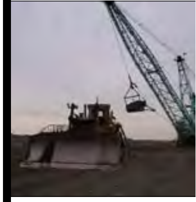
Air Quality
Impact Assessment
(PAEHolmes 2011)








APPENDIX P

AIR QUALITY IMPACT ASSESSMENT

ROCGLEN COAL MINE EXTENSION PROJECT

GSS Environmental

on behalf of

Whitehaven Coal Limited

Job No: 3769A

11 January 2011

A PEL Company

PROJECT TITLE:	**ROCGLEN COAL MINE EXTENSION PROJECT**
JOB NUMBER:	**3769**
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VERSION	DATE	AUTHOR/S	MODELLING	GREENHOUSE	REVIEWED BY
DRAFT V1	09.04.10	J Barnett R Kellaghan	J Barnett	C Isley R Kellaghan	R Kellaghan J Cox
FINAL DRAFT	28.04.10	J Barnett R Kellaghan	J Barnett	C Isley R Kellaghan	R Kellaghan J Cox
FINAL	14.05.10	J Barnett R Kellaghan	J Barnett	C Isley R Kellaghan	R Kellaghan
FINAL CUMULATIVE	31.10.10	J Barnett R Kellaghan	J Barnett	C Isley R Kellaghan	R Kellaghan
REVISED Y10 FINAL	11.01.11	J Barnett R Kellaghan	J Barnett J Beaney	C Isley R Kellaghan	

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1 INTRODUCTION

This report has been prepared by PAEHolmes on behalf of GSS Environmental for Whitehaven Coal Limited (WCL). It assesses the potential for impacts on air quality as a consequence of the proposed expansion of the Rocglen Coal Mine, near Gunnedah, New South Wales.

The Rocglen Coal Mine (formerly known as Belmont Coal Project) was originally approved by the Minister on the 15th April 2008 under *Project Approval (PA) 06_0198*. Coal production at Rocglen commenced in late 2008. Following further investigation into the resource, WCL now propose to expand operations at Rocglen in order to maximise coal recovery and allow for improved mine progression. This includes, but is not limited to, an expansion of the open cut pit and the provision of additional out-of-pit empalacement space and volume. The proposed site layout is shown in **Figure 1.1**.

1.1 Scope of Work

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 predicted dispersion and dust fallout patterns due to emissions from the mine and a comparison with the Department of Environment, Climate Change and Water (DECCW) assessment criteria;
- an analysis of cumulative dust impacts;
- mitigation and monitoring; and
- a greenhouse gas assessment.

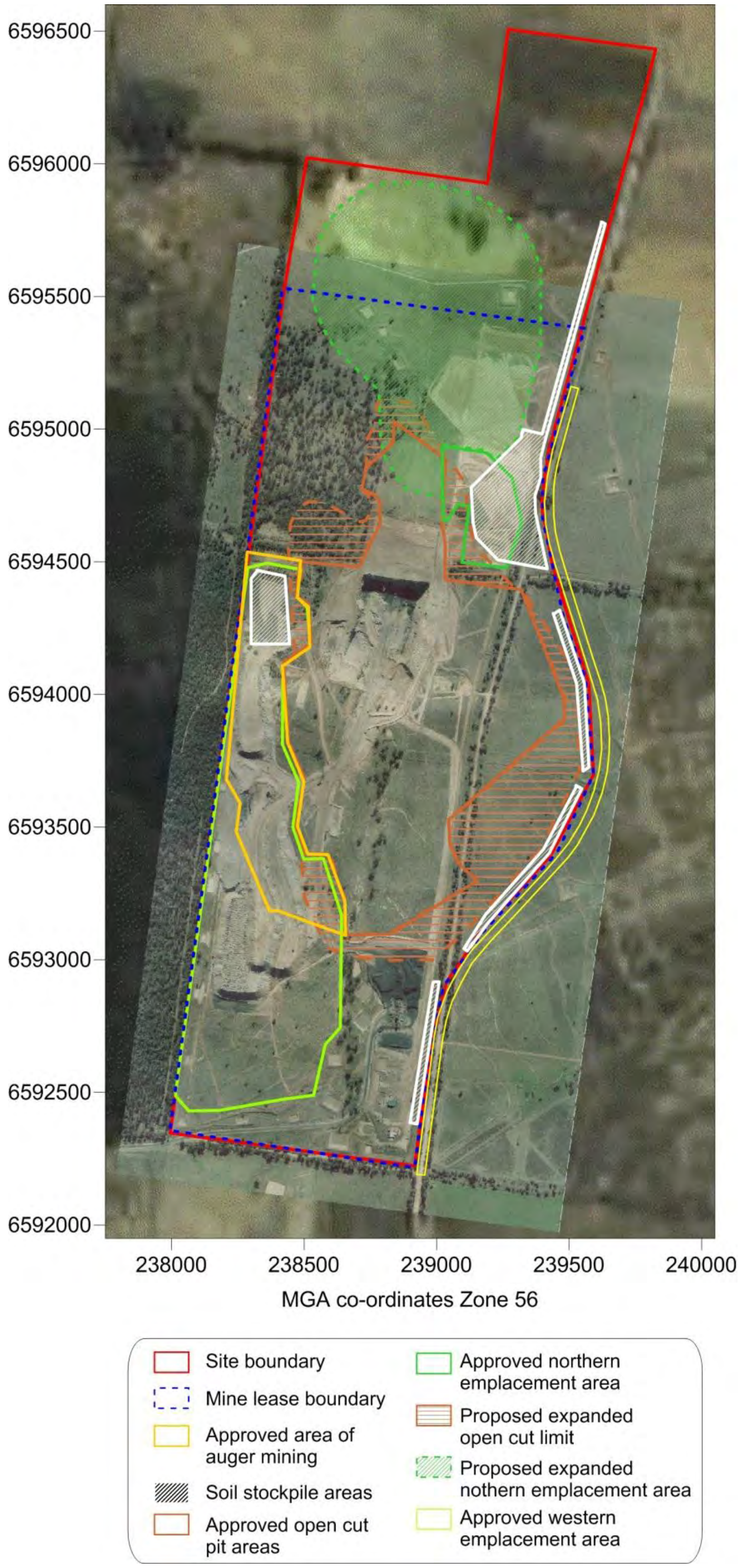

Figure 1.1: Proposed mine layout

2 PROJECT DESCRIPTION

2.1 The Site

The location of the existing Rocglen Coal Mine and surrounding areas is shown in **Figure 2.1**. This figure also shows the current dust monitoring network in the area, the locations of the nearest residences and the weather station on the 'Glenroc' property. The site lies on Wean Road, approximately 25 km north of Gunnedah and 23 km southeast of Boggabri in the Gunnedah coalfields of NSW. The nearest non-project related residence is located in excess of 1.5 km from the Project site.

The proposed extension site is typically rural grassland, primarily used for traditional agricultural activities such as livestock grazing and cropping. There is a significant terrain feature about 2 km east of the site in the Kelvin State Forest, and another terrain feature immediately to the west in the Vickery State Forest. Both these features are likely to cause winds to be channelled along the north/south axis as it passes between the elevated terrain to the west and east. **Figure 2.2** presents a pseudo 3-dimensional terrain plot of the area surrounding the site, including the current pit and dump sites.

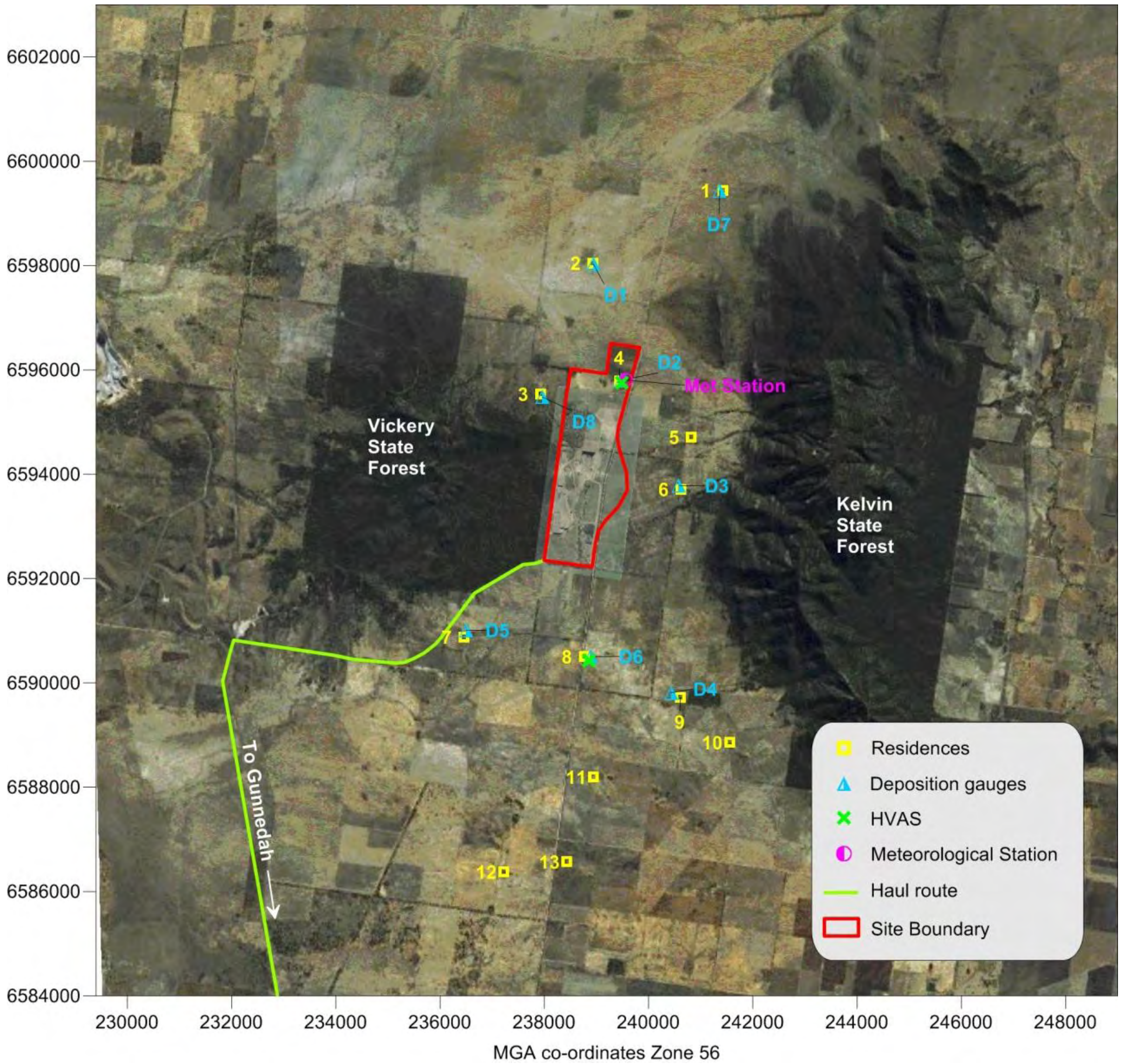

Figure 2.1: Location of the project area and surrounding landuse

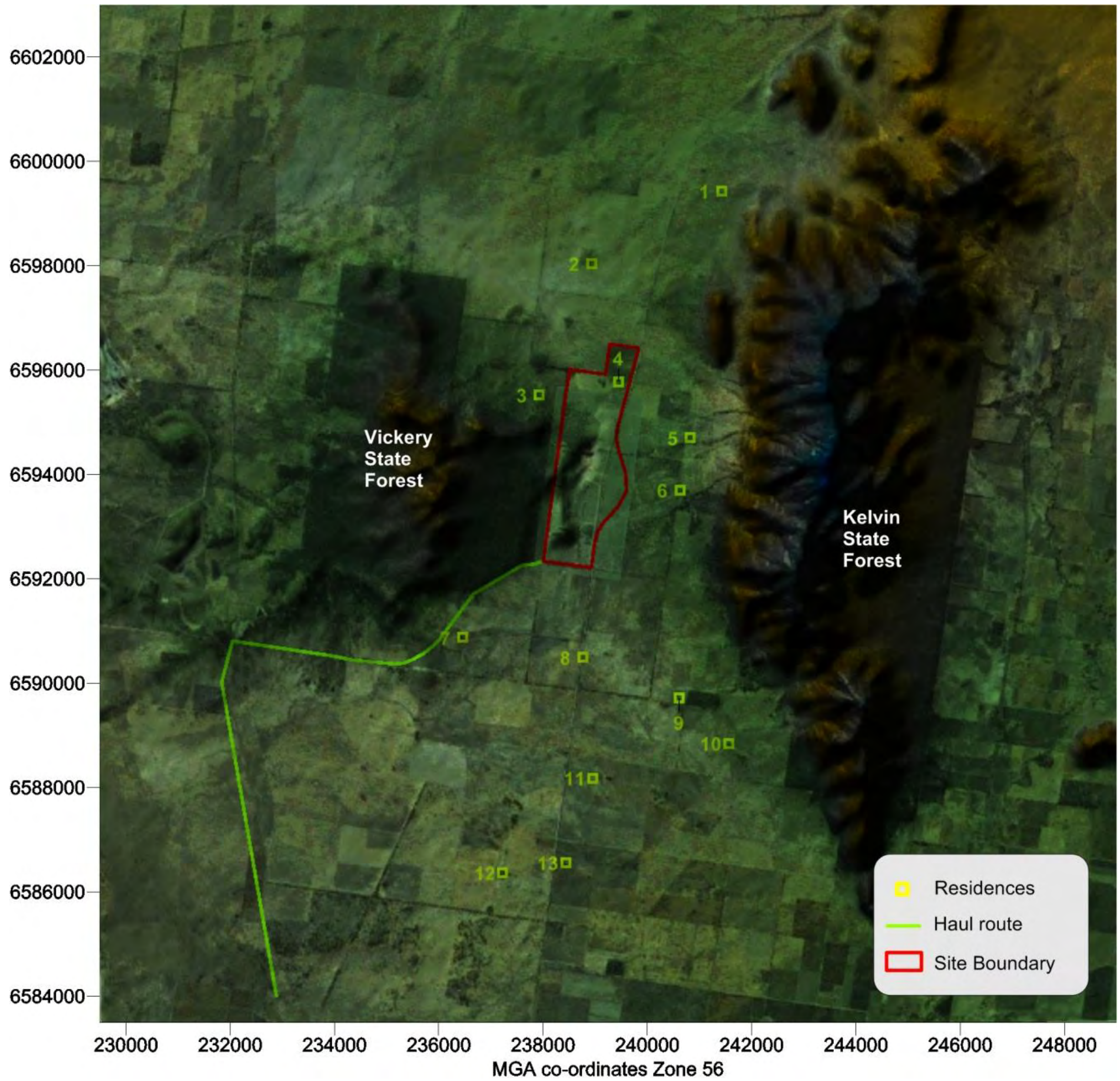

Figure 2.2: Pseudo 3D-plot of terrain surrounding Project area

2.2 Proposed Development

WCL propose to expand their current operations in order to access an additional 4.5 to 5 million tonnes (Mt) of coal not previously considered in the life of the mine plan. The following is a summary of the components of the proposed expansion which are relevant to air quality.

- Expansion of the open cut pit
  - The footprint of the current open cut pit will increase by 50 hectares (ha) bringing it to approximately 164 ha.
  - Coal will be extracted using current approved methods and at the existing rate of 1.5 million tonnes per annum (Mtpa). There are not anticipated to be any changes to the current operating hours or coal handling and processing techniques.

- Extension to life of mine
  - Based on the current production rate of 1.5 Mtpa, which will be maintained, it is anticipated that extraction activities will occur for approximately 10 years. This represents an increase to the projected life of mine, for coal extraction, of between 2 and 4 years.

- Expansion of the northern emplacement area
  - This area will need to be expanded to accommodate a maximum 12 million bank cubic metres (Mbcm) of overburden, combined from current and expanded operations.
  - This will result in a maximum design height increase of 50 m above the pre-mining landform, about the same height of the adjacent ridge to the west of the project site.

- Relocation of the northern stockpile area (topsoil and subsoil)
  - This topsoil and subsoil will be moved from the northern stockpile area to other locations within the Project Site to make room for the expanded northern emplacement area. It will be placed in either proposed new stockpile areas within the site or placed directly onto areas available for rehabilitation.

3 AIR QUALITY CRITERIA

Extraction of coal requires the clearing of land and excavation of overburden material to recover the coal by heavy earthmoving equipment. These operations generate fugitive dust emissions in the form of particulate matter described as total suspended particulate matter (TSP)[a], particulate matter with equivalent aerodynamic diameters 10 µm or less (PM_{10})[b] and particles with equivalent aerodynamic diameters of 2.5 µm and less ($PM_{2.5}$). In addition, combustion engines from vehicles release emissions through vehicle exhausts including carbon monoxide (CO) and minor quantities of sulphur dioxide (SO_2) and nitrogen dioxide (NO_2).

In practice, emissions of CO, SO_2 and NO_2 will occur from diesel-powered equipment. Emissions on open cut mines are too small and too widely dispersed to give rise to significant off-site concentrations. For this reason these pollutants are not considered further in this report.

This section provides information on the relevant air quality criteria used to assess the impact of emissions. The assessment criteria provide benchmarks, which if met, are intended to protect the community against the adverse effects of air pollutants. These criteria are generally considered to reflect current Australian community standards for the protection of health and protection against nuisance effects. To assist in interpreting the significance of predicted concentration and deposition levels some background discussion on the potential harmful effects is provided below.

3.1 Particulate Matter

3.1.1 Introduction

For the reasons discussed above, the focus of this study is on the potential effects of particulate matter. Particulate matter has the capacity to affect health and to cause nuisance effects.

Particulate matter can be categorised by size and/or by chemical composition. The potential for harmful effects depend on both.

The human respiratory system has in-built defensive systems that prevent particles larger than approximately 10 µm from reaching the more sensitive parts of the respiratory system. Particles with aerodynamic diameters less than 10 µm are referred to as PM_{10}. Particles larger than 10 µm, while not able to affect health, can soil materials and generally degrade aesthetic elements of the environment. For this reason air quality goals make reference to measures of the total mass of all particles suspended in the air. This is referred to as Total Suspended Particulate matter (TSP). In practice particles larger than 30 to 50 µm settle out of the atmosphere too quickly to be regarded as air pollutants. The upper size range for TSP is usually taken to be 30 µm. TSP includes PM_{10}.

3.1.2 DECCW Criteria

The health-based assessment criteria used by DECCW have, to a large extent, been developed by reference to epidemiological studies undertaken in urban areas with large populations where the primary pollutants are the products of combustion. This means that, in contrast to dust of crustal[c] origin, the particulate matter from urban areas would be composed of smaller particles and would generally contain acidic and carcinogenic substances that are associated with combustion.

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[a] TSP refers to all particles suspended in the air. In practice, the upper size range is typically 30 to 50 µm

[b] PM_{10} refers to all particles with the equivalent aerodynamic diameters of less than 10µm, that is, all particles that behave aerodynamically in the same way as spherical particles with a unit density.

[c] The term crustal dust is used to refer to dust generated from materials that constitute the earth's crust, such as topsoil, overburden and coal.

Table 3.1 summarises the air quality goals for concentrations of particulate matter that are relevant to this study. The air quality goals for TSP and annual average PM_{10} relate to the total dust burden in the air and not just the dust from the project. In other words, consideration of background dust levels needs to be made when using these goals to assess potential impacts. This is discussed further in **Section 6.1**.

Where mining projects are committed to best practice mitigation and management measures, the 24-hour average PM_{10} dust burden from the project alone is applied by government to assess the potential for adverse impacts.

Table 3.1: DECCW air quality standards / goals for particulate matter concentrations

Pollutant	Averaging period	Standard / Goal	Agency
Total suspended particulate matter (TSP)	Annual mean	90 µg/m^3	• NHMRC
Particulate matter with an equivalent aerodynamic diameter less than 10 µm (PM10)	24-hour maximum	50 µg/m^3	• NSW DECCW impact assessment criteria • NEPM reporting goal, allows five exceedences per year for bushfires and dust storms
	Annual mean	30 µg/m^3	• NSW DECCW impact assessment criteria

Notes: µg/m^3 – micrograms per cubic metre, µm – micrometre;

3.1.3 Department of Planning Acquisition Criterion for PM_{10}

While the DECCW applies the maximum 24-hour average PM_{10} level in any year to assess the potential for impacts from the project, the Department of Planning (DoP) in contemporary project approvals have invoked requirements for acquisition, negotiated agreements and the like if the DECCW criterion is exceeded on more than 5 days in any year (a 98.6 percentile level of compliance). This DoP criterion and also that for annual average PM_{10}, are outlined in **Table 3.2**.

Table 3.2: DoP acquisition criterion for PM_{10}

Pollutant	Averaging period	Criterion	Condition
Particulate matter (PM_{10})	24-hour maximum	50 µg/m^3	Allows five exceedences per year
	Annual mean	30 µg/m^3	-

3.1.4 Further Comments

In May 2003, the National Environment Protection Council (NEPC) released a variation to the National Environment Protection Measure (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 µg/m^3 and an annual average of 8 µg/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 commenced in 2005. 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 DECCW assessment criteria. While predictions have been made as to the likely contribution that emissions from Rocglen 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 A**.

3.2 Dust Deposition

In addition to potential health impacts, airborne dust also has the potential to cause nuisance effects by depositing on surfaces and possibly vegetation/crops. **Table 3.3** shows the maximum acceptable increase in dust deposition over the existing dust levels from an amenity perspective. These criteria for dust fallout levels are set to protect against nuisance impacts (**DEC, 2005**).

Table 3.3: DECCW criteria for dust (insoluble solids) fallout

Pollutant	Averaging period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust	Annual	2 g/m^2/month	4 g/m^2/month

4 EXISTING ENVIRONMENT

This section describes the dispersion meteorology, local climatic conditions and existing air quality in the area.

4.1 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[d] and mixing height[e].

The DECCW has 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* (**DEC, 2005**), hereafter referred to as the Approved Methods. 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.

WCL operates a weather station at the location shown in **Figure 2.1**, and is referred to as 'Glenroc' in this report. It records 15-minute values of temperature, wind speed, wind direction and sigma-theta (a measure of the fluctuation of the horizontal wind direction).

Data from March 2006 to February 2007 (inclusive) were used for this assessment as this was the most recent and complete data set available which contained all the necessary parameters required to determine stability class. These data were processed into a file suitable for the dispersion model. There were 8,760 hourly records available which satisfies the DECCW's requirement of 90% data recovery in the year (8,760 hours represents 100% of one year). Annual and seasonal windroses have been prepared from these data and are shown in **Figure 4.1**.

[d] 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.

[e] 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 most common winds are from the northwest and southeastern quadrants. This pattern of winds is evident in all seasons to various degrees, with a little more variation in the autumn months. Very few winds blow from the southwest or northeast, likely due to the channelling effects of the surrounding terrain. The percentage of calms throughout the year (that is, winds less than or equal to 0.5 m/s) is relatively high, at almost 17% annually. The mean wind speed for the 2006/2007 data was 2.3 m/s.

To use these wind data to assess dispersion, it is also necessary to have data available on atmospheric stability. The term atmospheric stability refers to the dispersive capacity of the atmosphere. In this study, a classification scheme referred to as the Pasquill-Gifford scheme has been used, using sigma-theta according to the method recommended by the United States Environment Protection Authority (US EPA) (**US EPA, 1986**).

The Pasquill-Gifford scheme classifies the atmosphere into six (sometimes seven) classes A to F (or G in the extended scheme);

- Class A occurs in the day with light winds and strong solar radiation with strong convection; dispersion is rapid.
- Class D, also known as "neutral conditions" occurs with moderate to strong winds and/or overcast skies; again dispersion is rapid.
- Class F (and G) occurs under light winds with clear skies at night. These conditions are conducive to the formation of ground-based inversions and as such; dispersion is slow.
- Classes B and C are intermediate between A and D, and E is intermediate between D and F.

Table 4.1 shows the frequency of occurrence of the stability classes expected in the area, using the 'Glenroc' data. The most common stability class in the area was determined to be D class at 25.9%. Under these conditions, pollutant emissions disperse rapidly. There is also a significant proportion of A class (rapid dispersion) and F class (slow dispersion) stabilities, indicating a wide varity of dispersion scenarios. Joint wind speed, wind direction and stability class frequency tables for the site data are provided in **Appendix B**.

Table 4.1: Frequency of occurrence of stability classes at 'Glenroc' 2006/2007

Stability Class	Percentage occurrence (%)
A	22.1
B	7.7
C	7.5
D	25.9
E	12.8
F	24.0
Total	**100**

Mixing height was determined using a scheme defined by **Powell** (**1976**) for day-time conditions and an approach described by **Venkatram**, (**1980**) for night-time conditions. These two methods provide a good estimate of mixing height in the absence of upper air data. 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.

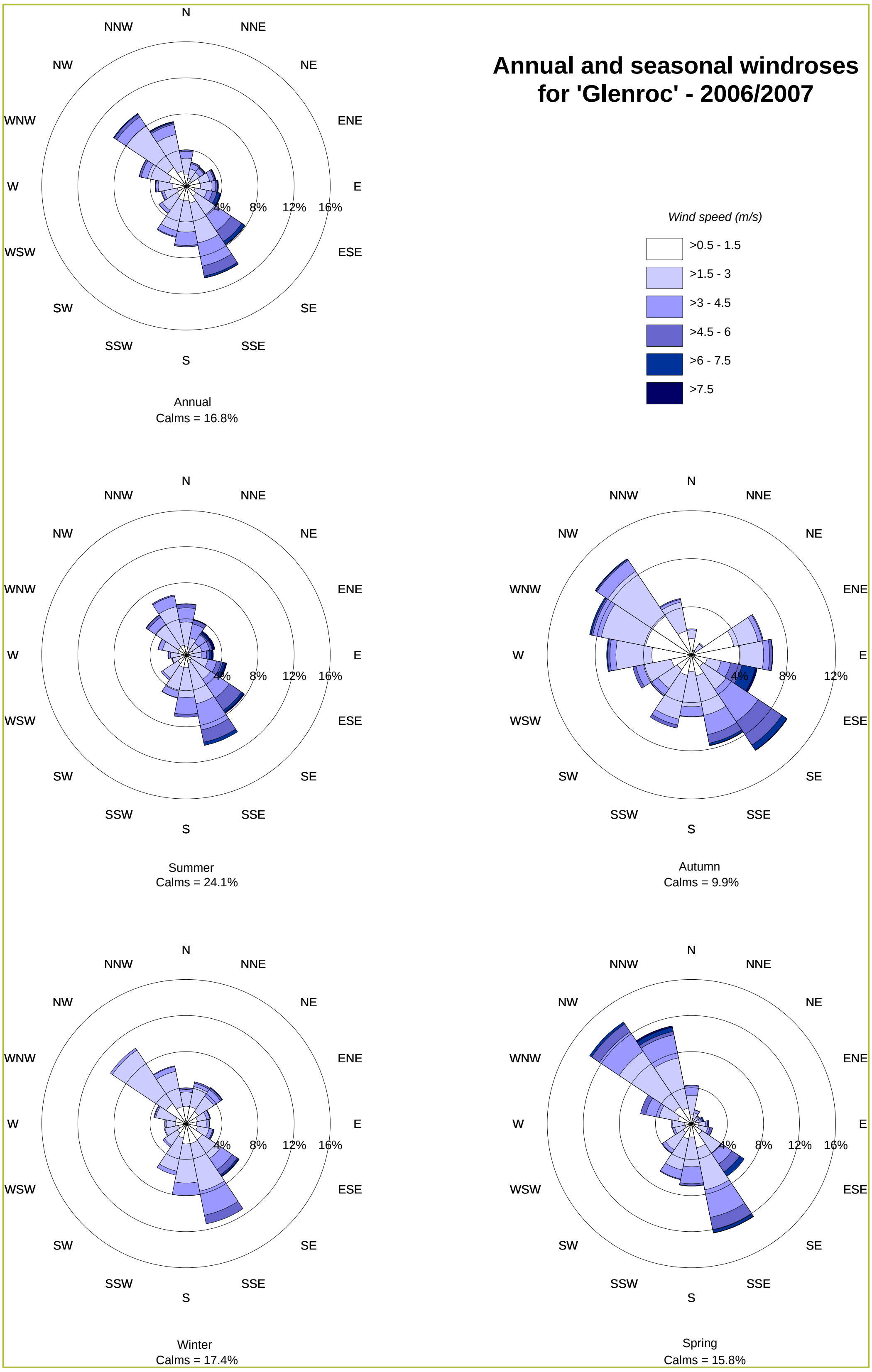


Figure 4.1: Annual and seasonal windroses for the 'Glenroc' weather station in 2006/2007

4.2 Climate Data

Temperature and humidity data for Gunnedah are presented in **Table 4.2**. These data were obtained from the Bureau of Meteorology's weather station operated at the Gunnedah Pool, which has collected data since 1876 and thus provides a useful historical record over the long term. January is the warmest month experiencing a mean monthly maximum temperature of 34.0 °C. July is the coolest month experiencing a mean monthly minimum temperature of 3.0 °C.

Annual average relative humidity at 9 am is 67%. Annual average 3 pm humidity is 46%. Mean annual rainfall has been 617.7 mm. January is the wettest month with an average rainfall of 71.1 mm and April is the month with lowest average rainfall (37.7 mm).

Table 4.2: Temperature, humidity and rainfall data for Gunnedah Pool

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Daily Maximum Temperature (°C)													
Mean	34.0	32.9	30.7	26.4	21.3	17.6	16.9	18.9	22.8	26.7	30.3	33.0	26.0
Daily Minimum Temperature (°C)													
Mean	18.3	18.1	15.8	11.4	7.1	4.3	3.0	4.1	6.9	10.7	14.1	16.8	10.9
9 am Relative Humidity (%)													
Mean	60	65	64	67	73	78	77	71	65	61	59	58	67
3 pm Relative Humidity (%)													
Mean	43	45	44	46	51	55	53	48	43	43	40	40	46
Rainfall (mm)													
Mean	71.1	66.5	47.9	37.7	42.5	43.9	42.2	41.3	39.8	55.2	60.9	68.6	617.7

Station number 055023; Commenced: 1876, Last record: 2009
Latitude (deg S): - 30.98; Longitude (deg E): 150.25; Elevation: 285 m

Source: Bureau of Meteorology (2009)

4.3 Existing Air Quality

The introduction in **Section 3** indicated that the relevant air quality parameters for this assessment would be fugitive dust emissions. This section provides an overview of the existing or background dust levels based on data from the monitoring network shown in **Figure 2.1**, which provides measurements of 24-hour average concentrations of PM_{10} on a six-day cycle and monthly averages of dust fallout levels.

4.3.1 Dust concentration

Twenty-four hour average concentrations of PM_{10} (on a six-day cycle) have been measured at two high volume air sampler (HVAS) monitoring sites, 'Glenroc' (BA1) and 'Roseberry' (BA2)[f] from October 2008 to the end of December 2009. The results are shown in **Figure 4.2**. The graph shows a data point for each 24-hour average measured every sixth day.

[f] This HVAS has been at its current location at 'Roseberry' since June 2009. From October 2008 to June 2009 it was located at 'Surrey', approximately 2km southeast of 'Roseberry'.

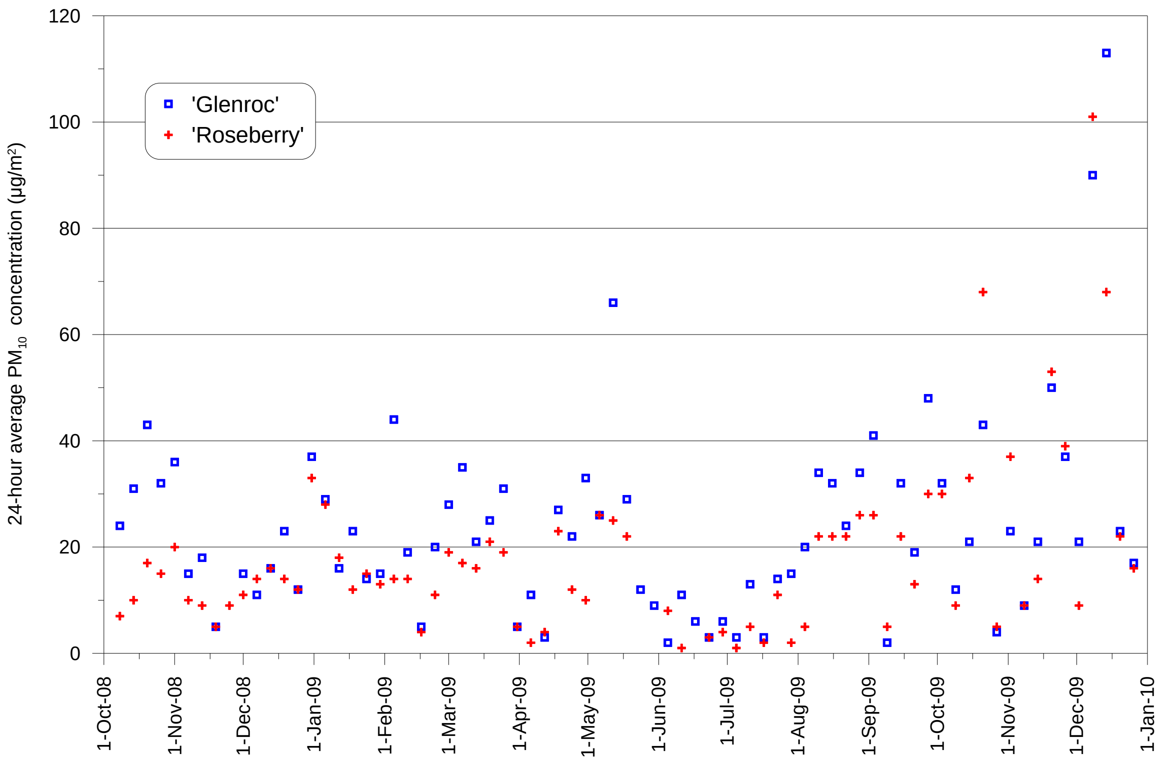


Figure 4.2: PM_{10} monitoring data from 2008 to 2009 at the 'Glenroc' and 'Roseberry' properties

There are four occasions at 'Roseberry' and three at 'Glenroc' where a 24-hour average PM_{10} level of 50 µg/m^3 is exceeded. Two of these occur on the same day at both locations (8th and 12th December 2009). As these values occur simultaneously in opposite directions from the mining activities, they are likely to be caused by some other more regional event such as a dust storm or bushfire, rather than direct emissions from the mine itself. High winds and dust storms were reported in the Gunnedah and Inverell areas at this time (**BoM, 2010**), and there were also bushfires in the adjacent Kelvin Range during December 2009.

There are three other occasions which measure exceedances of 50 µg/m^3, namely, 12th May 2009 at 'Glenrcoc' and 21st October and 20th November 2009 at 'Rosberry'. These may be due to a combination of mining activity emissions or more localised effects such as farming activity or stock movements. Without the availability of contemporaneous meteorological data it is not possible to determine what the prevailing wind directions were on those days and therefore what the likely source might be. It should also be noted that there were dust storms prevalent in the area in September and October 2009 which will have contributed to elevated levels.

As the data have only been collected for a little over a year there is no running annual average information available. However, the annual average for 2009 was calculated to be 24.3 µg/m^3 at 'Glenroc' and 19.4 µg/m^3 at 'Roseberry'. These values are both below the annual average air quality criterion of 30 µg/m^3.

4.3.2 Dust Deposition

Dust deposition is monitored using dust deposition gauges at eight locations in the vicinity of the Project (refer to **Figure 2.1** for the locations). Dust deposition gauges use a simple device consisting of a funnel and bottle to estimate the rate at which dust settles onto the surface over periods approximating one month. The measured dust fallout levels include the effects of all existing sources of particulate matter including the existing mining operations.

The complete monthly data set is shown in **Appendix C**, and these data are summarised in **Table 4.3**. It should be noted that in September 2009 there was a significant dust storm event in NSW and which would have made a substantial contribution to the elevated levels measured that month (shown in **Appendix C**). These measurements have been removed from the annual averages calculated for 2009 and listed in **Table 4.3**, as they are not representative of ambient levels likely to occur in the area.

Table 4.3: Dust deposition levels at each monitoring site (g/m^2/month)

Gauge	2008	2009	Average
BD1	1.3	No Data	**1.3**
BD2	1.0	1.6	**1.3**
BD3	1.1	1.2	**1.1**
BD4	1.2	1.0	**1.1**
BD5	0.7	1.3	**1.0**
BD6	1.0	1.2	**1.1**
BD7	1.2	1.4	**1.3**
BD8	1.1	1.3	**1.2**

There are only two complete years of data available for dust deposition so it is difficult to determine if any trends are present. However, levels in 2009 are slightly higher than in 2008 at most gauges (except for BD1 where no 2009 data are available and BD4 where there is a slight decrease). This is not unexpected since mining operations at the site began during that time.

When comparing the results for 2008 (before mining) and 2009 (during mining), it can be seen that the increase remains less than 2 g/m^2/month at all gauges. It can also be seen from the data that there are no exceedances of the 4 g/m^2/month cumulative criterion at any of the monitoring sites.

5 ESTIMATED DUST EMISSIONS

Dust emissions arise from various activities at open-cut coal mines. Total dust emissions due to proposed mining operations have been estimated by analysing the activities taking place at the site during the selected years of operation.

Emission factors developed both locally and by the US EPA have been applied to estimate the amount of dust produced by each activity. These emission factors are considered to be the most applicable and representative methods for determining dust generation rates for the proposed activities and modelling approach. The fraction of fine, inhalable and coarse particles for each activity has been taken into account for the dispersion modelling.

The assessment has considered three mine plan scenarios to represent the proposed expansion. While annual production remains constant from Years 1 to 10, the amount of waste generated varies significantly from year to year, as does the surface area of exposed pit and dump areas. As mining progresses from north to south it was also necessary to capture a scenario at each end of this spectrum. These scenarios were also chosen to be consistent with the worst case years for the assessment of noise. The three modelling scenarios are discussed below.

- Year 1 of expanded operation (anticipated to be 2011) represents the period when the in-pit mining activities are closest to the northern residences.
- Year 5 of expanded operation (anticipated to be 2015) represents the year when the northern emplacement area will reach its peak exposed surface area, and there will still be haulage and dumping at that location.
- Year 10 of expanded operation (anticipated to be 2020) represents the year when activities are closest to the southern residences and the overburden extraction rate is at its peak.

The proposed operations have been analysed to determine haul road routes and distances, stockpile and pit areas, activity operating hours, truck sizes, blast areas and other details that are necessary to estimate dust emissions for each year.

The significant dust generating activities from the proposed operations have been identified and the dust emission estimates for Years 1, 5 and 10 are presented below in **Table 5.1**. It is proposed that the ROM coal be transported to WCL's Coal Handling and Preparation Plant (CHPP) near Gunnedah to the south once it has been crushed and screened at the Rocglen site. The off-site transport does not form part of this assessment.

Details of the calculations of the dust emissions are presented in **Appendix D**. The estimated emissions take account of proposed air pollution controls including passive controls such as those included into the mine plan, including stockpile size and alignment, length of haul roads and active controls which include the intensity of watering and the extent of rehabilitation. **Appendix E** provides a summary of estimated dust emissions.

Table 5.1: Estimated TSP emissions due to proposed mining operations (kg/year)

Activity	Year 1	Year 5	Year 10
Topsoil - Removal using scrapers	17,213	17,213	17,213
OB - Dozers/Excavators	76,983	76,983	76,983
OB - Drilling	1,829	2,065	3,009
OB - Blasting	2,935	3,314	4,828
OB - Excavator loading OB to haul truck	19,704	22,585	33,091
OB - Hauling to emplacement area (internal dump)	154,898	145,152	245,650
OB - Hauling to emplacement area (external dump)	197,142	61,440	109,075
OB - Emplacing at emplacement area (internal dump)	0	18,859	24,824
OB - Emplacing at emplacement area (external dump)	19,704	3,725	8,267
OB - Rehandle Shovel/Excavators/FELs Loading	197	226	331
CL - Dozers ripping/pushing/clean-up in pit	91,952	91,952	91,952
CL - Sh/Ex/FELs Loading ROM to trucks	101,330	101,330	101,330
CL - Hauling ROM to ROM pad	40,000	80,000	62,000
CL - Dumping ROM at ROM pad	15,000	101,330	101,330
CL - Dozers on ROM stockpiles	61,967	61,967	61,967
CL - Sh/Ex/FELs Loading ROM to dump hopper	101,330	101,330	101,330
CL - Crushing ROM	4,050	4,050	4,050
CL - Screening ROM	18,750	18,750	18,750
CL - Loading crushed/screened ROM to trucks (via O/H bin)	21,000	21,000	21,000
CL - Hauling crushed ROM to site exit (unsealed)	15,000	15,000	15,000
WE - Northern emplacement area	105,120	210,240	21,024
WE – Western (Years 1 & 5)/Southern (Year 10) emplacement areas (and topsoil stockpiles in Years 1 & 10)	35,040	70,080	122,640
WE - Exposed mined pit area (and topsoil stockpiles in Year 5)	0	210,240	210,240
WE - Exposed active pit area	52,560	52,560	63,072
WE - ROM Pad area	17,520	17,520	15,768
Grading roads	163	163	163
Total	**1,171,386**	**1,509,075**	**1,534,888**

(OB = overburden, CL = coal, WE = Wind erosion)

6 APPROACH TO ASSESSMENT

The assessment has generally followed the DECCW's Approved Methods (**DEC, 2005**). The approved methods 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 and the relevant air quality criteria for assessing the significance of predicted concentration and deposition rates from a proposal.

The approach taken in this assessment generally follows the guidelines. The only deviation relates to the use of the ISCMOD model instead of the AUSPLUME, CALPUFF and TAPM models which are named models in the approved methods. ISCMOD has been specially developed from the US EPA's ISCST3 model to give improved performance in the prediction of short-term PM_{10} concentrations. It has been accepted for use in NSW by the DECCW for a number of years for recently completed mining and quarry assessments, including large Hunter Valley mines.

ISCMOD has been derived from the ISCST3[g] model by applying changes to the horizontal and vertical dispersion curves following recommendations made by the American Meteorological Society (AMS) Expert Panel on Dispersion Curves (**Hanna et al., 1977**) (see **Holmes Air Sciences, 2007**). ISCST3 is fully described in the user manual and the accompanying technical description (**US EPA, 1995**). The modelling has been based on the use of three particle-size categories (0 to 2.5 µm - referred to as $PM_{2.5}$, 2.5 to 10 µm - referred to as CM (coarse matter) and 10 to 30 µm - referred to as the Rest). Emission rates of TSP have been calculated using emission factors derived from **US EPA (1985)** and **SPCC (1983)** work (see **Appendix D**).

The distribution of particles has been derived from measurements in the **SPCC (1986)** study. The distribution of particles in each particle size range is as follows:

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

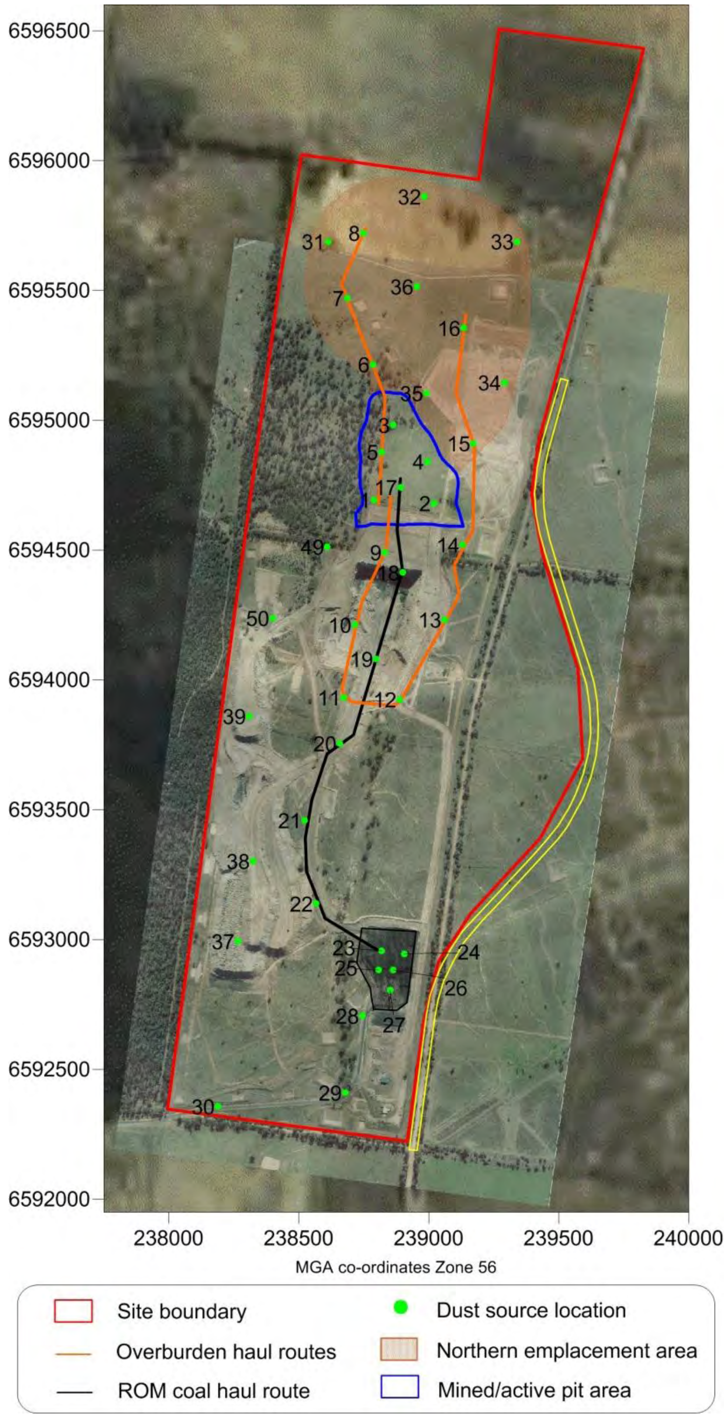
Modelling was done using three ISCMOD source groups. Each group corresponded to a particle size category. Each source in the group was assumed to emit at the full TSP emission rate and to deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter 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 models also have 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 or quarry operations where wind speed is an important factor in determining the rate at which dust is generated.

[g] In subsequent text, when referring to the operation of the ISCMOD or ISCST3 model, where the structure of the models is identical, the acronym ISC will be used.

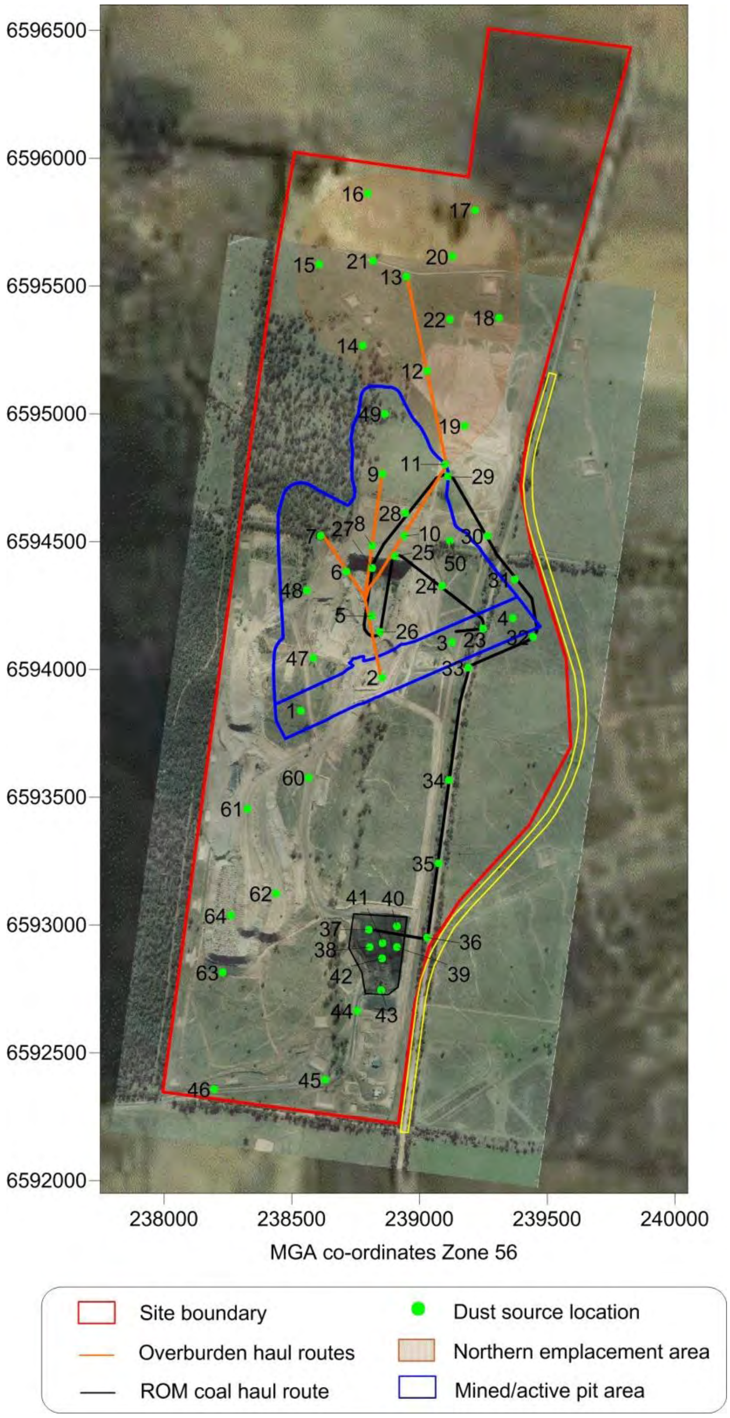
For the current study, the operations were represented by a series of volume sources located according to the location of activities for the modelled scenarios (see **Figure 6.1**, **Figure 6.2** and **Figure 6.3**). Estimates of emissions for each source were developed on an hourly time step taking 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 models 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) and also correspond with periods of poor dispersion. If these measures are not taken then the model has the potential to significantly overstate impacts.

In order to assess the cumulative impacts of the mine, estimates of background levels at Rocglen have been made using the air quality monitoring data discussed in **Section 4.3**). These data for 2008 indicate what dust levels were like before mining began at the current site and will therefore include both natural and anthropogenic sources. However, there are limited data for 2008, so an average of the available 2008 data and that for 2009 has been used. Background estimates are summarised in **Section 6.1**.



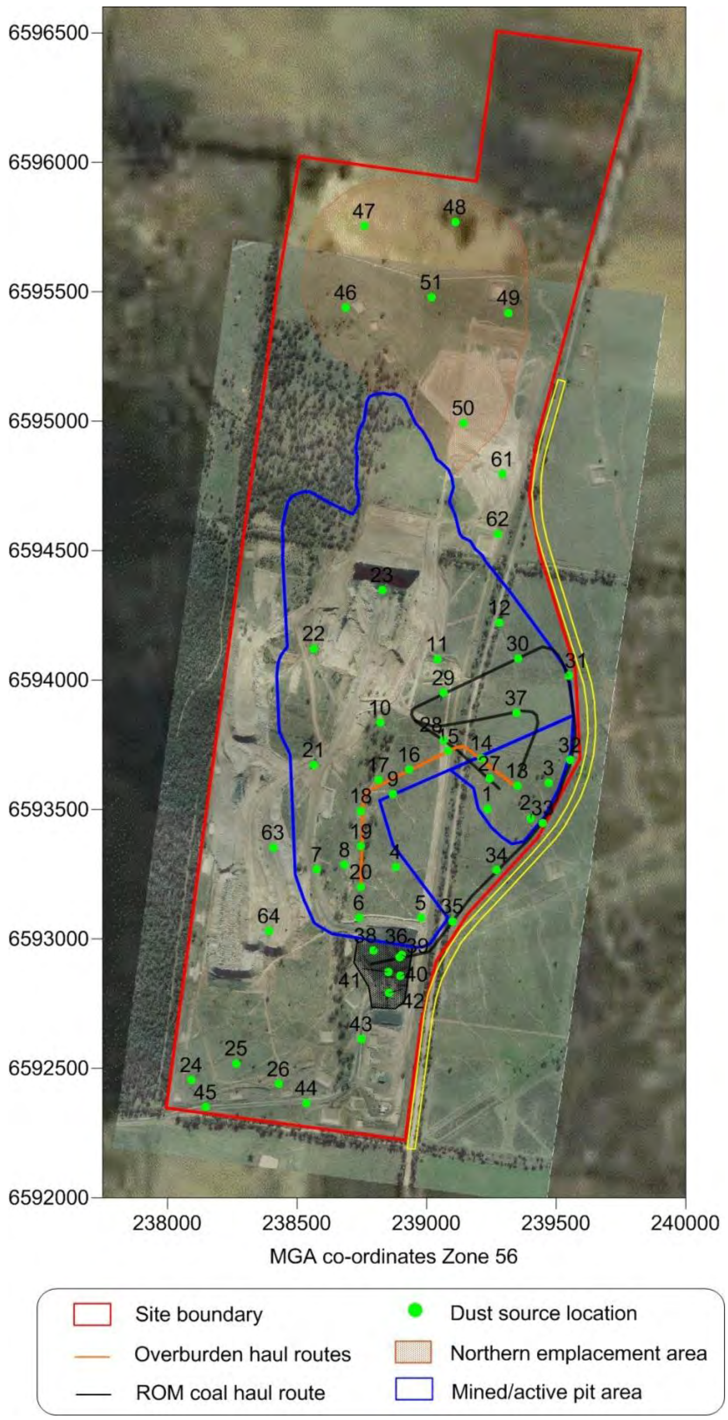
Species:	Location:	Scenario:	Modelling Year:	Plot:
Dust Sources	Rocglen Mine	N/A	Year 1	J Barnett

Figure 6.1: Location of modelled dust sources – Year 1



Species:	Location:	Scenario:	Modelling Year:	Plot:
Dust Sources	Rocglen Mine	N/A	Year 5	J Barnett

Figure 6.2: Location of modelled dust sources – Year 5



Species:	**Location:**	**Scenario:**	**Modelling Year:**	**Plot:**
Dust Sources	Rocglen Mine	N/A	Year 10	J Barnett

Figure 6.3: Location of modelled dust sources – Year 10

Dust concentrations and deposition rates have been predicted over the extent of the modelling domain shown in **Figure 2.1**. Model predictions have been made at discrete receptors, including residential locations, located in the study area. The co-ordinates for the location of each of these residences are listed in **Table 6.1**, although Residence 4 is not included in the results as it becomes part of the activity area during the life of the mine. The location of these receptors has been chosen to provide finer resolution closer to sensitive areas whilst still maintaining acceptable model run times.

Table 6.1: Locations of nearest residences

ID	Property	Ownership	Easting (MGA)	Northing (MGA)
1	Roseglass	Private	241427	6599438
2	Costa Vale	Whitehaven owned	238931	6598048
3	Yarrawonga	Whitehaven owned	237926	6595536
4	Glenroc	Whitehaven owned	239444	6595790
5	Yarrari	Whitehaven owned	240819	6594711
6	Belah	Whitehaven owned	240618	6593712
7	Stratford	Whitehaven owned	236459	6590879
8	Roseberry	Private	238764	6590505
9	Surrey	Private	240608	6589724
10	Carlton	Private	241553	6588858
11	Wundurra Stud	Private	238943	6588194
12	Brolga	Private	237217	658375
13	Braemar	Private	238428	6586570

The modelling has been performed using the meteorological data discussed in **Section 4.1** and the dust emission estimates from **Section 5**. All activities except drilling, blasting and scrapers on topsoil have been modelled for 24 hours per day. **Appendix F** provides a summary of how dust emissions were used in the modelling.

6.1 Accounting for Background Levels

As previously discussed, estimates of background dust levels have been made based on the air quality monitoring data summarised in **Section 4.3**. As there is only limited information for 2008 (before mining began) a conservative estimate has been made using an average of the 2008 and 2009 monitoring data. In the absence of any TSP monitoring data, an estimate has been made assuming that PM_{10} is approximately 40% of TSP. This is typical of the Hunter Valley area where there is a mix of coal mining and farming activity.

For non-modelled dust sources, the uniform constant background levels for annual average TSP, PM_{10} and dust deposition are estimated to be as follows:

- 53 $\mu g/m^3$ for annual average TSP;
- 21 $\mu g/m^3$ for annual average PM_{10}; and
- 1.2 g/m^2/month for annual average dust deposition.

These are conservative estimates and are likely to be lower than this as they include current mining contributions, but in the absence of long-term monitoring data these values will be used.

In addition to the consideration of annual averages, the DECCW guidelines require an assessment against 24-hour PM_{10} concentrations. Cumulative 24-hour impacts are assessed further in **Section 7.5**.

7 ASSESSMENT OF IMPACTS

7.1 Assessment criteria

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

The criteria are:

- 50 µg/m^3 for 24-hour average PM_{10} concentrations;
- 30 µg/m^3 for annual average PM_{10} consentrations;
- 90 µg/m^3 for annual average TSP concentrations;
- 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 sources.

A predicted level above any of the above air quality criteria at a privately owned residence was taken to represent an adverse air quality impact.

The Department of Planning (DoP) also considers the number of days annually that the 24-hour average PM_{10} criteria is exceeded when assessing projects. An assessment of this is also provided in the following sections. It is important that the criteria the DoP applies should not be confused with DECCW impact assessment criteria.

7.2 Approach to assessment

Dispersion model simulations have been undertaken for the Years 1, 5 and 10. This section provides an interpretation of the predicted dust concentration (PM_{10} and TSP) and dust deposition produced by these simulations.

Contours have been provided showing the predicted effects of the Project considered in isolation and the cumulative effects of the Project considered with other sources of dust in the area. For each of the three modelling years, isopleth diagrams are presented for:

- The predicted annual average PM_{10} concentration for Rocglen and other sources of particulate matter;
- The predicted annual average TSP concentration for Rocglen and other sources of particulate matter; and
- The predicted annual average dust deposition for Rocglen and other sources of particulate matter.

Contour plots of the maximum 24-hour PM_{10} concentration have not been included as such plots cannot be reasonably presented to show the dispersion pattern for any particular day, but would show the highest modelled predicted 24-hour average concentrations that occurred at any point for the worst day in the year.

In recent Conditions of Consent, the DoP has interpreted the 24-hour PM_{10} criterion of 50 µg/m³ as being applicable to the Project when considered in isolation, at the 98.6th percentile. The application of the 24-hour PM_{10} criteria applies when the mine can demonstrate that it will or does employ best-practice dust control measures including the use of real-time reactive dust measures.

For the 24-hour average PM_{10} predictions due to Rocglen on its own, a table of the predicted impacts at the nearby residences is presented for each year of the assessment (**Section 7.3**).

In the absence of any continuous PM_{10} monitoring data, the PM_{10} HVAS data collected close to the existing operations have been used to assess the cumulative 24-hour concentrations. It is important to note that these data will have been influenced by emissions from the existing operations and as such represent a conservative estimate of cumulative impacts. This has been discussed in more detail in **Section 7.5**.

7.3 Annual average model predictions

7.3.1 Year 1

Table 7.1 presents the model predictions for Year 1, for all sensitive receptors in the vicinity of the Rocglen mine. Values above the relevant criteria indicate that the Project is expected to adversely impact on air quality.

Contour plots are presented in **Figure 7.1** to **Figure 7.4** which include the relevant background value as listed in **Section 6.1**, where appropriate.

Table 7.1: Modelling predictions Year 1

Residence ID and Property name (ownership)	Annual PM_{10} Rocglen (plus background) (µg/m^3)	Annual TSP Rocglen (plus background) (µg/m^3)	Dust deposition (g/m^2/month)	
			Rocglen only	Rocglen plus background
Criteria ⇨	***30***	***90***	***2***	***4***
Non-mining background ⇨	***21***	***53***	***N/A***	***1.2***
1 Roseglass (Private)	2 (23)	2 (55)	0.02	1.2
2 Costa Vale (WCL)	3 (24)	4 (57)	0.09	1.3
3 Yarrawonga (WCL)	8 (29)	10 (63)	0.67	1.9
5 Yarrari (WCL)	4 (25)	5 (58)	0.09	1.3
6 Belah (WCL)	7 (28)	7 (60)	0.16	1.4
7 Stratford (WCL)	1 (22)	2 (55)	0.04	1.2
8 Roseberry (Private)	2 (23)	2 (55)	0.05	1.3
9 Surrey (Private)	3 (24)	3 (56)	0.05	1.3
10 Carlton (Private)	2 (23)	2 (55)	0.04	1.2
11 Wundurra Stud (Private)	1 (22)	1 (54)	0.02	1.2
12 Brolga (Private)	1 (22)	1 (54)	0.01	1.2
13 Braemar (Private)	1 (22)	1 (54)	0.01	1.2

7.3.1.1 Predicted annual average PM_{10} concentrations

Figure 7.1 shows the predicted annual PM_{10} concentrations from the Rocglen operations in Year 1, including the estimated background of 21 µg/m³. It can be seen that the 30 µg/m³ DECCW criterion is not exceeded at any of the nearest residences.

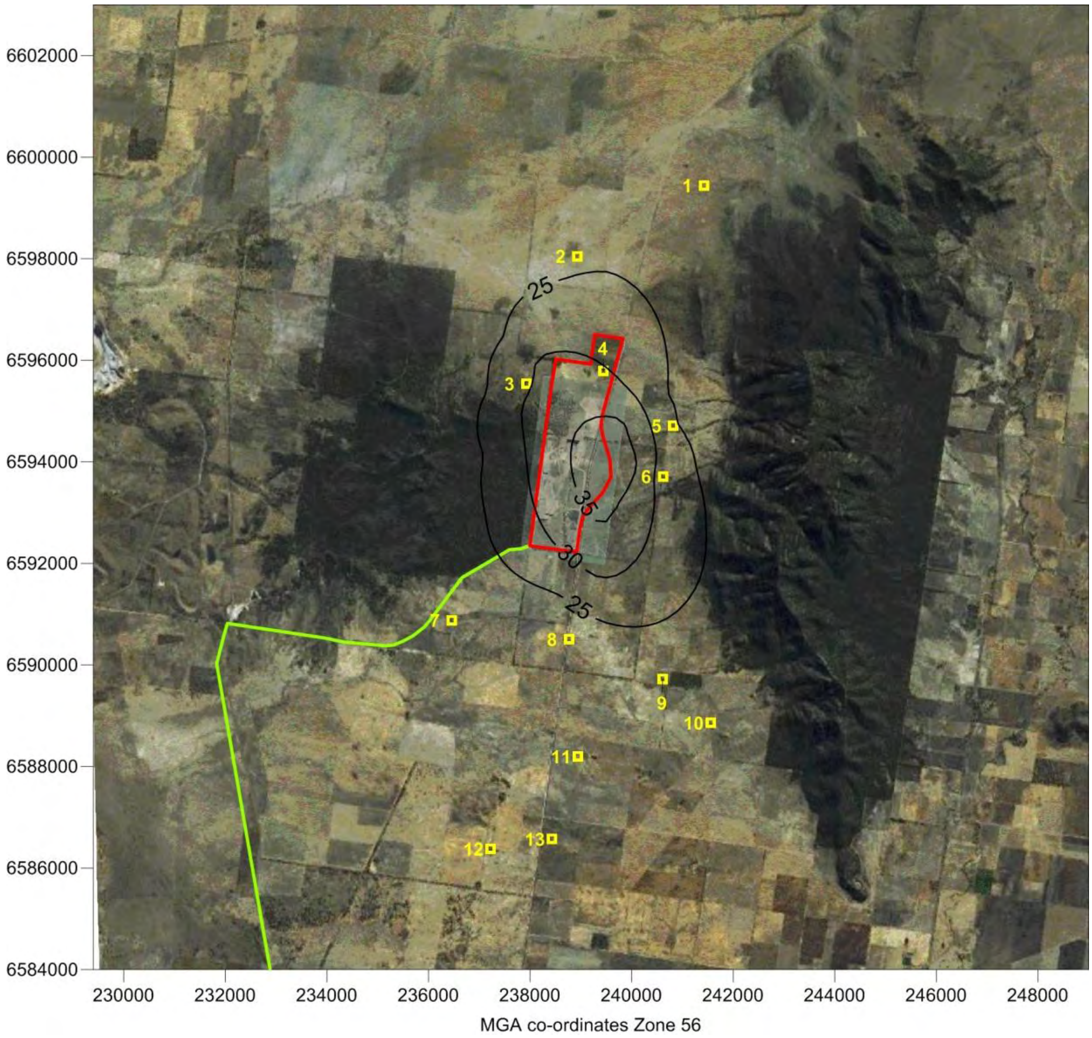
7.3.1.2 Predicted annual average TSP concentrations

Figure 7.2 shows the predicted annual average TSP concentrations from the Year 1 Rocglen operations, including the estimated background level of 53 µg/m³. The DECCW criterion of 90 µg/m³ is not predicted to be exceeded at the nearest sensitive receptors.

7.3.1.3 Predicted annual average dust deposition (insoluble solids)

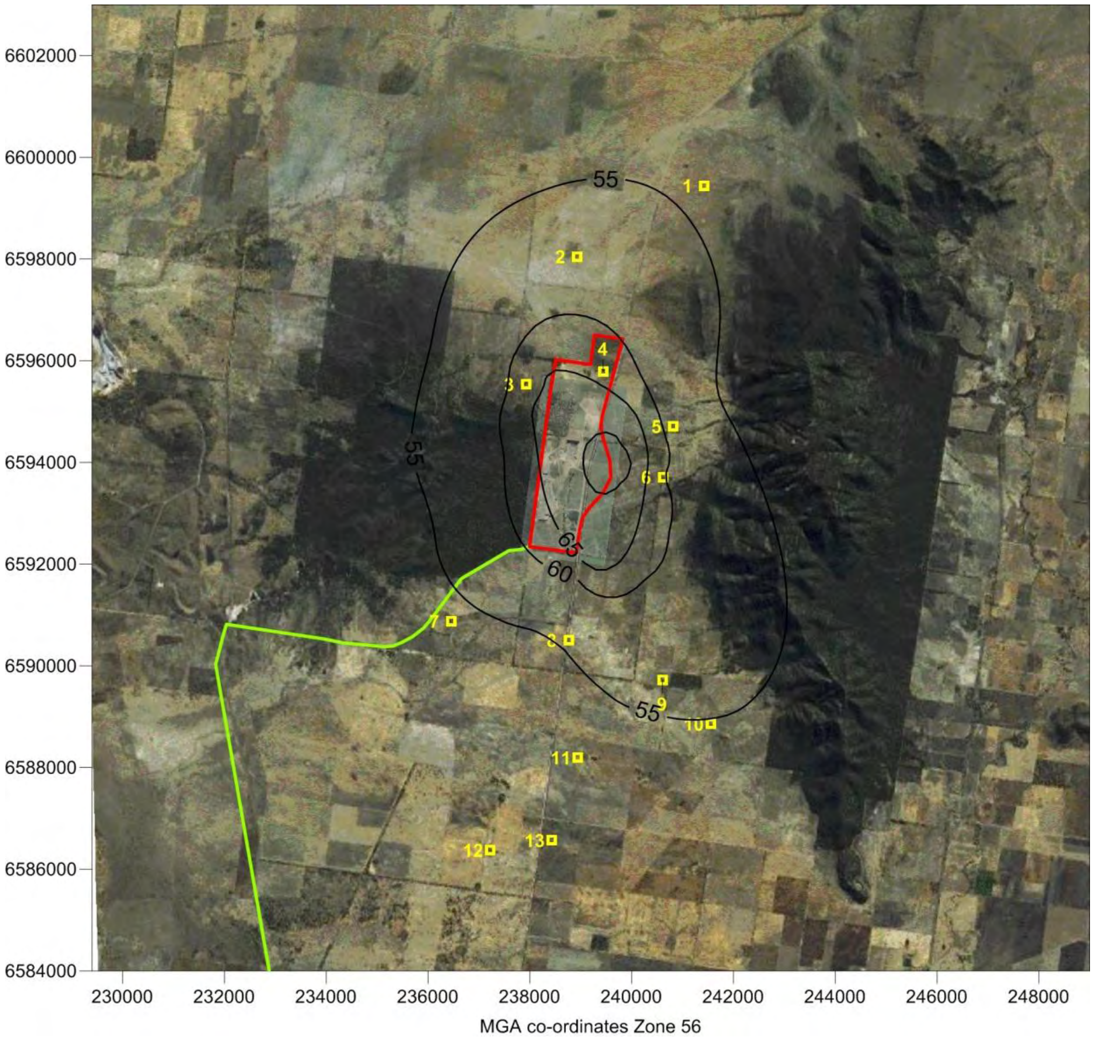
Figure 7.3 shows the predicted annual average dust deposition rate for Rocglen operations alone in Year 1. The assessment criterion is 2 g/m²/month (annual average). No residences are predicted to experience annual average dust deposition levels above 2 g/m²/month due to Rocglen emissions in Year 1.

To assess the project against the cumulative deposition criterion a background level of 1.2 g/m²/month has been added to the modelling results, as shown in **Figure 7.4**. The cumulative assessment criterion is 4 g/m²/month (annual average) and is not predicted to be exceeded at any of the residential receptors.



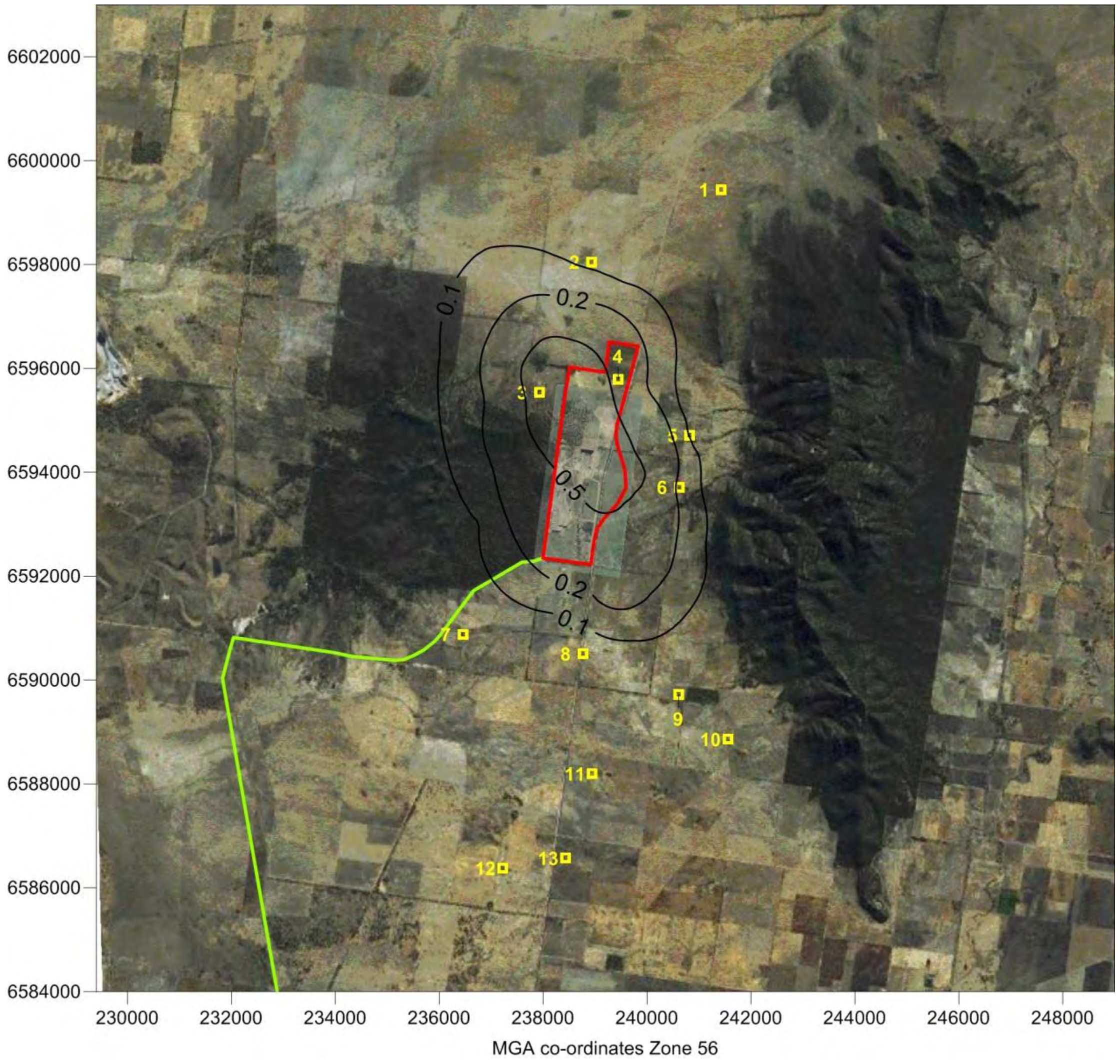
Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Rocglen	Year 1	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
ISCMOD	µg/m³	30 µg/m³	2006/2007	J. Barnett

Figure 7.1: Predicted annual average PM_{10} concentrations due to emissions from the Rocglen Mine and other sources – Year 1



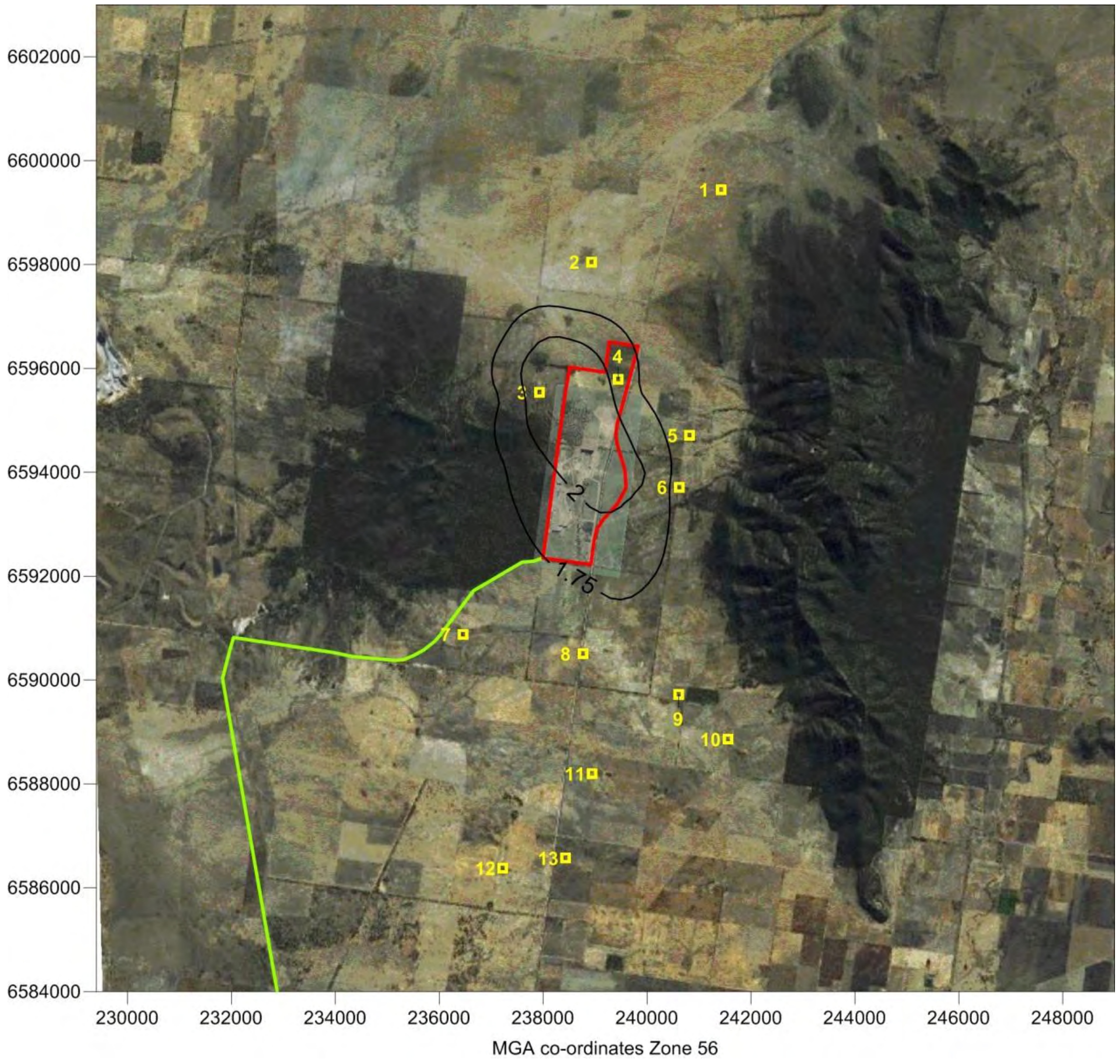
Species: TSP	**Location:** Rocglen	**Scenario:** Year 1	**Percentile:** N/A	**Averaging Time:** Annual
Model Used: ISCMOD	**Units:** µg/m³	**Guideline:** 90 µg/m³	**Met Data:** 2006/2007	**Plot:** J. Barnett

Figure 7.2: Predicted annual average TSP concentrations due to emissions from the Rocglen Mine and other sources – Year 1



Species: Deposition	Location: Rocglen	Scenario: Year 1	Percentile: N/A	Averaging Time: Annual
Model Used: ISCMOD	**Units:** g/m^2/month	**Guideline:** 2 g/m^2/month	**Met Data:** 2006/2007	**Plot:** J. Barnett

Figure 7.3: Predicted annual average dust deposition levels due to emissions from the Rocglen Mine only – Year 1



Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
Deposition	Rocglen	Year 1	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
ISCMOD	g/m^2/month	4 g/m^2/month	2006/2007	J. Barnett

Figure 7.4: Predicted annual average dust deposition levels due to emissions from the Rocglen Mine and other sources – Year 1

7.3.2 Year 5

Table 7.2 presents the model predictions for Year 5, for all sensitive receptors in the vicinity of the Rocglen mine. Values above the relevant criteria indicate that the Project is expected to adversely impact on air quality.

Contour plots are presented in **Figure 7.5** to **Figure 7.8** which include the relevant background value as listed in **Section 6.1**, where appropriate.

Table 7.2: Modelling predictions Year 5

Residence ID and Property name (ownership)	Annual PM_{10} Rocglen (plus background) (µg/m³)	Annual TSP Rocglen (plus background) (µg/m³)	Dust deposition (g/m²/month)	
			Rocglen only	Rocglen plus background
Criteria ⇨	***30***	***90***	***2***	***4***
Non-mining background ⇨	***21***	***53***	***N/A***	***1.2***
1 Roseglass (Private)	2 (23)	2 (55)	0.03	1.2
2 Costa Vale (WCL)	3 (24)	3 (56)	0.10	1.3
3 Yarrawonga (WCL)	7 (28)	9 (62)	0.89	1.9
5 Yarrari (WCL)	4 (25)	4 (57)	0.10	1.3
6 Belah (WCL)	7 (28)	7 (60)	0.19	1.4
7 Stratford (WCL)	2 (23)	2 (55)	0.06	1.2
8 Roseberry (Private)	3 (24)	3 (56)	0.08	1.3
9 Surrey (Private)	3 (24)	3 (56)	0.08	1.3
10 Carlton (Private)	2 (23)	2 (55)	0.05	1.2
11 Wundurra Stud (Private)	1 (22)	1 (54)	0.03	1.2
12 Brolga (Private)	1 (22)	1 (54)	0.01	1.2
13 Braemar (Private)	1 (22)	1 (54)	0.02	1.2

7.3.2.1 Predicted annual average PM_{10} concentrations

Figure 7.5 shows the predicted annual PM_{10} concentrations from the Rocglen operations in Year 5, including the estimated background of 21 µg/m^3. It can be seen that the 30 µg/m^3 level is not exceeded at any of the nearest residences.

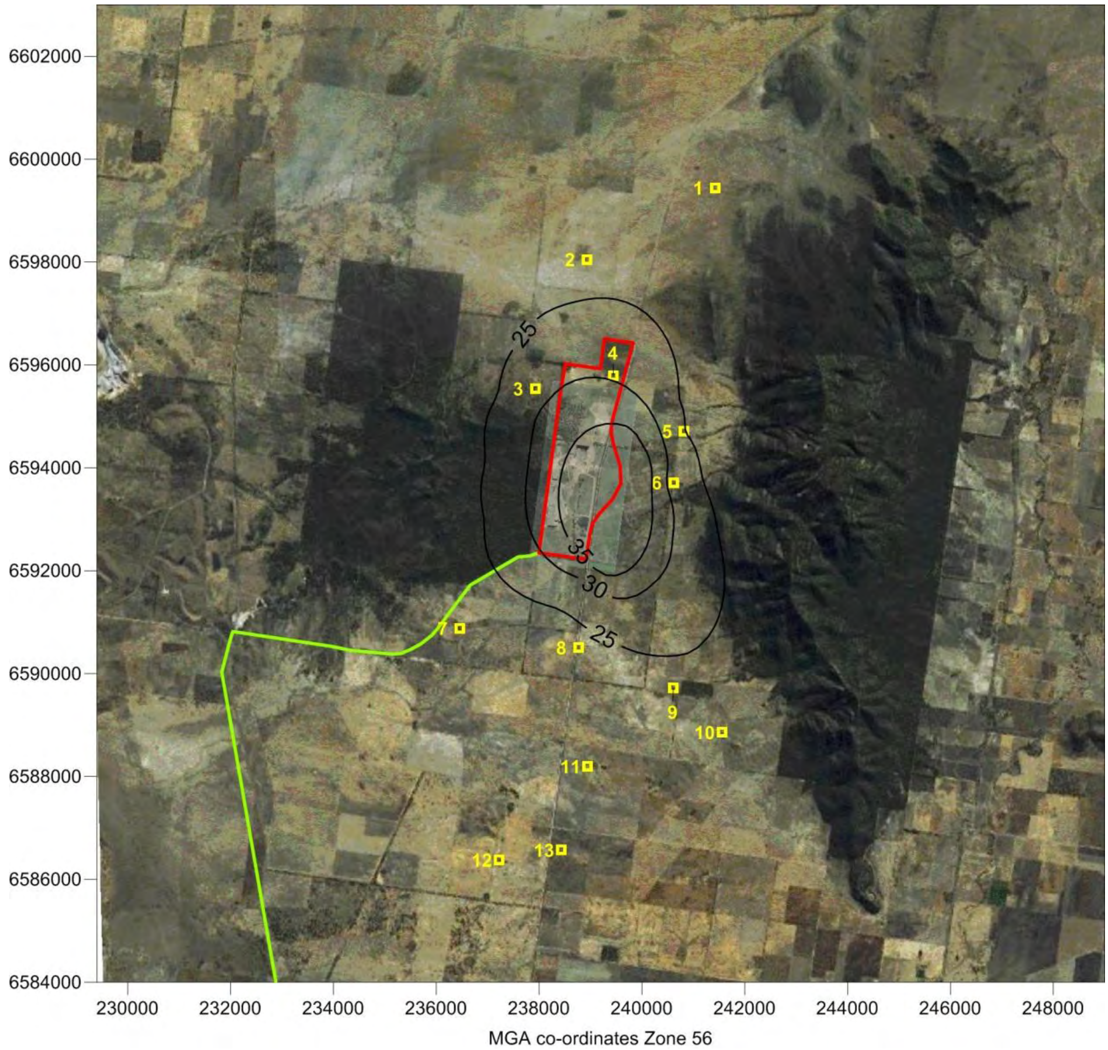
7.3.2.2 Predicted annual average TSP concentrations

Figure 7.6 shows the predicted annual average TSP concentrations from the Year 5 Rocglen operations, including the estimated background level of 53 µg/m^3. The DECCW criterion of 90 µg/m^3 is not predicted to be exceeded at the nearest sensitive receptors.

7.3.2.3 Predicted annual average dust deposition (insoluble solids)

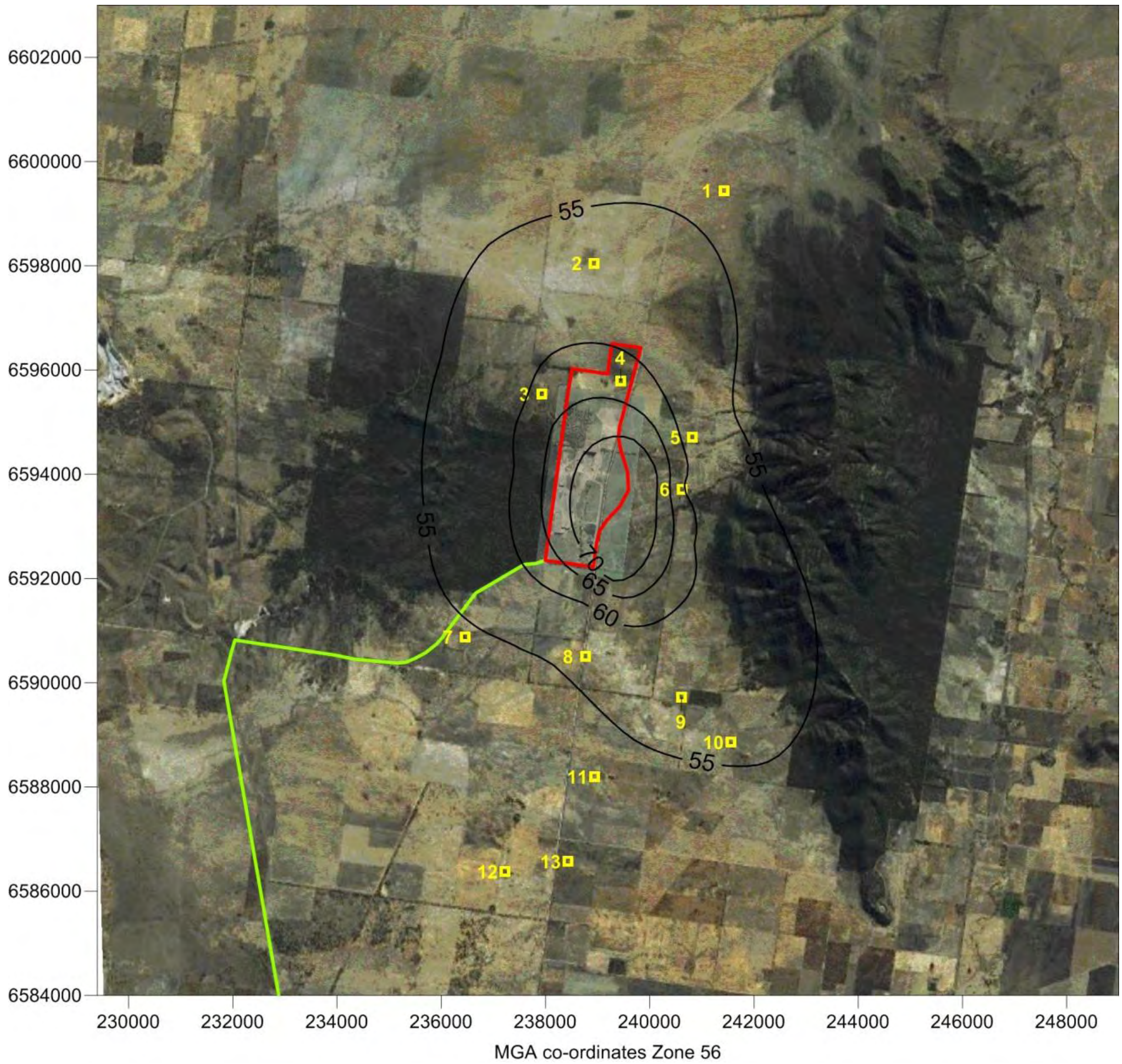
Figure 7.7 shows the predicted annual average dust deposition rate for Rocglen operations alone in Year 5. The assessment criterion is 2 g/m^2/month (annual average). No residences are predicted to experience annual average dust deposition levels above 2 g/m^2/month due to Rocglen emissions in Year 5.

To assess the project against the cumulative deposition criterion a background level of 1.2 g/m^2/month has been added to the modelling results, as shown in **Figure 7.8**. The cumulative assessment criterion is 4 g/m^2/month (annual average) and is not predicted to be exceeded at any of the residential receptors.



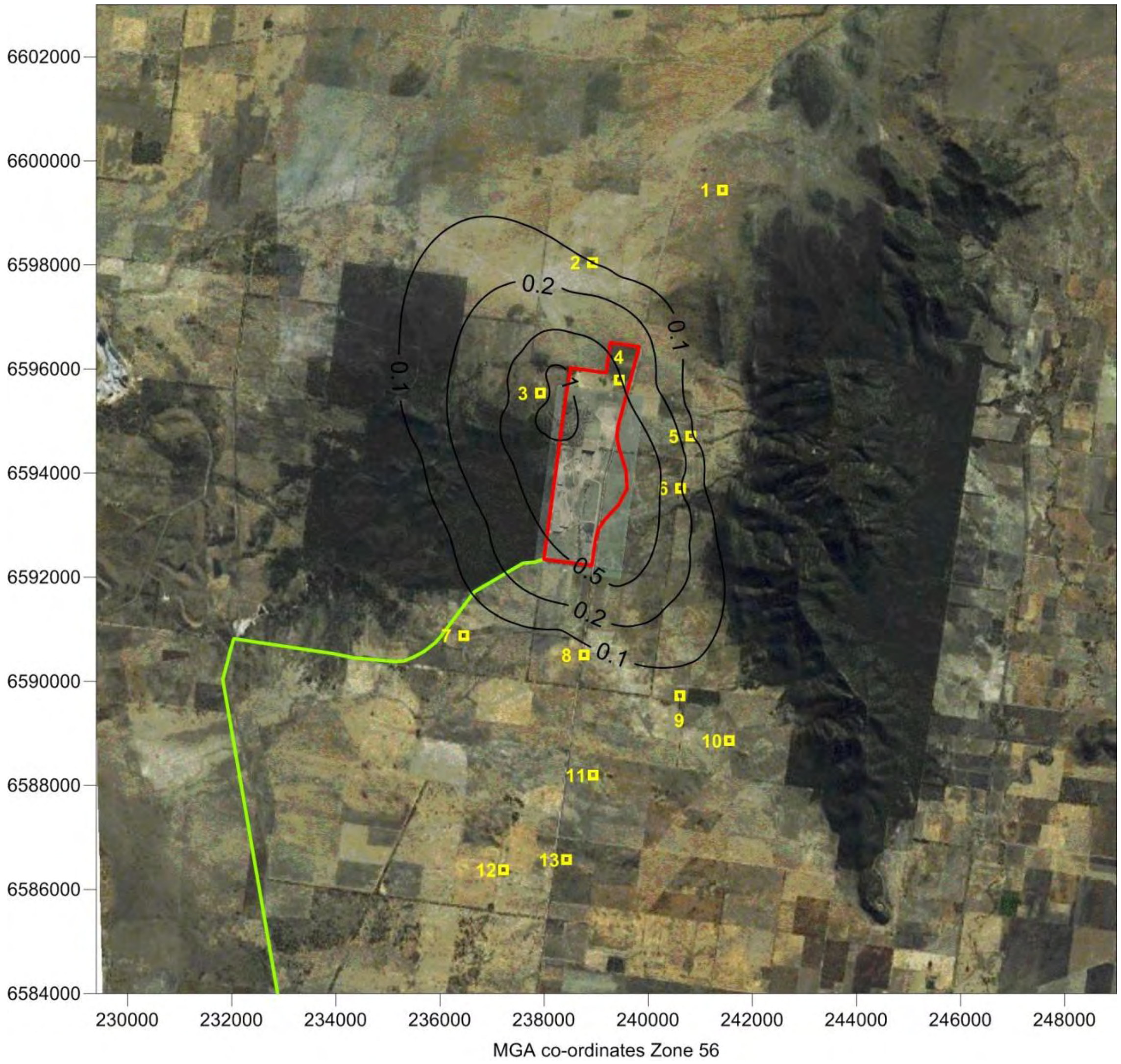
Species: PM$_{10}$	Location: Rocglen	Scenario: Year 5	Percentile: N/A	Averaging Time: Annual
Model Used: ISCMOD	**Units:** µg/m^3	**Guideline:** 30 µg/m^3	**Met Data:** 2006/2007	**Plot:** J. Barnett

Figure 7.5: Predicted annual average PM$_{10}$ concentrations due to emissions from the Rocglen Mine and other sources – Year 5



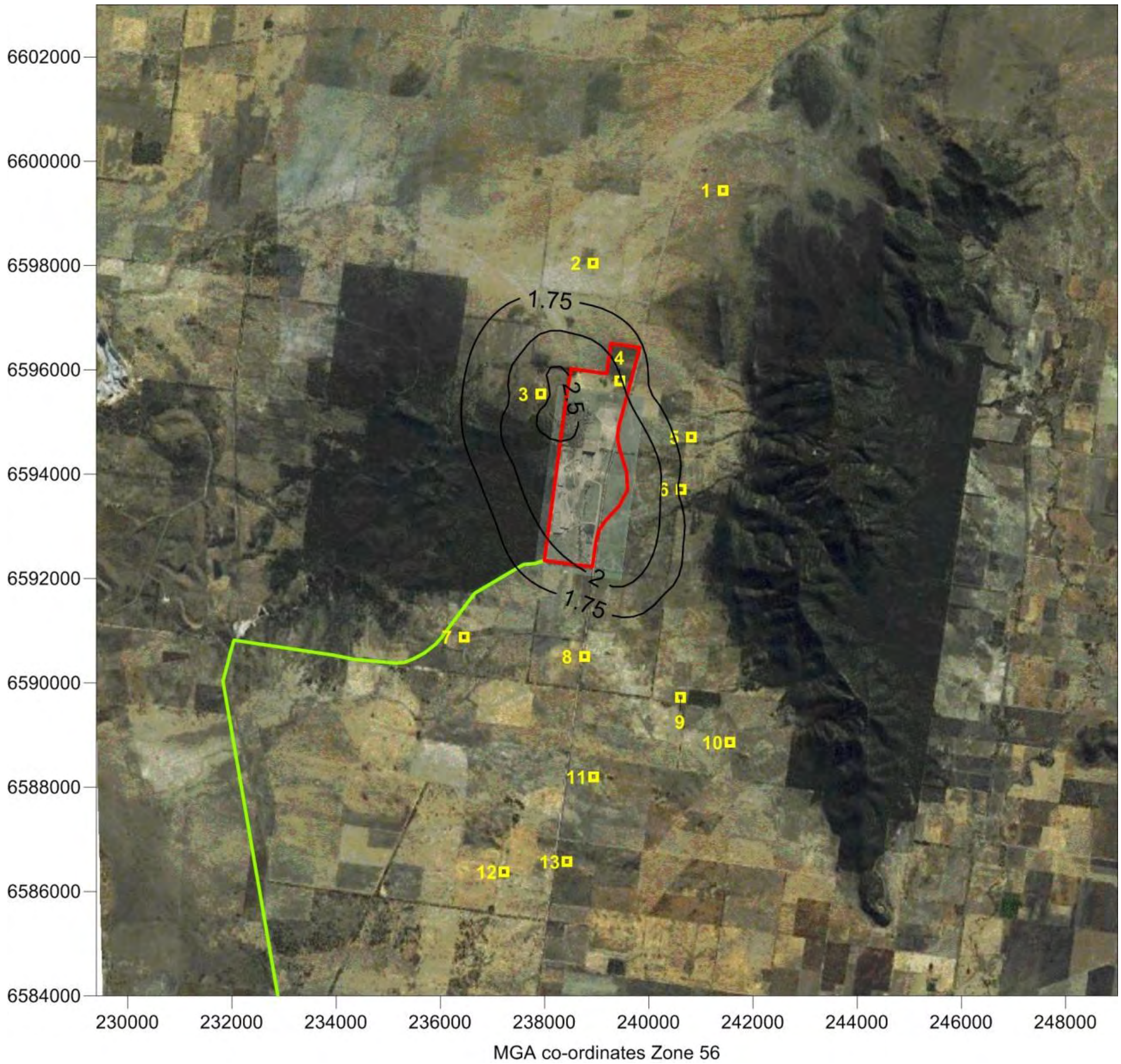
Species:	Location:	Scenario:	Percentile:	Averaging Time:
TSP	Rocglen	Year 5	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
ISCMOD	µg/m³	90 µg/m³	2006/2007	J. Barnett

Figure 7.6: Predicted annual average TSP concentrations due to emissions from the Rocglen Mine and other sources – Year 5



Species:	Location:	Scenario:	Percentile:	Averaging Time:
Deposition	Rocglen	Year 5	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
ISCMOD	$g/m^2/month$	2 $g/m^2/month$	2006/2007	J. Barnett

Figure 7.7: Predicted annual average dust deposition levels due to emissions from the Rocglen Mine only – Year 5



Species: Deposition	**Location:** Rocglen	**Scenario:** Year 5	**Percentile:** N/A	**Averaging Time:** Annual
Model Used: ISCMOD	**Units:** g/m^2/month	**Guideline:** 4 g/m^2/month	**Met Data:** 2006/2007	**Plot:** J. Barnett

Figure 7.8: Predicted annual average dust deposition levels due to emissions from the Rocglen Mine and other sources – Year 5

7.3.3 Year 10

Table 7.3 presents the model predictions for Year 10, for all sensitive receptors in the vicinity of the Rocglen mine. Values above the relevant criteria indicate that the Project is expected to adversely impact on air quality.

Contour plots are presented in **Figure 7.9** to **Figure 7.12** which include the relevant background value as listed in **Section 6.1**, where appropriate.

Table 7.3: Modelling predictions Year 10

Residence ID and Property name (ownership)	Annual PM_{10} Rocglen (plus background) ($\mu g/m^3$)	Annual TSP Rocglen (plus background) ($\mu g/m^3$)	Dust deposition (g/m^2/month)	
			Rocglen only	Rocglen plus background
Criteria ⇨	***30***	***90***	***2***	***4***
Non-mining background ⇨	***21***	***53***	***N/A***	***1.2***
1 Roseglass (Private)	2 (23)	2 (55)	0.03	1.2
2 Costa Vale (WCL)	3 (24)	3 (56)	0.07	1.3
3 Yarrawonga (WCL)	6 (27)	7 (60)	0.50	1.7
5 Yarrari (WCL)	5 (26)	5 (58)	0.11	1.3
6 Belah (WCL)	8 (29)	9 (62)	0.20	1.4
7 Stratford (WCL)	2 (23)	2 (55)	0.07	1.3
8 Roseberry (Private)	3 (24)	4 (57)	0.10	1.3
9 Surrey (Private)	4 (25)	4 (57)	0.10	1.3
10 Carlton (Private)	3 (24)	3 (56)	0.06	1.3
11 Wundurra Stud (Private)	1 (22)	2 (55)	0.03	1.2
12 Brolga (Private)	1 (22)	1 (54)	0.02	1.2
13 Braemar (Private)	1 (22)	1 (54)	0.02	1.2

7.3.3.1 Predicted annual average PM_{10} concentrations

Figure 7.9 shows the predicted annual PM_{10} concentrations from the Rocglen operations in Year 10, including the estimated background of 21 µg/m³. It can be seen that the 30 µg/m³ DECCW criterion is not exceeded at any of the nearest residences.

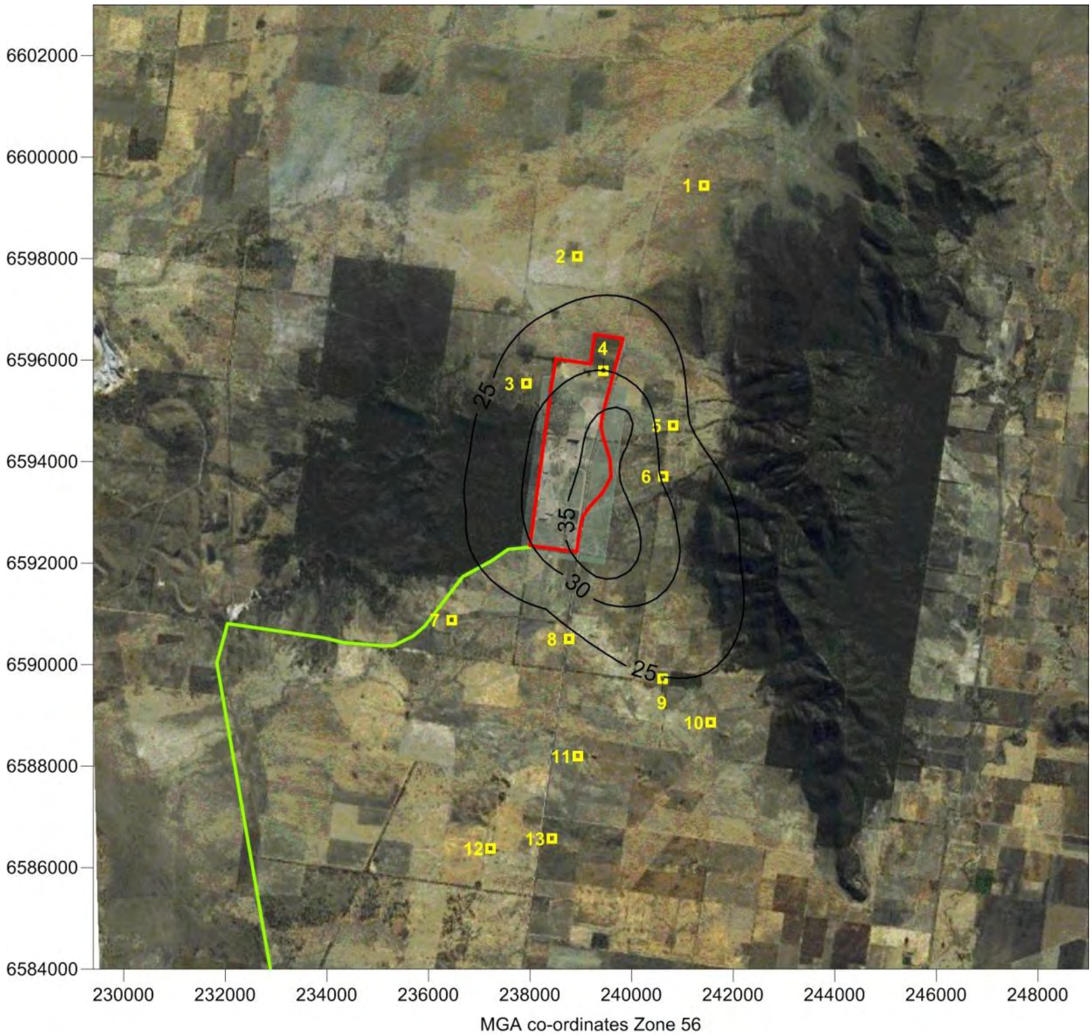
7.3.3.2 Predicted annual average TSP concentrations

Figure 7.10 shows the predicted annual average TSP concentrations from the Year 10 Rocglen operations, including the estimated background level of 53 µg/m³. The DECCW criterion of 90 µg/m³ is not predicted to be exceeded at the nearest sensitive receptors.

7.3.3.3 Predicted annual average dust deposition (insoluble solids)

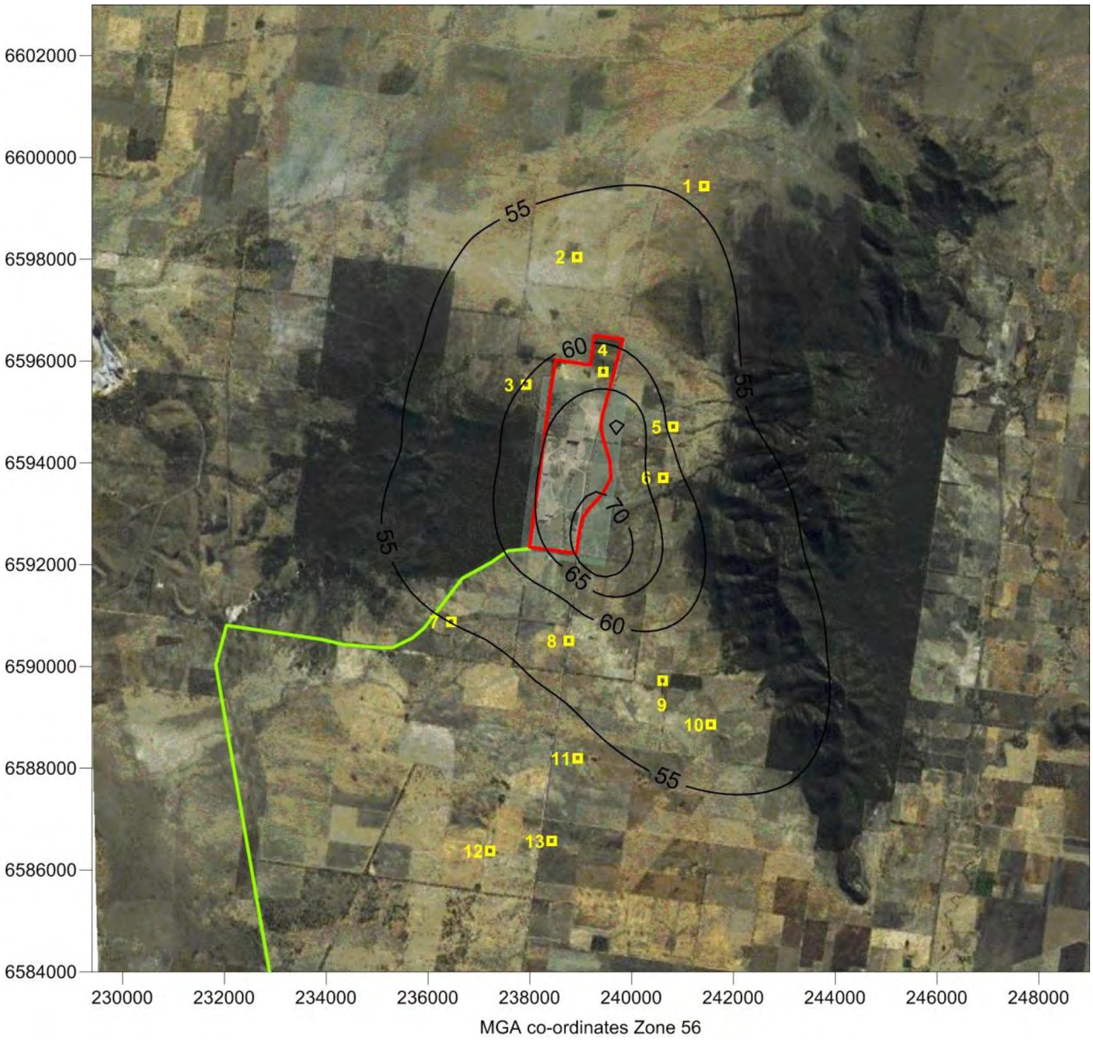
Figure 7.11 shows the predicted annual average dust deposition rate for Rocglen operations alone in Year 10. The assessment criterion is 2 g/m²/month (annual average). No residences are predicted to experience annual average dust deposition levels above 2 g/m²/month due to Rocglen emissions in Year 10.

To assess the project against the cumulative deposition criterion a background level of 1.2 g/m²/month has been added to the modelling results, as shown in **Figure 7.12**. The cumulative assessment criterion is 4 g/m²/month (annual average) and is not predicted to be exceeded at any of the residential receptors.



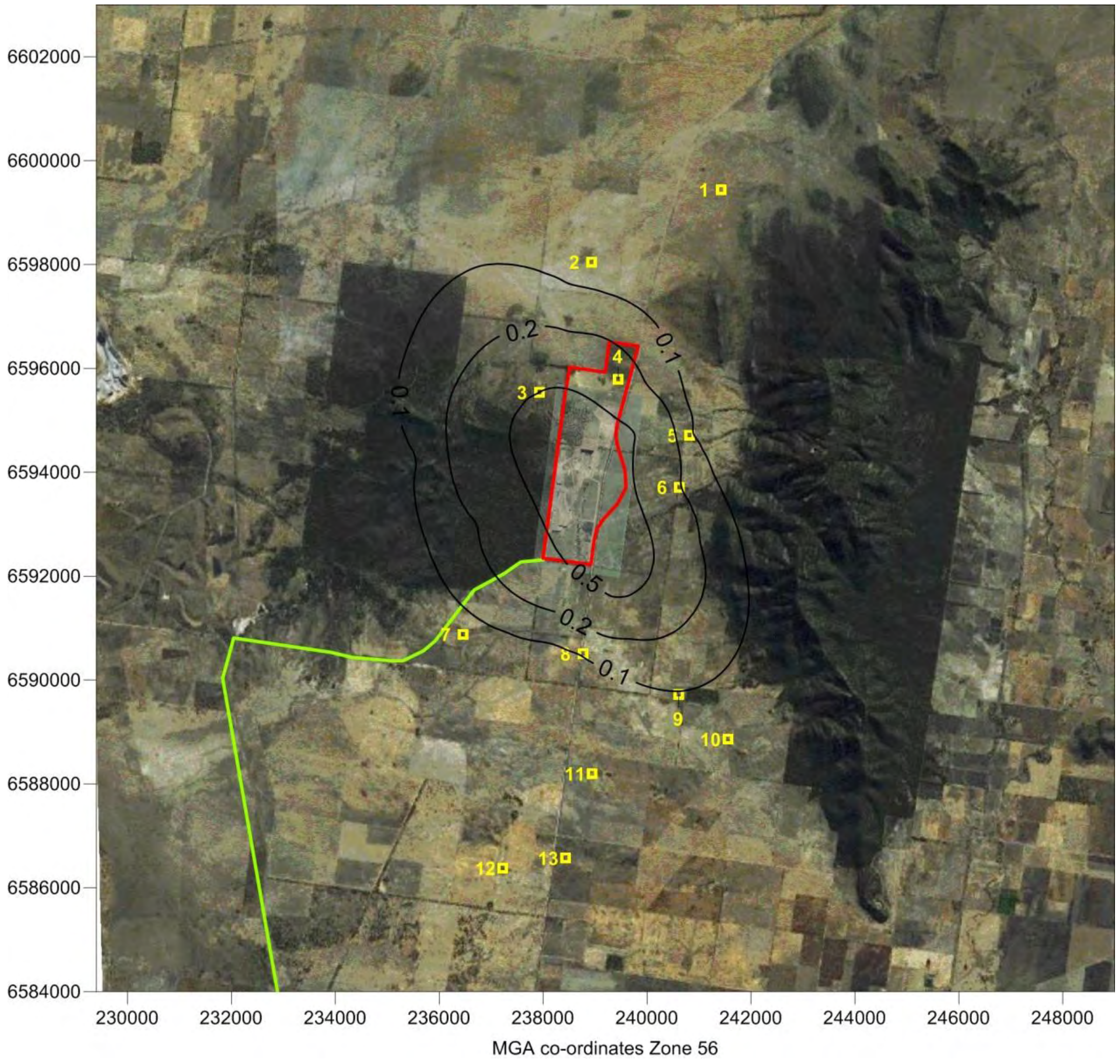
Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Rocglen	Year 10	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	30 µg/m^3	2006/2007	J. Barnett

Figure 7.9: Predicted annual average PM_{10} concentrations due to emissions from the Rocglen Mine and other sources – Year 10



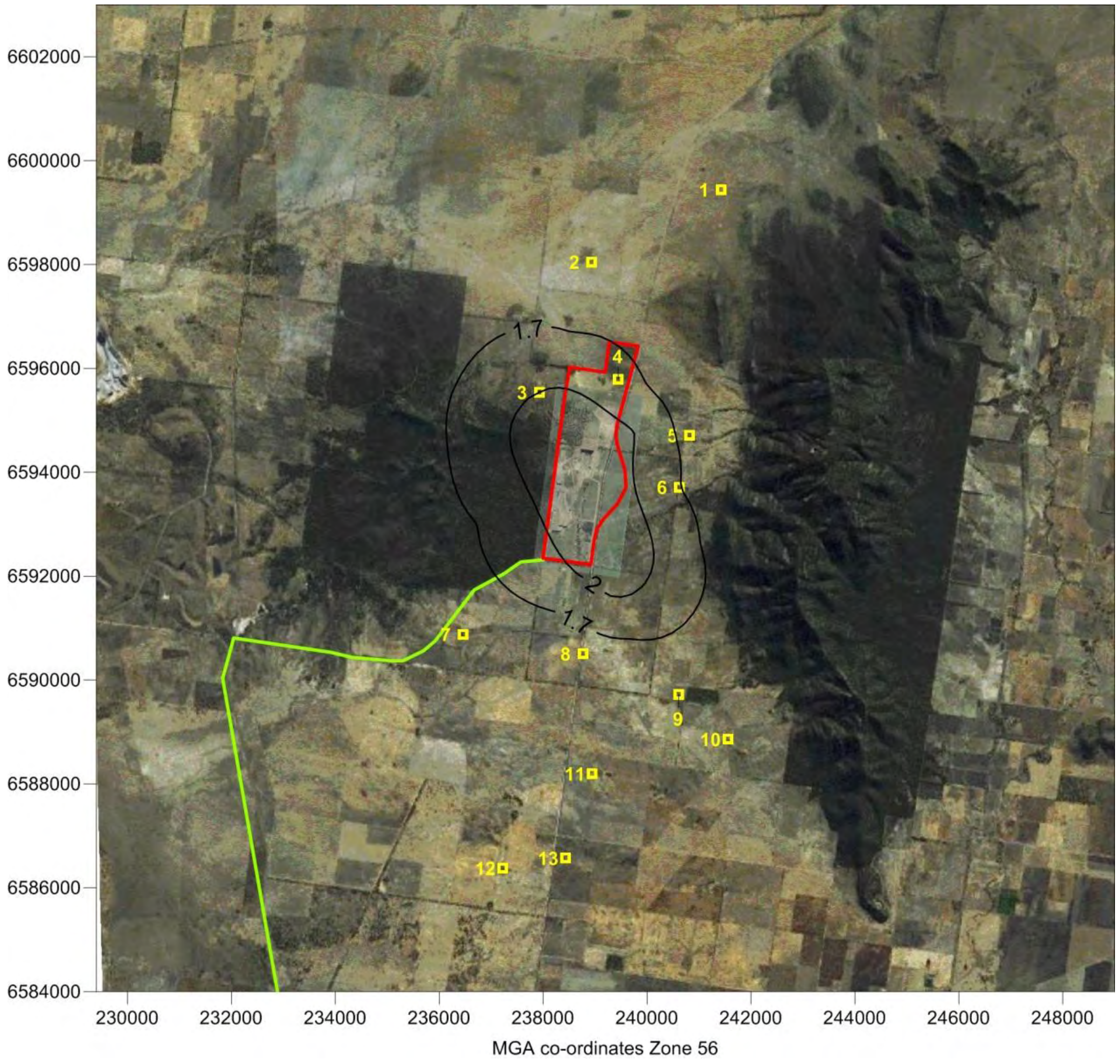
Species: TSP	**Location:** Rocglen	**Scenario:** Year 10	**Percentile:** N/A	**Averaging Time:** Annual
Model Used: ISCMOD	**Units:** µg/m³	**Guideline:** 90 µg/m³	**Met Data:** 2006/2007	**Plot:** J. Barnett

Figure 7.10: Predicted annual average TSP concentrations due to emissions from the Rocglen Mine and other sources – Year 10



Species: Deposition	Location: Rocglen	Scenario: Year 10	Percentile: N/A	Averaging Time: Annual
Model Used: ISCMOD	**Units:** g/m^2/month	**Guideline:** 2 g/m^2/month	**Met Data:** 2006/2007	**Plot:** J. Barnett

Figure 7.11: Predicted annual average dust deposition levels due to emissions from the Rocglen Mine alone – Year 10



Species: Deposition	**Location:** Rocglen	**Scenario:** Year 10	**Percentile:** N/A	**Averaging Time:** Annual
Model Used: ISCMOD	**Units:** g/m^2/month	**Guideline:** 2 g/m^2/month	**Met Data:** 2006/2007	**Plot:** J. Barnett

Figure 7.12: Predicted annual average dust deposition levels due to emissions from the Rocglen Mine and other sources – Year 10

7.4 Incremental 24-hour average PM_{10} concentrations

Table 7.4 presents the predicted maximum 24-hour average PM_{10} concentrations at the residences and highlights in bold those figures that are predicted to exceed the DECCW criteria of 50 µg/m^3. Only two residences are predicted to exceed this criteria, Residence 3 (Yarrawonga) in Year 1 and Residence 6 (Belah) in Year 10.

Table 7.4: Summary of maximum predicted 24-hour average PM_{10} concentrations (µg/m^3)

Property name (ownership)	ID	Year 1	Year 5	Year 10
Roseglass (Private)	1	10	8	11
Costa Vale (WCL)	2	21	15	15
Yarrawonga (WCL)	3	**60**	30	33
Yarrari (WCL)	5	27	19	42
Belah (WCL)	6	34	29	**60**
Stratford (WCL)	7	16	16	22
Roseberry (Private)	8	23	26	29
Surrey (Private)	9	19	20	29
Carlton (Private)	10	12	12	17
Wundurra Stud (Private)	11	10	11	14
Brolga (Private)	12	7	9	14
Braemar (Private)	13	7	7	9

As discussed in **Section 3.1.3**, recent Conditions of Consent issued by the DoP 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. This is in line with the NEPM requirements as it is understood the criteria could be exceeded due to natural events such as bushfires.

To facilitate the DoP assessment, further analysis was conducted on Residences 3 and 6 to determine the number of days that the 50 µg/m^3 criterion would be exceeded. It was determined that this would occur on 32 occasions at Residence 3 and on only four occasions at Residence 6. However, as both these residences have already been acquired by WCL the acquisition criteria become irrelevant for these properties.

No other residences are predicted to exceed the 50 µg/m^3 24-hour PM_{10} criteria for the mine alone.

7.5 Cumulative 24-hour average PM_{10} concentrations

It is important to note that it is not possible to accurately predict the cumulative 24-hour PM_{10} concentrations using dispersion modelling, due to the variability in ambient levels and spatial and temporal variation in any day to day anthropogenic activity, including mining in the future.

Experience shows that the worst-case 24-hour PM_{10} concentrations are strongly influenced by other sources in the area, such as bushfires and dust storms, which are essentially unpredictable. These events dominate the worst-case PM_{10} concentrations. However, this does not mean that no action should be taken to control mine dust emissions, and WCL are committed to the use of real-time management system, if requested by a private residence and assuming air quality becomes an issue, which will enable them to pro-actively manage the short-term impacts of the Rocglen mine.

There are currently no continuous measurements of PM_{10} available in the area that could be considered 'background', that is, ambient concentration due to all other sources excluding the impact of operations at the Rocglen Mine. The closest continuous monitoring data available are from the DECCW monitor located at Tamworth, approximately 70 km to the south-east of Rocglen. Due to the distance and terrain that exists between the two locations, and the significantly different land-uses at the two sites, the Tamworth data are unlikely to be representative of the background air quality in the vicinity of the Rocglen mine.

As discussed in **Section 4.3**, there are currently two HVAS monitors operating north and south of the existing mining operations, 'Glenroc' (to the north) and 'Roseberry' (to the south). The variability in 24-hour average PM_{10} concentrations can be clearly seen in **Figure 4.2**. The variation has a seasonal component (lower concentrations over the cooler months and higher levels in the hotter/drier months), although clearly that is not the only factor. These seasonal trends are common in areas such as the Hunter Valley in NSW, where there have been significant amounts of data collected over many years.

The high values in December 2009 were likely to be the result of significant high winds and dust storms across NSW and bushfires in the Kelvin Range. Under these conditions, the proportional contribution of mining activities to the total PM_{10} concentration will be minimal. It should also be noted that PM_{10} concentrations in general in 2009 are likely to be higher than average due to the prolonged period of drought experienced over the previous 6 to 7 years across NSW. Without available historical data however, it is not possible to verify this, but it has certainly been the case in other areas in NSW.

Figure 4.2 also shows that the values at 'Glenroc' are generally higher than those at 'Roseberry'. This is not unusual given that the 'Roseberry' site is more removed from current mining activity. In terms of estimating the background 24-hour average PM_{10} level, it would be more reasonable then to use data from 'Roseberry'. **Figure 7.13** shows a plot of these data, ranking the values from highest to lowest.

The 70th percentile[h] (22 µg/m^3) provides a simplistic indication of PM_{10} concentrations in the absence of anomalous data due to extreme events such as bushfires and dust storms. It does, however, provide a conservatively high estimation of 24-hour average background PM_{10} concentrations as contributions from the existing mining operations are still included. Using it as a background and adding it to modelling results also assumes that this level of 22 µg/m^3 will occur every day, which is clearly not the case as by definition it will be lower for 70 % of the time.

[h] The approach adopted by the Victorian EPA in the absence of hourly background data (VEPA, 2001).

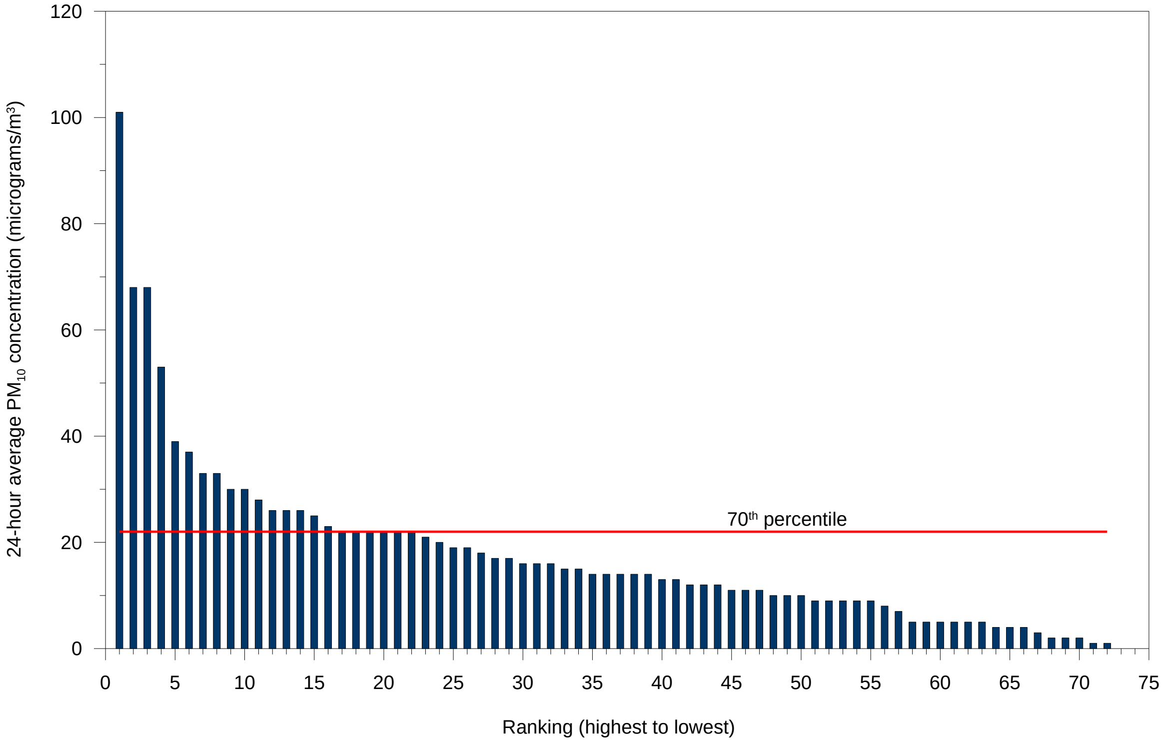


Figure 7.13: PM_{10} monitoring data from 2008 to 2009 at the 'Roseberry' property

Using the 70th percentile approach, a level of 22 µg/m^3 can be added to the maximum 24-hour average modelling predictions for each residence, as listed in **Table 7.4**. This leads to predicted exceedances of the 50 µg/m^3 criterion at Residences 3, 5, 6, 8 and 9, as shown in **Table 7.5**. The only additional residences that are not currently owned by WCL are Residences 8 and 9. Furthermore, these exceedances are only predicted for operations in Year 10.

Table 7.5: Summary of total predicted 24-hour average PM_{10} concentrations assuming 70th percentile at 'Roseberry' as background (µg/m^3)

Property name (ownership)	ID	Year 1	Year 5	Year 10
Roseglass (Private)	1	32	30	33
Costa Vale (WCL)	2	43	37	37
Yarrawonga (WCL)	3	**82**	**52**	**55**
Yarrari (WCL)	5	49	41	**64**
Belah (WCL)	6	**56**	**51**	**82**
Stratford (WCL)	7	38	38	44
Roseberry (Private)	8	45	48	**51**
Surrey (Private)	9	41	42	**51**
Carlton (Private)	10	34	34	39
Wundurra Stud (Private)	11	32	33	36
Brolga (Private)	12	29	31	36
Braemar (Private)	13	29	29	31

Further analysis of the modelling results for Residences 8 and 9 were carried out to determine how many times this exccedance may occur, when added to a background of 22 µg/m³. For the 24-hour average PM_{10} concentration to exceed 50 µg/m³ at Residences 8 and 9, a predicted concentration must be below 29 µg/m³.

The model was run to extract a predicted 24-hour average PM_{10} concentration for each day of the year at Residences 8 and 9, and these time series are shown in **Figure 7.14**. It can be seen that there is only one day of the year at each residence, when 29 µg/m³ is predicted to be exceeded, while the majority of values are estimated to be less than 15 µg/m³. Using this conservative approach then, the mine is predicted to comply with the DoP acquisition criterion at both Residences 8 and 9.

It should also be noted that the potential exceedances are predicted to be very small, within 2% of the criteria, and are also predicted to occur for less than 0.3% of the time. By definition, levels of 22 µg/m³ or more will occur for less than 30% of the time. The probability of these two events occurring simultaneously is approximately 0.09% of the time annually, or about one day in three years. This is very unlikely to pose any significant risk to receptors and indicates reasonably that cumulative 24-hour impacts are unlikely to arise.

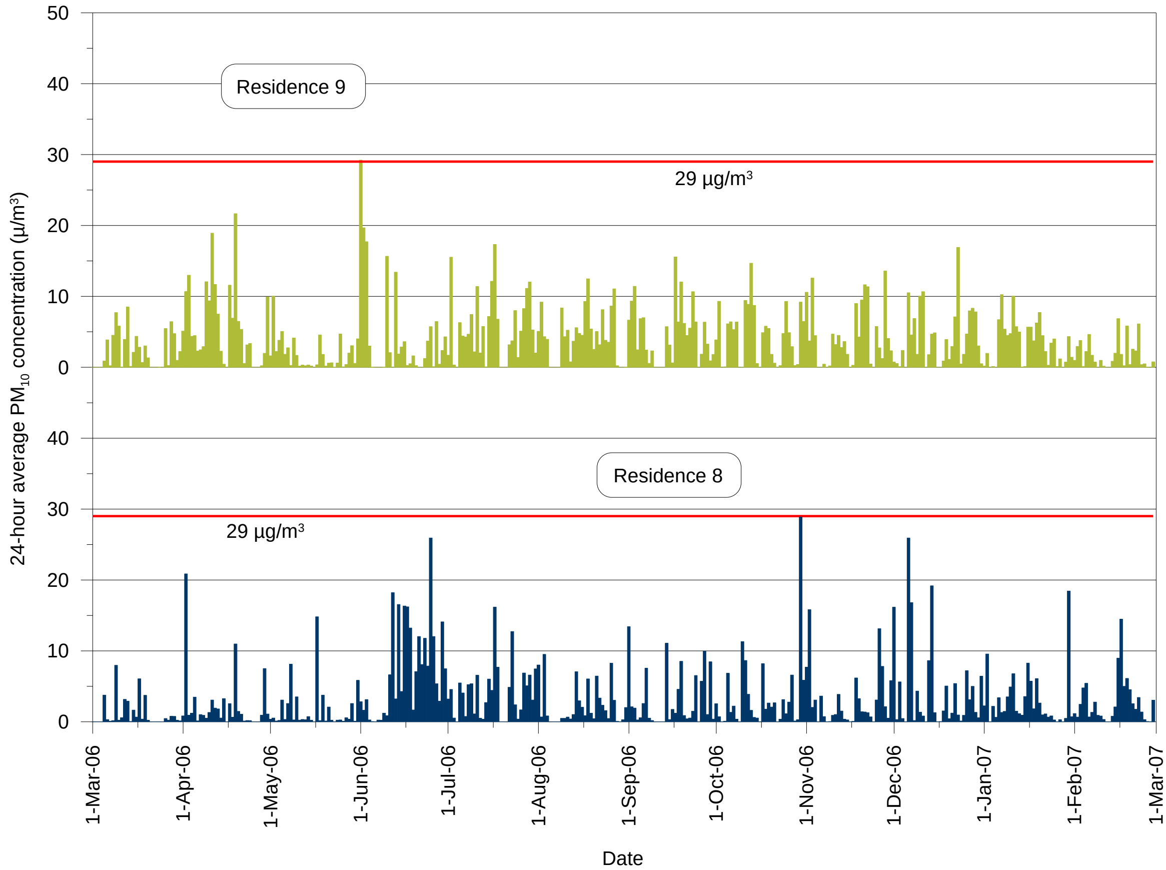


Figure 7.14: Time series of 24-hour PM_{10} model predictions at Residences 8 and 9

8 MITIGATION MEASURES

8.1 Introduction

The proposed mining activities have the potential to generate dust. It is therefore necessary to take reasonable and practicable measures to prevent or minimise dust impacts at sensitive receptors such as residential properties. This section outlines the procedures proposed for the management and control of dust emissions for the project extension. This section can be viewed as supplement to the current mitigation controls at the Rocglen Mine, as outlined in the mine's Annual Environmental Management Report (AEMR) (**Whitehaven Coal Mining Pty Ltd, 2009**).

8.2 Proposed dust management and control procedures

The following procedures are proposed to minimise dust emissions from the project. Dust is generated from two primary sources, these being:

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

Table 8.1 and **Table 8.2** list the different sources of wind-blown and mining-generated dust respectively, and the proposed controls.

Table 8.1: Control procedures for wind-blown dust

Source	Control Procedures
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.
Coal handling areas / stockpiles	Maintain coal handling areas / stockpiles in a moist condition to minimise wind-blown and traffic-generated dust.
ROM Coal Stockpiles	Have available water sprays on ROM coal stockpiles and use sprays to reduce airborne dust, as required.

Table 8.2: Mine-generated Dust and Controls

Source	Control procedures
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.
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.
Topsoil Stripping	Access tracks used by topsoil stripping equipment during their loading and unloading cycle will be watered.
Topsoil Stockpiling	Long term topsoil stockpiles, not used for over 3 months will be re-vegetated.
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.
Blasting	Adequate stemming will be used at all times. Restriction of blasting during unfavorable weather conditions will occur, where practicable.

8.3 Monitoring

In addition to having dust control and management procedures in place, WCL will continue to monitor the levels of dust at nearby residential locations surrounding the mine, as well as meteorological monitoring. As discussed in **Section 4.3**, this monitoring network consists of eight dust deposition gauges and two high volume air samplers. This enables WCL to ensure that measured dust levels remain below their relevant air quality criteria.

Whitehaven Coal Limited has also made a commitment to install and operate a real-time PM_{10} monitor at a location to be determined. The preferred location for this monitor would be at the 'Roseberry' residence, co-located with the existing HVAS. This would enable comparisons between both monitors and also provide real-time information for the majority of privately owned residences which are to the south of the mine. The site is also along the axis of prevailing wind directions in the area. The real-time monitor should also be fitted with a weather station to enable better contemporaneous analysis of the PM_{10} data collected from the site.

The current HVAS at the 'Glenroc' site will also need to be relocated to make way for the northern dump. It is recommended that this HVAS be moved to 'Costa Vale' (Residence 2), also along the axis of prevailing wind directions. The current weather station at 'Glenroc' will also be moved, and should be co-located with the HVAS to 'Costa Vale'. Meteorlogical data collected at 'Roseberry', in conjunction with that measured at 'Costa Vale' will be very helpful in determining the likely sources of airbourne dust on worst-case days, and enable much more effective management of mining activities.

9 GREENHOUSE GAS ASSESSMENT

9.1 Greenhouse gas science

The temperature of the earth's atmosphere is determined almost entirely[i] 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.

[i] 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.

9.2 Greenhouse gas assessment Policy Summary

9.2.1 Intergovernmental Panel on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) is a panel established in 1988 by the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP), to provide independent scientific advice on climate change. The panel was asked to prepare, based on available scientific information, a report on all aspects relevant to climate change and its impacts and to formulate realistic response strategies. This first assessment report of the IPCC served as the basis for negotiating the United Nations Framework Convention on Climate Change (UNFCCC).

Since the UNFCCC has entered into force, the IPCC remains the pivotal source for its scientific, technical and socio-economic information.

The stated aims of the IPCC are to assess scientific information relevant to:

- Human-induced climate change;
- The impacts of human-induced climate change; and
- Options for adaptation and mitigation.

The fourth IPCC assessment report was released in 2007 (**IPCC, 2007**). IPCC reports are widely cited in climate change debates and policies, and are generally regarded as authoritative.

9.2.2 United Nations Framework Convention on Climate Change (UNFCCC)

The Convention on Climate Change sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognises that the climate system is a shared resource, the stability of which can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The Convention enjoys near universal membership, with 183 countries (Parties) having ratified the contained treaty, the Kyoto Protocol (refer **Section 9.2.3**), including Australia, who ratified the Kyoto Protocol in December 2007.

Under the UNFCCC, governments:

- Gather and share information on greenhouse gas emissions, national policies and best practices;
- Launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries; and
- Cooperate in preparing for adaptation to the impacts of climate change.

9.2.3 Kyoto Protocol

The Kyoto Protocol entered into force on 16 February 2005. The Kyoto Protocol builds upon the UNFCCC by committing Annex I Parties to individual, legally-binding targets to limit or reduce their GHG emissions for the following gases:

- Carbon dioxide (CO_2);
- Methane (CH_4);

- Nitrous oxide (N_2O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Sulphur hexafluoride (SF_6).

The emission reduction targets are calculated based on a Party's domestic emission greenhouse inventories (which include the sectors land use change and forestry clearing, transportation, stationary energy, etc). Domestic inventories require approval by the Kyoto Enforcement Branch. The Kyoto Protocol requires developed countries to meet national targets for greenhouse gas emissions over a five year period between 2008 and 2012.

To achieve their targets, Annex I Parties must put in place *domestic policies and measures.* The Kyoto Protocol provides an indicative list of policies and measures that might help mitigate climate change and promote sustainable development.

Under the Kyoto Protocol, developed countries can use a number of flexible mechanisms to assist in meeting their targets. These are trading-based market mechanisms which include:

- Joint Implementation (JI) – where developed countries invest in GHG emission reduction projects in other developed countries; and
- Clean Development Mechanism (CDM) – where developed countries invest in GHG emission reduction projects in developing countries.

Annex I countries that fail to meet their emissions reduction targets during the 2008-2012 period may be liable for a 30 percent penalty, to be made up in the post 2012 commitment period.

9.2.4 Australia and the Kyoto Protocol

The Kyoto Protocol is an international agreement under the United Nations Framework Convention on Climate Change (UNFCCC) that was agreed in 1997. As of January 2009 it has been ratified by 183 countries. Australia ratified the protocol in December 2007. The aim of the Protocol is to reduce global greenhouse gas emissions by requiring developed countries to meet national targets for greenhouse gas emissions over the five year period from 2008 to 2012. Australia's annual target is 108% of the 1990 emissions. Countries are required to take on a range of monitoring and reporting commitments, which are designed to ensure they remain on track to meet their obligations and to measure the overall success of the Protocol.

9.2.5 National Greenhouse and Energy Reporting Act

The *National Greenhouse and Energy Reporting (NGER) Act 2007* was passed in September 2007. The NGER Act establishes a mandatory corporate reporting system for greenhouse gas emissions, energy consumption and production. The NGER scheme consolidates existing greenhouse reporting schemes. The NGER Act is underpinned by a number of legislative instruments that provide greater detail about obligations, which in conjunction with the NGER Act, form the National Greenhouse and Energy Reporting System, as follows:

- The National Greenhouse and Energy Reporting Regulations 2008; and
- The National Greenhouse and Energy Reporting (Measurement) Determination 2008.

NGER is seen as an important first step in the establishment of a domestic emissions trading scheme. Companies must register and report if they emit greenhouse emissions or produce/consume energy at or above the following trigger thresholds:

- If they own facilities that emit greater than 25 kt greenhouse emissions (expressed as CO_2-e) or produce consume greater than 100 TJ of energy; and/or
- If the corporate group emits greater than 125 kt of greenhouse emissions (expressed as CO_2-e) or produce consume greater than 500 TJ of energy.

9.2.6 Carbon Pollution Reduction Scheme

A green paper detailing Australia's plans to implement a domestic emissions trading scheme was released on the 16 July 2008. A subsequent white paper was released in December 2008 (**DCC, 2008b**) with the intent that a Carbon Pollution Reduction Scheme (CPRS) would commence in July 2010. Due to the global financial crisis, the proposed start date was deferred to July 2011. The proposed CPRS is a 'cap and trade' emissions trading mechanism scheme whereby emitters of greenhouse gases greater than 25,000 t carbon dioxide-equivalent (CO_2-e) (Scope 1 only) are required to purchase a permit for every tonne of greenhouse gas that they emit. Legislation was introduced to Parliament in May 2009, and again in November 2009 but was voted down in the senate. The government has now decided to defer implementation of the CPRS until 2013 due to parliamentary opposition.

9.3 Greenhouse Gas Emission Calculation

The Rocglen mine is anticipated to operate for approximately 10 years, with an average of 1.5 Mt of ROM to be removed each year.

Emissions of CO_2 and CH_4 will be the most significant greenhouse gases for the project. These gases are formed and released during the combustion of fuels used on site and from fugitive emissions occurring during the mining process, due to the fracturing of coal seams.

Inventories of greenhouse gas emissions can be calculated using published emission factors. Different gases have different greenhouse warming effects (referred to as global warming potentials) and emission factors take into account the global warming potentials of the gases created during combustion. The estimated emissions are referred to in terms of carbon dioxide equivalent or CO_2-equivalent (CO_2-e) emissions by applying the relevant global warming potential.

The greenhouse gas assessment has been conducted using the National Greenhouse Accounts (NGA) Factors, published by the Department of Climate Change (**DCC, 2009a**). DCC defines three 'scopes' (or emission categories):

- Scope 1 emissions cover direct emissions from sources within the project boundary such as fuel combustion and fugitive methane;
- Scope 2 emissions cover indirect emissions from the consumption of purchased electricity, steam or heat produced by another organisation; and
- Scope 3 emissions includes all other indirect emissions that are a consequence of the organisations activities but are not from sources owned or controlled by the organisations, for example, production of diesel fuel, off-site transport of the product, etc.

Project-related greenhouse gas sources included in the assessment are as follows:

- Fuel consumption (diesel) during mining operations -Scope 1;
- Release of fugitive methane during mining – Scope 1;
- Indirect emissions associated with the production and transport of fuels – Scope 3;
- Emissions from coal transportation – Scope 3; and
- Emissions from the burning of the product coal – Scope 3.

9.3.1 On-site Fuel Consumption

Greenhouse gas emissions from diesel consumption were estimated using the following equation:

$$E_{CO_2-e} = \frac{Q \times EF}{1000}$$

where:

E_{CO2-e}	=	Emissions of GHG from diesel combustion	(t CO_2-e)
Q	=	Estimated combustion of diesel	(GJ)
EF	=	Emission factor (Scope 1 or Scope 3)for diesel combustion	(kg CO_2-e/GJ)

The quantity of diesel consumed in kL for each year has been estimated based on the projected waste rock removed each year and a diesel intensity factor (kL/bcm) derived based on data reported in the 2009 Annual Environmental Management Report (AEMR) (**Whitehaven Coal Mining Pty Ltd, 2009**). The quantity of diesel consumed in GJ is then converted using an energy content factor for diesel of 38.6 GJ/kL.

Greenhouse gas emission factors and energy content for diesel were sourced from Table 3 and Table 38 of the NGA Factors (**DCC, 2009a**).

The estimated annual GHG emissions from diesel usage are presented in **Table 9.1**.

Table 9.1: Estimated annual CO_2-e (tonnes) for On-site Diesel Consumption

Project year	Waste (Mbcm)	Diesel Intensity Factor (kL/Mbcm)	Projected Consumption (kL/annum)	Energy Content (GJ/kL)	Emission Factor (kg CO_2-e/GJ		Total Emissions (t CO_2-e)		
					Scope 1	Scope 3	Scope 1	Scope 3	Total
Year 1	5.77	810	4,674	38.6	69.5	5.3	12,540	956	13,496
Year 2	4.17	810	3,378	39.6	69.5	5.3	9,297	709	10,006
Year 3	7.53	810	6,100	40.6	69.5	5.3	17,213	1,313	18,525
Year 4	6.74	810	5,460	41.6	69.5	5.3	15,786	1,204	16,990
Year 5	7.26	810	5,881	42.6	69.5	5.3	17,413	1,328	18,741
Year 6	7.20	810	5,833	43.6	69.5	5.3	17,674	1,348	19,022
Year 7	7.62	810	6,173	44.6	69.5	5.3	19,134	1,459	20,594
Year 8	8.36	810	6,772	45.6	69.5	5.3	21,463	1,637	23,100
Year 9	9.98	810	8,085	46.6	69.5	5.3	26,184	1,997	28,181
Year 10	10.87	810	8,806	47.6	69.5	5.3	29,131	2,222	31,353
Final	3.68	810	2,981	48.6	69.5	5.3	10,070	768	10,837
Total							**195,907**	**14,940**	**210,846**

9.3.2 Electricity

Greenhouse gas emissions from electricity usage were not applicable to this site as it generates its own electricity using diesel. Greenhouse emissions from diesel used to generate electricity for the Rocglen site have been included in **Section 9.3.1**.

9.3.3 Fugitive Methane

Emissions from fugitive methane were estimated based on the using the following equation:

$$E_{co2-e} = Q \times EF$$

where:

$E_{CO2\text{-}e}$	=	Emissions of greenhouse gases from fugitive methane	(t CO_2-e/annum)
Q	=	ROM coal extracted during the year	(tonnes)
EF	=	Scope 1 emission factor	(t CO_2-e/tonne)

Emission factors for fugitive methane (0.045 tonne CO_2-e /tonne ROM) were sourced from Table 8 of the NGA factors (**DCC, 2009a**). The emission factor used relates to open cut coal mines in NSW.

The estimated annual GHG emissions from fugitive methane are presented in **Table 9.2**.

Table 9.2: Estimated annual CO_2-e (tonnes) for Fugitive Methane

ROM (Mtpa)	Emission Factor (t CO_2-e / tonne ROM)	Scope 1 Emissions (t CO_2-e)
1.5	0.045	**67,500**

9.3.4 Explosives

Emissions from explosive usage were estimated based on the using the following equation:

$$E_{co2-e} = Q \times EF$$

where:

$E_{CO2\text{-}e}$	=	Emissions of greenhouse gases from explosives	(tCO_2-e/annum)
Q	=	Quantity of explosive used	(tonnes)
EF	=	Scope 1 emission factor	(t CO_2-e/tonne explosive)

Greenhouse gas emission factors were sourced from the product data sheets for each type of explosive (**Orica 2010**). Previously, the Australian Greenhouse Office (AGO) Factors and Methods Workbook – December 2006 included greenhouse gas emissions factors for explosives, it is noted that the AGO Factors and Methods were replaced by the NGA Factors (**DCC, 2009a**), however the emission factor for explosives was dropped from the latest version. Emissions from explosives do not have to be reported under NGERs. The estimated annual and project total GHG emissions from explosive usage are presented in **Table 9.3**.

Table 9.3: Estimated annual CO_2-e (tonnes) for Explosive Use

Explosive Type	Tonnes explosive used (2008-2009)	Emission Factors (kg CO_2 / tonne product)	Scope 1 Emissions (t CO_2-e)
ANFO	1,010	182	184
Fortan Coal	1,605	178	286
Fortis Coal	72	140	10
		Total	**480**

9.3.5 Other Scope 3 Emissions

9.3.5.1 Transportation

Product coal will be transported by truck to the Whitehaven CHPP (approximately 6 km west of Gunnedah) and will then be transported by rail to the Port of Newcastle. The return trip by truck is assumed to be 90 km. According to the Australian Bureau of Statistics (**ABS, 2008**), articulated trucks with diesel engines use an average of 0.546 L/km travelled.

Emissions from coal transportation have been estimated based on 1.1 Mtpa being transported to Newcastle for export (assuming 0.7 t product coal per t ROM based on data reported in the 2009 AEMR). Emissions associated with product coal transportation have been estimated based on an emission factor for loaded trains of 12.3 g/net tonne-km (**QR Network Access, 2002**). Emission factors were not available for unloaded trains so the factor for loaded trains is conservatively applied for the return trip. The return rail trip to the Port of Newcastle is assumed to be 710 km.

The total estimated GHG emissions from road and rail transport are provided in **Table 9.4**.

Table 9.4: Estimated CO_2-e (tonnes) for Road and Rail Transportation

Transport by Rail					
Product Coal Mtpa	km (return)		g/ net tonne-km		Scope 3 Emissions (t CO_2-e)
1.1	710		12.3		9,606
Transport by Road					
Product Coal Mtpa	Tonne product per truck	Number of trucks	Distance travelled (km return)	Fuel usage (L/km)	Scope 3 Emissions (t CO_2-e)
1.1	40	30,000	90	0.546	3,460
Total for transportation of product coal					
					Scope 3 Emissions (t CO_2-e)
					13,067

Emissions from the shipping of product coal are not included in this assessment due to the difficulties in emission estimates, including uncertainty in export markets and limited data on emission factors and / or fuel consumption for ocean going vessels.

9.3.5.2 Burning Product Coal

Greenhouse gas emissions from the burning of product coal were estimated using the following equation:

$$E_{CO_2-e} = \frac{Q \times EC \times EF}{1000}$$

Where:

$E_{CO2\text{-}e}$	=	Emissions of GHG from coal combustion	(t CO_2-e)
Q	=	Quantity of product coal burnt	(GJ)
EC	=	Energy Content Factor for black coal	(GJ/t)
EF	=	Emission factor for coal combustion	(kg CO_2-e/GJ)

The quantity of coal burnt in Mtpa is converted to GJ using an energy content factor for black coal of 27 GJ/t. The greenhouse gas emission factor and energy content for coal were sourced from Table 1 of the NGA Factors (**DCC, 2009a**).

The emissions associated with burning of the product coal are presented in **Table 9.5**.

Table 9.5: Scope 3 Emissions for Product Coal

Product Coal Mtpa	GJ/t	EF kg CO2 e/GJ	Scope 3 Emissions (t CO_2-e)
1.1	27	88	**2,506,991**

9.4 Summary of GHG Emissions

A summary of the total GHG emissions associated with the project is presented in **Table 9.6**.

Table 9.6: Summary of GHG Emissions (t CO_2-e)

Emission Source	Scope 1	Scope 3	Total
	Average t CO_2-e/annum		
Diesel	17,810	1,358	19,168
Explosives	480		480
Fugitive Methane	67,500		67,500
Coal Transportation		13,067	13,067
Coal Burning		2,506,991	2,506,991
Total – Annual	**85,789**	**2,521,415**	**2,607,205**
Total – 2010 - 2020	**875,703**	**25,215,512**	**26,091,215**

A comparison is made with the baseline 1990 Australian emissions, which are reported under the Kyoto Protocol as 547.7 Mt CO_2-e (**DCC, 2008b**). The baseline is used to assign the Australian target under the Kyoto Protocol, which is 108% of the 1990 level. Comparing the average annual Scope 1 emissions from Rocglen, against the 1990 baseline, results in a 0.02% increase from 1990 levels.

The annual greenhouse emissions for NSW in 2007 were 151.6 Mt (**DCC, 2009c**). Average annual Scope 1 emissions from Rocglen represent an approximate increase of 0.06%.

10 CONCLUSIONS

This report has assessed the potential impacts on air quality from the proposed expansion of operations at the Rocglen Coal Mine. Dispersion modelling has been used to predict off-site dust concentration and dust deposition levels due to the dust generating activities that would occur as part of the project. The modelling took account of the local meteorology and terrain and used dust emission estimates to predict the air quality impacts for three mining scenarios. These scenarios were determined to be most representative of worst case emissions based on the amount of overburden removed, length of haul roads and distance of operations from the nearest residences.

Predictions of air quality impacts considered the effects of other non-mining and non-modelled sources of dust. Model predictions at privately-owned residential receptors were compared with the relevant air quality criteria for both the NSW DECCW and the NSW DoP. Predictions equal to or below the criteria were considered to represent an acceptable air quality impact.

Analysis of the dispersion modelling results indicates that the proposed extension alone would comply with assessment criteria at all but one of the nearby residential properties. The Whitehaven owned 'Yarrawonga' property is predicted to exceed the DECCW 24-hour PM_{10} criterion and also the DoP acquisition criterion.

Cumulative 24-hour PM_{10} impacts were also assessed, with an excedance of the DECCW assessment criteria predicted at two privately owned residences. It should be stressed that this was a very conservative cumulative assessment, given the lack of historical and real-time PM_{10} monitoring to enable a realistic determination of the 24-hour background concentration. Even with this approach only one exceedance in one year of operation was predicted, achieving compliance with DoP acquisition criteria.

Whitehaven Coal Limited will continue to manage potential impacts associated with the project through a range of dust controls and continued monitoring of air quality in the area surrounding the mine. The company will also comit to installing a real-time PM_{10} monitor in order to continually observe levels, and enable better management of operational activities during periods of adverse weather conditions.

A greenhouse gas assessment was also carried out and it was found that there are not likely to be any measurable environmental effects due to the emissions of greenhouse gases from the Rocglen project.

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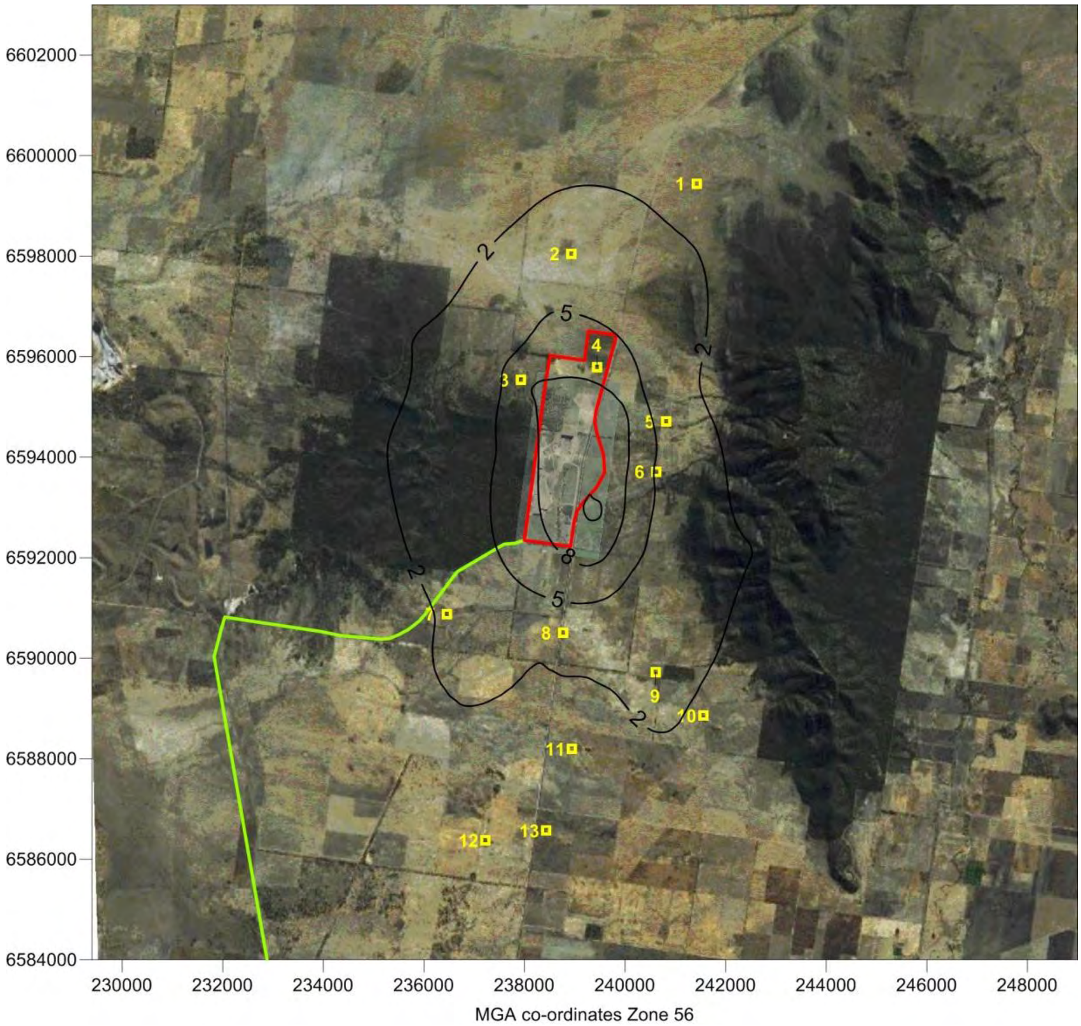
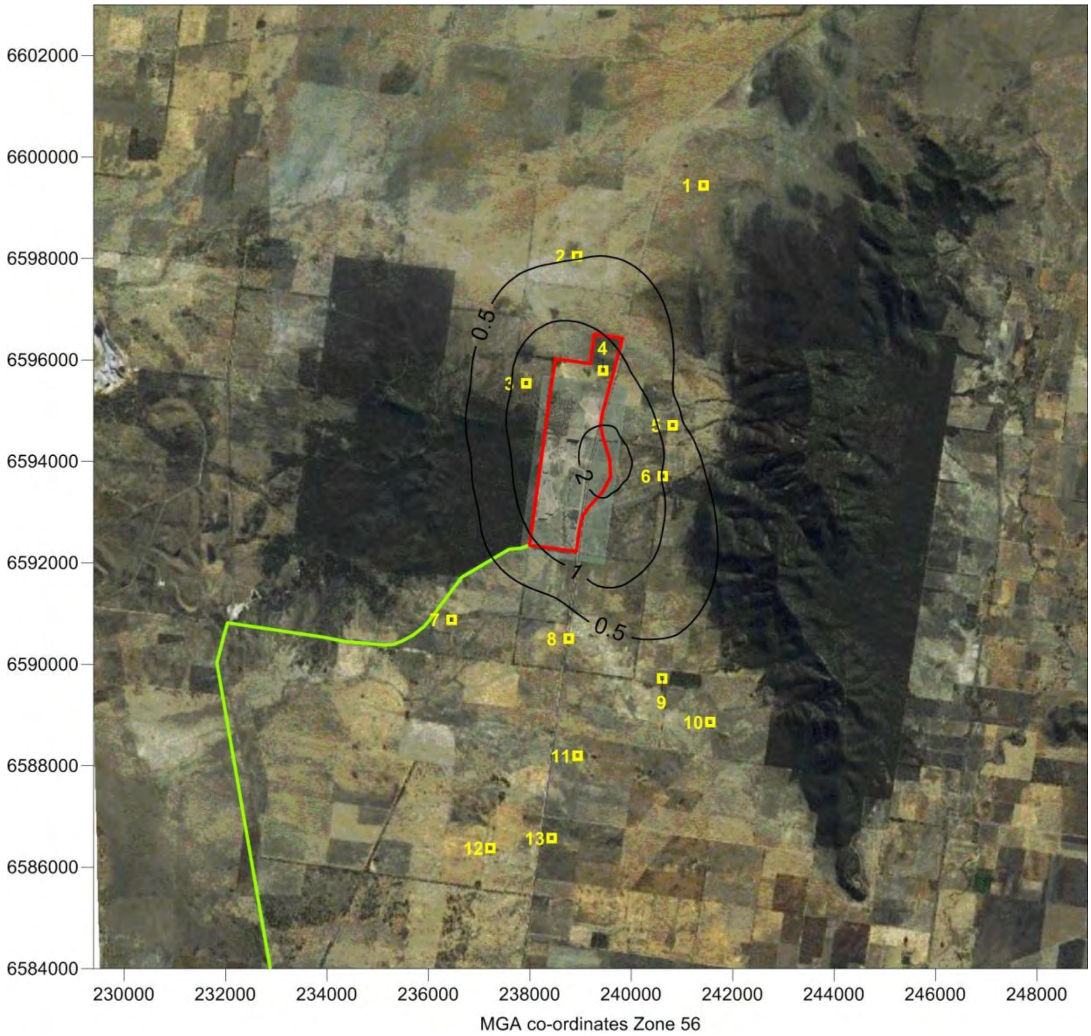
Appendix A: Contour plots of predicted $PM_{2.5}$ impacts due to the Rocglen Mine Project



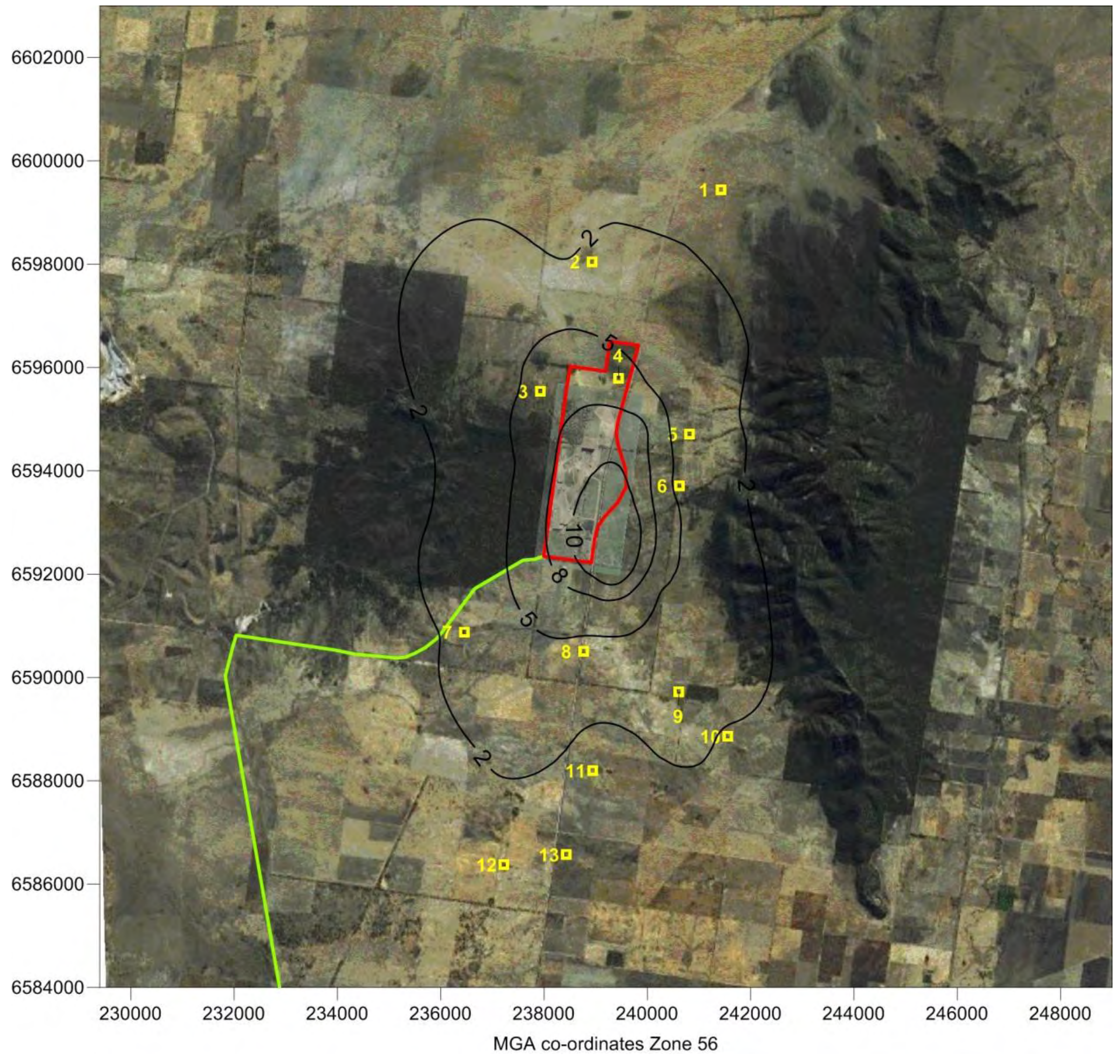
Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
$PM_{2.5}$	Rocglen	Year 1	Maximum	24-hour
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
ISCMOD	µg/m³	NEPC = 25 µg/m³	2006/2007	J. Barnett

Figure A.1: Predicted 24-hour average $PM_{2.5}$ concentrations - Rocglen operations Year 1



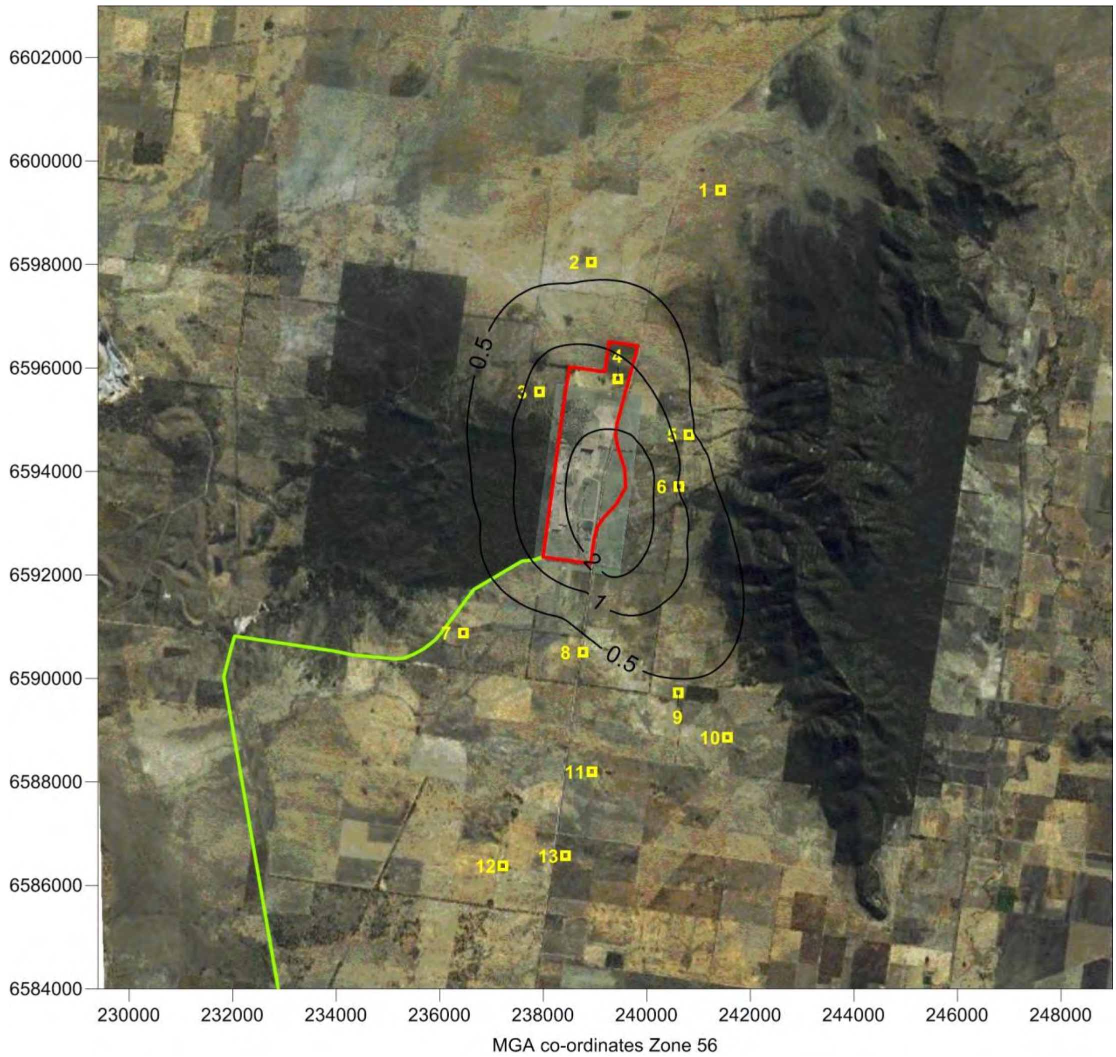
Species: PM2.5	Location: Rocglen	Scenario: Year 1	Percentile: N/A	Averaging Time: Annual
Model Used: ISCMOD	**Units:** µg/m³	**Guideline:** NEPC = 8 µg/m³	**Met Data:** 2006/2007	**Plot:** J. Barnett

Figure A.2: Predicted annual average $PM_{2.5}$ concentrations - Rocglen operations Year 1



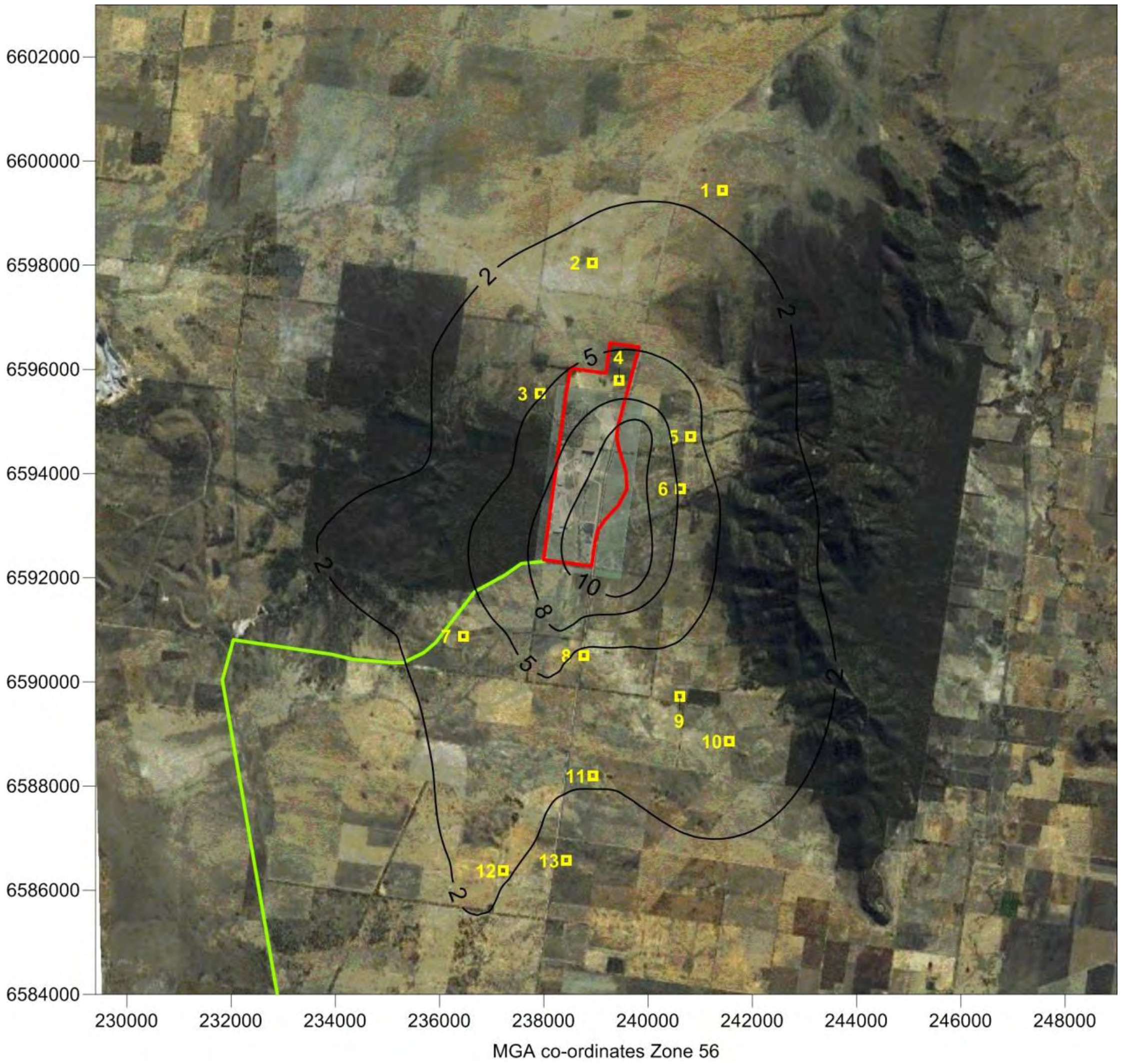
Species:	Location:	Scenario:	Percentile:	Averaging Time:
$PM_{2.5}$	Rocglen	Year 5	Maximum	24-hour
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
ISCMOD	µg/m³	NEPC = 25 µg/m³	2006/2007	J. Barnett

Figure A.3: Predicted 24-hour average $PM_{2.5}$ concentrations - Rocglen operations Year 5



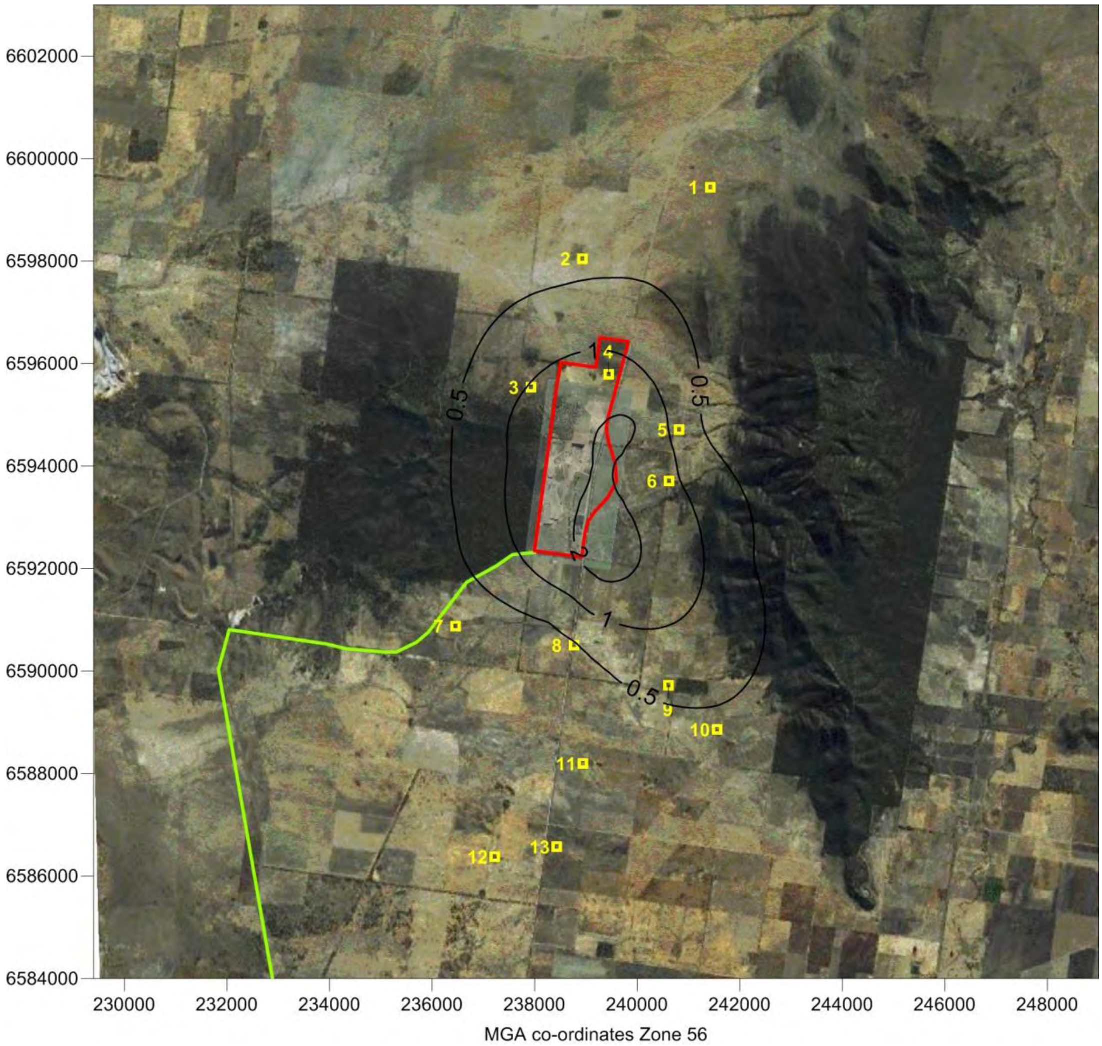
Species: PM$_{2.5}$	Location: Rocglen	Scenario: Year 5	Percentile: N/A	Averaging Time: Annual
Model Used: ISCMOD	**Units:** µg/m³	**Guideline:** NEPC = 8 µg/m³	**Met Data:** 2006/2007	**Plot:** J. Barnett

Figure A.4: Predicted 24-hour average PM$_{2.5}$ concentrations - Rocglen operations Year 5



Species: PM2.5	Location: Rocglen	Scenario: Year 10	Percentile: Maximum	Averaging Time: 24-hour
Model Used: ISCMOD	**Units:** µg/m³	**Guideline:** NEPC = 25 µg/m³	**Met Data:** 2006/2007	**Plot:** J. Barnett

Figure A.5: Predicted 24-hour average $PM_{2.5}$ concentrations - Rocglen operations Year 10



Species:	Location:	Scenario:	Percentile:	Averaging Time:
$PM_{2.5}$	Rocglen	Year 10	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
ISCMOD	µg/m³	NEPC = 8 µg/m³	2006/2007	J. Barnett

Figure A.6: Predicted 24-hour average $PM_{2.5}$ concentrations - Rocglen operations Year 10

Appendix B: Joint wind speed, wind direction and stability class frequency tables for Glenroc – 2006/2007

STATISTICS FOR FILE: C:\Jobs\3769 Rocglen Coal Mine\Metdata\groc0607.aus
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	0.002854	0.002397	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005251
NE	0.002511	0.002968	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005479
ENE	0.003196	0.003311	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.006507
E	0.003767	0.004224	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.007991
ESE	0.003881	0.007534	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.011416
SE	0.005137	0.010731	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.015868
SSE	0.006393	0.018265	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.024658
S	0.003425	0.009475	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.012900
SSW	0.003196	0.008790	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.011986
SW	0.002055	0.006279	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.008333
WSW	0.001941	0.006963	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.008904
W	0.001941	0.009475	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.011416
WNW	0.003995	0.011986	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.015982
NW	0.002740	0.010959	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.013699
NNW	0.002397	0.008904	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.011301
N	0.003539	0.005365	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.008904
CALM									0.040868
TOTAL	0.052968	0.127626	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.221461

MEAN WIND SPEED (m/s) = 1.65
NUMBER OF OBSERVATIONS = 1940

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	0.000457	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.000685
NE	0.000000	0.000228	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.000457
ENE	0.000342	0.000228	0.001484	0.000000	0.000000	0.000000	0.000000	0.000000	0.002055
E	0.000342	0.000913	0.000457	0.000000	0.000000	0.000000	0.000000	0.000000	0.001712
ESE	0.000228	0.000457	0.001370	0.000000	0.000000	0.000000	0.000000	0.000000	0.002055
SE	0.001370	0.003653	0.004909	0.000000	0.000000	0.000000	0.000000	0.000000	0.009932
SSE	0.001598	0.006164	0.005479	0.000000	0.000000	0.000000	0.000000	0.000000	0.013242
S	0.000685	0.002511	0.002854	0.000000	0.000000	0.000000	0.000000	0.000000	0.006050
SSW	0.000228	0.001712	0.001484	0.000000	0.000000	0.000000	0.000000	0.000000	0.003425
SW	0.000114	0.000913	0.000457	0.000000	0.000000	0.000000	0.000000	0.000000	0.001484
WSW	0.000228	0.001598	0.001256	0.000000	0.000000	0.000000	0.000000	0.000000	0.003082
W	0.000913	0.001598	0.001027	0.000000	0.000000	0.000000	0.000000	0.000000	0.003539
WNW	0.000571	0.003082	0.004566	0.000000	0.000000	0.000000	0.000000	0.000000	0.008219
NW	0.000685	0.003539	0.005251	0.000000	0.000000	0.000000	0.000000	0.000000	0.009475
NNW	0.000342	0.001712	0.001941	0.000000	0.000000	0.000000	0.000000	0.000000	0.003995
N	0.000457	0.001256	0.001142	0.000000	0.000000	0.000000	0.000000	0.000000	0.002854
CALM									0.004680
TOTAL	0.008105	0.030023	0.034132	0.000000	0.000000	0.000000	0.000000	0.000000	0.076941

MEAN WIND SPEED (m/s) = 2.63
NUMBER OF OBSERVATIONS = 674

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	0.000228	0.000342	0.000913	0.000228	0.000000	0.000000	0.000000	0.000000	0.001712
NE	0.000000	0.000685	0.000571	0.000114	0.000000	0.000000	0.000000	0.000000	0.001370
ENE	0.000000	0.000228	0.000342	0.000000	0.000000	0.000000	0.000000	0.000000	0.000571
E	0.000114	0.000342	0.001256	0.000457	0.000000	0.000000	0.000000	0.000000	0.002169
ESE	0.000228	0.000342	0.002283	0.001826	0.000000	0.000000	0.000000	0.000000	0.004680
SE	0.000342	0.002055	0.005594	0.004680	0.000000	0.000000	0.000000	0.000000	0.012671
SSE	0.001027	0.004566	0.005936	0.002397	0.000000	0.000000	0.000000	0.000000	0.013927
S	0.000457	0.001826	0.001712	0.000342	0.000000	0.000000	0.000000	0.000000	0.004338
SSW	0.000228	0.001256	0.000228	0.000571	0.000000	0.000000	0.000000	0.000000	0.002283
SW	0.000228	0.000342	0.001142	0.000228	0.000000	0.000000	0.000000	0.000000	0.001941
WSW	0.000228	0.000342	0.001027	0.000228	0.000000	0.000000	0.000000	0.000000	0.001826
W	0.000799	0.000571	0.000799	0.000342	0.000000	0.000000	0.000000	0.000000	0.002511
WNW	0.000571	0.000114	0.001826	0.002055	0.000000	0.000000	0.000000	0.000000	0.004566
NW	0.000913	0.000685	0.004110	0.003311	0.000000	0.000000	0.000000	0.000000	0.009018
NNW	0.000571	0.001256	0.002169	0.000571	0.000000	0.000000	0.000000	0.000000	0.004566
N	0.000342	0.000685	0.001027	0.000228	0.000000	0.000000	0.000000	0.000000	0.002283
CALM									0.004452
TOTAL	0.006279	0.015639	0.030936	0.017580	0.000000	0.000000	0.000000	0.000000	0.074886

MEAN WIND SPEED (m/s) = 3.43
NUMBER OF OBSERVATIONS = 656

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	0.001256	0.002397	0.003881	0.001370	0.000000	0.000000	0.000228	0.000000	0.009132
NE	0.000799	0.003311	0.003653	0.000799	0.000685	0.000457	0.000000	0.000000	0.009703
ENE	0.003425	0.002626	0.002055	0.001370	0.000685	0.000114	0.000342	0.000114	0.010731
E	0.004452	0.002511	0.001826	0.001027	0.000799	0.000457	0.000114	0.000114	0.011301
ESE	0.000571	0.002169	0.001712	0.003196	0.003767	0.000913	0.000000	0.000114	0.012443
SE	0.001941	0.003767	0.009703	0.009475	0.003881	0.000685	0.000000	0.000000	0.029452
SSE	0.002854	0.008447	0.013927	0.008904	0.002169	0.000228	0.000000	0.000000	0.036530
S	0.001256	0.008219	0.010160	0.001142	0.000114	0.000000	0.000000	0.000000	0.020890
SSW	0.000685	0.008219	0.004452	0.000457	0.000000	0.000000	0.000000	0.000000	0.013813
SW	0.000913	0.002055	0.001712	0.000114	0.000000	0.000000	0.000000	0.000000	0.004795
WSW	0.000571	0.000685	0.000228	0.000685	0.000000	0.000000	0.000000	0.000000	0.002169
W	0.001712	0.000342	0.000685	0.000342	0.000228	0.000000	0.000000	0.000000	0.003311
WNW	0.003082	0.001941	0.000457	0.000114	0.000342	0.000000	0.000000	0.000000	0.005936
NW	0.004795	0.014041	0.002626	0.000228	0.001027	0.000000	0.000000	0.000000	0.022717
NNW	0.003539	0.015183	0.006393	0.001142	0.001142	0.000457	0.000000	0.000000	0.027854
N	0.001941	0.003767	0.005023	0.001484	0.000000	0.000114	0.000000	0.000000	0.012329
CALM									0.026256
TOTAL	0.033790	0.079680	0.068493	0.031849	0.014840	0.003425	0.000685	0.000342	0.259361

MEAN WIND SPEED (m/s) = 3.07
NUMBER OF OBSERVATIONS = 2272

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	0.001256	0.002169	0.000685	0.000000	0.000000	0.000000	0.000000	0.000000	0.004110
NE	0.000799	0.001941	0.001027	0.000000	0.000000	0.000000	0.000000	0.000000	0.003767
ENE	0.005023	0.003082	0.000685	0.000000	0.000000	0.000000	0.000000	0.000000	0.008790
E	0.004795	0.003082	0.000571	0.000114	0.000000	0.000000	0.000000	0.000000	0.008562
ESE	0.001142	0.001484	0.000685	0.000000	0.000000	0.000000	0.000000	0.000000	0.003311
SE	0.000913	0.001256	0.001484	0.000114	0.000000	0.000000	0.000000	0.000000	0.003767
SSE	0.001826	0.002968	0.000685	0.000000	0.000000	0.000000	0.000000	0.000000	0.005479
S	0.002169	0.004452	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.006735
SSW	0.001598	0.005023	0.000571	0.000000	0.000000	0.000000	0.000000	0.000000	0.007192
SW	0.000799	0.002169	0.000685	0.000000	0.000000	0.000000	0.000000	0.000000	0.003653
WSW	0.001142	0.001256	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002397
W	0.002397	0.000913	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003311
WNW	0.002968	0.001598	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.004795
NW	0.004909	0.014726	0.000342	0.000000	0.000000	0.000000	0.000000	0.000000	0.019977
NNW	0.003082	0.009589	0.000913	0.000000	0.000000	0.000000	0.000000	0.000000	0.013584
N	0.001712	0.003082	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.005023
CALM									0.023174
TOTAL	0.036530	0.058790	0.008904	0.000228	0.000000	0.000000	0.000000	0.000000	0.127626

MEAN WIND SPEED (m/s) = 1.68
NUMBER OF OBSERVATIONS = 1118

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	0.003539	0.002626	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.006164
NE	0.002511	0.002511	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005023
ENE	0.003311	0.001712	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005023
E	0.002169	0.001826	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003995
ESE	0.003767	0.001598	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005365
SE	0.003653	0.003196	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.006849
SSE	0.005479	0.004680	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.010160
S	0.008105	0.008333	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.016438
SSW	0.010046	0.009247	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.019292
SW	0.008219	0.007991	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.016210
WSW	0.006050	0.003995	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.010046
W	0.007078	0.003311	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.010388
WNW	0.007877	0.005936	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.013813
NW	0.010731	0.011301	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.022032
NNW	0.007306	0.004452	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.011758
N	0.005251	0.003653	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.008904
CALM									0.068265
TOTAL	0.095091	0.076370	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.239726

MEAN WIND SPEED (m/s) = 1.22
NUMBER OF OBSERVATIONS = 2100

ALL PASQUILL STABILITY CLASSES
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	0.009132	0.010388	0.005708	0.001598	0.000000	0.000000	0.000228	0.000000	0.027055
NE	0.006621	0.011644	0.005479	0.000913	0.000685	0.000457	0.000000	0.000000	0.025799
ENE	0.015297	0.011187	0.004566	0.001370	0.000685	0.000114	0.000342	0.000114	0.033676
E	0.015639	0.012900	0.004110	0.001598	0.000799	0.000457	0.000114	0.000114	0.035731
ESE	0.009817	0.013584	0.006050	0.005023	0.003767	0.000913	0.000000	0.000114	0.039269
SE	0.013356	0.024658	0.021689	0.014269	0.003881	0.000685	0.000000	0.000000	0.078539
SSE	0.019178	0.045091	0.026027	0.011301	0.002169	0.000228	0.000000	0.000000	0.103995
S	0.016096	0.034817	0.014840	0.001484	0.000114	0.000000	0.000000	0.000000	0.067352
SSW	0.015982	0.034247	0.006735	0.001027	0.000000	0.000000	0.000000	0.000000	0.057991
SW	0.012329	0.019749	0.003995	0.000342	0.000000	0.000000	0.000000	0.000000	0.036416
WSW	0.010160	0.014840	0.002511	0.000913	0.000000	0.000000	0.000000	0.000000	0.028425
W	0.014840	0.016210	0.002511	0.000685	0.000228	0.000000	0.000000	0.000000	0.034475
WNW	0.019064	0.024658	0.007078	0.002169	0.000342	0.000000	0.000000	0.000000	0.053311
NW	0.024772	0.055251	0.012329	0.003539	0.001027	0.000000	0.000000	0.000000	0.096918
NNW	0.017237	0.041096	0.011416	0.001712	0.001142	0.000457	0.000000	0.000000	0.073059
N	0.013242	0.017808	0.007420	0.001712	0.000000	0.000114	0.000000	0.000000	0.040297
CALM									0.167694
TOTAL	0.232763	0.388128	0.142466	0.049658	0.014840	0.003425	0.000685	0.000342	1.000000

MEAN WIND SPEED (m/s) = 2.13
NUMBER OF OBSERVATIONS = 8760

FREQUENCY OF OCCURENCE OF STABILITY CLASSES

A : 22.1%
B : 7.7%
C : 7.5%
D : 25.9%
E : 12.8%
F : 24.0%

STABILITY CLASS BY HOUR OF DAY

Hour	A	B	C	D	E	F
01	0000	0000	0000	0137	0080	0148
02	0000	0000	0000	0125	0083	0157
03	0000	0000	0000	0141	0073	0151
04	0000	0000	0000	0125	0074	0166
05	0000	0000	0000	0114	0080	0171
06	0005	0000	0002	0118	0076	0164
07	0084	0024	0037	0082	0045	0093
08	0182	0041	0062	0080	0000	0000
09	0186	0056	0058	0065	0000	0000
10	0199	0071	0071	0024	0000	0000
11	0208	0076	0055	0026	0000	0000
12	0211	0062	0065	0027	0000	0000
13	0205	0075	0064	0021	0000	0000
14	0198	0083	0064	0020	0000	0000
15	0198	0082	0062	0023	0000	0000
16	0176	0072	0068	0033	0005	0011
17	0088	0032	0048	0075	0037	0085
18	0000	0000	0000	0126	0068	0171
19	0000	0000	0000	0161	0076	0128
20	0000	0000	0000	0170	0081	0114
21	0000	0000	0000	0152	0083	0130
22	0000	0000	0000	0146	0091	0128
23	0000	0000	0000	0138	0091	0136
24	0000	0000	0000	0143	0075	0147

Appendix C: Monthly dust deposition data

Monthly dust deposition data from the Rocglen monitoring network - $g/m^2/month$

Month	BD1	BD2	BD3	BD4	BD5	BD6	BD7	BD8
Oct-07	1.4	1.7	0.8	1.6	0.8	1.0	1.0	1.3
Nov-07	2.1	1.3	1.5	1.3	0.6	1.2	1.7	-
Dec-07	1.3	0.6	2.2	1.1	0.8	1.0	0.9	-
Annual	**1.6**	**1.2**	**1.5**	**1.3**	**0.7**	**1.1**	**1.2**	**1.3**
Jan-08	1.2	0.5	1.1	3.3	0.8	1.1	0.7	2.1
Feb-08	1.8	1.1	1.9	1.3	0.5	0.6	0.5	0.7
Mar-08	1.9	0.8	1.6	2.1	1.0	2.0	1.4	1.3
Apr-08	1.8	1.3	1.1	0.9	0.8	0.7	1.4	1.1
May-08	0.9	0.9	0.5	0.5	0.5	0.9	0.7	0.3
Jun-08	0.6	0.6	0.4	0.4	0.2	0.7	0.7	0.5
Jul-08	0.6	0.7	0.4	0.2	0.4	0.6	0.6	0.4
Aug-08	1.1	0.7	0.6	0.4	0.7	0.7	0.7	0.6
Sep-08	1.3	1.5	0.8	1.2	0.6	1.7	2.7	1.2
Oct-08	1.6	1.3	1.4	1.0	0.7	1.0	1.1	1.5
Nov-08	1.0	1.0	2.2	1.7	1.4	1.6	1.9	2.5
Dec-08	-	1.0	1.0	0.8	0.7	0.8	1.4	0.7
Annual	**1.3**	**1.0**	**1.1**	**1.2**	**0.7**	**1.0**	**1.2**	**1.1**
Jan-09	-	3.2	2.4	1.1	1.4	1.6	2.0	1.4
Feb-09	-	0.7	1.1	0.6	3.2	0.6	0.8	1.3
Mar-09	-	1.1	0.8	1.8	1.1	1.7	1.3	2.8
Apr-09	-	1.2	0.8	1.3	1.3	0.7	0.8	0.6
May-09	-	1.1	0.4	0.5	0.4	0.6	0.9	0.6
Jun-09	-	0.6	0.5	0.3	0.2	0.4	0.4	0.4
Jul-09	-	0.7	0.3	0.4	0.3	0.8	0.9	0.6
Aug-09	-	2.1	1.5	1.1	0.9	1.4	2.1	1.3
Sep-09*	**-**	**11.8**	**7.6**	**10.6**	**15.9**	**8.4**	**5.3**	**10.3**
Oct-09	-	3.3	2.3	1.2	2.9	2.8	3.6	2
Nov-09	-	1.0	1.5	2.0	2.0	1.2	1.9	2.6
Dec-09	-	2.2	1.6	0.6	1.1	1.0	0.9	0.9
Annual	**-**	**2.4**	**1.7**	**1.8**	**2.6**	**1.8**	**1.7**	**2.1**

* These values have been removed from any further calculations

Appendix D: Emission calculations

The dust emissions from the mine have been estimated from the operational description of the proposed mining activities provided. Emission factor equations that relate the quantity of dust liberated from particular activities to the intensity of the activity and the properties of the material being handled and/or the prevailing meteorological conditions are used to estimate the emissions. 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.

TOPSOIL AND OVERBURDEN

SCRAPERS ON TOPSOIL

Emissions of Total Suspended Particles (TSP) were estimated using the emission factor for scrapers removing topsoil of 1.64 kg per VKT (**SPCC, 1983**). It was assumed that the scrapers operated for approximately 1,600 h/y travelling at 8 km/h.

DRILLING OVERBURDEN

Emissions from drilling operations were estimated using the emission factor for drilling of 0.59 kg/hole (**USEPA, 1985**).

BLASTING OVERBURDEN

Emissions from blasting overburden were estimated using the following emission factor equation (**USEPA, 1985**):

$$EF = 0.00022 \times A^{1.5}$$

where:

EF	=	Emission factor for TSP from blasting	(kg/blast)
A	=	Area to be blasted	(m^2)

HAULING OVERBURDEN ON UNSEALED SURFACES

The uncontrolled emission factor for vehicles travelling on unsealed road is estimated to be 4 kg/VKT (**SPCC, 1983**). **Buonicore and Davis (1992)** show the level of control that can be achieved through the application of water and or chemical stabilisers. Controls of up to 95% can be achieved provided the moisture content of the surface material is maintained at 9%. For the current assessment a control of 75% has been assumed.

LOADING/EMPLACING OVERBURDEN

Loading overburden to trucks will generate emissions of TSP. The rate of emission is dependent on the wind speed and the moisture content of the overburden. Emissions were estimated using the following emission factor equation (**USEPA, 1985**):

$$EF = k \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \right)$$

where:

EF	=	Emission factor for TSP from loading overburden to trucks	(kg/tonne)
k	=	Particulate size specific factor for batch loading operations (k_{TSP} = 0.74)	(kg/tonne)
U	=	Wind speed	(m/s)
M	=	Moisture content of material loaded	(%)

DOZERS ON OVERBURDEN

Emissions from dozers on overburden have been calculated using the US EPA emission factor equation (**US EPA, 1985**). The equation is as follows:

$$EF = 2.6 \times \frac{S^{1.2}}{M^{1.3}}$$

EF	=	Emission factor for TSP from dozer operation on overburden	(kg/hour)
S	=	Silt content	(%)
M	=	Moisture content of material loaded	(%)

COAL

DRILLING

Same as overburden drilling

BLASTING

Same as overburden blasting

HAULING COAL ON UNSEALED SURFACE

Same as hauling overburden on unsealed surface

DOZERS RIPPING ON COAL

Emissions from dozers on coal have been calculated using the US EPA emission factor equation (**US EPA, 1985**). The equation is as follows:

$$EF = 35.6 \times \frac{s^{1.2}}{M^{1.4}}$$

EF	=	Emission factor for TSP from dozer operation on overburden	(kg/hour)
S	=	Silt content	(%)
M	=	Moisture content of material loaded	(%)

LOADING COAL TO TRUCKS

Emissions from dozers on coal have been calculated using the US EPA emission factor equation (US EPA, 1985). The equation is as follows:

$$EF = \frac{0.580}{M^{1.2}}$$

EF	=	Emission factor for TSP from loading operation on coal	(kg/hour)
M	=	Moisture content of material loaded	(%)

OTHER SOURCES

WIND EROSION

Emissions of TSP from wind erosion and conveying were estimated using the emission factor for exposed areas of 0.4 kg/ha/hr (**SPCC, 1983**).

GRADING ROADS

Estimated TSP emissions from grading roads have been made using the US EPA (1985 and updates) emission factor equation (Equation 5).

$$EF = 0.0034 \times S^{2.5}$$

where,

EF	=	Emission factor for TSP from grading operation on overburden	(kg/VKT)
S	=	Speed of grader	(km/hr)

Appendix E: Emission Inventories

Emissions Inventory for Year 1

ACTIVITY - Year 1	TSP emission (kg/y)	Intensity	units	Emission factor	units	Variable 1	units	Variable 2	units	Variable 3	units
Topsoil - Removal using scrapers	17,213	20,992	VKT/y	1.6	kg/VKT	8	speed of scraper in km/h	50%	control		
OB - Dozers	76,983	4,600	h/y	16.7	kg/h	2	moisture content in %	10	silt content in %		
OB - Drilling	1,829	3,100	holes/y	0.59	kg/hole	100	holes per blast				
OB - Blasting	2,935	31	blasts/y	95	kg/blast	5,700	Area of blast in square metres				
OB - Sh/Ex/FELs loading OB to haul truck	19,704	16,248,000	t/y	0.00121	kg/t	1.024	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Hauling to emplacement area (short route)	154,898	10,561,200	t/y	0.01467	kg/t	150	t/load	2.2	km/return trip	1.0	kg/VKT
OB - Hauling to emplacement area (longer route)	197,142	5,686,800	t/y	0.03467	kg/t	150	t/load	5.2	km/return trip	1.0	kg/VKT
OB - Emplacing at emplacement area (internal dump)	0	0	t/y	0.00121	kg/t	1.024	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Emplacing at emplacement area (external dump)	19,704	16,248,000	t/y	0.00121	kg/t	1.024	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Rehandle Sh/Ex/FELs Loading	197	162,480	t/y	0.00121	kg/t	1.024	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
CL - Dozers ripping/pushing/clean-up in pit	91,952	4,600	h/y	20.0	kg/h	6	moisture content in %	5	silt content		
CL - Sh/Ex/FELs Loading ROM to trucks	101,330	1,500,000	t/y	0.06755	kg/t	6	moisture content in %				
CL - Hauling ROM to ROM pad	40,000	1,500,000	t/y	0.02667	kg/t	150	t/load	4	km/return trip	1.0	kg/VKT
CL - Dumping ROM at ROM pad	15,000	1,500,000	t/y	0.01	kg/t	6	moisture content in %				
CL - Dozers on ROM stockpiles	61,967	3,100	h/y	20.0	kg/h	6	moisture content in %	5	silt content		
CL - Sh/Ex/FELs loading ROM to dump hopper	101,330	1,500,000	t/y	0.06755	kg/t	6	moisture content in %				
CL - Crushing ROM	4,050	1,500,000	t/y	0.00270	kg/t						
CL - Screening ROM	18,750	1,500,000	t/y	0.01250	kg/t						
CL - Loading crushed/screened ROM to trucks (via O/H bin)	21,000	1,500,000	t/y	0.014	kg/t						
CL - Hauling crushed ROM to site exit (sealed)	15,000	1,500,000	t/y	0.0100	kg/t	40	t/load	2	km/return trip	0.2	kg/VKT
WE - Northern emplacement area	105,120	30	ha	0.4	kg/ha/h	8,760	h/y				
WE - Western emplacement area and topsoil stockpiles	35,040	10	ha	0.4	kg/ha/h	8,760	h/y				
WE - Exposed mined pit dump area	0	0	ha	0.4	kg/ha/h	8,760	h/y				
WE - Exposed active pit area	52,560	15	ha	0.4	kg/ha/h	8,760	h/y				
WE - ROM Pad area	17,520	5	ha	0.4	kg/ha/h	8,760	h/y				
Grading roads	163	312	km	0.5	kg/km	7.5	speed of graders in km/h				

Emissions Inventory for Year 5

ACTIVITY - Year 5	TSP emission (kg/y)	Intensity	units	Emission factor	units	Variable 1	units	Variable 2	units	Variable 3	units
Topsoil - Removal using scrapers	17,213	20,992	VKT/y	1.6	kg/VKT	8	speed of scraper in km/h	50%	control		
OB - Dozers	76,983	4,600	h/y	16.7	kg/h	2	moisture content in %	10	silt content in %		
OB - Drilling	2,065	3,500	holes/y	0.59	kg/hole	100	holes per blast				
OB - Blasting	3,314	35	blasts/y	95	kg/blast	5,700	Area of blast in square metres				
OB - Sh/Ex/FELs loading OB to haul truck	22,585	18,624,000	t/y	0.00121	kg/t	1.024	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Hauling to emplacement area (internal dump)	145,152	15,552,000	t/y	0.00933	kg/t	150	t/load	1.4	km/return trip	1.0	kg/VKT
OB - Hauling to emplacement area (external dump)	61,440	3,072,000	t/y	0.02000	kg/t	150	t/load	3.0	km/return trip	1.0	kg/VKT
OB - Emplacing at emplacement area (internal dump)	18,859	15,552,000	t/y	0.00121	kg/t	1.024	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Emplacing at emplacement area (external dump)	3,725	3,072,000	t/y	0.00121	kg/t	1.024	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Rehandle Sh/Ex/FELs Loading	226	186,240	t/y	0.00121	kg/t	1.024	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
CL - Dozers ripping/pushing/clean-up in pit	91,952	4,600	h/y	20.0	kg/h	6	moisture content in %	5	silt content		
CL - Sh/Ex/FELs Loading ROM to trucks	101,330	1,500,000	t/y	0.06755	kg/t	6	moisture content in %				
CL - Hauling ROM to ROM pad	80,000	1,500,000	t/y	0.05333	kg/t	150	t/load	8	km/return trip	1.0	kg/VKT
CL - Dumping ROM at ROM pad	101,330	1,500,000	t/y	0.06755	kg/t	6	moisture content in %				
CL - Dozers on ROM stockpiles	61,967	3,100	h/y	20.0	kg/h	6	moisture content in %	5	silt content		
CL - Sh/Ex/FELs loading ROM to dump hopper	101,330	1,500,000	t/y	0.06755	kg/t	6	moisture content in %				
CL - Crushing ROM	4,050	1,500,000	t/y	0.00270	kg/t						
CL - Screening ROM	18,750	1,500,000	t/y	0.01250	kg/t						
CL - Loading crushed/screened ROM to trucks (via O/H bin)	21,000	1,500,000	t/y	0.014	kg/t						
CL - Hauling crushed ROM to site exit (sealed)	15,000	1,500,000	t/y	0.0100	kg/t	40	t/load	2	km/return trip	0.2	kg/VKT
WE - Northern emplacement area	210,240	60	ha	0.4	kg/ha/h	8,760	h/y				
WE - Topsoil stockpiles	70,080	20	ha	0.4	kg/ha/h	8,760	h/y				
WE - Exposed mined pit dump area and topsoil stockpiles	210,240	60	ha	0.4	kg/ha/h	8,760	h/y				
WE - Exposed active pit area	52,560	15	ha	0.4	kg/ha/h	8,760	h/y				
WE - ROM Pad area	17,520	5	ha	0.4	kg/ha/h	8,760	h/y				
Grading roads	163	312	km	0.5	kg/km	7.5	speed of graders in km/h				

Emissions Inventory for Year 10

ACTIVITY - Year 10	TSP emission (kg/y)	Intensity	units	Emission factor	units	Variable 1	units	Variable 2	units	Variable 3	units
Topsoil - Removal using scrapers	17,213	20,992	VKT/y	1.6	kg/VKT	8	speed of scraper in km/h	50%	control		
OB - Dozers	76,983	4,600	h/y	16.7	kg/h	2	moisture content in %	10	silt content in %		
OB - Drilling	3,009	5,100	holes/y	0.59	kg/hole	100	holes per blast				
OB - Blasting	4,828	51	blasts/y	95	kg/blast	5,700	Area of blast in square metres				
OB - Sh/Ex/FELs loading OB to haul truck	33,091	27,288,000	t/y	0.00121	kg/t	1.024	average of (wind speed/2.2)^1.3 in m/s	2.0	moisture content in %		
OB - Hauling to emplacement area (internal dump)	245,650	20,470,801	t/y	0.01200	kg/t	150	t/load	1.8	km/return trip	1.0	kg/VKT
OB - Hauling to emplacement area (external dump)	109,075	6,817,199	t/y	0.01600	kg/t	150	t/load	2.4	km/return trip	1.0	kg/VKT
OB - Emplacing at emplacement area (internal dump)	24,824	20,470,801	t/y	0.00121	kg/t	1.024	average of (wind speed/2.2)^1.3 in m/s	2.0	moisture content in %		
OB - Emplacing at emplacement area (external dump)	8,267	6,817,199	t/y	0.00121	kg/t	1.024	average of (wind speed/2.2)^1.3 in m/s	2.0	moisture content in %		
OB - Rehandle Sh/Ex/FELs Loading	331	272,880	t/y	0.00121	kg/t	1.024	average of (wind speed/2.2)^1.3 in m/s	2.0	moisture content in %		
CL - Dozers ripping/pushing/clean-up in pit	91,952	4,600	h/y	20.0	kg/h	6	moisture content in %	5	silt content		
CL - Sh/Ex/FELs Loading ROM to trucks	101,330	1,500,000	t/y	0.06755	kg/t	6	moisture content in %				
CL - Hauling ROM to ROM pad	62,000	1,500,000	t/y	0.04133	kg/t	150	t/load	6.2	km/return trip	1.0	kg/VKT
CL - Dumping ROM at ROM pad	101,330	1,500,000	t/y	0.06755	kg/t	6	moisture content in %				
CL - Dozers on ROM stockpiles	61,967	3,100	h/y	20.0	kg/h	6	moisture content in %	5	silt content		
CL - Sh/Ex/FELs loading ROM to dump hopper	101,330	1,500,000	t/y	0.06755	kg/t	6	moisture content in %				
CL - Crushing ROM	4,050	1,500,000	t/y	0.00270	kg/t						
CL - Screening ROM	18,750	1,500,000	t/y	0.01250	kg/t						
CL - Loading crushed/screened ROM to trucks (via O/H bin)	21,000	1,500,000	t/y	0.014	kg/t						
CL - Hauling crushed ROM to site exit (sealed)	15,000	1,500,000	t/y	0.0100	kg/t	40	t/load	2	km/return trip	0.2	kg/VKT
WE - Northern emplacement area	21,024	6	ha	0.4	kg/ha/h	8,760	h/y				
WE - Southern emplacement area and topsoil stockpiles	122,640	35	ha	0.4	kg/ha/h	8,760	h/y				
WE - Exposed mined pit dump area	210,240	60	ha	0.4	kg/ha/h	8,760	h/y				
WE - Exposed active pit area	63,072	18	ha	0.4	kg/ha/h	8,760	h/y				
WE - ROM Pad area	15,768	4.5	ha	0.4	kg/ha/h	8,760	h/y				
Grading roads	163	312	km	0.5	kg/km	7.5	speed of graders in km/h				

Appendix F: Emission summary for sources used in the modelling

YEAR 1

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------------------------------- 07-Apr-2010 09:36
  DUST EMISSION CALCULATIONS V2
 -------------------------------

 Output emissions file  : C:\Jobs\To Be
Archived\3769 Rocglen Coal Mine\ISC\Y1\y1_emis.dat
 Meteorological file    : C:\Jobs\To Be
Archived\3769 Rocglen Coal
Mine\Metdata\groc0607.isc
 Number of dust sources : 50
 Number of activities   : 26
 No-blast conditions    : None
 Wind sensitive factor  : 1.038 (1.038 adjusted
for activity hours)
 Wind erosion factor    : 26.967

  -----ACTIVITY SUMMARY-----
 ACTIVITY NAME : Topsoil removal using scrapers
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 17213 kg/y
 FROM SOURCES  : 10
1 2 3 4 5 6 7 8 49 50
 HOURS OF DAY  :
0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0

 ACTIVITY NAME : OB - Dozers/Excavators
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 76983 kg/y
 FROM SOURCES  : 5
1 2 3 4 5
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : OB - Drilling
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 1829 kg/y
 FROM SOURCES  : 5
1 2 3 4 5
 HOURS OF DAY  :
0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0

 ACTIVITY NAME : OB - Blasting
 ACTIVITY TYPE : Blasting
 DUST EMISSION : 2935 kg/y
 FROM SOURCES  : 5
1 2 3 4 5
 HOURS OF DAY  :
0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0

 ACTIVITY NAME : OB - Sh/Ex/FELs loading OB to
haul truck
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 19704 kg/y
 FROM SOURCES  : 5
1 2 3 4 5
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : OB - Hauling to emplacement area
(short route)
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 154898 kg/y
 FROM SOURCES  : 8
1 2 3 4 5 6 7 8
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : OB - Hauling to emplacement area
(longer route)
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 197142 kg/y
 FROM SOURCES  : 13
1 2 3 4 5 9 10 11 12 13 14 15 16
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : OB - Emplacing at emplacement
area (internal dump)
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 0 kg/y
 FROM SOURCES  : 1
1
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : OB - Emplacing at emplacement
area (external dump)
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 19704 kg/y
 FROM SOURCES  : 11
6 7 8 15 16 31 32 33 34 35 36
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : OB - Rehandle
Shovel/Excavators/FELs Loading
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 197 kg/y
 FROM SOURCES  : 5
1 2 3 4 5
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CL - Dozers
ripping/pushing/clean-up in pit
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 91952 kg/y
 FROM SOURCES  : 5
1 2 3 4 5
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CL - Sh/Ex/FELs Loading ROM to
trucks
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 101330 kg/y
 FROM SOURCES  : 5
1 2 3 4 5
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CL - Hauling ROM to ROM pad
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 40000 kg/y
 FROM SOURCES  : 7
17 18 19 20 21 22 23
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CL - Dumping ROM at ROM pad
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 15000 kg/y
 FROM SOURCES  : 3
23 24 25
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
```

ACTIVITY NAME : CL - Dozers on ROM stockpiles
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 61967 kg/y
FROM SOURCES : 3
23 24 25
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : CL - Sh/Ex/FELs loading ROM to dump hopper
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 101330 kg/y
FROM SOURCES : 1
26
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : CL - Crushing ROM
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 4050 kg/y
FROM SOURCES : 1
26
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : CL - Screening ROM
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 18750 kg/y
FROM SOURCES : 1
26
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : CL - Loading crushed/screened ROM to trucks (via O/H bin)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 21000 kg/y
FROM SOURCES : 1
27
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : CL - Hauling crushed ROM to site exit (sealed)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 15000 kg/y
FROM SOURCES : 3
28 29 30
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : WE - Northern emplacement area
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 105120 kg/y
FROM SOURCES : 11
6 7 8 15 16 31 32 33 34 35 36
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : WE - Western emplacement area and topsoil stockpiles
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 35040 kg/y
FROM SOURCES : 3
37 38 39
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : WE - Exposed mined pit dump area
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 0 kg/y
FROM SOURCES : 1
1
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : WE - Exposed active pit area
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 52560 kg/y
FROM SOURCES : 6
1 2 3 4 5 17
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : WE - ROM Pad area
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 17520 kg/y
FROM SOURCES : 5
23 24 25 26 27
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : Grading roads
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 163 kg/y
FROM SOURCES : 19
1 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

EXCEL source file : C:\Jobs\To Be Archived\3769 Rocglen Coal Mine\Emissions\Rocglen_Emissions_Final.xls

YEAR 5

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-------------------------------  07-Apr-2010 09:38
  DUST EMISSION CALCULATIONS V2
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 Output emissions file  : C:\Jobs\To Be
Archived\3769 Rocglen Coal Mine\ISC\Y5\y5_emis.dat
 Meteorological file    : C:\Jobs\To Be
Archived\3769 Rocglen Coal
Mine\Metdata\groc0607.isc
 Number of dust sources : 64
 Number of activities   : 26
 No-blast conditions    : None
 Wind sensitive factor  : 1.038 (1.038 adjusted
for activity hours)
 Wind erosion factor    : 26.967

  -----ACTIVITY SUMMARY-----
 ACTIVITY NAME : Topsoil removal using scrapers
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 17213 kg/y
 FROM SOURCES  : 6
1 3 4 60 61 62
 HOURS OF DAY  :
0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0

 ACTIVITY NAME : OB - Dozers
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 76983 kg/y
 FROM SOURCES  : 4
1 2 3 4
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : OB - Drilling
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 2065 kg/y
 FROM SOURCES  : 4
1 2 3 4
 HOURS OF DAY  :
0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0

 ACTIVITY NAME : OB - Blasting
 ACTIVITY TYPE : Blasting
 DUST EMISSION : 3314 kg/y
 FROM SOURCES  : 4
1 2 3 4
 HOURS OF DAY  :
0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0

 ACTIVITY NAME : OB - Sh/Ex/FELs loading OB to
haul truck
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 22585 kg/y
 FROM SOURCES  : 4
1 2 3 4
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : OB - Hauling to emplacement area
(internal dump)
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 145152 kg/y
 FROM SOURCES  : 9
1 2 3 4 5 6 7 8 9
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : OB - Hauling to emplacement area
(external dump)
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 61440 kg/y
 FROM SOURCES  : 18
1 2 3 4 5 10 11 12 13 14 15 16 17 18 19 20 21 22
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : OB - Emplacing at emplacement
area (internal dump)
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 18859 kg/y
 FROM SOURCES  : 6
6 7 47 48 49 50
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : OB - Emplacing at emplacement
area (external dump)
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 3725 kg/y
 FROM SOURCES  : 9
14 15 16 17 18 19 20 21 22
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : OB - Rehandle Sh/Ex/FELs Loading
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 226 kg/y
 FROM SOURCES  : 4
1 2 3 4
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CL - Dozers
ripping/pushing/clean-up in pit
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 91952 kg/y
 FROM SOURCES  : 4
1 2 3 4
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CL - Sh/Ex/FELs Loading ROM to
trucks
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 101330 kg/y
 FROM SOURCES  : 4
1 2 3 4
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CL - Hauling ROM to ROM pad
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 80000 kg/y
 FROM SOURCES  : 19
1 2 3 4 23 24 25 26 27 28 29 30 31 32 33 34 35 36
37
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CL - Dumping ROM at ROM pad
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 101330 kg/y
 FROM SOURCES  : 4
37 38 39 40
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
```

```
 ACTIVITY NAME : CL - Dozers on ROM stockpiles
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 61967 kg/y
 FROM SOURCES  : 4
37 38 39 40
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CL - Sh/Ex/FELs loading ROM to
dump hopper
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 101330 kg/y
 FROM SOURCES  : 2
41 42
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CL - Crushing ROM
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 4050 kg/y
 FROM SOURCES  : 1
42
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CL - Screening ROM
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 18750 kg/y
 FROM SOURCES  : 1
42
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CL - Loading crushed/screened ROM
to trucks (via O/H bin)
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 21000 kg/y
 FROM SOURCES  : 1
43
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CL - Hauling crushed ROM to site
exit (sealed)
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 15000 kg/y
 FROM SOURCES  : 3
44 45 46
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : WE - Northern emplacement area
 ACTIVITY TYPE : Wind erosion
 DUST EMISSION : 210240 kg/y
 FROM SOURCES  : 9
14 15 16 17 18 19 20 21 22
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : WE - Western emplacement area
 ACTIVITY TYPE : Wind erosion
 DUST EMISSION : 70080 kg/y
 FROM SOURCES  : 1
1
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : WE - Exposed mined pit dump area
and topsoil stockpiles
 ACTIVITY TYPE : Wind erosion
 DUST EMISSION : 210240 kg/y
 FROM SOURCES  : 13
5 6 7 9 10 11 24 47 48 49 50 63 64
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : WE - Exposed active pit area
 ACTIVITY TYPE : Wind erosion
 DUST EMISSION : 52560 kg/y
 FROM SOURCES  : 4
1 2 3 4
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : WE - ROM Pad area
 ACTIVITY TYPE : Wind erosion
 DUST EMISSION : 17520 kg/y
 FROM SOURCES  : 5
37 38 39 40 43
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : Grading roads
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 163 kg/y
 FROM SOURCES  : 23
5 6 7 8 9 10 11 12 13 23 24 25 26 27 28 29 30 31
32 33 34 35 36
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 EXCEL source file      : C:\Jobs\To Be
Archived\3769 Rocglen Coal
Mine\Emissions\Rocglen_Emissions_Final.xls
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------------------------------- 11-Jan-2011 10:44
  DUST EMISSION CALCULATIONS V2
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 Output emissions file  :
C:\Jobs\3769_Rocglen\emiss.dat
 Meteorological file    :
C:\Jobs\3769_Rocglen\groc0607.isc
 Number of dust sources : 64
 Number of activities   : 27
 No-blast conditions    : None
 Wind sensitive factor  : 1.038 (1.038 adjusted
for activity hours)
 Wind erosion factor    : 26.967

  -----ACTIVITY SUMMARY-----
 ACTIVITY NAME : Topsoil removal using scrapers
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 17213 kg/y
 FROM SOURCES  : 10
1 2 3 21 22 23 61 62 63 64
 HOURS OF DAY  :
0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0

 ACTIVITY NAME : OB - Dozers/Excavators
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 76983 kg/y
 FROM SOURCES  : 3
1 2 3
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : OB - Drilling
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 3009 kg/y
 FROM SOURCES  : 3
1 2 3
 HOURS OF DAY  :
0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0

 ACTIVITY NAME : OB - Blasting
 ACTIVITY TYPE : Blasting
 DUST EMISSION : 4828 kg/y
 FROM SOURCES  : 3
1 2 3
 HOURS OF DAY  :
0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0

 ACTIVITY NAME : OB - Sh/Ex/FELs loading OB to
haul truck
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 33091 kg/y
 FROM SOURCES  : 3
1 2 3
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : OB - Hauling to emplacement area
(internal dump)
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 356738 kg/y
 FROM SOURCES  : 11
1 2 3 8 9 10 11 12 21 22 23
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : OB - Hauling to emplacement area
(external dump)
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 87653 kg/y
 FROM SOURCES  : 12
4 5 6 7 13 14 15 16 17 18 19 20
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : OB - Emplacing at emplacement
area (internal dump)
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 24824 kg/y
 FROM SOURCES  : 8
8 9 10 11 12 21 22 23
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : OB - Emplacing at emplacement
area (external dump)
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 8267 kg/y
 FROM SOURCES  : 4
4 5 6 7
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : OB - Rehandle
Shovel/Excavators/FELs Loading
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 331 kg/y
 FROM SOURCES  : 3
1 2 3
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CL - Dozers
ripping/pushing/clean-up in pit
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 91952 kg/y
 FROM SOURCES  : 3
1 2 3
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CL - Sh/Ex/FELs Loading ROM to
trucks
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 101330 kg/y
 FROM SOURCES  : 3
1 2 3
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CL - Hauling ROM to ROM pad
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 59660 kg/y
 FROM SOURCES  : 14
1 2 3 27 28 29 30 31 32 33 34 35 36 37
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CL - Dumping ROM at ROM pad
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 101330 kg/y
 FROM SOURCES  : 4
37 38 39 40
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
```

ACTIVITY NAME : CL - Dozers on ROM stockpiles
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 61967 kg/y
FROM SOURCES : 4
37 38 39 40
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : CL - Sh/Ex/FELs loading ROM to dump hopper
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 101330 kg/y
FROM SOURCES : 5
37 38 39 40 41
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : CL - Crushing ROM
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 4050 kg/y
FROM SOURCES : 1
41
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : CL - Screening ROM
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 18750 kg/y
FROM SOURCES : 1
41
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : CL - Loading crushed/screened ROM to trucks (via O/H bin)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 21000 kg/y
FROM SOURCES : 1
42
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : CL - Hauling crushed ROM to site exit (sealed)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 15000 kg/y
FROM SOURCES : 4
42 43 44 45
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : CL - Hauling crushed ROM to Canyon CHPP (sealed)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 56250 kg/y
FROM SOURCES : 9
52 53 54 55 56 57 58 59 60
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : WE - Northern emplacement area
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 21024 kg/y
FROM SOURCES : 6
46 47 48 49 50 51
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : WE - Southern emplacement area and topsoil stockpiles
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 122640 kg/y
FROM SOURCES : 7
24 25 26 61 62 63 64
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : WE - Exposed mined pit dump area
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 210240 kg/y
FROM SOURCES : 12
4 5 6 7 8 9 10 11 12 21 22 23
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : WE - Exposed active pit area
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 42749 kg/y
FROM SOURCES : 3
1 2 3
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : WE - ROM Pad area
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 15768 kg/y
FROM SOURCES : 6
37 38 39 40 41 42
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

ACTIVITY NAME : Grading roads
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 163 kg/y
FROM SOURCES : 19
13 14 15 16 17 18 19 20 27 28 29 30 31 32 33 34 35 36 37
HOURS OF DAY :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1