AIR QUALITY AND GREENHOUSE GAS ASSESSMENT

Abel Upgrade Modification

Environmental Assessment

APPENDIX E

Resource Strategies

DONALDSONCOAL

Part of the Yancoal Australia Group

AIR QUALITY IMPACT AND GREENHOUSE GAS ASSESSMENT

ABEL UNDERGROUND MINE

Donaldson Coal Pty Ltd

29th November 2012

Job Number 12010058

Prepared by

Todoroski Air Sciences Pty Ltd
Suite 2B, 14 Glen Street
Eastwood, NSW 2122
Phone: (02) 9874 2123
Fax: (02) 9874 2125
Email: info@airsciences.com.au

Air Quality Impact and Greenhouse Gas Assessment Abel Underground Mine

Author(s): Aleks Todoroski Philip Henschke

Position: Director Atmospheric Physicist

Signature:

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1 INTRODUCTION

Todoroski Air Sciences (TAS) has prepared this report for Donaldson Coal Pty Ltd (hereafter referred to as Donaldson Coal). It provides an assessment of the potential air quality impacts and an assessment of the potential greenhouse gas (GHG) emissions generated from the proposed modifications to the Abel Underground Mine (hereafter referred to as the Modification).

The Abel Underground Mine is an existing mining operation, and is owned and operated by Donaldson Coal. Under the Project Approval for the Abel Underground Mine (05_0136) run-of-mine (ROM) coal is extracted from the underground mining area and transported via internal roads to the Bloomfield Coal Handling and Preparation Plant (CHPP) for processing. The Bloomfield CHPP is also approved to receive coal from other mining operations, including the Tasman Underground Mine, which is also owned and operated by Donaldson Coal.

The Modification involves changes in the method of mining at the Abel Underground Mine, resulting in increased efficiency of coal recovery and an associated increase in the amount of ROM coal processed at the Bloomfield CHPP. In addition the Modification would involve an increase in the amount of ROM coal received from the Tasman Underground Mine (subject to approval of the Tasman Extension Project (Application Number SSD-4962)).

This report incorporates the following aspects:

- background to the Abel Underground Mine and description of the proposed operations associated with the Modification;
- review of the existing environment surrounding the Abel Underground Mine site;
- description of the modelling approach used to assess impacts;
- presentation of the predicted results;
- discussion of the potential air quality impacts as a result of the proposed operations; and
- an estimation of the GHG emissions generated.

2 LOCAL SETTING

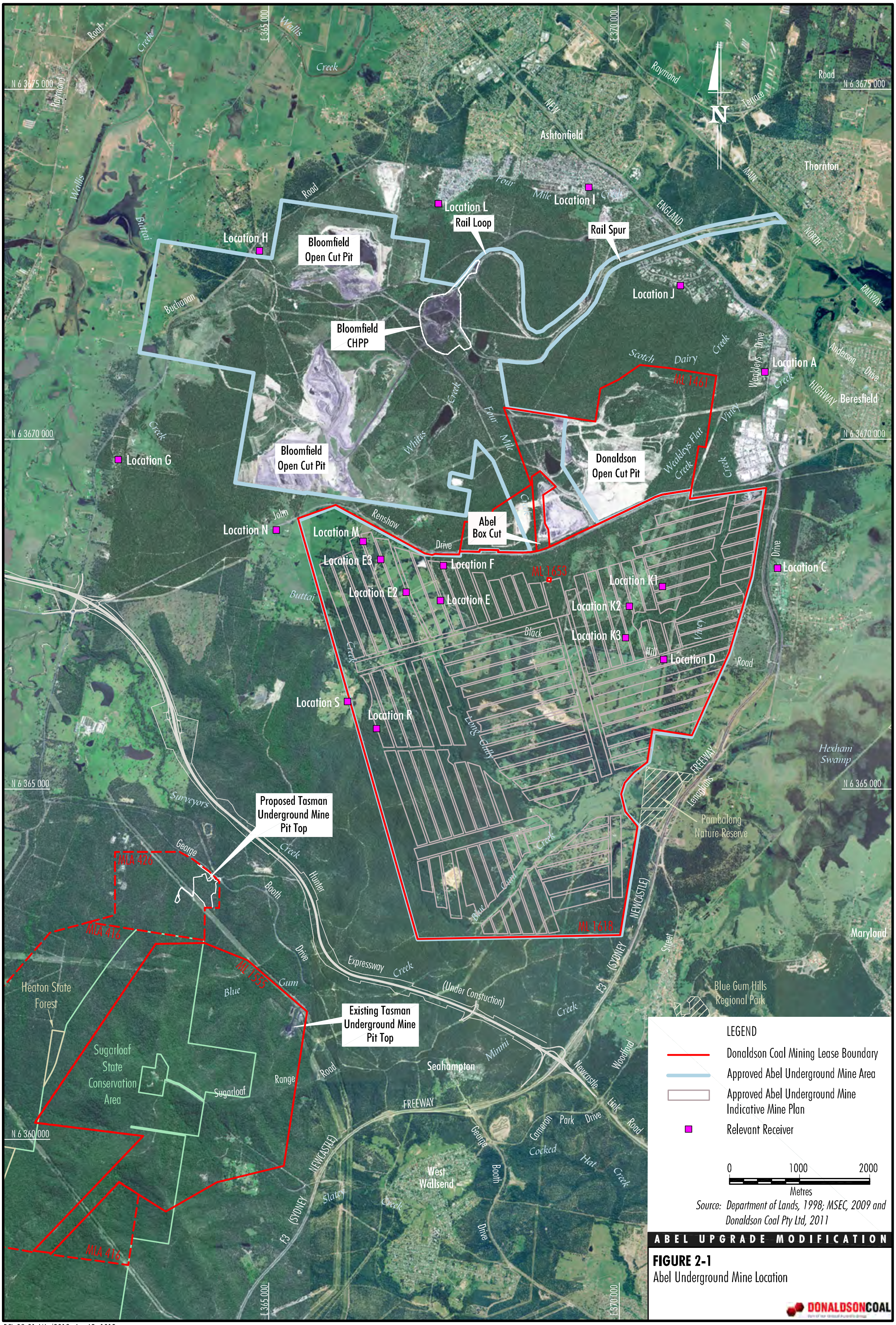
2.1 Topography and land use

The Abel Underground Mine (Figure 2-1) is located approximately 23 kilometres (km) north-west of the Port of Newcastle in the Newcastle Coalfield. Other nearby regional centres include Beresfield, located approximately 5km north-east, and Kurri Kurri located approximately 12km east of the Abel Underground Mine. Coal mining operations, agricultural activities and industrial activities dominate the land use surrounding the Abel Underground Mine area. Suburban residential areas are located in relatively close proximity to the north-east of the Abel Underground Mine. The Abel Underground Mine is also surrounded by dense forest (which would have a positive effect in limiting the transport of dust off-site).

Figure 2-2 presents a representative three-dimensional (3D) visualisation of the terrain in the general vicinity of the Abel Underground Mine area. To the south-west of the Abel Underground Mine, the terrain is undulating and gradually forms well-defined steep slopes as the elevation increases. To the east, the terrain is generally open and is essentially flat along the river flood plain towards the coast. To the north-west the terrain opens into the Hunter Valley region of New South Wales (NSW).

2.2 Relevant receivers

Consistent with the previous air quality assessment conducted for the Abel Underground Mine and the noise monitoring receiver locations specified in Project Approval 05_0136, the nearest affected residential receivers to the site are characterised by the locations presented on Figure 2-1. Appendix A provides a detailed list of the sensitive receptors assessed in this report.



ABEL UPGRADE MODIFICATION

FIGURE 2-1

Abel Underground Mine Location

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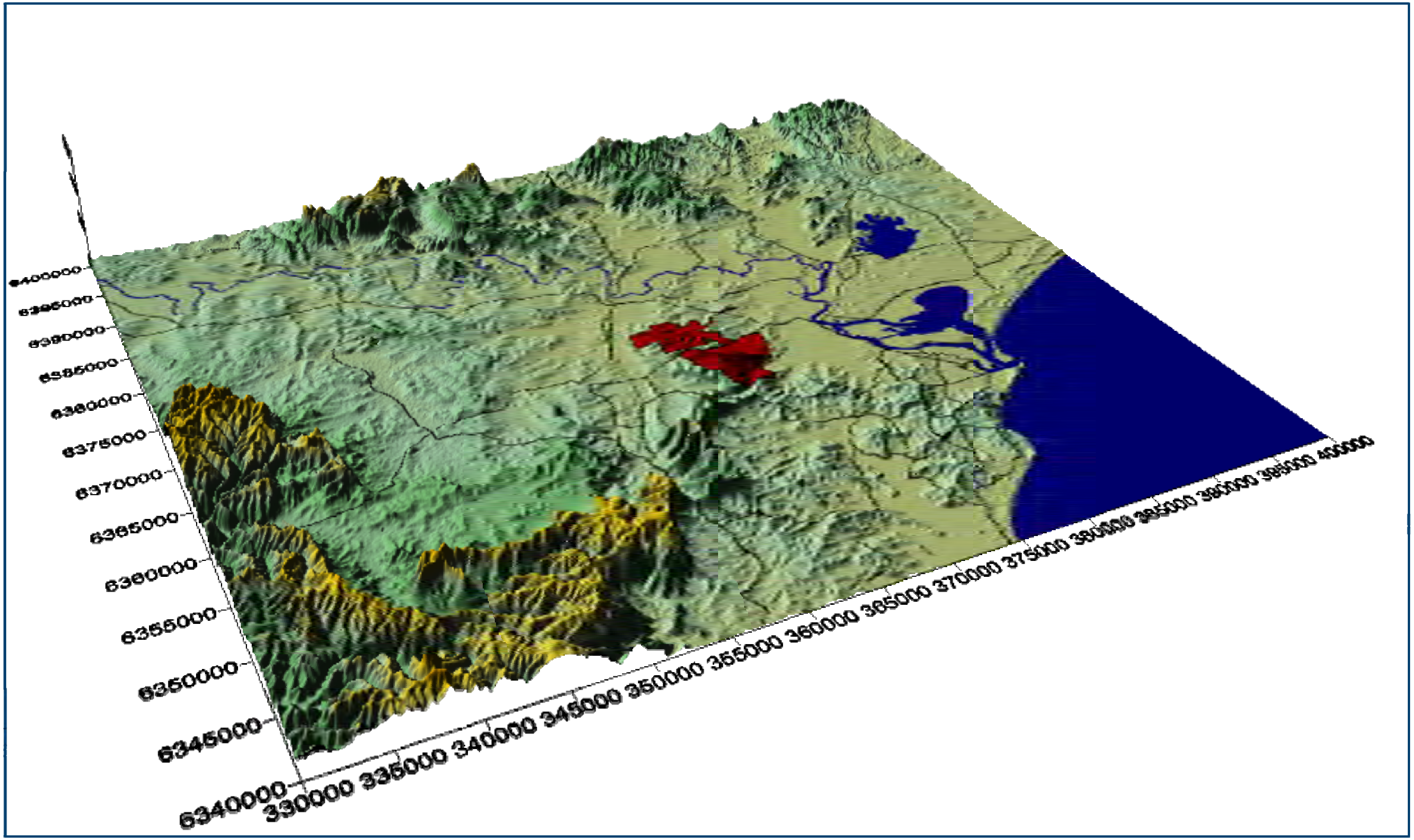


Figure 2-2: Representative 3D terrain view of the Abel Underground Mine location

3 EXISITING OPERATIONS AND MODIFICATION DESCRIPTION

3.1 Existing operations

The Abel Underground Mine is approved to operate in accordance with Project Approval 05_0136 granted on 7 June 2007 by the then NSW Minister for Planning pursuant to section 79J of the *Environment Planning and Assessment Act.1979* (EP&A Act).

The Abel Underground Mine is approved to extract up to 4.5 million tonnes per annum (Mtpa) ROM coal. ROM coal from the Abel Underground Mine is transported along an internal, sealed haul road to the Bloomfield CHPP and rail loading facility where the coal is processed prior to rail transport to the Port of Newcastle for export, or to other customers.

The potential environmental impacts of the existing Abel Underground Mine were assessed in the *Abel Underground Mine Part 3A Environmental Assessment* (Donaldson Coal Pty Limited, 2006), and potential air quality impacts were assessed in the *Air Quality Assessment* prepared by Holmes Air Sciences (2006) for the Abel Underground Mine Environmental Assessment (EA).

Under Project Approval 05_0136, approval was granted for the construction and use of an overland conveyor for the transportation of ROM coal from the Abel Underground Mine entrance to the Bloomfield CHPP should financial circumstances permit.

In addition, approval was granted for modifications to the Bloomfield CHPP, including increased stockpile areas and modifications to increase the capacity of the CHPP. However some of these modifications, including the full extension of the stockpile areas, have not been implemented.

In accordance with Project Approval 05_0136, the Bloomfield CHPP is approved to process up to 6.5Mtpa ROM coal from the Abel Underground Mine, Tasman Underground Mine, Donaldson Open Cut, Bloomfield Colliery and other sources.

3.2 The Modification

Donaldson Coal has requested a modification of Project Approval 05_0136 for upgrades to underground mining operations at the Abel Underground Mine to increase the efficiency of coal recovery (i.e. the Modification). The Modification would involve the continuation of underground mining within the approved area and approved seams using a combination of longwall, shortwall and board and pillar mining. In addition, the Modification would involve the receipt of ROM coal associated with the Tasman Extension Project (subject to approval of the Tasman Extension Project (Application SSD-4962)).

The key components of the Modification relevant to potential air quality impacts are summarised below:

- increased annual ROM coal production of up to 6.1Mtpa associated with the changes in the method of mining;
- an extension of the mine life of approximately two years (i.e. until 31 December 2030);
- an increase in the amount of ROM coal from the Abel Underground Mine and the Tasman Extension Project transported to the Bloomfield CHPP;
- increased throughput of coal at the Bloomfield CHPP and rail load out facility;
- modifications and upgrades to the Bloomfield CHPP;
- increased annual and total quantity of coarse rejects from the Bloomfield CHPP transported by haul truck and disposed at the Bloomfield Colliery; and,
- construction and use of a downcast ventilation shaft.

4 AIR QUALITY ASSESSMENT CRITERIA

4.1 Preamble

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. Section 4.2 to Section 4.4 below identifies the potential air emissions generated by the proposed operation and the applicable air quality criteria.

4.2 Particulate matter

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

TSP is defined further into two sub-components. These are PM_{10} particles, particulate matter with aerodynamic diameters of 10µm or less, and $PM_{2.5}$, particulate matter with aerodynamic diameters of 2.5µm or less.

Mining activities generate particles in all of the above size categories. The great majority of the particles generated are due to the abrasion or crushing of rock and coal and general disturbance of dusty material. These particulate emissions from mining activities will be generally larger than 2.5µm, as these fine particulates are often only generated through combustion processes.

Combustion particulates (i.e. $PM_{2.5}$) can be more harmful to human health as the particles have the ability to penetrate deep into the human respiratory system and generally include acidic and carcinogenic substances.

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

4.2.1 Office of Environment and Heritage impact assessment criteria

Table 4-1 summarises the air quality goals that are relevant to this study as outlined in the Office of Environment and Heritage (OEH) document *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (Department of Environment and Conservation (DEC), 2005). The air quality goals for total impact relate to the total dust burden in the air and not just the dust from the project. Consideration of background dust levels needs to be made when using these goals to assess potential impacts.

Table 4-1: OEH air quality impact assessment criteria

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

Source: NSW DEC, 2005
µg/m³ = micrograms per cubic metre
g/m²/month = grams per square metre per month

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

criterion to allow for bush fires and similar events. Similarly, it is normally the case that on days where ambient dust levels are affected by such events they are excluded from assessment as per the OEH criterion.

4.3 $PM_{2.5}$ concentrations

The OEH currently do not have impact assessment criteria for $PM_{2.5}$ concentrations, however the National Environment Protection Council (NEPC) has released a variation to the NEPM (NEPC, 2003) to include advisory reporting standards for $PM_{2.5}$ (see Table 4-2). The advisory reporting standards for $PM_{2.5}$ are a maximum 24-hour average of 25µg/m^3 and an annual average of 8µg/m^3, and as with the NEPM goals, apply to the average, or general exposure of a population, rather than to "hot spot" locations.

Predictions have been made as to the likely contribution that emissions from the Project would make to ambient $PM_{2.5}$ concentrations and are presented in Section 9.

Table 4-2: Advisory standard for $PM_{2.5}$ concentrations

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

Source: NEPC, 2003

4.4 Other air pollutants

Emissions of carbon monoxide, sulphur dioxide and nitrogen dioxide will also arise from mining activities. These emissions are generally too low to generate any significant off-site concentrations and have not been assessed further in this report.

5 EXISITING ENVIRONMENT

This section describes the existing climate and air quality in the area surrounding the Abel Underground Mine.

5.1 Local climate

Long-term climatic data from the Bureau of Meteorology (BoM) weather station at Williamtown Royal Australian Air Force (RAAF) (Site No. 061078) have been used to characterise the local climate in the proximity of the Abel Underground Mine (BoM, 2012). The Williamtown RAAF station is located approximately 21km east-northeast of the Abel Underground Mine.

Table 5-1 and Figure 5-1 present a summary of data from Williamtown RAAF collected over a 62-year period. The data indicate that January is the hottest month with a mean maximum temperature of 28.0ºC and July as the coldest month with a mean minimum temperature of 6.4ºC.

Table 5-1: Monthly climate statistics summary - Williamtown RAAF

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature												
Mean max. temperature (°C)	28.0	27.6	26.2	23.6	20.3	17.7	17.0	18.6	21.3	23.6	25.5	27.2
Mean min. temperature (°C)	18.0	18.1	16.3	13.2	10.1	7.9	6.4	6.9	9.1	12.0	14.3	16.5
Rainfall												
Rainfall (mm)	96.3	121.0	120.1	105.8	115.1	122.3	73.5	75.5	60.5	74.8	82.3	79.7
Mean No. of rain days (≥1mm)	7.2	7.4	8.3	7.4	8.0	8.1	6.3	6.2	5.6	7.4	7.4	7.1
9am conditions												
Mean temperature (°C)	23.0	22.5	21.2	18.2	14.3	11.6	10.5	12.2	15.7	18.8	20.5	22.2
Mean relative humidity (%)	72	76	77	76	79	80	77	71	66	64	66	68
Mean wind speed (km/h)	11.9	10.6	10.2	11.4	13.7	15.9	16.4	16.8	15.3	14.4	14.4	12.9
3pm conditions												
Mean temperature (°C)	26.5	26.1	24.9	22.5	19.3	16.8	16.2	17.6	20.0	21.9	23.8	25.6
Mean relative humidity (%)	59	62	61	59	60	60	55	50	50	54	55	56
Mean wind speed (km/h)	21.9	20.6	18.9	17.2	15.8	17.5	18.7	20.9	22.0	22.5	23.5	23.5

Source: BoM, 2012

Humidity levels exhibit variability and seasonal flux across the year. Mean 9am humidity levels range from 64% in October to 80% in June. Mean 3pm humidity levels range from 50% in August and September to 62% in February.

Rainfall peaks in the first half of the year during the months of summer and autumn and declines during winter. The data indicates that June is the wettest month with an average rainfall of 122.3mm over 8.1 days and September is the driest month with an average rainfall of 60.5mm over 5.6 days.

As expected, wind speeds during the warmer months have a greater spread between the 9am and 3pm conditions compared to the colder months. Mean 9am wind speeds range from 10.2km/h in March to 16.8km/h in August. Mean 3pm wind speeds range from 15.8km/h in May to 23.5km/h in November and December.

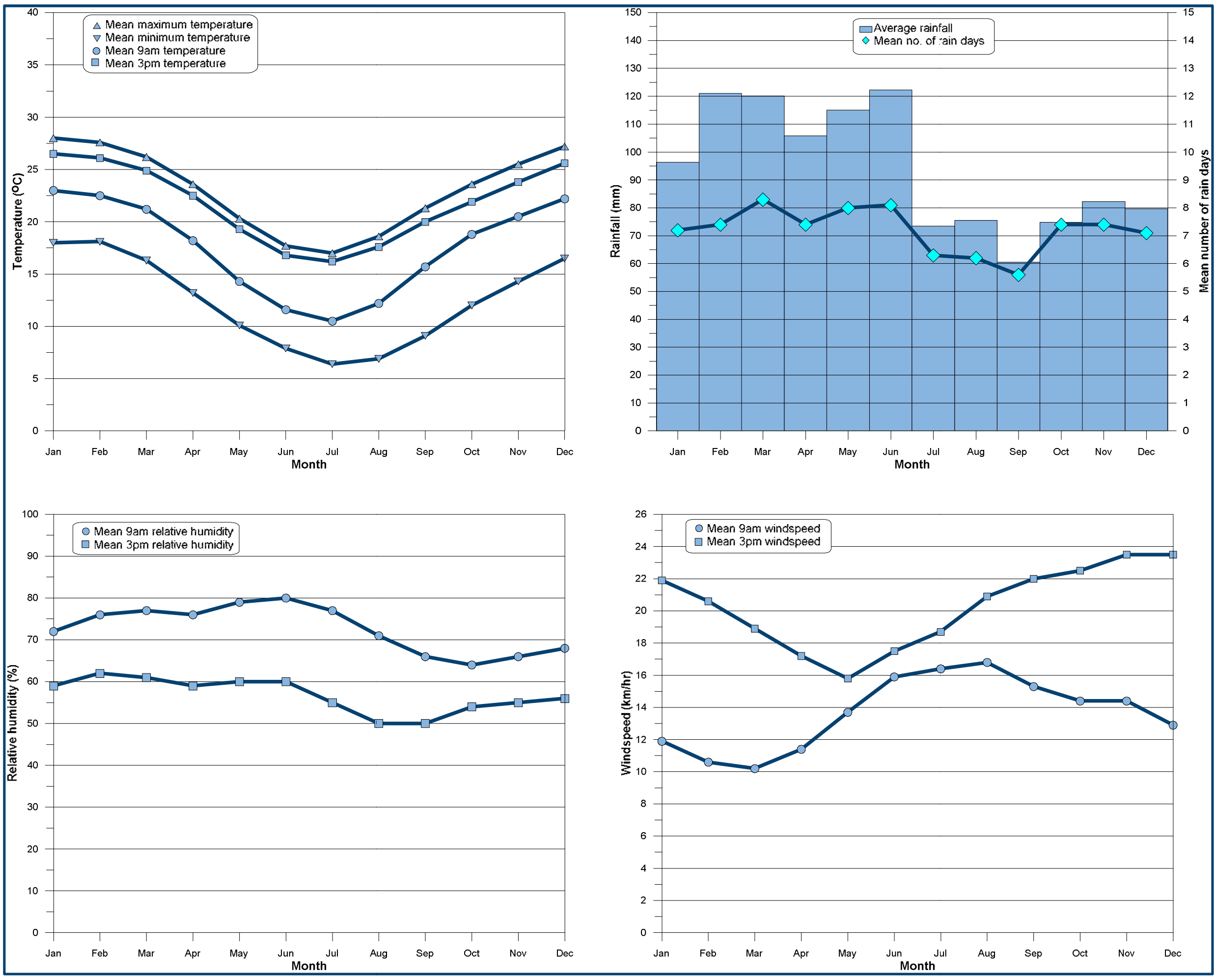


Figure 5-1: Monthly climate statistics summary - Williamtown RAAF

5.2 Local air quality

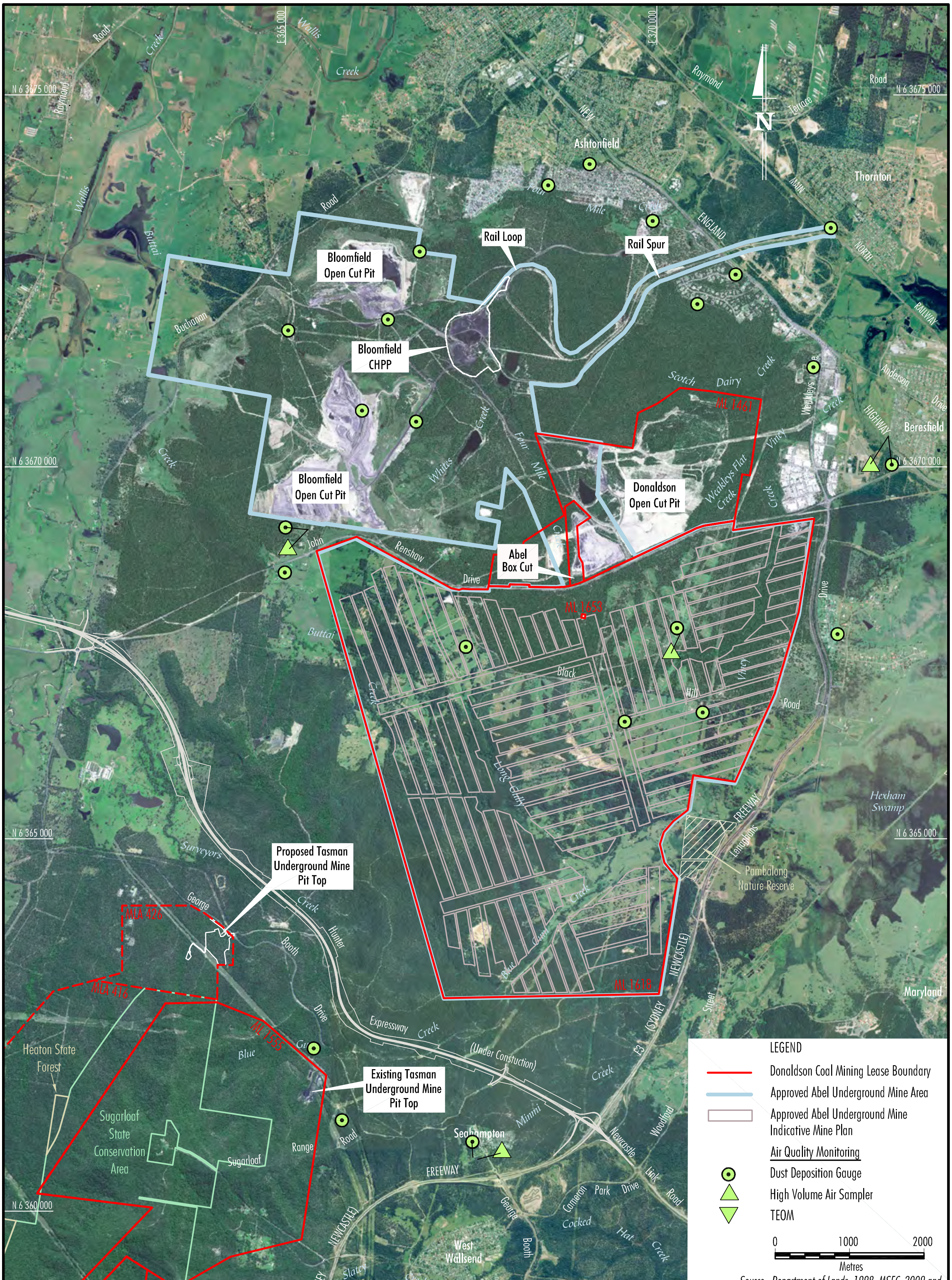
The main sources of particulate matter in the wider area of the Abel Underground Mine include active mining, agricultural activities, emissions from local anthropogenic activities such as motor vehicle exhaust and domestic wood heaters and various other industrial activities. This section reviews the ambient monitoring data collected from a number of ambient monitoring programs in the vicinity of the Abel Underground Mine.

The air quality monitors reviewed in this assessment include two Tapered Element Oscillating Microbalances (TEOMs), seven High Volume Air Samplers (HVAS) measuring either TSP or PM_{10}, and 25 dust deposition gauges sited in various locations surrounding the Abel Underground Mine.

Table 5-2 lists the monitoring stations reviewed in this section and Figure 5-2 shows the approximate location of the Donaldson Coal and Bloomfield Collieries' monitoring stations reviewed in this assessment. Appendix B provides a summary of all the monitoring data reviewed.

Table 5-2: Summary of monitoring locations

Monitoring site ID	Type	Monitoring data analysed
Wallsend OEH	TEOM - PM_{10}	January 2010 - December 2011
Beresfield OEH	TEOM - PM_{10}	January 2010 - December 2011
Rural Fire Service (R.F.S)	HVAS - PM_{10}	January 2010 - December 2011
Bloomfield	HVAS - PM_{10}	May 2011 - January 2012
Blackhill	HVAS - PM_{10}	January 2010 - December 2011
Golf Course	HVAS - PM_{10}	January 2010 - December 2011
R.F.S	HVAS - TSP	January 2010 - December 2011
Bloomfield	HVAS - TSP	May 2011 - January 2012
Blackhill	HVAS - TSP	January 2010 - December 2011
TASMAN D01	Dust gauge	January 2010 - December 2011
TASMAN D02	Dust gauge	January 2010 - December 2011
TASMAN D03	Dust gauge	January 2010 - December 2011
Donaldson D1	Dust gauge	January 2010 - September 2011
Donaldson D2	Dust gauge	January 2010 - September 2011
Donaldson D3	Dust gauge	January 2010 - September 2011
Donaldson D4	Dust gauge	January 2010 - September 2011
Donaldson D5A	Dust gauge	January 2010 - September 2011
Donaldson D6	Dust gauge	January 2010 - September 2011
Donaldson D7	Dust gauge	January 2010 - September 2011
Donaldson D8	Dust gauge	January 2010 - September 2011
Donaldson D9	Dust gauge	January 2010 - September 2011
Donaldson D10	Dust gauge	January 2010 - September 2011
Donaldson D11	Dust gauge	January 2010 - September 2011
Donaldson D12	Dust gauge	January 2010 - September 2011
Bloomfield D1	Dust gauge	January 2010 - December 2011
Bloomfield D2	Dust gauge	January 2010 - December 2011
Bloomfield D3	Dust gauge	January 2010 - December 2011
Bloomfield D4	Dust gauge	January 2010 - December 2011
Bloomfield D5	Dust gauge	January 2010 - December 2011
Bloomfield D6	Dust gauge	January 2010 - December 2011
Bloomfield D7	Dust gauge	January 2010 - December 2011
Bloomfield D8	Dust gauge	January 2010 - December 2011
Bloomfield D9	Dust gauge	January 2010 - December 2011
Bloomfield D10	Dust gauge	January 2010 - December 2011



ABEL UPGRADE MODIFICATION

FIGURE 5-2
Monitoring Locations

DONALDSONCOAL

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5.2.1 PM_{10} Monitoring

Ambient PM_{10} monitoring using TEOMs is conducted by the OEH at Beresfield and Wallsend. A summary of the data from both monitoring stations collected during the 2010 and 2011 calendar years is presented in Table 5-3 and Figure 5-3.

A review of Table 5-3 indicates that the annual average PM_{10} concentrations for each monitoring station were below the OEH criteria of 30µg/m^3. Figure 5-3 indicates that there was one day on which the maximum 24-hour average PM_{10} concentration recorded was above the 50µg/m^3 criterion at the Wallsend station during January 2010. An investigation into this exceedance failed to accurately determine the specific cause of the elevated levels, the monitor at Beresfield recorded lower levels during the same period indicating that a local source close to the Wallsend station would be the most likely cause. The maximum 24-hour average PM_{10} concentrations recorded at the Beresfield site were below the 50µg/m^3 criterion in 2010 and 2011.

Table 5-3: PM_{10} levels from TEOM monitoring (µg/m^3)

Month	Monthly average					Maximum monthly 24-hour average				
	Wallsend		Beresfield		Criteria	Wallsend		Beresfield		Criteria
	2010	2011	2010	2011		2010	2011	2010	2011	
January	24.0	19.5	24.0	18.6	-	**58.3**	38.9	50.0	42.8	**50**
February	18.9	18.0	16.6	18.0	-	32.8	32.1	30.2	39.6	**50**
March	10.6	14.3	16.3	16.5	-	14.8	25.5	40.6	27.1	**50**
April	15.0	11.6	17.7	15.6	-	26.1	19.4	37.3	30.7	**50**
May	12.8	13.1	16.2	17.1	-	19.1	20.5	28.1	29.9	**50**
June	12.2	12.4	15.1	15.5	-	17.5	20.0	22.7	24.5	**50**
July	11.3	11.4	13.6	14.8	-	18.1	18.8	24.8	27.0	**50**
August	11.7	14.4	15.0	18.4	-	19.4	26.7	27.8	38.7	**50**
September	16.4	16.2	19.2	21.6	-	28.6	35.2	32.2	41.4	**50**
October	15.2	14.2	14.6	17.4	-	23.7	23.6	25.2	32.3	**50**
November	15.0	15.2	14.9	16.7	-	22.3	24.6	20.8	27.2	**50**
December	16.1	11.1	16.2	14.8	-	23.6	16.2	26.6	29.0	**50**
Annual	15.0	14.3	16.6	17.1	**30**	**58.3**	38.9	50.0	42.8	-

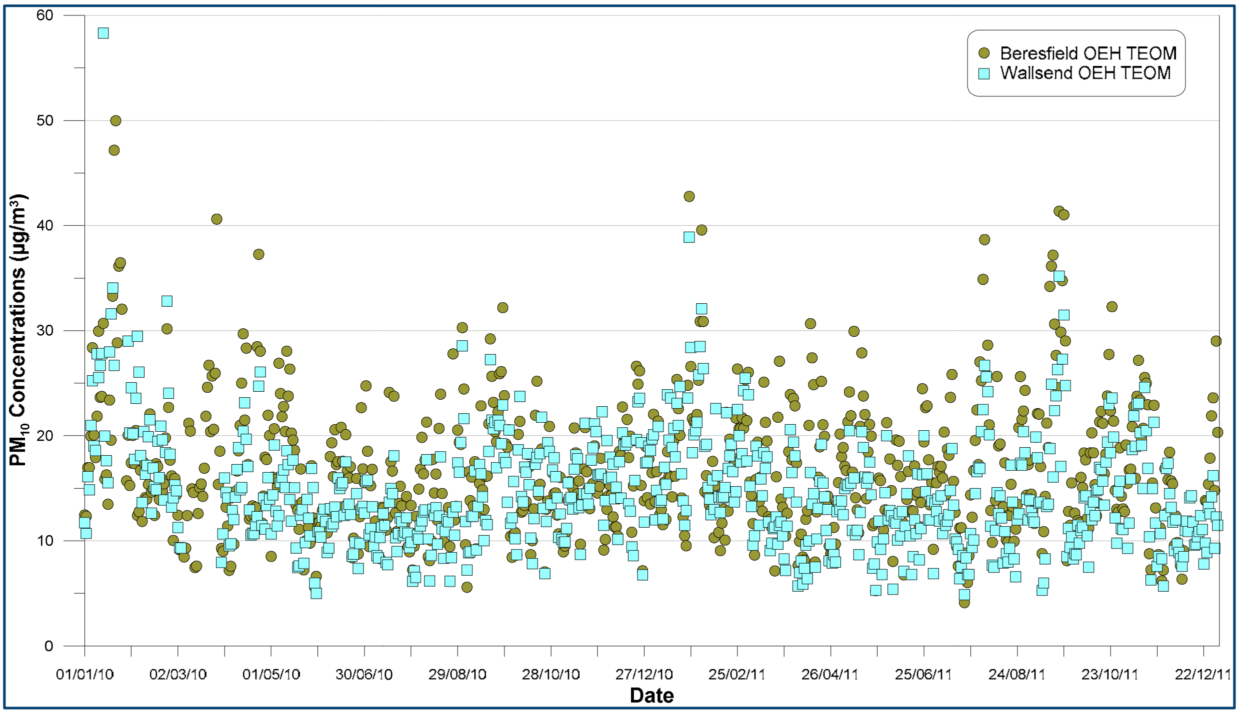

Figure 5-3: TEOM 24-hour average PM_{10} concentrations

A summary of the results from the four HVAS monitoring stations available during 2010 to 2012 is presented in Table 5-4 and Figure 5-4. The monitoring results in Table 5-4 indicate the annual average PM_{10} levels from these monitors are below the OEH criteria of 30µg/m^3 and are comparable to the annual average TEOM monitoring results for the same periods. Figure 5-4 indicates that there were no recorded levels above the 24-hour average PM_{10} criterion level of 50µg/m³ during 2010 to 2011.

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

Year	Annual average					Maximum 24-hour average				
	R.F.S	Bloomfield	Blackhill	Golf course	Criteria	R.F.S	Bloomfield	Blackhill	Golf course	Criteria
2010	12.3	ND	9.7	12.4	**30**	37.0	ND	23.0	36.0	**50**
2011	15.0	18.1(1)	13.2	14.2	**30**	39.0	43.0(1)	34.0	38.0	**50**

ND = No data
(1)Data available from May 2011

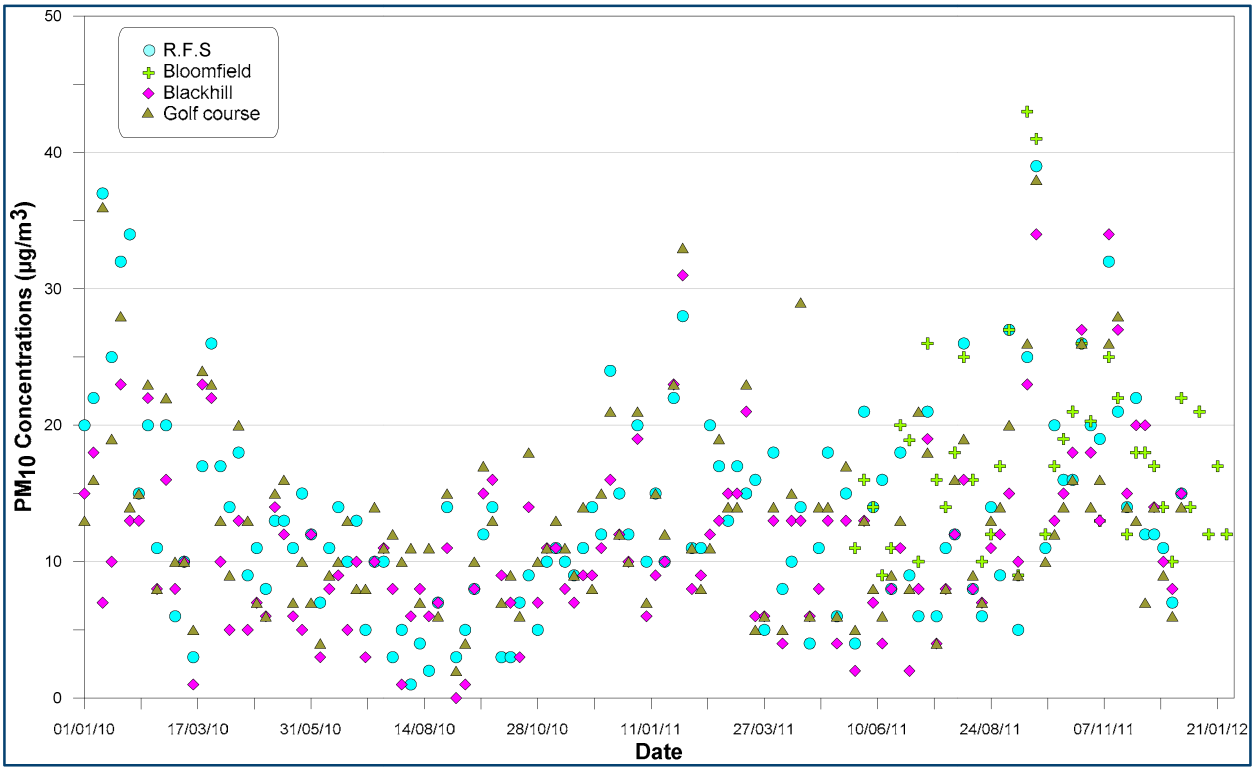

Figure 5-4: HVAS 24-hour average PM_{10} concentrations

5.2.2 TSP Monitoring

TSP monitoring data are collected using three HVAS monitors. The available results from the HVAS monitoring stations collected from 2010 to 2011 are summarised in Table 5-5 and are presented in Figure 5-5.

The monitoring data summarised in Table 5-5 indicate that the annual average TSP concentrations for each monitoring station were below the OEH criterion of 90µg/m^3. Figure 5-5 shows that the concentrations are nominally highest in spring and summer with the warmer weather raising the potential for pollen, bushfires and drier ground, which results in higher levels of windblown dust.

Table 5-5: TSP levels from HVAS monitoring (µg/m^3)

Year	Annual average			
	R.F.S	Bloomfield	Blackhill	Criteria
2010	25.5	ND	23.2	**90**
2011	32.3	39.6[1]	27.1	**90**

ND = No data
[1]Data available from May 2011

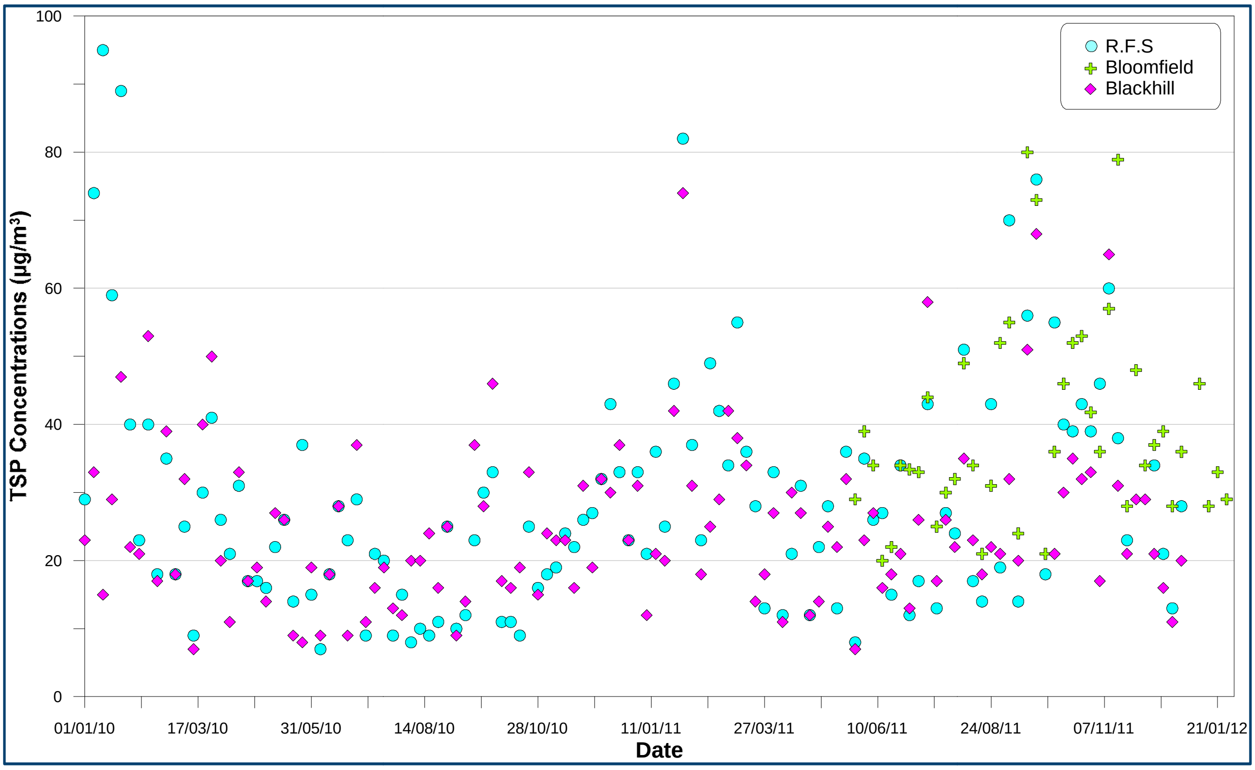

Figure 5-5: HVAS 24-hour average TSP concentrations

5.2.3 Dust deposition monitoring

Table -6 shows the annual average dust deposition levels at each gauge during 2010 and 2011. Field notes accompanying the monitoring data indicate that some of the samples were contaminated with materials such as bird droppings, insect and plant matter. This is a relatively common occurrence for this type of monitoring, and accordingly, contaminated samples have been excluded from the reported annual average results.

The majority of dust gauges recorded an annual average insoluble deposition level well below the OEH criterion of 4g/m^2/month and in general, the air quality in terms of deposition can be considered good.

The Bloomfield D6 gauge recorded a relatively high deposition level of 4.2g/m^2/month during 2011 and should be investigated for possible local contamination or interference.

Table 5-6: Annual average dust deposition (g/m^2/month)

Monitor	2010	2011	Criteria
TASMAN D01	0.6	0.6	**4**
TASMAN D02	1.3	2.0	**4**
TASMAN D03	0.8	1.2	**4**
Donaldson D1	0.8	0.7	**4**
Donaldson D2	2.6	1.3	**4**
Donaldson D3	2.2	2.2	**4**
Donaldson D4	1.0	0.8	**4**
Donaldson D5A	1.1	0.7	**4**
Donaldson D6	0.8	0.6	**4**
Donaldson D7	0.7	0.7	**4**
Donaldson D8	1.1	1.7	**4**
Donaldson D9	0.9	0.8	**4**
Donaldson D10	0.7	0.9	**4**
Donaldson D11	1.0	0.9	**4**
Donaldson D12	0.9	0.9	**4**
Bloomfield D1	1.4	1.3	**4**
Bloomfield D2	1.8	1.5	**4**
Bloomfield D3	1.7	1.4	**4**
Bloomfield D4	1.7	2.9	**4**
Bloomfield D5	1.0	1.3	**4**
Bloomfield D6	2.2	4.2	**4**
Bloomfield D7	1.5	1.4	**4**
Bloomfield D8	1.4	3.3	**4**
Bloomfield D9	1.1	0.9	**4**
Bloomfield D10	2.5	2.0	**4**

Note: Data from Donaldson gauges to September 2011.

5.3 Existing environmental compliance

5.3.1 Project Approval 05 0136

The Abel Underground Mine currently operates in accordance with consent conditions provided within Project Approval 05 0136.

In November 2011 an Independent Environmental Audit was conducted by Trevor Brown and Associates (Trevor Brown and Associates, 2011) for the Abel Underground Mine. In regard to air quality, the Independent Environmental Audit concluded:

The dust monitoring results for 2008 to 2011 have demonstrated compliance with the air quality criteria in Project Approval Schedule 4 condition 25 for dust deposition, TSP and PM_{10}.

...

The Air Quality Monitoring Program and management of operations in relation to dust generation are considered to be adequate for the management for air quality in the vicinity of the Abel Project.

An extract of the consent conditions relevant to air quality provided within the Project Approval 05 0136, and comments from the Independent Environmental Audit regarding existing compliance with these conditions is provided within Table 5-7.

Table 5-7: Summary of compliance with relevant consent conditions and statement of commitments

<table>
<tr><th>Ref.</th><th>Condition</th><th>Status</th><th>Comments</th></tr>
<tr><td colspan="4">Schedule 4 of Project Approval (05_0136)</td></tr>
<tr><td>25</td><td>Impact Assessment Criteria
Donaldson Coal shall ensure that dust generated by the project does not cause additional exceedances of the criteria listed in Tables 2 to 4 at any residence on privately-owned land, or on more than 25 percent of any privately-owned land.</td><td>Compliant</td><td>Results of the air quality monitoring are reported in the AEMR's section 3.2</td></tr>
<tr><td></td><td>
Table 2: Long term impact assessment criteria for particulate matter
<table>
<tr><td>Pollutant</td><td>Averaging Period</td><td>Criterion</td></tr>
<tr><td>Total suspended particulate (TSP) matter</td><td>Annual</td><td>90 µg/m³</td></tr>
<tr><td>Particulate matter < 10 µm (PM_{10})</td><td>Annual</td><td>30 µg/m³</td></tr>
</table>
Table 3: Short term impact assessment criteria for particulate matter
<table>
<tr><td>Pollutant</td><td>Averaging Period</td><td>Criterion</td></tr>
<tr><td>Particulate matter < 10 µm (PM_{10})</td><td>24 hour</td><td>50 µg/m³</td></tr>
</table>
Table 3: Long term impact assessment criteria for deposited dust
<table>
<tr><td>Pollutant</td><td>Averaging Period</td><td>Maximum increase in deposited dust level</td><td>Maximum total deposited dust</td></tr>
<tr><td>Deposited dust</td><td>Annual</td><td>2 g/m²/month</td><td>4 g/m²/month</td></tr>
</table>
</td><td>Compliant</td><td>All Abel Coal Mine dust monitoring results have demonstrated compliance with the criteria with no exceedances for deposited dust or total suspended particulate matter during the 2007 to 2011 period.</td></tr>
</table>

Ref.	Condition	Status	Comments
26	Monitoring Donaldson Coal shall prepare and implement an Air Quality Monitoring Program for the project to the satisfaction of the Director-General. This program must: • be submitted to the Director-General for approval within 6 months of this approval; • be prepared in consultation with the DEC; and • use a combination of high volume samplers and dust deposition gauges to monitor the performance of the project.	Compliant	*The Air Quality Monitoring Plan was prepared in consultation with the DEC and submitted to the Director-General on 7 December 2007, within 6 months of the Project Approval (dated June 2007).* *The Air Quality Monitoring Plan was revised and approved by DoP on 26 February 2008.* *The Air Quality Monitoring Program includes:* • *Six dust deposit gauges to measure monthly average dust deposition levels in accordance with AS 3580.10.1 1991.* • *One high volume air sampler fitted with a PM10 size selective inlet and operated on a one-day-in-six cycle in accordance with AS 3580.9.7 1990.* • *One high volume air sampler fitted with TSP inlet and operated on a one-day-in-six cycle in accordance with AS 2724.5 1987.*

Ref.	Condition	Status	Comments
Abel Underground Mine Statement of Commitments			
4.2	Air Quality Control Measures (a) The following actions would be adopted in relation to dust control on the site during operation of the proposed Abel Underground Mine and the operation of the Bloomfield CHPP: • All mobile equipment will be maintained in good working order to limit exhaust fumes. • Regular watering of all roads; • Use water sprays periodically on open stockpile areas and regular visual inspection will be undertaken and water sprays activated as required. (b) Dust emissions generated by the Abel Underground Mine and the Bloomfield CHPP will not exceed any statutory limits. (c) Dust control on site is to be aimed at prevention of air pollution and prevention of the degradation of local amenity. (d) Dust controls on the site will comply with all relevant NSW DEC guidelines and any applicable Environment Protection Licence issued under the POEO Act 1997. (e) Regular inspections for excessive visible dust generation will be undertaken and appropriate controls will be implemented when such events occur. This will include ceasing operations during high wind conditions if necessary to ensure effective dust control.	Compliant	*The control of air quality in relation to the Abel Coal Project occur during operation of the mine and CHPP facilities in accordance with the Air Quality Monitoring Plan.* *The establishment of the surface facilities for the Abel Mine included surfacing the access roads and storage areas and use of water trucks if necessary on unsealed areas.* *(a) Mobile equipment is regularly serviced in accordance with manufacturers' requirements. Access roads and hard stand areas are surfaced.* *(c) A dedicated water truck is in use on disturbed and all unpaved areas. Water sprays on stockpiles to be installed for the main ROM stockpile (when established in the West Cut area).* *(d) Dust monitoring results indicate no exceedances of dust criteria (see AEMR monitoring data summaries).* *(e) Daily site inspections are conducted by the Environmental Manager to check dust management at the site operations.*

Source: Trevor Brown and Associates (2011) "Independent Environmental Audit – November 2011. Abel Underground Coal Project", prepared for Donaldson Coal, November 2011.

6 MODELLING SCENARIOS

This assessment has considered a single mine plan year to represent the changes to the Abel Underground Mine associated with the Modification. The mine plan year assessed represents the maximum ROM coal extraction rate from the Modification which in turn represents the potential maximum dust generation and hence the maximum impacts.

The modelling scenarios include the product conveyor systems (Figure 6-1) as well as the additional coal throughput at the Bloomfield CHPP, which includes processing of ROM coal from the Bloomfield Colliery and the Tasman Extension Project.

As described in Section 3.2, the approved overland conveyor system from the Abel Underground Mine entrance to the Bloomfield CHPP (Figure 6-1) would only be constructed and used should financial circumstances permit. As such, two modelling scenarios have been considered:

- Hauling Scenario: continued transport of ROM coal from the Abel Underground Mine to the Bloomfield CHPP by haul truck along internal, sealed roads; and
- Conveyor Scenario: transportation of ROM coal from the Abel Underground Mine to the Bloomfield CHPP via the approved overland conveyor system, which would replace the haul trucks.

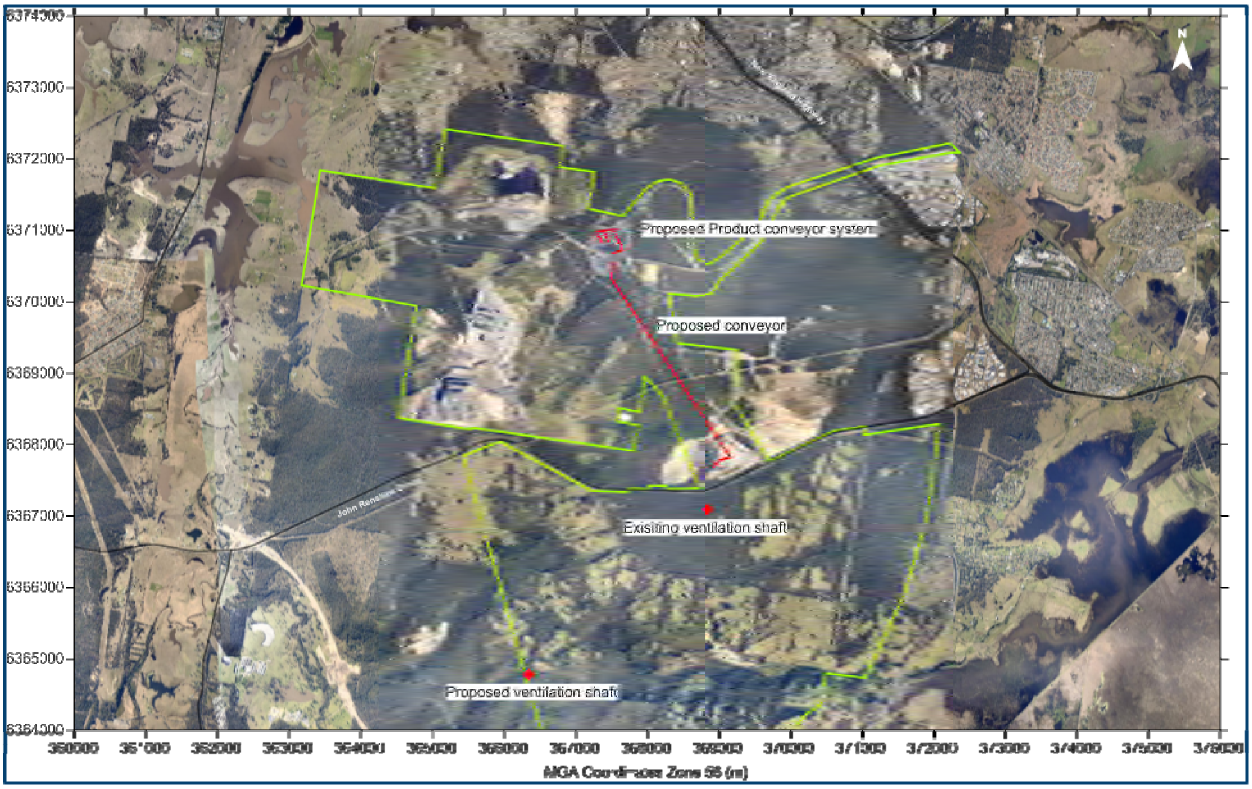

Figure 6-1: Proposed modifications to the Abel Underground Mine

6.1 Emission estimation

For each of the scenarios dust emission estimates have been calculated by analysing the various types of dust generating activities taking place and utilising suitable emission factors.

The emission factors applied are considered the most applicable and representative for determining dust generation rates for the proposed activities. The emission factors were sourced from both locally developed and United States Environmental Protection Agency (US EPA) developed documentation. Total dust emissions from all significant dust generating activities for the Modification are presented in Table 6-1. Detailed emissions inventories and emission estimation calculations are presented in Appendix C.

The dust emissions presented in Table 6-1 include best practice dust mitigation where applicable. Further details on the dust control measures applied at the Abel Underground Mine are outlined in the Section 6.2.

Emission estimates in Table 6-1 indicate that as expected, the use of the internal haulage option is likely to generate greater dust impacts when compared with the operation of the conveyor system based on the total dust emissions.

As such, only the Hauling Scenario has been modelled, as potential impacts for the Conveyor Scenario will be less than the Hauling Scenario.

Table 6-1: Estimated emissions for the Modification Scenarios (kg of TSP)

Activity	TSP emission (kg/y)	
	Hauling Scenario	Conveyor Scenario
Stack-out conveyor (Abel Pit Top)	18	N/A
Unloading ROM to Abel Pit Top ROM stockpile	1,991	N/A
Loading ROM to haul trucks (Front end loader [FEL])	23,924	N/A
Hauling Abel ROM to ROM pad (sealed road)	24,780	N/A
Stack-out conveyor, conveying ROM to Abel Pit ROM stockpile	N/A	109
Conveyor transfer point at Abel Box Cut	N/A	309
Conveyor transfer point at stack-out conveyor	N/A	309
Conveying ROM to Bloomfield CHPP	N/A	1,109
Hauling Tasman Underground Mine ROM to ROM pad (sealed road)	4,719	4,719
Unloading at ROM pad (Abel Underground Mine)	23,924	1,031
Unloading at ROM pad (Tasman Underground Mine)	4,556	4,556
Unloading at ROM pad (Bloomfield CHPP)	9,014	9,014
Loading ROM to hopper (FEL) (Bloomfield CHPP)	2,704	2,704
Loading ROM to hopper (FEL) (Abel and Tasman Underground Mine)	8,544	8,544
Plant feed conveyor	62	62
Crushing	5,112	5,112
Screening	9,372	9,372
No. 2 conveyor, conveying to Bloomfield CHPP	32	32
Product conveyors, conveying to product coal stockpile	69	69
Unloading to product stockpile	1,106	1,106
Dozers at product stockpile	11,030	11,030
Conveying from product coal stockpile to rail loading conveyor	134	134
Rail loading conveyor, conveying to rail load-out bin	241	241
Unloading product to train	2,602	2,602
Loading rejects	280	280
Hauling rejects	144,403	144,403
Unloading rejects	280	280
Wind erosion from Abel Pit Top ROM stockpile	57	N/A
Wind erosion from ROM Pad stockpile	150	150
Wind erosion from product stockpile	1,393	1,393
Mine ventilation system 1	25,278	25,278
Mine ventilation system 2	25,278	25,278
TOTAL	**331,053**	**259,226**

N/A - Not applicable, refers to activities taking place for each scenario

We note that at the time of modelling, it was proposed that an additional upcast ventilation shaft (Figure 6-1) would be required and is included in the emissions estimation in Table 6-1. Following the completion of this assessment, it was determined by Donaldson Coal that only a downcast ventilation shaft would be required for the Modification, which would not be a source of emissions. Notwithstanding, this assessment still conservatively includes the upcast ventilation shaft.

Currently, nearby approved mining operations include those at the Donaldson Open Cut Mine and the Bloomfield Colliery. Operations at the Donaldson Open Cut Mine are scheduled to cease at the end of 2013 (i.e. prior to changes to the Abel Underground Mine associated with the Modification).

As such, in addition to the estimated dust emissions from the Modification, approved mining operations from the Bloomfield Colliery were modelled, per their current consent, to assess potential cumulative dust effects. Emissions estimates from the Bloomfield Colliery were derived from information provided in air quality assessments available in the public domain at the time of modelling. These estimates are likely to be conservative, as in many cases, mines do not operate at the maximum extraction rates assessed in their respective EAs. Table 6-2 summarises the emissions for the Bloomfield Colliery.

Table 6-2: Estimated emissions for the Bloomfield Colliery (kg of TSP)

Mining Operation	TSP emission (kg/y)
Bloomfield Colliery*	1,423,499

*Source: PAEHolmes (2010)

6.2 Best Practice Mitigation Measures

Donaldson Coal has taken significant consideration of the possible range of mitigation measures that can be collectively applied to achieve a standard of mine operation consistent with current best practice for the control of dust emissions from coal mines in NSW. The measures applied to the Abel Underground Mine reflect those outlined in the recent OEH document, *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining*, (Katestone Environmental Pty Ltd (Katestone), 2010).

A summary of the notable dust controls currently applied at the Abel Underground Mine is shown in Table 6-3. These dust controls would continue to be implemented for the Modification. Where applicable these controls have been reflected in the dust emission estimates shown in Table 6-1.

Table 6-3: Best practice dust mitigation measures

Activity	Mitigation measures
Conveyors	✦ Enclosed where applicable.
Conveyor transfers	✦ Enclosed where applicable. ✦ Belt cleaning systems.
Hauling on sealed roads	✦ Seal or vegetate shoulders of sealed roads. ✦ Regularly clean road surface. ✦ Watering of road surface.
Hauling on unsealed roads	✦ Prevent material being deposited on haul roads. ✦ Apply vehicle speed restrictions. ✦ Watering of road surface.
Unloading ROM to hopper	✦ Enclosed dump hopper.
ROM and product stockpiles	✦ Water sprays.
Crushing and screening	✦ Water sprays.
Rail operations	✦ Ensure streamlined and consistent coal surface within rail wagons. ✦ Enclosed train loading point.

7 DISPERSION MODELLING APPROACH

7.1 Introduction

The following sections are included to provide the reader with an understanding of the model and modelling approach combined with the dust emission estimates for each of the assessed scenarios.

Those familiar with the approach used in historical assessments for Hunter Valley coal mines in NSW will notice that a similar approach has been followed in this assessment however the CALPUFF modelling suite is applied to dispersion modelling rather than ISCMOD. The CALPUFF model is an advanced "puff" model that can deal with the effects of complex local terrain on the dispersion meteorology over the entire modelling domain in a 3D, hourly varying time step. CALPUFF is an air dispersion model approved by OEH for use in air quality impact assessments.

7.2 Modelling methodology

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

CALMET is a meteorological model that uses the geophysical information and observed/simulated surface and upper air data as inputs and develops wind and temperature fields on a 3D gridded modelling domain.

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

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

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

A summary of the CALMET and CAPUFF input variables are presented in Appendix D.

7.2.1 CALMET meteorological modelling

This section aims to guide the reader through the process of the CALMET modelling setup and provides a brief analysis of the meteorological output.

To generate a 3D meteorological data field for the local region, CALMET requires, topographical and land use information, surface meteorological data (at 10 metre [m] height) and upper air data. Although it is always preferable to use observed surface and upper air meteorological data, CALMET has the option to use simulated datasets from a prognostic model (such as TAPM) output as input in the absence of any available observed meteorological data.

The centre of analysis for the TAPM modelling used is 32^{o}81' south and 151^{o}65' east. The simulation involved four nesting grids of 30km, 10km, 3km and 1km with 35 vertical grid levels.

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

The coarser grid domain was run on a 50 x 50km area with a 1km grid resolution. The available meteorological data for the 2010 calendar year from six surrounding meteorological monitoring sites were included in this model simulation.

Figure 7-1 presents the location of each of these sites and Table 7-1 outlines the parameters used from each station. The 3D upper air data were sourced from the TAPM output. The finer grid domain was run on a 28 x 25km grid with a 0.25km grid resolution for the modelled year. Local land use and detailed topographical information were included to produce realistic fine scale flow fields (such as terrain forced flows) in surrounding areas. Figure 7-2 presents a representative snapshot of the CALMET generated wind field for the Abel Underground Mine area.

Table 7-1: Surface observation data

Weather station	Parameters
Wallsend OEH Monitoring Station	Wind speed, Wind direction, Temperature, Humidity
Beresfield OEH Monitoring Station	Wind speed, Wind direction, Temperature, Humidity
Newcastle Nobbys Signal Station Automatic Weather Station (AWS) (Station No. 061055)	Wind speed, Wind direction, Temperature, Humidity
Paterson (Tocal) AWS (Station No. 061250)	Wind speed, Wind direction, Temperature, Humidity
Cessnock Airport AWS (Station No. 061260)	Wind speed, Wind direction, Temperature, Humidity, Sea level pressure
Williamtown RAAF (Station No. 061078)	Wind speed, Wind direction, Temperature, Humidity, Sea level pressure, Cloud height, Cloud amount

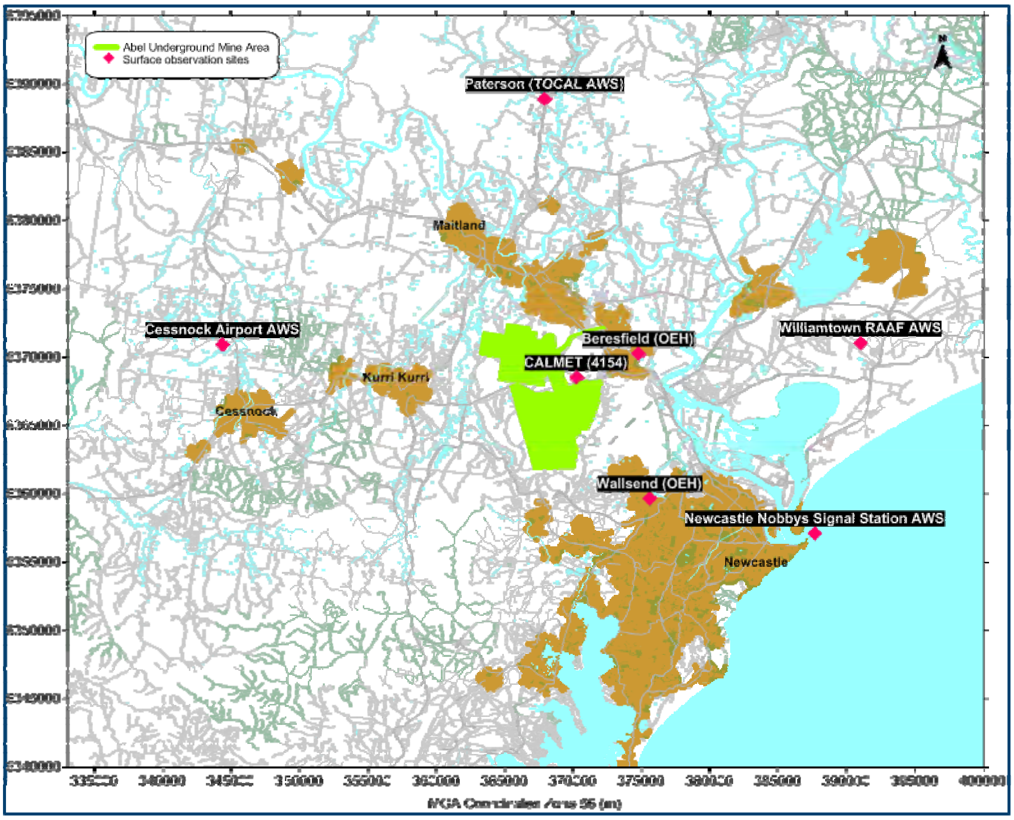

Figure 7-1: Location of surface observation stations

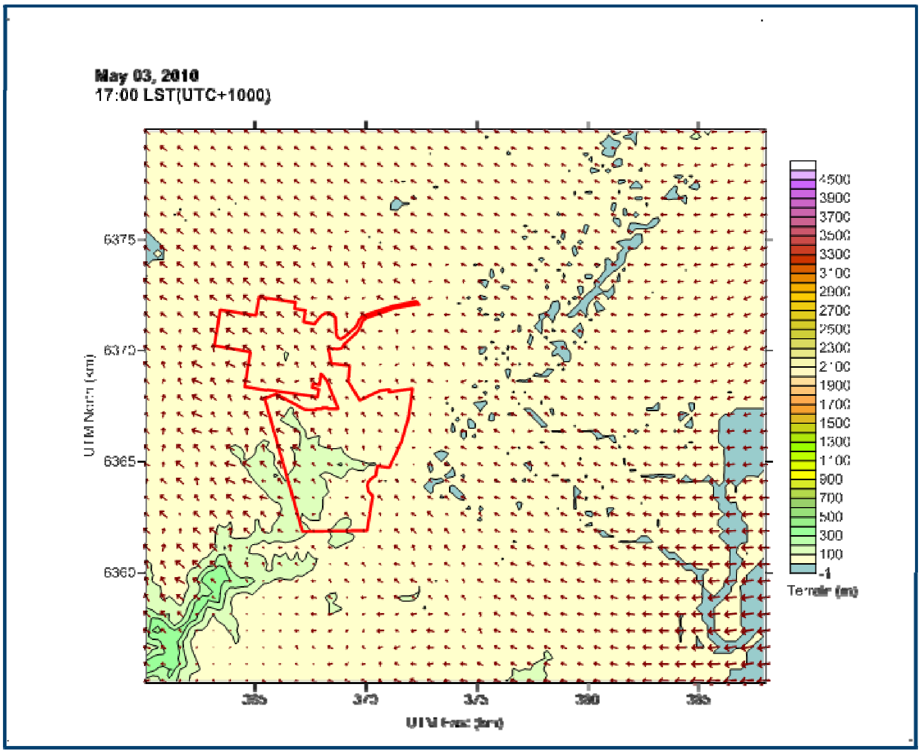

Figure 7-2: Representative snapshot of wind field for the Modification

CALMET generated meteorological data were extracted from a point (shown as CALMET [4154] on Figure 7-1) within the CALMET domain near the Abel Underground Mine (Figure 7-1). These data are graphically represented in Figure 7-3 and Figure 7-4.

Figure 7-3 presents the annual and seasonal windroses from the CALMET data. On an annual basis, winds from the west-northwest are most frequent. During summer, winds from the west-northwest dominate with a lesser portion of wind from the east to the south-southeast. The seasons of autumn and spring have a fairly similar wind distribution with winds predominately occurring from the west-northwest. In winter, west-northwest winds dominate the wind distribution.

Figure 7-4 includes graphs of the temperature, wind speed, mixing height and stability classification over the modelling period and show sensible trends considered to be representative of the area.

Figure 7-3: Annual and seasonal windroses from CALMET (Cell Ref 4154)

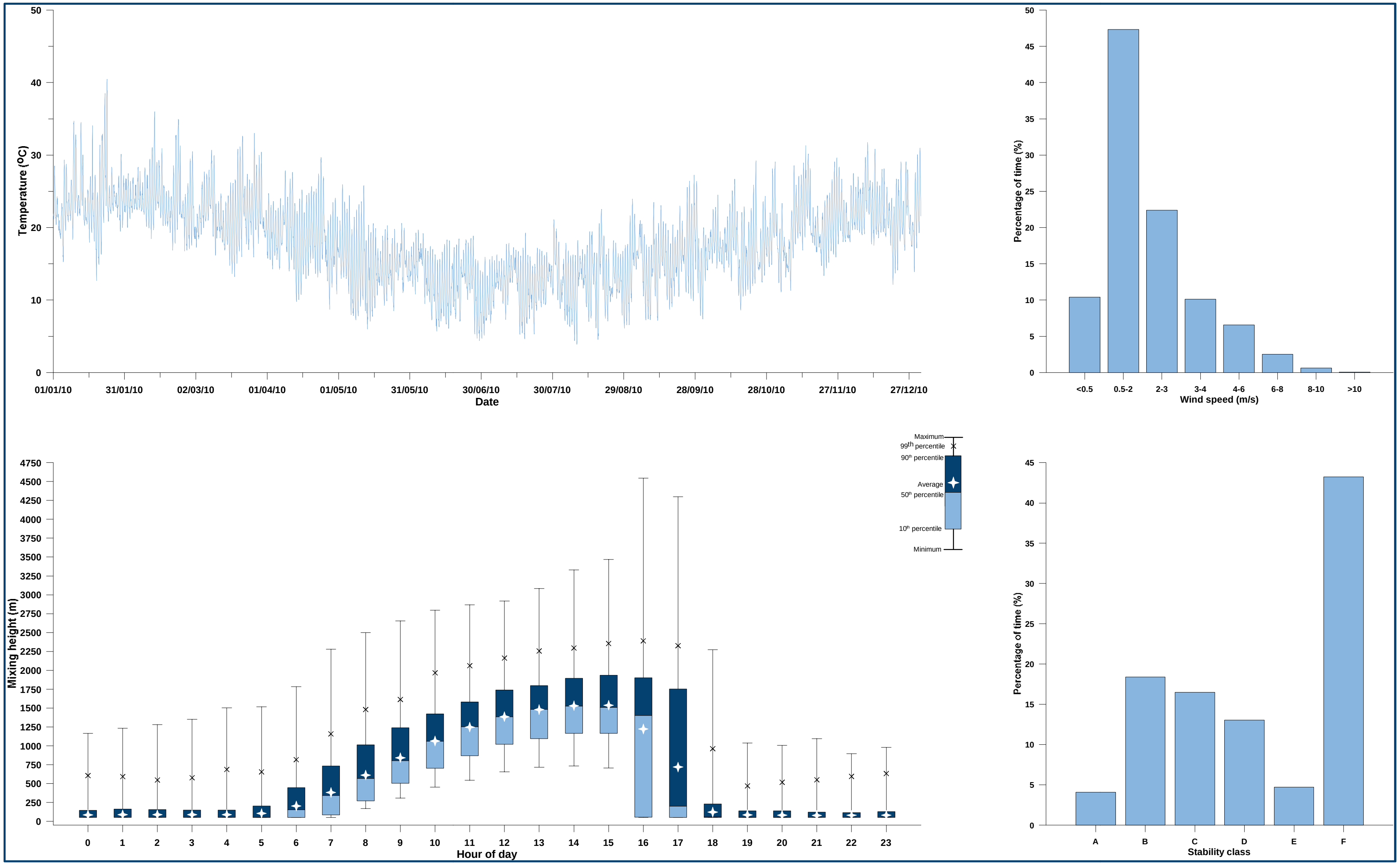

Figure 7-4: Meteorological analysis of CALMET (Cell Ref 4154)

7.2.2 Dispersion modelling

CALPUFF modelling is based on the application of three particle size categories Fine Particulates (FP), Coarse Matter (CM) and Rest (RE). The estimated emissions are presented in Section 6.1. The distribution of particles for each particle size category was derived from measurements made in the SPCC (1986) study and is presented in Table 7-2.

Emissions from each activity in Table 6-1 were represented by a series of volume sources and were included in the CALPUFF model via an hourly varying emission file. Meteorological conditions associated with dust generation (such as wind speed) and levels of dust generating activity were considered in calculating the hourly varying emission rate for each source. It should be noted that as a conservative measure, the effect of the precipitation rate (rainfall) in reducing dust emissions has not been considered in this assessment.

Table 7-2: Distribution of particles

Particle category	Size range	Distribution
Fine particulates (FP)	0 to 2.5 µm	4.68% of TSP
Coarse matter (CM)	2.5 to 10 µm	34.4% of TSP
Rest (RE)	10 to 30 µm	60.92% of TSP

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

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

8 ACCOUNTING FOR BACKGROUND DUST LEVELS

All significant dust generating operations surrounding the Abel Underground Mine and relevant to the Modification (i.e. the Bloomfield Colliery) were included in the dispersion model to assess the total potential dust impact.

Other, non-mining sources of particulate matter in the wider area would also have a contribution to existing ambient levels. As these sources have not been included in the dispersion modelling, an allowance for this contribution is required to fully assess the total potential impact.

The monitoring data collected in 2010, as presented in Section 5.2 have been used to estimate conservative background levels for use in assessing total potential air quality impacts.

It should be noted that these background levels would include the contribution from the existing operations at the Abel Underground Mine, Donaldson Open Cut Mine and Bloomfield Colliery. Hence the resulting estimate is considered to be significantly conservative for the purposes of this assessment.

The estimated annual average background levels that have been used for assessment purposes are presented in Table 8-1.

Table 8-1: Estimated background levels

Pollutant	Averaging period	Unit	Estimated background level
TSP	Annual	µg/m³	24
PM_{10}	Annual	µg/m³	13
Dust deposition	Annual	g/m²/month	1.3

To account for background levels when assessing total (cumulative) 24-hour average PM_{10} concentration impacts, only incremental levels are added to the estimated daily ambient dust levels (per the OEH contemporaneous assessment guidance). Further details regarding the total cumulative 24-hour average PM_{10} impacts are provided in Section 9.1.

9 DISPERSION MODELLING RESULTS

Dispersion model predictions are presented in this section. The results show:

- the estimated maximum 24-hour average $PM_{2.5}$ concentrations;
- annual average $PM_{2.5}$ concentrations;
- maximum 24-hour average PM_{10} concentrations;
- annual average PM_{10} concentrations;
- annual average TSP concentrations; and
- annual average dust (insoluble solids) deposition (DD).

It is important to note that when assessing impacts for a maximum 24-hour average concentration; these predictions show the highest modelled predicted 24-hour average concentrations that occur at any point within the modelling domain for the worst day (a 24-hour period) in the modelling period.

Each of the sensitive receptor locations shown in Figure 2-1 and detailed in Appendix A were assessed individually as discrete receptors. Results have been tabulated for both the "incremental" and "total" impacts. The incremental impacts refer to the potential impacts from activities only associated with the Abel Underground Mine and Bloomfield CHPP operating as per the Modification (i.e. those activities associated with the emissions detailed in Table 6-1). The total impacts refer to the cumulative impacts of the Modification and the Bloomfield Colliery (as per the emissions shown in Table 6-2 and the estimated background levels as described in Section 8).

Table 9-1 presents the model predictions at each of the discrete receptors and indicates that there are no predicted exceedances of the relevant criteria.

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

Table 9-1: Summary of dispersion modelling results (µg/m³)

Receptor ID	$PM_{2.5}$		PM_{10}		TSP	DD	PM_{10}	TSP	DD
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	24	8	50	-	-	2	30	90	4
Location A	0.8	0.1	6.1	0.9	1.6	0.05	15	27	1.4
Location C	0.3	0.1	2.4	0.4	0.8	0.02	15	27	1.4
Location D	0.2	0	1.7	0.2	0.4	0.01	14	26	1.4

Receptor ID	$PM_{2.5}$		PM_{10}		TSP	DD	PM_{10}	TSP	DD
	Incremental impact						Total impact		
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average
	Advisory*		Air quality impact criteria						
	24	8	50	-	-	2	30	90	4
Location E1	0.5	0.1	3.8	0.6	1.1	0.02	15	27	1.4
Location E2	0.4	0.1	3.2	0.6	1.2	0.02	15	27	1.4
Location E3	0.3	0.1	2.3	0.5	1	0.02	17	31	1.4
Location F	0.6	0.1	5.2	0.6	1.2	0.02	16	29	1.4
Location G	0.2	0	1.9	0.3	0.4	0.01	19	35	1.5
Location H	1.3	0.3	10.1	2.4	3.9	0.06	19	35	1.5
Location I	0.6	0.1	4.6	0.6	1	0.02	14	26	1.3
Location J	0.7	0.1	5.8	0.9	1.5	0.02	15	27	1.3
Location K1	0.5	0.1	3.6	0.7	1.4	0.05	15	28	1.5
Location K2	0.5	0.1	3.7	0.5	1	0.04	15	27	1.5
Location K3	0.3	0	2.6	0.3	0.5	0.01	14	26	1.4
Location L	3.1	0.5	24.5	3.5	6.1	0.08	18	33	1.4
Location M	0.4	0	2.7	0.4	0.6	0.01	20	36	1.5
Location N	0.3	0	1.9	0.2	0.4	0.01	19	33	1.4
Location R	0.5	0.1	4.3	0.6	1.4	0.05	14	26	1.4
Location S	0.6	0.1	4.7	0.5	1.3	0.05	14	26	1.4

*Advisory reporting standard for $PM_{2.5}$ concentrations (refer to Section 4.3)

9.1 Assessment of total (cumulative) 24-hour average PM_{10} concentrations

An assessment of cumulative 24-hour average PM_{10} impacts was undertaken in general accordance with the methods outlined in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW DEC, 2005).

As shown in Section 5.2, maximum recorded PM_{10} levels have in the past reached up to the criterion level or close to it (depending on the monitoring location) (and over it on one occasion at the Wallsend TEOM in January 2010). As a result, the first pass OEH approach of adding maximum background levels to maximum predicted mine only levels will show levels above the criterion regardless of any contribution from the Modification.

In such situations, the OEH approach applies a contemporaneous assessment of measured background levels added to that day's corresponding predicted mine only level.

Ambient (background) dust concentration data for the 2010 calendar year from the Beresfield TEOM station have been analysed for such an assessment.

As the existing mine was operational during this period, it is important to note that using measured data from the Beresfield TEOM would be significantly conservative, as it would "double count" existing activities at both the Abel Underground Mine and the Bloomfield Colliery in the cumulative assessment and hence provide a conservative over estimate of likely results.

In addition, the Beresfield TEOM is situated in an urban location, and as such, it would be exposed to a greater amount of particulate matter from various sources in comparison to the receivers around the Abel Underground Mine, which are generally situated in a more rural setting. This is quite evident when comparing the Beresfield TEOM data with the HVAS data measured near the Project.

To adjust for the potential bias in monitoring data and still permit assessment on all days (instead of on each sixth HVAS run day), an analysis of the HVAS and TEOM monitoring data for the same period was made. On average the HVAS monitors near the Abel Underground Mine recorded PM_{10} concentrations approximately 75% lower than the TEOM monitor. As a conservative measure a 10% reduction to the TEOM monitored results (instead of the full 25%) was applied to compensate for the potential bias in measured results.

Table 9-2 provides a summary of the number of days that the Modification would result in additional exceedances of the 24-hour PM_{10} criterion of 50µg/m³, based on the findings from the contemporaneous assessment.

Detailed tables of the full assessment results are provided in Appendix F.

The results in Table 9-2 indicate that the Modification could successfully operate without resulting in additional exceedances of the OEH 24-hour average PM_{10} criterion at any of the receiver locations.

Table 9-2: Contemporaneous assessment - maximum number of additional days above 24-hour average criterion

Receptor ID	Number of days
Location A	0
Location C	0
Location D	0
Location E1	0
Location E2	0
Location E3	0
Location F	0
Location G	0
Location H	0
Location I	0
Location J	0
Location K1	0
Location K2	0
Location K3	0
Location L	0
Location M	0
Location N	0
Location R	0
Location S	0

10 ASSESSMENT OF TRAIN DUST IMPACTS

10.1 Introduction

The product coal produced from the Bloomfield CHPP will be transported off-site via train to the Port of Newcastle. During this transportation process there is a potential for the generation of coal dust emissions, which will vary depending on various factors including the material properties of the product coal, meteorological factors and train factors. This section investigates the sources of emissions from train transport and factors that influence the emissions to provide a qualitative assessment of the potential train dust impacts originating from the transport of coal from the Abel Underground Mine.

10.2 Potential coal dust emissions

Coal dust emissions that occur during train transport have the potential to originate from the coal surface of loaded wagons, leakage from doors of wagon, wind erosion of spilled coal in corridor, residual coal in unloaded wagons, and parasitic load on sills, shear plates and bogies of wagons.

The emission from the surface of loaded wagons has been identified as the primary source with the most potential to generate dust emissions. This source provides a significant exposed area which is subject to wind erosion and air movement during transport. The amount of dust generated during this process is related to the inherent dustiness of the coal material (Connell Hatch, 2008).

Coal dust can potentially leak from the bottom doors of train wagons and fall into the ballast of the train line. This occurs when the doors of the wagon are not completely sealed, with the amount of material released depending on material properties of the coal and the vibrational forces experienced by the coal in the wagons potentially breaking down the coal material resulting in additional particles. Dust impacts from this source are considered to be low as the ballast would provide a sufficient shielding effect to prevent particle lift-off (Connell Hatch, 2008).

During the loading process and in transit, there is potential for coal material to be spilled into the train corridor and cause parasitic loading on the sills, shear plates and bogies. These sources of emissions are easily prevented by careful loading of the material and profiling the shape of the load (Connell Hatch, 2008).

Residual coal remaining in the unloaded wagons would quickly dry and become airborne during travel back to the site. This source is dependent on meteorological conditions and the train travel speed, turbulent air is generated in the unloaded wagon space causing the residual coal particles to become airborne.

10.3 Site specific product coal testing

Site specific testing was conducted to determine the relative dustiness of the product coal from the Bloomfield CHPP. Testing of the dust extinction moisture level (DEM) and the threshold friction velocity of the sample was conducted to determine the moisture level at which only minor dust emissions could be expected and the surface wind speeds at which dust begins to be raised from the surface respectively.

The result of the DEM testing for product coal from the Project is presented in Appendix G. The DEM of the sample was determined to be 5.5% moisture. This indicates that minimal dust emissions can be expected from the product coal when held at moisture content levels above this value, the typical moisture content of the product coal from the site is 8% which higher than the determined DEM.

Results of testing conducted on the product coal to determine those wind speeds at which saltation, minor dust lift-off and major dust-off occurs is provided in Appendix G. These results show that saltation occurs at wind speeds of 28.5 metres per second (m/s) (102.6 kilometres per hour (km/h)), minor lift-off at 29.6m/s (106.6km/h) and major lift-off at speeds greater than 30m/s (108km/h). When considering expected peak train travel speeds of 60 to 80km/hr, these results indicate that as the saltation wind speeds are substantially higher it is unlikely that dust lift-off would occur.

10.4 Analysis of potential emissions

Based on the laboratory testing of product coal from the Abel Underground Mine it is unlikely that significant emissions would be generated during the rail transport.

It is recognised that the surface of the coal material exposed on each wagon can lose moisture under influences of the prevailing meteorological conditions (such as temperature and wind speed) and train speed (air flow generated from train movement), and therefore the potential for dust emissions could increase. However as the approximate distance of rail transports to the Port of Newcastle from the Bloomfield CHPP is relatively short (25km one way), it is not anticipated that material drying of the coal surface would occur during rail transport.

A comprehensive study of dust emissions generated during rail transport of coal for Queensland Rail Limited (QR) has been conducted (Connell Hatch, 2008). The study found, through both monitoring and modelling of emissions of dust during rail transport of coal, there appears to be minimal risk of adverse impacts on human health or amenity outside the rail corridor.

Based on monitoring data, there was found to be no potential for adverse health impacts due to coal dust emissions from trains inside or outside of the rail corridor when assessed against relevant air quality criteria. There was found to be no potential for adverse impacts to amenity outside the rail corridor when assessed against dust deposition guideline levels.

Modelling conducted showed that ground-level concentrations of PM_{10} would be unlikely to exceed criteria levels at 10m from the track (Connell Hatch, 2008).

The findings of the QR study and the site specific testing of the product coal suggest that the potential dust emissions generated during the transportation of product coal from the Bloomfield CHPP would be minimal, and hence the potential for any adverse air quality impacts would also be low.

11 ASSESSMENT OF POTENTIAL CONSTRUCTION IMPACTS

To accommodate the increase in ROM coal production associated with the Modification and the Tasman Extension Project, modifications and upgrades to the Bloomfield CHPP are required. This involves the construction and installation of the additional CHPP module and associated upgrades to the conveyor system.

The construction and installation process will temporarily generate dust through minor earthworks within the area approved to be cleared and disturbed as part of the Abel Underground Mine EA.

The impact due to these activities is difficult to accurately quantify due to the short, sporadic periods of dust generating activity that may occur over the construction time frame. However the total amount of dust generated from such activities would be minor and given the construction activity would be located relatively close to the main dust generating activities of the mine, the additional sporadic impact due to construction activities would not be discernible at any off-site receptor.

To ensure dust generation from construction is controlled, the site would utilise the existing site air quality management and mitigation measures to control potentially unwarranted dust emissions. These management and mitigation measures would apply to the construction activities with the most potential for dust impacts and would be based on the prevention of any significant visible dust emissions and ensure all applicable best practice measures are taken to minimise dust during the construction process.

The major dust emissions during the construction phase are identified as vehicles travelling on temporary access roads, handling of materials and wind erosion of exposed areas.

Potential mitigation measures to control dust from the construction activities would include:

- maintaining sufficient levels of moisture on the surface of trafficked surfaces;
- limiting vehicle speeds on construction areas; and,
- rehabilitating completed sections of the site as soon as practicable.

Relative to the mining operations, the scale of emissions generated during construction would be small, and therefore, provided that reasonable construction dust controls are implemented and managed, there would not be any discernible effect at any off-site receptors above that predicted for ongoing operations.

12 GREENHOUSE GAS ASSESSMENT

12.1 Introduction

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

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

This assessment aims to estimate the predicted emissions of GHGs emitted to the atmosphere due to the Modification.

12.2 Greenhouse Gas Inventories

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

Scope 1 and 2 emissions encompass the direct sources from the proposed Project defined as:

> *...from sources within the boundary of an organisation as a result of that organisation's activities* (DCCEE, 2011a).

Scope 3 emissions occur due to the indirect sources from the proposed Project as:

> *...emissions generated in the wider economy as a consequence of an organisation's activities (particularly from its demand for goods and services), but which are physically produced by the activities of another organisation* (DCCEE, 2011a).

Scope 3 emissions can often result in a significant component of the total emissions inventory. As defined above, these emissions are not directly controlled by the Abel Underground Mine and as such are difficult to accurately quantify which can result in an overestimation of these emissions.

12.2.1 Emission Sources

Scope 1 and 2 emission sources identified from the operation of the Modification are the on-site combustion of liquid fuels and gaseous fuels, the release of methane from the coal seams as fugitive emissions and the on-site consumption of electricity. Scope 3 emissions have been identified as resulting from the purchase of fuels and electricity for use on-site, the emissions generated during the transport of the product to its final destination and the final use of the product (i.e. coal combustion).

Estimated quantities of materials that have the potential to emit GHG emissions associated with Scope 1 and 2 emissions for the Modification have been summarised in Table 12-1 below. These estimates are based on information provided by Donaldson Coal and provide a reasonable approximation for the purpose of this assessment.

Table 12-1: Summary of quantities of materials used for the Modification

Year	Product Coal (kt)	Electricity Usage (kWh)	Diesel usage (kL)	Petrol usage (kL)	Gaseous fuel (m^3)	Fugitive (kg CO_2-e)
1	2,137	36,070,687	1,398	23	738	52,615
2	3,537	59,716,439	2,314	38	1,222	87,106
3	4,800	81,046,574	3,141	52	1,658	118,219
4	4,753	80,252,648	3,110	51	1,642	117,061
5	4,240	71,585,627	2,774	46	1,465	104,419
6	4,425	74,708,401	2,895	48	1,529	108,974
7	4,492	75,846,361	2,939	48	1,552	110,634
8	4,219	71,228,360	2,760	45	1,458	103,898
9	3,337	56,342,255	2,183	36	1,153	82,184
10	2,800	47,265,039	1,832	30	967	68,943
11	2,809	47,423,824	1,838	30	970	69,175
12	1,305	22,031,436	854	14	451	32,136
13	1,169	19,742,284	765	13	404	28,797
14	814	13,748,145	533	9	281	20,054
15	858	14,489,143	561	9	296	21,135
16	1,522	25,696,726	996	16	526	37,483
17	667	11,260,512	436	7	230	16,425

Scope 3 emissions generated from the transport and final use of the coal may have the potential to vary in the future depending on the market situation at the time. To provide a reasonable estimate of the emissions generated, assumptions have been made that include the transport mode of rail and emissions from the final use of the coal have also been estimated based on the energy content factor of the various types of coal.

The estimated electrical usage required for the operation of the Bloomfield CHPP is summarised in Table 12-2 below. These estimates are based on information provided by Donaldson Coal and provide a reasonable approximation for the purpose of this assessment.

Table 12-2: Summary of electricity usage for the Bloomfield CHPP

Year	Electricity Usage (kWh)
1	5,201,000
2	6,391,000
3	8,376,000
4	8,520,000
5	8,138,000
6	8,374,000
7	8,460,000
8	8,183,000
9	7,058,000
10	6,372,000
11	5,084,000
12	3,093,000
13	2,920,000
14	2,467,000
15	2,112,000
16	2,406,000
17	1,313,000
18	241,000

12.2.2 Emission Factors

To quantify the amount of carbon dioxide equivalent (CO_2-e) material generated from the proposed Project, emission factors obtained from the NGA Factors (DCCEE, 2011a) are required and are summarised in Table 12-3.

Table 12-3: Summary of emission factors

Type	Energy content factor	Emission Factor			Units	Scope	Source
		CO_2	CH_4	N_20			
Diesel oil	38.6 GJ/kL	69.2	0.2	0.5	(kg CO2-e/GJ)	1	Table 4 (DCCEE, 2011a)
	-	5.3	-	-		3	Table 38 (DCCEE, 2011a)
Gasoline	34.2 GJ/kL	66.7	0.6	2.3	(kg CO2-e/GJ)	1	Table 4 (DCCEE, 2011a)
	-	5.3	-	-		3	Table 38 (DCCEE, 2011a)
Gaseous fuel	39.3×10^{-3} GJ/m^3	51.2	0.1	0.03	(kg CO2-e/GJ)	1	Table 2 (DCCEE, 2011a)
	-	15	-	-		3	Table 38 (DCCEE, 2011a)
Electricity usage	-	0.89	-	-	(kg CO2-e/GJ)	2	Table 5 (DCCEE, 2011a)
	-	0.17	-	-		3	Table 39 (DCCEE, 2011a)

The emission factor based on the release of methane from the coal seams at the Abel Underground Mine is determined by following methods used to estimate fugitive emissions from underground coal mining. This emission factor has been calculated based on actual testing of the methane gas from the coal seam provided by Donaldson Coal. The equivalent fugitive emissions generated from the mine are estimated at 24.6 t CO_2-e/kt of product coal, and this rate of emissions is assumed to continue for the life of the Modification. This emission factor is lower than the default factor provided in the NGA Factors document and should provide a more accurate estimate of emissions generated for the site. It should be also noted that no flaring of GHG gases currently occurs at the Abel Underground Mine.

Emissions associated with the transport of product coal to customers will occur via rail. Product coal is transported to the Port of Newcastle by rail; with the approximate return rail distance taken to be 50km. The emission factor associated with the rail transport activity is taken to be 12.3g/tonne/km (QR Network Access, 2002).

The emissions generated from the end use of coal produced by the Abel Underground Mine have assumed that all product coal is consumed as thermal coal or coking coal. As it is difficult to estimate emissions from power stations in other countries, this assessment has assumed the emissions generated would be equivalent to those generated from a power station in NSW. The NGA Factors document provides an emission factor of 88.43kg CO2-e/GJ and 90.22kg CO2-e/GJ, with an energy content factor of 27GJ/t and 30GJ/t for thermal coal and coking coal respectively (DCCEE, 2011a).

12.3 Summary of Emissions

Table 12-4 summarises the estimated annual CO_2-e emissions generated from the Modification.

Table 12-4: Summary of CO_2-e emissions for the Modification (t CO_2-e)

Year	Diesel		Petrol		Gas		Fugitive	Electricity		Rail	Coal Burning	
											Thermal	Coking
	Scope 1	Scope 3	Scope 1	Scope 3	Scope 1	Scope 3	Scope 1	Scope 2	Scope 3	Scope 3	Scope 3	Scope 3
1	3,772	286	55	4	1	0	52,615	32,103	6,132	1,314	3,927,874	1,330,011
2	6,244	473	91	7	2	1	87,106	53,148	10,152	2,175	6,502,749	2,201,886
3	8,474	643	123	9	3	1	118,219	72,131	13,778	2,952	8,825,468	2,988,378
4	8,391	636	122	9	3	1	117,061	71,425	13,643	2,923	8,739,015	2,959,104
5	7,485	568	109	8	3	1	104,419	63,711	12,170	2,608	7,795,230	2,639,531
6	7,812	592	113	9	3	1	108,974	66,490	12,700	2,721	8,135,281	2,754,675
7	7,931	601	115	9	3	1	110,634	67,503	12,894	2,763	8,259,197	2,796,634
8	7,448	565	108	8	3	1	103,898	63,393	12,109	2,595	7,756,326	2,626,358
9	5,891	447	86	7	2	1	82,184	50,145	9,578	2,052	6,135,321	2,077,472
10	4,942	375	72	5	2	1	68,943	42,066	8,035	1,722	5,146,869	1,742,773
11	4,959	376	72	5	2	1	69,175	42,207	8,062	1,728	5,164,160	1,748,628
12	2,304	175	33	3	1	0	32,136	19,608	3,745	803	2,399,086	812,351
13	2,064	157	30	2	1	0	28,797	17,571	3,356	719	2,149,812	727,945
14	1,438	109	21	2	1	0	20,054	12,236	2,337	501	1,497,088	506,927
15	1,515	115	22	2	1	0	21,135	12,895	2,463	528	1,577,778	534,249
16	2,687	204	39	3	1	0	37,483	22,870	4,368	936	2,798,214	947,499
17	1,177	89	17	1	0	0	16,425	10,022	1,914	410	1,226,200	415,202
TOTAL	**84,534**	**6,411**	**1,228**	**93**	**32**	**10**	**1,179,258**	**719,524**	**137,436**	**29,450**	**88,035,668**	**29,809,623**

Table 12-5 summarises the estimated annual CO_2-e emissions generated from the Bloomfield CHPP.

Table 12-5: Summary of CO_2-e emissions for the Bloomfield CHPP (t CO_2-e)

Year	Electricity	
	Scope 2	Scope 3
1	4,629	884
2	5,688	1,086
3	7,455	1,424
4	7,583	1,448
5	7,243	1,383
6	7,453	1,424
7	7,529	1,438
8	7,283	1,391
9	6,282	1,200
10	5,671	1,083
11	4,525	864
12	2,753	526
13	2,599	496
14	2,196	419
15	1,880	359
16	2,141	409
17	1,169	223
18	214	41

12.4 Contribution of Greenhouse Gas Emissions

Table 12-6 summarises GHG emissions associated with the Modification based on Scopes 1, 2 and 3.

Table 12-6: Summary of CO_2-e emissions per Scope (t CO_2-e)

Year	Scope 1	Scope 2	Scope 3	Scope 1+2
1	56,442	36,732	5,266,506	93,174
2	93,443	58,836	8,718,530	152,278
3	126,820	79,586	11,832,654	206,406
4	125,577	79,008	11,716,780	204,585
5	112,015	70,954	10,451,498	182,969
6	116,902	73,943	10,907,403	190,845
7	118,682	75,033	11,073,538	193,715
8	111,456	70,676	10,399,352	182,132
9	88,163	56,426	8,226,078	144,589
10	73,959	47,737	6,900,863	121,696
11	74,208	46,732	6,923,824	120,940
12	34,474	22,361	3,216,689	56,835
13	30,892	20,169	2,882,487	51,062
14	21,513	14,431	2,007,382	35,944
15	22,672	14,775	2,115,493	37,447
16	40,210	25,011	3,751,633	65,221
17	17,620	11,190	1,644,040	28,811
TOTAL	**1,265,048**	**803,600**	**118,034,750**	**2,068,649**

In 2010, the estimated GHG emissions for Australia were 543 million tonnes (Mt) CO_2-e (DCCEE, 2011b). In comparison, the estimated annual average GHG emission for the life of the Project is 0.12 Mt CO_2-e (Scopes 1 and 2). Therefore, the annual contribution of GHG emissions from the Modification in comparison to the Australian GHG emissions in 2010 is approximately 0.02%.

12.5 Greenhouse Gas Management

The Abel Underground Mine has identified various mitigation and energy management measures to help reduce GHG emissions, including:

- monitoring fuel efficiency of diesel equipment;
- optimising conditions for fleet operations;
- use of high efficiency electric motors;
- investigating efficiency of transformers;
- maximising production during off-peak hours and reducing during peak hours;
- conducting energy awareness programs for staff;
- efficient lighting systems with photo-sensors and timers; and
- a review of alternative renewable energy sources.

These measures would provide the basis for identifying and reducing GHG emissions associated with the Modification.

13 DUST MITIGATION AND MANAGEMENT

The activities associated with the Modification will generate dust. To ensure these activities have a minimal effect on the surrounding environment and sensitive receptors, it is required that all reasonable and practicable dust mitigation measures are utilised.

The Abel Underground Mine currently has suitable dust emissions management and control procedures in place as well as a comprehensive air quality monitoring network.

These practices are based on current best practice measures, and would continue to be implemented for the Modification and have been summarised in Section 6.2.

The location of the existing air quality monitoring network is shown in Figure 5-2. This network is considered representative of areas nearby sensitive receptors and appears suitable for the current Abel Underground Mine. Given that there would be no change to the location of potential dust sources (i.e. they are associated with fixed infrastructure), the existing air quality monitoring network would be suitable for the Modification.

14 CONCLUSIONS

The Abel Underground Mine is an existing underground mine that has been operating since 2008 in close proximity to the Donaldson Open Cut Mine and Bloomfield Colliery.

The existing Abel Underground Mine has been compliant with relevant environmental conditions for the site relevant to air quality.

The Modification has the potential to increase dust emission from the Abel Underground Mine due to an increase in ROM coal production, handling, transport and processing.

This study has examined the potential dust impacts that may arise from the Modification.

The study has found that no sensitive receptor would be subject to any annual average impacts above criteria for PM_{10}, TSP and deposited dust. This includes potential impacts from the Modification, the Bloomfield Colliery and background sources. It should be noted that the Donaldson Open Cut Mine is scheduled for completion at the end of 2013 (i.e. prior to changes to the Abel Underground Mine associated with the Modification), and as such, some improvement to background air quality in the area would be expected.

This assessment also found that levels of $PM_{2.5}$ would be low and below advisory standard levels.

A contemporaneous assessment of 24-hour average PM_{10} levels indicated that maximum 24-hour average PM_{10} dust concentrations for the Modification would not cause additional impacts at any receptor location.

An assessment of the potential dust impacts from rail transport found that emissions from this activity are low and potential impacts are unlikely to extend beyond the rail corridor.

The Modification would not be likely to result in any adverse air quality impacts at any sensitive receptor or in the general vicinity.

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