NAMOI MINING PTY LTD

ABN: 24 071 158 373

Sunnyside Coal Project

via Gunnedah

Air Quality Assessment

Prepared by

Heggies Pty Ltd

October, 2007

Specialist Consultant Studies Compendium
Part 5

Air Quality Assessment

of the

Sunnyside Coal Project

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EXECUTIVE SUMMARY

Heggies Pty Ltd has been commissioned by Olsen Environmental Consulting Pty Ltd on behalf of Namoi Mining Pty Ltd to undertake an Air Quality Assessment for the proposed Sunnyside Coal Project, an open cut coal mine on the “Sunnyside” property, west of Gunnedah.

As part of the assessment, an analysis of the existing air quality environment has been undertaken.

Historical dust deposition monitoring data gathered by Whitehaven Coal Mining Pty Ltd from the nearby Whitehaven Coal Mine has been used to derive a dust deposition average for the region surrounding the Project Site.

Ambient concentrations of PM_{10} were assessed using the NSW Department of Environment and Climate Change air quality monitoring station located at Tamworth, 110km east-southeast from the Project Site.

Existing background greenhouse gases are assumed to be negligible given the rural setting of the Project Site.

An assessment of the local meteorology conditions has been conducted using The Air Pollution Model (TAPM). TAPM was used to generate a meteorological data set, using the data assimilation option to incorporate observations from the Bureau of Meteorology’s (BoM) Gunnedah Airport Automatic Weather Station (located approximately 13km east-northeast of the Project Site. Weather data recorded at the nearby Whitehaven Coal Mine was also used to provide a wider view of the regional meteorology.

A review of all particulate generating activities due to the operation of the Sunnyside Coal Project has been undertaken. The modelling of PM_{10} and dust attributable to operations at the SCP shows that at all nine receptors closest to the Project Site, NSW DECC dust and PM_{10} criteria are met. The maximum 24-hour PM_{10} concentration is predicted to be below the project criteria of 50ug/m^3 at 49.5ug/m^3 with annual average PM_{10} predicted to be below the project criteria of 30µg/m^3 at 22.1ug/m^3. Modelling of deposited dust indicates that at the surrounding residences, deposition levels are predicted to be 1.9g/m^2/month, below the NSW DECC criteria of 2g/m^2/month.

A full fuel life cycle greenhouse gas assessment of the Project predicts that the worst case annual emissions of CO_2-Equivalent as a result of the Project are likely to be of the order of 3.0Mt of CO_2-Equivalent per annum. This assessment accounts not only for greenhouse gas emissions as a result of on-site activities, but also an estimation of emissions associated with transportation, and combustion of the coal by end users. A comparison of the predicted emissions from the Project with estimates of total International greenhouse gas emissions for the year 2000 demonstrates that operations associated with the Project would represent an increase of approximately 0.009% on this estimate.

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1 INTRODUCTION

Heggies Pty Ltd (Heggies) has been commissioned by Olsen Environmental Consulting Pty Ltd (Olsen) on behalf of Namoi Mining Pty Ltd (NMPL) – a company within the Whitehaven Coal Limited (WCL) Group of Companies to undertake an Air Quality Assessment for the proposed Sunnyside Coal Project (hereafter referred to as "the Project").

NMPL proposes to develop and operate an open cut coal mine on the "Sunnyside" property, located approximately 15km west of Gunnedah in the Gunnedah Basin. **Figure 1** illustrates the regional setting of the Project, while **Figure 2** details the location of the Project in relation to the surrounding mining tenements located in the Gunnedah area.

Figure 1
Regional Setting of the Sunnyside Coal Project

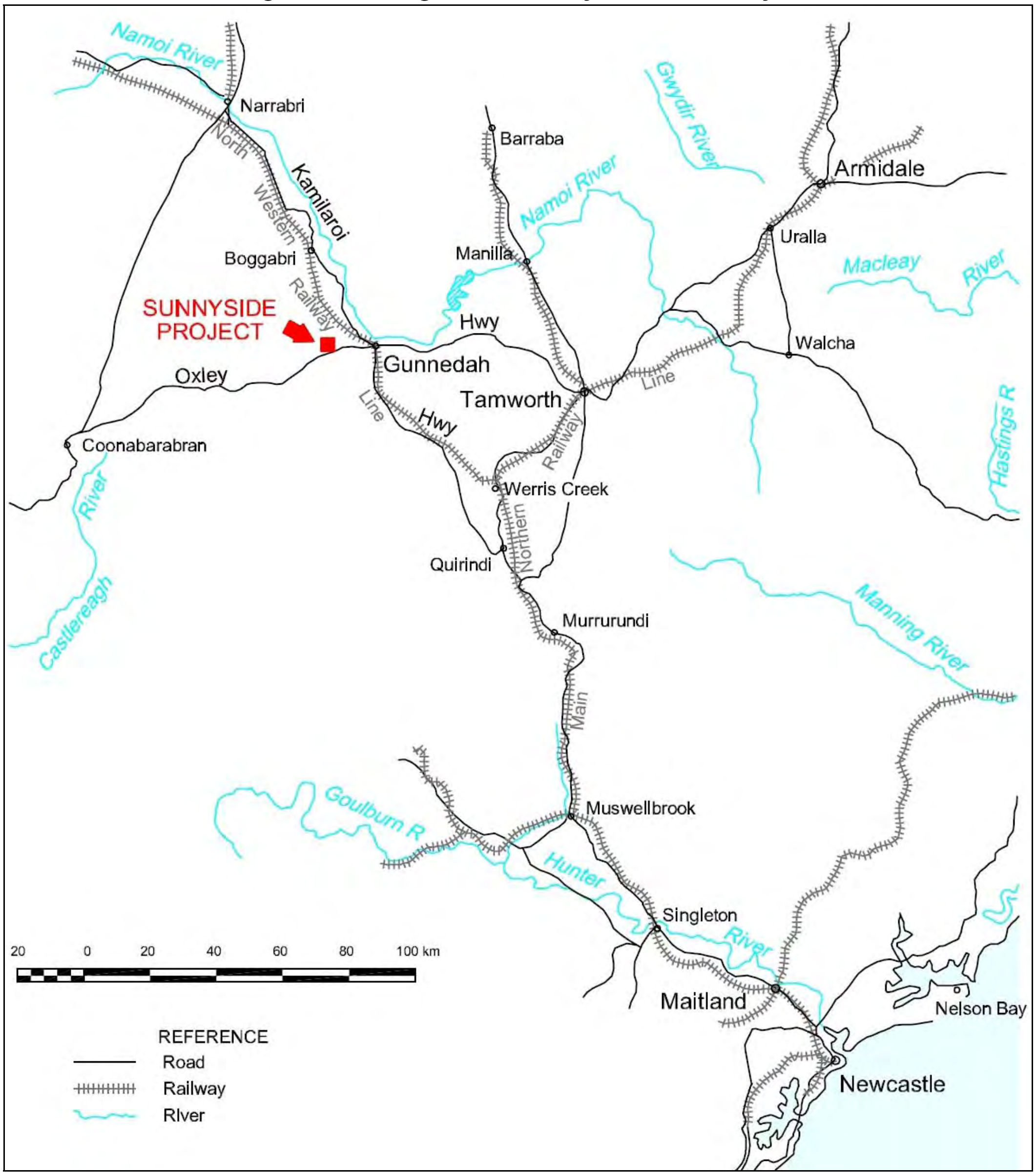

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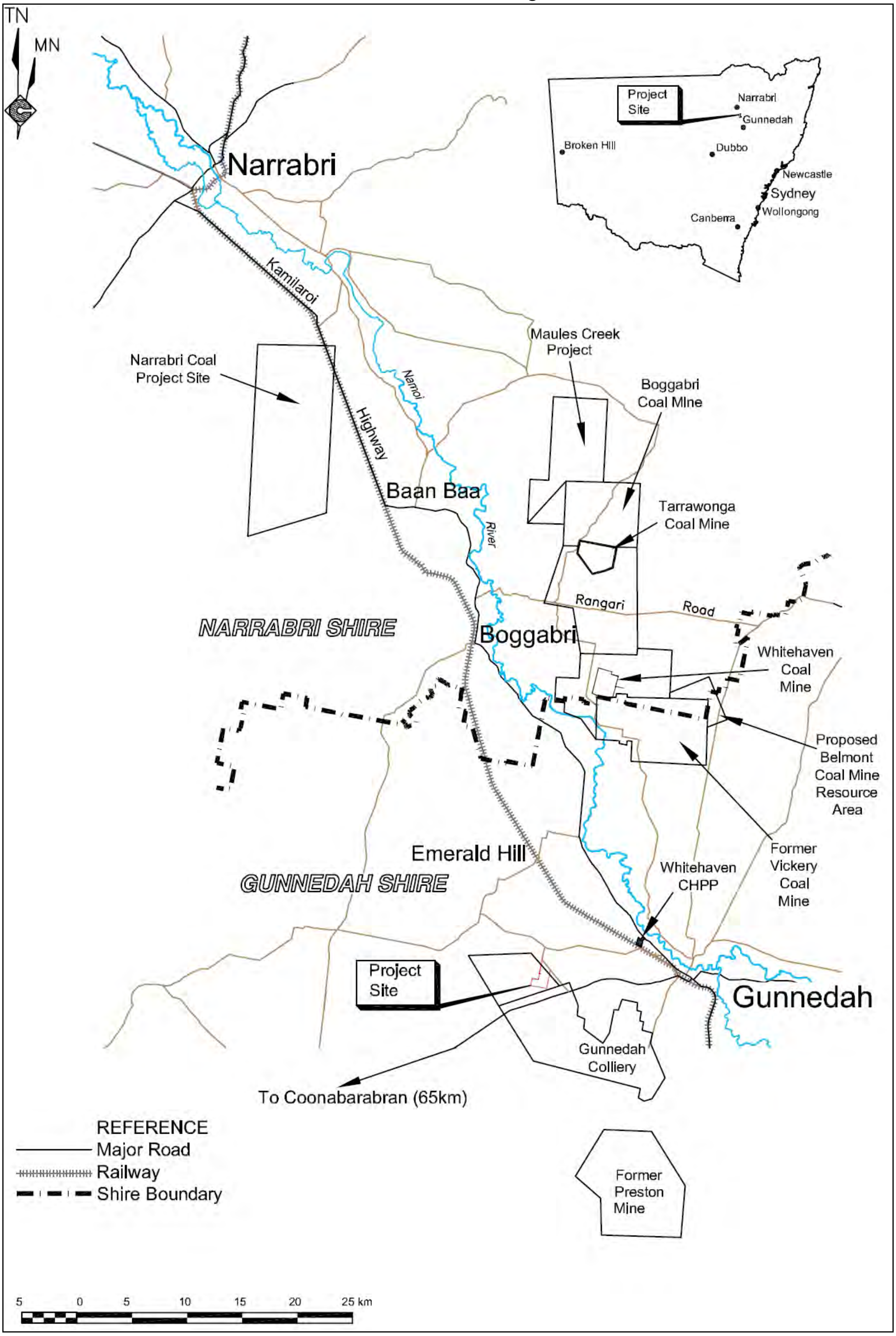
Figure 2
Gunnedah Area Mining Tenements



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PROJECT OVERVIEW

2.1 Project Description

The Sunnyside Coal Project Site (hereafter, "the Project Site"), is situated just north of the Oxley Highway and the old Gunnedah No. 5 Colliery site and west of Coocooboonah Lane. It is contained entirely within the "Sunnyside" property. The Project Site lies within the Exploration Licence (EL) 5183 and the Consolidated Coal Lease (CCL) 701, covering an area of approximately 231ha. Currently the land is used for cropping and grazing. The proposed open cut mine and the out-of-pit overburden emplacement and Site Facilities Area covers an area of approximately 100ha. This represents the maximum area of surface disturbance from mining activities. **Figure 3** shows the Project Site.

Key aspects of the Project include the following.

- Coal mining over an area of 43ha by conventional open cut methods involving drilling and blasting, operation of heavy equipment to remove and emplace overburden. Highwall or auger mining may also be used.
- Coal removal from the open cut and transportation from the mine to an existing rail siding approximately 5km west of Gunnedah.
- An annual run-of-mine (ROM) coal production of up to 1Mt, with an estimated operational life of 5 to 6 years.
- Following ramp establishment, mining would commence from a box cut area and then progress to the east. Following completion of the box cut to its maximum length, then 50-70m width strip development.
- Overburden from the box cut would be hauled to an out-of-pit emplacement area to the north of the box cut. Following this, overburden from strip and block mining down dip would be progressively placed in the box cut and later, into and over formerly mined areas of the open cut.
- Facilities for the ROM crushing, blending and temporary stockpiling of an unwashed thermal coal product would be established on the Project Site. Additionally, facilities for general administration, storage and maintenance would be established on the Project Site.
- Mining would be conducted from 7:00am to 10:00pm daily up to six days per week. Haulage of product coal may be up to 6 days per week. At a maximum, an average 3,500 tonnes of product coal per day would be dispatched from the Project Site, equating to approximately 125 truck loads per day. This number of trucks is based on 28t capacity vehicles. Should B-Double trucks be used with a 40t capacity, the number of truck loads per day would reduce to approximately 88.
- The product coal transport route between the Project Site and the Whitehaven Coal Handling and Preparation Plant (CHPP) and Rail Loading Facility would follow the Oxley Highway, Blackjack Road and Quia Road.

Figure 3
Local Setting and Layout of Sunnyside Coal Project

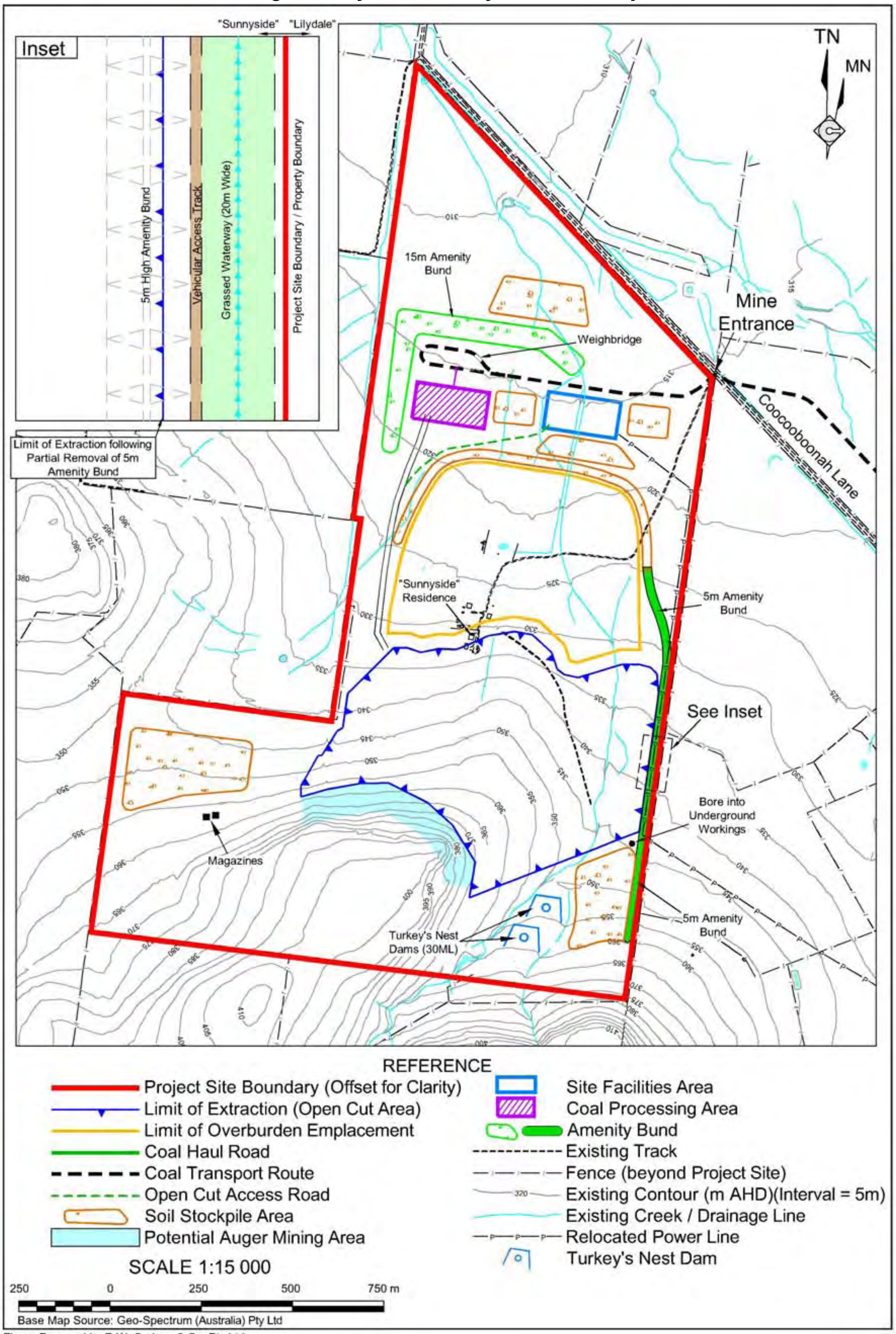


Figure Prepared by R.W. Corkery & Co. Pty Ltd

Note: A colour version of this figure is presented on the Project CD

Power for site operations would be provided by onsite diesel-powered generators.

- Progressive rehabilitation and revegetation of the Project Site is proposed. The final landform would revert to an agricultural land use with some enhancement of fauna habitat.

2.2 Onsite Equipment

The equipment (or equivalent) planned for use during coal mining operations at the Project Site include:

- 1 x Terex RH170 Hydraulic Excavator;
- 3 x Cat 785 150t Haul Trucks;
- 1 x Blast Hole Rig;
- 2 x Cat 657 Scrapers (There would be a third Scraper on site for the initial three months of overburden removal);
- 1 x Cat D11R Bulldozer;
- 2 x Cat 988 Front- end Loader;
- 1 x Cat 14H Grader;
- 1 x 16kL Water Truck;
- 3 x Lighting Plants;
- 1 x Crushing/Screening Plant;
- 1 x 600kVA/415V genset; and
- 1 x 100kVA genset.

2.3 Regional and Project Site Topography

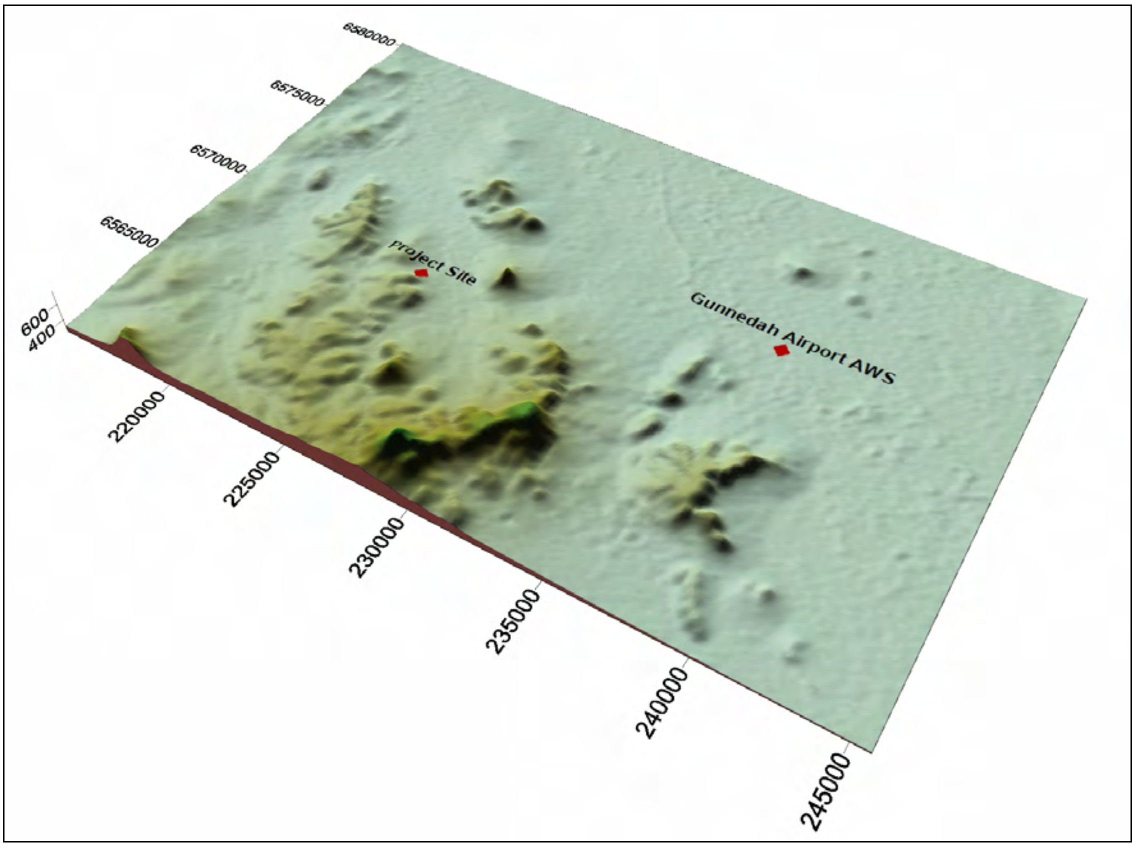
The topography of the "Sunnyside" property has an altitudinal range of between 310m AHD along its northern boundary to approximately 420m AHD at its southern boundary. The slope of the Project Site is moderate, increasing from north to south. The proposed Site Facilities and Mining Area has an altitudinal range of between approximately 330m AHD to approximately 370m AHD, increasing gradually from north to south.

A three-dimensional representation of the topography of the region surrounding the Project Site is presented in **Figure 4**.

2.4 Nearest Residences

Dispersion modelling can be used to predict pollutant concentrations at the nearest potentially affected sensitive receptors. In the case of the Sunnyside Coal Project, all potentially affected receptors are residences. Although much of the immediate surroundings is rural in nature, scattered residential dwellings exist within the vicinity of the Project Site.

Figure 4
Three-Dimensional Regional Topography (Vertical Exaggeration 4)

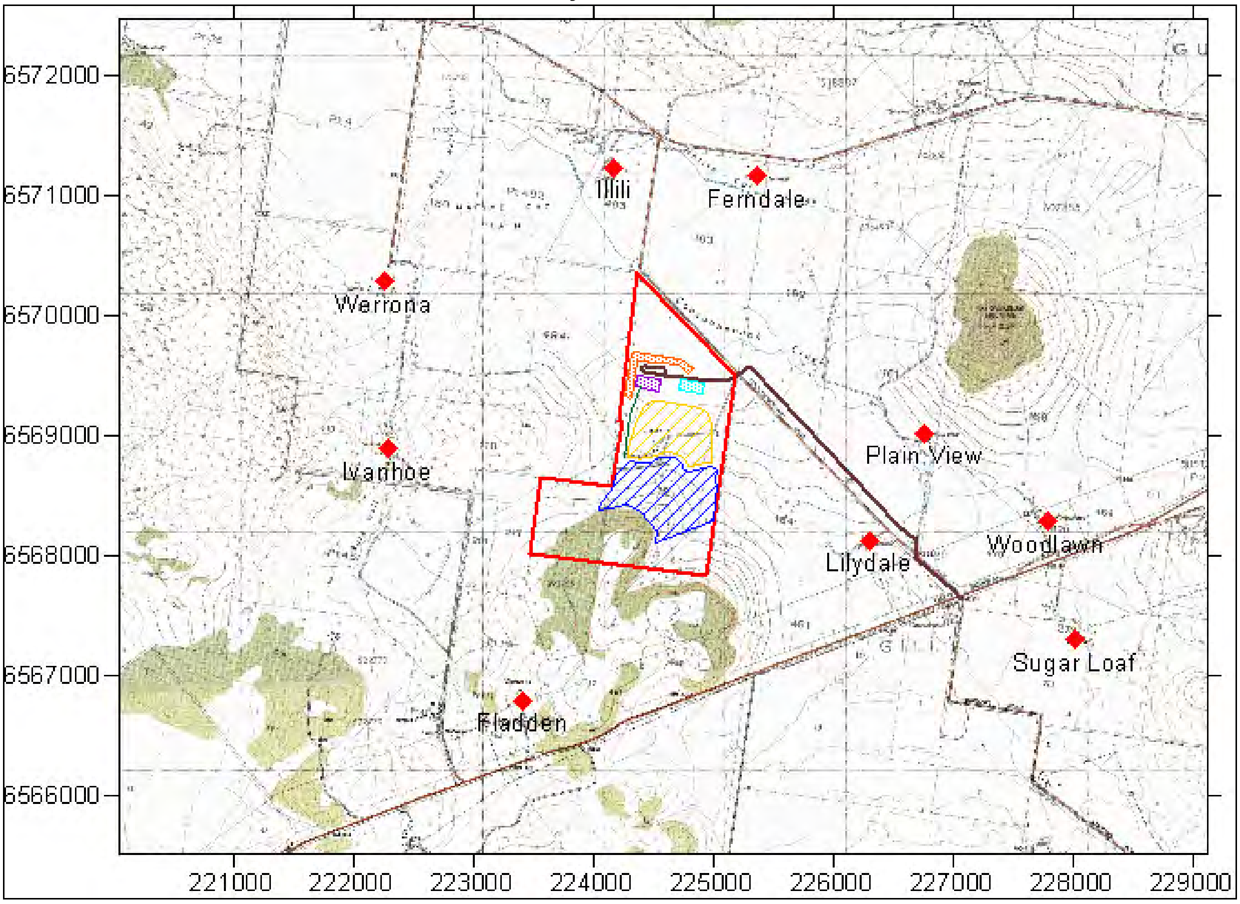


A summary of the closest non-project related residences to the Project Site is given in **Table 1** and presented in **Figure 5**.

Table 1
Closest Non-Project Related Residences to the Project Site

Residence ID	Residence Name	Easting	Northing	Orientation from Project Site	Distance (m) from Project Site Boundary	Distance to ROM Area (m)	Distance to Open Cut Pit (m)
R1	“Flodden”	223417	6566795	Southwest	440	2770	1660
R2	“Ivanhoe”	222296	6568893	West	1320	2170	1900
R3	“Werrona”	222263	6570289	Northwest	2000	2270	2600
R4	“Illili”	224176	6571234	North	900	1760	2450
R5	“Ferndale”	225368	6571169	North-northeast	1400	1890	2500
R6	“Plain View”	226765	6569022	East	1700	2200	1800
R7	“Woodlawn”	227785	6568292	East	2730	2770	3360
R8	“Sugarloaf”	228022	6567304	East-southeast	3080	3990	3180
R9	“Lilydale”	226303	6568130	East-southeast	1260	2130	1300

Figure 5
Closest Non-Project Related Residences



Note: A colour version of this figure is presented on the Project CD

3 EXISTING AIR QUALITY ENVIRONMENT

The focus of this Air Quality Impact Assessment is on the potential for emissions of particulate matter (PM) resulting from the mining activities. Vehicle exhaust emissions of oxides of nitrogen (NO_X) and carbon monoxide (CO) from mining equipment are expected to be distributed across the mine site and easily assimilated into the local airshed. Similarly, the low sulphur content of Australian diesel is expected to ensure air quality goals for sulphur dioxide (SO_2) would be met at the nearest sensitive receivers.

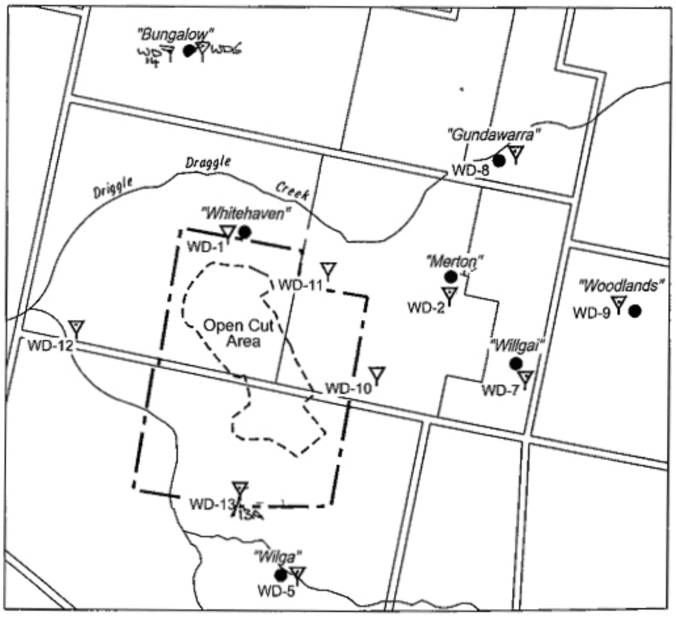
Additionally, the potential for project-related greenhouse gas emissions has been assessed as part of this report.

3.1 Background Dust Deposition Environment

Historical dust deposition monitoring data gathered by Whitehaven Coal Mining Pty Ltd (WCM) from the nearby Whitehaven Coal Mine has been used to derive a dust deposition average for the area surrounding the Project Site.

Monitoring has been ongoing since July 2000, for various periods, at a range of sites around the Whitehaven Coal Mine, located approximately 20km to 25km north of the Project Site (see **Figure 6)**.

Figure 6
Location of Dust Monitoring Sites around the Whitehaven Coal Mine



Results of dust deposition monitoring at eight monitoring locations around this site, for the period January 2004 to September 2006 are presented in **Table 2**. The eight locations in **Table 2** represent those dust deposition monitoring sites least influenced by mining activities, and thus most representative of background conditions. All available data for the period January 2004 to September 2006 have been selected, however it is noted that a number of monitoring months from the various locations have been disregarded due to local contamination of the samples returning abnormally high results. This monitoring dataset has been selected as this is this the most recent dataset available at the time of writing this report.

The results listed in **Table 2** provide background levels attributable to rural activities and natural sources together with a small proportion of dust generated by the activities within the Whitehaven Coal Mine.

Hence, the levels listed in **Table 2** are considered to be an over-estimate of the background levels for the Project Site. The average for all sites at the Whitehaven Coal Mine between January 2004 and August 2006 is 1.8g/m^2/month.

The use of a background ambient level of less than 2g/m^2/month means that the incremental increase in dust deposition would be the governing criterion for the Project (refer to **Section 4.3**).

Table 2
Dust Deposition Monitoring Data
Whitehaven Coal Mine - Average Monthly Deposition - January 2004 - September 2006

Site Location	Monitoring Period	Total Insoluble Solids (Non Filtrable Residue) g/m^2/month	Non Combustible Material (Ash) g/m^2/month
Location WD2 (Merton)	Jan 04 - Sep 2006	2.1	1.1
Location WD5 (Wilga)	Jan 04 - Sep 2006	1.2	0.8
Location WD6 (Bungalow)	Jan 04 - Sep 2006	1.3	0.7
Location WD7 (Wilgai)	Jan 04 - Sep 2006	2.1	1.1
Location WD8 (Gundawarra)	Jan 04 - Sep 2006	2.3	1.6
Location WD12 (Whitehaven)	Jan 04 - Sep 2006	1.7	1.2
Location WD13 (Womboola)	Jan 04 - Sep 2006	1.3	0.8
Location WD14 (Bungalow)	Jan 04 - Sep 2006	2.5	1.0
Average		**1.8**	**1.0**

3.2 Background Particulate Matter Environment

The term *"particulate matter"* refers to a category of airborne particles typically less than 50µm in aerodynamic diameter and ranging down to 0.1µm in size. Particles less than 10µm and 2.5µm are referred to in this report as PM_{10} and $PM_{2.5}$ particles respectively.

The closest site monitoring particulate matter is maintained by the NSW Department of Environment and Climate Change (DECC) in Tamworth, approximately 110km to the east-southeast of the Project Site. The site was commissioned in October 2000 and is located in Hyman Park, off Robert Road and Vue Street, Tamworth.

It is noted that, although Tamworth is located 110km from the Project Site, the dataset can be used to provide a conservative estimate of background PM_{10} concentrations in the vicinity of the Project Site.

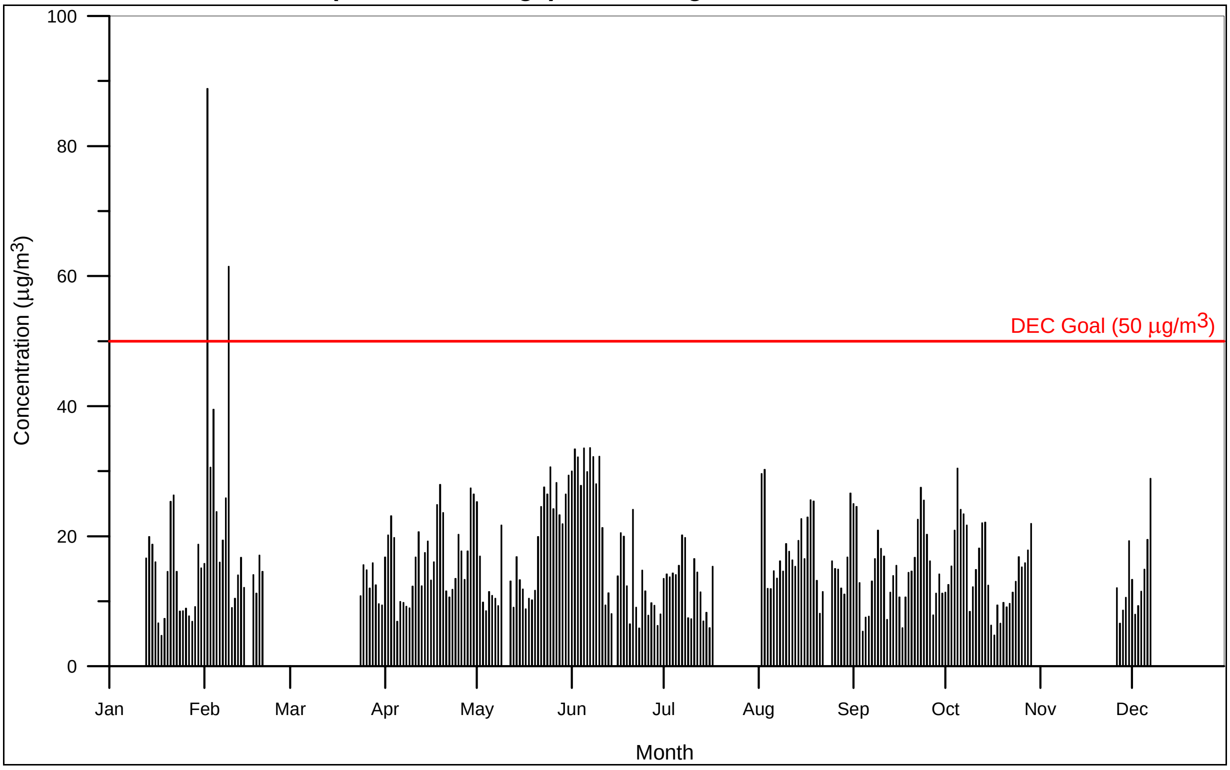
The following air pollutants and meteorological variables are currently measured at Tamworth.

- Fine particles as PM_{10}.
- Wind speed, wind direction and sigma theta.

Ambient concentrations of PM_{10} were assessed using the DECC air quality monitoring data recorded by a Tapered Element Oscillating Microbalance (TEOM) instrument. This instrument gives real-time recordings of ambient particulate matter, detected by observing changes to the loading on a filter mounted within the unit.

The verified data for 2005 showing 24-hour average PM_{10} concentrations at the Tamworth monitoring site has been obtained from the NSW DECC and is presented in **Figure 7**.

Figure 7
DECC PM_{10} (24-hour Average) Monitoring Results for Tamworth, 2006



Data for 2005 has been selected as the most recent validated data set available from the DECC at the time of writing. The results indicate that the highest 24-hour average PM_{10} concentration at the Tamworth monitoring site was 89µg/m^3, recorded on 2 February 2005. This is above the NSW DECC goal of 50µg/m^3. A further exceedance occurred on the 9 February 2005.

It is likely that these exceedances were as a result of an anomalous local event such as a dust storm or bushfire. However, in accordance with the DECC (2005), these values have been included in the assessment as it is appropriate to demonstrate that no additional exceedances of the impact assessment criteria would occur as a result of the proposed activity.

The annual average PM_{10} concentration for 2005, recorded at the DECC's Tamworth monitoring site was 16.5µg/m^3.

It is noted that the PM_{10} sub-set is typically approximately 50% of total suspended particulates (TSP) in the ambient air in regions where road traffic is not the dominant particulate source, such as rural areas (USEPA, 2001). In the absence of monitoring data for TSP, the annual average TSP concentration for the region may therefore be derived by multiplying the annual average PM_{10} concentration by a factor of two.

To estimate a background concentration of annual TSP, this report has taken the annual average PM_{10} records at Tamworth for 2005 (16.5µg/m^3), and used the above multiplier to derive the annual average TSP concentration. This corresponds to a background TSP concentration of 33µg/m^3.

3.3 Background Greenhouse Gas Environment

The potential for project-related greenhouse gas generation comes from combustion sources (Carbon Dioxide (CO_2), Carbon Monoxide (CO), Oxides of Nitrogen (NO_X) and Non-methane Volatile Organic Compounds (NMVOCs)) and the release of coal bed methane (CH_4) during excavation and post-excavation activities.

Existing background concentrations of greenhouse gases are assumed to be negligible given the rural nature of the Project Site.

3.4 Background Air Quality Environment for Assessment Purposes

For the purposes of assessing the potential air quality impacts of the Project, an estimate of background air quality parameters is required. For each pollutant, the maximum background concentration has been selected, for each relevant averaging period.

This conservatively high estimate of background concentration has been used as per Section 5 of the NSW DECC's *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*, 2005 (DECC Approved Methods).

Based on the data and discussion provided in **Sections 3.1**, **3.2** and **3.3,** the site-specific background air quality levels adopted for this assessment are presented in **Table 3**.

Table 3
Background Air Quality Environment for Assessment Purposes

Air Quality Parameter	Averaging Period	Assumed Background Level
TSP	Annual	33µg/m^3
PM_{10}	24-Hour	Daily Varying
	Annual	16.5µg/m^3
Dust	Annual	<2g/m^2/month
Greenhouse Gases	All Periods	Negligible

4 AIR QUALITY GOALS

4.1 Goals Applicable to Particulate Matter

Emissions of PM_{10} and $PM_{2.5}$ particles are considered important pollutants in terms of impact due to their ability to penetrate into the respiratory system. In the case of the $PM_{2.5}$ category, recent health research has shown that this penetration can occur deep into the lungs (NSW DECC, 1998). Potential adverse health impacts associated with exposure to PM_{10} and $PM_{2.5}$ include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.

One of the difficulties in dealing with air quality goals governing fine particles such as PM_{10} and $PM_{2.5}$ is that the medical community has not been able to establish a threshold value (for either PM_{10} or $PM_{2.5}$) below which there are no adverse health impacts.

The NSW PM_{10} assessment goals as expressed in the DECC Approved Methods are:

- A 24-hour maximum of 50µg/m^3; and
- An annual average of 30µg/m^3.

The 24-hour PM_{10} reporting standard of 50µg/m^3 is numerically identical to the equivalent National Environment Protection Measure (or NEPM) reporting standard except that the NEPM reporting standard allows for five exceedances per year. These NEPM goals were developed by the National Environmental Protection Council (NEPC) in 1998 to be achieved within 10 years of commencement.

In December 2000, the NEPC initiated a review to determine whether a new ambient air quality goal for particulates of 2.5 microns or less in aerodynamic diameter ($PM_{2.5}$) was needed in Australia, and the feasibility of developing such a goal. The review found that:

- there are health effects associated with fine particles;
- the health effects observed overseas are supported by Australian studies; and
- fine particle standards have been set in Canada and the USA, and an interim goal proposed for New Zealand.

The review concluded that there is sufficient community concern regarding $PM_{2.5}$ to consider it an entity separate from PM_{10}.

As such, in July 2003 a variation to the Ambient Air Quality NEPM was made to extend its coverage to $PM_{2.5.}$ This document references the following goals for $PM_{2.5}$.

- A 24-hour maximum of 25µg/m^3.
- An annual average of 8µg/m^3.

As there is little data available regarding $PM_{2.5}$ emission factors, $PM_{2.5}$ has not been quantitatively assessed using atmospheric dispersion modelling. It is possible however, to provide a semi-quantitative assessment of likely $PM_{2.5}$ concentrations attributable to the Project, based on modelling of PM_{10} concentrations. This approach has been adopted in this assessment

4.2 Goals Applicable to Total Suspended Particulates (TSP)

The annual average goal for Total Suspended Particulates (or TSP) is given as 90µg/m^3, as recommended by the National Health and Medical Research Council (NHMRC) at their 92nd session in October 1981. It was developed before the more recent results of epidemiological studies suggested a relationship between health impacts and exposure to PM_{10} concentrations.

As discussed in **Section 3.2**, since in rural areas the PM_{10} particle size fraction is typically of the order of 50% of the TSP mass, the goal is consistent with an annual PM_{10} goal of approximately 45µg/m^3. Thus, the historical NHMRC goal may be regarded as less stringent than the newer DECC PM_{10} goal of 30µg/m^3 expressed as an annual average.

Therefore, as the annual TSP goal is seen to be achieved if the annual PM_{10} goal is satisfied, TSP has not been considered further in this report.

4.3 Nuisance Impacts of Fugitive Emissions

The preceding sections are concerned in large part with the health impacts of particulate matter. Nuisance impacts also need to be considered, mainly in relation to dust. In NSW, accepted practice regarding the nuisance impact of dust is that dust-related nuisance can be expected to impact on residential areas when annual average dust deposition levels exceed 4g/m^2/month.

To avoid dust nuisance, the DECC has developed assessment goals for dust fallout. **Table 4** presents the allowable increase in dust deposition relative to the ambient levels.

Table 4
DECC Goals for Allowable Dust Deposition

Averaging Period	Maximum Increase in Deposited Dust Level	Maximum Total Deposited Dust Level
Annual	2g/m^2/month	4g/m^2/month
Source: DECC Approved Methods		

As the ambient dust deposition level has been assumed to be less than 2g/m^2/month (see **Section 3.1**), the maximum increase in deposited dust level would be the governing goal for the Project.

5 ATMOSPHERIC DISPERSION MODELLING

5.1 Methodology

The atmospheric dispersion modelling carried out in the present assessment utilises the Ausplume Gaussian Plume Dispersion Model software (Version 6.0) developed by the EPA (Victoria).

Ausplume is the approved dispersion model for use in the majority of applications in New South Wales. Default options specified in the Technical Users Manual (EPA Victoria, 2000) have been used, as per the AMMAAP.

5.2 Regional Climate Averages

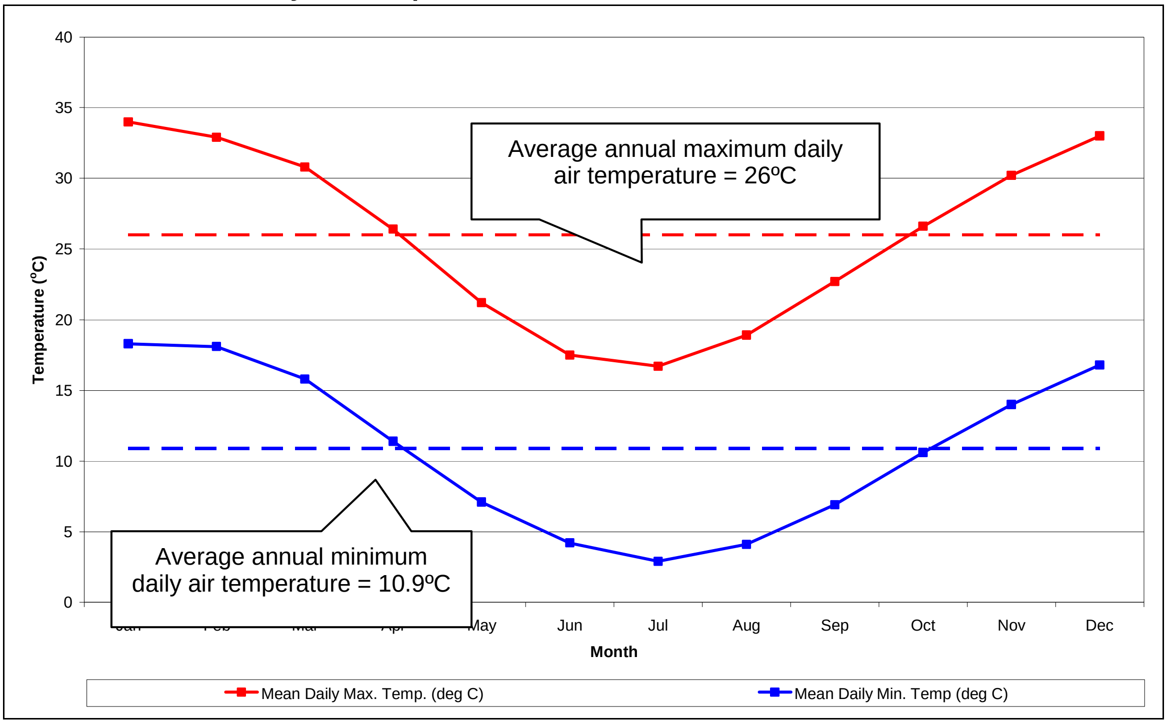
The nearest Bureau of Meteorology (BoM) automatic weather station (AWS) to the Project Site that contains historic climate averages is located at Gunnedah Pool (station number 055023). Records are available from this station since records began in 1876 until 2004.

A detailed summary of the climatic average observations for this monitoring site is presented in **Appendix 1**. The key aspects of local climatic conditions, including air temperature, precipitation and relative humidity are analysed in more detail in the following sections.

5.2.1 Air Temperature

A graph displaying the monthly fluctuations in mean daily minimum and mean daily maximum temperatures at the Gunnedah Pool AWS is shown in **Figure 8**.

Figure 8
Mean Daily Air Temperature Measurements, Gunnedah Pool AWS



It can be seen from **Figure 8** that the temperature in the vicinity of the Project Site may be described as mild to hot in nature.

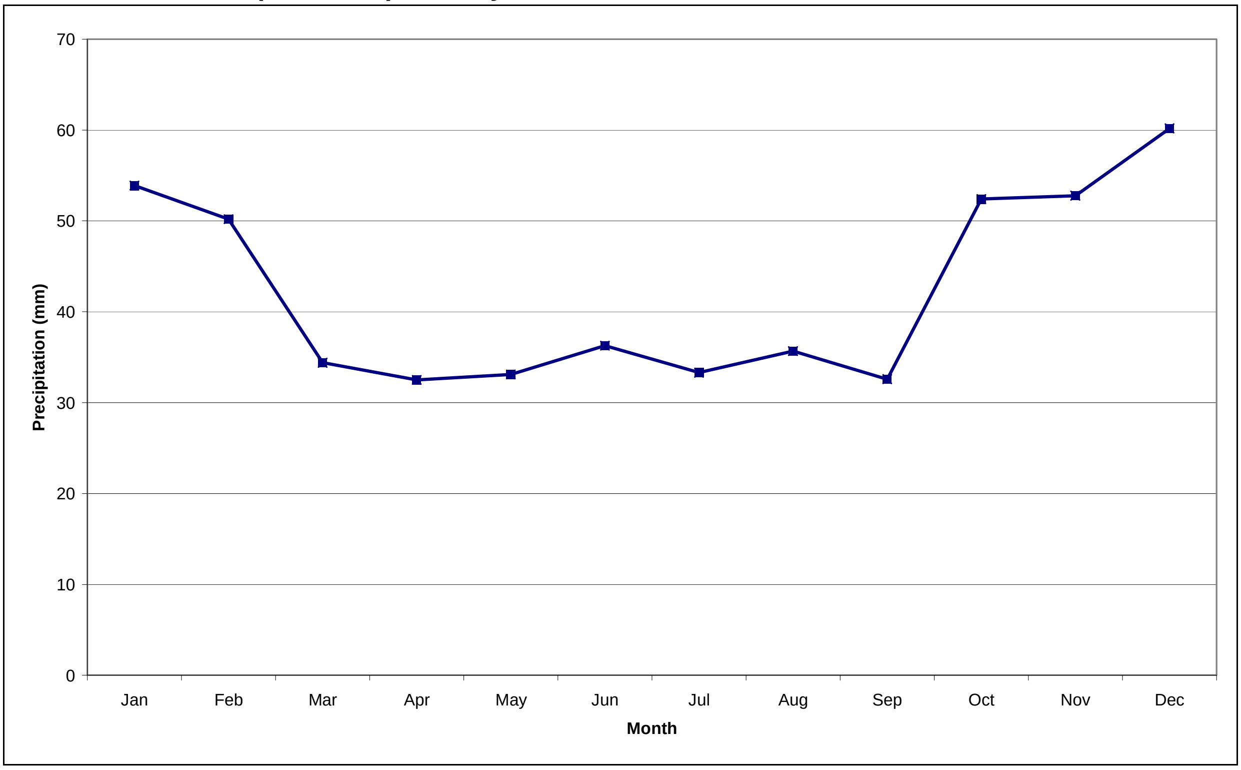
Air temperatures during the day tend to be mild to hot, varying from 16.7ºC-18.9ºC in winter, to 32.9ºC-34.0ºC in summer. Air temperatures during the night tend to be cool to mild, varying from 2.9 ºC- 4.2ºC in winter to 16.8ºC-18.3ºC in summer.

The average annual maximum daily air temperature is 26ºC, and the average annual minimum daily air temperature is 10.9ºC.

5.2.2 Rainfall

A graph displaying the median (5th decile) monthly rainfall at Gunnedah Pool AWS is shown in **Figure 9**.

Figure 9
Median (5th decile) Monthly Rainfall Measurements, Gunnedah Pool AWS



The rainfall experienced at Gunnedah Pool AWS can be described as low, with the area receiving, on average, approximately 620mm per annum. Rainfall at Gunnedah Pool AWS is relatively uniform in nature throughout the seasons.

Rainfall has a significant effect on the way in which particles behave in the atmosphere, and hence the way in which pollution is dispersed. When rainfall occurs, pollutants are flushed out of the atmosphere quickly, thus reducing potential nuisance impacts, as well as those on health and visibility.

5.2.3 Relative Humidity

The relative humidity of Gunnedah Pool AWS can be described as medium. The mean 9am and 3pm relative humidity is 67% and 46% respectively, with an increase occurring through the winter months.

5.3 Dispersion Meteorology

To provide an indication of local meteorology, The Air Pollution Model (TAPM) was used to generate a meteorological data set, using the data assimilation option to incorporate observations from the Bureau of Meteorology's (BoM) Gunnedah Airport Automatic Weather Station (AWS) (Station Number 055202), located approximately 13km east-northeast of the Project Site. The data set selected for the modelling was 2005 given it was the most recent complete data set available during the preparation of the report.

The TAPM model predicts wind speed and direction, temperature, air pressure, water vapour, cloud, rain water and turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, and synoptic scale meteorological analyses) which are subsequently used in the model input to generate site-specific hourly meteorological observations, with no local inputs required.

Additionally, the TAPM model may assimilate wind observations so that they can optionally be included in a model solution. The wind speed and direction observations are used to re-align the predicted solution towards the observation values. This function of accounting for actual meteorological observations within the region of interest is referred to as “data assimilation”.

Further background on the TAPM model, including details of validation exercises, is presented in **Appendix 2**.

The 2005 annual wind rose is presented in **Appendix 3**. The wind rose is representative of the meteorological input file used in the assessment, and displays occurrences of winds from all quadrants.

The annual wind rose indicates that winds are experienced predominantly from the east and east-southeast and are mild to moderate in nature, having an average wind speed of between 1.5m/s and 8m/s. Calm conditions occur approximately 2.3% of the time.

The seasonal variation in wind behaviour at the Project Site is also presented in **Appendix 3**. The seasonal wind roses indicate the following.

- In summer, the prevailing wind directions are from the east-southeast and southeast.
- In autumn, the prevailing wind directions are from the southeast and east-southeast.
- In winter, the prevailing wind directions are from the east-southeast and southeast.
- In spring, the prevailing wind directions are from the east-southeast, southeast and east.
- The strongest winds occur in the summer and autumn months and prevail from the southeast and east-southeast respectively.

For comparison, the annual and seasonal wind roses for Gunnedah Airport AWS are presented in **Appendix 4**. The wind roses indicate that the prevailing wind directions are from the south-southeast and the southeast. The slight different in wind direction may be as a result of the influence of local topography at the Project Site. Calms are represented more frequently than at the Project Site, occurring 4.8% of the time.

Analysis of meteorological data recorded at the nearby Whitehaven Coal Mine by WCL’s on-site weather station between 2004 and 2005 shows similar wind behaviour to that experienced at Gunnedah. The annual wind rose for Whitehaven Coal Mine for the monitoring period indicates that winds tend to be experienced predominately from the southeast; however it is noted that a more defined northeast and northwest component exists in this dataset in comparison to the wind measurements at Gunnedah. Wind speeds at the Whitehaven Coal Mine are mild to moderate in nature.

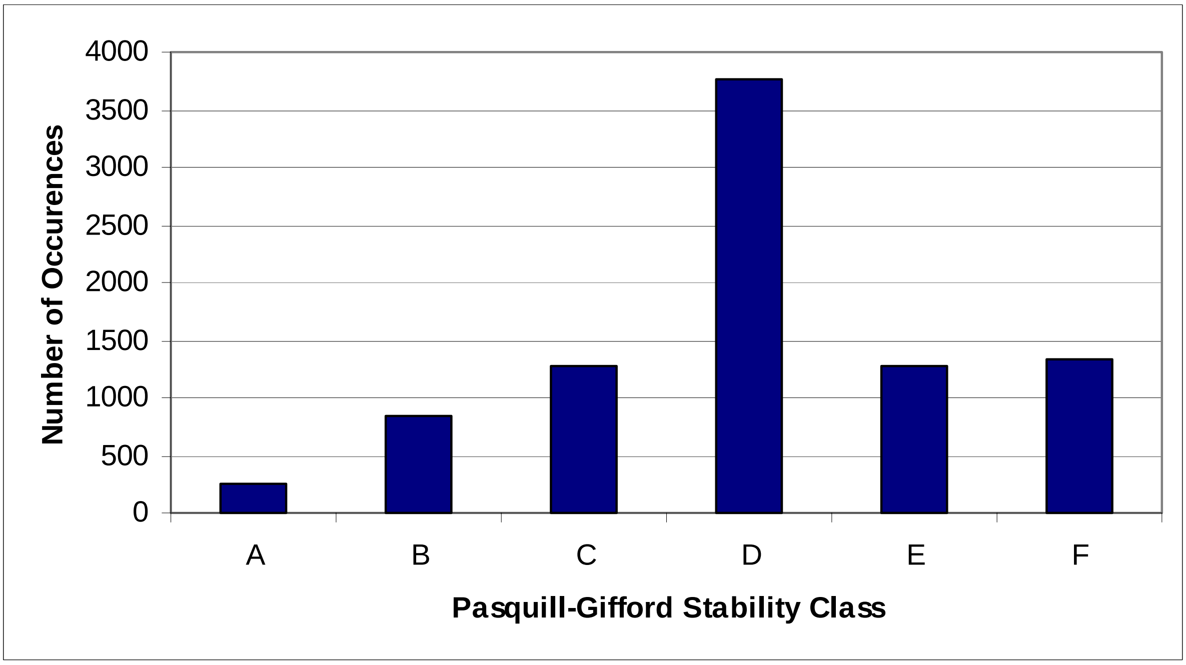
Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Turner assignment scheme identifies six Stability Classes, "A" to "F", to categorise the degree of atmospheric stability. These classes indicate the characteristics of the prevailing meteorological conditions.

Stability Class "A" represents highly unstable conditions that are typically found during summer, and are categorised by strong winds and convective conditions. Conversely, stability class "F" relates to highly stable conditions, typically associated with clear skies, light winds and the presence of a temperature inversion. Classes "B" through to "E" represent conditions intermediate to these extremes.

The frequency of occurrence of stability class at the Project Site for 2005 is presented in **Figure 10**. The results indicate a high frequency of conditions typical of Stability Class "D" throughout the year. This is indicative of neutral conditions, conducive to a moderate level of pollutant dispersion due to mechanical mixing.

Appendix 5 illustrates the seasonal variation in atmospheric stability class at the Project Site. The frequency distribution of stability class indicates that Stability Class "D" dominates throughout the year.

Figure 10
Annual Stability Class Distribution for the Project Site, 2005



5.4 Project Site Topography

As discussed in **Section 2.3**, the topography of the area within and surrounding the Project Site is relatively uniform. Subsequently, topography has not been considered in the atmospheric dispersion model, as significant impacts on modelled concentrations at the nearest residences would not be seen with the inclusion of such uncomplicated near-field topography.

Additionally, the topography of the region surrounding the Project Site would not be conducive to katabatic flow to any large extent. Katabatic flow is the movement of cool air down sloping terrain, typically occurring in a valley, and is a key element in the formation of temperature inversions.

Diurnal re-circulation of pollutants is not expected to be an issue at the Project Site due to its inland location, approximately 350 km from the NSW East Coast.

5.5 Modelling Scenario

The modelling scenario chosen for this assessment was selected considering the following factors.

- Location of mining and other operational activities.
- Location of ROM processing area.
- The proximity of these factors to the closest non-project related residences.

The scenario chosen takes into consideration the movement of mobile plant and equipment across different sections of the Project Site and aims to be representative of worst case conditions present during a site operational year.

The chosen modelling scenario is as follows.

- Operational Year 4 - incorporates the operation of the Project Site including drilling, blasting and removal of topsoil and overburden, extraction of coal at the open cut pit area by bulldozer and excavator, ROM processing plant operations and ROM and Product Coal haulage.

5.6 Emission Factors

5.6.1 Operational Activities

A review has been carried out of the potentially particulate-generating activities expected at the Project Site. The following activities (where applicable) have been included in the particulate emissions inventory.

- Removal and transfer of topsoil at open cut pit area (Drilling, blasting and handling).
- Operation of the open cut pit area (excavator, bulldozer and front-end loader (FEL)).
- Operation of the ROM area (FEL, crusher, conveyor, truck loadout)
- Wind erosion of open cut pit areas, stockpiles (out-of pit emplacement, top soil/subsoil and product stockpiles) and noise embankments.
- Movement of heavy vehicles on unsealed roads within the Project Site (haul truck wheel-generated dust).

Table 5 Error! Reference source not found. presents the emission factors used for the key atmospheric pollutants used in the dispersion modelling carried out for this report. These relate to emissions expected under normal operating conditions. The ratio of the PM_{10} fraction of the total particulate emission (used to predict dust deposition) ranges from 50% (eg wind erosion) down to 25% (eg wheel-generated dust). The proportion of the PM_{10} fraction for each activity was derived primarily from the National Pollutant Inventory document, *Emission Estimation Technique Manual for Mining, Version 2.3*, (EETMM) (Environment Australia, 2001).

Table 5
Particulate Emission Factors for Air Quality Dispersion Modelling

Activity	Total Particulate Emission Factor[1]	PM_{10} Emission Factor	Emission Factor Units
Blasting	66.25	34.45	kg/blast
Dozer on Overburden	16.74	4.07	kg/hr
Loading Haul Trucks with Overburden	0.0024	0.0011	kg/t
Placement of Overburden on Stockpile	0.012	0.0043	kg/t
Scraper on Overburden	1.81	0.59	kg/hr
Coal Excavation	0.04	0.017	kg/t
Dozer on Coal	75.21	23.12	kg/hr
Front-end Loader on Coal	0.037	0.018	kg/t
Exposed Areas/Stockpile Wind Erosion (Various)	24,677.9	9,871.2	kg/ha/year
Unloading Trucks at ROM	0.01	0.0042	kg/t
Front-end Loader on Coal	0.037	0.018	kg/t
Product Crushing[2]	0.2	0.02	kg/t
Loading Product Trucks	0.004	0.0017	kg/t
Haulage Truck generated dust	5.49	1.48	kg/VKT[3]
Product Truck generated dust	2.41	0.65	kg/VKT[3]

Note 1: Total Particulate emission factor is used to derive the rate of dust deposition
Note 2: Includes crushing and all associated processes
Note 3: VKT = Vehicle Kilometre Travelled

In general, default emission factors have been used as contained in Table 1 of the EETMM. In some instances, the moisture content of materials at the Project Site is not adequately reflected within the default emission factors contained in the EETMM, and the equations given in Table 1 of the EETMM document were therefore used to derive representative emission factors. The following emission factors were derived using this method.

- Blasting
- Dozers.
- Loading haul trucks.
- Scraper on Overburden
- Coal Excavation
- Front-end Loader

The equation for wheel-generated dust is taken from the Chapter 13.2.2 Unpaved Roads (2003) of the USEPA AP42 which has not been incorporated into the NPI as yet.

5.6.2 Wind Erosion

Wind erosion from exposed surfaces has been estimated using the USEPA AP 42 Emission Factor for wind erosion (Chapter 13, Section 13.2.5 Industrial Wind Erosion).

The threshold friction velocity is an important parameter which is needed in the estimate of wind erosion from both "limited" and "unlimited" erosion potential sites. Threshold friction velocity Ut is the friction velocity at which wind erosion is initiated.

When the actual friction velocity at the Project Site is greater than the threshold friction velocity, wind erosion can be expected, however, when the threshold friction velocity is equal to or greater than the actual friction velocity at the Project Site then wind erosion would not occur.

The threshold friction velocity for the Project Site was determined from the modelled relationship proposed by Marticorena & Bergametti (1995) based on the relationship between erosion threshold and aerodynamic roughness length. The roughness height was determined by taking 1/30 of the diameter of the particles on the bed surface (Bagnold, 1941).

The friction velocity was determined from the expression:

$$u^* = A\ u_{10}$$

where A is a function of the roughness height (Z_o) and U_{10} is the wind speed measured at a height of 10 meters. Assuming a typical surface roughness height of 0.5 cm, A is given as 0.053.

Mean atmospheric wind speeds are not generally sufficient to sustain wind erosion from flat surfaces and estimated emissions would be related to the gusts of highest wind. The variable that best reflects the magnitude of wind gusts is the fastest mile of wind. Fastest mile of wind is not routinely recorded by the Bureau of Meteorology. An alternative approach is to use a “gust factor” to convert hourly wind speed data to the fastest mile of wind. The fastest mile of wind has been shown to range from 1.18 to 1.27 times the hourly wind speed (Krayer & Marshall (1992) in SKM (2005)).

The erosion potential from exposed surfaces is then calculated using:

$$P = 58\ (U^* - Ut^*)^2 + 25\ (U^* - Ut^*)$$
$$(P = 0 \text{ for } U^* <= Ut^*)$$

5.7 Emission Inventory for the Proposed Operation

Appendix 6 provides details of the emission inventory associated with the modelled scenario for the Project using the emission factors given in **Table 5**Error! Reference source not found..

The emission inventory has been derived to reflect the worst-case scenario for airborne emissions over a 24 hour period, and mean average operational conditions for annual assessments.

The following assumptions were made in creating the emissions inventory for the Project.

1. For blasting operations, it has been assumed that the volume of each blast would remove 220'000 bcm of overburden per blast. The depth of each blast hole is 50 m while the area blasted is assumed to be approximately 70 m^2. It is also assumed that there would be 16 blasts per annum.
2. The drill rig used for blastholes has not been modelled, as drilling is not anticipated to occur on the same day as blasting, and the blast Emission Factor has been selected to simulate 'worst-case' conditions.
3. The grader has not been included in the modelling as its use is anticipated to be for on-site road maintenance, which is likely to have minimal air quality impacts due to comparatively low annual hours of operation.
4. The total annual extraction rate of materials at the Project Site is calculated to be 8 Mt, based on the following.
   - An average Stripping Ratio of 5:1 (bcm/t)
   - An annual Coal Production rate of 1 Mt
   - A density of 1.6 t/m^3 for the extracted overburden
5. For modelling purposes, the mining components have been assumed to have the following working schedule.
   - Blasting – Once per day
   - Overburden scraper operations – 11 hours per day (0700 – 1800)
   - Overburden removal and placement – 15 hours per day (0700 – 2200)
   - Internal haulage of raw coal to ROM crushing/stockpiling facility – 15 hours per day (0700 – 2200)
   - On site coal processing – 11 hours per day (0700 – 1800)
   - Product transport – 10 hours per day (0700 – 1700)
6. It has been assumed that coal excavation, coal dozing and front-end loader operation on coal would be undertaken on a one on, one off process.
7. All mining components have been assumed to have a working schedule of 5 days a week for the entire year. This totals 260 days of operation.
8. Product haulage is assumed to have a working schedule of 6 days a week for the entire year. This equates to 312 days of operation.
9. Hourly throughput tonnage values for the various relevant mine components have been calculated from quoted extraction totals and annual processing totals against operational hours of 11 hours a day, 260 days a year.
10. The following moisture content (mc) and silt content (sc) were assumed for the modelling.
    - Overburden: mc – 2%, sc – 10% (Environment Australia, 2001)
    - Coal: mc – 2.8%, sc – 6.2%
    - Unsealed Coal Transport Routes: mc – 1.1%, sc – 6.4% (USEPA, 1998)

11. It is assumed that the coal processing plant consists of the following potentially dust generating components:
    - Crushing
    - Loading product trucks
12. Emission rates for the processing plant components listed in the previous point have been taken from the default emission rates quoted in Table 2 of "Emission Estimation Technique Manual for Mining, Version 2.3".
13. Any emission factors taken from Table 2 of "Emission Estimation Technique Manual for Mining, Version 2.3" were assumed to be for Low Moisture Content Ore (a moisture content of 4% or lower by weight)
14. Haul trucks per hour were calculated from the hourly extracted tonnage and an average truck load capacity of 150 t.
15. A 'Pit Retention' control factor has been applied to emission rates/fluxes corresponding to activities occurring within the mining area. This equates to 50% control for TSP and 5% for PM_{10}, as per Table 3 of the "Emission Estimation Technique Manual for Mining, Version 2.3".
16. The emission factors for the dozer and loading of trucks were derived from Table 1 of "Emission Estimation Technique Manual for Mining, Version 2.3". The equations corresponding to Excavators/ Front-end Loaders (on overburden) and Bulldozers (on overburden) were used.
17. The emission factor for blasting of overburden was derived from Table 1 of "Emission Estimation Technique Manual for Mining, Version 2.3". The equation corresponding to Blasting was used.
18. The emission factors for the excavation (excavator) at the mining area and loading of coal (by excavator and front-end loader) at various areas of the SCP site were derived from Table 1 of "Emission Estimation Technique Manual for Mining, Version 2.3". The equation corresponding to Excavators/ Front-end Loaders (on coal) was used.
19. For the out-of-pit overburden emplacement located to the north of the open cut, it is assumed that one-eight of this area is "active" with management by dozer/scraper. The remaining area is assumed to be stabilised due to the long term nature of the stockpile.
20. To account for the steep gradient of the open cut, a 'Pit Retention' control factor has been applied to emission rates/fluxes corresponding to all activities occurring below the existing ground surface, based on 50% control for TSP and 5% for PM_{10}, as per Table 3 of the EETMM. Additionally, a wind break control factor of 30% has been applied. This accounts for Ausplume's inability to represent the design of the open cut pit within the model.
21. The emission factors for the product conveying were included in the crushing Emission Factor as per section A1.2.3 of "Emission Estimation Technique Manual for Mining, Version 2.3".
22. The emission factors for the trucks unloading and open cut pit wind erosion were derived the default values listed in Table 1 of "Emission Estimation Technique Manual for Mining, Version 2.3".

23. The default emission factor for wind erosion from all stockpiles and noise wall embankments has been taken from Table 1 of "Emission Estimation Technique Manual for Mining, Version 2.3".
24. An emission control reduction of 99% for vegetation has been applied to the noise wall embankments (Table 3 of "Emission Estimation Technique Manual for Mining, Version 2.3").
25. An emission control reduction of 30% for wind breaks has been applied to the coal stockpile within the ROM area (Table 3 of "Emission Estimation Technique Manual for Mining, Version 2.3").
26. An emission control reduction of 50% for water spraying has been applied to all active stockpiles when wind velocity exceeds 8m/s.
27. The closest receptors chosen for the modelling assessment are:
    - "Flodden"
    - "Illili"
    - "Woodlawn"
    - "Ivanhoe"
    - "Ferndale"
    - "Sugarloaf"
    - "Werrona"
    - "Plain View"
    - "Lilydale"
28. The coal transport route is assumed to stretch from the ROM area, rounding the Site Facilities Area before heading south to the Oxley Highway. This distance of this section of the coal transport route is approximately 3.5 km.
29. The movement of trucks (haul and product) has been represented as a simulated line source using the "volume source" Ausplume input. Each volume source is located along the centreline of the real line source with a horizontal spread of half the source spacing.:.
    - ROM Coal Haulage Parameters: Road length is 3500 m, twelve (12) sources with interval of 320 m.
    - Haul Truck Parameters: Road length is 840m, five (5) sources with interval of 180 m.
30. It has been assumed that Level 2 watering (2 Litres/m2/h) would be applied to all unsealed internal haul roads. As such, a reduction factor of 75% has been applied to relevant haul truck movements. Reduction factor was obtained from Table 3 of "Emission Estimation Technique Manual for Mining Version 2.3".
31. Load in haul trucks of 150t has been used in the modelling. Maximum weight of haul trucks is assumed to be 246 t, from official specs for CAT785C Off-Highway Haul Truck, while minimum weight is assumed to be 96 t. The average weight of haul truck used for emission factors is 171 t, to account for the movement of empty (minimum weight) and loaded (maximum weight) haul trucks about the Project Site, and has been calculated from the sum of the maximum and minimum weights.
32. There is assumed to be 125 truck loads each day dispatched from the coal processing area in trucks of 28 t capacity. Total Gross Vehicle Mass for Product Transport trucks is assumed to be 55 t.

It is noted that at the time of modelling, the coal transportation route was assumed to be unsealed and consequently, particulate emissions from this source were calculated accordingly. It has since been confirmed by NMPL that the coal transportation route would in fact be fully sealed. Therefore, the predicted results at the surrounding residences are highly conservative, as sealing this route would be expected to significantly reduce the emissions from this activity.

6 EMISSIONS ASSESSMENT

6.1 Dust Deposition

Table 6 shows the results of the Ausplume predictions for dust deposition using the emission rates calculated in **Appendix 6**. The results show the mean average monthly dust deposition predicted at the residences surrounding the Project Site over a one-year time frame. As detailed in **Section 3.1** it has been assumed that the background level of dust deposition is 1.8g/m^2/month for the nearest residences and therefore the incremental increase in dust deposition becomes the governing criterion for the assessment (refer **Section 4.3**. A contour plot of the modelled incremental increase in dust deposition attributable to the Project is presented in **Appendix 7**.

Table 6
Background and Incremental Dust Deposition at Nearest Non-project Related Residences

Residence	Dust - Annual Average (g/m^2/month)	
	Increment Increase attributable to the Project	Project Goal
"Flodden"	0.1	2.0
"Ivanhoe"	0.5	2.0
"Werrona"	1.3	2.0
"Illili"	0.5	2.0
"Ferndale"	0.2	2.0
"Plain View"	0.9	2.0
"Woodlawn"	0.5	2.0
"Sugarloaf"	0.4	2.0
"Lilydale"	1.9	2.0

It can be seen from **Table 6** that the predicted incremental annual average dust deposition associated with the Project is predicted to be less than 1.9g/m^2/month, at all the nearest non-project related residences. As such, levels of dust deposition are predicted to satisfy the Project goal (incremental increase less than 2g/m^2/month at all residences).

6.2 PM_{10} (24-Hour Average)

Table 7 presents the results of the Ausplume predictions for 24-hour PM_{10} concentrations using the emission rates calculated in **Appendix 6**.

As detailed in **Section 3.2**, it has been assumed that background levels of PM_{10} vary on a daily basis. These background levels have been incorporated into the model; however elevated existing PM_{10} concentrations within the background file, already exceed the impact assessment criteria on two occasions, namely the 2 February 2006 and 9 February 2006.

In accordance with Section 5 of the DECC Approved Methods, the purpose of this assessment is to demonstrate that no further exceedances of the impact assessment criteria would occur as a result of the Project. Accordingly, the results in **Table 7** present the maximum (background plus increment) 24-hour average concentration of PM_{10} predicted at the residences surrounding the Project Site, excluding the two days when the background already exceeds the DECC impact assessment criterion.

Similarly, a contour plot of the 3rd highest 24-hour PM_{10} concentration (background plus increment) attributable to the Project is presented in **Appendix 8**.

Table 7
Background and Incremental PM_{10} Concentrations at Nearest Residences

Residence	PM_{10} - 24-Hour Average (µg/m³)				
	Background	**Increment attributable to the Project**	**Background + Increment**	**Date of Occurrence**	**Project Goal**
"Flodden"	39.5	0.5	40.0	04/02/2005	50
"Ivanhoe"	39.5	2.0	41.5	04/02/2005	50
"Werrona"	33.4	7.7	41.1	02/06/2005	50
"Illili"	39.5	0.0	39.5	04/02/2005	50
"Ferndale"	39.5	0.0	39.5	04/02/2005	50
"Plain View"	27.4	18.8	46.2	29/04/2005	50
"Woodlawn"	39.5	1.2	40.7	04/02/2005	50
"Sugarloaf"	39.5	2.0	41.5	04/02/2005	50
"Lilydale"	32.2	17.3	49.5	03/06/2005	50

It is noted that the varying background concentrations across the selected residences shown in **Table 7** is a direct result of the modelling process. Ausplume predicts the absolute maximum (background plus increment) 24-hour average ground level concentration at each residence surrounding the Project Site for the total modelled period. As a result of the radial spread of locations about the Project Site, daily-varying meteorological conditions can sufficiently influence the dispersion of on-site emissions, causing the maximum predicted concentrations to occur on different days at the chosen residences. From these maximum predicted concentrations (listed in column 4 of **Table 7**), the corresponding background concentration (listed in column 2 of **Table 7**) is subtracted to derive the incremental increase attributable to the Project (listed in column 3 of **Table 7**).

It can be seen from **Table 7** that the maximum 24-hour average PM_{10} concentrations (excluding the two days when the background already exceeds the Project goal) are predicted to be less than 49.5µg/m³ at all the nearest non-project related residences.

For further analysis into the potential impact of the Project on the surrounding environment, the maximum predicted increment at each of the surrounding residences from the modelling period is presented in **Table 8**. It can be seen in **Table 8** that the maximum predicted 24-hour average increment of PM_{10} occurs at the residence "Lilydale", with a concentration of 31.9µg/m³.

Table 8
Maximum Predicted Increment at Nearest Residences – 24-hour Average PM_{10}

Residence	Increment (µg/m³)	Date of Occurrence
"Flodden"	10.2	8/11/2005
"Ivanhoe"	10.7	17/08/2005
"Werrona"	12.4	28/04/2005
"Illili"	11.9	13/05/2005
"Ferndale"	10.3	28/03/2005
"Plain View"	23.0	17/09/2005
"Woodlawn"	10.6	11/05/2005
"Sugarloaf"	9.9	24/07/2005
"Lilydale"	31.9	24/07/2005

6.3 PM_{10} (Annual Average)

Table 9 presents the results of the Ausplume predictions for annual average PM_{10} using the emission rates calculated in **Appendix 6**. It has been assumed that the annual average background concentration of PM_{10} is 16.5µg/m^3 at the nearest residences. This background level has been incorporated into the model.

A contour plot of the modelled annual average PM_{10} concentrations (background plus increment) attributable to the Project is presented in **Appendix 9**.

Table 9
Background and Incremental Annual PM_{10} Concentrations at Nearest Residences

Residence	PM_{10} - Annual Average (µg/m³)			
	Background	Increment attributable to the Project	Background + Increment	Project Goal
"Flodden"	16.5	0.6	17.1	30
"Ivanhoe"	16.5	1.2	17.7	30
"Werrona"	16.5	2.0	18.5	30
"Illili"	16.5	0.9	17.4	30
"Ferndale"	16.5	0.6	17.1	30
"Plain View"	16.5	1.7	18.2	30
"Woodlawn"	16.5	0.9	17.4	30
"Sugarloaf"	16.5	0.7	17.2	30
"Lilydale"	16.5	5.6	22.1	30

The results indicate that the predicted annual average PM_{10} concentrations (background plus increment) associated with the Project are predicted to be less than 22.1µg/m^3 at all nearest non-project related residences. As such, annual concentrations of PM_{10} are predicted to satisfy the Project goal of 30µg/m^3.

6.4 $PM_{2.5}$

Chapter 4 (Watson et al, 2000) of the *Air Quality Engineering Manual*, (Davis, W. T. (ed.), 2000), details size distributions of several particulate source emissions, which are quoted as the following.

- Fugitive dust from road and soil dust - approximately 20% of the PM_{10} particle size fraction would constitute $PM_{2.5}$.
- Fugitive dust from construction dust - approximately 17% of the PM_{10} particle size fraction would constitute $PM_{2.5}$.

Additionally, it is important to recognise the contribution of vehicle traffic to ambient concentrations of fine particulates. Recent studies of differing Australian airsheds have been carried out for the National Pollutant Inventory. The percentage contribution of motor vehicle PM_{10} emissions to the total ambient PM_{10} concentrations within the airshed of focus are detailed for each study. A summary of these percentage contributions is detailed in **Table 10**.

Table 10
Percentage Contribution of Motor Vehicles to Total PM_{10} - Australian Airsheds

NPI Study Title	Airshed of Interest	% of PM_{10} Attributable to Vehicles
NPI Summary Report: Adelaide and Regional Airsheds 1998 - 1999	Adelaide	8
	Regional South Australia	2
NPI Summary Report of Fifth Year Data 2002 - 2003	South East Queensland	10
NPI Summary Report of Sixth Year Data 2003 - 2004	Port Phillip	18

The airsheds reported in **Table 10** represent a varied range of land-use types, from industrial (Port Phillip) to semi-rural (Regional South Australia). An average of these values has been used to determine the percentage contribution of motor vehicular emitted PM_{10}, stated as follows.

- PM_{10} from vehicles may contribute in the order of 9.5% to the total emission inventory of PM_{10}.

Finally, the size distributions from diesel truck exhaust are quoted by Watson et al (2000) as the following.

- Approximately 96% of PM_{10} from diesel combustion would be emitted as $PM_{2.5}$.

A simple calculation based on the above assumptions, combined with the maximum predicted PM_{10} concentrations in **Table 7** and **Table 9** above (49.5µg/m^3 and 22.1µg/m^3 respectively), indicates that, inclusive of the Project activities:

- 24-hour average $PM_{2.5}$ are predicted to be of the order of 13.7 µg/m^3, thus satisfying the 24-hour average goal for $PM_{2.5}$ of 25µg/m^3; and
- Annual average $PM_{2.5}$ are predicted to be of the order of 6.1µg/m^3, thus satisfying the annual average goal for $PM_{2.5}$ of 8µg/m^3.

6.5 Greenhouse Gas Assessment

Mining operations at the proposed Project have the potential to generate greenhouse gas emissions from a number of sources. These sources include the following.

- The combustion of fuel by diesel-powered equipment and vehicles.
- The release of coal bed methane during excavation and post-excavation activities.
- Use of Explosives for blasting.
- Distribution of Product materials.
- End use of produced materials.

A full life cycle assessment of worst case annual greenhouse gas emissions from the Project has been conducted and detailed in **Appendix 10**. The results of this assessment indicate that the maximum annual emissions of CO_2-Equivalent as a result of the operations at the Project are predicted to be of the order of 3.0Mt of CO_2-Equivalent per annum.

The potential maximum emissions from the Project Site for combined Scope 1 and 2, Scope 3 and Total CO_2-Equivalent emissions are presented in **Table 11**. The three emission scopes are defined as follows:

- Scope 1 emissions are those which result from activities under a company's control or from sources which they own. (eg on-site generation of electricity, on-site transportation emissions)
- Scope 2 emissions are those which relate to the generation of purchased electricity consumed in its owned or controlled equipment or operations.
- Scope 3 emissions are defined as those which do not result from the activities of a company although arise from sources not owned or controlled by the company. (eg off-site transportation of purchased fuels, the use of sold products and services).

Additionally, greenhouse gas emissions for each Scope breakdown are compared against estimated total Australian and International emissions of CO_2-equivalent, where relevant. It is noted that total Australian emissions for 1990 and International emissions for 2000, estimated to be 551.9Mt CO_2-equivalent (AGO, 2006) and 33,666Mt CO_2-equivalent (WRI, 2005) respectively, have been used in this comparison.

Table 11
Comparison of Project Emissions of Greenhouse Gases with Australian and International Emissions

Emissions Estimation Period	Scope 1 & 2 Emissions CO_2-e (%-age Comparison with Australian 1990 emissions[1])	Scope 3 Emissions CO_2-e (%-age Comparison with International 2000 emissions[2])	Total Project Emissions CO_2-e (%-age Comparison with International 2000 emissions[2])
Worst Case Year (1Mtpa production)	73kt (0.013%)	2.9Mt (0.009%)	3.0Mt (0.009%)

1: From AGO (2006), *National Greenhouse Inventory 2004*
2: From WRI (2005), *Navigating the Numbers – Greenhouse Gas Data and International Climate Policy*

7 DESIGN AND OPERATIONAL SAFEGUARDS

Results provided in **Section 6** show that predicted air quality impacts would comply with Project air quality goals, provided the operational safeguards detailed in **Section 5.7** are adhered to for the life of the Project.

Specifically, these include:

- Employ watering (>2 litres/m^2/application) to all internal haul roads.
- The construction of the amenity bund surrounding the ROM pad, having the added effect of providing a wind break.
- Revegetation of the amenity bund to prevent wind erosion.
- Sealing of the coal transportation route.

Further, a dust management plan would be implemented at the Project Site to minimise potential emissions during adverse weather condition days when excessive amounts of dust could be generated. Adverse weather conditions from an air quality perspective include moderate wind speeds prevailing from the northwest (blowing in the direction of the closest non-project related residences). The installation of automatic sprays fitted with anaemometers to identify such conditions, at key areas of wind-generated emissions (ie. active coal stockpiles), can assist with the mitigation of dust at the Project Site.

8 AIR QUALITY MONITORING RECOMMENDATIONS

The air quality assessment indicates that fugitive particulate emissions are anticipated to be acceptable for the conditions modelled and as such air quality is not anticipated to be adversely affected at the nearest residences.

However, to demonstrate compliance with the Project air quality goals established in **Section** ongoing monitoring is recommended at appropriate locations and frequencies throughout the life of the Project, with an annual review of the extent of monitoring conducted.

All monitoring would be conducted in accordance with the following Australian Standards:

- *Approved Methods for the Sampling and Analysis of Air Pollutants in New South* Wales (DECC, 2005b);
- AS 2922-1987 *Ambient Air - Guide for the Siting of Sampling Units*.

Monthly monitoring for dust deposition would be undertaken at four locations throughout the operational life of the Project. The most suitable locations for dust deposition monitoring would be within the property boundary of the four residences identified as follows and subject to negotiation with the property owners.

- DDG1: “Lilydale”;
- DDG2: “Plain View”;

- DDG3: "Ivanhoe"; and
- DDG4: "Illili".

Monitoring for dust deposition would be conducted in accordance with the following Australian Standard.

- AS 3580.10.1-2003 *Methods for Sampling and Analysis of Ambient Air - Determination of Particulates - Deposited Matter - Gravimetric Method*.

Monitoring of PM_{10} is recommended at the nearest non-project related residence, being either "Lilydale" or "Plain View" and subject to negotiation with the property owners. Monitoring for PM_{10} would be undertaken according to the following Australian Standard.

- AS 3580.9.6-2003 *Particulate Matter - PM_{10} - high volume sampler with size-selective inlet*.

9 CONCLUSION

Modelling of fugitive dust emissions was undertaken to determine the resulting air quality impacts of the Sunnyside Coal Project.

Atmospheric dispersion modelling predictions of fugitive emissions from the Project Site were undertaken using the Ausplume Gaussian Plume Dispersion Model software developed by EPA (Victoria).

These predictions indicate that, provided the specific design and operational safeguards documented within this report are implemented, particulate matter and dust deposition attributable to the Sunnyside Coal Project are predicted to be within the current NSW DECC (and NEPM) air quality goals at all surrounding residences. The maximum 24-hour PM_{10} concentration is predicted to be below the project criteria of 50ug/m^3 at 49.5ug/m^3 with annual average PM_{10} predicted to be below the project criteria of 30 µg/m^3 at 22.1ug/m^3. Modelling of dust indicates that at the surrounding residences, dust deposition rates are predicted to be less than 1.9g/m^2/month, below the NSW DECC criteria of 2g/m^2/month.

10 REFERENCES

The following documents and resources have been used in the production of this report:

- Australian Greenhouse Office (2006), *National Greenhouse Inventory 2004 – Accounting for the 108% Target.*
- AS 2922-1987 *Ambient Air - Guide for the Siting of Sampling Unit*s.
- AS 3580.10.1-2003 *Methods for Sampling and Analysis of Ambient Air - Determination of Particulates - Deposited Matter - Gravimetric Method*.
- AS/NZS 3580.9.6-2003 *Methods for sampling and analysis of ambient air – Determination of suspended particulate matter –* PM_{10} *high volume sampler with size selective inlet – Gravimetric Method*.
- Bagnold, R. A. (1941). *The Physics of Blown Sand and Desert Dunes,* London, Chapman and Hall.
- Davis, W. T. (ed.) (2000), Fugitive Dust Emissions, *Air Quality Engineering Manual*, Chapter 4 – Watson, J. G, Chow, J.C, Pace, T. G. Fugitive Dust Emissions.
- Department of Environment and Heritage (2004), *National Pollutant Inventory Summary Report of Fifth Year Data 2002-2003*.
- Department of Environment and Heritage (2005), *National Pollutant Inventory Summary Report of Sixth Year Data 2003-2004*.
- Dust deposition monitoring undertaken by the WCL from January 2004 to December 2004 at eight locations around the Whitehaven Coal Mine.
- Environment Australia National Pollution Inventory (2000), *Emission Estimation Technique Manual for Combustion Engines Version 2.1*.
- Environment Australia National Pollution Inventory (2001), *Emission Estimation Technique Manual for Mining Version 2.3*.
- Environment Protection Authority South Australia (2002), *NPI Summary Report: Adelaide and Regional Airsheds 1998-99*.
- Environment Protection Authority Victoria (2000), *AUSPLUME Gaussian Plume Dispersion Model Technical User Manual*.
- Heggies generated meteorology file (hourly observations for the year 2005) for Project Site using TAPM software.
- Hourly observations for 2005 from the BoM AWS at Gunnedah Airport.
- Krayer W.R., and Marshall R.D. (1992). Gust Factors Applied to Hurricane Winds, *Bulletin of American Meteorological Society*, 73, 613-617.
- Marticorena B. and Bergametti G. (1995). Modelling the Atmospheric Dust Cycle. 1. Design of a Soil-Derived Dust Emission Scheme. *Journal of Geophysical Research*, 100, 16 415 - 16430.

- National Environmental Protection Council (1998) “National Environmental Protection Measure for Ambient Air Quality”.
- National Health and Medical Research Council, 92nd Session, (1981).
- NSW Department of Environment and Conservation (1998) “Action for Air, the NSW Government’s 25-Year Air Quality Management Plan”, 1998.
- NSW Department of Environment and Climate Change (2005a), *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*.
- NSW Department of Environment and Climate Change (2005b), *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.
- NSW Department of Environment and Climate Change (2005), PM_{10} data as measured by TEOM at the DECC’s Tamworth monitoring site.
- SKM (2005). *Improvement of the NPI Fugitive Particulate Matter Emission Estimation Techniques*.
- USEPA (1998). Miscellaneous Sources, Unpaved Roads – Background Documentation, AP-42: Compilation of Air Pollutant Emission Factors, Fifth Edition. Chapter 13.2.2.
- USEPA (2001) *“Federal Register: Control of Air Pollution from New Motor Vehicles: Heavy Duty Engine and Vehicle Standards; Highway Diesel Fuel Sulfur Control Requirements; Proposed Rules”.*
- USEPA (2003) Compilation of Air Pollutant Emission Factors AP-42 - Chapter 13.2.2 Unpaved Roads.
- USEPA (2006) Compilation of Air Pollutant Emission Factors AP-42 (Chapter 13, Section 13.2.5 Industrial Wind Erosion).
- World Resources Institute (2005) *Navigating the Numbers – Greenhouse Gas Data and International Climate Policy*.

11 GLOSSARY OF ACRONYMS AND SYMBOLS

AHD	Australian Height Datum
AWS	Automatic Weather Station
BoM	Australian Bureau of Meteorology
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DECC	Department of the Environment and Climate Change
EL	Exploration Licence
Heggies	Heggies Pty Ltd
mg	Milligram (g x 10^{-3})
µg	Microgram (g x 10^{-6})
µm	Micrometre or micron (metre x 10^{-6})
m^3	Cubic metre
Mtpa	Million tonnes per annum
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NO_2	Nitrogen dioxide
PM_{10}	Particulate matter less than 10microns in aerodynamic diameter
$PM_{2.5}$	Particulate matter less than 2.5microns in aerodynamic diameter
SO_2	Sulphur dioxide
TAPM	“The Air Pollution Model”
TEOM	Tapered Element Oscillating Microbalance
TSP	Total Suspended Particulate
USEPA	United States Environmental Protection Agency
WCM	Whitehaven Coal Mine

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APPENDICES

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Appendix 1

Climate Averages for Gunnedah

(No. of pages excluding this page = 1)

Climate averages for Station: 055023 GUNNEDAH POOL Commenced: 1876; Last record: 2004; Latitude (deg S): -30.9841; Longitude (deg E): 150.2540; State: NSW

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean daily maximum temperature - deg C	34	32.9	30.8	26.4	21.2	17.5	16.7	18.9	22.7	26.6	30.2	33	26
Mean no. of days where Max Temp >= 40.0 deg C	2.5	0.9	0.2	0	0	0	0	0	0	0	0.4	1.4	5.2
Mean no. of days where Max Temp >= 35.0 deg C	12.9	8.5	3.4	0.2	0	0	0	0	0	0.8	4.7	10	40.7
Mean no. of days where Max Temp >= 30.0 deg C	23.8	21	17.4	4.7	0.1	0	0	0	1	6.7	15.2	21.5	111.4
Highest daily Max Temp - deg C	48.7	44.4	45	37.2	34.4	30.4	26.7	31.1	35.4	40	43.3	46.1	48.7
Mean daily minimum temperature - deg C	18.3	18.1	15.8	11.4	7.1	4.2	2.9	4.1	6.9	10.6	14	16.8	10.9
Mean no. of days where Min Temp <= 2.0 deg C	0	0	0	0.2	3.1	8.5	12.4	9	2.9	0.4	0.1	0	36.8
Mean no. of days where Min Temp <= 0.0 deg C	0	0	0	0.1	1	4.4	7	4.2	0.9	0.1	0	0	17.7
Lowest daily Min Temp - deg C	2.2	3.3	-1	-3.9	-5.3	-8.6	-8.3	-7.5	-6.7	-2.2	0.6	1.1	-8.6
Mean 9am air temp - deg C	25	23.9	22.2	18.2	13.3	9.8	8.6	10.9	14.9	19	22.1	24.5	17.8
Mean 9am wet bulb temp - deg C	19.7	19.3	17.7	14.7	11.1	8.1	6.9	8.4	11.6	14.6	16.7	18.7	14
Mean 9am dew point - deg C	16.3	16.3	14.6	11.7	8.5	5.9	4.6	5.4	8.1	10.8	12.7	14.7	10.8
Mean 9am relative humidity - %	61	65	64	67	73	78	77	71	65	61	58	57	67
Mean 9am wind speed - km/h	7.7	8.4	8.2	6.7	5.8	5.8	5.4	5.8	6.8	8	7.9	7.3	7
Mean 3pm air temp - deg C	31.4	30.3	28.8	24.7	19.9	16.4	15.6	17.5	21.2	24.3	27.7	30.3	24.1
Mean 3pm wet bulb temp - deg C	21.6	21.2	20.1	17.2	14.3	12	10.8	11.7	14.2	16.1	18.1	20.1	16.3
Mean 3pm dew point - deg C	15.7	15.6	14.2	11.4	9.2	7.2	5.4	5.6	7.3	9.4	10.6	12.9	10.2
Mean 3pm relative humidity - %	43	43	44	46	52	55	53	48	43	43	39	38	46
Mean 3pm wind speed - km/h	9.8	9.1	9.7	8.7	7.7	9.2	10.2	11	11	10.5	11.2	10.5	9.9
Mean monthly rainfall - mm	72.4	65.9	48.5	38.2	43.3	42.5	42.3	41.9	39.5	55.6	59.9	66.3	616.4
Median (5th decile) monthly rainfall - mm	53.9	50.2	34.4	32.5	33.1	36.3	33.3	35.7	32.6	52.4	52.8	60.2	619.9
9th decile of monthly rainfall - mm	163.1	138.3	108.3	83.2	101.2	83.8	85.2	88.9	94.2	101.6	115.3	126.4	843.4
1st decile of monthly rainfall - mm	14.2	9.8	3.7	1.4	3.2	8	7	5.8	5.3	10.1	10.6	14.8	373.6
Mean no. of raindays	6.5	6	4.7	4.3	5.3	6.2	6.2	6.2	5.8	6.9	6.7	6.9	71.7
Highest monthly rainfall - mm	301	253.5	367.6	151.4	171.2	172.5	177.8	138.5	128	161.2	259.3	185.4	
Lowest monthly rainfall - mm	0	0	0	0	0	0	0	0	0.5	0	0.3	0	
Highest recorded daily rainfall - mm	184	127.3	158	65.5	88.9	68.3	81	68.3	64.4	66.5	99.1	83.8	184
Mean no. of clear days	12.8	10.9	14.4	13	11.8	10.8	12.7	13.6	13	12.9	12.7	13.3	151.7
Mean no. of cloudy days	5.9	5.9	4.4	4.4	6.3	6	6.2	5.4	4.4	6.1	5.6	5.1	65.7

Appendix 2

TAPM Verification Exercises

(No. of pages excluding this page = 2)

B1 Introduction

This appendix clarifies the use of The Air Pollution Model (TAPM) in the generation of site-specific meteorological data.

B2 Meteorology and Dispersion Modelling

Air pollutant dispersion models, such as the Ausplume Gaussian Plume Dispersion Model software developed by EPA Victoria, require meteorological data inputs to simulate the potential impacts of pollutants on the nearest receptors. In the past, this has been achieved using observations from the nearest meteorological monitoring station and converting these into a format suitable for dispersion modelling (Martin & Cook, 2002).

However, there are a number of problems inherent in this approach. Upper air parameters such as mixing height are often inaccurately estimated due to the small number of upper air stations in Australia (Martin & Cook, 2002). Additionally, there is often a significant geographical separation between study areas and the nearest meteorological stations, particularly in rural areas.

The Air Pollution Model (TAPM) software, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), is often used simulate the meteorology of an area where insufficient on-site meteorological data is available. TAPM is a prognostic model which may be used to predict three-dimensional meteorological data, with no local data inputs required.

The model predicts wind speed and direction, temperature, pressure, water vapour, cloud, rain water and turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, sea surface temperature and synoptic scale meteorological analyses) which are subsequently used in the model input to generate site-specific hourly meteorological observations. TAPM is often used to drive the regulatory Ausplume model where insufficient on-site meteorology data is available.

The TAPM model also allows for the assimilation of wind observations to be optionally included in a model simulation. The wind speed and direction observations are used to “nudge” the predicted solution towards the observation values.

B3 TAPM Verification Studies

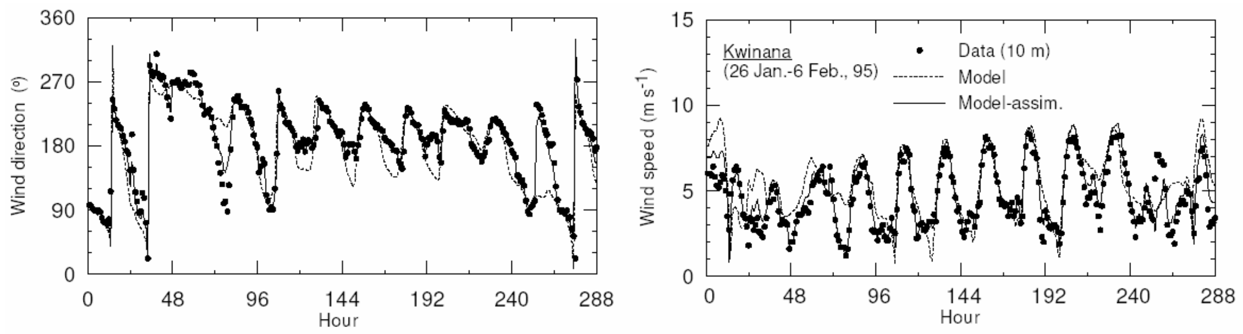
There exists a number of studies that investigate the effectiveness of the TAPM software in simulating site-specific meteorological data. These verification studies demonstrate that TAPM performs well in a variety of regions throughout Australia and for a range of important phenomena such as convective dispersion (Hurley *et al*., 2002). A select number of these studies are detailed below:

The TAPM software was used to simulate the meteorology in Melbourne for winter (July 1998) and summer (December 1998). These predictions were compared with observational data measured as part of the EPA Victoria air quality monitoring. The results of this comparison indicate that TAPM predicts both winds and temperature very well, with no significant biases (Hurley *et al*., 2002).

The effectiveness of TAPM in estimating annual urban meteorology was assessed by comparing a TAPM-simulated data set for Perth with meteorological observations. An analysis of ambient temperature, wind speed and wind direction demonstrates that the meteorology of Perth was well-simulated by the TAPM software throughout the year (Hurley *et al*., 2002).

A comparison of observed and predicted meteorology was undertaken for Kwinana, a coastal industrial region south of Perth, Western Australia. A comparison of these data sets indicates that TAPM simulates the meteorology of the area well, particularly with respect to wind speed and wind direction (Luhar & Hurley, 2002). **Figure A** demonstrates the comparison of observed results with TAPM predictions for these parameters.

Figure A
Hourly Average Wind Speed and Wind Direction (Observed and TAPM-Generated) at Kwinana, WA (Source: Luhar & Hurley, 2002)



TAPM predictions of wind speed, wind direction, temperature and relative humidity were compared with observational data for the Pilbara region, WA. The comparison indicates that there is a strong correlation between predicted and observed results at this site, demonstrating that TAPM-generated meteorology is a useful tool in dispersion modelling (Hurley *et al.,* 2003).

B4 REFERENCES

Hurley P.J., Physick W.L. & Luhar A.K. (2002) *The Air Pollution Model (TAPM) Version 2. Part 2: Summary of Some Verification Studies.* CSIRO Atmospheric Research Technical Paper No.57.

Hurley P.J., Physick W.L., Cope M., Borgas M. & Brace P. (2003) An evaluation of TAPM for photochemical smog applications in the Pilbara region of WA. *17th International Clean Air and Environment Conference of the Clean Air Society of Australia & New Zealand, 23-27 November 2003, Conference Proceedings.*

Luhar A.K. & Hurley P.J. (2002) Evaluation of TAPM using the Indianapolis (urban) and Kwinana (coastal) field data sets. 16th International Clean Air and Environment Conference of the Clean Air Society of Australia & New Zealand, 19-22 August 2002, Conference Proceedings.

Martin A.P. & Cook B.J. (2002) Modelling of meteorological events using observations, TAPM and CALMET. 16th International Clean Air and Environment Conference of the Clean Air Society of Australia & New Zealand, 19 - 22 August 2002, Conference Proceedings.

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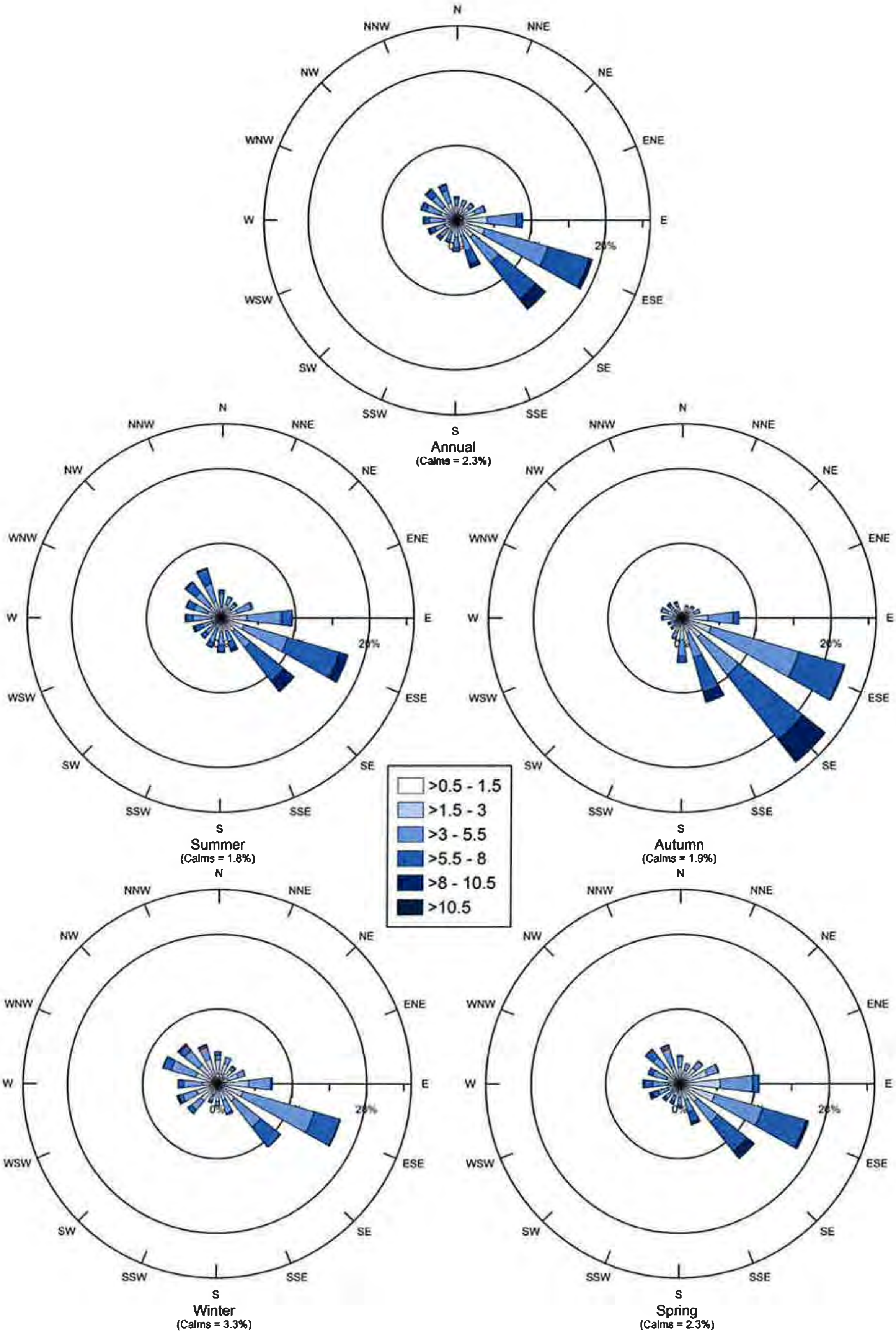
Appendix 3

Wind Roses for Project Site - 2005

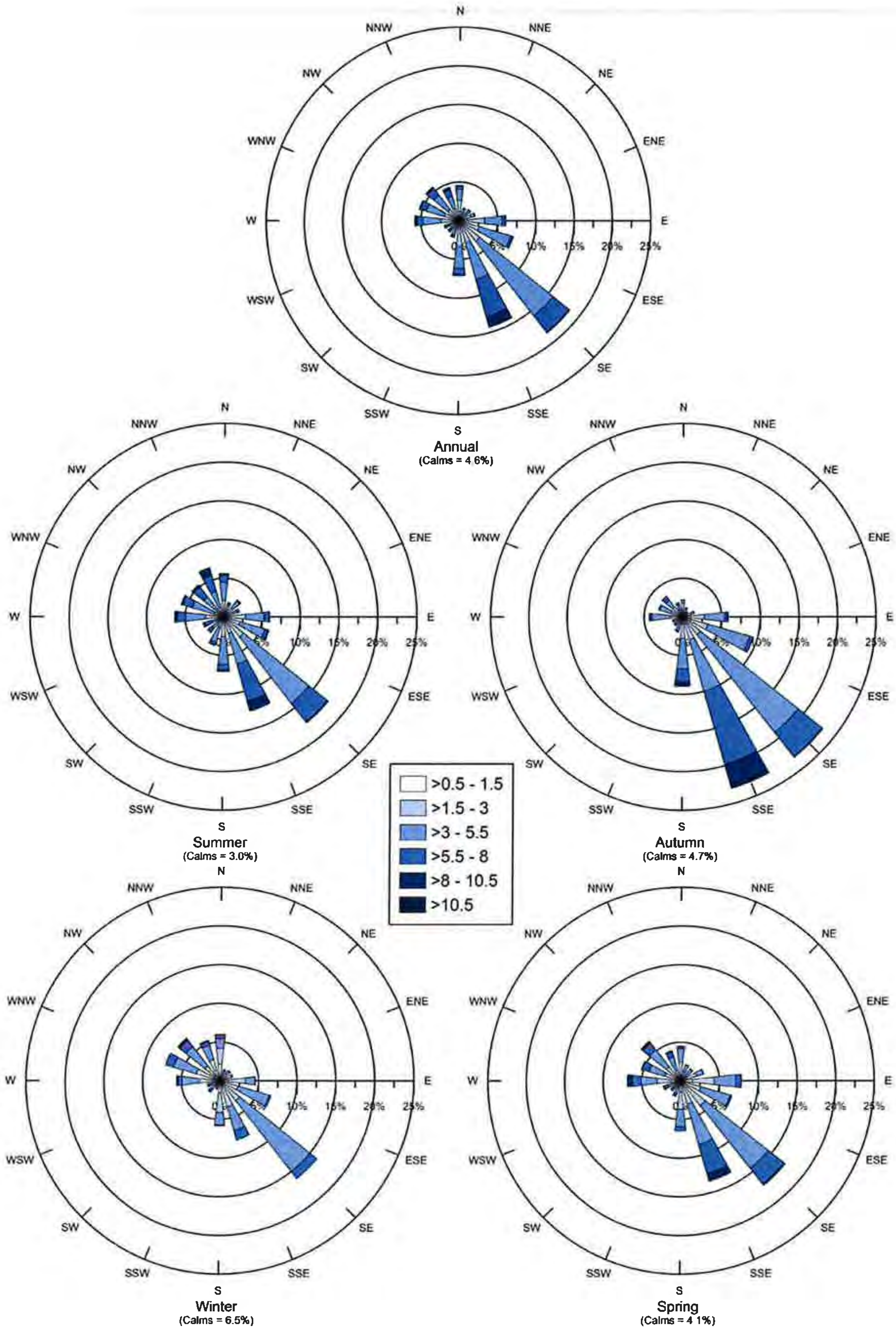
(No. of pages excluding this page = 1)


N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
20%
Annual
(Calms = 2.3%)
Summer
(Calms = 1.8%)
Autumn
(Calms = 1.9%)
Winter
(Calms = 3.3%)
Spring
(Calms = 2.3%)
>0.5 - 1.5
>1.5 - 3
>3 - 5.5
>5.5 - 8
>8 - 10.5
>10.5

Appendix 4

Wind Roses for Gunnedah Airport - 2005

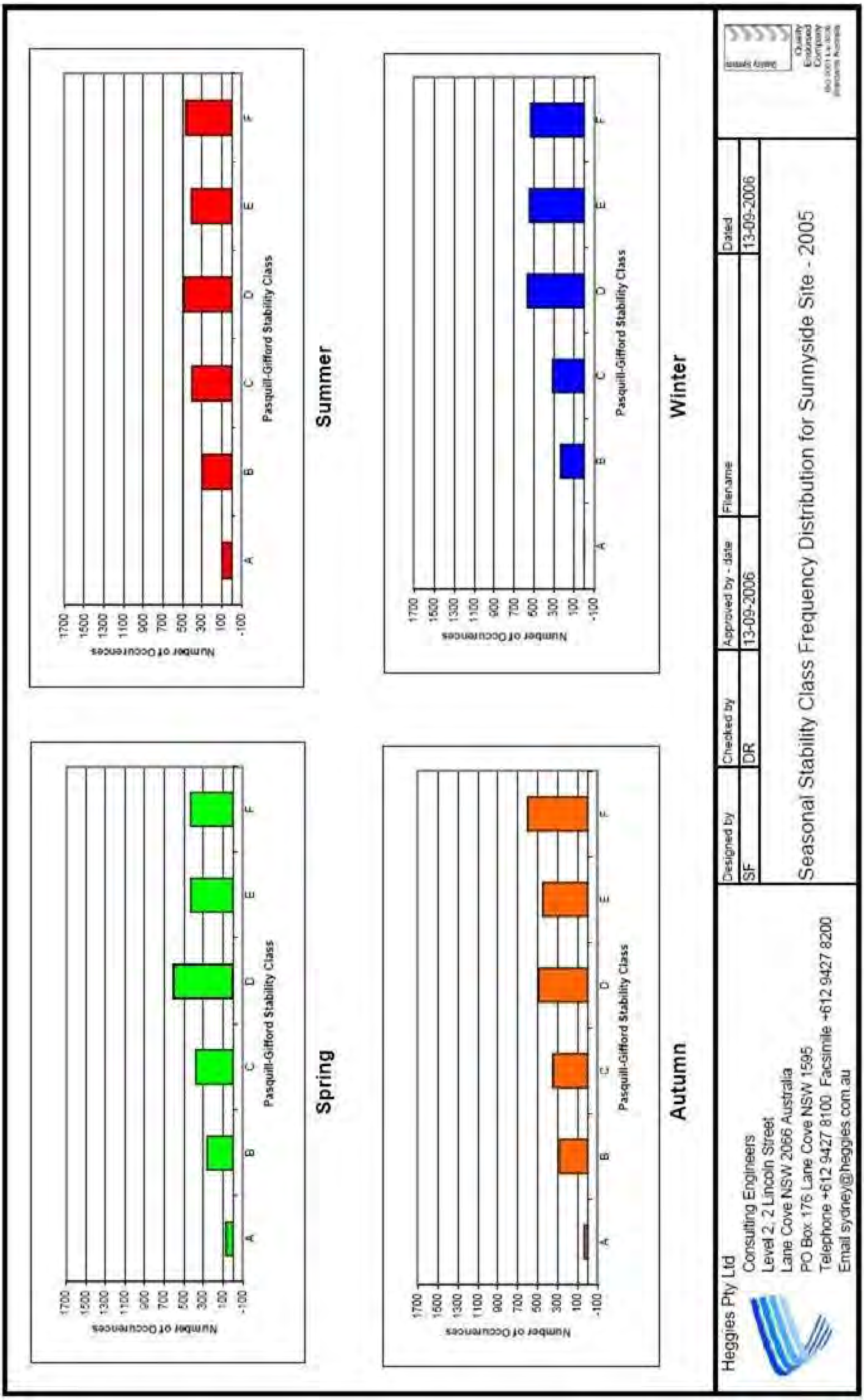
(No. of pages excluding this page = 1)


N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
0%
5%
10%
15%
20%
25%
Annual
(Calms = 4.6%)
Summer
(Calms = 3.0%)
Autumn
(Calms = 4.7%)
Winter
(Calms = 6.5%)
Spring
(Calms = 4 1%)
>0.5 - 1.5
>1.5 - 3
>3 - 5.5
>5.5 - 8
>8 - 10.5
>10.5

Appendix 5

Seasonal Stability Class Frequency Distribution

(No. of pages excluding this page = 1)


Summer
Spring
Winter
Autumn
Pasquill-Gifford Stability Class
Number of Occurrences
A
B
C
D
E
F
1700
1500
1300
1100
900
700
500
300
100
-100
Heggies Pty Ltd
Consulting Engineers
Level 2, 2 Lincoln Street
Lane Cove NSW 2066 Australia
PO Box 176 Lane Cove NSW 1595
Telephone +612 9427 8100 Facsimile +612 9427 8200
Email sydney@heggies.com.au
Designed by
SF
Checked by
DR
Approved by - date
13-09-2006
Filename
Dated
13-09-2006
Seasonal Stability Class Frequency Distribution for Sunnyside Site - 2005

Appendix 6

Emissions Inventory for Sunnyside Coal Project

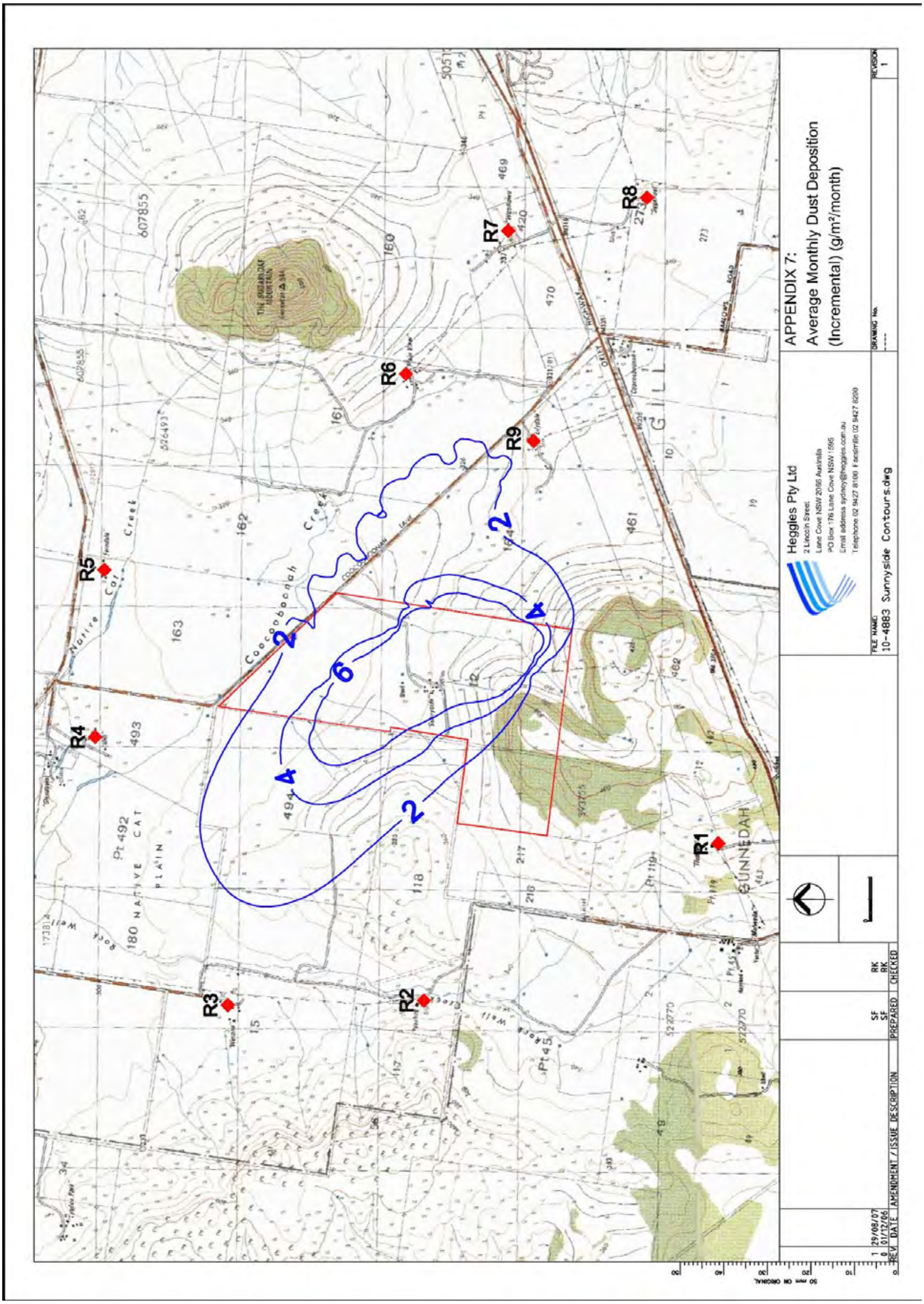
(No. of pages excluding this page = 1)

Sunnyside Coal Project	TSP Emission Factor	PM10 Emission Factor	Emission Factor Units	Throughput (tonnes per hour)	Average number of kilometres per hour	Working days available	Working hours per day	Dust Deposition Emission Rate (mg/s)	Dust Deposition Working Days (mg/s)	PM10 Emission Rate (mg/s)	PM10 Working Days (mg/s)
Blasting											
Blasting	66.255	34.453	kg/blast	N/A	N/A	260	1	6441.44	4588.42	6364.15	4533.36
Activities on resulting overburden											
Dozer on Overburden	16.735	4.074	kg/hr	N/A	N/A	260	15	1627.05	1158.99	752.59	536.09
Loading Haul Trucks (Overburden)	0.002	0.001	kg/t	1794.9	N/A	260	15	420.46	299.50	377.84	269.15
Out of Mine Dumping Area											
Dumping of Overburden	0.012	0.004	kg/t	1794.9	N/A	260	15	2991.45	2130.90	2143.87	1527.14
Scraper on Overburden	1.813	0.586	kg/hr	N/A	N/A	260	11	503.55	358.69	162.82	115.98
Mining Area											
Excavator on Coal	0.037	0.018	kg/t	349.7	N/A	260	4	1251.20	891.27	1142.93	814.14
Dozer on Coal	75.214	23.119	kg/hr	N/A	N/A	260	4	7312.47	5208.89	4270.60	3042.07
FEL on Coal	0.037	0.018	kg/t	240.0	N/A	260	4	858.83	611.77	784.50	558.83
Haulage											
Haul Trucks Wheel Dust (Volume Source 1-5)	5.487	1.481	kg/VKT	N/A	4.149	312	15	158.10	135.14	81.09	69.32
Product Truck Haulage (Volume Sources 1-11) Wind Break	2.411	0.651	kg/VKT	N/A	72.917	312	15	1109.83	948.68	299.61	256.10
Product Truck Haulage (Volume Sources 1-11)	2.411	0.651	kg/VKT	N/A	72.917	312	15	776.88	664.07	209.72	179.27
ROM Area											
Unloading Trucks	0.010	0.004	kg/t	349.7	N/A	260	15	339.94	242.15	271.27	193.23
FEL on coal	0.037	0.018	kg/t	240.0	N/A	260	15	858.83	611.77	784.50	558.83
Crushing	0.200	0.020	kg/t	240.0	N/A	312	15	4666.67	3989.04	886.67	757.92
Loading Product Trucks	0.004	0.002	kg/t	349.7	N/A	312	15	135.98	116.23	109.80	93.86
Wind Erosion	**TSP Emission Flux (mg/s/m2)**						**PM10 Emission Flux (mg/s/m2)**				
Wind Band	**5.14-8.3**		**8.3-10.8**		**>10.8**		**5.14-8.3**		**8.3-10.8**		**>10.8**
Open Pit	0.049		0.505		1.312		0.0375		0.3837		0.997
Overburden Stockpiles	0.0014		0.014		0.04		0.000565		0.00577		0.015
Overburden Dump	0.0989		0.505		1.31		0.0396		0.202		0.525
Noise Bund	0.0014		0.0144		0.037		0.000565		0.00577		0.015
Coal Stockpile	0.099		0.505		1.312		0.0396		0.2019		0.5248

Appendix 7

Dust Deposition Isopleths

(No. of pages excluding this page = 1)

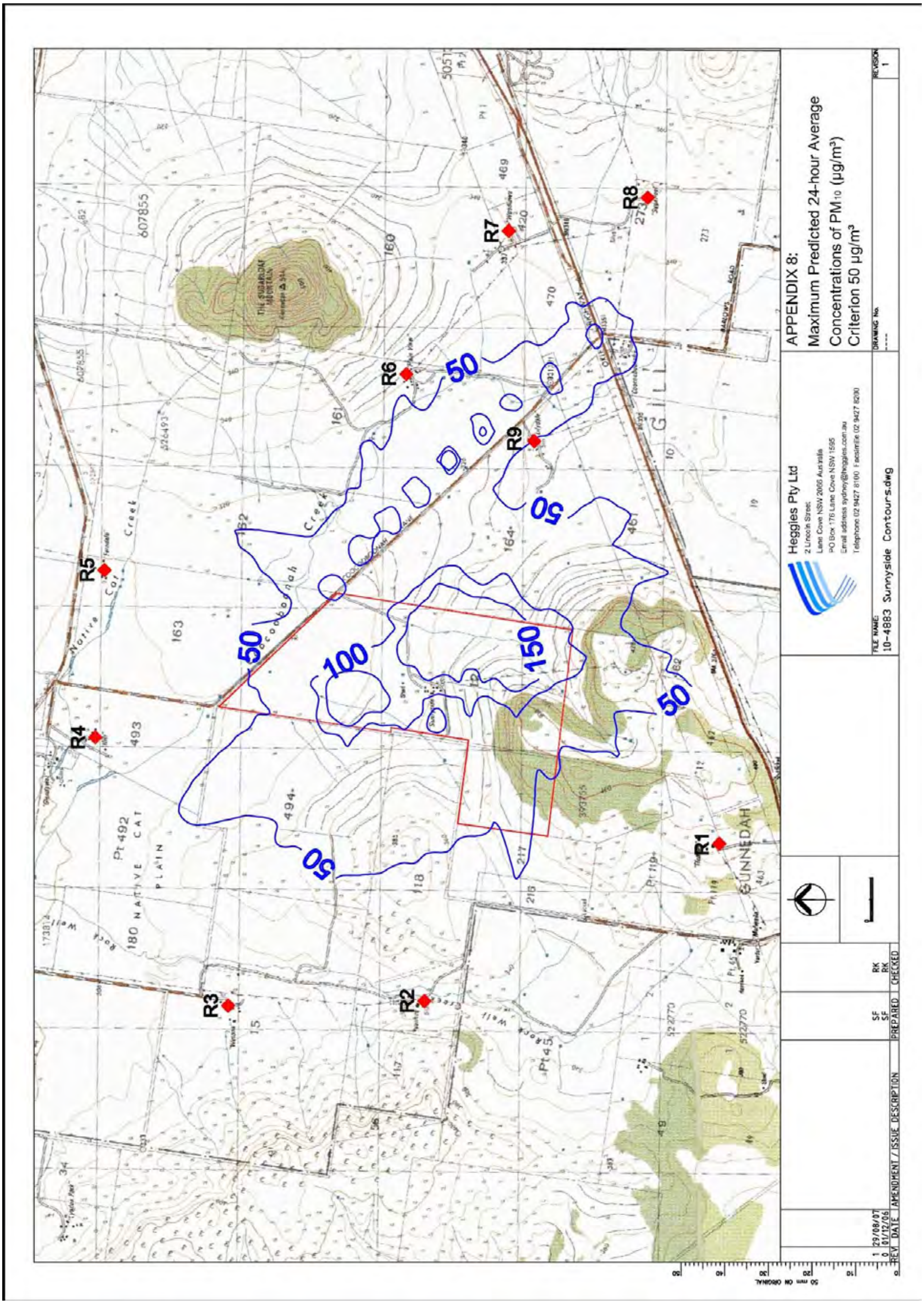


Note: A colour version of this figure is presented on the Project CD

Appendix 8

24-hour Average PM_{10} Concentration Isopleths

(No. of pages excluding this page = 1)

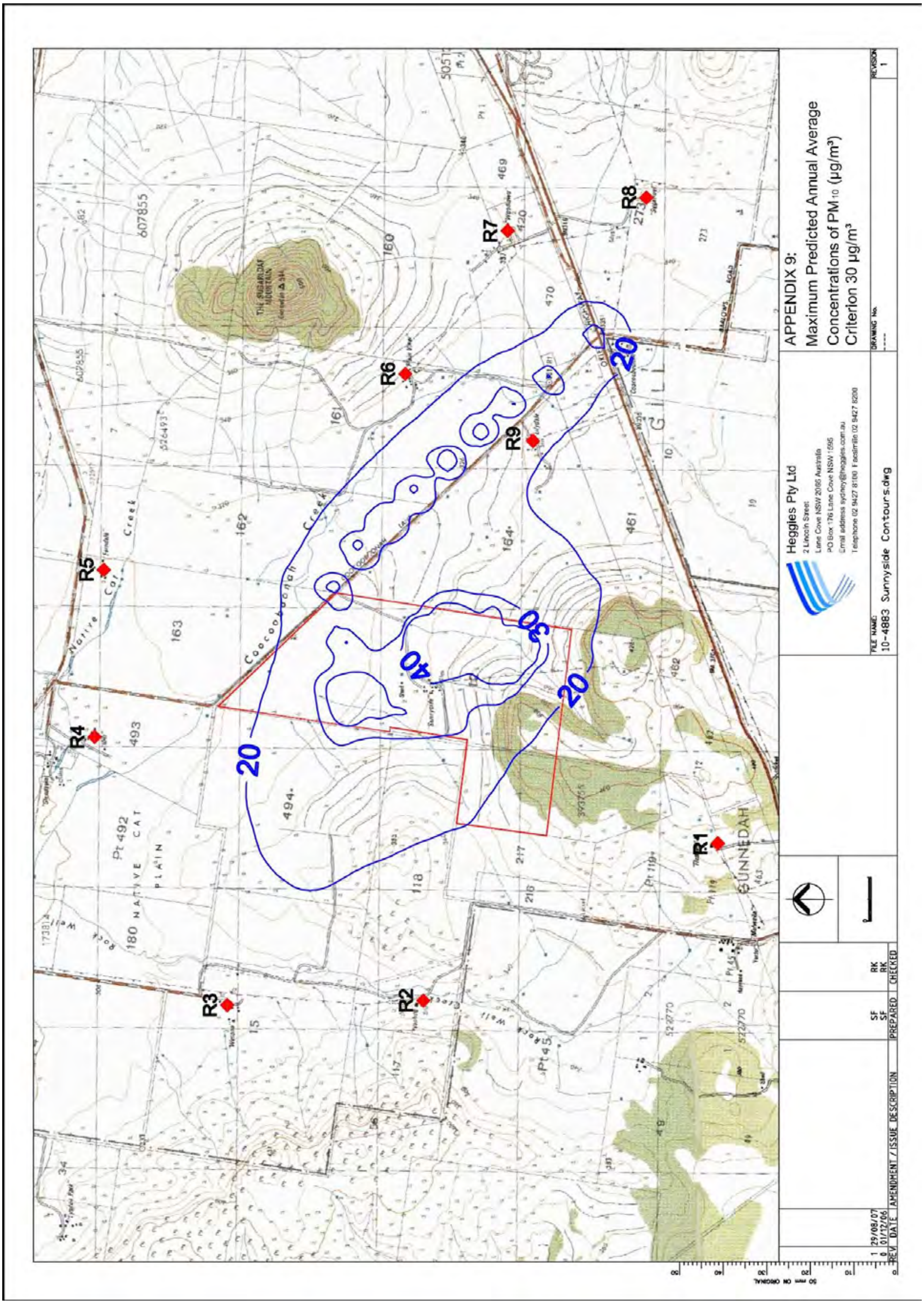


Note: A colour version of this figure is presented on the Project CD

Appendix 9

Annual Average PM_{10} Concentration Isopleths

(No. of pages excluding this page = 1)



Note: A colour version of this figure is presented on the Project CD

Appendix 10

Greenhouse Gas Assessment

(No. of pages excluding this page = 10)

1 The Greenhouse Gas Protocol Initiative

1.1 Introduction

The Greenhouse Gas Protocol Initiative (hereafter, "the GHG Protocol") is a multi-stakeholder partnership of businesses, non-governmental organizations (NGOs), governments, and others convened by the World Resources Institute (WRI), a U.S.-based environmental NGO, and the World Business Council for Sustainable Development (WBCSD), a Geneva-based coalition of 170 international companies. Launched in 1998, the Initiative's mission is to develop internationally accepted greenhouse gas (GHG) accounting and reporting standards for business and to promote their broad adoption. (WBCSD, 2005).

The GHG Protocol comprises two separate but linked standards:

- *GHG Protocol Corporate Accounting and Reporting Standard* (this document, which provides a step-by-step guide for companies to use in quantifying and reporting their greenhouse gas emissions).
- *GHG Protocol Project Quantification Standard* (forthcoming; a guide for quantifying reductions from greenhouse gas mitigation projects).

There are three scopes of emissions that are established for greenhouse gas accounting and reporting purposes, defined as follows.

1.2 Scope 1 Emissions – Direct GHG Emissions

The GHG Protocol defines Scope 1 emissions as those which result from activities under the company's control or from sources which they own. They are principally a result of the following activities.

- Generation of electricity, heat or steam. These emissions result from the combustion of fuels in stationary sources, e.g. boilers, furnaces or turbines.
- Physical or chemical processing. The majority of these emissions result from the manufacture or processing of chemicals and materials e.g. the manufacture of cement, aluminium, adipic acid and ammonia, or waste processing.
- Transportation of materials, products, waste, and employees. These emissions result from the combustion of fuels in company owned/controlled mobile combustion sources (e.g., trucks, trains, ships, airplanes, buses, and cars).
- Fugitive emissions. These emissions result from intentional or unintentional releases, e.g., equipment leaks from joints, seals, packing, and gaskets; carbon dioxide and methane emissions from coal mines and venting; hydrofluorocarbon (HFC) emissions during the use of refrigeration and air conditioning equipment; and methane leakages from gas transport.

1.3 Scope 2 Emissions – Electricity indirect GHG Emissions

Scope 2 emissions are those which relate to the generation of purchased electricity consumed in its owned or controlled equipment or operations. For many companies, purchased electricity represents one of the largest sources of GHG emissions and the most significant opportunity to reduce these emissions.

1.4 Scope 3 Emissions – Other indirect GHG Emissions

The GHG protocol states that Scope 3 reporting is optional and covers all other indirect GHG emissions. Scope 3 emissions are defined as those which do not result from the activities of a company although arise from sources not owned or controlled by the company. Examples of Scope 3 emissions include the extraction and production of purchased materials, transportation of purchased fuels and the use of sold products and services.

In the case of the coal mining industry, Scope 3 emissions may include the transportation of sold coal and the use of this coal, either at home or overseas.

The GHG protocol flags the issue that the reporting of Scope 3 emissions may result in the double counting of emissions. A second problem is that as their reporting is optional, comparisons between countries and / or projects may become difficult. The GHG protocol also states that compliance regimes are more likely to focus on the “point of release” of emissions (direct emissions) and / or indirect emissions from the use of electricity. However, for GHG risk management and voluntary reporting, double counting is less important.

2 AGO Workbook

The Australian Greenhouse Office (AGO) Workbook, published by The Department of Environment and Heritage (DEH) in December 2005 provides a single source of current greenhouse gas emission factors for Australian organisations to estimate their emissions and abatement. It should be noted that the emission factors in the December 2005 AGO Workbook have been harmonised with the international reporting framework of the World Resources Institute / World Business Council for Sustainable Development (The GHG Protocol).

2.1 Direct Emissions

Direct emissions are defined in the AGO Workbook as those which are produced from sources within the boundary of an organisation and as a direct result of that organisation’s activities and arise from the following activities:

- Generation of energy, heat steam and electricity, including carbon dioxide (CO_2) and the products of incomplete combustion (methane (CH_4) and nitrous oxide (N_2O)).
- Manufacturing processes, which produce emissions (for example, cement, aluminium and ammonia production).

- Transportation of materials, products, waste and people; for example, use of vehicles owned and operated by the reporting organisation.
- Fugitive emissions – intentional or unintentional GHG releases (such as methane emissions from coal mines, natural gas leaks from joints and seals), and
- On-site waste management, such as emissions from company owned and operated landfill sites.

The AGO gives several examples of direct emissions; a company with a vehicle fleet would report the GHG emissions from the combustion of petrol or diesel in these vehicles as direct emissions. A mining company would report methane escaping from a coal seam during mining (fugitive emissions) as direct emissions and a cement manufacturer would report carbon dioxide released during cement production as direct emissions.

2.2 Indirect Emissions

The AGO Workbook defines indirect emissions as those which are generated in the wider economy as a consequence of an organisation's activities (particularly from its demand for goods and services), but which are physically produced by the activities of another organisation. The most important category of indirect emissions is from the consumption of electricity. Other examples of indirect emissions from an organisation's activities include upstream emissions generated in the extraction and production of fossil fuels, downstream emissions from transport of an organisation's product to customers, and emissions from contracted / outsourced activities. The appropriate emissions factor for these activities depends on the parts of the upstream production and downstream use considered in calculating emissions associated with the activity.

For purposes of harmonisation, the AGO emission factors for indirect emissions have been subdivided into Scope 2 and Scope 3 emissions (adopted by the GHG Protocol).

Broadly, the AGO Workbook defines Scope 3 emissions as including the following.

- Disposal of waste generated (e.g. if the waste is transported outside the organisation and disposed of).
- Use of products manufactured and sold.
- Disposal (end of life) of products sold.
- Employee business travel (in vehicles or aircraft not owned or operated by the reporting organisation).
- Employees commuting to and from work.
- Extraction, production and transport of purchased fuels consumed.
- Extraction, production and transport of other purchased good and materials.
- Purchase of electricity that is sold to an end user (reported by electricity retailer).
- Generation of electricity that is consumed in a transport and distribution system (reported by end user).

- Out-sourced activities, and
- Transportation of products, materials and waste.

3 Draft Guidelines for Energy and Greenhouse in EIA

The Draft NSW EIA Guidelines were prepared in August 2002 by the NSW Sustainable Energy Development Authority (SEDA) and Planning NSW (now the Department of Planning (DOP)). The guidelines state that they are an advisory document and would principally be applied to projects which require an EIS under Part 4 and Part 5 of the Environmental Planning and Assessment Act 1979 (NSW) but can also be used for the assessment of other projects.

The Draft NSW EIA Guidelines define four scopes of emissions, the first three being adopted along the lines of the GHG Protocol with the fourth relating to emission abatement.

3.1 Scope 1: Direct Energy Use or GHG Emissions

Scope 1 considers energy use and GHG emissions that occur on site or are under a Proponent's direct and immediate control. Scope 1 emissions broadly consist of the energy use and GHG emissions produced by the following activities.

- Production of electricity, heat or steam.
- Combustion of fossil fuels for any other purpose.
- Physical or chemical processing on site.
- Transportation of materials, products, waste and employees by Proponent controlled vehicles.
- Fugitive emissions occurring on site.
- On site landfill wastes or wastewater treatment.
- Animal husbandry, and
- On site vegetation or soil disturbance.

3.2 Scope 2: Indirect Energy Use or GHG Emissions from Import and Exports of Electricity, Heat or Steam

Scope 2 broadly focuses on the indirect emissions associated with the generation of purchased and imported electricity, heat or steam.

3.3 Scope 3: Other Indirect Energy Use or GHG Emissions

Scope 3 considers the indirect energy use or GHG emissions that are a consequence of the Project but do not occur on site or those emissions which are removed from the Proponent's direct control. Examples of Scope 3 emissions as described in the Draft NSW EIA Guidelines include the following;

- Off site waste management (e.g. land filled waste or waste water treatment).
- Transportation of products, materials and waste by vehicles not controlled by the Proponent.
- Employee related business or commuter travel.
- Outsourced activities.
- Production of imported materials, plant and equipment. and
- Use of products or services produced by the Project (and end of life phases of products).

3.4 Scope 4: GHG Emission Abatement from Offset Opportunities

Scope 4 reporting under the Draft NSW EIA Guidelines allows the reporting of any carbon offsets which have occurred as a direct result of the Project. Proponents may report the following if applicable.

- Carbon sequestration performed by the Proponents.
- Community based energy use or emissions reduction initiatives.
- The use of government endorsed Kyoto Protocol flexibility mechanisms such as Clean Development Mechanism (CDM) and Joint Implementation (JI) (refer **Section 3.4.1** below).

3.4.1 Kyoto Protocol Flexibility Mechanisms

Although Australia has not currently ratified the Kyoto Protocol (KP) and is therefore not bound by its commitments, the GHG offset mechanisms contained within the KP can be used as instruments for carbon reduction and can be reported in Scope 4 of the Draft NSW EIA Guidelines. The following mechanisms are relevant for reporting under Scope 4.

- Clean Development Mechanism (CDM) – Developed countries can invest in greenhouse gas emission reduction projects in developing countries.
- Joint Implementation (JI) – Developed countries can invest in greenhouse gas reduction projects in other developed countries.

4 Policy Instruments

4.1 The NSW Greenhouse Plan

Published in November 2005, the NSW Greenhouse Plan is a strategic document which sets out the NSW Government's aims and initiatives in terms of greenhouse gas emissions abatement over the next 20 to 45 years. The NSW Government state that it would like to meet the following criteria:

- A 60% reduction in greenhouse gas emissions by 2050, and
- Cutting greenhouse gas emissions to year 2000 levels by 2025.

The NSW Greenhouse Plan does not set out a methodology for reporting greenhouse gas emissions, rather seeks to:

- Increase awareness among those expected to be most affected by the impacts of climate change,
- Begin to develop adaptation strategies to those unavoidable climate change impacts, and
- Put NSW on track to meeting the targets set out above.

5 GHG Reporting

Table 1 shows the GHG emissions attributable to the Project under the Scope 1, 2 and 3 emissions categories as described in **Sections 1, 2** and **3**. For comparative purposes, non-CO_2 greenhouse gases are awarded a "CO_2-equivalence" based on their contribution to the enhancement of the greenhouse effect. The CO_2-equivalence of a gas is calculated using an index called the Global Warming Potential (GWP). The GWPs for a variety of non-CO_2 greenhouse gases are contained within the Intergovernmental Panel on Climate Change (IPCC) document *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*.

The GWPs of relevance to this assessment are:

- **Methane (CH_4)**: GWP of 21 (21 times more effective as a greenhouse gas than CO_2); and
- **Nitrous Oxide (N_2O)**: GWP of 310 (310 times more effective as a greenhouse gas than CO_2).

The short-lived gases such as CO, NO_2, and NMVOCs vary spatially and it is consequently difficult to quantify their global radiative forcing impacts. For this reason, GWP values are generally not attributed to these gases nor have they been considered further as part of this assessment.

Table 1
Greenhouse Gas Emissions – Sunnyside Coal Project (Maximum Annual Potential – 1Mtpa Throughput)

ROM Production (tonnes)	**Saleable Coal (tonnes)[1]**	**Emissions Source**	**Usage**			**Total Use**	**Units**
			Scope 1	**Scope 2**	**Scope 3**		
1,000,000	1,000,000	Methane	3,028			3,028	tonnes
		Diesel	3,400		2,839	6,239	kL
		Explosives	1,430			1,430	tonnes
		Electricity		0	0	0	kWh
		Coal			1,000,000	1,000,000	tonnes

ROM Production (tonnes)	Saleable Coal (tonnes)[1]	Emissions Source	Emission Factors			Emissions (t CO_2-e)			Total (t CO_2-e)[2]
			Scope 1	Scope 2	Scope 3	Scope 1	Scope 2	Scope 3	63,593
1,000,000	1,000,000	Methane	21			63,593			10,032
		Diesel	2.7		0.3	9,180		852	239
		Explosives	0.1673			239			0
		Electricity		0.835	0.15		0	0	2,906,575
		Coal			97.7				
TOTAL								2,906,575	**2,980,439**

1) Based on 100% saleable coal 2) t CO2-e - tonnes of CO2 equivalent

The activities associated with the Project have been assessed for their GHG producing potential under the 3 Scope emission descriptions;

5.1 Scope 1: Direct Emissions

5.1.1 Fugitive emissions – Coal Bed Methane

The process of coal formation creates significant amounts of methane (CH_4). This CH_4 remains trapped in the coal until the pressure on the coal is reduced, which occurs during the coal mining process. The stored CH_4 is then released to the atmosphere.

The amount of CH_4 released during coal mining varies considerably as a function of factors such as the coal rank and depth, gas content, excavation methods and moisture levels (IPCC, 1996). As such, there are inherent uncertainties that must be considered when using estimates of CH_4 emission factors for coal excavation.

A proportion of the total CH_4 emitted from coal mining is generated by post-excavation activities such as coal processing and transportation. The processing of coal, including breaking, crushing and thermal drying, increases the surface area of the coal resulting in an increased rate of adsorption. CH_4 is desorbed during the transportation of coal as a result of direct exposure of the coal to air (IPCC, 1996).

The annual emissions of methane from this source have been estimated using Table 6 Section 4 of the AGO document *Factors and Methods Workbook, December 2005*.

5.1.2 Diesel Usage

Scope 1 GHG emissions attributable to diesel relate to the use of on site machinery (including on site transportation of coal product) and on site power generation.

The primary fuel source for the vehicles operating on site would be Automotive Diesel Oil (ADO). Data is available on the diesel consumption for all mobile and fixed equipment servicing the Project Site, including onsite electricity generation, and is estimated as 3.4ML/year.

The annual emissions of CO_2 and other greenhouse gases from this source have been estimated using the Australian Greenhouse Office (AGO) document *AGO Factors and Methods Workbook, December 2005*. It has been assumed that the energy content of ADO is 38.6 MJ/L (ABARE, 2004)

5.1.3 Explosives

The use of explosives in mining leads to the release of greenhouse gases. The activity level is the mass of explosive used (in tonnes). Emissions factors are available for the three main types of explosives (Ammonium Nitrate with Fuel Oil (ANFO), Heavy ANFO and Emulsion). The amount of explosives to be used on site is estimated to be 1,430t per annum.

An estimate of the CO_2 emissions resulting from blasting activities has been derived using information contained in Table 12 of the AGO document *Factors and Methods Workbook, December 2005*.

5.2 Scope 2: Electricity Indirect Emissions

5.2.1 Consumption of Purchased Electricity

The production of electricity by on site power generating equipment is covered in Scope 1 GHG emissions. There is not anticipated to be significant amounts of purchased electricity used at the Project Site, therefore no emissions from this component have been estimated or included in this assessment.

5.3 Scope 3: Other Indirect Emissions

5.3.1 Use of Products Manufactured and Sold

Indirect emissions of GHG from the combustion of product coal are expected “downstream” due to the extraction activities at the Project. A maximum of 1 Mt of coal is expected to be produced by this Project annually, with the majority destined for international markets.

The GHG emissions from combustion of product coal have been based on a coal energy content of 29.75 GJ/t (7105 kcal/kg). Standard emission factors for coal combustion (Black coal – NSW Electricity Generation) have been taken from Table 1 of the AGO document *Factors and Methods Workbook, December 2005*.

The emission factors from Table 1 of the AGO document *Factors and Methods Workbook, December 2005* are generally used for Scope 1 emissions where fuel is being combusted on site, although in this context, the greenhouse gas emissions for the full life cycle of the coal are being assessed and are being reported as Scope 3 emissions as the coal is being combusted elsewhere. A full fuel life cycle for coal is possible with the addition of the Scope 3 emissions which relate to the extraction, production and transport of the fuel in question.

5.3.2 Employees Commuting to and from Work

Fuel usage and consequent GHG emissions attributable to company employees commuting to and from work can be reported under Scope 3 GHG emissions. Fuel consumption rates by vehicle type are given in Table 4 and fuel combustion emission factors are given in Table 3 of the AGO document *Factors and Methods Workbook, December 2005*. Assumptions regarding the fuel types and distances travelled by each employee are made where specific information is not available.

Employee vehicles are assumed to be in the category of Passenger Cars and use Automotive Diesel Oil (ADO). Distance travelled to and from work per employee is calculated based on the radius of the distance from the Project Site to the closest habitation(s) of significance.

Information supplied by the Proponent indicates that a maximum of 24 full-time and 7 part-time staff members would be employed at the Project Site. The closest habitation of significance to the Project is Gunnedah, approximately 15km by road. Assuming a worst case scenario of diesel usage in all employee vehicles, an annual diesel consumption attributable to employee travel to work is estimated to be 55 kL.

5.3.3 Extraction, Production and Transport of Purchased Fuels Consumed

See **Section 5.3.1**

5.3.4 Extraction, Production and Transport of other Purchased Materials or Goods

GHG emissions relating to the extraction, production and transport of other purchased materials or goods such as raw materials in the production of concrete, for example would be reported here. In addition, if any other fuels are consumed on site, such as natural gas, the emissions would be reported both in Scope 1 emissions (direct emissions) and under this heading in Scope 3 relating to the extraction, production and transport of the fuel. In terms of the Project, no significant items relate to this category.

5.3.5 Generation of Electricity Consumed in a T & D System

See **Section 5.2.1**.

5.3.6 Transportation of Products, Materials and Waste

Transportation of product coal from the site of extraction to the site of combustion would generally involve transport via road, rail and / or boat. Transport of coal from the Project Site to its international distribution point at Port Newcastle is expected to occur as a two-step procedure, with initial haulage via truck to the Whitehaven Coal Handling and Processing Plant at Gunnedah before being shipped via train to Newcastle. Based on fuel information provided by the Proponent, total diesel fuel consumption for this coal transportation is estimated to be in the order of 2.8ML per annum.

6 References

- ABARE (Australian Bureau of Agricultural and Resource Economics) (2004) *Energy Abbreviations and Definitions.*
- Commonwealth of Australia (2005), *AGO Factors and Methods Workbook, December 2005*.
- IPCC (1996), *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*
- NSW Government (2005), *NSW Greenhouse Plan*
- Sustainable Energy Development Authority and Planning NSW (2002), *Draft NSW Energy and Greenhouse Guidelines for Environmental Impact Assessment*.
- World Business Council for Sustainable Development and World Resources Institute (2005), *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standar*d

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Appendix 11

Environmental Assessment Requirements Relating to Air Quality

(No. of pages excluding this page = 1)

Coverage of Environmental Assessment Requirements Relating to Air Quality

ENVIRONMENTAL REQUIREMENTS RAISED BY THE DIRECTOR-GENERAL	
	Relevant Section(s)
• Air Quality: Greenhouse Gases – including assessment of greenhouse gas emissions generated by on-site activities and the transport of coal to Port Newcastle	6.5, Appendix 10
Refer to: • *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW.*	3, 4, 5
Environmental Issues Raised by Government Agencies Relating to Air Quality	
	Relevant Section(s)
Department of Environment and Conservation	
• The goal is to maintain existing rural air quality and protect sensitive receptors, both on and off site, from adverse impacts of dust and odour. • Dust (PM2.5, PM10 and TSP) is the primary concern with potential emissions from construction activity, clearing and open cut mining operations, heavy equipment movement, crushing equipment and conveyors, transfer points, loading facilities and from coal, topsoils and overburden stockpiles. • The air quality impacts from the proposed development would need to be assessed using the methodology detailed in the DEC document *"Approved Methods and for the Modelling and Assessment of Air Pollutants in New South Wales".* In particular all assumptions used in modelling impacts would need to be clearly identified and justified. In particular, if the modelling and proposed management incorporates dust suppression using water then the volume requirements and source of the water must be identified, particularly for early stages of construction and operations where mining void water and stored water from storm runoff may not be available.	5, 6