Tasman Extension Project

Environmental Impact Statement

APPENDIX J

AIR QUALITY AND GREENHOUSE GAS ASSESSMENT

Resource Strategies

DONALDSON COAL

Part of Gloucester Coal

REPORT

TASMAN EXTENSION PROJECT – AIR QUALITY AND GREENHOUSE GAS ASSESSMENT

Donaldson Coal Pty Limited

Job No: 6131

4 April 2012

A PEL Company

PROJECT TITLE:	**AIR QUALITY IMPACT ASSESSMENT – TASMAN EXTENSION PROJECT**
JOB NUMBER:	**6131**
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EXECUTIVE SUMMARY

Overview

Donaldson Coal Pty Limited is seeking consent for the extension of underground mining operations at the existing Tasman Underground Mine (herein referred to as the Tasman Extension Project). The proposed extension would allow for an additional operational life of approximately 15 years. Run-of-mine coal produced for the Project would continue to be transported by public and private road approximately 16 kilometres to the Bloomfield Coal Handling and Preparation Plant where the coal is processed prior to rail transport to the Port of Newcastle and other customers.

An Air Quality and Greenhouse Gas Assessment for the proposed extension has been prepared in accordance with the relevant assessment requirements.

Existing Environment

The majority of the Development Application area comprises vegetated land reserved as the Sugarloaf State Conservation Area and Heaton State Forest. The area is characterised by undulating to steep terrain comprising the prominent Sugarloaf Range ridgeline trending north-south and several natural drainage gullies. Private land holdings occur within the western and northern portions of the Development Application area and for the purposes of assessing impacts from the Project, discrete receptor locations are selected.

Meteorological data collected at a meteorological station at the Tasman Underground Mine shows a prominent westerly pattern of winds for the area. An air quality monitoring program, established in November 2006, shows that since monitoring has begun there have been no exceedances of the long term impact average assessment criteria for particulate matter with an equivalent aerodynamic diameter less than 10 mircons (µm) (PM_{10}), total suspended particles (TSP) and dust deposition.

Emissions

The key air quality issues assessed are emissions of dust and particulate matter (PM) during the operation of the Tasman Extension Project. During construction, fugitive dust emissions can also be expected, however the total estimated dust emissions are less than 40 percent (%) of the emissions estimated to occur during operation of the Project. Therefore compliance with air quality goals during the operation of the mine is assumed to represent compliance during mine construction. During operation, the Project will result in emissions of PM from coal handling activities at the pit top and the operation of upcast ventilation shafts.

Impact Assessment

Two modelling scenarios were assessed, accounting for maximum coal production at the proposed new pit top and coal production when both the existing pit top and the new pit top are operational. The results of the modelling indicate that the predicted incremental PM_{10}, particulate matter with an equivalent aerodynamic diameter less than 2.5µm ($PM_{2.5}$), TSP and dust deposition at the closest residential receptors are all well below the impact assessment criteria. A cumulative assessment, incorporating existing background levels, indicates that the Project is unlikely to result in any additional exceedances of relevant impact assessment criteria.

Greenhouse Gas Assessment

An assessment of the greenhouse gas emissions associated with the Project indicates that average annual scope 1 emissions would represent approximately 0.003% of Australia's commitment under the Kyoto Protocol (591.5 million tonnes of carbon dioxide equivalent [Mt CO_2-e]) and a very small portion of global greenhouse emissions.

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1 INTRODUCTION

Donaldson Coal Pty Limited (Donaldson Coal), is seeking consent for the extension of underground mining operations at the existing Tasman Underground Mine (herein referred to as the Tasman Extension Project [the Project]). Approval is sought from the New South Wales (NSW) Minister for Planning and Infrastructure under Division 4.1 of Part 4 of the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act) for the Project.

1.1 Background

The Tasman Underground Mine is an underground coal mining operation located approximately 20 kilometres (km) west of the Port of Newcastle, NSW in the Newcastle Coalfield. It is currently approved to produce approximately 975,000 tonnes per annum (tpa) of run-of-mine (ROM) coal using bord and pillar mining methods.

ROM coal produced at the Tasman Underground Mine is transported approximately 16 km along public roads (i.e. George Booth Drive and John Renshaw Drive) and then approximately 4 km along private sealed roads to the Bloomfield Coal Handling and Preparation Plant (CHPP) where the coal is processed prior to rail transport to the Port of Newcastle and other customers.

Donaldson Coal also operates the Donaldson Open Cut Mine and Abel Underground Mine within the Newcastle Coalfield.

1.2 Study Requirements

The Air Quality and Greenhouse Gas Assessment is guided by the Director-General's Environmental Assessment Requirements (EARs), outlined in **Table 1.1**. Detailed agency comments have also been outlined by the NSW Office of Environment and Heritage (OEH)[1] and Lake Macquarie City Council and are provided in **Table 1.2 and Table 1.3**.

The Air Quality and Greenhouse Gas Assessment has been prepared in accordance with the EARs, the NSW OEH *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (Approved Methods) (**DEC, 2005**) and other agency comments.

[1] The NSW EPA exists as a legal entity operated within the Office of Environment and Heritage (OEH) which came into existence in April 2011. The OEH was previously part of the Department of Environment, Climate Change and Water (DECCW). The DECCW was also recently known as the Department of Environment and Climate Change (DECC), and prior to that the Department of Environment and Conservation (DEC). The terms NSW EPA, OEH, DECCW, DECC and DEC are interchangeable in this report.

Table 1.1: Director-General's environmental assessment requirements

Discipline	Requirement
Air	*"including a quantitative assessment of potential:*
	- *construction and operational impacts, with a particulate focus of dust emissions including $PM_{2.5}$ and PM_{10} emissions and dust generation from coal transport;*
	- *reasonable and feasible mitigation measures to minimise dust emissions, including evidence that there are no such measures available other than those proposed; and*
	- *monitoring and management measures, in particular real time air quality monitoring;"*
Greenhouse Gases	*"including:*
	- *a quantitative assessment of the potential scope 1, 2 and 3 greenhouse gas emissions from the project;*
	- *a qualitative assessment of the potential impacts of these emissions on the environment; and*
	- *an assessment of the reasonable and feasible measures that could be implemented on site to minimise the greenhouse gas emissions of the project"*

Table 1.2: OEH specific agency comments

Air Quality	Addressed In
Assess the risk associated with potential discharges of fugitive and point source emissions for all stages of the proposal. Assessment of risk relates to environmental harm, risk to human health and amenity. Justify the level of assessment undertaken on the basis of risk factors, including but not limited to: *a. proposal location,* *b. characteristics of the receiving environment,* *c. type and quantity of pollutants emitted.*	Section 6.1.3
Describe the receiving environment in detail. The proposal must be contextualised within the receiving environment (local, regional and inter-regional as appropriate). The description must include but need not be limited to: *a. Meteorology and climate,* *b. Topography,* *c. Surrounding land use, receptors and* *d. Ambient air quality.*	Sections 3 and 5
Include a description of the proposal. All processes that could results in air emissions must be identified and described. Sufficient detail to accurately communicate the characteristics and quantify of all emissions must be provided.	Sections 2 and 8.2
Include a consideration of 'worse case' emission scenarios and impacts at proposed emission limits.	Section 9
Account for cumulative impacts associated with existing emission sources as well as any currently approved developments linked to the receiving environment.	Section 8.4
Include air dispersion modelling where there is a risk of adverse air quality impacts or where there is sufficient uncertainty to warrant a rigorous numerical impact assessment. Air dispersion modelling must be conducted in accordance with the Approved Methods of the Modelling and Assessment of Air Pollutants in NSW (2005). http://www.environment.nsw.gov.au/resources/air/ammodelling05361.pdf.	Sections 8 and 9
Demonstrate the proposals ability to comply with the relevant regulatory framework specifically the Protection of the Environment Operations (POEO) Act (1997) and the POEO (Clean Air) Regulation (2002).	Section 4.2.1
Provide an assessment of the project in terms of the priorities and targets adopted under the NSW State plan 2010 and its implementation plan Action for Air.	Section 4.2.2
Detail emission control techniques / practices that will be employed by the proposal.	Section 10

Air Quality Greenhouse Gas	Addressed In
The EIA should include a comprehensive assessment of, and report on, the project's predicted greenhouse gas emissions (tCO2e). Emissions should be reported broken down by: • *direct emissions (scope 1 as defined by the Greenhouse Gas Protocol),* • *indirect emissions from electricity (scope 2), and* • *upstream and downstream emissions (scope 3).* *before and after implementation of the project, including annual emissions for each year of the project (construction, operation and decommissioning).*	Section 9
The EIA should include an estimate of the greenhouse emissions intensity (per unit of production). Emissions intensity should be compared with best practice if possible.	
The emissions should be estimated using an appropriate methodology, in accordance with NSW, Australian and international guidelines.	
The proponent should also evaluate and report on the feasibility of measures to reduce greenhouse gas emissions associated with the project. This could include a consideration of energy efficiency opportunities or undertaking an energy use audit for the site	

Table 1.3: Lake Macquarie City Council comments

Air Quality	Addressed In
Regarding the air quality impact assessment, the DGRs should include a study in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (NSW DEC, 2005), incorporating the following:	
Description of existing local air environment, including dispersion meteorology and existing dust levels, using site representative monitoring data.	Section 5
Determination of background concentrations at nearest sensitive receivers, in terms of total suspended particles (TSP), particulate matter (less than 10 micrometres diameter, namely PM_{10}) and dust deposition.	Section 5
Identification of all dust sources from both the construction stage and the operational stage of the development, and associated estimation of quantified emissions.	Section 7
Discussion of air quality goals relevant to assessment, such as impact assessment criteria presented in the Approved Methods (NSW DEC, 2005).	Section 4
Description of approach to the assessment, including assumptions underlying modelling methods.	Section 6
Estimation of air quality impacts and comparison with impact assessment criteria. For example, parameters as follows: *- Predicted annual average TSP concentration, micrograms per cubic metre ($\mu g/m^3$)* *- Predicted maximum 24-hour average PM_{10} concentration, $\mu g/m^3$* *- Predicted annual average PM_{10} concentration, $\mu g/m^3$* *- Predicted annual average dust deposition, (g/m^2/month)*	Section 8
Description of dust mitigation measures and equipment, and management protocols for both construction and operational stages.	Section 10
Greenhouse Gas	
Discussion of all greenhouse gases and source activities associated with both the construction stage and the operational stage of the development.	Section 9
Quantified estimation of each greenhouse gas produced per year, in accordance with the methods of the National Greenhouse and Energy Reporting (NGER) scheme.	
Discussion of options for alternative fuel sources and technologies to reduce greenhouse gas emissions.	
Justification for chosen fuel source and technology in terms of greenhouse gas emissions.	

2 PROJECT DESCRIPTION

The Tasman Underground Mine is located approximately 20 kilometres (km) west of the Port of Newcastle, NSW in the Newcastle Coalfield (refer **Figure 2.1**). The Project is a proposed extension of underground mining operations at the Tasman Underground Mine for an additional operational life of approximately 15 years.

The Project would include the following activities:

- continued underground mining of the Fassifern Seam using a combination of total and partial pillar extraction methods within Mining Lease (ML) 1555;
- underground mining of the West Borehole Seam using a combination of total and partial pillar extraction methods;
- production of ROM coal up to 1.5 million tonnes per annum (Mtpa);
- development of a new pit top facility, associated ROM coal handling infrastructure and intersection with George Booth Drive;
- development of ventilation surface infrastructure;
- continued transport of Fassifern Seam ROM coal from the existing Tasman Underground Mine pit top to the Bloomfield CHPP via truck on public and private roads to approximately 2015 (inclusive);
- transport of West Borehole Seam ROM coal from the new pit top to the Bloomfield CHPP via truck on public and private roads;
- progressive development of sumps, pumps, pipelines, water storages and other water management equipment and structures;
- ongoing exploration activities;
- ongoing surface monitoring, rehabilitation and remediation of subsidence effects; and
- other associated infrastructure, plant, equipment and activities.

An indicative Project general arrangement is shown in **Figure 2.2** including the extent of underground mining in the Fassifern and West Borehole seams.

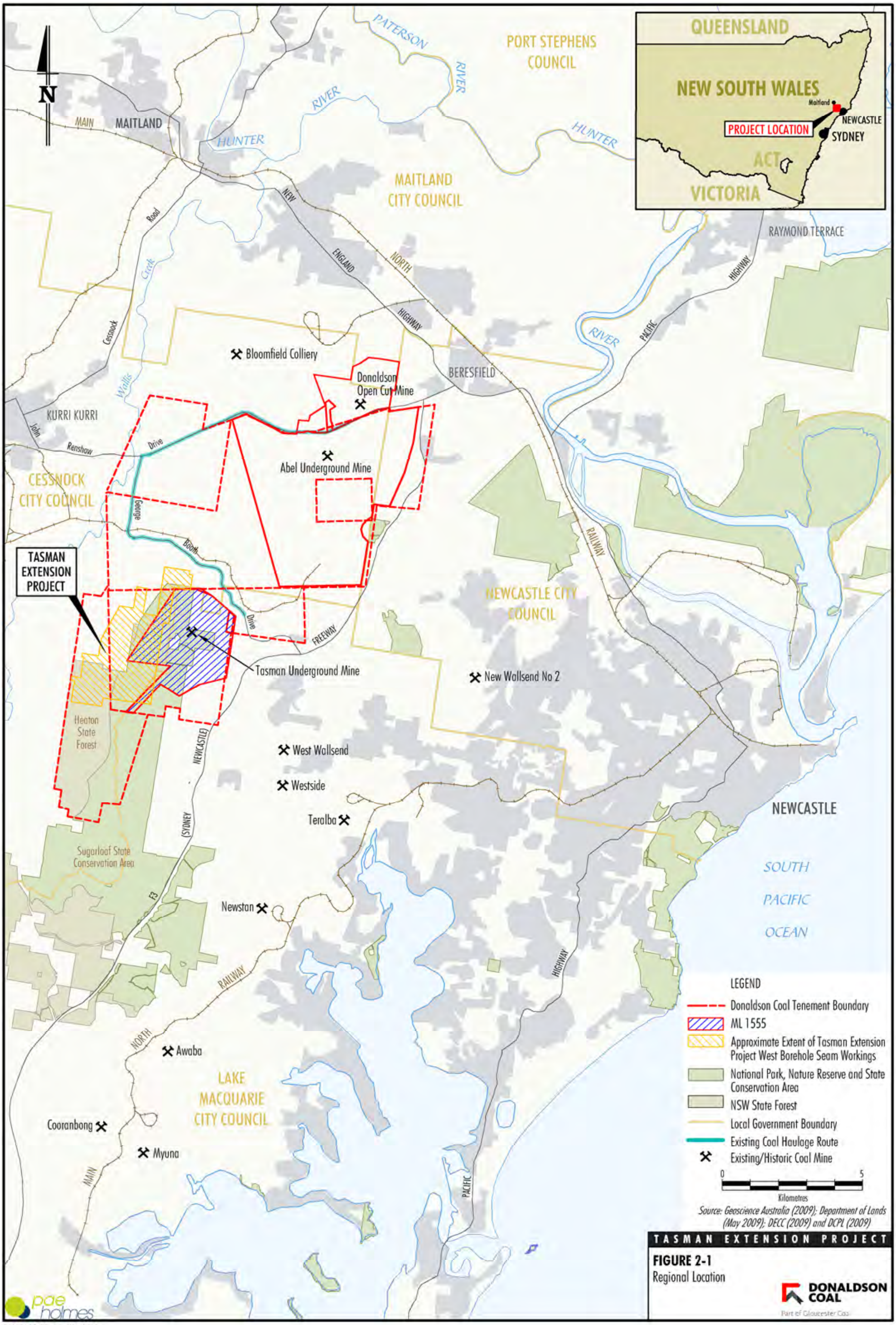

FIGURE 2-1
Regional Location

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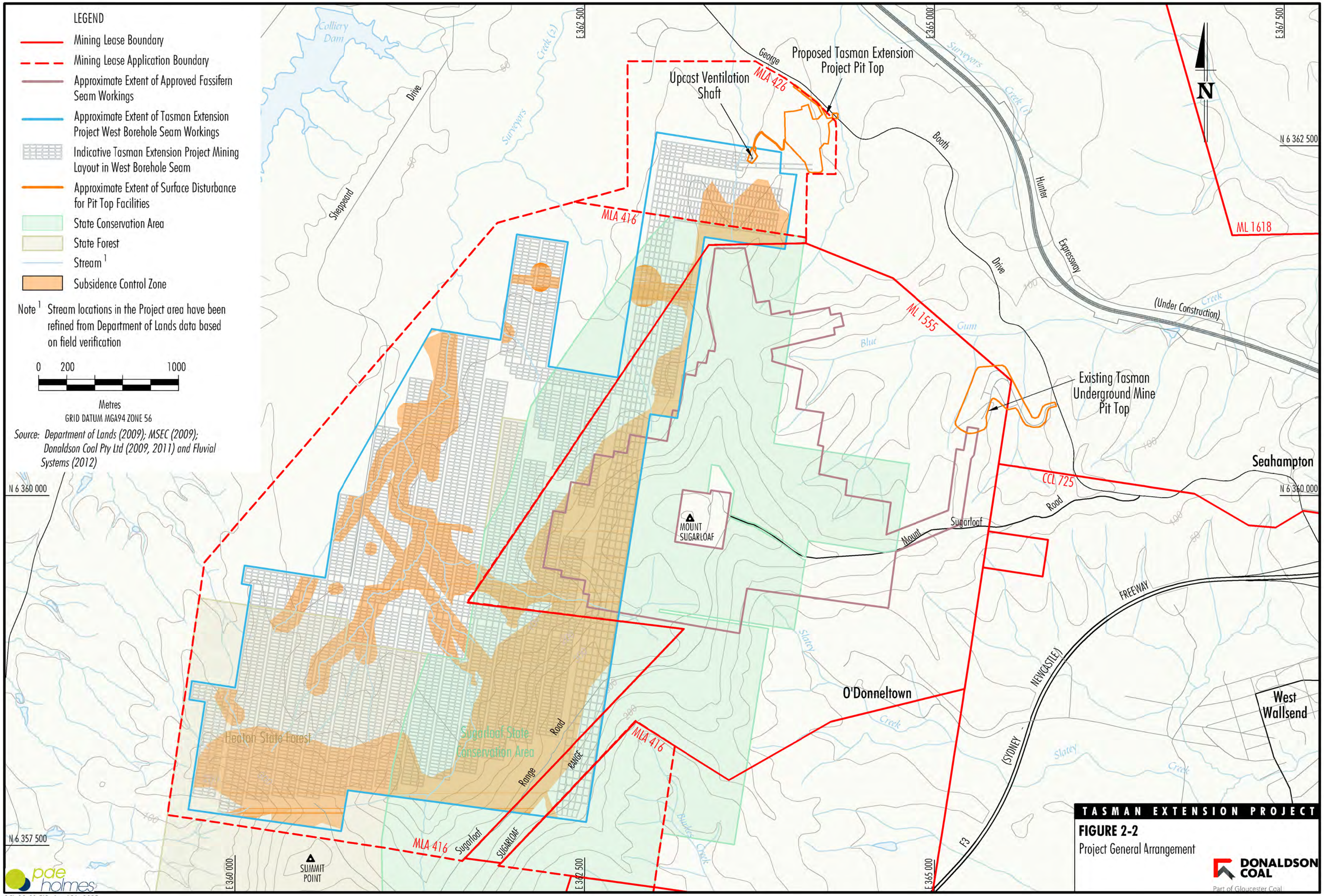

TASMAN EXTENSION PROJECT
FIGURE 2-2
Project General Arrangement
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pae holmes
DCL-09-01 EIS_App AQA_102E

3 LOCAL SETTING

The majority of the Project area comprises vegetated land reserved as the Sugarloaf State Conservation Area and Heaton State Forest. Private land holdings occur within the western and northern portions of the Project area. The area is characterised by undulating to steep terrain comprising the prominent Sugarloaf Range ridgeline trending north-south and several natural drainage gullies. Mount Sugarloaf is the highest topographic point at 412 metres (m) Australian Height Datum (AHD) within the Project area. A three-dimensional (3-D) representation of the local topography (for an area approximately 70 km by 70 km centred on the Project) is shown in **Figure 3.1**.

Other industrial operations in the vicinity of the Project area include:

- Orica Ammonium Nitrate Emulsion Plant, approximately 1 km west;
- West Wallsend Colliery, approximately 5 km south-east;
- Westside Colliery, approximately 6 km south-east;
- Abel Underground Mine, approximately 8 km north-east;
- Donaldson Open Cut Mine, approximately 10 km north-east; and
- Bloomfield Colliery, approximately 10 km north-northeast;
- Daracon Quarry, approximately 2.5 km north; and
- Stockrington Quarry, approximately 3.5 km east.

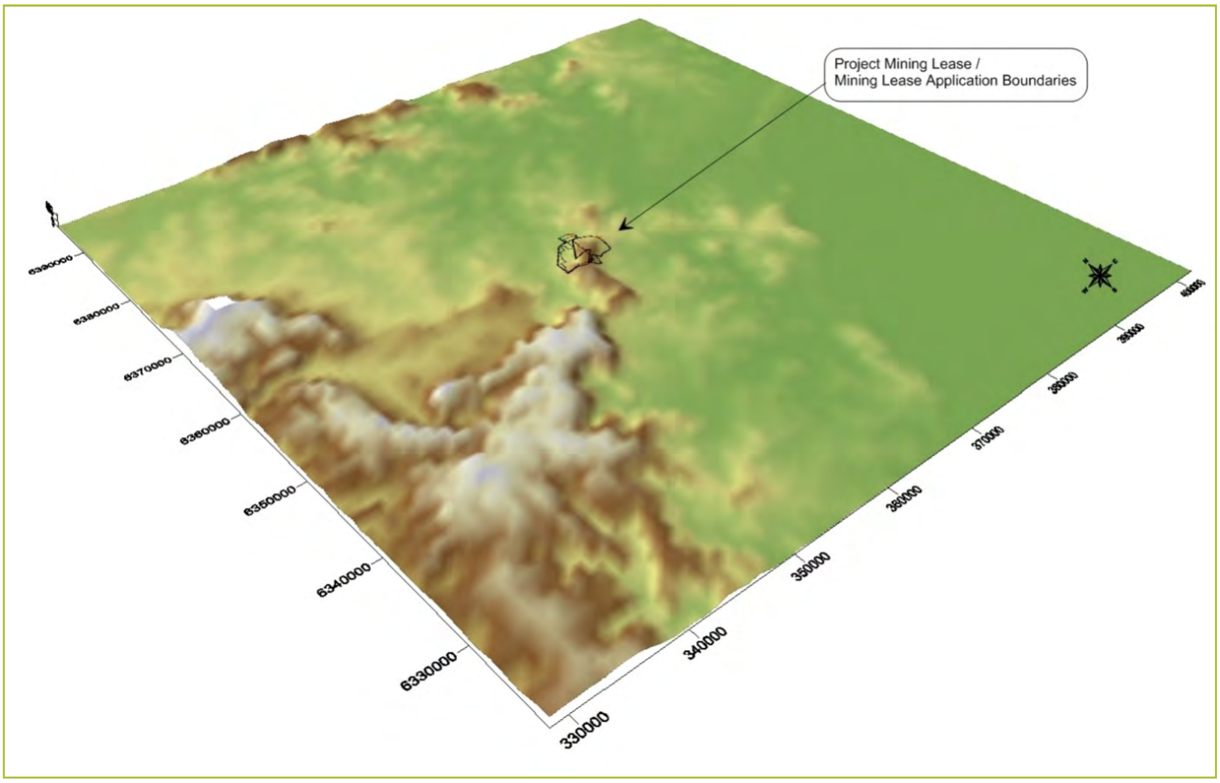

Figure 3.1: Pseudo 3-D representation of regional topography within modelling domain

For the purposes of assessing impacts from the Project, discrete receptor locations are selected and presented in **Table 3-1** and **Figure 3.2**. These receptors represent privately-owned residences in close proximity to the Project. For some properties in close proximity to the Project, dwellings have not been identified on the property. To account for potential future dwellings, receptor locations have been assumed on these properties. The locations of these receptors within the relevant property have conservatively been taken to be at the shortest distance to dust generating activities associated with the Project (e.g. the new pit top area).

Table 3-1: Relevant Receptor Locations

ID	Name	Easting (m)	Northing (m)	Elevation (m)
O'Donneltown	(represents receivers at O'Donneltown)	364493	6358732	63.7
Seahampton	(represents receivers at Seahampton)	367488	6360131	50.9
West Wallsend	(represents receivers at West Wallsend)	366860	6358574	121.5
5a	Four Mile Pty Limited	365200	6367940	41.8
5b	Four Mile Pty Limited	364950	6367845	37.8
10	Roads and Traffic Authority of New South Wales	362418	6366670	30
14	Orica Australia Pty Limited	362946	6362886	59.1
16a	ARM & C Roach	361705	6364675	25.1
16b	ARM & C Roach	361764	6364647	40.9
18	AR Sager	364469	6359042	119.9
19	AS & KL Green	360610	6361245	86.6
24	BG & M Smith	360525	6361530	82.5
35	D & JA Hoey	360730	6359340	48.7
37	GW & KM Cameron	360970	6359620	92.4
40	GT, SD, JR & MA Holmes	362301	6364425	48
43a	GG & CA Morris	361875	6364817	55.9
43b	GG & CA Morris	361850	6364720	32.6
45	GK Hooler	360880	6360420	84.5
48	H Spruce & JW Rhind	361880	6362634	34.8
51	JM Spruce	362051	6361823	48.8
57	KH & DM Starr	361200	6360535	64.1
58	KM & LJ Spruce	364671	6359057	68.7
60	LD & KA Bradbery	361668	6364494	32.9
64	ME Hooley	361740	6365116	33.2
65	MA Honeysett	360585	6359770	70.6
70	The Minister for Lands	363411	6360046	48.8
74	PJ Crowhurst	361155	6360900	61.3
75	PE Maytom	361982	6364605	39.8
83	PW & DL Dryden	361234	6361289	114.2
96	Transgrid	360360	6360990	58.2
97	WC & LM Gibson	361975	6363954	40.8
99	LJ & LM Jones	362370	6366475	27.8
100	DR & KL Bishop	366088	6365301	51.8
101	GR & RL Watts	368604	6363400	43
103	DJ & SL Ayre	361989	6365400	24.6
104	KP & J Mantle	361901	6365545	28.8
105	LJ & C Fairhall	361975	6365534	14.9
106	F Valicek	365258	6367688	136.2
107	CR & L Parker	362115	6366265	19
108	AM Williams	361940	6365708	44.5
109	CR & ML Parnell	364885	6367530	52.6
110	ME & KD Elliott	365065	6367680	60.8
102a	IR & MMF Gee	362090	6366033	14.4
102b	IR & MMF Gee	362290	6365614	74

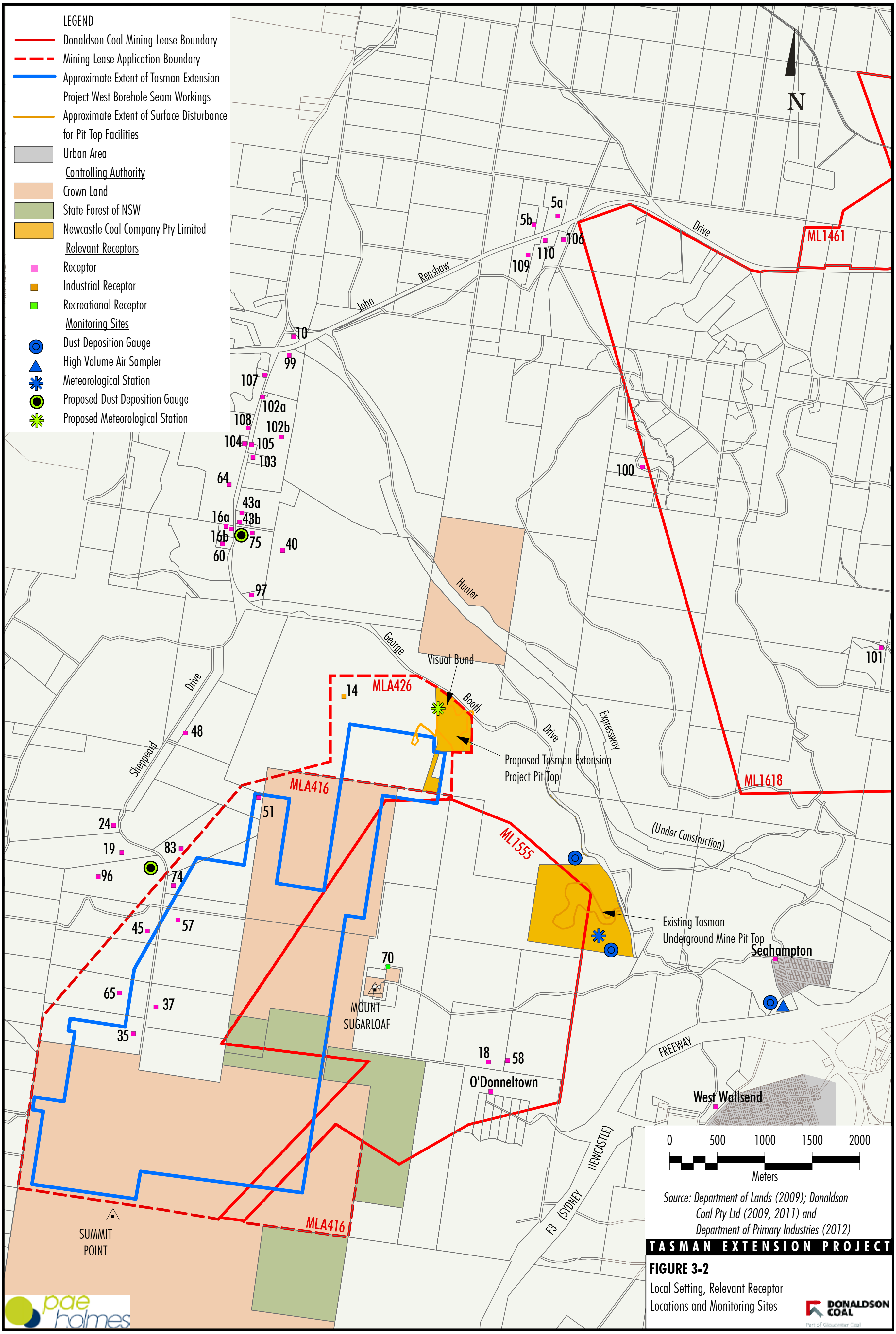

FIGURE 3-2
Local Setting, Relevant Receptor Locations and Monitoring Sites

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4 LEGISLATIVE SETTING

4.1 Particulate Matter and Health

The key air quality issue for mining is emissions of particulate matter (PM) (i.e. dust). Underground mining generates PM from surface activities, including handling of coal, hauling by heavy vehicles and wind erosion from stockpiles and exposed surfaces. PM is formed when particulate becomes entrained in the atmosphere by the turbulent action of wind, by the mechanical disturbance of materials, or through the release of particulate-rich gaseous emissions from combustion sources.

Suspended PM can be defined by its size, chemical composition and source. Particle size is an important factor influencing its dispersion and transport in the atmosphere and its potential effects on human health. Typically, the size of suspended particles ranges from approximately 0.005 to 100 micrometers (µm) and is often described by the aerodynamic diameter of the particle.

The particulate size ranges are commonly described as:

- TSP – total suspended PM refers to all suspended particles in the air. In practice, the upper size range is typically 30 µm – 50 µm.
- PM_{10} – refers to all particles with equivalent aerodynamic diameters of less than 10µm, that is, all particles that behave aerodynamically in the same way as spherical particles with a unit density.
- $PM_{2.5}$ – refers to all particles with equivalent aerodynamic diameters of less than 2.5 µm diameter (a subset of PM_{10}). Often referred to as the fine particles.
- $PM_{2.5-10}$ – defined as the difference between PM_{10} and $PM_{2.5}$ mass concentrations. Often referred to as coarse particles.

Both natural and anthropogenic processes contribute to the atmospheric load of PM. Coarse particles ($PM_{2.5-10}$) are derived primarily from mechanical processes resulting in the suspension of dust, soil, or other crustal[2] materials from roads, farming, mining, dust storms, and so forth. Coarse particles also include sea salts, pollen, mould, spores, and other plant parts.

Fine particles or $PM_{2.5}$ are derived primarily from combustion processes, such as vehicle emissions, wood burning, coal burning for power generation, and natural processes, such as bush fires. Fine particles also consist of transformation products, including sulphate and nitrate particles, and secondary organic aerosol from volatile organic compound emissions.

Mining dust is likely to be composed of predominantly coarse PM (and larger) (**SPCC, 1986**).

There have been a number of extensive reviews of the health effects of particulates over the past several years. Particles have been associated with a range of acute and chronic adverse health effects, including increased daily hospital admissions and emergency room visits for respiratory and cardiovascular symptoms, and decreased lung function.

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

The effects of PM on human health are primarily determined by:

- the physical and chemical nature of the particles;
- the physics of deposition and distribution in the respiratory tract; and
- the physiological events that occur in response to the presence of the particle.

The size of particles determine their behaviour in the respiratory system, including how far the particles are able to penetrate, where they deposit, and how effective the body's clearance mechanisms are in removing them. Additionally, particle size is an important parameter in determining the residence time and spatial distribution of particles in ambient air, key considerations in assessing exposure. It is generally thought that the smaller PM are of greater health concern as these particles can penetrate deep into the respiratory tract.

This is demonstrated in **Figure 4.1** which shows the relative deposition by particle size within various regions of the respiratory tract.

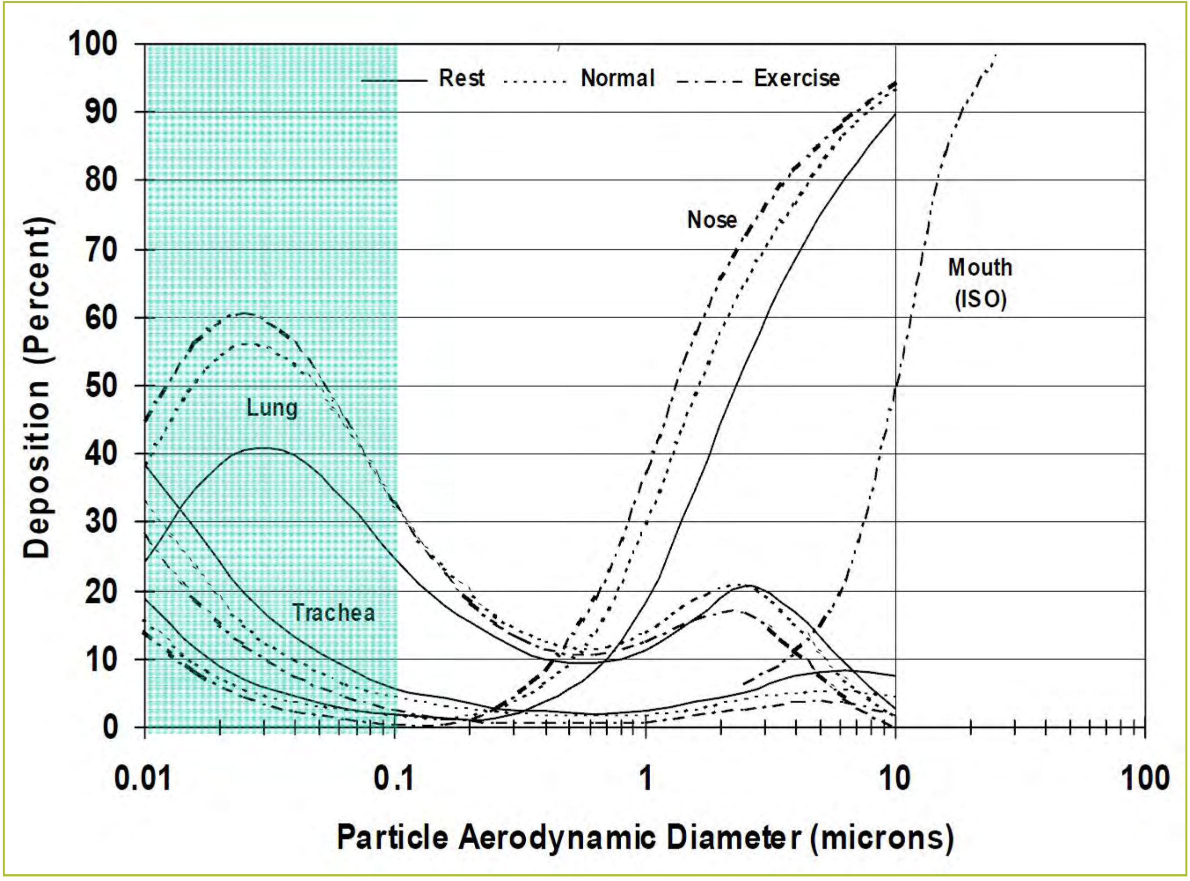


Figure 4.1: Particle Deposition within the Respiratory Tract (Source: Chow, 1995)

4.1.1 Impact Assessment Criteria

In the Approved Methods, the OEH specifies air quality assessment criteria relevant for assessing impacts from air pollution (**DEC, 2005**). The air quality goals 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.

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

In May 2003, NEPC released a variation to the Ambient Air-NEPM (**NEPC, 2003**) to include advisory reporting standards for $PM_{2.5}$. The purpose of the variation was to gather sufficient data nationally to facilitate the review of the Ambient Air-NEPM which is currently underway. Advisory reporting standards were established to assess monitoring data representative of average population and are not currently used for compliance or impact assessment for specific projects.

Table 4.1 summarises the air quality goals for concentrations of PM that are relevant to this study.

Table 4.1: OEH air quality standards/goals for particulate matter concentrations

Pollutant	Averaging period	Standard / Goal	Agency
TSP	Annual mean	90 $\mu g/m^3$	National Health and Medical Research Council (NHMRC)
PM_{10}	24-hour maximum	50 $\mu g/m^3$	OEH impact assessment criteria; NEPM reporting goal, allows five exceedances per year for bushfires and dust storms;[1]
	Annual mean	30 $\mu g/m^3$	OEH impact assessment criteria;
$PM_{2.5}$	24-hour average	25 $\mu g/m^3$	NEPM Advisory Reporting Standard
	Annual mean	8 $\mu g/m^3$	

In addition to health impacts, airborne dust also has the potential to cause nuisance effects by depositing on surfaces, including vegetation. Larger particles do not tend to remain suspended in the atmosphere for long periods of time and will fallout relatively close to the emission source. Dust fallout can generally degrade aesthetic elements of the environment and are assessed for nuisance or amenity impacts.

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 (**DEC, 2005**).

Table 4.2: OEH 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

Notes: g/m^2/month – grams per square metre per month.

4.2 Air Quality Criteria for other Potential Emissions

The Approved Methods contains air quality criteria for numerous other air-borne substances (e.g. production of combustion). In addition to emissions of PM, emissions of Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), and sulphur dioxide (SO_2) will occur from diesel-powered equipment, however these emissions are typically too small to give rise to significant off-site concentrations. As such, an assessment of air quality impacts for products of combustion is not considered to be required.

4.3 Action for Air

In 1998, the NSW Government implemented a 25 year air quality management plan, Action for Air, for Sydney, Wollongong and the Lower Hunter (**DECCW, 2009**). Action for Air seeks to provide long-term ongoing emission reductions. It does not target acute and extreme exceedances from events such as bushfires. The aim of Action for Air includes:

- meeting the national air quality standards for six pollutants as identified in the Ambient Air-NEPM; and
- reducing the population's exposure to air pollution, and the associated health costs.

The six pollutants in the Ambient Air-NEPM are CO, NO_2, SO_2, lead, ozone and PM_{10}. The pollutant from the Project that is relevant to the Action for Air is PM_{10}.

Action for Air aims to reduce air emissions to enable compliance with the Ambient Air-NEPM targets to achieve the aims described above, with a focus on motor vehicle emissions.

The Project would address the aims of the Action for Air Plan by implementing reasonable and feasible mitigation measures to reduce dust (e.g. PM_{10}) emissions and continue to implement an air quality monitoring plan to assess the Project against the Ambient Air-NEPM goals

4.4 Odour

The Approved Methods contains criteria for odour. The Project could potentially produce odorous emissions the mine ventilation air from the existing and proposed ventilation shafts.

A post commission review of odour and PM from the existing Tasman ventilation shaft (i.e. Fassifern Seam) (**HAS, 2007**) found that measured odour levels in the shaft were low and no odour impacts would arise from the operation of the shaft.

Recent gas testing conducted for coal samples from the West Borehole Seam detected negligible levels of methane (CH_4), and no potentially odorous higher level hydrocarbons or hydrogen sulphide were detected (**GeoGas, 2011**).

The Preliminary Hazard Analysis for the Project (Appendix N to the EIS) states that coal from the West Borehole Seam coal has a low to medium potential for spontaneous combustion, and in addition, there would be no long-term storage of coal at the existing or new pit tops (i.e. only temporary storage). As such, potential odour impacts associated with spontaneous combustion are not expected.

Based on the above, odour impacts from the Project have not been considered further in this assessment.

5 EXISTING ENVIRONMENT

5.1 Meteorology

5.1.1 Local Climatic Conditions

The Bureau of Meteorology (BoM) collects climatic information in the vicinity of the study area. A range of climatic information collected from Paterson (Tocal AWS), located approximately 28 km from the Project, are presented in **Table 5-1**. Temperature and humidity data consist of monthly averages of 9.00 am and 3.00 pm readings. Also presented are monthly averages of maximum and minimum temperatures. Rainfall data consist of mean monthly rainfall and the average number of rain days per month.

The annual average maximum and minimum temperatures experienced at Paterson are 24 degrees Celsius (°C) and 12°C, respectively. On average January is the hottest month, with an average maximum temperature of 29.7°C. July is the coldest month, with average minimum temperature of 6.1°C.

The annual average relative humidity reading collected at 9.00 am from the Paterson station is 73% and at 3.00 pm the annual average is 53%. The months with the highest relative humidity on average are March and May with 9.00 am averages of 80%. The months with the lowest relative humidity are August and September with 3.00 pm averages of 46%.

Rainfall data collected at Paterson shows that February is the wettest month, with an average rainfall of 119.3 millimetres (mm) over 8.8 rain days. The average annual rainfall is 927.5 mm with an average of 90 rain days.

Table 5-1: Climate Information for Paterson (Tocal AWS) for 1964-2011

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
9 am Mean Dry-bulb and Wet-bulb Temperatures (°C)[1] and Relative Humidity (%)													
Dry-bulb	22.7	22	20.6	18	14.6	11.9	11	12.6	16.2	19.1	20.1	22.2	17.6
Humidity	74	79	80	77	80	78	76	69	64	64	69	69	73
3 pm Mean Dry-bulb and Wet-bulb Temperatures (°C)[1] and Relative Humidity (%)													
Dry-bulb	28.3	27.4	25.7	23	19.7	16.8	16.4	18.3	20.9	23.3	25.1	27.5	22.7
Humidity	52	56	58	56	58	59	55	46	46	48	49	49	53
Mean Maximum Temperature (°C) [1]													
Mean	29.7	28.7	26.9	24.2	20.7	17.8	17.3	19.3	22.3	24.9	26.6	29.1	24
Mean Minimum Temperature (°C) [1]													
Mean	17.6	17.6	15.6	12.4	9.7	7.5	6.1	6.5	8.9	11.5	13.9	16.2	12
Rainfall (mm)[2]													
Mean	104.5	119.3	114.7	80.6	75.4	76.6	40.8	36.7	49.2	67.3	80.1	78.9	927.5
Raindays (Number)													
Mean	8.7	8.8	9.2	7.5	7.5	7.5	6	5.1	5.7	7.5	8.8	7.5	89.8

Source: BOM (2011) *Climate averages for Station: 061250; Commenced: 1967-1972, Last record: August 2011; Latitude: 32.63 °S°S; Longitude: 151.59 °E*

5.1.2 Local Wind Data

Meteorological data have been collected at a meteorological station at the Tasman Underground Mine. Data are available for this site from November 2006 to May 2011.

Annual and seasonal windrose have been created for the meteorological data collected during 2010. Wind roses show the frequency of occurrence of winds by direction and strength. **Figure** 5.1 presents the annual and seasonal windroses from the meteorological data collected at the Tasman Underground Mine.

On an annual basis, **Figure 5.1** shows a prominent westerly pattern of winds. Winds from the north-east and the southern quadrants are also prominent. The annual percentage of calms (winds less than 0.5 metres per second [m/s]) is 15.4%. The annual average wind speed is 2.3 m/s.

Meteorological data is also recorded at the Donaldson Coal Mine located approximately 9 km northeast of the Project. However, the weather station is in a sheltered location and is not considered to be representative of the meteorological conditions in the vicinity of the Project.

5.2 Existing Ambient Air Quality

Air quality standards and criteria refer to pollutant levels that include the contribution from specific projects and existing sources of dust. To assess impacts against relevant air quality standards and criteria it is necessary to have information or estimates of existing dust concentrations and deposition levels in the Project area. It is important to note that the existing air quality conditions (that is, background conditions) may be influenced by existing mining operations in the area.

An air quality monitoring program for the Tasman Underground Mine was established in November 2006 to monitor dust deposition and dust concentration (as PM_{10} and TSP) in the vicinity of the mine. The current monitoring network includes:

- High Volume Air Sampler (HVAS) measuring PM_{10} on a one day in six cycle.
- HVAS measuring TSP on a one day in six cycle.
- Three dust deposition gauges.

The HVASs are located near the settlement of Seahampton, which represent the closest settlement to the existing Pit top area. Dust deposition gauges are located to the north and south of the existing Project boundary and in the vicinity of the sensitive receptors at Seahampton.

5.2.1 PM_{10} and TSP Concentrations

Table 5-2 provides a summary of the annual average PM_{10} concentration data collected at this site. Monitoring results show that since monitoring has begun there have been no exceedances of the OEH impact average assessment criterion of 30 µg/m^3. The average for the monitoring period is 15 µg/m^3.

Table 5-2 also provides a summary of the annual average TSP concentration data collected at this site. Monitoring results show that from 2006 to 2011 there have been no exceedances of the OEH impact average assessment criterion of 90 µg/m^3. The average for the monitoring period is 31 µg/m^3.

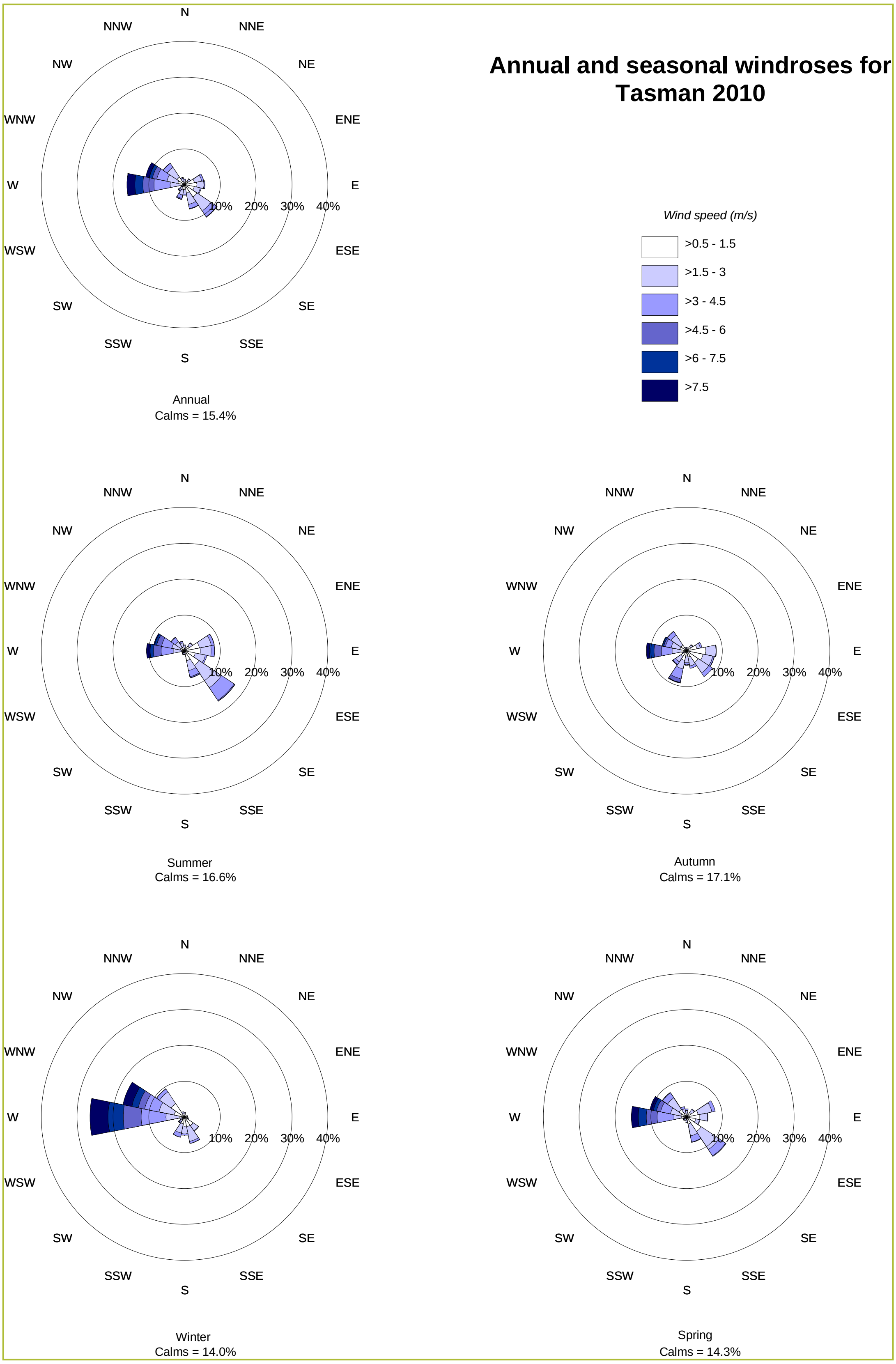


Figure 5.1: Annual and seasonal windroses for Tasman Mine weather station

Table 5-2: Annual average PM_{10} and TSP concentration for the Tasman Mine

Year	PM_{10} (µg/m³)	TSP (µg/m³)
2006	14	31
2007	19	35
2008	16	31
2009	16	32
2010	12	26
2011	15	32
Average	**16**	**31**

Figure 5.2 presents a graph of the 24-hour PM_{10} concentrations for the monitoring period. Also shown is a running annual average. The figure shows that over the course of the monitoring period, the 24-hour criterion has been exceeded three times, on 5 May 2007, 31 December 2007 and 20 October 2008. There were no significant events reported for these days (bushfires, dust storms), however the BoM Monthly Significant Weather Summaries reported conditions as hot, dry and windy around these periods (http://www.bom.gov.au/climate/mwr/).

It should also be noted that the Beresfield and Blackhill HVASs, which form part of the Donaldson Coal Mine air quality monitoring network (refer **Section 5.2.3**), recorded elevated PM_{10} concentrations on 5 May 2007 and 20 October 2008, indicating that at least two of the three exceedances recorded at the Tasman HVAS were due to regional dust events (i.e. 48 and 44 µg/m³ were recorded for the Beresfield and Blackhill HVASs, respectively, on 5 May 2007, and 43 and 38 µg/m³ were recorded for the Beresfield and Blackhill HVASs, respectively, on 20 October 2008). The Beresfield and Blackhill HVASs recorded 33 and 19 µg/m³ on 31 December 2007.

5.2.2 Dust Deposition

Table 5-3 provides a summary of the annual average dust deposition data collected at the Tasman Underground Mine dust deposition monitoring sites. Monitoring results show that over the course of the monitoring period there have been no exceedances of the OEH assessment criterion of 4 g/m²/month. The average over all sites for the monitoring period is 1.1 g/m²/month which is well within the OEH assessment criterion.

OEH criterion is not exceeded during the monitoring period.

Table 5-3: Dust Deposition Yearly Average (insoluble solids) for the Tasman Mine

Year	D01 (g/m²)	D02 (g/m²)	D03 (g/m²)
2006	1.3	1.3	1.3
2007	0.6	0.8	0.7
2008	0.7	1.1	0.9
2009	1.3	1.3	1.8
2010	0.6	1.3	0.8
2011	0.6	2.0	1.2
Average	**0.8**	**1.3**	**1.1**
Average over all sites			**1.1**

Figure 5.3 shows a graph of monthly dust deposition at the three dust deposition gauges in the mine monitoring network.

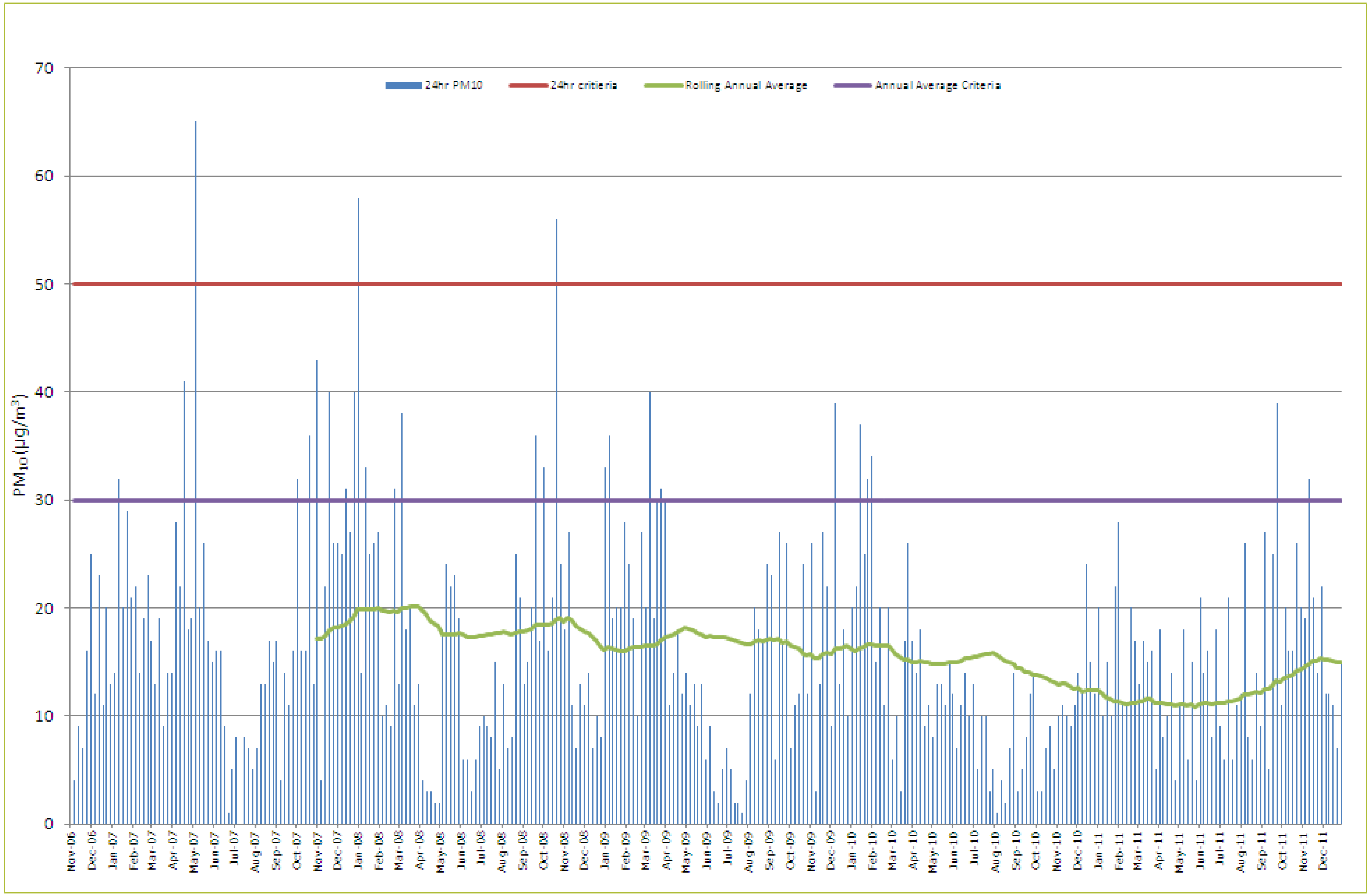


Figure 5.2: 24hr PM$_{10}$ concentrations for November 2006 to December 2011

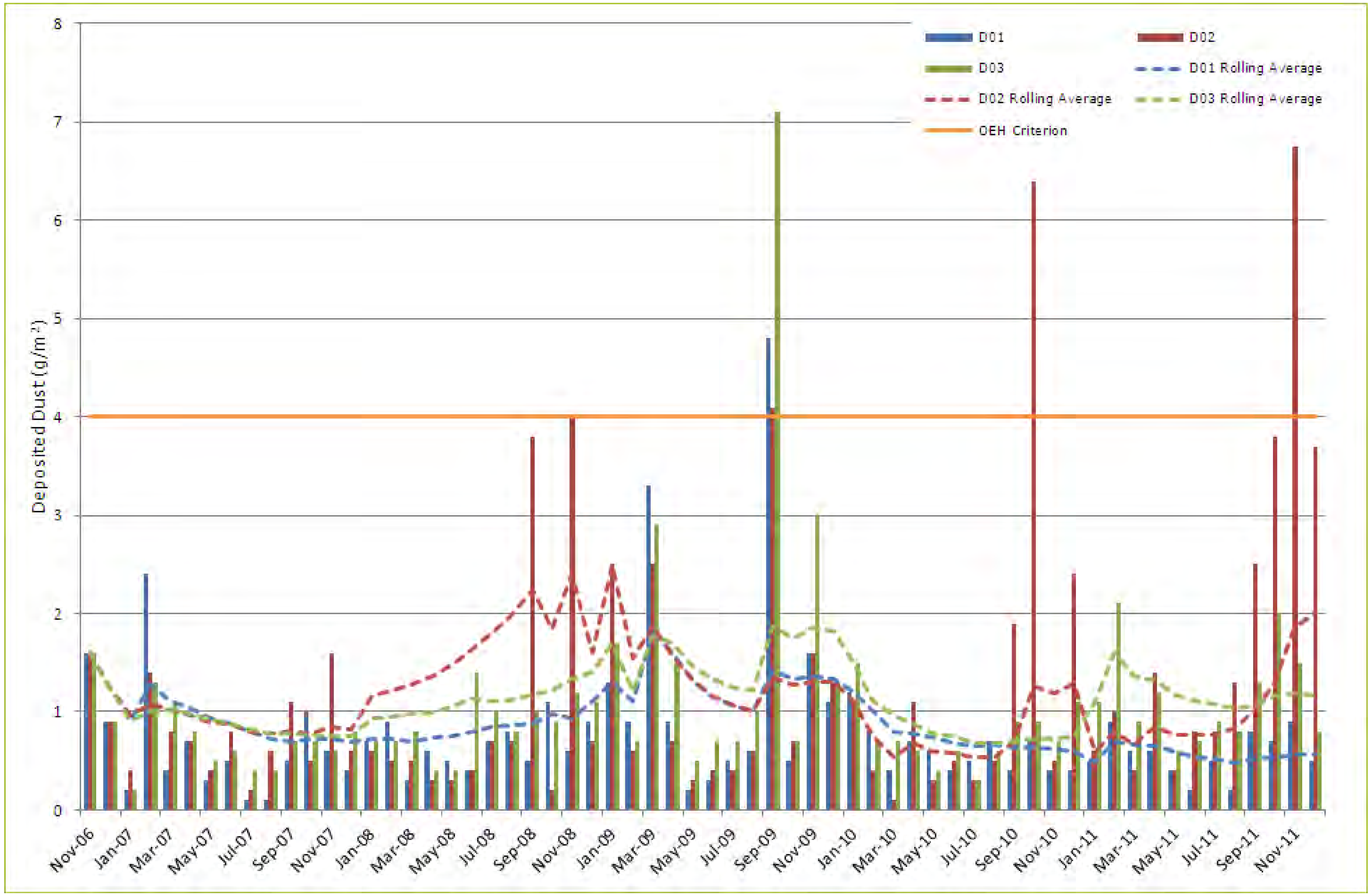


Figure 5.3: Monthly Dust Deposition for November 2006 to December 2011

There are three occasions where high monthly readings were recorded. The first of these (September 2009) corresponded to a period of excess dust storms across all of NSW (http://www.bom.gov.au/climate/mwr/). Accompanying field notes indicated that the second occasion corresponded to a period of clearing activity for high voltage power lines. It should be noted that these high monthly dust recordings are not exceedances of the OEH criteria, as the OEH criteria has an annual averaging period.

5.2.3 Donaldson Coal Mine Air Quality Monitoring Network

An air quality monitoring program for Donaldson Coal Mine was established in May 2000 to monitor dust deposition and dust concentration (as PM_{10} and TSP) in the vicinity of the mine lease, including:

- two HVASs measuring PM_{10};
- one HVAS measuring TSP; and
- twelve dust deposition gauges.

Table 5-4 provides a summary of the annual average PM_{10} and TSP concentration for the previous six years. Monitoring results for this period demonstrate compliance with the annual average PM_{10} assessment criterion of 30 µg/m^3. The average PM_{10} concentration across the six years is 19 µg/m^3 at Beresfield and 15 µg/m^3 at Blackhill.

Monitoring results for TSP demonstrate compliance with the annual average assessment criterion of 90 µg/m^3. The average TSP concentration across the six years is 30 µg/m^3.

Table 5-4: Annual average PM_{10} and TSP concentration for Donaldson Coal Mine

Year	Beresfield PM_{10} (µg/m^3)	Blackhill PM_{10} (µg/m^3)	Blackhill TSP (µg/m^3)
2006	21	17	35
2007	22	16	32
2008	23	15	29
2009	19	16	33
2010	12	10	23
2011	15	13	28
Average	**19**	**15**	**30**

Table 5-5 provides a summary of the annual average dust deposition data collected for the previous six years. Monitoring results show that over the course of the monitoring period there have been no exceedances of the OEH assessment criterion of 4 g/m^2/month. The average over all sites for this period is 1.2 g/m^2/month, which is well within the OEH assessment criterion.

Table 5-5: Dust Deposition Yearly Average (insoluble solids) for Donaldson Coal Mine

	DG1	DG2	DG3	DG4	DG5A	DG6	DG7	DG8	DG9	DG10	DG11	DG12
						(g/m^2)						
2006	1.4	1.4	1.4	1.3	1.1	1.7	1.2	2.2	1.2	2.4	1.7	
2007	1.4	0.7	1.3	1.0	1.1	1.0	1.0	1.4	0.7	0.9	1.1	
2008	1.1	1.1	1.3	0.8	0.8	1.0	0.7	1.4	0.8	0.8	1.1	
2009	1.0	2.6	1.3	1.9	0.9	2.6	1.1	2.1	1.3	1.7	1.4	
2010	0.8	2.6	2.2	1.0	1.1	0.8	0.7	1.1	0.9	0.7	1.0	0.9
2011	0.7	1.3	2.0	0.9	0.8	0.6	0.8	1.6	0.8	0.7	1.0	1.0
Average	**1.1**	**1.6**	**1.6**	**1.2**	**1.0**	**1.3**	**0.9**	**1.6**	**1.0**	**1.2**	**1.2**	**1.0**
Average over all sites												**1.2**

5.2.4 $PM_{2.5}$ Concentrations

No $PM_{2.5}$ concentration data are available in the vicinity of the Project. Co-located monitors for PM_{10} and $PM_{2.5}$ are operated by the NSW Environment Protection Agency (EPA) at Beresfield and Wallsend. The ratio of $PM_{2.5}/PM_{10}$ for these sites is shown in **Figure 5.4**. The average ratio of $PM_{2.5}/PM_{10}$ across all sites is 0.3. Based on this ratio and annual average PM_{10} concentration recorded by the Tasman HVAS (**Table 5.2**), the annual average $PM_{2.5}$ concentration is estimated to be approximately 5 µg/m^3.

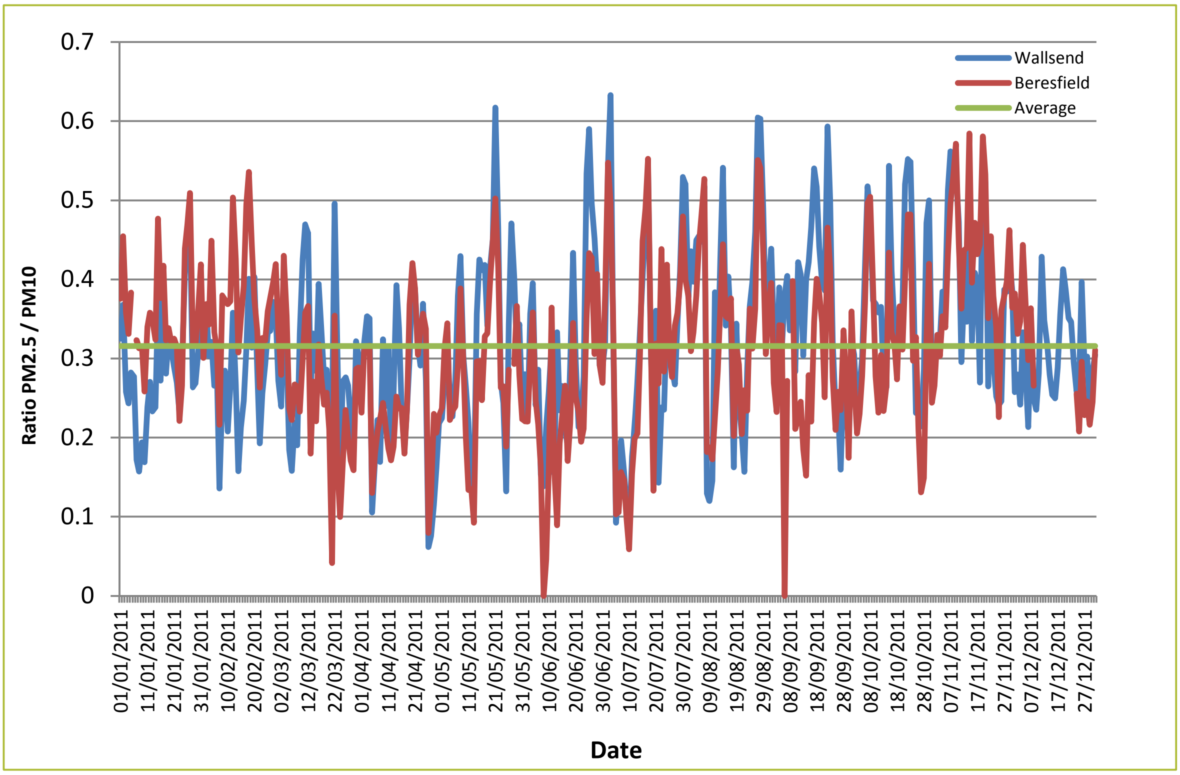


Figure 5.4: Ratio of $PM_{2.5}$ and PM_{10} 24-Hour PM_{10} concentrations (ug/m^3)

5.2.5 Existing Air Quality for Assessment Purposes

The assessment of air quality impacts for the Project requires consideration of the contributions of dust and PM from other local sources, such as vehicles using unsealed roads, stock movements, cropping and exposed ground. In addition, regional air quality sources such as bushfires and dust storms also have the potential to be significant dust sources.

The location of the HVAS and dust gauges mean that air quality data includes contributions from the existing Tasman Underground Mine, as well as other industrial operations in the region (refer to **Section 3**). In addition, the air quality data would include contributions from the construction of the Hunter Expressway, which commenced in August 2010.

Based on the data recorded by the existing Tasman air quality monitoring network, average PM_{10} concentrations across all years is approximately 16 µg/m^3, average TSP concentration across all years is approximately 31 µg/m^3 and the dust deposition average for the all sites across all years is 1.1 g/m^2/month.

Although these data include contributions from the existing Tasman Underground Mine there are some years when dust levels are higher than these averages. Therefore a background level is adopted for the assessment based on the averages across all years.

In summary, for the purposes of assessing potential air quality impacts, the following existing air quality levels are assumed for sources other than local mining activity.

- annual average PM_{10} concentration of 16 µg/m^3;
- 24-hour PM_{10} concentrations – daily varying;
- annual average $PM_{2.5}$ concentration of 5 µg/m^3;
- 24-hour $PM_{2.5}$ concentrations – daily varying;
- annual average TSP concentration of 31 µg/m^3; and
- annual average dust deposition of 1.1 g/m^2/month.

These background air quality levels are comparable with monitoring results recorded by the Donaldson Coal Mine air quality monitoring network (**Section 5.2.3**).

6 MODELLING APPROACH

The assessment has been conducted in accordance with the Approved Methods (**DEC, 2005**).

6.1 Modelling System

The CALMET/CALPUFF modelling system was chosen for this study. CALMET is a meteorological pre-processor that includes a wind field generator containing objective analysis and parameterised treatments of slope flows, terrain effects and terrain blocking effects. The pre-processor produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables to produce the 3-D meteorological fields that are utilised in the CALPUFF dispersion model. CALMET uses the meteorological inputs in combination with land use and geophysical information for the modelling domain to predict gridded meteorological fields for the region. CALPUFF is a multi-layer, multi-species non-steady state puff dispersion model that can simulate the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal (**Scire *et al*., 2000**). The model contains algorithms for near-source effects such as building downwash, partial plume penetration, sub-grid scale interactions as well as longer-range effects such as pollutant removal, chemical transformation, vertical wind shear and coastal interaction effects. The model employs dispersion equations based on a Gaussian distribution of pollutants across the puff and takes into account the complex arrangement of emissions from point, area, volume, and line sources.

In March 2011 the NSW OEH published generic guidance and optional settings for the CALPUFF modelling system for inclusion in the Approved Methods (**TRC, 2011**). The model set up for this study has been conducted in consideration of these guidelines.

6.2 Model Set Up

CALMET was initially run for a coarse outer grid domain of 75 km x 75 km with a 1 km resolution. Observed hourly surface data were incorporated into the outer domain modelling, including the Tasman site data, OEH data from Wallsend and Beresfield plus the BoM data from Cessnock, Patterson, Cooranbong, Newcastle and Williamtown RAAF base. Cloud amount and cloud heights were sourced from observations at Williamtown RAAF base. Any gaps in the data were supplemented with data extracted from TAPM[3].

The CALMET generated 3-D meteorological parameters from the outer grid were then used as input into a finer resolution inner grid domain of 25 km x 25 km with a 200 m resolution, centred on the Tasman site. Further details on model set up are provided in **Appendix A**.

[3] The Air Pollution Model, or TAPM, is a three dimensional meteorological and air pollution model developed by the CSIRO Division of Atmospheric Research. Detailed description of the TAPM model and its performance is provided in (Hurley 2008; Hurley, Edwards et al. 2009).

6.3 Dispersion Meteorology

To compare winds predicted by the model with the measured data from the Tasman Underground Mine, a CALMET windrose is presented in **Figure 6.1**.

The CALMET windrose is extracted for a single point at the approximate location of the Tasman meteorological site. The CALMET wind rose displays similar characteristics to the measured data at Tasman with dominant winds from west, west-northwest and southeast. The wind speeds extracted from CALMET are lighter and the % occurrence of calm conditions (defined as wind speeds less than 0.5m/s) are less with 15% recorded at Tasman compared with 3.7% predicted by CALMET.

This has implications for dispersion modelling. Under lighter winds, dispersion is less favourable and predicted concentrations will tend to be higher. Conversely, the potential for wind generated dust emissions are lower.

However, the total annual emissions from product stockpiles (the only wind dependent source) have been calculated based on the measured wind speed which results in a higher total emission than if the CALMET wind data were used.

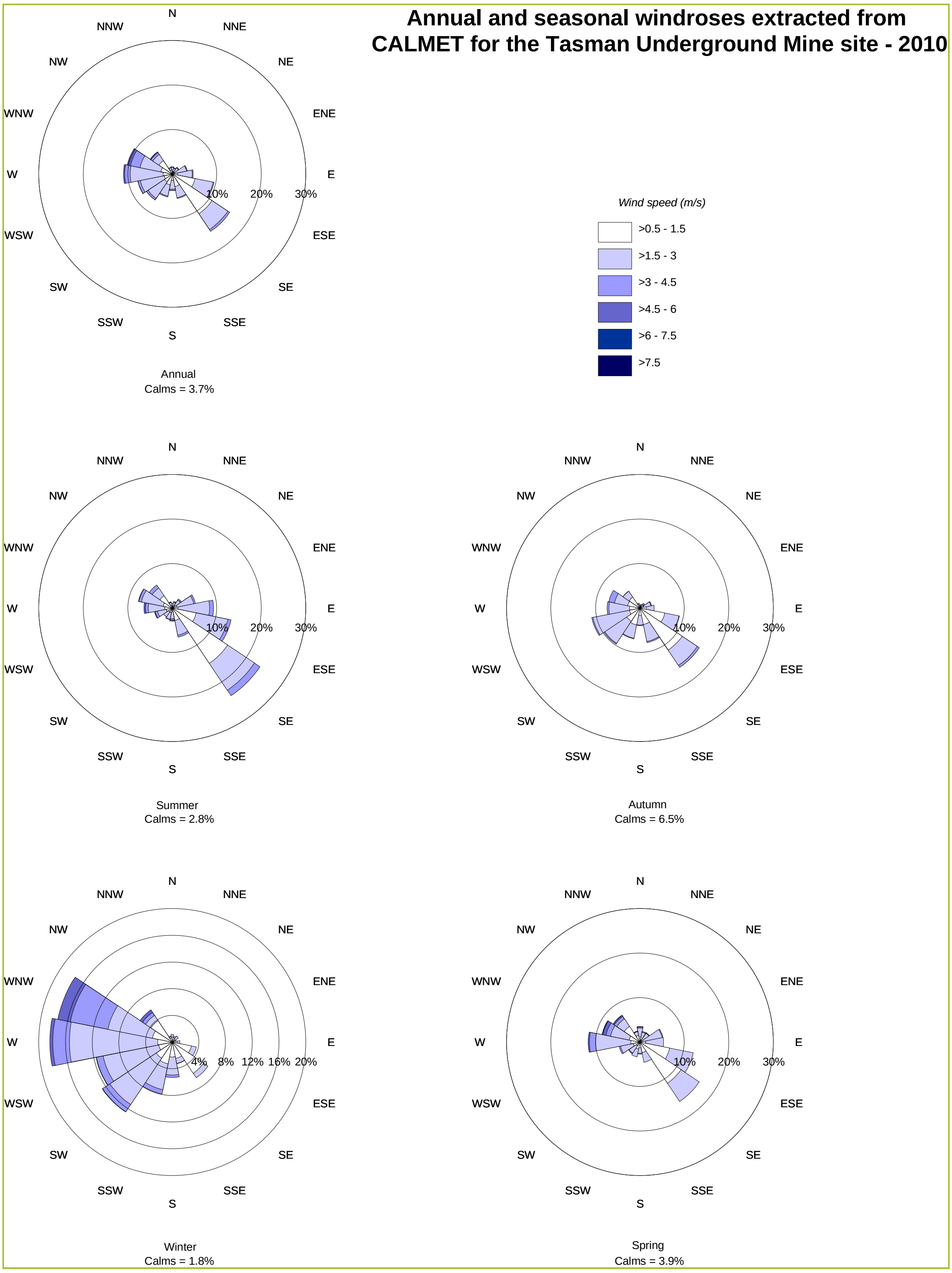


Figure 6.1: Windrose extracted from CALMET

7 EMISSIONS TO AIR

7.1 Construction

During construction of the new pit top area, fugitive dust emissions can be expected from the following activities:

- excavation for the box cut and ROM stockpile area (generating a maximum of approximately 525,000 cubic metres [m^3] waste rock);
- loading of waste rock to trucks and transport off-site;
- dozer activity; and
- two graders working road construction.

An estimate of the amount of dust produced during the construction phase of the Tasman Underground Mine was provided in the original Environmental Assessment (**HAS, 2002**). It was estimated that dust emissions during construction would be significantly lower than during the operational phase of the Project and dispersion modelling was not presented for the construction phase of the mine.

An estimate of the amount of dust produced during the construction phase for the Project is presented in **Table 7-1**. The total estimated emissions are less than 40% of the emissions estimated to occur during operation of the Project (refer **Section 7.2**) and therefore further assessment for construction is not required. Compliance with air quality goals during the operation of the mine is assumed to represent compliance during mine construction.

It should be noted that the bulk earthworks required for the construction of the pit top are expected to occur over a period of approximately six months. However, the emissions associated with dozers and graders (which are dependent on hours of operation) presented in **Table 7-1**, have conservatively been assumed to occur over a period of one year.

Table 7-1: Estimated Dust Emission – Construction

Mining Activities	TSP emission rate (kg/y)
Excavation	549
Loading Trucks	549
Haulage	17,843
Dozers	26,048
Graders	26,957
TOTAL	**71,946**

Notwithstanding the above, suitable dust mitigation measures would be implemented during the construction phase to ensure that dust emissions are kept to a minimum, especially during adverse meteorological conditions. These mitigation measures are discussed in **Section 10**.

7.2 Operation

During operations, the Project will result in emissions of PM, primarily from coal handling activities at the pit top and the operation of upcast ventilation shafts.

Dust emissions during operations have been estimated by analysing the activities taking place in the Project area.

Two operational scenarios are presented as follows:

- Scenario 1 – Year 2 operations with a total ROM production of 1,499 kilotonnes per annum (ktpa) split between the existing pit top (460 ktpa from Fassifern seam) and the new pit top (1,039 ktpa from the West Borehole seam). Note that this represents the maximum product rate from simultaneous operation of the existing and new pit tops. Actual production in Year 2 is expected to be lower than what has been assessed (refer Table 2-2 of the Main Volume of the EIS).
- Scenario 2 – Year 7 operations with a maximum of 1,500 ktpa ROM coal production at the new pit top area only.

The estimated dust emissions during the operational stage of the mine are presented in **Table 7-2** and **Table 7-3**. These estimates assume some control of dust emissions through the use of watering carts on all unsealed haul roads and trafficked areas.

Dust sources at the pit top have been modelled as volume sources, located according to the layouts of the existing and new pit top areas. All activities and emissions are assumed to occur 24 hours per day, seven days per week with the exception of coal haulage and loading trucks, which would occur between the hours of 7.00 am and 10.00 pm.

Table 7-2: Estimated Dust Emission – Scenario 1 (Year 2)

Mining Activities	TSP emission rate (kg/y)
Tasman Pit Top	
Loading to stockpile from conveyor	22,003
Loading coal to trucks from stockpile	22,003
Hauling coal off site (unsealed roads)	3,956
Active Stockpile – wind erosion and maintenance	7,253
Ventilation Shaft	8,881
New Pit Top	
Loading to stockpile from conveyor	49,698
Loading coal to trucks from stockpile	49,698
Hauling coal off site (unsealed roads)	8,935
Active Stockpile – wind erosion and maintenance	3,627
Ventilation Shaft	18,871
TOTAL	**194,923**

Table 7-3: Estimated Dust Emission – Scenario 2 (Year 7)

Mining Activities	TSP emission rate (kg/y)
Loading to stockpile from conveyor	71,748
Loading coal to trucks from stockpile	71,748
Hauling coal off site (unsealed roads)	12,899
Active Stockpile – wind erosion and maintenance	3,627
Ventilation Shaft	18,871
TOTAL	**178,893**

The modelling has been based on the use of three particle-size categories (0 to 2.5 µm - referred to as $PM_{2.5}$, 2.5 to 10 µm - referred to as CM (coarse matter) and 10 to 30 µm - referred to as the Rest). Mass emission rates in each of these size ranges have been determined using the factors derived from the **SPCC (1986)** study and TSP emission rates calculated using emission factors derived from **US EPA (1995)** and **NERDDC (1988)** work (see **Appendix B**).

The distribution of particles in each particle size range is as follows:

- $PM_{2.5}$ (FP) is 0.0468 of the TSP;
- $PM_{2.5-10}$ (CM) is 0.3440 of TSP; and
- PM_{10-30} (Rest) is 0.6090 of TSP.

Modelling was done using these three size fractions which are assumed to emit according to the distribution above and deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mass mean of the particle size range. The resultant predicted concentrations were then combined as follows to determine the concentrations of each size fraction:

- $PM_{2.5}$ = FP;
- PM_{10} = FP + CM; and
- TSP = FP +CM+ Rest.

The ventilation shafts were modelled as vertically discharging point sources with the exit velocity reduced to account for non-vertical discharge. PM and odour testing was conducted for the existing ventilation shaft at the Tasman site, in accordance with the conditions of consent (**HAS, 2007**). The results of the testing are summarised in **Table 7-4** and have been used to estimate emissions from the existing and proposed vent shaft for the Project.

Table 7-4: Existing Ventilation Shaft Test Results

Parameter	Value
Height	3.0 m
Internal Diameter	2.5 m
Exit Velocity	7.5 m/s @ 45 degrees from horizontal (adjusted to 5.3 m/s as vertical component)
Actual Temperature	294 K
Flow Rate	36.6 Am^3/s (33.4 Nm^3/s)
TSP Concentration	4.715 mg/Nm^3
TSP Emissions Rate	157.5 mg/s

During the initial years of the Project when coal is extracted from the two seams, both vent shafts will be operational. The measured emission rate for the existing ventilation shaft was used in the modelling for the existing ventilation shaft. The measured in stack TSP concentration for the existing ventilation shaft was used to derive an emission rate for the proposed ventilation shaft based on a design flow rate of 170 cubic metres per second (m^3/s). The new shaft has an assumed diameter of 3.6 m resulting in an exit velocity of 17 m/s.

7.2.1 Transportation of Coal

Dust emissions from the haulage of coal on unsealed roads within the pit top areas (i.e. private roads) have been considered in the emissions estimates presented in **Table 7-2** and **Table 7-3**.

All road vehicles have the potential to generate PM emissions (e.g. through wheel generated dust and exhaust emissions). To prevent dirt track out from the pit top areas, and mitigate the potential for additional wheel generated dust on public roads (from all vehicles), there is a wheel wash installed at the existing pit top area, and there would be a wheel wash installed at the new pit top area.

Coal haulage trucks also have the potential to generate fugitive coal dust emissions (e.g. through wind erosion of exposed coal if the truck load is uncovered). All trucks transporting ROM coal along public roads from the existing Tasman Underground Mine to the Bloomfield CHPP cover their loads, in accordance with the existing Development Consent (DA 274-9-2002) and *Road Transport Protocol for Coal haulage from the Tasman Mine to the Bloomfield Coal Receival*. Coal haulage trucks for the Project would continue to cover their loads.

The *Environmental Evaluation of Fugitive Coal Dust Emissions from Coal Trains, Final Report, Queensland Rail Limited* (**Connell Hatch, 2008**) states that covering the loads of coal wagons would reduce emissions by 99% (in comparison with uncovered wagons), and therefore, covering the loads of coal haulage trucks would also be expected to reduce emissions by 99%. As such, the covering of the loads of coal haulage trucks effectively prevents fugitive coal dust emissions during transportation.

Based on the above, no further assessment of potential air quality impacts from coal haulage on public roads is considered to be required.

8 IMPACT ASSESSMENT

8.1 Prescribed Limits

The *Protection of the Environment Operations (Clean Air) Regulations 2010* (**POEO, 2010**) sets out standards of concentration for emissions to air from scheduled activities. The maximum pollution levels relevant to this assessment, allowed under the regulations for general activities, are provided in **Table 8.1**.

Table 8.1: Maximum Allowable Emission Levels

Air Impurity	Activity or Plant	Standard of Concentration
Solid Particles	Any process emitting solid particles	50 mg/m^3

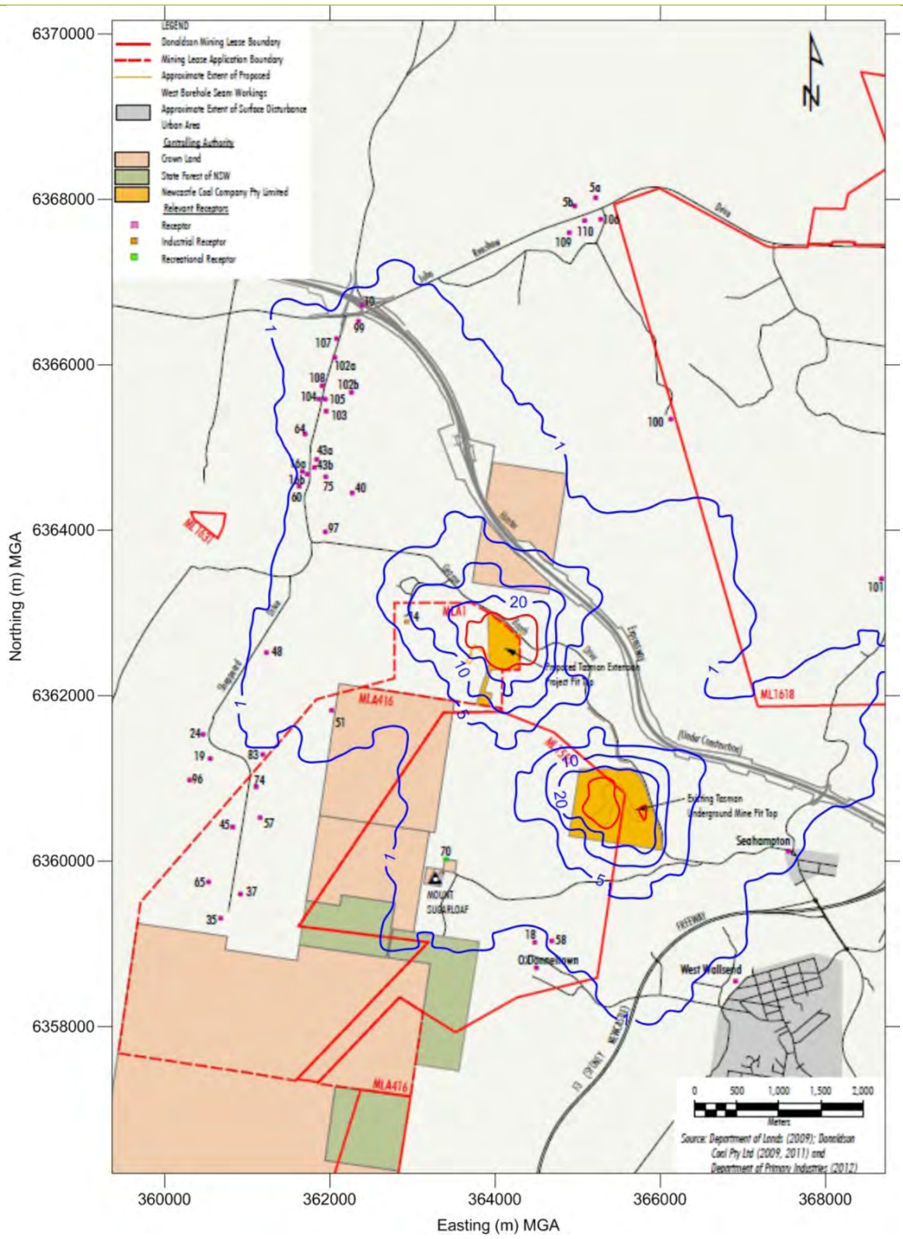
The results of PM testing conducted for the existing ventilation shaft at the Tasman site showed a TSP concentration of 4.715 milligrams per normalised cubic metre (**HAS, 2007**). As such, the concentrations of particles from the proposed vent shaft are expected to be well below the emission limits prescribed by the Clean Air Regulations

8.2 Modelling Results

The results of the predictions for the Project are presented in **Figure 8.1** to **Figure 8.12**. The contours show the incremental predicted 24-hour PM_{10} and $PM_{2.5}$ concentrations and annual average PM_{10}, $PM_{2.5}$, TSP and dust deposition for both scenarios. The red contour line shows the relevant impact assessment criteria.

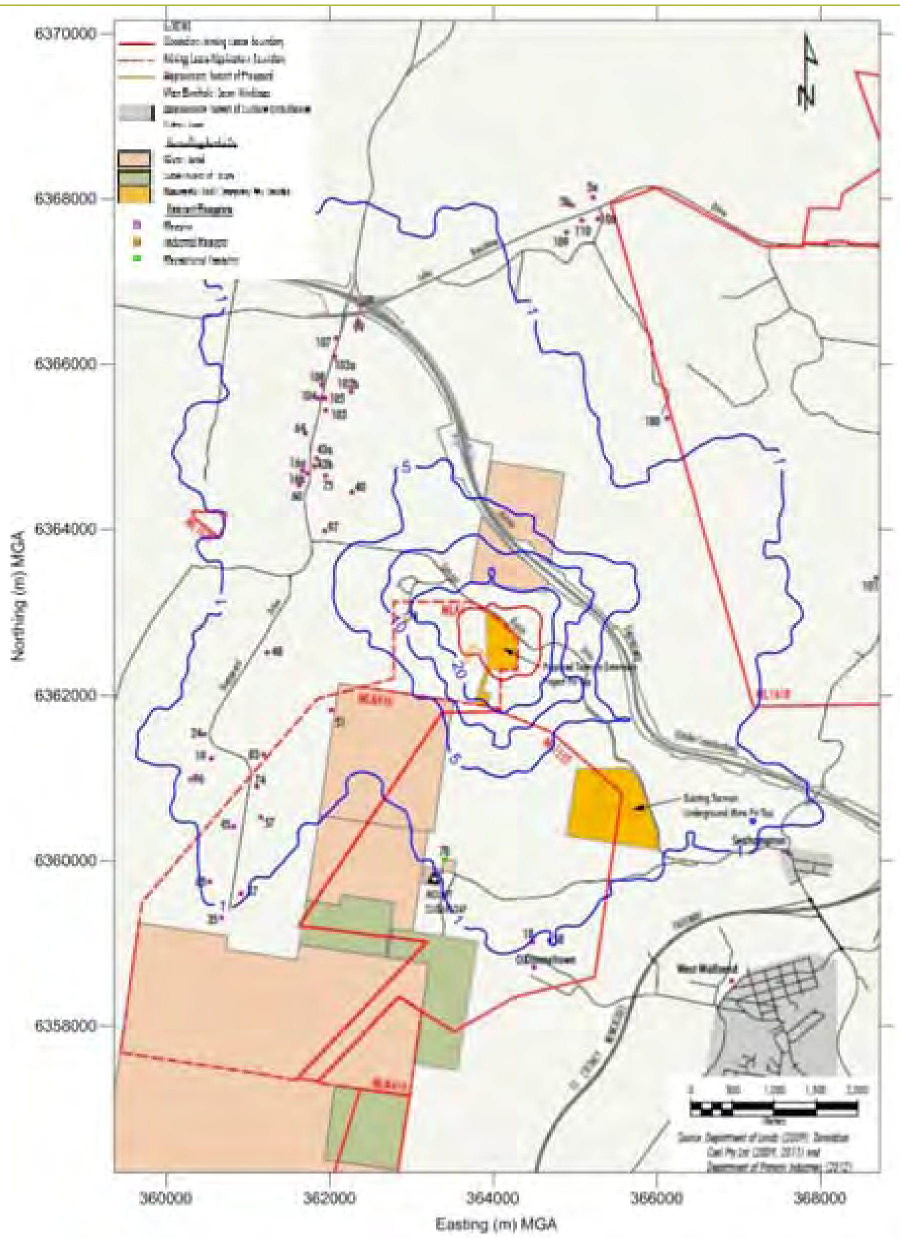
The plots are indicative of the concentrations that could potentially be reached, under the conditions modelled.

8.2.1 PM_{10}



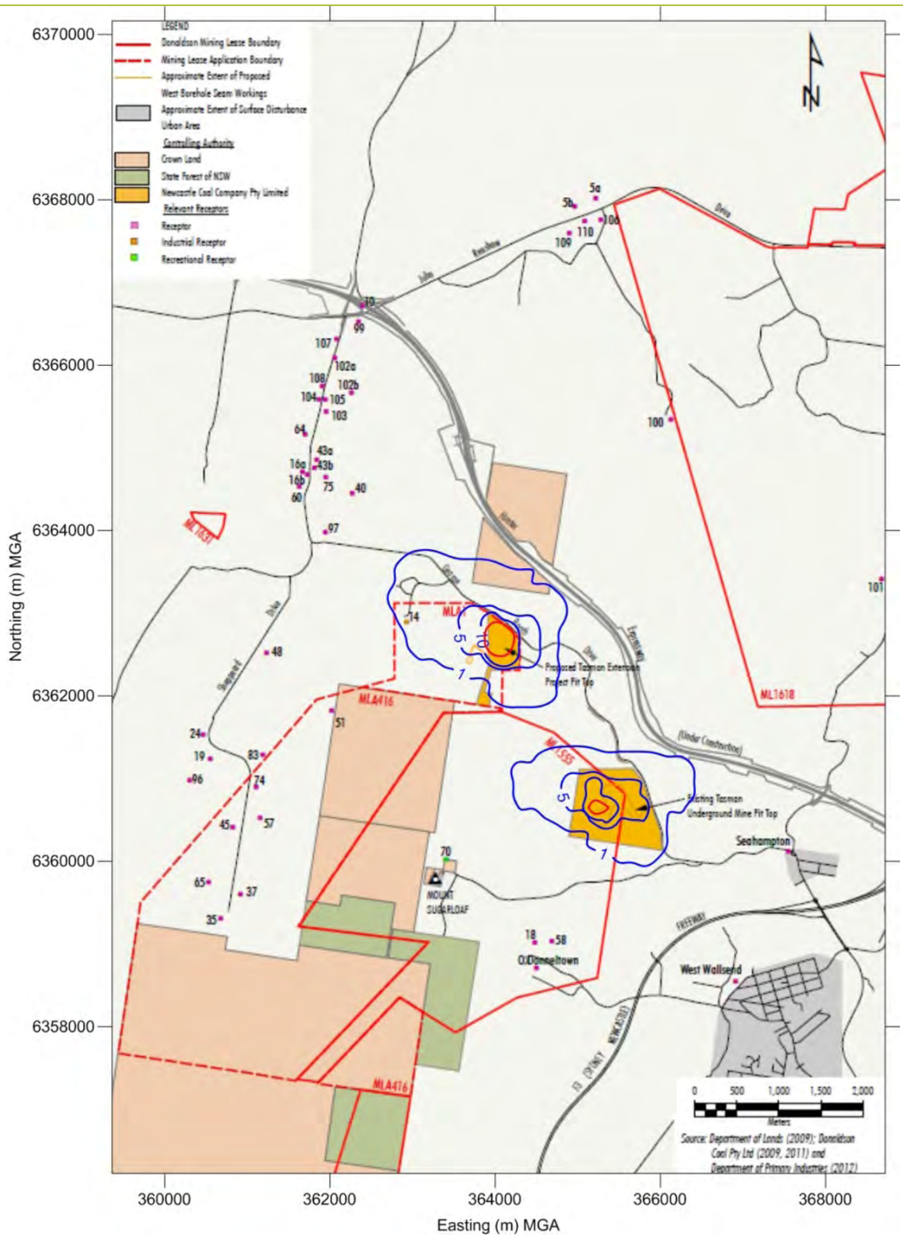
Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
PM_{10}	Tasman Mine	Scenario 1	Maximum	24-Hour
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.262	$\mu g/m^3$	50 $\mu g/m^3$	CALMET	R. Kellaghan

Figure 8.1: Incremental Max 24-Hour PM_{10} Concentration – Scenario 1



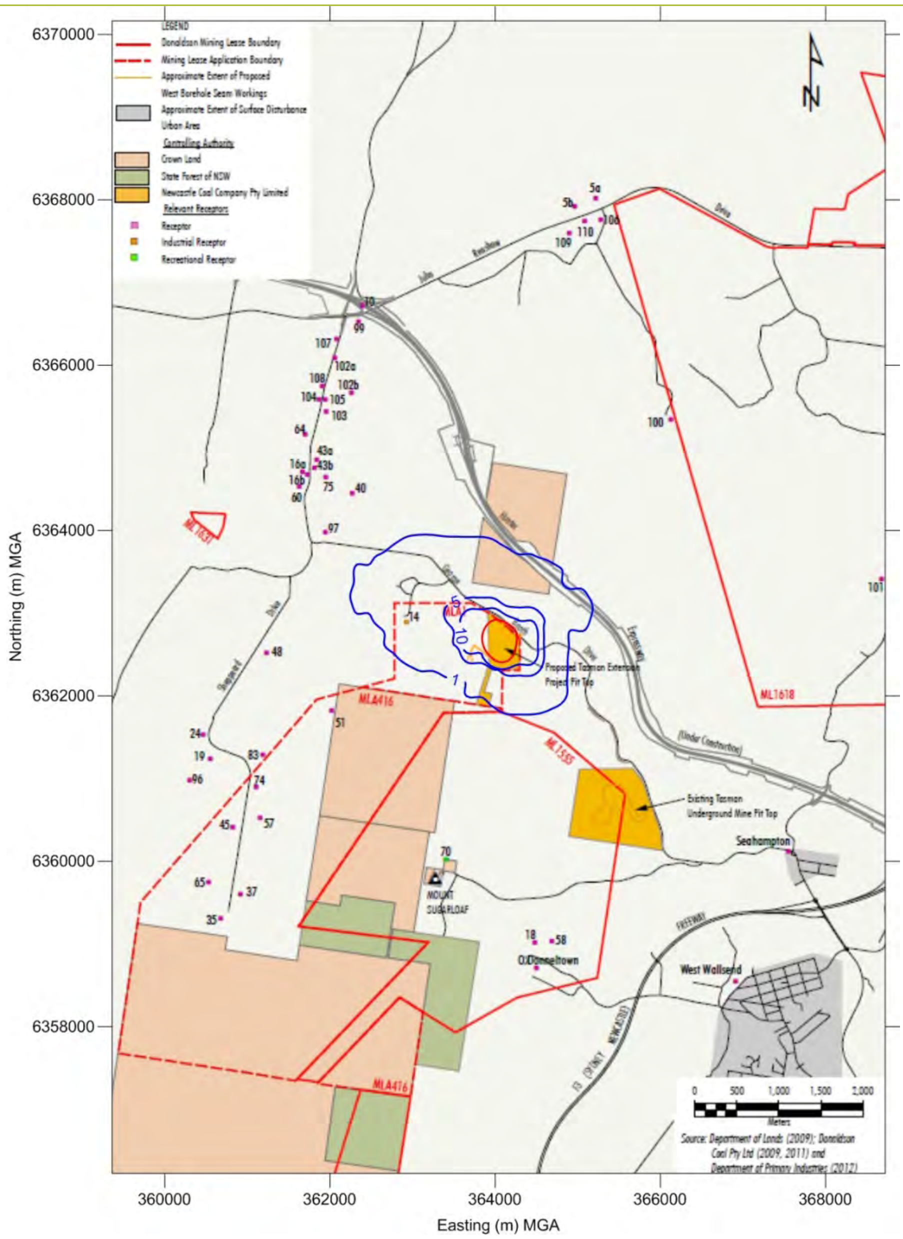
Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Tasman Mine	Scenario 2	Maximum	24-Hour
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.262	µg/m³	50 µg/m³	CALMET	R. Kellaghan

Figure 8.2: Incremental Max 24-Hour PM_{10} Concentration – Scenario 2



Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Tasman Mine	Scenario 1	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.262	$\mu g/m^3$	30 $\mu g/m^3$	CALMET	R. Kellaghan

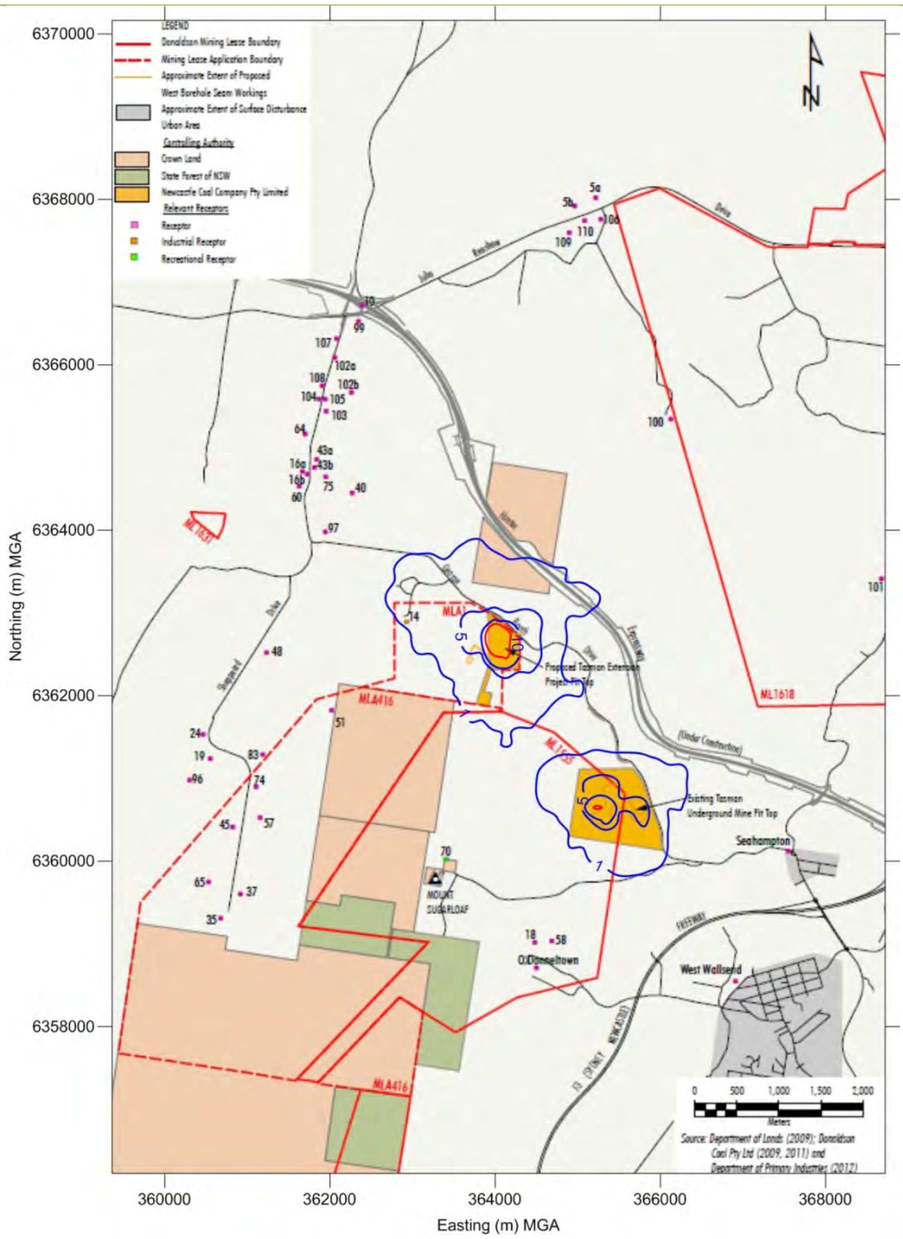
Figure 8.3: Incremental Annual Average PM_{10} Concentration – Scenario 1



Species: PM$_{10}$	Location: Tasman Mine	Scenario: Scenario 2	Percentile: N/A	Averaging Time: Annual
Model Used: CALPUFF v6.262	**Units:** µg/m^3	**Guideline:** 30 µg/m^3	**Met Data:** CALMET	**Plot:** R. Kellaghan

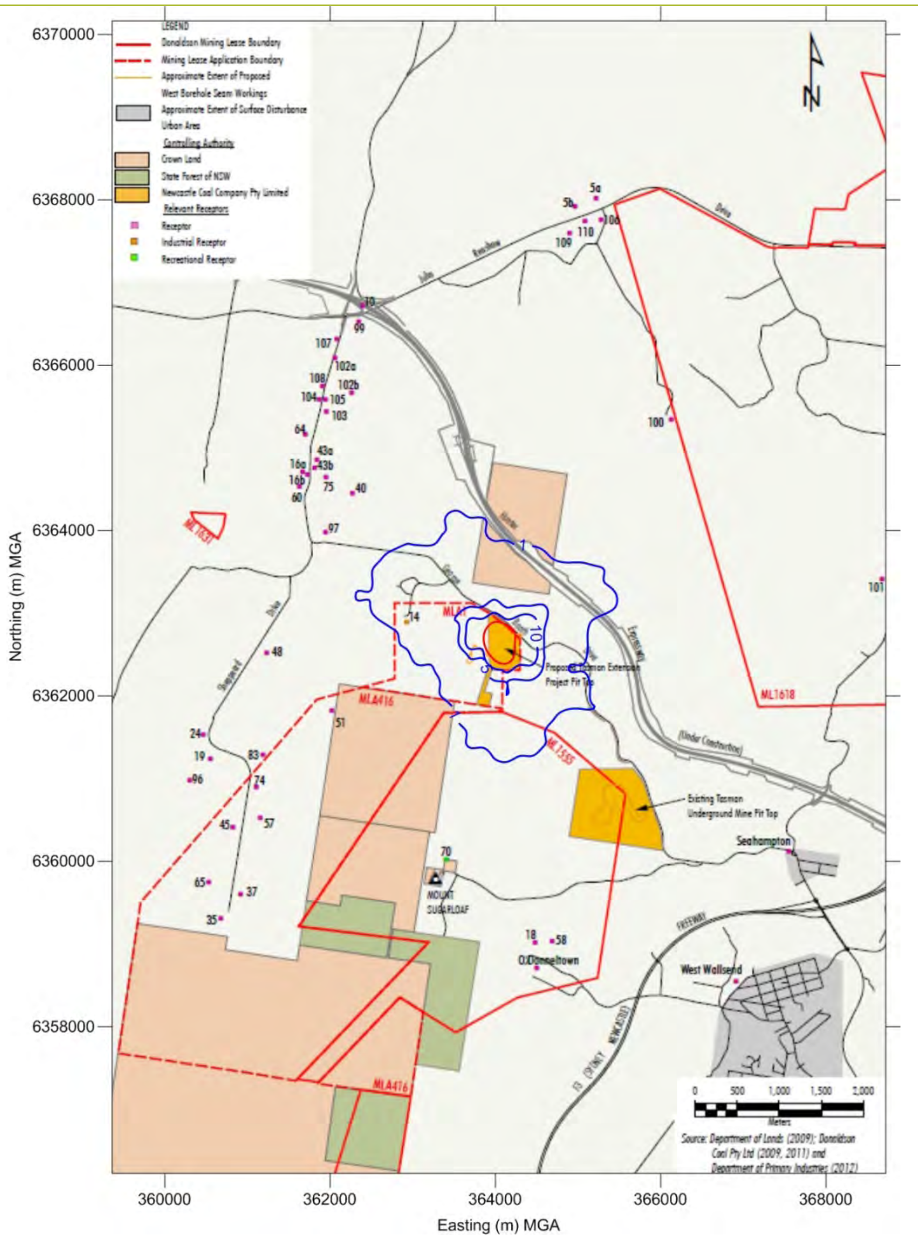
Figure 8.4: Incremental Annual Average PM$_{10}$ Concentration – Scenario 2

8.2.2 $PM_{2.5}$



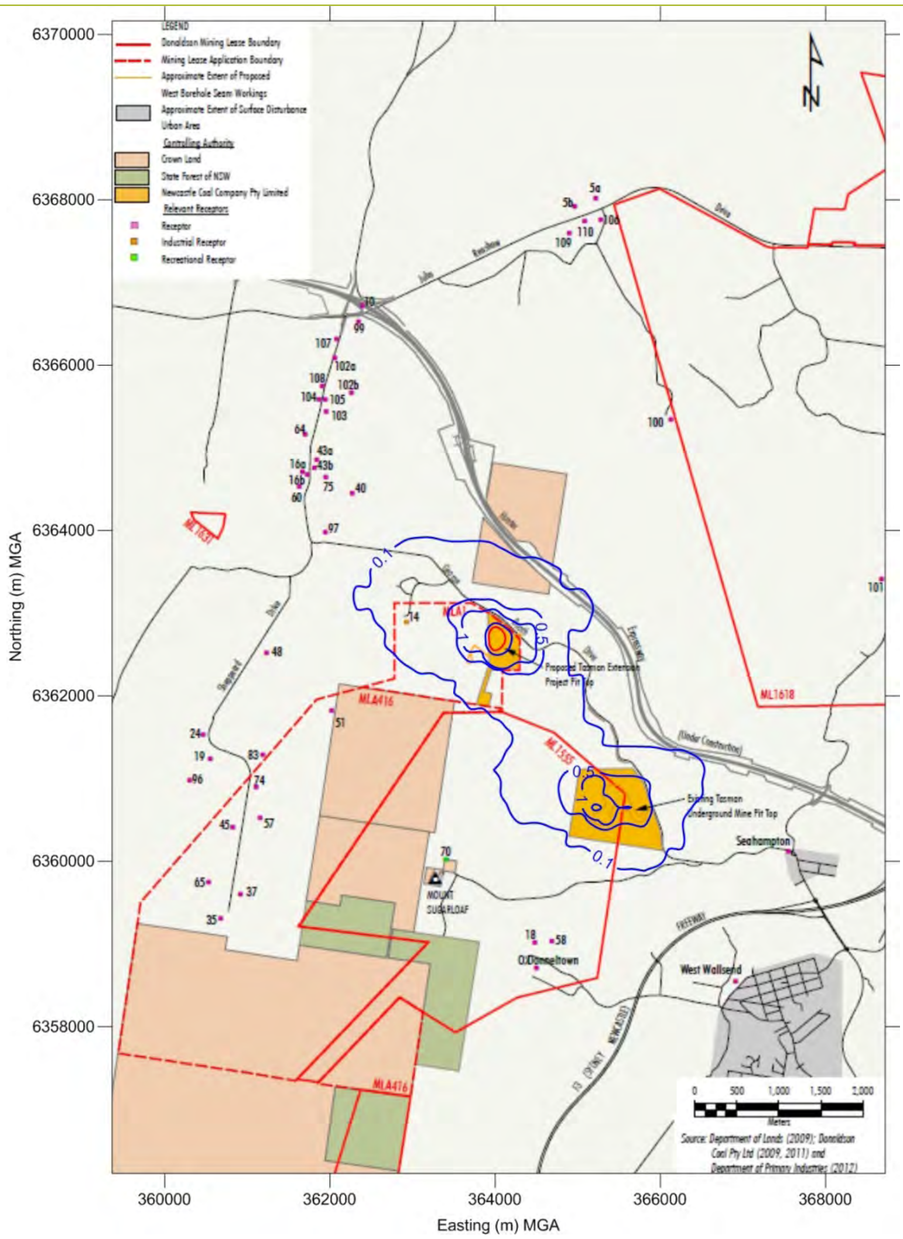
Species:	Location:	Scenario:	Percentile:	Averaging Time:
$PM_{2.5}$	Tasman Mine	Scenario 1	Maximum	24-Hour
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.262	µg/m^3	25 µg/m^3	CALMET	R. Kellaghan

Figure 8.5: Incremental Max 24-Hour $PM_{2.5}$ Concentration – Scenario 1



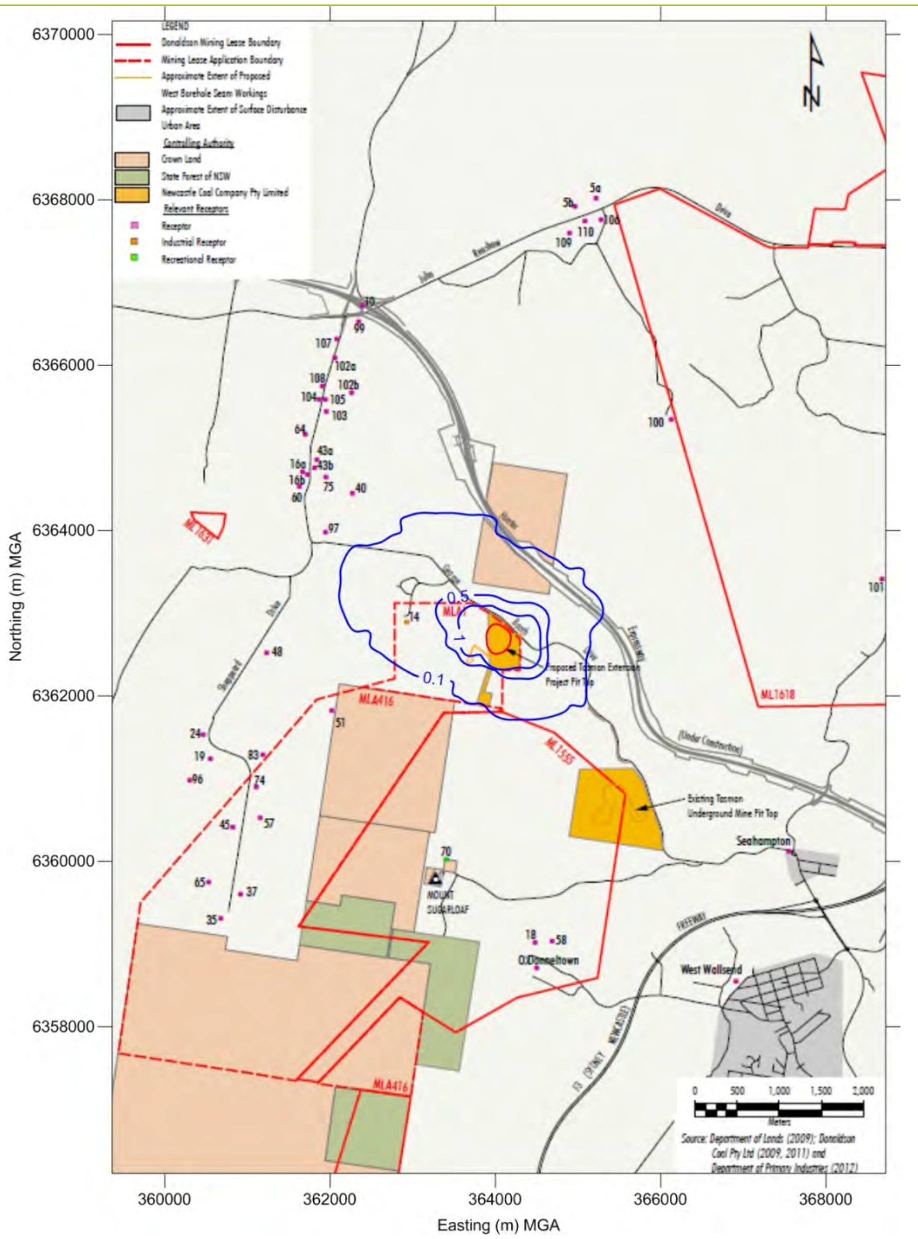
Species: PM2.5	Location: Tasman Mine	Scenario: Scenario 2	Percentile: Maximum	Averaging Time: 24-Hour
Model Used: CALPUFF v6.262	**Units:** µg/m³	**Guideline:** 25 µg/m³	**Met Data:** CALMET	**Plot:** R. Kellaghan

Figure 8.6: Incremental Max 24-Hour $PM_{2.5}$ Concentration – Scenario 2



Species: PM$_{2.5}$	**Location:** Tasman Mine	**Scenario:** Scenario 1	**Percentile:** N/A	**Averaging Time:** Annual
Model Used: CALPUFF v6.262	**Units:** µg/m^3	**Guideline:** 8 µg/m^3	**Met Data:** CALMET	**Plot:** R. Kellaghan

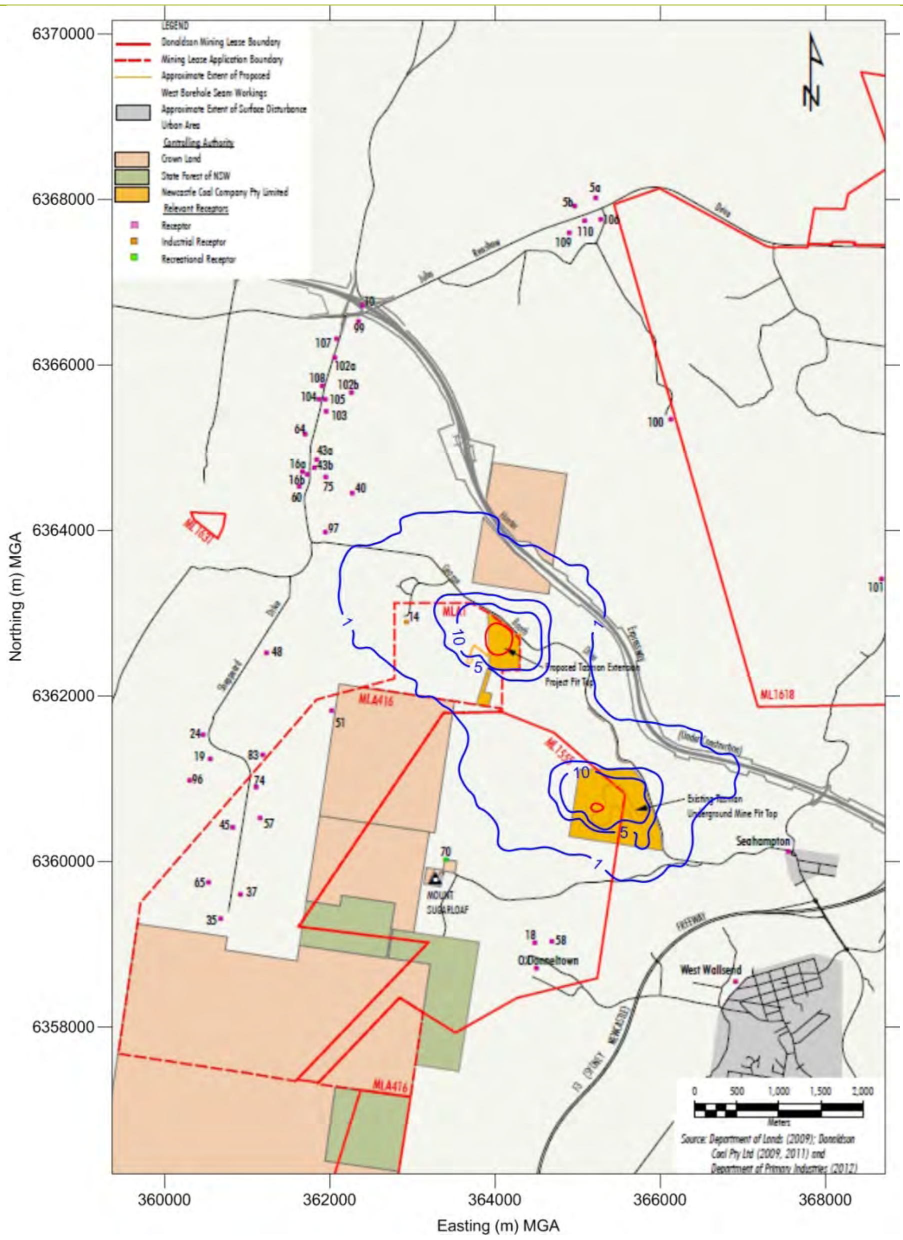
Figure 8.7: Incremental Annual Average PM$_{2.5}$ Concentration – Scenario 1



Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
$PM_{2.5}$	Tasman Mine	Scenario 2	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.262	µg/m³	8 µg/m³	CALMET	R. Kellaghan

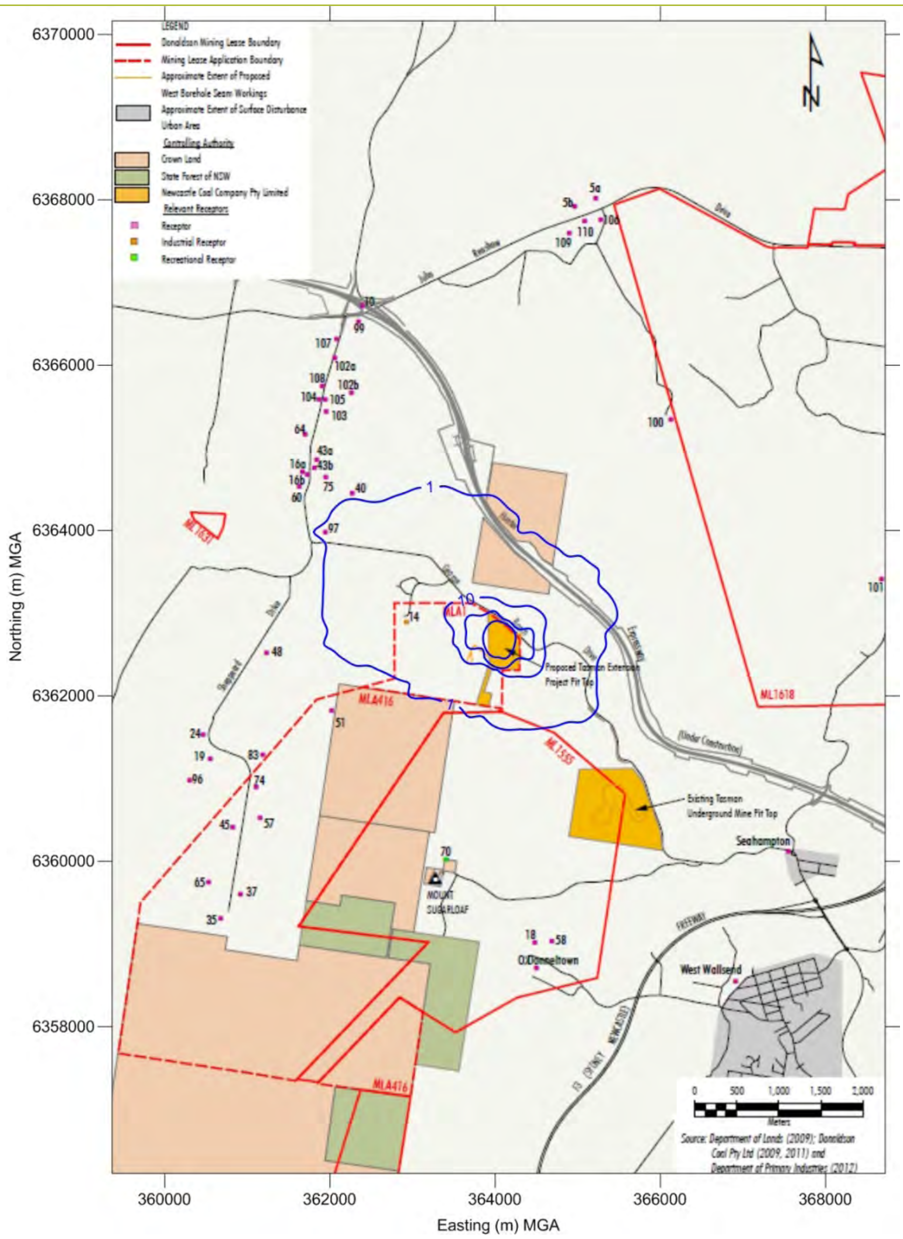
Figure 8.8: Incremental Annual Average $PM_{2.5}$ Concentration – Scenario 2

8.2.3 TSP



Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
TSP	Tasman Mine	Scenario 1	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.262	µg/m^3	90 µg/m^3	CALMET	R. Kellaghan

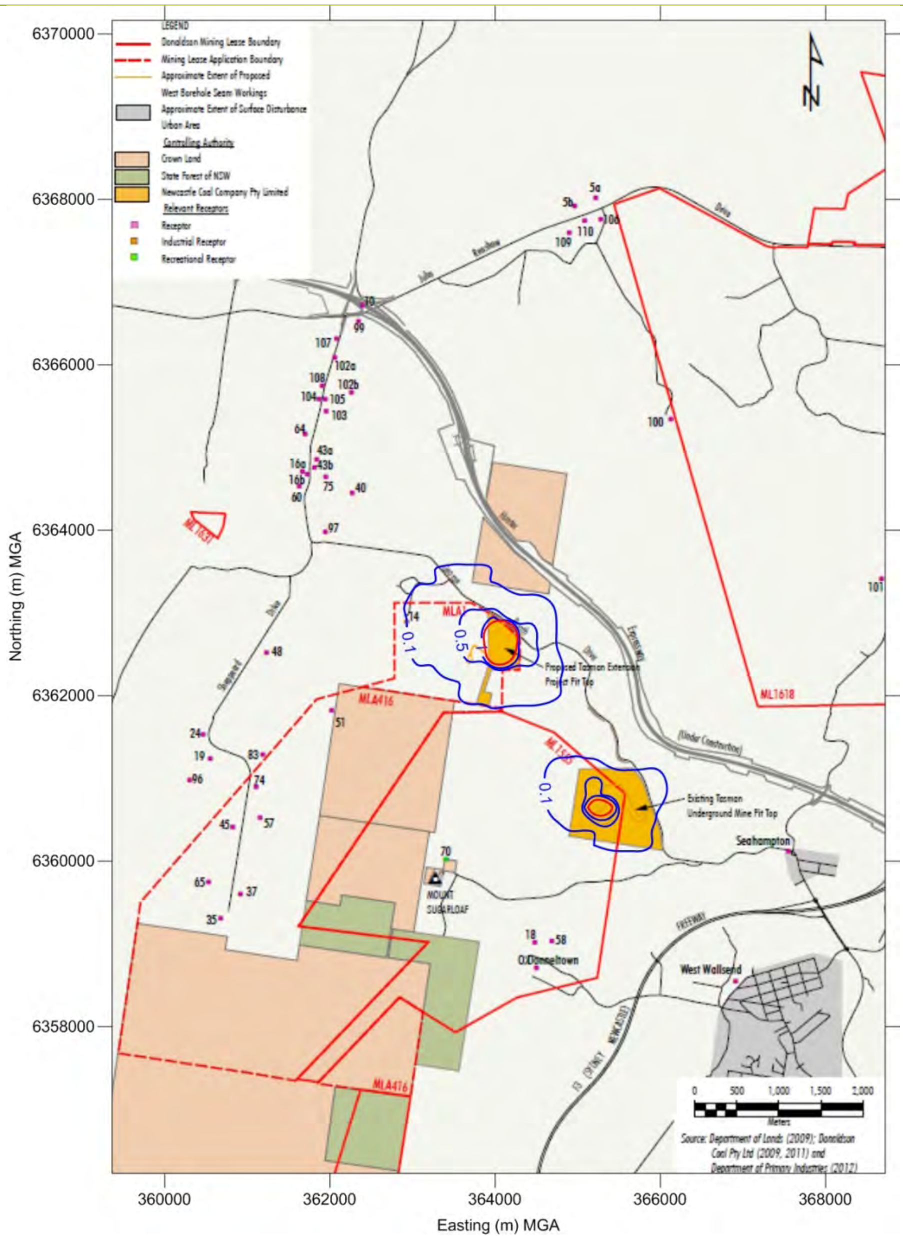
Figure 8.9: Incremental Annual Average TSP Concentration – Scenario 1



Species:	Location:	Scenario:	Percentile:	Averaging Time:
TSP	Tasman Mine	Scenario 2	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.262	µg/m^3	90 µg/m^3	CALMET	R. Kellaghan

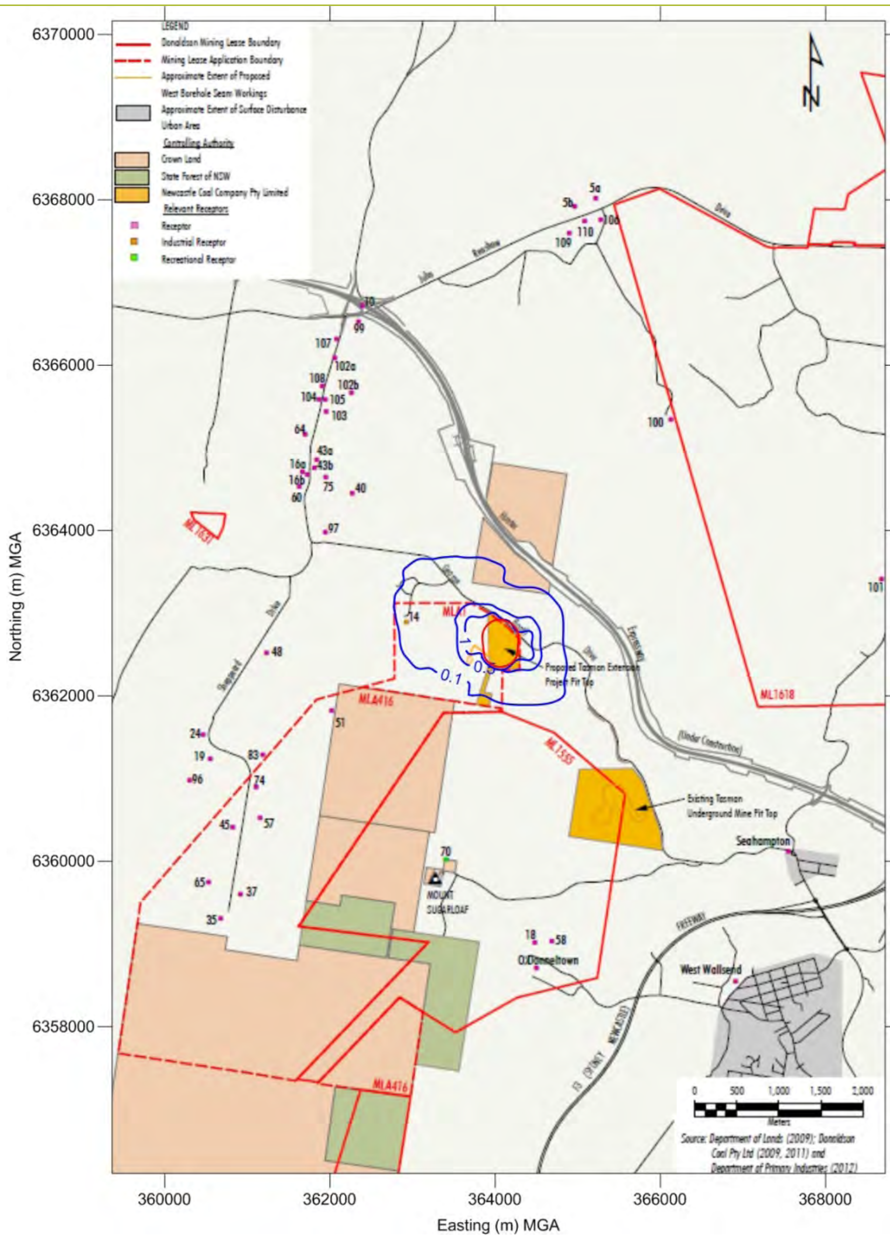
Figure 8.10: Incremental Annual Average TSP Concentration – Scenario 2

8.2.4 Dust Deposition



Species: Dust Deposition	**Location:** Tasman Mine	**Scenario:** Scenario 1	**Percentile:** N/A	**Averaging Time:** Annual
Model Used: CALPUFF v6.262	**Units:** g/m^2/month	**Guideline:** 2 g/m^2/month	**Met Data:** CALMET	**Plot:** R. Kellaghan

Figure 8.11: Incremental Annual Average Dust Deposition – Scenario 1



Species: Dust Deposition	**Location:** Tasman Mine	**Scenario:** Scenario 2	**Percentile:** N/A	**Averaging Time:** Annual
Model Used: CALPUFF v6.262	**Units:** g/m^2/month	**Guideline:** 2 g/m^2/month	**Met Data:** CALMET	**Plot:** R. Kellaghan

Figure 8.12: Incremental Annual Average Dust Deposition – Scenario 2

8.3 Summary of Results at Discrete Receptors

The predicted pollutant concentrations at each of the sensitive receptors in **Table 3-1** are presented in **Table 8-2** and **Table 8-3**. The results indicate that the predicted PM_{10}, $PM_{2.5}$, TSP and dust deposition at the closest residential receptors are all well below the impact assessment criteria.

Table 8-2: Predicted Modelling Results at Receptor Locations– Scenario 1

ID	Name	24-Hour Average				Annual Average							
		PM_{10}	Goal	$PM_{2.5}$	Goal	PM_{10}	Goal	$PM_{2.5}$	Goal	TSP	Goal	Dust Dep	Goal
O'Donneltown		0.6	50	0.1	25	0.1	30	0.01	8	0.1	90	0.00	4
Seahampton		1.2	50	0.2	25	0.1	30	0.02	8	0.2	90	0.02	4
West Wallsend		0.8	50	0.1	25	0.1	30	0.01	8	0.1	90	0.01	4
5a	Four Mile Pty Limited	0.4	50	0.1	25	0.0	30	0.00	8	0.1	90	0.00	4
5b	Four Mile Pty Limited	0.4	50	0.1	25	0.0	30	0.00	8	0.1	90	0.00	4
10	Roads and Traffic Authority of New South Wales	1.2	50	0.2	25	0.1	30	0.01	8	0.2	90	0.00	4
14	Orica Australia Pty Limited	8.0	50	1.3	25	1.3	30	0.19	8	2.6	90	0.10	4
16a	ARM & C Roach	1.1	50	0.2	25	0.2	30	0.04	8	0.5	90	0.01	4
16b	ARM & C Roach	1.2	50	0.2	25	0.2	30	0.04	8	0.5	90	0.01	4
18	AR Sager	0.8	50	0.1	25	0.1	30	0.01	8	0.2	90	0.01	4
19	AS & KL Green	0.9	50	0.2	25	0.1	30	0.02	8	0.3	90	0.01	4
24	BG & M Smith	0.9	50	0.2	25	0.1	30	0.02	8	0.3	90	0.01	4
35	D & JA Hoey	0.7	50	0.2	25	0.1	30	0.01	8	0.1	90	0.00	4
37	GW & KM Cameron	0.7	50	0.2	25	0.1	30	0.01	8	0.1	90	0.01	4
40	GT, SD, JR & MA Holmes	1.8	50	0.3	25	0.3	30	0.05	8	0.6	90	0.02	4
43a	GG & CA Morris	1.3	50	0.2	25	0.2	30	0.04	8	0.4	90	0.01	4
43b	GG & CA Morris	1.3	50	0.2	25	0.2	30	0.04	8	0.5	90	0.01	4
45	GK Hooler	0.8	50	0.2	25	0.1	30	0.02	8	0.2	90	0.01	4
48	H Spruce & JW Rhind	2.0	50	0.4	25	0.4	30	0.06	8	0.7	90	0.03	4
51	JM Spruce	1.1	50	0.2	25	0.2	30	0.03	8	0.4	90	0.02	4
57	KH & DM Starr	0.8	50	0.2	25	0.1	30	0.02	8	0.2	90	0.01	4
58	KM & LJ Spruce	1.1	50	0.2	25	0.1	30	0.01	8	0.2	90	0.01	4

ID	Name	24-Hour Average				Annual Average							
		PM_{10}	Goal	$PM_{2.5}$	Goal	PM_{10}	Goal	$PM_{2.5}$	Goal	TSP	Goal	Dust Dep	Goal
60	LD & KA Bradbery	1.2	50	0.2	25	0.2	30	0.04	8	0.5	90	0.01	4
64	ME Hooley	1.3	50	0.2	25	0.2	30	0.03	8	0.3	90	0.01	4
65	MA Honeysett	0.7	50	0.2	25	0.1	30	0.01	8	0.2	90	0.01	4
70	The Minister for Lands	1.8	50	0.3	25	0.3	30	0.03	8	0.5	90	0.02	4
74	PJ Crowhurst	0.9	50	0.2	25	0.1	30	0.02	8	0.2	90	0.01	4
75	PE Maytom	1.4	50	0.2	25	0.3	30	0.04	8	0.5	90	0.01	4
83	PW & DL Dryden	1.0	50	0.2	25	0.2	30	0.02	8	0.3	90	0.01	4
96	Transgrid	0.8	50	0.2	25	0.1	30	0.02	8	0.2	90	0.01	4
97	WC & LM Gibson	1.9	50	0.4	25	0.4	30	0.06	8	0.7	90	0.02	4
99	LJ & LM Jones	1.2	50	0.2	25	0.1	30	0.02	8	0.2	90	0.00	4
100	DR & KL Bishop	0.5	50	0.1	25	0.0	30	0.01	8	0.1	90	0.00	4
101	GR & RL Watts	0.6	50	0.1	25	0.1	30	0.01	8	0.1	90	0.01	4
103	DJ & SL Ayre	1.5	50	0.3	25	0.1	30	0.02	8	0.3	90	0.01	4
104	KP & J Mantle	1.4	50	0.2	25	0.1	30	0.02	8	0.2	90	0.01	4
105	LJ & C Fairhall	1.5	50	0.3	25	0.1	30	0.02	8	0.2	90	0.01	4
106	F Valicek	0.4	50	0.1	25	0.0	30	0.00	8	0.1	90	0.00	4
107	CR & L Parker	1.2	50	0.2	25	0.1	30	0.02	8	0.2	90	0.00	4
108	AM Williams	1.4	50	0.3	25	0.1	30	0.02	8	0.2	90	0.01	4
109	CR & ML Parnell	0.5	50	0.1	25	0.0	30	0.01	8	0.1	90	0.00	4
110	ME & KD Elliott	0.4	50	0.1	25	0.0	30	0.00	8	0.1	90	0.00	4
102a	IR & MMF Gee	1.4	50	0.2	25	0.1	30	0.02	8	0.2	90	0.00	4
102b	IR & MMF Gee	1.7	50	0.3	25	0.1	30	0.02	8	0.2	90	0.01	4

Table 8-3: Predicted Modelling Results at Receptor Locations – Scenario 2

ID	Name	24-Hour Average				Annual Average							
		PM_{10}	Goal	$PM_{2.5}$	Goal	PM_{10}	Goal	$PM_{2.5}$	Goal	TSP	Goal	Dust Dep	Goal
O'Donneltown		0.9	50	0.2	50	0.0	30	0.01	8	0.1	90	0.00	4
Seahampton		0.9	50	0.1	50	0.1	30	0.01	8	0.1	90	0.01	4
West Wallsend		0.5	50	0.4	50	0.0	30	0.00	8	0.0	90	0.00	4
5a	Four Mile Pty Limited	0.6	50	0.1	25	0.0	30	0.00	8	0.1	90	0.00	4
5b	Four Mile Pty Limited	0.6	50	0.1	25	0.0	30	0.01	8	0.1	90	0.00	4
10	Roads and Traffic Authority of New South Wales	1.7	50	0.2	25	0.1	30	0.02	8	0.2	90	0.01	4
14	Orica Australia Pty Limited	13.9	50	1.8	25	2.1	30	0.26	8	3.8	90	0.12	4
16a	ARM & C Roach	2.0	50	0.3	50	0.4	30	0.05	8	0.7	90	0.02	4
16b	ARM & C Roach	2.1	50	0.3	50	0.4	30	0.05	8	0.7	90	0.02	4
18	AR Sager	1.0	50	0.2	50	0.1	30	0.01	8	0.1	90	0.00	4
19	AS & KL Green	1.3	50	0.2	50	0.2	30	0.02	8	0.3	90	0.01	4
24	BG & M Smith	1.4	50	0.2	50	0.2	30	0.02	8	0.3	90	0.01	4
35	D & JA Hoey	1.0	50	0.1	25	0.1	30	0.01	8	0.1	90	0.00	4
37	GW & KM Cameron	1.0	50	0.1	25	0.1	30	0.01	8	0.1	90	0.00	4
40	GT, SD, JR & MA Holmes	2.6	50	0.4	50	0.5	30	0.07	8	1.0	90	0.03	4
43a	GG & CA Morris	1.9	50	0.2	50	0.4	30	0.05	8	0.7	90	0.01	4
43b	GG & CA Morris	2.0	50	0.3	25	0.4	30	0.05	8	0.7	90	0.02	4
45	GK Hooler	1.3	50	0.2	50	0.1	30	0.01	8	0.2	90	0.01	4
48	H Spruce & JW Rhind	3.5	50	0.5	25	0.5	30	0.07	8	1.0	90	0.03	4
51	JM Spruce	2.3	50	0.3	25	0.3	30	0.04	8	0.5	90	0.02	4
57	KH & DM Starr	1.5	50	0.2	50	0.1	30	0.01	8	0.2	90	0.01	4
58	KM & LJ Spruce	1.0	50	0.2	50	0.0	30	0.01	8	0.1	90	0.00	4

ID	Name	24-Hour Average				Annual Average							
		PM_{10}	Goal	$PM_{2.5}$	Goal	PM_{10}	Goal	$PM_{2.5}$	Goal	TSP	Goal	Dust Dep	Goal
60	LD & KA Bradbery	2.2	50	0.3	50	0.4	30	0.05	8	0.7	90	0.02	4
64	ME Hooley	1.8	50	0.2	25	0.3	30	0.03	8	0.5	90	0.01	4
65	MA Honeysett	1.1	50	0.2	25	0.1	30	0.01	8	0.1	90	0.00	4
70	The Minister for Lands	1.3	50	0.2	25	0.1	30	0.01	8	0.1	90	0.01	4
74	PJ Crowhurst	1.6	50	0.2	50	0.1	30	0.02	8	0.2	90	0.01	4
75	PE Maytom	2.1	50	0.3	50	0.4	30	0.06	8	0.8	90	0.02	4
83	PW & DL Dryden	1.6	50	0.3	50	0.2	30	0.02	8	0.3	90	0.01	4
96	Transgrid	1.2	50	0.2	50	0.1	30	0.02	8	0.2	90	0.01	4
97	WC & LM Gibson	3.7	50	0.5	50	0.6	30	0.07	8	1.1	90	0.03	4
99	LJ & LM Jones	1.8	50	0.3	25	0.1	30	0.02	8	0.2	90	0.01	4
100	DR & KL Bishop	0.6	50	0.1	50	0.1	30	0.01	8	0.1	90	0.01	4
101	GR & RL Watts	0.6	50	0.1	50	0.1	30	0.01	8	0.1	90	0.00	4
103	DJ & SL Ayre	2.1	50	0.3	25	0.2	30	0.03	8	0.4	90	0.01	4
104	KP & J Mantle	1.9	50	0.3	25	0.2	30	0.02	8	0.3	90	0.01	4
105	LJ & C Fairhall	2.1	50	0.3	25	0.2	30	0.02	8	0.3	90	0.01	4
106	F Valicek	0.6	50	0.1	25	0.0	30	0.01	8	0.1	90	0.00	4
107	CR & L Parker	1.8	50	0.3	25	0.1	30	0.02	8	0.2	90	0.01	4
108	AM Williams	2.1	50	0.3	25	0.2	30	0.02	8	0.3	90	0.01	4
109	CR & ML Parnell	0.6	50	0.1	25	0.0	30	0.01	8	0.1	90	0.00	4
110	ME & KD Elliott	0.6	50	0.1	25	0.0	30	0.01	8	0.1	90	0.00	4
102a	IR & MMF Gee	2.1	50	0.3	25	0.1	30	0.02	8	0.3	90	0.01	4
102b	IR & MMF Gee	2.6	50	0.4	50	0.2	30	0.02	8	0.3	90	0.01	4

Recent conditions of consent in relation to air quality have included reference to vacant land in air quality criteria. Specifically, vacant land is considered to be affected if greater than 25% of a property is predicted to exceed the impact assessment criteria.

The relevant air quality contours and land tenure information for the Project have been reviewed. From this review, no vacant land impacts have been identified for the Project.

8.3.1 Cumulative Impacts

The purpose of the cumulative assessment is to demonstrate that no additional exceedances of the impact assessment criteria will occur as a result of the operation of the Project.

A summary of the potential impacts of the Project, inclusive of background levels, is provided below:

- The maximum annual average PM_{10} at any residential receptor is less than 1 µg/m^3. Adding this to the adopted background of 16 µg/m^3 would not result in any exceedances of the impact assessment criteria of 30 µg/m^3.
- The maximum annual average $PM_{2.5}$ at any residential receptor is less than 1 µg/m^3. Adding this to the adopted background of 5 µg/m^3 would not result in any exceedances of the impact assessment criteria of 8 µg/m^3.
- The maximum annual average TSP at any residential receptor is less than 2 µg/m^3. Adding this to the adopted background of 31 µg/m^3 would not result in any exceedances of the impact assessment criteria of 90 µg/m^3.
- The annual average dust deposition adopted for background is 1.1 g/m^2/month. The predicted increase in dust deposition from the Project is minor and would not result in any exceedances of the impact assessment criteria.

The maximum predicted increment in 24-hour PM_{10} concentrations from the Project at any residential receptor is 3.7 µg/m^3. As such, for the Project to result in an exceedance of the 24-hour PM_{10} criteria (of 50 µg/m^3), the background PM_{10} concentration would have to be greater than approximately 46 µg/m^3. As shown in **Figure 5.2**, the Tasman HVAS has recorded PM_{10} concentrations greater than 46 µg/m^3 on only three occasions for the period November 2006 to December 2011 (and none since November 2008). Typical background PM_{10} levels in the Project area are 16 µg/m^3 (**Section 5.2.5**), which well below 50 µg/m^3.

The maximum predicted 24-hour $PM_{2.5}$ concentration is 0.5 µg/m^3. As such, the Project is predicted to have a negligible impact on total $PM_{2.5}$ concentrations at residential receptors, and any exceedance of the 24-hour $PM_{2.5}$ criteria of 25 µg/m^3 would be primarily due to non-mine sources. Typical background $PM_{2.5}$ levels in the Project area are 5 µg/m^3, which well below 25 µg/m^3 (**Section 5.2.5**).

8.3.2 Other Industrial Operations

The adopted background levels used for the assessment of cumulative impacts associated with the Project have been developed based on monitoring data in the region of the Project, and therefore, these background levels are inclusive of dust generated by existing industrial operations (if relevant).

Projects that have recently been approved by the NSW Department of Planning and Infrastructure (DP&I), and proposed projects, are not included in the adopted background levels. A description of recently approved or proposed projects in the vicinity of the Project is provided below.

The Orica Ammonium Nitrate Emulsion (ANE) Project, located approximately 1.3 km to the west of the new pit top area, was approved on 26 July 2010. The ANE process involves mixing only, and therefore, no dust emissions during operation are expected (**Umwelt, 2009**).

The West Wallsend Coal Project, located approximately 8 km to the south of the new pit top area, was approved on 25 January 2012. The air quality assessment prepared for the West Wallsend Coal Project predicted that the proposed operations would result in a maximum increment in 24-hour PM_{10} concentrations (at a receptor) of 3 µg/m^3. The receptor experiencing this maximum increment is located in Killingworth, which is located approximately 7.5 km south of the new pit top area (**Environ, 2010).** Potential impacts from the Project at Killingworth would be negligible.

The proposed modification to the Abel Underground Mine (Abel Upgrade Modification), located approximately 7.5 km to the north east of the new pit top area, involves increased ROM coal production from the Abel Underground Mine, and increased throughput at the Bloomfield CHPP (including the processing of ROM coal from the Project). Donaldson Coal lodged an application for the Abel Upgrade Modification with the DP&I (05_0136 MOD 3) in December 2011. An air quality assessment will be prepared as part of the Environmental Assessment for the Abel Upgrade Modification.

Given the distances separating the Project from the West Wallsend Coal Project and Abel Upgrade Modification, cumulative impacts associated with their concurrent operations are not expected.

The eastern section of the Hunter Expressway involves the construction and use of a four-land highway between the F3 Freeway and Kurri Kurri. The proximity of the Hunter Expressway to the Project is shown in Figure 2-2. Construction of the eastern section of the Hunter Expressway commenced in August 2010, and is expected to be completed by the end of 2013 (i.e. prior to the commencement of proposed mining operations at the new pit top area). No impacts to air quality are expected for the Hunter Expressway during its operation (**NSW Department of Urban Affairs and Planning, 2001**; **RTA, 2007**).

9 GREENHOUSE GAS ASSESSMENT

9.1 Introduction

Greenhouse gas (GHG) emissions have been estimated based on the methods outlined in the following documents:

- The World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) Greenhouse Gas Protocol *The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard Revised Edition* **(WRI/WBCSD, 2004)**;
- *National Greenhouse and Energy Reporting (Measurement) Determination 2008*; and
- The Commonwealth Department of Climate Change and Energy Efficiency (DCCEE) *National Greenhouse Accounts* (NGA) *Factors 2011* (**DCCEE, 2011)**.

The GHG Protocol establishes an international standard for accounting and reporting of GHG emissions. The GHG Protocol has been adopted by the International Standard Organisation, endorsed by GHG initiatives (such as the Carbon Disclosure Project) and is compatible with existing GHG trading schemes.

Three 'scopes' of emissions (scope 1, scope 2 and scope 3) are defined for GHG accounting and reporting purposes, as described below. This terminology has been adopted in Australian GHG reporting and measurement methods and has been employed in this assessment.

The 'scope' of an emission is relative to the reporting entity. Indirect scope 2 and scope 3 emissions will be reportable as direct scope 1 emissions from another facility.

1) Scope 1: Direct Greenhouse Gas Emissions

Direct GHG emissions are defined as those emissions that occur from sources that are owned or controlled by the reporting entity. Direct GHG emissions are those emissions that are principally the result of the following types of activities undertaken by an entity:

- Generation of electricity, heat or steam. These emissions result from combustion of fuels in stationary sources.
- Physical or chemical processing. Most of these emissions result from manufacture or processing of chemicals and materials (e.g. the manufacture of cement, aluminium, etc.).
- Transportation of materials, products, waste and employees. These emissions result from the combustion of fuels in entity owned/controlled mobile combustion sources (e.g. trucks, trains, ships, aeroplanes, buses and cars).
- Fugitive emissions. These emissions result from intentional or unintentional releases (e.g. equipment leaks from joints, seals, packing and gaskets; methane (CH_4) emissions from coal mines and venting); hydroflurocarbon (HFC) emissions during the use of refrigeration and air conditioning equipment; and CH_4 leakages from gas transport.

2) Scope 2: Energy Product Use Indirect Greenhouse Gas Emissions

Scope 2 emissions are a category of indirect emissions that account for GHG emissions from the generation of purchased energy products (principally, electricity, steam/heat and reduction materials used for smelting) by the entity.

Scope 2 in relation to coal mines typically covers purchased electricity, defined as electricity that is purchased or otherwise brought into the organisational boundary of the entity.

3) Scope 3: Other Indirect Greenhouse Gas Emissions

Scope 3 emissions are defined as those emissions that are a consequence of the activities of an entity, but which arise from sources not owned or controlled by that entity. Some examples of scope 3 activities provided in the GHG Protocol are extraction and production of purchased materials, transportation of purchased fuels, and use of sold products and services.

In the case of the Project, scope 3 emissions will include emissions associated with the extraction, processing and transport of diesel, and the transportation and combustion of product coal. The GHG Protocol provides that reporting scope 3 emissions is optional. If an organisation believes that scope 3 emissions are a significant component of the total emissions inventory, these can be reported along with scope 1 and scope 2. However, the GHG Protocol notes that reporting scope 3 emissions can result in double counting of emissions and can also make comparisons between organisations and/or products difficult because reporting is voluntary.

Double counting needs to be avoided when compiling national (country) inventories under the Kyoto Protocol. The GHG Protocol also recognises that compliance regimes are more likely to focus on the "point of release" of emissions (i.e. direct emissions) and/or indirect emissions from the purchase of electricity.

9.2 Greenhouse Gas Emission Estimates

Emissions of carbon dioxide (CO_2) and CH_4 would be the most significant GHGs for the Project. These gases are formed and released during the combustion of fuels used on site and from fugitive emissions occurring during the mining process, due to the liberation of CH_4 from coal seams.

Inventories of GHG emissions can be calculated using published emission factors. Different gases have different greenhouse warming effects (referred to as global warming potentials) and emission factors take into account the global warming potentials of the gases created during combustion. The estimated emissions are referred to in terms of carbon dioxide equivalent (CO_2-e) emissions by applying the relevant global warming potential. The GHG assessment has been conducted using the National Greenhouse Account (NGA) Factors, published by the **DCCEE (2011)**.

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

- fuel consumption (diesel) during mining operations and construction – scope 1;
- release of fugitive CH_4 during mining – scope 1;
- indirect emissions associated with on-site electricity use – scope 2;
- indirect emissions associated with the production and transport of fuels – scope 3;
- emissions from the processing of coal at the Bloomfield CHPP – scope 3;
- emissions from coal transportation – scope 3; and
- emissions from the use of the product coal – scope 3.

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

9.2.1 Fuel Consumption

GHG emissions from diesel consumption were estimated using the following equation:

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

where:

E_{CO2-e}	=	Emissions of GHG from diesel combustion	(t CO_2-e)[1]
Q	=	Estimated combustion of diesel	(GJ)[2]
EF	=	Emission factor (scope 1 or scope 3) for diesel combustion	(kg CO_2-e/GJ)[3]

[1] tCO_2-e = tonnes of carbon dioxide equivalent.

[2] GJ = gigajoules.

[3] kg CO_2-e/GJ = kilograms of carbon dioxide equivalents per gigajoule.

The quantity of diesel consumed (Q) in each year is based on a diesel intensity rate (kilolitres [kL] diesel/t ROM), derived from the 2010/2011 diesel consumption (722 kL) and ROM rate of 616,034 tpa. The quantity of diesel consumed in gigajoules (GJ) (Q) is then calculated using an energy content factor for diesel of 38.6 gigajoules per kilolitre (GJ/kL).

GHG emission factors and energy content for diesel were sourced from the NGA Factors (**DCCEE, 2011**). The estimated annual and Project total GHG emissions from diesel usage are presented in **Table 9.1**.

Note that for Year 1 of the Project (2013-2014) it has been assumed that approximately 20,000 GJ of diesel would be required for construction of the new pit top area, as estimated based on the expected construction equipment fleet. This diesel consumption is included in the GHG estimates for 2013-2014 presented below.

Table 9.1: Estimated CO2-e (tonnes) for diesel consumption

Year	ROM (tpa)	Emissions (t CO2-e)		Total
		Scope 2	Scope 3	
2013-14	578,000	2,740	148	2,888
2014-15	951,000	3,198	244	3,442
2015-16	1,155,000	3,884	296	4,180
2016-17	1,428,000	4,802	366	5,168
2017-18	1,428,000	4,802	366	5,168
2018-19	1,428,000	4,802	366	5,168
2019-20	1,500,000	5,044	385	5,429
2020-21	1,500,000	5,044	385	5,429
2021-22	1,500,000	5,044	385	5,429
2022-23	1,500,000	5,044	385	5,429
2023-24	1,428,000	4,802	366	5,168
2024-25	1,428,000	4,802	366	5,168
2025-26	1,428,000	4,802	366	5,168
2026-27	1,017,000	3,420	261	3,681
2027-28	464,000	1,560	119	1,679
2028-29	462,000	1,554	118	1,672
2029-30	241,000	810	62	872
Total		**66,158**	**4,984**	**71,142**

9.2.2 Electricity

GHG emissions from electricity usage were estimated using the following equation:

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

where:

$E_{CO2\text{-}e}$	=	Emissions of GHG from electricity usage	(tCO_2-e/annum)
Q	=	Estimated electricity usage	(kWh/annum)[1]
EF	=	Emission factor (Scope 2 or Scope 3) for electricity usage	($kgCO_2$-e/kWh)[2]

[1] kWh/annum = kilowatt hours per annum

[2] $kgCO_2$-e/kWh = kilograms of carbon dioxide equivalents per kilowatt hour

The quantity of electricity used each year is based on an intensity rate (kWh/tpa ROM) derived from the 2010/2011 electricity use (7,866,816 kWh) and ROM rate of 616,034 tpa. GHG emission factors were sourced from the NGA Factors (**DCCEE, 2011**). The estimated annual and Project total GHG emissions from electricity usage are presented in **Table 9.2.** Included in the totals are emissions from the Bloomfield CHPP, which were estimated based on an assumed consumption figure of 1 kWh/tonne, as per the existing consumption rate.

Table 9.2: Estimated CO_2-e (tonnes) for electricity

Year	ROM (tpa)	Emissions (t CO2-e)			Total
		Scope 2	Scope 3		
		Project	Project	Bloomfield CHPP	
2013-14	578,000	6,569	1,329	618	8,516
2014-15	951,000	10,808	2,186	1,018	14,012
2015-16	1,155,000	13,127	2,655	1,236	17,018
2016-17	1,428,000	16,230	3,282	1,528	21,040
2017-18	1,428,000	16,230	3,282	1,528	21,040
2018-19	1,428,000	16,230	3,282	1,528	21,040
2019-20	1,500,000	17,048	3,448	1,605	22,101
2020-21	1,500,000	17,048	3,448	1,605	22,101
2021-22	1,500,000	17,048	3,448	1,605	22,101
2022-23	1,500,000	17,048	3,448	1,605	22,101
2023-24	1,428,000	16,230	3,282	1,528	21,040
2024-25	1,428,000	16,230	3,282	1,528	21,040
2025-26	1,428,000	16,230	3,282	1,528	21,040
2026-27	1,017,000	11,559	2,338	1,088	14,984
2027-28	464,000	5,274	1,067	496	6,837
2028-29	462,000	5,251	1,062	494	6,807
2029-30	241,000	2,739	554	258	3,551
Total		**220,898**	**44,676**	**20,797**	**286,370**

9.2.3 Fugitive Methane

Emissions from fugitive CH_4 were estimated using the following equation:

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

where:

E_{CO2-e}	=	Emissions of GHG from fugitive CH_4	(t CO_2-e/annum)
Q	=	ROM coal extracted during the year	(t)
EF	=	Scope 1 emission factor	(t CO_2-e/tonne)

A site specific emission factor (EF) of 0.01 t CO_2-e/tonne has been determined based on gas content testing of a core from an exploration borehole in the West Borehole seam in the EL5498 area (**GeoGas, 2011**). The measured gas content in m^3/t (**GeoGas, 2011**) was converted to CO_2-e based on the National Greenhouse and Energy Reporting System (NGERS) methodology (Division 3.2.2, Subdivision 3.2.2.2 Method 4) (**DCC, 2009**).

The estimated annual and Project total GHG emissions from fugitive CH_4 are presented in **Table 9.3.**

Table 9.3: Estimated CO2-e (tonnes) for fugitive methane

Year	ROM (tpa)	Scope 1 Emissions (t CO2-e)
2013-14	578,000	8,004
2014-15	951,000	13,168
2015-16	1,155,000	15,993
2016-17	1,428,000	19,773
2017-18	1,428,000	19,773
2018-19	1,428,000	19,773
2019-20	1,500,000	20,770
2020-21	1,500,000	20,770
2021-22	1,500,000	20,770
2022-23	1,500,000	20,770
2023-24	1,428,000	19,773
2024-25	1,428,000	19,773
2025-26	1,428,000	19,773
2026-27	1,017,000	14,082
2027-28	464,000	6,425
2028-29	462,000	6,397
2029-30	241,000	3,337
Total		**269,129**

9.2.4 Vegetation Clearing

There is minimal vegetation stripping required for the Project (restricted to small areas around the surface infrastructure and there GHG emissions due to vegetation clearance have not been calculated.

9.2.5 ROM Coal and Product Coal Transportation

GHG emissions associated with transport of ROM coal to the Bloomfield CHPP have been included in the calculations for diesel consumption. The total diesel fuel consumption used to calculate the diesel intensity factor includes the diesel consumption by the haulage contractor.

The scope 3 emissions associated with product coal transportation have been estimated based on all product coal being transported to the Port of Newcastle for export by rail. Emissions associated with product coal transportation have been estimated based on an emission factor for loaded trains of 12.3 grams per net tonne per kilometre (**QR Network Access, 2002**). Emission factors were not available for unloaded trains so the factor for loaded trains is conservatively applied for the return trip.

The return rail trip to the port of Newcastle is estimated to be 50 km. The total estimated GHG emissions from rail transport of product coal are provided in **Table 9.4.**

Table 9.4: Estimated CO_2-e (tonnes) for product coal transportation

Year	Product Coal (tpa)	Scope 1 Emissions (t CO2-e)
2013-14	455,000	280
2014-15	691,000	425
2015-16	907,000	558
2016-17	1,086,000	668
2017-18	1,021,000	628
2018-19	1,038,000	638
2019-20	966,000	594
2020-21	926,000	569
2021-22	889,000	547
2022-23	903,000	555
2023-24	906,000	557
2024-25	923,000	568
2025-26	885,000	544
2026-27	620,370	382
2027-28	283,040	174
2028-29	281,820	173
2029-30	147,010	90
Total		**7,951**

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

9.2.6 Energy Production from Product Coal

The scope 3 emissions associated with the combustion of product coal were estimated using the following equation:

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

Where:

E_{CO2-e}	=	Emissions of GHG from coal combustion	(t CO_2-e)
Q	=	Quantity of product coal burnt	(GJ)
EC	=	Energy Content Factor for black / coking coal	(GJ/t)[1]
EF	=	Emission factor for black / coking coal combustion	(kg CO_2-e/GJ)

[1] GJ/t = gigajoules per tonne

The quantity of thermal saleable coal has been estimated based estimated production rates of thermal and coking coal. These production rates are converted to GJ using an energy content factor of 27 GJ/t for black coal (i.e. thermal coal) and 30 GJ/t for coking coal. The GHG emission factors and energy contents for coal were sourced from the NGA Factors (**DCCEE, 2011**).

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

Table 9.5: Scope 3 emissions for energy production from product coal

Year	Thermal Product Coal tpa	Coking Product Coal tpa	Scope 3 Emissions Thermal and Coking (t CO2-e)
2013-14	406,487	48,513	1,102,100
2014-15	398,492	292,508	1,744,729
2015-16	412,569	494,431	2,325,957
2016-17	493,490	592,510	2,785,156
2017-18	463,993	557,007	2,618,445
2018-19	471,502	566,498	2,662,113
2019-20	375,861	590,139	2,497,874
2020-21	372,380	553,620	2,390,523
2021-22	358,084	530,916	2,294,816
2022-23	393,558	509,442	2,321,276
2023-24	413,606	492,394	2,322,909
2024-25	468,809	454,191	2,351,105
2025-26	446,106	438,894	2,255,414
2026-27	369,328	251,042	1,562,640
2027-28	179,588	103,452	709,349
2028-29	186,768	95,052	703,711
2029-30	104,299	42,711	364,858
Total			**33,012,977**

9.3 Summary of Emissions

A summary of the annual GHG emissions is provided in **Table 9.6**. Average annual scope 1 emissions from the Project (~20 kt CO_2-e) would represent 0.003% of Australia's annual average Kyoto commitment (591.5 Mt CO_2-e) and a very small portion of global greenhouse emissions.

Table 9.6: Summary of Annual Greenhouse Gas Emissions

Year	Scope 1 Emissions (t CO_2-e)			Scope 2 Emissions (t CO_2-e)	Scope 3 Emissions (t CO_2-e)					
	Diesel	Fugitive Methane	Total	Electricity	Diesel	Electricity	Bloomfield CHPP	Coal Burning	Rail	Total
2013-14	2,740	8,004	10,743	6,569	148	1,433	618	1,102,100	280	1,104,475
2014-15	3,198	13,168	16,367	10,808	244	2,357	1,018	1,744,729	425	1,748,601
2015-16	3,884	15,993	19,877	13,127	296	2,863	1,236	2,325,957	558	2,330,702
2016-17	4,802	19,773	24,576	16,230	366	3,539	1,528	2,785,156	668	2,791,001
2017-18	4,802	19,773	24,576	16,230	366	3,539	1,528	2,618,445	628	2,624,249
2018-19	4,802	19,773	24,576	16,230	366	3,539	1,528	2,662,113	638	2,667,928
2019-20	5,044	20,770	25,815	17,048	385	3,718	1,605	2,497,874	594	2,503,906
2020-21	5,044	20,770	25,815	17,048	385	3,718	1,605	2,390,523	569	2,396,530
2021-22	5,044	20,770	25,815	17,048	385	3,718	1,605	2,294,816	547	2,300,801
2022-23	5,044	20,770	25,815	17,048	385	3,718	1,605	2,321,276	555	2,327,269
2023-24	4,802	19,773	24,576	16,230	366	3,539	1,528	2,322,909	557	2,328,643
2024-25	4,802	19,773	24,576	16,230	366	3,539	1,528	2,351,105	568	2,356,849
2025-26	4,802	19,773	24,576	16,230	366	3,539	1,528	2,255,414	544	2,261,134
2026-27	3,420	14,082	17,502	11,559	261	2,521	1,088	1,562,640	382	1,566,709
2027-28	1,560	6,425	7,985	5,274	119	1,150	496	709,349	174	711,205
2028-29	1,554	6,397	7,951	5,251	118	1,145	494	703,711	173	705,560
2029-30	810	3,337	4,148	2,739	62	597	258	364,858	90	365,822
Total	**66,158**	**269,129**	**335,286**	**220,898**	**4,984**	**48,174**	**20,797**	**33,012,977**	**7,951**	**33,091,385**
Average	**3,892**	**15,831**	**19,723**	**12,994**	**293**	**2,834**	**1,223**	**1,941,940**	**468**	**1,946,552**

9.4 Impact on the Environment

According to the Intergovernmental Panel of Climate Change's (IPCC) Fourth Assessment Report, global surface temperature has increased 0.74 ± 0.18ºC during the 100 years ending 2005 (**IPCC, 2007a**). The IPCC has determined *"most of the observed increase in globally averaged temperatures since the mid-twentieth century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations".* "Very likely" is defined by the IPCC as greater than 90% probability of occurrence (**IPCC, 2007b**).

Climate change projections specific to Australia have been determined by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), based on the following global emissions scenarios predicted by the IPCC (**CSIRO, 2007**):

- A1F1 (high emissions scenario) – assumes very rapid economic growth, a global population that peaks in mid-century and technological change that is fossil fuel intensive.
- A1B (mid emissions scenario) – assumes the same economic and population growth as A1F1, with a balance between fossil and non-fossil fuel intensive technological changes.
- B1 (low emissions scenario) – assumes the same economic and population growth as A1F1, with a rapid change towards clean and resource efficient technologies.

For the global emissions scenarios described above, the projected changes in annual temperature relative to 1990 levels for Australian cities for 2030 and 2070 are presented in **Table 9.7** as determined by the **CSIRO (2007)**. The towns/cities presented in **Table 9.7** are those closest to the Project for which results are available.

Table 9.7: Projected changes in annual temperature (relative to 1990)

Location	2030 - A1B (mid-range emissions scenario)	2070 - B1 (low emissions scenario)	2070 - A1F1 (high emissions scenario)
	Temperature (°C)		
Sydney	0.6 - 1.3	1.1 - 2.2	2.1 - 4.3
Brisbane	0.7 - 1.4	1.1 - 2.3	2.1 - 4.4
Dubbo	0.7 - 1.5	1.2 - 2.5	2.2 - 4.8
St George (Queensland)	0.7 - 1.6	1.2 - 2.7	2.4 - 5.2

Notes: Range of values represents the 10th and 90th percentile results.
For 2030, only A1B results are shown as there is little variation in projected results for the global emission scenarios A1B, B1 and A1F1 (**CSIRO, 2007**).

Source: **CSIRO (2007)** *Climate Change in Australia – Technical Report 2007*, Commonwealth Scientific and Industrial Research Organisation.

The CSIRO also details projected changes to other meteorological parameters (for example rainfall, potential evaporation, wind speed, relative humidity and solar radiation) and the predicted changes to the prevalence of extreme weather events (for example droughts, bush fires and cyclones).

The potential social and economic impacts of climate change to Australia are detailed in The Garnaut Climate Change Review (**Garnaut, 2008**), which draws on IPCC assessment work and the CSIRO climate projections. The Garnaut review details the negative and positive impacts associated with predicted climate change with respect to:

- agricultural productivity;
- water supply infrastructure;
- urban water supplies;

- buildings in coastal settlements;
- temperature related deaths;
- ecosystems and biodiversity; and
- geopolitical stability and the Asia-Pacific region.

The Project's contribution to projected climate change, and the associated impacts, would be in proportion with its contribution to global GHG emissions.

Average annual scope 1 emissions from the Project (0.02 Mt CO_2-e) would represent approximately 0.003% of Australia's annual average commitment under the Kyoto Protocol (591.5 Mt CO_2-e) and a very small portion of global greenhouse emissions, given that Australia contributed approximately 1.5% of global GHG emissions in 2005 **(Commonwealth of Australia, 2011)**. A comparison of predicted annual GHG emissions from the Project with global, Australian and NSW emissions inventories are presented in **Table 9.8**.

Table 9.8: Comparison of greenhouse gas emissions

Geographic coverage	Source coverage	Timescale	Emission Mt CO_2-e	Reference
Project	Scope 1 only	Average annual	0.02	This report.
Global	Consumption of fossil fuels	Total since industrialisation 1750 - 1994	865,000	IPCC (2007a) Figure 7.3 converted from Carbon unit basis to CO_2 basis. Error is stated greater than ±20%.
Global	CO_2-e emissions	2005	35,000	Based on Australia representing 1.5% of global emissions (Commonwealth of Australia, 2011). Australian National Greenhouse Gas Inventory (2005) taken from http://www.ageis.greenhouse.gov.au/
Global	CO_2-e emission increase 2004 to 2005	2005	733	IPCC (2007a) From tabulated data presented in Table 7.1 on the basis of an additional 733 Mt/a. Data converted from Carbon unit basis to CO_2 basis.
Australia	1990 Base	1990	547.7	Taken from the National Greenhouse Gas Inventory (2009) http://www.ageis.greenhouse.gov.au/
Australia	Kyoto target	Average annual 2008 - 2012	591.5	Based on 1990 net emissions multiplied by 108% Australia's Kyoto emissions target.
Australia	Total	2009	564.5	Taken from the National Greenhouse Gas Inventory (2009) http://www.ageis.greenhouse.gov.au/
NSW	Total	2009	160.5	Taken from the National Greenhouse Gas Inventory (2009) http://www.ageis.greenhouse.gov.au/

GHG from Australian sources will be collectively managed at a national level, through initiatives implemented by the Australian Government. The Australian Government has committed to reduce GHG emissions by between 5-25% below 2000 levels by 2020, with the level of reduction dependent on the extent of reduction actions undertaken internationally **(Commonwealth of Australia, 2011)**. Similarly, the Federal Opposition has committed to a 5% reduction below 1990 levels by 2020 in its Direct Action Plan **(Liberal Party of Australia, 2010)**.

The commitment from the Australian Government to reduce GHG emissions is proposed to be achieved through the introduction of the Australian Government's proposed carbon pricing mechanisms. From 1 July 2012, this will involve a fixed price on GHG emissions, with no cap on Australia's GHG emissions, or emissions from individual facilities **(Commonwealth of Australia, 2011)**.

From 1 July 2015 an emissions trading scheme is proposed to be implemented. As such, Australia's GHG emissions, inclusive of emissions associated with the Project, would be capped at a level specified by the Australian Government. Under the emissions trading scheme, there will specifically be no limit on the level of GHG emissions from individual facilities, with the incentive for facilities to reduce their GHG emissions driven by the carbon pricing mechanism **(Commonwealth of Australia, 2011)**.

The Project may exceed the facility threshold of 25,000 t CO_2-e per annum for participation in the carbon pricing mechanisms during the Project, and as such scope 1 GHG emissions from the Project would be subject to the carbon pricing mechanism. As such, the Project would directly contribute to the revenue generated by the carbon pricing mechanism, which is to be used to fund the following initiatives designed to reduce Australia's GHG emissions **(Commonwealth of Australia, 2011)**:

- $1.2 billion Clean Technology Program to improve energy efficiency in manufacturing industries and support research and development in low-pollution technologies.
- $10 billion Clean Energy Finance Corporation to invest in renewable energy, low-pollution and energy efficiency technologies.
- $946 million Biodiversity Fund (over the first six years) to protect biodiverse carbon stores and secure environmental outcomes from carbon farming.

9.5 Greenhouse Gas Emissions Intensity

The estimated GHG emissions intensity of the Project is approximately 0.02 t CO_2-e/t ROM coal (scope 1 emissions only). The estimated emissions intensity of the Project is less than the majority of open cut and underground coal mines in Australia (0.05 t CO_2-e/t coal) (scope 1 emissions only) (**Deslandes, 1999**). **Figure 9.1** derived from **Deslandes** (**1999**) shows the GHG intensity of the Project compared to other Australian coal mines.

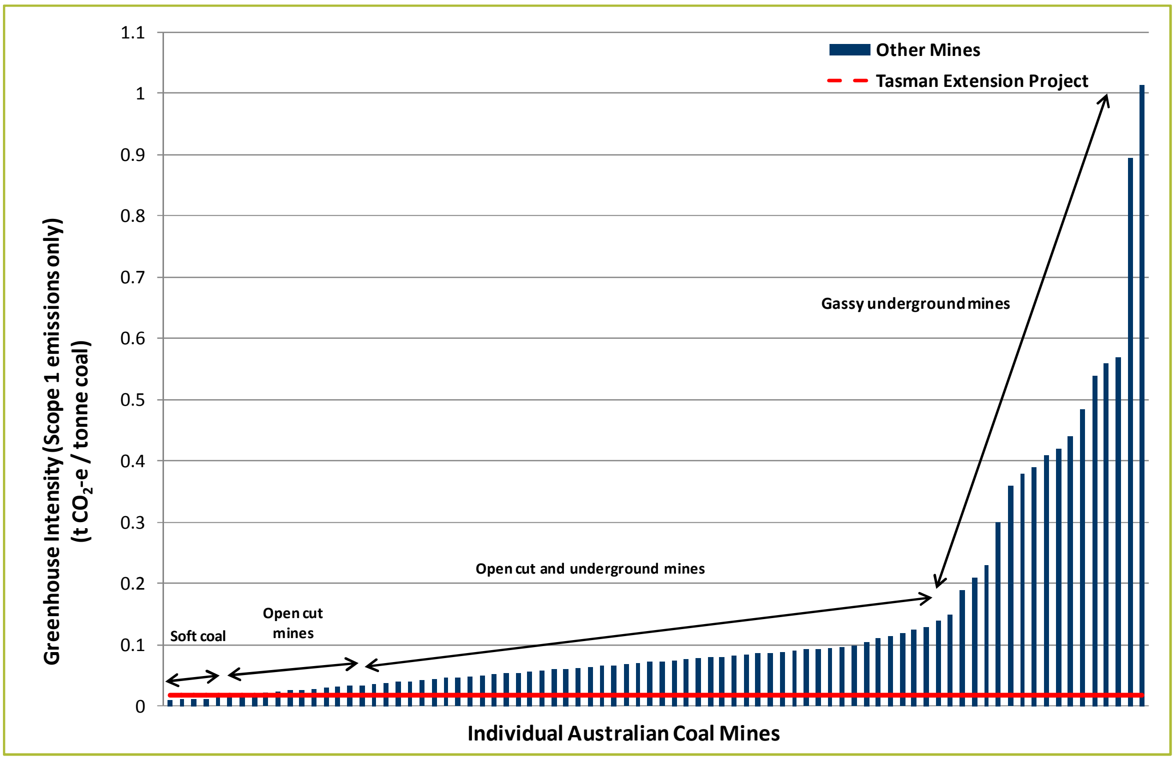


Figure 9.1: GHG Intensity Comparison

9.6 Project Greenhouse Gas and Energy Reduction Measures

Minimising diesel and electricity consumption (and therefore mining GHG emissions) is an integral part of mine and financial planning at the Tasman Underground Mine, and this would continue for the Project. Energy reduction measures implemented for the Project would include:

- Employees would conduct awareness training to reinforce energy efficient operation of equipment (e.g. shutting down equipment that is not in use).
- Appropriately size power factor correction equipment would be installed to achieve a power factor of greater than 0.9.
- Equipment would be regularly maintained, minimising energy consumption requirements.
- High efficiency lighting would be installed.

Ongoing monitoring and management of GHG emissions and energy consumption for the Project would be achieved through Donaldson Coal's (as a subsidiary of Gloucester Coal Limited) participation in the Commonwealth Government's (NGERS). Under NGERS requirements, relevant sources of GHG emissions and energy consumption must be measured and reported on an annual basis, allowing major sources and trends in emissions/energy consumption to be identified.

10 DUST MANAGEMENT AND MONITORING

10.1 Construction

Air quality impacts during the construction phase will be relatively short lived and would be controlled through commonly applied dust management measures. This would include watering of haul roads and stockpiles with a water cart, minimising disturbance areas to the minimum possible area, and maintaining dedicated internal roadways.

10.2 Operation

Sources of emissions during operation of the Project are described in **Table 7-2** and **Table 7-3**. Emissions associated with the handling of coal, haulage on unsealed roads and wind erosion from the active ROM coal stockpile would continue to be managed and mitigated through the use of water carts at both the existing and the new pit top areas.

Based on the existing air quality monitoring results and predicted impacts from the Project, the use of water carts would control emissions to an acceptable level, and as such are considered to be best practice, in accordance with the NSW EPA best practice document '*NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining*' (**Donnelly et al., 2011**).

10.3 Monitoring

The existing monitoring network would be reviewed and augmented for the Project. This would include additional dust deposition gauges at the proposed locations shown on **Figure 3.2** (i.e. on George Booth Drive and Sheppeard Drive) (note that these locations would be subject to landowner agreement).

The *Abel Underground Coal (Integrated with Donaldson Open Cut, Tasman Underground and Bloomfield Open Cut Coal Mines) Integrated Environmental Monitoring Program* would be updated to reflect the updated air quality monitoring regime for the Project.

Based on the existing monitoring data and the predicted impact from the Project, a real time air quality monitoring system is not considered necessary.

11 CONCLUSION

An Air Quality and Greenhouse Gas Assessment has been prepared in accordance for the extension of underground mining operations at the Project.

The key air quality issues assessed are emissions of PM (i.e. dust) during the operation of the Project. During construction, fugitive dust emissions can also be expected, however the total estimated dust emissions are less than 40% of the emissions estimated to occur during operation of the Project. Therefore compliance with air quality goals during the operation of the mine is assumed to represent compliance during mine construction.

During operation, the Project will result in emissions of PM from coal handling activities at the pit top and the operation of upcast ventilation shafts.

Two modelling scenarios were assessed, accounting for maximum coal production at the proposed new pit top and coal production when both the existing pit top and the new pit top are operational.

The results of the modelling indicate that the predicted incremental PM_{10}, $PM_{2.5}$, TSP and dust deposition at the closest residential receptors are all well below the impact assessment criteria. A cumulative assessment, incorporating existing background levels, indicates that the Project is unlikely to result in any additional exceedances of relevant impact assessment criteria.

An assessment of the GHG emissions associated with the Project indicates that average annual scope 1 emissions would represent approximately 0.003% of Australia's commitment under the Kyoto Protocol (591.5 Mt CO_2-e) and a very small portion of global greenhouse emissions.

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APPENDIX A

Model Set Up

Model Set Up

TAPM (v 4.0.4)	
Number of grids (spacing)	5 (30 km, 10 km, 3 km, 1 km, 300 m)
Number of grid points	25 x 25
Year of analysis	2010
Centre of analysis (local coordinates)	Tasman Underground Mine (365333, 6360726)
CALMET (v. 6.333)	
Meteorological grid domain – Outer	75 km x 75 km
- Inner	25 km x 25 km
Meteorological grid resolution - Outer	1 km
- Inner	0.2 km
Input data – Outer	Surface station data from Tasman, Wallsend, Beresfield, Newcastle, Patterson, Coorangbong, Cessnock, Williamtown. Prognostic 3D.dat extracted from TAPM at 1 km grid
- Inner	Diagnostic 3-D data from outer CALMET run

CALMET Model Options used

Flag	Descriptor	Default	Value Used
IEXTRP	Extrapolate surface wind observations to upper layers	Similarity theory	Similarity theory
BIAS (NZ)	Relative weight given to vertically extrapolated surface observations versus upper air data	NZ * 0	-1, -0.5, -0.25, 0, 0, 0, 0
TERRAD	Radius of influence of terrain	No default (typically 5- 15km)	10 km
RMAX1 and RMAX2	Maximum radius of influence over land for observations in layer 1 and aloft	No Default	0.1 km
R1 and R2	Distance from observations in layer 1 and aloft at which observations and Step 1 wind fields are weighted equally	No Default	0.05 km

CALPUFF Model Options used

Flag	Flag Descriptor	Value Used	Value Description
MCHEM	Chemical Transformation	0	Not modelled
MDRY	Dry Deposition	1	Yes
MTRANS	Transitional plume rise allowed?	1	Yes
MTIP	Stack tip downwash?	1	Yes
MRISE	Method to compute plume rise	1	Briggs plume rise
MSHEAR	Vertical wind Shear	0	Vertical wind shear not modelled
MPARTL	Partial plume penetration of elevated inversion?	1	Yes
MSPLIT	Puff Splitting	0	No puff splitting
MSLUG	Near field modelled as slugs	0	Not used
MDISP	Dispersion Coefficients	2	Based on micrometeorology
MPDF	Probability density function used for dispersion under convective conditions	0	No
MROUGH	PG sigma y,z adjusted for z	0	No
MCTADJ	Terrain adjustment method	3	Partial Plume Adjustment
MBDW	Method for building downwash	1	ISC method

APPENDIX B

Estimated Emissions

Tasman Extension Project

Estimated emissions are presented for all significant dust generating activities associated with the construction and operation of the Project.

Fugitive dust emissions can be expected during construction from the following activities:

- excavation of waste rock material for the box cut and ROM stockpile area;
- loading of waste rock to trucks and transport off-site;
- dozers on waste rock; and
- graders working road construction

Fugitive dust emissions can be expected during operation from the following activities:

- loading stockpile from conveyor;
- loading of coal to trucks;
- haulage of coal off-site
- wind erosion from stockpiles; and
- upcast ventilation shafts.

Loading / dumping waste rock

Each tonne of material loaded will generate a quantity of TSP that will depend on the wind speed and the moisture content according to the US EPA emission factor equation (**US EPA, 1985 and updates**) shown below:

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

Where:

K = 0.74

U – wind speed (m/s)

M – moisture content (%)

The moisture content of waste material is assumed to be 4% and the wind speed is taken from the measured wind at Tasman.

Hauling material / coal on unsealed surfaces

The emission estimate of wheel generated dust associated with hauling at the pit top areas (i.e. for hauling of waste rock material during construction, as well as hauling coal from the stockpile area during operation) is based the US EPA AP42 emission equation for unpaved surfaces at industrial sites (**US EPA, 1985 and updates**) shown below:

$$E\_TSP\ \ (kg/VKT) = 0.2819 \times [4.9\ \times (s/12)\text{^}0.7 \times ((W \times 1.1023)/3)\text{^}0.45]$$

Where:

s = silt content of road surface

W = mean vehicle weight

The silt content (s) for the haulage routes is assumed to be 4%.

The mean vehicle weight used in the emissions estimates is an average of the loaded and unloaded gross vehicle mass, to account for one empty trip and one loaded trip. Coal trucks transporting coal offsite are assumed to have a payload of 40 tonnes (t) and a tare weight of 20 t. Haul trucks carrying waste during construction are assumed to have a payload of 63.5 t and a tare weight of 46 t.

Dozers working on waste rock

Emissions from dozers on waste have been calculated using the US EPA emission factor equation (**US EPA, 1985 and updates**).

$$E_{TSP}\ (kg/hr) = 2.6\ \times \frac{s^{1.2}}{M^{1.3}}$$

Where:

s = silt content (assumed to be 10%)

M = moisture content (assumed to be 4%).

Grading roads

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

$$E_{TSP}\ (kg/VKT) = 0.0034\ \times S^{2.5}$$

Where:

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

Loading / unloading coal

The following **US EPA (1985 and updates)** emission factor equation has been used for both loading coal to stockpiles, and loading coal from the stockpile to trucks.

$$E_{TSP}\ \left(\frac{kg}{t}\right) = \frac{0.580}{M^{1.2}}$$

Where:

M = moisture content and is taken as 8%.

Active Stockpiles – Wind Erosion and Maintenance

The following **US EPA (1985 and updates)** emission factor equation has been used for wind erosion.

$$E_{TSP}\ (kg/ha/hr) = 1.8\ x\ U$$

Where:

U= mean wind speed (m/s) and is taken as 2.3 m/s.

Estimated emissions of TSP for Scenario 1

ACTIVITY	TSP Emission kg/year	Intensity	units	Emission factor	units	Variable 1	units	Variable 2	units	Variable 3	units	Variable 4	units	Variable 5	units	Variable 6	units
TASMAN Pit Top (FASSIFERN SEAM)																	
CL - Loading ROM stockpile from conveyor	22,003	460,000	t/y	0.04783	kg/t	8	moisture content in %										
CL - FEL loading trucks	22,003	460,000	t/y	0.04783	kg/t	8	moisture content in %										
CL - Hauling ROM from Tasman Pit Top off-site (Unsealed)	3,956	460,000	t/y	0.00860	kg/t	40.0	t/load	0.70	km/return trip	0.49	kg/VKT	40	Vehicle gross mass (t)	4	% silt content	75	% control
CL - Active Stockpiles (wind erosion and maintenance)	7,253	0.2	ha	4.14	kg/ha/hr	8760	h/y	2.3	average wind speed m/s								
Ventilation shaft - Tasman Pit Top	4,966	1,053,302,400	m3/yr	4.715	In-stack TSP Conc. (mg/m3)	8760	h/y	120,240	Flow Rate (m3/h)								
New Pit Top (WEST BORE HOLE SEAM)																	
CL - Loading ROM stockpile from conveyor	49,698	1,039,000	t/y	0.04783	kg/t	8	moisture content in %										
CL - FEL loading trucks	49,698	1,039,000	t/y	0.04783	kg/t	8	moisture content in %										
CL - Hauling ROM from new Pit Top off-site (Unsealed)	8,935	1,039,000	t/y	0.00860	kg/t	40.0	t/load	0.70	km/return trip	0.49	kg/VKT	40	Vehicle gross mass (t)	4	% silt content	75	% control
CL - Active Stockpiles (wind erosion and maintenance)	3,627	0.1	ha	4.14	kg/ha/hr	8760	h/y	2.3	average wind speed m/s								
Ventilation shaft - New Pit Top	25,278	5,361,120,000	m3/yr	4.715	In-stack TSP Conc. (mg/m3)	8760	h/y	612,000	Flow Rate (m3/h)								

Estimated emissions of TSP for Scenario 2

ACTIVITY	TSP Emission kg/year	Intensity	units	Emission factor	units	Variable 1	units	Variable 2	units	Variable 3	units	Variable 4	units	Variable 5	units	Variable 6	units
New Pit Top (WEST BORE HOLE SEAM)																	
CL - Loading ROM stockpile from conveyor	71,748	1,500,000	t/y	0.04783	kg/t	8	moisture content in %										
CL - FEL loading trucks	71,748	1,500,000	t/y	0.04783	kg/t	8	moisture content in %										
CL - Hauling ROM from new Pit Top off-site (Unsealed)	12,899	1,500,000	t/y	0.00860	kg/t	40.0	t/load	0.70	km/return trip	0.49	kg/VKT	40	Vehicle gross mass (t)	4	% silt content	75	% control
CL - Active Stockpiles (wind erosion and maintenance)	3,627	0.1	ha	4.14	kg/ha/hr	8760	h/y	2.3	average wind speed m/s								
Ventilation shaft - New Pit Top	25,278	5,361,120,000	m3/yr	4.715	In-stack TSP Conc. (mg/m3)	8760	h/y	612,000	Flow Rate (m3/h)								