Appendix

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Air Quality Assessment

AIR QUALITY ASSESSMENT

CONTINUATION OF BOGGABRI COAL MINE

Hansen Bailey on behalf of Boggabri Coal Pty Limited

Job No: 3362

30 November 2010

A PEL Company

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1 INTRODUCTION

This report has been prepared by PAEHolmes on behalf of Hansen Bailey Pty Ltd for the Continuation of Boggabri Coal Mine (hereafter referred to as the Project). Boggabri Coal Pty Limited (Boggabri Coal) is a wholly owned subsidiary of Idemitsu Australia Resources Pty Ltd (IAR) and operates the Boggabri Coal Mine. The Boggabri Coal Mine is located approximately 15 km north east of Boggabri in the Narrabri Shire Council (NSC) Local Government Area (LGA) in the central north of NSW.

The purpose of this report is to assess the air quality effects of the Project. This has been completed following the procedures outlined in the Department of Environment and Climate Change and Water's (DECCW) *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (**NSW DEC, 2005**) (referred to hereafter as the *Approved Methods*). This requires the use of the US EPA's ISCST3 (adapted to ISCMOD) computer based dispersion model to predict dust concentration and deposition levels due to the Project. The emissions inventories have been used with local meteorological data to predict the maximum 24-hour PM_{10}, annual average PM_{10}, annual average TSP and annual average dust deposition (insoluble solids) for four stages of the Project's mining operations.

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 Project;
- the predicted dispersion and dust fallout patterns due to emissions from the Project and the Project with other sources;
- a comparison of the proposed impacts at sensitive receptors with the *Approved Methods*;
- mitigation and monitoring; and
- greenhouse gas assessment.

2 LOCAL SETTING

The Boggabri Coal Project is 15 km to the northeast of Boggabri, located in the northwest slopes and plains of New South Wales. The regional setting of the Project is shown in **Figure 2.1**.

The closest regional centres are Gunnedah and Narrabri, located approximately 40 km to the north and 60 km to the south, respectively. The Willow Tree Range forms part of the Leard State Forest and borders the existing Boggabri Coal Mine to the north, east and west. Apart from the forest, the surrounding land is predominantly used for agriculture which includes cattle grazing, cotton and wheat farming. To the south and west of the Project, respectively, is the open cut mine known as Tarrawonga Coal Project and the most significant water body in the region, the Namoi River. To the northwest is Maules Creek Mine, however, this mine has never been developed.

There are also a number of isolated rural residences associated with the surrounding farms. The locations of these residences along with the meteorological station and dust deposition monitors are shown in **Figure 2.2**. Land ownership details are provided in **Appendix A**.

The surrounding terrain is gently undulating with steeper slopes emerging near ridgelines, encompassing the Project boundary. To the south of the Project is the Gunnedah basin, with an altitude of 250 m above sea level. **Figure 2.3** shows a pseudo 3-dimensionsal representation of the terrain in the area of the mine and surrounds.

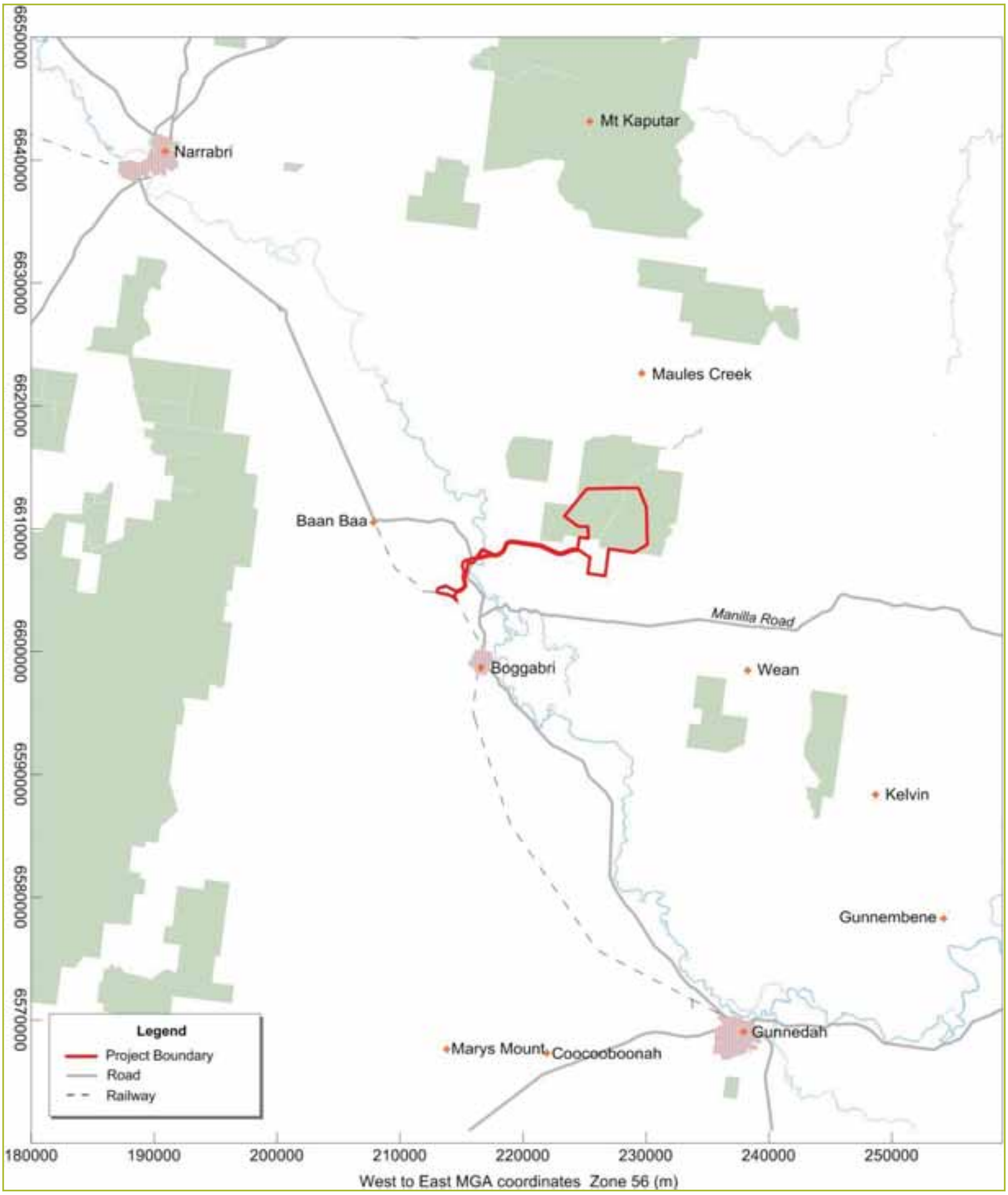


Figure 2.1: Location of Project Boundary

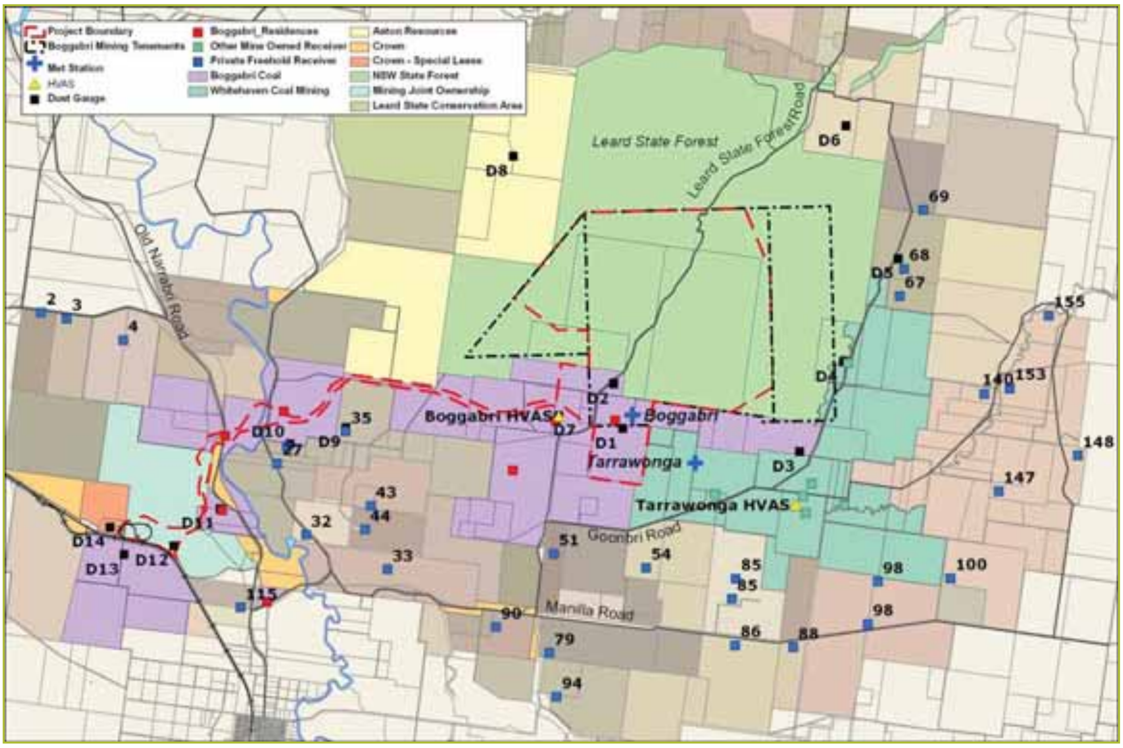


Figure 2.2: Location of residences, meteorological station and air quality monitors

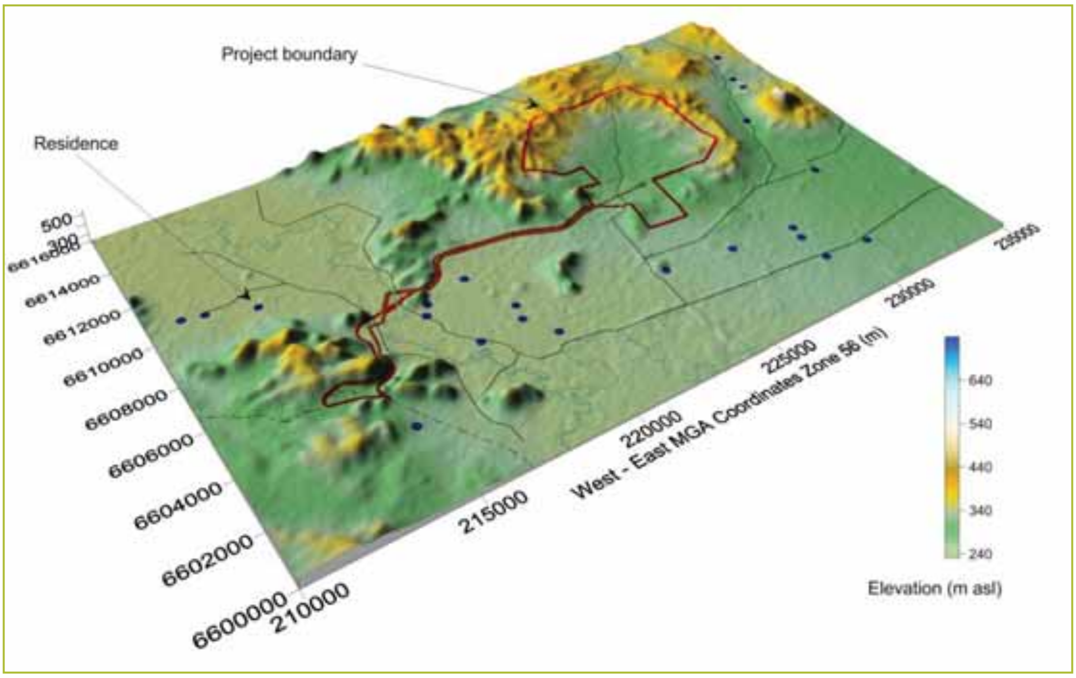


Figure 2.3: Pseudo 3-dimensional plot of the terrain surrounding the Project

3 PROJECT DESCRIPTION

Boggabri Coal is proposing to apply for approval to continue its open cut mining operations for a further 21 years. Project Approval is sought under Part 3A of the Environmental Planning and Assessment Act 1979 (EP&A Act) to gain a single, contemporary planning approval for the continuation of its mining operations within the Project Boundary.

The Project generally comprises the following:

- Continuation of mining operations via open cut methods of up to 7 Mtpa product coal to the Merriown seam;
- Open cut mining fleet including excavators and fleet of haul trucks, dozers, graders, water carts and other equipment with the flexibility to introduce a dragline as required utilising up to 500 employees;
- Modifications to existing and continuation of approved (but not yet constructed) infrastructure including:
    - Coal Handling and Preparation Plant (CHPP);
    - Modifications to existing site infrastructure capacities including: Run of Mine (ROM) coal hopper, second crusher, stockpile area, coal loading facilities, water management and irrigation system;
    - Rail loop and 17 km rail line across the Namoi River and flood plain including overpasses across the Kamilaroi Highway, Therribri Road and Namoi River;
    - Minor widening of the existing coal haul road including overpasses across the Kamilaroi Highway, Therribri Road and Namoi River;
    - Upgrading and relocating site facilities including offices, car parking and maintenance sheds as and when required;
- Closing a section of Leard Forest Road; and
- Upgrading the power supply capacity to 132 kilovolt (kV) high voltage lines suitable for dragline operations.

The Project will include the continuation of the existing Boggabri Coal Mine, with work progressing in an easterly direction. When mining operations approach the eastern boundary, work is proposed to progress northwest in 75 m strips from east to west. The spoil would be transported using haul trucks, with either a 240 t or 363 t capacity, to an overburden emplacement area to the southeast of the pit. These areas would then be rehabilitated using the emplaced overburden and subsequent construction of a top soil layer for revegetation of the final rehabilitated landform.

For assessment purposes, four representative stages of the Project have been assessed (Years 1, 5, 10 and 21). **Table 3-1** provides the quantities of ROM coal to be removed from Boggabri Coal Mine.

Table 3-1: Quantities of ROM coal removed

Year scenario	ROM Coal (Mtpa)
Year 1	2.50
Year 5	6.97
Year 10	7.89
Year 21	7.23

Operating hours would occur 24 hours per day, 7 days per week, with the exception of blasting, which would be performed at approximately midday up to six days per week. **Table 3-2** lists the equipment that would be used onsite.

Table 3-2: Indicative Project Equipment List

Mining Equipment	Indicative Make / model	Year 1	Year 5	Year 10	Year 21
Blasthole Drill	Terex SKF	0	2	2	1
Blasthole Drill	Terex SKS-W	2	6	5	6
Small Excavator (<300 t)	Hitachi EX2500	2	3	3	3
Mid Size Excavator (300-500 t)	Hitachi EX3600	1	1	1	1
Large Excavator (500 t+)	Hitachi EX5500	1	2	2	3
150 t Haul Trucks	Cat 785C trucks	3	8	8	8
240 t Haul Truck	Cat 793D	11	20	19	26
Ultra Class Truck (363 t)	Liebherr T282	0	8	8	9
Water truck	Cat 777F	2	5	4	4
Wheel Dozer	Komatsu WD900	1	3	2	2
Track Dozer	D10T	3	7	7	8
Track Dozer	D11T	3	8	7	9
Front End Loader	Komatsu WA900	0	1	1	1
Grader	Cat 16M	2	6	5	6
Large Electric Rope Shovel	P&H 4100XPC	0	1	1	1

4 AIR QUALITY ASSESSMENT CRITERIA

4.1 Introduction

Extraction of coal using open cut mining methods 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).

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

The Project will give rise to emissions of various forms of particulate matter (dust), namely Total Suspended Particulate matter (TSP), particles with equivalent aerodynamic diameters less than 10 μm (PM_{10}) and deposited dust. In addition, the Project will give rise to emissions of greenhouse gases such as methane from the exposed coal and emissions of carbon dioxide from fuel used by earth moving equipment, blasting and indirectly from electricity usage. It is the impact of emissions of particulate matter and greenhouse gases that form the focus of the assessment.

This section provides information on the air quality criteria used to assess the impact of emissions. The assessment criteria provides 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.

4.2 Particulate Matter

4.2.1 Health

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 depends 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 larger than 10 μm, while not able to affect health, can soil materials and generally

[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 10 μm, that is, all particles that behave aerodynamically in the same way as spherical particles with a unit density.

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 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}.

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. The indication therefore is that particulate matter of crustal origin, such as dust from mining, may be less harmful to health as it contains a smaller fraction of fine particulate matter, (e.g. $PM_{2.5}$ and PM_1) and also relatively less matter containing acidic and carcinogenic substances.

Just as PM_{10} particles are a sub-component of TSP, so $PM_{2.5}$ particles are a sub-component of PM_{10} and therefore a sub-component of TSP. $PM_{2.5}$ are fine particles with aerodynamic diameters of 2.5 μm or less which can penetrate deep into the respiratory system and there is evidence that particles in this size range are more harmful than the coarser component of PM_{10} namely the 2.5 to 10 μm fraction.

Mining emissions will also include particles from diesel exhausts in activities where diesel powered equipment is used. Thus mining generates particles in all the above size categories, namely $PM_{2.5}$, PM_{10} and TSP. However, the great majority of the particles from mining operations are due to the abrasion, crushing of rock and coal and general disturbance of dusty material. As such most of the emissions will be larger than 2.5 μm. This is in contrast to particles found in bushfire smoke, or in the atmosphere in urban areas, where many of the particles are the result of combustion processes. A study of the distribution of particle sizes near (10 to 200 m) mining dust sources was undertaken on behalf of the State Pollution Control Commission (SPCC – now EPA) in 1986. The average of approximately 120 samples showed that $PM_{2.5}$ comprised 4.7% of the TSP, and PM_{10} comprised 39.1% of the TSP in the samples (**SPCC, 1986**). Thus, although emissions of $PM_{2.5}$ do occur from mining the percentages of the emissions in this size range are small and in practice the concentrations of $PM_{2.5}$ in the vicinity of mining dust sources are likely to be low compared with internationally recognised goals.

4.2.2 DECCW Criteria

In the *Approved Methods*, the DECCW specifies air quality assessment criteria relevant for assessing impacts from mining (**NSW DEC, 2005**). **Table 4-1** 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 6.3**.

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

[c] Crustal dust refers to dust generated from materials derived from the earth's crust.

Table 4-1: DECCW air quality standards / goals for particulate matter concentrations

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

Notes: $\mu g/m^3$ – micrograms per cubic metre, μm – micrometre.

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 4-2** 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 (**NSW DEC, 2005**).

Table 4-2: 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

4.2.3 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 or 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 4-3**.

Table 4-3: DoP acquisition criterion for PM_{10}

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

Notes: $\mu g/m^3$ – micrograms per cubic metre, μm – micrometre.

4.2.4 Further Comments

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

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

5 EXISTING ENVIRONMENT

This section describes the dispersion meteorology, local climatic conditions and existing air quality in the area. The prevailing air quality conditions will be influenced by existing mining operations and other land uses in the vicinity of the Project.

5.1 Dispersion Meteorology

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

The DECCW have listed requirements for meteorological data that are used for air dispersion modelling in their *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.

Boggabri Coal operates an automatic weather station (AWS) located to the south of the Project Boundary (see **Figure 2.2**). The meteorological data consist of 15-minute readings of temperature, wind speed, wind direction and sigma-theta (a measure of the fluctuation of the horizontal wind direction). The data from this site were incomplete and did not meet the DECCW's requirements of 90% with data missing from 1st November 2008 to 25th December 2008 and 1st September 2009 to 17th September 2009. These data have been replaced with meteorological data from a nearby weather station operated by the Tarrawonga Coal Mine, 2 km southeast of the Boggabri AWS (see **Figure 2.2**). There are still data missing from the Tarrawonga dataset for the period from the 2nd May to 2nd June in 2009. However, with the supplemented data from 1st November 2008 to 25th December 2008 and 1st September 2009 to 17th September 2009, the meteorological file is now 90.1% complete and meets the DECCW's requirements.

Annual and seasonal windroses compiled from the onsite meteorological data are presented in **Figure 5.1**. The windroses show that on an annual basis, winds are predominantly from the north, west-northwest and southeast. During summer and autumn, winds from the southeast are predominant, with very few winds originating from the north-eastern quadrant. As winter progresses, the wind distribution pattern is predominantly from the north and the northwest. This wind pattern carries through until spring, when winds from the south and south-southeast are present in more significant proportions. The percentage of calms (when the wind speed is less than 0.5 ms^{-1}) is 14.7%. The annual average wind speed for the 2008/2009 data is 2.3 m/s.

To assess dispersion, it is necessary to have data available on atmospheric stability. A stability class was calculated for each hour of the meteorological dataset using sigma-theta according to

[d] 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 method recommended by the United States Environmental Protection Agency (US EPA) (**US EPA, 1985**).

The Pasquill-Gifford scheme classifies atmospheric stability 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; and
- Classes B and C are intermediate between A and D, and E is intermediate between D and F.

Table 5-1 shows the frequency of occurrence of the different stability categories expected in the area. The most common stability class in the area was determined to be F class at 33.9%. Under these conditions, pollutant emissions dispersion is poor. Joint wind speed, wind direction and stability class frequency tables are presented in **Appendix B**.

Table 5-1: Frequency of Occurrence of Stability Classes at Boggabri

Stability Class	Boggabri AWS September 2008 to August 2009
A	20.9%
B	7.9%
C	7.6%
D	20.8%
E	9.0%
F	33.9%
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 5.1: Annual and seasonal windroses for Boggabri September 2008 to August 2009

5.2 Climate data

The Bureau of Meteorology collects climatic information from the monitoring station located at Gunnedah Pool (Station Number 055023) approximately 40 km to the south-southeast of the Project. These data provide information on the long-term average values of climatic elements such as temperature, humidity, rainfall, the number of raindays per year etc.

Table 5-2 presents temperature, humidity and rainfall data collected at Gunnedah between 1876 and 2009 (**Bureau of Meteorology, 2009)**. Temperature and humidity data consist of monthly averages of 9am and 3pm readings. Also presented are monthly averages of maximum and minimum temperatures. Rainfall data consist of mean and median monthly rainfall and the average number of raindays per month.

The annual average maximum and minimum temperatures experienced at Gunnedah are 26.0°C and 10.9°C, respectively. On average, January is the hottest month with an average maximum temperature of 34.0°C. July is the coldest month, with average minimum temperature of 3.0°C.

The annual average humidity reading observed at 9 am at Gunnedah is 67 percent, and at 3 pm the annual average is 46 percent. The month with the highest humidity on average is June with a 9 am average of 78 percent, and the lowest is November and December with a 3 pm average of 40 percent.

Rainfall data collected at Gunnedah shows that January is the wettest month, with an average rainfall of 71.1 mm over 6.5 days. The average annual rainfall is 617.1 mm with an average of 71.6 raindays.

Table 5-2: Climate Information for Gunnedah Pool Monitoring Station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
9 am Mean Dry-bulb and Wet-bulb Temperatures (°C) and Relative Humidity (%)													
Dry-bulb	25.0	23.9	22.1	18.3	13.3	9.8	8.8	10.9	14.9	19.1	22.0	24.4	17.7
Wet-bulb	19.7	19.3	17.7	14.6	11.1	8.2	7.0	8.4	11.6	14.6	16.7	18.8	14.0
Humidity	60	65	64	67	73	78	77	71	65	61	59	58	67
3 pm Mean Dry-bulb and Wet-bulb Temperatures (°C) and Relative Humidity (%)													
Dry-bulb	31.2	30.3	28.7	24.9	20.0	16.7	15.8	17.7	21.2	24.5	27.6	30.2	24.1
Wet-bulb	21.6	21.4	19.9	17.2	14.3	12.0	11.0	11.8	14.2	16.4	18.2	20.2	16.5
Humidity	43	45	44	46	51	55	53	48	43	43	40	40	46
Mean 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
Mean 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
Rainfall (mm)													
Mean	71.1	66.5	47.9	37.7	42.5	43.9	42.2	41.3	39.6	55.2	61.2	68.0	617.1
Raindays (Number)													
Mean	6.5	6.1	4.6	4.3	5.1	6.3	6.2	6.1	5.8	6.9	6.8	6.9	71.6

5.3 Existing Air Quality

5.3.1 Introduction

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

The following sections provide a summary of the monitoring results for dust deposition, PM_{10} and TSP in the area surrounding the Project.

5.3.2 Dust Deposition

Dust deposition is monitored using dust deposition gauges at 15 locations in the vicinity of the Project (refer to **Figure 2.2** 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 a period of one month. The measured dust fallout levels include the effects of all existing sources of particulate matter including the existing mining operations.

Data collected from the gauges between 2005 and 2008 are summarised in **Table 5-3**.

The data indicate that deposition levels are generally low and within the DECCW's annual average assessment criteria of 4 g/m^2/month for insoluble solids.

Table 5-3: Dust deposition data (insoluble solids) (g/m^2/month)[(a)]

Dust gauge	2005 average	2006 average	2007 average	2008 average	2009 average (to July)
D1	0.7	0.9	1.8	2.1	1.4
D2	0.7	1.5	2.0	2.1	1.6
D3	2.1	1.6	2.9	1.8	2.9
D4	2.2	1.5	2.3	1.6	1.8
D5	1.4	1.3	1.7	1.4	1.3
D6	1.5	1.0	1.7	1.6	1.4
D7	0.8	1.2	1.5	1.2	0.9
D8	1.1	1.1	1.3	1.2	0.9
D9	1.1	1.3	1.0	1.3	1.8
D10	1.1	0.8	1.1	1.1	0.7
D11	1.5	1.2	1.0	1.4	1.1
D12	1.1	1.6	1.9	1.7	1.6
D13	1.5	1.8	2.2	2.4	1.7
D14	0.9	0.9	1.6	1.7	4.0
D15	-	-	-	1.1	1.2

(a) Excluding contaminated data

5.3.3 PM_{10} and TSP concentrations

Particulate matter (PM_{10}) concentrations have been monitored by Boggabri Coal since 2005. Twenty-four hour average concentrations of PM_{10} are collected at site D7 every sixth day using a High Volume Air Sampler (HVAS). An additional HVAS monitor is located to the south of the Project as a part of the Tarrawonga Mine environmental monitoring system. The location of the HVAS's are shown on **Figure 2.2**.

The data collected by Boggabri Coal is available between August 2005 and April 2010 and are presented in **Appendix CC**. There have been five elevated readings above the DECCW 24-hour average goal of 50 $\mu g/m^3$. Two of these events in December 2005 are a result of strong northerly winds. Narrabri, 60 km northwest of Boggabri, recorded winds greater than 115 km/h on the 28th December 2005. There were two other days where the dust levels were recorded to be above the DECCW criterion, both of which occurred in November and December of 2009.

The monitoring data collected at the Tarrawonga HVAS indicates that there have been five elevated recordings above the DECCW goal, with four occurring between September and December 2009 a period in which a number of dust storms and strong winds were experienced in New South Wales. The maximum 24-hour average PM_{10} concentration recorded was 97 µg/m^3 on the 8th December 2009, a day when most of the State experienced strong winds and elevated dust levels.

Although the data indicates fewer than the five exceedances per year allowed by the DECCW goal, it should be noted that the monitoring is not continuous and so it is not possible to conclude that the area complies with the PM_{10} Air-NEPM standard. However the fact that the exceedances are attributable to periods of severe wind suggests that air quality is satisfactory. **Figure 5.2** shows a graphical representation of the data.

The rolling annual average is below the DECCW goal of 30 µg/m^3. In April 2009, the rolling annual average PM_{10} concentrations were 19 µg/m^3, and have been as high as 25 µg/m^3 (April 2007). Overall, the PM_{10} concentrations decreased significantly in June 2008 and began to increase again in spring 2009.

There are no TSP data collected, however, experience with monitoring in other mining areas in the State indicates that where mining activities are a significant source of the particulate matter, then on an annual basis, approximately 40% of the TSP will be in the form PM_{10}. This would suggest that the annual average TSP concentrations are in the range 48 µg/m^3 to 63 µg/m^3. These concentrations are less than DECCW's annual average 90 µg/m^3 assessment criterion for TSP.

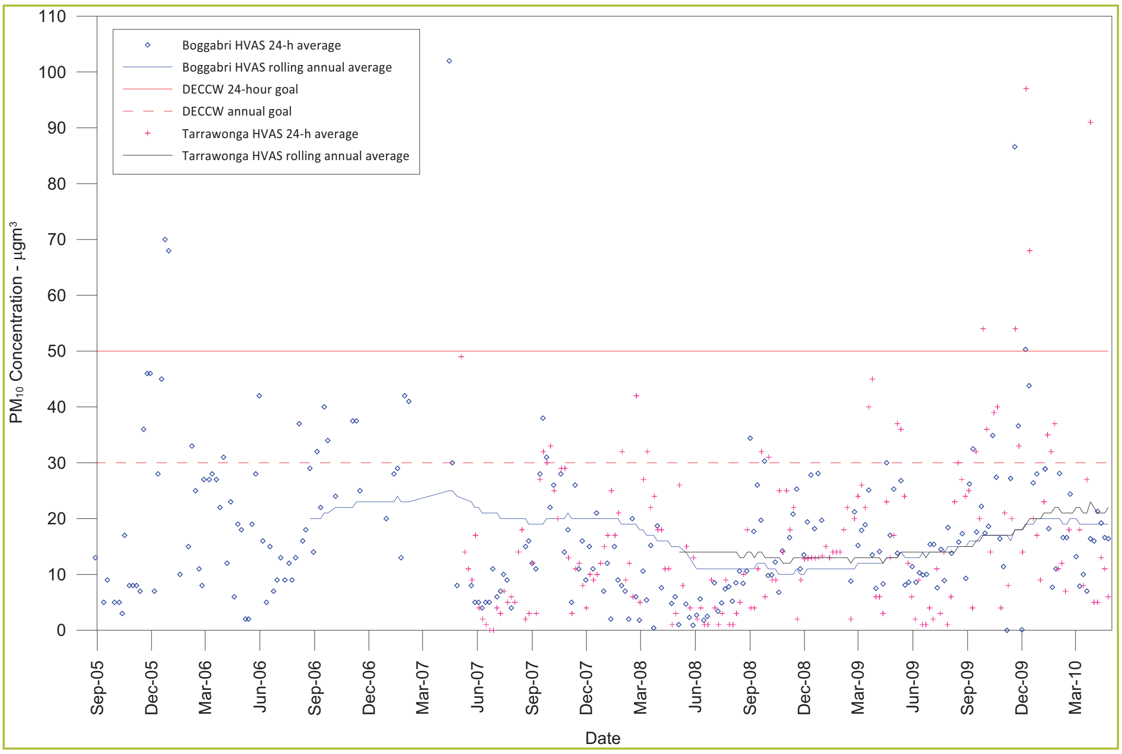


Figure 5.2: Measured PM_{10} concentrations (HVAS)

6 ESTIMATED EMISSIONS OF PARTICULATE MATTER

6.1 Introduction

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

- The open-cut mining operations from the Project; and
- Approved operations at other mines in the area.

6.2 Estimated emissions from the Project

To meet a maximum production target of 7 Mtpa the Project will involve the following:

- Progression of the pit in an easterly and then north-westerly direction;
- Increase in mining fleet to correspond with ROM production rates;
- Modification to existing infrastructure capacities for example; ROM crusher, stockpile area and coal loading facilities;
- The introduction of a CPP; and
- The upgrade of the private haul road or the introduction of a rail spur to transport product coal from the mine to the Werris Creek to Mungindi rail line.

The operation of the mine has been analysed and estimates of dust emissions for the individual activities and operations have been made. Emissions have been estimated using emission factor equations published in AP-42 (**US EPA, 1985** and updates from the US EPA website) and from studies undertaken by the coal industry in the Hunter Valley and published in a report prepared for the National Energy Research and Development and Demonstration Council (**NERDDC, 1988**). The emission factors applied are considered to be the most reliable or up-to-date methods for determining dust generation rates. The mining plans for the Project have been analysed and detailed emissions inventories have been prepared for four stages of mining operations:

- Year 1;
- Year 5;
- Year 10; and
- Year 21.

The detailed calculations are presented in **Appendix D**, which provides information on the equations used, the basic assumptions about material properties (e.g. moisture content, silt content etc), information on the way in which equipment would be used to undertake different mining operations and the quantities of materials that would be handled in each operation.

Table 6-1 summarises the quantities of TSP estimated to be released by each activity associated with the proposed development. The table also includes the estimated TSP emissions for Tarrawonga Coal Mine for Year 1 and Year 5 as current approval for operations at Tarrawonga Coal Mine are to cease in Year 6 of the Project's lifetime.

Two alternatives to the proposed operations in Year 5 have been developed, firstly the introduction of a dragline to substitute part of the truck and shovel method for the removal of overburden and secondly, a rail spur for the transportation of product coal to the main rail line.

The estimated quantities of TSP emissions for the two alternatives have been summarised in **Table 6-2**.

In addition to emissions data, the ISCMOD dispersion model requires information on particle size distributions in the emitted dust. Data from the State Pollution Control Commission (**SPCC, 1986**) have been used for this. Three particle size categories (Fine Particles (FP) - 0 to 2.5 μm, Coarse Particles (CP) - 2.5 to 10 μm and the Rest (RE) - 10 to 30 μm) have been used. The average percentage in each size range (averaged over all activities) is as follows.

- FP– 4.7%.
- CP – 34.4%.
- RE – 60.9%

Modelling was performed 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.

For the proposed expansion, 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** to **Figure 6.5**). Source identification tables are presented in **Appendix D**. 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.

Table 6-1: Summary of estimated TSP emissions from the Project (kg/y)

ACTIVITY	Year 1	Year 5	Year 10	Year 21
Topsoil Removal-Dozers/Excavators stripping topsoil	2,512	9,801	3,831	4,664
Topsoil removal-Sh/Ex/FELs loading topsoil	194	758	296	361
Topsoil removal -Hauling topsoil to emplacement area	8,612	50,404	21,892	29,318
Topsoil removal -Emplacing topsoil at emplacement area	194	758	296	361
OB - Drilling	33,630	67,260	67,260	67,260
OB - Blasting	125,158	250,316	250,316	250,316
OB - Dragline removal of overburden	n/a	n/a	n/a	n/a
OB - Excavator loading OB to haul truck	38,777	123,118	93,533	97,281
OB - Hauling to emplacement area	895,313	2,182,006	1,779,947	2,286,185
OB - Emplacing at emplacement area	38,777	123,118	93,533	97,281
OB - Dozers removing OB	54,844	219,374	219,374	219,374
OB - Dozers on OB dumping in emplacement area	109,687	219,374	219,374	219,374
CL - Dozers ripping/pushing/clean-up	403,385	806,769	806,769	1,075,692
CL - Hauling open pit coal to ROM pad	108,333	274,222	286,119	416,723
CL - Unloading ROM to ROM stockpiles	35,874	81,979	75,473	69,211
CL - Loading ROM directly to hopper to be crushed	83,706	327,916	301,890	276,844
CL – Loading from stockpile to crusher using FELs	35,874	81,979	75,473	69,211
CL - Crushing ROM	6,750	23,137	21,301	19,534
CL - Unloading Product coal from crusher	25,000	85,694	78,893	72,348
CL- Loading coal from hopper for transfer to CHPP (2 Mtpa production rate).	n/a	354	354	354
CL - Hauling coal from hopper to CHPP	n/a	n/a	n/a	n/a
CL - Unloading to CHPP[e]	n/a	531	443	354
CL - Handle coal at CHPP[e]	n/a	389	324	259
CL - Rehandle coal at CHPP[e]	n/a	89	32	26
CL - Dozers at ROM Pad	12,090	9,046	9,046	9,046
CL - Loading product coal to haul trucks	443	903	907	907
CL - Hauling product coal to rail loop	134,167	373,921	375,667	375,667
CL - Unloading product coal at rail loop	443	903	907	907
CL - Loading product coal to trains	443	903	907	907
CL - Loading rejects to haul trucks	n/a	208	115	30
CL - Hauling rejects from CHPP	n/a	41,010	37,944	12,521
CL - Unloading rejects	n/a	208	115	30
WE - OB dump area	579,322	902,650	1,486,078	1,602,027
WE - Open pit	283,904	507,945	543,607	743,019
WE - ROM stockpiles	16,118	16,118	16,118	16,118
WE - Product stockpiles	14,507	16,493	16,493	16,493
WE - Topsoil area and stockpiles	433,223	372,728	586,186	306,739
WE - Product stockpiles at Rail loop	17,408	19,792	19,792	17,408
Grading roads	10,783	26,957	21,566	21,566
Tarrawonga Coal Mine	1,600,000	1,600,000	n/a	n/a
Total	**3,509,469**	**7,219,260**	**7,512,262**	**8,395,716**

[e]Please note that modelling has been performed based on a 2 Mtpa processing capacity, however up to 3 Mtpa may be processed. The increase in emissions as a result of the additional processing would be no greater than 0.007%. As such there would be no determinable change to the predicted air quality impacts.

Table 6-2: Summary of estimated TSP emissions from the Project (kg/y)

ACTIVITY	Year 5 (rail spur)	Year 5 (dragline)
Topsoil Removal-Dozers/Excavators stripping topsoil	9,801	9,801
Topsoil removal-Sh/Ex/FELs loading topsoil	758	758
Topsoil removal -Hauling topsoil to emplacement area	50,404	50,404
Topsoil removal -Emplacing topsoil at emplacement area	758	758
OB - Drilling	67,260	67,260
OB - Blasting	250,316	250,316
OB - Dragline removal of overburden	n/a	594,311
OB - Excavator loading OB to haul truck	123,118	79,807
OB - Hauling to emplacement area	2,182,006	1,414,404
OB - Emplacing at emplacement area	123,118	123,118
OB - Dozers removing OB	219,374	219,374
OB - Dozers on OB dumping in emplacement area	219,374	219,374
CL - Dozers ripping/pushing/clean-up	806,769	806,769
CL - Hauling open pit coal to ROM pad	274,222	274,222
CL - Unloading ROM to ROM stockpiles	81,979	81,979
CL - Loading ROM directly to hopper to be crushed	327,916	327,916
CL - Loading from stockpile to crusher using FELs	81,979	81,979
CL - Crushing ROM	23,137	23,137
CL - Unloading Product coal from crusher	85,694	85,694
CL- Loading coal from hopper for transfer to CHPP (2 Mtpa production rate).	354	354
CL - Hauling coal from hopper to CHPP	n/a	n/a
CL - Unloading to CHPP[e]	531	531
CL - Handle coal at CHPP[e]	389	389
CL - Rehandle coal at CHPP[e]	39	39
CL - Dozers at ROM Pad	9,046	9,046
CL - Loading product coal to haul trucks	903	903
CL - Hauling product coal to rail loop	n/a	373,921
CL - Unloading product coal at rail loop	n/a	903
CL - Loading product coal to trains	n/a	903
CL - Loading rejects to haul trucks	208	208
CL - Hauling rejects from CHPP	41,010	41,010
CL - Unloading rejects	208	208
WE - OB dump area	902,650	902,650
WE - Open pit	507,945	507,945
WE - ROM stockpiles	16,118	16,118
WE - Product stockpiles	16,493	16,493
WE - Topsoil area and stockpiles	372,728	372,728
WE - Product stockpiles at Rail loop	n/a	19,792
Grading roads	26,957	26,957
Tarrawonga Coal Mine	1,600,000	1,600,000
Total	**6,823,742**	**7,002,658**

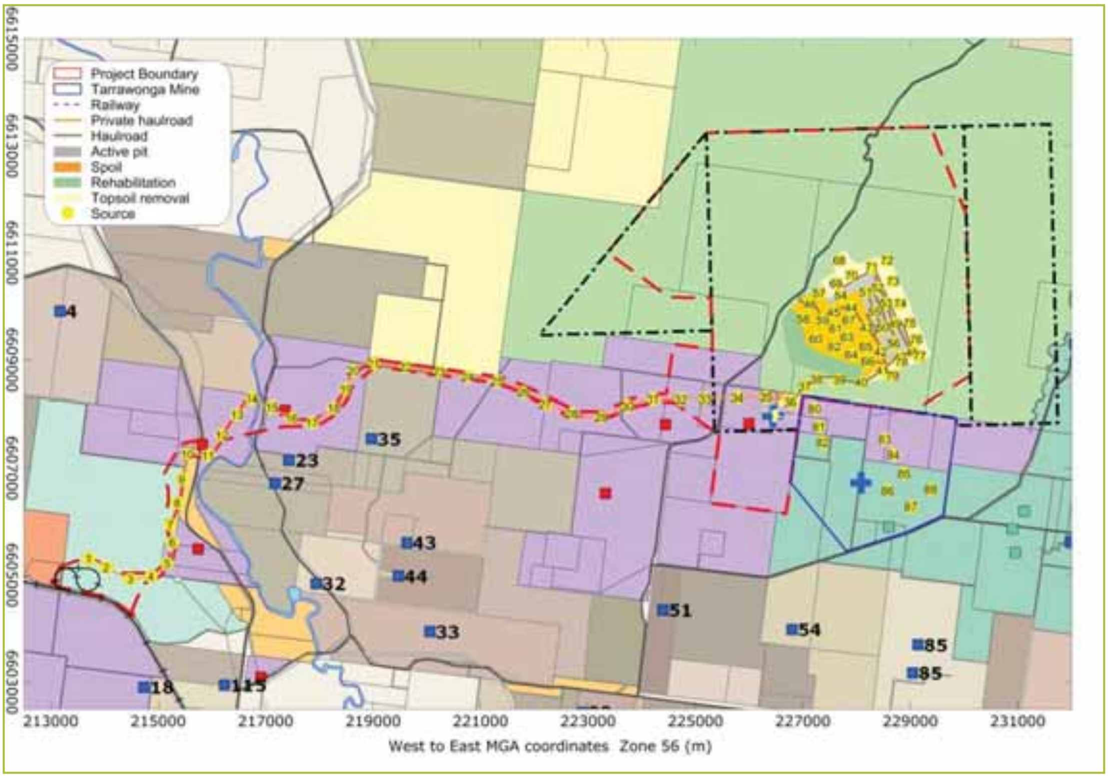


Figure 6.1: Modelling source locations for Year 1

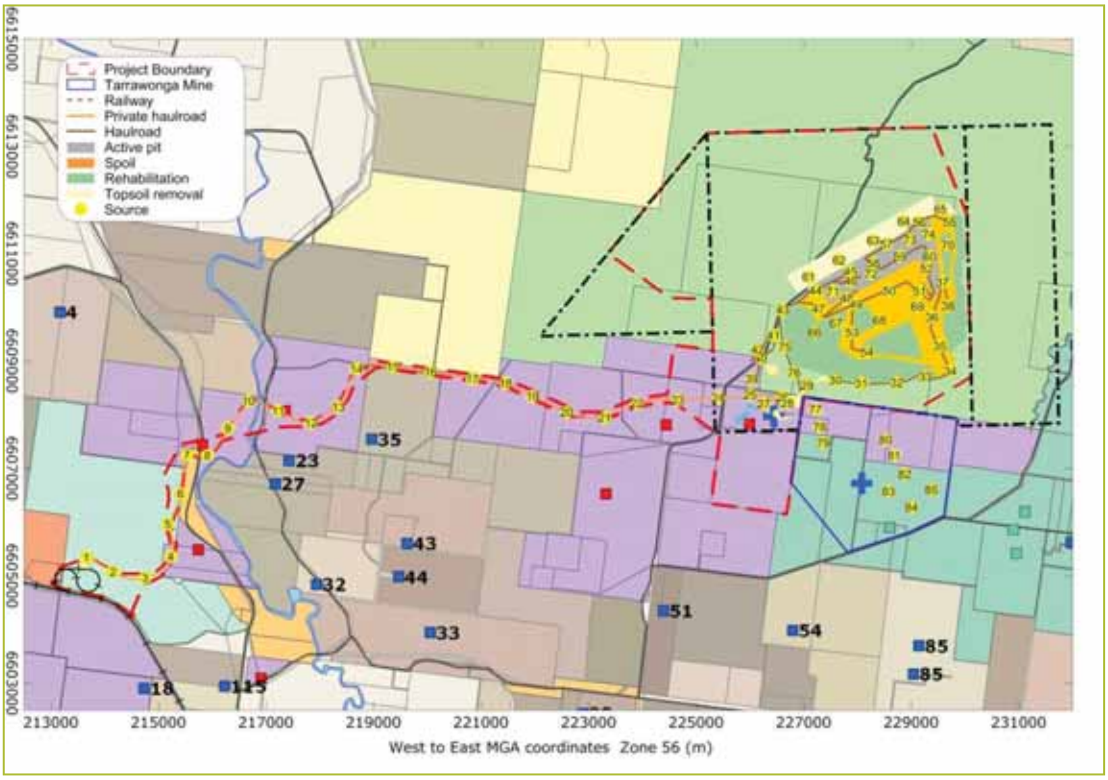


Figure 6.2: Modelling source locations for Year 5

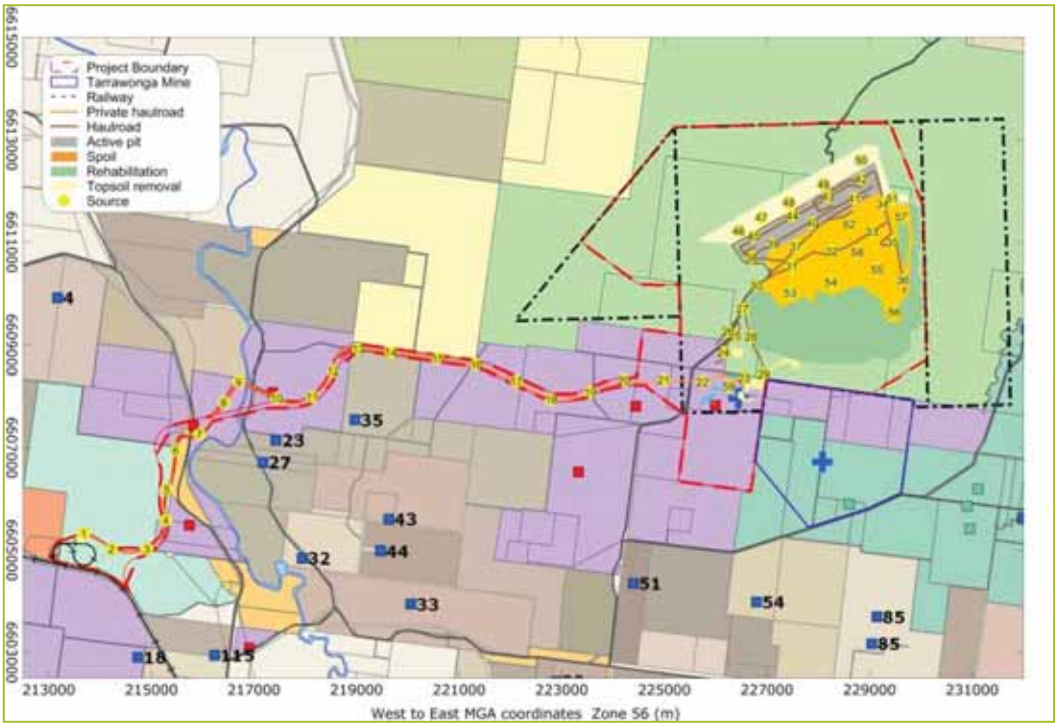


Figure 6.3: Modelling source locations for Year 10

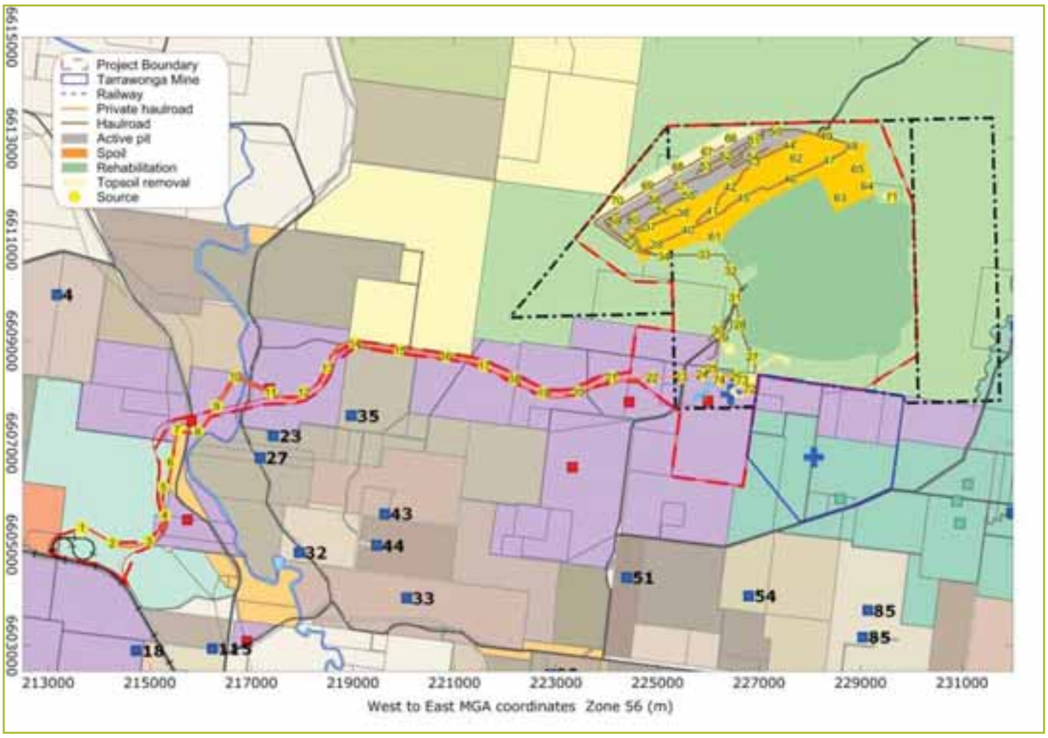


Figure 6.4: Modelling source locations for Year 21

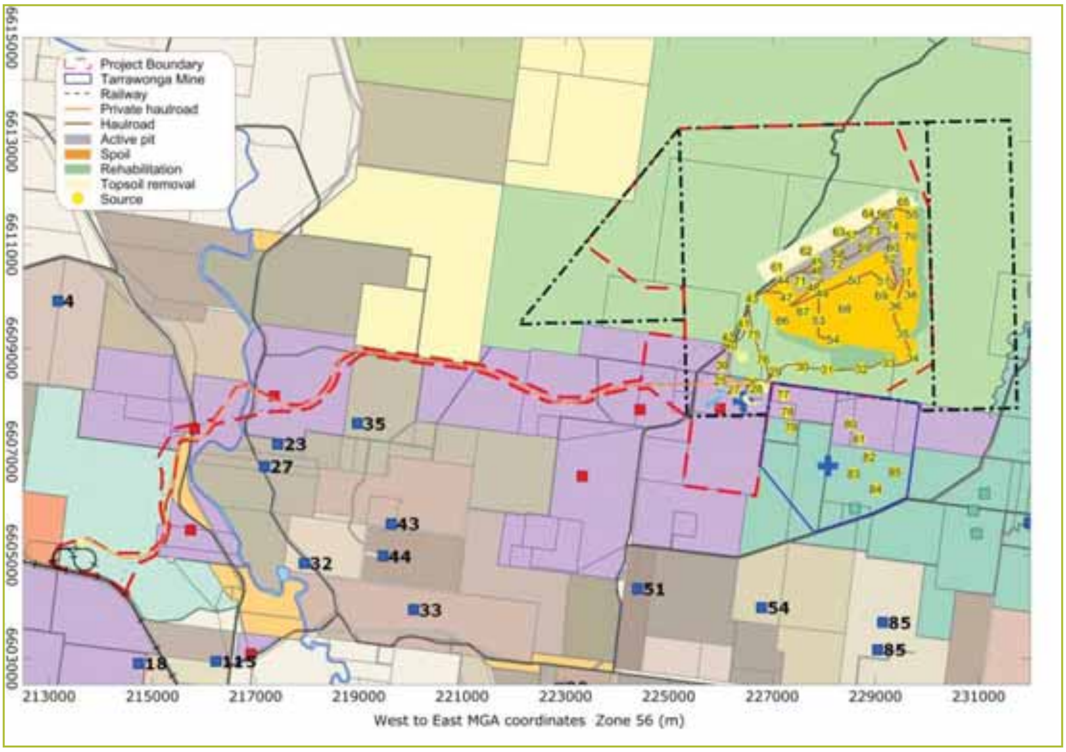


Figure 6.5: Modelling source locations for Year 5 (rail spur scenario)

6.3 Estimated emissions from neighbouring mines

The inventories used in the modelling of Year 1 and Year 5 include operations at the site and estimates of emissions from Tarrawonga Coal Mine located to the south of Boggabri Coal Mine. At the time the air quality impact assessment was completed, no information was available on the proposed modification to Tarrawonga Coal Mine. The potential impacts of this are assessed in **Section 8.11.2**.

In the cumulative modelling work, Tarrawonga Coal Mine has been treated as nine volume sources located at the apparent points of major emissions as estimated from the known locations of the pits and/or major dust sources on the mine or facility.

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

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

For the Tarrawonga Coal Mine, the proportion of emissions in each of these categories have been assumed to be:

- 0.73 for emissions independent of wind speed;
- 0.14 for emissions that depend on wind speed (such as loading and dumping); and
- 0.13 for wind erosion sources.

These factors are based on a detailed analysis of mine dust inventories undertaken as part of the Mount Arthur North EIS (**URS, 2000**) and these factors have been applied to subsequent air quality impact assessments for coal mines.

Appendix E presents a Simultaneous Worst Cast Cumulative Impact Scenario (SWCCIS) review of Other Projects that may proceed in the area, but for which no details are yet available.

6.4 Estimated emissions from other sources

In addition to those sources identified in **Section 6.3**, contributions from, for example, small local sources of dust such as dust from vehicles using private unsealed access roads, stock movements and fugitive emissions of coal dust from trains will contribute to $PM_{2.5}$, PM_{10}, TSP concentrations and dust deposition.

Estimating the background allowance for non-mining sources is difficult. A comparison of the predicted cumulative impact with the monitoring data,[f] suggests that the annual average quantity of particulate matter contributed to by these more distant sources is 12 µg/m^3 for annual average PM_{10}, 33 µg/m^3 for annual average TSP and 0.5 g/m^2/month for annual average deposited dust.

6.5 Emissions from construction activities

As discussed in **Section 3**, the Project also includes the construction of:

- Coal Handling and Preparation Plant (CHPP), conveyor and other auxiliary equipment;
- Flexibility to introduce a dragline;
- Modifications to existing site infrastructure capacities including: Run of Mine (ROM) coal hopper, second crusher, stockpile area, coal loading facilities, water management and irrigation system;
- Rail loop and 17 km rail line across the Namoi River and flood plain including overpasses across the Kamilaroi Highway, Therribri Road and Namoi River;
- Minor widening of the existing coal haul road including overpasses across the Kamilaroi Highway, Therribri Road and Namoi River; and
- Upgrading and relocating site facilities including offices, car parking and maintenance sheds as and when required.

While dust would be generated from earthworks associated with the proposed infrastructure upgrade and expansion, there are a number of safeguards that can be put in place during these types of operations to ensure there is no detrimental impact on the local air quality. Therefore the impacts have not been specifically modelled.

Nominal equipment to be used during the construction works will include:

- Scrapers;
- Graders;
- Excavators;
- Backhoes;
- Crane;

[f] At the time modelling was completed, monitoring data were only available up to July 2009.

- Smooth drum rollers;
- Pad foot rollers;
- Flat bed trucks;
- Fuel Truck;
- Water carts; and
- Dozers.

Mitigation measures to ensure minimal dust generation during construction may include:

- Establishment of vegetation on all disturbed areas as each stage is completed;
- All roadways, entrances and main traffic areas will be compacted, sealed or coated with a dust suppressant or mist spray regularly;
- Establishment of wind breaks composed of earth banks and other screens to protect areas by reducing capacity of the wind to raise dust;
- Trucks entering and leaving the site being well maintained in accordance with the manufacturer's specification to comply with all relevant regulations;
- Truck movements controlled onsite and restricted to designated roadways;
- Truck wheel washes or other dust removal procedures being installed to minimise transport of dust offsite; and
- Modifying construction activities during periods of high wind.

6.6 Emissions from rail transport

There is currently a Pollution Reduction Program in place for the Australian Rail Track Corporation (ARTC) in relation to fugitive coal dust emissions for the transport of coal on NSW's rail network. At present these mitigation strategies have not yet been released to the public.

However, in 2008 Connell Hatch investigated fugitive coal dust emissions from locomotives transporting coal in central Queensland along the Goonyella, Blackwater and Moura rail corridor (**Connell Hatch, 2008**). The main sources of the fugitive coal dust emissions were from:

- Coal surface of loaded wagons;
- Coal leakage from the doors of loaded wagons;
- Wind erosion of spilled coal in corridor;
- Residual coal in unloaded wagons and leakage of residual coal from doors; and
- Parasitic load on sill, shear plates and bogies of wagons.

The findings of this study showed that impacts of the coal loaded trains on ambient air quality were measurable at a distance of no more than 15 m from the track and that ground level PM_{10} concentrations were unlikely to exceed the NEPM air quality guidelines 10 m from the tracks in residential areas. Furthermore, the study also concluded that there was minimal risk of adverse impacts on human health due to the course nature of the coal particles and relatively low concentrations measured and predicted at the edge of the rail corridor. Impacts on amenity were also determined to be minimal as concentrations were found to be below levels that adversely affect amenity.

For the reasons stated above, this assessment has not included fugitive coal dust emissions from the transport of coal via the ARTC rail network.

7 ASSESSMENT METHODOLOGY

The DECCW's *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, the way in which emissions should be estimated and the relevant air quality criteria for assessing the significance of predicted concentration and deposition rates from the proposal. The approach taken in this assessment follows as close as possible to the approaches suggested by the *Approved Methods*.

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

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

The ISCST3 model has a tendency to overestimate short-term (24-hour) PM_{10} concentrations (see for example **Holmes Air Sciences, 2002** and **2006**). To overcome this difficulty it has been modified to create ISCMOD. ISCMOD is identical to ISC except that the horizontal plume spreading dispersion curves have been modified to adopt the recommendations of the American Meteorological Society's (AMS) expert panel on dispersion curves (**Hanna, 1977**) and the suggestions made by **Arya (1999)**. The suggested changes were recommended because, as the AMS panel notes, the original horizontal dispersion curves relate to an averaging time of three minutes and they recommend that these be adjusted to the one hour curves required by ISC. The change involves increasing the horizontal plume widths by a factor of 1.82 $(60 \text{ minutes} / 3 \text{ minute})^{0.2}$. The modifications improve the performance of the model in predicting 24-hour concentrations and make almost no difference to the annual average predictions.

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

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

The distribution of particles has been derived from measurements published by the SPCC **(SPCC, 1986)**. The distribution of particles in each particle size range is 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 performed using three ISC source groups with each group corresponding to a particle size category. Each source in the group was assumed to emit at the full TSP emission rate and to deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mean of the limits of the particle size range, except for the $PM_{2.5}$ group, which was assumed to have a particle size of 1 μm. The predicted concentration in the three plot output files for each group were then combined according to the weightings in the dot points above to determine the concentration of PM_{10} and TSP.

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

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

Operations were represented by a series of volume sources located according to the location of activities for the modelled scenario (as shown in **Figure 6.1** to **Figure 6.5**).

Dust concentrations and deposition rates have been predicted in the vicinity of the Project site for the four stages of the proposed operations. The local terrain and terrain on Boggabri Coal Mine at each stage of operations has been taken into consideration in the modelling. Pit retention has also been included.

The modelling was performed using the meteorological data discussed in **Section 5.1** and the dust emission estimates from **Section 6.2**. As an example, an ISCMOD input file is provided in **Appendix F**.

All activities have been modelled for 24 hours per day. **Appendix D** provides a summary of dust emissions, hours of emission and allocation of sources for each activity.

8 ASSESSMENT OF IMPACTS – PARTICULATE MATTER

8.1 Assessment criteria

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

The criteria are:

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

Contour plots for 24-hour and annual average $PM_{2.5}$ concentrations for the Project have been provided in **Appendix G**.

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

8.2 Approach to assessment

Dispersion model simulations have been undertaken for the proposed increase in coal production rate and mine site modifications. 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 Tarrawonga Coal Mine and other non-mining sources of dust. For each of the four scenarios, isopleth diagrams are presented for:

- The predicted maximum 24-hour average PM_{10} concentration for the Project alone;
- The predicted annual average PM_{10} concentration for the Project;
- The predicted annual average TSP concentration for the Project;
- The predicted annual average dust deposition for the Project;
- The predicted annual average PM_{10} concentration for the Project with other sources of particulate matter;
- The predicted annual average TSP concentration for the Project with other sources of particulate matter; and
- The predicted annual average dust deposition for the Project with other sources of particulate matter.

Rather than provide a detailed discussion of each isopleth figure, the following sections provide a summary of the results in tabular form for each year. The nearby residences are listed, with those that are predicted to experience particulate matter deposition or concentration levels above the NSW DECCW's assessment criteria shown in bold. The contour plots of dust concentrations and deposition levels show the areas of land that are affected by dust at different levels.

In recent Conditions of Consent, the Department of Planning has interpreted the 24-hour PM_{10} criterion of 50 $\mu g/m^3$ as being applicable to the Project when considered in isolation at the 98.6^{th} 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 the Project on its own, a table of the predicted impacts at the nearby residences is presented for each year of the assessment (**Section 8.9**). For those residences where the criterion of 50 $\mu g/m^3$ is predicted to be exceeded, an assessment of the number of days in the year above the criteria has also been presented.

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 (see **Section 8.9.2**). 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.

8.3 Year 1

Table 8-1 presents the predicted dust concentration results for all receptors in the vicinity of the Project and highlights in bold those values above the relevant project specific criteria or cumulative criteria where the Project is expected to influence air quality.

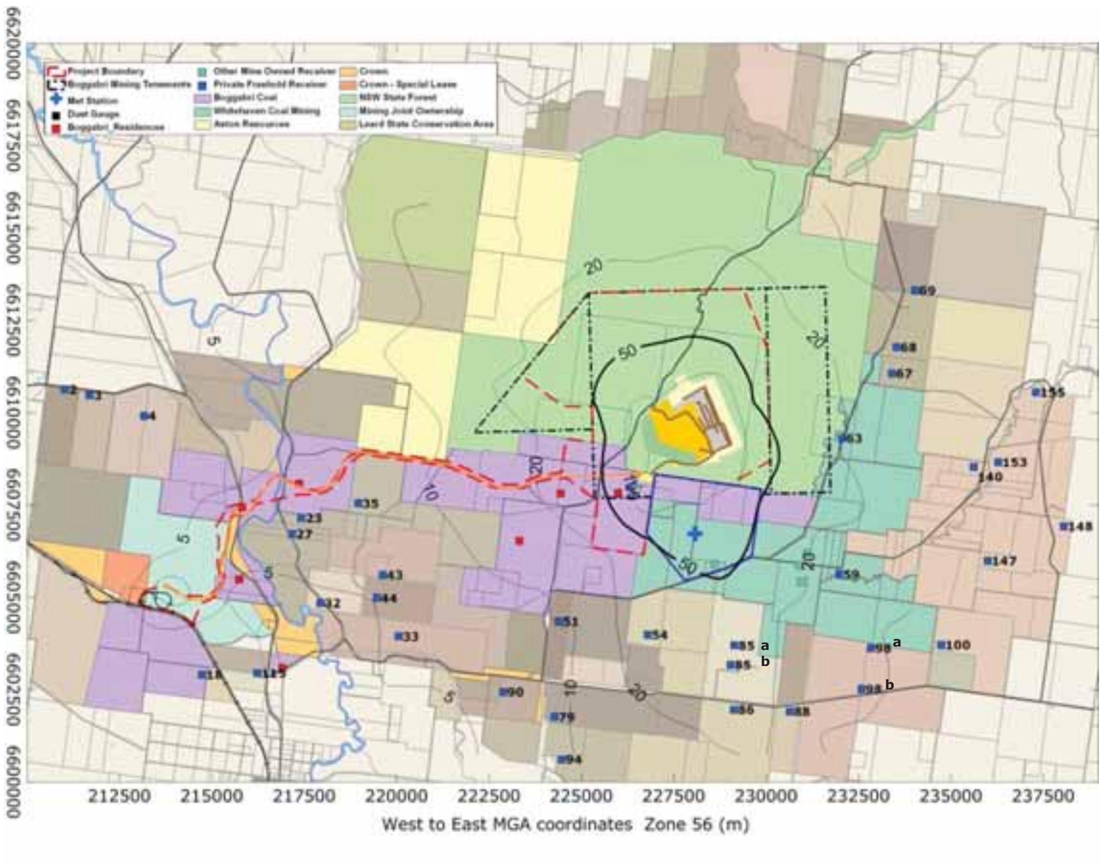
Figure 8.1 to **Figure 8.7** show the predicted annual average PM_{10} and TSP concentrations and dust deposition levels for operations in Year 1 showing the effects of the Project by itself and the Project in combination with other sources.

In summary, no exceedances of the DECCW goals have been predicted for Year 1.

Table 8-1: Predicted PM_{10}, TSP and dust deposition for Year 1

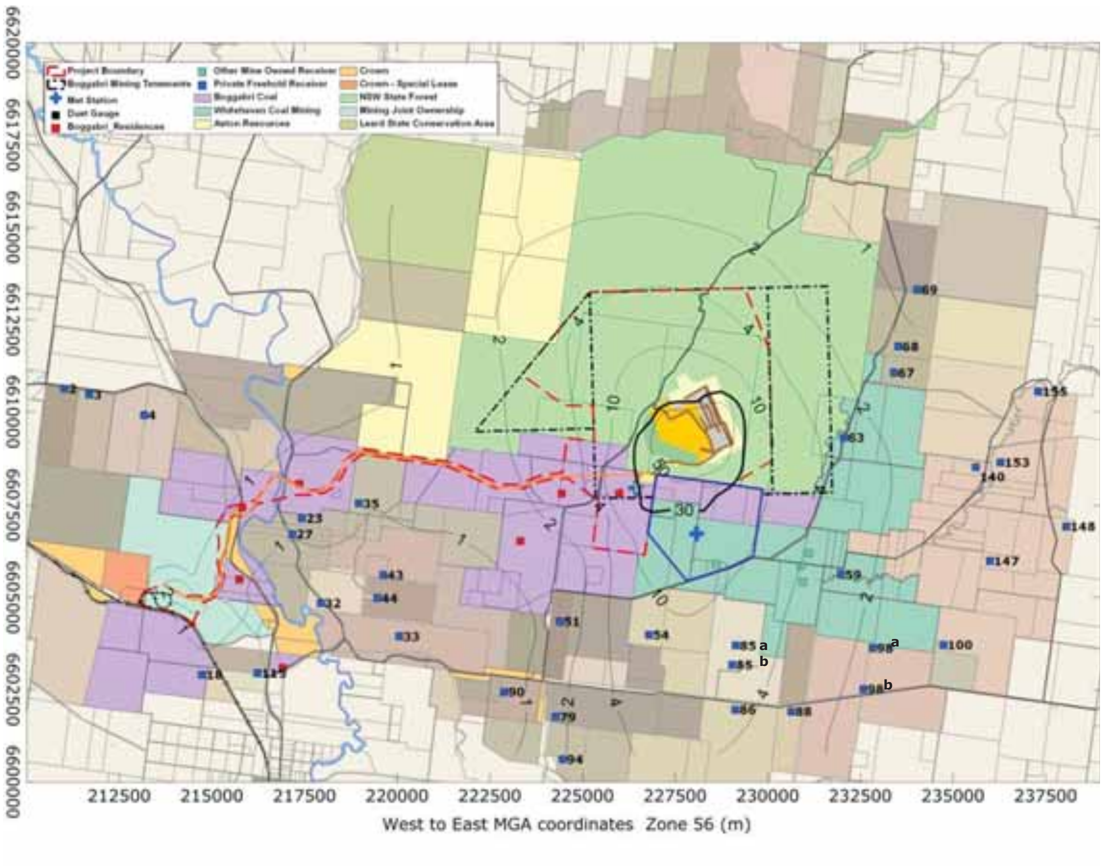
		Project alone				Project and other sources		
		PM_{10} ($\mu g/m^3$)		TSP ($\mu g/m^3$)	Dust Deposition ($g/m^2/month$)	PM_{10} ($\mu g/m^3$)	TSP ($\mu g/m^3$)	Dust Deposition ($g/m^2/month$)
Averaging Period		24-hour	Annual	Annual	Annual	Annual	Annual	Annual
		Impact Assessment Criteria						
Owner	ID	*50*	*30*	*90*	*2*	*30*	*90*	*4*
FJ Maunder	2	3	0	0	0.0	12	33	0.5
RB & ML Kerr	3	3	0	0	0.0	12	33	0.5
Glek Pty Ltd	4	3	0	0	0.0	13	34	0.5
H & M Bullock[(a)]	18	3	1	1	0.0	13	34	0.5
Cooboobindi	23	7	1	2	0.0	14	35	0.5
Cooboobindi	27	6	1	1	0.0	13	34	0.5
Billabong	32	4	1	1	0.0	13	34	0.5
Brighton	33	6	1	1	0.0	13	34	0.5
Belleview	35	7	1	1	0.0	14	35	0.5
Roma	43	6	1	1	0.0	13	34	0.5
Glenhope	44	5	1	1	0.0	13	34	0.5
Jeralong	51	11	1	1	0.0	14	35	0.5
Tarrawonga	54	29	8	8	0.1	26	47	0.7
DC & EL Cheeseman[(b)]	59	14	3	3	0.1	17	38	0.7
Bradlock Pty Ltd[(b)]	63	21	3	3	0.2	16	37	0.7
Goonbri	67	12	1	1	0.0	14	35	0.6
Goonbri	68	13	1	1	0.0	14	35	0.5
Wirrilah	69	8	1	1	0.0	13	34	0.5
Northham	79	8	1	2	0.0	14	35	0.5
Ambardo	85a	32	6	6	0.1	28	49	0.7
Ambardo	85b	35	6	6	0.1	30	52	0.7
Kyalla	86	26	5	5	0.0	23	44	0.6
Pine Grove	88	15	3	3	0.0	18	39	0.6
Barbers Lagoon	90	6	1	1	0.0	13	34	0.5
Callandar	94	8	2	2	0.0	15	36	0.5
Flixton	98a	11	2	2	0.0	15	36	0.6
Flixton	98b	11	2	2	0.0	15	36	0.6
Bailey Park	100	8	1	1	0.0	14	35	0.6
Hazeldene	115	3	1	1	0.0	13	34	0.5
JE & RJ Picton	140	9	1	1	0.0	14	35	0.6
JE & RJ Picton	147	10	1	1	0.1	14	35	0.6
JE & RJ Picton	148	6	1	1	0.0	13	34	0.5
JE & RJ Picton	153	8	1	1	0.0	13	35	0.5
JE & RJ Picton	155	5	1	1	0.0	13	34	0.5

(a) Purchased by Boggabri Coal after the air quality assessment was completed.
(b) Purchased by Tarrawonga Mine after the air quality assessment was completed.



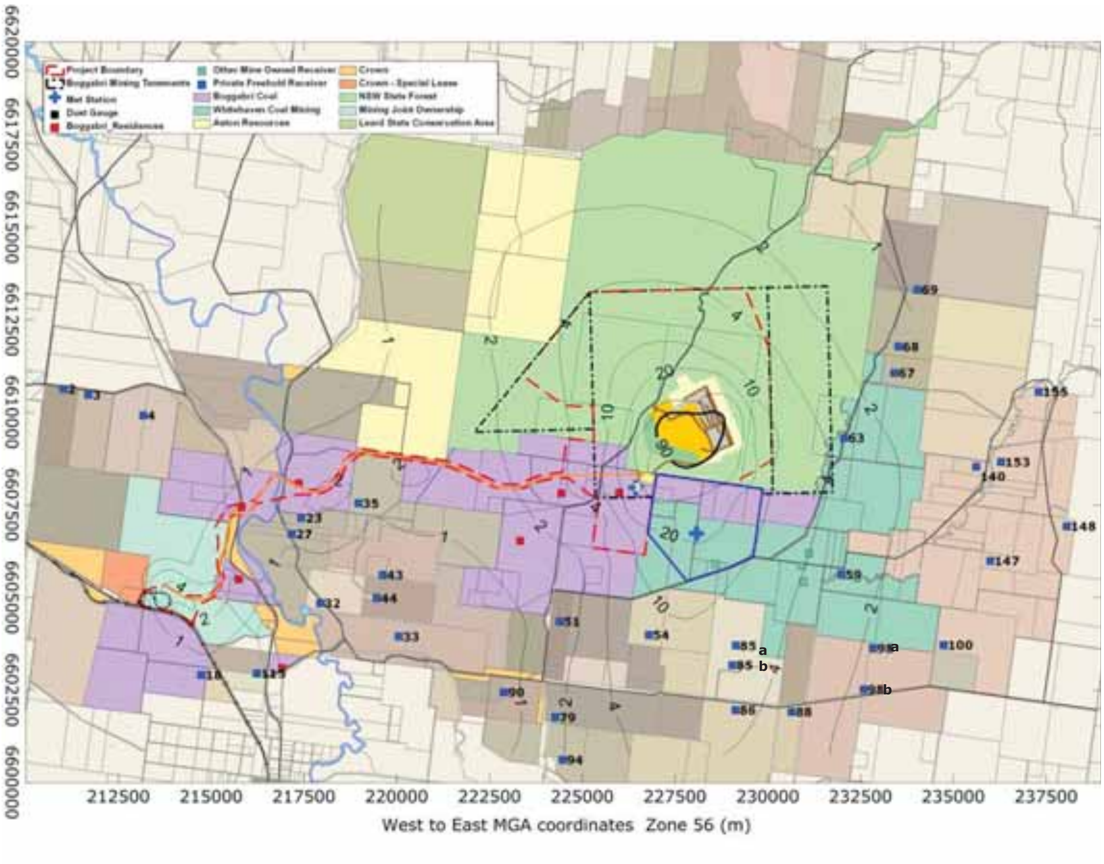
Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
PM_{10}	Boggabri Mine	Year 1	Maximum	24-hour
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	50 µg/m^3	Boggabri 08/09	J Beaney

Figure 8.1: Predicted maximum 24-hour average PM_{10} concentrations due to emissions for the Project alone – Year 1



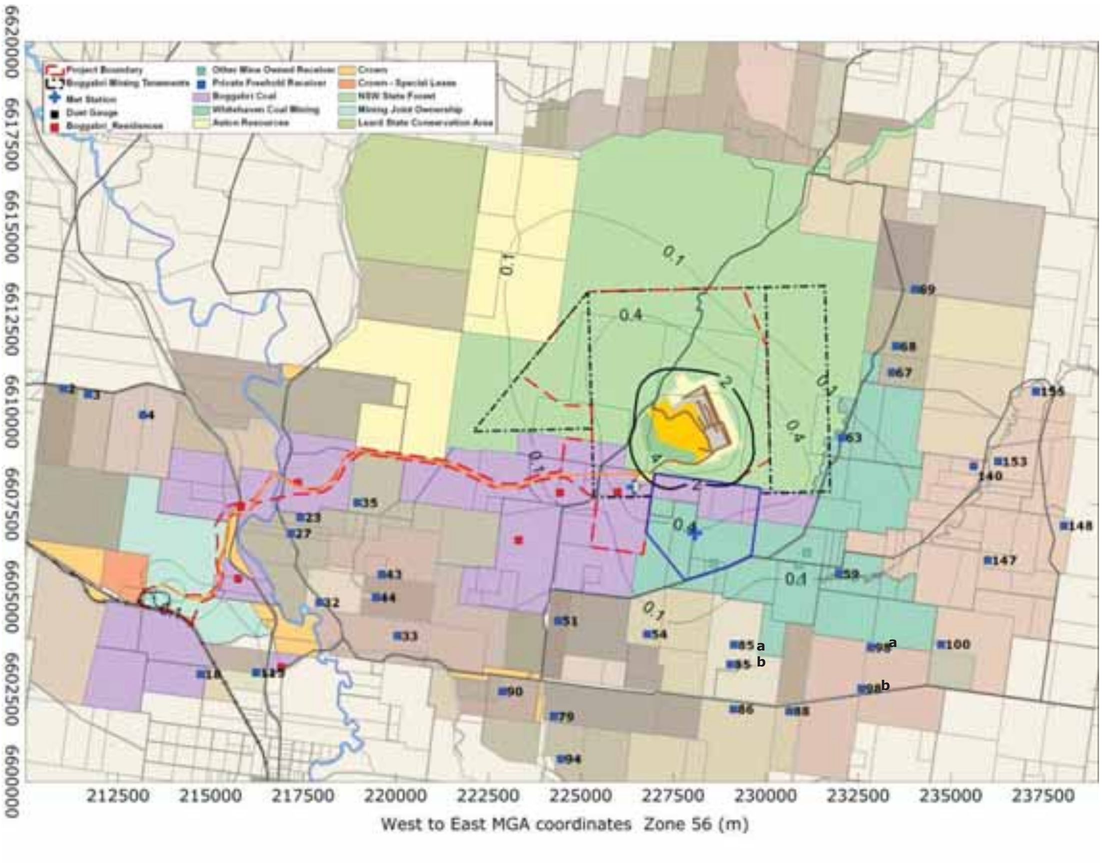
Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Boggabri Mine	Year 1	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	n/a	Boggabri 08/09	J Beaney

Figure 8.2: Predicted annual average PM_{10} concentrations due to emissions for the Project alone – Year 1



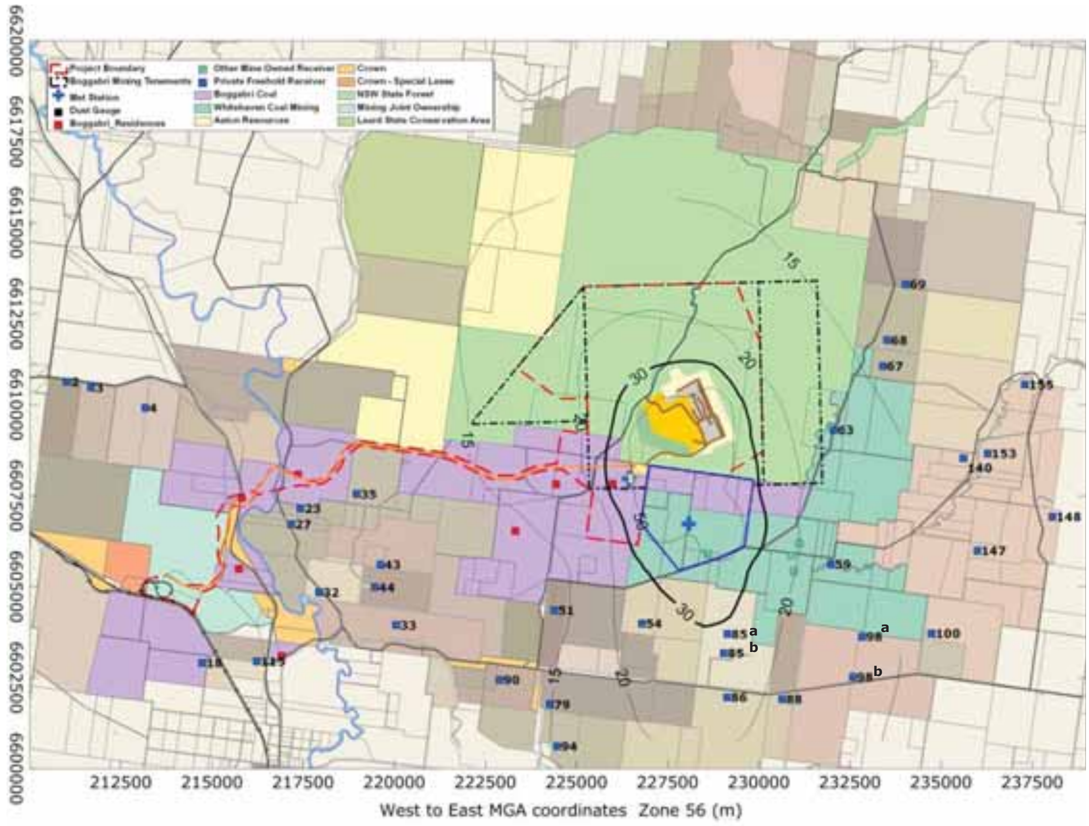
Species:	Location:	Scenario:	Percentile:	Averaging Time:
TSP	Boggabri Mine	Year 1	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m³	n/a	Boggabri 08/09	J Beaney

Figure 8.3: Predicted annual average TSP concentrations due to emissions for the Project alone – Year 1



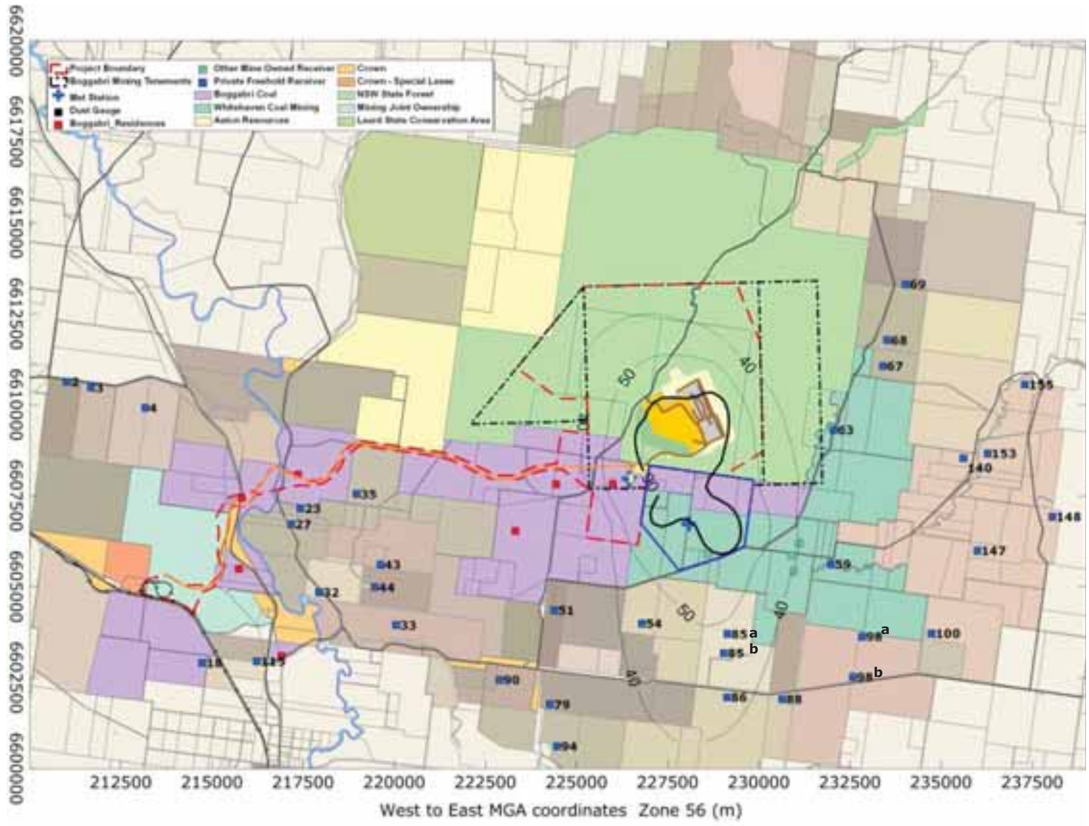
Species:	Location:	Scenario:	Percentile:	Averaging Time:
Dust deposition	Boggabri Mine	Year 1	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	g/m^2/month	2 µg/m^3	Boggabri 08/09	J Beaney

Figure 8.4: Predicted annual average dust deposition levels due to emissions for the Project alone – Year 1



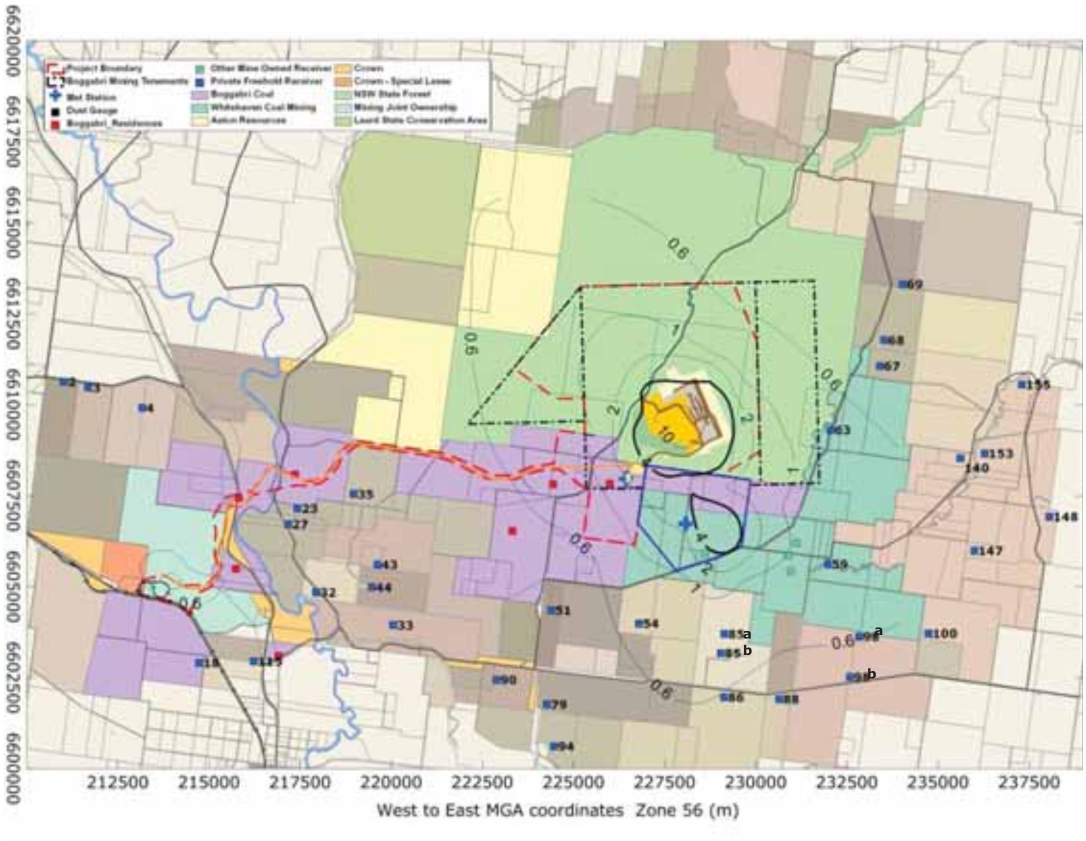
Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
PM_{10}	Boggabri Mine	Year 1	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	$\mu g/m^3$	30 $\mu g/m^3$	Boggabri 08/09	J Beaney

Figure 8.5: Predicted annual average PM_{10} concentrations due to emissions from the Project and other sources- Year 1



Species:	Location:	Scenario:	Percentile:	Averaging Time:
TSP	Boggabri Mine	Year 1	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	90 µg/m^3	Boggabri 08/09	J Beaney

Figure 8.6: Predicted annual average TSP concentrations due to emissions from the Project and other sources – Year 1



Species:	Location:	Scenario:	Percentile:	Averaging Time:
Dust deposition	Boggabri Mine	Year 1	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m³	4 g/m²/month	Boggabri 08/09	J Beaney

Figure 8.7: Predicted annual average dust deposition levels due to emissions from the Project and other sources – Year 1

8.4 Year 5

Figure 8.8 to **Figure 8.14** show the predicted annual average PM_{10} and TSP concentrations and dust deposition levels for operations in Year 5 showing the effects of the Project by itself and the Project in combination with other sources.

Table 8-2 presents the predicted dust concentration results for all receptors in the vicinity of the Project and highlights in bold those values above the relevant project specific criteria or cumulative criteria where the Project is expected to influence air quality.

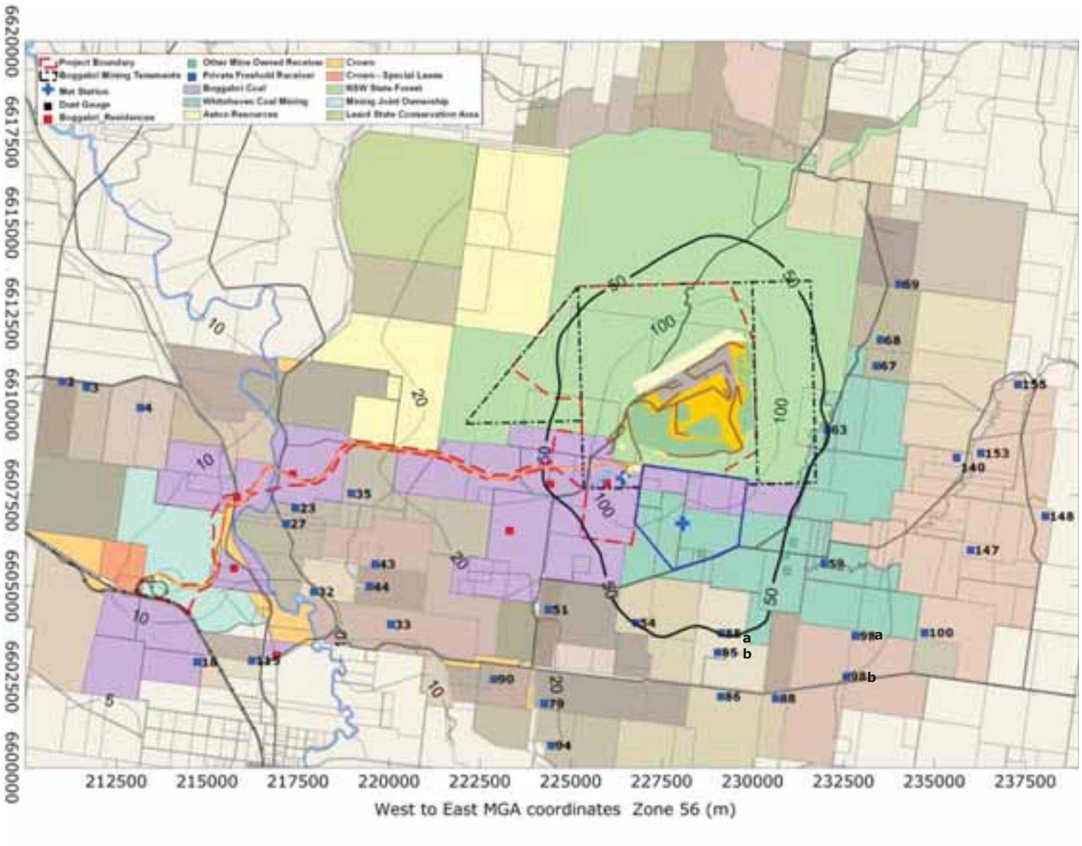
In summary for Year 5, the following receptors where criteria are exceeded have been identified:

- Annual average PM_{10} above 30 µg/m³ due to the Project and other mines and other sources – Two privately owned residences (Tarrawonga and Ambardo) - see **Figure 8.12**.

Table 8-2: Predicted PM10, TSP and dust deposition for Year 5

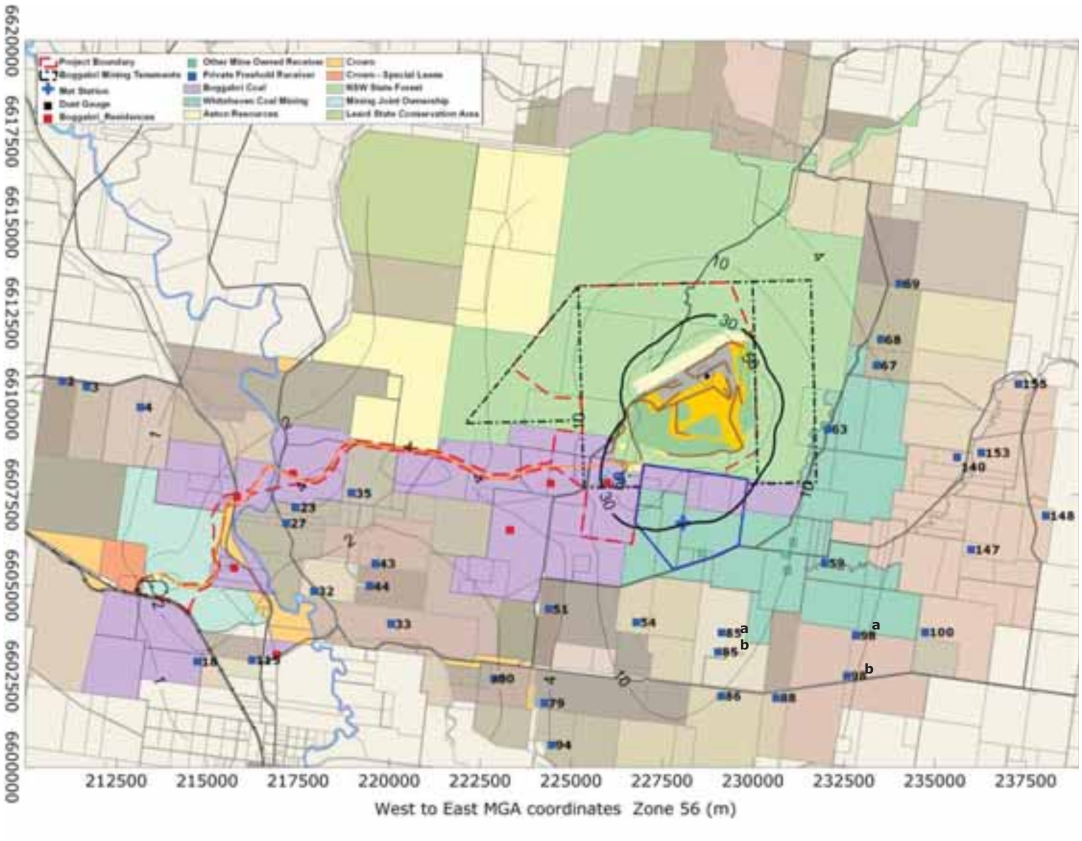
		Project alone				Project and other sources		
		PM_{10} (µg/m³)		TSP (µg/m³)	Dust Deposition (g/m²/month)	PM_{10} (µg/m³)	TSP (µg/m³)	Dust Deposition (g/m²/month)
Averaging Period		24-hour	Annual	Annual	Annual	Annual	Annual	Annual
Owner	ID	*Impact Assessment Criteria*						
		50	*30*	*90*	*2*	*30*	*90*	*4*
FJ Maunder	2	5	1	1	0.0	13	34	0.5
RB & ML Kerr	3	5	1	1	0.0	13	34	0.5
Glek Pty Ltd	4	6	1	1	0.0	13	34	0.5
H & M Bullock[(a)]	18	7	2	2	0.0	14	35	0.5
Cooboobindi	23	14	3	3	0.1	15	36	0.6
Cooboobindi	27	13	3	3	0.1	15	36	0.6
Billabong	32	10	2	2	0.0	14	35	0.5
Brighton	33	13	1	1	0.0	14	35	0.5
Belleview	35	15	3	3	0.1	15	36	0.6
Roma	43	13	2	2	0.0	14	35	0.5
Glenhope	44	12	1	2	0.0	14	35	0.5
Jeralong	51	22	3	3	0.0	16	37	0.6
Tarrawonga	54	50	15	15	0.1	**33**	54	0.7
DC & EL Cheeseman[(b)]	59	32	7	7	0.1	21	42	0.8
Bradlock Pty Ltd[(b)]	63	50	8	9	0.5	21	43	1.1
Goonbri	67	31	4	4	0.1	17	38	0.6
Goonbri	68	28	3	4	0.1	16	37	0.6
Wirrilah	69	27	3	3	0.1	15	36	0.6
Northham	79	16	3	4	0.0	16	37	0.5
Ambardo	85a	47	12	13	0.1	**34**	56	0.7
Ambardo	85b	50	13	14	0.1	**37**	59	0.8
Kyalla	86	40	10	10	0.1	28	50	0.6
Pine Grove	88	40	7	7	0.1	22	44	0.6
Barbers Lagoon	90	14	2	2	0.0	14	35	0.5
Callandar	94	16	4	4	0.0	17	38	0.5
Flixton	98a	23	4	4	0.1	18	39	0.6
Flixton	98b	19	4	4	0.1	18	39	0.6
Bailey Park	100	15	3	3	0.1	16	37	0.6
Hazeldene	115	7	1	1	0.0	14	35	0.5
JE & RJ Picton	140	19	3	3	0.1	15	37	0.6
JE & RJ Picton	147	20	2	3	0.1	15	36	0.6
JE & RJ Picton	148	15	2	2	0.1	14	35	0.6
JE & RJ Picton	153	16	2	3	0.1	15	36	0.6
JE & RJ Picton	155	14	2	2	0.0	14	35	0.6

(a) Purchased by Boggabri Coal after the air quality assessment was completed.
(b) Purchased by Tarrawonga Mine after the air quality assessment was completed.



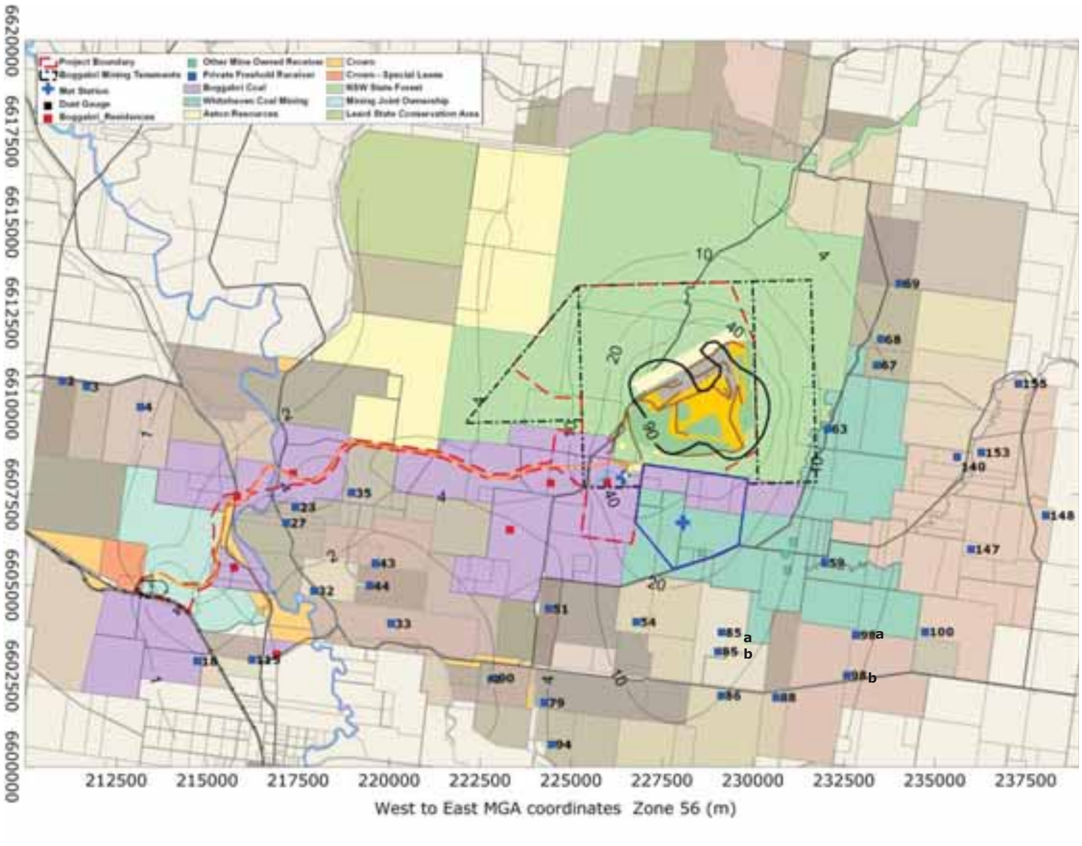
Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Boggabri Mine	Year 5	Maximum	24-hour
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	50 µg/m^3	Boggabri 08/09	J Beaney

Figure 8.8: Predicted maximum 24-hour average PM_{10} concentrations due to emissions for the Project alone – Year 5



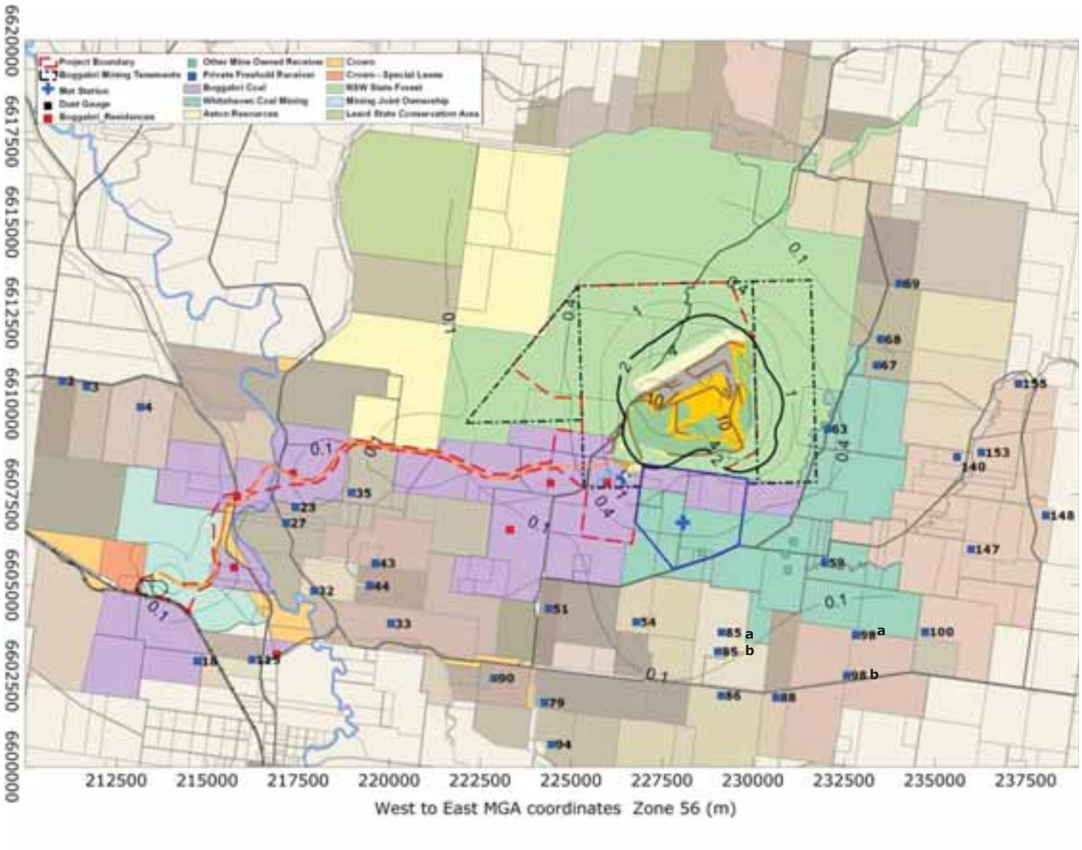
Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Boggabri Mine	Year 5	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	n/a	Boggabri 08/09	J Beaney

Figure 8.9: Predicted annual average PM_{10} concentrations due to emissions for the Project alone – Year 5



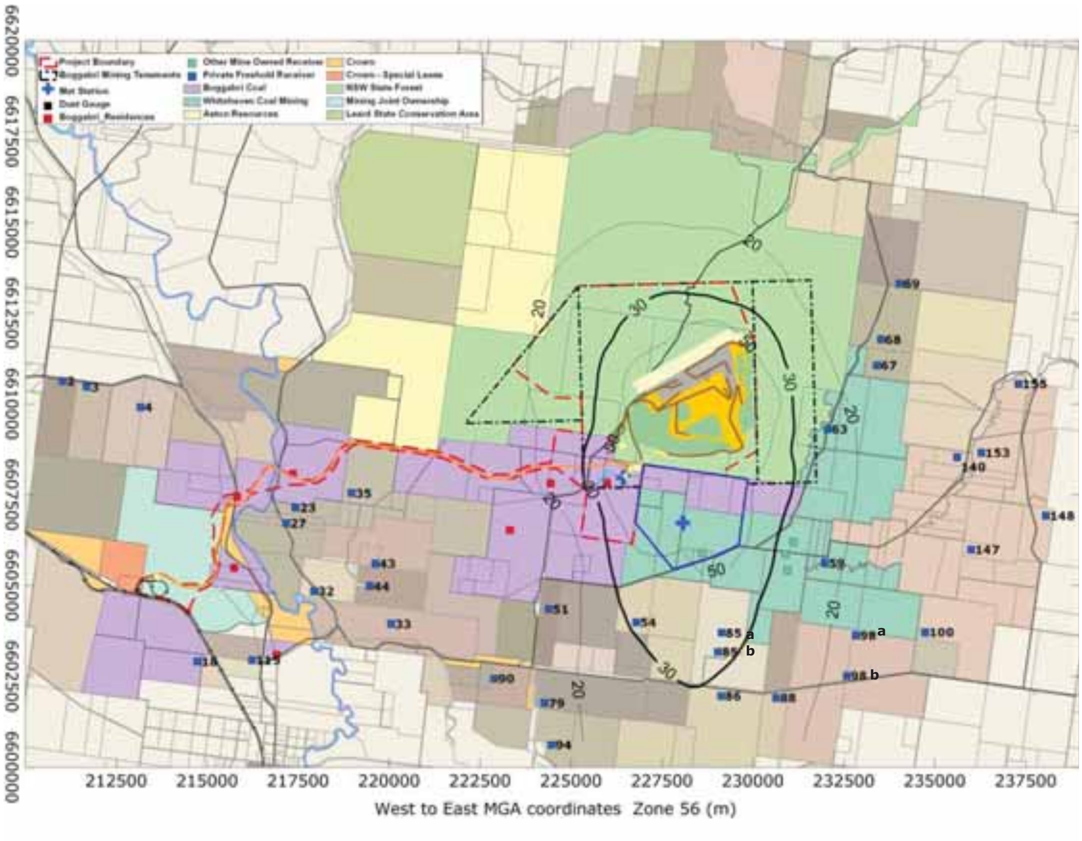
Species:	Location:	Scenario:	Percentile:	Averaging Time:
TSP	Boggabri Mine	Year 5	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	n/a	Boggabri 08/09	J Beaney

Figure 8.10: Predicted annual average TSP concentrations due to emissions for the Project alone – Year 5



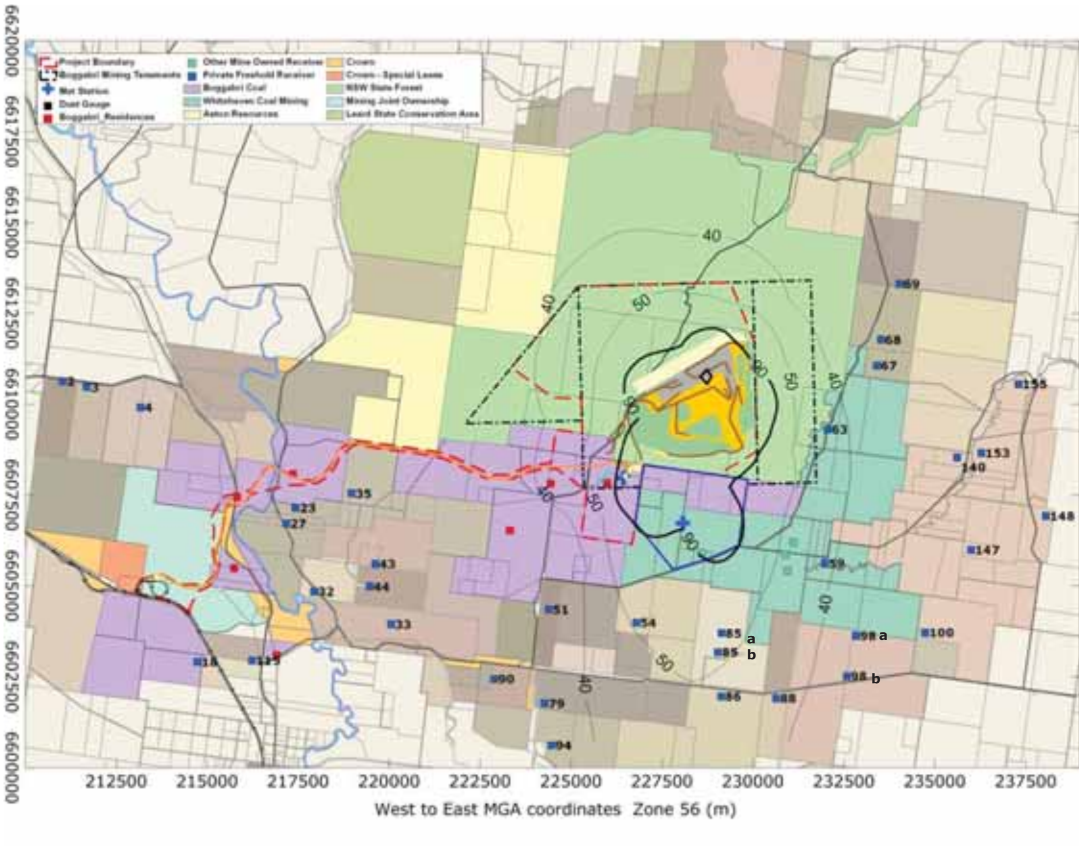
Species:	Location:	Scenario:	Percentile:	Averaging Time:
Dust deposition	Boggabri Mine	Year 5	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	g/m^2/month	2 $\mu g/m^3$	Boggabri 08/09	J Beaney

Figure 8.11: Predicted annual average dust deposition levels due to emissions for the Project alone – Year 5



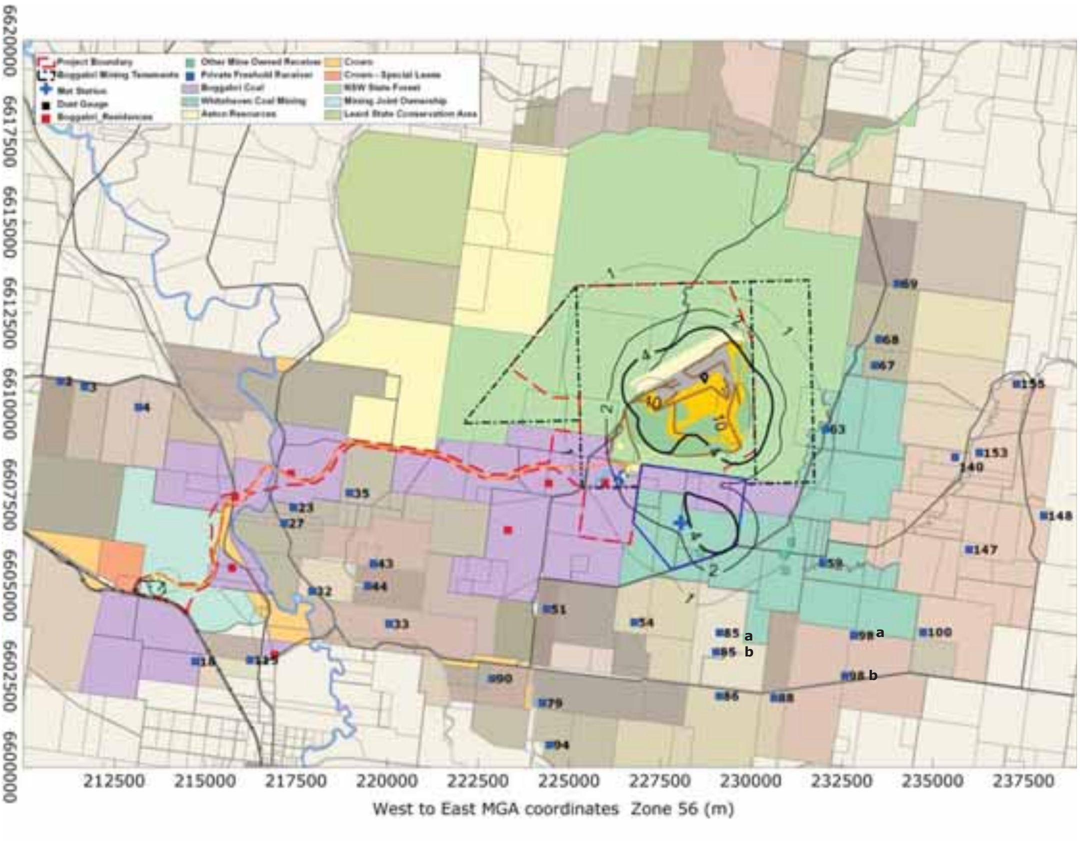
Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
PM_{10}	Boggabri Mine	Year 5	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m³	30 µg/m³	Boggabri 08/09	J Beaney

Figure 8.12: Predicted annual average PM_{10} concentrations due to emissions from the Project and other sources- Year 5



Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
TSP	Boggabri Mine	Year 5	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	90 µg/m^3	Boggabri 08/09	J Beaney

Figure 8.13: Predicted annual average TSP concentrations due to emissions from the Project and other sources – Year 5



Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
Dust deposition	Boggabri Mine	Year 5	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	4 g/m^2/month	Boggabri 08/09	J Beaney

Figure 8.14: Predicted annual average dust deposition levels due to emissions from the Project and other sources – Year 5

8.5 Year 10

Table 8-3 presents the predicted dust concentration results for all receptors in the vicinity of the Project and highlights in bold those values above the relevant project specific criteria or cumulative criteria where the Project is expected to influence air quality.

Figure 8.15 to **Figure 8.21** show the predicted annual average PM_{10} and TSP concentrations and dust deposition levels for operations in Year 1 showing the effects of the Project by itself and the Project in combination with other sources.

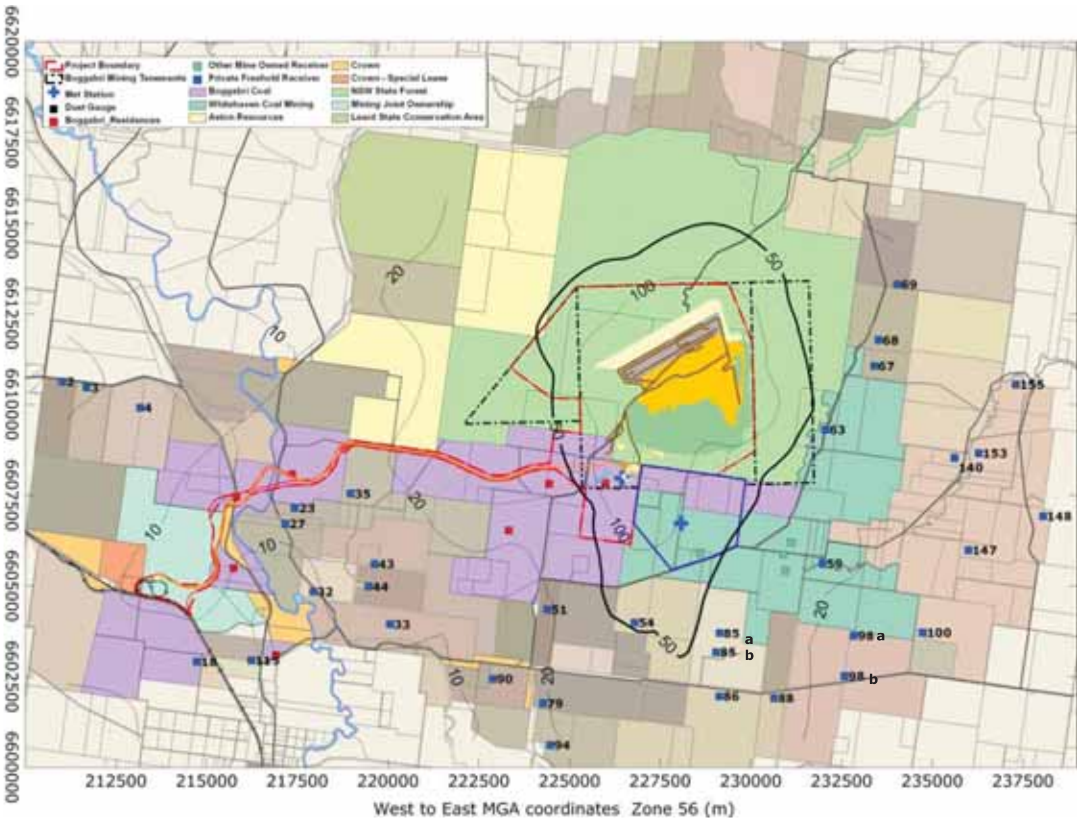
In summary for Year 10, the following receptors where criteria are exceeded have been identified:

- 24-hour average PM_{10} above 50 µg/m^3 due to the Project alone – One Privately owned residence (Tarrawonga)

Table 8-3: Predicted PM_{10}, TSP and dust deposition for Year 10

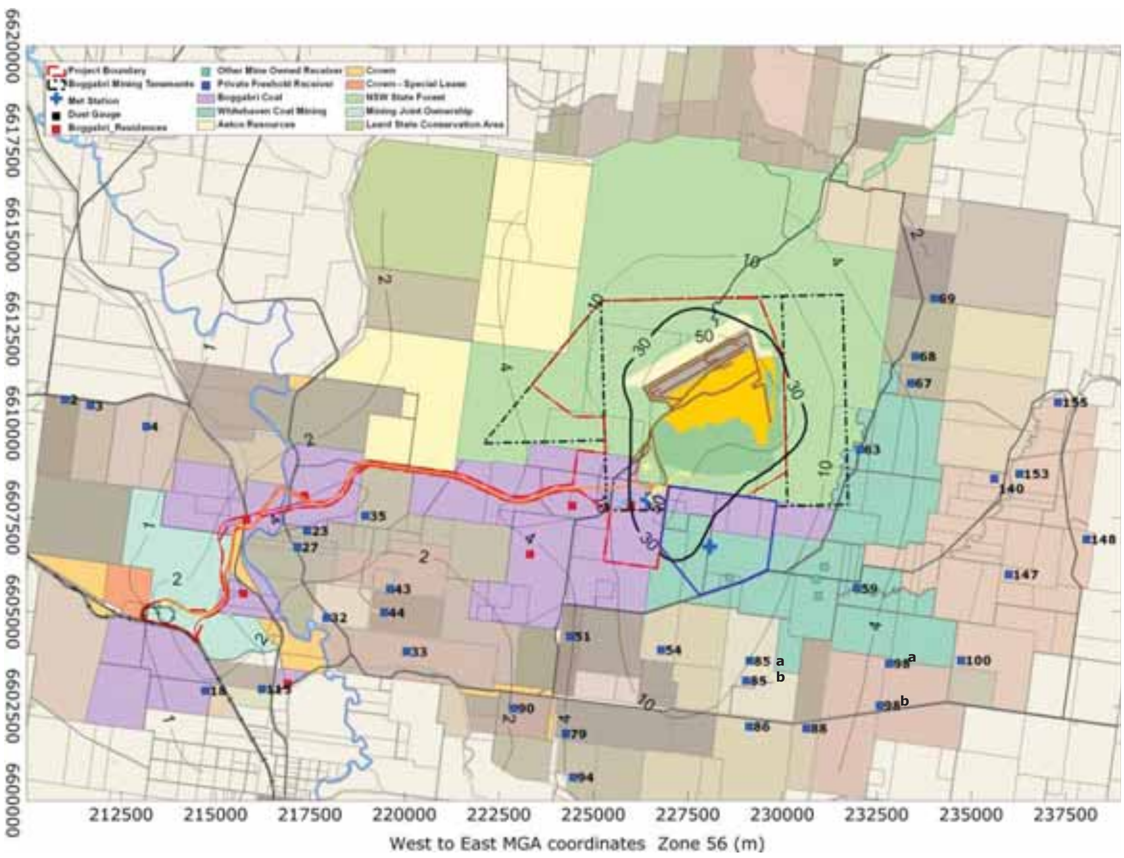
		Project alone				Project and other sources		
		PM_{10} (µg/m^3)		TSP (µg/m^3)	Dust Deposition (g/m^2/month)	PM_{10} (µg/m^3)	TSP (µg/m^3)	Dust Deposition (g/m^2/month)
Averaging Period		24-hour	Annual	Annual	Annual	Annual	Annual	Annual
Owner	ID	*Impact Assessment Criteria*						
		50	*30*	*90*	*2*	*30*	*90*	*4*
FJ Maunder	2	4	1	1	0.0	13	34	0.5
RB & ML Kerr	3	5	1	1	0.0	13	34	0.5
Glek Pty Ltd	4	6	1	1	0.0	13	34	0.5
H & M Bullock[(a)]	18	6	2	2	0.0	14	35	0.5
Cooboobindi	23	15	3	4	0.1	15	37	0.6
Cooboobindi	27	11	3	3	0.1	15	36	0.6
Billabong	32	10	2	2	0.0	14	35	0.5
Brighton	33	11	1	1	0.0	13	34	0.5
Belleview	35	14	3	3	0.1	15	36	0.6
Roma	43	13	2	2	0.0	14	35	0.5
Glenhope	44	12	2	2	0.0	14	35	0.5
Jeralong	51	18	4	4	0.0	16	37	0.5
Tarrawonga	54	**52**	14	15	0.1	26	48	0.6
DC & EL Cheeseman[(b)]	59	22	5	5	0.1	17	38	0.6
Bradlock Pty Ltd[(b)]	63	41	6	7	0.5	18	40	1.0
Goonbri	67	27	4	4	0.2	16	37	0.7
Goonbri	68	24	3	3	0.1	15	36	0.6
Wirrilah	69	20	2	2	0.1	14	35	0.6
Northham	79	17	4	4	0.0	16	37	0.5
Ambardo	85a	41	9	10	0.1	21	43	0.6
Ambardo	85b	41	10	10	0.1	22	43	0.6
Kyalla	86	37	8	8	0.1	20	41	0.6
Pine Grove	88	26	5	6	0.1	17	39	0.6
Barbers Lagoon	90	12	2	2	0.0	14	35	0.5
Callandar	94	19	4	4	0.0	16	37	0.5
Flixton	98a	16	3	4	0.1	15	37	0.6
Flixton	98b	14	3	3	0.0	15	36	0.5
Bailey Park	100	12	2	2	0.1	14	35	0.6
Hazeldene	115	7	1	1	0.0	13	34	0.5
JE & RJ Picton	140	18	2	3	0.1	14	36	0.6
JE & RJ Picton	147	16	2	2	0.1	14	35	0.6
JE & RJ Picton	148	14	2	2	0.1	14	35	0.6
JE & RJ Picton	153	16	2	2	0.1	14	35	0.6
JE & RJ Picton	155	13	2	2	0.1	14	35	0.6

(a) Purchased by Boggabri Coal after the air quality assessment was completed.
(b) Purchased by Tarrawonga Mine after the air quality assessment was completed.



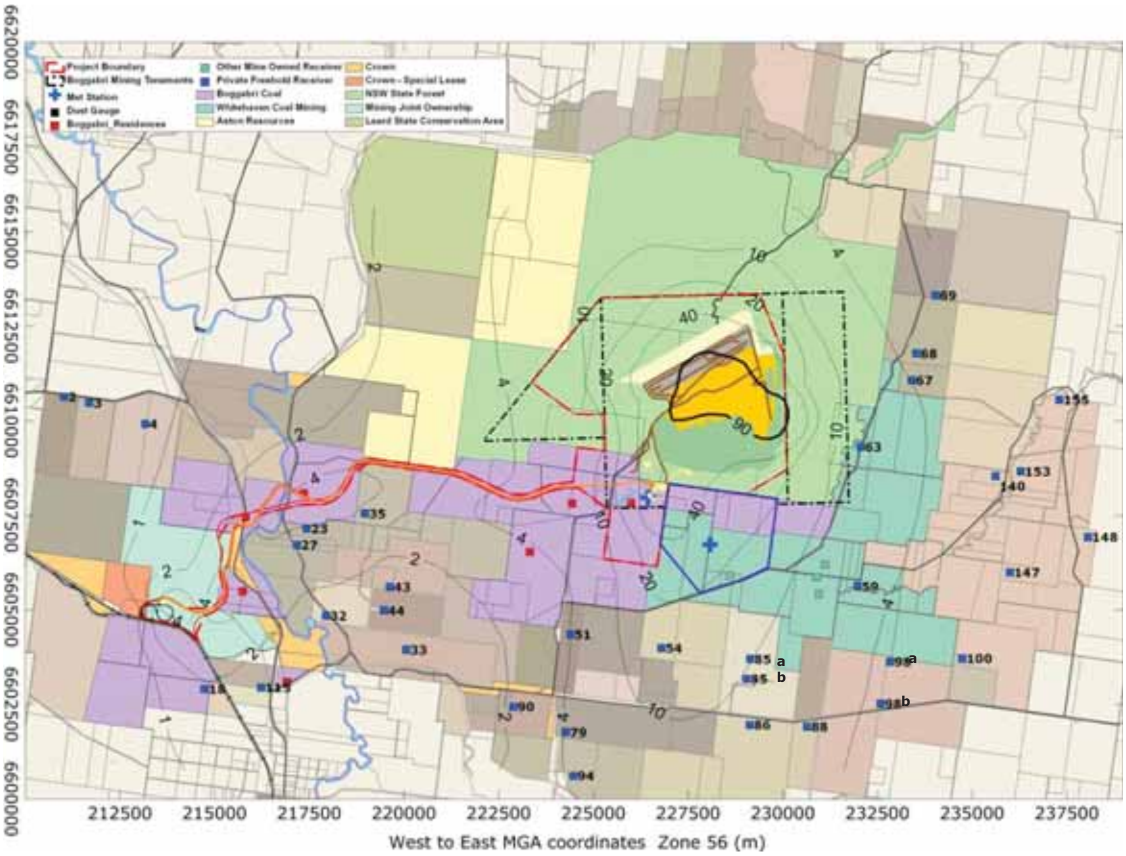
Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Boggabri Mine	Year 10	Maximum	24-hour
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	50 µg/m^3	Boggabri 08/09	J Beaney

Figure 8.15: Predicted maximum 24-hour average PM_{10} concentrations due to emissions for the Project alone – Year 10



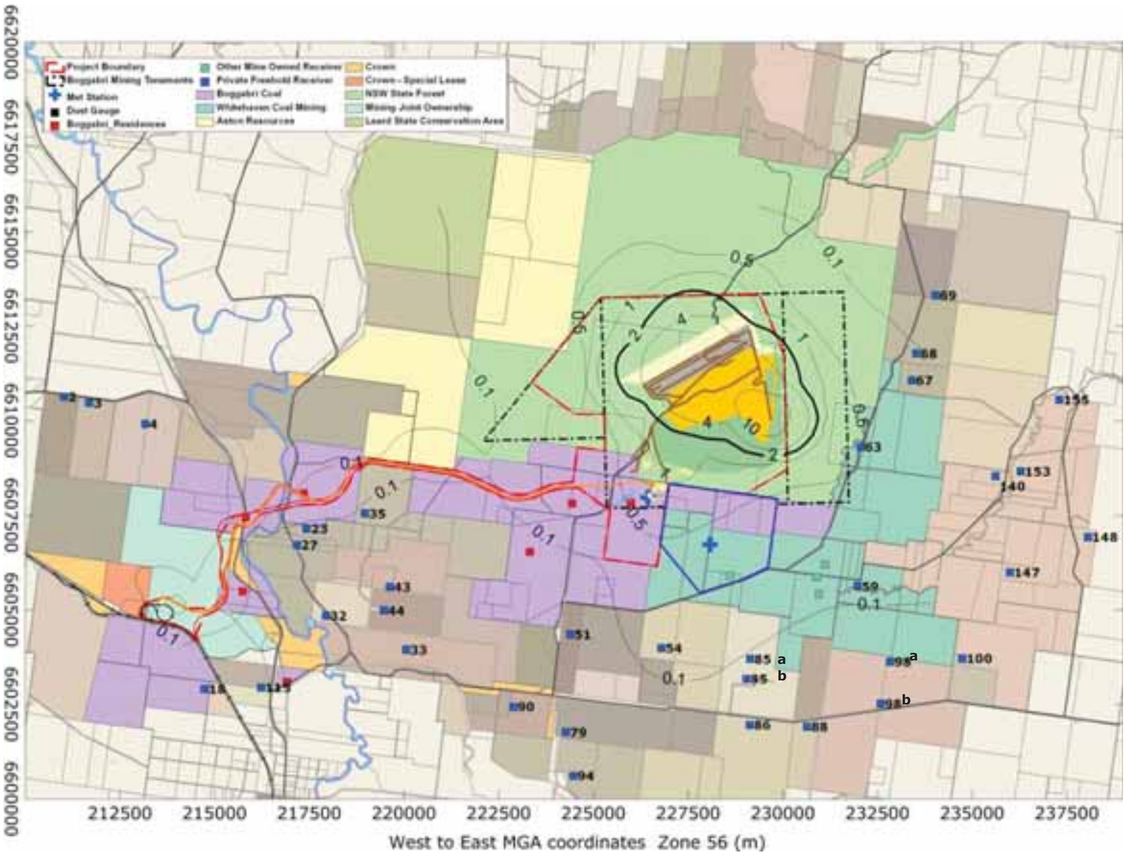
Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
PM_{10}	Boggabri Mine	Year 10	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	n/a	Boggabri 08/09	J Beaney

Figure 8.16: Predicted annual average PM_{10} concentrations due to emissions for the Project alone – Year 10



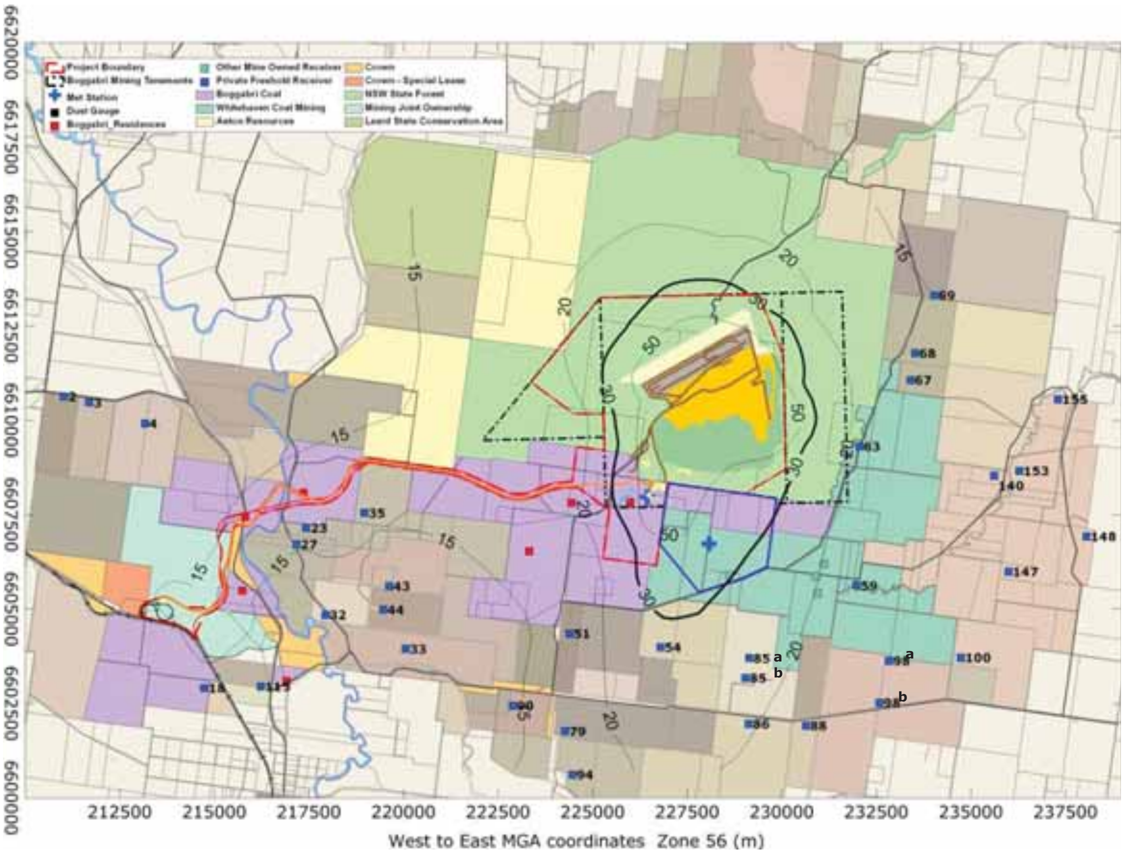
Species:	Location:	Scenario:	Percentile:	Averaging Time:
TSP	Boggabri Mine	Year 10	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m³	n/a	Boggabri 08/09	J Beaney

Figure 8.17: Predicted annual average TSP concentrations due to emissions for the Project alone – Year 10



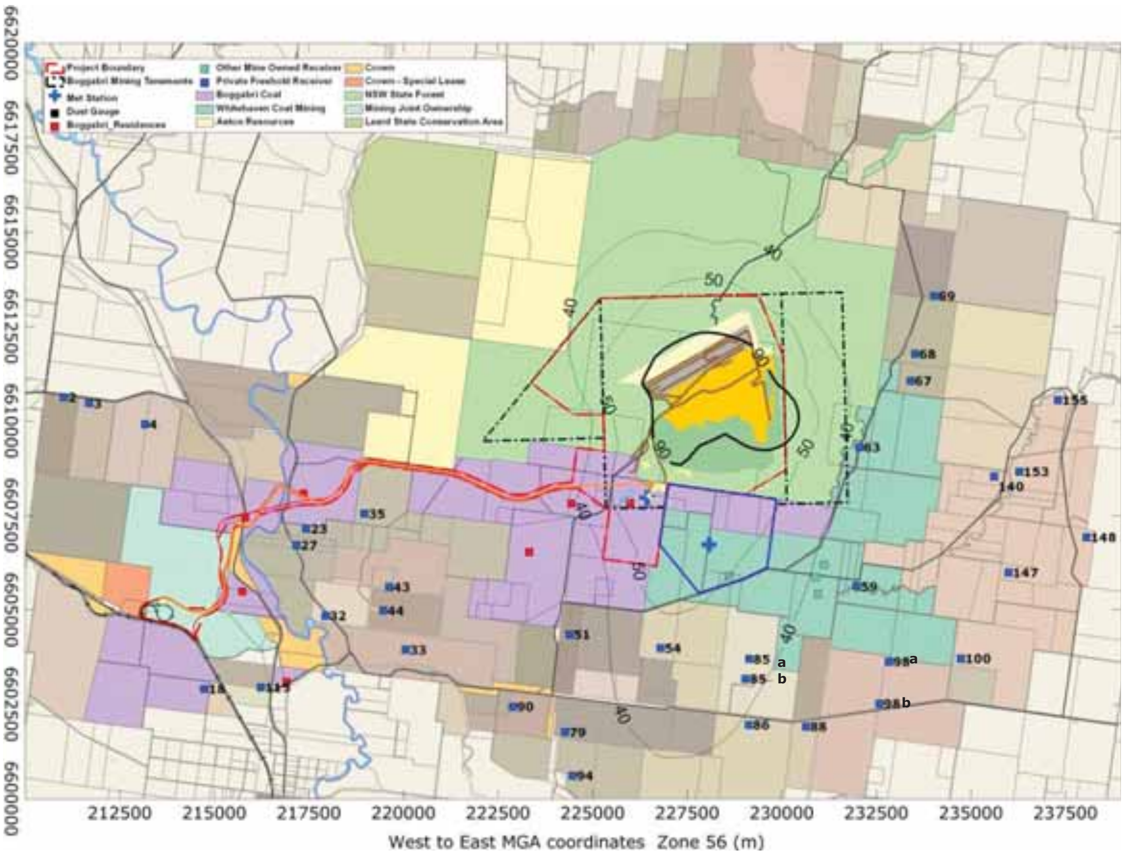
Species: Dust deposition	Location: Boggabri Mine	Scenario: Year 10	Percentile: Maximum	Averaging Time: Annual
Model Used: ISCMOD	**Units:** g/m²/month	**Assessment Criteria:** 2 µg/m³	**Met Data:** Boggabri 08/09	**Plot:** J Beaney

Figure 8.18: Predicted annual average dust deposition levels due to emissions for the Project alone – Year 10



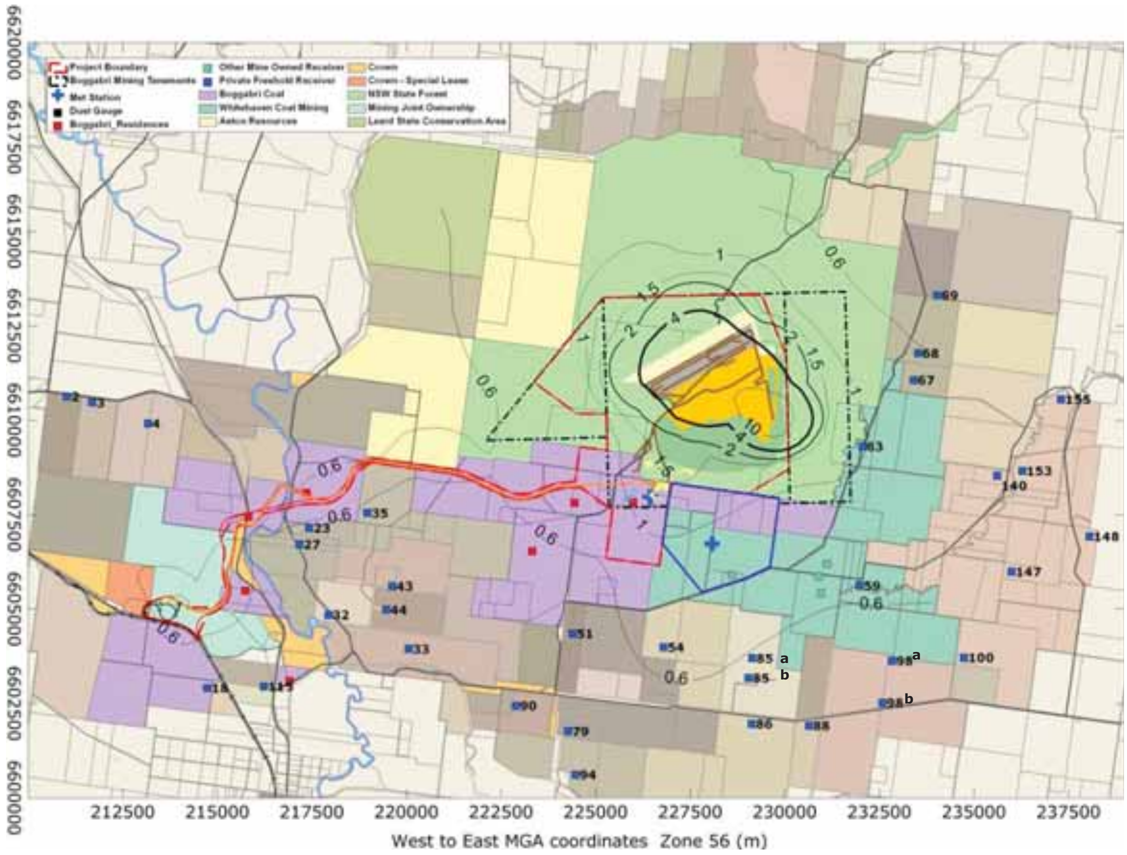
Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Boggabri Mine	Year 10	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	30 µg/m^3	Boggabri 08/09	J Beaney

Figure 8.19: Predicted annual average PM_{10} concentrations due to emissions from the Project and other sources- Year 10



Species:	Location:	Scenario:	Percentile:	Averaging Time:
TSP	Boggabri Mine	Year 10	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	90 µg/m^3	Boggabri 08/09	J Beaney

Figure 8.20: Predicted annual average TSP concentrations due to emissions from the Project and other sources – Year 10



Species:	Location:	Scenario:	Percentile:	Averaging Time:
Dust deposition	Boggabri Mine	Year 10	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m³	4 g/m²/month	Boggabri 08/09	J Beaney

Figure 8.21: Predicted annual average dust deposition levels due to emissions from the Project and other sources – Year 10

8.6 Year 21

Figure 8.22 to **Figure 8.28** show the predicted annual average PM_{10} and TSP concentrations and dust deposition levels for operations in Year 21 showing the effects of the Project by itself and the Project in combination with other sources.

Table 8-4 presents the predicted dust concentration results for all receptors in the vicinity of the Project and highlights in bold those values above the relevant project specific criteria or cumulative criteria where the Project is expected to influence air quality.

In summary for Year 21, the following receptors where criteria are exceeded have been identified:

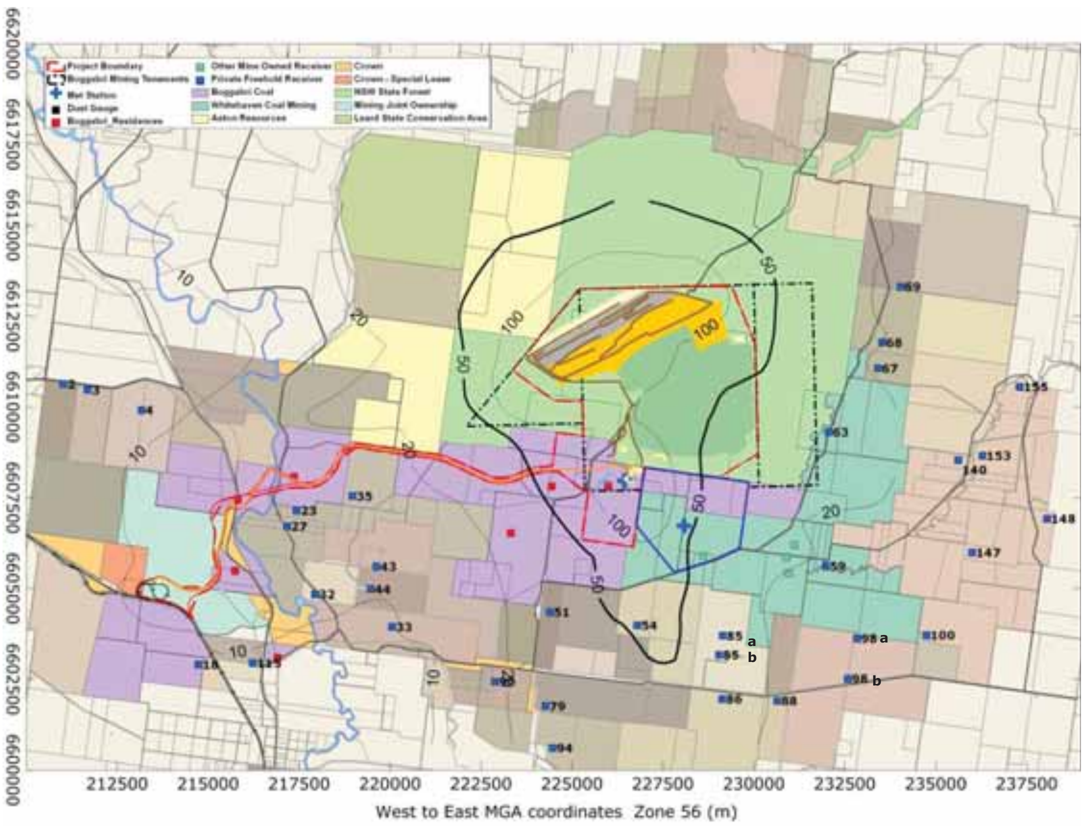
- 24-hour average PM_{10} above 50 $\mu g/m^3$ due to the Project alone – One privately owned residence (Tarrawonga)

Table 8-4: Predicted PM10, TSP and dust deposition for Year 21

		Project alone				Project and other sources		
		PM_{10} ($\mu g/m^3$)		TSP ($\mu g/m^3$)	Dust Deposition (g/m^2/month)	PM_{10} ($\mu g/m^3$)	TSP ($\mu g/m^3$)	Dust Deposition (g/m^2/month)
Averaging Period		24-hour	Annual	Annual	Annual	Annual	Annual	Annual
Owner	ID	*Impact Assessment Criteria*						
		50	*30*	*90*	*2*	*30*	*90*	*4*
FJ Maunder	2	6	1	1	0.0	13	34	0.5
RB & ML Kerr	3	7	1	1	0.0	13	34	0.5
Glek Pty Ltd	4	8	1	1	0.0	13	34	0.5
H & M Bullock[(a)]	18	9	2	2	0.0	14	35	0.5
Cooboobindi	23	13	3	3	0.1	15	36	0.6
Cooboobindi	27	11	2	3	0.1	14	36	0.6
Billabong	32	13	2	2	0.0	14	35	0.5
Brighton	33	10	2	2	0.0	14	35	0.5
Belleview	35	15	3	3	0.1	15	36	0.6
Roma	43	14	2	2	0.0	14	35	0.5
Glenhope	44	11	2	2	0.0	14	35	0.5
Jeralong	51	32	10	10	0.1	22	43	0.6
Tarrawonga	54	**55**	14	14	0.1	26	47	0.6
DC & EL Cheeseman[(b)]	59	19	4	4	0.1	16	37	0.6
Bradlock Pty Ltd[(b)]	63	26	4	4	0.2	16	37	0.7
Goonbri	67	19	3	3	0.1	15	36	0.6
Goonbri	68	20	3	3	0.1	15	36	0.6
Wirrilah	69	16	2	2	0.1	14	35	0.6
Northham	79	27	7	7	0.1	19	40	0.6
Ambardo	85a	31	6	7	0.1	18	40	0.6
Ambardo	85b	32	7	7	0.1	19	40	0.6
Kyalla	86	27	6	6	0.1	18	39	0.6
Pine Grove	88	18	4	4	0.0	16	37	0.5
Barbers Lagoon	90	18	5	5	0.0	17	38	0.5
Callandar	94	26	7	7	0.1	19	40	0.6
Flixton	98a	13	3	3	0.1	15	36	0.6
Flixton	98b	13	3	3	0.0	15	36	0.5
Bailey Park	100	10	2	2	0.1	14	35	0.6
Hazeldene	115	9	2	2	0.0	14	35	0.5
JE & RJ Picton	140	16	2	2	0.1	14	35	0.6
JE & RJ Picton	147	15	2	2	0.1	14	35	0.6
JE & RJ Picton	148	13	1	1	0.1	13	34	0.6
JE & RJ Picton	153	14	2	2	0.1	14	35	0.6
JE & RJ Picton	155	11	2	2	0.1	14	35	0.6

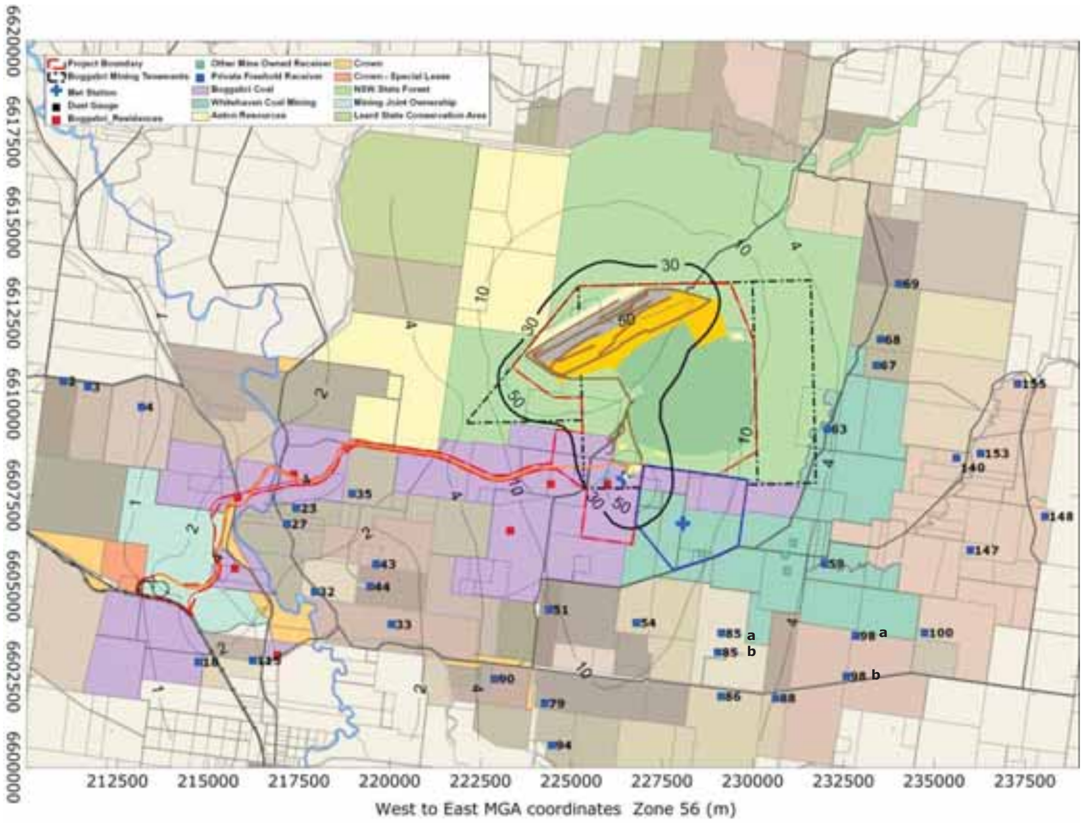
(a) Purchased by Boggabri Coal after the air quality assessment was completed.

(b) Purchased by Tarrawonga Mine after the air quality assessment was completed.



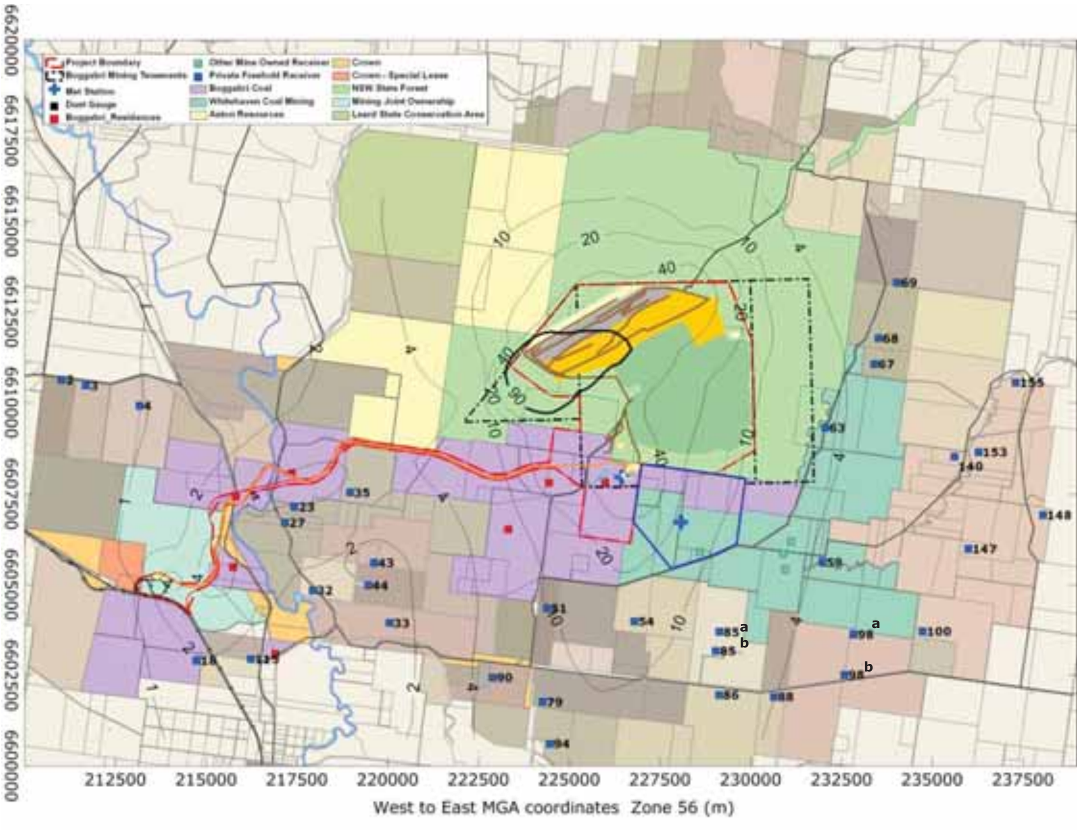
Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Boggabri Mine	Year 21	Maximum	24-hour
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	$\mu g/m^3$	50 $\mu g/m^3$	Boggabri 08/09	J Beaney

Figure 8.22: Predicted maximum 24-hour average PM_{10} concentrations due to emissions for the Project alone – Year 21



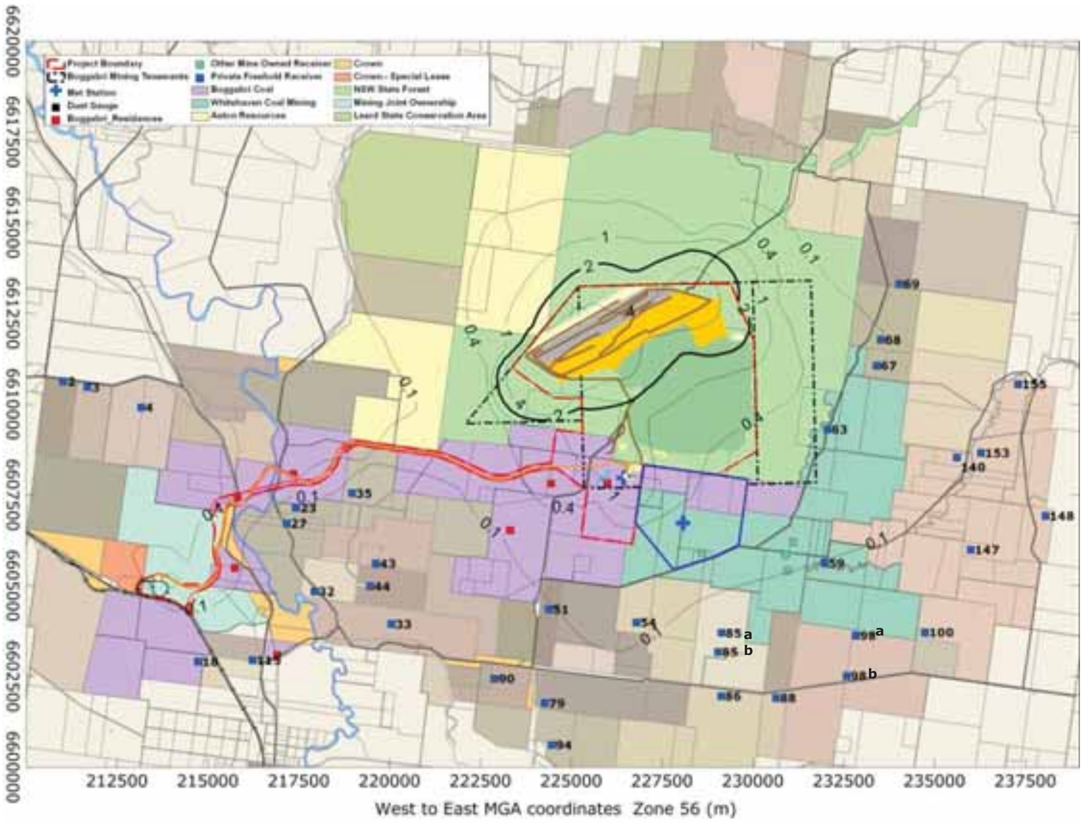
Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Boggabri Mine	Year 21	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	n/a	Boggabri 08/09	J Beaney

Figure 8.23: Predicted annual average PM_{10} concentrations due to emissions for the Project alone – Year 21



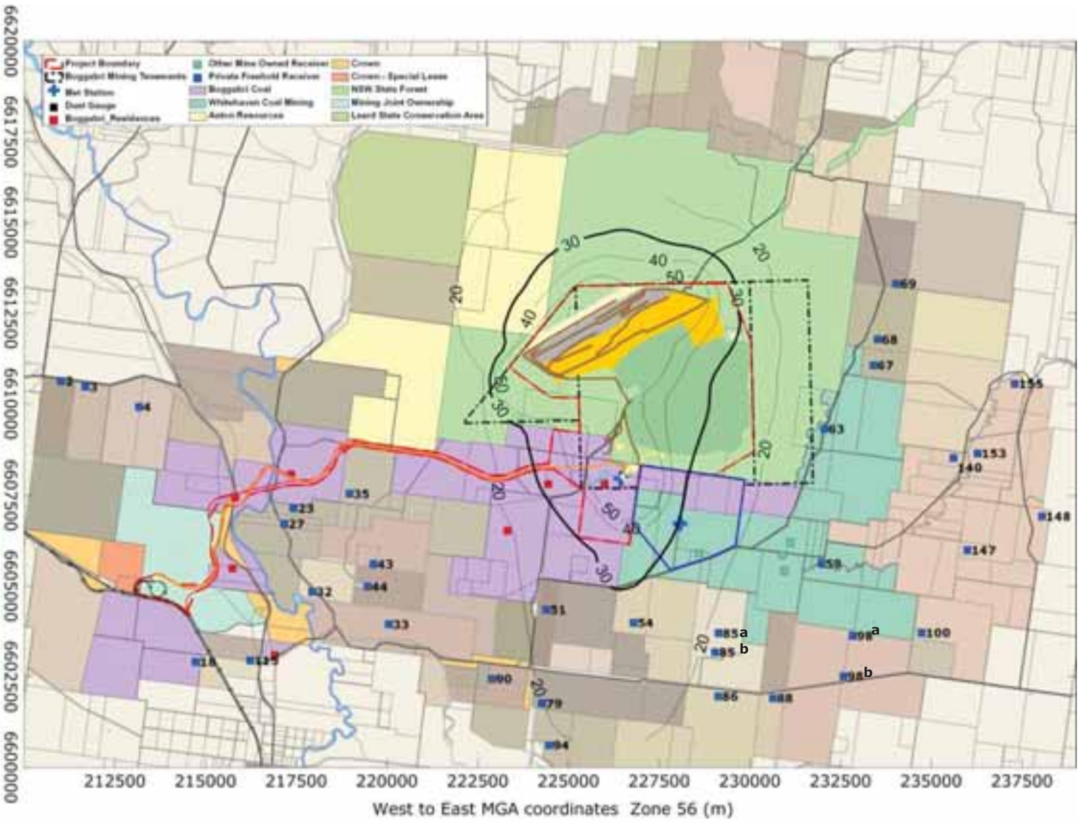
Species:	Location:	Scenario:	Percentile:	Averaging Time:
TSP	Boggabri Mine	Year 21	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m³	n/a	Boggabri 08/09	J Beaney

Figure 8.24: Predicted annual average TSP concentrations due to emissions for the Project alone – Year 21



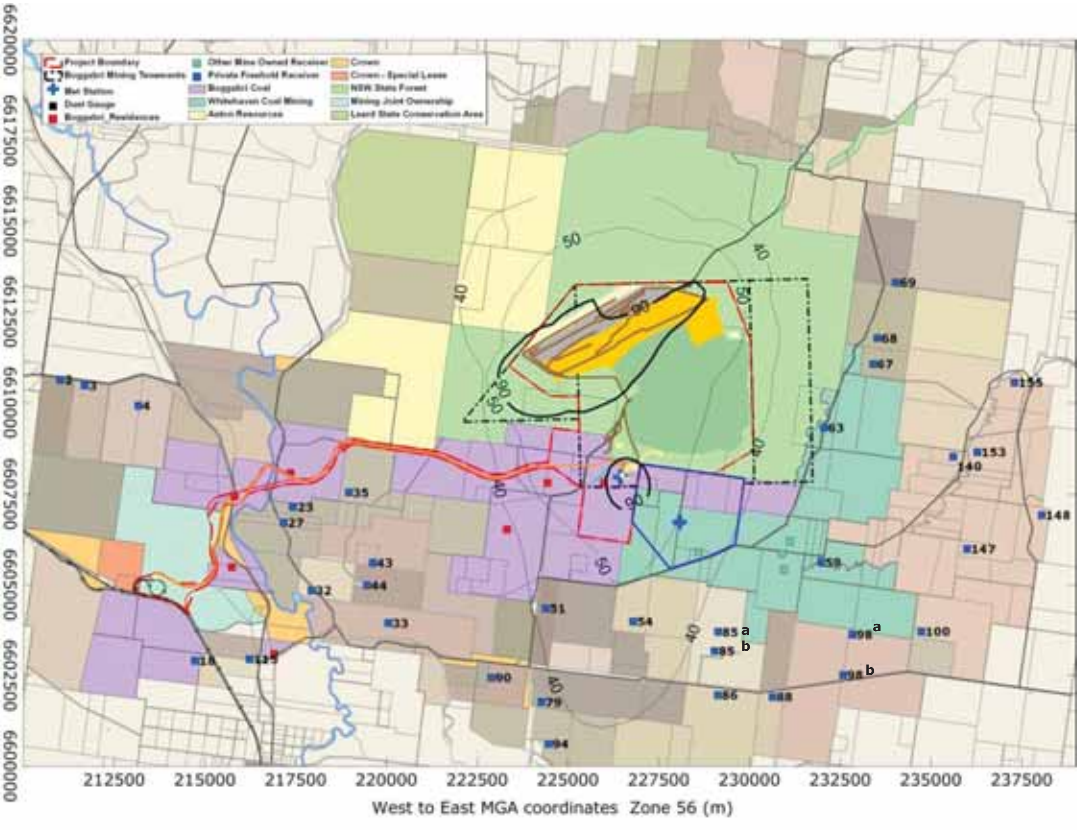
Species:	Location:	Scenario:	Percentile:	Averaging Time:
Dust deposition	Boggabri Mine	Year 21	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	$g/m^2/month$	2 $\mu g/m^3$	Boggabri 08/09	J Beaney

Figure 8.25: Predicted annual average dust deposition levels due to emissions for the Project alone – Year 21



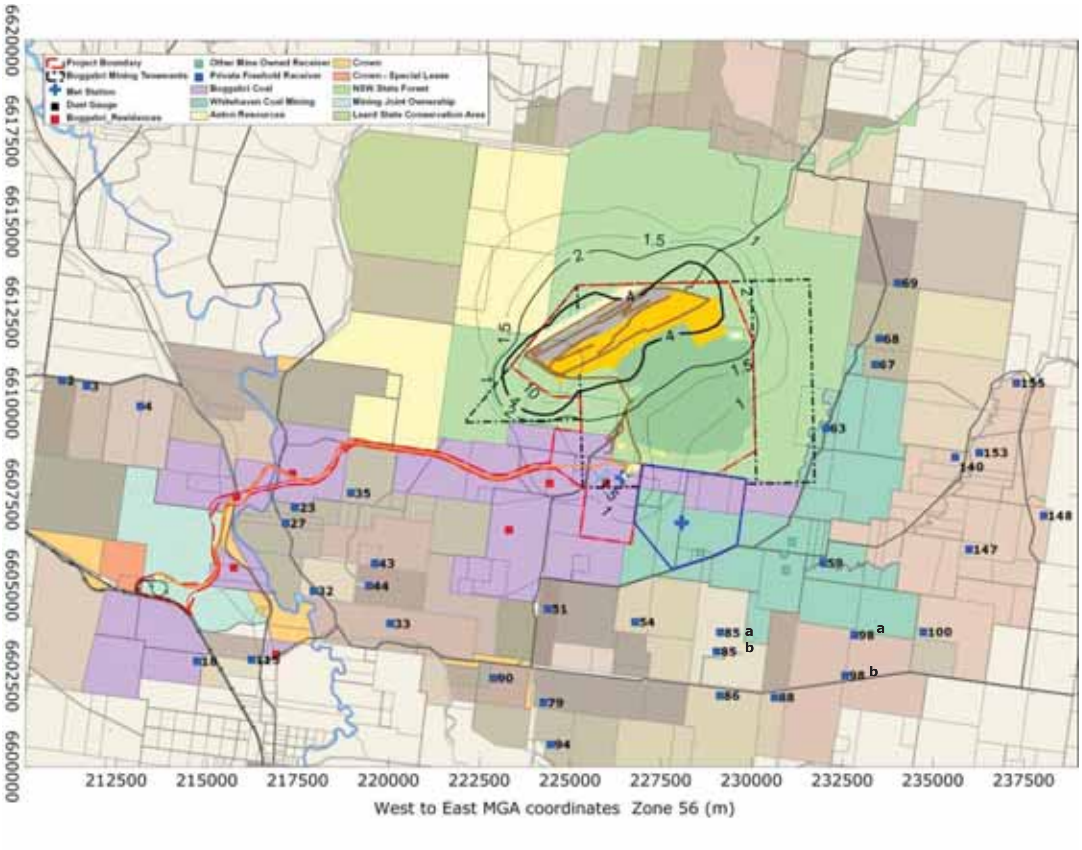
Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Boggabri Mine	Year 21	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	30 µg/m^3	Boggabri 08/09	J Beaney

Figure 8.26: Predicted annual average PM_{10} concentrations due to emissions from the Project and other sources- Year 21



Species:	Location:	Scenario:	Percentile:	Averaging Time:
TSP	Boggabri Mine	Year 21	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	90 µg/m^3	Boggabri 08/09	J Beaney

Figure 8.27: Predicted annual average TSP concentrations due to emissions from the Project and other sources – Year 21



Species: Dust deposition	Location: Boggabri Mine	Scenario: Year 21	Percentile: Maximum	Averaging Time: Annual
Model Used: ISCMOD	**Units:** µg/m³	**Assessment Criteria:** 4 g/m²/month	**Met Data:** Boggabri 08/09	**Plot:** J Beaney

Figure 8.28: Predicted annual average dust deposition levels due to emissions from the Project and other sources – Year 21

8.7 Year 5 – Rail spur scenario

The implementation of the rail spur to transport the product coal from the CHPP and crusher will reduce emissions by approximately 395,519kg for Year 5 (see **Table 6-1** and **Table 6-2**). The modelling results for the operational rail spur are detailed below.

Figure 8.29 to **Figure 8.35** show the predicted annual average PM_{10} and TSP concentrations and dust deposition levels for operations in Year 5 showing the effects of the Project by itself and the Project in combination with other sources.

Table 8-5 presents the predicted dust concentration results for all receptors in the vicinity of the Project and highlights in bold those values above the relevant project specific criteria or cumulative criteria where the Project is expected to influence air quality.

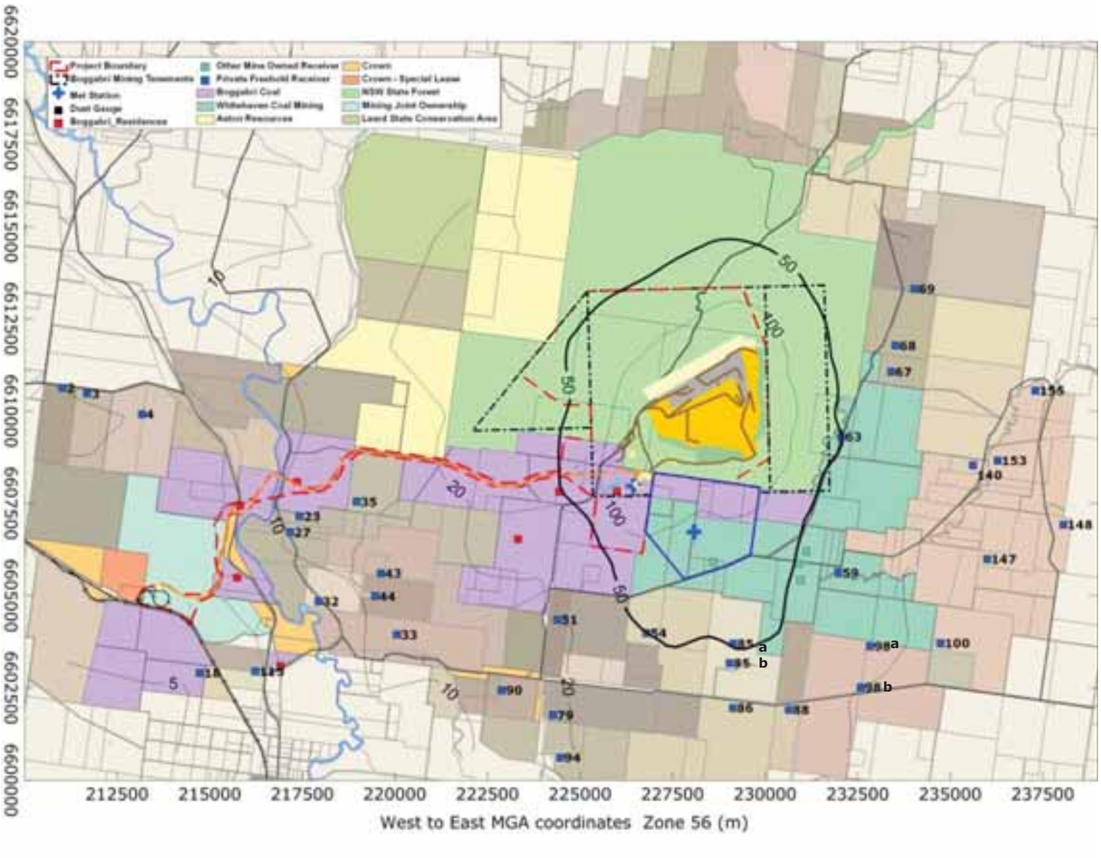
In summary for Year 5 (rail spur scenario), the following receptors where criteria are exceeded have been identified:

- 24-hour average PM_{10} above 50 µg/m^3 due to the Project alone – One privately owned residence (Ambardo); and
- Annual average PM_{10} above 30 µg/m^3 due to the Project and other mines and other sources – Two privately owned residences (Tarrawonga and Ambardo) - see **Figure 8.33**.

Table 8-5: Predicted PM_{10}, TSP and dust deposition for Year 5 (rail spur)

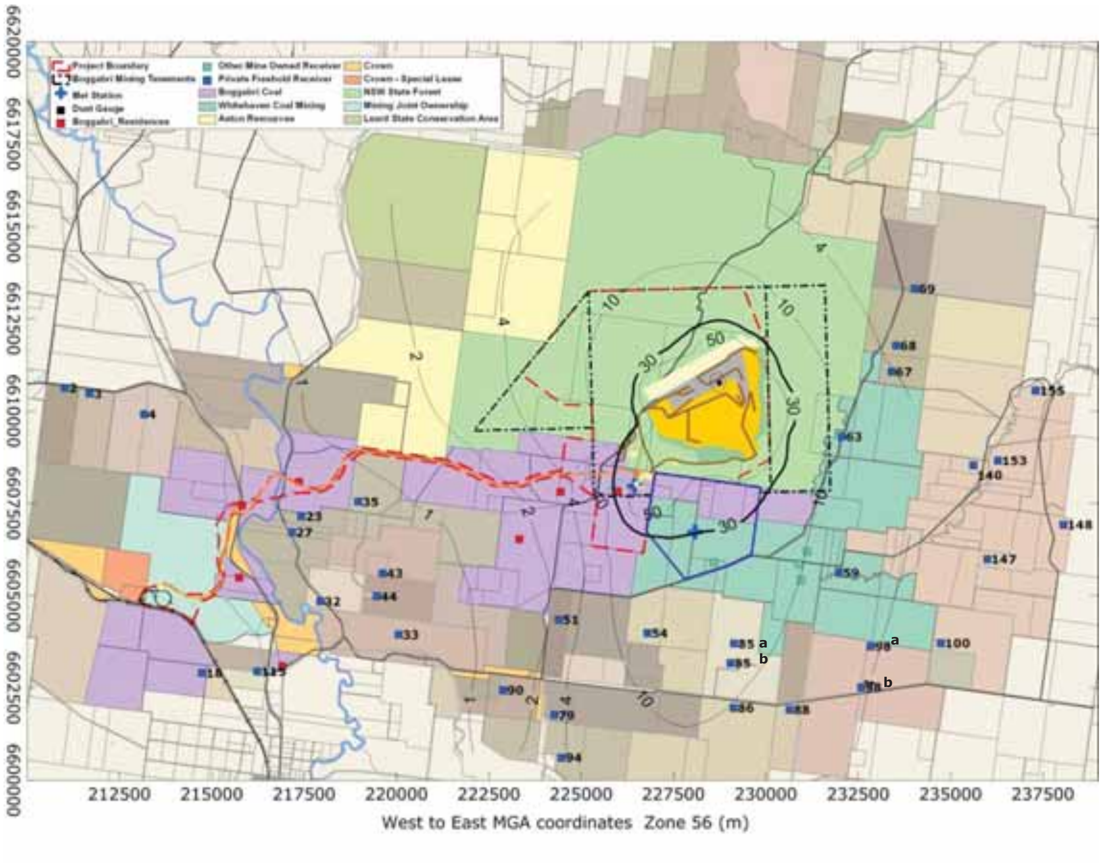
		Project alone				Project and other sources		
		PM_{10} (µg/m^3)		TSP (µg/m^3)	Dust Deposition (g/m^2/month)	PM_{10} (µg/m^3)	TSP (µg/m^3)	Dust Deposition (g/m^2/month)
Averaging Period		24-hour	Annual	Annual	Annual	Annual	Annual	Annual
		Impact Assessment Criteria						
Owner	ID	*50*	*30*	*90*	*2*	*30*	*90*	*4*
FJ Maunder	2	5	0	0	0.0	13	34	0.5
RB & ML Kerr	3	5	0	0	0.0	13	34	0.5
Glek Pty Ltd	4	5	1	1	0.0	13	34	0.5
H & M Bullock[(a)]	18	5	0	0	0.0	12	33	0.5
Cooboobindi	23	11	1	1	0.0	13	34	0.5
Cooboobindi	27	10	1	1	0.0	13	34	0.5
Billabong	32	9	0	0	0.0	13	34	0.5
Brighton	33	12	1	1	0.0	13	34	0.5
Belleview	35	13	1	1	0.0	13	34	0.5
Roma	43	11	1	1	0.0	13	34	0.5
Glenhope	44	11	1	1	0.0	13	34	0.5
Jeralong	51	21	2	3	0.0	15	36	0.6
Tarrawonga	54	50	14	15	0.1	**32**	54	0.7
DC & EL Cheeseman[(b)]	59	32	6	7	0.1	21	42	0.8
Bradlock Pty Ltd[(b)]	63	50	8	9	0.5	21	43	1.1
Goonbri	67	30	4	4	0.1	17	38	0.6
Goonbri	68	28	3	4	0.1	16	37	0.6
Wirrilah	69	27	2	3	0.1	15	36	0.6
Northham	79	16	3	3	0.0	16	37	0.5
Ambardo	85a	47	12	12	0.1	**34**	55	0.7
Ambardo	85b	**51**	13	13	0.1	**37**	59	0.8
Kyalla	86	40	10	10	0.1	28	49	0.6
Pine Grove	88	40	7	7	0.1	22	44	0.6
Barbers Lagoon	90	13	1	1	0.0	14	35	0.5
Callandar	94	16	4	4	0.0	16	38	0.5
Flixton	98a	23	4	4	0.1	18	39	0.6
Flixton	98b	19	4	4	0.1	18	39	0.6
Bailey Park	100	15	3	3	0.1	16	37	0.6
Hazeldene	115	6	0	0	0.0	12	34	0.5
JE & RJ Picton	140	19	3	3	0.1	15	37	0.6
JE & RJ Picton	147	20	2	2	0.1	15	36	0.6
JE & RJ Picton	148	14	2	2	0.1	14	35	0.6
JE & RJ Picton	153	16	2	3	0.1	15	36	0.6
JE & RJ Picton	155	14	2	2	0.0	14	35	0.6

(a) *Purchased by Boggabri Coal since air quality assessment was completed.*
(b) *Purchased by Tarrawonga Mine since air quality assessment was completed.*



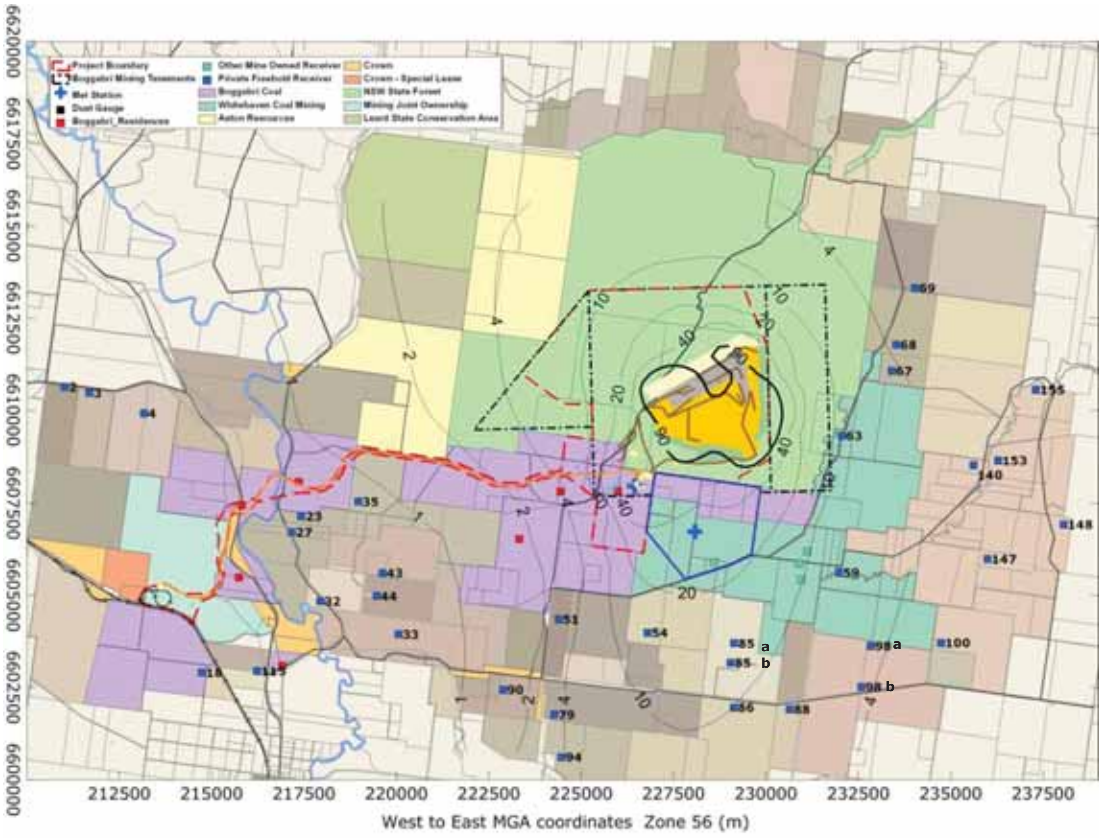
Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Boggabri Mine	Year 5 (rail spur)	Maximum	24-hour
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	$\mu g/m^3$	50 $\mu g/m^3$	Boggabri 08/09	J Beaney

Figure 8.29: Predicted maximum 24-hour average PM_{10} concentrations due to emissions for the Project alone – Year 5 rail spur scenario



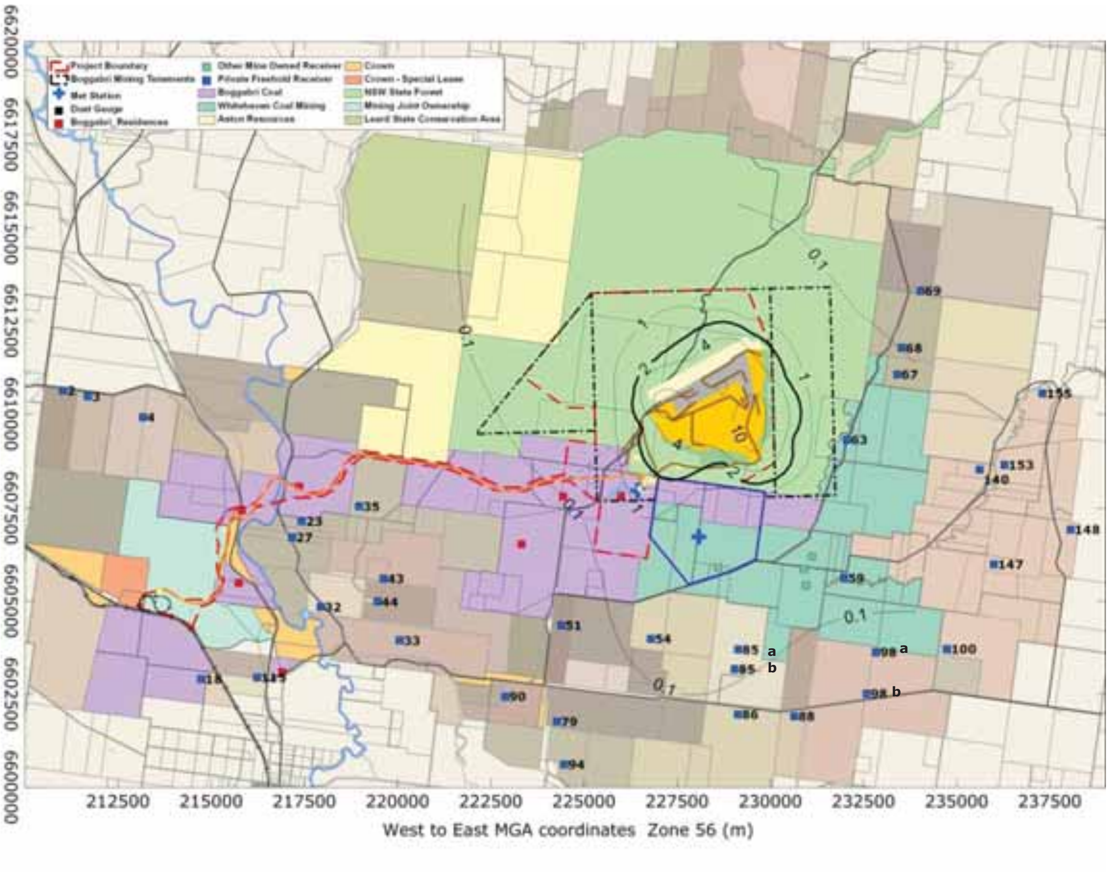
Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Boggabri Mine	Year 5 (rail spur)	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	n/a	Boggabri 08/09	J Beaney

Figure 8.30: Predicted annual average PM_{10} concentrations due to emissions for the Project alone – Year 5 rail spur scenario



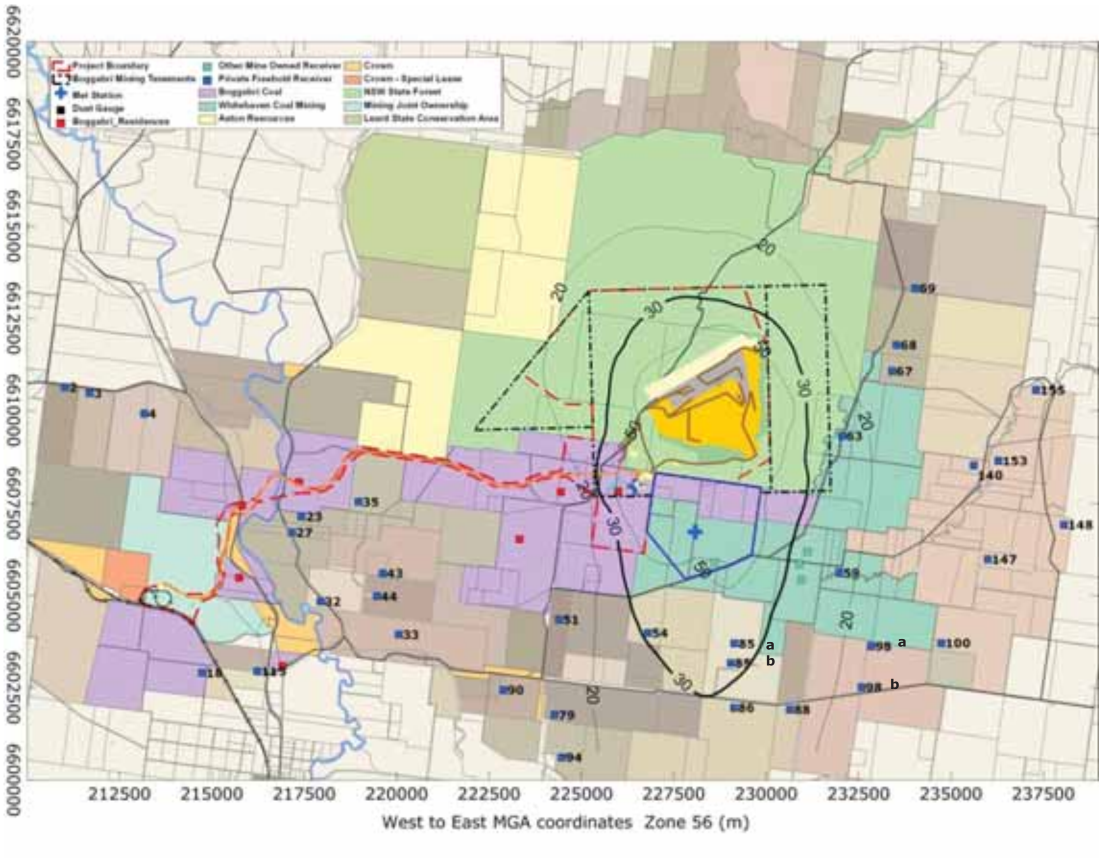
Species:	Location:	Scenario:	Percentile:	Averaging Time:
TSP	Boggabri Mine	Year 5 (rail spur)	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	n/a	Boggabri 08/09	J Beaney

Figure 8.31: Predicted annual average TSP concentrations due to emissions for the Project alone – Year 5 rail spur scenario



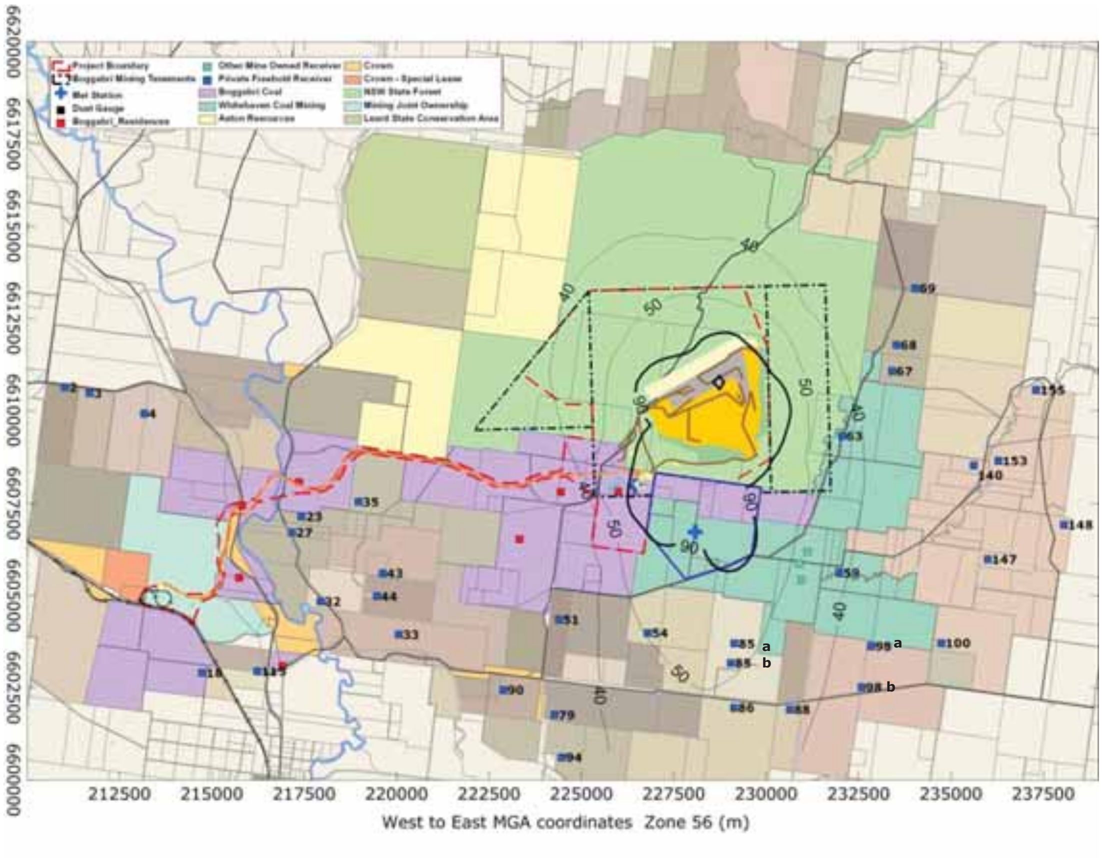
Species:	Location:	Scenario:	Percentile:	Averaging Time:
Dust deposition	Boggabri Mine	Year 5 (rail spur)	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	g/m^2/month	2 µg/m^3	Boggabri 08/09	J Beaney

Figure 8.32: Predicted annual average dust deposition levels due to emissions for the Project alone – Year 5 rail spur scenario



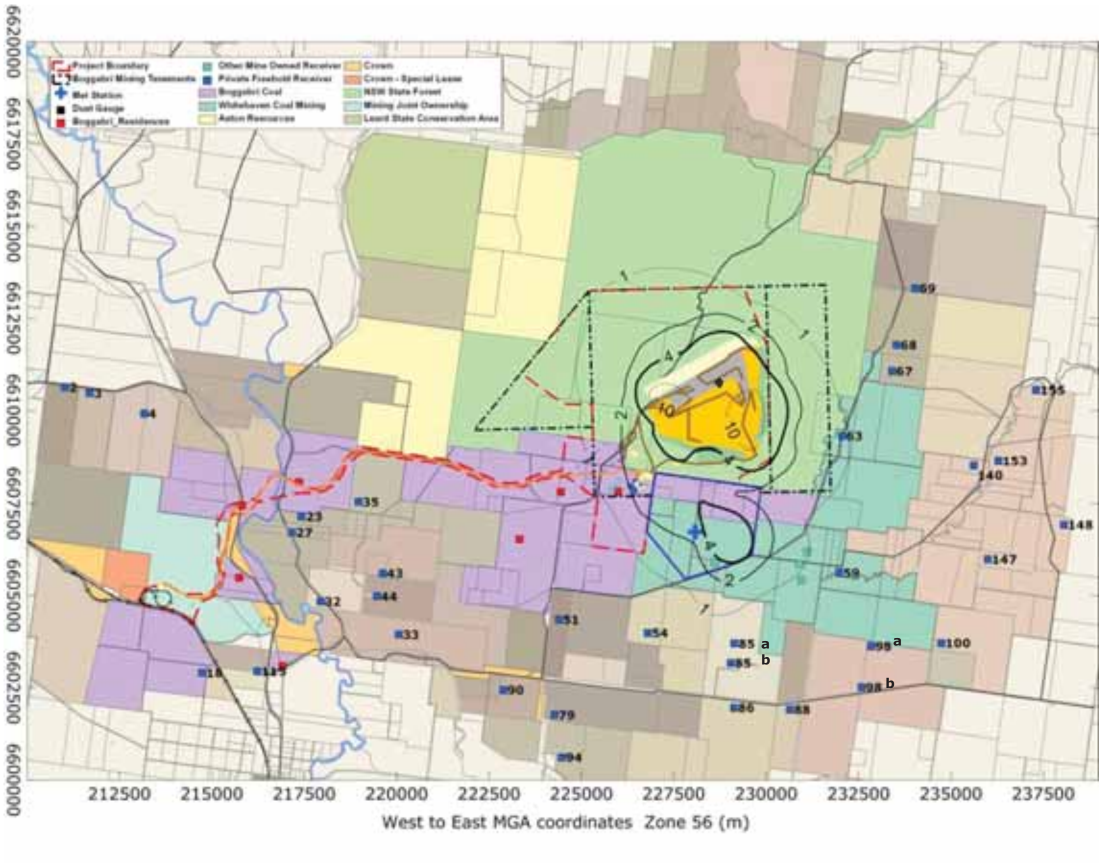
Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Boggabri Mine	Year 5 (rail spur)	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	$\mu g/m^3$	30 $\mu g/m^3$	Boggabri 08/09	J Beaney

Figure 8.33: Predicted annual average PM_{10} concentrations due to emissions from the Project and other sources- Year 5 rail spur scenario



Species:	Location:	Scenario:	Percentile:	Averaging Time:
TSP	Boggabri Mine	Year 5 (rail spur)	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	90 µg/m^3	Boggabri 08/09	J Beaney

Figure 8.34: Predicted annual average TSP concentrations due to emissions from the Project and other sources – Year 5 rail spur scenario



Species:	Location:	Scenario:	Percentile:	Averaging Time:
Dust deposition	Boggabri Mine	Year 5 (rail spur)	Maximum	Annual
Model Used:	**Units:**	**Assessment Criteria:**	**Met Data:**	**Plot:**
ISCMOD	$\mu g/m^3$	4 g/m^2/month	Boggabri 08/09	J Beaney

Figure 8.35: Predicted annual average dust deposition levels due to emissions from the Project and other sources – Year 5 rail spur scenario

8.8 Year 5 – Dragline Scenario

An alternative to the truck and shovel method is the use of a dragline to remove the overburden. The estimated emissions using the truck and shovel method are 7,218,763 kg per year and for the implementation of dragline operations TSP emissions are estimated at 7,002,161 kg per year. The overall decrease in TSP emissions as a result of the dragline will be approximately 216,602 kg (3%) for Year 5.

8.9 Assessment of 24-hour average PM_{10}

8.9.1 Project alone 24-hour Average PM_{10} concentrations

Table 8-6 presents the predicted maximum 24-hour 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.

In summary, the following properties are predicted to experience an exceedance of the 24-hour PM_{10} assessment criteria, due to emissions from the Project only:

- Year 10 – One privately owned residence (Tarrawonga)
- Year 21 - One privately owned residence (Tarrawonga)
- Year 5 (rail spur scenario) – One privately owned residence (Ambardo)

Table 8-6. Summary of maximum predicted 24-hour average PM_{10} concentrations (µg/m^3)

Owner	ID	Year 1	Year 5	Year 10	Year 21	Year 5 (rail spur)
		Assessment criteria = 50 µg/m^3				
FJ Maunder	2	3	5	4	6	5
RB & ML Kerr	3	3	5	5	7	5
Glek Pty Ltd	4	3	6	6	8	5
H & M Bullock[(a)]	18	3	7	6	9	5
Cooboobindi	23	7	14	15	13	11
Cooboobindi	27	6	13	11	11	10
Billabong	32	4	10	10	13	9
Brighton	33	6	13	11	10	12
Belleview	35	7	15	14	15	13
Roma	43	6	13	13	14	11
Glenhope	44	5	12	12	11	11
Jeralong	51	11	22	18	32	21
Tarrawonga	54	29	50	**52**	**55**	50
DC & EL Cheeseman[(b)]	59	14	32	22	19	32
Bradlock Pty Ltd[(b)]	63	21	50	41	26	50
Goonbri	67	12	31	27	19	30
Goonbri	68	13	28	24	20	28
Wirrilah	69	8	27	20	16	27
Northham	79	8	16	17	27	16
Ambardo	85	32	47	41	31	47
Ambardo	85	35	50	41	32	**51**
Kyalla	86	26	40	37	27	40
Pine Grove	88	15	40	26	18	40
Barbers Lagoon	90	6	14	12	18	13
Callandar	94	8	16	19	26	16
Flixton	98	11	23	16	13	23
Flixton	98	11	19	14	13	19
Bailey Park	100	8	15	12	10	15
DW & AM Keys	115	3	7	7	9	6
JE & RJ Picton	140	9	19	18	16	19
JE & RJ Picton	147	10	20	16	15	20
JE & RJ Picton	148	6	15	14	13	14
JE & RJ Picton	153	8	16	16	14	16
JE & RJ Picton	155	5	14	13	11	14

(a) Purchased by Boggabri Coal after the air quality assessment was completed.
(b) Purchased by Tarrawonga Mine after the air quality assessment was completed.

As discussed in **Section 4.2.3**, 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 Residence 54 and 85 to determine the number of days that the 50 µg/m^3 criterion would be exceeded. From **Table 8-6** it can be seen that the 24-hour PM_{10} goal of 50 µg/m^3 is predicted to be exceeded at Tarrawonga in Year 10 and Year 21 and for Ambardo in Year 5 (rail spur scenario).

Table 8-7 summarises the number of days predicted to exceed the 24-hour average PM_{10} concentration at Tarrawonga and Ambardo. It can be seen that the number of predicted exceedances is below the DoP requirements.

Table 8-7: Number of days per year the predicted 24-hour average PM_{10} concentration will exceed five days

Residence ID	Year 1	Year 5	Year 10	Year 21	Year 5 (rail spur)
Tarrawonga	n/a	n/a	2	1	n/a
Ambardo	n/a	n/a	n/a	n/a	1

A time series plot of the 24-hour PM_{10} concentration predictions at Tarrawonga and Ambardo for the duration of the modelling period are shown in **Figure 8.36** to **Figure 8.38** for the years of exceedance. It can be seen that the majority of predictions at the Tarrawonga and Ambardo residences are below 50 µg/m^3.

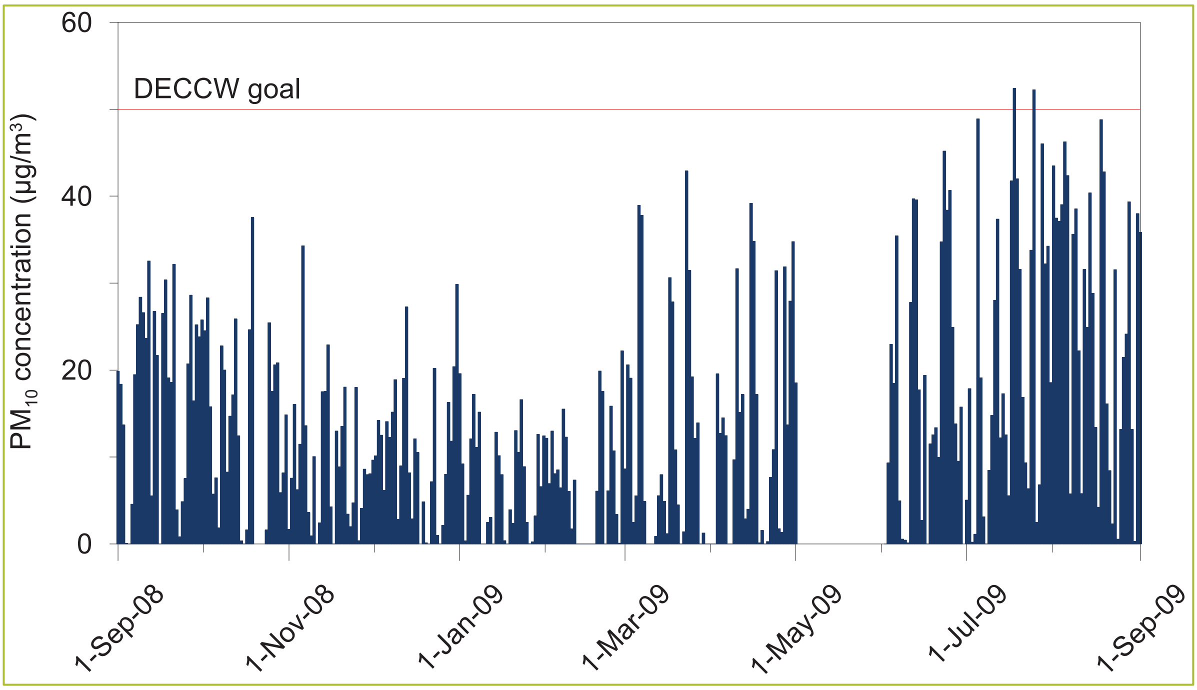


Figure 8.36: Predicted 24-hour average PM_{10} concentrations for each modelled day – Year 10, Tarrawonga

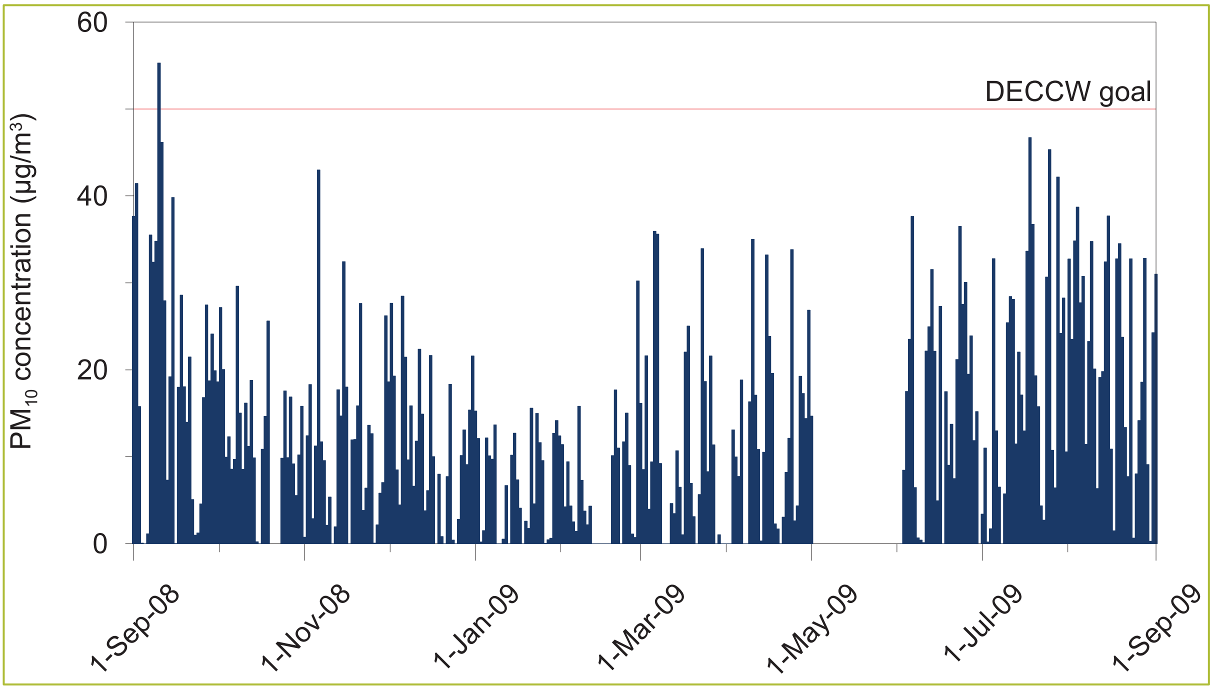


Figure 8.37: Predicted 24-hour average PM_{10} concentrations for each modelled day – Year 21, Tarrawonga

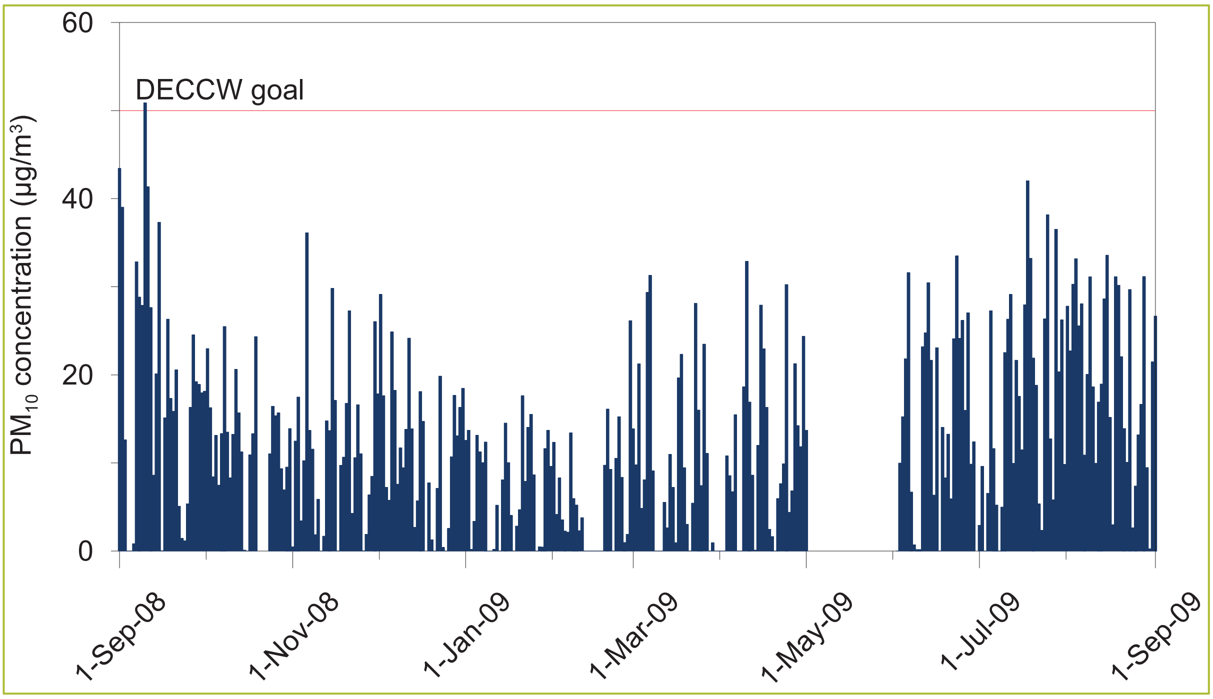


Figure 8.38: Predicted 24-hour average PM_{10} concentrations for each modelled day – Year 5 (rail spur scenario), Ambardo

8.9.2 Cumulative 24-hour Average PM_{10} concentrations

8.9.2.1 Introduction

The DECCW's (2005) *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* describes two methods for assessing cumulative air quality effects (see Section 11.2 of the Approved Methods).

- A Level 1 assessment (suitable for a screening assessment) requires the highest predicted concentration from the proposal is added to the highest observed concentration in a data set which provides measurements of PM_{10} concentrations representative of conditions at the site being assessed. If this results in exceedences of the PM_{10} impact assessment criteria, a Level 2 assessment is required.
- A Level 2 assessment, provides a more rigorous approach when background levels are elevated and requires (1) that the highest ten observed 24-hour PM_{10} concentrations (below criteria) are added to the predicted concentrations for the same days and (2) the ten highest predicted 24-hour PM_{10} concentrations are added to the observed concentrations for the same days.

8.9.2.2 Background ambient monitoring data

Both the Level 1 and Level 2 assessments assume that background ambient monitoring data exists that can provide information on 24-hour PM_{10} concentrations representative of the site being assessed.

The Level 2 assessment can work reasonably well when there are ambient monitoring data available for each day and the data are representative of the site being assessed.

Some 24-hour PM_{10} monitoring data (collected every sixth day using HVAS's) are available from Boggabri Coal's monitoring program. Similar data are available for Tarrawonga (see **Figure 2.2** for location of monitors).

The nearest continuous PM_{10} monitoring data are available from the Tamworth DECCW monitoring station located 90 km south east of the site. Tamworth is an urban area whereas the Boggabri site is a rural area, apart from the existence of the mines.

As shown below, an analysis of the available datasets shows that the Tamworth data set is not representative of the Boggabri area. This is not unexpected given the difference in land uses and the distance to Tamworth.

Figure 8.39 and **Figure 8.40** shows how contemporaneous data collected at the Tamworth TEOM, compare with the Boggabri and Tarrawonga HVAS data, respectively. **Figure 8.41** shows how contemporaneous data collected at Boggabri and Tarrawonga HVAS data compare.

The "R^2" value indicates how well the two datasets are correlated. An R^2 value of between 0 and 0.3 indicates the correlation is poor, between 0.3 and 0.7 the correlation is moderately good, and between 0.7 and 0.9 the correlation is excellent.

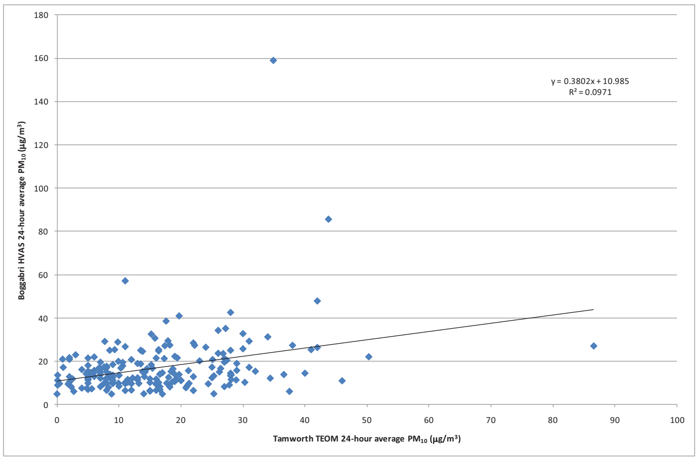


Figure 8.39: Plot of matching Boggabri HVAS data and Tamworth TEOM data

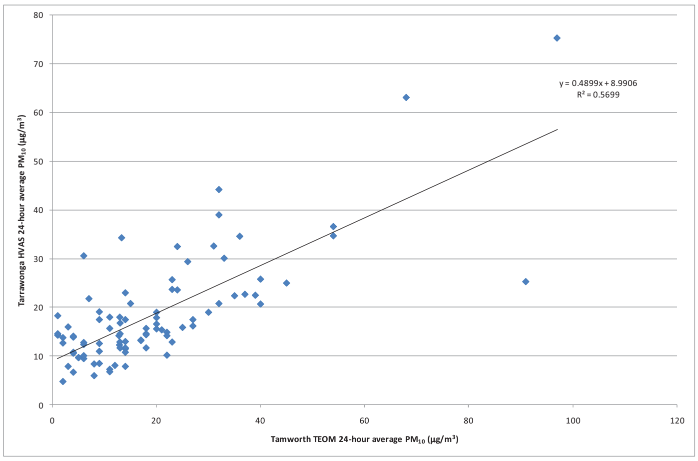


Figure 8.40: Plot of matching Tarrawonga HVAS data and Tamworth TEOM data

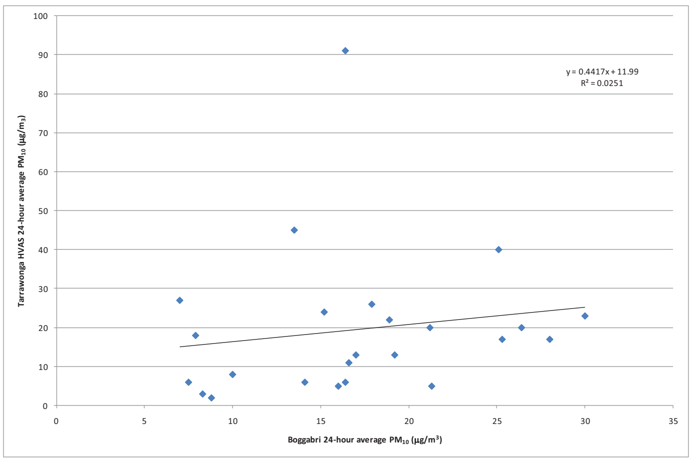


Figure 8.41: Plot of matching Tarrawonga HVAS data and Boggabri HVAS data

As shown in **Figure 8.39**, the R^2 value of 0.0971 indicates there is poor correlation between the Boggabri HVAS data and the Tamworth data. **Figure 8.40** shows an R^2 value of 0.56, which indicates there is a moderately good relationship between the Tarrawonga HVAS data and the Tamworth data.

However, this cannot address the spatial variability in asking whether data on any day is representative of the area. For example, as shown on **Figure 8.41**, there is also poor correlation between the Tarrawonga and Boggabri HVAS data. This is expected as the two monitors are on either side of a mine and a different impact at the same time, simply because when one site is upwind of mine operations, the other is downwind.

Figure 8.42 and **Figure 8.43** present an analysis of all available data from the HVAS's located at Boggabri Coal Mine and Tarrawonga Mine, and the TEOM data from Tamworth. These data show the 24-hour average PM_{10} concentrations collected between 29 August 2005 to 25 April 2010 for the Boggabri HVAS and Tamworth TEOM data, the data from the Tarrawonga HVAS were available for the period 2 September 2008 to 25 April 2010.

In general, it can be seen that the PM_{10} concentrations measured at Tamworth are significantly higher than those measured by the Boggabri HVAS and Tarrawonga HVAS (see **Figure 8.42**). In comparison to the Tamworth TEOM measurements the data show that whilst the spread of data is somewhat similar between the three sites, the Tamworth site experiences a higher proportion of days when the 24-hour average PM_{10} concentration is between 20 $\mu g/m^3$ and 50 $\mu g/m^3$. Conversely, the Boggabri HVAS and Tarrawonga HVAS show a higher proportion of PM_{10} concentrations below 20 $\mu g/m^3$ (see **Figure 8.43**).

Given the differences between the local and Tamworth data, the distant Tamworth data is not considered to be site representative, and thus it is considered to be more appropriate to use the local monitoring data although it is less complete and is already affected by emissions from the existing mine operations. This means that the assessment will be conservative because it will unavoidably double-count some of the effects of mining emissions.

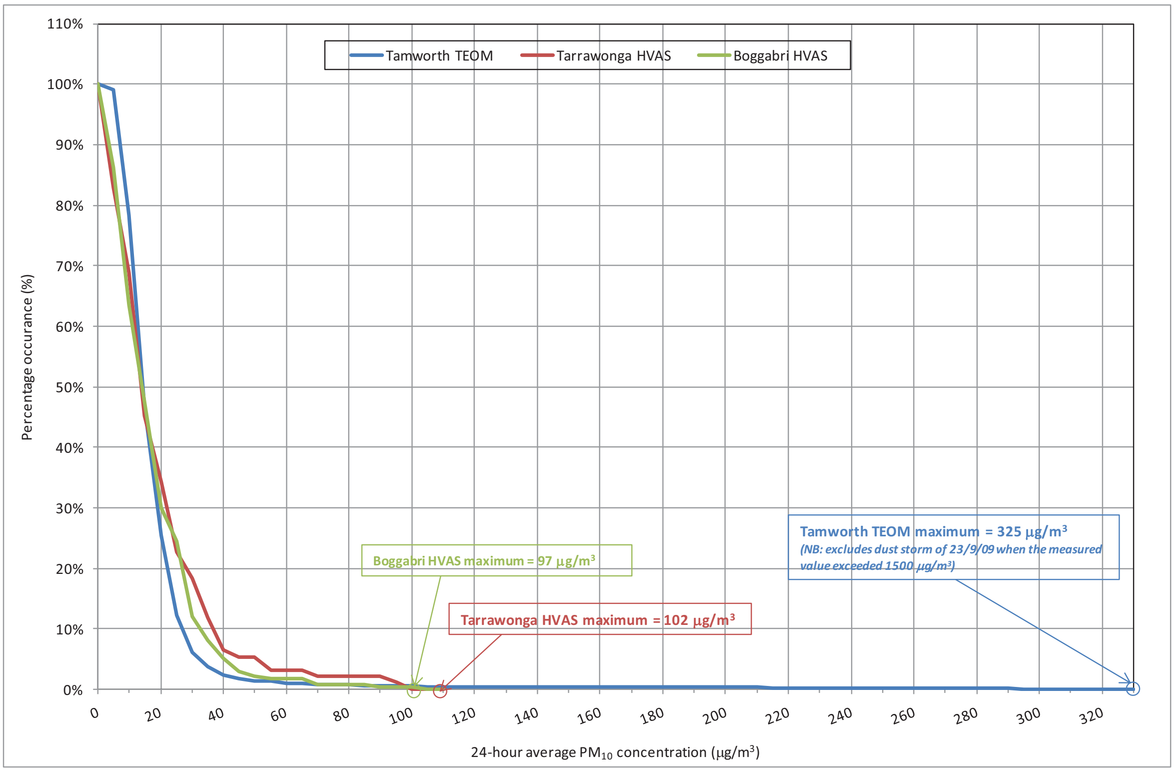


Figure 8.42: Plot of available HVAS and TEOM data

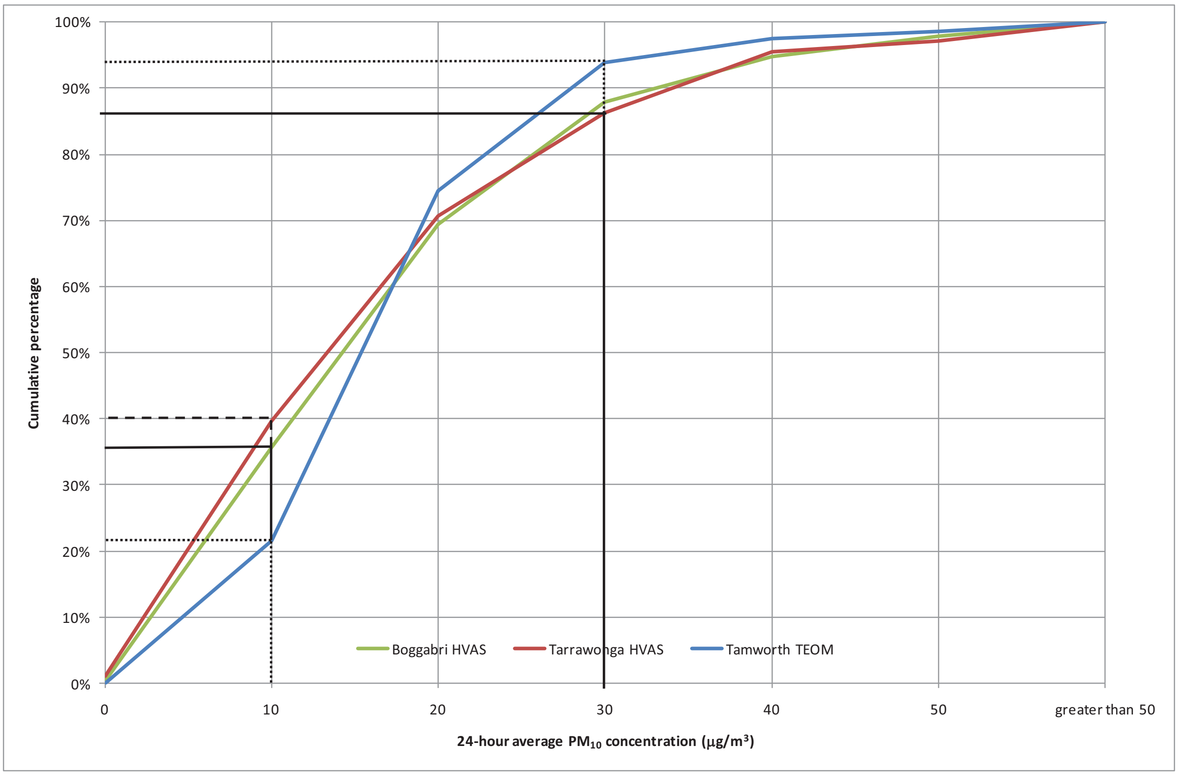


Figure 8.43: Cumulative frequency plot of HVAS and TEOM data

8.9.2.3 Level 2 Approved Methods Assessment

The practical implementation of the DECCW Level 2 assessment is as follows; predicted PM_{10} concentrations are paired with actual 24-hour average PM_{10} measurements recorded by the HVAS monitor for the duration of the modelling period (September 2008 to August 2009). The HVAS measurements are made on every 6^{th} day and hence, it is not possible to compare every day's model prediction with the HVAS data. It should also be noted that these measurements already include the contributions from current mining operations being undertaken by Boggabri Coal and Tarrawonga Coal Mine along with other non-modelled sources.

The future years modelled for the Project are based on representative meteorological data for the period 1 September 2008 to 31 August 2009, and so it is important to match the measured dust data for this period with the predictions. The highest 24-hour average PM_{10} concentrations measured by the HVAS (see **Appendix B**) for the period matching with the meteorological file used in the dispersion modelling was 34.4 µg/m^3 on the 1 September 2008.

This leaves an approximate 15 µg/m^3 buffer for Boggabri Coal's contribution before the 50 µg/m^3 DECCW criterion is met using a Level 1 approach. On that basis, the residences selected to be investigated further, for each year, are those that are predicted to experience greater than 15 µg/m^3 for the Project alone 24-hour average contribution.

It is important to note that it is not possible to accurately predict the magnitude or location of cumulative 24-hour PM_{10} concentrations many years into the future using dispersion modelling due to the spatial and temporal variability in background levels and also any 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 an area, such as bushfires and dust storms, which are essentially unpredictable. These events tend to dominate the worst-case PM_{10} concentrations outside mine lease areas.

However, some assessment can be made of the potential cumulative impact arising from a project.

Appendix H provides an analysis of the potential cumulative impacts for 24-hour average PM_{10} concentrations as per the DECCW Level 2 assessment method using contemporaneous impact and background data.

For each year and for each of the selected residences the top ten 24-hour average PM_{10} HVAS measurements have been identified and compared to the model predictions. In addition, the top ten predicted Project alone maximum 24-hour average PM_{10} concentration are also presented. To supplement the assessment, frequency distribution plots for the Project alone maximum 24-hour average PM_{10} concentration are also presented.

Due to the gaps in the HVAS data (measured on a one-day-in-six run cycle) there will be gaps in the data when following the DECCW Level 2 assessment approach, and especially when pairing the highest ten model predictions with background data on those days. Due to this, further detail is provided using a more comprehensive approach and is presented in **Section 8.9.2.4**.

8.9.2.4 Additional probability assessment of cumulative 24-hour impacts

As shown above, and in **Appendix H**, there are limitations in the ability to determine the potential for additional exceedences of the 24-hour average PM_{10} criteria when applying the DECCW Level 2 Approved Methods approach, when the only representative background data are one-day-in-six HVAS data.

In order to provide both the community and Government with the best possible information upon which to make a reasonable assessment of the potential cumulative 24-hour average PM_{10} impacts that may arise from the Project, the following presents additional information which assesses the potential cumulative 24-hour PM_{10} levels in more detail. Whilst the following approach is not specified in the DECCW Approved Methods, DoP have indicated that they are willing to consider alternative approaches in the environmental impact assessment, however, it is acknowledged that DoP may not endorse alternative assessment methodologies.

The assessment considers the probability that the dust contribution from the Project will coincide with a background concentration sufficiently high to result in cumulative dust concentrations greater than 50 $\mu g/m^3$. As noted previously, the HVAS data collected by Boggabri Coal and the Tarrawonga Mine are already influenced by existing mining operations, as such the following presents a conservative estimate of the potential impacts as the mine contribution is “double-counted”.

However, the alternative approach allows one to examine the likelihood of cumulative impacts across the full dataset, and not just those days where HVAS data are available.

Table 8-8 presents a summary of the maximum predicted 24-hour average PM_{10} concentrations at the closest residences due to the Project alone and the modelled year in which this was predicted (see **Table 8-6** for maximum predicted impacts for all residences in each year assessed). If the same predicted impact occurred in more than one year of the assessment, both years are presented. In addition, an analysis has been completed for all years where the increment from the Project alone was greater than 50 mg/m^3 (for example Residence ID 54 “Tarrawonga”).

Table 8-8. Summary of maximum predicted 24-hour average PM_{10} concentrations due to the Project alone (µg/m^3)

Owner	ID	Maximum predicted 24-hour average PM_{10} concentration due to Project alone	Modelled year
FJ Maunder	2	6	Year 21
RB & ML Kerr	3	7	Year 21
Glek Pty Ltd	4	8	Year 21
H & M Bullock[(a)]	18	9	Year 21
Cooboobindi	23	15	Year 10
Cooboobindi	27	13	Year 5
Billabong	32	13	Year 21
Brighton	33	13	Year 5
Belleview	35	15	Year 5 Year 21
Roma	43	14	Year 21
Glenhope	44	12	Year 5 Year 10
Jeralong	51	32	Year 21
Tarrawonga	54	52	Year 10
		55	Year 21
DC & EL Cheeseman[(b)]	59	32	Year 5 (rail spur)
Bradlock Pty Ltd[(b)]	63	50	Year 5 Year 5 (rail spur)
Goonbri	67	31	Year 5
Goonbri	68	28	Year 5 Year 5 (rail spur)
Wirrilah	69	27	Year 5 Year 5 (rail spur)
Northham	79	27	Year 10
Ambardo	85a	47	Year 5 Year 5 (rail spur)
Ambardo	85b	51	Year 5 (rail spur)
Kyalla	86	40	Year 5 Year 5 (rail spur)
Pine Grove	88	40	Year 5 Year 5 (rail spur)
Barbers Lagoon	90	18	Year 10
Callandar	94	26	Year 21
Flixton	98a	23	Year 5 Year 5 (rail spur)
Flixton	98b	19	Year 5 Year 5 (rail spur)
Bailey Park	100	15	Year 5 Year 5 (rail spur)
DW & AM Keys	115	9	Year 21
JE & RJ Picton	140	19	Year 5 Year 5 (train)
JE & RJ Picton	147	20	Year 5 Year 5 (train)
JE & RJ Picton	148	15	Year 5
JE & RJ Picton	153	16	Year 5 Year 5 (train)
JE & RJ Picton	155	14	Year 5 Year 5 (train)

(a) Purchased by Boggabri Coal after the air quality assessment was completed.
(b) Purchased by Tarrawonga Mine after the air quality assessment was completed.

For each of the residences, an estimation of the statistical probability that the cumulative impact of the proposed operations would result in a 24-hour average PM_{10} concentration greater than 50 $\mu g/m^3$ was completed.

The analysis was completed for the following scenarios for each of the Boggabri and Tarrawonga HVAS data:

- Assuming the HVAS data is greater than or equal to 40 $\mu g/m^3$ AND the predicted impact is greater than 10 $\mu g/m^3$;
- Assuming the HVAS data is greater than or equal to 30 $\mu g/m^3$ AND the predicted impact is greater than 20 $\mu g/m^3$;
- Assuming the HVAS data is greater than or equal to 20 $\mu g/m^3$ AND the predicted impact is greater than 30 $\mu g/m^3$; and
- Assuming the HVAS data is greater than or equal to 10 $\mu g/m^3$ AND the predicted impact is greater than 40 $\mu g/m^3$.

Table 8-9 and **Table 8-10** present a summary of the analysis using the Boggabri Coal and Tarrawonga Mine HVAS data respectively for residences where the cumulative probability of the 24-hour concentration exceeding 50 $\mu g/m^3$ is 2% or greater. The statistical analysis for each residence is presented in detail in **Appendix H**.

The data suggests that there are six private residences (R51, R54, R85a, R85b, R86 and R88) which may experience PM_{10} concentrations above the impact assessment criteria of 50 $\mu g/m^3$ 2% of the time or greater.

Residence 54 ("Tarrawonga") has the most potential to experience cumulative 24-hour average PM_{10} concentrations greater than 50 $\mu g/m^3$ when the contribution from all other sources is greater than 20 $\mu g/m^3$.

It is important to note that this analysis includes some "double-counting" as the HVAS data is already influenced by emissions from the existing operations. In addition, no consideration has been given to the prevailing wind directions in relation to each residence.

8.9.2.5 Conclusion

The two approaches presented in **Section 8.9.2** produce similar results, that residences to the south of the Boggabri operations might be impacted on the basis of cumulative 24-hour average PM_{10} concentrations.

Table 8-9: Probability of cumulative concentration being greater than 50 $\mu g/m^3$ for 2% of the time or more – Boggabri HVAS data

		Boggabri HVAS	Residence		Boggabri HVAS	Residence		Boggabri HVAS	Residence		Boggabri HVAS	Residence	
ID	Year	*Probability >40 $\mu g/m^3$ (%)*	*Probability >10 $\mu g/m^3$ (%)*	Cumulative Probability (%)	*Probability >30 $\mu g/m^3$ (%)*	*Probability >20 $\mu g/m^3$ (%)*	Cumulative Probability (%)	*Probability >20 $\mu g/m^3$ (%)*	*Probability >30 $\mu g/m^3$ (%)*	Cumulative Probability (%)	*Probability >10 $\mu g/m^3$ (%)*	*Probability >40 $\mu g/m^3$ (%)*	Cumulative Probability (%)
R51	Y21	5.2	41.0	2.1	12.0	13.0	1.6	30.0	1.0	0.3	63.5	0.0	0.0
R54	Y10	5.2	55.0	2.8	12.0	28.0	3.4	30.0	16.0	4.8	63.5	5.0	3.2
R54	Y21	5.2	55.0	2.8	12.0	25.0	3.0	30.0	12.0	3.6	63.5	2.0	1.3
R63	Y5T	5.2	31.0	1.6	12.0	11.0	1.3	30.0	5.0	1.5	63.5	1.0	0.6
R85a	y5	5.2	54.0	2.8	12.0	23.0	2.8	30.0	6.0	1.8	63.5	1.0	0.6
R85a	y5T	5.2	51.0	2.7	12.0	23.0	2.8	30.0	6.0	1.8	63.5	1.0	0.6
R85b	y5T	5.2	55.0	2.8	12.0	24.0	2.9	30.0	7.0	2.1	63.5	1.0	0.6
R86	y5	5.2	44.0	2.3	12.0	15.0	1.8	30.0	2.0	0.6	63.5	0.0	0.0
R86	y5T	5.2	43.0	2.2	12.0	15.0	1.8	30.0	2.0	0.6	63.5	0.0	0.0
R88	y5T	5.2	55.0	2.8	12.0	24.0	2.9	30.0	7.0	2.1	63.5	1.0	0.6

Table 8-10: Probability of cumulative concentration being greater than 50 $\mu g/m^3$ for 2% of the time or more – Tarrawonga HVAS data

		Tarrawonga HVAS	Residence		Tarrawonga HVAS	Residence		Tarrawonga HVAS	Residence		Tarrawonga HVAS	Residence	
ID	Year	*Probability >40 $\mu g/m^3$ (%)*	*Probability >10 $\mu g/m^3$ (%)*	Cumulative Probability (%)	*Probability >30 $\mu g/m^3$ (%)*	*Probability >20 $\mu g/m^3$ (%)*	Cumulative Probability (%)	*Probability >20 $\mu g/m^3$ (%)*	*Probability >30 $\mu g/m^3$ (%)*	Cumulative Probability (%)	*Probability >10 $\mu g/m^3$ (%)*	*Probability >40 $\mu g/m^3$ (%)*	Cumulative Probability (%)
R51	Y21	6.5	41.0	2.6	18.3	13.0	2.4	34.4	1.0	0.3	68.8	0.0	0.0
R54	Y10	6.5	55.0	3.5	18.3	28.0	5.1	34.4	16.0	5.5	68.8	5.0	3.4
R54	Y21	6.5	55.0	3.5	18.3	25.0	4.6	34.4	12.0	4.1	68.8	2.0	1.4
R63	Y5	6.5	31.0	2.0	18.3	11.0	2.0	34.4	5.0	1.7	68.8	1.0	0.7
R63	Y5T	6.5	31.0	2.0	18.3	11.0	2.0	34.4	5.0	1.7	68.8	1.0	0.7
R85a	y5	6.5	54.0	3.5	18.3	23.0	4.2	34.4	6.0	2.1	68.8	1.0	0.7
R85a	y5T	6.5	52.0	3.4	18.3	23.0	4.2	34.4	6.0	2.1	68.8	1.0	0.7
R85b	y5T	6.5	55.0	3.5	18.3	24.0	4.4	34.4	7.0	2.4	68.8	1.0	0.7
R86	y5	6.5	44.0	2.8	18.3	15.0	2.7	34.4	2.0	0.7	68.8	0.0	0.0
R86	y5T	6.5	43.0	2.8	18.3	15.0	2.7	34.4	2.0	0.7	68.8	0.0	0.0
R88	y5T	6.5	55.0	3.5	18.3	24.0	4.4	34.4	7.0	2.4	68.8	1.0	0.7

8.10 The 25% Rule for land area

Further to the DoP's requirements to assess the potential impacts at individual residences (i.e. the physical location of a house or dwelling), the Project must also comply with the "25% rule". **Section 8.3** to **Section 8.7** described in detail the predicted impacts at individual residences.

The "25% rule" requires identifying privately-owned land where more than 25% of the land is predicted to experience dust levels above the relevant DECCW criteria. This applies to privately-owned land with or without a residence, including vacant land. Privately-owned land belonging to the same owner that are contiguous (i.e. adjoining) have been considered as a single property of privately-owned land. If privately-owned land belonging to the same owner is separated by a road, this has not been considered to be contiguous. For example, as shown on **Figure 8.44**, the privately-owned land identified as 54, 55, 83, 86, 95 and 96 are all owned by the same landowner. Lots 54, 55 and 83 are considered contiguous, as are lots 86, 95 and 96, but the two areas are not contiguous with each other as Manilla Road and another property splits the land.

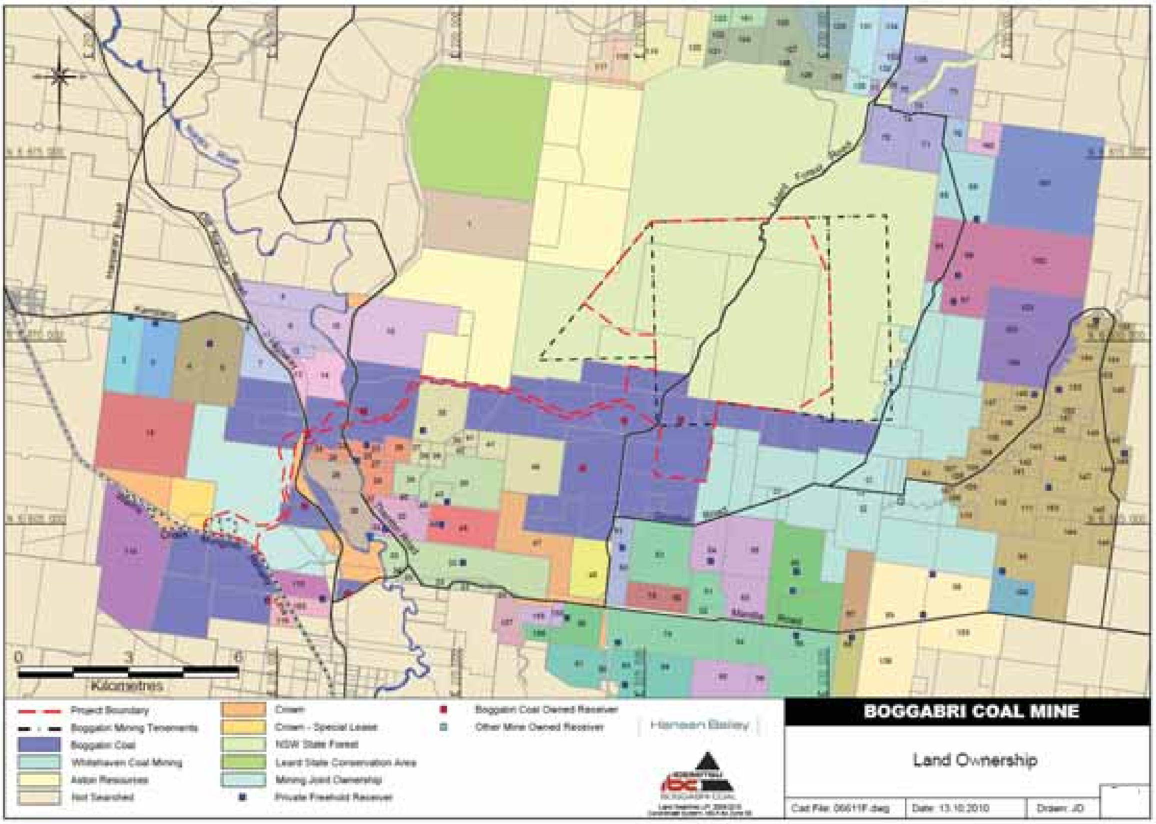


Figure 8.44: Land ownership

Analysis of the contour plots presented in **Section 8.3** to **Section 8.7** shows that some part of the following privately-owned land is predicted to experience impacts above one or more of the relevant DECCW criteria:

- RP & RD McGregor (Tarrawonga) – Lots 54, 55, 83
- DJ Wellwood (Ambardo) – Lot 85
- RR &PL Crosby (Northam) – Lots 53, 81

The *percentage* of this privately-owned land that is predicted to be impacted by dust levels above the DECCW criteria is presented in **Table 8-11**.

Table 8-11: Percentage of privately-owned land area predicted to be impacted

Owner (Property)	Year 1 (%)	Year 5 (%)	Year 10 (%)	Year 21 (%)	Year 5 (rail spur) (%)
Maximum 24-hour average PM_{10} concentration					
RP & RD McGregor (Tarrawonga)	0	**60**	**72**	**62**	**58**
DJ Wellwood (Ambardo)	0	**37**	4	0	**38**
RR &PL Crosby (Northam)	0	1	3	6	1
Annual average PM_{10} concentration					
RP & RD McGregor (Tarrawonga)	21	**91**	10	1	**88**
DJ Wellwood (Ambardo)	18	**69**	0	0	**68**
RR &PL Crosby (Northam)	0	1	0	0	1

It can be seen from **Table 8-11** that only the Tarrawonga and Ambardo properties are predicted to experience dust impacts on more than 25% of their land area.
No other properties were identified as receiving dust impacts over more than 25% of their property area.

8.11 Cumulative Impacts - Tarrawonga Coal Mine Modification

It is understood that the adjacent Tarrawonga Coal Mine recently submitted an application to the NSW Department of Planning (DoP) which was supported by an Environmental Assessment (EA) dated April 2010 (**Resources Strategies, 2010**).

Tarrawonga Coal Mine are seeking to increase the total amount of coal removed from the mine to 16.4 Mt, whilst maintaining the currently approved extraction rate of 2.0 Mt per year. There would also be an additional 34.8 million bcm of waste rock that would need to be removed and emplaced and subsequent increase in the height of the overburden emplacement and topsoil stockpiles.

In addition, the open cut disturbance area would be increased by 38 ha (160 ha to 198 ha) and would extend out further to the east of the existing northern emplacement area.

A more detailed description of the proposed modification to the Tarrawonga Coal Mine is provided in the Tarrawonga EA (**Resources Strategies, 2010**). At the time of undertaking the Air Quality Impact Assessment (AQIA) for the Project, the proposed modifications to Tarrawonga Coal Mine were not known and hence, not included in the original EA for the Project submitted to DoP in July 2010.

In light of the proposed modifications to the Tarrawonga Coal Mine, this section assesses if the proposed modifications to the already approved Tarrawonga Coal Mine would have any material impact on the air quality assessment and modelling outputs completed for the Project.

8.11.1 Assumptions applied in the Project air quality assessment

Based on the air quality assessment prepared for the Tarrawonga Coal Mine (formerly East Boggabri), the annual extraction rate was assumed to be 1.6 Mtpa (**Heggies, 2005**). Mining operations commenced in 2006 and the reported life of mine was eight to ten years (ending 2014 to 2016).

Year 1 of the Project is scheduled to commence in 2012 and therefore concurrent emissions from the Tarrawonga Coal Mine would arise in Year 1 and Year 5 of the Boggabri Project.

Information on the total amount of TSP emissions from mining operations at Tarrawonga Coal Mine was not provided in the **Heggies (2005)** assessment. Therefore a conservative ratio of 1.0 kg TSP per tonne ROM coal was adopted. Typically this ratio is between 0.5 to 0.8 kg TSP/ t ROM coal for modern open cut coal mines.

On the basis of 1.0 kg TSP/ t ROM, it was assumed that emissions from the Tarrawonga Coal Mine would equate to approximately 1,600,000 kg of TSP per year.

The source locations for the Tarrawonga Coal Mine are shown in **Figure 6.1** and **Figure 6.2** of this report. The source locations were based on the approximate locations of activities presented in Figure 9 of **Heggies (2005)** assessment.

The modelling results using this TSP estimate and approximate source locations correlate well with the modelled predictions for Year 8 of the Tarrawonga Coal Mine assessment (**Heggies, 2005**).

8.11.2 Impacts of proposed Tarrawonga modification on air quality modelling for the Project

The proposed modifications to the Tarrawonga Coal Mine assume a maximum ROM extraction rate of 2.0 Mt per year, compared with the 1.6 Mt per year assumed in the Boggabri Project AQIA. There is therefore potential that the TSP emissions from the Tarrawonga Coal Mine have been underestimated in the Boggabri Air Quality Impact Assessment (AQIA).

However, a comparison of the predicted impacts at neighbouring residences demonstrates the conservative assessment presented in the Project AQIA. It is noted that the Tarrawonga AQIA did not explicitly assess the cumulative impacts with the Project (**Heggies, 2010** Section 8.1.4 "Cumulative Impacts with Surrounding Sources"). The assumption was that the existing cumulative impacts are observed in the air quality monitoring and as such a background value of 15.8 $\mu g/m^3$ was added to the predicted impacts from the Tarrawonga Coal Mine operations. Therefore the Tarrawonga AQIA has taken no account of the proposed changes at the Boggabri Coal Mine.

Residence 54 in the Boggabri Coal AQIA corresponds to the 'Tarrawonga' residence in the Tarrawonga Coal Mine modification (**Heggies, 2010**), and Residence 85 corresponds to the 'Ambardo' residence in the Tarrawonga Coal Mine modification[g].

Table 8-12 and **Table 8-13** compare the predicted annual average PM_{10} concentrations at these residences in Year 5 of the Boggabri AQIA (the year in which these residences are predicted to be most impacted) with the predicted impacts presented in the Tarrawonga AQIA.

[g] The lot on which the Residence 85 ('Ambardo') is located contains two properties. The Boggabri Coal AQIA assessed potential impacts at the most northerly of the two residences, whereas the Tarrawonga AQIA assessed the impacts at the most southerly of the two. There is however less than 600 m between the two properties.

Table 8-12: Comparison of model predictions of annual average PM_{10} concentrations at Residence 54 ('Tarrawonga') for Year 5

	Boggabri EA	Tarrawonga EA
Contribution due to Boggabri Project	15 µg/m^3 (a)	-
Contribution due to Tarrawonga Coal Mine	5 µg/m^3 (b)	1 µg/m^3 (c)
Cumulative impacts (including background)	32 µg/m^3 (a)	17 µg/m^3 (c)

*(a) See Table 8-2, **Section 8.4***
(b) Contribution of Tarrawonga = Cumulative impacts – background of 12 µg/m^3 – contribution of Boggabri
(c) Table 13 Tarrawonga Coal Mine modification (Heggies, 2010)

Table 8-13: Comparison of model predictions of annual average PM_{10} concentrations at Residence 85 ('Ambardo') for Year 5

	Boggabri EA	Tarrawonga EA
Contribution due to Boggabri Project	13 µg/m^3 (a)	-
Contribution due to Tarrawonga Coal Mine	10 µg/m^3 (b)	3 µg/m^3 (c)
Cumulative impacts (including background)	35 µg/m^3 (a)	16 µg/m^3 (c)

*(a) See Table 8-2, **Section 8.4***
(b) Contribution of Tarrawonga = Cumulative impacts – background of 12 µg/m^3 – contribution of Boggabri
(c) Table 13 Tarrawonga Coal Mine modification (Heggies, 2010)

From this analysis, it can be seen that the Boggabri AQIA has predicted higher impacts than the Tarrawonga AQIA, when considering both the impacts due to the operations at Tarrawonga Coal Mine, and the cumulative impacts.

8.11.3 Conclusions

In conclusion, whilst the Boggabri AQIA did not explicitly assess the proposed changes to the Tarrawonga Coal Mine, it is considered that the Boggabri AQIA presents a very conservative estimate of potential impacts due to the Tarrawonga Coal Mine.

As such the air quality modelling completed to date for the Project is considered to be representative of any potential additional impacts from the proposed modifications at Tarrawonga Coal Mine.

9 MITIGATION AND MONITORING

9.1 Introduction

The modelling results presented above are based on the assumption that the Proponent applies the control measures discussed in **Section 9.2** to minimise dust emissions. The location of the Tarrawonga and Ambardo residences are within the prevailing wind direction. Because of this, it will be necessary to ensure that dust emissions are kept to the minimum practicable level and that cumulative impacts with other mining projects (Tarrawonga Coal Mine) are kept to acceptable levels. This section outlines procedures proposed for the management and control of dust emissions, including mine design, monitoring and a proactive management plan.

9.2 Mine design

Changes to the mine plan have been undertaken to minimise the potential for impact on neighbouring residences. These include the transportation of product coal by haul trucks on a sealed private haul road. There is the possible implementation in Year 5 of a rail spur to transport product coal from the mine site eliminating the need for the private haul road altogether. Another alternative is the use of a dragline to remove overburden to the emplacement area. An enclosed conveyor has been designed to be used to transport the coal from the crusher to the CHPP. Exposed surface areas are planned to be rehabilitated in the shortest possible timeframe. Haul road surfaces within the mine are planned to be sprayed with a chemical suppressant or repeatedly watered to minimise windblown dust emissions.

9.3 Proposed dust management and control procedures

The term "best practice" is frequently used in pollution control and pollution management. However, what constitutes "best practice" is difficult to define in practical situations. Environment Australia published a series of booklets in the 1990's to assist the mining industry with incorporating best practice environmental management through all phases of mineral production from exploration through construction and eventual closure. In the booklet for Dust Control (**Environment Australia, 1998**) they defined "best practice" as follows:

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

This document since been updated by the Department of Energy, Resources and Tourism (DERT) who have published the handbook *Leading Practice Sustainable Development Program for the Mining Industry* (**DERT, 2009**). This new handbook introduces the term "leading practice", in which:

"...considers the latest and most appropriate technology applied in order to seeking better financial, social and environmental outcomes for present stakeholders and future generations."

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

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

The proposed controls have been considered against those determined to be leading practice in the **DERT (2009)** handbook. **Table 9-1** lists the sources of dust as a result of mine design, the proposed controls and identifies those considered to be leading practice. **Table 9-2** and **Table 9-3** list the different sources of wind-blown and mining-generated dust respectively, the proposed controls, and identify those considered to be leading-practice.

Table 9-1: Leading Practice Control Procedures for Mine Design

Source	Control Procedures	Applied at Boggabri
Transport of coal	Largest practical truck size	Yes
	Shortest route	Yes
	Chemical suppressant on haul roads	Yes
	Enclosed conveyor	Yes
	Replace truck haulage with dragline	Yes
	Rail spur to eliminate 17 km haul road to rail loop	Yes
Overburden dumps	Decreased overburden dump area to allow for increased rehabilitation	Yes
Revegetation	Complete as soon as practical after disturbance	Yes
	Apply as widely as practical	Yes

Table 9-2: Leading Practice Control Procedures for Wind-blown Dust

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

Table 9-3: Leading Practice Controls for Mine-generated Dust

Source	Control procedures	Applied at Boggabri
Product Coal Haul Road	Sealed	Yes
Haul Roads Within Disturbance Area	All unsealed haul roads will have a chemical suppressant applied to reduce dust emissions	Yes
Transportation of Overburden	Possible implementation of a dragline rather than truck and shovel methodology	Proposed Year 5
Transportation of Product Coal	Proposed implementation of a rail spur to eliminate the need to transport coal (via 17 km haul road) to the rail loop	Proposed Year 5
Topsoil Stripping	Access tracks used by topsoil stripping equipment during their loading and unloading cycle will be watered or chemical suppressant applied.	Yes
Blasting	Blasting performed at approximately midday	Yes
Conveyors	All conveyors will be covered and transfer points enclosed, with the exception of the Skyline conveyor.	Yes

9.4 Monitoring

The locations of the current monitoring stations are shown on **Figure 2.2**. It is envisaged that the monitoring program necessary to verify environmental performance will incorporate the following:

- The current network of fifteen deposition gauges, or as otherwise approved by the DECCW, to monitor dust fallout;
- The implementation of additional dust gauges to the south of the Project to monitor dust fallout near the Tarrawonga and Ambardo residences; and
- The ongoing monitoring of PM_{10} concentrations by a HVAS located at DG7 (see **Figure 2.2**)

10 GREENHOUSE GAS EMISSIONS

10.1 Introduction

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

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

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

This section examines the scientific principles that relate greenhouse gases (GHG) to the global warming effect and estimates emissions of GHGs associated with coal operations from the proposed extension of the Project.

It is demonstrated that when all categories (that is, Scopes 1, 2 and 3) of GHG emissions from the Project are taken into account, the Project will comply with the principles of ESD. Scope 1 and Scope 2 are emissions due to the actual operation of Boggabri Coal Mine and Scope 3 are emissions that would result from the offsite transport and burning of the coal produced by Boggabri Coal Mine.

10.2 Science of global warming

The technical assessment reports produced approximately every five years by the Intergovernmental Panel on Climate Change (IPCC) are regarded as the most authoritative and comprehensive documents dealing with the science of global warming. To date, the IPCC has published five technical assessment reports, the most recent being in 2007 (**IPCC, 2007**). These documents represent the scientific community's consensus view on climate change. They also provide a useful database to help to understand the significance of various human activities in the context of climate change. They include quantitative information on the production and fate of greenhouse gases and estimates of the expected increases in global temperatures for a range feasible in the future. These scenarios are chosen to illustrate the range of uncertainty in the predictions of temperature increases.

The Garnaut Climate Change Review, commissioned by Australia's Commonwealth, State and Territory governments, released a final report in September 2008 which suggested that emissions are tracking the upper bounds of the scenarios modelled by the IPCC (**Garnaut, 2008**).

The temperature of the earth's atmosphere is determined almost entirely[h] by the balance between 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 re-radiate 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 associated climate change) is considered to occur 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 may place stresses on current ecological systems that have adapted to current climate regimes.

Increasing concentrations of CO_2, CH_4 and other GHGs may 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.

Increasing concentrations of CO_2 and CH_4 are largely attributable to growth 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 changes to CO_2 concentrations.

10.3 Quantifying greenhouse effects

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

[h] 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.

The estimated quantity of carbon dioxide stored in the atmosphere now is approximately 3,000 Gigatonnes (Gt). The International Energy Agency (**IEA, 2009**) estimates that in 2006, the global emissions of CO_2 from burning fossil fuels were 29,195.4 Mt per year, of which Australia's emissions of CO_2 from burning fossil fuels were 417.06 Mt CO_2 (i.e. 1.4% of the global anthropogenic, or human-related, total).

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

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

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

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

10.4 Greenhouse gas inventories

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

The protocol nominates the following GHGs:

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

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

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

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

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

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

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

10.5 Emission factors

The National Greenhouse Accounts (NGA) Factors published by the Department of Climate Change (**DCC, 2008a and DCC, 2009a**) have been used to convert fuel usage and electricity consumption into CO_2-equivalent emissions. The relevant emission factors are summarised in **Table 10-1**.

Table 10-1: Summary of greenhouse gas emission factors

Type of Fuel and Electricity		Emission factor		Scope	Source
Diesel - onsite activitie1s [a]		69.5	kg CO_2-e/GJ	1	Table 3 DCC, 2009a
		5.3	kg CO_2-e/GJ	3	Table 38 DCC, 2009a
		38.6	GJ/kL		
Explosives use[c]	ANFO	0.17	t CO_2-e/tonne	1	Table 4 DCC, 2008a
	Heavy ANFO	0.18	t CO_2-e/tonne	1	Table 4 DCC, 2008a
	Emulsion	0.17	t CO_2-e/tonne	1	Table 4 DCC, 2008a
Electricity[d]		0.89	kg CO_2-e/kWh	2	Table 5 DCC, 2009a
		0.18	kg CO_2-e/kWh	3	Table 39 DCC, 2009a
Extraction of coal		0.045	t CO_2-e/tonne ROM	1	Table 8 DCC 2009a
Transport of Coal (Rail)		11[e]	t CO_2-e/Mt.km	3	Proponent
Transport of Coal (Shipping)		[f]	t CO_2-e/Mt.km	3	Proponent

Notes:
(a) The emission factors for diesel use include Scope 1 emission (i.e. those activities associated with actual use of fuel) and Scope 3 emissions (those associated the production, processing and transport of diesel fuel to the site).
(b) Refers to all equivalent greenhouse gases where applicable.
(c) As the calculation of emissions from explosives use are no longer required under the NGER reporting requirements, the GHG emissions factor for explosives use has been removed from NGA Factors published June 2009 (**DCC, 2009a**). Therefore the factors published in February 2008 (**DCC, 2008a**) have been used.
(d) The emission factors for electrical energy include Scope 2 emissions (i.e. those associated with generating the electricity) and Scope 3 emissions (those associated with producing the fuel for the power station and the distribution losses involved in delivering electricity to the mine).
(e) The emission factor associated with the transport of coal via rail has been obtained from the Proponent.
(f) The emission factor associated with the transport of coal using ships has been provided by the Proponent. This varies depending on type of ship used (see **Section 10.6.3.2**).

10.6 Boggabri Coal greenhouse emissions

10.6.1 Introduction

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

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

The following sections present the calculation of CO_2-e due to extraction, processing, transport and usage of coal from the Project only.

10.6.2 Emissions from extraction and processing

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

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

Information was provided by Boggabri Coal on the usage of electrical energy, usage of explosives and diesel fuel for the year ending June 2006/2007, 2007/2008 and 2008/2009. **Table 10-2** provides a summary of this information and the consumption rates used to pro-rata future energy consumption based on ROM removal.

Table 10-2: Fuel, energy and explosives usage from mining processing

Emission source	2006/2007	2007/2008	2008/2009	Average Consumption rate (per tonne of ROM)
Product coal exported (t)	826,375	1,302,313	1,450,147	n/a
ROM coal mined (t)	924,000	1,399,277	1,467,939	n/a
Fuel consumption (diesel) (kL)	7,473	8,409	9,802	0.007
Explosives (t)	1,186	5,503	7,371	0.003
Electricity consumption (kWh)	575,765	598,302	640,514	0.496

Table 10-3 summarises the fuel and energy usage for the extraction and processing of the coal.

Table 10-4 summarises the estimated annual average CO_2-e emissions from the Project due to extraction and processing using the emissions factors presented in **Table 10-1**.

Table 10-3: Fuel, energy and explosives usage from mining processing

Year	Total ROM coal (kt ROM coal/y)	Electrical energy used (processing) (kWh)	Diesel used in extraction total (Litres/y)	Explosives used in blasting (kt/y)
1	2,500,000	1,239,198	17,312,182	8,531
2	3,500,000	1,734,877	24,237,055	11,944
3	4,538,131	2,249,457	31,425,982	15,487
4	6,340,753	3,142,979	43,908,908	21,638
5	8,569,440	4,247,692	59,342,284	29,244
6	8,019,461	3,975,079	55,533,746	27,367
7	7,761,767	3,847,345	53,749,248	26,487
8	7,859,531	3,895,805	54,426,251	26,821
9	7,804,512	3,868,534	54,045,257	26,633
10	7,889,317	3,910,569	54,632,515	26,923
11	7,572,897	3,753,727	52,441,348	25,843
12	7,603,179	3,768,737	52,651,049	25,946
13	7,443,246	3,689,462	51,543,535	25,400
14	7,366,816	3,651,576	51,014,262	25,140
15	7,328,062	3,632,367	50,745,898	25,007
16	7,233,577	3,585,533	50,091,602	24,685
17	7,159,786	3,548,956	49,580,609	24,433
18	7,190,672	3,564,266	49,794,490	24,538
19	7,152,872	3,545,529	49,532,730	24,409
20	7,207,882	3,572,796	49,913,663	24,597
21	7,234,767	3,586,123	50,099,842	24,689
Total	**145,276,667**	**72,010,605**	**1,006,022,454**	**495,762**

Table 10-4: Summary of estimated CO_2-e emissions from mining and processing of coal from the Project

Year	CO_2-e from electrical energy (processing) (t/y)		CO_2-e from mining (diesel usage) (t/y)		CO_2-e from blasting (t/y)	CO_2-e from CH_4 released during mining (t/y)	Total (t/y)	
	Scope 2	Scope 3	Scope 1	Scope 3	Scope 1	Scope 1	Scope 1 & 2	Scope 3
1	1,103	223	46,711	3,542	1,450	112,500	161,764	3,765
2	1,544	312	65,395	4,958	2,030	157,500	226,469	5,271
3	2,002	405	84,792	6,429	2,633	204,216	293,642	6,834
4	2,797	566	118,472	8,983	3,678	285,334	410,282	9,549
5	3,780	765	160,114	12,140	4,971	385,625	554,490	12,905
6	3,538	716	149,838	11,361	4,652	360,876	518,904	12,077
7	3,424	693	145,023	10,996	4,503	349,280	502,229	11,689
8	3,467	701	146,850	11,135	4,560	353,679	508,555	11,836
9	3,443	696	145,822	11,057	4,528	351,203	504,995	11,753
10	3,480	704	147,406	11,177	4,577	355,019	510,483	11,881
11	3,341	676	141,494	10,728	4,393	340,780	490,009	11,404
12	3,354	678	142,060	10,771	4,411	342,143	491,968	11,450
13	3,284	664	139,072	10,545	4,318	334,946	481,619	11,209
14	3,250	657	137,644	10,436	4,274	331,507	476,674	11,094
15	3,233	654	136,920	10,382	4,251	329,763	474,166	11,035
16	3,191	645	135,154	10,248	4,196	325,511	468,053	10,893
17	3,159	639	133,775	10,143	4,154	322,190	463,278	10,782
18	3,172	642	134,353	10,187	4,172	323,580	465,276	10,829
19	3,156	638	133,646	10,133	4,150	321,879	462,831	10,772
20	3,180	643	134,674	10,211	4,182	324,355	466,390	10,854
21	3,192	646	135,176	10,249	4,197	325,565	468,130	10,895
Total	**64,089**	**12,962**	**2,714,389**	**205,812**	**84,280**	**6,537,450**	**9,400,209**	**218,774**

10.6.3 Emissions from export and burning of the product coal

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

Information has been provided by the proponent that all product coal will be shipped overseas and that all coal destined for shipment overseas is transported by rail to the Port of Newcastle, a distance of approximately 364 km (one way) from Boggabri Coal Mine. According to a study commissioned by **QR Network Access (2002)** the Australian average CO_2-e emission rate for rail transport is 12.3 g/net tonne-km for a loaded train. As it is assumed that the train would at some point return to Boggabri Coal Mine, emissions estimations have incorporated the return trip from the Port of Newcastle, and conservatively assumed the same emissions factor.

Using this information, **Table 10-5** presents a summary of the CO_2-e emissions from transporting the product coal from the Project Site to the Port of Newcastle and the return journey.

Table 10-5: Estimated CO_2-e emissions from rail transport of product coal (t/y)

Year	Product coal to Port of Newcastle (t/y)	Total CO_2-e from rail transport (t) Scope 3
1	2,500,000	22,386
2	3,500,000	31,340
3	4,299,379	38,498
4	5,500,000	49,249
5	6,967,477	62,390
6	7,000,000	62,681
7	6,793,925	60,836
8	7,000,000	62,681
9	7,000,000	62,681
10	7,000,000	62,681
11	7,000,000	62,681
12	7,000,000	62,681
13	7,000,000	62,681
14	7,000,000	62,681
15	7,000,000	62,681
16	7,000,000	62,681
17	7,000,000	62,681
18	7,000,000	62,681
19	7,000,000	62,681
20	7,000,000	62,681
21	7,000,000	62,681
Total	**134,560,780**	**1,204,911**

10.6.3.2 Emissions from shipping of product coal overseas

There will also be emissions associated with the shipping of the product coal to overseas customers and the use of the product coal overseas. Estimating emissions from these activities is difficult to calculate for the life of the mine as the final destination and use of the product will vary. **Table 10-6** presents a summary of assumed coal destination and shipping distances from the Port of Newcastle.

Table 10-6: Port of Newcastle coal destinations and distances

Location	Country	% of coal[a]	Distance one-way (km)[b]
Osaka	Japan	81	8065
Kaohsiung	Taiwan	6	7821
Penang	Malaysia	11	8488
Shanghai	China	2	8469

[a] **Information provided by the Proponent**
[b] **Umwelt (2008)**

Emissions were estimated as follows:

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

Estimated CO_2-e emissions from the sea transportation of the coal are provided in **Table 10-7**.

Table 10-7: Estimated CO_2-e emissions from sea transport of product coal (Mt)

Year	Japan	Malaysia	Taiwan	China	Total CO_2-e from sea transport (Mt) Scope 3
1	0.29	0.04	0.02	0.01	0.36
2	0.40	0.06	0.03	0.01	0.50
3	0.50	0.07	0.04	0.01	0.62
4	0.64	0.09	0.05	0.02	0.79
5	0.80	0.12	0.06	0.02	1.00
6	0.81	0.12	0.06	0.02	1.00
7	0.78	0.11	0.06	0.02	0.97
8	0.81	0.12	0.06	0.02	1.00
9	0.81	0.12	0.06	0.02	1.00
10	0.81	0.12	0.06	0.02	1.00
11	0.81	0.12	0.06	0.02	1.00
12	0.81	0.12	0.06	0.02	1.00
13	0.81	0.12	0.06	0.02	1.00
14	0.81	0.12	0.06	0.02	1.00
15	0.81	0.12	0.06	0.02	1.00
16	0.81	0.12	0.06	0.02	1.00
17	0.81	0.12	0.06	0.02	1.00
18	0.81	0.12	0.06	0.02	1.00
19	0.81	0.12	0.06	0.02	1.00
20	0.81	0.12	0.06	0.02	1.00
21	0.81	0.12	0.06	0.02	1.00
Total	**15.54**	**2.22**	**1.12**	**0.40**	**19.28**

10.6.4 Emissions from use of coal

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

The convention of not including these emissions avoids double counting of the emissions: leaving the accounting of the emissions from the use of the coal to the end user is also desirable as emissions due to the end use depend on the method by which the coal is used to produce energy and any control measures that might be in place. Various methods of burning will be used by different customers. As most coal from the Project is to be exported, any assessment of greenhouse emissions by its use in those other jurisdictions will be speculative and potentially unreliable. However, based on information provided by the Proponent, it has been assumed that 10% of the coal would be used in steel production and it is assumed that the remainder of the coal is burnt in a power station.

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

It is assumed that 90% of the coal would be used in a power station and that the power station would have similar emissions to a power station in NSW burning black coal. The emissions can then be estimated using the NGA emission factor of 88.43 kg CO_2-equivalent/GJ (Table 1, Scope 1 of **DCC, 2009a**).

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

Table 10-8 summarises the estimated CO_2-e emissions for each year of the Project due to usage of the product.

Table 10-8: Estimated CO_2-e emissions from usage of coal (Mt)

Year	Coal used in steel production (Mt/y)	Coal used in power stations (Mt/y)	CO_2-e from steel production (Mt/y) Scope 3	CO_2-e from power production (Mt/y) Scope 3	Total CO_2-e emissions from usage (Mt/y) Scope 3
1	0.25	2.25	0.68	5.37	6.05
2	0.35	3.15	0.95	7.52	8.47
3	0.43	3.87	1.16	9.24	10.40
4	0.55	4.95	1.49	11.82	13.31
5	0.70	6.27	1.89	14.97	16.86
6	0.70	6.30	1.89	15.04	16.94
7	0.68	6.11	1.84	14.60	16.44
8	0.70	6.30	1.89	15.04	16.94
9	0.70	6.30	1.89	15.04	16.94
10	0.70	6.30	1.89	15.04	16.94
11	0.70	6.30	1.89	15.04	16.94
12	0.70	6.30	1.89	15.04	16.94
13	0.70	6.30	1.89	15.04	16.94
14	0.70	6.30	1.89	15.04	16.94
15	0.70	6.30	1.89	15.04	16.94
16	0.70	6.30	1.89	15.04	16.94
17	0.70	6.30	1.89	15.04	16.94
18	0.70	6.30	1.89	15.04	16.94
19	0.70	6.30	1.89	15.04	16.94
20	0.70	6.30	1.89	15.04	16.94
21	0.70	6.30	1.89	15.04	16.94
Total	**13.46**	**121.10**	**36.42**	**289.15**	**325.57**

10.6.5 Total CO_2-equivalent emissions

Table 10-9 summarises the total emissions from all sources.

Table 10-9: Summary of total estimated CO_2-e emissions all sources (Mt)

Year	Product coal (Mt)	CO_2-e Mining and extraction (Mt)		CO_2-e Transport of product coal (rail & sea) (Mt)	CO_2-e Usage of product coal (Mt)	CO_2-e Total (Mt)	
		Scope 1 & 2	Scope 3	Scope 3	Scope 3	Scope 1 & 2	Scope 3
1	2.50	0.16	0.004	0.38	6.05	0.16	6.43
2	3.50	0.23	0.005	0.53	8.47	0.23	9.01
3	4.30	0.29	0.007	0.65	10.40	0.29	11.06
4	5.50	0.41	0.010	0.84	13.31	0.41	14.15
5	6.97	0.55	0.013	1.06	16.86	0.55	17.93
6	7.00	0.52	0.012	1.07	16.94	0.52	18.01
7	6.79	0.50	0.012	1.03	16.44	0.50	17.48
8	7.00	0.51	0.012	1.07	16.94	0.51	18.01
9	7.00	0.50	0.012	1.07	16.94	0.50	18.01
10	7.00	0.51	0.012	1.07	16.94	0.51	18.01
11	7.00	0.49	0.011	1.07	16.94	0.49	18.01
12	7.00	0.49	0.011	1.07	16.94	0.49	18.01
13	7.00	0.48	0.011	1.07	16.94	0.48	18.01
14	7.00	0.48	0.011	1.07	16.94	0.48	18.01
15	7.00	0.47	0.011	1.07	16.94	0.47	18.01
16	7.00	0.47	0.011	1.07	16.94	0.47	18.01
17	7.00	0.46	0.011	1.07	16.94	0.46	18.01
18	7.00	0.47	0.011	1.07	16.94	0.47	18.01
19	7.00	0.46	0.011	1.07	16.94	0.46	18.01
20	7.00	0.47	0.011	1.07	16.94	0.47	18.01
21	7.00	0.47	0.011	1.07	16.94	0.47	18.01
Total	**134.56**	**9.40**	**0.22**	**20.49**	**325.57**	**9.40**	**346.28**
						TOTAL (Scope 1, 2 & 3)	**355.68**
						Annual Average (Scope 1, 2 & 3)	**16.94**

10.6.6 Important additional considerations

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

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

The web site notes the following:

> *"Industry has continuously striven to increase efficiencies of conventional plant; for example, the average thermal efficiency of US power stations has increased from 5% in 1900, to around 35% currently. In China, most power plants are relatively small,*

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

average efficiency is about 28% compared to an OECD average of 38%. New conventional [pulverised fuel] *PF power plants achieve above 40% efficiency.*

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

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

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

10.6.7 Contribution to global warming and conclusions

This section provides a discussion on the contribution of the Project to global emissions. Because the relationship between global warming and greenhouse gas concentrations is not linear, there is no accepted method to determine the contribution that a given emission of greenhouse gases might make to global warming.

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

At any point in time, it would be reasonably simple to compare the estimated emission of CO_2-e from the various activities with the 3,000 Gt of CO_2-e currently estimated to be stored in the atmosphere. On this basis, average annual emissions over the lifetime of the proposed Boggabri Coal Mine modifications from the mining and burning of coal (including mining, transporting the coal to the Port of Newcastle and usage of the coal) are estimated to be 0.012% of the current global CO_2–e atmospheric load. Thus, the proposed Boggabri Coal Mine modifications could be considered to contribute 0.012% to the increase in global temperatures caused by the increase in greenhouse gas emissions as they are currently. This invites the question as to what temperature rise might be attributed to the GHG emissions from the proposed Boggabri Coal continuation.

Based on the IPCC estimate that a doubling of the CO_2-e concentration in the atmosphere would lead to a 2.5^oC increase in global average temperature (see **Section 10.3**), and that the current global CO_2–e load is approximately 3,000 Gt, it can be estimated that the annual average emissions (Scope 1, 2 and 3) during the life of proposed Project (including mining, transporting the coal to the Port of Newcastle and overseas and usage of the coal) could lead to an annual increase in global temperature of 0.000014 ^oC [$(1.69 \times 10^7/3{,}000 \times 10^9) \times 2.5^oC$].

The total CO_2–e emissions for the State of NSW in 2007 were 162.7 Mt CO_2 –e (**DCC, 2009b**). The average annual emissions estimated for the lifetime of the proposed Boggabri Coal Mine modifications (Scopes 1 and 2) are 0.45 Mt CO_2–e. This equals approximately 0.28% of the total emissions for NSW in 2007.

In 2007, Australia's total greenhouse gas emissions were estimated at 541.2 Mt CO_2-e (**DCC, 2009b**). When comparing emissions for (Scope 1 and 2) associated with the Project, the predicted increase is 0.08% of total 2007 Australian emissions.

Based on the above, there are not likely to be any measurable environmental effects due to the emissions of GHGs from the proposed Boggabri Coal Mine modifications, i.e. the contribution of the Project to GHG emissions is negligible. Given this, it is clear that Boggabri Coal Mine will comply with the principles of ESD.

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

10.6.8 Proposed GHG emissions management and control procedures

Scope 1 greenhouse gas emissions are under the control of the Project. Idemitsu Australia Resources (IAR), hence Boggabri Coal, will continue to review and monitor emissions and the activities that lead to emissions, to ensure that emissions are kept to the minimum practicable level and will attempt to keep the ratio of greenhouse gas emissions per tonne of coal produced as low as possible. In order to facilitate the control of GHG emissions, IAR have developed a Greenhouse Gas Management Policy. The Policy forms the foundation for the management of GHG impacts resulting from IAR operations over which IAR has influence.

IAR will implement the following initiatives in order to achieve the commitments outlined above:

- IAR will ensure compliance with all relevant Government Legislation, policies and GHG reduction strategies and obligations;
- IAR will maintain transparency within appropriate disclosure limits set by the NGER Act with regard to GHG impacts;
- IAR will take action to increase the energy-efficiency of their operations including the following initiatives:
  - Consideration of bio fuels as an alternative to diesel;
  - Improved Coal Stacking technology;
  - Minimisation of material rehandling, coal and overburden haulage distances;
  - Coal handling to avoid spontaneous combustion;
  - The maximised production of bypass coal;
  - The high standard maintenance of haul road surfaces;
  - Optimisation of waste haul profiles; and
  - Using lighting and heating equipment only when required.
- IAR will accelerate the uptake of energy-efficient and clean coal technology through research initiatives;
- IAR will integrate GHG management strategies into business decision-making; and
- IAR will provide communication and training opportunities to staff regarding GHG management strategies.

11 SPONTANEOUS COMBUSTION

11.1 Introduction

Spontaneous combustion occurs when coal and other carbonaceous materials undergo natural oxidation and generate heat. Under the right conditions, the heat from the oxidation reaction can build-up to a point where the coal and contaminated overburden materials will ignite and burn. For self-heating to occur, the composition of the coal must be such that low temperature oxidation can occur. Further the material must be confined in such a way that heat from the oxidation is trapped, allowing the temperature to build up, but not so confined as to preclude the ingress of oxygen to the combustible material at a rate sufficient to promote the combustion and release of heat energy. The ventilation of the coal must not be rapid as to remove the heat.

Once the coal reaches a high enough temperature it will liberate smoke (i.e. fine particulate matter), steam and volatile organic compounds, some of which are odorous and some of which are harmful.

There is potential for the Project coal to heat spontaneously which would require management measures to be employed to minimise spontaneous combustion and the effect on local air quality.

11.2 Potential air quality impacts

Spontaneous combustion results in the release of toxic and/or odorous gases:

- Particulates;
- Sulfur dioxide (SO_2);
- Oxides of nitrogen (NO_x);
- Hydrogen sulfide (H_2S);
- Carbon monoxide (CO);
- Polycyclic aromatic hydrocarbons (PAHs) and
- Volatile organic compounds (VOCs).

In addition, greenhouse gas (GHG) emissions will also be released:

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

Detailed monitoring was completed by CSIRO under the Australian Coal Association Research Program (ACARP) in the Hunter Valley (**Carras et al., 1999**). The CSIRO monitoring involved measuring concentrations of CH_4, CO_2, CO and Non-Methane Hydrocarbons (NMHC) (47 species) and 15 species of PAHs both inside a bulldozer cabin and in the external air.

Whilst these samples were taken primarily to ascertain occupational exposures rather than to test for compliance with ambient air quality criteria, further analysis of these data indicated that whilst it is unlikely that relevant air quality criteria would be exceeded, there may be a detectable odour in the residential areas on occasion (**Holmes Air Sciences, 2007**).

As the odour emission rate cannot be accurately quantified, it is difficult to apply the DECCW's standard assessment criterion. In these circumstances, the most practical approach appears to be to ensure that odour emissions are kept to the minimum practical level. This is the same as requiring that spontaneous combustion be controlled to the maximum extent that it can be practically controlled. Boggabri Coal Mine's current efforts to do this are discussed in the following section, and it is recommended similar actions are taken at the proposed operations.

Although no similar data are available for the Project site, it is likely similar conclusions can be drawn in relation to the potential impacts.

11.3 Monitoring and control of spontaneous combustion

Spontaneous combustion is controlled by avoiding disposing of combustible material in waste emplacement areas and emplacing combustible materials in locations where oxygen ingress is minimised, that is, combustible material must be disposed of in impermeable cells.

Boggabri Coal currently employs these principles to minimise the occurrence of spontaneous combustion and has had significant success in reducing the area affected by spontaneous combustion. However, there are practical impediments to application of these principles. Areas that are currently being mined cannot be capped and in some cases, it is not practical to cap areas, which will need to be reworked in the near or medium future.

Boggabri Coal Mine would be required to monitor and manage spontaneous combustion throughout the life of the Project. These techniques would likely be consistent with techniques currently employed at Boggabri Coal Mine and include:

- Managing spontaneous combustion in accordance with the spontaneous combustion management plan;
- Capping of all areas of spontaneous combustion with inert material;
- Monitoring and placement of coal stockpiles and their temperature;
- Monitoring and reporting of Spontaneous Combustion, including:
  - Quarterly mapping of areas affected by spontaneous combustion;
  - Quarterly reporting to DECCW of areas affected by spontaneous combustion and mitigation measures implemented and their effectiveness;
  - Monthly inspections of the mining operations; and
  - Compilation and enforcement of monthly action plans.

12 CONCLUSIONS

This study has assessed the potential air quality impacts of the Project with respect to particulate matter and greenhouse gas emissions. The construction impacts of the Project have not been assessed as there are many safeguards in place to ensure that there are no detrimental impacts on air quality.

The air quality assessment for the Project included the development of dust emissions inventories for Years 1, 5, 10 and 21 of the Project. The modelled years have been selected to represent the potential worst case air quality impacts that the Project would have in the area over the 21-year approval period. The emissions inventories developed for each of the stages have been used with local meteorological data and the US EPA's ISCMOD model to predict the maximum 24-hour PM_{10}, annual average PM_{10}, annual average TSP and annual average dust deposition (insoluble solids).

The air quality impacts have been modelled for the Project in isolation, and the cumulative effects of the Project with the neighbouring mine, Tarrawonga Mine, including contributions of other local sources of dust. As current Consent Conditions for Tarrawonga Mine only approved Year 1 and Year 5 of the Project, the particulate matter contributions have only been assessed for these years.

The modelling work indicates that over the 21-year approval period of the Project, there will be some residences that will experience particulate matter deposition rates or concentrations above the DECCW's assessment criteria. The following provides a brief summary of the findings of this report.

- **Year 1** - The modelling results indicate that there will not be any exceedances of the DECCW's goals for any of the residences;
- **Year 5** – It has been predicted that the cumulative impacts will result in the exceedance of the DECCW goal of 30 $\mu g/m^3$ at two residences (Tarrawonga and Ambardo);
- **Year 5 (rail spur)** – The implementation of the rail spur may result in an exceedance of the DECCW's maximum 24-hour average PM_{10} concentration at Ambardo. It is predicted that the goal is to be exceeded for 1-day per year. For the cumulative impacts it is predicted that Tarrawonga and Ambardo may experience an annual average PM_{10} concentration above the DECCW assessment criteria of 30 $\mu g/m^3$;
- **Year 5 (dragline)** – The TSP emissions for the alternative of using a dragline to transport overburden from the pit to the overburden emplacement area has been calculated but not modelled. The implementation for the dragline is likely to reduce emissions from the Project by approximately 3%;
- **Year 10** – For the Project in isolation, one residence (Tarrawonga) is predicted to experience maximum 24-hour average PM_{10} concentrations above the assessment criterion of 50 $\mu g/m^3$. It is predicted that the goal is to be exceeded for 2-days per year; and
- **Year 21** - As with Year 10, when the Project is considered in isolation Tarrawonga is predicted to exceed the maximum 24-hour average PM_{10} concentration. It is predicted that Tarrawonga will experience an exceedance for 1-day over the course of a year.

An assessment of greenhouse gas emissions, based on an inventory for each year of the Project, was used to determine the contribution of the Project to global emissions. It is estimated that for an average year, the Project would contribute approximately 0.012% of the current global atmospheric load.

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Appendix A: Land Ownership

Table A.1: Land Ownership

ID	Name	Receiver	ID	Name	Receiver	ID	Name	Receiver
1	MJ & ML Nott (PL) (Louinville)		47	LE James & KE Woodward (Wilboroi)		98	JL Alker (Flixton)	■ ■
2	FJ Maunder	■	48	KR & KA Pryor (Wilboroi East)		99	JE & RJ Picton	
3	RB & ML Kerr	■		Boggabri Coal owned from XX previously owned by Bradlock Pty Ltd		100	AIM Johnson & TR Hall (Bailey Park)	■
4	Glek Pty Ltd	■	51	HM Lockwood (Jeralong)		101	NF Smith	
5	Glek Pty Ltd		52	HM Lockwood (Jeralong)	■	102	VP & SM McAuliffe (Goonbri)	
6	PJ Watson		53	RR & PL Crosby (Northam)		103	PM & MI Mainey	
7	PJ Watson		54	RP & RD McGregor (Tarrawonga)	■	104	PM & MI Mainey	
8	PJ Watson & G Parkin (Rosewood)		55	RP & RD McGregor (Tarrawonga)		105	JE & RJ Picton	
9	PJ Watson & G Parkin (Rosewood)			Properties purchased by Tarrawonga Mine previously owned by GOM Johnson and DC & EL Cheeseman	■	106	JE & RJ Picton	
10	MF, TT, SL Hart & PF Rice (Kelso)		61	JE & RJ Picton		107	JE & RJ Picton	
11	PJ Watson & G Parkin (Rosewood)			Purchased by Tarrawonga Mine previously owned by Bradlock Pty Ltd	■	108	JE & RJ Picton	
12	PJ Watson & G Parkin (Rosewood)		67	VP & SM McAuliffe (Goonbri)	■	109	JE & RJ Picton	
13	LE Christie-Rockliff (Horse Shoe)		68	VP & SM McAuliffe (Goonbri)	■	110	JE & RJ Picton	
14	LE Christie-Rockliff (Horse Shoe)		69	Bank of NSW (Wirrilah)	■	111	GOM Johnson	
15	LJ & KJ Shields (Leyetonstone)		70	JD & DJ Duncan(Myal Plains)			Purchased by Tarrawonga Mine previously owned by GOM Johnson	
	Boggabri Coal owned from XX previously owned by G.L. Eather		71	MJ Brennan (Oakleigh)		113	JE & RJ Picton	
	Boggabri Coal owned from XX previously owned by H & M Bullock	■	72	MJ Brennan (Oakleigh)		114	RE & MJ Stoltenberg (Dunvegan)	
	Boggabri Coal owned from 3/02/10 previously owned by DE Eather	■	73	MJ Brennan (Oakleigh)		115	DW & AM Keys (Hazeldene)	■
23	RW & A Grover (Cooboobindi)	■	74	MJ Brennan (Oakleigh)		116	RA & CM Collyer	
24	RW & A Grover (Cooboobindi)		75	MJ Brennan (Oakleigh)		117	DJC Watson	
25	RW & A Grover (Cooboobindi)		76	MJ Brennan (Oakleigh)		118	DJC Watson	
26	RW & A Grover (Cooboobindi)		77	PD & LA Finlay		119	VA & MA Younger	
27	RW & A Grover (Cooboobindi)	■	78	BJ Crosby		120	VA & MA Younger	
28	GP, LF & WP Clarke (Bullock Paddock)		79	RR & PL Crosby (Northam)	■	121	CM & RRF Morse	
29	RW & A Grover (Cooboobindi)		80	BJ Crosby		122	CM & RRF Morse	
30	GP, LF & WP Clarke (Bullock Paddock)		81	RR & PL Crosby (Northam)		123	CM Morse	
31	RW & A Grover (Cooboobindi)		82	RR & PL Crosby (Northam)		124	CM & RRF Morse	
32	RJ & EJ Browning (Billabong)	■	83	RP & RD McGregor (Tarrawonga)		125	CM & RRF Morse	
33	RJ Heiler (Brighton)	■	84	RR & PL Crosby (Northam)		126	CM & RRF Morse	
34	RJ Heiler (Brighton)		85	DJ Wellwood (Ambardo)	■ ■	127	CM & RRF Morse	
35	KR Druce (Belleview)	■	86	RR & PL Crosby (Kyalla)	■	128	CM & RRF Morse	
36	RW & A Grover (Cooboobindi)		87	PL & AC Laird (Templemore)		129	Morse Investments Pty Ltd.	
37	KR Druce (Belleview)		88	MA, CM, JM & SL Bull (Pine Grove)	■	130	PD & LA Finlay	

ID	Name	Receiver	ID	Name	Receiver	ID	Name	Receiver
38	KR Druce (Belleview)		89	JL Alker (Flixton)		131	PD & LA Finlay	
39	RJ Heiler (Roma)		90	KD Gillham (Barbers Lagoon)	■	132	LA & KA & PD Finlay	
40	RJ & EJ Browning (Billabong)		91	RP McGregor (Callandar)		133	Narrabri Shire Council (Oakleigh)	
41	KR Druce (Belleview)		92	RP McGregor (Callandar)		134	LA & KA & PD Finlay	
42	KR Druce (Belleview)		93	RP McGregor (Callandar)		135	MJ Brennan (Oakleigh)	
43	RJ Heiler (Roma)	■	94	RP McGregor (Callandar)	■	136	JL Alker (Flixton)	
44	DV Gillham (Glenhope)	■	95	RP & RD McGregor		137	JE & RJ Picton	
45	DV & RJ Gillham		96	RP & RD McGregor		138	JE & RJ Picton	
46	KR Druce (Belleview)			Purchased by Tarrawonga Mine previously owned by GOM Johnson		139	JE & RJ Picton	
140	JE & RJ Picton	■	148	JE & RJ Picton	■	156	KD Gillham (Barbers Lagoon)	
141	JE & RJ Picton		149	JE & RJ Picton		157	DV Gillham (Hopetoun Park)	
142	JE & RJ Picton		150	JE & RJ Picton		158	KL Grover	
143	JE & RJ Picton		151	JE & RJ Picton		159	JL Alker (Flixton)	
144	JE & RJ Picton		152	JE & RJ Picton		160	MJ & KA Brennan (Oakleigh)	
145	JE & RJ Picton		153	JE & RJ Picton	■	161	CM Morse	
146	JE & RJ Picton		154	JE & RJ Picton		162	RW & EJ Kemp	
147	JE & RJ Picton	■	155	JE & RJ Picton	■	163	JE & RJ Picton	

Appendix B: Joint Wind Speed Direction and Stability Class tables for Boggabri (September 2008 to August 2009)

STATISTICS FOR FILE: C:\Jobs\Bogg09\Met\Bogg09_2.isc
MONTHS: All
HOURS : All
OPTION: Counts

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	00000028	00000015	00000000	00000000	00000000	00000000	00000000	00000000	00000043
NE	00000012	00000007	00000000	00000000	00000000	00000000	00000000	00000000	00000019
ENE	00000005	00000006	00000000	00000000	00000000	00000000	00000000	00000000	00000011
E	00000008	00000014	00000000	00000000	00000000	00000000	00000000	00000000	00000022
ESE	00000014	00000040	00000000	00000000	00000000	00000000	00000000	00000000	00000054
SE	00000044	00000082	00000000	00000000	00000000	00000000	00000000	00000000	00000126
SSE	00000071	00000104	00000000	00000000	00000000	00000000	00000000	00000000	00000175
S	00000085	00000127	00000000	00000000	00000000	00000000	00000000	00000000	00000212
SSW	00000051	00000087	00000000	00000000	00000000	00000000	00000000	00000000	00000138
SW	00000038	00000060	00000000	00000000	00000000	00000000	00000000	00000000	00000098
WSW	00000026	00000067	00000000	00000000	00000000	00000000	00000000	00000000	00000093
W	00000019	00000074	00000000	00000000	00000000	00000000	00000000	00000000	00000093
WNW	00000021	00000044	00000000	00000000	00000000	00000000	00000000	00000000	00000065
NW	00000025	00000025	00000000	00000000	00000000	00000000	00000000	00000000	00000050
NNW	00000033	00000020	00000000	00000000	00000000	00000000	00000000	00000000	00000053
N	00000074	00000030	00000000	00000000	00000000	00000000	00000000	00000000	00000104
CALM		00000292							
TOTAL	00000554	00000802	00000000	00000000	00000000	00000000	00000000	00000000	00001648

MEAN WIND SPEED (m/s) = 1.51
NUMBER OF OBSERVATIONS = 1648

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	00000005	00000001	00000002	00000000	00000000	00000000	00000000	00000000	00000008
NE	00000001	00000000	00000002	00000000	00000000	00000000	00000000	00000000	00000003
ENE	00000001	00000002	00000002	00000000	00000000	00000000	00000000	00000000	00000005
E	00000000	00000007	00000009	00000000	00000000	00000000	00000000	00000000	00000016
ESE	00000004	00000011	00000035	00000000	00000000	00000000	00000000	00000000	00000050
SE	00000004	00000008	00000061	00000001	00000000	00000000	00000000	00000000	00000074
SSE	00000008	00000013	00000032	00000000	00000000	00000000	00000000	00000000	00000053
S	00000011	00000013	00000022	00000001	00000000	00000000	00000000	00000000	00000047
SSW	00000007	00000011	00000016	00000000	00000000	00000000	00000000	00000000	00000034
SW	00000008	00000013	00000017	00000000	00000000	00000000	00000000	00000000	00000038
WSW	00000008	00000003	00000026	00000001	00000000	00000000	00000000	00000000	00000038
W	00000005	00000013	00000053	00000002	00000000	00000000	00000000	00000000	00000073
WNW	00000007	00000008	00000035	00000000	00000000	00000000	00000000	00000000	00000050
NW	00000002	00000009	00000023	00000000	00000000	00000000	00000000	00000000	00000034
NNW	00000007	00000002	00000007	00000001	00000000	00000000	00000000	00000000	00000017
N	00000013	00000004	00000004	00000000	00000000	00000000	00000000	00000000	00000021
CALM		00000062							
TOTAL	00000091	00000118	00000346	00000006	00000000	00000000	00000000	00000000	00000623

MEAN WIND SPEED (m/s) = 2.67
NUMBER OF OBSERVATIONS = 623

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	00000004	00000002	00000000	00000001	00000000	00000000	00000000	00000000	00000007
NE	00000000	00000000	00000001	00000000	00000000	00000000	00000000	00000000	00000001
ENE	00000002	00000002	00000003	00000002	00000000	00000000	00000000	00000000	00000009
E	00000003	00000006	00000007	00000009	00000000	00000000	00000000	00000000	00000025
ESE	00000000	00000007	00000031	00000036	00000000	00000000	00000000	00000000	00000074
SE	00000002	00000010	00000028	00000022	00000000	00000000	00000000	00000000	00000062
SSE	00000006	00000006	00000012	00000022	00000000	00000000	00000000	00000000	00000046
S	00000000	00000007	00000006	00000005	00000000	00000000	00000000	00000000	00000018
SSW	00000000	00000006	00000008	00000003	00000000	00000000	00000000	00000000	00000017
SW	00000000	00000003	00000003	00000006	00000000	00000000	00000000	00000000	00000012
WSW	00000000	00000003	00000010	00000014	00000000	00000000	00000000	00000000	00000027
W	00000000	00000007	00000021	00000033	00000001	00000000	00000000	00000000	00000062
WNW	00000001	00000014	00000032	00000077	00000000	00000000	00000000	00000000	00000124
NW	00000000	00000007	00000024	00000029	00000000	00000000	00000000	00000000	00000060
NNW	00000003	00000003	00000014	00000006	00000000	00000000	00000000	00000000	00000026
N	00000007	00000004	00000004	00000003	00000000	00000000	00000000	00000000	00000018
CALM		00000007							
TOTAL	00000028	00000087	00000204	00000268	00000001	00000000	00000000	00000000	00000595

MEAN WIND SPEED (m/s) = 4.13
NUMBER OF OBSERVATIONS = 595

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	00000017	00000024	00000027	00000010	00000001	00000001	00000000	00000000	00000080
NE	00000001	00000009	00000011	00000003	00000000	00000000	00000000	00000000	00000024
ENE	00000003	00000007	00000006	00000001	00000001	00000003	00000000	00000000	00000021
E	00000005	00000014	00000026	00000021	00000007	00000001	00000000	00000000	00000074
ESE	00000007	00000032	00000051	00000022	00000016	00000002	00000000	00000001	00000131
SE	00000014	00000040	00000091	00000064	00000039	00000017	00000006	00000004	00000275
SSE	00000004	00000023	00000026	00000033	00000022	00000005	00000006	00000002	00000121
S	00000010	00000015	00000014	00000009	00000002	00000001	00000000	00000000	00000051
SSW	00000004	00000006	00000005	00000007	00000003	00000000	00000000	00000000	00000025
SW	00000005	00000004	00000006	00000003	00000001	00000000	00000000	00000000	00000019
WSW	00000005	00000004	00000009	00000002	00000006	00000000	00000000	00000000	00000026
W	00000003	00000012	00000023	00000013	00000014	00000001	00000000	00000000	00000066
WNW	00000007	00000018	00000044	00000042	00000059	00000021	00000002	00000003	00000196
NW	00000010	00000016	00000037	00000027	00000032	00000010	00000004	00000003	00000139
NNW	00000026	00000018	00000019	00000006	00000007	00000002	00000000	00000000	00000078
N	00000092	00000048	00000027	00000010	00000008	00000003	00000001	00000001	00000190
CALM		00000128							
TOTAL	00000213	00000290	00000422	00000273	00000218	00000067	00000019	00000014	00001644

MEAN WIND SPEED (m/s) = 3.89
NUMBER OF OBSERVATIONS = 1644

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	00000010	00000028	00000006	00000002	00000000	00000000	00000000	00000000	00000046
NE	00000004	00000005	00000002	00000000	00000000	00000000	00000000	00000000	00000011
ENE	00000002	00000007	00000005	00000000	00000000	00000000	00000000	00000000	00000014
E	00000002	00000011	00000015	00000001	00000000	00000000	00000000	00000000	00000029
ESE	00000003	00000021	00000022	00000000	00000000	00000000	00000000	00000000	00000046
SE	00000005	00000027	00000040	00000004	00000000	00000000	00000000	00000000	00000076
SSE	00000004	00000021	00000019	00000000	00000000	00000000	00000000	00000000	00000044
S	00000009	00000007	00000004	00000000	00000000	00000000	00000000	00000000	00000020
SSW	00000005	00000006	00000001	00000000	00000000	00000000	00000000	00000000	00000012
SW	00000004	00000006	00000003	00000000	00000000	00000000	00000000	00000000	00000013
WSW	00000005	00000001	00000006	00000000	00000000	00000000	00000000	00000000	00000012
W	00000001	00000010	00000008	00000000	00000000	00000000	00000000	00000000	00000019
WNW	00000005	00000016	00000025	00000001	00000000	00000000	00000000	00000000	00000047
NW	00000011	00000014	00000017	00000000	00000000	00000000	00000000	00000000	00000042
NNW	00000028	00000025	00000005	00000000	00000000	00000000	00000000	00000000	00000058
N	00000079	00000066	00000013	00000002	00000000	00000000	00000000	00000000	00000160
CALM		00000058							
TOTAL	00000177	00000271	00000191	00000010	00000000	00000000	00000000	00000000	00000707

MEAN WIND SPEED (m/s) = 2.20
NUMBER OF OBSERVATIONS = 707

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	00000108	00000083	00000000	00000000	00000000	00000000	00000000	00000000	00000191
NE	00000023	00000023	00000000	00000000	00000000	00000000	00000000	00000000	00000046
ENE	00000016	00000016	00000000	00000000	00000000	00000000	00000000	00000000	00000032
E	00000035	00000045	00000000	00000000	00000000	00000000	00000000	00000000	00000080
ESE	00000036	00000052	00000000	00000000	00000000	00000000	00000000	00000000	00000088
SE	00000067	00000069	00000000	00000000	00000000	00000000	00000000	00000000	00000136
SSE	00000052	00000056	00000000	00000000	00000000	00000000	00000000	00000000	00000108
S	00000061	00000049	00000000	00000000	00000000	00000000	00000000	00000000	00000110
SSW	00000031	00000033	00000000	00000000	00000000	00000000	00000000	00000000	00000064
SW	00000037	00000031	00000000	00000000	00000000	00000000	00000000	00000000	00000068
WSW	00000026	00000037	00000000	00000000	00000000	00000000	00000000	00000000	00000063
W	00000042	00000038	00000000	00000000	00000000	00000000	00000000	00000000	00000080
WNW	00000043	00000054	00000000	00000000	00000000	00000000	00000000	00000000	00000097
NW	00000069	00000042	00000000	00000000	00000000	00000000	00000000	00000000	00000111
NNW	00000166	00000057	00000000	00000000	00000000	00000000	00000000	00000000	00000223
N	00000416	00000153	00000000	00000000	00000000	00000000	00000000	00000000	00000569
CALM		00000613							
TOTAL	00001228	00000838	00000000	00000000	00000000	00000000	00000000	00000000	00002679

MEAN WIND SPEED (m/s) = 1.25
NUMBER OF OBSERVATIONS = 2679

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	00000172	00000153	00000035	00000013	00000001	00000001	00000000	00000000	00000375
NE	00000041	00000044	00000016	00000003	00000000	00000000	00000000	00000000	00000104
ENE	00000029	00000040	00000016	00000003	00000001	00000003	00000000	00000000	00000092
E	00000053	00000097	00000057	00000031	00000007	00000001	00000000	00000000	00000246
ESE	00000064	00000163	00000139	00000058	00000016	00000002	00000000	00000001	00000443
SE	00000136	00000236	00000220	00000091	00000039	00000017	00000006	00000004	00000749
SSE	00000145	00000223	00000089	00000055	00000022	00000005	00000006	00000002	00000547
S	00000176	00000218	00000046	00000015	00000002	00000001	00000000	00000000	00000458
SSW	00000098	00000149	00000030	00000010	00000003	00000000	00000000	00000000	00000290
SW	00000092	00000117	00000029	00000009	00000001	00000000	00000000	00000000	00000248
WSW	00000070	00000115	00000051	00000017	00000006	00000000	00000000	00000000	00000259
W	00000070	00000154	00000105	00000048	00000015	00000001	00000000	00000000	00000393
WNW	00000084	00000154	00000136	00000120	00000059	00000021	00000002	00000003	00000579
NW	00000117	00000113	00000101	00000056	00000032	00000010	00000004	00000003	00000436
NNW	00000263	00000125	00000045	00000013	00000007	00000002	00000000	00000000	00000455
N	00000681	00000305	00000048	00000015	00000008	00000003	00000001	00000001	00001062
CALM		00001160							
TOTAL	00002291	00002406	00001163	00000557	00000219	00000067	00000019	00000014	00007896

MEAN WIND SPEED (m/s) = 2.27
NUMBER OF OBSERVATIONS = 7896

FREQUENCY OF OCCURENCE OF STABILITY CLASSES

A : 20.9%
B : 7.9%
C : 7.5%
D : 20.8%
E : 9.0%
F : 33.9%

STABILITY CLASS BY HOUR OF DAY

Hour	A	B	C	D	E	F
01	0000	0001	0000	0098	0109	0121
02	0000	0000	0000	0090	0083	0156
03	0000	0000	0000	0077	0071	0181
04	0000	0000	0000	0061	0058	0210
05	0000	0000	0000	0060	0040	0229
06	0000	0000	0000	0104	0031	0194
07	0093	0009	0013	0107	0016	0091
08	0160	0034	0033	0087	0000	0015
09	0183	0041	0032	0073	0000	0000
10	0186	0069	0045	0029	0000	0000
11	0203	0053	0050	0023	0000	0000
12	0184	0058	0058	0029	0000	0000
13	0157	0068	0072	0032	0000	0000
14	0147	0078	0062	0042	0000	0000
15	0134	0079	0077	0039	0000	0000
16	0128	0067	0079	0046	0001	0008
17	0072	0050	0047	0082	0015	0063
18	0001	0016	0027	0105	0033	0147
19	0000	0000	0000	0111	0051	0167
20	0000	0000	0000	0094	0065	0170
21	0000	0000	0000	0081	0043	0205
22	0000	0000	0000	0065	0030	0234
23	0000	0000	0000	0056	0026	0247
24	0000	0000	0000	0053	0035	0241

STABILITY CLASS BY MIXING HEIGHT

Mixing height	A	B	C	D	E	F
<=500 m	0334	0057	0053	0317	0676	2555
<=1000 m	0672	0202	0202	0421	0013	0043
<=1500 m	0642	0364	0340	0532	0018	0081
<=2000 m	0000	0000	0000	0201	0000	0000
<=3000 m	0000	0000	0000	0148	0000	0000
>3000 m	0000	0000	0000	0025	0000	0000

MIXING HEIGHT BY HOUR OF DAY

Hour	0000 to 0100	0100 to 0200	0200 to 0400	0400 to 0800	0800 to 1600	1600 to 3200	Greater than 3200
01	0117	0088	0040	0035	0036	0013	0000
02	0147	0079	0022	0027	0040	0014	0000
03	0173	0065	0021	0018	0041	0011	0000
04	0192	0064	0018	0012	0037	0006	0000
05	0216	0041	0018	0017	0027	0009	0001
06	0145	0105	0057	0009	0006	0007	0000
07	0095	0053	0119	0062	0000	0000	0000
08	0000	0060	0101	0168	0000	0000	0000
09	0000	0000	0084	0172	0073	0000	0000
10	0000	0000	0000	0202	0127	0000	0000
11	0000	0000	0000	0109	0220	0000	0000
12	0000	0000	0000	0090	0239	0000	0000
13	0000	0000	0000	0000	0329	0000	0000
14	0000	0000	0000	0000	0329	0000	0000
15	0000	0000	0000	0000	0329	0000	0000
16	0000	0000	0000	0000	0329	0000	0000
17	0006	0001	0001	0000	0317	0004	0000
18	0056	0031	0018	0000	0199	0022	0003
19	0096	0091	0032	0004	0051	0049	0006
20	0119	0084	0032	0005	0044	0039	0006
21	0154	0079	0015	0002	0037	0042	0000
22	0187	0062	0015	0001	0032	0032	0000
23	0191	0068	0014	0001	0028	0027	0000
24	0203	0052	0021	0002	0027	0024	0000

Appendix C: PM_{10} 24-hour average and rolling annual average concentration monitoring data (µg/m^3)

Date	24-hour average	Rolling annual average
29/08/2005	13	-
12/09/2005	5	-
18/09/2005	9	-
24/09/2005	-	-
30/09/2005	5	-
8/10/2005	5	-
13/10/2005	3	-
17/10/2005	17	-
25/10/2005	8	-
31/10/2005	8	-
6/11/2005	8	-
12/11/2005	7	-
18/11/2005	36	-
24/11/2005	46	-
29/11/2005	46	-
6/12/2005	7	-
12/12/2005	28	-
18/12/2005	45	-
24/12/2005	**70**	-
30/12/2005	**68**	-
6/01/2006	-	-
12/01/2006	-	-
18/01/2006	10	-
24/01/2006	-	-
1/02/2006	15	-
7/02/2006	33	-
13/02/2006	25	-
19/02/2006	11	-
24/02/2006	8	-
27/02/2006	27	-
8/03/2006	27	-
13/03/2006	28	-
20/03/2006	27	-
26/03/2006	22	-
1/04/2006	31	-
7/04/2006	12	-
13/04/2006	23	-
19/04/2006	6	-
25/04/2006	19	-
1/05/2006	18	-
8/05/2006	2	-
13/05/2006	2	-
19/05/2006	19	-
25/05/2006	28	-
31/05/2006	42	-
6/06/2006	16	-
12/06/2006	5	-
18/06/2006	15	-
24/06/2006	7	-
30/06/2006	9	-
6/07/2006	13	-
13/07/2006	9	-
20/07/2006	12	-

Date	24-hour average	Rolling annual average
25/07/2006	9	-
31/07/2006	13	-
6/08/2006	37	-
12/08/2006	16	-
17/08/2006	18	-
24/08/2006	29	20
30/08/2006	14	20
5/09/2006	32	20
11/09/2006	22	20
17/09/2006	40	21
23/09/2006	34	21
6/10/2006	24	22
4/11/2006	38	22
10/11/2006	38	23
16/11/2006	25	23
30/12/2006	20	23
12/01/2007	28	23
18/01/2007	29	24
24/01/2007	13	23
30/01/2007	42	23
6/02/2007	41	23
15/04/2007	**102**	25
20/04/2007	30	25
28/04/2007	8	24
22/05/2007	8	23
28/05/2007	5	22
3/06/2007	5	22
9/06/2007	4	21
15/06/2007	5	21
21/06/2007	5	21
27/06/2007	11	21
4/07/2007	6	21
10/07/2007	7	20
15/07/2007	10	20
21/07/2007	9	20
28/07/2007	4	20
21/08/2007	15	20
26/08/2007	16	19
1/09/2007	12	19
7/09/2007	11	19
14/09/2007	28	19
19/09/2007	38	19
25/09/2007	31	20
1/10/2007	22	20
7/10/2007	26	20
19/10/2007	28	20
25/10/2007	14	20
31/10/2007	18	21
6/11/2007	5	20
12/11/2007	26	20
18/11/2007	11	20
24/11/2007	16	20
30/11/2007	9	20

Date	24-hour average	Rolling annual average
6/12/2007	15	20
12/12/2007	11	20
18/12/2007	21	20
30/12/2007	7	20
5/01/2008	12	20
11/01/2008	2	20
17/01/2008	15	20
23/01/2008	9	20
29/01/2008	8	19
4/02/2008	7	19
10/02/2008	2	19
16/02/2008	20	19
22/02/2008	6	19
28/02/2008	2	18
5/03/2008	11	18
11/03/2008	5	17
18/03/2008	15	17
23/03/2008	0.4	17
29/03/2008	19	16
4/04/2008	8	16
10/04/2008	<0.5	15
16/04/2008	<0.5	15
22/04/2008	4.8	15
28/04/2008	6	14
4/05/2008	1.0	14
16/05/2008	4.7	14
22/05/2008	2.3	13
28/05/2008	0.9	11
3/06/2008	2.7	11
9/06/2008	5.6	11
15/06/2008	1.8	11
21/06/2008	2.5	10
3/07/2008	8.5	11
9/07/2008	3.4	11
15/07/2008	4.9	11
21/07/2008	7.4	11
27/07/2008	7.8	11
2/08/2008	5.2	11
8/08/2008	8.5	11
14/08/2008	10.6	11
20/08/2008	8.4	11
26/08/2008	10.6	11
1/09/2008	34.4	11
7/09/2008	17.7	11
13/09/2008	26	11
19/09/2008	19.7	11
25/09/2008	30.3	11
1/10/2008	9.8	11
7/10/2008	9.9	11
13/10/2008	12.2	10
19/10/2008	6.8	10
25/10/2008	14.2	10
6/11/2008	16.6	10

Date	24-hour average	Rolling annual average
12/11/2008	20.8	10
18/11/2008	25.3	10
24/11/2008	11	10
30/11/2008	13.5	10
6/12/2008	19.4	10
12/12/2008	27.8	10
18/12/2008	18.2	11
24/12/2008	28.1	11
30/12/2008	19.7	11
17/02/2009	8.8	11
23/02/2009	21.2	11
1/03/2009	15.2	11
7/03/2009	17.9	11
13/03/2009	18.9	11
19/03/2009	25.1	12
25/03/2009	13.5	12
31/03/2009	7.5	12
6/04/2009	14.1	12
12/04/2009	8.3	12
18/04/2009	30	12
24/04/2009	17	12
30/04/2009	25.3	13
6/05/2009	13.8	13
12/05/2009	26.8	13
19/05/2009	8.1	13
25/05/2009	8.6	13
31/05/2009	11.4	13
6/06/2009	8.6	13
12/06/2009	10.3	13
18/06/2009	9.9	14
24/06/2009	10	14
30/06/2009	15.4	14
6/07/2009	15.4	14
12/07/2009	7.6	14
18/07/2009	14.5	14
24/07/2009	8.9	14
30/07/2009	18.4	15
4/08/2009	13.8	15
16/08/2009	15.8	15
23/08/2009	17.3	15
29/08/2009	9.3	16
4/09/2009	26.2	16
10/09/2009	32.5	16
16/09/2009	17.6	16
24/09/2009	22.2	17
30/09/2009	17.4	17
6/10/2009	18.6	17
13/10/2009	34.9	17
19/10/2009	27.4	17
25/10/2009	16.4	17
31/10/2009	11.4	17
6/11/2009	0.0	17
12/11/2009	27.2	16

Date	24-hour average	Rolling annual average
19/11/2009	**86.6**	18
25/11/2009	36.6	18
1/12/2009	0.1	18
7/12/2009	**50.3**	19
13/12/2009	43.8	19
20/12/2009	26.4	19
26/12/2009	28.0	20
9/01/2010	28.9	20
9/01/2010	28.9	20
15/01/2010	18.2	20
21/01/2010	7.7	20
27/01/2010	11.0	20
2/02/2010	28.1	20
8/02/2010	16.6	19
14/02/2010	16.6	19
20/02/2010	24.4	20
2/03/2010	13.2	20
8/03/2010	7.9	19
14/03/2010	10.0	19
20/03/2010	7.0	19
26/03/2010	16.4	19
1/04/2010	16.0	19
7/04/2010	21.3	19
13/04/2010	19.2	19
19/04/2010	16.6	19
25/04/2010	16.4	19

Appendix D: Details of Dust Emissions Estimates

Boggabri Open Cut Coal Mine Part 3A

Description of operations

The dust emission inventories have been prepared using the operational description of the proposed mining activities provided by Hansen Bailey on behalf of Boggabri Coal Pty Limited.

Topsoil would be removed using a dozer at a rate of 500 bcm per hour. Blasting will be used to fragment the waste rock prior to excavation using loaders and trucks. The waste rock would be hauled for placement out-of-pit. Following removal of the waste rock, the exposed coal would be cleaned using a dozer and/or grader. The coal seam would then be ripped, loaded into haul trucks using an excavator or front-end-loader (FEL) and transported to a temporary ROM stockpile located within the pit. The ROM coal will then be reloaded to haul trucks and transported to the ROM pad located at the existing mine facilities. The ROM coal will either be directly fed into the crusher or stockpiled for crushing. After Year 5 the CHPP will process a maximum of 2 Mtpa of ROM per year. All product coal (crushed and processed) will be transported via a sealed private haul road to a rail loop located 17 km to the west of the mine site.

There are two other alternatives that have been considered to the above operations. The first is that a dragline will be implemented for the removal of a portion of the overburden and secondly, a rail spur constructed to transport the coal from the mine to the Werris Creek to Mungindi rail line.

Emission estimates

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

All activities have been modelled for 24 hours per day, with the exception of blasting of overburden, which has been assumed to occur at approximately midday each day.

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

Removal of topsoil

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

Drilling overburden and coal

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

The number of holes per year were calculated based on information provided by Hansen Bailey. The number of holes has been calculated to be 380 holes/blast with a hole spacing of 8m and a depth of 7m.

Blasting overburden and coal

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

Equation 1

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

where,

A = area to be blasted in m^2

The area to be blasted per blast and number of blasts per year were calculated based on information provided by Hansen Bailey. The maximum number of blasts per year was determined to be 300.

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

Equation 2

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

where,
E_{TSP} = *TSP emissions*
$k = 0.74$
U = *wind speed(m/s)*
M = *moisture content(%)*
[where $0.25 \leq M \leq 4.8$*]*

The wind speed value was taken from the Boggabri Coal 2008/2009 meteorological dataset. The moisture content for overburden and topsoil was assumed to be 2.5%. A density of 2.4 t/bcm was assumed.

Dragline operations
The TSP emissions from dragline operations were estimated using **US EPA (1985 and updates)** emission factor equation given in **Equation 3**.

Equation 3

$$E_{TSP} = 0.0046 \times \frac{d^{1.1}}{M^{0.3}}$$¶

E_{TSP} = *TSP emissions*
d = drop distance of dragline (m)
M = moisture content (%)
[where $0.25 \leq M \leq 4.8$*]*

The moisture content of the overburden was assumed to be 2.5% and the drop distance of the dragline 7 m.

Hauling material / product on unsealed surfaces

After the application of water, the emission factor used for trucks hauling waste rock or ROM coal on unsealed surfaces is 0.8 kg per vehicle kilometre travelled (kg/VKT). This emission factor includes the implementation of a chemical suppressant to further reduce dust emissions.

The return trip for each year was measured from the location of the haul routes. It was assumed haul trucks with an average capacity of 150 t, 240 t and 360 t are used for the hauling of overburden and topsoil. A weighted average based on equipment numbers was used to determine the truck capacity for each year of operations (see **Table 3.2** for the indicative equipment list). In reality the transportation of overburden would most likely be using 300 t to 360 t trucks, however, the inclusion of the smaller trucks provides a more conservative approach to estimating the emissions from vehicular movements.

The product coal will be transported using 120 t trucks which will be hauled along the private haul road (sealed). The emissions factor for trucks hauling the product coal on a sealed surface is 0.2 kg/VKT.

Dozers on overburden
Emissions from dozers on overburden have been calculated using the US EPA emission factor equation (**US EPA, 1985 and updates**), per **Equation 4**.

Equation 4

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

where,

$E_{TSP} = TSP\ emissions$

s = silt content (%), and

M = moisture (%)

The silt content in the overburden was assumed to be 10%, and the moisture content 2.5%. This results in an emission factor of 12.5 kg/h.

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

Equation 5

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

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

The silt content in the coal whilst ripping was assumed to be 10%, and the moisture content 8%, resulting in an emission factor of 30.7 kg/h.

Loading/unloading coal

The **US EPA (1985 and updates)** emission factor equation has been used. It is given below in **Equation 6**.

Equation 6

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

where,

$E_{TSP} = TSP\ emissions$

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

The moisture content was assumed to be 8%.

Reloading of coal after processing at the CHPP
Equation 2 was used and the moisture content was assumed to be 10%. The emissions factor has been taken to be 0.01 kg/t and it is assumed that 10% of the coal is rehandled.

Wind erosion

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

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

Equation 7

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

where,

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

The following tables present the calculated emissions for each year of operations modelled and the allocation of the sources as represented in **Figure 6.1** to **Figure 6.5**.

The abbreviations used in the tables are as follows:

- O/B - overburden
- CL - coal
- Sh/Ex/FELs -shovels/excavators/front-end-loaders
- WE - wind erosion emissions
- WI - wind insensitive emissions
- WS - wind sensitive emissions

Estimated emissions of TSP for the Project – Year 1

ACTIVITY	TSP emissions (kg/y)	Intensity	units	Emission factor	units	Variable 1	units	Variable 2	units	Variable 3	units
Topsoil Removal - Dozers/Excavators stripping topsoil	2,512	179	h/y	14.0	kg/h						
Topsoil removal - Sh/Ex/FELs loading topsoil	194	215,290	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	2.5	moisture content in %		
Topsoil removal - Hauling topsoil to emplacement area	8,612	215,290	t/y	0.040000	kg/t	150	t/truck load	6.0	km/return trip	1.0	kg/VKT
Topsoil removal - Emplacing topsoil at emplacement area	194	215,290	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	2.5	moisture content in %		
OB - Drilling	33,630	57,000	holes/y	0.59	kg/hole						
OB - Blasting	125,158	150	blasts/y	834	kg/blast	24320	Area of blast in square metres	380	holes/blast		
OB - Excavator loading OB to haul truck	38,777	42,975,010	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	2.5	moisture content in %		
OB - Hauling to emplacement area	895,313	42,975,010	t/y	0.02083	kg/t	240	t/truck load	5.0	km/return trip	1.0	kg/VKT
OB- Emplacing at emplacement area	38,777	42,975,010	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	2.5	moisture content in %		
OB - Dozers removing OB	54,844	4,380	h/y	12.521	kg/h	10	silt content in %	2.5	moisture content in %		
OB - Dozers on OB dumping in emplacement area	109,687	8,760	h/y	12.521	kg/h	10	silt content in %	2.5	moisture content in %		
CL - Dozers ripping/pushing/clean-up	403,385	13,140	h/y	30.6990	kg/h	10	silt content in %	8	moisture content in %		
CL - Sh/Ex/FELs Loading ROM for transfer to temp	-	-	t/y	0.04783	kg/t	8	moisture content in %				
CL - Unloading coal for storage at temp stockpile in pit	-	-	t/y	0.04783	kg/t	8	moisture content in %				
CL - Sh/Ex/FELs loading ROM from temp stockpile to trucks	-		t/y	0.04783	kg/t	8	moisture content in %				
CL - Hauling open pit coal to ROM pad	108,333	2,500,000	t/y	0.04333	kg/t	150	t/load	6.5	km/return trip	1.0	kg/VKT
CL - Unloading ROM to ROM stockpiles	35,874	750,000	t/y	0.04783	kg/t	8	moisture content in %				
CL - Loading ROM directly to hopper to be crushed	83,706	1,750,000	t/y	0.04783	kg/t	8	moisture content in %				
CL - Loading from stockpile to crusher using FELs	35,874	750,000	t/y	0.04783	kg/t	8	moisture content in %				
CL - Crushing ROM	6,750	2,500,000	t/y	0.00270	kg/t						
CL- Dozers at ROM Pad	12,090	4,380	h/y	2.760	kg/h	10	silt content in %	8	moisture content in %		
CL - Unloading Product coal fom crusher	25,000	2,500,000	t/y	0.01	kg/t						
CL - Loading product coal to haul trucks	443	2,500,000	t/y	0.0002	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	8	moisture content in %		
CL - Hauling product coal to rail loop	134,167	2,500,000	t/y	0.05367	kg/t	120	t/load	32.2	km/return trip	0.2	kg/VKT
CL - Unloading product coal at rail loop	443	2,500,000	t/y	0.0002	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	8	moisture content in %		
CL - Loading product coal to trains	443	2,500,000	t/y	0.0002	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	8	moisture content in %		
WE - OB dump area	579,322	165	ha	0.4	kg/ha/h	8760	h/y				
WE - Open pit	283,904	81	ha	0.4	kg/ha/h	8760	h/y				
WE - ROM stockpiles	16,118	5	ha	0.4	kg/ha/h	8760	h/y				
WE - Product stockpiles	14,507	4	ha	0.4	kg/ha/h	8760	h/y				
WE - Topsoil area and stockpiles	433,223	124	ha	0.4	kg/ha/h	8760	h/y				
WE - Product stockpiles at Rail loop	17,408	5	ha	0.4	kg/ha/h	8760	h/y				
Grading roads	10,783	17,520	km	0.6	kg/km	8	speed of graders in km/h				
Tarrawonga Coal Mine	1,600,000	1,600,000	t/y	1.00	kg/t ROM						
Total TSP emissions for Yr 1	**3,509,469**										

Table D.1: Year 1 – source allocation

ACTIVITY	Source ID		
Topsoil Removal - Dozers/Excavators stripping topsoil	69 - 78		
Topsoil removal - Sh/Ex/FELs loading topsoil	69 - 78		
Topsoil removal - Hauling topsoil to emplacement area	69 - 78		
Topsoil removal - Emplacing topsoil at emplacement area	68 - 79		
OB - Drilling	49 - 56		
OB - Blasting	49 - 56		
OB - Excavator loading OB to haul truck	49 - 56		
OB - Hauling to emplacement area	42 - 46	59	66
OB- Emplacing at emplacement area	42 - 46	57 - 67	
OB - Dozers removing OB	49 - 56		
OB - Dozers on OB dumping in emplacement area	42 - 46	57 - 67	
CL - Dozers ripping/pushing/clean-up	49 - 56		
CL - Hauling open pit coal to ROM pad	36 - 41	47 - 56	
CL - Unloading ROM to ROM stockpiles	36		
CL - Loading ROM directly to hopper to be crushed	36		
CL - Loading from stockpile to crusher using FELs	36		
CL - Crushing ROM	36		
CL- Dozers at ROM Pad	36		
CL - Unloading Product coal fom crusher	36		
CL - Loading product coal to haul trucks	36		
CL - Hauling product coal to rail loop	1 - 35		
CL - Unloading product coal at rail loop	1		
CL - Loading product coal to trains	1		
WE - OB dump area	42 - 46	57 - 67	
WE - Open pit	49 - 56		
WE - ROM stockpiles	36		
WE - Product stockpiles	36		
WE - Topsoil area and stockpiles	68 - 79		
WE - Product stockpiles at Rail loop	1		
Grading roads	37 - 53	73 - 77	
Tarrawonga Coal Mine	80 - 88		

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DUST EMISSION CALCULATIONS V2

Output emissions file : C:\Jobs\Bogg09\Emiss\Yr1\Y1_emiss.dat
Meteorological file : C:\Jobs\Bogg09\Met\Bogg09_2.isc
Number of dust sources : 80
Number of activities : 36
No-blast conditions : None
Wind sensitive factor : 1.149 (1.149 adjusted for activity hours)
Wind erosion factor : 40.275

-----ACTIVITY SUMMARY-----
ACTIVITY NAME : Topsoil Removal - Dozers/Excavators stripping topsoil
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 2512 kg/y
FROM SOURCES : 10
69 70 71 72 73 74 75 76 77 78
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 : Topsoil removal - Sh/Ex/FELs loading topsoil
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 194 kg/y
FROM SOURCES : 10
69 70 71 72 73 74 75 76 77 78
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 : Topsoil removal - Hauling topsoil to emplacement area
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 8612 kg/y
FROM SOURCES : 10
69 70 71 72 73 74 75 76 77 78
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 : Topsoil removal - Emplacing topsoil at emplacement area
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 194 kg/y
FROM SOURCES : 12
68 69 70 71 72 73 74 75 76 77 78 79
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 : 33630 kg/y
FROM SOURCES : 8
49 50 51 52 53 54 55 56
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 - Blasting
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 125158 kg/y
FROM SOURCES : 8
49 50 51 52 53 54 55 56
HOURS OF DAY :
0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0

ACTIVITY NAME : OB - Excavator loading OB to haul truck
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 38777 kg/y
FROM SOURCES : 8
49 50 51 52 53 54 55 56
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
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 895313 kg/y
FROM SOURCES : 7
42 43 44 45 46 59 66
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
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 38777 kg/y
FROM SOURCES : 16
42 43 44 45 46 57 58 59 60 61 62 63 64 65 66 67
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 - Dozers removing OB
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 54844 kg/y
FROM SOURCES : 8
49 50 51 52 53 54 55 56
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 - Dozers on OB dumping in emplacement area
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 109687 kg/y
FROM SOURCES : 16
42 43 44 45 46 57 58 59 60 61 62 63 64 65 66 67
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
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 403385 kg/y
FROM SOURCES : 8
49 50 51 52 53 54 55 56
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 for transfer to temp stockpile in pit
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 8
49 50 51 52 53 54 55 56
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 - Unloading coal for storage at temp stockpile in pit
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 8
49 50 51 52 53 54 55 56
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 from temp stockpile to trucks
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 8
49 50 51 52 53 54 55 56
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 open pit coal to ROM pad
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 108333 kg/y
FROM SOURCES : 16
36 37 38 39 40 41 47 48 49 50 51 52 53 54 55 56
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 - Unloading ROM to ROM stockpiles
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 35874 kg/y
FROM SOURCES : 1
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 : CL - Loading ROM directly to hopper to be crushed
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 83706 kg/y
FROM SOURCES : 1
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 : CL - Loading from stockpile to crusher using FELs
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 35874 kg/y
FROM SOURCES : 1
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 : CL - Crushing ROM
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 6750 kg/y
FROM SOURCES : 1
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 : CL- Dozers at ROM Pad
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 12090 kg/y
FROM SOURCES : 1
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 : CL - Unloading Product coal fom crusher
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 25000 kg/y
FROM SOURCES : 1
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 : CL - Loading product coal to haul trucks
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 443 kg/y
FROM SOURCES : 1
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 : CL - Hauling product coal to rail loop
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 134167 kg/y
FROM SOURCES : 35
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
28 29 30 31 32 33 34 35
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 - Unloading product coal at rail loop
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 443 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 : CL - Loading product coal to trains
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 443 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 - OB dump area
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 579322 kg/y
FROM SOURCES : 16
42 43 44 45 46 57 58 59 60 61 62 63 64 65 66 67
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 - Open pit
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 283904 kg/y
FROM SOURCES : 8
49 50 51 52 53 54 55 56
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 stockpiles
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 16118 kg/y
FROM SOURCES : 1
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 - Product stockpiles
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 14507 kg/y
FROM SOURCES : 1
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 - Topsoil area and stockpiles
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 433223 kg/y
FROM SOURCES : 12
68 69 70 71 72 73 74 75 76 77 78 79
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 - Product stockpiles at Rail loop
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 17408 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 : Grading roads
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 10783 kg/y
FROM SOURCES : 21
37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 73 74 75 76
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 : Tarrawonga Coal Mine WI
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 1168000 kg/y
FROM SOURCES : 1
80
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 : Tarrawonga Coal Mine WS
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 224000 kg/y
FROM SOURCES : 1
80
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 : Tarrawonga Coal Mine WE
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 208000 kg/y
FROM SOURCES : 1
80
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

----EMISSIONS SUMMARY-----(g/s)
Source Hour Wind_insensitive Wind_sensitive Wind_erosion
Blasting

Pit retention sources: 8
49 50 51 52 53 54 55

Estimated emissions of TSP for the Project – Year 5

ACTIVITY	TSP emissions (kg/y)	Intensity	units	Emission factor	units	Variable 1	units	Variable 2	units	Variable 3	units
Topsoil Removal - Dozers/Excavators stripping topsoil	9,801	700	h/y	14.0	kg/h						
Topsoil removal - Sh/Ex/FELs loading topsoil	758	840,074	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.	2.5	moisture content in %		
Topsoil removal - Hauling topsoil to emplacement area	50,404	840,074	t/y	0.060000	kg/t	150	t/truck load	9.0	km/return trip	1.0	kg/VKT
Topsoil removal - Emplacing topsoil at emplacement are	758	840,074	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.	2.5	moisture content in %		
OB - Drilling	67,260	114,000	holes/y	0.59	kg/hole						
OB - Blasting	250,316	300	blasts/y	834	kg/blast	24320	Area of blast in square metres	380	holes/blast		
OB - Excavator loading OB to haul truck	123,118	136,446,192	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.	2.5	moisture content in %		
OB - Hauling to emplacement area	2,182,006	136,446,192	t/y	0.01599	kg/t	275	t/truck load	5.5	km/return trip	0.8	kg/VKT
OB- Emplacing at emplacement area	123,118	136,446,192	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.	2.5	moisture content in %		
OB - Dozers removing OB	219,374	17,520	h/y	12.521	kg/h	10	silt content in %	2.5	moisture content in %		
OB - Dozers on OB dumping in emplacement area	219,374	17,520	h/y	12.521	kg/h	10	silt content in %	2.5	moisture content in %		
CL - Dozers ripping/pushing/clean-up	806,769	26,280	h/y	30.6990	kg/h	10	silt content in %	8	moisture content in %		
CL - Loading ROM for transfer to temp stockpile in pit	-	-	t/y	0.04783	kg/t	8	moisture content in %				
CL - Unloading coal for storage at temp stockpile in pit	-	-	t/y	0.04783	kg/t	8	moisture content in %				
CL - Sh/Ex/FELs loading ROM from temp stockpile to	-		t/y	0.04783	kg/t	8	moisture content in %				
CL - Hauling open pit coal to ROM pad	274,222	8,569,440	t/y	0.04000	kg/t	150	t/load	7.5	km/return trip	0.8	kg/VKT
CL - Unloading ROM to ROM pad (20%)	81,979	1,713,888	t/y	0.04783	kg/t	8	moisture content in %				
CL - Loading ROM directly to hopper to be crushed	327,916	6,855,552	t/y	0.04783	kg/t	8	moisture content in %				
CL - Loading from stockpile to crusher using FELs	81,979	1,713,888	t/y	0.04783	kg/t	8	moisture content in %				
CL - Crushing ROM (100%)	23,137	8,569,440	t/y	0.00270	kg/t						
CL - ROM hopper unloading coal (100%)	85,694	8,569,440	t/y	0.01	kg/t						
CL- Loading coal from hopper for transfer to CHPP	354	2,000,000	t/y	0.0002	kg/t	1.042	average of (wind speed/2.2)^1.	8	moisture content in %		
CL - Conveying coal from hopper to CHPP	-	-	t/y								
CL - Unloading to CHPP	354	2,000,000	t/y	0.0002	kg/t	1.042	average of (wind speed/2.2)^1.	8	moisture content in %		
CL- Handle coal at CHPP	259	2,000,000	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.	10	moisture content in %		
CL- Rehandle coal at CHPP	26	200,000	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.	10	moisture content in %		
CL- Dozers at CHHP / ROM Pad	9,046	4,380	h/y	2.065	kg/h	10	silt content in %	10	moisture content in %		
CL - Loading product coal to haul trucks	903	6,967,477	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.	10	moisture content in %		
CL - Hauling product coal to rail loop (from crusher to	373,921	6,967,477	t/y	0.05367	kg/t	120	t/load	32.2	km/return trip	0.2	kg/VKT
CL - Unloading product coal at rail loop	903	6,967,477	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.	10	moisture content in %		
CL - Loading product coal to trains	903	6,967,477	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.	10	moisture content in %		
CL - Loading rejects and tailings to haul trucks	208	1,601,963	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.	10	moisture content in %		
CL - Hauling rejects from CHPP	41,010	1,601,963	t/y	0.03200	kg/t	150.0	t/truck load	6.0	km/return trip	0.8	
Cl - Unloading rejects	208	1,601,963	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.	10	moisture content in %		
WE - OB dump area	902,650	258	ha	0.4	kg/ha/h	8760	h/y				
WE - Open pit	507,945	145	ha	0.4	kg/ha/h	8760	h/y				
WE - ROM stockpiles	16,118	5	ha	0.4	kg/ha/h	8760	h/y				
WE - Product stockpiles	16,493	5	ha	0.4	kg/ha/h	8760	h/y				
WE - Topsoil area and stockpiles	372,728	106	ha	0.4	kg/ha/h	8760	h/y				
WE - Product stockpiles at Rail loop	19,792	6	ha	0.4	kg/ha/h	8760	h/y				
Grading roads	26,957	43,800	km	0.6	kg/km	8	speed of graders in km/h				
Tarrawonga Coal Mine	1,600,000	1,600,000	t/y	1.00	kg/t ROM						
Total TSP emissions for Yr 5	**7,218,763**										

Table D.2: Year 5 – source allocation

ACTIVITY	Source ID				
Topsoil Removal - Dozers/Excavators stripping topsoil	61 - 64				
Topsoil removal - Sh/Ex/FELs loading topsoil	61 - 64				
Topsoil removal - Hauling topsoil to emplacement area	61 - 65				
Topsoil removal - Emplacing topsoil at emplacement area	61	65			
OB - Drilling	44 - 46	52	56 - 60	71 - 74	
OB - Blasting	44 - 46	52	56 - 60	71 - 74	
OB - Excavator loading OB to haul truck	44 - 46	52	56 - 60	71 - 74	
OB - Hauling to emplacement area	34 - 38	44 - 60			
OB- Emplacing at emplacement area	34 - 38	47 - 51	55	66	69
OB - Dozers removing OB	44 - 46	52	56 - 60		
OB - Dozers on OB dumping in emplacement area	34 - 38	47 - 51	55	66	69
CL - Dozers ripping/pushing/clean-up	44 - 46	52	56 - 60		
CL - Hauling open pit coal to ROM pad	29	43 - 46	52	56 - 60	75 - 76
CL - Unloading ROM to ROM pad (20%)	28				
CL - Loading ROM directly to hopper to be crushed (80%)	26				
CL - Loading from stockpile to crusher using FELs (20%)	28				
CL - Crushing ROM (100%)	26				
CL - ROM hopper unloading coal (100%)	26				
CL- Loading coal from hopper for transfer to CHPP 2Mtpa	26				
CL - Hauling coal from hopper to CHPP	26	28			
CL - Unloading to CHPP	28				
CL- Handle coal at CHPP	28				
CL- Rehandle coal at CHPP	28				
CL- Dozers at CHHP / ROM Pad	26	28			
CL - Loading product coal to haul trucks	28				
CL - Hauling product coal to rail loop (from crusher to CHPP)	1 - 26				
CL - Unloading product coal at rail loop	1				
CL - Loading product coal to trains	1				
CL - Loading rejects and tailings to haul trucks	26	28			
CL - Hauling rejects from CHPP	29 - 44	47 - 51	53 - 54		
Cl - Unloading rejects	34 - 38	47 - 51	55		
WE - OB dump area	34 - 38	47 - 51	55	66	69
WE - Open pit	44 - 46	52	56 - 60		
WE - ROM stockpiles	27				
WE - Product stockpiles	27				
WE - Topsoil area and stockpiles	61 - 65				
WE - Product stockpiles at Rail loop	1				
Grading roads	29 - 60				
Tarrawonga Coal Mine	77 - 85				

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DUST EMISSION CALCULATIONS V2

Output emissions file : C:\Jobs\Bogg09\Emiss\Yr5\Y5_emiss.dat
Meteorological file : C:\Jobs\Bogg09\Met\Bogg09_2.isc
Number of dust sources : 78
Number of activities : 44
No-blast conditions : None
Wind sensitive factor : 1.149 (1.149 adjusted for activity hours)
Wind erosion factor : 40.275

-----ACTIVITY SUMMARY-----
ACTIVITY NAME : Topsoil Removal - Dozers/Excavators stripping topsoil
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 9801 kg/y
FROM SOURCES : 4
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 : Topsoil removal - Sh/Ex/FELs loading topsoil
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 758 kg/y
FROM SOURCES : 4
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 : Topsoil removal - Hauling topsoil to emplacement area
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 50404 kg/y
FROM SOURCES : 5
61 62 63 64 65
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 : Topsoil removal - Emplacing topsoil at emplacement area
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 758 kg/y
FROM SOURCES : 2
61 65
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 : 67260 kg/y
FROM SOURCES : 13
44 45 46 52 56 57 58 59 60 71 72 73 74
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 - Blasting
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 250316 kg/y
FROM SOURCES : 13
44 45 46 52 56 57 58 59 60 71 72 73 74
HOURS OF DAY :
0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0

ACTIVITY NAME : OB - Excavator loading OB to haul truck
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 123118 kg/y
FROM SOURCES : 13
44 45 46 52 56 57 58 59 60 71 72 73 74
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
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 2182006 kg/y
FROM SOURCES : 22
34 35 36 37 38 44 45 46 47 48 49 50 51 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 : OB- Emplacing at emplacement area
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 123118 kg/y
FROM SOURCES : 13
34 35 36 37 38 47 48 49 50 51 55 66 69
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 - Dozers removing OB
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 219374 kg/y
FROM SOURCES : 9
44 45 46 52 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 : OB - Dozers on OB dumping in emplacement area
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 219374 kg/y
FROM SOURCES : 13
34 35 36 37 38 47 48 49 50 51 55 66 69
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
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 806769 kg/y
FROM SOURCES : 9
44 45 46 52 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 : CL - Loading ROM for transfer to temp stockpile in pit
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 9
44 45 46 52 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 : CL - Unloading coal for storage at temp stockpile in pit
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 9
44 45 46 52 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 : CL - Sh/Ex/FELs loading ROM from temp stockpile to trucks
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 9
44 45 46 52 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 : CL - Hauling open pit coal to ROM pad
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 274222 kg/y
FROM SOURCES : 13
29 43 44 45 46 52 56 57 58 59 60 75 76
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 - Unloading ROM to ROM pad (20%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 81979 kg/y
FROM SOURCES : 1
28
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 ROM directly to hopper to be crushed (80%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 327916 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 from stockpile to crusher using FELs (20%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 81979 kg/y
FROM SOURCES : 1
28
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 (100%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 23137 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 - ROM hopper unloading coal (100%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 85694 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 coal from hopper for transfer to CHPP 2Mtpa
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 354 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 - Hauling coal from hopper to CHPP
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 2
26 28
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 - Unloading to CHPP
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 354 kg/y
FROM SOURCES : 1
28
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- Handle coal at CHPP
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 259 kg/y
FROM SOURCES : 1
28
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- Rehandle coal at CHPP
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 26 kg/y
FROM SOURCES : 1
28
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 at CHHP / ROM Pad
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 9046 kg/y
FROM SOURCES : 2
26 28
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 product coal to haul trucks
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 903 kg/y
FROM SOURCES : 1
28
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 product coal to rail loop
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 373921 kg/y
FROM SOURCES : 26
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 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 - Unloading product coal at rail loop
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 903 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 : CL - Loading product coal to trains
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 903 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 : CL - Loading rejects and tailings to haul trucks
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 208 kg/y
FROM SOURCES : 2
26 28
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 rejects from CHPP
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 41010 kg/y
FROM SOURCES : 23
29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 47 48 49 50 51 53 54
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 - Unloading rejects
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 208 kg/y
FROM SOURCES : 11
34 35 36 37 38 47 48 49 50 51 55
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 - OB dump area
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 902650 kg/y
FROM SOURCES : 13
34 35 36 37 38 47 48 49 50 51 55 66 69
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 - Open pit
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 507945 kg/y
FROM SOURCES : 9
44 45 46 52 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 - ROM stockpiles
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 16118 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 : WE - Product stockpiles
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 16493 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 : WE - Topsoil area and stockpiles
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 372728 kg/y
FROM SOURCES : 5
61 62 63 64 65
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 - Product stockpiles at Rail loop
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 19792 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 : Grading roads
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 26957 kg/y
FROM SOURCES : 32
29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 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 : Tarrawonga Coal Mine WI
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 1168000 kg/y
FROM SOURCES : 2
77 78
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 : Tarrawonga Coal Mine WS
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 224000 kg/y
FROM SOURCES : 2
77 78
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 : Tarrawonga Coal Mine WE
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 208000 kg/y
FROM SOURCES : 2
77 78
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

----EMISSIONS SUMMARY-----(g/s)
Source Hour Wind_insensitive Wind_sensitive Wind_erosion Blasting

Pit retention sources: 11
45 46 52 56 57 59 60 71 72 73 74

Estimated emissions of TSP for the Project – Year 10

ACTIVITY	TSP emissions (kg/y)	Intensity	units	Emission factor	units	Variable 1	units	Variable 2	units	Variable 3	units
Topsoil Removal - Dozers/Excavators stripping topsoil	3,831	274	h/y	14.0	kg/h						
Topsoil removal - Sh/Ex/FELs loading topsoil	296	328,387	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	2.5	moisture content in %		
Topsoil removal - Hauling topsoil to emplacement area	21,892	328,387	t/y	0.066667	kg/t	150	t/truck load	10.0	km/return trip	1.0	kg/VKT
Topsoil removal - Emplacing topsoil at emplacement area	296	328,387	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	2.5	moisture content in %		
OB - Drilling	67,260	114,000	holes/y	0.59	kg/hole						
OB - Blasting	250,316	300	blasts/y	834	kg/blast	24320	Area of blast in square metres	380	holes/blast		
OB - Excavator loading OB to haul truck	93,533	103,658,050	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	2.5	moisture content in %		
OB - Hauling to emplacement area	1,779,947	103,658,050	t/y	0.02146	kg/t	280	t/truck load	7.5	km/return trip	0.8	kg/VKT
OB- Emplacing at emplacement area	93,533	103,658,050	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	2.5	moisture content in %		
OB - Dozers removing OB	219,374	17,520	h/y	12.521	kg/h	10	silt content in %	2.5	moisture content in %		
OB - Dozers on OB dumping in emplacement area	219,374	17,520	h/y	12.521	kg/h	10	silt content in %	2.5	moisture content in %		
CL - Dozers ripping/pushing/clean-up	806,769	26,280	h/y	30.6990	kg/h	10	silt content in %	8	moisture content in %		
CL - Loading ROM for transfer to temp stockpile in pit	-	-	t/y	0.04783	kg/t	8	moisture content in %				
CL - Unloading coal for storage at temp stockpile in pit	-	-	t/y	0.04783	kg/t	8	moisture content in %				
CL - Sh/Ex/FELs loading ROM from temp stockpile to trucks	-		t/y	0.04783	kg/t	8	moisture content in %				
CL - Hauling open pit coal to ROM pad	286,119	7,889,317	t/y	0.04533	kg/t	150.0	t/load	8.5	km/return trip	0.8	kg/VKT
CL - Unloading ROM to ROM stockpiles (20%)	75,473	1,577,863	t/y	0.04783	kg/t	8	moisture content in %				
CL - Loading ROM directly to hopper to be crushed (80%)	301,890	6,311,454	t/y	0.04783	kg/t	8	moisture content in %				
CL - Loading from stockpile to crusher using FELs (20%)	75,473	1,577,863	t/y	0.04783	kg/t	8	moisture content in %				
CL - Crushing ROM (100%)	21,301	7,889,317	t/y	0.00270	kg/t						
CL - ROM hopper unloading coal	78,893	7,889,317	t/y	0.01	kg/t						
CL- Loading coal from hopper for transfer to CHPP (40%)	354	2,000,000	t/y	0.0002	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	8	moisture content in %		
CL - Conveying coal from hopper to CHPP	-	-	t/y								
CL - Unloading to CHPP	354	2,000,000	t/y	0.0002	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	8	moisture content in %		
CL- Handle coal at CHPP	259	2,000,000	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
CL- Rehandle coal at CHPP	26	200,000	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
CL- Dozers at CHHP	9,046	4,380	h/y	2.065	kg/h	10	silt content in %	10	moisture content in %		
CL - Loading product coal to trucks (100%)	907	7,000,000	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
CL - hauling product coal to rail loop	375667	7,000,000	t/y	0.05367	kg/t	120.0	t/load	32.2	km/return trip	0.2	kg/VKT
CL - Unloading product coal at rail loop	907	7,000,000	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
CL - Loading product coal to trains at rail loop	907	7,000,000	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
CL - Loading rejects and tailings to haul trucks	115	889,317	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
CL - Hauling rejects	37,944	889,317	t/y	0.05333	kg/t	120.0	t/truck load	8	km/return trip	0.8	kg/VKT
Cl - Unloading rejects	115	889,317	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
WE - OB dump area	1,486,078	424	ha	0.4	kg/ha/h	8760	h/y				
WE - Open pit	543,607	155	ha	0.4	kg/ha/h	8760	h/y				
WE - ROM stockpiles	16,118	5	ha	0.4	kg/ha/h	8760	h/y				
WE - Product stockpiles	16,493	5	ha	0.4	kg/ha/h	8760	h/y				
WE - Topsoil area and stockpiles	586,186	167	ha	0.4	kg/ha/h	8760	h/y				
WE - Product stockpiles at Rail loop	19,792	6	ha	0.4	kg/ha/h	8760	h/y				
Grading roads	21,566	35,040	km	0.6	kg/km	8	speed of graders in km/h				
Tarrawonga Coal Mine	-	1,600,000	t/y	1.00	kg/t ROM						
Total TSP emissions for Yr 10	**7,512,014**										

Table D.3: Year 10 – source allocation

ACTIVITY	Source ID	
Topsoil Removal - Dozers/Excavators stripping topsoil	46 - 50	
Topsoil removal - Sh/Ex/FELs loading topsoil	46 - 50	
Topsoil removal - Hauling topsoil to emplacement area	46 - 51	
Topsoil removal - Emplacing topsoil at emplacement area	51	
OB - Drilling	38 - 45	
OB - Blasting	38 - 45	
OB - Excavator loading OB to haul truck	38 - 45	
OB - Hauling to emplacement area	31 - 45	
OB- Emplacing at emplacement area	31 - 37	52 - 48
OB - Dozers removing OB	38 - 45	
OB - Dozers on OB dumping in emplacement area	31 - 37	52 - 48
CL - Dozers ripping/pushing/clean-up	38 - 45	
CL - Hauling open pit coal to ROM pad	27 - 30	38 - 45
CL - Unloading ROM to ROM stockpiles (20%)	29	
CL - Loading ROM directly to hopper to be crushed (80%)	29	
CL - Loading from stockpile to crusher using FELs (20%)	29	
CL - Crushing ROM (100%)	29	
CL - ROM hopper unloading coal	29	
CL- Loading coal from hopper for transfer to CHPP (40%)	29	
CL - Hauling coal from hopper to CHPP	23	29
CL - Unloading to CHPP	23	
CL- Handle coal at CHPP	23	
CL- Rehandle coal at CHPP	23	
CL- Dozers at CHHP	23	29
CL - Loading product coal to trucks (100%)	23	29
CL - hauling product coal to rail loop	1 - 23	
CL - Unloading product coal at rail loop	1	
CL - Loading product coal to trains at rail loop	1	
CL - Loading rejects and tailings to haul trucks	23	29
CL - Hauling rejects	24 - 37	
Cl - Unloading rejects	31 - 37	52 - 58
WE - OB dump area	31 - 37	52 - 58
WE - Open pit	38 - 45	
WE - ROM stockpiles	29	
WE - Product stockpiles	59	
WE - Topsoil area and stockpiles	46 - 50	
WE - Product stockpiles at Rail loop	1	
Grading roads	23 - 45	
Tarrawonga Coal Mine	-	

------------------------------- 06-Jan-2010 13:54
DUST EMISSION CALCULATIONS V2

Output emissions file : C:\Jobs\Bogg09\Emiss\Yr10\Y10_emiss.dat
Meteorological file : C:\Jobs\Bogg09\Met\Bogg09_2.isc
Number of dust sources : 59
Number of activities : 41
No-blast conditions : None
Wind sensitive factor : 1.149 (1.149 adjusted for activity hours)
Wind erosion factor : 40.275

-----ACTIVITY SUMMARY-----
ACTIVITY NAME : Topsoil Removal - Dozers/Excavators stripping topsoil
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 3831 kg/y
FROM SOURCES : 5
46 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 : Topsoil removal - Sh/Ex/FELs loading topsoil
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 296 kg/y
FROM SOURCES : 5
46 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 : Topsoil removal - Hauling topsoil to emplacement area
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 21892 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 : Topsoil removal - Emplacing topsoil at emplacement area
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 296 kg/y
FROM SOURCES : 1
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 : OB - Drilling
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 67260 kg/y
FROM SOURCES : 8
38 39 40 41 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 : OB - Blasting
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 250316 kg/y
FROM SOURCES : 8
38 39 40 41 42 43 44 45
HOURS OF DAY :
0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0

ACTIVITY NAME : OB - Excavator loading OB to haul truck
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 93533 kg/y
FROM SOURCES : 8
38 39 40 41 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 : OB - Hauling to emplacement area
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 1779947 kg/y
FROM SOURCES : 15
31 32 33 34 35 36 37 38 39 40 41 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 : OB- Emplacing at emplacement area
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 93533 kg/y
FROM SOURCES : 14
31 32 33 34 35 36 37 52 53 54 55 56 57 58
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 - Dozers removing OB
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 219374 kg/y
FROM SOURCES : 8
38 39 40 41 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 : OB - Dozers on OB dumping in emplacement area
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 219374 kg/y
FROM SOURCES : 14
31 32 33 34 35 36 37 52 53 54 55 56 57 58
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
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 806769 kg/y
FROM SOURCES : 8
38 39 40 41 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 - Loading ROM for transfer to temp stockpile in pit
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 8
38 39 40 41 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 - Unloading coal for storage at temp stockpile in pit
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 8
38 39 40 41 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 - Sh/Ex/FELs loading ROM from temp stockpile to trucks
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 8
38 39 40 41 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 open pit coal to ROM pad
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 286119 kg/y
FROM SOURCES : 12
27 28 29 30 38 39 40 41 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 - Unloading ROM to ROM pad (20%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 75473 kg/y
FROM SOURCES : 1
29
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 ROM directly to hopper to be crushed (80%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 301890 kg/y
FROM SOURCES : 1
29
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 from stockpile to crusher using FELs (20%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 75473 kg/y
FROM SOURCES : 1
29
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 (100%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 21301 kg/y
FROM SOURCES : 1
29
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 - ROM hopper unloading coal (100%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 78893 kg/y
FROM SOURCES : 1
29
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 coal from hopper for transfer to CHPP 2Mtpa
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 354 kg/y

FROM SOURCES : 1
29
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 coal from hopper to CHPP
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 2
23 29
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 - Unloading to CHPP
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 354 kg/y
FROM SOURCES : 1
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- Handle coal at CHPP
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 259 kg/y
FROM SOURCES : 1
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- Rehandle coal at CHPP
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 26 kg/y
FROM SOURCES : 1
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- Dozers at CHHP / ROM Pad
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 9046 kg/y
FROM SOURCES : 2
23 29
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 product coal to haul trucks
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 907 kg/y
FROM SOURCES : 2
23 29
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 product coal to rail loop
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 375667 kg/y
FROM SOURCES : 23
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 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 - Unloading product coal at rail loop
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 907 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 : CL - Loading product coal to trains
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 907 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 : CL - Loading rejects and tailings to haul trucks
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 115 kg/y
FROM SOURCES : 2
23 29
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 rejects from CHPP
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 37944 kg/y
FROM SOURCES : 14
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 - Unloading rejects
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 115 kg/y
FROM SOURCES : 14
31 32 33 34 35 36 37 52 53 54 55 56 57 58
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 - OB dump area
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 1486078 kg/y
FROM SOURCES : 14
31 32 33 34 35 36 37 52 53 54 55 56 57 58
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 - Open pit
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 543607 kg/y
FROM SOURCES : 8
38 39 40 41 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 : WE - ROM stockpiles
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 16118 kg/y
FROM SOURCES : 1
29
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 - Product stockpiles
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 16493 kg/y
FROM SOURCES : 1
59
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 - Topsoil area and stockpiles
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 586186 kg/y
FROM SOURCES : 5
46 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 : WE - Product stockpiles at Rail loop
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 19792 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 : Grading roads
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 21566 kg/y
FROM SOURCES : 23
23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 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

----EMISSIONS SUMMARY-----(g/s)
Source Hour Wind_insensitive Wind_sensitive Wind_erosion
Blasting

Estimated emissions of TSP for the Project – Year 21

ACTIVITY	TSP emissions (kg/y)	Intensity	units	Emission factor	units	Variable 1	units	Variable 2	units	Variable 3	units
Topsoil Removal - Dozers/Excavators stripping topsoil	4,664	333	h/y	14.0	kg/hr						
Topsoil removal - Sh/Ex/FELs loading topsoil	361	399,797	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	2.5	moisture content in %		
Topsoil removal - Hauling topsoil to emplacement area	29,318	399,797	t/y	0.073333	kg/t	150	t/truck load	11.0	km/return trip	1.0	kg/VKT
Topsoil removal - Emplacing topsoil at emplacement area	361	399,797	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	2.5	moisture content in %		
OB - Drilling	67,260	114,000	holes/y	0.59	kg/hole						
OB - Blasting	250,316	300	blasts/y	834	kg/blast	24320	Area of blast in square metres	380	holes/blast		
OB - Excavator loading OB to haul truck	97,281	107,811,317	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	2.5	moisture content in %		
OB - Hauling to emplacement area	2,286,185	107,811,317	t/y	0.02651	kg/t	272	t/truck load	9.0	km/return trip	0.8	kg/VKT
OB- Emplacing at emplacement area	97,281	107,811,317	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	2.5	moisture content in %		
OB - Dozers removing OB	219,374	17,520	h/y	12.521	kg/h	10	silt content in %	2.5	moisture content in %		
OB - Dozers on OB dumping in emplacement area	219,374	17,520	h/y	12.521	kg/h	10	silt content in %	2.5	moisture content in %		
CL - Dozers ripping/pushing/clean-up	1,075,692	35,040	h/y	30.6990	kg/h	10	silt content in %	8	moisture content in %		
CL - Loading ROM for transfer to temp stockpile in pit	-	-	t/y	0.04783	kg/t	8	moisture content in %				
CL - Unloading coal for storage at temp stockpile in pit	-	-	t/y	0.04783	kg/t	8	moisture content in %				
CL - Sh/Ex/FELs loading ROM from temp stockpile to trucks	-		t/y	0.04783	kg/t	8	moisture content in %				
CL - Hauling open pit coal to ROM pad	416,723	7,234,767	t/y	0.07200	kg/t	150.0	t/load	13.5	km/return trip	0.8	kg/VKT
CL - Unloading ROM to ROM pad (20%)	69,211	1,446,953	t/y	0.04783	kg/t	8	moisture content in %				
CL - Loading ROM directly to hopper to be crushed (80%)	276,844	5,787,814	t/y	0.04783	kg/t	8	moisture content in %				
CL - Loading from stockpile to crusher using FELs (20%)	69,211	1,446,953	t/y	0.04783	kg/t	8	moisture content in %				
CL - Crushing ROM (100%)	19,534	7,234,767	t/y	0.00270	kg/t						
CL - ROM hopper unloading coal	72,348	7,234,767	t/y	0.01	kg/t						
CL- Loading coal from hopper for transfer to CHPP	354	2,000,000	t/y	0.0002	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	8	moisture content in %		
CL - Conveying coal from hopper to CHPP	-	-	t/y								
CL - Unloading to CHPP	354	2,000,000	t/y	0.0002	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	8	moisture content in %		
CL- Handle coal at CHPP	259	2,000,000	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
CL- Rehandle coal at CHPP	26	200,000	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
CL- Dozers at CHHP	9,046	4,380	h/y	2.065	kg/h	10	silt content in %	10	moisture content in %		
CL - Loading product coal to train (100%)	907	7,000,000	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
CL - hauling product coal to rail loop	375667	7,000,000	t/y	0.05367	kg/t	120.0	t/load	32.2	km/return trip	0.2	kg/VKT
CL - Unloading product coal at rail loop	907	7,000,000	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
CL - Loading product coal to trains	907	7,000,000	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
CL - Loading rejects and tailings to haul trucks	30	234,767	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
CL - Hauling rejects	12,521	234,767	t/y	0.06667	kg/t	120.0	t/truck load	10	km/return trip	0.8	kg/VKT
Cl - Unloading rejects	30	234,767	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
WE - OB dump area	1,602,027	457	ha	0.4	kg/ha/h	8760	h/y				
WE - Open pit	743,019	212	ha	0.4	kg/ha/h	8760	h/y				
WE - ROM stockpiles	16,118	5	ha	0.4	kg/ha/h	8760	h/y				
WE - Product stockpiles	16,493	5	ha	0.4	kg/ha/h	8760	h/y				
WE - Topsoil area and stockpiles	306,739	88	ha	0.4	kg/ha/h	8760	h/y				
WE - Product stockpiles at Rail loop	17,408	5	ha	0.4	kg/ha/h	8760	h/y				
Grading roads	21,566	35,040	km	0.6	kg/km	8	speed of graders in km/h				
Tarrawonga Coal Mine	-	-	t/y	1.00	kg/t ROM						
Total TSP emissions for Yr 21	**8,395,716**										

Table D.4: Year 21 – source allocation

ACTIVITY	Source ID	
Topsoil Removal - Dozers/Excavators stripping topsoil	66 - 70	
Topsoil removal - Sh/Ex/FELs loading topsoil	66 - 70	
Topsoil removal - Hauling topsoil to emplacement area	66 - 70	
Topsoil removal - Emplacing topsoil at emplacement area		71
OB - Drilling	50 - 60	
OB - Blasting	50 - 60	
OB - Excavator loading OB to haul truck	50 - 60	
OB - Hauling to emplacement area	35 - 59	
OB- Emplacing at emplacement area	35 - 49	61 - 65
OB - Dozers removing OB	50 - 60	
OB - Dozers on OB dumping in emplacement area	35 - 49	61 - 65
CL - Sh/Ex/FELs loading ROM from temp stockpile to trucks	50 - 60	
CL - Hauling open pit coal to ROM pad	27 - 35	50 - 59
CL - Unloading ROM to ROM stockpiles (20%)	72	
CL - Loading ROM directly to hopper to be crushed (80%)	73	
CL - Loading from stockpile to crusher using FELs (20%)	72	
CL - Crushing ROM (100%)	73	
CL - ROM hopper unloading coal (100%)	73	
CL- Loading coal from hopper for transfer to CHPP (40%)	73	
CL - Hauling coal from hopper to CHPP	73	
CL - Unloading to CHPP	73	
CL- Handle coal at CHPP	73	
CL- Rehandle coal at CHPP	73	
CL- Dozers at CHHP	73	
CL - Loading product coal to trucks (100%)	73	
CL - hauling product coal to rail loop	1 - 26	
CL - Unloading product coal at rail loop	1	
CL - Loading product coal to trains at rail loop	1	
CL - Loading rejects and tailings to haul trucks	73	
CL - Hauling rejects	26 - 49	
Cl - Unloading rejects	35 - 49	61 - 65
WE - OB dump area	35 - 49	61 - 65
WE - Open pit	50 - 60	
WE - ROM stockpiles	72	
WE - Product stockpiles	74	
WE - Topsoil area and stockpiles	66 - 71	
WE - Product stockpiles at Rail loop	1	
Grading roads	24 - 59	
Tarrawonga Coal Mine	-	

------------------------------- 06-Jan-2010 14:13
DUST EMISSION CALCULATIONS V2

Output emissions file : C:\Jobs\Bogg09\Emiss\Yr21\Y21_emiss.dat
Meteorological file : C:\Jobs\Bogg09\Met\Bogg09_2.isc
Number of dust sources : 74
Number of activities : 41
No-blast conditions : None
Wind sensitive factor : 1.149 (1.149 adjusted for activity hours)
Wind erosion factor : 40.275

-----ACTIVITY SUMMARY-----
ACTIVITY NAME : Topsoil Removal - Dozers/Excavators stripping topsoil
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 4664 kg/y
FROM SOURCES : 5
66 67 68 69 70
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 : Topsoil removal - Sh/Ex/FELs loading topsoil
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 361 kg/y
FROM SOURCES : 5
66 67 68 69 70
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 : Topsoil removal - Hauling topsoil to emplacement area
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 29318 kg/y
FROM SOURCES : 5
66 67 68 69 70
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 : Topsoil removal - Emplacing topsoil at emplacement area
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 361 kg/y
FROM SOURCES : 1
71
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 : 67260 kg/y
FROM SOURCES : 11
50 51 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 : OB - Blasting
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 250316 kg/y
FROM SOURCES : 11
50 51 52 53 54 55 56 57 58 59 60
HOURS OF DAY :
0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0

ACTIVITY NAME : OB - Excavator loading OB to haul truck
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 97281 kg/y
FROM SOURCES : 11
50 51 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 : OB - Hauling to emplacement area
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 2286185 kg/y
FROM SOURCES : 25
35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59
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
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 97281 kg/y
FROM SOURCES : 20
35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 61 62 63 64 65
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 - Dozers removing OB
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 219374 kg/y
FROM SOURCES : 11
50 51 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 : OB - Dozers on OB dumping in emplacement area
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 219374 kg/y
FROM SOURCES : 20
35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 61 62 63 64 65
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
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 1075692 kg/y
FROM SOURCES : 11
50 51 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 : CL - Loading ROM for transfer to temp stockpile in pit
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 11
50 51 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 : CL - Unloading coal for storage at temp stockpile in pit
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 11
50 51 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 : CL - Sh/Ex/FELs loading ROM from temp stockpile to trucks
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 11
50 51 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 : CL - Hauling open pit coal to ROM pad
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 416723 kg/y
FROM SOURCES : 19
27 28 29 30 31 32 33 34 35 50 51 52 53 54 55 56 57 58 59
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 - Unloading ROM to ROM pad (20%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 69211 kg/y
FROM SOURCES : 1
72
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 ROM directly to hopper to be crushed (80%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 276844 kg/y
FROM SOURCES : 1
73
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 from stockpile to crusher using FELs (20%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 69211 kg/y
FROM SOURCES : 1
72
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 (100%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 19534 kg/y
FROM SOURCES : 1
73
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 - ROM hopper unloading coal
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 72348 kg/y
FROM SOURCES : 1
73
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 coal from hopper for transfer to CHPP
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 354 kg/y
FROM SOURCES : 1
73
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 coal from hopper to CHPP

ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 1
73
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 - Unloading to CHPP
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 354 kg/y
FROM SOURCES : 1
73
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- Handle coal at CHPP
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 259 kg/y
FROM SOURCES : 1
73
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- Rehandle coal at CHPP
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 26 kg/y
FROM SOURCES : 1
73
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 at CHHP
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 9046 kg/y
FROM SOURCES : 1
73
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 product coal to trucks
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 907 kg/y
FROM SOURCES : 2
26 73
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 product coal to rail loop
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 375667 kg/y
FROM SOURCES : 26
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 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 - Unloading product coal at rail loop
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 907 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 : CL - Loading product coal to trains
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 907 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 : CL - Loading rejects and tailings to haul trucks
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 30 kg/y
FROM SOURCES : 2
26 73
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 rejects
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 12521 kg/y
FROM SOURCES : 24
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48
49
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 - Unloading rejects
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 30 kg/y
FROM SOURCES : 20
35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 61 62 63 64 65
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 - OB dump area
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 1602027 kg/y
FROM SOURCES : 20
35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 61 62 63 64 65
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 - Open pit
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 743019 kg/y
FROM SOURCES : 11
50 51 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 - ROM stockpiles
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 16118 kg/y
FROM SOURCES : 1
72
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 - Product stockpiles
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 16493 kg/y
FROM SOURCES : 1
74
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 - Topsoil area and stockpiles
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 306739 kg/y
FROM SOURCES : 6
66 67 68 69 70 71
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 - Product stockpiles at Rail loop
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 17408 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 : Grading roads
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 21566 kg/y
FROM SOURCES : 36
24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46
47 48 49 50 51 52 53 54 55 56 57 58 59
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

----EMISSIONS SUMMARY-----(g/s)
Source Hour Wind_insensitive Wind_sensitive Wind_erosion
Blasting

Pit retention sources: 11
50 51 52 53 54 55 56 57 58 59 60

Estimated emissions of TSP for the Project – Year 5 (rail spur scenario)

ACTIVITY	TSP emissions (kg/y)	Intensity	units	Emission factor	units	Variable 1	units	Variable 2	units	Variable 3	units
Topsoil Removal - Dozers/Excavators stripping topsoil	9,801	700	h/y	14.0	kg/h						
Topsoil removal - Sh/Ex/FELs loading topsoil	758	840,074	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	2.5	moisture content in %		
Topsoil removal - Hauling topsoil to emplacement area	50,404	840,074	t/y	0.060000	kg/t	150	t/truck load	9.0	km/return trip	1.0	kg/VKT
Topsoil removal - Emplacing topsoil at emplacement are	758	840,074	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	2.5	moisture content in %		
OB - Drilling	67,260	114,000	holes/y	0.59	kg/hole						
OB - Blasting	250,316	300	blasts/y	834	kg/blast	24320	Area of blast in square metres	380	holes/blast		
OB - Excavator loading OB to haul truck	123,118	136,446,192	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	2.5	moisture content in %		
OB - Hauling to emplacement area	2,182,006	136,446,192	t/y	0.01599	kg/t	275	t/truck load	5.5	km/return trip	0.8	kg/VKT
OB- Emplacing at emplacement area	123,118	136,446,192	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	2.5	moisture content in %		
OB - Dozers removing OB	219,374	17,520	h/y	12.521	kg/h	10	silt content in %	2.5	moisture content in %		
OB - Dozers on OB dumping in emplacement area	219,374	17,520	h/y	12.521	kg/h	10	silt content in %	2.5	moisture content in %		
CL - Dozers ripping/pushing/clean-up	806,769	26,280	h/y	30.6990	kg/h	10	silt content in %	8	moisture content in %		
CL - Loading ROM for transfer to temp stockpile in pit	-	-	t/y	0.04783	kg/t	8	moisture content in %				
CL - Unloading coal for storage at temp stockpile in pit	-	-	t/y	0.04783	kg/t	8	moisture content in %				
CL - Sh/Ex/FELs loading ROM from temp stockpile to	-		t/y	0.04783	kg/t	8	moisture content in %				
CL - Hauling open pit coal to ROM pad	274,222	8,569,440	t/y	0.04000	kg/t	150	t/load	7.5	km/return trip	0.8	kg/VKT
CL - Unloading ROM to ROM pad (20%)	81,979	1,713,888	t/y	0.04783	kg/t	8	moisture content in %				
CL - Loading ROM directly to hopper to be crushed	327,916	6,855,552	t/y	0.04783	kg/t	8	moisture content in %				
CL - Loading from stockpile to crusher using FELs	81,979	1,713,888	t/y	0.04783	kg/t	8	moisture content in %				
CL - Crushing ROM (100%)	23,137	8,569,440	t/y	0.00270	kg/t						
CL - ROM hopper unloading coal (100%)	85,694	8,569,440	t/y	0.01	kg/t						
CL- Loading coal from hopper for transfer to CHPP	354	2,000,000	t/y	0.0002	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	8	moisture content in %		
CL - Conveying coal from hopper to CHPP	-	-	t/y								
CL - Unloading to CHPP	354	2,000,000	t/y	0.0002	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	8	moisture content in %		
CL- Handle coal at CHPP	259	2,000,000	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
CL- Rehandle coal at CHPP	26	200,000	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
CL- Dozers at CHHP / ROM Pad	9,046	4,380	h/y	2.065	kg/h	10	silt content in %	10	moisture content in %		
CL - Loading product coal to trains	903	6,967,477	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
CL - transporting coal using rail line	-	-	t/y	0.05367	kg/t	120	t/load	32.2	km/return trip	0.2	kg/VKT
CL - Unloading product coal at rail loop	-	-	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
CL - Loading product coal to trains	-	-	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
CL - Loading rejects and tailings to haul trucks	208	1,601,963	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
CL - Hauling rejects from CHPP	41,010	1,601,963	t/y	0.03200	kg/t	150.0	t/truck load	6.0	km/return trip	0.8	
Cl - Unloading rejects	208	1,601,963	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %		
WE - OB dump area	902,650	258	ha	0.4	kg/ha/h	8760	h/y				
WE - Open pit	507,945	145	ha	0.4	kg/ha/h	8760	h/y				
WE - ROM stockpiles	16,118	5	ha	0.4	kg/ha/h	8760	h/y				
WE - Product stockpiles	16,493	5	ha	0.4	kg/ha/h	8760	h/y				
WE - Topsoil area and stockpiles	372,728	106	ha	0.4	kg/ha/h	8760	h/y				
WE - Product stockpiles at Rail loop	-	-	ha	0.4	kg/ha/h	8760	h/y				
Grading roads	26,957	43,800	km	0.6	kg/km	8	speed of graders in km/h				
Tarrawonga Coal Mine	1,600,000	1,600,000	t/y	1.00	kg/t ROM						
Total TSP emissions for Yr 5	**6,823,245**										

Table D.5: Year 5 (rail spur scenario) – source allocation

ACTIVITY	Source ID				
Topsoil Removal - Dozers/Excavators stripping topsoil	61 - 64				
Topsoil removal - Sh/Ex/FELs loading topsoil	61 - 64				
Topsoil removal - Hauling topsoil to emplacement area	61 - 65				
Topsoil removal - Emplacing topsoil at emplacement area	61	65			
OB - Drilling	44 - 46	52	56 - 60	71 - 74	
OB - Blasting	44 - 46	52	56 - 60	71 - 74	
OB - Excavator loading OB to haul truck	44 - 46	52	56 - 60	71 - 74	
OB - Hauling to emplacement area	34 - 38	44 - 60			
OB- Emplacing at emplacement area	34 - 38	47 - 51	55	66 - 70	
OB - Dozers removing OB	44 - 46	52	56 - 60		
OB - Dozers on OB dumping in emplacement area	34 - 38	47 - 51	55	66 - 70	
CL - Dozers ripping/pushing/clean-up	44 - 46	52	56 - 60		
CL - Hauling open pit coal to ROM pad	29	43 - 46	52	56 - 60	75 - 76
CL - Unloading ROM to ROM pad (20%)	28				
CL - Loading ROM directly to hopper to be crushed (80%)	26				
CL - Loading from stockpile to crusher using FELs (20%)	28				
CL - Crushing ROM (100%)	26				
CL - ROM hopper unloading coal (100%)	26				
CL- Loading coal from hopper for transfer to CHPP 2Mtpa	26				
CL - Hauling coal from hopper to CHPP	26	28			
CL - Unloading to CHPP	28				
CL- Handle coal at CHPP	28				
CL- Rehandle coal at CHPP	28				
CL- Dozers at CHHP / ROM Pad	26	28			
CL - Loading product coal to trains	28				
CL - Loading rejects and tailings to haul trucks	26	28			
CL - Hauling rejects from CHPP	29 - 44	47 - 51	53 - 54		
CI - Unloading rejects	34 - 38	47 - 51	55		
WE - OB dump area	34 - 38	47 - 51	55	66 - 70	
WE - Open pit	44 - 46	52	56 - 60		
WE - ROM stockpiles	27				
WE - Product stockpiles	27				
WE - Topsoil area and stockpiles	61 - 65				
Grading roads	29 - 60				
Tarrawonga Coal Mine	77 - 84				

------------------------------ 06-Jan-2010 12:47
DUST EMISSION CALCULATIONS V2

Output emissions file : C:\Jobs\Bogg09\Emiss\Yr5train\Y5T_emis.dat
Meteorological file : C:\Jobs\Bogg09\Met\Bogg09_2.isc
Number of dust sources : 78
Number of activities : 40
No-blast conditions : None
Wind sensitive factor : 1.149 (1.149 adjusted for activity hours)
Wind erosion factor : 40.275

-----ACTIVITY SUMMARY-----
ACTIVITY NAME : Topsoil Removal - Dozers/Excavators stripping topsoil
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 9801 kg/y
FROM SOURCES : 4
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 : Topsoil removal - Sh/Ex/FELs loading topsoil
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 758 kg/y
FROM SOURCES : 4
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 : Topsoil removal - Hauling topsoil to emplacement area
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 50404 kg/y
FROM SOURCES : 5
61 62 63 64 65
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 : Topsoil removal - Emplacing topsoil at emplacement area
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 758 kg/y
FROM SOURCES : 2
61 65
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 : 67260 kg/y
FROM SOURCES : 13
44 45 46 52 56 57 58 59 60 71 72 73 74
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 - Blasting
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 250316 kg/y
FROM SOURCES : 13
44 45 46 52 56 57 58 59 60 71 72 73 74
HOURS OF DAY :
0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0

ACTIVITY NAME : OB - Excavator loading OB to haul truck
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 123118 kg/y
FROM SOURCES : 13
44 45 46 52 56 57 58 59 60 71 72 73 74
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
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 2182006 kg/y
FROM SOURCES : 22
34 35 36 37 38 44 45 46 47 48 49 50 51 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 : OB- Emplacing at emplacement area
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 123118 kg/y
FROM SOURCES : 16
34 35 36 37 38 47 48 49 50 51 55 66 67 68 69 70
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 - Dozers removing OB
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 219374 kg/y
FROM SOURCES : 9
44 45 46 52 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 : OB - Dozers on OB dumping in emplacement area
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 219374 kg/y
FROM SOURCES : 16
34 35 36 37 38 47 48 49 50 51 55 66 67 68 69 70
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
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 806769 kg/y
FROM SOURCES : 9
44 45 46 52 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 : CL - Loading ROM for transfer to temp stockpile in pit
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 9
44 45 46 52 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 : CL - Unloading coal for storage at temp stockpile in pit
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 9
44 45 46 52 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 : CL - Sh/Ex/FELs loading ROM from temp stockpile to trucks
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 9
44 45 46 52 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 : CL - Hauling open pit coal to ROM pad
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 274222 kg/y
FROM SOURCES : 13
29 43 44 45 46 52 56 57 58 59 60 75 76
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 - Unloading ROM to ROM pad (20%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 81979 kg/y
FROM SOURCES : 1
28
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 ROM directly to hopper to be crushed (80%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 327916 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 from stockpile to crusher using FELs (20%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 81979 kg/y
FROM SOURCES : 1
28
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 (100%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 23137 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 - ROM hopper unloading coal (100%)
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 85694 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 coal from hopper for transfer to CHPP 2Mtpa
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 354 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 - Hauling coal from hopper to CHPP
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 0 kg/y
FROM SOURCES : 2
26 28
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 - Unloading to CHPP
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 354 kg/y
FROM SOURCES : 1
28
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- Handle coal at CHPP
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 259 kg/y
FROM SOURCES : 1
28
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- Rehandle coal at CHPP
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 26 kg/y
FROM SOURCES : 1
28
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 at CHHP / ROM Pad
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 9046 kg/y
FROM SOURCES : 2
26 28
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 product coal to trains
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 903 kg/y
FROM SOURCES : 1
28
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 rejects and tailings to haul trucks
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 208 kg/y
FROM SOURCES : 2
26 28
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 rejects from CHPP
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 41010 kg/y
FROM SOURCES : 23
29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 47 48 49 50 51 53 54
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 - Unloading rejects
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 208 kg/y
FROM SOURCES : 11
34 35 36 37 38 47 48 49 50 51 55
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 - OB dump area
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 902650 kg/y
FROM SOURCES : 16
34 35 36 37 38 47 48 49 50 51 55 66 67 68 69 70
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 - Open pit
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 507945 kg/y
FROM SOURCES : 9
44 45 46 52 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 - ROM stockpiles
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 16118 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 : WE - Product stockpiles
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 16493 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 : WE - Topsoil area and stockpiles
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 372728 kg/y
FROM SOURCES : 5
61 62 63 64 65
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 : 26957 kg/y
FROM SOURCES : 32
29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51
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 : Tarrawonga Coal Mine WI
ACTIVITY TYPE : Wind insensitive
DUST EMISSION : 1168000 kg/y
FROM SOURCES : 2
77 78
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 : Tarrawonga Coal Mine WS
ACTIVITY TYPE : Wind sensitive
DUST EMISSION : 224000 kg/y
FROM SOURCES : 2
77 78
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 : Tarrawonga Coal Mine WE
ACTIVITY TYPE : Wind erosion
DUST EMISSION : 208000 kg/y
FROM SOURCES : 2
77 78
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

----EMISSIONS SUMMARY-----(g/s)
Source Hour Wind_insensitive Wind_sensitive Wind_erosion
Blasting

Pit retention sources: 10
45 46 52 56 59 60 71 72 73 74

Estimated emissions of TSP for the Project – Year 5 (dragline scenario)

ACTIVITY	TSP emissions (kg/y)	Intensity	units	Emission factor	units	Variable 1	units	Variable 2	units	Variable 3	units
Topsoil Removal - Dozers/Excavators stripping topsoil	9,801	700	h/y	14.0	kg/h						
Topsoil removal - Sh/Ex/FELs loading topsoil	758	840,074	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.	2.5	moisture content in %		
Topsoil removal - Hauling topsoil to emplacement area	50,404	840,074	t/y	0.060000	kg/t	150	t/truck load	9.0	km/return trip	1.0	kg/VKT
Topsoil removal - Emplacing topsoil at emplacement are	758	840,074	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.	2.5	moisture content in %		
OB - Drilling	67,260	114,000	holes/y	0.59	kg/hole						
OB - Blasting	250,316	300	blasts/y	834	kg/blast	24320	Area of blast in square metres	380	holes/blast		
OB - Dragline removal of overburden	594,311	20,000,000	bcm/y	0.02972	kg/m3 (l	7	drop distance (m)	2.5	moisture content in %		
OB - Excavator loading OB to haul truck	79,807	88,446,192	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.	2.5	moisture content in %		
OB - Hauling to emplacement area	1,414,404	88,446,192	t/y	0.01599	kg/t	275	t/truck load	5.5	km/return trip	0.8	kg/VKT
OB- Emplacing at emplacement area	123,118	136,446,192	t/y	0.00090	kg/t	1.042	average of (wind speed/2.2)^1.	2.5	moisture content in %		
OB - Dozers removing OB	219,374	17,520	h/y	12.521	kg/h	10	silt content in %	2.5	moisture content in %		
OB - Dozers on OB dumping in emplacement area	219,374	17,520	h/y	12.521	kg/h	10	silt content in %	2.5	moisture content in %		
CL - Dozers ripping/pushing/clean-up	806,769	26,280	h/y	30.6990	kg/h	10	silt content in %	8	moisture content in %		
CL - Loading ROM for transfer to temp stockpile in pit	-	-	t/y	0.04783	kg/t	8	moisture content in %				
CL - Unloading coal for storage at temp stockpile in pit	-	-	t/y	0.04783	kg/t	8	moisture content in %				
CL - Sh/Ex/FELs loading ROM from temp stockpile to	-	-	t/y	0.04783	kg/t	8	moisture content in %				
CL - Hauling open pit coal to ROM pad	274,222	8,569,440	t/y	0.04000	kg/t	150	t/load	7.5	km/return trip	0.8	kg/VKT
CL - Unloading ROM to ROM pad (20%)	81,979	1,713,888	t/y	0.04783	kg/t	8	moisture content in %				
CL - Loading ROM directly to hopper to be crushed	327,916	6,855,552	t/y	0.04783	kg/t	8	moisture content in %				
CL - Loading from stockpile to crusher using FELs	81,979	1,713,888	t/y	0.04783	kg/t	8	moisture content in %				
CL - Crushing ROM (100%)	23,137	8,569,440	t/y	0.00270	kg/t						
CL - ROM hopper unloading coal (100%)	85,694	8,569,440	t/y	0.01	kg/t						
CL- Loading coal from hopper for transfer to CHPP	354	2,000,000	t/y	0.0002	kg/t	1.042	average of (wind speed/2.2)^1.	8	moisture content in %		
CL - Conveying coal from hopper to CHPP	-	-	t/y								
CL - Unloading to CHPP	354	2,000,000	t/y	0.0002	kg/t	1.042	average of (wind speed/2.2)^1.	8	moisture content in %		
CL- Handle coal at CHPP	259	2,000,000	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.	10	moisture content in %		
CL- Rehandle coal at CHPP	26	200,000	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.	10	moisture content in %		
CL- Dozers at CHHP / ROM Pad	9,046	4,380	h/y	2.065	kg/h	10	silt content in %	10	moisture content in %		
CL - Loading product coal to haul trucks	903	6,967,477	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.	10	moisture content in %		
CL - Hauling product coal to rail loop (from crusher to	373,921	6,967,477	t/y	0.05367	kg/t	120	t/load	32.2	km/return trip	0.2	kg/VKT
CL - Unloading product coal at rail loop	903	6,967,477	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.	10	moisture content in %		
CL - Loading product coal to trains	903	6,967,477	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.	10	moisture content in %		
CL - Loading rejects and tailings to haul trucks	208	1,601,963	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.	10	moisture content in %		
CL - Hauling rejects from CHPP	41,010	1,601,963	t/y	0.03200	kg/t	150.0	t/truck load	6	km/return trip	0.8	
Cl - Unloading rejects	208	1,601,963	t/y	0.0001	kg/t	1.042	average of (wind speed/2.2)^1.	10	moisture content in %		
WE - OB dump area	902,650	258	ha	0.4	kg/ha/h	8760	h/y				
WE - Open pit	507,945	145	ha	0.4	kg/ha/h	8760	h/y				
WE - ROM stockpiles	16,118	5	ha	0.4	kg/ha/h	8760	h/y				
WE - Product stockpiles	16,493	5	ha	0.4	kg/ha/h	8760	h/y				
WE - Topsoil area and stockpiles	372,728	106	ha	0.4	kg/ha/h	8760	h/y				
WE - Product stockpiles at Rail loop	19,792	6	ha	0.4	kg/ha/h	8760	h/y				
Grading roads	26,957	43,800	km	0.6	kg/km	8	speed of graders in km/h				
Tarrawonga Coal Mine	1,600,000	1,600,000	t/y	1.00 kg/tROM							
Total TSP emissions for Yr 5	**7,002,161**										

Appendix E: Air Quality Simultaneous Worst Case Cumulative Impact Assessment

INTRODUCTION

PAEHolmes prepared an Air Quality Assessment dated April 2010 for the Continuation of Boggabri Coal Mine Project Environmental Assessment (EA). This assessment included the cumulative impacts of known projects in the vicinity of Boggabri Coal Mine. Since preparing the assessment, further limited information has become available on other large scale coal mining projects proposed in the immediate vicinity of Boggabri Coal Mine. The Department of Planning (DoP) has requested that this additional information be considered for the potential cumulative impacts in the vicinity of the Leard State Forest. The following is a high level assessment of cumulative impacts associated with the Continuation of Boggabri Coal Mine Project and these other projects, which include:

- Maules Creek Coal Project;
- Tarrawonga Extension; and
- Goonbri Project.

The Cumulative Impacts - A Good Practice Guide for the Australian Coal Mining Industry (**Franks et al, 2010**) was considered when preparing this high level cumulative impact assessment. The assessment draws on the results and findings from the Continuation of Boggabri Coal Mine Air Quality Assessment report dated September 2010.

The locations of each of these mining projects are shown on **Figure E.1**. **Figure E.2** shows the windrose of the meteorological data used in the air quality assessment completed for Boggabri Coal.

BACKGROUND

In August 2009 Boggabri Coal Pty Limited commenced consultation with the DoP regarding a new project approval for continuation of the existing Boggabri Project. To progress that proposal, the following steps were taken:

1.	26 August 2009	Preliminary Environmental Assessment (PEA) submitted
2.	9 September 2009	Planning focus meeting
3.	25 September 2009	Revised PEA and Project Application submitted
4.	15 December 2009	EPBC Referral submitted
5.	17 December 2009	Director-Generals Requirements (DGRs) issued
6.	2 July 2010	EA submitted for adequacy
7.	20 August 2010	NSW DoP letter requesting further information.

During the course of the above approval process further information has come to the attention of Boggabri Coal relating to other large scale coal mining projects in the immediate vicinity of the Boggabri Project which have since sought or may seek approval at some time in the future (Other Projects).

Accordingly, a Simultaneous Worst Case Cumulative Impact Scenario (SWCCIS) review has been undertaken in order to attempt to gain a very high level appreciation of the potential worst case cumulative impacts if all of the Other Projects were to proceed in conjunction with the Boggabri Coal project.

The appreciation is necessarily high level and based upon some highly speculative assumptions which are detailed in this review.

The SWCCIS review is separate to the EA for the Boggabri Coal Project. Whilst it draws upon the findings made from the assessments in the Boggabri EA, this review is prepared on a different basis to the quantitative environmental assessments in the Boggabri EA as it is making qualitative assessments for the purposes of a high level review.

This Air Quality Cumulative Impact Assessment forms part of the SWCCIS review.

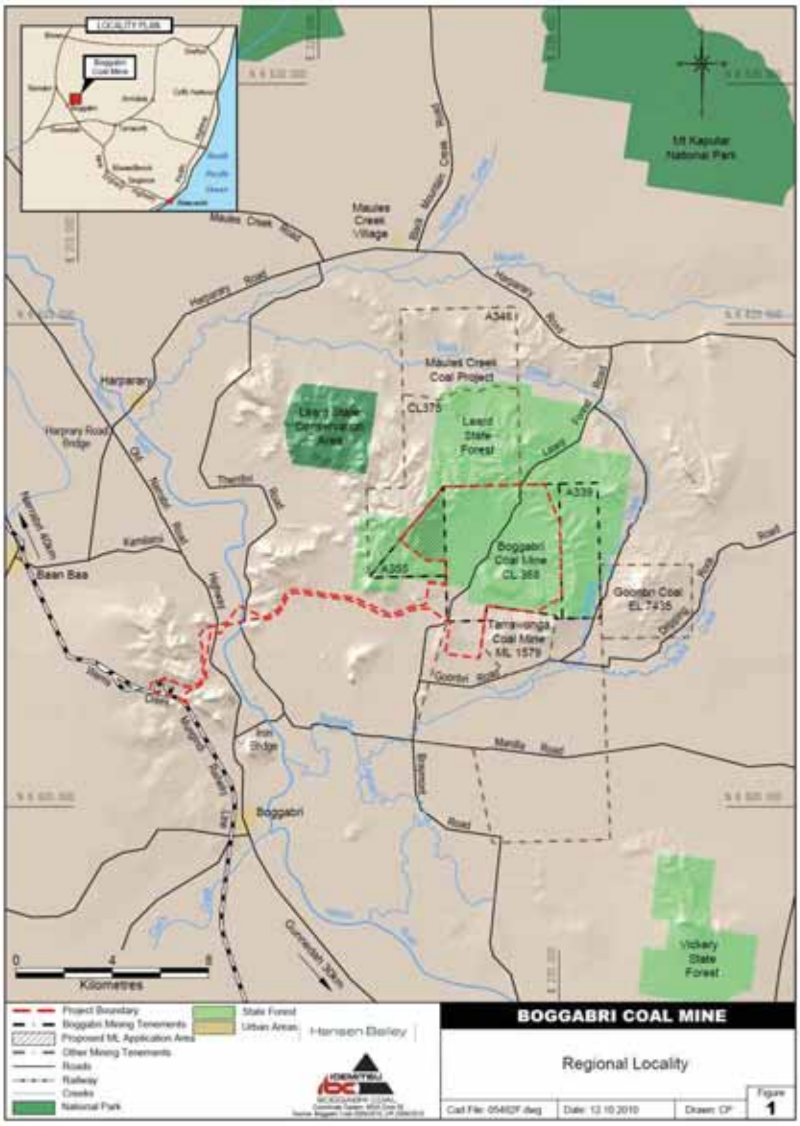

Figure E.1: Mining lease locations

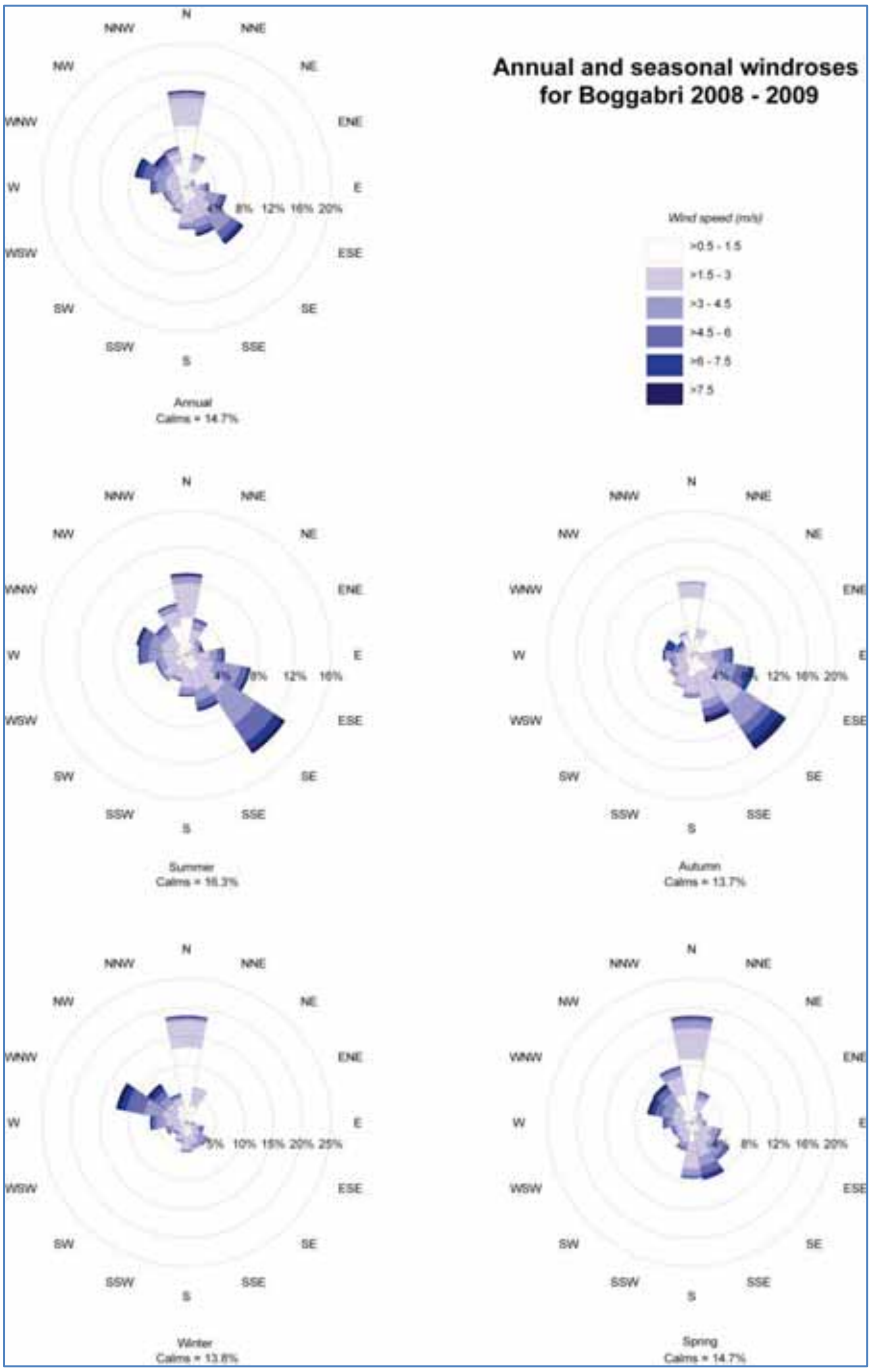

Figure E.2: Annual windrose Boggabri Coal – September 2008 to August 2009

At the time of writing, no air dispersion modelling had been completed for any of the proposed operations. As such, the following sections present a qualitative assessment of the potential for cumulative impacts with the Boggabri Project from each of the Other Projects, and the worst case cumulative impact scenario.

MAULES CREEK COAL MINE PROPOSAL

Aston Coal 2 Pty Ltd submitted a Preliminary Environmental Assessment (PEA) as part of its referral under the Environmental Planning Biodiversity Conservation Act 1999 in July 2010 to develop the Maules Creek Coal Project (**Hansen Bailey, 2010**).

As shown on **Figure E.1**, the southern boundary of the Maules Creek Coal Project mining lease abuts the northern boundary of the Boggabri Project mining lease. At this stage the Maules Creek Coal Project is still under preliminary development and as such only high level information as contained in the PEA is available.

With respect to air quality, the key components of the Maules Creek Coal Project are:

- The construction and operation of an open cut mining operation extracting up to 13 Mtpa ROM;
- Open cut mining fleet including excavators, shovels and fleet of haul trucks, dozers, graders and water carts;
- The construction and operation of a CHPP with a throughput of 13 Mtpa ROM;
- The construction and operation of Tailings Drying Areas;
- The construction and operation of a rail spur, rail loop, associated load out facility and connection to the Werris Creek to Mungindi Railway Line. An alternative option to this is joint use of part of Boggabri Coal's rail infrastructure; and
- Construction and operation of a Mine Access Road.

The PEA indicates that the Maules Creek Coal Project would commence production at approximately 4 Mtpa ROM coal from Year 1 with production rates scheduled to increase to full production of 13 Mtpa ROM by Year 5.

The conceptual mine plans for Years 1, 5 10 and 21 of the proposed Maules Creek Coal project show that mining operations would commence in the central west of the mining area, progressing to the south-west before turning toward the south-east in around Year 5. The mine plan then progresses towards the eastern boundary and advances north to Year 21.

The proposed Boggabri Coal project commences in the south-east of the mine lease, progressing to the north-west until Year 21.

No meteorological data were presented in the PEA for the Maules Creek Project, and due to the terrain that currently exists between the two sites it would be anticipated that prevailing wind directions would differ to those identified in the Boggabri assessment, particularly in the early years. Assuming that the prevailing northerly winds (see **Figure F.2**) do exist, it is likely to give a conservative estimate of the potential for cumulative impacts.

Figure E.3 to **Figure E.6** show the conceptual mine plans for the Maules Creek Coal Project together with the Boggabri Project mine plans. The following discussion is based on the assumption that Year 1 of the Maules Creek Coal Project would coincide with Year 1 of the Boggabri Project.

In Year 1 (**Figure E.3**) the active pit areas of Maules Creek Coal and Boggabri Coal would be approximately 5 km apart. In addition, the vegetation and terrain that currently exist between the two sites would largely remain, thus providing a buffer to any dust emissions generated by the Maules Creek Coal Project. It is therefore considered that the potential for the operations at the Maules Creek Coal Project to have any significant impact on those residences south of Boggabri is minimal.

By Year 10 (**Figure E.5**) of the proposed Maules Creek Project the vegetation buffer will have been partly mined and mining continues through this area until the end of the proposed 21-year mine life (**Figure E.6**). Therefore, from Year 10 onwards, there is potential for additional cumulative impact due to operations at Maules Creek Coal and Boggabri Coal. As no air quality modelling has yet been completed for the Maules Creek Project, the extent of these impacts is not known.

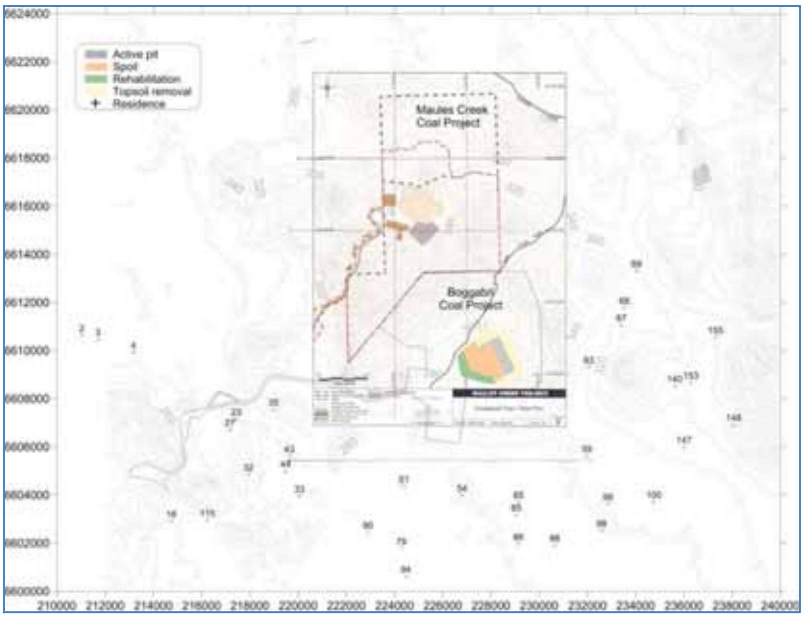

Figure E.3: Year 1 Boggabri Coal and Maules Creek mine plans

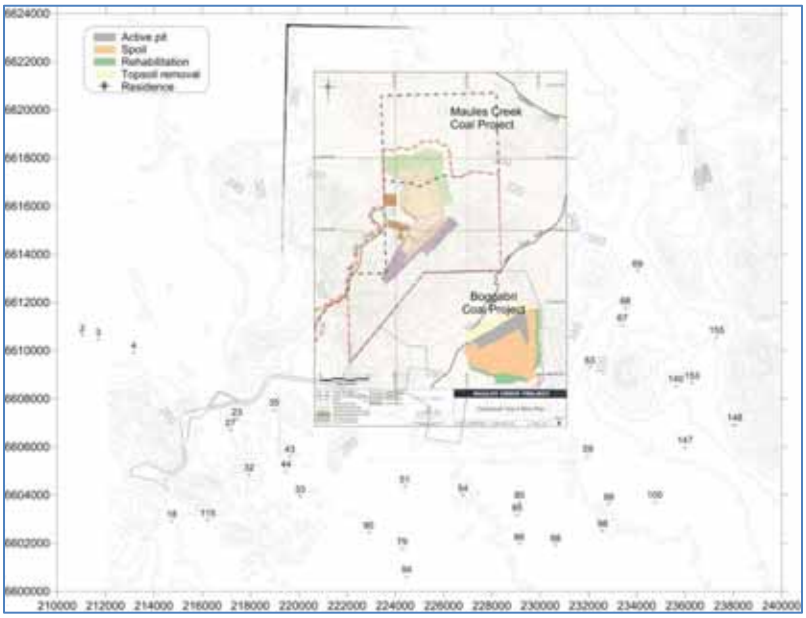

Figure E.4: Year 5 Boggabri Coal and Maules Creek mine plans

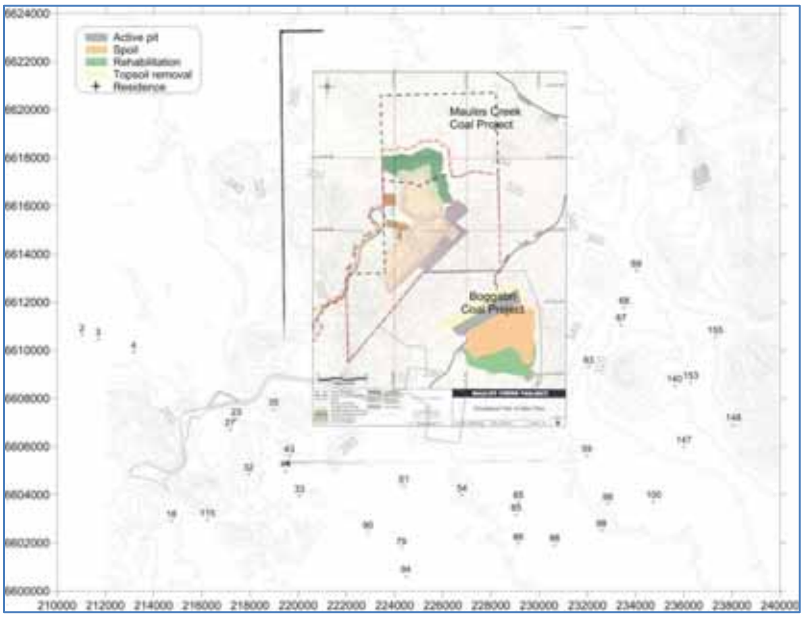

Figure E.5: Year 10 Boggabri Coal and Maules Creek mine plans

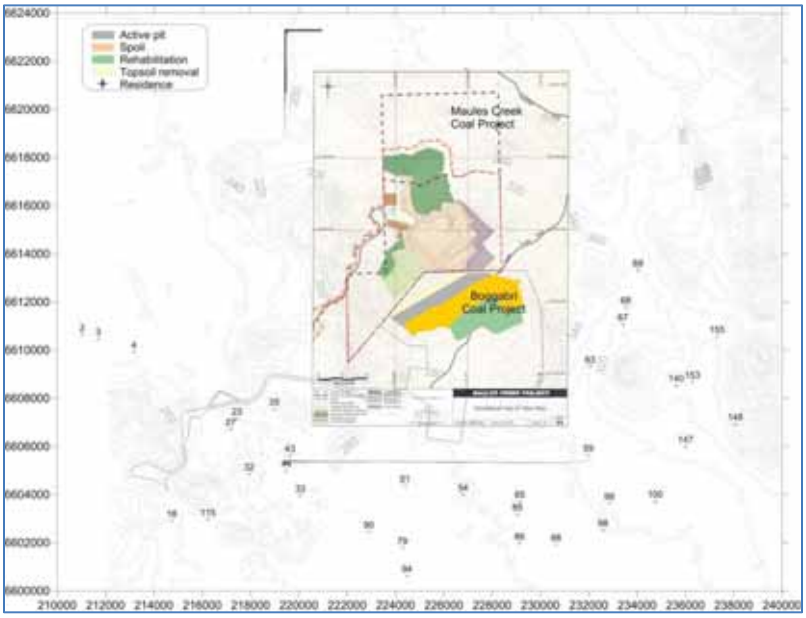

Figure E.6: Year 20 Boggabri Coal and Year 21 Maules Creek mine plans

TARRAWONGA EXTENSION

In addition to the Tarrawonga Modification that was put on public display in April 2010 (the potential impacts of which have been discussed in **Section 8.11.2** of the Boggabri Coal Air Quality Assessment September 2010), it is understood that there is the possibility of a further expansion of the Tarrawonga Coal Mine (whether by new project approval or further modification of the existing Tarrawonga approvals).

At the time of writing no approvals have been issued and no public documents describing the project are available. Therefore the extent of the operations (and hence the potential impacts on air quality) are not known.

As shown in **Figure E.1**, the Tarrawonga mine is directly south of the Boggabri Project. On an annual basis, the prevailing winds are from the north (as shown on **Figure E.2**). As such, any increase in emissions from the Tarrawonga Mine has the potential for additional impacts to the south of the operations. However, in summer and autumn, the prevailing winds from the south-east are unlikely to result in any significant additional impacts.

"GOONBRI" PROJECT

Project approval may be sought at some time in the future for the "Goonbri" Project. It is unkown at this time if this will be an open cut or underground coal mining operation. At the time of writing there have been no approvals granted for this project and no public documents describing the project are available. All that is known about the project is the existence of Exploration Licence 7435, and some media statements, therefore the extent of the operations, and hence the specific potential impacts on air quality, are not known.

As shown on **Figure E.1**, the "Goonbri" mine lease is located directly east of Boggabri Coal. On an annual basis there are very few winds from the east (see **Figure E.2**), and as such the potential for any significant cumulative impacts to the west of Boggabri Coal is limited. However, in winter there are a significant proportion of winds from the west-northwest which could result in additional cumulative impacts to the east-southeast.

LIMITATIONS

The Other Projects are constructed from a combination of published information and from the author's speculation as described above.

The results of this assessment are therefore speculative, qualitative in nature and should not be relied upon to predict accurate environmental impacts.

This is not a fully quantitative report created using the normal scientific methodology for preparing formal environmental assessments in the context of a known, detailed project (because project descriptions of the Other Projects are speculative). Air quality modelling incorporating the Other Projects has not been undertaken as part of this assessment.

However, quantitative information has been used where possible. The methodology is sound. However, base data relies on assumptions (described above) and not on legal commitments inherent in Approved Conditions or obligations.

The assessment has considered future mining by open cut methods. Potential surface water impacts associated with possible future underground mining have not been considered.

CONCLUSIONS

All Other Projects are still in the early stages of development and there is limited accurate information available (in some cases none) on the extent of the operations. This is particularly true when considering the proposed Tarrawonga Extension and "Goonbri" Projects which at the time of writing have not been defined as being open cut or underground mining operations.

No air quality modelling is available or has been completed for any of the proposed projects, and as such, it is not possible to assess with any accuracy the potential for cumulative impacts. The high level sensitivity assessment presented in the previous sections has considered the location of each of the mines in relation to the Boggabri Project, and the potential for cumulative impacts based on their relative locations with respect to the prevailing wind directions.

The worst case cumulative impact scenario would occur when all four projects (i.e. Boggabri Coal, Maules Creek, Tarrawonga Extension, and "Goonbri" Project) are operating simultaneously. When this scenario is considered together with the prevailing wind directions (see **Figure E.1** and **Figure E.2**), the following observations and conclusions can be made:

- There is potential for additional cumulative impacts to occur to properties to the south of the Boggabri Project due to the combined impacts of Boggabri Coal, Maules Creek and Tarrawonga Extension;
- Due to the minimal winds from the east, there is limited potential for any significant cumulative impacts to properties to the west of Boggabri Coal and Maules Creek Coal Project by the "Goonbri" Project;
- Any additional dust emissions from the Tarrawonga Extension and/or the "Goonbri" Project, could potentially result in cumulative impacts to properties to the south-east of Boggabri Coal. This is due to the prevalence of winds from the north and west (most evident in spring and winter); and
- The Maules Creek Project, Tarrawonga Extension and/or the "Goonbri" Project could potentially result in cumulative impacts to properties to the north-west of Boggabri Coal. This is due to predominant winds from the east and south (most evident in summer and autumn).

Appendix F: Example ISCMOD input file – Year 5

```
**  ISCST3 model input runstream : Dust
CO STARTING
   TITLEONE ISCST3 Dust Model Run
   MODELOPT RURAL CONC DDEP DRYDPLT
   AVERTIME 24 PERIOD
   POLLUTID TSP
   ERRORFIL error.log
   TERRHGTS ELEV
   RUNORNOT RUN
CO FINISHED

SO STARTING
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LOCATION   POINT155   VOLUME   227306 6607767 289.0
LOCATION   POINT156   VOLUME   229013 6606290 286.0
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Appendix G: Predicted $PM_{2.5}$ emissions from mining sources

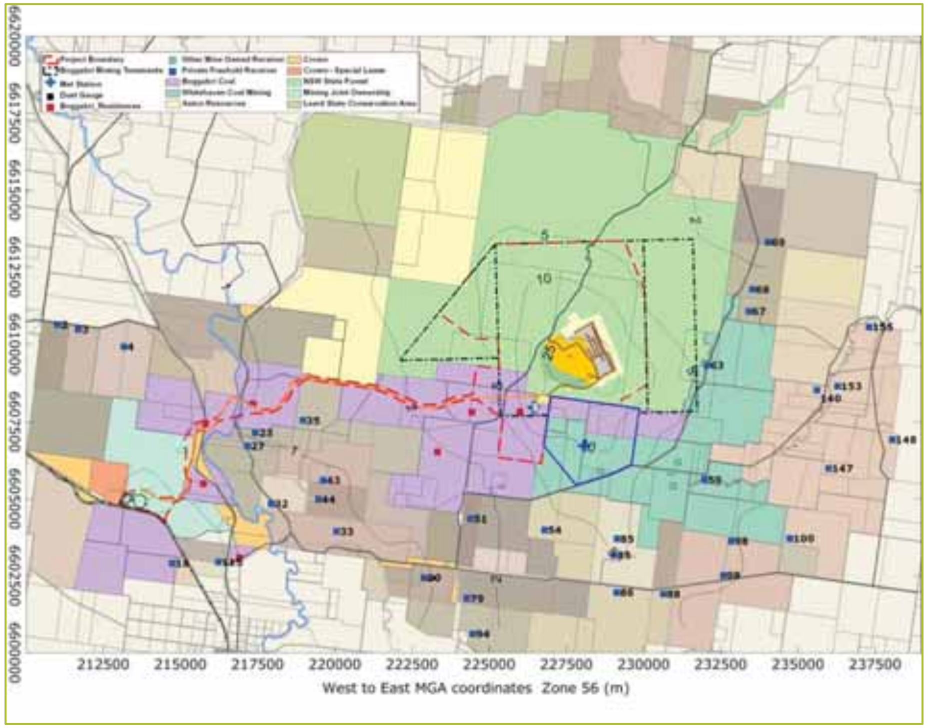


Figure G.1: Predicted 24-hour average $PM_{2.5}$ concentration due to emissions from the Project – Year 1

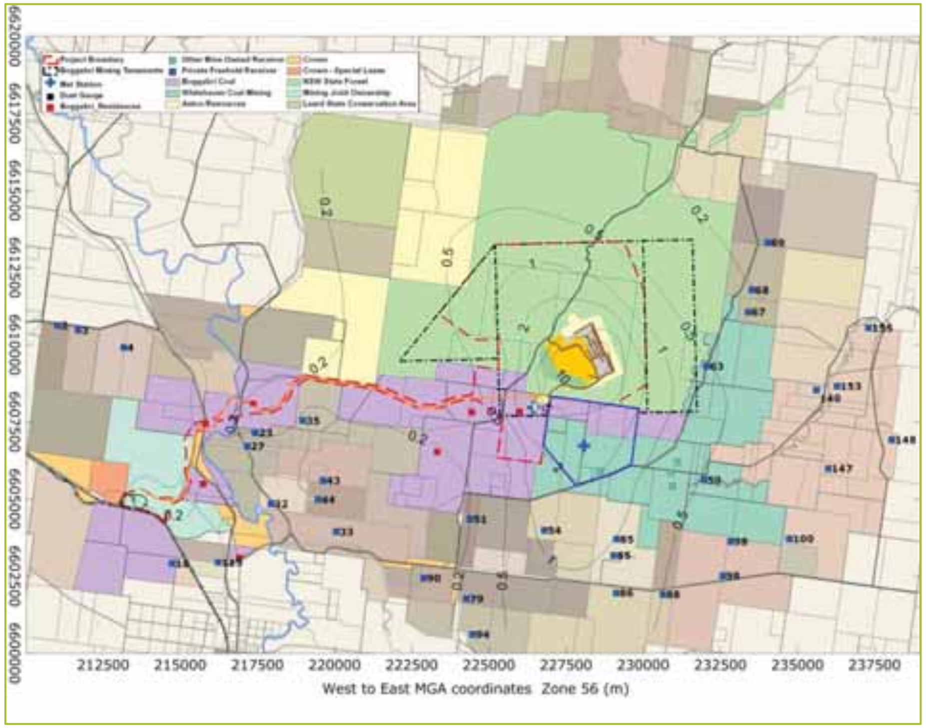


Figure G.2: Predicted annual average $PM_{2.5}$ concentration due to emissions from the Project – Year 1

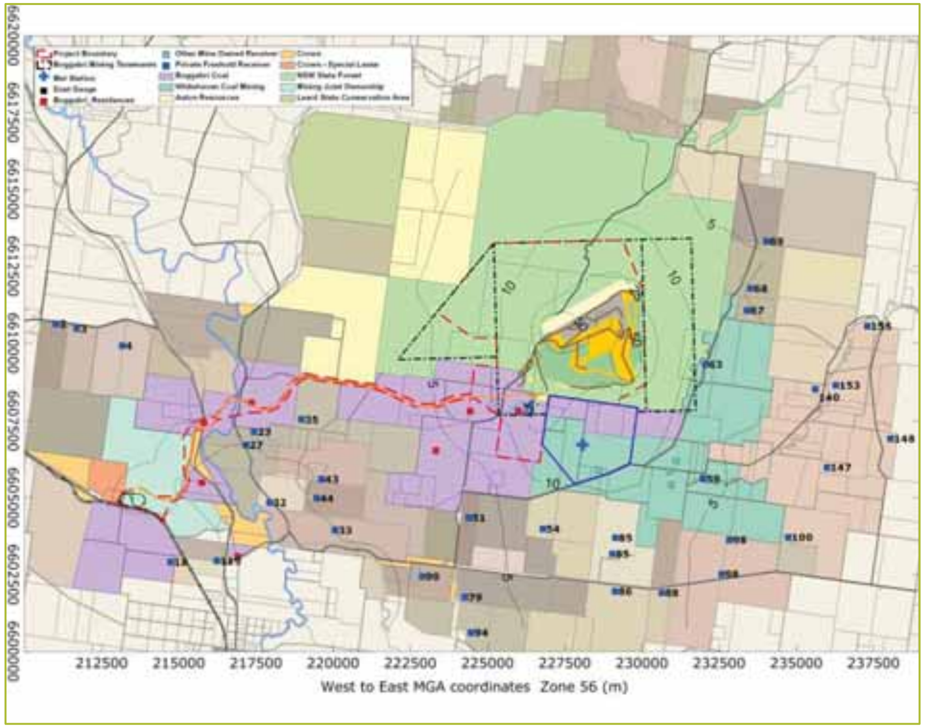


Figure G.3: Predicted 24-hour average $PM_{2.5}$ concentration due to emissions from the Project – Year 5

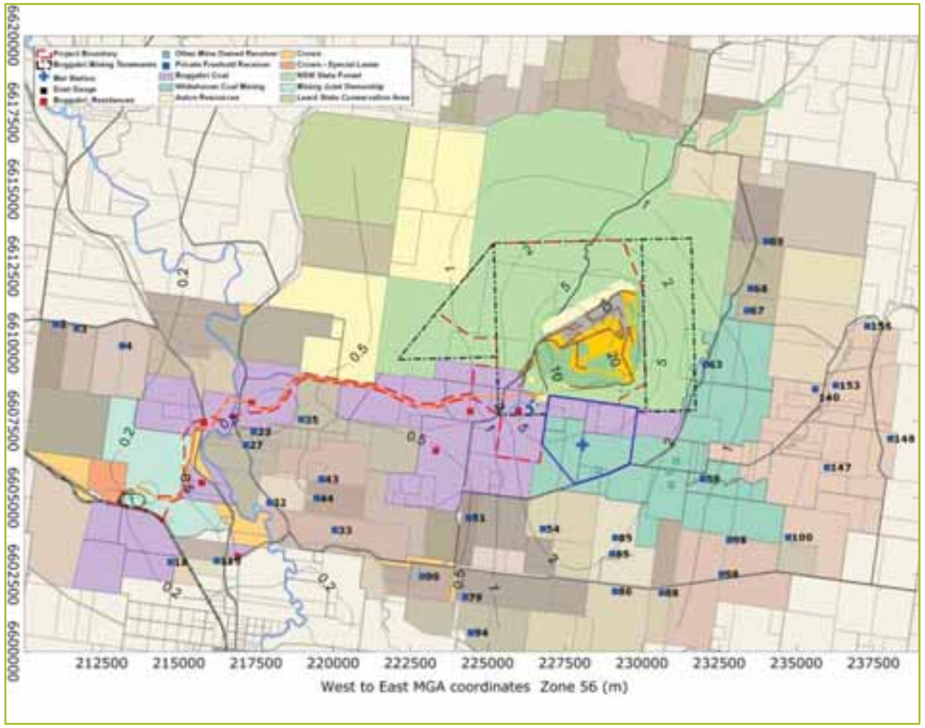


Figure G.4: Predicted annual average $PM_{2.5}$ concentration due to emissions from the Project – Year 5

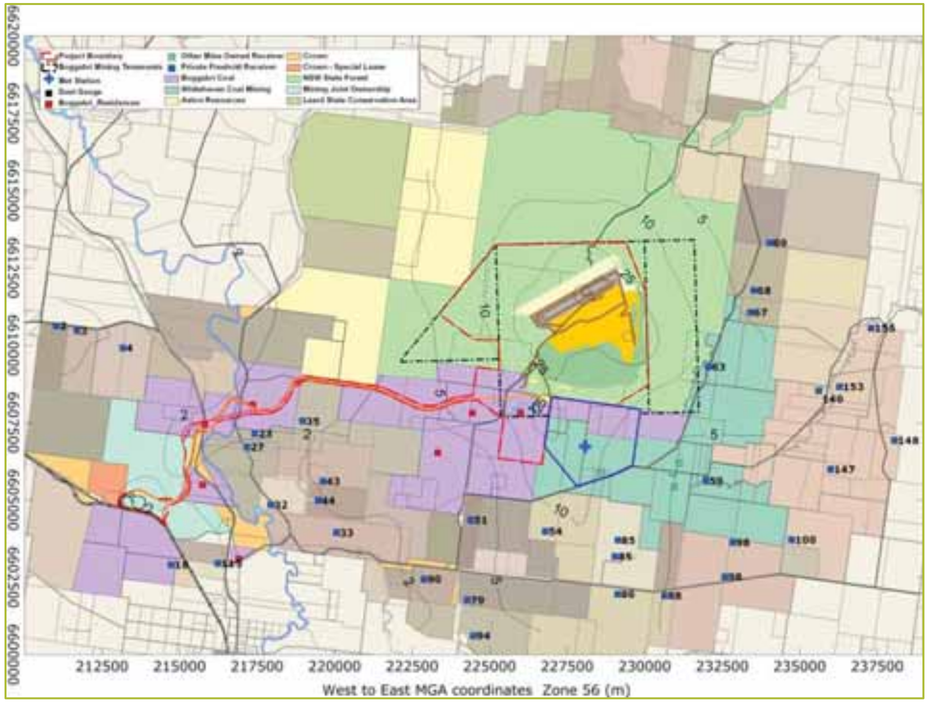


Figure G.5: Predicted 24-hour average $PM_{2.5}$ concentration due to emissions from the Project – Year 10

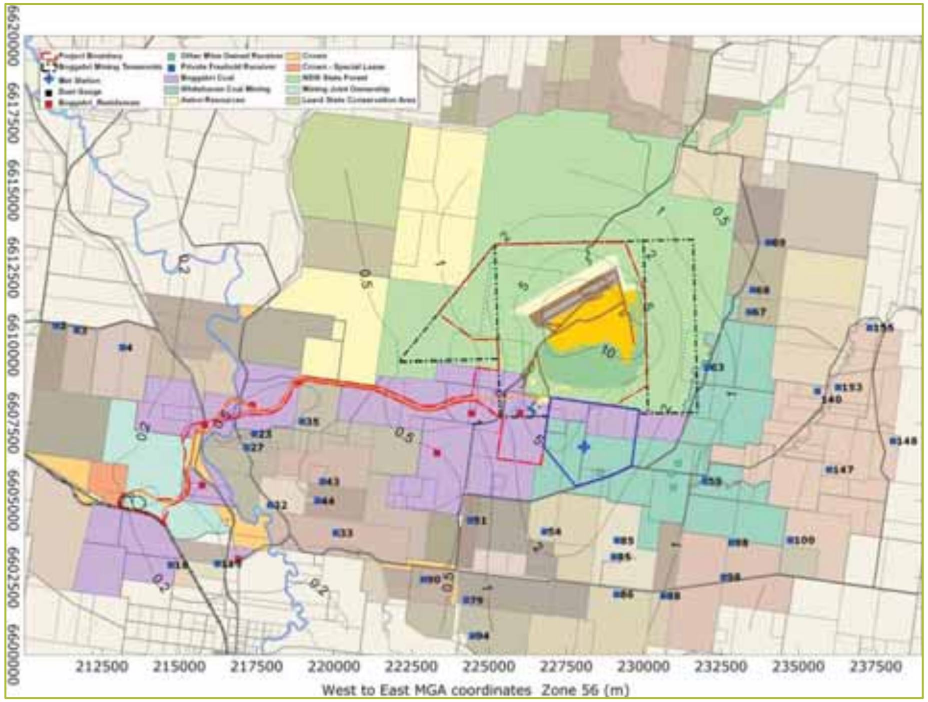


Figure G.6: Predicted annual average $PM_{2.5}$ concentration due to emissions from the Project – Year 10

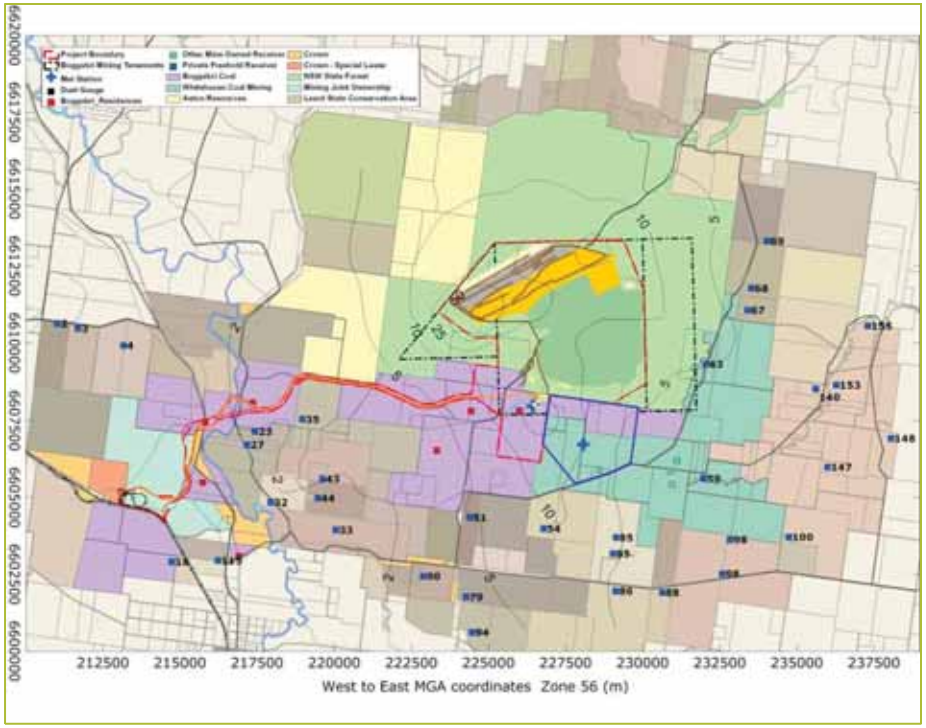


Figure G.7: Predicted 24-hour average $PM_{2.5}$ concentration due to emissions from the Project – Year 21

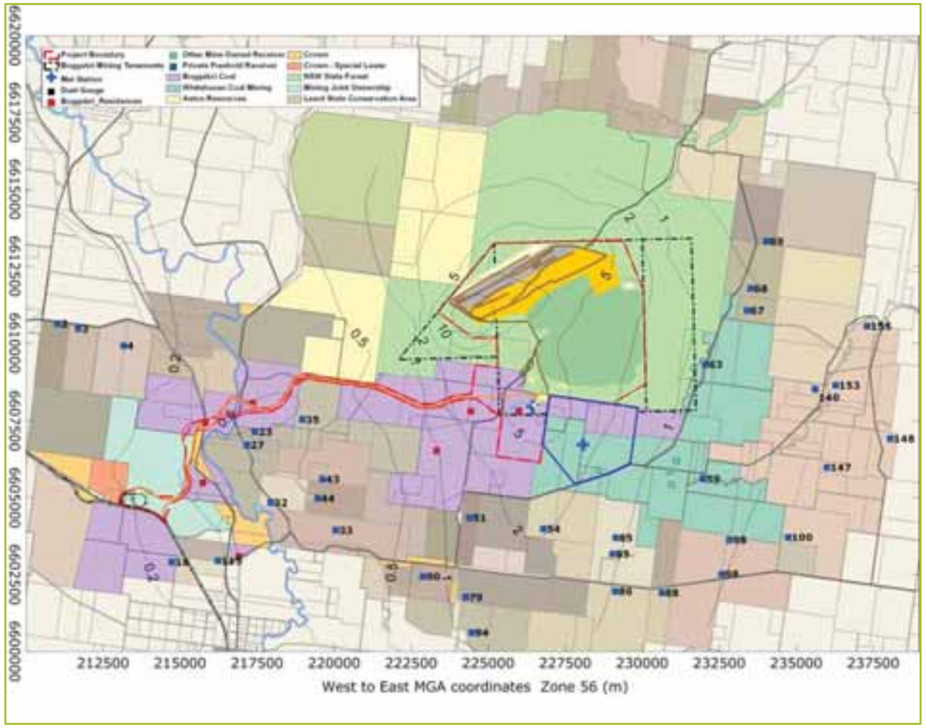


Figure G.8: Predicted annual average $PM_{2.5}$ concentration due to emissions from the Project – Year 21

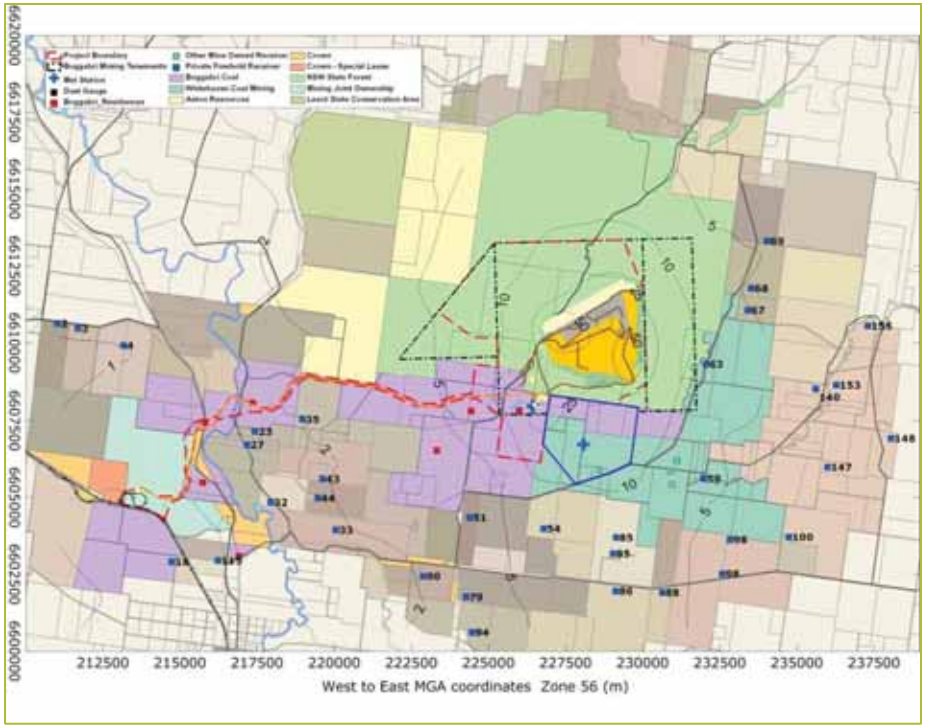


Figure G.9: Predicted 24-hour average $PM_{2.5}$ concentration due to emissions from the Project – Year 5 (rail spur scenario)

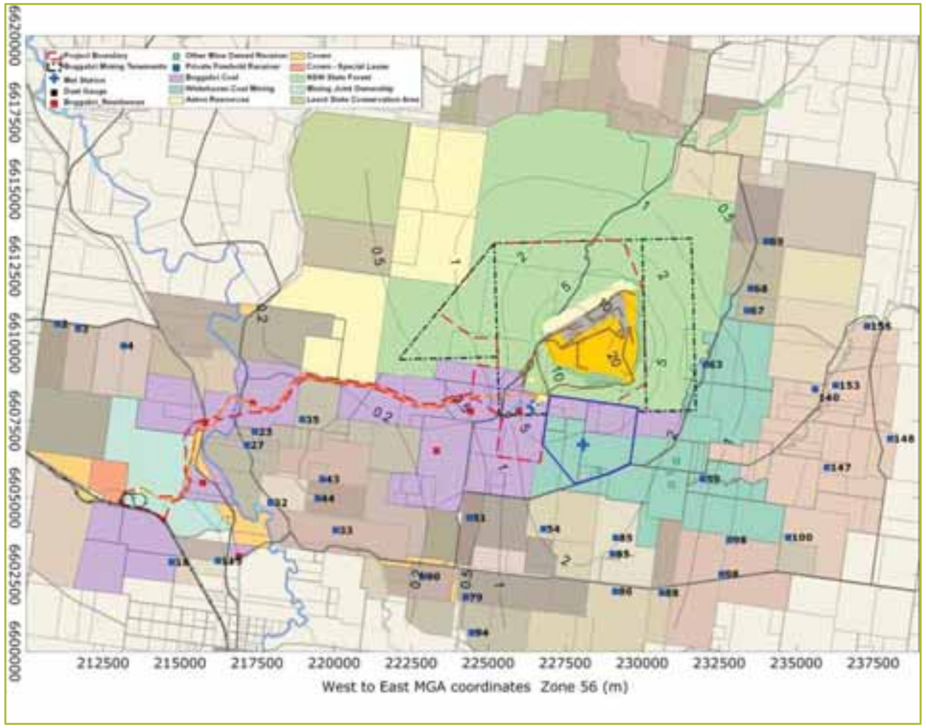


Figure G.10: Predicted annual average $PM_{2.5}$ concentration due to emissions from the Project – Year 5 (rail spur scenario)

Appendix H: DECCW Level 2 Assessment - residence analysis for cumulative 24-hour assessment

Introduction

The following provides an analysis of the potential cumulative impacts for 24-hour average PM_{10} concentrations as per the DECCW Level 2 assessment method.

For each year, and for each of the selected residences, the top ten 24-hour average PM_{10} HVAS measurements have been identified and compared to the model predictions. In addition, the top ten predicted Project alone maximum 24-hour average PM_{10} concentration are also presented. In addition, frequency distribution plots for the Project alone maximum 24-hour average PM_{10} concentration presented.

Year 1

For year one there were six residences (54, 63, 85a, 85b, 86 and 88) that were predicted to experience greater than 15 µg/m^3 as a result of the project alone and hence be at any risk of potential exceedence as per the DECCW Level 1 assessment method.

The highest ten 24-hour average PM_{10} HVAS measurements with the corresponding model prediction are presented in **Table H-1**.

Table H-1: Top ten HVAS concentration for modelling period with corresponding Project alone concentration (µg/m^3) – Year 1

Date	HVAS	54	63	85	85	86	88
1/09/2008	34.4	5.1	0.1	22.8	26.6	7.9	14.5
25/09/2008	30.3	1.9	0.0	0.6	0.9	0.3	0.6
18/04/2009	30.0	0.0	0.0	1.7	2.1	0.5	2.7
24/12/2008	28.1	0.7	0.2	0.2	0.2	0.2	0.2
12/12/2008	27.8	6.2	0.9	9.8	11.1	6.2	6.6
13/09/2008	26.0	3.2	1.0	4.9	5.7	1.8	3.7
18/11/2008	25.3	4.0	0.0	4.1	3.9	1.8	0.2
30/04/2009	25.3	11.1	5.3	8.5	8.7	3.7	5.2
19/03/2009	25.1	4.8	0.5	3.6	4.4	1.5	5.6
23/02/2009	21.2	1.4	0.8	5.9	6.8	2.2	5.3

At the two residences located at property ID 85 the cumulative 24-hour average PM_{10} concentration is predicted to exceed the criterion. The potential exceedence would occur on the 1 September 2008, the day of the highest HVAS 24-hour average PM_{10} concentration.

Table H-2 presents the top ten days of model predictions for the selected residences with the corresponding background, where available.

Table H-2: Top ten maximum 24-hour average PM_{10} concentration predictions with corresponding HVAS measurement (µg/m^3) – Year 1

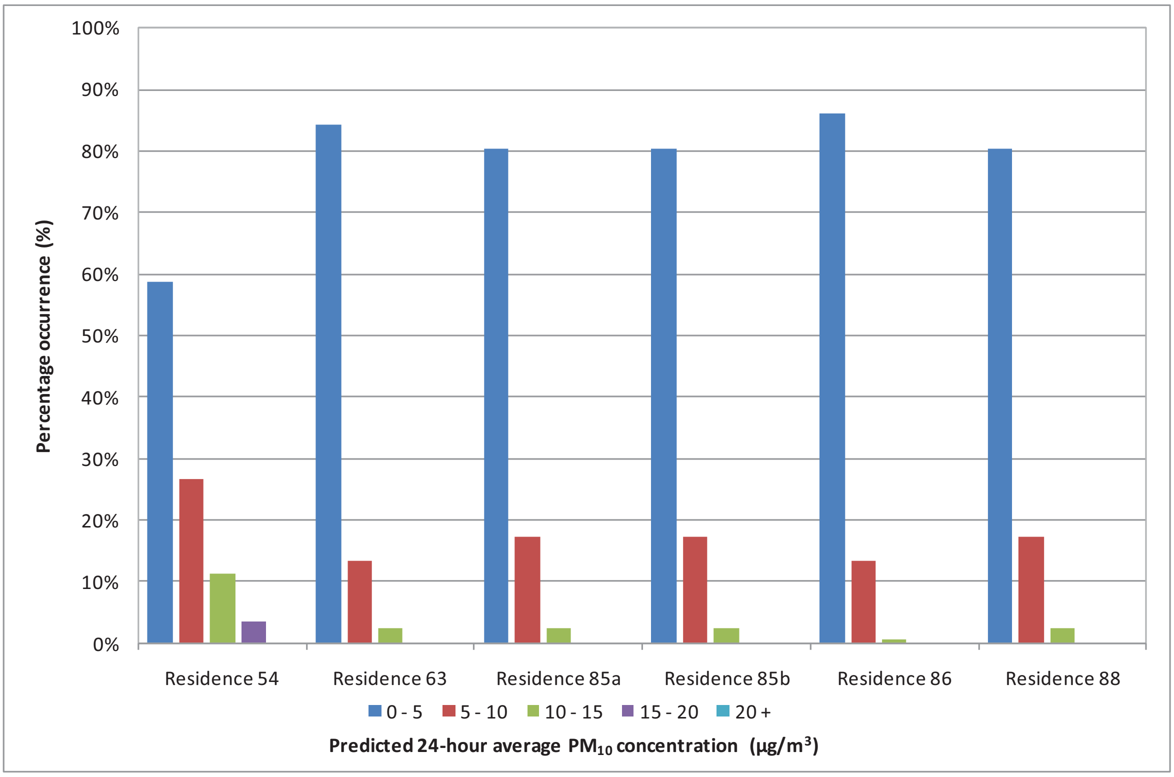
	Residence 54			Residence 63	
Date	HVAS	Project alone	Date	HVAS	Project alone
1/08/2009	No Data	18.1	14/04/2009	No Data	14.6
19/07/2009	No Data	17.3	1/07/2009	No Data	14.3
5/07/2009	No Data	17.0	29/06/2009	No Data	13.9
12/06/2009	10.3	16.6	30/08/2009	No Data	12.5
25/07/2009	No Data	16.0	6/12/2008	19.4	11.5
28/07/2009	No Data	16.0	8/02/2009	No Data	11.1
18/07/2009	14.5	15.8	26/04/2009	No Data	11.0
15/04/2009	No Data	15.8	16/07/2009	No Data	10.2
25/06/2009	No Data	15.5	13/08/2009	No Data	10.0
23/06/2009	No Data	15.4	3/07/2009	No Data	9.8

	Residence 85a			Residence 85b	
Date	HVAS	Project alone	Date	HVAS	Project alone
10/09/2008	No Data	32.1	10/09/2008	No Data	35.4
11/09/2008	No Data	26.3	11/09/2008	No Data	28.6
2/09/2008	No Data	24.5	2/09/2008	No Data	28.1
1/09/2008	34.4	22.8	1/09/2008	34.4	26.6
15/09/2008	No Data	22.1	15/09/2008	No Data	24.9
7/09/2008	17.7	18.4	2/12/2008	No Data	20.6
6/11/2008	16.6	18.3	7/09/2008	17.7	20.3
2/12/2008	No Data	17.6	30/11/2008	13.5	19.3
15/08/2008	No Data	17.5	6/11/2008	16.6	18.7
15/11/2008	No Data	16.6	15/11/2008	No Data	18.0
	Residence 86			**Residence 88**	
Date	**HVAS**	**Project alone**	**Date**	**HVAS**	**Project alone**
10/09/2008	No Data	14.5	2/09/2008	No Data	14.7
11/09/2008	No Data	12.2	1/09/2008	34.4	14.5
15/09/2008	No Data	9.5	30/11/2008	13.5	13.7
6/06/2009	8.6	8.9	2/12/2008	No Data	12.4
6/11/2008	16.6	8.6	10/09/2008	No Data	12.0
2/09/2008	No Data	8.3	7/09/2008	17.7	11.7
15/08/2009	No Data	8.3	11/09/2008	No Data	10.6
18/07/2009	14.5	8.0	15/09/2008	No Data	10.2
19/07/2009	No Data	7.9	26/07/2009	No Data	9.6
1/09/2008	34.4	7.9	24/01/2009	No Data	8.8

There is limited capacity for the DECCW method to work with one day in six HVAS data, as shown by the many "No Data" periods in **Table H-2**. However, there are HVAS data on 17 of the 60 top ten maximum days examined, whereas only ten days might be expected based on one in six HVAS data availability. This indicates that there is likely to be an existing influence from the mine on the top ten days of background levels, probably due to the prevailing weather conditions at the time impacts are highest, and the proximity of the receptor/monitor to the mine.

Nevertheless, with the available data there are two occasions where the predicted cumulative 24-hour average PM_{10} concentration would have exceeded the 50 µg/m^3 criterion. The potential exceedence would be at the two residences at property 85, on 1 September 2008 the day of the highest HVAS 24-hour average PM_{10} concentration measurement.

A frequency distribution plot of the predicted dust levels for the selected residences is shown in **Figure H.1**.



[a] – This includes existing mine dust contributions that are (double-counted) in the background levels also.

Figure H.1: Frequency distribution plot of dust levels for residences predicted to experience greater than 15 µg/m^3 for the Project alone [a] – Year 1

Year 5

For Year 5 there were 21 residences (35, 51, 54, 59, 63, 68, 69, 79, 85a, 85b, 86, 88, 94, 98a, 98b, 100, 140, 147, 148 and 153) that were predicted to experience greater than 15 µg/m^3 as a result of the project alone, and hence are at risk of potential exceedence as per the DECCW Level 1 assessment method.

The highest ten 24-hour average PM_{10} HVAS measurements with the corresponding model prediction are presented in **Table H-3**.

Table H-3: Top ten HVAS concentration for modelling period with corresponding Project alone PM_{10} concentration ($\mu g/m^3$) – Year 5

Date	HVAS	35	51	54	59	63	67	68
1/09/2008	34.4	1.0	1.1	12.4	13.8	0.1	0.4	0.8
25/09/2008	30.3	0.4	0.4	3.9	7.7	0.3	0.0	0.0
18/04/2009	30.0	0.1	0.1	0.1	0.5	0.0	0.0	0.0
24/12/2008	28.1	1.4	3.2	1.9	0.4	0.4	0.5	0.5
12/12/2008	27.8	4.0	4.5	13.7	15.9	16.3	0.6	1.0
13/09/2008	26.0	1.0	2.9	6.1	5.9	6.9	1.9	2.0
18/11/2008	25.3	13.5	3.8	8.8	0.0	0.0	0.0	0.0
30/04/2009	25.3	1.1	2.0	23.4	4.0	3.8	5.4	3.9
19/03/2009	25.1	1.1	2.7	9.8	11.7	2.2	1.4	2.3
23/02/2009	21.2	5.0	1.3	3.6	2.7	9.4	1.5	2.5
Date	**HVAS**	**69**	**79**	**85a**	**85b**	**86**	**88**	**94**
1/09/2008	34.4	3.4	1.3	39.0	43.5	18.2	21.1	1.4
25/09/2008	30.3	0.0	0.3	4.5	5.6	1.9	1.1	0.4
18/04/2009	30.0	0.0	0.1	2.4	2.5	1.3	2.3	0.1
24/12/2008	28.1	0.6	3.1	0.4	0.4	0.3	0.4	2.3
12/12/2008	27.8	3.1	2.4	21.6	24.6	13.8	12.0	2.2
13/09/2008	26.0	1.8	3.7	8.5	8.9	4.1	4.8	3.6
18/11/2008	25.3	0.0	2.2	9.4	9.7	5.0	1.7	2.1
30/04/2009	25.3	5.3	4.0	24.0	24.5	11.8	6.5	6.3
19/03/2009	25.1	9.0	3.7	9.5	9.8	4.5	5.8	5.2
23/02/2009	21.2	6.9	1.1	9.7	10.6	5.3	5.8	0.9
Date	**HVAS**	**98a**	**98b**	**100**	**140**	**147**	**148**	**153**
1/09/2008	34.4	15.1	17.2	1.8	2.9	0.0	0.0	0.0
25/09/2008	30.3	6.0	4.2	6.2	0.5	0.6	0.0	0.0
18/04/2009	30.0	0.7	2.2	0.0	0.3	0.0	0.0	0.0
24/12/2008	28.1	0.3	0.3	0.2	0.1	0.1	0.1	0.1
12/12/2008	27.8	12.5	10.9	6.0	3.4	8.5	5.7	3.5
13/09/2008	26.0	6.2	6.0	3.6	0.9	5.3	1.0	0.9
18/11/2008	25.3	0.0	0.0	0.0	6.6	0.0	0.0	0.0
30/04/2009	25.3	4.4	6.6	0.5	1.8	0.7	1.5	3.8
19/03/2009	25.1	10.8	11.6	7.2	1.7	2.2	0.5	0.6
23/02/2009	21.2	1.4	3.5	0.8	2.8	2.7	4.3	3.1

At Residences 85a and 85b, the cumulative 24-hour average PM_{10} concentration is predicted to exceed the criterion on 1 September 2008, the day of the highest HVAS 24-hour average PM_{10} concentration, and on 12 December 2008.

Table H-4 presents the top ten days of model predictions for the selected residences with corresponding background, where available.

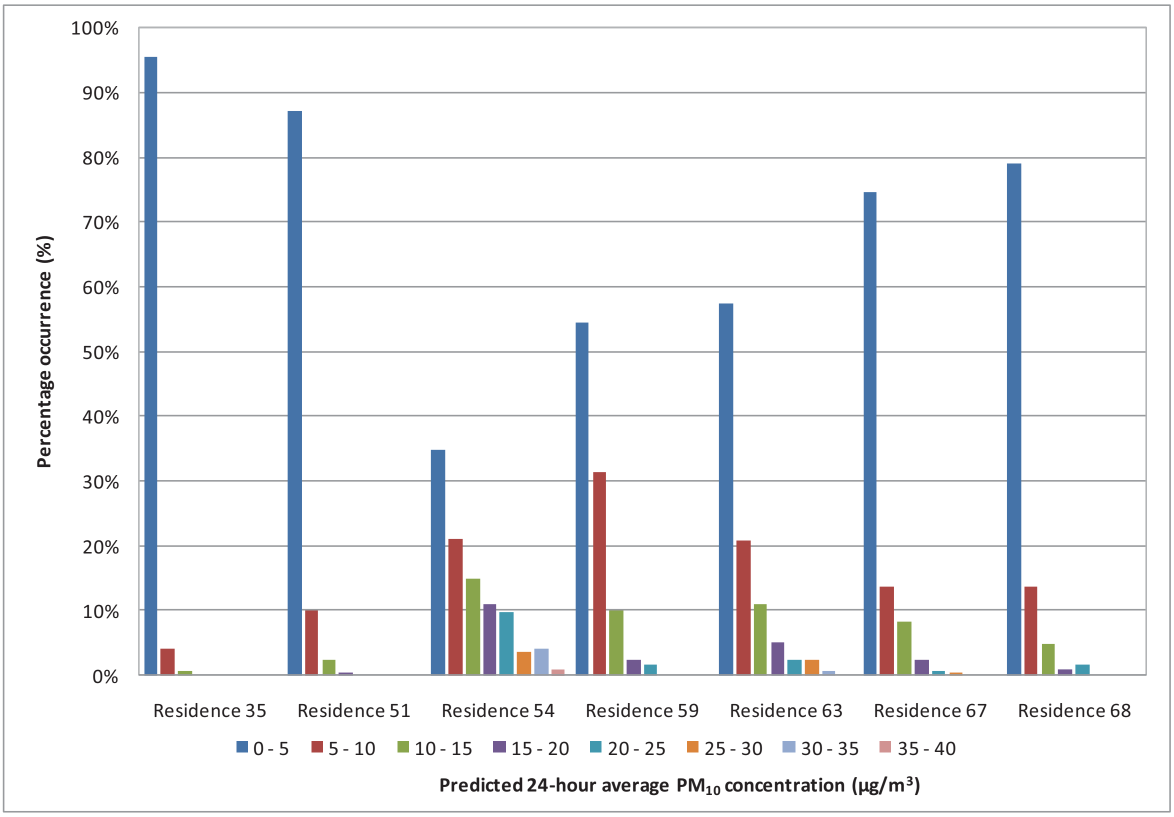
Table H-4: Top ten maximum 24-hour average PM_{10} concentration predictions with corresponding HVAS measurement (µg/m^3) – Year 5

Residence 35			Residence 51		
Date	HVAS	Project alone	Date	HVAS	Project alone
18/11/2008	25.3	13.5	26/06/2009	No Data	15.7
13/11/2008	No Data	12.5	10/10/2008	No Data	12.7
11/11/2008	No Data	8.1	8/12/2008	No Data	12.7
8/12/2008	No Data	8.0	21/01/2009	No Data	11.8
21/06/2009	No Data	7.1	17/09/2008	No Data	11.7
22/03/2009	No Data	7.0	9/12/2008	No Data	11.4
22/12/2008	No Data	6.8	27/12/2008	No Data	11.1
17/11/2008	No Data	6.8	29/04/2009	No Data	10.8
10/12/2008	No Data	6.1	4/06/2009	No Data	10.0
4/11/2008	No Data	6.0	21/06/2009	No Data	9.9
Residence 54			**Residence 59**		
Date	**HVAS**	**Project alone**	**Date**	**HVAS**	**Project alone**
1/08/2009	No Data	36.8	23/11/2008	No Data	24.7
5/07/2009	No Data	35.9	16/08/2009	15.8	23.9
25/07/2009	No Data	35.5	28/12/2008	No Data	22.8
18/07/2009	14.5	34.8	12/10/2008	No Data	22.2
19/07/2009	No Data	34.5	4/07/2009	No Data	20.5
23/06/2009	No Data	33.6	24/11/2008	11	19.9
28/07/2009	No Data	33.0	26/10/2008	No Data	19.2
12/06/2009	10.3	32.1	21/07/2009	No Data	17.9
15/04/2009	No Data	31.7	12/12/2008	27.8	15.9
4/08/2009	13.8	31.5	11/08/2009	No Data	15.7
Residence 63			**Residence 67**		
Date	**HVAS**	**Project alone**	**Date**	**HVAS**	**Project alone**
16/07/2009	No Data	42.0	30/08/2009	No Data	25.8
15/06/2009	No Data	31.0	9/11/2008	No Data	22.8
27/07/2009	No Data	30.2	14/04/2009	No Data	20.5
13/08/2009	No Data	29.8	29/11/2008	No Data	16.6
2/07/2009	No Data	29.2	3/02/2009	No Data	15.9
7/08/2009	No Data	29.1	3/07/2009	No Data	15.7
23/11/2008	No Data	28.6	21/06/2009	No Data	15.6
8/06/2009	No Data	28.1	19/02/2009	No Data	15.2
14/12/2008	No Data	26.1	15/10/2008	No Data	15.2
4/07/2009	No Data	25.7	22/08/2009	No Data	15.1
Residence 68			**Residence 69**		
Date	**HVAS**	**Project alone**	**Date**	**HVAS**	**Project alone**
9/11/2008	No Data	24.4	21/06/2009	No Data	24.7
30/08/2009	No Data	22.6	15/04/2009	No Data	17.3
26/07/2009	No Data	22.4	15/12/2008	No Data	17.1
19/02/2009	No Data	20.7	31/07/2009	No Data	16.7
11/01/2009	No Data	20.0	9/11/2008	No Data	15.0
21/06/2009	No Data	19.9	27/06/2009	No Data	15.0
27/06/2009	No Data	16.7	11/07/2009	No Data	14.8
9/12/2008	No Data	16.5	24/02/2009	No Data	14.3
11/04/2009	No Data	14.9	29/10/2008	No Data	13.8
10/06/2009	No Data	14.4	16/04/2009	No Data	13.7
Residence 79			**Residence 85a**		
Date	**HVAS**	**Project alone**	**Date**	**HVAS**	**Project alone**
8/08/2009	No Data	16.3	10/09/2008	No Data	46.6
7/11/2008	No Data	13.7	18/07/2009	14.5	40.2
18/08/2009	No Data	13.0	1/09/2008	34.4	39.0
23/01/2009	No Data	13.0	11/09/2008	No Data	38.0
8/09/2008	No Data	12.7	25/07/2009	No Data	36.3
17/09/2008	No Data	12.4	2/09/2008	No Data	35.6
10/10/2008	No Data	11.5	28/07/2009	No Data	35.0
28/10/2008	No Data	11.1	15/09/2008	No Data	33.9
25/03/2009	13.5	11.1	6/11/2008	16.6	33.9
3/10/2008	No Data	11.0	19/07/2009	No Data	32.5
Residence 85a			**Residence 86**		
Date	**HVAS**	**Project alone**	**Date**	**HVAS**	**Project alone**
10/09/2008	No Data	50.5	10/09/2008	No Data	27.6
1/09/2008	34.4	43.5	11/09/2008	No Data	23.2
18/07/2009	14.5	42.1	18/07/2009	14.5	22.1
11/09/2008	No Data	41.1	28/07/2009	No Data	21.7
2/09/2008	No Data	38.8	19/07/2009	No Data	21.2
25/07/2009	No Data	38.1	6/06/2009	8.6	20.7
15/09/2008	No Data	37.1	15/09/2008	No Data	20.4
28/07/2009	No Data	36.5	6/11/2008	16.6	19.2
6/11/2008	16.6	36.0	25/07/2009	No Data	19.0
23/06/2009	No Data	33.6	15/08/2009	No Data	18.4

Residence 88			Residence 94		
Date	HVAS	Project alone	Date	HVAS	Project alone
10/09/2008	No Data	27.7	8/08/2009	No Data	16.1
11/09/2008	No Data	22.9	5/07/2009	No Data	15.9
1/09/2008	34.4	21.1	1/08/2009	No Data	14.7
2/09/2008	No Data	20.7	20/07/2009	No Data	14.1
15/09/2008	No Data	19.0	23/06/2009	No Data	14.0
2/12/2008	No Data	17.9	29/07/2009	No Data	13.8
30/11/2008	13.5	17.6	3/10/2008	No Data	13.3
7/09/2008	17.7	16.6	25/03/2009	13.5	12.9
8/09/2008	No Data	12.7	7/11/2008	No Data	12.8
27/06/2009	No Data	12.6	28/10/2008	No Data	12.7
Residence 98a			Residence 98b		
Date	HVAS	Project alone	Date	HVAS	Project alone
12/10/2008	No Data	23.2	12/10/2008	No Data	18.9
16/08/2009	15.8	20.7	1/09/2008	34.4	17.2
28/12/2008	No Data	20.4	28/12/2008	No Data	16.2
23/11/2008	No Data	19.2	26/10/2008	No Data	15.2
26/10/2008	No Data	17.9	24/11/2008	11	14.9
21/07/2009	No Data	17.3	21/07/2009	No Data	14.2
4/07/2009	No Data	16.5	24/01/2009	No Data	14.2
24/11/2008	11	15.5	16/08/2009	15.8	13.4
1/09/2008	34.4	15.1	23/11/2008	No Data	13.4
12/07/2009	7.6	14.0	30/11/2008	13.5	12.9
Residence 100			Residence 140		
Date	HVAS	Project alone	Date	HVAS	Project alone
16/08/2009	15.8	14.5	17/10/2008	No Data	7.3
7/07/2009	No Data	14.4	18/11/2008	25.3	6.6
23/11/2008	No Data	14.3	4/11/2008	No Data	5.9
13/12/2008	No Data	13.9	30/01/2009	No Data	5.3
4/07/2009	No Data	12.1	20/03/2009	No Data	5.3
28/12/2008	No Data	11.4	8/08/2009	No Data	4.8
20/01/2009	No Data	10.8	8/12/2008	No Data	4.5
21/07/2009	No Data	10.7	7/12/2008	No Data	4.4
12/04/2009	8.3	10.6	10/07/2009	No Data	4.3
5/06/2009	No Data	10.3	14/10/2008	No Data	3.8
Residence 147			Residence 148		
Date	HVAS	Project alone	Date	HVAS	Project alone
16/07/2009	No Data	20.3	16/07/2009	No Data	13.8
27/07/2009	No Data	16.9	13/08/2009	No Data	13.3
14/12/2008	No Data	16.4	2/07/2009	No Data	13.3
23/11/2008	No Data	14.1	7/08/2009	No Data	12.7
4/07/2009	No Data	13.2	15/06/2009	No Data	11.7
15/06/2009	No Data	13.0	4/07/2009	No Data	10.1
8/06/2009	No Data	11.8	29/06/2009	No Data	9.3
9/06/2009	No Data	11.7	8/06/2009	No Data	8.5
6/07/2009	15.4	11.5	23/11/2008	No Data	8.5
28/06/2009	No Data	10.5	1/07/2009	No Data	8.5
Residence 148					
Date	HVAS	Project alone			
13/08/2009	No Data	15.5			
2/07/2009	No Data	14.8			
16/07/2009	No Data	14.2			
29/06/2009	No Data	14.1			
1/07/2009	No Data	13.5			
7/08/2009	No Data	13.3			
19/01/2009	No Data	13.3			
6/12/2008	19.4	12.7			
8/02/2009	No Data	12.5			
24/06/2009	10	11.1			

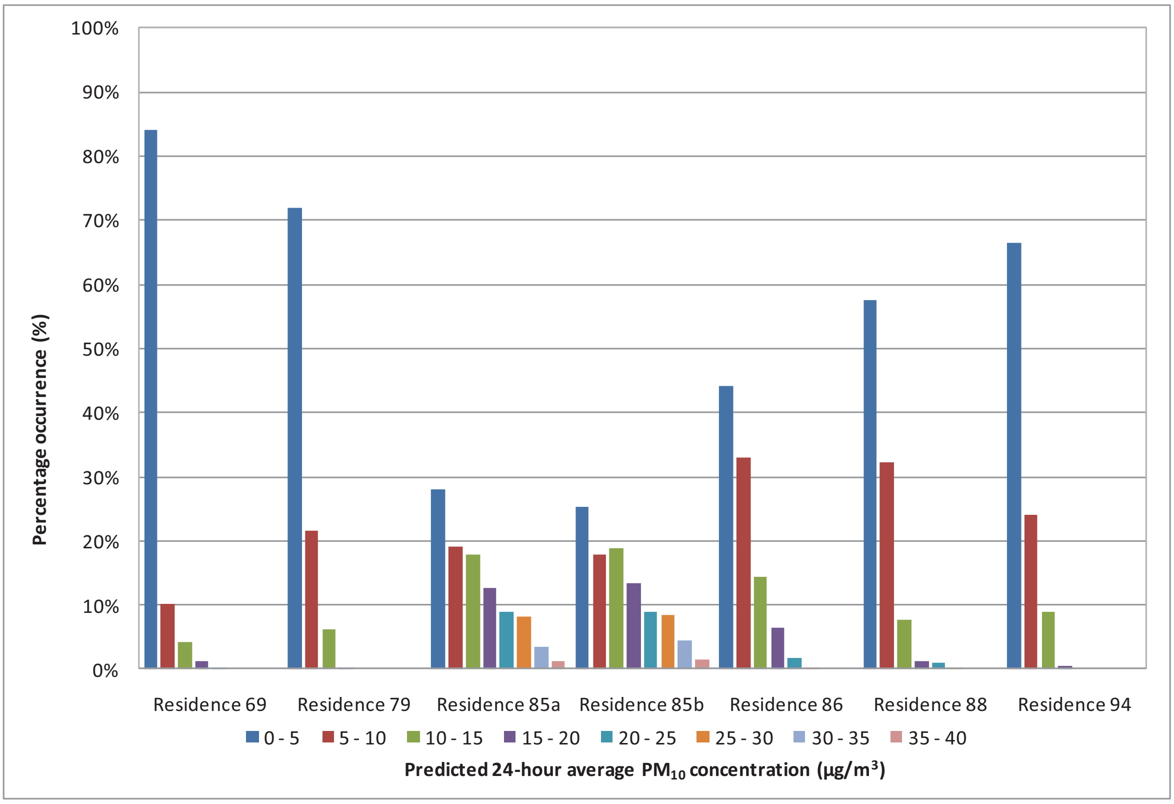
There were three days where the predicted cumulative 24-hour average PM_{10} concentration would have exceeded the 50 $\mu g/m^3$ criterion at residences 85a and 85b. The potential exceedances would be on 1 September 2008, 6 November 2008 and 18 July 2009. At residence 98b, an exceedence was predicted to occur on 1 September 2008, the day of the maximum background level. As there is double-counting occurring, it is likely that the background level includes at least 1.6 $\mu g/m^3$ from the Project, and so there may not be an exceedence at residence 98b.

A frequency distribution plot for the selected residences is shown in **Figure H.2** for residences 35 through 68, **Figure H.3** for residences 69 through 94 and **Figure H.4** for residences 98a through 153.



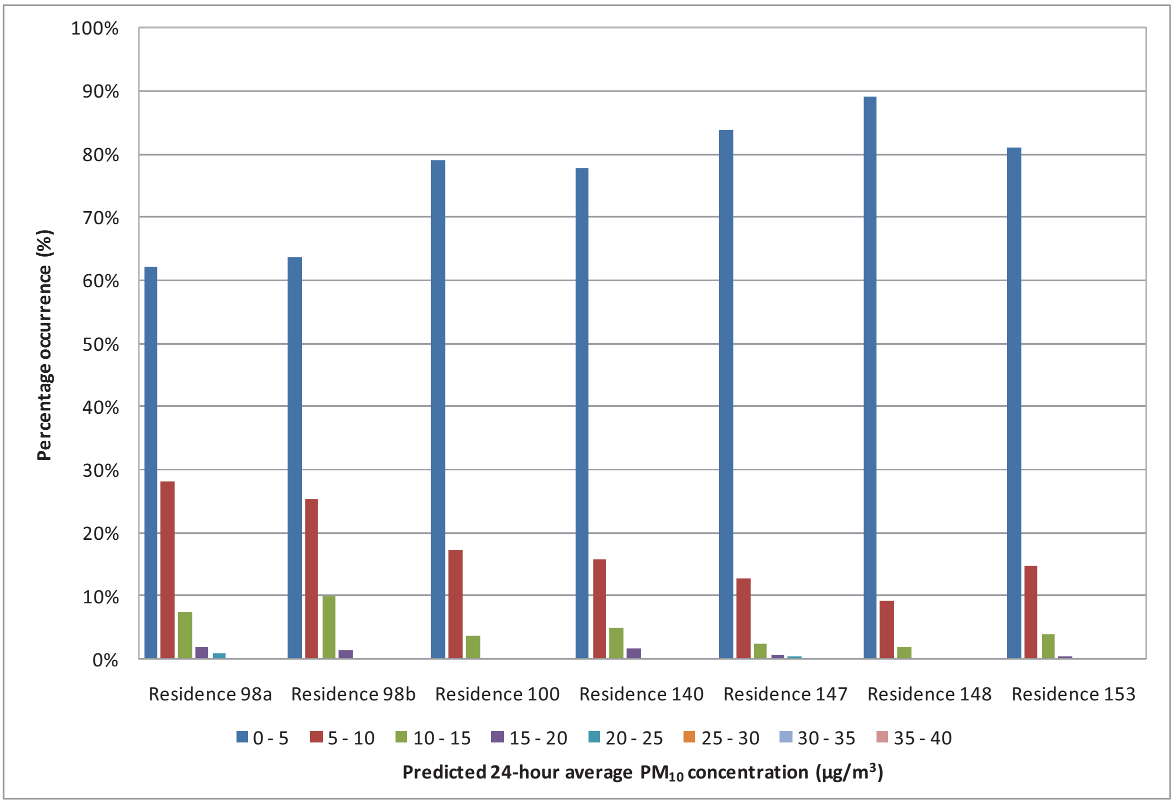
[a] – This includes existing mine dust contributions that are (double-counted) in the background levels also.

Figure H.2: Frequency distribution plot of dust levels for residences (35 to 68) predicted to experience greater than 15 µg/m³ for the Project alone [a] – Year 5



[a] – This includes existing mine dust contributions that are (double-counted) in the background levels also.

Figure H.3: Frequency distribution plot of dust levels for residences (69 to 94) predicted to experience greater than 15 µg/m³ for the Project alone [a] – Year 5



[a] – This includes existing mine dust contributions that are (double-counted) in the background levels also.

Figure H.4: Frequency distribution plot of dust levels for residences (98 to 153) predicted to experience greater than 15 µg/m³ for the Project alone [a] – Year 5

Year 10

For Year 10 there were 18 residences (23, 51, 54, 59, 63, 67, 68, 69, 79, 85a, 85b, 86, 88, 94, 98a, 140, 147 and 153) that were predicted to experience greater than 15 µg/m³ as a result of the project alone, and hence are at risk of potential exceedence as per the DECCW level 1 assessment method.

The highest ten 24-hour average PM_{10} HVAS measurements with the corresponding model predictions are presented in **Table H-5**.

Table H-5: Top ten HVAS concentration for modelling period with corresponding Project alone PM_{10} concentration (µg/m^3) – Year 10

Date	HVAS	23	51	54	59	63	67
1/09/2008	34.4	3.5	1.1	14.3	10.1	0.1	0.1
25/09/2008	30.3	1.2	0.4	5.3	5.9	2.0	0.0
18/04/2009	30.0	0.1	0.1	0.1	0.5	0.0	0.0
24/12/2008	28.1	0.9	3.3	0.8	0.3	0.3	0.3
12/12/2008	27.8	6.6	3.3	15.7	11.4	13.3	1.0
13/09/2008	26.0	1.6	3.9	4.8	5.1	8.4	1.5
18/11/2008	25.3	13.2	2.6	9.4	0.0	0.0	0.0
30/04/2009	25.3	3.4	3.0	25.0	3.3	1.3	7.6
19/03/2009	25.1	2.5	2.9	8.4	9.4	4.4	0.8
23/02/2009	21.2	3.8	1.1	4.2	1.9	6.2	1.4
Date	**HVAS**	**68**	**69**	**79**	**85a**	**85b**	**86**
1/09/2008	34.4	0.3	1.6	1.4	34.9	38.3	18.0
25/09/2008	30.3	0.0	0.0	0.4	2.0	2.5	0.9
18/04/2009	30.0	0.0	0.0	0.1	3.9	3.8	1.6
24/12/2008	28.1	0.4	0.5	2.4	0.3	0.4	0.3
12/12/2008	27.8	0.4	1.3	2.2	16.4	18.2	11.2
13/09/2008	26.0	1.5	1.5	4.0	8.1	9.0	4.0
18/11/2008	25.3	0.0	0.0	2.2	5.8	5.8	3.3
30/04/2009	25.3	4.7	3.6	5.6	17.2	17.9	8.2
19/03/2009	25.1	1.4	3.9	4.8	9.1	10.2	3.6
23/02/2009	21.2	1.6	2.8	1.0	10.9	10.7	5.6
Date	**HVAS**	**88**	**94**	**98a**	**140**	**147**	**153**
1/09/2008	34.4	17.0	1.7	10.5	0.0	0.0	0.0
25/09/2008	30.3	0.8	0.5	4.7	0.0	1.0	0.0
18/04/2009	30.0	2.1	0.1	0.6	0.0	0.0	0.0
24/12/2008	28.1	0.3	1.6	0.3	0.1	0.1	0.1
12/12/2008	27.8	9.3	2.4	9.0	6.5	6.0	4.7
13/09/2008	26.0	4.3	3.6	5.1	1.4	4.9	1.0
18/11/2008	25.3	0.9	2.3	0.0	0.0	0.0	0.0
30/04/2009	25.3	5.7	7.8	3.3	1.3	0.5	1.5
19/03/2009	25.1	5.6	6.3	8.8	0.6	2.6	0.5
23/02/2009	21.2	4.8	0.9	1.2	4.8	1.4	3.9

At residences 85, 86 and 88 the cumulative 24-hour average PM_{10} concentration is predicted to exceed the criterion on 1 September 2008, the day of the highest HVAS 24-hour average PM_{10} concentration. It is noted that there is double-counting and that residences 86 and 88 may not actually exceed as background levels may already include 2.4 µg/m^3 or higher contribution from the existing mine.

Table H-6 presents the top ten days of model predictions for the selected residences with corresponding background where available.

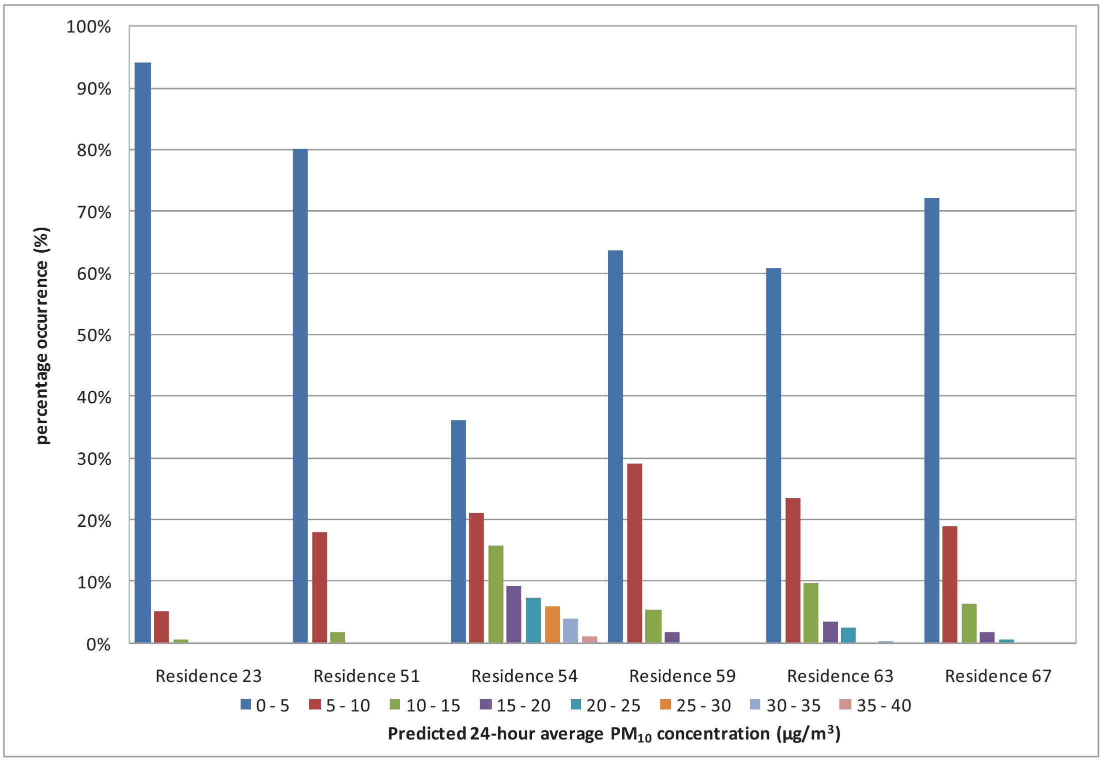
Table H-6: Top ten maximum 24-hour average PM_{10} concentration predictions with corresponding HVAS measurement (µg/m³) – Year 10

Residence 23			Residence 51		
Date	HVAS	Project alone	Date	HVAS	Project alone
18/11/2008	25.3	13.2	17/09/2008	No Data	12.4
8/12/2008	No Data	10.5	8/08/2009	No Data	12.0
22/03/2009	No Data	8.8	26/06/2009	No Data	12.0
13/11/2008	No Data	8.7	10/10/2008	No Data	11.9
11/11/2008	No Data	8.1	7/11/2008	No Data	11.7
4/11/2008	No Data	6.8	18/08/2009	No Data	11.3
17/10/2008	No Data	6.8	24/07/2009	8.9	9.9
12/12/2008	27.8	6.6	12/09/2008	No Data	9.7
21/06/2009	No Data	6.1	9/12/2008	No Data	9.6
6/11/2008	16.6	5.9	27/12/2008	No Data	9.6
Residence 54			**Residence 59**		
Date	**HVAS**	**Project alone**	**Date**	**HVAS**	**Project alone**
18/07/2009	14.5	38.9	23/11/2008	No Data	18.6
25/07/2009	No Data	36.5	28/12/2008	No Data	17.4
28/07/2009	No Data	36.3	16/08/2009	15.8	17.4
19/07/2009	No Data	34.5	12/10/2008	No Data	16.4
5/07/2009	No Data	34.1	24/11/2008	11	16.2
1/08/2009	No Data	33.7	4/07/2009	No Data	16.2
5/08/2009	No Data	33.6	21/07/2009	No Data	14.1
18/08/2009	No Data	33.6	26/10/2008	No Data	13.9
19/08/2009	No Data	32.7	13/12/2008	No Data	13.3
15/04/2009	No Data	32.6	11/08/2009	No Data	13.1
Residence 63			**Residence 67**		
Date	**HVAS**	**Project alone**	**Date**	**HVAS**	**Project alone**
16/07/2009	No Data	32.1	14/04/2009	No Data	24.2
8/06/2009	No Data	24.0	30/08/2009	No Data	20.9
23/11/2008	No Data	23.5	1/07/2009	No Data	18.5
9/06/2009	No Data	23.4	29/06/2009	No Data	18.5
15/06/2009	No Data	22.5	3/07/2009	No Data	16.6
27/07/2009	No Data	22.1	31/08/2009	No Data	16.2
7/08/2009	No Data	21.9	26/04/2009	No Data	15.9
28/06/2009	No Data	20.5	8/02/2009	No Data	15.1
14/12/2008	No Data	20.5	9/11/2008	No Data	15.0
2/07/2009	No Data	19.7	21/06/2009	No Data	14.3
Residence 68			**Residence 69**		
Date	**HVAS**	**Project alone**	**Date**	**HVAS**	**Project alone**
30/08/2009	No Data	20.3	26/07/2009	No Data	19.0
14/04/2009	No Data	17.3	21/06/2009	No Data	18.8
9/11/2008	No Data	16.3	11/01/2009	No Data	18.8
3/07/2009	No Data	13.2	9/11/2008	No Data	17.2
29/11/2008	No Data	12.9	10/06/2009	No Data	16.1
3/02/2009	No Data	12.6	19/02/2009	No Data	14.7
31/08/2009	No Data	12.3	30/08/2009	No Data	14.7
21/06/2009	No Data	11.9	27/06/2009	No Data	13.7
22/08/2009	No Data	11.7	15/12/2008	No Data	13.0
14/03/2009	No Data	11.2	14/04/2009	No Data	11.9
Residence 79			**Residence 85**		
Date	**HVAS**	**Project alone**	**Date**	**HVAS**	**Project alone**
8/08/2009	No Data	17.0	10/09/2008	No Data	41.1
5/07/2009	No Data	14.9	2/09/2008	No Data	36.1
1/08/2009	No Data	14.1	1/09/2008	34.4	34.9
23/06/2009	No Data	13.7	11/09/2008	No Data	34.4
23/01/2009	No Data	13.7	15/09/2008	No Data	30.6
7/11/2008	No Data	13.3	7/09/2008	17.7	29.4
3/10/2008	No Data	13.3	2/12/2008	No Data	26.8
28/10/2008	No Data	13.2	30/11/2008	13.5	26.7
29/07/2009	No Data	13.1	18/07/2009	14.5	26.0
8/09/2008	No Data	13.0	25/07/2009	No Data	25.0
Residence 85			**Residence 86**		
Date	**HVAS**	**Project alone**	**Date**	**HVAS**	**Project alone**
10/09/2008	No Data	41.4	10/09/2008	No Data	27.8
1/09/2008	34.4	38.3	11/09/2008	No Data	23.1
2/09/2008	No Data	36.0	15/09/2008	No Data	19.9
11/09/2008	No Data	34.6	2/09/2008	No Data	19.7
15/09/2008	No Data	30.8	1/09/2008	34.4	18.0
7/09/2008	17.7	29.9	7/09/2008	17.7	16.3
2/12/2008	No Data	27.8	6/06/2009	8.6	15.8
30/11/2008	13.5	27.2	6/11/2008	16.6	15.6
18/07/2009	14.5	27.1	2/12/2008	No Data	15.6
15/08/2009	No Data	25.1	19/07/2009	No Data	15.5

Residence 88			Residence 94		
Date	HVAS	Project alone	Date	HVAS	Project alone
10/09/2008	No Data	18.6	5/07/2009	No Data	19.2
1/09/2008	34.4	17.0	1/08/2009	No Data	17.4
11/09/2008	No Data	15.7	23/06/2009	No Data	16.9
2/09/2008	No Data	15.3	20/07/2009	No Data	16.6
30/11/2008	13.5	14.0	29/07/2009	No Data	16.2
2/12/2008	No Data	13.8	8/08/2009	No Data	15.4
15/09/2008	No Data	13.3	9/08/2009	No Data	14.9
7/09/2008	17.7	13.1	22/06/2009	No Data	14.4
27/06/2009	No Data	10.0	25/03/2009	13.5	14.2
26/03/2009	No Data	9.8	19/07/2009	No Data	14.2
Residence 98a			Residence 140		
Date	HVAS	Project alone	Date	HVAS	Project alone
12/10/2008	No Data	16.2	16/07/2009	No Data	17.0
16/08/2009	15.8	15.4	2/07/2009	No Data	16.7
28/12/2008	No Data	15.1	7/08/2009	No Data	15.3
23/11/2008	No Data	14.8	13/08/2009	No Data	15.1
21/07/2009	No Data	13.4	15/06/2009	No Data	14.4
26/10/2008	No Data	12.8	4/07/2009	No Data	11.9
4/07/2009	No Data	12.7	8/06/2009	No Data	11.6
24/11/2008	11	12.1	3/07/2009	No Data	11.0
20/01/2009	No Data	10.9	27/07/2009	No Data	10.8
11/08/2009	No Data	10.8	23/11/2008	No Data	10.7
Residence 147			Residence 153		
Date	HVAS	Project alone	Date	HVAS	Project alone
16/07/2009	No Data	15.6	2/07/2009	No Data	15.0
14/12/2008	No Data	12.3	13/08/2009	No Data	14.0
27/07/2009	No Data	11.9	16/07/2009	No Data	13.7
9/06/2009	No Data	10.4	7/08/2009	No Data	13.6
23/11/2008	No Data	10.2	15/06/2009	No Data	11.3
8/06/2009	No Data	9.7	19/01/2009	No Data	10.4
6/06/2009	8.6	9.6	29/06/2009	No Data	9.8
4/07/2009	No Data	9.6	3/07/2009	No Data	9.7
15/06/2009	No Data	9.2	1/07/2009	No Data	9.7
12/04/2009	8.3	9.2	8/06/2009	No Data	9.5

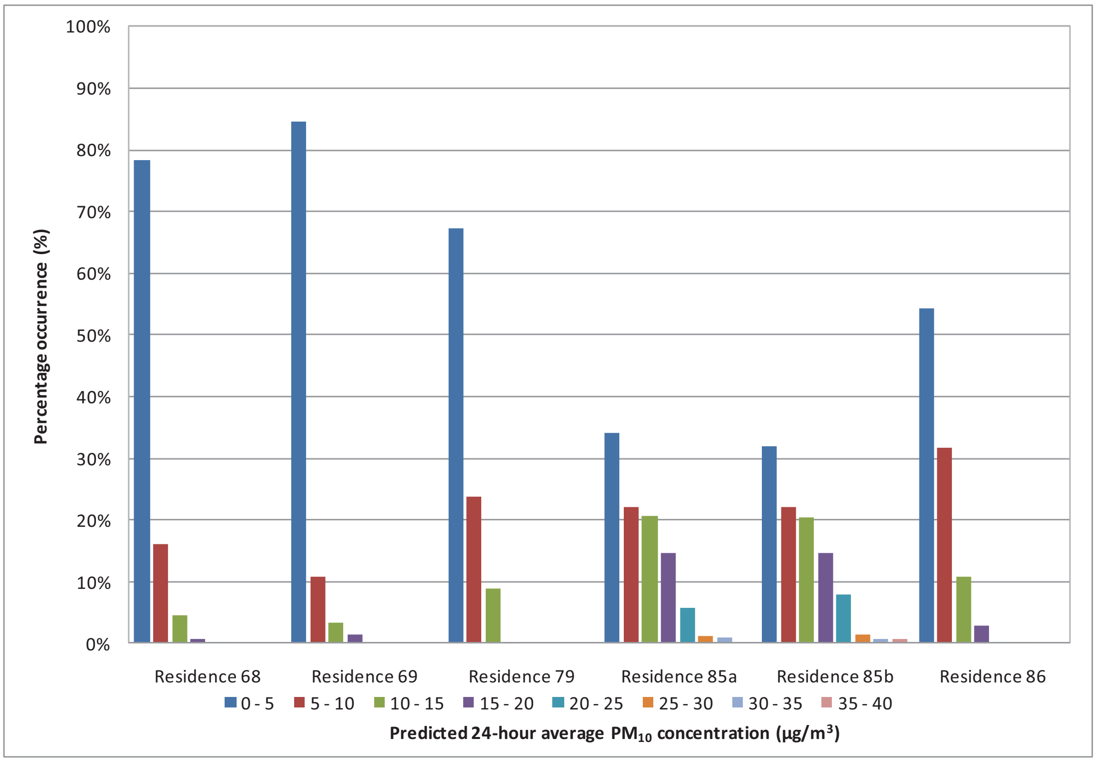
There were four residences (85, 85, 86 and 88) predicted to experience an exceedence of the 24-hour average PM_{10} concentration on 1 September 2008, with cumulative 24-hour average concentrations predicted to be greater than 50 µg/m^3. Residence 54 predicted an exceedence on 18 July 2009 with a predicted cumulative concentration of 53 µg/m^3, and due to double counting this may not be an actual exceedence.

A frequency distribution plot for the selected residences is shown in **Figure H.5** for residences 23 through 67, **Figure H.6** for residences 68 through 86 and **Figure H.7** for residences 88 to 153.



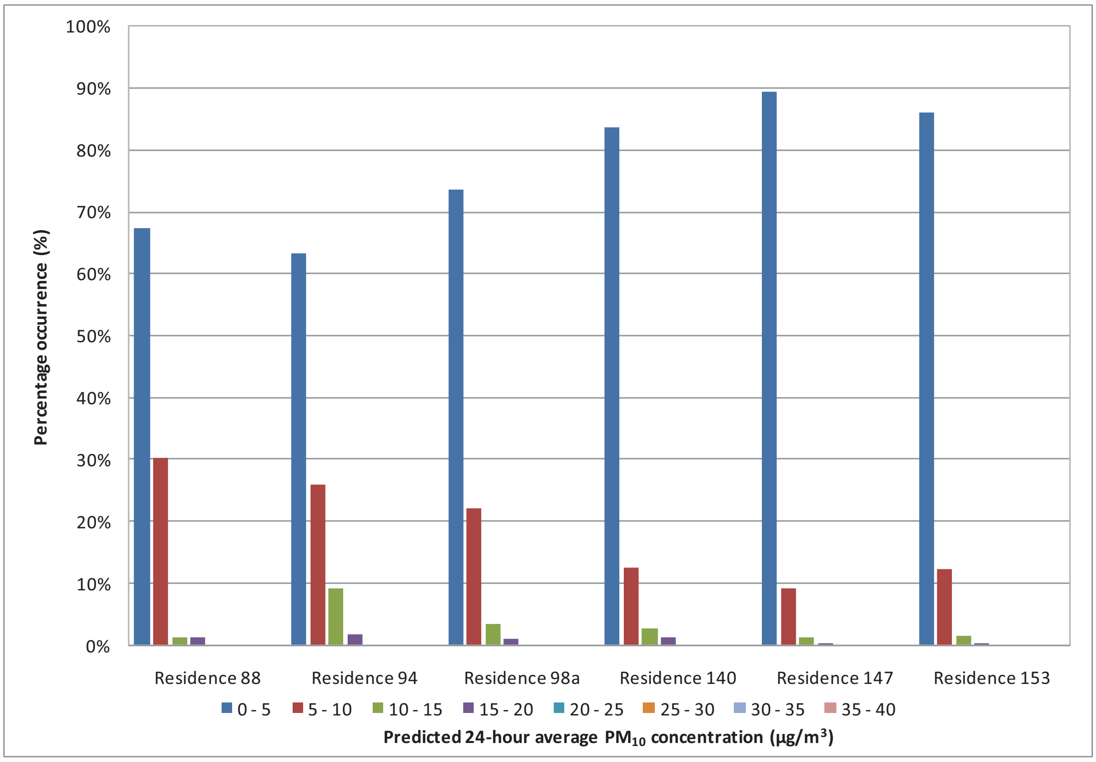
[a] – *This includes existing mine dust contributions that are (double-counted) in the background levels also.*

Figure H.5: Frequency distribution plot of dust levels for residences (23 to 67) predicted to experience greater than 15 µg/m³ for the Project alone [a] – Year 10



[a] – *This includes existing mine dust contributions that are (double-counted) in the background levels also.*

Figure H.6: Frequency distribution plot of dust levels for residences (68 to 86) predicted to experience greater than 15 µg/m³ for the Project alone [a] – Year 10



[a] – *This includes existing mine dust contributions that are (double-counted) in the background levels also.*

Figure H.7: Frequency distribution plot of dust levels for residences (88 to 153) predicted to experience greater than 15 µg/m³ for the Project alone [a] – Year 10

Year 21

For Year 21 there were 17 residences (35, 51, 54, 59, 63, 67, 68, 69, 79, 85, 85, 86, 88, 90, 94, 140 and 147) that were predicted to experience greater than 15 µg/m³ as a result of the project in isolation, and hence are at risk of potential exceedence as per the DECCW level 1 assessment method.

The highest ten 24-hour average PM_{10} HVAS measurements with the corresponding model predictions are presented in **Table H-7**.

Table H-7: Top ten HVAS concentration for modelling period with corresponding Project alone PM_{10} concentration ($\mu g/m^3$) – Year 21

Date	HVAS	35	51	54	59	63	67
1/09/2008	34.4	1.1	5.5	22.6	3.2	0.1	0.1
7/09/2008	30.3	0.3	1.9	3.0	4.1	0.8	0.0
13/09/2008	30.0	0.1	0.1	1.1	0.1	0.0	0.0
19/09/2008	28.1	0.9	2.0	0.4	0.3	0.2	0.2
25/09/2008	27.8	5.6	8.5	18.4	8.7	7.6	2.5
1/10/2008	26.0	0.7	4.7	4.9	4.6	5.1	1.3
7/10/2008	25.3	11.3	4.5	7.5	0.0	0.0	0.0
13/10/2008	25.3	1.4	11.6	16.6	1.1	1.2	5.2
19/10/2008	25.1	1.5	6.5	4.5	6.0	2.4	0.8
25/10/2008	21.2	5.3	1.7	6.7	2.1	3.6	2.5
Date	**HVAS**	**68**	**69**	**79**	**85a**	**85b**	**86**
1/09/2008	34.4	0.2	1.1	1.4	31.4	31.9	13.6
7/09/2008	30.3	0.0	0.0	0.4	1.8	3.4	0.3
13/09/2008	30.0	0.0	0.0	0.1	3.7	3.0	2.1
19/09/2008	28.1	0.3	0.3	2.4	0.4	0.4	0.4
25/09/2008	27.8	0.9	0.6	2.2	14.2	15.9	9.3
1/10/2008	26.0	1.2	1.3	4.0	8.5	8.0	3.7
7/10/2008	25.3	0.0	0.0	2.2	1.5	1.3	0.8
13/10/2008	25.3	5.1	1.4	5.6	11.4	10.4	5.5
19/10/2008	25.1	1.5	2.4	4.8	11.8	11.9	5.2
25/10/2008	21.2	1.6	1.2	1.0	7.4	6.4	4.4
Date	**HVAS**	**88**	**90**	**94**	**140**	**147**	
1/09/2008	34.4	9.6	2.4	7.7	0.0	0.0	
7/09/2008	30.3	1.7	0.8	2.9	0.0	0.8	
13/09/2008	30.0	1.1	0.1	0.1	0.0	0.0	
19/09/2008	28.1	0.3	2.1	0.7	0.1	0.1	
25/09/2008	27.8	7.6	3.8	8.0	5.5	5.5	
1/10/2008	26.0	2.6	4.0	3.1	1.6	3.8	
7/10/2008	25.3	0.1	3.1	5.1	0.0	0.0	
13/10/2008	25.3	3.5	8.6	16.2	1.1	0.6	
19/10/2008	25.1	5.0	6.3	7.4	0.6	2.0	
25/10/2008	21.2	2.4	1.1	2.1	3.5	1.9	

At residence 54 and 85 the cumulative 24-hour average PM_{10} concentration is predicted to exceed the criterion. The potential exceedence would occur on the 1 September 2008, the day of the highest HVAS 24-hour average PM_{10} concentration.

Table H-8 presents the top ten days of model predictions for the selected residences with corresponding background where available.

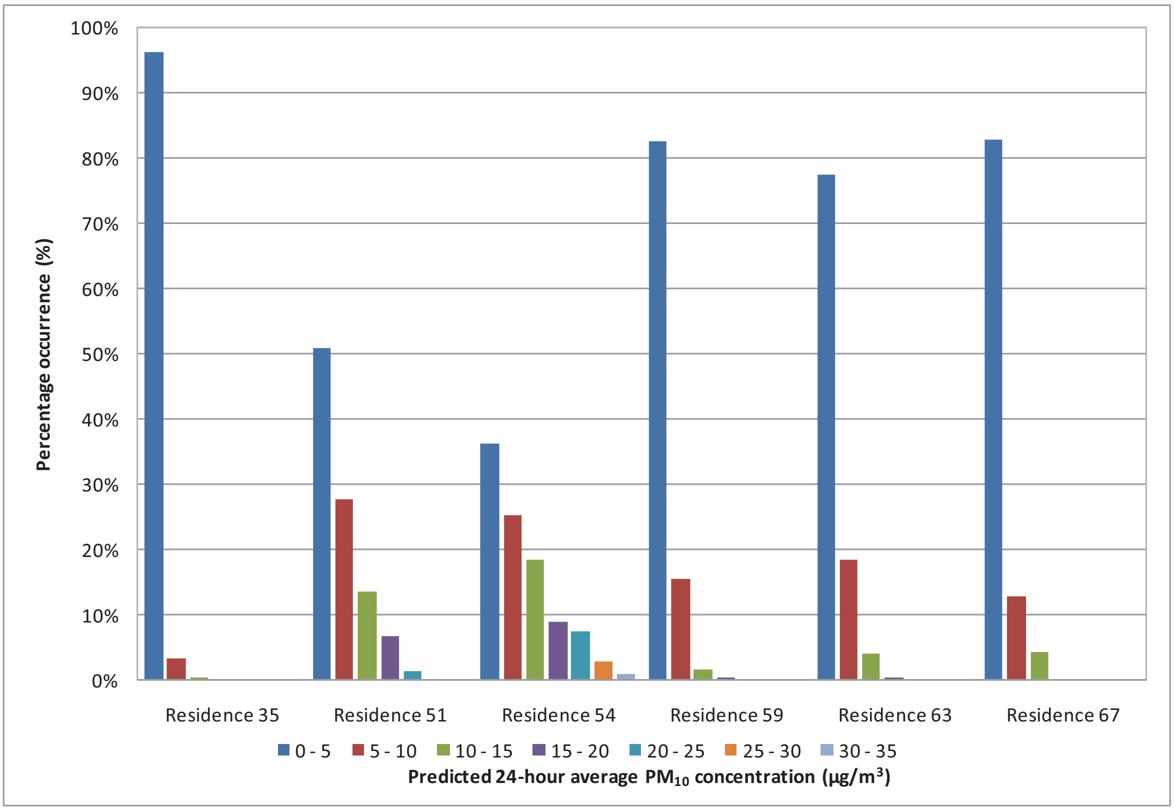
Table H-8: Top ten maximum 24-hour average PM_{10} concentration predictions with corresponding HVAS measurement (µg/m^3) – Year 21

	Residence 35			Residence 51	
Date	HVAS	Project alone	Date	HVAS	Project alone
18/11/2008	25.3	11.3	19/07/2009	No Data	22.1
17/10/2008	No Data	8.1	1/08/2009	No Data	21.3
4/11/2008	No Data	7.3	12/06/2009	10.3	20.8
8/12/2008	No Data	6.6	29/07/2009	No Data	20.6
20/03/2009	No Data	6.0	28/07/2009	No Data	19.4
22/12/2008	No Data	5.7	15/04/2009	No Data	19.3
10/07/2009	No Data	5.7	30/07/2009	18.4	18.9
12/12/2008	27.8	5.6	5/07/2009	No Data	18.0
23/02/2009	21.2	5.3	2/08/2009	No Data	17.2
28/01/2009	No Data	5.2	25/06/2009	No Data	17.1
	Residence 54			Residence 59	
Date	HVAS	Project alone	Date	HVAS	Project alone
10/09/2008	No Data	37.1	23/11/2008	No Data	15.3
18/07/2009	14.5	31.7	16/07/2009	No Data	12.0
11/09/2008	No Data	31.1	4/07/2009	No Data	11.7
28/07/2009	No Data	30.3	16/08/2009	15.8	11.6
6/06/2009	8.6	29.0	13/12/2008	No Data	10.5
6/11/2008	16.6	28.3	28/12/2008	No Data	10.3
25/07/2009	No Data	28.1	15/06/2009	No Data	10.0
19/07/2009	No Data	27.6	24/11/2008	11	9.5
15/09/2008	No Data	26.9	9/06/2009	No Data	9.2
15/04/2009	No Data	25.8	20/01/2009	No Data	8.8
	Residence 63			Residence 67	
Date	HVAS	Project alone	Date	HVAS	Project alone
16/07/2009	No Data	19.9	14/04/2009	No Data	15.0
8/06/2009	No Data	14.3	29/06/2009	No Data	14.2
9/06/2009	No Data	14.0	1/07/2009	No Data	14.1
27/07/2009	No Data	13.2	16/07/2009	No Data	12.7
23/11/2008	No Data	12.8	13/08/2009	No Data	12.5
15/06/2009	No Data	12.3	21/06/2009	No Data	11.7
14/12/2008	No Data	12.3	8/02/2009	No Data	11.6
7/08/2009	No Data	11.5	6/12/2008	19.4	11.5
4/07/2009	No Data	11.5	30/08/2009	No Data	11.0
13/08/2009	No Data	11.4	3/07/2009	No Data	11.0
	Residence 68			Residence 69	
Date	HVAS	Project alone	Date	HVAS	Project alone
14/04/2009	No Data	15.4	30/08/2009	No Data	13.4
30/08/2009	No Data	11.9	9/11/2008	No Data	12.5
29/06/2009	No Data	11.6	19/02/2009	No Data	10.8
1/07/2009	No Data	11.5	9/12/2008	No Data	9.4
23/07/2009	No Data	9.8	29/11/2008	No Data	9.1
26/04/2009	No Data	9.8	28/10/2008	No Data	8.7
3/07/2009	No Data	9.8	15/10/2008	No Data	8.5
9/11/2008	No Data	9.6	26/07/2009	No Data	8.0
31/08/2009	No Data	9.6	24/02/2009	No Data	7.8
21/06/2009	No Data	9.5	3/02/2009	No Data	7.8
	Residence 79			Residence 85a	
Date	HVAS	Project alone	Date	HVAS	Project alone
5/07/2009	No Data	31.7	1/09/2008	34.4	31.4
23/06/2009	No Data	30.0	10/09/2008	No Data	24.0
25/07/2009	No Data	29.0	2/09/2008	No Data	23.1
1/08/2009	No Data	28.9	30/11/2008	13.5	22.3
18/08/2009	No Data	28.6	7/09/2008	17.7	21.5
19/07/2009	No Data	27.2	2/12/2008	No Data	21.4
12/06/2009	10.3	26.9	12/10/2008	No Data	21.2
18/07/2009	14.5	26.3	11/09/2008	No Data	20.6
5/08/2009	No Data	25.5	26/03/2009	No Data	19.6
6/08/2009	No Data	25.4	24/01/2009	No Data	18.7
	Residence 85b			Residence 86	
Date	HVAS	Project alone	Date	HVAS	Project alone
1/09/2008	34.4	31.9	10/09/2008	No Data	18.4
12/10/2008	No Data	26.1	11/09/2008	No Data	15.9
10/09/2008	No Data	21.8	1/09/2008	34.4	13.6
2/12/2008	No Data	21.1	30/11/2008	13.5	13.5
30/11/2008	13.5	20.7	2/09/2008	No Data	13.3
2/09/2008	No Data	20.3	7/09/2008	17.7	12.7
27/06/2009	No Data	20.0	2/12/2008	No Data	12.1
26/03/2009	No Data	19.1	15/09/2008	No Data	12.1
7/09/2008	17.7	19.1	12/09/2008	No Data	9.5
28/12/2008	No Data	18.9	12/12/2008	27.8	9.3

Date	Residence 88 HVAS	Project alone	Date	Residence 90 HVAS	Project alone
12/10/2008	No Data	9.7	1/08/2009	No Data	17.7
1/09/2008	34.4	9.6	5/07/2009	No Data	17.7
28/12/2008	No Data	8.6	29/07/2009	No Data	17.0
26/10/2008	No Data	8.4	20/07/2009	No Data	16.6
24/11/2008	11	8.3	23/06/2009	No Data	16.0
30/11/2008	13.5	7.8	8/08/2009	No Data	15.6
12/12/2008	27.8	7.6	25/03/2009	13.5	14.9
2/12/2008	No Data	7.4	19/07/2009	No Data	14.7
16/08/2009	15.8	7.3	9/08/2009	No Data	14.6
23/11/2008	No Data	7.1	22/06/2009	No Data	14.5
Date	**Residence 94 HVAS**	**Project alone**	**Date**	**Residence 140 HVAS**	**Project alone**
5/07/2009	No Data	25.6	16/07/2009	No Data	15.5
25/07/2009	No Data	24.1	2/07/2009	No Data	12.5
1/08/2009	No Data	24.0	15/06/2009	No Data	11.5
19/07/2009	No Data	23.9	7/08/2009	No Data	11.1
23/06/2009	No Data	23.6	13/08/2009	No Data	10.9
12/06/2009	10.3	23.3	4/07/2009	No Data	10.3
18/07/2009	14.5	22.6	27/07/2009	No Data	10.2
18/08/2009	No Data	21.7	8/06/2009	No Data	9.7
25/06/2009	No Data	21.6	23/11/2008	No Data	9.1
5/08/2009	No Data	21.4	28/06/2009	No Data	8.5
Date	**Residence 147 HVAS**	**Project alone**			
16/07/2009	No Data	14.2			
27/07/2009	No Data	9.8			
14/12/2008	No Data	9.5			
23/11/2008	No Data	9.3			
4/07/2009	No Data	9.2			
15/06/2009	No Data	9.2			
9/06/2009	No Data	8.5			
8/06/2009	No Data	8.5			
28/06/2009	No Data	7.6			
6/07/2009	15.4	7.5			

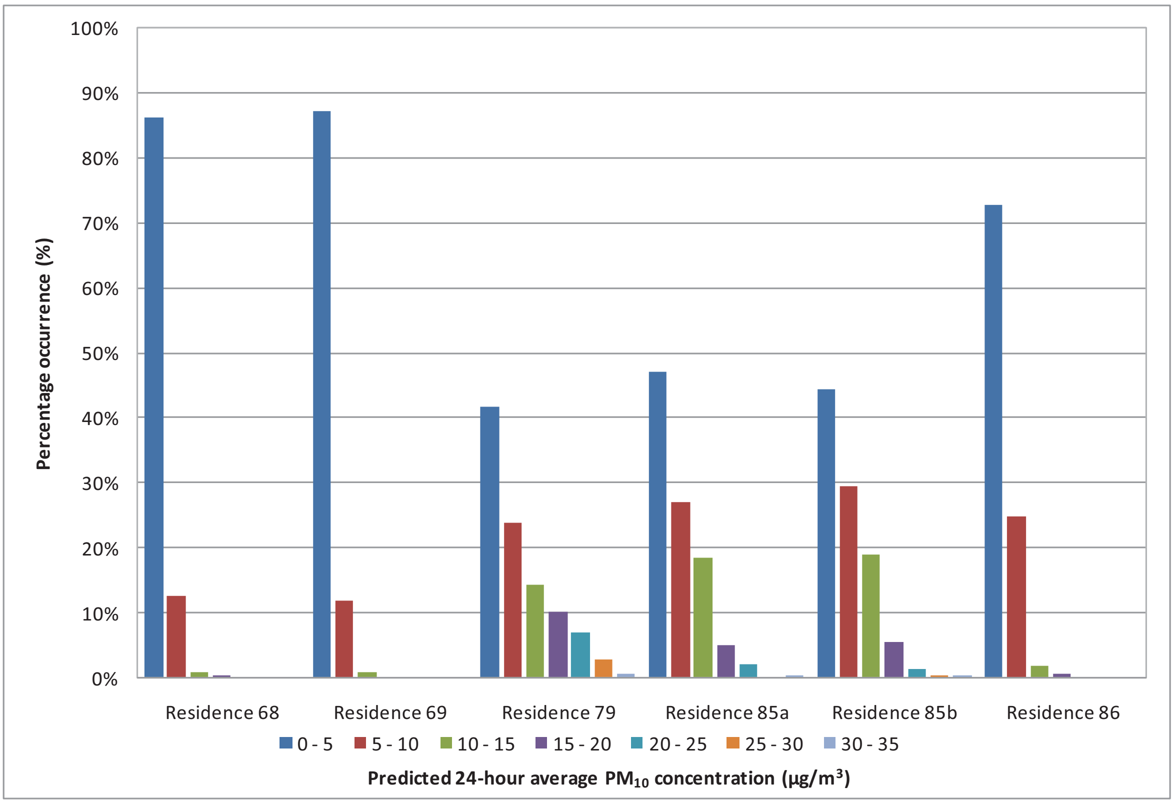
These results show that there is one residence (85) that is predicted to experience an exceedence on 1 September 2008, the day of the highest 24-hour average PM_{10} concentration.

A frequency distribution plot for the selected residences is shown in **Figure H.8** for residences 35 through 67, **Figure H.9** for residences 68 through 86 and **Figure H.10** for residences 88 through 147.



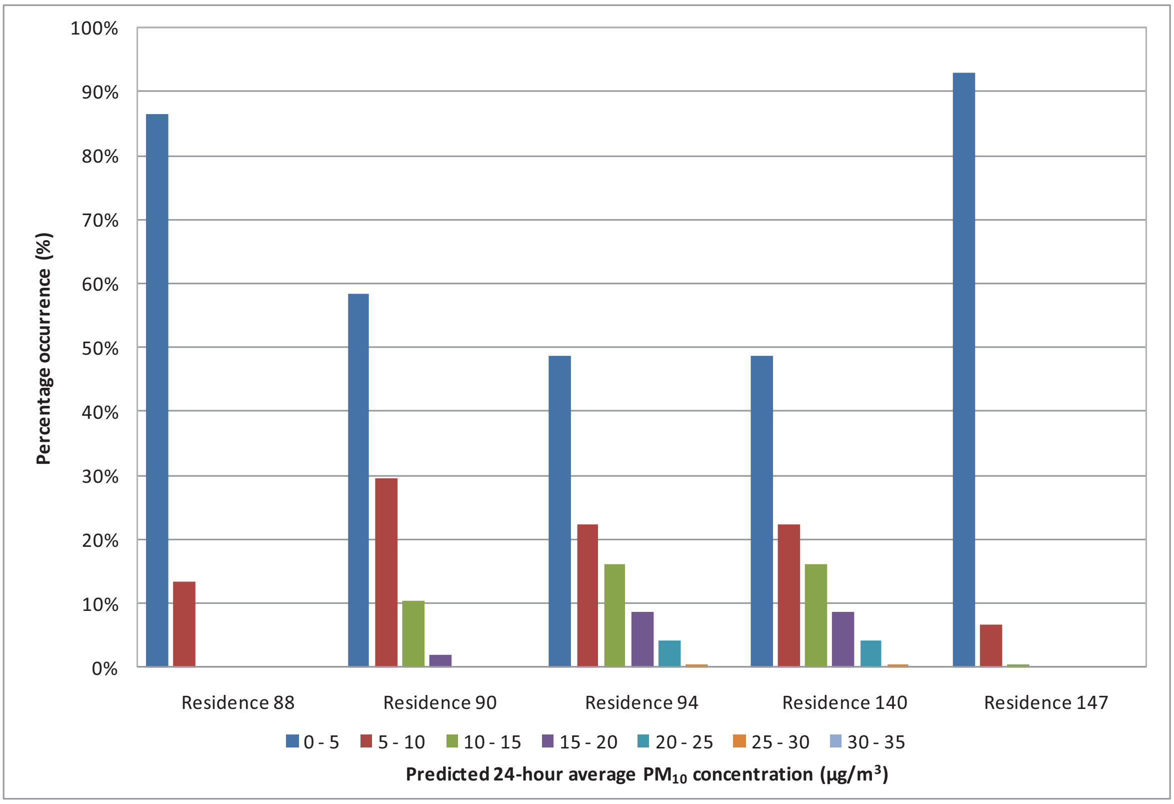
a – This includes existing mine dust contributions that are (double-counted) in the background levels also.

Figure H.8: Frequency distribution plot of dust levels for residences (35 to 67) predicted to experience greater than 15 µg/m^3 for the Project alone [a] – Year 21



a – This includes existing mine dust contributions that are (double-counted) in the background levels also.

Figure H.9: Frequency distribution plot of dust levels for residences (68 to 86) predicted to experience greater than 15 µg/m^3 for the Project alone [a] – Year 21



[a] – This includes existing mine dust contributions that are (double-counted) in the background levels also.

Figure H.10: Frequency distribution plot of dust levels for residences (88 to 147) predicted to experience greater than 15 µg/m³ for the Project alone [a] – Year 21

Year 5 (railspur scenario)

For Year 5 (railspur scenario) there were 19 residences (51, 54, 59, 63, 67, 68, 69, 79, 85a, 85b, 86, 88, 94, 98a, 98b, 100, 140, 147 and 153) that were predicted to experience greater than 15 µg/m^3 as a result of the project in isolation, and hence at risk of potential exceedence as per the DECCW level 1 assessment method.

The highest ten 24-hour average PM_{10} HVAS measurements with the corresponding model predictions are presented in **Table H-9**.

Table H-9: Top ten HVAS concentration for modelling period with corresponding Project alone PM_{10} concentration (µg/m³) – Year 5(train scenario)

Date	HVAS	51	54	59	63	67	68	69
1/09/2008	34.4	0.0	14.4	13.9	1.7	1.2	2.0	4.8
25/09/2008	30.3	0.0	4.8	7.8	0.3	0.0	0.0	0.0
18/04/2009	30	0.0	0.0	0.6	0.0	0.0	0.0	0.0
24/12/2008	28.1	3.3	2.1	0.5	0.5	0.6	0.7	0.7
12/12/2008	27.8	5.8	18.7	20.2	17.4	1.3	1.7	3.6
13/09/2008	26	2.6	7.3	6.9	7.5	2.3	2.3	2.0
18/11/2008	25.3	9.1	14.4	0.0	0.0	0.0	0.0	0.0
30/04/2009	25.3	1.4	29.0	5.6	4.7	6.3	4.2	5.3
19/03/2009	25.1	2.8	13.4	12.1	2.9	3.0	4.8	10.2
23/02/2009	21.2	1.2	4.1	5.2	9.8	3.0	3.7	7.5
Date	**HVAS**	**79**	**85a**	**85b**	**86**	**88**	**94**	**98a**
1/09/2008	34.4	0.1	38.8	43.4	22.8	25.4	0.3	15.2
25/09/2008	30.3	0.0	4.2	5.3	2.2	1.5	0.1	6.0
18/04/2009	30	0.0	2.4	2.5	1.9	2.9	0.0	0.7
24/12/2008	28.1	3.1	0.4	0.4	0.5	0.5	2.3	0.3
12/12/2008	27.8	1.5	21.2	24.2	19.1	16.3	1.4	12.2
13/09/2008	26	3.2	8.2	8.6	5.2	5.9	3.3	6.0
18/11/2008	25.3	1.9	9.4	9.7	6.1	1.7	1.9	0.0
30/04/2009	25.3	3.2	23.9	24.4	15.0	8.4	5.6	4.4
19/03/2009	25.1	3.0	9.1	9.5	5.7	8.1	4.7	10.8
23/02/2009	21.2	0.6	9.6	10.5	7.0	6.9	0.6	1.2
Date	**HVAS**	**98b**	**100**	**140**	**147**	**153**		
1/09/2008	34.4	17.3	1.8	0.0	0.0	0.0		
25/09/2008	30.3	4.2	6.3	0.0	0.6	0.0		
18/04/2009	30	2.3	0.0	0.0	0.0	0.0		
24/12/2008	28.1	0.3	0.2	0.1	0.1	0.1		
12/12/2008	27.8	10.7	5.8	5.8	8.5	3.6		
13/09/2008	26	5.9	3.6	1.2	5.4	0.9		
18/11/2008	25.3	0.0	0.0	0.0	0.0	0.0		
30/04/2009	25.3	6.6	0.5	3.4	0.5	3.7		
19/03/2009	25.1	11.5	7.3	0.6	2.2	0.6		
23/02/2009	21.2	3.4	0.7	4.8	2.7	3.1		

There are a total of six residences that are predicted to exceed 50 µg/m³ for the predicted cumulative 24-hour average PM_{10} concentration. These are predicted to occur on 1 September for residences 85a, 85b, 86, 88 and 98b, on 12 December 2008 for residence 85 and also on 30 April 2009 for residence 54.

Table H-10 presents the top ten days of model predictions for the selected residences with corresponding background, where available.

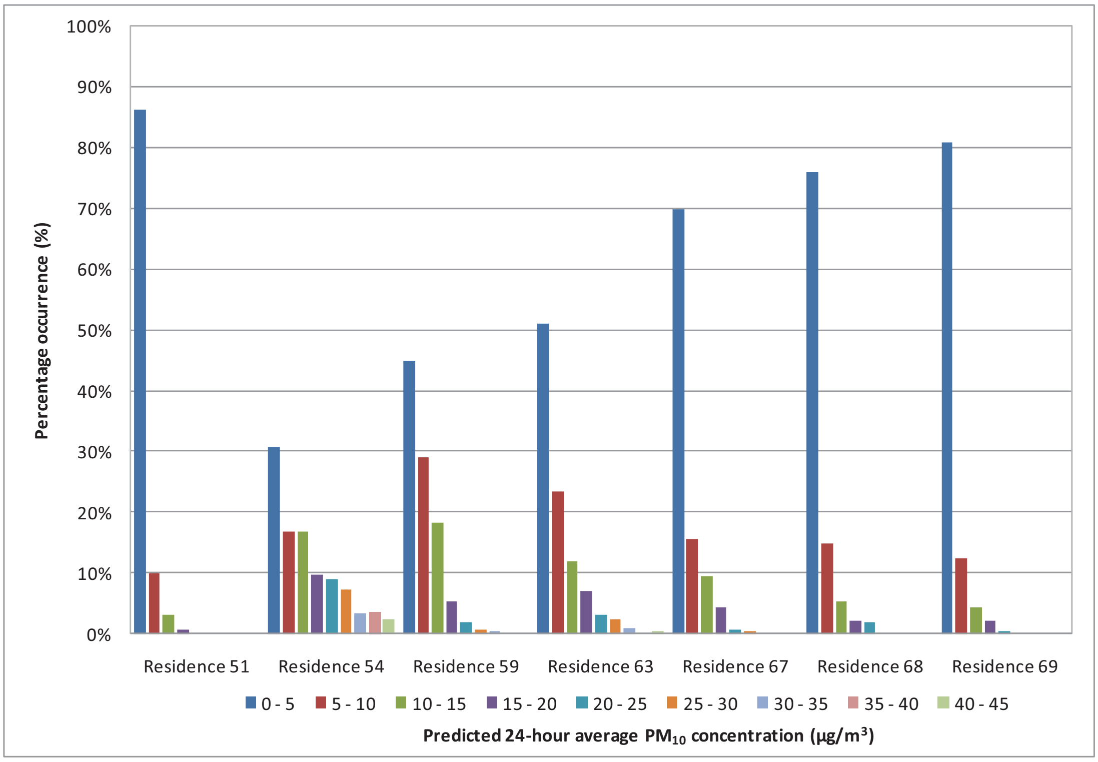
Table H-10: Top ten maximum 24-hour average PM_{10} concentration predictions with corresponding HVAS measurement (µg/m³) – Year 5 (railspur scenario)

Residence 51			Residence 54		
Date	**HVAS**	**Project alone**	**Date**	**HVAS**	**Project alone**
8/12/2008	No Data	16.6	1/08/2009	No Data	46.6
26/06/2009	No Data	16.5	19/07/2009	No Data	44.1
10/10/2008	No Data	13.1	18/07/2009	14.5	43.4
9/12/2008	No Data	12.7	5/07/2009	No Data	42.6
21/01/2009	No Data	12.1	25/07/2009	No Data	42.5
26/12/2008	No Data	11.6	28/07/2009	No Data	42.3
29/04/2009	No Data	11.5	12/06/2009	10.3	41.6
17/09/2008	No Data	11.4	15/04/2009	No Data	41.0
27/12/2008	No Data	11.0	23/06/2009	No Data	40.4
4/06/2009	No Data	10.4	25/06/2009	No Data	39.8
Residence 59			**Residence 63**		
Date	**HVAS**	**Project alone**	**Date**	**HVAS**	**Project alone**
23/11/2008	No Data	30.7	16/07/2009	No Data	41.9
4/07/2009	No Data	26.1	27/07/2009	No Data	34.9
16/07/2009	No Data	25.8	15/06/2009	No Data	32.2
28/12/2008	No Data	24.8	13/08/2009	No Data	30.7
16/08/2009	15.8	24.4	7/08/2009	No Data	29.1
24/11/2008	11	23.4	2/07/2009	No Data	29.0
15/06/2009	No Data	22.8	8/06/2009	No Data	28.8
12/10/2008	No Data	22.6	23/11/2008	No Data	28.7
12/12/2008	27.8	20.2	4/07/2009	No Data	27.3
26/10/2008	No Data	19.8	14/12/2008	No Data	27.1
Residence 67			**Residence 68**		
Date	**HVAS**	**Project alone**	**Date**	**HVAS**	**Project alone**
30/08/2009	No Data	25.6	9/11/2008	No Data	24.9
9/11/2008	No Data	24.3	30/08/2009	No Data	22.4
14/04/2009	No Data	22.7	26/07/2009	No Data	21.9
21/06/2009	No Data	18.8	11/01/2009	No Data	21.3
3/02/2009	No Data	18.1	21/06/2009	No Data	21.3
29/11/2008	No Data	17.3	19/02/2009	No Data	21.0
3/07/2009	No Data	16.5	27/06/2009	No Data	18.1
5/03/2009	No Data	16.5	9/12/2008	No Data	17.6
29/10/2008	No Data	16.3	11/04/2009	No Data	16.3
9/12/2008	No Data	16.0	24/02/2009	No Data	15.9
Residence 69			**Residence 79**		
Date	**HVAS**	**Project alone**	**Date**	**HVAS**	**Project alone**
21/06/2009	No Data	24.7	8/08/2009	No Data	15.7
15/12/2008	No Data	18.9	7/11/2008	No Data	13.1
15/04/2009	No Data	17.4	23/01/2009	No Data	12.5
31/07/2009	No Data	16.7	18/08/2009	No Data	12.1
11/07/2009	No Data	16.4	8/09/2008	No Data	11.9
27/06/2009	No Data	15.5	17/09/2008	No Data	11.9
9/11/2008	No Data	15.2	10/10/2008	No Data	11.2
24/02/2009	No Data	15.2	25/03/2009	13.5	10.6
16/04/2009	No Data	14.8	28/10/2008	No Data	10.5
11/06/2009	No Data	14.8	3/06/2009	No Data	10.3
Residence 85b			**Residence 85b**		
Date	**HVAS**	**Project alone**	**Date**	**HVAS**	**Project alone**
10/09/2008	No Data	46.9	10/09/2008	No Data	50.9
18/07/2009	14.5	40.1	1/09/2008	34.4	43.4
1/09/2008	34.4	38.8	18/07/2009	14.5	42.0
11/09/2008	No Data	38.3	11/09/2008	No Data	41.4
25/07/2009	No Data	36.4	2/09/2008	No Data	39.0
2/09/2008	No Data	35.7	25/07/2009	No Data	38.2
28/07/2009	No Data	35.0	15/09/2008	No Data	37.3
15/09/2008	No Data	34.1	28/07/2009	No Data	36.5
6/11/2008	16.6	34.0	6/11/2008	16.6	36.1
19/07/2009	No Data	32.4	15/08/2009	No Data	33.6
Residence 86			**Residence 88**		
Date	**HVAS**	**Project alone**	**Date**	**HVAS**	**Project alone**
10/09/2008	No Data	36.0	10/09/2008	No Data	31.9
11/09/2008	No Data	30.3	11/09/2008	No Data	26.7
19/07/2009	No Data	29.3	1/09/2008	34.4	25.4
28/07/2009	No Data	29.2	2/09/2008	No Data	23.2
18/07/2009	14.5	28.7	30/11/2008	13.5	21.8
6/06/2009	8.6	28.5	2/12/2008	No Data	21.5
15/09/2008	No Data	27.1	15/09/2008	No Data	21.3
15/04/2009	No Data	25.3	7/09/2008	17.7	20.1
6/11/2008	16.6	24.6	12/12/2008	27.8	16.3
19/08/2009	No Data	24.4	12/09/2008	No Data	16.1

	Residence 94			Residence 98a	
Date	HVAS	Project alone	Date	HVAS	Project alone
8/08/2009	No Data	15.6	12/10/2008	No Data	23.2
5/07/2009	No Data	15.0	16/08/2009	15.8	20.8
1/08/2009	No Data	13.9	28/12/2008	No Data	20.3
29/07/2009	No Data	13.1	23/11/2008	No Data	18.8
20/07/2009	No Data	13.1	26/10/2008	No Data	17.9
23/06/2009	No Data	13.0	21/07/2009	No Data	17.2
3/10/2008	No Data	12.7	4/07/2009	No Data	16.0
25/03/2009	13.5	12.5	24/11/2008	11	15.3
7/11/2008	No Data	12.3	1/09/2008	34.4	15.2
28/10/2008	No Data	12.3	12/07/2009	7.6	14.0
	Residence 98b			Residence 100	
Date	HVAS	Project alone	Date	HVAS	Project alone
12/10/2008	No Data	18.9	16/08/2009	15.8	14.7
1/09/2008	34.4	17.3	7/07/2009	No Data	14.5
28/12/2008	No Data	16.1	23/11/2008	No Data	14.0
26/10/2008	No Data	15.3	13/12/2008	No Data	13.8
24/11/2008	11	14.7	4/07/2009	No Data	11.7
24/01/2009	No Data	14.2	28/12/2008	No Data	11.3
21/07/2009	No Data	14.1	20/01/2009	No Data	10.9
16/08/2009	15.8	13.4	21/07/2009	No Data	10.8
23/11/2008	No Data	13.0	12/04/2009	8.3	10.6
30/11/2008	13.5	12.8	5/06/2009	No Data	10.2
	Residence 140			Residence 147	
Date	HVAS	Project alone	Date	HVAS	Project alone
13/08/2009	No Data	19.1	16/07/2009	No Data	19.9
2/07/2009	No Data	18.4	27/07/2009	No Data	16.8
16/07/2009	No Data	17.5	14/12/2008	No Data	16.3
7/08/2009	No Data	17.3	23/11/2008	No Data	14.1
29/06/2009	No Data	15.0	4/07/2009	No Data	13.0
1/07/2009	No Data	14.3	15/06/2009	No Data	12.8
19/01/2009	No Data	14.2	8/06/2009	No Data	11.6
15/06/2009	No Data	13.6	9/06/2009	No Data	11.6
6/12/2008	19.4	13.6	6/07/2009	15.4	11.5
8/02/2009	No Data	13.4	12/04/2009	8.3	10.5
	Residence 153				
Date	HVAS	Project alone			
13/08/2009	No Data	15.6			
2/07/2009	No Data	14.8			
16/07/2009	No Data	14.2			
29/06/2009	No Data	14.0			
7/08/2009	No Data	13.5			
1/07/2009	No Data	13.4			
19/01/2009	No Data	13.3			
6/12/2008	19.4	12.6			
8/02/2009	No Data	12.4			
24/06/2009	10	11.1			

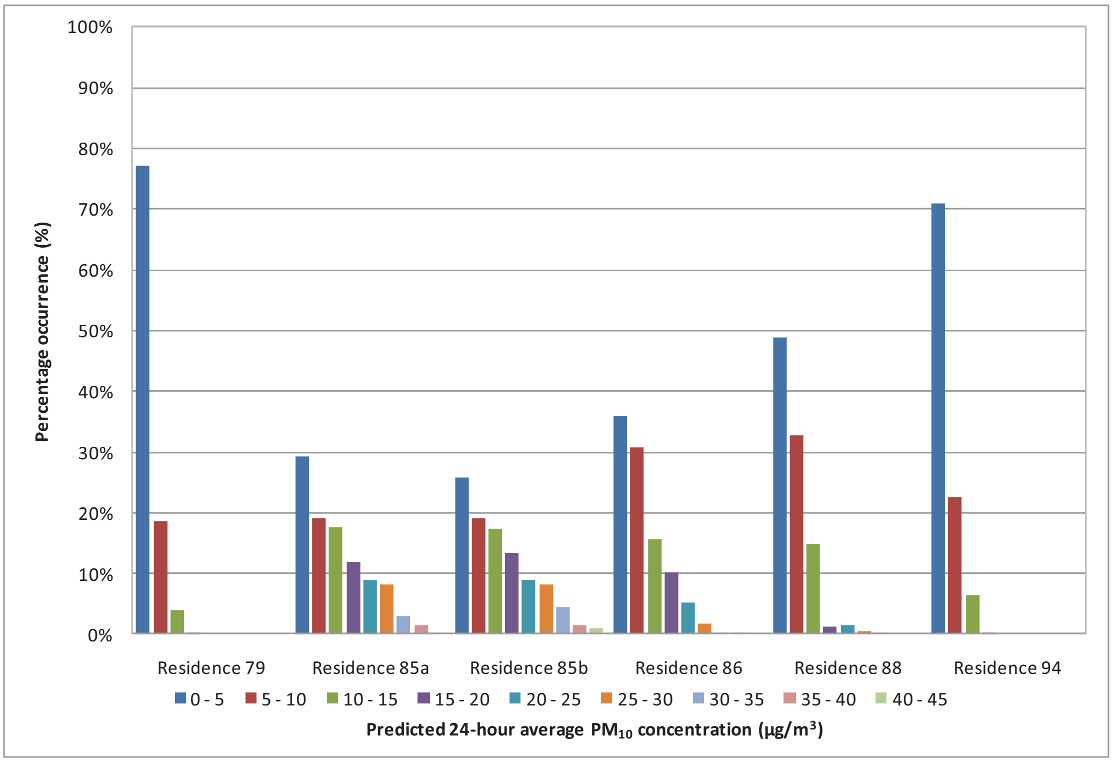
The cumulative 24-hour average PM_{10} concentration is predicted to have exceeded 50 µg/m3 at several residences for the Year 5 rail spur scenario. For residence 54, this was predicted to be on two occasions, on 12 June 2009 and 18 July 2009. For the two residences at 85 this was predicted to occur on 1 September 2008, 18 July 2009 and 6 November 2008. Also predicted to exceed the criterion on 1 September 2008 are residences 88 and 98b.

A frequency distribution plot for the selected residences is shown in **Figure H.11** for residences 51 through 69, **Figure H.12** for residences 79 through 94 and **Figure H.13** for residences 98 through 153.



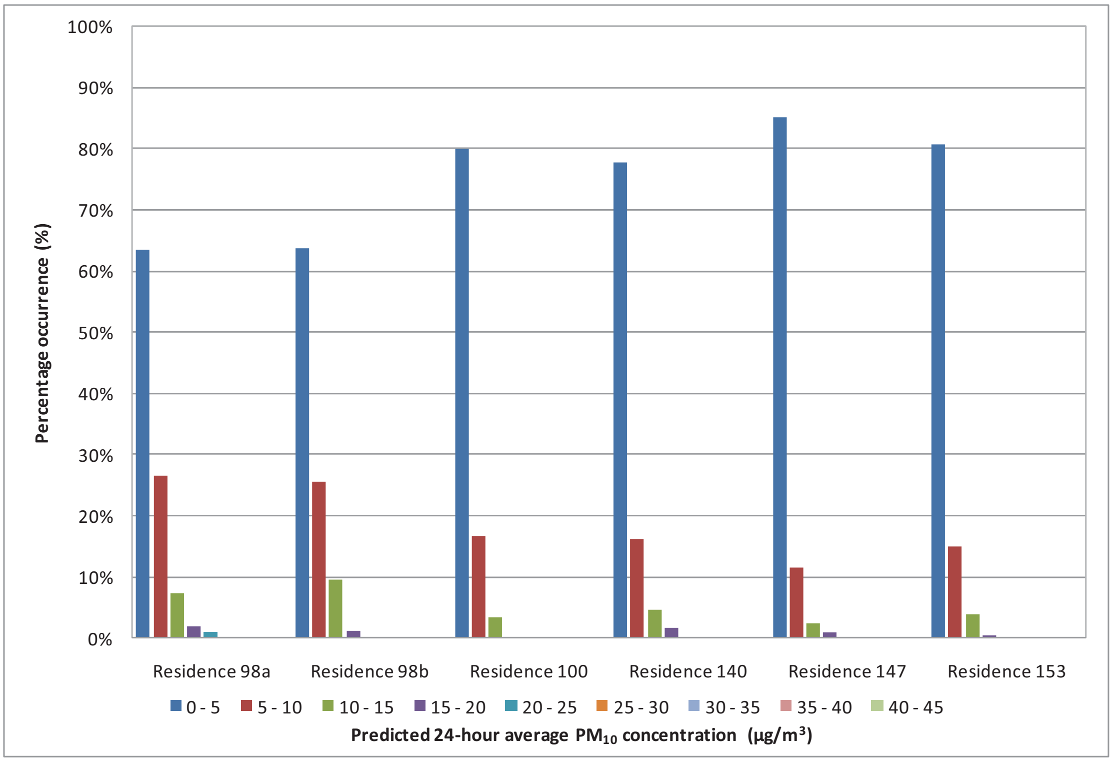
[a] – *This includes existing mine dust contributions that are (double-counted) in the background levels also.*

Figure H.11: Frequency distribution plot of dust levels for residences (51 to 69) predicted to experience greater than 15 µg/m³ for the Project alone [a] – Year 5 (rail spur scenario)



[a] – *This includes existing mine dust contributions that are (double-counted) in the background levels also.*

Figure H.12: Frequency distribution plot of dust levels for residences (79 to 94) predicted to experience greater than 15 µg/m³ for the Project alone [a] – Year 5 (rail spur scenario)



[a] – *This includes existing mine dust contributions that are (double-counted) in the background levels also.*

Figure H.13: Frequency distribution plot of dust levels for residences (98 to 153) predicted to experience greater than 15 µg/m³ for the Project alone [a] – Year 5 (rail spur scenario)

Appendix I: Supporting data for additional probability residence analysis for cumulative 24-hour assessment

Table I.1: Probability of cumulative concentration greater than 50 μg/m³ – Boggabri HVAS data

ID	Year	Boggabri HVAS Probability >40 μg/m³ (%)	Residence Probability >10 μg/m³ (%)	Cumulative Probability (%)	Boggabri HVAS Probability >30 μg/m³ (%)	Residence Probability >20 μg/m³ (%)	Cumulative Probability (%)	Boggabri HVAS Probability >20 μg/m³ (%)	Residence Probability >30 μg/m³ (%)	Cumulative Probability (%)	Boggabri HVAS Probability >10 μg/m³ (%)	Residence Probability >40 μg/m³ (%)	Cumulative Probability (%)
R2	Y21	5.2	0.0	0.0	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R3	Y21	5.2	0.0	0.0	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R4	Y21	5.2	0.0	0.0	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R18	Y21	5.2	0.0	0.0	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R23	Y10	5.2	1.0	0.1	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R27	Y5	5.2	1.0	0.1	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R32	Y21	5.2	0.0	0.0	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R33	Y5	5.2	1.0	0.1	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R35	y5	5.2	1.0	0.1	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R35	Y21	5.2	1.0	0.1	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R43	Y21	5.2	1.0	0.1	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R44	y5	5.2	1.0	0.1	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R44	y10	5.2	1.0	0.1	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R51	Y21	5.2	41.0	2.1	12.0	13.0	1.6	30.0	1.0	0.3	63.5	0.0	0.0
R54	Y10	5.2	55.0	2.8	12.0	28.0	3.4	30.0	16.0	4.8	63.5	5.0	3.2
R54	Y21	5.2	55.0	2.8	12.0	25.0	3.0	30.0	12.0	3.6	63.5	2.0	1.3
R59	Y5T	5.2	26.0	1.3	12.0	3.0	0.4	30.0	1.0	0.3	63.5	0.0	0.0
R63	Y5	5.2	31.0	1.6	12.0	11.0	1.3	30.0	5.0	1.5	63.5	1.0	0.6
R63	Y5T	5.2	31.0	1.6	12.0	11.0	1.3	30.0	5.0	1.5	63.5	1.0	0.6
R67	y5	5.2	17.0	0.9	12.0	1.0	0.1	30.0	0.0	0.0	63.5	0.0	0.0
R68	y5	5.2	10.0	0.5	12.0	2.0	0.2	30.0	0.0	0.0	63.5	0.0	0.0
R68	y5T	5.2	11.0	0.6	12.0	2.0	0.2	30.0	0.0	0.0	63.5	0.0	0.0
R69	y5	5.2	6.0	0.3	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R69	y5T	5.2	6.0	0.3	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R79	y10	5.2	9.0	0.5	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R85a	y5	5.2	54.0	2.8	12.0	23.0	2.8	30.0	6.0	1.8	63.5	1.0	0.6
R85a	y5T	5.2	51.0	2.7	12.0	23.0	2.8	30.0	6.0	1.8	63.5	1.0	0.6
R85b	y5T	5.2	55.0	2.8	12.0	24.0	2.9	30.0	7.0	2.1	63.5	1.0	0.6
R86	y5	5.2	44.0	2.3	12.0	15.0	1.8	30.0	2.0	0.6	63.5	0.0	0.0
R86	y5T	5.2	43.0	2.2	12.0	15.0	1.8	30.0	2.0	0.6	63.5	0.0	0.0
R88	y5	5.2	29.0	1.5	12.0	3.0	0.4	30.0	1.0	0.3	63.5	0.0	0.0
R88	y5T	5.2	55.0	2.8	12.0	24.0	2.9	30.0	7.0	2.1	63.5	1.0	0.6
R90	Y10	5.2	1.0	0.1	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R94	Y21	5.2	30.0	1.5	12.0	5.0	0.6	30.0	0.0	0.0	63.5	0.0	0.0
R98a	y5	5.2	10.0	0.5	12.0	1.0	0.1	30.0	0.0	0.0	63.5	0.0	0.0
R98a	y5T	5.2	10.0	0.5	12.0	1.0	0.1	30.0	0.0	0.0	63.5	0.0	0.0
R98b	y5	5.2	11.0	0.6	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R98b	y5T	5.2	11.0	0.6	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R100	y5	5.2	4.0	0.2	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R100	y5T	5.2	3.0	0.2	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R115	Y21	5.2	0.0	0.0	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R140	y5	5.2	6.0	0.3	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R140	Y5T	5.2	6.0	0.3	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R147	y5	5.2	3.0	0.2	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R147	Y5T	5.2	3.0	0.2	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R148	y5	5.2	2.0	0.1	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R153	y5	5.2	4.0	0.2	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R153	Y5T	5.2	4.0	0.2	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R153	Y10	5.2	2.0	0.1	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R155	y5	5.2	1.0	0.1	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0
R155	Y5T	5.2	1.0	0.1	12.0	0.0	0.0	30.0	0.0	0.0	63.5	0.0	0.0

Table I.2: Probability of cumulative concentration greater than 50 $\mu g/m^3$ – Tarrawonga HVAS data

ID	Year	Tarrawonga HVAS	Residence		Tarrawonga HVAS	Residence		Tarrawonga HVAS	Residence		Tarrawonga HVAS	Residence	
		Probability >40 $\mu g/m^3$ (%)	*Probability >10 $\mu g/m^3$ (%)*	Cumulative Probability (%)	*Probability >30 $\mu g/m^3$ (%)*	*Probability >20 $\mu g/m^3$ (%)*	Cumulative Probability (%)	*Probability >20 $\mu g/m^3$ (%)*	*Probability >30 $\mu g/m^3$ (%)*	Cumulative Probability (%)	*Probability >10 $\mu g/m^3$ (%)*	*Probability >40 $\mu g/m^3$ (%)*	Cumulative Probability (%)
R2	Y21	6.5	0.0	0.0	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R3	Y21	6.5	0.0	0.0	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R4	Y21	6.5	0.0	0.0	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R18	Y21	6.5	0.0	0.0	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R23	Y10	6.5	1.0	0.1	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R27	Y5	6.5	1.0	0.1	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R32	Y21	6.5	0.0	0.0	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R33	Y5	6.5	1.0	0.1	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R35	y5	6.5	1.0	0.1	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R35	Y21	6.5	1.0	0.1	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R43	Y21	6.5	1.0	0.1	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R44	y5	6.5	1.0	0.1	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R44	y10	6.5	1.0	0.1	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R51	Y21	6.5	41.0	2.6	18.3	13.0	2.4	34.4	1.0	0.3	68.8	0.0	0.0
R54	Y10	6.5	55.0	3.5	18.3	28.0	5.1	34.4	16.0	5.5	68.8	5.0	3.4
R54	Y21	6.5	55.0	3.5	18.3	25.0	4.6	34.4	12.0	4.1	68.8	2.0	1.4
R59	Y5T	6.5	26.0	1.7	18.3	3.0	0.5	34.4	1.0	0.3	68.8	0.0	0.0
R63	Y5	6.5	31.0	2.0	18.3	11.0	2.0	34.4	5.0	1.7	68.8	1.0	0.7
R63	Y5T	6.5	31.0	2.0	18.3	11.0	2.0	34.4	5.0	1.7	68.8	1.0	0.7
R67	y5	6.5	17.0	1.1	18.3	1.0	0.2	34.4	0.0	0.0	68.8	0.0	0.0
R68	y5	6.5	10.0	0.6	18.3	2.0	0.4	34.4	0.0	0.0	68.8	0.0	0.0
R68	y5T	6.5	11.0	0.7	18.3	2.0	0.4	34.4	0.0	0.0	68.8	0.0	0.0
R69	y5	6.5	6.0	0.4	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R69	y5T	6.5	6.0	0.4	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R79	y10	6.5	9.0	0.6	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R85a	y5	6.5	54.0	3.5	18.3	23.0	4.2	34.4	6.0	2.1	68.8	1.0	0.7
R85a	y5T	6.5	52.0	3.4	18.3	23.0	4.2	34.4	6.0	2.1	68.8	1.0	0.7
R85b	y5T	6.5	55.0	3.5	18.3	24.0	4.4	34.4	7.0	2.4	68.8	1.0	0.7
R86	y5	6.5	44.0	2.8	18.3	15.0	2.7	34.4	2.0	0.7	68.8	0.0	0.0
R86	y5T	6.5	43.0	2.8	18.3	15.0	2.7	34.4	2.0	0.7	68.8	0.0	0.0
R88	y5	6.5	29.0	1.9	18.3	3.0	0.5	34.4	1.0	0.3	68.8	0.0	0.0
R88	y5T	6.5	55.0	3.5	18.3	24.0	4.4	34.4	7.0	2.4	68.8	1.0	0.7
R90	Y10	6.5	1.0	0.1	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R94	Y21	6.5	30.0	1.9	18.3	5.0	0.9	34.4	0.0	0.0	68.8	0.0	0.0
R98a	y5	6.5	10.0	0.6	18.3	1.0	0.2	34.4	0.0	0.0	68.8	0.0	0.0
R98a	y5T	6.5	10.0	0.6	18.3	1.0	0.2	34.4	0.0	0.0	68.8	0.0	0.0
R98b	y5	6.5	11.0	0.7	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R98b	y5T	6.5	11.0	0.7	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R100	y5	6.5	4.0	0.3	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R100	y5T	6.5	3.0	0.2	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R115	Y21	6.5	0.0	0.0	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R140	y5	6.5	6.0	0.4	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R140	Y5T	6.5	6.0	0.4	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R147	y5	6.5	3.0	0.2	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R147	Y5T	6.5	3.0	0.2	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R148	y5	6.5	2.0	0.1	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R153	y5	6.5	4.0	0.3	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R153	Y5T	6.5	4.0	0.3	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R153	Y10	6.5	2.0	0.1	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R155	y5	6.5	1.0	0.1	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0
R155	Y5T	6.5	1.0	0.1	18.3	0.0	0.0	34.4	0.0	0.0	68.8	0.0	0.0

The following tables present an analysis of the predicted 24-hour PM_{10} concentrations at each of the residences for the year in which the maximum concentration was predicted to occur. The analysis shows the percentage occurrence of the predicted impacts for selected concentration ranges.

Residence ID	R2	R3	R4	R18	R23
Year	Year 21	Year 21	Year 21	Year 21	Year 10
Concentration (µg/m³)	Percentage occurrence				
0	10.33%	10.03%	8.21%	3.04%	0.91%
0 - 10	89.67%	89.97%	91.79%	96.96%	98.18%
10 - 20	0.00%	0.00%	0.00%	0.00%	0.91%
20 -30	0.00%	0.00%	0.00%	0.00%	0.00%
30 - 40	0.00%	0.00%	0.00%	0.00%	0.00%
40-50	0.00%	0.00%	0.00%	0.00%	0.00%
>50	0.00%	0.00%	0.00%	0.00%	0.00%

Residence ID	R27	R32	R33	R35	R35
Year	Year 5	Year 21	Year 5	Year 5	Year 21
Concentration (µg/m³)	Percentage occurrence				
0	0.91%	1.22%	2.74%	0.30%	0.30%
0 - 10	98.48%	98.48%	96.66%	98.48%	98.78%
10 - 20	0.61%	0.30%	0.61%	1.22%	0.91%
20 -30	0.00%	0.00%	0.00%	0.00%	0.00%
30 - 40	0.00%	0.00%	0.00%	0.00%	0.00%
40-50	0.00%	0.00%	0.00%	0.00%	0.00%
>50	0.00%	0.00%	0.00%	0.00%	0.00%

Residence ID	R43	R44	R44	R51	R54
Year	Year 21	Year 5	Year 10	Year 21	Year 10
Concentration (µg/m³)	Percentage occurrence				
0	1.22%	1.22%	1.52%	5.78%	6.08%
0 - 10	98.18%	98.18%	97.87%	52.89%	39.51%
10 - 20	0.61%	0.61%	0.61%	27.66%	27.36%
20 -30	0.00%	0.00%	0.00%	12.46%	11.85%
30 - 40	0.00%	0.00%	0.00%	1.22%	10.64%
40-50	0.00%	0.00%	0.00%	0.00%	3.95%
>50	0.00%	0.00%	0.00%	0.00%	0.61%

Residence ID	R54	R59	R63	R63	R67
Year	Year 21	Year 5 (Rail spur)	Year 5	Year 5 (Rail spur)	Year 5
Concentration ($\mu g/m^3$)	Percentage occurrence				
0	7.90%	9.73%	11.85%	11.85%	14.59%
0 - 10	36.47%	64.44%	58.05%	57.45%	68.39%
10 - 20	30.40%	22.80%	19.76%	20.36%	15.81%
20 -30	13.07%	2.13%	6.08%	6.08%	0.91%
30 - 40	10.03%	0.91%	3.65%	3.65%	0.30%
40-50	1.82%	0.00%	0.61%	0.61%	0.00%
>50	0.30%	0.00%	0.00%	0.00%	0.00%

Residence ID	R68	R68	R69	R69	R79
Year	Year 5	Year 5 (Rail spur)	Year 5	Year 5 (Rail spur)	Year 10
Concentration ($\mu g/m^3$)	Percentage occurrence				
0	13.07%	13.07%	12.16%	12.16%	6.08%
0 - 10	76.60%	76.60%	81.16%	81.16%	84.80%
10 - 20	8.21%	8.51%	6.38%	6.38%	9.12%
20 -30	2.13%	1.82%	0.30%	0.30%	0.00%
30 - 40	0.00%	0.00%	0.00%	0.00%	0.00%
40-50	0.00%	0.00%	0.00%	0.00%	0.00%
>50	0.00%	0.00%	0.00%	0.00%	0.00%

Residence ID	R85a	R85a	R85b	R86	R86
Year	Year 5	Year 5 (Rail spur)	Year 5 (Rail spur)	Year 5	Year 5 (Rail spur)
Concentration ($\mu g/m^3$)	Percentage occurrence				
0	8.21%	9.73%	9.73%	8.51%	10.33%
0 - 10	38.91%	38.60%	35.26%	47.72%	47.72%
10 - 20	30.70%	29.48%	30.70%	29.48%	27.66%
20 -30	17.02%	17.02%	17.02%	12.77%	12.77%
30 - 40	4.56%	4.56%	6.08%	1.52%	1.52%
40-50	0.61%	0.61%	0.91%	0.00%	0.00%
>50	0.00%	0.00%	0.30%	0.00%	0.00%

Residence ID	R88	R88	R90	R94	R98a
Year	Year 5	Year 5 (Rail spur)	Year 10	Year 5	Year 5
Concentration (μg/m³)	Percentage occurrence				
0	8.51%	9.73%	5.78%	8.21%	9.12%
0 - 10	62.92%	35.26%	93.62%	62.61%	80.85%
10 - 20	25.84%	30.70%	0.61%	24.62%	9.12%
20 -30	1.52%	17.02%	0.00%	4.56%	0.91%
30 - 40	1.22%	6.08%	0.00%	0.00%	0.00%
40-50	0.00%	0.91%	0.00%	0.00%	0.00%
>50	0.00%	0.30%	0.00%	0.00%	0.00%

Residence ID	R98a	R98b	R98b	R100	R100
Year	Year 5 (Rail spur)	Year 5	Year 5 (Rail spur)	Year 5	Year 5 (Rail spur)
Concentration (μg/m³)	Percentage occurrence				
0	10.94%	9.12%	10.94%	10.03%	11.25%
0 - 10	79.03%	79.64%	78.42%	86.32%	85.41%
10 - 20	9.12%	11.25%	10.64%	3.65%	3.34%
20 -30	0.91%	0.00%	0.00%	0.00%	0.00%
30 - 40	0.00%	0.00%	0.00%	0.00%	0.00%
40-50	0.00%	0.00%	0.00%	0.00%	0.00%
>50	0.00%	0.00%	0.00%	0.00%	0.00%

Residence ID	R115	R140	R140	R147	R147
Year	Year 21	Year 5	Year 5 (Rail spur)	Year 5	Year 5 (Rail spur)
Concentration (μg/m³)	Percentage occurrence				
0	3.34%	17.33%	17.93%	13.68%	13.98%
0 - 10	96.66%	76.29%	75.99%	82.98%	82.67%
10 - 20	0.00%	6.38%	6.08%	3.04%	3.34%
20 -30	0.00%	0.00%	0.00%	0.30%	0.00%
30 - 40	0.00%	0.00%	0.00%	0.00%	0.00%
40-50	0.00%	0.00%	0.00%	0.00%	0.00%
>50	0.00%	0.00%	0.00%	0.00%	0.00%

Residence ID	R148	R153	R153	R153	R155	R155
Year	Year 5	Year 5	Year 5 (Rail spur)	Year 10	Year 5	Year 5 (Rail spur)
Concentration (μg/m³)	Percentage occurrence					
0	17.33%	17.63%	18.24%	17.33%	18.84%	19.15%
0 - 10	98.18%	78.12%	77.51%	80.85%	80.24%	79.94%
10 - 20	1.82%	4.26%	4.26%	1.82%	0.91%	0.91%
20 -30	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
30 - 40	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
40-50	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
>50	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%