8**	-
8	Chisholm	**13**	**9**	**8**	-
11	Richards	**7**	3	**7**	-
18	Turner	1	1	5	-
23	Lopes	-	-	3	-
024A	Vollebreght & Clarke	-	-	3	-
024B	Vollebreght & Clarke	-	-	3	-
26	Schubert	-	-	2	-
30	Bennett	-	-	1	-
34	Olofsson	-	-	3	-
35	Jong	-	-	2	-
46	Nowland, Moore & Dunn	**54**	**13**	**10**	-
50	Standing	**57**	**9**	**7**	-
51	Bailey	**127**	**19**	**10**	-
52	Foord	-	-	3	-
83	Hall	3	**14**	**9**	-
084A	Tisdell	-	**8**	4	-
084B	Tisdell	2	**13**	**9**	-
114[b]	Richards	4	3	3	-
117	McInerney	-	2	2	-
119	Beasley	**130**	**10**	**9**	-
120	Ernst	**29**	**15**	-	-
121	Burgess	**49**	**43**	**26**	-
129[c]	Bowman & Elder	-	**20**	NA	NA
130A	Bowman	-	3	**27**	**34**
151	Trustees of Church Property-Diocese of Newcastle	2	2	2	-
187	Stapleton	-	-	1	-

Notes:

a. These residences have Acquisition Right agreements with Glendell Mine.

b. These residences have Acquisition Right agreements with Mt Owen Mine.

c. This residence would not exist by Year 5 due to mining.

8.5 Summary of impacted residences

Table 8. summarises the private residences where the SEOC is expected to influence air quality and where the impacts are predicted to exceed the relevant project specific criteria, or cumulative criteria. The table should be read in conjunction with **Section 8.2.3** (Interpretation of impacts at sensitive receptors).

Table 8.: Summary of private residences where impacts predicted to exceed assessment criteria

ID	PM_{10} ($\mu g/m^3$)		TSP ($\mu g/m^3$)	Dust deposition (g/m^2/month)	
	24 hour Project alone[a)]	Annual Project & other sources	Annual Project & other sources	Annual Project alone	Annual Project & other sources
	50	*30*	*90*	*2*	*4*
Private Residences					
2	Year 1, Year 3, Year 5	-	-	-	-
8	Year 1, Year 3, Year 5	-	-	-	-
11	Year 1, Year 5	-	-	-	-
23	-	Year 1	-	-	-
024A	-	Year 1	-	-	-
024B	-	Year 1	-	-	-
26	-	Year 1	-	-	-
30	-	Year 1	-	-	-
32	-	Year 1	-	-	-
34	-	Year 1	-	-	-
35	-	Year 1	-	-	Year 1
46	Year 1, Year 3, Year 5	Year 1	-	-	-
50	Year 1, Year 3, Year 5	Year 1	-	-	-
51	Year 1, Year 3, Year 5	Year 1	Year 1	Year 1	-
52	-	Year 1	-	-	-
83	Year 3, Year 5	-	-	-	-
084A	Year 3	-	-	-	-
084B[c]	Year 3, Year 5	-	-	-	-
117	-	Year 1	-	-	-
119	Year 1, Year 3, Year 5	Year 1	-	-	-
120	Year 1, Year 3	Year 1	-	-	-
121	Year 1, Year 3, Year 5	Year 1, Year 3	-	-	-
129	Year 3	Year 3	-	-	-
130A	Year 5, Year 7	Year 5, Year 7	-	-	-

Note:

a. Only includes residences where the predicted concentrations exceed the 24-hour average PM_{10} impact assessment criteria on more than five days.

b. These residences have Acquisition Right agreement with Glendell Mine.

c. These residences have Acquisition Right agreements with Mt Owen Mine.

Table 8. summarises the mine-owned residences where the impacts are predicted to exceed the assessment criteria. This summary shows annual exceedances only.

Table 8.: Summary of mine-owned residences where impacts predicted to exceed assessment criteria

ID	PM10 (µg/m3)	TSP (µg/m3)	Dust deposition (g/m2/month)	
	Annual Project & other sources	Annual Project & other sources	Annual Project alone	Annual Project & other sources
	30	90	2	4
Mine Owned Residences				
21	Year 1	-	-	-
22	Year 1	-	-	-
25	Year 1	-	-	-
27	Year 1	-	-	-
28	Year 1	-	-	-
29	Year 1	-	-	-
33	Year 1	-	-	-
36	Year 1	-	-	Year 1
36	Year 1	-	-	Year 1
38	Year 1	-	-	-
39	Year 1	-	-	-
40	Year 1	-	-	-
41	Year 1	-	-	-
43	Year 1	-	-	Year 1
44	Year 1	-	-	-
45	Year 1	-	-	-
47	Year 1	-	-	-
49	Year 1	-	-	-
115	Year 1	Year 1	-	Year 1

9 MITIGATION AND MONITORING

9.1 Introduction

The modelling results presented above are based on the assumption that the Proponent applies the control measures discussed in **Section 9.2** to minimise dust emissions. The location of Camberwell Village northeast of the Project Area is in the prevailing downwind direction. Because of this, it will be necessary to ensure that dust emissions are kept to the minimum practicable level and that cumulative impacts with other mining projects are kept to acceptable levels. This section outlines procedures proposed for the management and control of dust emissions, including mine design, real-time monitoring and a real-time management plan.

9.2 Mine design

Extensive iterations of mine design were undertaken to minimise the potential for impact on Camberwell Village. This included the alignment of the proposed open cut pit and specific design of overburden dumps and the embankment faces to reduce the speed of surface winds that would carry dust into the village. Exposed surface areas would be rehabilitated in the shortest possible timeframe to minimise windblown dust emissions.

A covered conveyor would also be installed to transport ROM coal to the CHPP, thus avoiding the need for haulage, and significantly reducing potential dust emission. **Table 9.** lists the best practice control procedures for mine design.

9.3 Proposed dust management and control procedures

The term "best practice" is frequently used in pollution control and pollution management. However, what constitutes "best practice" is difficult to define in practical situations. Environment Australia has published a series of booklets to assist the mining industry with incorporating best practice environmental management through all phases of mineral production from exploration through construction and eventual closure. In the booklet for Dust Control (**Environment Australia, 1998**[a]) have defined "best practice" as follows:

"Best Practice can be defined as the most practical and effective methodology that is currently in use or otherwise available. Best practice dust management can be achieved by appropriate planning in the case of new or expanding mining operations, and by identifying and controlling dust sources during the active phases of all mining operations."

The following procedures are proposed for the management of dust emissions from the Project. The aim of these is to minimise the emission of dust in a cost effective manner. The effects of these controls are included in the model simulations. Dust can be generated from two primary sources:

- wind blown dust from exposed areas; and
- dust generated by mining activities.

The proposed controls have been considered against those determined to be best practice in the Environment Australia booklet for Dust Control. **Table 9.** lists the sources of dust as a result of mine design, the proposed controls and identifies those considered to be best practice. **Table 9.** and **Table 9.** lists the different sources of wind-blown and mining-generated dust respectively, the proposed controls, and identifies those considered to be best-practice.

[a] Note that this document is currently under review but has not yet been released.

Table 9.: Best Practice Control Procedures for Mine Design

Source	Control Procedures	Applied at Ashton
Transport of coal	Largest practical truck size	Yes
	Shortest route	Yes
	Replace truck haulage with conveyors	Yes
	Enclosed conveyor	Yes
Overburden dumps	Orientation to minimise profile exposure to receptors	Yes
	Profiling of surfaces to reduce surface speed	Yes
	Contouring of dump shape to avoid strong wind flows and smooth gradients to reduce turbulence at surface	Yes
Revegetation	Complete as soon as practical after disturbance	Yes
	Apply as widely as practical	Yes

Table 9.: Best Practice Control Procedures for Wind-blown Dust

Source	Control Procedures	Applied at Ashton
Areas disturbed by mining	Disturb only the minimum area necessary for mining. Reshape, topsoil and rehabilitate completed overburden emplacement areas as soon as practicable after the completion of overburden tipping.	Yes
Coal handling areas / stockpiles	Maintain coal handling areas / stockpiles in a moist condition using water carts to minimise wind-blown and traffic-generated dust.	Yes
ROM Coal Stockpiles	Have available water sprays on ROM coal stockpiles and use sprays to reduce airborne dust, as required.	Yes

Table 9.: Best Practice Controls for Mine-generated Dust

Source	Control procedures	Applied at Ashton
Haul Road Dust	All roads and trafficked areas will be watered as required using water trucks to minimise the generation of dust. All haul roads will have edges clearly defined with marker posts or equivalent to control their locations, especially when crossing large overburden emplacement areas. Obsolete roads will be ripped and re-vegetated.	Yes
Minor roads	Development of minor roads will be limited and the locations of these will be clearly defined. Minor roads used regularly for access etc will be watered. Obsolete roads will be ripped and re-vegetated.	Yes
Topsoil Stripping	Access tracks used by topsoil stripping equipment during their loading and unloading cycle will be watered.	Yes
Topsoil Stockpiling	Long term topsoil stockpiles, not used for over 3 months will be re-vegetated.	Yes
Drilling	Dust aprons will be lowered during drilling. Drills will be equipped with dust extraction cyclones, or water injection systems. Water injection or dust suppression sprays will be used when high levels of dust are being generated.	Yes
Blasting	Meteorological conditions will be assessed prior to blasting. Adequate stemming will be used at all times.	Yes
Conveyors	All conveyors will be covered and transfer points enclosed.	Yes
Real-time monitoring	Real-time air quality monitoring will be used in locations predicted likely to experience dust levels above the 24-hour average PM_{10} goal. Remedial action will be taken should the 24-hour concentrations approach the cumulative assessment criteria of 150 $\mu g/m^3$.	Yes

9.4 Monitoring

The locations of the current monitoring stations are shown on **Figure 5.**. It is envisaged that the monitoring program necessary to verify environmental performance will incorporate the following:

- Two meteorological stations in the current locations.
- Four high volume TSP monitors in the current locations, or as otherwise approved by the DECC.
- The current network of twelve deposition gauges, or as otherwise approved by the DECC, to monitor dust fallout.
- Six real-time PM_{10} monitors (TEOMs) at the current locations, or as otherwise approved by the DECC.

10 GREENHOUSE GAS EMISSIONS

10.1 Introduction

In November 2006, the NSW Land and Environment Court handed down a landmark decision (the judgement of Her Honour Pain J in the matter of *Gray v The Minister for Planning and ors NSWLEC 720*) which requires all new industry developments to undertake a global warming impact study in the context of the principles of ecologically sustainable development (ESD).

For the purposes of this report, the ESD principles have been taken to be those defined by the Department of Planning (**DUAP, 2000**), which are as follows.

1. The precautionary principle – namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
2. Inter-generational equity – namely, that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
3. Conservation of biological diversity and ecological integrity.
4. Improved valuation and pricing of environmental resources.

This section examines the scientific principles that relate greenhouse gases (GHG) to the global warming effect and estimates emissions of GHGs associated with the Project. It is demonstrated that when all categories (that is, Scopes 1, 2 and 3) of GHG emissions from the Project are taken into account, the Project will comply with the principles of ESD.

Scope 1 and Scope 2 are emissions due to the actual operation of the Project and Scope 3 are emissions that would result from the off-site transport and burning of the coal produced by the Project.

10.2 Science of global warming

It is considered that the most authoritative and comprehensive documents dealing with the science of global warming are the technical assessment reports produced approximately every five years by the Intergovernmental Panel on Climate Change (IPCC). To date, the IPCC has published four technical assessment reports, the most recent being in 2007 (**IPCC, 2007**). These documents are essentially the scientific community's consensus view on climate change. The reports also provide a useful database that is necessary to understand the significance of various human activities in the context of climate change. In summary, the IPCC reports provide well written information critical to understanding the science of global warming. They include quantitative information on the production and fate of greenhouse gases and estimates of the expected increases in global temperatures for a range of scenarios intended to cover a range of possible futures. These scenarios are chosen to illustrate the range of uncertainty in the predictions of temperature increases. The Garnaut Climate Change Review, commissioned by Australia's Commonwealth, State and Territory governments, released a final report in September 2008 which suggests that emissions are tracking at the upper bounds of the scenarios modelled by the IPCC (**Garnaut, 2008**).

The temperature of the earth's atmosphere is determined almost entirely[a] by the balance in radiation received from the sun and that re-radiated to outer space (see for example **IPCC, 2001**).

The parts of the radiation spectrum through which the earth can re-radiate and lose energy to outer space depends on the composition of the atmosphere. Certain gases including water vapour, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and a range of other gases absorb electromagnetic energy in the infrared spectrum. Solar radiation from the sun contains most of its energy in the infrared, visible and ultraviolet parts of the spectrum.

Sunlight passes through the atmosphere and warms both the atmosphere and the earth's surface. Clouds and the earth's surface directly reflect some of the sun's radiation back to space, but much of the sun's radiation is absorbed by the earth's surface and some by the atmosphere, which are warmed. The warmed earth and its atmosphere then reradiate this energy back to space. For the average global temperature to remain constant, the incoming radiation from the sun must be balanced by the outgoing energy radiated from the earth and atmosphere.

Global warming (and the associated climate change) occurs because of the changing composition of the atmosphere, namely the increasing concentrations of GHGs, in particular CO_2, CH_4 and N_2O. These gases reduce the parts of the electromagnetic spectrum through which energy can be re-radiated from the earth. In response, the earth's temperature must increase to allow the rate of energy loss from the earth to increase and thereby allow the incoming and outgoing radiation to be brought back into balance.

In summary, GHGs absorb electromagnetic energy and change the radiation balance of the earth causing the temperature to increase so that the radiation balance is restored.

Without the presence of any GHGs, the earth's average temperature would be extremely cold (-18 ^{o}C) (**Seinfeld and Pandis, 1998**) and most of the planet would be uninhabitable. However, the effect of increasing greenhouse gases is to change existing climates and this will place stresses on current ecological systems that have adapted to current climate regimes.

Increasing concentrations of CO_2, CH_4 and other GHGs will cause the temperature of the atmosphere to increase but, because the earth transports heat from the equator towards the poles in a complicated way via ocean currents and winds, the precise effect of increasing concentrations is difficult to estimate for any particular location.

The cause of the increasing concentrations of CO_2 and CH_4 is largely attributable to the increase in the worldwide use of fossil fuels to provide energy for increasing populations, which also have increasing per capita consumptions of energy. However, land clearing on a global scale is also an important cause in the change in the concentrations of CO_2.

10.3 Quantifying greenhouse effects

Scientific publications sometimes refer to the quantity of carbon stored in the atmosphere or may refer to the equivalent quantity of carbon dioxide. In this context, 1.0 tonne (t) of carbon is the same as 3.67 t of CO_2. Most of the analysis in this report will refer to CO_2 rather than carbon, as this appears to be the most common approach used in Australia.

The estimated quantity of carbon dioxide stored in the atmosphere now is approximately 3,000 Gigatonnes (Gt). The International Energy Agency (**IEA, 2009**) estimates that in 2006, the global

[a] The words "almost entirely" are used because the residual heat from the earth's formation and from the decay of radioactive elements in the earth have some effect on the earth's temperature.

emissions of CO_2 from burning fossil fuels were 29,195.4 Mt per year, of which Australia's emissions of CO_2 from burning fossil fuels were 417.06 Mt CO_2 (i.e. 1.4% of the global anthropogenic, or human-related, total).

Because the relationship between global warming and greenhouse gas concentrations is not linear[a] there is no accepted method to determine the contribution that a given emission of greenhouse gases might make to global warming.

To understand this point it is useful to consider the following discussion from Section 1.3.1 of the Second Scientific Assessment Report prepared by the IPCC (**IPCC, 1996**).

> *"The amount of carbon dioxide in the atmosphere has increased by more than 25% in the past century and since the beginning of the industrial revolution, an increase which is known to be in large part due to the combustion of fossil fuels and the removal of forests (Chapter 2 [*of the report*]). In the absence of controls, projections are that the future rate of increase in carbon dioxide amount may accelerate and concentrations could double from pre-industrial values within the next 50 to 100 years (**IPCC, 1994**).*
>
> *The increased amount of carbon dioxide is leading to climate change and will produce, on average, a global warming of the Earth's surface because of its enhanced greenhouse effect – although the magnitude and significance of the effects are not yet fully resolved. If, for instance, the amount of carbon dioxide in the atmosphere were suddenly doubled, but with other things remaining the same, the outgoing long-wave radiation would be reduced by about 4 Wm^{-2}. To restore the radiative balance, the atmosphere must warm up and, in the absence of other changes, the warming at the surface and throughout the troposphere would be about 1.2 ^oC. However, many other factors will change, and various feedbacks come into play (see Section 1.4.1* [of the report]*), so the best estimate of the average global warming for doubled carbon dioxide is 2.5 ^oC (**IPCC, 1990**). Such a change is very large by historical standards and would be associated with major climate changes around the world.*
>
> *Note if carbon dioxide were removed from the atmosphere altogether, the change in out going radiation would be about 30 Wm^{-2} – 7 to 8 times as big as the change for doubling – and the magnitude of the temperature change would be similarly enhanced. The reason is that the carbon dioxide absorption is saturated over part of the spectral region where it absorbs, so the amount of absorption changes at a much smaller rate than the concentration of the gas (Chapter 2* [of the report]*). If the concentrations of carbon dioxide are more than doubled, then the relationship between radiative forcing and concentration is such that each further doubling provides a further radiative forcing of about 4 Wm^{-2}."*

[a] The warming effect of a given quantity of greenhouse gases to the atmosphere is less and less as the concentration become higher and higher.

10.4 Greenhouse gas inventories

Greenhouse gas inventories are calculated according to a number of different methods. The procedures specified under the Kyoto Protocol United Nations Framework Convention on Climate Change are the most common.

The protocol nominates the following GHGs:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous oxide (N_2O);
- Hydrofluorocarbons (HFCs); and
- Perfluorocarbons (PFCs).

From the point of view of the Project, only CO_2, CH_4 and N_2O are relevant.

CO_2 and N_2O are formed and released during the combustion of gaseous, liquid and solid fuels. These would be the most significant gases for the Project. They are liberated when fuels are burnt in diesel powered equipment and in the generation of the electrical energy that will be used by the Project.

Inventories of greenhouse gas emissions can be calculated using published emission factors. Different gases have different greenhouse warming effects (referred to as warming potentials) and emission factors take into account the global warming potentials of the gases created during combustion.

The global warming potentials assumed in the Department of Climate Change (**DCC, 2009a**) emission factors are as follows.

- CO_2 – 1.
- CH_4 – 21.
- N_2O – 310.
- NO_2 – not included.

When the global warming potentials are applied to the estimated emissions then the resulting estimate is referred to in terms of CO_2-equivalent emissions.

10.5 Emission factors

The National Greenhouse Accounts (NGA) Factors published by the Department of Climate Change (**DCC, 2008 and DCC, 2009a**) have been used to convert fuel usage and electricity consumption into CO_2-equivalent emissions. The relevant emission factors are summarised in **Table 10.**.

Table 10.: Summary of greenhouse gas emission factors

Type of Fuel and Electricity		Emission factor		Scope	Source
Mining and extraction					
Diesel - on-site transport activities[a]		2.7	t CO_2-e/kL	1	Table 4 (**DCC, 2009a**)
		0.2	t CO_2-e/kL	3	Table 38 (**DCC, 2009a**)
Explosives use[b]	ANFO	0.17	t CO_2-e/tonne	1	Table 4 (**DCC, 2008a**)
Electricity[c]		0.89	kg CO_2-e/kWh	2	Table 39 (**DCC, 2009a**)
		0.18	kg CO_2-e/kWh	3	
Extraction of coal		45.0	kg CO_2-e/tonne ROM	1	Table 8 (**DCC 2009a**)
Transport of product coal					
Rail transport		12.3	g CO_2-e/t-km	3	**QR Network Access (2002)**
Fuel oil (ship transport)		73.1	kg CO_2-e/GJ	3 [d]	Table 4 (**DCC, 2009a**)
		5.3	kg CO_2-e/GJ	3	Table 38 (**DCC, 2009a**)
Usage of product coal					
Burning coal in a power station		3.00	kg CO_2-e/tonne	3	Table 1 (**DCC, 2009a**)
Burning coke for steelmaking		90.22	kg CO_2-e/GJ	3	Table 1 (**DCC, 2009a**)

Notes:

[a] The emission factors for diesel usage include Scope 1 emissions which are associated with burning the fuel and Scope 3 emissions which are associated with producing the diesel.

[b] As the calculation of emissions from explosives use are no longer required under the NGER reporting requirements, the GHG emissions factor for explosives use has been removed from NGA Factors since the version published November 2008. Therefore the factors published in February 2008 (**DCC, 2008a**) have been used.

[c] The emission factors for electrical energy include Scope 2 emissions (i.e. those associated with generating the electricity) and Scope 3 emissions (those associated with producing the fuel for the power station and the distribution losses involved in delivering electricity to the mine).

[d] The emission factor provided is for Scope 1 fuel usage, but as this is being applied to the shipment of coal, it is being used as Scope 3 emission factor.

10.6 Ashton Coal Project greenhouse emissions

10.6.1 Introduction

CO_2-equivalent (CO_2-e) emissions from the Project would result from the following sources:

1. The extraction and processing of the open cut coal due to the combustion of diesel fuel (used in diesel-powered equipment, in blasting and to power the diesel generators).
2. The transport of the product open cut to The Port of Newcastle and the transport of the product coal overseas.
3. The combustion of the open cut coal in steelmaking and power generating facilities.

The following sections present the calculation of CO2-e due to extraction, processing, transport and usage of coal from the SEOC only. Emissions due to the coal from the underground operations are not included.

10.6.2 Emissions from extraction and processing

As discussed in **Section 10.5**, to estimate CO_2-e emissions from extraction of the coal, the following assumptions have been made.

- Each kWh of electrical energy used results in the release of 1.07 kg of CO_2.
- Each litre of diesel fuel burnt is assumed to result in the release of 2.9 kg of CO_2.
- Each tonne of explosive used is assumed to result in the release of 0.17 t of CO_2.
- Each tonne of open cut ROM coal mined results in the release of 2.17 kg of methane and that methane has a greenhouse warming potential of 21 (This means that each kilogram of methane, because of its lifetime in the atmosphere and its spectral absorption characteristics, is equivalent to 21 kg of CO_2). Therefore, the CO_2-e emissions released for each tonne of ROM coal mined is equal to 45.0 kg (see Table 8, **DCC 2009a**).

Information was provided by ACOL on the usage of electrical energy, usage of explosives and diesel fuel. Electrical energy usage was assumed to be 3.49 kWh/t of ROM processed.

Table 10. summarises the fuel and energy usage for the extraction and processing of the coal,

Table 10. summarises the estimated annual average CO_2 emissions from the Project due to extraction and processing using the emissions factors presented in **Table 10.**.

Table 10.: Fuel, energy and explosives usage from mining processing

Year	Total ROM coal (kt ROM coal/y)	Electrical energy used (processing) (kWh)	Diesel used in extraction total (Litres/y)	ANFO used in blasting (kt/y)
1	2.93	10,218,720	18,160,960	32.397"
2	3.54	12,354,600	18,160,960	32.397"
3	3.10	10,808,530	18,160,960	32.397"
4	3.32	11,600,760	18,183,000	32.397"
5	3.42	11,939,290	18,756,040	32.397"
6	3.17	11,052,830	19,340,100	32.397"
7	1.12	3,919,270	19,373,160	32.397"
Total	**20.60**	**71,894,000**	**130,135,180**	**71,225**

Table 10.: Summary of estimated CO_2-e emissions from mining and processing of coal from the Project

Year	CO_2-e from electrical energy (processing) (kt/y)		CO_2-e from mining (diesel usage) (kt/y)		CO_2-e from blasting (kt/y)	CO_2-e from CH_4 released during mining (kt/y)	Total (kt/y)	
	Scope 2	Scope 3	Scope 1	Scope 3	Scope 1	Scope 1	Scope 1 & 2	Scope 3
1	9,095	1,839	49,001	3,715	1,730	131,760	191,585	5,555
2	10,996	2,224	49,001	3,715	1,730	159,300	221,026	5,939
3	9,620	1,946	49,001	3,715	1,730	139,365	199,715	5,661
4	10,325	2,088	49,060	3,720	1,730	149,580	210,695	5,808
5	10,626	2,149	50,606	3,837	1,730	153,945	216,907	5,986
6	9,837	1,990	52,182	3,957	1,730	142,515	206,264	5,946
7	3,488	705	52,271	3,963	1,730	50,535	108,024	4,669
Total	**63,986**	**12,941**	**351,123**	**26,623**	**12,108**	**927,000**	**1,354,217**	**39,564**

10.6.3 Emissions from export and burning of the product coal

10.6.3.1Emissions from off-site transport of product coal via rail

For the purpose of this analysis, it has been assumed that all coal for shipment overseas is carried by rail to the Port of Newcastle a distance of approximately 130 km (one way). According to a study commissioned by **QR Network Access (2002)** the Australian average CO_2-e emission rate for rail transport is 12.3 g/net tonne-km for a loaded train. As the destination of the return journey of the train is not known, and in the absence of a specific emission factor for unloaded trains, no allowance has been made for the return trip.

Using this information, **Table 10.** presents a summary of the CO_2 emissions from transporting the product coal from the Project Area to the Port of Newcastle.

Table 10. summarises the estimated CO_2 emissions for each year of operation due to transport of the product via rail.

Table 10.: Estimated CO_2-e emissions from rail transport of product coal (t/y)

Year	Product coal to Port of Newcastle (t/y)	Total CO_2-e from rail transport (t) Scope 3
1	1,833,000	2,931
2	2,145,000	3,430
3	1,780,000	2,846
4	1,886,000	3,016
5	1,848,000	2,955
6	1,845,000	2,950
7	719,843	1,151
Total	**12,056,843**	**19,279**

10.6.3.2Emissions from shipping of product coal overseas

There will also be emissions associated with the shipping of the product overseas. **Table 10.** presents a summary of coal destination and shipping distances from the Port of Newcastle.

Table 10.: Port of Newcastle coal destinations and distances

Location	Country	% of coal	Distance one-way (km)
Osaka	Japan	59	8065
Kaohsiung	Taiwan	14	7821
Busan	Korea	11	8380
Mazatlan	Mexico	7	12453
Penang	Malaysia	4	8488
Shanghai	China	3	8469
Rotterdam	Netherlands	2	21530

Source: **Umwelt (2008)**

Emissions were estimated as follows:

- Average ship capacity of 89,000 t (**Boyle, 2009**)
- Freight shipping energy efficiency is equal to 4.16 tkm/MJ (**The Allen Consulting Group, 2001**)
- Ships are assumed to burn heavy fuel oil

Estimated GHG emissions from the sea transportation of the coal are provided in **Table 10.**.

Table 10.: Estimated CO_2-e emissions from sea transport of product coal (Mt)

Year	Japan	Taiwan	Korea	Mexico	Malaysia	China	Netherlands	Total CO_2-e from sea transport (Mt) Scope 3
1	0.15	0.04	0.03	0.03	0.01	0.01	0.01	0.28
2	0.18	0.04	0.03	0.03	0.01	0.01	0.02	0.33
3	0.15	0.03	0.03	0.03	0.01	0.01	0.01	0.27
4	0.16	0.04	0.03	0.03	0.01	0.01	0.01	0.29
5	0.16	0.04	0.03	0.03	0.01	0.01	0.01	0.28
6	0.16	0.04	0.03	0.03	0.01	0.01	0.01	0.28
7	0.06	0.01	0.01	0.01	0.00	0.00	0.01	0.11
Total	**1.01**	**0.23**	**0.20**	**0.19**	**0.07**	**0.05**	**0.09**	**1.85**

10.6.4 Emissions from use of coal

The Proponent's customers will make use of the coal, and there will inevitably be GHG emissions associated with the end use. The emissions from burning the product coal will be much larger than those associated with the extraction and processing of the coal. The adopted convention is that these emissions are attributed to the user of the coal not the producer, however, to address the judgement of her Honour Pain J in the matter of *Gray v The Minister for Planning*, estimates of the GHG emissions associated with the use of the coal have been made.

The convention of not including these emissions avoids double counting of the emissions: leaving the accounting of the emissions from the use of the coal to the end user is also desirable as emissions due to the end use depend on the method by which the coal is used to produce energy and any control measures that might be in place. Various methods of burning will be used by different customers. As most coal from the Project is to be exported, any assessment of greenhouse emissions by its use in those other jurisdictions will be speculative and potentially unreliable. However, based on information provided by the Proponent, it has been assumed that 80% of the coal would be used in steel production and it is assumed that the remainder of the coal is burnt in a power station.

The quantity of CO_2 emitted can be estimated with a reasonable degree of reliability if the carbon content of the coal is known. It is reasonable to assume that all the carbon will be converted to CO_2 and that minor emissions of CO will be converted to CO_2 reasonable rapidly (in 1 to 4 months) (**Seinfeld and Pandis, 1998**). There will, however, be some uncertainty as to the production of N_2O, which depends not only on the nitrogen content in the fuel but the temperature of the combustion process. Some small quantity of carbon will also be retained in the ash from combustion in power stations.

It is assumed that 20% of the coal would be used in a power station and that the power station would have similar emissions to a power station in NSW burning black coal. The emissions can then be estimated using the NGA emission factor of 88.43 kg CO_2-equivalent/GJ (Table 1, Scope 1 of **DCC, 2009a**).

There is insufficient information available to use the detailed method defined in **DCC, 2009a** to calculate emissions from usage in steel production, therefore the default emission factor for metallurgical (coking) coal has been used. The NGA emission factor is 90.22 kg CO_2-equivalent/GJ (Table 1, Scope 1 of **DCC, 2009a**).

Table 10. summarises the estimated CO_2-e emissions for each year of the Project due to usage of the product.

Table 10.: Estimated CO_2-e emissions from usage of coal (Mt)

Year	Coal used in steel production (t/y)	Coal used in power stations (t/y)	CO_2-e from steel production (t/y) Scope 3	CO_2-e from power production (t/y) Scope 3	Total CO_2-e emissions from usage Scope 3
1	1.47	0.37	3.97	0.88	4.84
2	1.72	0.43	4.64	1.02	5.67
3	1.42	0.36	3.85	0.85	4.70
4	1.51	0.38	4.08	0.90	4.98
5	1.48	0.37	4.00	0.88	4.88
6	1.48	0.37	3.99	0.88	4.88
7	0.58	0.14	1.56	0.34	1.90
Total	**9.65**	**2.41**	**26.11**	**5.76**	**31.86**

10.6.5 Total CO_2-equivalent emissions

Table 10. summarises the total emissions from all sources.

Table 10.: Summary of total estimated CO_2-e emissions all sources (Mt)

Year	Product coal (Mt)	CO_2-e Mining and extraction (Mt)		CO_2-e Transport of product coal (rail & sea) (Mt)	CO_2-e Usage of product coal (Mt)	CO_2-e Total (Mt)	
		Scope 1 & 2	Scope 3	Scope 3	Scope 3	Scope 1 & 2	Scope 3
1	1.83	0.19	0.006	0.28	4.84	0.19	5.13
2	2.15	0.22	0.006	0.33	5.67	0.22	6.01
3	1.78	0.20	0.006	0.28	4.70	0.20	4.99
4	1.89	0.21	0.006	0.29	4.98	0.21	5.28
5	1.85	0.22	0.006	0.29	4.88	0.22	5.18
6	1.85	0.21	0.006	0.29	4.88	0.21	5.17
7	0.72	0.11	0.005	0.11	1.90	0.11	2.02
Total	**12.06**	**1.35**	**0.04**	**1.87**	**31.86**	**1.35**	**33.77**
						TOTAL (Scope 1, 2 & 3) (Mt)	**35.13**
						Annual average (Mt/y)	**5.02**

10.6.6 Important additional considerations

While it is possible to assess the significance of these emissions by comparing them with other sources of greenhouse gases, it is also important to note that the efficiency with which the coal is used is also very important. All other things being equal[a], global CO_2-equivalent emissions could be halved if power station efficiencies were doubled, or halved if the efficiency by which end users' consumed electricity was doubled or waste was reduced and so on.

Different customers will use the coal in power plants of different thermal efficiencies. The Australian Coal Association provides some typical statistics for power station efficiencies on their web site (**ACA, 2006**).

The web site notes the following:

[a] Population remaining fixed and the per capita consumption of energy being fixed.

"*Industry has continuously striven to increase efficiencies of conventional plant; for example, the average thermal efficiency of US power stations has increased from 5% in 1900, to around 35% currently. In China, most power plants are relatively small, average efficiency is about 28% compared to an OECD average of 38%. New conventional* [pulverised fuel] *PF power plants achieve above 40% efficiency.*

Advanced modern plants use specially developed high strength alloy steels, which enable the use of supercritical and ultra-supercritical steam (pressures >248 bar and temperatures >566°C) and can achieve, depending on location, close to 45% efficiency.

Application of new advanced materials to PF power plant should enable efficiencies of 55% to be achieved in the future. This results in corresponding reductions in CO_2 emissions as less fuel is used per unit of electricity generated".

The Proponent does not propose, nor does its application for approval, seek approval to burn any of the coal produced.

10.6.7 Contribution to global warming and conclusions

Finally, it is useful to consider the contribution that might be made to global warning from:

- emissions from mining;
- emissions from burning Project-related product coal; and
- the combined emissions from both mining and burning Project-related product coal.

The annual average Scope 1 and Scope 2 emissions from the Project are 0.19 Mt per year. When compared with 2007 Scope 1 and Scope 2 emissions in Australia and NSW, this represents approximately:

- 0.3% of the annual greenhouse emissions of 69.5 Mt from mining in Australia (**DCC, 2009b**);
- 0.9% of the annual greenhouse emissions of 21.6 Mt from mining in NSW (**DCC, 2009b**);
- 0.03% of the total annual greenhouse emissions of 597.2 Mt in Australia (**DCC, 2009c**); and
- 0.12% of the total annual greenhouse emissions of 162.7 Mt in NSW (**DCC, 2009c**).

Because the relationship between global warming and greenhouse gas concentrations is not linear[a] there is no accepted method to determine the contribution that a given emission of greenhouse gases might make to global warming.

To understand this point, it is useful to consider the discussion from Section 1.3.1 of the Second Scientific Assessment Report prepared by the IPCC (**IPCC, 1996**), which was provided earlier in **Section 10.3**.

At any point in time, it would be reasonable simply to compare the estimated emission of CO_2-equivalent from the various activities with the estimated equivalent global emission from fuel burning of 29,195.42 Mtpa (**IEA, 2009**). On this basis, average annual emissions over the lifetime of the Project from the mining and burning of coal (including transportation) are estimated to be 0.02% of global CO_2-equivalent annual emissions from fuel burning. Thus, the Project could be considered to contribute 0.02% to the increase in global temperatures caused by the increase

[a] The warming effect of a given quantity of greenhouse gases to the atmosphere is less and less as the concentration become higher and higher (see **Section 10.3**).

in greenhouse gas emissions as they are currently. This invites the question as to what temperature rise might be attributed to the GHG emissions from the Project.

Based on the IPPC estimate that a doubling of the CO_2-equivalent concentration in the atmosphere would lead to a 2.5°C increase in global average temperature (see **Section 10.3**), and that the current global CO_2 load is approximately 3,000 Gt, we can estimate that the annual average emissions during the life of the Project (including mining, transporting the coal to the Port of Newcastle and overseas, and usage of the coal) would lead to an increase in global temperature of 0.000004 °C [($5.02 \times 10^6/3,000 \times 10^9$) x 2.5°C].

There will clearly be no measurable environmental effect due to the emissions of GHGs from the Project, even when the customer's use of the coal is taken into account. Any environmental assessment would conclude that the effects of the emissions from the Project are unable to be measured. Given this, it is clear that the Project would comply with the principles of ESD.

In practice, of course, the effects of global warming and associated climate change are the cumulative effect of many thousands of such sources and it is the cumulative effects that pose a threat to ESD principles.

This analysis highlights the problem of dealing with climate change on a mine-by-mine, or project-by-project basis. Indeed, if this approach is adopted, it is likely to be ineffective since the coal will simply be sourced from some other place.

Ultimately, the control of greenhouse gas emissions is likely to occur via economic instruments such as the Carbon Pollution Reduction Scheme, as outlined in the Australian Government green paper released in July 2008 (**DCC, 2008b**), and subsequent white Paper released in December 2008 (**DCC, 2008c**), which detail the design of a national emissions trading scheme.

The scheme will require businesses and industry to buy a 'pollution permit' for each tonne of carbon they contribute to the atmosphere, giving them a strong incentive to reduce pollution, encourage the development of carbon capture and sequestration, encourage the development of renewable forms of energy generation and improve the efficiency with which electricity is used. At the time of writing the emissions trading scheme had been delayed to July 2011, and the legislation has yet to be passed through Parliament.

11 CONCLUSIONS

This report has developed dust emissions inventories for the proposed SEOC Project operations at four stages of operation. These stages have been selected to represent the potential air quality impacts that the Project would have in the area over the lifetime of the Project.

The emissions inventories developed for each of the stages have been used with local meteorological data and the US EPA's ISCST3 model (adapted to ISCMOD) to predict the maximum 24-hour PM_{10}, annual average PM_{10}, annual average TSP and annual average dust deposition (insoluble solids) over an area spanning approximately 17 km (east-west) and 18 km (north-south). Open-cut mining as well as underground operations activity was included in the modelling. The modelling shows both the effect of the Project only and the cumulative effects of the Project with neighbouring mines and other sources of dust.

Incremental 24-hour average PM_{10} impacts were assessed and it was found that fifteen private residences (Residences 2, 8, 11, 46, 50, 51, 83, 084A, 084B, 119, 120, 121, 126, 129 and 130A) would experience dust levels exceeding the 24-hour average PM_{10} assessment criterion (at the

98.6th percentile, that is more than five days per year) of 50 μg/m^3 due to the Ashton SEOC project alone. Note that residence 126 is in an area that would be part of the active mine, and hence will not actually exist in any modelled years due to mining. Similarly, residence 129 will not exist in years 5 and 7 due to mining.

Cumulative annual average PM_{10} impacts were assessed and it was found that across the modelling domain, twenty-nine private residences (Residences 23, 024A, 024B, 26, 30, 32, 34, 35, 46, 50, 51, 52, 63, 81, 100A, 100B, 100C, 101A, 117, 119, 120, 121, 126, 129, 130A, 162, 164, 198 and 217) would experience dust levels exceeding the annual average PM_{10} assessment criterion of 30 μg/m^3 for the Project and other sources. Note that residence 126 is in an area that would be part of the active mine, and hence will not actually exist in any modelled years due to mining. Similarly, residence 129 will not exist in years 5 and 7 due to mining. Residences 126 and 129 aside, there are seventeen residences where the project could materially affect the predicted levels (residences 23, 024A, 024B, 26, 30, 32, 34, 35, 46, 50, 51, 52, 117, 119, 120, 121 and 130A.

Cumulative TSP impacts were assessed and it was found that three private residences (51, 126 and 129) would experience dust levels exceeding the TSP assessment criterion of 90 μg/m^3 for the Project and other sources. Note that residence 126 is in an area that would be part of the active mine, and hence will not actually exist in any modelled years due to mining. Similarly, residence 129 will not exist in years 5 and 7 due to mining. Residences 126 and 129 aside, the project could materially affect the predicted levels at residence 51.

Incremental Deposited Dust impacts were assessed and it was found that three private residences (Residences 51, 126 and 129) would experience dust levels exceeding the annual average 2 g/m^2/month (insoluble solids) deposition level assessment criteria from the Project alone. Note that residence 126 is in an area that would be part of the active mine, and hence will not actually exist in any modelled years due to mining. Similarly, residence 129 will not exist in years 5 and 7 due to mining. Residences 126 and 129 aside, the project could materially affect the predicted levels at residence 51.

Cumulative Deposited Dust impacts were assessed and it was found that five private residences (Residences 35, 51, 126, 129 and 198) would experience dust levels exceeding the annual average 4 g/m^2/month (insoluble solids) deposition level assessment criteria for dust from the Project and other sources. Note that residence 126 is in an area that would be part of the active mine, and hence will not actually exist in any modelled years due to mining. Similarly, residence 129 will not exist in years 5 and 7 due to mining. Residences 126 and 129 aside, the project would not materially affect the predicted levels at any residence.

The CO_2 emissions released during the mining operations are small compared to the CO_2 emissions released during the combustion of the coal proposed for extraction. ACOL is committed to reviewing and monitoring GHG emissions and the activities that lead to GHG emissions, to ensure that these emissions are kept to the minimum practicable level and will attempt to keep the ratio of greenhouse gas emissions per tonne of coal produced as low as possible.

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Appendix : Residence ownership details

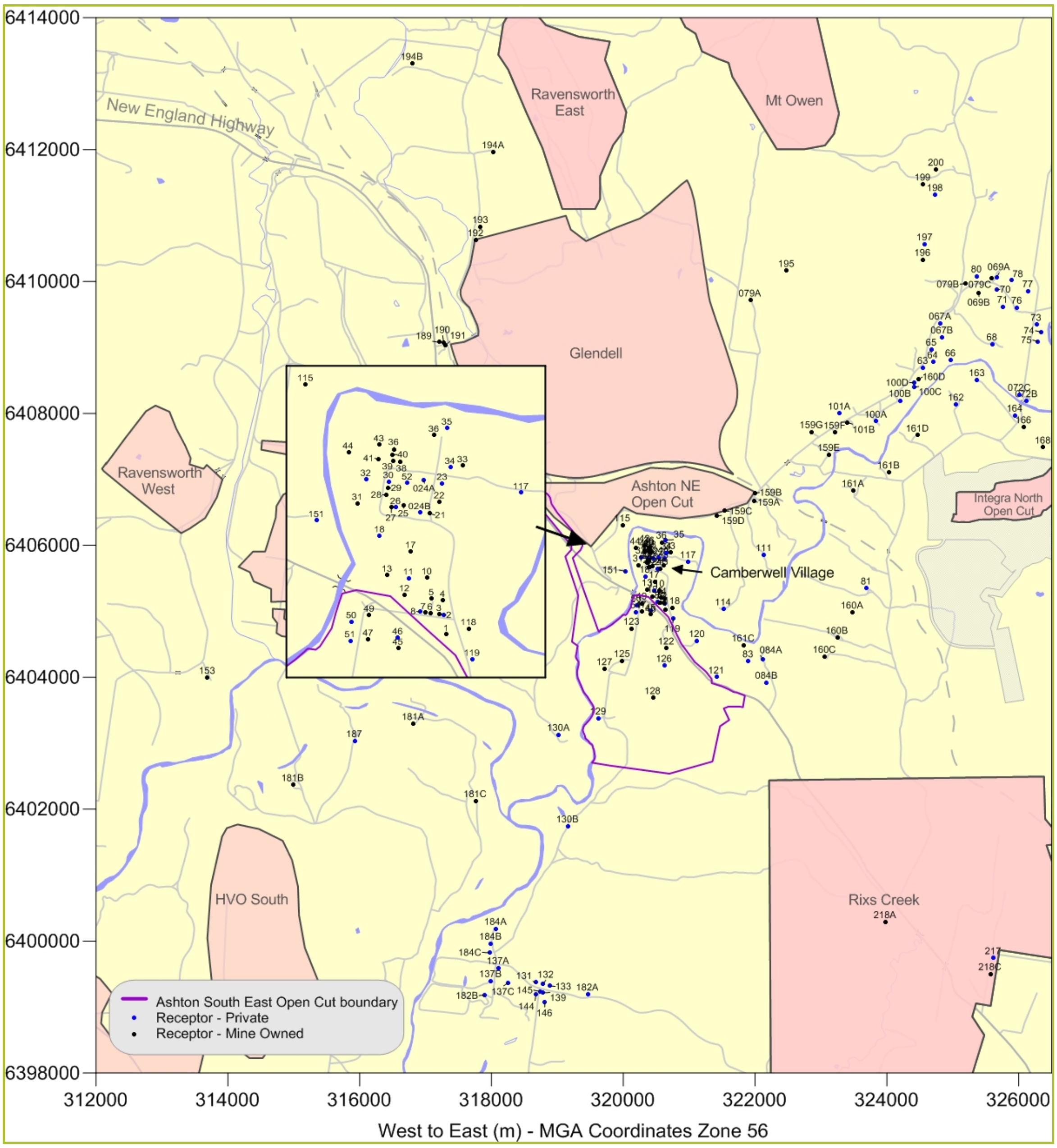


Figure A.: Sensitive receptor locations and numbering

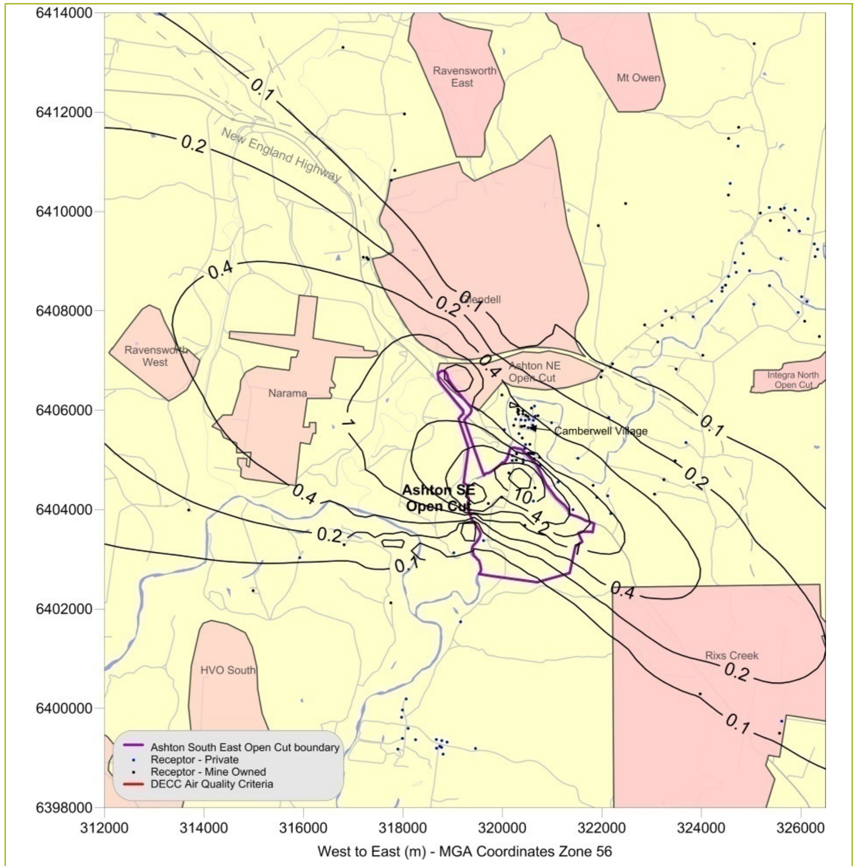
Easting (m)	Northing (m)	ID	Owner
Private Residences			
320628.469	6405120	2	Ronald Wayne Ninness
320519.781	6405136.5	8	Michael James Chisholm
320466.281	6405310.5	11	Bruce Howard Richards, Rosalie Ellen Richards
320332.594	6405528	18	Sandra Phyllis Turner
320622.906	6405796.5	23	Valda Kim Lopes
320536.812	6405813.5	024A	John Leonardus Vollebreght & Tracey Lee Clarke
320519.406	6405646.5	024B	John Leonardus Vollebreght & Tracey Lee Clarke
320407.531	6405672.5	26	Corey Ian Schubert & Rosemary Anne Schubert
320373.906	6405806.5	30	Alan John Bennett
320269.344	6405816.5	32	Colin Leslie Stapleton
320659.719	6405879	34	Torbjorn Anders Olofsson & Diedre Ella Olofsson
320645.25	6406081	35	Meindert De Jong & Thelma Eileen De Jong
320417	6405004.5	46	Alfred Nowland, Edgar Moore, John Thomas Dunn
320202.188	6405087	50	Clinton Standing
320195.938	6404988.5	51	Robert John Bailey & Cindy Narelle Bailey
320460.906	6405797.5	52	Leslie Alan Foord & Susan Dorothy Foord
324549.125	6408691.5	63	Mark James Smith & Georgina Mary Smith
324702.594	6408777.5	64	Stephen James McInerney
324678	6408969	65	Graham Stanley Watson & Marilyn Jan Watson
324970.594	6408808.5	66	Errol Thomas Foster & Dianne Gayle Foster
324814.281	6409364	067A	Paula Joy Hedges
324841.562	6409154	067B	Paula Joy Hedges
325600.094	6409047.5	68	David Martin Moran
325671.031	6410067.5	069A	Private Freehold - White
325665.312	6409874	70	Bevan George Wilson & Dianne Jennifer Wilson
325759.906	6409620	71	Gillian Louise Holmes
326122.531	6408189	072B	Graeme William Cheetham & Kay Heather Cheetham
326015.5	6408284	072C	Graeme William Cheetham & Kay Heather Cheetham
326269.594	6409346	73	Bruce Moran & Janet Mary Moran
326337.031	6409236	74	M&S Boyce
326288.5	6409092	75	D&M Bridge
325974.469	6409606.5	76	K&J Badior
326144.531	6409852	77	David Neville Bynon & Lynne Agatha Bynon
325887	6410028	78	Vicki Margaret Conroy
325365.094	6410080.5	80	Martin Henry Westcott & Judy Anne Westcott
323690.594	6405348.5	81	Rodney George Hall & Doreen Ann Hall
321897.969	6404244	83	Gregory James Hall

Easting (m)	Northing (m)	ID	Owner
322118.531	6404277.5	084A	Isobel Mary Tisdell
322178	6403920	084B	Isobel Mary Tisdell
323836.844	6407879	100A	Alan Charles Noble
324203.656	6408195	100B	Alan Charles Noble
324416.344	6408394	100C	Alan Charles Noble
324421	6408470	100D	Alan Charles Noble
323284.469	6408000	101A	Gregory James Donnellan
322138	6405854	111	Bruce Howard Richards & Rosalie Ellen Richards
321519.812	6405033	114	Bruce Howard Richards & Rosalie Ellen Richards
320987.812	6405749	117	John Charles McInerney & Judith McInerney
320760.812	6404893.5	119	Mark Andrew Beasley & Michele Kathleen Beasley
321122.344	6404551.5	120	Stephen Francis Ernst & Carol Dawn Ernst
321417.188	6404001	121	Trevor Geoffrey Burgess
320624.188	6404173	126	Neville Gordon Smiles & Margaret Fay Smiles
319622.719	6403376	129	W.H. Bowman, M. H. Bowman, W.G. Bowman & G. R. Elder
319022.625	6403128.5	130A	Alistair Stuart Bowman
319158.906	6401742	130B	Alistair Stuart Bowman
318672.188	6399372	131	Malcolm James Ryan & Elaine Tze Mei Ryan
318783.906	6399350	132	Paul Raymond Burley & Catherine Maree Burley
318889.25	6399321	133	Tony Zanardi & Sandra Maree Zanardi
318104.75	6399595.5	137A	Wyoming Holsteins PTY Limited
317991.438	6399396	137B	Wyoming Holsteins PTY Limited
318253.188	6399367.5	137C	Wyoming Holsteins PTY Limited
318779.906	6399215.5	139	Robert John Algie
318676.156	6399197.5	144	Chriss Ivan Maskey
318741.594	6399235.5	145	HJ Kauter, WH Bowman & H Wright
318807.062	6399079.5	146	Todd Anthony Mills & Sharron Ann Mills
320040	6405606	151	Trustees of Church Property-Diocese of Newcastle
325054.719	6408134	162	William Edwin Gardner & Anne Mary Gardner
325370.969	6408509	163	John Henry Morre & Margaret Rose Moore
325944.938	6407969.5	164	Brian William Cherry & Roselea Ann Cherry
319460.656	6399193.5	182A	Elizabeth Stuart Bowman
317897.25	6399180.5	182B	Elizabeth Stuart Bowman
318067.094	6400189	184A	Bruce Eric Moxey & Thea Anne Moxey
317991.594	6399965	184B	Bruce Eric Moxey & Thea Anne Moxey
317973.188	6399822	184C	Bruce Eric Moxey & Thea Anne Moxey
315923.906	6403033.5	187	Neville Robert Stapleton
324578	6410566	197	Fairfull J & LS
324736	6411314	198	Deaves IP & SJ
325617.906	6399742.5	217	M Eveleigh, K Penfold & R Eveleigh

Easting (m)	Northing (m)	ID	Owner
Mine Owned Residences			
320642.062	6405021.5	1	Ashton Coal Mines Limited
320608.125	6405123.5	3	Ashton Coal Mines Limited
320625.094	6405196	4	Ashton Coal Mines Limited
320572.812	6405205	5	Ashton Coal Mines Limited
320567.406	6405130	6	Ashton Coal Mines Limited
320543.875	6405133.5	7	Ashton Coal Mines Limited
320552.062	6405312	10	Ashton Coal Mines Limited
320448.312	6405225	12	Ashton Coal Mines Limited
320367.719	6405326.5	13	Ashton Coal Mines Limited
320476.656	6405447.5	17	Ashton Coal Mines Limited
320563.375	6405642.5	21	Ashton Coal Mines Limited
320610.125	6405702	22	Ashton Coal Mines Pty Limited
320442.938	6405684.5	25	Ashton Coal Mines Limited
320386.656	6405673	27	Ashton Coal Mines Limited
320361.938	6405737.5	28	Ashton Coal Mines Limited
320370.719	6405773	29	Ashton Coal Mines Limited
320230.25	6405694.5	31	Ashton Coal Mines Limited
320717.812	6405887.5	33	Ashton Coal Mines Limited
320584.594	6406043.5	36	Ashton Coal Mines Limited
320398	6405970	36	Ashton Coal Mines Limited
320428.094	6405907.5	38	Ashton Coal Mines Limited
320394.25	6405911	39	Ashton Coal Mines Limited
320392.062	6405944.5	40	Ashton Coal Mines Limited
320325.875	6405919	41	Ashton Coal Mines Limited
320330.156	6405994.5	43	Ashton Coal Mines Limited
320187.938	6405956.5	44	Ashton Coal Mines Limited
320418.094	6404951	45	Ashton Coal Mines Limited
320280.031	6404996.5	47	Ashton Coal Mines Limited
320284.375	6405120	49	Ashton Coal Mines Limited
325389.625	6409818.5	069B	Xstrata Mt Owen PTY Limited
321928	6409716	079A	Hunter Valley Coal Corporation PTY Limited
325187.344	6409968	079B	Hunter Valley Coal Corp. Pty Ltd
325594.219	6410045	079C	Hunter Valley Coal Corp. Pty Ltd
323404.844	6407862.5	101B	Mine Owned - Xstrata or Subsidiary
319988.875	6406304.5	115	Ashton Coal Mines Limited
320745	6405051	118	Ashton Coal Mines Limited
320655.688	6404437	122	Ashton Coal Mines Limited

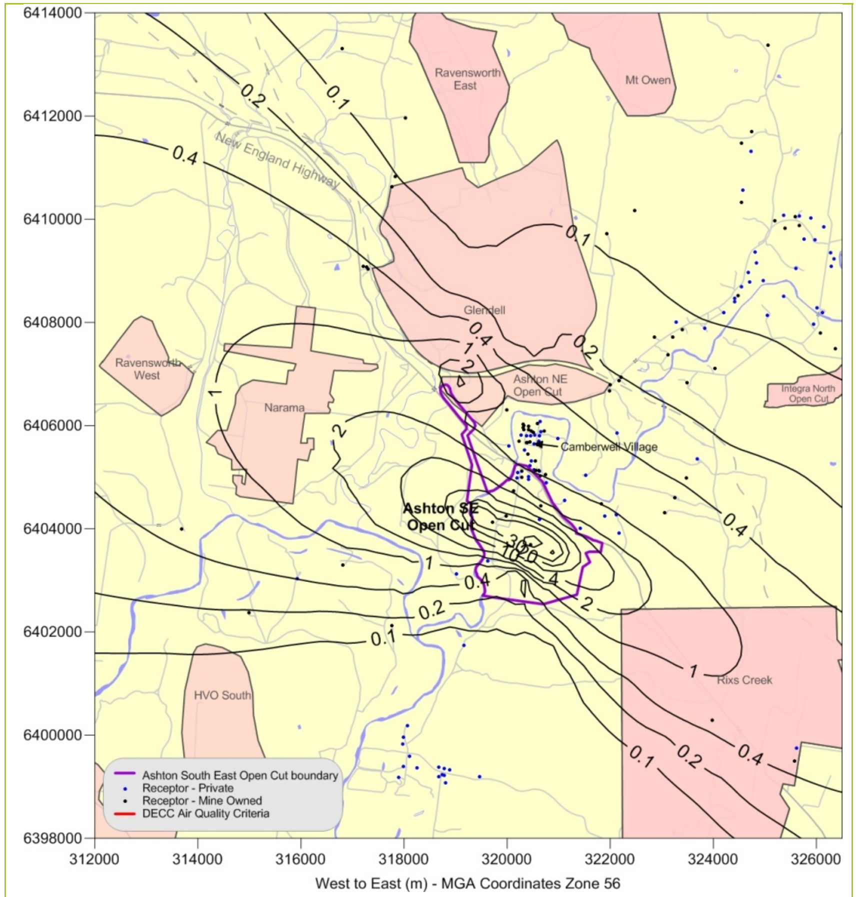
Easting (m)	Northing (m)	ID	Owner
320130.906	6404739	123	Ashton Coal Mines Limited
319986.094	6404251.5	125	Ashton Coal Mines Limited
319720.125	6404124	127	Ashton Coal Mines Limited
320450.375	6403685	128	Ashton Coal Mines Limited
313691.688	6403991.5	153	Mine Owned - Xstrata or Subsidiary
321981.156	6406667.5	159A	Glendell Tenements PTY Limited
322002.688	6406793	159B	Mine Owned - Xstrata or Subsidiary
321537.469	6406522.5	159C	Glendell Tenements PTY Limited
321424.5	6406444.5	159D	Glendell Tenements PTY Limited
323124.156	6407374.5	159E	Mine Owned - Xstrata or Subsidiary
323212.188	6407709.5	159F	Mine Owned - Xstrata or Subsidiary
322859.75	6407718.5	159G	Mine Owned - Xstrata or Subsidiary
323477.219	6404984	160A	RHA Pastoral Company PTY Limited
323247.188	6404600	160B	RHA Pastoral Company PTY Limited
323057.656	6404313.5	160C	RHA Pastoral Company PTY Limited
324484.875	6408518.5	160D	RHA Pastoral Company PTY Limited
323491.625	6406830	161A	Vale Australia (GC), Maitland Main Colleries P/L, NS Glennies Creek P/L, POS-GC P/L, JS Glennies Creek P/L & JFE Steel Aus. P/L
324031.312	6407105	161B	CVRD AUSTRALIA (GC) P/L & MAITLAND MAIN COLLIERIES P/L & NS GLENNIES CREEK P/L & POS-GC P/L & JS GLENNIES CREEK P/L & JFE GLENNIES CREEK P/L & JFE STE
321824.812	6404485.5	161C	Vale Australia (GC), Maitland Main Colleries P/L, NS Glennies Creek P/L, POS-GC P/L, JS Glennies Creek P/L & JFE Steel Aus. P/L
324467	6407668	161D	Vale Australia (GC), Maitland Main Colleries P/L, NS Glennies Creek P/L, POS-GC P/L, JS Glennies Creek P/L & JFE Steel Aus. P/L
326078.688	6407793	166	Integra Coal Operations Pty Ltd
326370.688	6407486	168	Integra Coal Operations Pty Ltd
316816	6403293	181A	Coal & Allied Operations Pty Limited
314988.094	6402368.5	181B	Coal & Allied Operations Pty Limited
317758.281	6402122.5	181C	Coal & Allied Operations Pty Limited
317206	6409079	189	Mine Owned - Xstrata or Subsidiary
317274.188	6409071	190	Mine Owned - Xstrata or Subsidiary
317305	6409034.5	191	Mine Owned - Xstrata or Subsidiary
317763	6410629	192	Mine Owned - Xstrata or Subsidiary
317836	6410828	193	Mine Owned - Xstrata or Subsidiary
318030	6411960	194A	LIDDELL TENEMENTS PTY LIMITED
316796	6413303	194B	LIDDELL TENEMENTS PTY LIMITED
322480.312	6410161	195	Enex Ravensworth PTY Limited
324545	6410331	196	Mine Owned - Xstrata or Subsidiary
324547	6411471	199	Mine Owned - Xstrata or Subsidiary
324751	6411695	200	Mine Owned - Xstrata or Subsidiary
323977.406	6400291	218A	Rix's Creek Pty Limited
325665.406	6398722.5	218B	Rix's Creek Pty Limited
325571.5	6399501.5	218C	Rix's Creek Pty Limited

Appendix : Predicted $PM_{2.5}$ emissions from mining sources



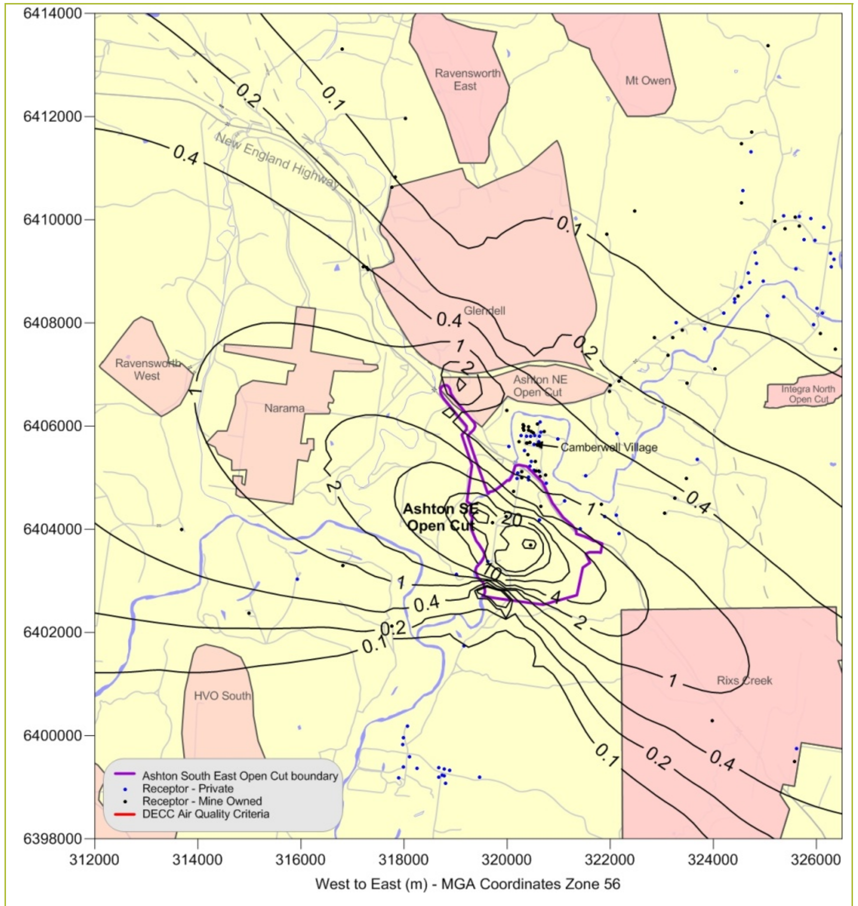
Species: PM$_{2.5}$	Averaging Time: Annual	Percentile: Maximum	Scenario: Year 1 Project only	Location: Ashton SEOC
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria :** N/A	**Met Data:** Repeater Station 2007-2008	**Plot:** J Cox

Figure B.: Predicted annual average PM$_{2.5}$ concentration due to emissions from the Proposal – Year 1



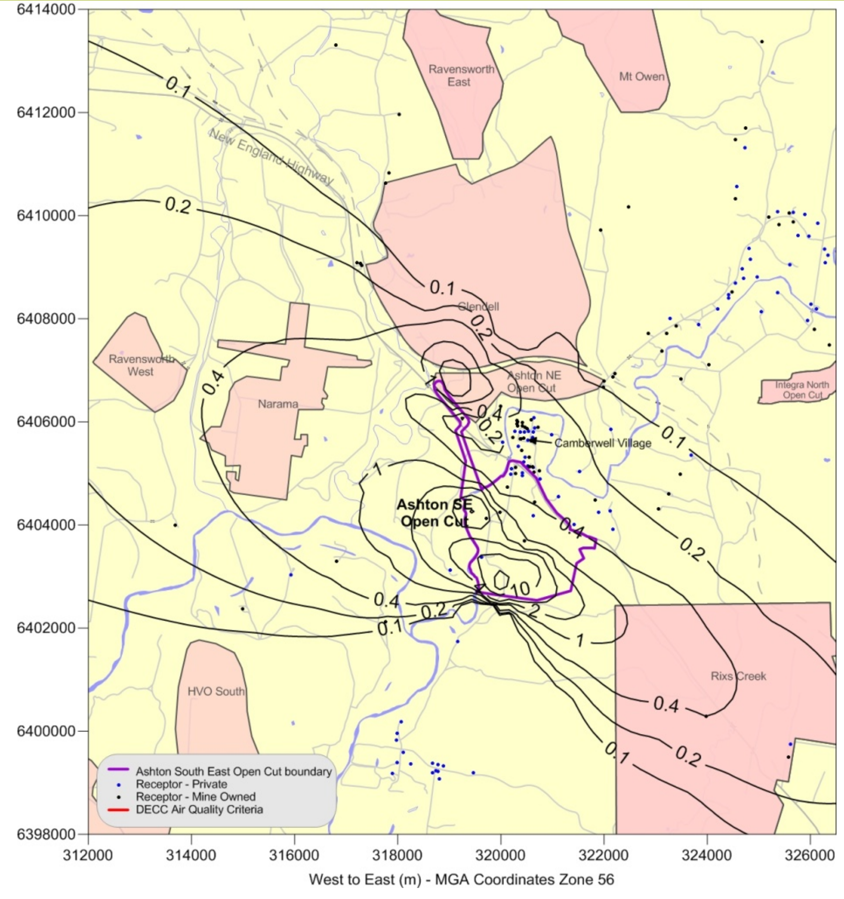
Species: PM$_{2.5}$	Averaging Time: Annual	Percentile: Maximum	Scenario: Year 3 Project only	Location: Ashton SEOC
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria :** N/A	**Met Data:** Repeater Station 2007-2008	**Plot:** J Cox

Figure B.: Predicted annual average PM$_{2.5}$ concentration due to emissions from the Proposal – Year 3



Species: $PM_{2.5}$	Averaging Time: Annual	Percentile: Maximum	Scenario: Year 5 Project only	Location: Ashton SEOC
Model Used: ISCMOD	**Units:** $\mu g/m^3$	**Assessment criteria :** N/A	**Met Data:** Repeater Station 2007-2008	**Plot:** J Cox

Figure B.: Predicted annual average $PM_{2.5}$ concentration due to emissions from the Proposal – Year 5



Species: $PM_{2.5}$	Averaging Time: Annual	Percentile: Maximum	Scenario: Year 7 Project only	Location: Ashton SEOC
Model Used: ISCMOD	**Units:** $\mu g/m^3$	**Assessment criteria :** N/A	**Met Data:** Repeater Station 2007-2008	**Plot:** J Cox

Figure B.: Predicted annual average $PM_{2.5}$ concentration due to emissions from the Proposal– Year 7

Appendix : Joint wind speed, wind direction and stability class tables for Ashton Coal meteorological station

STATISTICS FOR FILE: C:\Jobs\Ashton2008\Met\Ashton_Repeater_Met\Ashton_Repeater_Jul07-Jun08.isc
MONTHS: All
HOURS : All
OPTION: Frequency

PASQUILL STABILITY CLASS 'A'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000114
NE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ENE	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000114
E	0.000342	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000456
ESE	0.000569	0.000342	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000911
SE	0.000342	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000342
SSE	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000114
S	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000114
SSW	0.000456	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000569
SW	0.000456	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000456
WSW	0.001025	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001139
W	0.000114	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000342
WNW	0.000456	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000569
NW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
N	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
CALM									0.000569
TOTAL	0.004214	0.001025	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005808

MEAN WIND SPEED (m/s) = 1.15
NUMBER OF OBSERVATIONS = 51

PASQUILL STABILITY CLASS 'B'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ENE	0.000114	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000228
E	0.000569	0.000456	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001025
ESE	0.001253	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001480
SE	0.000114	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000228
SSE	0.000683	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000797
S	0.000456	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000456
SSW	0.000569	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000569
SW	0.000114	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000342
WSW	0.000456	0.000342	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000797
W	0.001139	0.000797	0.000342	0.000000	0.000000	0.000000	0.000000	0.000000	0.002278
WNW	0.000797	0.001480	0.000342	0.000000	0.000000	0.000000	0.000000	0.000000	0.002619
NW	0.000114	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000342
NNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
N	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
CALM									0.000911
TOTAL	0.006377	0.004100	0.000683	0.000000	0.000000	0.000000	0.000000	0.000000	0.012072

MEAN WIND SPEED (m/s) = 1.50
NUMBER OF OBSERVATIONS = 106

PASQUILL STABILITY CLASS 'C'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ENE	0.000911	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001025
E	0.000683	0.001708	0.000342	0.000000	0.000000	0.000000	0.000000	0.000000	0.002733
ESE	0.002961	0.002392	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005352
SE	0.001253	0.002164	0.001480	0.000456	0.000000	0.000000	0.000000	0.000000	0.005352
SSE	0.001253	0.000911	0.000683	0.000000	0.000000	0.000000	0.000000	0.000000	0.002847
S	0.001025	0.000456	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001480
SSW	0.000569	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000797
SW	0.000569	0.000342	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000911
WSW	0.000456	0.000114	0.000000	0.000114	0.000000	0.000000	0.000000	0.000000	0.000683
W	0.001253	0.002505	0.002278	0.001936	0.000000	0.000000	0.000000	0.000000	0.007972
WNW	0.001708	0.005466	0.007858	0.007972	0.000000	0.000000	0.000000	0.000000	0.023004
NW	0.000228	0.000911	0.000797	0.000456	0.000000	0.000000	0.000000	0.000000	0.002392
NNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
N	0.000000	0.000000	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000114
CALM									0.001594
TOTAL	0.012869	0.017310	0.013552	0.010933	0.000000	0.000000	0.000000	0.000000	0.056258

MEAN WIND SPEED (m/s) = 2.85
NUMBER OF OBSERVATIONS = 494

PASQUILL STABILITY CLASS 'D'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000456	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000683
NE	0.001594	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001822
ENE	0.001480	0.001594	0.000228	0.000342	0.000000	0.000000	0.000000	0.000000	0.003644
E	0.008769	0.017766	0.017880	0.008313	0.001936	0.000683	0.000000	0.000000	0.055347
ESE	0.016513	0.038264	0.024599	0.025737	0.009680	0.002278	0.000456	0.000000	0.117526
SE	0.013552	0.018563	0.015260	0.003189	0.000000	0.000000	0.000000	0.000000	0.050564
SSE	0.003530	0.002278	0.000797	0.000000	0.000000	0.000000	0.000000	0.000000	0.006605
S	0.002733	0.001025	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003758
SSW	0.002164	0.000342	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002505
SW	0.002278	0.000911	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.003416
WSW	0.004214	0.001367	0.000797	0.000114	0.000000	0.000000	0.000000	0.000000	0.006491
W	0.006036	0.006947	0.003189	0.001936	0.002847	0.002164	0.000228	0.000000	0.023346
WNW	0.009224	0.021638	0.022549	0.019929	0.021524	0.012072	0.005580	0.002392	0.114907
NW	0.006264	0.007402	0.008200	0.010705	0.008086	0.007061	0.003075	0.002164	0.052955
NNW	0.000797	0.000683	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.001594
N	0.000569	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000683
CALM									0.027332
TOTAL	0.080173	0.119349	0.093839	0.070265	0.044072	0.024257	0.009338	0.004555	0.473181

MEAN WIND SPEED (m/s) = 3.62
NUMBER OF OBSERVATIONS = 4155

PASQUILL STABILITY CLASS 'E'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000911	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000911
NE	0.000797	0.001025	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001822
ENE	0.001253	0.001708	0.001139	0.000000	0.000000	0.000000	0.000000	0.000000	0.004100
E	0.003758	0.009680	0.004783	0.000569	0.000000	0.000000	0.000000	0.000000	0.018791
ESE	0.005580	0.033254	0.036328	0.006036	0.000000	0.000000	0.000000	0.000000	0.081198
SE	0.007516	0.018221	0.004441	0.000000	0.000000	0.000000	0.000000	0.000000	0.030179
SSE	0.001480	0.001708	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003189
S	0.001480	0.000683	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002164
SSW	0.001367	0.000569	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001936
SW	0.001594	0.001025	0.000456	0.000000	0.000000	0.000000	0.000000	0.000000	0.003075
WSW	0.002392	0.002619	0.000569	0.000342	0.000000	0.000000	0.000000	0.000000	0.005922
W	0.002847	0.005352	0.000569	0.000000	0.000000	0.000000	0.000000	0.000000	0.008769
WNW	0.003075	0.017766	0.024485	0.003644	0.000000	0.000000	0.000000	0.000000	0.048969
NW	0.003416	0.005808	0.012983	0.003416	0.000000	0.000000	0.000000	0.000000	0.025624
NNW	0.001253	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001367
N	0.000000	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000114
CALM									0.020727
TOTAL	0.038720	0.099647	0.085753	0.014008	0.000000	0.000000	0.000000	0.000000	0.258854

MEAN WIND SPEED (m/s) = 2.54
NUMBER OF OBSERVATIONS = 2273

PASQUILL STABILITY CLASS 'F'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NE	0.000456	0.000797	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001253
ENE	0.002847	0.001594	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.004441
E	0.011047	0.007972	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.019018
ESE	0.018449	0.028357	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.046806
SE	0.025054	0.019246	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.044300
SSE	0.004555	0.002619	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.007175
S	0.002961	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003189
SSW	0.002392	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002505
SW	0.001936	0.000456	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002392
WSW	0.002164	0.000797	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002961
W	0.003530	0.003075	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.006605
WNW	0.008313	0.016627	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.024940
NW	0.006833	0.008200	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.015032
NNW	0.001367	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001367
N	0.000569	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000569
CALM									0.011274
TOTAL	0.092472	0.090081	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.193828

MEAN WIND SPEED (m/s) = 1.48
NUMBER OF OBSERVATIONS = 1702

ALL PASQUILL STABILITY CLASSES

Wind Speed Class (m/s)

WIND	0.50 TO	1.50 TO	3.00 TO	4.50 TO	6.00 TO	7.50 TO	9.00 TO	GREATER THAN

SECTOR	1.50	3.00	4.50	6.00	7.50	9.00	10.50	10.50	TOTAL
NNE	0.001480	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001708
NE	0.002847	0.002050	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.004897
ENE	0.006719	0.005125	0.001367	0.000342	0.000000	0.000000	0.000000	0.000000	0.013552
E	0.025168	0.037695	0.023004	0.008883	0.001936	0.000683	0.000000	0.000000	0.097369
ESE	0.045325	0.102836	0.060927	0.031773	0.009680	0.002278	0.000456	0.000000	0.253274
SE	0.047831	0.058308	0.021182	0.003644	0.000000	0.000000	0.000000	0.000000	0.130965
SSE	0.011616	0.007630	0.001480	0.000000	0.000000	0.000000	0.000000	0.000000	0.020727
S	0.008769	0.002392	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.011160
SSW	0.007516	0.001367	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.008883
SW	0.006947	0.002961	0.000683	0.000000	0.000000	0.000000	0.000000	0.000000	0.010591
WSW	0.010705	0.005352	0.001367	0.000569	0.000000	0.000000	0.000000	0.000000	0.017993
W	0.014919	0.018904	0.006377	0.003872	0.002847	0.002164	0.000228	0.000000	0.049311
WNW	0.023574	0.063091	0.055233	0.031545	0.021524	0.012072	0.005580	0.002392	0.215010
NW	0.016855	0.022549	0.021979	0.014577	0.008086	0.007061	0.003075	0.002164	0.096344
NNW	0.003416	0.000797	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.004328
N	0.001139	0.000228	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.001480
CALM									0.062407
TOTAL	0.234825	0.331511	0.193828	0.095206	0.044072	0.024257	0.009338	0.004555	1.000000

MEAN WIND SPEED (m/s) = 2.84
NUMBER OF OBSERVATIONS = 8781

FREQUENCY OF OCCURENCE OF STABILITY CLASSES

A : 0.6%
B : 1.2%
C : 5.6%
D : 47.3%
E : 25.9%
F : 19.4%

STABILITY CLASS BY HOUR OF DAY

Hour	A	B	C	D	E	F
01	0000	0000	0000	0044	0156	0166
02	0000	0000	0000	0044	0167	0154
03	0000	0000	0000	0046	0160	0160
04	0000	0000	0000	0041	0164	0161
05	0000	0000	0000	0060	0160	0146
06	0000	0000	0000	0101	0129	0136
07	0001	0002	0002	0218	0073	0070
08	0003	0004	0005	0354	0000	0000
09	0002	0005	0018	0341	0000	0000
10	0003	0006	0041	0316	0000	0000
11	0006	0013	0051	0296	0000	0000
12	0006	0019	0085	0256	0000	0000
13	0013	0020	0071	0262	0000	0000
14	0006	0014	0086	0260	0000	0000
15	0004	0013	0073	0276	0000	0000
16	0005	0007	0042	0289	0021	0002
17	0002	0003	0020	0250	0072	0019
18	0000	0000	0000	0189	0128	0049
19	0000	0000	0000	0160	0150	0056
20	0000	0000	0000	0111	0180	0075
21	0000	0000	0000	0071	0202	0093
22	0000	0000	0000	0061	0189	0116
23	0000	0000	0000	0057	0174	0135
24	0000	0000	0000	0052	0148	0164

STABILITY CLASS BY MIXING HEIGHT

Mixing height	A	B	C	D	E	F
<=500 m	0004	0006	0018	0830	2160	1681
<=1000 m	0015	0029	0168	1357	0033	0006
<=1500 m	0032	0071	0308	1481	0080	0015

```
   <=2000 m    0000 0000 0000 0232 0000 0000
   <=3000 m    0000 0000 0000 0236 0000 0000
    >3000 m    0000 0000 0000 0019 0000 0000

----------------------------
MIXING HEIGHT BY HOUR OF DAY
----------------------------
       0000  0100  0200  0400  0800  1600  Greater
        to    to    to    to    to    to   than
Hour   0100  0200  0400  0800  1600  3200  3200
  01   0135  0124  0069  0008  0011  0019  0000
  02   0142  0117  0067  0008  0012  0019  0000
  03   0153  0104  0075  0006  0009  0018  0001
  04   0167  0105  0063  0004  0012  0015  0000
  05   0194  0086  0047  0005  0016  0017  0001
  06   0117  0120  0107  0001  0007  0013  0001
  07   0126  0056  0114  0070  0000  0000  0000
  08   0000  0064  0130  0172  0000  0000  0000
  09   0000  0000  0099  0188  0079  0000  0000
  10   0000  0000  0000  0236  0130  0000  0000
  11   0000  0000  0000  0142  0224  0000  0000
  12   0000  0000  0000  0092  0274  0000  0000
  13   0000  0000  0000  0000  0366  0000  0000
  14   0000  0000  0000  0000  0366  0000  0000
  15   0000  0000  0000  0000  0366  0000  0000
  16   0000  0000  0000  0000  0366  0000  0000
  17   0010  0011  0013  0004  0313  0014  0001
  18   0029  0047  0051  0006  0195  0037  0001
  19   0044  0074  0090  0014  0055  0089  0000
  20   0049  0099  0110  0006  0026  0076  0000
  21   0069  0106  0124  0009  0013  0045  0000
  22   0088  0119  0106  0006  0015  0032  0000
  23   0100  0133  0080  0006  0015  0030  0002
  24   0127  0126  0062  0007  0013  0028  0001
```

Appendix : Dust deposition, TEOM PM_{10} monitoring and HVAS TSP monitoring data

Table D.: Dust deposition monitoring data (g/m²/month)

	Deposition gauge ID													
	Month	**DG2**	**DG3**	**DG4**	**DG5**	**DG6**	**DG7**	**DG8**	**DG9**	**DG10**	**DG11**	**DG12**	**DG13**	**DG14**
2004	January	1.4	2.2	1.6	3.1	2.1	2.5	2.8	3.7	2.5	1.8	6.8	2.6	ND
	February	4.1	3.9	1.5	2.2	2.0	2.0	2.3	ND	1.6	1.9	11.6	35.2	ND
	March	8.8	1.3	3.9	2.3	1.8	2.9	2.5	5.2	1.9	0.8	32.7	3.7	ND
	April	ND	1.6	6.9	2.3	2.6	4.9	3.1	ND	4.9	4.3	30.7	2.4	ND
	May	ND	5.2	3.4	4.1	2.8	3.7	2.8	3.4	1.7	ND	30.7	2.4	ND
	June	2.6	6.1	4.2	2.0	2.6	5.1	2.7	3.8	4.1	1.5	26.6	4.2	ND
	July	4.8	15.3	8.5	2.6	2.6	4.2	3.2	4.6	4.0	2.1	43.5	20.0	ND
	August	2.0	7.7	2.9	1.4	2.6	3.0	2.4	4.8	1.0	2.4	3.4	2.4	ND
	September	3.1	2.9	3.2	0.5	2.0	2.2	2.8	0.5	5.3	2.8	7.9	2.8	ND
	October	ND	4.5	2.5	1.4	1.5	2.3	1.9	2.5	1.2	1.5	2.9	ND	ND
	November	1.4	4.1	0.2	0.3	2.3	1.1	3.4	0.6	4.4	1.2	1.2	0.4	ND
	December	2.7	1.2	1.0	1.5	1.9	2.0	1.7	ND	2.7	0.4	4.3	1.5	ND
	Average	**3.4**	**4.7**	**3.3**	**2.0**	**2.2**	**3.0**	**2.6**	**3.2**	**2.9**	**1.9**	**16.9**	**7.1**	**-**
2005	January	2.1	2.6	2.5	2.2	3.3	3.5	2.7	ND	6.6	2.3	7.5	3.9	ND
	February	1.9	2.7	1.4	1.9	1.4	2.5	2.7	1.4	6.5	1.2	5.0	ND	ND
	March	2.3	2.4	1.1	1.7	1.6	2.5	2.3	ND	2.6	ND	4.5	2.7	ND
	April	0.7	2.5	ND	2.5	1.9	3.5	2.7	2.8	3.2	1.5	8.2	ND	ND
	May	2.8	3.3	1.5	1.0	2.3	2.7	3.3	2.7	4.2	1.4	8.3	2.7	ND
	June	ND	7.4	ND	ND	ND	4.3	2.4	2.2	3.3	1.8	4.1	ND	ND
	July	4.7	3.8	3.8	2.3	3.9	3.3	3.3	4.5	3.1	1.8	5.5	3.9	ND
	August	ND	1.4	2.2	ND	2.7	3.8	2.9	2.8	1.9	1.8	6.1	2.5	ND
	September	3.1	3.5	2.8	2.3	3.0	5.1	2.7	2.6	2.0	1.8	5.0	5.1	ND
	October	3.9	3.7	2.8	1.5	0.8	2.3	2.6	3.1	0.7	2.2	2.7	ND	ND
	November	6.5	1.8	ND	5.5	4.1	3.6	3.4	5.4	2.3	2.5	7.7	7.4	ND
	December	4.5	6.5	2.1	5.7	2.6	3.5	1.9	2.0	1.7	2.4	10.5	2.4	ND
	Average	**3.3**	**3.5**	**2.2**	**2.7**	**2.5**	**3.4**	**2.7**	**3.0**	**3.2**	**1.9**	**6.3**	**3.8**	**-**
2006	January	1.5	3.1	1.4	1.7	2.9	3.6	2.7	2.0	2.4	1.6	7.1	5.9	ND
	February	1.3	1.5	2.7	ND	1.6	ND	2.5	3.3	1.9	1.2	8.4	ND	ND
	March	2.7	1.4	5.7	4.6	2.0	3.0	2.1	4.1	5.0	1.1	3.4	ND	ND
	April	3.9	2.1	2.7	1.7	1.7	4.6	2.3	2.9	2.4	2.2	7.0	4.5	ND
	May	2.0	3.2	ND	3.8	3.0	3.8	4.4	5.5	3.1	4.2	ND	3.7	ND
	June	2.7	5.0	2.0	1.7	2.4	7.1	3.3	4.9	4.2	1.9	ND	6.1	ND
	July	1.6	3.1	3.4	2.5	3.4	6.8	3.9	ND	3.0	2.9	ND	4.8	ND
	August	1.9	8.4	4.0	2.6	4.4	9.9	4.9	2.9	5.6	3.5	ND	4.2	ND
	September	2.6	8.8	0.9	1.4	ND	2.9	3.3	6.5	1.2	1.8	ND	3.3	ND
	October	1.2	7.8	3.0	2.3	3.9	5.4	3.5	ND	2.6	2.2	ND	ND	1.9
	November	2.0	6.5	3.0	2.8	4.6	4.9	4.9	ND	3.0	2.9	ND	4.7	4.7
	December	3.0	3.7	1.1	2.6	2.1	2.8	2.9	3.1	1.6	1.9	ND	ND	2.9
	Average	**2.2**	**4.6**	**2.7**	**2.5**	**2.9**	**5.0**	**3.4**	**3.9**	**3.0**	**2.3**	**6.5**	**4.7**	**3.2**
2007	January	3.8	2.5	1.3	1.9	1.7	3.3	2.6	3.1	2.7	1.9	ND	4.7	1.6
	February	C	3.6	3.3	3.5	3.0	3.7	3.4	2.6	2.5	3.2	ND	4.9	1.7
	March	3.9	C	4.0	3.6	3.3	7.9	3.6	4.1	2.1	4.4	ND	6.5	CT4.8
	April	C	12.6	1.4	2.1	3.9	6.0	3.1	1.5	4.9	3.3	ND	1.5	4.8
	May	4.7	10.0		1.3	4.0	5.4	4.3	3.6	1.7	4.7	ND	5.7	1.7
	June	6.8	Decommissioned	6.4	1.2	2.6	3.0	3.5	1.4	2.5	1.3	ND	1.4	1.9
	July	3.2	ND	6.1	1.9	5.2	9.0	6.4	6.2	5.0	1.2	ND	4.1	1.3
	August	2.7	ND	2.5	1.3	2.1	2.4	2.6	ND	1.6	4.6	ND	1.8	1.9
	September	2.9	ND	4.2	3.0	3.6	4.8	2.0	ND	1.3	4.9	ND	3.0	1.2
	October	2.9	ND	ND	1.8	1.9	3.4	1.9	3.7	5.6	1.9	ND	2.9	1.3
	November	3.2	ND	ND	1.9	3.3	1.9	1.7	3.7	1..5	1.5	ND	2.3	2.3
	December	C	ND	ND	1.2	2.3	1.5	1.3	6.6	2.8	1.7	ND	5.3	C
	Average	**3.8**	**7.2**	**3.7**	**2.1**	**3.1**	**4.4**	**3.0**	**3.7**	**3.0**	**2.9**	**-**	**3.7**	**2.0**
2008	January	2.4	ND	ND	2.2	1.2	1.3	1.6	4.1	4.0	1.5	ND	3.9	0.8
	February	7.6	ND	2.4	2.0	2.4	2.2	2.6	1.5	2.8	2.1	ND	4.1	5.3
	March	4.1	ND	ND	5.2	ND	5.5	3.2	ND	7.4	4.1	ND	6.1	3.5
	April	4.1	ND	4.1	2.2	2.3	3.5	2.3	2.2	1.7	2.1	ND	3.0	1.0
	May	8.7	ND	8.0	2.0	3.0	4.3	2.6	3.0	3.0	1.4	ND	3.8	2.6
	June	8.0	ND	5.6	1.5	3.4	6.1	3.6	5.5	6.0	2.4	ND	3.0	2.1
	July	4.2	ND	ND	1.9	3.2	3.2	2.9	ND	6.9	2.6	ND	ND	2.3
	August	8.1	ND	ND	1.7	4.7	ND	4.7	2.3	ND	3.4	ND	3.4	1.5
	September	8.1	ND	ND	3.6	ND	3.5	4.2	2.1	ND	3.6	ND	ND	1.4
	October	5.1	ND	7.0	4.6	4.1	4.3	3.3	4.1	2.5	4.0	ND	4.8	3.0
	November	3.5	ND	ND	2.1	2.1	2.8	3.3	3.0	ND		ND	3.7	4.3
	December	2.6	ND	ND	2.1	2.1	2.8	3.3	3.0	ND	3.8	ND	3.7	1.6
	Average	**5.5**	**-**	**5.4**	**2.6**	**2.9**	**3.6**	**3.1**	**3.1**	**4.3**	**2.8**	**-**	**4.0**	**2.5**
2009	January	4.0	ND	ND	4.1	2.8	4.0	3.3	3.1	3.7	3.6	ND	5.5	ND
	February	ND	ND	ND	ND	2.7	2.1	3.0	2.7	ND	1.8	ND	ND	3.5
	March	2.5	ND	4.9	4.4	4.5	3.1	2.3	6.1	2.5	2.9	ND	7.4	2.0
	April	ND	ND	5.4	3.8	3.9	5.3	3.6	2.9	2.7	3.0	ND	6.9	1.8
	May	2.8	ND	3.6	5.6	3.4	5.0	2.7	2.8	2.5	2.3	ND	4.7	1.7
	June	7.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	July	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	August	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	September	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	October	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	November	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	December	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Average	**4.1**	**-**	**4.6**	**4.5**	**3.5**	**3.9**	**3.0**	**3.5**	**2.9**	**2.7**	**-**	**6.1**	**2.3**

Notes:
ND – No data
C – Sample contaminated

Appendix : Example ISCMOD input file

```
**  ISCST3 model input runstream : Dust - Y3 Ashton second run
CO STARTING
   TITLEONE ISCST3 Dust Model Run
   MODELOPT RURAL CONC DDEP DRYDPLT HE>ZI
   AVERTIME 24 PERIOD
   POLLUTID TSP
   ERRORFIL C:\Jobs\Ashton2008\ISC\Year3\Model2\error.log
   TERRHGTS ELEV
   RUNORNOT RUN
CO FINISHED

SO STARTING
   LOCATION  POINT1  VOLUME  319733 6403748 59.8
   LOCATION  POINT2  VOLUME  319908 6403748 61.0
   LOCATION  POINT3  VOLUME  320133 6403741 68.4
   LOCATION  POINT4  VOLUME  320505 6403741 68.6
   LOCATION  POINT5  VOLUME  319726 6403974 60.4
   LOCATION  POINT6  VOLUME  319915 6403959 63.0
   LOCATION  POINT7  VOLUME  320075 6403901 64.4
   LOCATION  POINT8  VOLUME  320265 6403894 66.4
   LOCATION  POINT9  VOLUME  319733 6403857 60.0
   LOCATION  POINT10  VOLUME  319995 6403835 62.8
   LOCATION  POINT11  VOLUME  320206 6403799 67.4
   LOCATION  POINT12  VOLUME  320381 6403726 69.0
   LOCATION  POINT13  VOLUME  320512 6403617 72.4
   LOCATION  POINT14  VOLUME  320658 6403537 76.7
   LOCATION  POINT15  VOLUME  320826 6403573 75.8
   LOCATION  POINT16  VOLUME  320993 6403588 77.8
   LOCATION  POINT17  VOLUME  320826 6403675 74.7
   LOCATION  POINT18  VOLUME  320665 6403777 72.1
   LOCATION  POINT19  VOLUME  320578 6403952 72.6
   LOCATION  POINT20  VOLUME  320359 6404010 71.4
   LOCATION  POINT21  VOLUME  320133 6404090 70.5
   LOCATION  POINT22  VOLUME  321066 6403624 78.9
   LOCATION  POINT23  VOLUME  320804 6403777 75.5
   LOCATION  POINT24  VOLUME  320680 6403901 75.0
   LOCATION  POINT25  VOLUME  320563 6404018 74.0
   LOCATION  POINT26  VOLUME  319842 6403886 61.2
   LOCATION  POINT27  VOLUME  320141 6403850 65.5
   LOCATION  POINT28  VOLUME  320403 6403835 67.8
   LOCATION  POINT29  VOLUME  320184 6403974 66.9
   LOCATION  POINT30  VOLUME  320010 6404061 66.1
   LOCATION  POINT31  VOLUME  319820 6404127 63.0
   LOCATION  POINT32  VOLUME  319543 6404214 59.1
   LOCATION  POINT33  VOLUME  320775 6403464 80.2
   LOCATION  POINT34  VOLUME  320971 6403515 78.4
   LOCATION  POINT35  VOLUME  321124 6403486 81.7
   LOCATION  POINT36  VOLUME  320920 6403726 78.0
   LOCATION  POINT37  VOLUME  320687 6403661 72.0
   LOCATION  POINT38  VOLUME  320541 6403872 70.2
   LOCATION  POINT39  VOLUME  319929 6404178 66.6
   LOCATION  POINT40  VOLUME  319696 6404069 61.3
   LOCATION  POINT41  VOLUME  319696 6404258 61.4
   LOCATION  POINT42  VOLUME  319529 6404120 58.0
   LOCATION  POINT43  VOLUME  319536 6404316 60.7
   LOCATION  POINT44  VOLUME  319492 6404280 60.2
   LOCATION  POINT45  VOLUME  319500 6404498 60.3
   LOCATION  POINT46  VOLUME  319500 6404761 59.9
   LOCATION  POINT47  VOLUME  319507 6404957 65.5
   LOCATION  POINT48  VOLUME  319405 6405241 86.5
   LOCATION  POINT49  VOLUME  319325 6405526 99.5
   LOCATION  POINT50  VOLUME  319208 6405846 98.3
   LOCATION  POINT51  VOLUME  319325 6405955 92.1
   LOCATION  POINT52  VOLUME  319135 6406174 72.7
   LOCATION  POINT53  VOLUME  318968 6406363 78.9
   LOCATION  POINT54  VOLUME  318873 6406458 78.6
   LOCATION  POINT55  VOLUME  318888 6406611 74.5
   LOCATION  POINT56  VOLUME  318771 6406779 69.0
   LOCATION  POINT57  VOLUME  318924 6406749 70.8
   LOCATION  POINT58  VOLUME  319070 6406924 69.6
   LOCATION  POINT59  VOLUME  319296 6406932 75.0
   LOCATION  POINT60  VOLUME  318918 6406871 69.9
   LOCATION  POINT61  VOLUME  319256 6406673 61.0
   LOCATION  POINT62  VOLUME  319733 6403748 59.8
   LOCATION  POINT63  VOLUME  319908 6403748 61.0
   LOCATION  POINT64  VOLUME  320133 6403741 68.4
   LOCATION  POINT65  VOLUME  320505 6403741 68.6
   LOCATION  POINT66  VOLUME  319726 6403974 60.4
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LOCATION  POINT67  VOLUME  319915 6403959 63.0
LOCATION  POINT68  VOLUME  320075 6403901 64.4
LOCATION  POINT69  VOLUME  320265 6403894 66.4
LOCATION  POINT70  VOLUME  319733 6403857 60.0
LOCATION  POINT71  VOLUME  319995 6403835 62.8
LOCATION  POINT72  VOLUME  320206 6403799 67.4
LOCATION  POINT73  VOLUME  320381 6403726 69.0
LOCATION  POINT74  VOLUME  320512 6403617 72.4
LOCATION  POINT75  VOLUME  320658 6403537 76.7
LOCATION  POINT76  VOLUME  320826 6403573 75.8
LOCATION  POINT77  VOLUME  320993 6403588 77.8
LOCATION  POINT78  VOLUME  320826 6403675 74.7
LOCATION  POINT79  VOLUME  320665 6403777 72.1
LOCATION  POINT80  VOLUME  320578 6403952 72.6
LOCATION  POINT81  VOLUME  320359 6404010 71.4
LOCATION  POINT82  VOLUME  320133 6404090 70.5
LOCATION  POINT83  VOLUME  321066 6403624 78.9
LOCATION  POINT84  VOLUME  320804 6403777 75.5
LOCATION  POINT85  VOLUME  320680 6403901 75.0
LOCATION  POINT86  VOLUME  320563 6404018 74.0
LOCATION  POINT87  VOLUME  319842 6403886 61.2
LOCATION  POINT88  VOLUME  320141 6403850 65.5
LOCATION  POINT89  VOLUME  320403 6403835 67.8
LOCATION  POINT90  VOLUME  320184 6403974 66.9
LOCATION  POINT91  VOLUME  320010 6404061 66.1
LOCATION  POINT92  VOLUME  319820 6404127 63.0
LOCATION  POINT93  VOLUME  319543 6404214 59.1
LOCATION  POINT94  VOLUME  320775 6403464 80.2
LOCATION  POINT95  VOLUME  320971 6403515 78.4
LOCATION  POINT96  VOLUME  321124 6403486 81.7
LOCATION  POINT97  VOLUME  320920 6403726 78.0
LOCATION  POINT98  VOLUME  320687 6403661 72.0
LOCATION  POINT99  VOLUME  320541 6403872 70.2
LOCATION  POINT100  VOLUME  319929 6404178 66.6
LOCATION  POINT101  VOLUME  319696 6404069 61.3
LOCATION  POINT102  VOLUME  319696 6404258 61.4
LOCATION  POINT103  VOLUME  319529 6404120 58.0
LOCATION  POINT104  VOLUME  319536 6404316 60.7
LOCATION  POINT105  VOLUME  319492 6404280 60.2
LOCATION  POINT106  VOLUME  319500 6404498 60.3
LOCATION  POINT107  VOLUME  319500 6404761 59.9
LOCATION  POINT108  VOLUME  319507 6404957 65.5
LOCATION  POINT109  VOLUME  319405 6405241 86.5
LOCATION  POINT110  VOLUME  319325 6405526 99.5
LOCATION  POINT111  VOLUME  319208 6405846 98.3
LOCATION  POINT112  VOLUME  319325 6405955 92.1
LOCATION  POINT113  VOLUME  319135 6406174 72.7
LOCATION  POINT114  VOLUME  318968 6406363 78.9
LOCATION  POINT115  VOLUME  318873 6406458 78.6
LOCATION  POINT116  VOLUME  318888 6406611 74.5
LOCATION  POINT117  VOLUME  318771 6406779 69.0
LOCATION  POINT118  VOLUME  318924 6406749 70.8
LOCATION  POINT119  VOLUME  319070 6406924 69.6
LOCATION  POINT120  VOLUME  319296 6406932 75.0
LOCATION  POINT121  VOLUME  318918 6406871 69.9
LOCATION  POINT122  VOLUME  319256 6406673 61.0
LOCATION  POINT123  VOLUME  319733 6403748 59.8
LOCATION  POINT124  VOLUME  319908 6403748 61.0
LOCATION  POINT125  VOLUME  320133 6403741 68.4
LOCATION  POINT126  VOLUME  320505 6403741 68.6
LOCATION  POINT127  VOLUME  319726 6403974 60.4
LOCATION  POINT128  VOLUME  319915 6403959 63.0
LOCATION  POINT129  VOLUME  320075 6403901 64.4
LOCATION  POINT130  VOLUME  320265 6403894 66.4
LOCATION  POINT131  VOLUME  319733 6403857 60.0
LOCATION  POINT132  VOLUME  319995 6403835 62.8
LOCATION  POINT133  VOLUME  320206 6403799 67.4
LOCATION  POINT134  VOLUME  320381 6403726 69.0
LOCATION  POINT135  VOLUME  320512 6403617 72.4
LOCATION  POINT136  VOLUME  320658 6403537 76.7
LOCATION  POINT137  VOLUME  320826 6403573 75.8
LOCATION  POINT138  VOLUME  320993 6403588 77.8
LOCATION  POINT139  VOLUME  320826 6403675 74.7
LOCATION  POINT140  VOLUME  320665 6403777 72.1
LOCATION  POINT141  VOLUME  320578 6403952 72.6
LOCATION  POINT142  VOLUME  320359 6404010 71.4
LOCATION  POINT143  VOLUME  320133 6404090 70.5
LOCATION  POINT144  VOLUME  321066 6403624 78.9
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   LOCATION  POINT145  VOLUME  320804 6403777 75.5
   LOCATION  POINT146  VOLUME  320680 6403901 75.0
   LOCATION  POINT147  VOLUME  320563 6404018 74.0
   LOCATION  POINT148  VOLUME  319842 6403886 61.2
   LOCATION  POINT149  VOLUME  320141 6403850 65.5
   LOCATION  POINT150  VOLUME  320403 6403835 67.8
   LOCATION  POINT151  VOLUME  320184 6403974 66.9
   LOCATION  POINT152  VOLUME  320010 6404061 66.1
   LOCATION  POINT153  VOLUME  319820 6404127 63.0
   LOCATION  POINT154  VOLUME  319543 6404214 59.1
   LOCATION  POINT155  VOLUME  320775 6403464 80.2
   LOCATION  POINT156  VOLUME  320971 6403515 78.4
   LOCATION  POINT157  VOLUME  321124 6403486 81.7
   LOCATION  POINT158  VOLUME  320920 6403726 78.0
   LOCATION  POINT159  VOLUME  320687 6403661 72.0
   LOCATION  POINT160  VOLUME  320541 6403872 70.2
   LOCATION  POINT161  VOLUME  319929 6404178 66.6
   LOCATION  POINT162  VOLUME  319696 6404069 61.3
   LOCATION  POINT163  VOLUME  319696 6404258 61.4
   LOCATION  POINT164  VOLUME  319529 6404120 58.0
   LOCATION  POINT165  VOLUME  319536 6404316 60.7
   LOCATION  POINT166  VOLUME  319492 6404280 60.2
   LOCATION  POINT167  VOLUME  319500 6404498 60.3
   LOCATION  POINT168  VOLUME  319500 6404761 59.9
   LOCATION  POINT169  VOLUME  319507 6404957 65.5
   LOCATION  POINT170  VOLUME  319405 6405241 86.5
   LOCATION  POINT171  VOLUME  319325 6405526 99.5
   LOCATION  POINT172  VOLUME  319208 6405846 98.3
   LOCATION  POINT173  VOLUME  319325 6405955 92.1
   LOCATION  POINT174  VOLUME  319135 6406174 72.7
   LOCATION  POINT175  VOLUME  318968 6406363 78.9
   LOCATION  POINT176  VOLUME  318873 6406458 78.6
   LOCATION  POINT177  VOLUME  318888 6406611 74.5
   LOCATION  POINT178  VOLUME  318771 6406779 69.0
   LOCATION  POINT179  VOLUME  318924 6406749 70.8
   LOCATION  POINT180  VOLUME  319070 6406924 69.6
   LOCATION  POINT181  VOLUME  319296 6406932 75.0
   LOCATION  POINT182  VOLUME  318918 6406871 69.9
   LOCATION  POINT183  VOLUME  319256 6406673 61.0
** Point Source       QS    RH  IL    IV
** Parameters        ----   --- ---   ---
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   SRCPARAM  POINT2  1.0 2.0 10.0 2.0
   SRCPARAM  POINT3  1.0 2.0 10.0 2.0
   SRCPARAM  POINT4  1.0 2.0 10.0 2.0
   SRCPARAM  POINT5  1.0 2.0 10.0 2.0
   SRCPARAM  POINT6  1.0 2.0 10.0 2.0
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Appendix : Emission calculations

Ashton Coal South East Open Cut Emissions Inventory

Description of operations

The dust emission inventories have been prepared using the operational description of the proposed mining activities provided by ACOL.

Topsoil would be removed using a scraper followed by blasting to fragment the waste rock prior to excavation using loaders and trucks. Following removal of the waste rock, the exposed coal would be cleaned using a dozer and/or grader. The coal seam would then be ripped, loaded into haul trucks using an excavator or front-end-loader (FEL) and transported either directly or via a temporary ROM stockpile to the existing Coal Handling Preparation Plant (CHPP) at Ashton North East Open Cut via conveyor.

The waste rock would be hauled for placement out-of-pit.

Emission estimates

Estimated emissions are presented for all significant dust generating activities associated with the operations. The relevant emission factors used for the study are described below.

All activities have been modelled for 24 hours per day, with the exception of topsoil removal, drilling of overburden, and grading, which have been assumed to occur between the hours of 7am and 7pm, and the blasting of overburden, which has been assumed to occur between the hours of 9am and 5pm only.

Dust from wind erosion is assumed to occur over 24 hours per day, however, wind erosion is also assumed to be proportional to the third power of wind speed. This will mean that most wind erosion occurs in the day when wind speeds are highest.

Removal of topsoil
The TSP emission factor for removal of topsoil is 14 kg/h (**SPCC, 1983**) was applied.

Drilling overburden
The emission factor used for drilling has been taken to be 0.59 kg/hole (**US EPA, 1985 and updates**).

The number of holes per year were calculated based on information provided by ACOL.

Blasting overburden
TSP emissions from blasting were estimated using the **US EPA (1985 and updates)** emission factor equation given in **Equation 1**.

Equation 1

$$E_{TSP} = 0.00022 \times A^{1.5} \qquad \text{kg/blast}$$

where,

A = area to be blasted in m^2

The area to be blasted per blast and number of blasts per year were calculated based on information provided by ACOL.

Loading material / dumping topsoil and overburden using shovels/excavators/FELs
Each tonne of material loaded will generate a quantity of TSP that will depend on the wind speed and the moisture content. **Equation 2** shows the relationship between these variables.

Equation 2

$$E_{TSP} = k \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2} \right)^{1.3}}{\left(\frac{M}{2} \right)^{1.4}} \right) \qquad kg/t$$

where,

$E_{TSP} = TSP\ emissions$

$k = 0.74$

$U = wind\ speed (m/s)$

$M = moisture\ content\ (\%)$

$[where\ 0.25 \leq M \leq 4.8]$

The wind speed value was taken from the Repeater Station 2007/2008 meteorological dataset. The moisture content for overburden was assumed to be 4% for topsoil and 2% for overburden.

Hauling material / product on unsealed surfaces
After the application of water, the emission factor used for trucks hauling waste rock or ROM coal on unsealed surfaces is 1 kg per vehicle kilometre travelled (kg/VKT).

The return trip for each year was measured from the location of the haul routes. It was assumed haul trucks with an average capacity of between 171 t and 192 t are used for the hauling of overburden. For ROM coal the average truck capacity was assumed to be 195 t.

Dozers on overburden
Emissions from dozers on overburden have been calculated using the US EPA emission factor equation (**US EPA, 1985 and updates**), per **Equation 3**.

Equation 3

$$\mathrm{E_{TSP}} = 2.6 \times \frac{s^{1.2}}{M^{1.3}} \qquad \mathrm{kg/hour}$$

where,

$\mathrm{E_{TSP}} = TSP\ \ emissions$

$\mathrm{s = silt\ content\ (\%), and}$

$\mathrm{M = moisture\ (\%)}$

The silt content in the overburden was assumed to be 6%, and the moisture content 2%. This results in a emission factor of 9.1 kg/h.

Dozers ripping coal
The **US EPA (1985 and updates)** emission factor equation has been used. It is given below in **Equation 4**.

Equation 4

$$E_{TSP} = 35.6 \times \frac{s^{1.2}}{m^{1.4}} \qquad kg/hour$$

Where,

s = silt content (%), and
M = moisture (%)

The silt content in the coal whilst ripping was assumed to be 10%, and the moisture content 7%, resulting in an emission factor of 37 kg/h.

Loading/unloading coal
The **US EPA (1985 and updates)** emission factor equation has been used. It is given below in **Equation 5**.

Equation 5

$$\mathrm{E_{TSP}} = \frac{0.580}{M^{1.2}} \qquad \mathrm{kg/t}$$

where,

$$\mathrm{E_{TSP}} = TSP \ \ emissions$$

$$\mathrm{M = moisture\,(\%)}$$

The moisture content was assumed to be 7%.

Reloading coal from stockpiles to trains
Equation 2 was used and the moisture content was assumed to be 7%.

Wind erosion

The emission factor for wind erosion was assumed to be 0.4kg/ha/h as per **SPCC (1983)**.

Grading roads
Estimations of TSP emissions from grading roads have been made using the **US EPA (1985 and updates)** emission factor equation (**Equation 7**).

Equation 7

$$\mathrm{E_{TSP}} = 0.0034 \times S^{2.5} \qquad \mathrm{kg/VKT}$$

where,

S = speed of the grader in km/h (taken to be 8 km/h)

The following tables present the calculated emissions for each year of operations modelled and the allocation of the sources as represented in **Figure 7.** to **Figure 7.**.

The abbreviations used in the tables are as follows:

- O/B - overburden
- CL - coal
- WE - wind erosion emissions
- WI - wind insensitive emissions
- WS - wind sensitive emissions

Table F. : Year 1 – detailed emission calculations

ACTIVITY	TSP emission/year for 2010-2011 in(kg/y)	TSP emission for July-Oct 2010 (TO MODEL)	TSP emission for Nov 2010 - June 2011 (TO MODEL)	Intensity	units	Emission factor	units	Variable 1	units	Variable 2	units	Variable 3	units
Topsoil Removal - Dozers/Excavators stripping topsoil	2,039	340	1,359	300	h/y	6.8	kg/h	10	silt content in %	4	moisture content in %		
Topsoil removal - Sh/Ex/FELs loading topsoil	804	134	603	960,000	t/y	0.00084	kg/t	1.866	average of (wind speed/2.2)^1.3 in	4	moisture content in %		
Topsoil removal - Hauling topsoil to emplacement area	10,378	1,730	7,784	960,000	t/y	0.010811	kg/t	222	t/truck load	2.4	km/return trip	1.0	kg/VKT
Topsoil removal - Emplacing topsoil at emplacement area	804	134	603	960,000	t/y	0.00084	kg/t	1.866	average of (wind speed/2.2)^1.3 in	4	moisture content in %		
OB - Drilling	11,943	1,991	8,957	20,243	holes/y	0.59	kg/hole						
OB - Blasting	21,825	3,638	16,369	150		146	kg/blast	7591	Area of blast in square metres	135	holes/blast		
OB - Excavator loading OB to haul truck	73,685	12,281	55,264	40,862,800	t/y	0.00180	kg/t	1.523	average of (wind speed/2.2)^1.3 in	2	moisture content in %		
OB - Hauling to emplacement area (north)	210,288	35,048	157,716	16,345,120	t/y	0.01287	kg/t	171	t/truck load	2.2	km/return trip	1.0	kg/VKT
OB - Hauling to emplacement area (south)	458,810	76,468	344,108	24,517,680		0.01871	kg/t	171	t/truck load	3.2	km/return trip	1.0	kg/VKT
OB- Emplacing at emplacement area (north)	29,474	4,912	22,106	16,345,120	t/y	0.00180	kg/t	1.523	average of (wind speed/2.2)^1.3 in	2	moisture content in %		
OB- Emplacing at emplacement area (south)	44,211	7,369	33,158	24,517,680	t/y	0.00180	kg/t	1.523	average of (wind speed/2.2)^1.3 in	2	moisture content in %		
OB - Dozers on OB	11,967	1,995	8,975	1,320	h/y	9.066	kg/h	6	silt content in %	2	moisture content in %		
CL - Dozers ripping/pushing/clean-up	48,852	8,142	36,639	1,320	h/y	37.0095	kg/h	10	silt content in %	7	moisture content in %		
CL - Sh/Ex/FELs loading open pit coal to trucks	164,392	27,399	123,294	2,928,000	t/y	0.05614	kg/t	7	moisture content in %				
CL - Hauling open pit coal to ROM pad	63,065	10,511	47,298	2,928,000	t/y	0.02154	kg/t	195	t/load	4.2	km/return trip	1.0	kg/VKT
CL - Unloading ROM to ROM stockpiles	20,496	3,416	15,372	2,049,600	t/y	0.01	kg/t						
CL - Loading ROM directly to hopper to be crushed	49,318	8,220	36,988	878,400	t/y	0.05614	kg/t	7	moisture content in %				
CL - Loading from stockpile to crusher using FELs	115,075	19,179	86,306	2,049,600	t/y	0.05614	kg/t	7	moisture content in %				
CL - Crushing ROM	7,906	1,318	5,929	2,928,000	t/y	0.00270	kg/t						
CL - ROM hopper unloading coal to conveyor 1	29,280	4,880	21,960	2,928,000	t/y	0.01	kg/t						
CL- Conveyor to CHPP	993	166	745	0.4050	ha	0.4	kg/ha/h	8760	h/y			0.7	%control
CL - Unloading to transfer point 1	640	107	480	2,928,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in	7	moisture content in %	0.7	%control
CL - Unloading to transfer point 2	640	107	480	2,928,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in	7	moisture content in %	0.7	%control
CL - Unloading to transfer point 3	640	107	480	2,928,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in	7	moisture content in %	0.7	%control
CL - Unloading to transfer point 4	640	107	480	2,928,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in	7	moisture content in %	0.7	%control
CL - Unloading to transfer point 5	640	107	480	2,928,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in	7	moisture content in %	0.7	%control
CL - Unloading to CHPP	914	152	685	2,928,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in	7	moisture content in %		
CL - Unloading underground coal to CHPP	30,000	5,000	22,500	3,000,000	t/y	0.0100	kg/t						
CL- Handle coal at CHPP (100%)	1,850	308	1,388	5,928,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in	7	moisture content in %		
CL- Rehandle coal at CHPP (+10%)	185	31	139	592,800	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in	7	moisture content in %		
CL - Loading product coal to trains	1,134	189	851	3,633,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in	7	moisture content in %		
CL - Loading rejects and tailings to haul trucks	473	79	355	1,514,700	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in	7	moisture content in %		
CL - Hauling rejects and tailings to NEOC voids	21,348	3,558	16,011	1,514,700	t/y	0.01409	kg/t	171	t/truck load	2.41	km/return trip	1.0	kg/VKT
Cl - Unloading rejects and tailings to NEOC voids	473	79	355	1,514,700	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in	7	moisture content in %		
WE - OB dump area	63,773	10,629	47,830	18	ha	0.4	kg/ha/h	8760	h/y				
WE - Open pit	58,517	9,753	43,888	17	ha	0.4	kg/ha/h	8760	h/y				
WE - ROM stockpiles	10,232	1,705	7,674	3	ha	0.4	kg/ha/h	8760	h/y				
WE - Product stockpiles	3,504	584	2,628	1	ha	0.4	kg/ha/h	8760	h/y				
WE - Dam construction	1,051	175	788	0	ha	0.4	kg/ha/h	8760	h/y				
Grading roads	43,132	7,189	32,349	70,080	km	1	kg/ha/h	8	speed of graders in km/h				
Upcast Vent	31,536	5,256	23,652	200	m^3/s	5	mg/m^3	8760	h/y				

Table F.: Year 1 – source allocation

CEVKXKV["	Source ID									
Topsoil Removal - Dozers/Excavators stripping topsoil	17	18	19							
Topsoil removal - Sh/Ex/FELs loading topsoil	17	18	19							
Topsoil removal - Hauling topsoil to emplacement area	10	11	12	13	14	15	16	17		
Topsoil removal - Emplacing topsoil at emplacement area	14									
OB - Drilling	15	16								
OB - Blasting	15	16								
OB - Excavator loading OB to haul truck	15	16								
OB - Hauling to emplacement area (north)	9	10	15	20	21	22	23			
OB - Hauling to emplacement area (south)	10	11	12	13	14	15	20	21	22	23
OB- Emplacing at emplacement area (north)	9									
OB- Emplacing at emplacement area (south)	14									
OB - Dozers on OB	1-14									
CL - Dozers ripping/pushing/clean-up	1-14									
CL - Sh/Ex/FELs loading open pit coal to trucks	15	16	20-34							
CL - Hauling open pit coal to ROM pad	27-38									
CL - Unloading ROM to ROM stockpiles	39	40								
CL - Loading ROM directly to hopper to be crushed	38									
CL - Loading from stockpile to crusher using FELs	39	40								
CL - Crushing ROM	38									
CL - ROM hopper unloading coal to conveyor 1	41									
CL- Conveyor to CHPP	41-52									
CL - Unloading to transfer point 1	44									
CL - Unloading to transfer point 2	47									
CL - Unloading to transfer point 3	48									
CL - Unloading to transfer point 4	49									
CL - Unloading to transfer point 5	52									
CL - Unloading to CHPP	52									
CL - Unloading underground coal to CHPP	63									
CL- Handle coal at CHPP (100%)	53	54	55	56						
CL- Rehandle coal at CHPP (+10%)	53	54	55	56						
CL - Loading product coal to trains	56									
CL - Loading rejects and tailings to haul trucks	63									
CL - Hauling rejects and tailings to NEOC voids	57	58	59	60	61	62	63			
Cl - Unloading rejects and tailings to NEOC voids	57									
WE - OB dump area	1-14									
WE - Open pit	15	16	20-32							
WE - ROM stockpiles	39	40								
WE - Product stockpiles	55	63								
WE - Dam construction	64									
Grading roads	9-23	27-38	57-63							
Upcast Vent	57									

Table F.: Year 3 – detailed emission calculations

ACTIVITY	TSP emission/year for 2012-2013 in(kg/y)	Intensity	units	Emission factor	units	Variable 1	units	Variable 2	units	Variable 3	units
Topsoil Removal - Dozers/Excavators stripping topsoil	2,039	300	h/y	6.8	kg/h	10	silt content in %	4	moisture content in %		
Topsoil removal - Sh/Ex/FELs loading topsoil	2,260	2,700,000	t/y	0.00084	kg/t	1.866	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %		
Topsoil removal - Hauling topsoil to emplacement area	35,270	2,700,000	t/y	0.013063	kg/t	222	t/truck load	2.9	km/return trip	1.0	kg/VKT
Topsoil removal - Emplacing topsoil at emplacement area	2,260	2,700,000	t/y	0.00084	kg/t	1.866	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %		
OB - Drilling	11,943	20,243	holes/y	0.59	kg/hole						
OB - Blasting	21,825	150	blasts/y	146	kg/blast	7591	Area of blast in square metres	135	holes/blast		
OB - Excavator loading OB to haul truck	72,761	40,350,200	t/y	0.00180	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Hauling to emplacement area (east)	608,792	24,210,120	t/y	0.02515	kg/t	171	t/truck load	4	km/return trip	1.0	kg/VKT
OB - Hauling to emplacement area (west)	471,932	16,140,080		0.02924	kg/t	171	t/truck load	5.0	km/return trip	1.0	kg/VKT
OB- Emplacing at emplacement area (east)	43,656	24,210,120	t/y	0.00180	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB- Emplacing at emplacement area (west)	29,104	16,140,080	t/y	0.00180	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Dozers on OB	11,967	1,320	h/y	9.066	kg/h	6	silt content in %	2	moisture content in %		
CL - Dozers ripping/pushing/clean-up	48,852	1,320	h/y	37.0095	kg/h	10	silt content in %	7	moisture content in %		
CL - Sh/Ex/FELs loading open pit coal to trucks	173,881	3,097,000	t/y	0.05614	kg/t	7	moisture content in %				
CL - Hauling open pit coal to ROM pad	55,587	3,097,000	t/y	0.01795	kg/t	195	t/load	3.5	km/return trip	1.0	kg/VKT
CL - Unloading ROM to ROM stockpiles	21,679	2,167,900	t/y	0.01	kg/t						
CL - Loading ROM directly to hopper to be crushed	52,164	929,100	t/y	0.05614	kg/t	7	moisture content in %				
CL - Loading from stockpile to crusher using FELs	121,717	2,167,900	t/y	0.05614	kg/t	7	moisture content in %				
CL - Crushing ROM	8,362	3,097,000	t/y	0.00270	kg/t						
CL - ROM hopper unloading coal to conveyor 1	30,970	3,097,000	t/y	0.01	kg/t						
CL- Conveyor to CHPP	993	0.4050	ha	0.4	kg/ha/h	8760	h/y			0.7	%contr
CL - Unloading to transfer point 1	677	3,097,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %	0.7	%contr
CL - Unloading to transfer point 2	677	3,097,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %	0.7	%contr
CL - Unloading to transfer point 3	677	3,097,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %	0.7	%contr
CL - Unloading to transfer point 4	677	3,097,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %	0.7	%contr
CL - Unloading to transfer point 5	677	3,097,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %	0.7	%contr
CL - Unloading to CHPP	967	3,097,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %		
CL - Unloading underground coal to CHPP	50,000	5,000,000	t/y	0.0100	kg/t						
CL- Handle coal at CHPP (100%)	2,527	8,097,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %		
CL- Rehandle coal at CHPP (+10%)	253	809,700	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %		
CL - Loading product coal to trains	1,492	4,780,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %		
WE - OB dump area	139,810	40	ha	0.4	kg/ha/h	8760	h/y				
WE - Open pit	51,859	15	ha	0.4	kg/ha/h	8760	h/y				
WE - ROM stockpiles	10,232	3	ha	0.4	kg/ha/h	8760	h/y				
WE - Product stockpiles	3,504	1	ha	0.4	kg/ha/h	8760	h/y				
Grading roads	43,132	70,080	km	1	kg/ha/h	8	speed of graders in km/h				
Upcast Vent	31,536	200	m³/s	5	mg/m³	8760	h/y				

Table F.: Year 3 – source allocation

ACTIVITY	Source ID															
Topsoil Removal - Dozers/Excavators stripping topsoil	1	2	3	4	12											
Topsoil removal - Sh/Ex/FELs loading topsoil	1	2	3	4	12											
Topsoil removal - Hauling topsoil to emplacement area	12	13	14	15	16	22	23	24	25							
Topsoil removal - Emplacing topsoil at emplacement area	25															
OB - Drilling	5	6	7	8	9	10	11	26	27	28						
OB - Blasting	5	6	7	8	9	10	11	26	27	28						
OB - Excavator loading OB to haul truck	5	6	7	8	9	10	11	26	27	28						
OB - Hauling to emplacement area (east)	9	10	11	12	13	14	15	16	22	23	24	25				
OB - Hauling to emplacement area (west)	9	10	11	12	13	14	15	16	17	18	19	20	21			
OB- Emplacing at emplacement area (east)	25															
OB- Emplacing at emplacement area (west)	21															
OB - Dozers on OB	14	15	16	17	18	19	20	21	22	23	24	25	29	30	31	33 - 41
CL - Dozers ripping/pushing/clean-up	14	15	16	17	18	19	20	21	22	23	24	25	29	30	31	33 - 41
CL - Sh/Ex/FELs loading open pit coal to trucks	5	6	7	8	9	10	26	27	28							
CL - Hauling open pit coal to ROM pad	26	27	28	29	30	31	32	38								
CL - Unloading ROM to ROM stockpiles	42	43														
CL - Loading ROM directly to hopper to be crushed	32															
CL - Loading from stockpile to crusher using FELs	42	43														
CL - Crushing ROM	32															
CL - ROM hopper unloading coal to conveyor 1	44															
CL- Conveyor to CHPP	44	45	46	47	48	49	50	51	52	53	54	55				
CL - Unloading to transfer point 1	47															
CL - Unloading to transfer point 2	50															
CL - Unloading to transfer point 3	51															
CL - Unloading to transfer point 4	54															
CL - Unloading to transfer point 5	55															
CL - Unloading to CHPP	55															
CL - Unloading underground coal to CHPP	59															
CL- Handle coal at CHPP (100%)	56	57	58	59	60											
CL- Rehandle coal at CHPP (+10%)	56	57	58	59	60											
CL - Loading product coal to trains	59															
WE - OB dump area	14	15	16	17	18	19	20	21	22	23	24	25	29	30	31	33 - 41
WE - Open pit	5	6	7	8	9	10	11	26	27	28						
WE - ROM stockpiles	42	43														
WE - Product stockpiles	58	60														
Grading roads	9	10	11	12	13	14	15	16	17	18	19	20 -32	38			
Upcast Vent	61															

Table F.: Year 5 – detailed emission calculations

ACTIVITY	TSP emission/year for 2014-2015 in(kg/y)	Intensity	units	Emission factor	units	Variable 1	units	Variable 2	units	Variable 3	units
Topsoil Removal - Dozers/Excavators stripping topsoil	2,039	300	h/y	6.8	kg/h	10	silt content in %	4	moisture content in %		
Topsoil removal - Sh/Ex/FELs loading topsoil	2,612	3,120,000	t/y	0.00084	kg/t	1.866	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %		
Topsoil removal - Hauling topsoil to emplacement area	49,189	3,120,000	t/y	0.015766	kg/t	222	t/truck load	3.5	km/return trip	1.0	kg/VKT
Topsoil removal - Emplacing topsoil at emplacement area	2,612	3,120,000	t/y	0.00084	kg/t	1.866	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %		
OB - Drilling	11,943	20,243	holes/y	0.59	kg/hole						
OB - Blasting	21,825	150	blasts/y	146	kg/blast	7591	Area of blast in square metres	135	holes/blast		
OB - Excavator loading OB to haul truck	72,761	40,350,200	t/y	0.00180	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Hauling from pit (north) to emplacement area	561,693	20,175,100	t/y	0.02784	kg/t	176	t/truck load	5	km/return trip	1.0	kg/VKT
OB - Hauling from pit (south) to emplacement area	584,619	20,175,100		0.02898	kg/t	176	t/truck load	5	km/return trip	1.0	kg/VKT
OB- Emplacing at emplacement area	72,761	40,350,200	t/y	0.00180	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Dozers on OB	11,967	1,320	h/y	9.066	kg/h	6	silt content in %	2	moisture content in %		
CL - Dozers ripping/pushing/clean-up	48,852	1,320	h/y	37.0095	kg/h	10	silt content in %	7	moisture content in %		
CL - Sh/Ex/FELs loading open pit coal to trucks	192,072	3,421,000	t/y	0.05614	kg/t	7	moisture content in %				
CL - Hauling open pit coal to ROM pad	78,946	3,421,000	t/y	0.02308	kg/t	195	t/load	4.5	km/return trip	1.0	kg/VKT
CL - Unloading ROM to ROM stockpiles	23,947	2,394,700	t/y	0.01	kg/t						
CL - Loading ROM directly to hopper to be crushed	57,622	1,026,300	t/y	0.05614	kg/t	7	moisture content in %				
CL - Loading from stockpile to crusher using FELs	134,450	2,394,700	t/y	0.05614	kg/t	7	moisture content in %				
CL - Crushing ROM	9,237	3,421,000	t/y	0.00270	kg/t						
CL - ROM hopper unloading coal to conveyor 1	34,210	3,421,000	t/y	0.01	kg/t						
CL- Conveyor to CHPP	993	0	ha	0.4	kg/ha/h	8760	h/y			0.7	%contr
CL - Unloading to transfer point 1	747	3,421,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %	0.7	%contr
CL - Unloading to transfer point 2	747	3,421,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %	0.7	%contr
CL - Unloading to transfer point 3	747	3,421,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %	0.7	%contr
CL - Unloading to transfer point 4	747	3,421,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %	0.7	%contr
CL - Unloading to transfer point 5	747	3,421,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %	0.7	%contr
CL - Unloading to CHPP	1,068	3,421,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %		
CL - Unloading underground coal to CHPP	50,000	5,000,000	t/y	0.0100	kg/t						
CL- Handle coal at CHPP (100%)	2,629	8,421,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %		
CL- Rehandle coal at CHPP (+10%)	263	842,100	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %		
CL - Loading product coal to trains	1,513	4,848,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %		
WE - OB dump area	128,947	37	ha	0.4	kg/ha/h	8760	h/y				
WE - Open pit	99,864	29	ha	0.4	kg/ha/h	8760	h/y				
WE - ROM stockpiles	10,232	3	ha	0.4	kg/ha/h	8760	h/y				
WE - Product stockpiles	3,504	1	ha	0.4	kg/ha/h	8760	h/y				
Grading roads	43,132	70080	km	0.61547	kg/ha/h	8	speed of graders in km/h				
Upcast Vent	31,536	200	m³/s	5	mg/m³	8760	h/y				

Table F.: Year 5 – source allocation

ACTIVITY	Source ID																	
Topsoil Removal - Dozers/Excavators stripping topsoil	1	2	3	4	5	6	17											
Topsoil removal - Sh/Ex/FELs loading topsoil	1	2	3	4	5	6	17											
Topsoil removal - Hauling topsoil to emplacement area	16	17	22	23	24	25	26	27	28	29								
Topsoil removal - Emplacing topsoil at emplacement area	29																	
OB - Drilling	7	8	9	10	11	12	13	14	15	16	18	19	20	21	30	31	32	33
OB - Blasting	7	8	9	10	11	12	13	14	15	16	18	19	20	21	30	31	32	33
OB - Excavator loading OB to haul truck	7	8	9	10	11	12	13	14	15	16	18	19	20	21	30	31	32	33
OB - Hauling from pit (north) to emplacement area	18	19	20	21	22	23	24	25	26	27	28	29						
OB - Hauling from pit (south) to emplacement area	13	14	15	16	17	22	23	24	25	26	27	28	29					
OB- Emplacing at emplacement area	29																	
OB - Dozers on OB	23	24	25	26	27	28	29	34	35	36	40	41	42	43	44	45	46	47
CL - Dozers ripping/pushing/clean-up	23	24	25	26	27	28	29	34	35	36	40	41	42	43	44	45	46	47
CL - Sh/Ex/FELs loading open pit coal to trucks	7	8	9	10	11	12	13	14	15	16	18	19	20	21	30	31	32	33
CL - Hauling open pit coal to ROM pad	30	31	32	33	34	35	36	37	38	39								
CL - Unloading ROM to ROM stockpiles	48	49																
CL - Loading ROM directly to hopper to be crushed	39																	
CL - Loading from stockpile to crusher using FELs	48	49																
CL - Crushing ROM	39																	
CL - ROM hopper unloading coal to conveyor 1	50																	
CL- Conveyor to CHPP	50	51	52	53	54	55	56	57	58	59	60	61						
CL - Unloading to transfer point 1	53																	
CL - Unloading to transfer point 2	56																	
CL - Unloading to transfer point 3	57																	
CL - Unloading to transfer point 4	60																	
CL - Unloading to transfer point 5	61																	
CL - Unloading to CHPP	61																	
CL - Unloading underground coal to CHPP	66																	
CL- Handle coal at CHPP (100%)	61	62	63	64	65	66												
CL- Rehandle coal at CHPP (+10%)	61	62	63	64	65	66												
CL - Loading product coal to trains	66																	
WE - OB dump area	23	24	25	26	27	28	29											
WE - Open pit	7	8	9	10	11	12	13	14	15	16	18	19	20	21	30	31	32	33
WE - ROM stockpiles	48	49																
WE - Product stockpiles	64	65																
Grading roads	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30-39
Upcast Vent	67																	

Table F.: Year 7 – detailed emission calculations

ACTIVITY	TSP emission/year for 2016-2017 in(kg/y)	Intensity	units	Emission factor	units	Variable 1	units	Variable 2	units	Variable 3	units
Topsoil Removal - Dozers/Excavators stripping topsoil	-		h/y	6.8	kg/h	10	silt content in %	4	moisture content in %		
Topsoil removal - Sh/Ex/FELs loading topsoil	-	-	t/y	0.00084	kg/t	1.866	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %		
Topsoil removal - Hauling topsoil to emplacement area	-	-	t/y	0.000000	kg/t	222	t/truck load		km/return trip	1.0	kg/VKT
Topsoil removal - Emplacing topsoil at emplacement area	-	-	t/y	0.00084	kg/t	1.866	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %		
OB - Drilling	11,943	20,243	holes/y	0.59	kg/hole						
OB - Blasting	21,825	150	blasts/y	146	kg/blast	7591	Area of blast in square metres	135	holes/blast		
OB - Excavator loading OB to haul truck	37,092	20,570,000	t/y	0.00180	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Hauling from pit to emplacement area	342,042	20,570,000	t/y	0.01663	kg/t	192	t/truck load	3.2	km/return trip	1.0	kg/VKT
OB- Emplacing at emplacement area	37,092	20,570,000	t/y	0.00180	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Dozers on OB	11,967	1,320	h/y	9.066	kg/h	6	silt content in %	2	moisture content in %		
CL - Dozers ripping/pushing/clean-up	48,852	1,320	h/y	37.0095	kg/h	10	silt content in %	7	moisture content in %		
CL - Sh/Ex/FELs loading open pit coal to trucks	63,051	1,123,000	t/y	0.05614	kg/t	7	moisture content in %				
CL - Hauling open pit coal to ROM pad	28,795	1,123,000	t/y	0.02564	kg/t	195	t/load	5	km/return trip	1.0	kg/VKT
CL - Unloading ROM to ROM stockpiles	7,861	786,100	t/y	0.01	kg/t						
CL - Loading ROM directly to hopper to be crushed	18,915	336,900	t/y	0.05614	kg/t	7	moisture content in %				
CL - Loading from stockpile to crusher using FELs	44,136	786,100	t/y	0.05614	kg/t	7	moisture content in %				
CL - Crushing ROM	3,032	1,123,000	t/y	0.00270	kg/t						
CL - ROM hopper unloading coal to conveyor 1	11,230	1,123,000	t/y	0.01	kg/t						
CL- Conveyor to CHPP	993	0.4050	ha	0.4	kg/ha/h	8760	h/y			0.7	%contr
CL - Unloading to transfer point 1	245	1,123,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %	0.7	%contr
CL - Unloading to transfer point 2	245	1,123,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %	0.7	%contr
CL - Unloading to transfer point 3	245	1,123,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %	0.7	%contr
CL - Unloading to transfer point 4	245	1,123,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %	0.7	%contr
CL - Unloading to transfer point 5	245	1,123,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %	0.7	%contr
CL - Unloading to CHPP	351	1,123,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %		
CL - Unloading underground coal to CHPP	50,000	5,000,000	t/y	0.0100	kg/t						
CL- Handle coal at CHPP (100%)	1,911	6,123,000	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %		
CL- Rehandle coal at CHPP (+10%)	191	612,300	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %		
CL - Loading product coal to trains	1,161	3,719,843	t/y	0.0003	kg/t	1.523	average of (wind speed/2.2)^1.3 in m/s	7	moisture content in %		
WE - OB dump area	114,230	33	ha	0.4	kg/ha/h	8760	h/y				
WE - Open pit	97,762	28	ha	0.4	kg/ha/h	8760	h/y				
WE - ROM stockpiles	10,232	3	ha	0.4	kg/ha/h	8760	h/y				
WE - Product stockpiles	3,504	1	ha	0.4	kg/ha/h	8760	h/y				
Grading roads	43,132	70,080	km	0.61547	kg/ha/h	8	speed of graders in km/h				
Upcast Vent	31,536	200	m³/s	5	mg/m³	8760	h/y				

Table F.: Year 7 – source allocation

CEVKXKV["	Source ID															
OB - Drilling	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
OB - Blasting	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
OB - Excavator loading OB to haul truck	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
OB - Hauling from pit to emplacement area	11	12	13	14	15	16	17	18	19	20						
OB- Emplacing at emplacement area	20															
OB - Dozers on OB	17	18	19	20	21	22										
CL - Dozers ripping/pushing/clean-up	17	18	19	20	21	22	23									
CL - Sh/Ex/FELs loading open pit coal to trucks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CL - Hauling open pit coal to ROM pad	11	12	13	14	15	16	17	21	22	23	24	25	26			
CL - Unloading ROM to ROM stockpiles	35	36														
CL - Loading ROM directly to hopper to be crushed	26															
CL - Loading from stockpile to crusher using FELs	35	36														
CL - Crushing ROM	26															
CL - ROM hopper unloading coal to conveyor 1	37															
CL- Conveyor to CHPP	37	38	39	40	41	42	43	44	45	46	47	48				
CL - Unloading to transfer point 1	40															
CL - Unloading to transfer point 2	43															
CL - Unloading to transfer point 3	44															
CL - Unloading to transfer point 4	47															
CL - Unloading to transfer point 5	48															
CL - Unloading to CHPP	48															
CL - Unloading underground coal to CHPP	53															
CL- Handle coal at CHPP (100%)	48	49	50	51	52	53										
CL- Rehandle coal at CHPP (+10%)	48	49	50	51	52	53										
CL - Loading product coal to trains	53															
WE - OB dump area	17	18	19	20	21	22	27	28	29	30	31	32	33	34		
WE - Open pit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
WE - ROM stockpiles	35	36														
WE - Product stockpiles	51	52														
Grading roads	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Upcast Vent	54															