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1. Introduction

Mining & Energy Technical Services Pty Ltd ('MET Serve'), on behalf of AMCI (Alpha) Pty Ltd ('AMCI'), engaged Noise Mapping Australia ('NMA') to prepare an air quality assessment for the proposed South Galilee Coal Project (SGCP), west of Alpha.

The objective of this assessment is to provide AMCI with information to assist with obtaining the necessary approvals for the proposed SGCP.

This report addresses the following issues:

- description of existing air quality environment;
- description of air emissions from proposed mining operations;
- description of air emissions from proposed railway operations;
- assessment of air quality to appropriate standards; and
- recommendations for relevant impact mitigation and management measures.

1.1 Project Description

The SGCP is a proposed open-cut and underground coal mine located approximately 12 kilometres (km) west of Alpha and 170 km west of Emerald in Central Queensland.

The SGCP will be located within Mining Lease Application (MLA) 70453, in the Barcaldine Regional Council Local Government Area.

The proposed run-of-mine (ROM) extraction rate for surface and underground mining is expected to ramp up to approximately 19 Mtpa by 2026 to enable an estimated coal production rate of up to 17 Mtpa by 2041. The open cut component will involve clearing of vegetation, salvage of topsoil, stripping of overburden, extraction of coal, replacement of overburden, placement of topsoil or growth media and revegetation. Open cut coal mining will be performed using trucks and shovels as well as using draglines. Mined areas will be progressively rehabilitated.

1.1 Locality Description

The SGCP is situated west of Alpha in a well established grazing region.

The region is relatively flat comprising open grazing land and native scrublands. Part of the Alpha township is situated on the floodplain of Alpha Creek and in December 2010, Alpha and the surrounding districts were subjected to heavy rainfall and flooding. In the months that followed, this resulted in extensive grassy coverage of the farmlands and low ambient dust levels. Many of the roads surrounding the SGCP are unsealed.

Although there are no existing coal mines near the SGCP, there several mines proposed to the north of the SGCP (e.g. Galilee Coal Project, Alpha Coal Project, Kevin's Corner Project and the Carmichael Coal Mine and Rail). These mines are currently in the process of obtaining the necessary approvals to permit operation. As part of the development of these mines, a railway line will need to be constructed to link the Galilee Basin to the coal export facilities on the coast. A number of rail lines have been proposed by other mining proponents, the closest of which is located approximately 40 km north of the SGCP. All of these rail line proponents have indicated that third party access will be available. The SGCP proposal includes a railway spur to link to one of the proposed common user rail lines.

The sensitive locations in the vicinity of the SGCP comprise the homesteads of the cattle properties of the region, the Alpha township and the accommodation village within MLA 70453. The closest sensitive locations are shown on Figure 1. The locations and separation distances are contained in Table 1.

Table 1: Sensitive Receptors Adjacent to MLA 70453 and Infrastructure Corridor

Sensitive Receptor	***Separation Distance [km] From Sensitive Receptor to***		
	MLA 70453	Surface Works	Railway Corridor
Alpha Township	7	14	8
Betanga Station Homestead	2	12	18
Bonanza Station Homestead	2	10	9
Chesalon Station Homestead	1	6	15
Corntop Station Homestead	3	12	18
Creek Farm Station Homestead	1	8	8
Eureka Station Homestead	12	14	11
Oakleigh Station Homestead	6	8	2
Saltbush Station Homestead	17	19	2
Villafield Station Homestead	1	9	6
Proposed Accommodation Village	Within MLA 70453	3	2

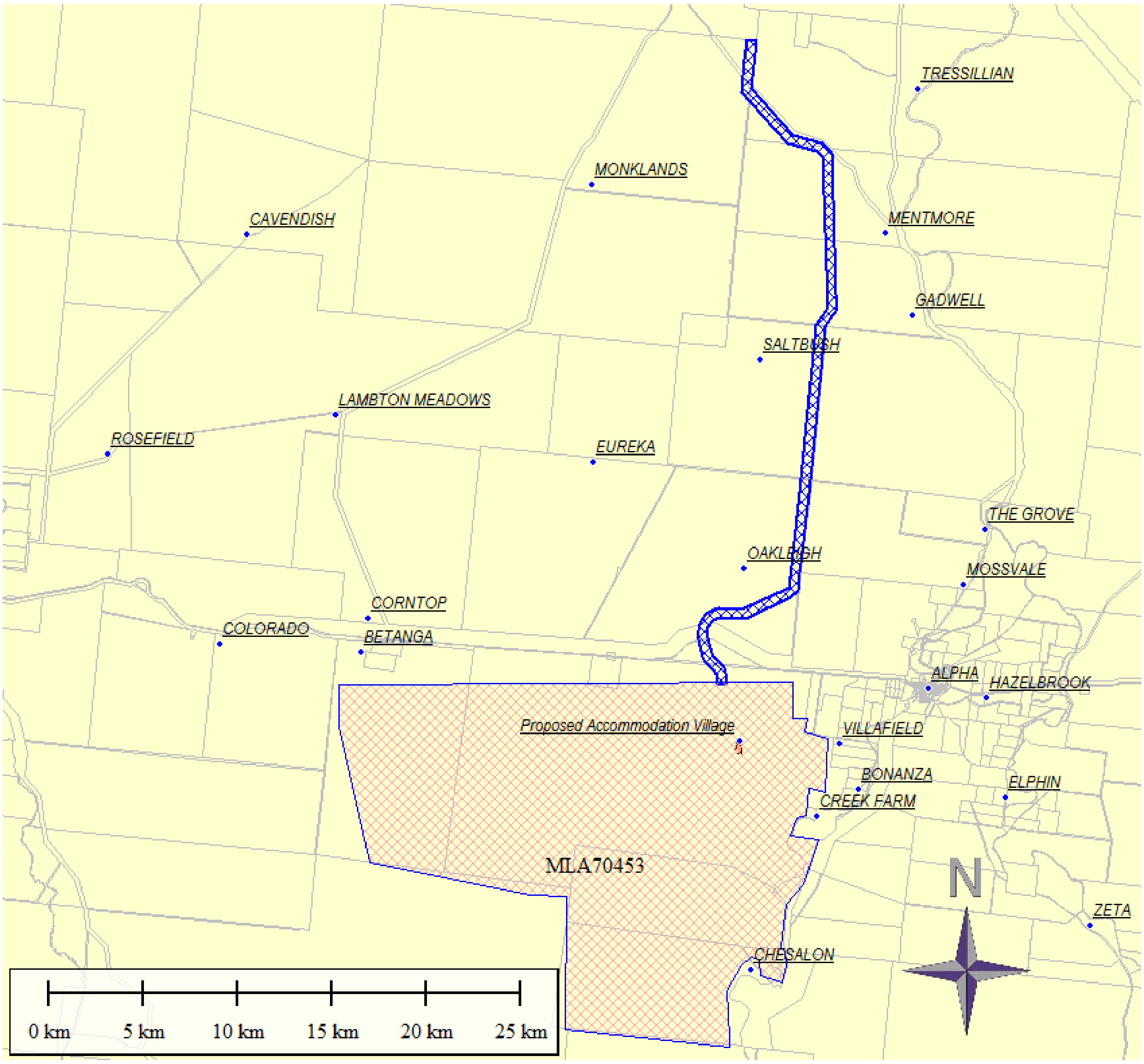


Figure 1: Regional View Showing MLA 70453, the Infrastructure Corridor, Proposed Accommodation Village, Alpha and Homesteads

1.2 Identification of Issues to be Addressed

The activities proposed to be undertaken at the SGCP comprise extraction, handling, processing and placement of soil, overburden, interburden and coal. These processes will result in the release of particulate matter into the atmosphere. There is a potential for the ground level concentration of particulates and deposition of particulate matter to exceed environmental air quality limits which is, as a result, the primary focus of this report.

The assessment of particulates needs to identify four main issues:

1. the existing exposure level in the environment without the mine;
2. the likely emissions from the proposed operation incorporating controls provided by rainfall and water application;
3. the meteorology for the site to determine the off-site transport and dilution effects of the atmosphere; and
4. calculated cumulative atmospheric dust concentration at nearest sensitive receptors, including the effects from other nearby proposed mines.

It is necessary to identify key stages in the project and model using a suitable atmospheric dispersion model, in this case CSIRO's The Air Pollution Model (TAPM). Impacts are assessed by taking into account the combined effect of existing and predicted exposures. The modelling adopted for this project involves a sophisticated approach to identify the emissions for each hour over a two year period using meteorological data to refine the emission rates. The meteorological data was also obtained from TAPM. By following this approach, a realistic estimate of dust emissions has been made incorporating the usual industry standard control methods adopted by mining operations.

The combustion of diesel in mining machines will result in gaseous emissions of CO, NOx and SO_2. Blasting also results in gaseous emissions. In practice, the sources of gaseous emissions are widely dispersed and have low levels of emission and a very localised impact. Thus the likelihood of exceeding environmental air quality limits beyond the lease boundary is minimal. As a consequence it is not proposed to address the gaseous emissions.

However, the use of diesel fuels, along with release of methane from coal and other matters makes the project a source of greenhouse gases. This report addresses the emissions of greenhouse gases using the Australian Greenhouse Office Factors and Methods Workbook (AGO, 2008).

2. Description of Existing Environment

2.1 Climate

The SGCP is situated between Emerald and Barcaldine. Both of these locations maintain a Bureau of Meteorology weather monitoring station. Refer to Appendix 1 for a summary of the main statistics collected at these sites. Barcaldine (Latitude 23.55, Longitude 145.29) is a manual station with the weather records recorded twice daily. Figure 2 is an extract of the collected climate data for Barcaldine. The closest Bureau of Meteorology continuous recording automatic weather station (AWS) is at Emerald (Latitude 23.57, Longitude 148.18).

Alpha is situated in central western Queensland, an inland tropical area. The region has a warm climate with two distinct seasons, a dry winter season and a wet summer season. Dry season temperatures average from 9°C to 30°C, while wet season temperatures range from around 18°C to 35°C. The region averages approximately 500 mm of rainfall each year, falling mostly between November and March.

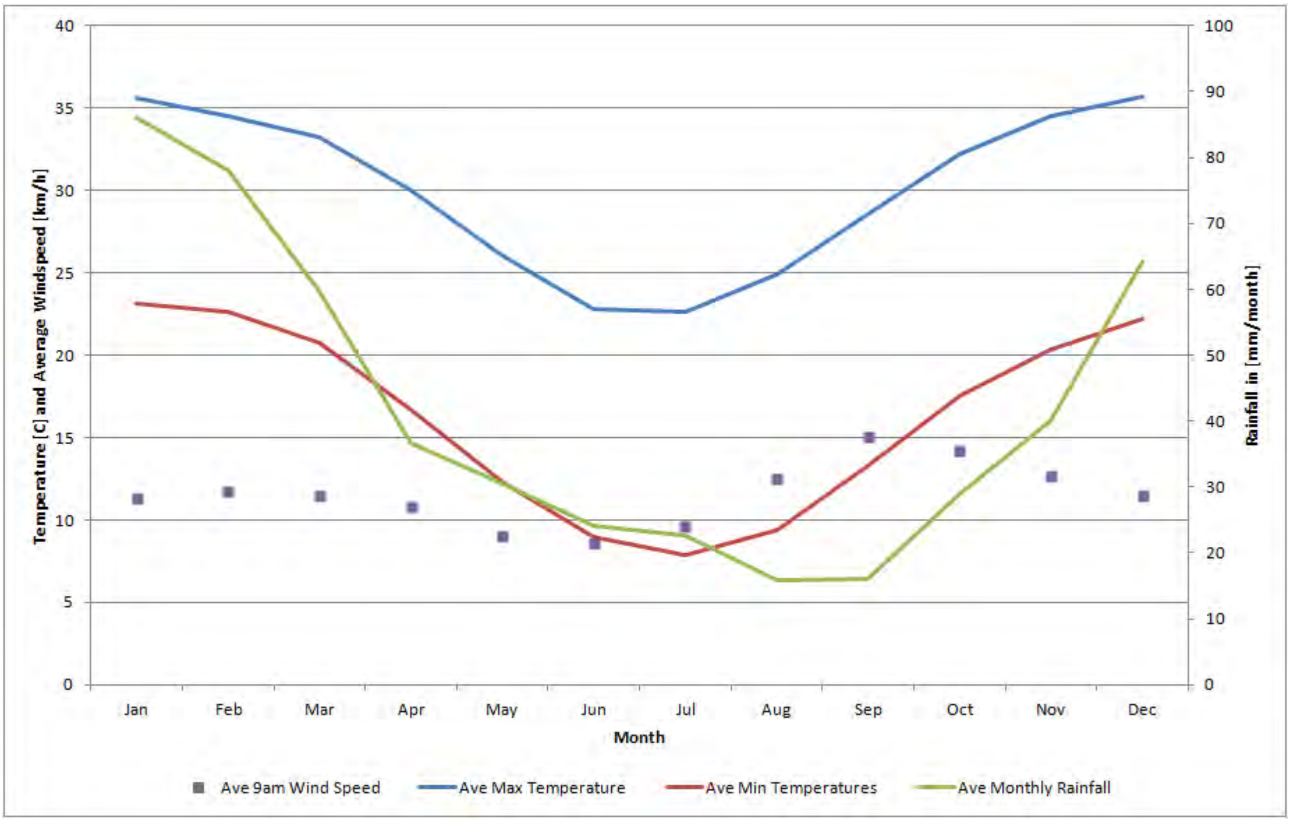


Figure 2: Typical Climate Data for Barcaldine

During the wet summer season the soil moisture content increases and there is increased grass ground cover. This results in lower dust emissions from most activities, including from local roads and grazing lands. During the dry winter season the soil moisture content reduces (particularly at and close to the surface) and grass cover reduces. Dust emissions from all (non-mining) activities are more prevalent from most activities during this period. This is also the period when grass fires (including permitted fires) are likely to occur. These types of fire release significant quantities of smoke into the lower atmosphere.

There is a dominant easterly component to the winds at Emerald. Thus any particulate or gaseous emissions from the SGCP are mostly likely to travel away from Alpha to the west, towards isolated rural residences.

2.2 Dust

Potential sources of particulate emissions from the surrounding environment primarily comprise:

- farming and grazing activities;
- existing commercial operations;
- unsealed roads; and
- smoke from grass/bush fires (permitted or otherwise).

A survey of the existing dust levels was undertaken at three locations, one in Alpha (east of the SGCP), one to the east of the SGCP (Creek Farm Homestead) and one to the north (Oakleigh Station Homestead). Since easterly winds dominate, it was considered appropriate that dust measurements be obtained upwind and downwind of the proposed development (mining and transport infrastructure). The equipment at each monitoring location comprised two TSI Dusttrak Aerosol monitors, one configured to record PM10 concentrations and the other PM2.5 and both set to fifteen minute intervals. To convert between fifteen minute averaging time and 24 hours averaging it was necessary to arithmetically average the 96 fifteen minute measurements making up the twenty four hours. The equipment was located near homesteads in the house compounds at least 4 m from buildings.

Existing atmospheric dust concentrations were measured at a dwelling in Alpha over a period of one week from 20 July 2011 to 26 July 2011. The dust sampler recorded PM10 and PM2.5 in fifteen minute intervals and the 24 hour averages were calculated from the samples. The site is situated in Byron Street, an elevated residential district of Alpha (not flood prone). The charts of the diurnal distribution of PM 10 and PM2.5 are shown in Figure 3 and Figure 4 respectively.

There appears to be a daily cycle in the monitored dust concentration levels. The minimum dust levels occur between 2:00 and 06:00 hours and seem to vary between 0 μg/m^3 and 4 μg/m^3 for PM2.5 and between 9 μg/m^3 and 15 μg/m^3 for PM10. The dust levels are generally higher during the day with both a morning and evening peak. The daily maximums occur at about 18:00 as well as a large number of short-term peaks with dust concentration much higher than the typical range. This is most likely due to dust sources (or dust generating activities) in the vicinity of the monitor (e.g. vehicular traffic, lawn mowing etc.).

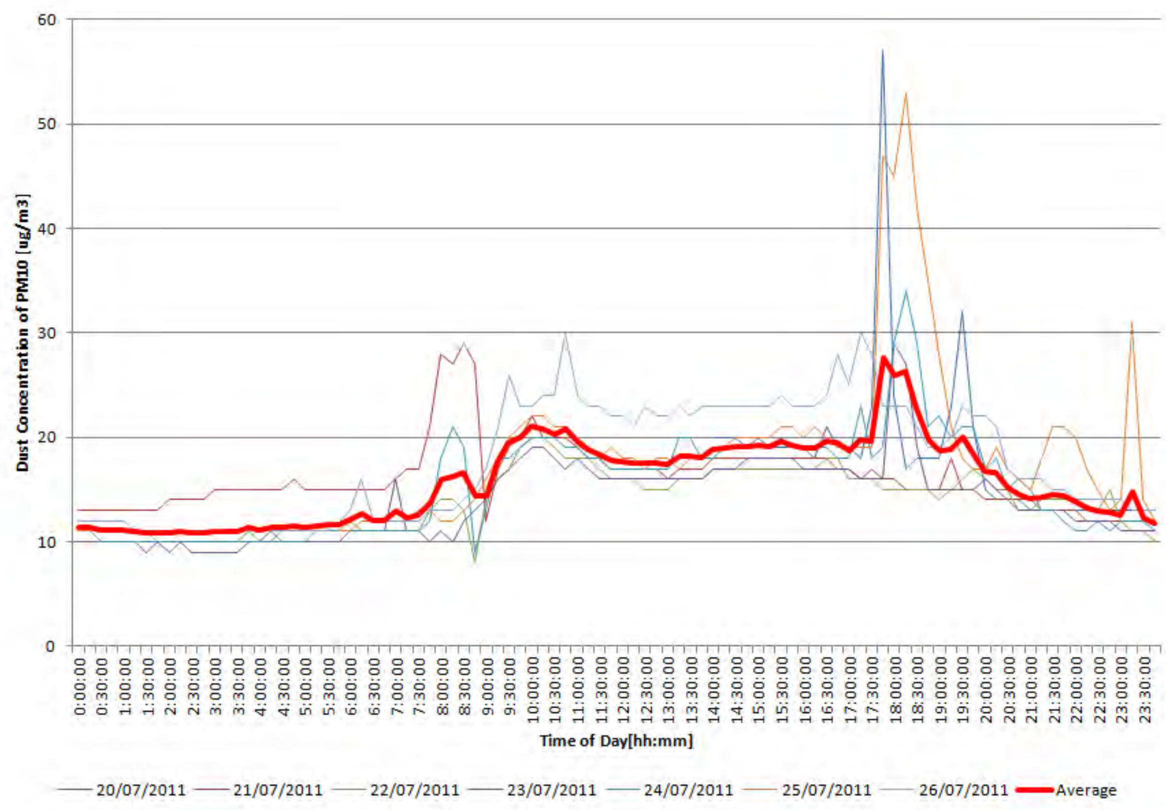


Figure 3: Measured PM10 Dust Concentration For Alpha - Diurnal Distribution

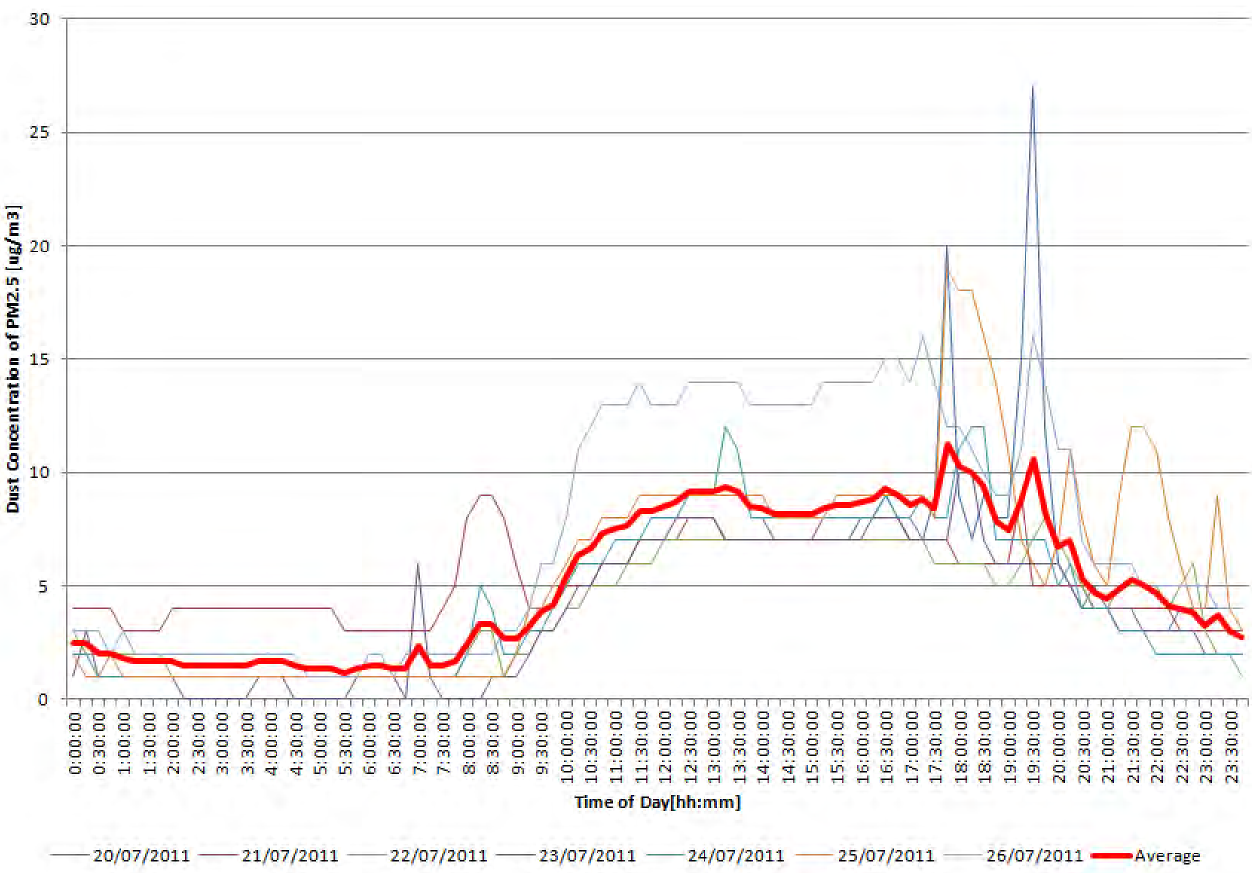


Figure 4: Measured PM2.5 Dust Concentration For Alpha - Diurnal Distribution

Existing atmospheric dust concentrations were measured at Creek Farm over a period of one week from 20 July 2011 to 27 July 2011. The dust sampler recorded the PM10 and PM2.5 in fifteen minute intervals and the 24 hour averages were calculated from the samples. The charts of the diurnal distribution of PM10 and PM2.5 are shown in Figure 5 and Figure 6 respectively.

As with the dust monitoring carried out in Alpha, there is a daily cycle in the monitored dust concentration levels. The minimum dust levels appear to occur between midnight and 06:00 hours and vary between 1 µg/m^3 and 4 µg/m^3 for PM2.5 and between 9 µg/m^3 and 20 µg/m^3 for PM10 .

The dust levels are generally higher during the day with an evening peak. At or close to 18:00 a large number of short-term peaks occur having dust concentration levels much higher than this typical range. This is most likely due to dust sources or dust making activities in the vicinity of the monitor (e.g. cars/machinery on the unsealed roads, lawn mowing etc.).

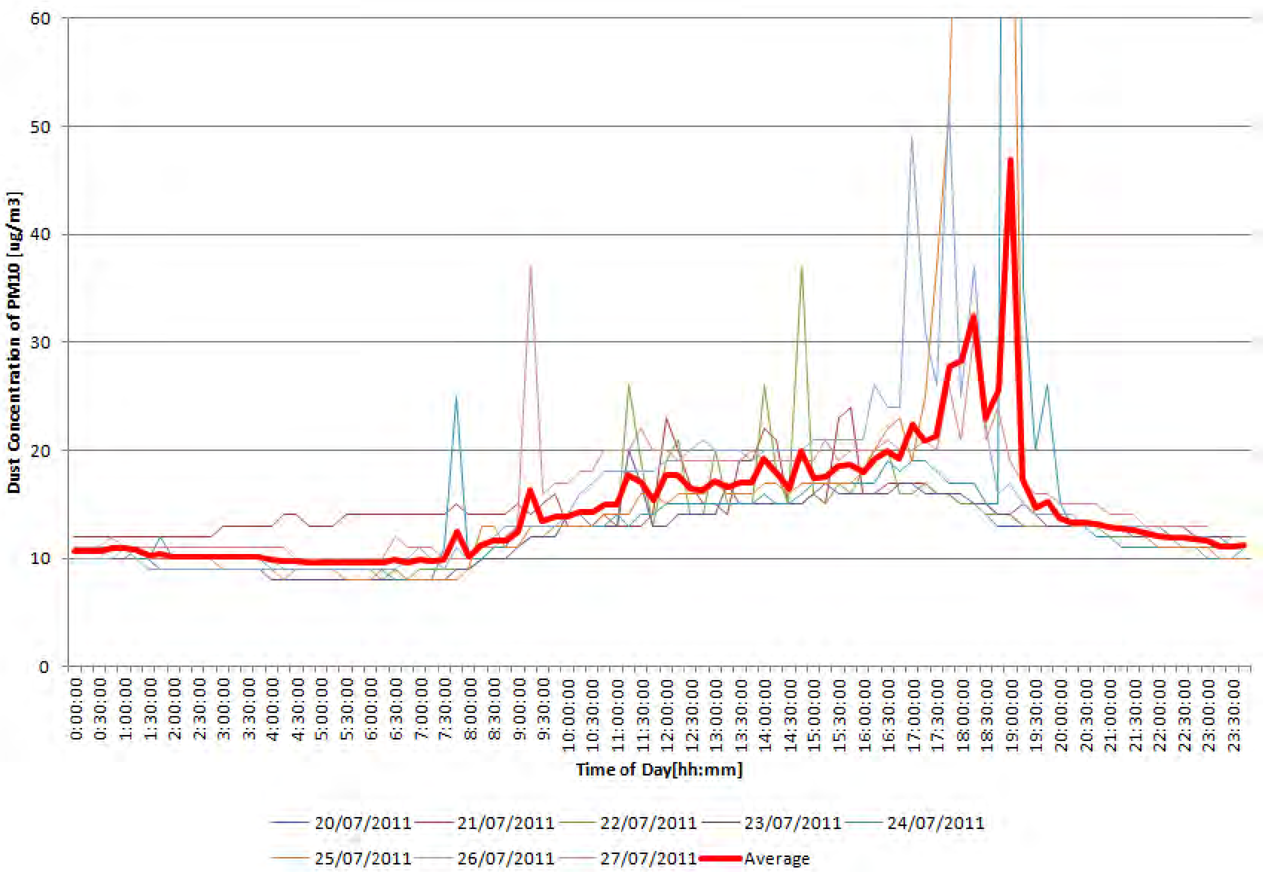


Figure 5: Measured PM10 Dust Concentration For Creek Farm Station Homestead - Diurnal Distribution

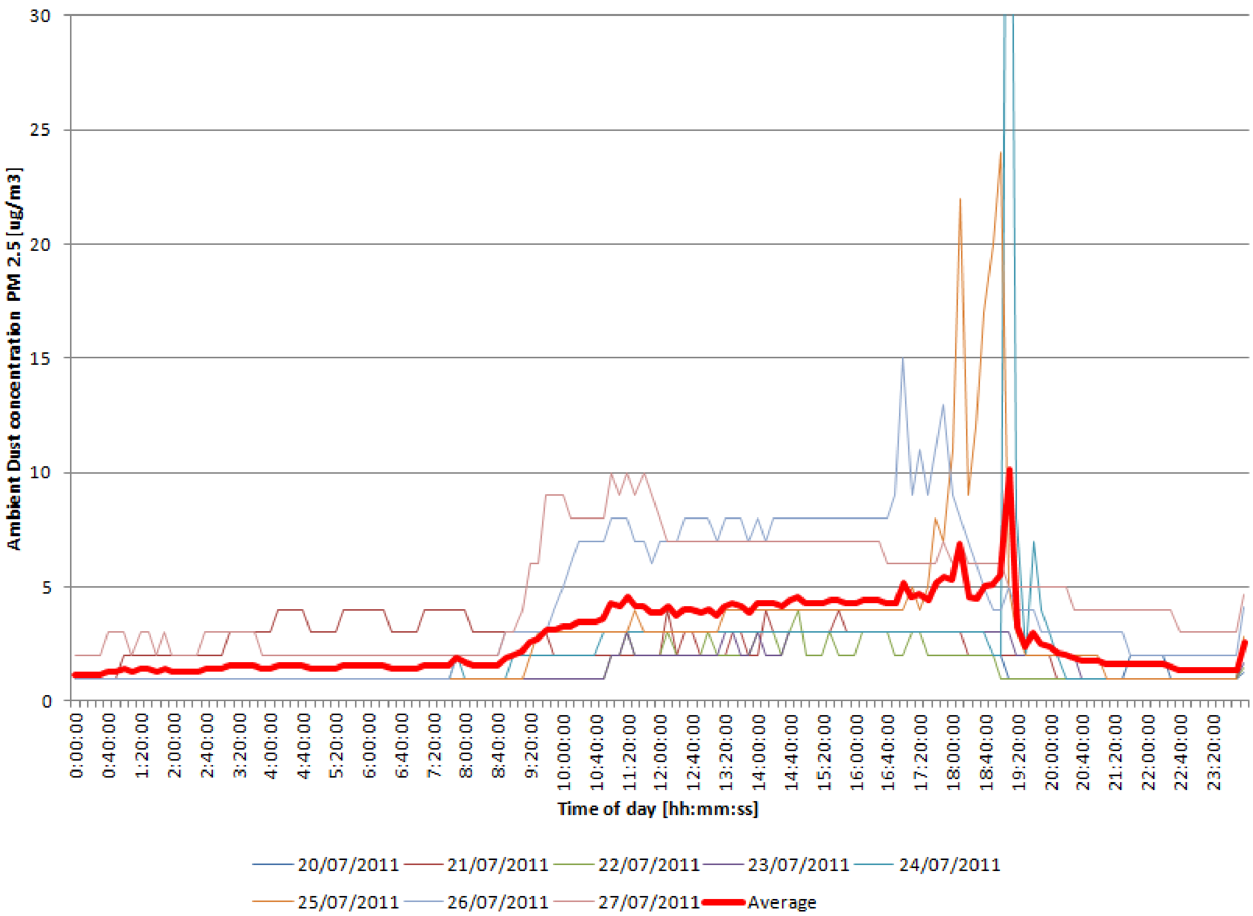


Figure 6: Measured PM2.5 Dust Concentration For Creek Farm Homestead - Diurnal Distribution

Existing atmospheric dust concentrations were measured near Oakleigh Station homestead over a period of one week from 21 July 2011 to 28 July 2011. The dust sampler recorded the PM10 and PM2.5 in fifteen minute intervals and the 24 hour averages were calculated from the samples. The site is situated close to the dwelling which was not occupied during the monitoring period. Recently the area surrounding the homestead had a controlled burn of the undergrowth and the area was still recovering from the fire. The charts of the diurnal distribution of PM10 and PM2.5 are shown in Figure 7 and Figure 8 respectively.

As with the dust monitoring carried out elsewhere, there is a daily cycle in the monitored dust concentration levels. The minimum dust levels appear to occur between 2:00 and 06:00 hours and vary between 1 µg/m^3 and 3 µg/m^3 for PM2.5 and between 2 µg/m^3 and 10 µg/m^3 for PM10. The dust levels are generally higher during the day with an evening peak. The PM2.5 daily maximum typically occurs about 14:00 and are about 10 µg/m^3 higher than the minimums. The PM10 daily maximum typically occurs about 18:00 and are also about 10 µg/m^3 higher than the minimums. The monitoring at this site produced unusual results. The dust levels during the day appear to mostly comprise PM2.5 particulates. These atypical results are likely to be due to the recent fires.

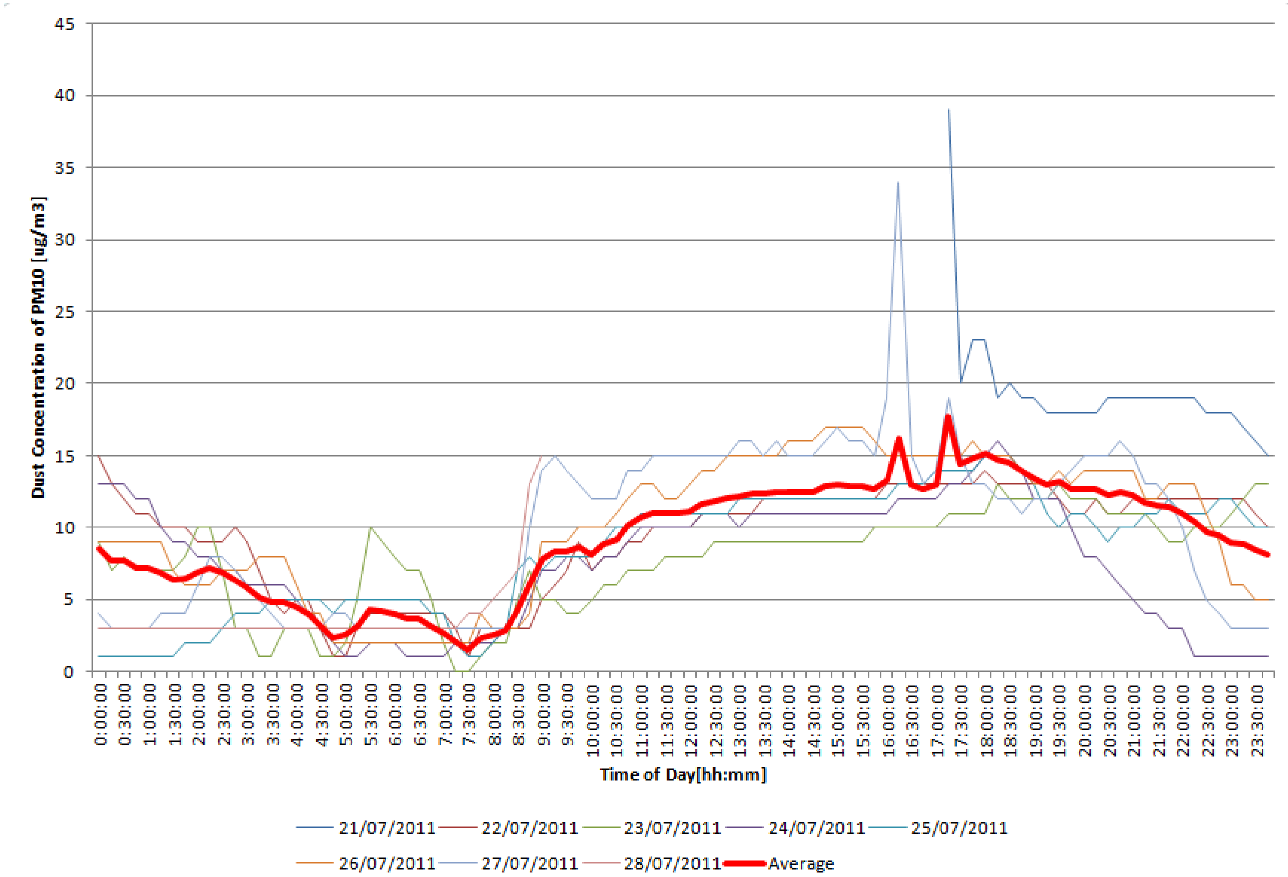


Figure 7: Measured PM10 Dust Concentration For Oakleigh Station Homestead - Diurnal Distribution

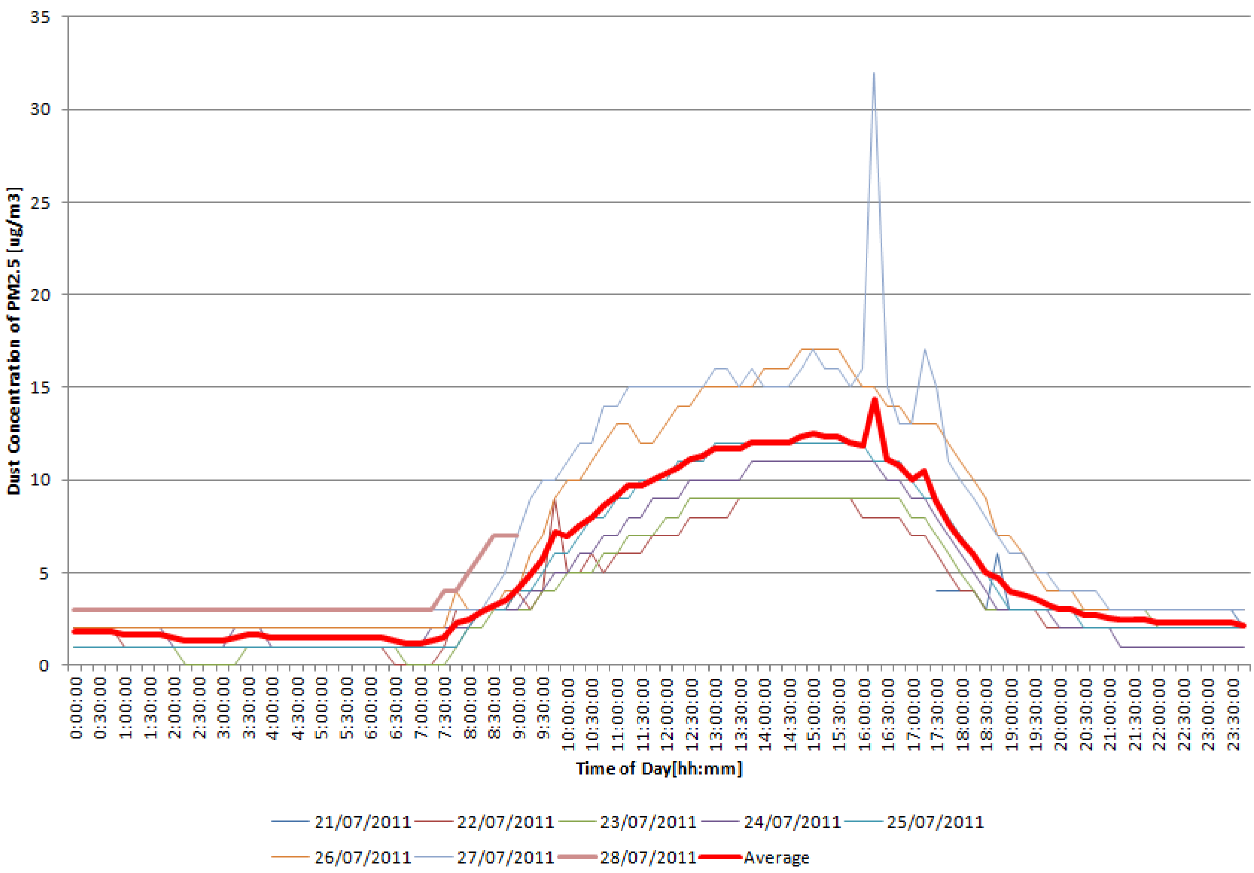


Figure 8: Measured PM2.5 Dust Concentration For Oakleigh Station Homestead - Diurnal Distribution

Experience with long-term dust monitoring in the central Queensland region has revealed only minor seasonal fluctuations in dust levels. In this instance the monitoring was carried out several months after the 2011 floods during the dry season. Therefore the dust levels are considered to be representative of the typical dust exposure for this area.

The measured PM10(24 hour) and PM2.5(24 hour) for each day and location is contained in Table 2 along with the median measurement. The highest median value is taken to be representative of the existing background annual average dust levels, whilst the maximum dust level is taken to be representative of the existing 24 hour background dust level.

Table 2: Summary of the Ambient Atmospheric Dust Concentrations (PM10 and PM2.5) for Alpha, Creek Farm Homestead and Oakleigh Homestead

Date	**Ambient Dust Concentrations - 24 Hour Average**					
	Alpha		**Creek Farm Homestead**		**Oakleigh Homestead**	
	PM2.5 (ug/m^3)	**PM10 (ug/m^3)**	**PM2.5 (ug/m^3)**	**PM10 (ug/m^3)**	**PM2.5 (ug/m^3)**	**PM10 (ug/m^3)**
20 July 2011	7 (Note 1)	18 (Note 1)	1 (Note 1)	13 (Note 1)	-	-
21 July 2011	5	16	2	14	3 (Note 1)	19 (Note 1)
22 July 2011	4	14	1	13	4	9
23 July 2011	4	14	2	12	4	8
24 July 2011	5	15	2	15	4	8
25 July 2011	6	17	3	17	5	8
26 July 2011	7	18	4	15	7	10
27 July 2011	-	-	5 (Note 1)	16 (Note 1)	8	10
28 July 2011	-	-	-	-	4 (Note 1)	4 (Note 1)
Median	5	15	2	14	4	8
Maximum	7	18	4	17	8	10

Note 1: Averaging period less than 24 hours

SGCP has commenced dust deposition sampling at representative sensitive locations surrounding the proposed mine, including:

- Alpha;
- Betanga Station Homestead;
- Chesalon Station Homestead;
- Creek Farm Station Homestead;
- Oakleigh Station Homestead;
- Saltbush Station Homestead; and
- Villafield Station Homestead.

The sampling results for September, October and November 2011 are contained in Table 3. The results for four of the locations during the September period show an unusually high amount of soluble matter, most likely birds soiling the sample. Hence, the total insoluble solids is taken to be representative of dust fallout for all locations during September 2011.

The highest monthly dust recording was at Oakleigh Station for the month of October. In this instance there was a high proportion of soluble matter and combustible matter suggesting an organic origin of the dust fallout. The ash component of the dust fallout has remained the most reliable indicator of dust fallout. Ash is almost certainly only due to crustal matter since there is very little commercial or industrial activity in the region mostly centred on Alpha. Ignoring the unusually high reading for Oakleigh Station, the highest dust deposition (based on insoluble solids) is 45 mg/m^2/day.

Table 3: Dust Deposition Sampling Results for September and October 2011

Location	Date	Total Solids [mg/m^2/day]	Insoluble Solids [mg/m^2/day]	Ash [mg/m^2/day]	Soluble Matter [mg/m^2/day]	Combustible Matter [mg/m^2/day]
Alpha [House]	Sept 2011	121	28	22	93	6
	Oct 2011	56	42	30	14	12
	Nov 2011	83	45	5	38	40
Oakleigh Station	Sept 2011	118	21	18	97	3
	Oct 2011	165	90	31	75	59
	Nov 2011	62	16	8	46	8
Saltbush Station	Sept 2011	108	28	21	80	7
	Oct 2011	50	38	30	12	8
Villafield Station	Sept 2011	69	19	14	50	5
	Oct 2011	38	26	15	12	11
	Nov 2011	61	23	14	38	9
Creek Farm Homestead	Sept 2011	21	13	11	8	2
	Oct 2011	43	37	30	6	7
Betanga Station	Oct 2011	49	29	21	20	8
	Non 2011	48	29	18	19	11
Chesalon Station	Oct 2011	58	41	30	14	12
	Nov 2011	65	27	16	38	11

Note: Dust deposition not recorded at Betanga and Chesalon Stations in September 2011 or at Creek Farm and Saltbush Stations in November due to sampling problems.

Two DRX dust samplers have been installed near the proposed mine. One has been located at Creek Farm and the other in Alpha. The DRX samplers records the PM01, PM2.5, PM04, PM10 and PM(total) every 10 minutes. This data is uploaded to a web server at regular (hourly) intervals. The equipment was installed on 3 Dec 2011 and has been in continuous operation since installation.

Refer to Figure 9 for a chart of the PM10 (24 hour) and PM2.5 (24 hour) running average atmospheric dust concentration levels for Alpha and Figure 10 for Creek Farm station homestead. The figures also contain the daily rainfall for the period recorded at Barcaldine Post office.

Typically rainfall during December is the result of thunderstorm cells. As a consequence, the rainfall is patchy and not regional. Although there was rainfall at Barcaldine it does not follow that rainfall occurred in Alpha. There was only one significant rainfall event in December. The rainfall during late January is widespread including Alpha.

The atmospheric dust concentration results for both Alpha and Creek Farm station homestead are highly correlated. The dust exposure levels, apart from the occasional local peak, are the result of a regional dust exposure.

It should also be noted that almost all the PM10 dust is comprised of the PM2.5 fraction. It was observed (though not plotted) that almost all the 'dust' comprises sub PM01 particulates. It is very unusual to have dusts made up of these ultra-fine particulates. Thus the source of the observed 'dust' is most likely due to smoke from fires or from wind-generated dusts from exposed areas a large distance from Alpha.

It is therefore concluded that the period December to mid January is not representative of typical dust exposures in and around Alpha and therefore is not appropriate to use as a basis for developing an acceptable background level. The period after mid-January is subjected to heavy rainfall and also not representative of typical dust exposures.

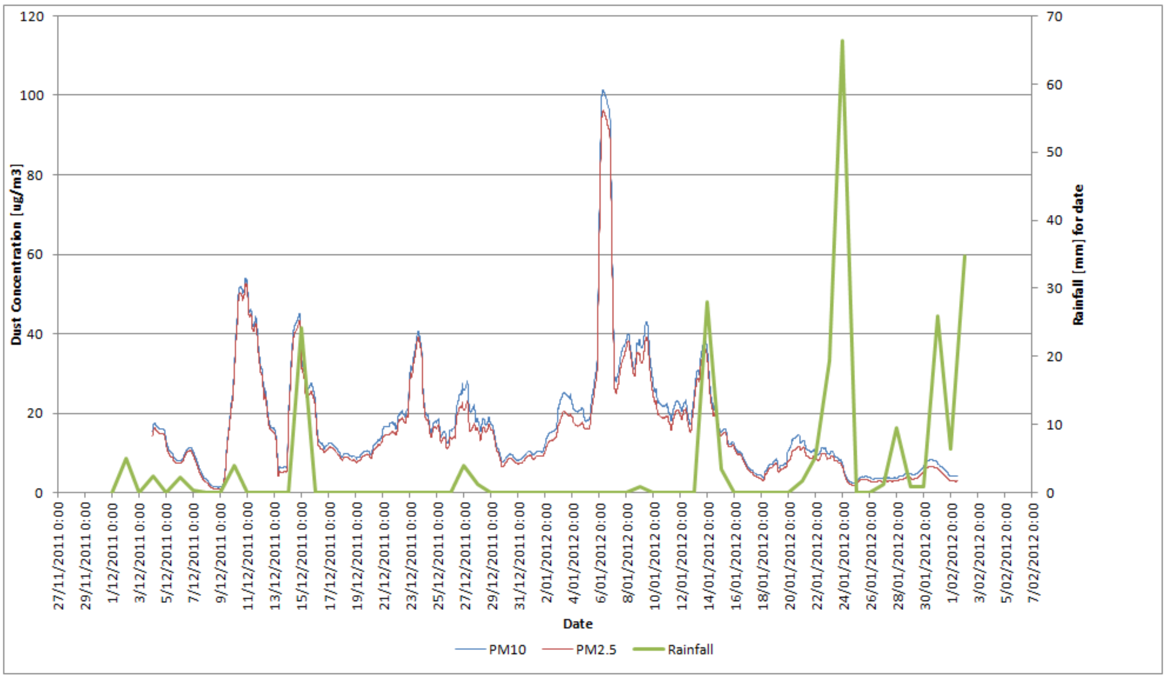


Figure 9: Permanent Dust Monitoring Station Alpha PM10 (24 hour) and PM2.5 (24 hour) running average [µg/m^3]

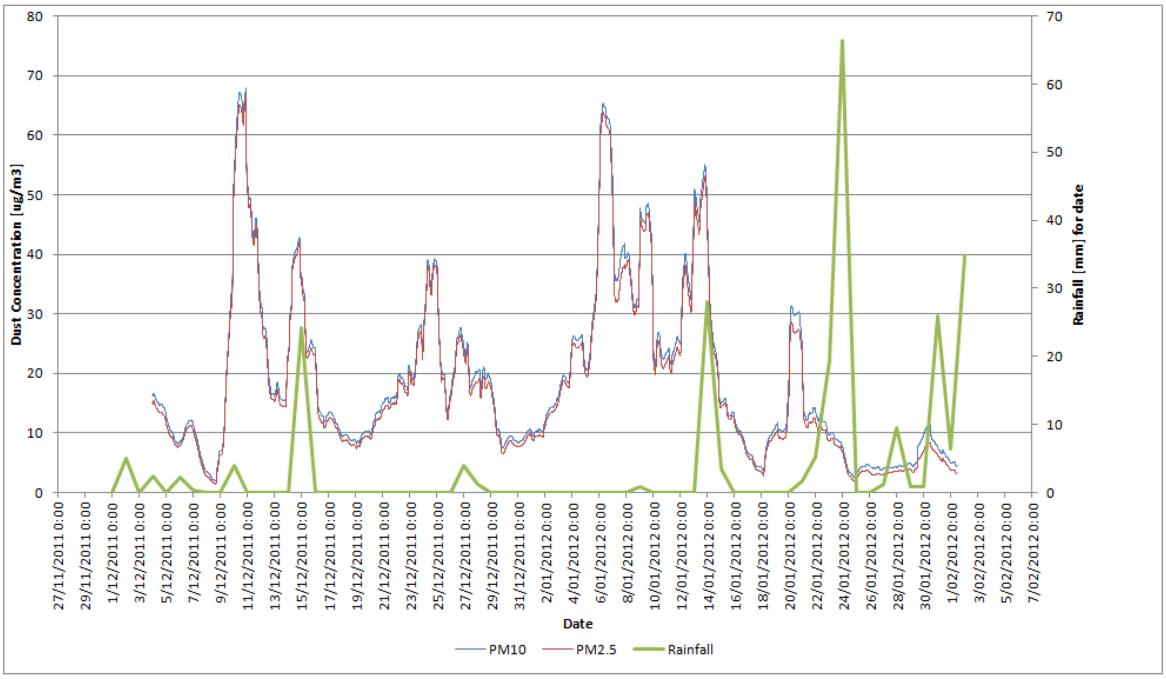


Figure 10: Permanent Dust Monitoring Station Alpha PM10 (24 hour) and PM2.5 (24 hour) running average [µg/m^3]

3. Air Quality Criteria

3.1 Environmental Protection (Air) Policy

The Queensland Environmental Protection (Air) Policy 2008 (EPP(Air) 2008) commenced on 1 January 2009. The EPP (Air) 2008 (Part 2 Section 5) aims to achieve the object of the *Environmental Protection Act 1994* (the Act) in relation to Queensland's air environment. The object of the Act is ".. to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development)."

Specifically the EPP (Air) 2008 addresses the environmental values to be enhanced or protected namely—

(a) the qualities of the air environment that are conducive to protecting the health and biodiversity of ecosystems; and

(b) the qualities of the air environment that are conducive to human health and wellbeing; and

(c) the qualities of the air environment that are conducive to protecting the aesthetics of the environment, including the appearance of buildings, structures and other property; and

(d) the qualities of the air environment that are conducive to protecting agricultural use of the environment.

In order to meet the environmental values, Schedule 1 of the EPP (Air) nominates relevant air quality indicators and goals. Relevant air quality indicators from Schedule 1 are those dealing with particulates, as follows:

a) Total suspended particulate 90 µg/m^3 averaged over a year.

b) PM2.5 8 µg/m^3 averaged over one year.

c) PM2.5 25 µg/m^3 averaged over 24 hours.

d) PM10 50 µg/m^3 averaged over 24 hours, and no greater than 5 occurrences per year.

All these indicators are qualities of the air environment that are conducive to human health and wellbeing. The indicators apply at any sensitive or commercial place, such as residences, parks, gardens, schools, shopping precincts, etc.

3.2 EPA License and Permits – Guideline 8

Although the EPP(Air) 2008 is the primary reference for air quality criteria in Queensland, it does not address dust deposition. Dust deposition monitoring is the most common method to measure the level of dustiness in areas surrounding developments and is used as an indicator to undertake more detailed investigations. The sampling is conducted in accordance with Australian Standard AS3580.10.1: *Methods for Sampling and Analysis of Ambient Air – Method 10.1: Determination of Particulate Matter – Deposited Matter - Gravimetric Method*. Furthermore, mine licenses issued by DERM historically include a dust deposition limit.

The relevant guideline for the assessment of air quality in relation to the SGCP is the DERM's (formerly EPA), "Preparing an Environmental Management Overview Strategy (EMOS) for Non-standard Mining Projects". This guideline requires that the release of dust or particulate matter or both resulting from the mining activity must not cause an environmental nuisance at any sensitive or commercial place. According to the guideline, the maximum permissible measured dust levels relevant to the proposed SGCP comprise:

(a) Dust deposition of 120 milligrams per square metre per day ($mg/m^2/day$), averaged over one month; and

(b) PM10 150 $\mu g/m^3$ averaged over 24 hours, at a sensitive or commercial place downwind of the operational land.

The PM10 criterion has been superseded by the more recent and more stringent EPP(Air) 2008 levels for PM10 (Section 3.1).

3.3 National Environmental Protection Measure Air

The National Environmental Protection Measure (Air) 1998 was developed by the National Environment Protection Council. The desired environmental outcome of the measure is to provide ambient air quality that allows for the adequate protection of human health and well-being, refer to Table 4. This goal is the same as that contained in the EPP(Air).

Table 4: NEPM Standards and Goal for PM_{10}

Pollutant	Averaging Period	Maximum Concentration	Goal Maximum Allowable Exceedences
Particles as PM10	1 day	50 µg/m3	5 days a year

3.4 Site Specific Air Quality Criteria

Dusts are often described as respirable and inhalable. Respirable dusts are those small enough to penetrate the nose and enter into the lung. Respirable dusts that penetrate past the nose and upper respiratory system are likely to be retained in the body. This involves dusts having an aerodynamic diameter of up to 10 µm. Inhalable dusts are dusts which enter the body but are collected in the nose and upper respiratory system and rejected. Inhalable dusts are those having an aerodynamic diameter of nominally 10 µm and larger.

As a general guide, dusts having diameters of 7 to 10 µm are mostly large enough to be caught by nose and throat. Particles in the range 0.5 to 7 are small enough to reach the lung yet large enough to be retained. Since these dusts remain in the lung they may be hazardous to health and wellbeing.

In summary the applicable air quality criteria (from NEPM, EPP Air and EPA Guideline 8) are:

- dust concentration of PM2.5 25 $\mu g/m^3$ averaged over 24 hours;
- dust concentration of PM2.5 8 $\mu g/m^3$ averaged over a year;
- dust concentration of PM10 of 50 $\mu g/m^3$ over a 24 hour averaging time and no more 5 occurrences per annum;

- total suspended particulate 90 μg/m^3 averaged over a year; and
- dust deposition of 120 mg/m^2/day.

All these indicators (except deposition) are qualities of the air environment that are important to protect human health and wellbeing. The deposition goal (or dust fallout) is for assessing dust nuisance. The indicators apply at any sensitive or commercial place, such as residences, parks, gardens, schools, shopping precincts, etc.

4. Air Quality Modelling

4.1 Modelling Methodology

Typically, particulate matter is characterised by its size. The particulate size ranges specified in ambient air criteria are total suspended particulate (TSP), particulate matter below 10 microns (PM10) and particulate matter below 2.5 microns (PM2.5). By definition, TSP includes both the PM10 and PM2.5 fractions, and PM10 includes the PM2.5 fraction.

Under normal conditions, dust particles with aerodynamic diameters of more than PM10 will typically fall out and be deposited onto the ground within several minutes of release.

The PM10 and PM2.5 dusts do not have a significant settling velocity and will behave in a gaseous fashion, that is, the fall out time is significantly longer than a few minutes. The settling velocity for PM10 dust is nominally 5 mm/s while for PM2.5 it is 0.5 mm/s. This may be compared with PM20 where the settling velocity is approximately 20 mm/s (Baumeister, 1982).

The air quality modelling methodology comprised three phases namely:

(a) preparation of meteorological data;

(b) development of an emissions database using US-EPA AP-42 (2003) 5th Update 2003 and the Australian National Pollution Inventory (NPI) “Emission Estimation Technique Manual for Mining Version 2.3”; and

(c) modelling of the likely downwind ground level concentrations using The Air Pollution Model (TAPM).

The averaging period for ground level concentrations of pollutants are consistent with the relevant averaging periods for air quality indicators and goals in the EPP (Air) 2008 and the National Environmental Protection Measure (NEPM) Air. The ToR indicates that the modelling of PM10 must be conducted for 1-hour, 24-hours and annual averaging periods. However, the 1-hour averaging time has not been provided since there is no appropriate criterion for PM10 1-hour.

4.1.1 Preparation of Meteorological Data

TAPM predicts meteorology and pollutant concentration for a range of pollutants important for air pollution applications. The model consists of coupled prognostic meteorological and air pollution concentration components, eliminating the need to have site-specific meteorological observations. Instead, the model predicts the flows important to local-scale air pollution, such as sea breezes and terrain induced flows, against a background of larger-scale meteorology provided by synoptic analyses.

Some limitations of TAPM include:

- it is not suitable for horizontal domain sizes above approximately 1,000 km by 1,000 km;
- it cannot be used to accurately represent deep atmospheric circulations or extreme weather events (cyclones);
- it cannot be used for very steep terrain because of the use of a terrain following coordinate system in the model. Thus the model cannot represent discontinuities in terrain height (for example, cliffs or bluffs); and

- it assumes that cloud processes are resolved by the typical inner grid spacings used in the model (i.e. 3km or less). Therefore no large-scale cloud convection parameterisation is included.

These limitations are of minor significance to the modelling of pollution for this study. The area of interest is much smaller than the maximum horizontal domain size. Extreme weather events (such as cyclones) are not of interest from an air pollution perspective. The terrain within the region does not have significant cliffs or bluff bodies and it is expected that the inclusion of large-scale cloud convection would only slightly change the radiation and moisture balances.

TAPM is highly regarded in the scientific community as a suitable tool to develop meteorological data sets for sites without site-specific meteorological observations. However, the meteorological dataset can be improved by incorporating local meteorology. In this instance the dataset from Emerald AWS was used to nudge the results. Nudging is the process by which the meteorology model is improved by the addition of local data.

The TAPM meteorological file developed for the site covered the two year period 2004 and 2005. This period was used for modelling since Queensland was generally free from extreme weather events such as cyclones.

The general features of winds affecting plume dispersion are illustrated in the wind rose table for the year 2004 and 2005, refer to Table 5 and Appendix 3. Table 4 summarises the wind statistics at a 10 m height on site, as calculated by the TAPM meteorological model. Table 4 shows the frequency of occurrence of winds by direction (corresponding to the eight compass points N, NE, E etc.) and strength in km/h. The value in the table represents the calculated percentage of time wind occurs during the month having the specified direction and wind speed range. It is noted that the predominant wind direction during the year is from the north-east through to the south-east. The representative frequency of Pasquil stability classes for the region is based on data from TAPM. Pasquil stability classes represent the stability of the atmosphere. Table 6 shows the frequency of stability classes for the site.

Table 5: Windrose for Site (TAPM)

Hourly Average Wind Speed in km/h and Direction [% of Time per month]											
Direction	**1 to 5**	**6 to 10**	**11 to 20**	**21 to 30**	**31 and above**	**Dirn**	**1 to 5**	**6 to 10**	**11 to 20**	**21 to 30**	**31 and above**
January						February					
N	2	7	3	0	0	N	2	6	2	0	0
NE	1	18	11	0	0	NE	2	18	7	0	0
E	1	7	13	1	0	E	2	18	14	0	0
SE	2	5	10	0	0	SE	1	6	8	0	0
S	1	3	1	0	0	S	0	2	6	0	0
SW	0	1	1	0	0	SW	0	0	1	0	0
W	1	2	1	0	0	W	1	0	0	0	0
NW	2	3	1	0	0	NW	2	2	0	0	0
March						April					

Hourly Average Wind Speed in km/h and Direction [% of Time per month]											
Direction	**1 to 5**	**6 to 10**	**11 to 20**	**21 to 30**	**31 and above**	**Dirn**	**1 to 5**	**6 to 10**	**11 to 20**	**21 to 30**	**31 and above**
N	1	1	0	0	0	N	0	0	0	0	0
NE	2	7	5	0	0	NE	1	3	1	0	0
E	1	22	28	1	0	E	2	19	36	0	0
SE	0	6	14	0	0	SE	0	13	22	0	0
S	0	1	5	0	0	S	0	1	0	0	0
SW	0	1	1	0	0	SW	0	1	0	0	0
W	1	1	1	0	0	W	0	0	0	0	0
NW	0	0	0	0	0	NW	0	0	0	0	0
May						June					
N	1	1	1	0	0	N	0	1	2	0	0
NE	0	3	3	0	0	NE	1	6	4	0	0
E	1	10	11	0	0	E	1	15	13	0	0
SE	1	10	35	0	0	SE	1	11	18	0	0
S	1	7	11	0	0	S	1	6	9	0	0
SW	0	3	1	0	0	SW	0	3	1	0	0
W	1	0	0	0	0	W	0	4	2	0	0
NW	0	0	0	0	0	NW	0	1	0	0	0
July						August					
N	1	2	1	0	0	N	0	3	3	0	0
NE	0	7	3	0	0	NE	1	8	10	0	0
E	1	10	16	1	0	E	1	6	14	0	0
SE	1	9	25	0	0	SE	0	6	17	0	0
S	1	4	11	0	0	S	1	5	10	0	0
SW	1	1	2	0	0	SW	1	2	4	0	0
W	0	1	1	0	0	W	0	1	2	0	0
NW	1	0	1	0	0	NW	0	2	1	0	0
September						October					
N	1	7	7	0	0	N	3	8	7	0	0
NE	1	17	13	0	0	NE	2	14	12	0	0
E	1	10	3	0	0	E	3	5	6	0	0
SE	1	4	15	0	0	SE	1	5	10	0	0
S	1	2	6	0	0	S	0	4	5	0	0
SW	0	1	4	0	0	SW	1	1	3	0	0
W	1	1	1	0	0	W	0	2	2	0	0
NW	1	2	0	0	0	NW	1	2	2	0	0
November						December					
N	1	6	6	0	0	N	3	6	10	0	0

Hourly Average Wind Speed in km/h and Direction [% of Time per month]											
Direction	1 to 5	6 to 10	11 to 20	21 to 30	31 and above	Dirn	1 to 5	6 to 10	11 to 20	21 to 30	31 and above
NE	1	15	22	0	0	NE	2	12	23	1	0
E	1	7	12	0	0	E	1	4	6	0	0
SE	1	4	9	0	0	SE	1	3	9	0	0
S	0	1	6	0	0	S	1	3	5	0	0
SW	0	1	2	0	0	SW	1	1	2	0	0
W	0	1	2	0	0	W	1	1	2	0	0
NW	0	1	1	0	0	NW	1	2	1	0	0

Table 6: Frequency of Stability Classes at Site

Stability Class	***Description***	***Frequency of Occurrence (%)***
A	Very unstable	4
B	Moderately unstable	14
C	Slightly unstable	16
D	Neutral	21
E	Slightly stable	10
F	Stable	35

4.1.2 Development of the Emissions Database

Construction Phase

The main components of the SGCP construction phase include construction of the following:

- an internal road network including access from the Capricorn Highway to the accommodation village and mining areas and heavy vehicle haul roads;
- initial development of the open cut pits;
- development of underground operations (including sinking shafts and declines);
- a railway line, rail loop and rail loader;
- CHPP;
- various supporting infrastructure including administration and workshops;
- materials handling infrastructure;
- power supply and reticulation infrastructure;
- water supply and management infrastructure; and
- accommodation village.

The construction of these features will involve vegetation clearance and some earthworks and at a level of activity several orders of magnitude less than the operational coal mine. Dust emissions will be the main emissions during construction. These operations are relatively minor in comparison to emissions from the operational mine and take place in similar location to the mine. The construction phase has not been modelled since the construction phase dust emissions are predicted to be substantially lower than the emissions modelled for an operational mine. Conservatively, the assessment of the operational mine applies for the construction phase.

Operational Phase

The development of an accurate and representative emissions database has been primarily based on the National Pollution Inventory Emission Estimation Technique Manual for Mining Version 2.3 (NPI 2003) as well as US-EPA AP-42 (2003) 5th Update. The main mining activities and processes that produce, or could produce, dust emissions were identified for the SGCP operations and throughput. Flowcharts for handling of overburden, interburden, coal and waste rock were developed and an emission factor (from NPI) was attributed to every handling point, handling activity and transport section. In addition, emissions for exposed surfaces were identified and included in the database.

All emission factor equations and default emission factors in the NPI document are for uncontrolled emissions. However this database has included the control effects from rainfall and from water trucks on haul roads. The effectiveness of the controls has also been extracted from the NPI document. Several dust control activities have been provided at key emission points, as per Table 7.

Table 7: Dust Control for Mine

Dust Source	Control	Effectiveness of Control
Conveyor transfer stations	Enclosed	75%
Pit Retention Factor	Natural ability of pits to retain dust	50% retention for TSP, 5% retention for PM10 and PM2.5
Haul Roads	Watering at more than 2 litres/m^2 per hour	Up to 75%, see discussion

The dust emissions were calculated for every hour of the day for the two years of the modelling simulation. Calculating emissions is a four-step process:

1. Identify sources of emissions.
2. Obtain information on the scale of the activity.
3. Apply the relevant emission factor equation or default emission factor from NPI 2003 to the activity data (see Appendix 2).
4. Where applicable, apply control efficiency reduction factors based on rainfall or water truck use or control options mentioned in Table 7.

The steps to establish the moisture content of overburden and undisturbed coal due to rain comprises:

1. the TAPM model was initially run in meteorology mode only and an hourly meteorological file for the entire year extracted. This TAPM calculated and generated file containing, inter alia, wind speed and rainfall for each hour;
2. if more than 0.5 mm of rainfall occurred during that hour then the moisture content of the ground is assumed to be 15%;
3. following rainfall, moisture content of the overburden reduced by 1% per hour until returning to the relevant dry season or wet season moisture content; and
4. otherwise the assumed moisture content for the ground or overburden is 10% during the wet season and 2% during the dry season.

The steps to establish the moisture content of roads and haulage routes due to rain and water truck operations comprises:

1. the TAPM model was initially run in meteorology mode only and an hourly meteorological file for the entire year extracted. This TAPM calculated and generated file containing, inter alia, wind speed and rainfall for each hour;
2. if there was at least 0.5mm of rain during that hour then the level of dust control is 75%; and
3. for all other hours the level of dust control varies randomly between 0 and 75% dust control. This is based on a maximum water application rate of more than 2 litres/m^2 per hour. The randomised level of dust control was adopted to account for the issues associated with spot watering adopted on the inclines and declines in the pit.

Rather than adopt a constant emission rate for the entire modelling period, the model uses a methodology that provides an emission rate from every operation, for each hour of the simulation period and includes the effects of dust emission controls due to rainfall and the operation of water trucks. In addition, the emissions from wind-generated dusts have also been included, with control only provided by rainfall.

The reported emission database excludes the pit retention factor. Heavier fractions of dust tend to be trapped by the pit and the emission reduction factor specified in the NPI 2003 is 50% for TSP, 5% for PM10 and 5% for PM2.5.

The main dust sources comprise the dragline(s), trucks and shovels, unpaved roads, conveying and dumping ROM coal, dumping and spreading overburden and loading trucks and trains. Since the pit is progressively backfilled as mining progresses westward, waste emplacement will take place in the pit. However, the emplacement and reprofiling of waste rock also takes place on waste rock emplacements elevated above the pit. Once final height of the waste rock emplacements is reached they will be progressively rehabilitated.

Two main cases are addressed representing year 2017 and year 2040.

The first case is during the initial phase of the mine, Year 3 (2017) when the projected waste rock reaches its maximum at 55.3 million bank cubic meters (Mbcm). The product coal for this year is approximately 9.7 Mtpa.

The second case (Year 26 - 2040) is a fully developed mine with the projected waste rock reaches its local maximum at approximately 37.7 Mbcm. The product coal for this year is approximately 15.1 Mtpa.

Both cases relate to the maximum rate of handling of overburden for the respective mining phases. During the first 20 years of the mine's life there are only three years where the total waste rock exceeds 40 Mbcm, with the typical mining rate being in the range of 20 to 30 Mbcm. Although total ROM coal increases up to approximately 17 Mtpa during this period, the increase is mostly due to the ramp up in underground mining operations.

During the later phase of the mine the peak waste rock is in Year 26 of the mine's operation and is considered representative of the worst case emissions after the 20th year of operation. At this time the open cut pits have joined and operations have progressed in a westerly direction for the full north to south extent of the pit.

A description of modelling Case 1 and Case 2 is contained in Table 8. The annual emission rates are contained in Table 9 for the individual dust sources. The total annual emission rates are contained in Table 10 for the combined dust sources excluding the pit retention factor.

Finally, the emissions database incorporates a contingency factor. For the purposes of calculating the emission rates, the annual mining and handling of overburden and coal is assumed to take place over 48 weeks rather than 52 weeks, effectively increasing the emissions rates by 9%. This is to account for minor fluctuations in production, production stoppages and minor emission sources (e.g. drill and blast) not accounted for in the emissions database.

By adopting this methodology the modelling inherently addresses the worst case emissions. Specifically the modelling contains the following:

1. The models have been based on the maximum production rate likely during the life of the mine.
2. The model allows for only 48 weeks per year operations but models for every hour of the modelling year and effective 9% increase in emissions.
3. The level of dust control is randomly varied for each hour throughout the year, from effective to not very effective control. This is particularly relevant to the watering of roads since it is possible watering is not applied as often as required for the heat load or truck usage rates. Hence the modelling incorporates a less than optimum dust control throughout the modelling period and in doing so it implies that worst-case emissions (low levels of dust control) are also incorporated in the modelling.
4. The modelling is based on a two year modelling simulation, specifically years 2004 and 2005. These were years that were in the middle of a six year period of below average rainfall for Queensland, with better than average rainfall returning and remaining since 2007. The period was also hotter than the long-term average for Queensland and with lower than average high wind events. All of these considerations imply that adopting the years 2004 and 2005 for the purpose of the simulation will lead to 'worst case' meteorology.

Hence, all aspects of the modelling has been designed to achieve a realistic worst-case down-wind atmospheric dust concentrations for modelling dust emissions from the mine.

Table 8: Modelling Cases

Item	Case 1	Case 2
Title	Development with one dragline (2017) and underground commencement	Two draglines and fully developed underground mine (2040)
Annual Product Coal (MTPA)	9.7	15.1
Annual ROM Coal (MTPA)	7.35 Open Cut 3.04 Underground	5.3 Open Cut 11.5 Underground
Waste rock (MBCM)	55	38
In pit operations	Dragline in north and southern pit Excavator on overburden Excavator on coal Dump trucks to overburden dump Haul trucks to ROM Bin (coal) Wind erosion	Dragline in north and southern pits Excavator on overburden Excavator on coal Dump trucks to overburden dump Haul trucks to ROM Bin (coal) Wind erosion
Out of pit operations	Dragline to waste rock emplacements Dump trucks to waste rock emplacements Haul trucks to ROM Bin (coal) Conveying (coal) from underground and ROM Bin to CHPP CHPP Rail loader Wind erosion Stockpiles	Dragline to waste rock emplacements Dump trucks to waste rock emplacements Haul trucks to ROM Bin (coal) Conveying (coal) from underground and ROM Bin to CHPP CHPP Rail loader Wind erosion Stockpiles
Underground Mining	Vents (Ventilation fans)	Vents (Ventilation fans)

Table 9: Dust Emissions for Main Dust Activities in Tonnes/Annum (Excluding Pit retention factor and including Dust Controls)

Source	Location	Case 1 – Year 3 [Total Annual Tonnes/Annum]			Case 2 – Year 26 [Total Annual Tonnes/Annum]		
		PM2.5	**PM10**	**TSP**	**PM2.5**	**PM10**	**TSP**
Dragline	Northern pit	-	-	-	46	367	847
	Southern pit	168	1,345	3,104	69	551	1,271
Excavator (overburden)	Northern pit	1.3	10	21	0.4	3	7
	Southern pit	0.3	3	5	0.6	5	11
Excavator (coal)	Northern pit	9.3	74	154	8.9	71	148
	Southern pit	21.6	173	360	13.4	107	223
Dump truck (overburden) travelling	Northern pit	10.7	85	387	8.8	70	318
	Southern pit	26.7	214	967	13.2	105	477
	Spoil dumps & rehabilitation areas	16.0	128	580	14.7	117	530
Haul truck (coal) travelling	Northern pit	8.0	64	288	5.5	44	199
	Southern pit	11.6	93	419	8.2	66	298
	Haul road north	11.8	94	428	13.1	105	475
	Haul roads south	16.0	128	579	16.0	128	580

Source	Location	Case 1 – Year 3 [Total Annual Tonnes/Annum]			Case 2 – Year 26 [Total Annual Tonnes/Annum]		
		PM2.5	PM10	TSP	PM2.5	PM10	TSP
Conveyor	From underground to CHPP	3.2	45	113	1.6	23	58
	Transfer towers	1.7	14	29	0.9	7	15
Bulldozer (coal)	Northern pit	11.9	95	298	21.4	171	537
	Southern pit	23.8	190	596	32.1	257	805
	CHPP & Process area	23.8	190	596	35.6	285	895
Truck dumping coal	Northern dump station	3.4	28	68	9.1	77	183
	Southern dump station	7.9	66	158	9.1	77	183
Truck dumping overburden	Northern pit	29.2	233	650	10.6	85	236
	Southern pit	26.0	207	577	16.0	127	355
	Spoil dumps & rehabilitation areas	9.7	78	217	17.7	141	394
Drilling and Blasting	Northern pit	0.2	1	3	0.1	1	2
	Southern pit	0.2	1	3	0.2	2	3
Graders	Northern pit	2.1	17	53	0.8	6	20
	Southern pit	3.1	25	76	1.2	10	30
	Haul road north	3.2	25	78	1.9	15	48
	Haul roads south	4.3	34	106	2.4	19	58

Source	**Location**	**Case 1 – Year 3 [Total Annual Tonnes/Annum]**			**Case 2 – Year 26 [Total Annual Tonnes/Annum]**		
		PM2.5	**PM10**	**TSP**	**PM2.5**	**PM10**	**TSP**
Loading stockpiles	CHPP & Process area	9.6	77	181	15.6	124	293
Unloading stockpiles	CHPP & Process area	73.5	588	1,356	118.9	951	2,196
Loading trains	CHPP & Process area	0.4	4	8	0.7	6	13
Vents from underground mining	Various locations	5.0	28	40	8.5	47	68
Bulldozer (Overburden)	Northern pit	24.7	197	839	14.0	112	477
	Southern Pit	21.9	175	746	21.1	168	716
	Spoil dumps & rehabilitation areas	8.2	66	280	23.4	187	795
Erosion	Northern pit	13.2	105	211	8.8	70	140
	Southern pit	8.8	70	140	13.2	105	211
	Spoil dumps & rehabilitation areas	8.8	70	140	6.6	53	105
	Process areas	2.2	18	35	2.2	18	35
	Haul roads north	6.6	53	105	6.6	53	105
	Haul roads south	4.4	35	70	6.6	53	105
Totals [Tonnes/Annum]		**642**	**5146**	**15,064**	**625**	**4991**	**14,468**

Table 10: Dust Emissions for Main Dust Sources in Tonnes/Annum (Excluding Pit retention Factor and Including Dust Controls)

Operation	***Emission type***	***Pit Retention Factors Applies***	***Case 1[Tonnes/Annum]***			***Case 2[Tonnes/Annum]***		
			PM2.5	***PM10***	***TSP***	***PM2.5***	***PM10***	***TSP***
In pit sources combined	Coal & Overburden	Y	423	3,378	9,897	313	2,505	7,332
Spoil dumps and regeneration areas	Overburden	N	43	342	1,217	62	498	1,825
Roads	Road base	N	46	369	1,365	47	373	1,372
CHPP, Rail Loader, Dump stations	Coal	N	121	971	2,403	191	1538	3,797
Underground operations, vents, conveyor and transfer stations	Coal	N	10	86	182	11	77	141

Note: The effect of pit retention factors have not been included in this table of annual emissions.

4.1.3 Dispersion Model

TAPM was adopted as the dispersion model for the SGCP. According to Hurley *et al*. (2005), air pollution predictions for environmental impact assessments usually use Gaussian plume/puff models driven by observationally-based meteorological inputs. An alternative approach is to use prognostic meteorological and air pollution models, which have many advantages over the Gaussian approach and are a viable tool for performing year-long simulations. TAPM performs well for general dispersion in complex rural conditions. In particular, TAPM performs very well for the prediction of extreme pollution statistics, important for environmental impact assessments and for particulates.

TAPM V3 was used to determine the downwind ground level pollutant concentrations. It is designed to predict ground-level concentrations or dry deposition of pollutants emitted from one or more sources, which may comprise either stacks, area sources, volume sources, line sources or any combination of these.

The sources in the TAPM model comprised the in-pit sources, the out-of pit sources, mine ventilation fans, road, conveyors and the CHPP and plant. All these sources were modelled as volume sources having dimensions similar to the extent of the source. The overland conveyors and roads were modelled as line sources.

The in-pit sources were modelled as a number of small volume source having a footprint encompassing the open cut mining area and a depth of 50 m (above the natural surface). Similarly the waste rock emplacements were also modelled as a number of volume sources having a depth of 25 m (above the natural terrain). The CHPP (including coal stockpiles and rail loader) and several ventilation fans have plan dimensions consistent with the dimensions of the sources and a depth of 10 m (above natural ground levels).

The conveyor and roads were modelled as line sources. The height of these sources has been modelled as 5 m for conveyors and 15 m for roads.

The innermost meteorological grid was based on a 1 km by 1 km grid and the domain is 40 km by 40 km. The pollution grid was reduced to 500m by 500m grid covering the entire innermost domain. Test runs were conducted using a 250 m grid, however computer run times were excessively long and the predicted downwind concentrations varied on marginally. All modelling, for dust was carried out using volume sources and line sources. The lagrangian particle mode (LPM) in TAPM is only relevant to point sources. Since the model doesn't have point sources it only uses the Eulerian grid mode.

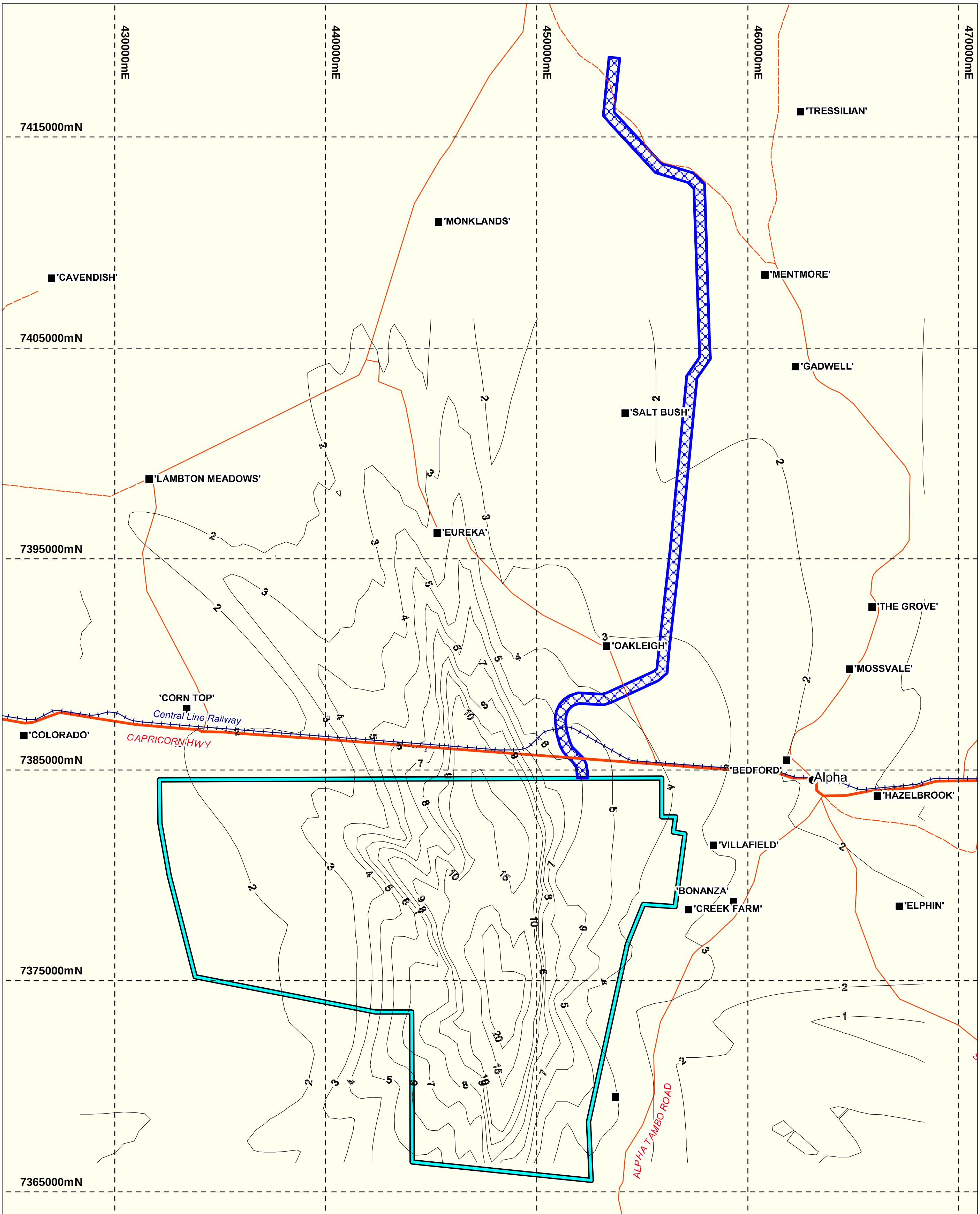
4.2 Air Quality Results

The calculated dust emissions described in Section 4.1.2 were included in the TAPM model at the appropriate locations. The likely dust levels due to the operation of the mine at each nearby sensitive receptor have been determined and these are shown in Table 11 for Case 1 2017 and Table 12 for Case 2 year 2040.

The calculated dust deposition and concentration contours are contained in:

- **Figure 9** – Case 1 PM2.5 (24 hour) maximum with concentration contours expressed in terms of µg/m^3;
- **Figure 10** – Case 1 PM2.5 (annual average) with concentration contours expressed in terms of µg/m^3;
- **Figure 11** – Case 1 PM10 (24 hour) maximum with concentration contours expressed in terms of µg/m^3;
- **Figure 12** – Case 1 PM10 (24 hour) 5^{th} highest with concentration contours expressed in terms of µg/m^3;
- **Figure 13** – Case 1 TSP (annual average) with concentration contours expressed in terms of µg/m^3; and,
- **Figure 14** – Case 1 Dust deposition (maximum month) with deposition contours expressed in terms of mg/m^2/day.
- **Figure 15** – Case 2 PM2.5 (24 hour) maximum with concentration contours expressed in terms of µg/m^3;
- **Figure 16** – Case 2 PM2.5 (annual average) with concentration contours expressed in terms of µg/m^3;
- **Figure 17** – Case 2 PM10 (24 hour) maximum with concentration contours expressed in terms of µg/m^3;
- **Figure 18** – Case 2 PM10 (24 hour) 5^{th} highest with concentration contours expressed in terms of µg/m^3;
- **Figure 19** – Case 2 TSP (annual average) with concentration contours expressed in terms of µg/m^3; and,
- **Figure 20** – Case 2 Dust deposition (maximum month) with deposition contours expressed in terms of mg/m^2/day.

Note that the predicted dust concentration/deposition presented in **Table 11** and **Table 12** include the assumed background level, whereas **Figure 9** to **Figure 20** do not.



Noise Mapping Australia

Scalable Consulting Solutions

LEGEND

- MLA70453
- SGCP Infrastructure Corridor
- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- River
- Population centre

Air Quality Results

- PM2.5 (24 hour) Maximum Contour (ug/m3)

Data Source:
Tenement - DEEDI. Topography (250k) - Geoscience Australia.

Alpha Coal Pty Ltd

South Galilee Coal Project

Case 1 - PM2.5 (24 hour) Maximum

0 5 10

Kilometres

Scale: 1:250,000 (A4)

16/12/2011

Datum: GDA94
Projection: MGA55

FIGURE 9

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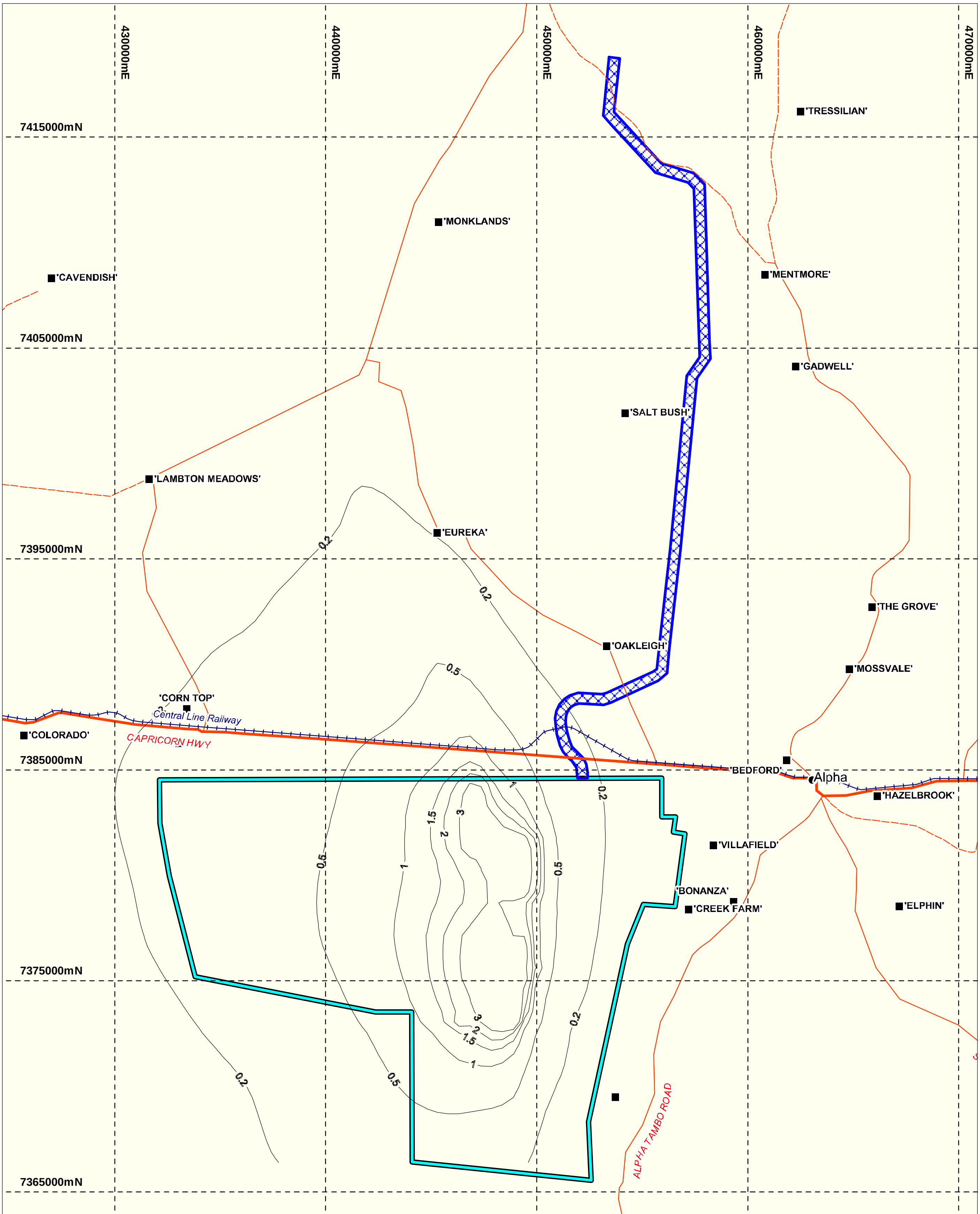

LEGEND

- MLA70453
- SGCP Infrastructure Corridor
- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- River
- Population centre

Air Quality Results

- PM2.5 (Annual Average) Contour (ug/m3)

Data Source:
Tenement - DEEDI. Topography (250k) - Geoscience Australia.

Noise Mapping Australia
Scalable Consulting Solutions

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Alpha Coal Pty Ltd

South Galilee Coal Project

Case 1 - PM2.5 (Annual Average)

0 5 10

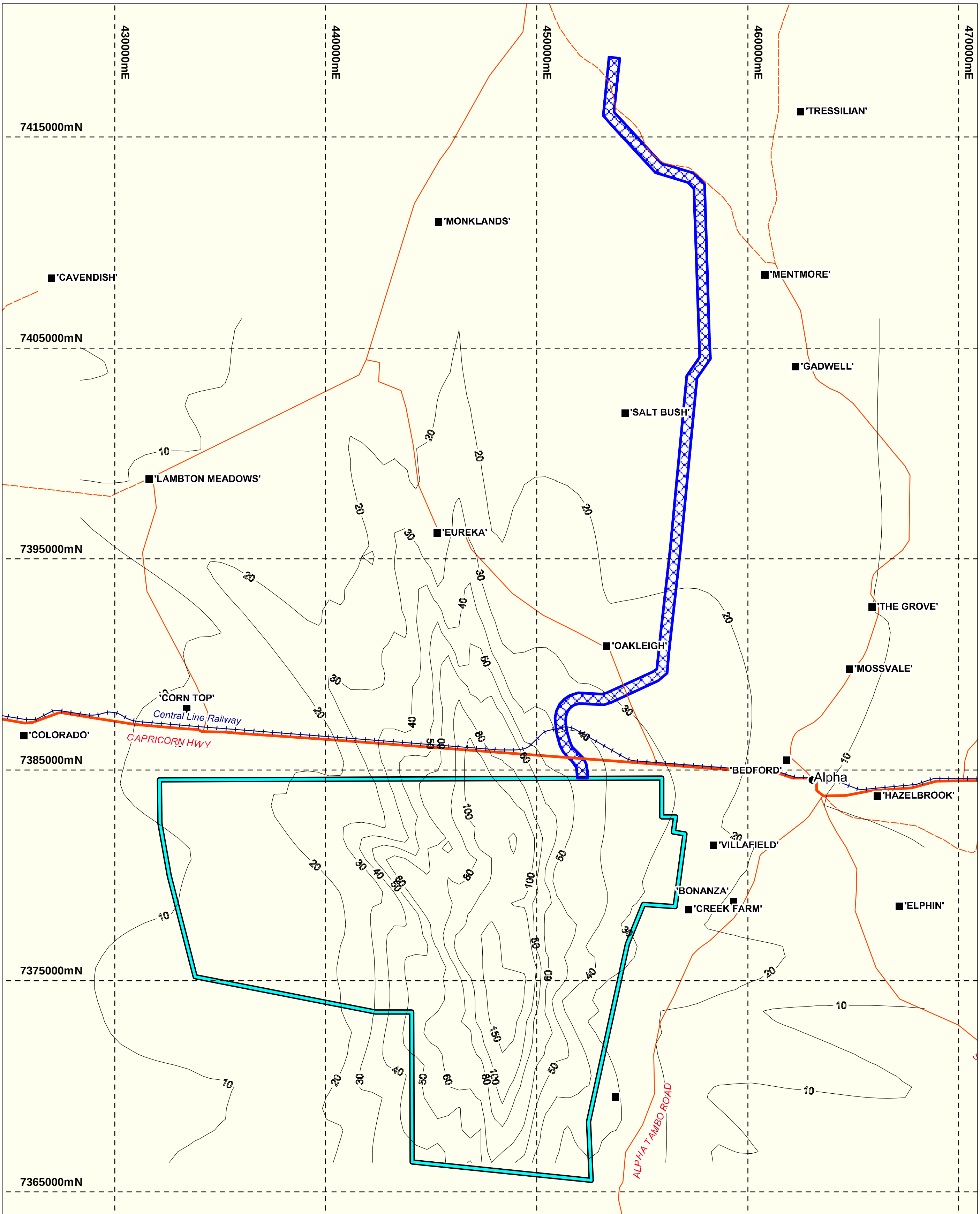
Kilometres

Scale: 1:250,000 (A4)

16/12/2011

Datum: GDA94
Projection: MGA55

FIGURE 10



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Noise Mapping Australia
Scalable Consulting Solutions

LEGEND

- MLA70453
- SGCP Infrastructure Corridor
- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- River
- Population centre

Air Quality Results

- PM10 (24 hour) Maximum Contour (ug/m3)

Data Source:
Tenement - DEEDI. Topography (250k) - Geoscience Australia.

Alpha Coal Pty Ltd
South Galilee Coal Project

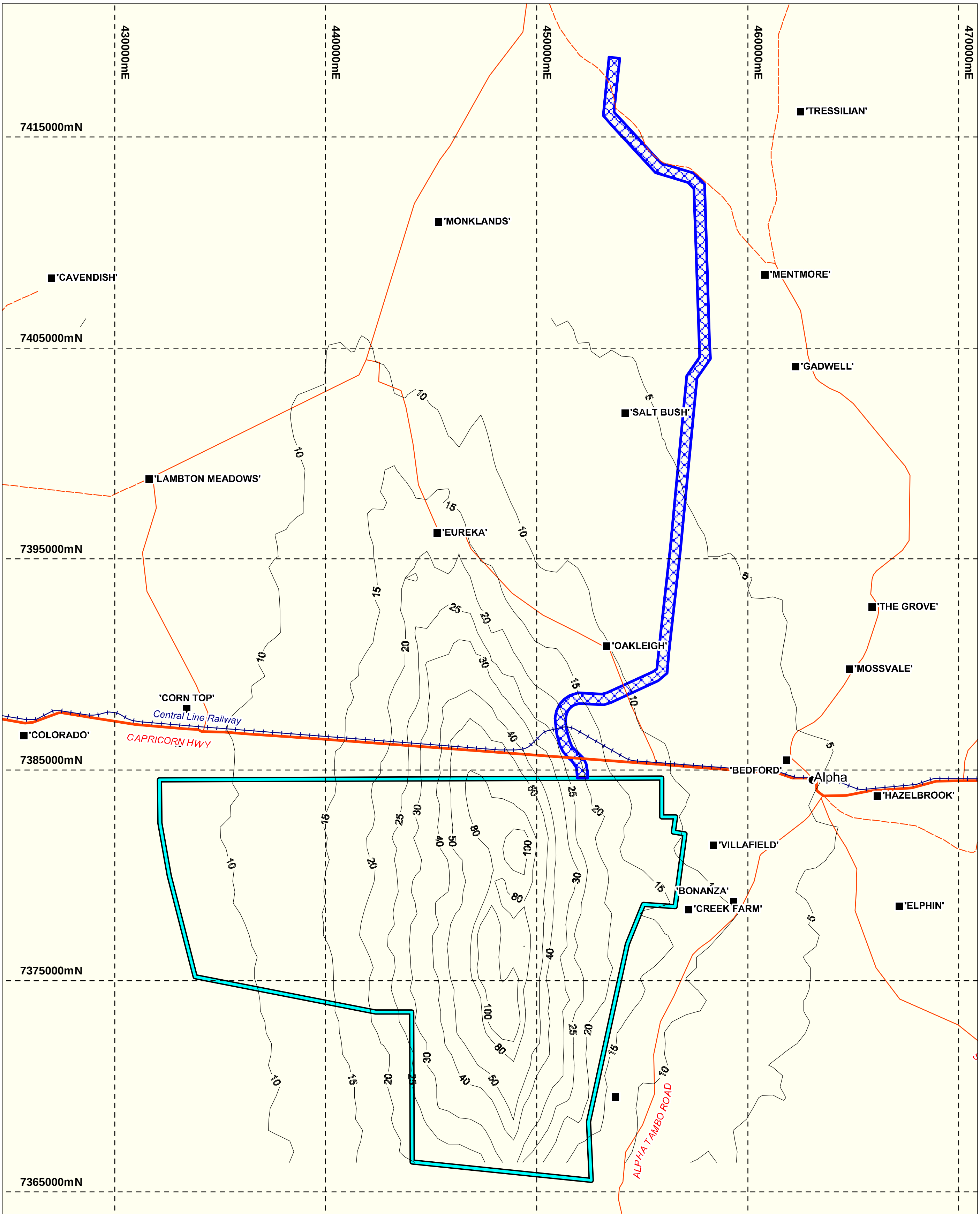
Case 1 - PM10 (24 hour) Maximum

0 5 10
Kilometres
Scale: 1:250,000 (A4)

16/12/2011

Datum: GDA94
Projection: MGA55

FIGURE 11



LEGEND

- MLA70453
- SGCP Infrastructure Corridor
- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- River
- Population centre

Air Quality Results

- PM10 (24 hour) 5th Highest Contour (ug/m3)

Data Source:
Tenement - DEEDI. Topography (250k) - Geoscience Australia.

Alpha Coal Pty Ltd

South Galilee Coal Project

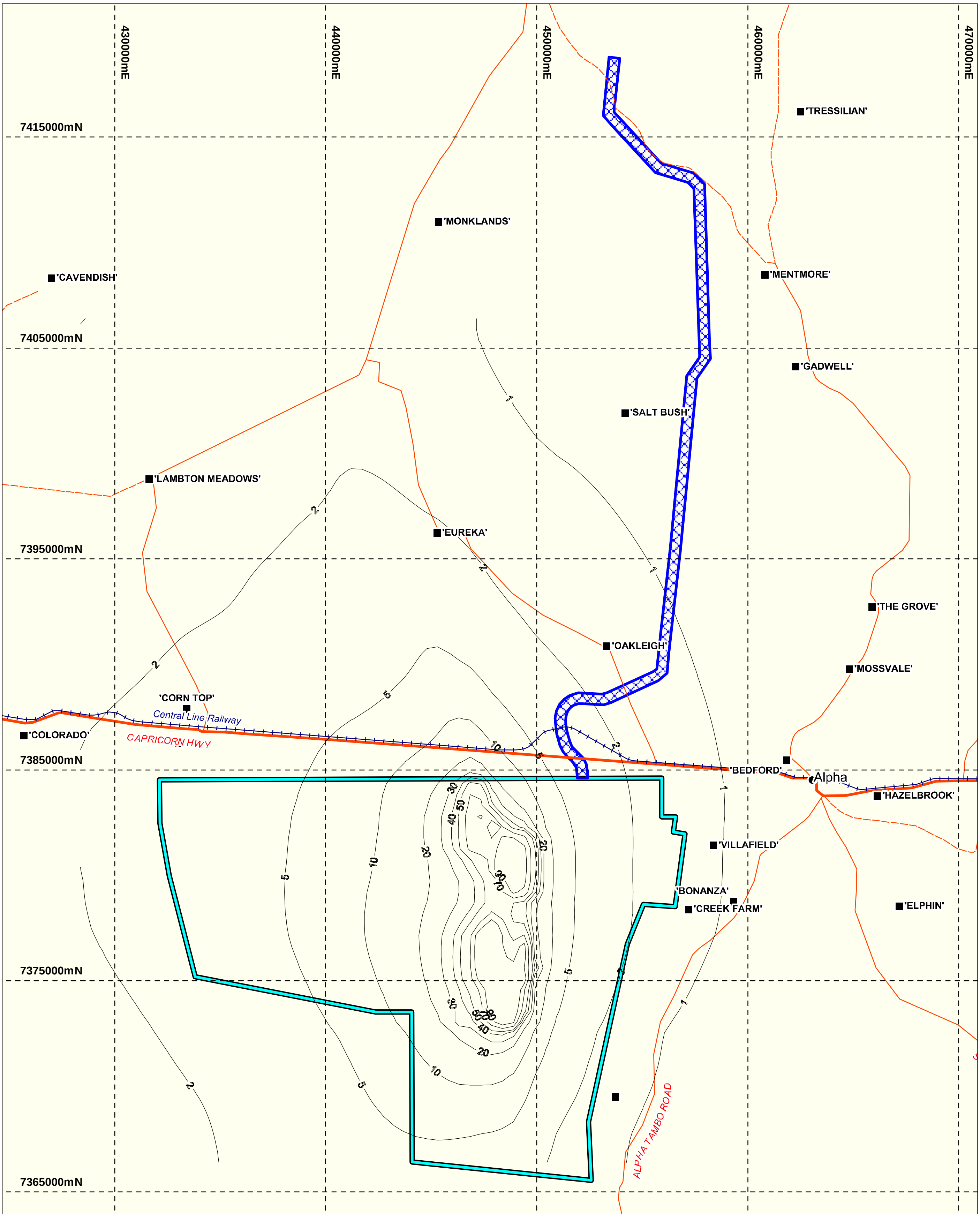
Case 1 - PM10 (24 hour) 5th Highest

0 5 10
Kilometres
Scale: 1:250,000 (A4)

16/12/2011

Datum: GDA94
Projection: MGA55

FIGURE 12



LEGEND

MLA70453

SGCP Infrastructure Corridor

Principal road

Road (sealed)

Road (unsealed)

Railway

River

Population centre

Air Quality Results

TSP (Annual Average) Contour (ug/m3)

Data Source:
Tenement - DEEDI. Topography (250k) - Geoscience Australia.

Noise Mapping Australia
Scalable Consulting Solutions

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Alpha Coal Pty Ltd

South Galilee Coal Project

Case 1 - TSP (Annual Average)

0 5 10

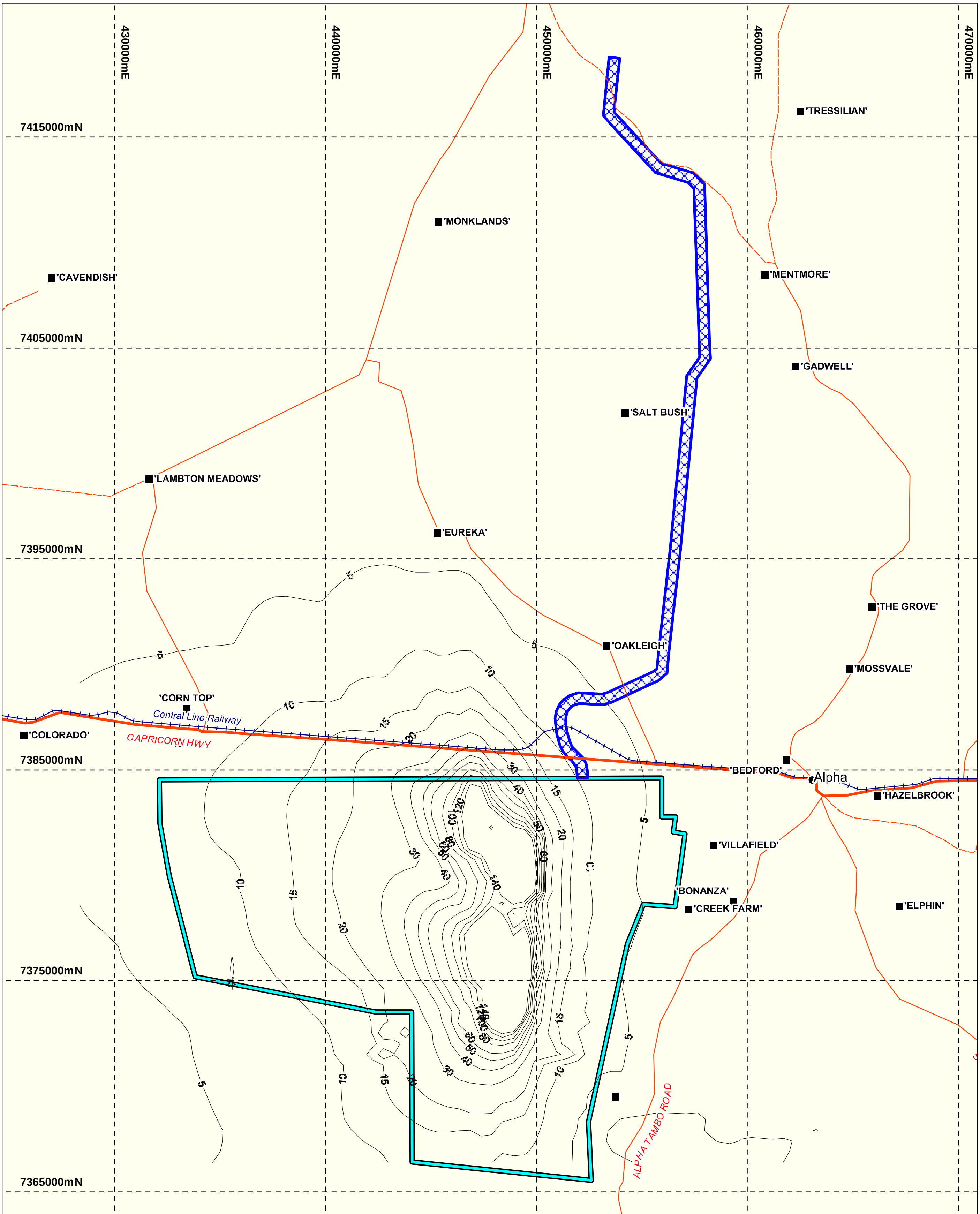
Kilometres

Scale: 1:250,000 (A4)

19/12/2011

Datum: GDA94
Projection: MGA55

FIGURE 13



LEGEND

MLA70453

SGCP Infrastructure Corridor

Principal road

Road (sealed)

Road (unsealed)

Railway

River

Population centre

Air Quality Results

Dust deposition (Maximum Month) Contour (mg/m2/day)

Data Source:
Tenement - DEEDI. Topography (250k) - Geoscience Australia.

Noise Mapping Australia
Scalable Consulting Solutions

Alpha Coal Pty Ltd
South Galilee Coal Project

Case 1 - Dust Deposition (Maximum Month)

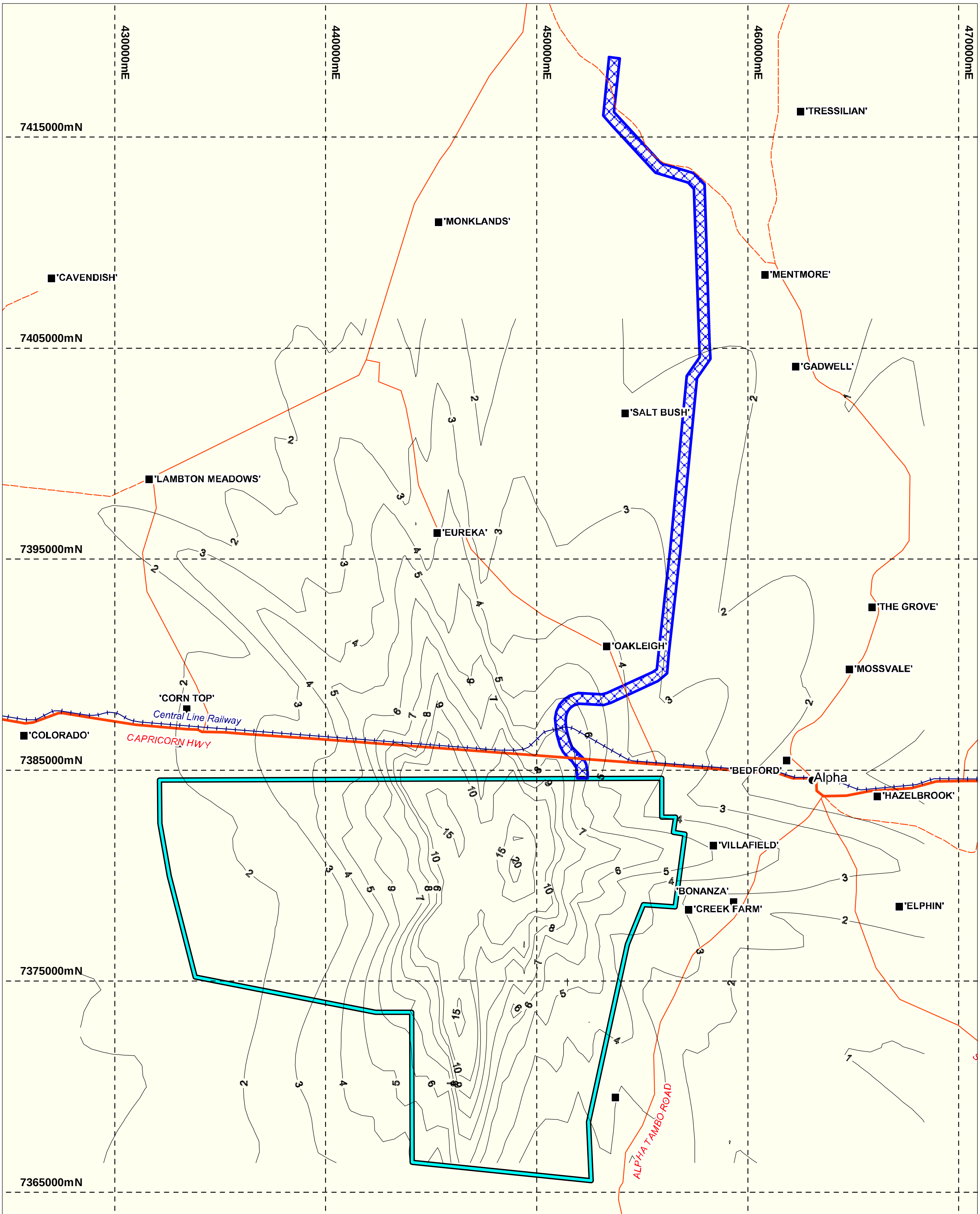
0 5 10
Kilometres
Scale: 1:250,000 (A4)

19/12/2011

Datum: GDA94
Projection: MGA55

FIGURE 14

S:\Projects\AM001 Sth Galilee EIS_MapInfo\Workspaces\AM001_M396A.wor



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Noise Mapping Australia
Scalable Consulting Solutions

LEGEND

- MLA70453
- SGCP Infrastructure Corridor
- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- River
- Population centre

Air Quality Results

- PM2.5 (24 hour) Maximum Contour (ug/m3)

Data Source:
Tenement - DEEDI. Topography (250k) - Geoscience Australia.

Alpha Coal Pty Ltd
South Galilee Coal Project

Case 2 - PM2.5 (24 hour) Maximum

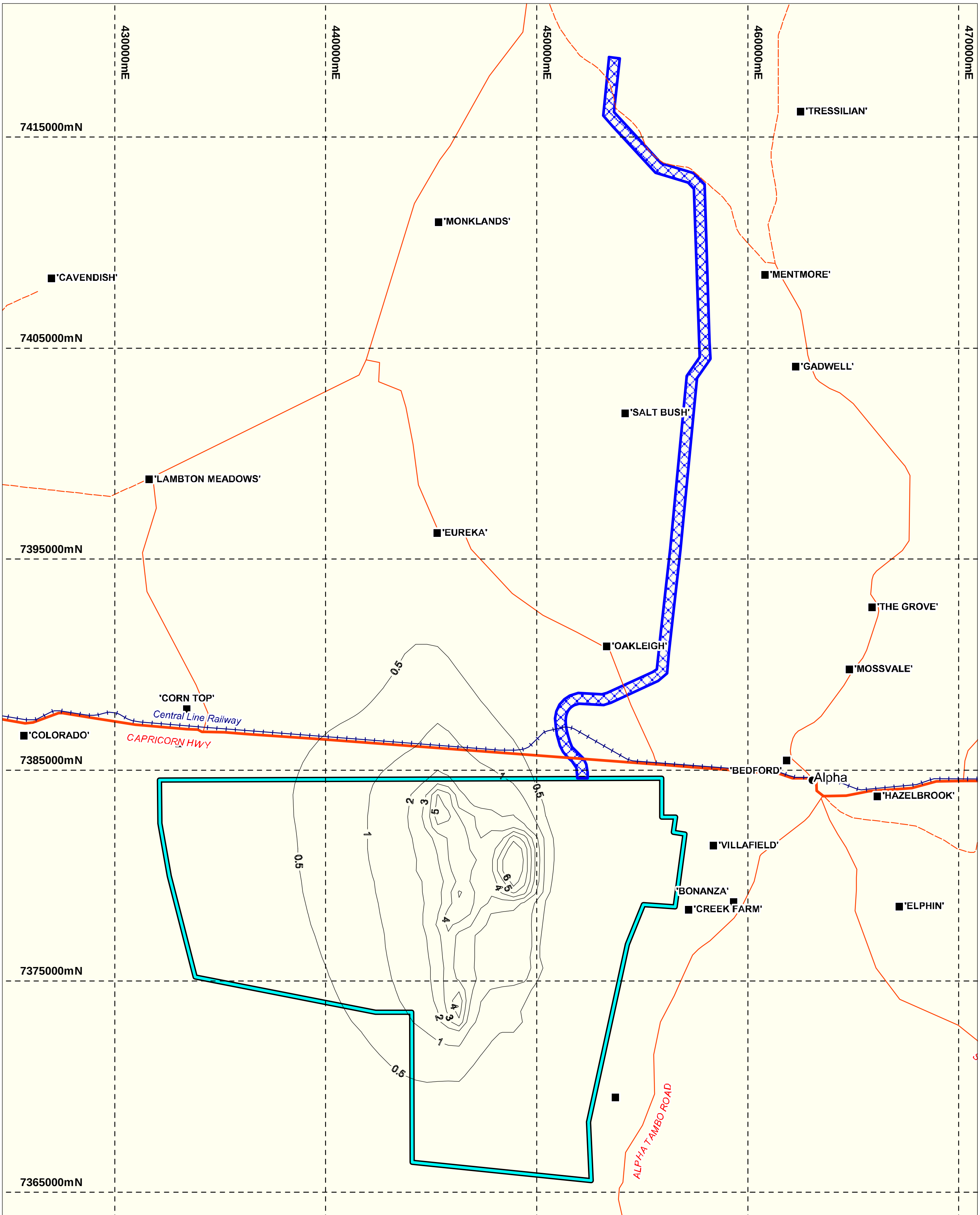
0 5 10
Kilometres

Scale: 1:250,000 (A4)

19/12/2011

Datum: GDA94
Projection: MGA55

FIGURE 15



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Noise Mapping Australia
Scalable Consulting Solutions

LEGEND

- MLA70453
- SGCP Infrastructure Corridor
- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- River
- Population centre

Air Quality Results

- PM2.5 (Annual Average) Contour (ug/m3)

Data Source:
Tenement - DEEDI. Topography (250k) - Geoscience Australia.

Alpha Coal Pty Ltd

South Galilee Coal Project

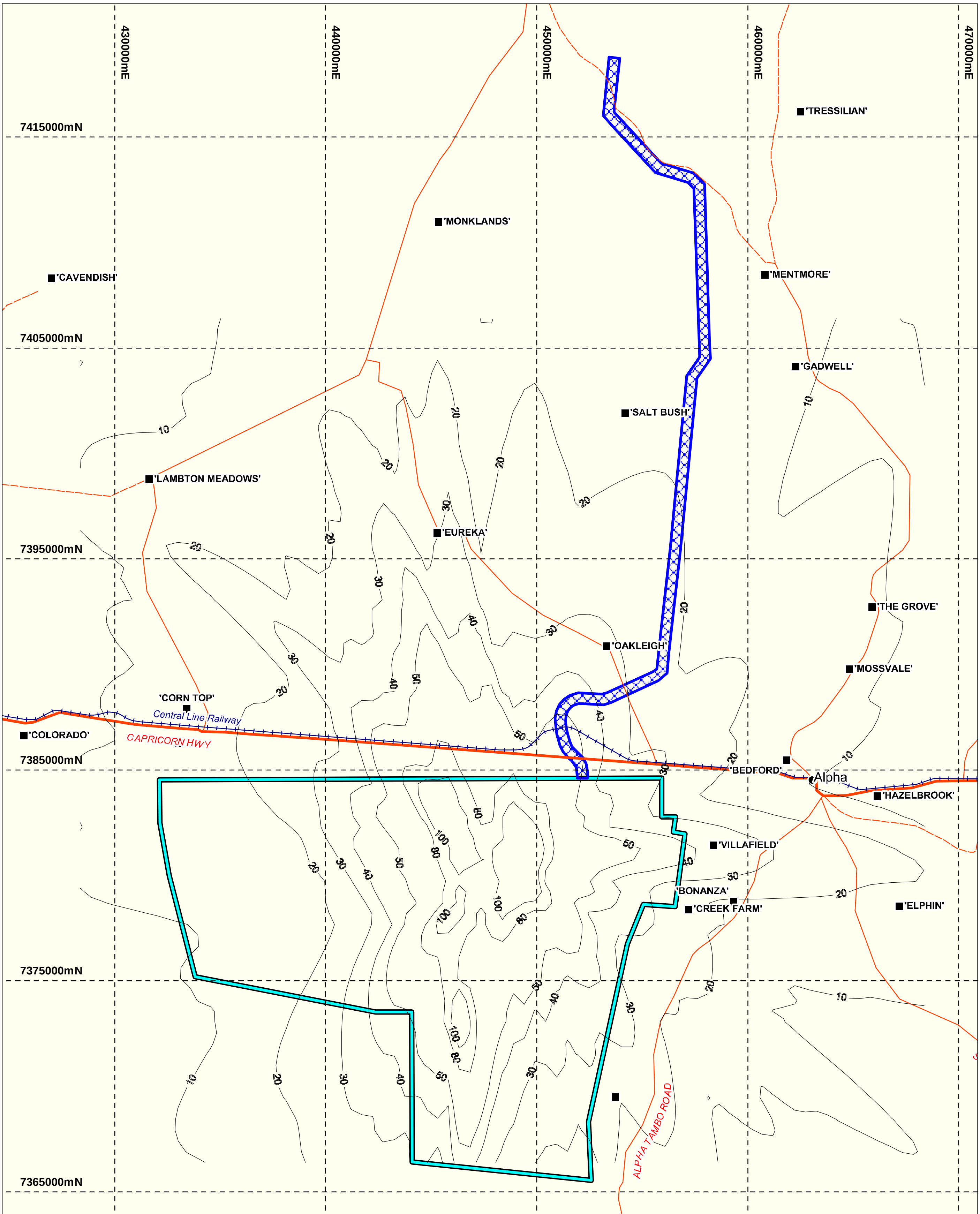
Case 2 - PM2.5 (Annual Average)

0 5 10
Kilometres
Scale: 1:250,000 (A4)

19/12/2011

Datum: GDA94
Projection: MGA55

FIGURE 16



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Noise Mapping Australia
Scalable Consulting Solutions

LEGEND

- MLA70453
- SGCP Infrastructure Corridor
- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- River
- Population centre

Air Quality Results

- PM10 (24 hour) Maximum Contour (ug/m3)

Data Source:
Tenement - DEEDI. Topography (250k) - Geoscience Australia.

Alpha Coal Pty Ltd
South Galilee Coal Project

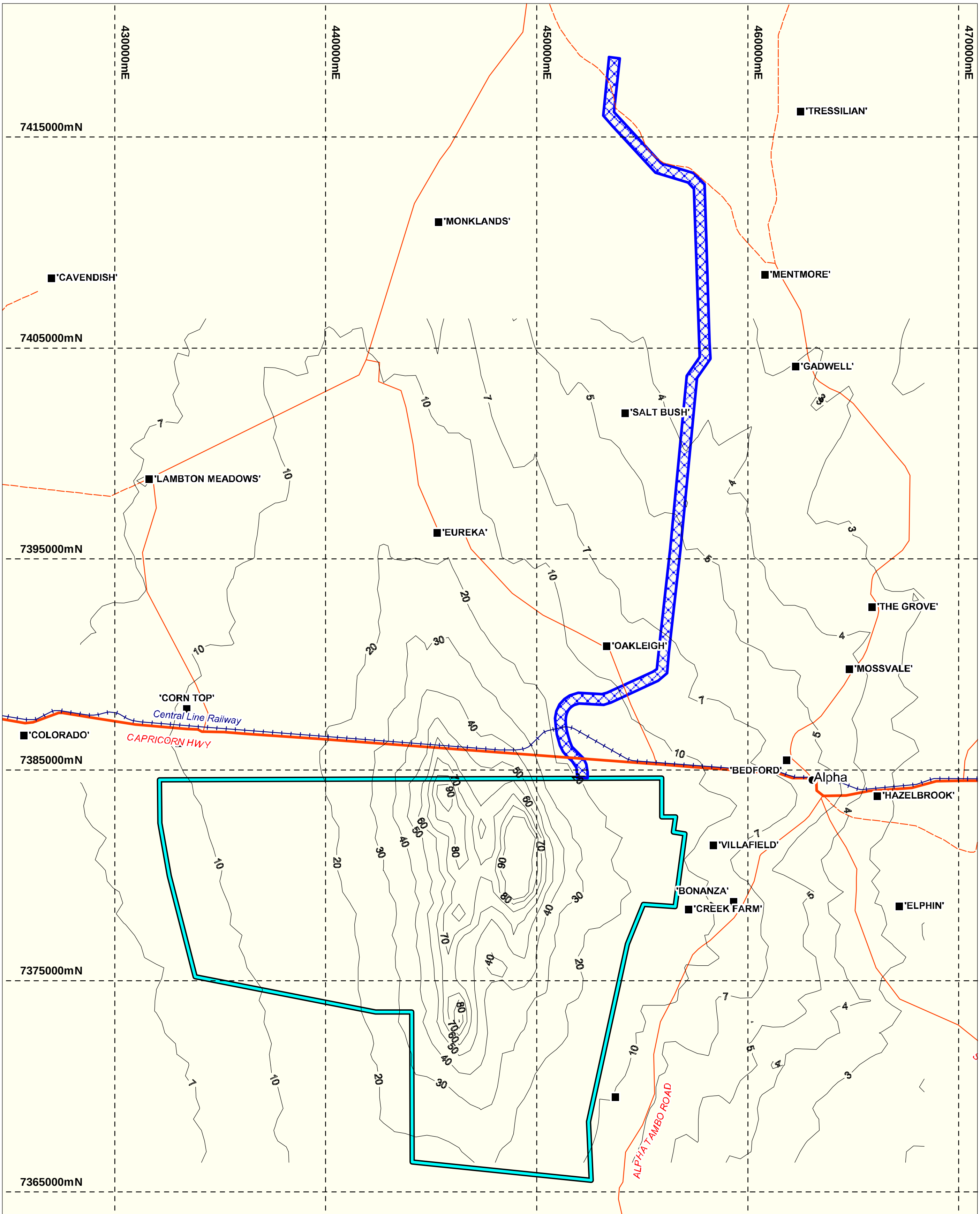
Case 2 - PM10 (24 hour) Maximum

0 5 10
Kilometres
Scale: 1:250,000 (A4)

19/12/2011

Datum: GDA94
Projection: MGA55

FIGURE 17



LEGEND

- MLA70453
- SGCP Infrastructure Corridor
- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- River
- Population centre

Air Quality Results

- PM10 (24 hour) 5th Highest Contour (ug/m3)

Data Source:
Tenement - DEEDI. Topography (250k) - Geoscience Australia.

Noise Mapping Australia
Scalable Consulting Solutions

S:\Projects\AM001 Sth Galilee EIS_MapInfo\Workspaces\AM001_M400A.wor

Alpha Coal Pty Ltd
South Galilee Coal Project

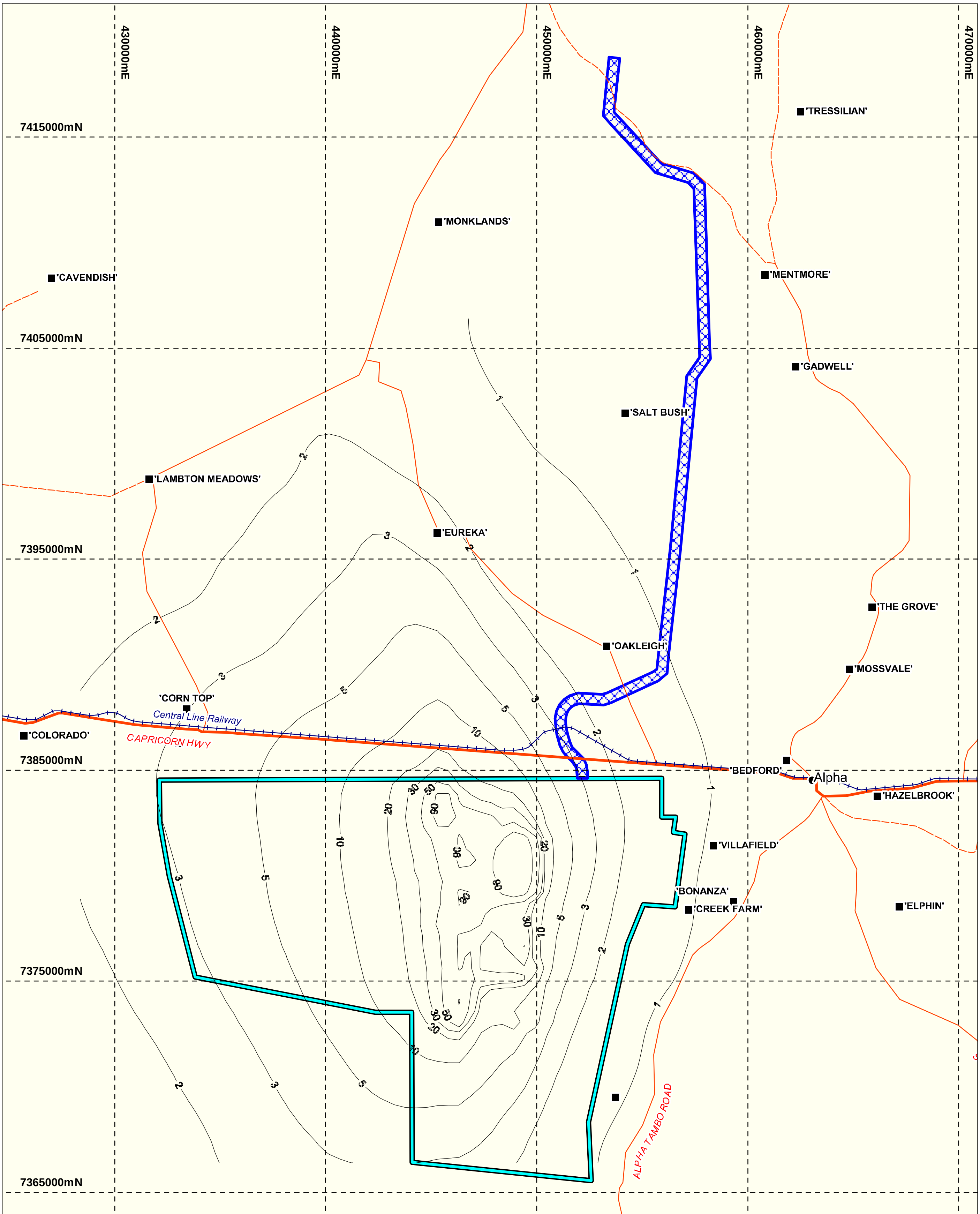
Case 2 - PM10 (24 hour) 5th Highest

0 5 10
Kilometres
Scale: 1:250,000 (A4)

19/12/2011

Datum: GDA94
Projection: MGA55

FIGURE 18



Data Source:
Tenement - DEEDI. Topography (250k) - Geoscience Australia.

Alpha Coal Pty Ltd

South Galilee Coal Project

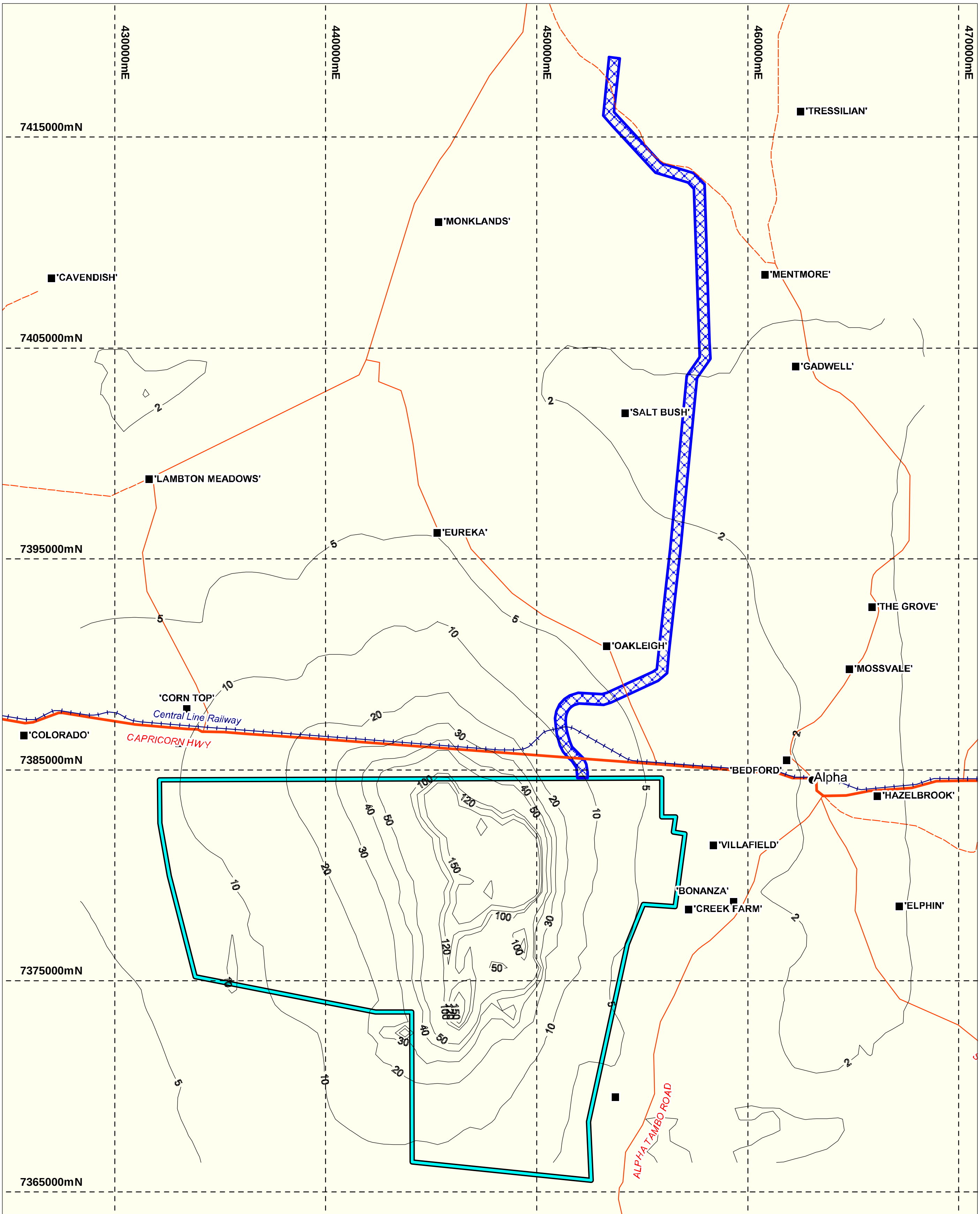
Case 2 - TSP (Annual Average)

Scale: 1:250,000 (A4)

19/12/2011

FIGURE 19

S:\Projects\AM001 Sth Galilee EIS_MapInfo\Workspaces\AM001_M401A.wor



S:\Projects\AM001 Sth Galilee EIS_MapInfo\Workspaces\AM001_M402A.wor

Noise Mapping Australia

Scalable Consulting Solutions

LEGEND

- MLA70453
- SGCP Infrastructure Corridor
- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- River
- Population centre

Air Quality Results

- Dust Deposition (Maximum Month) Contour (mg/m2/day)

Data Source:
Tenement - DEEDI. Topography (250k) - Geoscience Australia.

Alpha Coal Pty Ltd

South Galilee Coal Project

Case 2 - Dust Deposition (Maximum Month)

0 5 10

Kilometres

Scale: 1:250,000 (A4)

19/12/2011

Datum: GDA94
Projection: MGA55

FIGURE 20

Table 11: Predicted Dust Concentration and Dust Deposition For Sensitive Receptors (including assumed ambient levels) – Case 1

Receptor	***Calculated Dust Levels At Nearby Residences***					
	PM2.5 (24 hour) (maximum) ***(μg/m³)***	***PM2.5 (annual average)*** ***(μg/m³)***	***PM10 (24 hour) (5th highest)*** ***(μg/m³)***	***PM10 (24 hour) (maximum)*** ***(μg/m³)***	***TSP (annual average)*** ***(μg/m³)***	***Dust Deposition (maximum month)*** ***(mg/m²/day)***
Limit	**25**	**8**	**50**	**50**	**90**	**120**
Existing Ambient	***8***	***5***	***18***	***18***	***25***	***45***
Alpha Township	10	5	24	33	25	47
Betanga Station Homestead	10	5	27	30	28	47
Bonanza Station Homestead	11	5	27	38	26	50
Chesalon Station Homestead	12	5	32	50	27	50
Corntop Station Homestead	10	5	27	29	28	53
Creek Farm Station Homestead	11	5	31	41	27	50
Eureka Station Homestead	12	5	34	45	27	49
Oakleigh Station Homestead	11	5	29	43	27	50
Saltbush Station Homestead	10	5	33	24	26	49
Villafield Station Homestead	11	5	26	41	26	50
Proposed Accommodation Village	14	5	38	**58** (exceeds 50 for one 24 hour period)	29	55

Table 12: Predicted Dust Concentration and Dust Deposition For Sensitive Receptors (including assumed ambient levels) – Case 2

Receptor	***Calculated Dust Levels At Nearby Residences***					
	PM2.5 (24 hour) (maximum) ***(µg/m³)***	***PM2.5 (annual average)*** ***(µg/m³)***	***PM10 (24 hour) (5th highest)*** ***(µg/m³)***	***PM10 (24 hour) (maximum)*** ***(µg/m³)***	***TSP (annual average)*** ***(µg/m³)***	***Dust Deposition (maximum month)*** ***(mg/m²/day)***
Limit	**25**	**8**	**50**	**50**	**90**	**120**
Existing Ambient	***8***	***5***	***18***	***18***	***25***	***45***
Alpha Township	10	5	25	33	25	48
Betanga Station Homestead	10	5	29	33	28	55
Bonanza Station Homestead	11	5	26	40	26	49
Chesalon Station Homestead	11	5	28	40	27	49
Corntop Station Homestead	10	5	29	33	28	55
Creek Farm Station Homestead	11	5	30	43	27	49
Eureka Station Homestead	12	5	36	48	27	50
Oakleigh Station Homestead	12	5	27	50	27	49
Saltbush Station Homestead	10	5	23	36	26	47
Villafield Station Homestead	13	5	26	**54** (exceeds 50 for one 24 hour period)	26	49
Proposed Accommodation Village	16	5	43	**78** (exceeds 50 for three 24 hour periods)	29	55

4.3 Air Quality Assessment

The predicted average ground level concentrations at nearby sensitive areas have been modelled and Section 4.1 contains a full description of the modelling methods. The methodology includes both normal and expected maximum emission conditions and the worst case meteorological conditions. The ground level predictions were made at all sensitive locations and the contours cover adjacent industrial and agricultural areas. All the techniques used to obtain the predictions are referenced and key assumptions and data sets explained.

Case 1 - Year 3

PM2.5

Both the PM10 and PM2.5 have similar shaped contours. The modelled PM2.5(24 hour maximum) and PM2.5 (annual average) levels comply with the limits for PM2.5 at all sensitive receptors.

PM10

The dust contours, particularly the maximum 24 hour contours, show that there are periods over the two year modelling simulation when adverse meteorological conditions persist for at least 24 hours leading to elevated dust levels some distance from the SGCP. For instance a south-west wind led to an elevated dust level to the north-west (i.e. towards Lambton Meadows from the northern parts of the mine and towards Betanga and Corntop from the southern pit). Winds from the south lead to an elevated maximum dust level to the north towards Eureka Homestead. There is also a minor increase in dust levels to the east of the site, due to westerly winds, however, the increase in dust levels is south of Alpha. The dust concentration levels at all sites comply with the dust limits.

The maximum PM10(24 hour) concentration exceeds the 50 µg/m^3 limit at the accommodation village for one 24 hour period over the two year simulation period.

The dust level at Chesalon Station Homestead meets the limit of 50 ug/m^3 (including the assumed ambient level). All PM10 (24 hour) dust levels comply with the dust limit.

TSP

TSP comprises the all fractions of dust. The heavier fractions rarely travel significant distances, especially under meteorological conditions likely to lead to high downwind concentrations (low wind speed, wind direction remaining steady for a long period of time, neutral to stable atmosphere). Thus the increase in the annual average TSP is predicted to be very low and will be mostly associated with the lighter dust fractions (i.e. PM10). The TSP (annual average) limit is met at all sensitive receptors.

Dust Deposition

The dust deposition (maximum month) contours show that most dust fall will occur west of the site above the underground mining area. The highest dust fallout occurs at the accommodation village and the maximum month is 55 mg/m^2/day (including the assumed background of 45 mg/m^2/day) compared with the 120 mg/m^2/day dust deposition limit. The dust fallout at all sensitive receptors readily complies with the goal.

Case 2 - Year 26

PM2.5

Both the PM10 and PM2.5 have similar shaped contours. Both the PM2.5(24 hour maximum) and PM2.5 (annual average) limits for PM2.5 are met at all sensitive receptors.

PM10

As with Case 1, the dust contours, particularly the maximum PM10 (24 hour) contours show that there are periods over the two year modelling simulation when adverse meteorological conditions persist for at least 24 hours leading to elevated dust levels some distance from the mining areas. It should be noted that the total dust emissions from the operations are similar for both Case 1 and Case 2. However, with Case 2 there is greater activity in the northern parts of the site and, as a consequence, the Case 2 off-site dust exposure is greater for those locations closer to the northern pits than the southern pits.

The most significant difference is the increase in the PM10 (24 hour maximum) dust levels to the south of Alpha. The PM10(24 hour) maximum at Villafield increases from 41 $\mu g/m^3$ to 54 $\mu g/m^3$ between Case 1 and Case 2. This increase is due to more intensive activity in the northern pits. The PM10(24 hour) maximum at Chesalon decreases from 50 $\mu g/m^3$ to 40 $\mu g/m^3$ between Case 1 and Case 2. This reduction is due to less intensive activity in the southern pits and the westward progress in the southern open cut mining area.

The maximum PM10(24 hour) concentration exceeds the 50 $\mu g/m^3$ limit at the accommodation village for three days per year. However, the PM10(24 hour) 5th highest readily complies with the 50 $\mu g/m^3$ limit.

The PM10 (24 hour maximum) concentration exceeds the limit at Villafield, however the PM10 (24 hour 5th highest) readily complies with the 50 $\mu g/m^3$ limit.

TSP

The TSP (annual average) limit is readily met at all sensitive receptors.

Dust Deposition

The dust deposition (maximum month) contours show that most dust fall will occur west of the site above the underground mining area. Dust deposition is highest at the accommodation village, Betanga and Corntop Station Homesteads. At these locations the maximum month fallout is 55 $mg/m^2/day$ (including the assumed background of 45 $mg/m^2/day$) although this is still significantly less than the 120 $mg/m^2/day$ limit. The dust fallout at all sensitive receptors readily complies with the limit.

Comment on Cumulative Impacts

The impact has been based on the incremental increase above the existing ambient conditions. However, it is understood that development of this mine is contingent on a railway line to be built as part of the Galilee Coal Project, some 40 km north of the SGCP.

It is likely that Galilee Coal Project will cause an increase in dust exposures for sensitive locations north of the subject site. The further north the greater the likely exposure. The greatest impact will be in terms of the annual average exposures. For instance, Eureka Station Homestead is situated between the two mines. This location is likely to experience an increase in the TSP (annual average) of 2 µg/m^3 and the overall exposure including a background of 25 µg/m^3 is 27 µg/m^3. If the Galilee Coal Project exposure is of a similar magnitude the total cumulative exposure would still be considerably below the limit of 90 µg/m^3.

The maximum (24 hour) dust levels are not cumulative, these are "acute" exposures. For instance the highest dust levels at sensitive receptors north of the subject site require a southerly wind from SGCP and a northerly wind from Galilee Coal Project. Hence the reported maximum "acute" dust exposure levels do not require further correction for other dust sources.

Generally the increase above existing ambient levels at all sensitive receptors is relatively low (i.e. an increase in dust exposure of less than 20% and in many instances less than 10% above the dust levels currently experienced in the area). This implies that the SGCP has minimal impact on the air sheds' ability to accept additional industrial (mining) operations.

4.4 Railway Corridor Assessment

As described in Section 1.1, AMCI proposes to connect to a common user rail line linking the Galilee Basin and Abbot Point Coal Terminal. This proposed rail line is likely to terminate approximately 40 km north of the SGCP. It is understood the railway proposed for the Galilee Coal Project comprises a standard gauge railway to support up to 25,000 tonne trains. Furthermore a dual track is proposed, one for loaded trains and the other for empty trains returning to the mines.

It is beyond the scope of this assessment to address the dust emissions for the entire rail line route. PAE Holmes (2011) has assessed the dust emissions for the route between the Galilee Coal Project and the Abbot Point Coal Terminal. The PAE Holmes (2011) assessment assumed a total modelled transport coal capacity of 400 Mtpa, rather than the 40 Mtpa from Waratah Coal only in order to reflect the projected cumulative impacts along the rail corridor (including use of the common user rail line by the SGCP).

Hence this assessment addresses the rail spur from the SGCP to the proposed common user rail line.

This assessment has been based on the current best emission methods. However, the proponent is committed to complying with QR's Coal Dust Management Plan, which stipulates various control measures (e.g. spray-on coal dust suppressant). This assessment is conservatively based on current dust emissions, rather than future controlled (lower) emissions.

4.4.1 Railway Modelling

Emission Rate

Dust is emitted from wagons whilst in transit. According to Connell Hatch (2008), coal dust can be emitted from the following sources in the coal rail system:

- coal surface of loaded wagons;
- coal leakage from doors of loaded wagons;
- wind erosion of spilled coal in corridor;
- residual coal in unloaded wagons and leakage of residual coal from doors; and
- parasitic load on sills, shear plates and bogies of wagons.

That study also concluded that at least six ambient air quality monitoring studies have been undertaken since 1993 to specifically investigate and quantify concentrations of TSP, PM10 and dust deposition rates adjacent to rail lines carrying coal. These studies did not find the potential for health impacts inside or outside of the rail corridor as assessed against current air quality goals due to coal dust emissions from trains. These studies did not find the potential for amenity impacts outside the rail corridor due to coal dust emissions from trains when assessed against current air quality guidelines for nuisance. It also concluded that ground level concentrations of TSP (and PM10) comply with EPP(Air) goal and NEPM(Air) standard for human health at distance up to 10-15 m from the railway line.

The Connell Hatch (2008) study determined that the emission rate for coal dust from the coal surface of loaded wagons to be in the form:

$$m = k_1.v^2 + k_2.v + k_3$$

where:

- m is the mass emission rate of coal dust (as TSP) from the wagon surface in g/km/tonne of coal transported;
- k_1 is a constant with a value of 0.0000378;
- k_2 is a constant with a value of -0.000126;
- k_3 is a constant with a value of 0.000063; and
- v is the air velocity travelling over the surface of the train in km/h.

Since the Connell Hatch study concluded that the dust goals are met very close to railways it is considered to be a low-impact dust source. Hence a simplified model has been developed assuming a coal train travelling at high speed and various setback distances incorporating the site meteorology.

Assuming that the coal train is travelling at 80 km/h and the wind speed is 20 km/h (i.e. effectively 100 km/h over the surface of the coal) and an annual tonnage of product coal of 17 Mtpa, then the total annual emissions per km of track is 5.8 tonnes per km of track per year. It is understood that each loaded train carries an average of 9,500 tonnes of coal. This implies that up to 1700 trains per annum or 4.6 trains per day. It is likely that the peak number of trains in a single day would be less than nine (i.e. during periods of high demand). Hence for the purposes of modelling the maximum daily emission rate is taken to be double the long term average (i.e. 9.2 trains per day).

Thus the daily emission rate per km of railway line is conservatively assessed to be 0.032 tonnes of TSP. The PM10 fraction is taken to be 0.5 of TSP (Connell Hatch 2008) and PM2.5 fraction to be 12% of the PM10.

The emission rate is worst-case since the train travelling at the maximum speed with a head wind of 20 km/h and the number of trains per day has been increased by 100% above the long term average to account for production fluctuations.

Modelling

It is not proposed to model the entire route, rather it is proposed to model a 10 km length of the SGCP rail spur and calculate the dust concentration at setbacks between 100 m and 10 km west of the railway. The Ausplume modelling has been run with the TAPM meteorological file developed for the site. The railway line was modelled as a series of volume sources with a spacing of 50 m between each source as recommended by the Ausplume manual.

The calculated ground level atmospheric dust concentration is contained in Table 13.

Table 13: Calculated Dust Concentration Levels at Various Setback Distance from The Railway Line Between SGCP and Proposed Railway

Dust Index	**Atmospheric Dust Concentrations in (µg/m^3) at various setback distances from Railway**							
	100 m	**200 m**	**300 m**	**500 m**	**1 km**	**2 km**	**5 km**	**10 km**
PM2.5 (24 hour) Maximum	0.7	0.5	0.4	0.3	0.2	0.2	0.1	0.1
PM2.5 (Annual Average)	0.5	0.3	0.2	0.2	0.1	0.1	0.0	0.0
PM10 (24 hour) Maximum	3.8	3.1	2.5	1.9	1.3	0.8	0.4	0.2
TSP (Annual Average)	2.9	2.1	1.6	1.0	0.6	0.3	0.1	0.0

The closest sensitive receptor to the railway is approximately 2 km, refer to Table 1, specifically, Oakleigh Station Homestead, Saltbush Station Homestead and the proposed mining camp. The closest residence to the east of the railway corridor is Mentmore Station homestead is more than 2 km distant. Since the speed of the train is close to zero near the proposed mining camp this assessment does not apply and the dust emission would be considerably lower in the vicinity of the rail loop. The total dust exposure at the sensitive receptors within 2 km of the railway line and at Alpha is contained in Table 14. The railway causes a slight increase in the PM10 (24 hour) dust exposure at Colorado Station and Saltbush Station Homesteads. However, the total dust level complies with the proposed exposure goals.

Table 14: Calculated Dust Levels At Alpha, and Sensitive Receptors Within 2 km of the Railway Line (Incorporating Mining Dust Exposure and Background Dust Levels)

Receptor	***Calculated Dust Levels At Nearby Residences***					
	PM2.5 (24 hour) (Maximum) (µg/m^3)	***PM2.5 (annual average) (µg/m^3)***	***PM10 (24 hour) (5th Highest) (µg/m^3)***	***PM10 (24 hour) (Maximum) (µg/m^3)***	***TSP(Annual Average) (µg/m^3)***	***Dust Deposition (max month) (mg/m^2/day)***
Limit	**25**	**8**	**50**	**50**	**90**	**120**
Existing Ambient	***8***	***5***	***18***	***18***	***25***	***45***
Case 1 2017						
Alpha Township	10	5	24	33	25	47
Oakleigh Station Homestead	9	5	24	27	27	52
Saltbush Station Homestead	10	5	25	37	26	47
Proposed Accommodation Village	14	5	38	58 {exceeds 50 for 1 24 hour period}	29	55
Case 2 2040						
Alpha Township	10	5	25	33	25	48
Oakleigh Station Homestead	9	5	26	27	27	50
Saltbush Station Homestead	11	5	27	35	26	47
Proposed Accommodation Village	16	5	43	78 {exceeds 50 for 3 24 hour periods}	29	55

4.5 Recommendations and Mitigation Measures

4.5.1 Long-term Dust Monitoring

To address the issues of:

(a) potential PM10 (24 hour maximum) exceedance at the proposed accommodation village in Case 1;
(b) potential PM10 (24 hour maximum) exceedance at Villafield Station Homestead and the proposed accommodation village in Case 2;
(c) future dust exposure levels from the Galilee Coal Project; and
(d) the effect of the tree zone on dust fallout,

it is recommended that the existing long-term real-time dust concentration monitoring network (i.e. the Creek Farm station homestead and Alpha) be maintained to demonstrate seasonal variation of the air quality of the area. The units should be left in place for a minimum period to account for the ramp up in production and the operation of the dragline in the northern pits.

As this monitoring network has be installed prior to the commencement of construction, it will provide details of the existing long-term dust levels as it will be subjected to dust from non-SGCP activities (agricultural activities, homesteads and Alpha township).

The units are capable of recording PM10 atmospheric concentrations on a daily basis. Once construction has commenced the monitoring results should be reviewed on a monthly basis to assess whether the site is causing an increase in dust concentration above that predicted in this study. When reviewing the dust concentration monitoring data, other relevant data should be considered including the prevailing meteorology, extraction rates and other operations processes.

The proponent has installed two ESI DRX systems and the units are currently being field tested and results evaluated. DRX systems generally have demonstrated good accuracy with a wide variety of dusts. However, the proponent in this instance intends to calibrate the units to a high-volume reference standard. This calibration will take place during the dry season when ambient dust levels are likely to be higher. The calibration factor will be programmed into the unit so that all reported results include the calibration correction.

As discussed with DERM, in order to evaluate the accuracy of the units, a high volume sampler monitoring event should be scheduled within the first 12 months of operation of the long-term dust monitoring units.

4.5.2 Meteorological Monitoring

Local meteorological data will be collected from a monitoring station installed by the SGCP at the Creek Farm Homestead. It is recommended that this station continue to collect temperature, relative humidity, rainfall and wind speed data over the life of the SGCP.

4.5.3 Dust Deposition Monitoring

As described in Table 3, a network of seven dust deposition gauges has been installed at sensitive receptors surrounding the SGCP. It is recommended that dust deposition (fallout) monitoring continues to be undertaken at these locations over the life of the SGCP.

4.5.4 Dust Management Plan

A Dust Management Plan should be developed and implemented to mitigate adverse air quality impacts under worst case meteorological conditions.

Although many of these measures are standard operating procedures for the mine, Table 15 provides a summary of control procedures to mitigate dust emissions.

Table 15: Dust Mitigation Measures

Source	**Mitigation Measure**
Mining Areas	Disturb the minimum area necessary for mining and rehabilitate promptly.
Coal Handling Area	Use water sprays and water trucks to suppress dust in coal handling areas.
Stockpiles	Maintain water sprays on raw and product coal stockpile and transfer points. Topsoil stockpiles should be sown with an appropriate plant mix and managed to ensure adequate ground cover is maintained.
Haul Roads	Maintain haul roads in good condition and use water trucks regularly to suppress dust. Investigate use of chemical suppressants if haul roads become too slippery.
Other Roads	Keep usage to a minimum and maintain in good condition. Use water trucks regularly to suppress dust.
Waste Rock Emplacements	Keep these areas moist, particularly if used by dump trucks. Keep the recently spread material moist to encourage crusting of surface.

5. Greenhouse Gas Emissions

The Australian Department of Climate Change and Energy Efficiency (DCCEE) delivers the majority of programs under the Australian Government's climate change strategy. The DCCEE provides a workbook, the 'National Greenhouse Accounts (NGA) Factors' (June 2011) to enable industry to calculate greenhouse gas emissions (GHG) using appropriate methods and emission factors.

The *National Greenhouse and Energy Reporting Act 2007* (the NGER Act) introduced a national framework for the reporting and dissemination of information about the greenhouse gas emissions, greenhouse gas projects, and energy use and production of corporations. The NGER doesn't cover Scope 3 reporting. Hence NGER is used for Scope 1 and Scope 2 future emissions and the 2009 NGA Workbook was used to estimate the Scope 3 future emissions from the project.

The scope that emissions are reported under is determined by whether the activity is within the organisation's boundary (direct emissions are scope 1) or outside it (indirect emissions scope 2 and scope 3).

5.1 Estimated Greenhouse Gas Emissions

It is expected the SGCP construction phase would commence in 2013. The operations phase will commence in 2015, with production ramped-up over five years. Operations are anticipated to continue for 33 years.

The principal sources of Scope 1 greenhouse gas emissions would be:

- the consumption of diesel by the mining fleet;
- methane emissions (fugitive) from coal;
- burning of cleared vegetation.

Total biomass of the type of vegetation to be cleared is sourced from Raison (2003) and accounts for Eucalypts biomass, other species biomass, dead biomass and root biomass. The likely biomass is in the range 36 tonnes/ha to 123 tonnes/ha. Based on the generally disturbed nature of the site, it is proposed to adopt a biomass of 36 tonnes/hectare. The assessment assumes that all vegetation to be removed would be burned to provide a conservative worst case assessment.

The clearing of Eucalypts biomass not only results in direct emissions from burning but also involves a loss of carbon sink area. Most of the cleared areas will be progressively revegetated with similar local plant species. After the project is complete the loss of vegetation area (and acting as a carbon sink) is equivalent to the size of the pit and any remaining supporting roads and infrastructure area.

In terms of the project timeline, initial clearing of vegetation will occur in the pit, waste rock emplacments, roads, railways and infrastructure areas. This is the initial extent of cleared vegetation and hence carbon sink. Once the mine is operating at capacity, the removal of forest will be approximately balanced by the revegetation of the overburden dumps. Once pit mining is complete, the revegetation of overburden would continue over the site to include all relevant mining and overburden areas.

The annual capacity of Eucalypt forest to fix carbon is dependent on a large number of environmental factors such as rainfall, temperature etc. Typically the long-term average carbon sink capacity for Eucalypt biomass in central Queensland is 0.53 tC Ha^{-1} y^{-1} (Burrows et. al., 2002). It is understood that approximately 500 hectares will be cleared initially and for the purpose of this assessment it is conservatively assumed that 500 hectares will remain cleared. Thus there is a loss of carbon sink of 265 tC per annum for the duration of the project. This is multiplied by 3.67 (source NGA 2011) to obtain an annual loss of sink capacity of 970 tonnes CO2 -e.

The coal will be hauled by diesel locomotives. An in-service fuel consumption of 0.0026 L per kilometre per tonne for loaded trains and 0.0077 L per tonne km for unloaded trains has been assumed (Connell Wagner, 2006). A payload capacity of 20,000 tonnes per train has been assumed, and 25,000 tonnes gross. It is assumed that each train has a journey of 500 km to port. Thus total fuel consumption for each return journey per 20,000 tonnes of coal is 51,750 litres of diesel.

The key assumptions underlying the greenhouse gas inventory are accessed from the 2011 NGA workbook and listed below.

- The Scope 1 CO_2 emissions or direct emissions for diesel transport are calculated using the 69.2 kg CO2-e/GJ or 2.7 kg CO2-e/L factor for energy factor of 38.6 GJ/kL. For CH_4 the emission factors are 0.2 kg CO2-e/GJ and for N_2O the emissions are 0.5 kg CO2-e/GJ.
- The Scope 1 emissions or direct emission associated with coal seam methane release prior to the production of coal (fugitive) for open cut mining in Queensland is 0.017 CO2-e/tonne raw coal as CH_4.
- The Scope 1 emissions or direct emissions for ANFO is 0.167 t CO2 / t product as N_2O.
- The Scope 1 emissions or direct emissions associated with clearing vegetation is estimated to be 36 tonnes/ha. To calculate the carbon dioxide emitted when this vegetation is burned the quantity of carbon is multiplied by 3.67 (source NGA 2011).
- The Scope 2 emissions or indirect emissions from the Queensland electricity grid are calculated to be 0.89 kg CO2-e/kWh.
- The Scope 3 emissions or indirect emissions for production of diesel is 5.3 kg CO2-e/GJ.
- The Scope 3 emissions or indirect emissions from the Queensland electricity grid are 0.12 kg CO2-e/kWh. These are associated with losses in the electricity distribution system.
- The Scope 3 emissions or indirect emissions as the consequence of transportation by Rail (diesel locomotives) to the port is 69.2 kg CO2-e/kWh. For CH_4 the emission factors are 0.2 kg CO2-e/GJ and for N_2O the emissions are 0.5 kg CO2-e/GJ.

The electricity and diesel consumption for the mine have been provided by the proponent. It is assumed that ANFO consumption will be 200 t/Million tonnes of overburden.

Based on these assumptions, the projected emissions over the life of the project are contained in Table 16 for Scope 1 emissions and Table 17 for Scope 2 and 3 emissions. The total annual emissions in tonnes for Scope 1 greenhouse gases (CH_4, CO_2 and N_20) are given in Table 18.

Table 16: Greenhouse Gas Emissions for Life of Mine (Scope 1)

Year	Source Data					Greenhouse Gas Emissions (tonnes *10³ CO2-e)				
	Coal ROM	Total Waste (Prime)	ANFO	Diesel for Machinery	Cleared and Burnt	Scope 1				
	M tonnes	M tonnes	k tonnes	kL	ha	Coal Seam Gas	Diesel for Machinery	ANFO	Burning Biomass	Total
2013	0.0	4.3	0.9	3,515	501	0	9	0	66	75
2014	0.0	4.4	0.9	3,715	167	0	10	0	22	32
2015	5.6	54.1	10.8	25,949	167	95	70	2	22	189
2016	5.7	67.3	13.5	27,441	167	98	74	2	22	196
2017	10.4	81.8	16.4	27,782	167	177	75	3	22	277
2018	11.9	77.1	15.4	26,862	167	202	72	3	22	299
2019	14.2	84.5	16.9	27,084	167	241	73	3	22	339
2020	14.0	80.8	16.2	27,713	167	238	75	3	22	338
2021	15.4	68.1	13.6	18,817	167	262	51	2	22	337
2022	18.0	68.6	13.7	18,893	167	306	51	2	22	381
2023	17.2	57.1	11.4	13,666	167	292	37	2	22	353
2024	18.6	56.4	11.3	13,310	167	317	36	2	22	377
2025	17.6	54.5	10.9	12,121	167	299	33	2	22	356
2026	17.6	56.0	11.2	12,820	167	300	34	2	22	358
2027	17.9	44.7	8.9	14,278	167	305	38	1	22	367
2028	17.5	41.5	8.3	12,527	33	297	34	1	4	336
2029	17.5	46.0	9.2	13,224	33	298	36	2	4	340
2030	17.8	51.0	10.2	13,891	33	303	37	2	4	346
2031	18.6	53.8	10.8	13,712	33	317	37	2	4	360
2032	17.7	67.0	13.4	13,182	33	300	35	2	4	341
2033	17.8	60.0	12.0	12,477	33	303	34	2	4	343
2034	17.2	66.9	13.4	13,534	33	292	36	2	4	334
2035	16.6	66.4	13.3	13,043	33	282	35	2	4	323
2036	17.0	67.8	13.6	13,753	33	289	37	2	4	332
2037	17.4	74.4	14.9	14,171	33	296	38	2	4	340
2038	16.6	74.3	14.9	14,151	33	283	38	2	4	327
2039	18.0	86.1	17.2	15,679	33	306	42	3	4	355
2040	16.8	86.8	17.4	15,677	33	286	42	3	4	335
2041	16.9	73.4	14.7	14,286	33	288	38	2	4	332
2042	17.4	60.9	12.2	15,407	33	296	41	2	4	343

Year	Source Data					Greenhouse Gas Emissions (tonnes *10^3 CO2-e)				
	Coal ROM	Total Waste (Prime)	ANFO	Diesel for Machinery	Cleared and Burnt	Scope 1				
	M tonnes	M tonnes	k tonnes	kL	ha	Coal Seam Gas	Diesel for Machinery	ANFO	Burning Biomass	Total
2043	11.2	60.6	12.1	15,036	0	191	40	2	0	233
2044	10.5	70.5	14.1	15,514	0	178	42	2	0	222
2045	10.4	62.7	12.5	15,250	0	177	41	2	0	220
2046	10.9	82.6	16.5	16,436	0	185	44	3	0	232
2047	10.9	82.6	16.5	16,436	0	185	44	3	0	232
Total	499	2,195	439	561,352	3,334	8,484	1,509	72	434	10,507

Table 17:Greenhouse Gas Emissions for Life of Mine (Scope 2 and 3)

Year	Source Data						Greenhouse Gas Emissions (tonnes * 10^3 CO2 -e)					
	Coal Product	Overburden	Diesel	Elect	Rail		Scope 2		Scope 3			
	M tonnes	M tonnes	kL	Mwh	Trips	Fuel kL	Elec QLD Grid	Total	Diesel	Elect. grid loss	Diesel Rail	Total
2013	0	4	3,515	0	0	0	0	0	1	0	0	1
2014	0	4	3,715	0	0	0	0	0	1	0	0	1
2015	5.4	54	25,949	10,815	270	13,973	10	10	5	1	38	44
2016	5.4	67	27,441	38,925	271	14,024	34	34	6	5	38	49
2017	9.7	82	27,782	67,470	483	24,995	59	59	6	8	67	81
2018	10.7	77	26,862	65,436	536	27,712	58	58	6	8	75	89
2019	13.0	84	27,084	67,470	650	33,612	59	59	6	8	90	104
2020	12.7	81	27,713	67,689	635	32,861	60	60	6	8	88	102
2021	13.9	68	18,817	79,741	693	35,863	70	70	4	10	96	110
2022	16.1	69	18,893	79,741	804	41,581	70	70	4	10	112	126
2023	15.3	57	13,666	79,741	766	39,641	70	70	3	10	107	120
2024	16.6	56	13,310	79,961	829	42,901	70	70	3	10	115	128
2025	15.6	55	12,121	79,741	782	40,443	70	70	2	10	109	121
2026	15.7	56	12,820	79,741	783	40,520	70	70	3	10	109	122
2027	15.9	45	14,278	51,116	797	41,245	45	45	3	6	111	120
2028	15.5	42	12,527	51,257	777	40,184	45	45	3	6	108	117
2029	15.5	46	13,224	57,250	777	40,210	50	50	3	7	108	118
2030	15.9	51	13,891	65,429	793	41,038	58	58	3	8	110	121
2031	15.7	54	13,712	71,563	785	40,624	63	63	3	9	109	121
2032	15.7	67	13,182	100,464	787	40,701	88	88	3	12	110	125
2033	15.9	60	12,477	89,965	794	41,090	79	79	3	11	111	125
2034	15.4	67	13,534	100,188	771	39,873	88	88	3	12	107	122
2035	14.9	66	13,043	100,188	744	38,502	88	88	3	12	104	119
2036	15.2	68	13,753	100,464	762	39,434	88	88	3	12	106	121
2037	15.6	74	14,171	112,456	780	40,365	99	99	3	13	109	125
2038	15.0	74	14,151	112,456	748	38,683	99	99	3	13	104	120
2039	16.2	86	15,679	130,858	811	41,943	115	115	3	16	113	132

Year	Source Data						Greenhouse Gas Emissions (tonnes * 10^3 CO2 -e)					
	Coal Product	Overburden	Diesel	Elect	Rail		Scope 2		Scope 3			
	M tonnes	M tonnes	kL	Mwh	Trips	Fuel kL	Elec QLD Grid	Total	Diesel	Elect. grid loss	Diesel Rail	Total
2040	15.1	87	15,677	131,218	756	39,097	115	115	3	16	105	124
2041	15.2	73	14,286	110,411	762	39,434	97	97	3	13	106	122
2042	15.8	61	15,407	81,786	788	40,779	72	72	3	10	110	123
2043	10.3	61	15,036	81,786	515	26,651	72	72	3	10	72	85
2044	9.7	70	15,514	100,464	483	24,969	88	88	3	12	67	82
2045	9.6	63	15,250	85,875	482	24,944	76	76	3	10	67	80
2046	9.6	83	16,436	122,533	482	24,944	108	108	3	15	67	85
2047	9.6	83	16,436	122,533	482	24,944	108	108	3	15	67	85
Total	447.4	2,195	561,352	2,776,731	22,378	1,157,780	2,444	2,441	119	336	3,115	3,564

Table 18: Estimated Emissions of Scope 1 Greenhouse Gas Components

Year	Emissions of Greenhouse Gas (tonnes*1000) For Year		
	CO_2	CH_4	N_20
2013	75.6	0.0	0.00
2014	32.0	0.0	0.00
2015	91.2	4.5	0.04
2016	95.2	4.7	0.05
2017	96.1	8.4	0.05
2018	93.6	9.6	0.05
2019	94.2	11.5	0.06
2020	95.9	11.3	0.05
2021	72.2	12.5	0.05
2022	72.4	14.6	0.05
2023	58.5	13.9	0.04
2024	57.5	15.1	0.04
2025	54.4	14.2	0.04
2026	56.2	14.3	0.04
2027	60.1	14.5	0.03

Year	Emissions of Greenhouse Gas (tonnes*1000) For Year		
	CO_2	CH_4	N_20
2028	37.8	14.2	0.03
2029	39.6	14.2	0.03
2030	41.4	14.4	0.03
2031	40.9	15.1	0.04
2032	39.5	14.3	0.04
2033	37.6	14.4	0.04
2034	40.5	13.9	0.04
2035	39.2	13.4	0.04
2036	41.0	13.8	0.04
2037	42.2	14.1	0.05
2038	42.1	13.5	0.05
2039	46.2	14.6	0.06
2040	46.2	13.6	0.06
2041	42.5	13.7	0.05
2042	45.5	14.1	0.04
2043	40.0	9.1	0.04
2044	41.3	8.5	0.05
2045	40.6	8.5	0.04
2046	43.8	8.8	0.05
2047	43.8	8.8	0.05
Total	1,937	404	1.5

5.2 Discussion and Abatement Measures

The development of underground operations to extract coal (rather than only open pit operations) is a significant mitigation measure to reduce greenhouse gas emissions. This underground operation has necessitated a conveyor system to transport coal to the CHPP. Since this infrastructure passes the open pit, there are dump stations to the conveyor to significantly shorten the coal haul route. Similarly, draglines are more efficient that diesel operated trucks. The SGCP has adopted both systems. Both these operations have significantly lower carbon equivalent emission compared with transport by diesel operated trucks. This is a direct means of reducing greenhouse gases.

The sizing and selection of mobile diesel powered equipment has an important bearing on greenhouse gas emissions. Diesel fuel consumption rates are an integral part of the decision matrix for their selection and fuel costs and efficiencies one of the most important parameters. Therefore higher fuel prices have made coal producers increasingly aware of fuel costs with flow on effects on consumption and greenhouse gas emissions subsequently.

The proponent is committed to the concept of sustainable development and the Greenhouse

Challenge Plus, which was part of the Australian Government's Climate Change Strategy. The proponent is fully committed and complies with its obligations under the National Greenhouse Energy reporting (NGER) and specifically annual reporting of greenhouse gas emissions. The proponent is committed to reducing the greenhouse gas emissions of its operations, accelerating the uptake of energy efficiency, integrating greenhouse issues into business decision making and providing more consistent reporting of greenhouse gas emission levels.

Direct means of reducing greenhouse gas emissions could include such measures as:

- minimising clearing at the site;
- utilising the existing Central Line Railway where practicable to transport construction material/equipment;
- utilising the Galilee Basin common user rail line to transport supplies/equipment during the operations phase, where practicable;
- maximising the use of renewable energy sources; and
- improved accuracy in greenhouse gas measurement by advancing from default factors to direct measurement methodologies.

Indirect means of reducing greenhouse gas emissions could include such measures as:

- carbon sequestration at nearby or remote locations by:
  - progressive rehabilitation of disturbed areas; and
  - planting trees or other vegetation to achieve greater biomass than that cleared for the SGCP; and
- carbon trading through recognised markets.

The Environmental Management Plan will include a specific module to address greenhouse abatement. This module will include:

- commitments to the abatement of greenhouse gas emissions from the development with details of the intended objectives, measures and performance standards to avoid, minimise and control emissions;
- commitments to energy management, including undertaking periodic energy audits with a view to progressively improving energy efficiency;
- a process for regular review of new technologies to identify opportunities to reduce emissions and use energy efficiently, consistent with best practice environmental management;
- any voluntary initiatives such as projects undertaken as a component of the national Energy Efficiency Opportunities program, or research into improving the lifecycle and reducing the embodied energy and carbon intensity of the project’s processes or products;
- opportunities for offsetting greenhouse emissions, including, if appropriate, carbon sequestration and renewable energy uses; and
- commitments to monitor, audit and report on greenhouse emissions from all relevant

activities and the success of offset measures.

5.3 Climate Change Adaptation

The Garnaut Review (2008) states "Effects of future warming on rainfall patterns are difficult to predict because of interactions with complex regional climate systems. Best-estimate projections show considerable drying in southern Australia, with risk of much greater drying. The mainstream Australian science estimates that there may be a 10 per cent chance of a small increase in average rainfall, accompanied by much higher temperatures and greater variability in weather patterns."

The life of the mine is approximately 35 years and the likely changes over this time will be gradual and relatively minor. A reduction in rainfall and an increase in temperatures will result in higher dust emissions. However, the changes are only likely to be small and within the capacity of management to respond within the bounds of current dust control technology. It is expected the risk of a significant increase in emissions is very small.

Management commits to undertake, where practicable, a cooperative approach with government, other industry and sectors to address adaptation to climate change. The proponent is committed to reducing its greenhouse gas emissions and is an active contributor to research programs to develop clean coal technologies.

6. Conclusion

Monitoring of the existing environment has revealed that the existing PM10 levels are relatively low. There appears to be a diurnal cycle with the lowest dust levels at night and the highest during the day.

It was determined that the key issue to be addressed in the assessment is dust and that other air pollution measures have minor and impacts localised to the lease area. From the EPP(Air) there are four environmental objectives associated with health and wellbeing. From the DERM Licensing and Permits, a single nuisance objective was obtained.

The modelling was carried out using the TAPM air quality model. This model was also used to develop the meteorology data set used in the modelling. The modelling simulation was carried out over two years, 2004 and 2005.

The development of the representative emissions database has been primarily based on the National Pollution Inventory Emission Estimation Technique Manual for Mining Version 2.3. The main mining activities and processes that produce, or could produce, dust emissions were identified for the SGCP operations. Flowcharts for handling of overburden, interburden, coal and waste rock were developed and an emission factor (from NPI) was attributed to every handling point, handling activity and transport section. In addition emissions from exposed surfaces were identified and included in the database.

The predicted average ground level concentrations at nearby sensitive areas were modelled and Section 4.1 contains a full description of the modelling methods. The methodology includes both normal and expected maximum emission conditions and the worst meteorological conditions. The ground level predictions were made at all residential locations and the contours cover adjacent industrial and agricultural developments. All the techniques used to obtain the predictions have are referenced and key assumptions and data sets explained.

Two main cases were addressed representing Year 3 and Year 26.

The first case is during the initial phase of the mine, Year 3 (2017) when the projected waste rock reaches it's maximum at 55.3 Mbcm. The product coal for this year is 9.7 Mtpa.

The second case (Year 26 - 2040) is a fully developed mine with the projected waste rock reaches its local maximum at 37.7 Mbcm. The product coal for this year is 15.1 Mtpa.

Both cases relate to the maximum rate of handling of overburden for the respective mining phases. During the first 20 years of the mine's life there are only three cases where the total waste rock exceeds 40 Mbcm, with the typical mining rate being 20 to 30 Mbcm. Although total ROM coal increases up to 18 Mtpa during this period, the increase is mostly due to the ramp up in underground mining operations.

The modelling results for both cases at selected locations likely are contained in Table 19. For most sensitive locations the dust exposure is low and well below the dust goals. However, it is possible that the PM10(24 hour) maximum is likely to exceed the goal between one and three occasions per year at the mining camp. It is likely that Villafield Station Homestead will be exceed the PM10(24 hour) maximum on one occasions over the two-year modelling simulation. However, the PM10(24 hour) 5th highest limit of 50 µg/m^3 is readily met at all locations for both cases. The annual average dust exposure at Alpha is within 5% of the existing dust levels.

Table 19: Dust Exposure Levels At Selected Sensitive Receptors For Case 1 and Case 2

Receptor	***Calculated Dust Levels At Nearby Residences***					
	PM2.5 (24 hour) (Maximum) ($\mu g/m^3$)	***PM2.5 (annual average) ($\mu g/m^3$)***	***PM10 (24 hour) (5th Highest) ($\mu g/m^3$)***	***PM10 (24 hour) (Maximum) ($\mu g/m^3$)***	***TSP(Annual Average) ($\mu g/m^3$)***	***Dust Deposition (max month) ($mg/m^2/day$)***
Limit	**25**	**8**	**50**	**50**	**90**	**120**
Existing Ambient	***8***	***5***	***18***	***18***	***25***	***45***
Case 1 2017						
Proposed Accommodation Village	14	5	38	58 {exceeds 50 for 1 24 hour period}	29	55
Chesalon Station Homestead	12	5	32	50	27	50
Villafield Station Homestead	11	5	26	41	26	50
Bonanza Station Homestead	11	5	26	40	26	49
Creek Farm Station Homestead	11	5	31	41	27	50
Oakleigh Station Homestead	11	5	29	43	27	50
Eureka Station Homestead	12	5	34	45	27	49
Alpha Township	10	5	24	33	25	47
Case 2 2040						
Proposed Accommodation Village	16	5	43	78 {exceeds 50 for 3 24 hour periods}	29	55
Chesalon Station Homestead	11	5	28	40	27	49
Villafield Station Homestead	13	5	26	54 {exceeds 50 for 1 24 hour period}	26	49
Bonanza Station Homestead	11	5	26	40	26	49
Creek Farm Station Homestead	11	5	30	43	27	49
Oakleigh Station Homestead	12	5	27	50	27	49
Eureka Station Homestead	12	5	36	48	27	50
Alpha Township	10	5	25	33	25	48

The likely dust levels from the railway line has also been modelled. A conservative modelling methodology has been adopted and based on the latest emission rates for Queensland coal trains. It was determined that the dust exposure at all sensitive receptors is negligible and the cumulative impact (railway and mining) readily complies will all dust goals.

Subject to the dust emission controls described in Table 7 the mine complies with the proposed dust goals at all sensitive receptors. It is possible that under certain adverse conditions the mining camp may be subjected several days with elevated PM10 dust levels per year. During the later phase of the project (after a draglines commence operations in the northern pit), Villafield Station homestead may also be subject to a PM10(24 hour) maximum dust level every two years.

A greenhouse gas assessment was carried out utilising the 2011 NGA workbook and the best available projections for the SGCP. The SGCP will result in greenhouse gas emissions as the result of the use of diesel fuel, explosives, clearing and indirectly in the use of electrical power. Methane will be released from the coal seam. The quantities of greenhouse emissions are small and unlikely to have a measureable effect on climate. Nevertheless the proponent intends to seek new and improved ways to reduce greenhouse gas emissions and use clean coal technologies, whilst maintaining active involvement in appropriate greenhouse gas programs.

Glossary of Terms

PM10	particles in the air environment with an equivalent aerodynamic diameter of not more than 10microns.
PM2.5	particles in the air environment with an equivalent aerodynamic diameter of not more than 2.5 microns
PM01	particles in the air environment with an equivalent aerodynamic diameter of not more than 1microns.
TSP	total suspended particles are particles in the air environment with an equivalent aerodynamic diameter of not more than 50 microns.
air emission	a substance released into the air.

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Appendix 1 Climate Data for Emerald and Barcaldine

Emerald Climate Data

Statistic Element	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Mean maximum temperature (Degrees C) for years 1992 to 2011	34.3	33.4	32.8	29.9	26.2	23.3	23.2	25.3	28.9	31.7	33.1	34.2
Highest temperature (Degrees C) for years 1992 to 2011	45.6	41.5	40.8	36.7	34.3	31.3	31	35.2	37.7	42.4	42.9	43
Year of Highest temperature for years 1992 to 2011	1994	2005	2007	2006	2007	2003	1995	2009	1997	2003	2006	2001
Lowest maximum temperature (Degrees C) for years 1992 to 2011	24.1	20.9	21.9	17.2	17	9.7	13.6	12.6	15.7	21	20.7	19
Date of Lowest maximum temperature for years 1992 to 2011	2010	2000	2008	2011	2000	2007	2008	1996	1993	1995	1997	2006
Decile 1 maximum temperature (Degrees C) for years 1992 to 2011	30.6	29	29.8	26.6	23	19	20	21.2	24.6	27.8	29	29.5
Decile 9 maximum temperature (Degrees C) for years 1992 to 2011	38.3	37	36	33	29.1	27	26.2	29	33	36.3	37.2	38.7
Mean number of days >= 30 Degrees C for years 1992 to 2011	28.5	24.3	27.5	15.8	1.5	0.2	0.1	2.1	11.5	22	24.6	27.2
Mean number of days >= 35 Degrees C for years 1992 to 2011	12.9	9.4	6.1	0.6	0	0	0	0.1	1.1	5.3	9.3	13.7
Mean number of days >= 40 Degrees C for years 1992 to 2011	1.2	0.4	0.2	0	0	0	0	0	0	0.6	0.7	1.4
Mean minimum temperature (Degrees C) for years 1992 to 2011	22.2	22.1	20.3	17	12.9	10.1	8.8	10	13.5	17.2	19.5	21.4
Lowest temperature (Degrees C) for years 1992 to 2011	17	16.5	12.1	6.5	2	1.4	2	1	3	9.5	10.7	12.3

Year of Lowest temperature for years 1992 to 2011	2001	1996	2008	1994	2000	2009	2002	2003	1996	1992	2006	2006
Highest minimum temperature (Degrees C) for years 1992 to 2011	32.9	28.8	27.6	24	22	20	18.2	19.4	21.9	26.8	25.5	28.2
Year of Highest minimum temperature for years 1992 to 2011	1994	1995	2007	2000	1998	2002	2004	2011	1992	2003	2004	2005
Decile 1 minimum temperature (Degrees C) for years 1992 to 2011	20	19.7	17.5	13.6	8.3	5.1	4.5	6	9.5	13.9	16.7	18.6
Decile 9 minimum temperature (Degrees C) for years 1992 to 2011	24.5	24.4	23	20.5	17	14.6	13.7	14.5	17.6	20.5	22.4	24.3
Mean number of days <= 2 Degrees C for years 1992 to 2011	0	0	0	0	0.1	0.2	0.1	0.2	0	0	0	0
Mean number of days <= 0 Degrees C for years 1992 to 2011	0	0	0	0	0	0	0	0	0	0	0	0
Mean rainfall (mm) for years 1992 to 2011	87.9	81.5	50.9	33.7	19.3	30.8	11.8	24.2	30.5	40.1	56.1	91.2
Highest rainfall (mm) for years 1992 to 2011	231.6	216.2	335.2	130.1	66.6	143.4	76.4	128.2	167.6	213.4	143.6	263.8
Date of Highest rainfall for years 1992 to 2011	2004	2010	1994	1998	2005	2007	2008	1998	2010	1998	2008	2010
Lowest rainfall (mm) for years 1992 to 2011	6.2	3.7	1.4	0	0	0	0	0	0	0.2	2.8	10.2
Date of Lowest rainfall for years 1992 to 2011	1998	1993	2004	1993	2004	2004	2009	2006	2011	2002	2003	1994
Decile 1 monthly rainfall (mm) for years 1992 to 2011	15.5	17.1	3.9	1.8	0.2	1.2	0	0	0	4.5	6.2	22.5
Decile 5 (median) monthly rainfall (mm) for years 1992 to 2011	70.8	66.4	16.4	24.4	12.4	13.4	5.3	14	8.6	23.8	55.4	80.2
Decile 9 monthly rainfall (mm) for years	179.9	176	103.5	86.8	41.9	64.8	32.6	63.8	84.6	96.5	104.8	157.7

1992 to 2011												
Highest daily rainfall (mm) for years 1992 to 2011	132	112.8	140	90.5	49.2	36	60.2	51.5	48.2	72.8	43.6	119.8
Year of Highest daily rainfall for years 1992 to 2011	1996	2009	1994	1998	2005	2008	2008	1993	1996	1998	1996	2010
Mean number of days of rain for years 1800 to 3000	7.7	8.4	5.2	4.3	3.4	4.2	2.3	3.1	3.4	5.4	7.6	7.9
Mean number of days of rain >= 1 mm for years 1992 to 2011	5.7	5.8	3.5	3	2.2	3	1.3	2.2	2.5	3.9	5.8	5.9
Mean number of days of rain >= 10 mm for years 1992 to 2011	2.5	2.3	1.3	1.1	0.7	1.1	0.4	0.7	1.1	1.3	1.9	2.8
Mean number of days of rain >= 25 mm for years 1992 to 2011	1.1	1	0.7	0.4	0.1	0.5	0.1	0.3	0.4	0.4	0.7	1.2
Mean daily wind run (km) for years 1998 to 2011	300	289	289	266	237	249	251	254	266	303	313	314
Maximum wind gust speed (km/h) for years 1998 to 2011	78	81	72	61	63	68	59	70	76	144	106	106
Date of Maximum wind gust speed for years 1998 to 2011	2010	2008	2005	2011	2007	2006	2008	2010	1999	2007	2004	1998
Mean daily solar exposure (MJ/(m*m)) for years 1990 to 2011	25.3	23.4	22.8	19.2	16.3	14.5	15.6	18.3	21.9	24.3	25.5	26.3
Mean number of clear days for years 1992 to 2010	4.7	2.6	7.9	8.6	9.1	11.2	10.2	13.9	10.7	9.7	7.8	5.1
Mean number of cloudy days for years 1992 to 2010	8.6	10.1	6.1	4.5	5.3	4	5.3	5.3	5.1	5.8	7.4	7.6
Mean 9am temperature (Degrees C) for years 1992 to 2010	27.3	26.6	25.7	23	19.1	15.8	15.1	17.1	20.9	24	25.8	27.2

Mean 9am wet bulb temperature (Degrees C) for years 1992 to 2010	22	22.3	20.4	17.9	15	12.1	11.2	12.5	15.1	17.9	19.6	21.3
Mean 9am dew point temperature (Degrees C) for years 1992 to 2010	19.2	19.7	17.3	14.1	10.6	8.5	6.9	7.7	10.3	13.1	15.4	17.6
Mean 9am relative humidity (%) for years 1992 to 2010	63	68	61	60	60	64	60	57	54	53	55	58
Mean 9am cloud cover (okas) for years 1992 to 2010	4.6	4.7	4.3	3.8	3.7	3.8	3.9	3.5	3.8	3.6	3.9	4.5
Mean 9am wind speed (km/h) for years 1992 to 2010	15	15.2	16.1	15.4	14.9	15.6	14.6	15.3	15.4	16.3	15.1	15.1
Mean 3pm temperature (Degrees C) for years 1992 to 2010	33.1	32.3	31.9	29.2	25.6	22.6	22.5	24.4	28	30.6	32.1	33.2
Mean 3pm wet bulb temperature (Degrees C) for years 1992 to 2010	22.9	23.1	21.4	19	16.8	14.8	14.1	15.1	16.8	19.1	20.5	21.9
Mean 3pm dew point temperature (Degrees C) for years 1992 to 2010	17	17.7	14.5	11.5	8.9	7.5	5.7	5.7	6.9	9.5	12	14.5
Mean 3pm relative humidity (%) for years 1992 to 2010	41	45	37	36	37	41	36	32	30	31	33	36
Mean 3pm cloud cover (oktas) for years 1992 to 2010	4.8	5.3	3.8	4.3	3.9	3.5	3.7	3.6	3.7	3.3	4	4
Mean 3pm wind speed (km/h) for years 1992 to 2010	15.4	15	15.6	14.6	13.7	13.9	13.7	14.5	14.4	14.7	15.1	15

Source: Bureau of Meteorology web site (2011) for Emerald.

Barcaldine Climate Data

Statistic Element	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Mean maximum temperature (Degrees C) for years 1913 to 2011	35.6	34.5	33.2	30	26	22.8	22.6	24.9	28.6	32.2	34.5	35.7
Highest temperature (Degrees C) for years 1962 to 2011	44.8	42.6	41.3	37.3	35.2	33	32	35.7	39	41.8	45.1	44.6
Date of Highest temperature for years 1962 to 2011	1905	1983	1985	1966	2007	2002	1996	1970	1988	2002	2006	1979
Lowest maximum temperature (Degrees C) for years 1962 to 2011	22.4	20.8	21.7	14.2	15.2	7.8	12.6	12.9	16.6	18.7	20.9	20
Date of Lowest maximum temperature for years 1962 to 2011	1997	1989	1973	1983	1974	2007	1984	1996	2010	1964	1999	2006
Decile 1 maximum temperature (Degrees C) for years 1962 to 2011	31	30.7	30.2	26.8	22	18.8	18.3	20.7	24.2	28	30.2	31.4
Decile 9 maximum temperature (Degrees C) for years 1962 to 2011	39.6	38.5	36.7	33.7	29.6	27.1	26.8	29.5	33.6	36.8	39	40
Mean number of days >= 30 Degrees C for years 1962 to 2011	28.6	25.9	28	17.8	2.4	0.2	0.3	2.5	12.2	23.8	26.9	28.5
Mean number of days >= 35 Degrees C for years 1962 to 2011	19	14.5	9.1	1.1	0	0	0	0.1	1.3	7.6	14.1	19.3
Mean number of days >= 40 Degrees C for years 1962 to 2011	2.7	1.1	0.1	0	0	0	0	0	0	0.3	1.5	3.3
Mean minimum temperature (Degrees C) for years 1913 to 2011	23.1	22.6	20.8	16.7	12.3	9	7.9	9.4	13.3	17.5	20.3	22.2
Lowest temperature (Degrees C) for years 1962 to 2011	13	15.2	10.9	5.6	2.8	-1.6	-1.6	-0.3	2.2	5.8	10	12.2

Date of Lowest temperature for years 1962 to 2011	1970	2005	1966	1999	2000	1976	1974	2003	1976	1966	1964	1964
Highest minimum temperature (Degrees C) for years 1962 to 2011	29.3	30	28.6	25.8	21.1	19.1	18.9	20.5	23.4	26.8	28.3	30.4
Date of Highest minimum temperature for years 1962 to 2011	1999	2003	1985	2006	1995	2002	1993	1973	2003	2004	1995	1996
Decile 1 minimum temperature (Degrees C) for years 1962 to 2011	20.7	20.1	18.1	13.2	7.8	4.3	3.2	4.8	8.4	13.2	16.3	19.2
Decile 9 minimum temperature (Degrees C) for years 1962 to 2011	26.3	25.6	24.1	21	18	14.8	13.9	15.3	18.7	21.9	24.3	25.8
Mean number of days <= 2 Degrees C for years 1962 to 2011	0	0	0	0	0	0.7	1.3	0.3	0	0	0	0
Mean number of days <= 0 Degrees C for years 1962 to 2011	0	0	0	0	0	0.1	0.3	0	0	0	0	0
Mean daily ground minimum temperature Degrees C for years null to null												
Lowest ground temperature Degrees C for years null to null												
Date of Lowest ground temperature for years null to null												
Mean number of days ground min. temp. <= -1 Degrees C for years null to null												
Mean rainfall (mm) for years 1886 to 2011	86.1	78	59.8	36.7	30.5	24.2	22.7	15.9	16	29	40.1	64.2
Highest rainfall (mm) for years 1886 to 2011	481.2	362.6	357.1	333.6	255	124.2	171.6	123.4	152.2	154.2	285.5	298.3
Date of Highest rainfall for years 1886 to 2011	1974	1940	1963	1990	1983	1912	1984	1978	2010	1908	2010	1907

Lowest rainfall (mm) for years 1886 to 2011	0	0	0	0	0	0	0	0	0	0	0	0
Date of Lowest rainfall for years 1886 to 2011	1908	1959	2004	2008	2002	2004	2009	2011	2003	2002	1969	1938
Decile 1 monthly rainfall (mm) for years 1886 to 2011	11	9.5	2.1	0	0	0	0	0	0	1.9	4.2	8.9
Decile 5 (median) monthly rainfall (mm) for years 1886 to 2011	71	55.6	28.8	20.9	11.8	11	9.1	6.2	5.1	20.6	25.4	47.4
Decile 9 monthly rainfall (mm) for years 1886 to 2011	182.3	179.8	142.4	90.5	90.8	67.5	63	43.2	51.9	66.8	98.5	150.1
Highest daily rainfall (mm) for years 1887 to 2011	158.8	167.6	176.5	116.8	109.6	64.8	91.6	59.8	97.8	74.9	99.2	156.2
Date of Highest daily rainfall for years 1887 to 2011	1905	1922	1936	1918	1977	1945	1978	1978	1903	1945	2001	1907
Mean number of days of rain for years 1800 to 3000	7.3	6.8	5.1	3.3	2.8	2.8	2.4	2.1	2.5	4	5.2	6.5
Mean number of days of rain >= 1 mm for years 1887 to 2011	6	5.5	4.2	2.5	2.2	2.2	1.9	1.6	1.9	3.1	4	5.3
Mean number of days of rain >= 10 mm for years 1887 to 2011	2.5	2.1	1.6	1	0.9	0.8	0.8	0.5	0.5	1	1.2	1.9
Mean number of days of rain >= 25 mm for years 1887 to 2011	1.1	0.9	0.7	0.4	0.3	0.3	0.2	0.1	0.1	0.2	0.3	0.7
Mean daily wind run (km) for years null to null												
Maximum wind gust speed (km/h) for years null to null												
Date of Maximum wind gust speed for years null to null												
Mean daily sunshine (hours) for years null to												

null												
Mean daily solar exposure (MJ/(m*m)) for years 1990 to 2011	26.4	25.1	23.5	19.9	16.8	15.1	16.1	18.9	22.6	25.2	26.7	27.2
Mean number of clear days for years 1962 to 2010	8.8	7.4	11.5	13.9	14.3	17.3	20.2	20.5	19.6	17.2	11.9	10.1
Mean number of cloudy days for years 1962 to 2010	8.3	7.6	5.9	4.6	6.1	4.4	3.7	3	2.6	3.6	4.9	6.4
Mean daily evaporation (mm) for years null to null												
Mean 9am temperature (Degrees C) for years 1913 to 2010	28.2	27.2	26	22.8	18.5	14.7	14	16.5	20.8	24.7	27.2	28.4
Mean 9am wet bulb temperature (Degrees C) for years 1913 to 2010	21.6	21.6	20.1	17.1	13.9	11.3	10.2	11.4	14.1	16.8	19.1	20.8
Mean 9am dew point temperature (Degrees C) for years 1962 to 2010	18.4	18.6	16.5	13.9	10.2	8	6	5.9	8.1	10.6	13.5	16.5
Mean 9am relative humidity (%) for years 1938 to 2010	56	62	58	57	58	64	59	50	46	44	44	49
Mean 9am cloud cover (okas) for years 1913 to 2010	2.9	2.9	2.2	1.8	2.2	2	1.6	1.3	1.2	1.6	2	2.4
Mean 9am wind speed (km/h) for years 1962 to 2010	11.3	11.7	11.5	10.8	9	8.6	9.6	12.5	15	14.2	12.7	11.5
Mean 3pm temperature (Degrees C) for years 1962 to 2010	34.3	33.5	32.5	29.5	25.5	22.5	22.2	24.4	28.3	31.5	33.5	34.7
Mean 3pm wet bulb temperature (Degrees C) for years 1962 to 2010	22.9	22.7	21.4	19.1	16.6	14.5	13.5	14.5	16.5	18.4	20.4	21.8
Mean 3pm dew point temperature (Degrees C) for years 1962 to 2010	16.4	16.8	14.5	12	8.9	6.8	4.8	4.1	5.9	8.1	10.9	13.9

Mean 3pm relative humidity (%) for years 1962 to 2010	38	40	37	38	36	38	34	29	27	27	28	32
Mean 3pm cloud cover (oktas) for years 1962 to 2010	4.6	4.8	4.2	3.6	3.4	2.5	2.1	2	2.1	3	3.8	4.3
Mean 3pm wind speed (km/h) for years 1962 to 2010	9.7	9.8	10.1	9.2	8.3	8.9	9.8	11.1	11.4	10.9	10.4	10

Source: Bureau of Meteorology web site (2011) for Barcaldine.

Appendix 2 Dust Emission Rate Calculation Methodology

Extract from NPI Emission Estimation Technique Manual for Mining V2.3

TABLE 1 Emission Factor Equations and Default Emission Factors for Various Operations at Coal Mines [1,3]

Operation/Activity	TSP Equation	PM_{10} Equation	TSP Default Emission Factor	PM_{10} Default Emission Factor	PM_{10}/TSP Ratio based on Emission Factors	Units	Emission Factor Rating
Draglines	$EF = 0.0046 * d^{1.1} * M^{-0.3}$	$EF = 0.0022 * d^{0.7} * M^{-0.3}$	0.06	0.026	0.43	kg/bcm	B
Excavators/Shovels/Front-end loaders (on overburden)	$EF = k * 0.0016 * (U/2.2)^{1.3} * (M/2)^{-1.4}$, k=0.74	As for TSP, using k=0.35	0.025	0.012	0.47	kg/t	C
Excavators/Shovels/Front-end loaders (on coal)	$EF = k * 0.0596 * M^{-0.9}$ using k = 1.56	As for TSP, using k=0.75	0.029	0.014	0.48	kg/t	C
Bulldozers on coal	$EF = 35.6 * s^{1.2} * M^{-1.4}$	$EF = 6.33 * s^{1.5} * M^{-1.4}$	102	32.5	0.29	kg/h	B
Bulldozer on material other than coal	$EF = 2.6 * s^{1.2} * M^{-1.3}$	$EF = 0.34 * s^{1.5} * M^{-1.4}$	17	4	0.24	kg/h	B
Trucks (dumping overburden)	--	--	0.012	0.0043	0.35	kg/t	
Trucks (dumping coal)	--	--	0.010	0.0042	0.42	kg/t	
Drilling	--	--	0.59	0.31	0.52	kg/hole	B
Blasting[4]	$EF = 344 * A^{0.8} * M^{-1.9} * D^{-1.8}$	As for TSP, Multiplying by 0.52	--	--	0.52	kg/blast	C
Wheel and bucket	--[2]	--[2]	--[2]	--[2]			

TABLE 1 (cont') Emission Factor Equations and Default Emission Factors for Various Operations at Coal Mines [1,3]

Operation/Activity	TSP Equation	PM_{10} Equation	TSP Default Emission Factor	PM_{10} Default Emission Factor	PM_{10}/TSP Ratio based on Emission Factors	Units	Emission Factor Rating
Wheel Generated Dust from Unpaved Roads	$EF = k * (s/12)^{A} * (W/3)^{B} / (M/0.2)^{C}$, where k = 2.82	As for TSP, using k= 0.733	3.88	0.96	0.25	kg/VKT	
Scrapers	$EF = 7.6 * 10^{-6} * s^{1.3} * W^{2.4}$	$EF = 1.32 * 10^{-6} * s^{1.4} * W^{2.5}$	1.64	0.53	0.32	kg/VKT	A
Graders	$EF = 0.0034 * S^{2.5}$	$EF = 0.0034 * S^{2.0}$				kg/VKT	B
Loading stockpiles	--	--	0.004	0.0017	0.42	kg/t	
Unloading from stockpiles	--	--	0.03	0.013	0.42	kg/t	
Loading to trains	--	--	0.0004	0.00017	0.42	kg/t	
Miscellaneous transfer points	$EF = k * 0.0016 (U/2.2)^{1.3} * (M/2)^{-1.4}$, where k = 0.74	As for TSP, using k = 0.35	0.00032	0.00015	0.47	kg/t	
Wind erosion	--	--	0.4	0.2	0.50	kg/ha/h	

[1] See Appendix A for details of the sources of these emission factors and emission estimation equations

[2] A significant proportion of open cut coal mining for softer brown coals is carried out using bucket wheel excavators. The moisture content of these coals is generally very high and dust emissions are generally minor. For coals with a moisture content of less than 10%, use the equation for miscellaneous transfer and conveying. (Appendix A1.1.18 and A.1.1.14)

[3]

d = drop distance in metres;	M = moisture content in %;
U = mean wind speed in m/s;	A = area blasted in m^2;
D = depth of blast holes in metres;	VKT = vehicle kilometres travelled;
s = silt content in %;	W = vehicle gross mass in tonnes;
S = mean vehicle speed in km/h;	L= road surface silt loading in g/m^2;
bcm = bank cubic metres;	t = tonne;
-- = negligible	

Exponents for "Wheel Generated Dust from Unpaved Roads"

A = 0.8 (for PM_{10}) & 0.8 (for TSP) B = 0.4 (for PM_{10}) & 0.5 (for TSP)

C = 0.3 (for PM_{10}) & 0.4 (for TSP)

[4] Additional guidance on the characterisation of emissions of PM_{10} and other substances is provided in the *Emission Estimation Technique Manual for Explosives Detonation.*

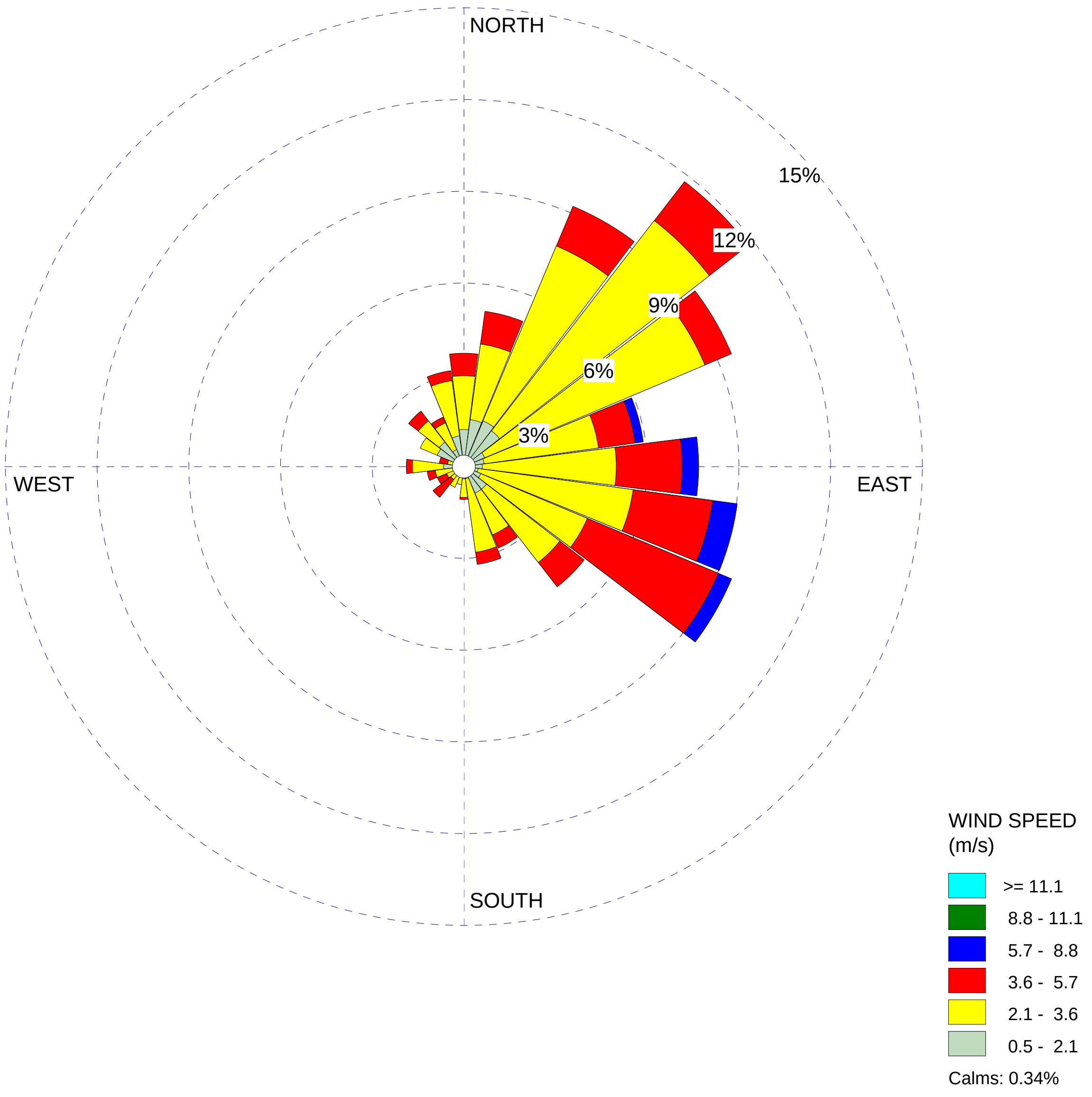
Appendix 3 Windroses For SGCP - From TAPM

WIND ROSE PLOT:

SGCP - Alpha

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:

Wind Rose for January

DATA PERIOD:

Start Date: 1/01/2004 - 00:00
End Date: 31/01/2005 - 23:00

COMPANY NAME:

Noise Mapping Australia

MODELER:

C Simpson

CALM WINDS:

0.34%

TOTAL COUNT:

1488 hrs.

AVG. WIND SPEED:

2.99 m/s

DATE:

2/02/2012

PROJECT NO.:

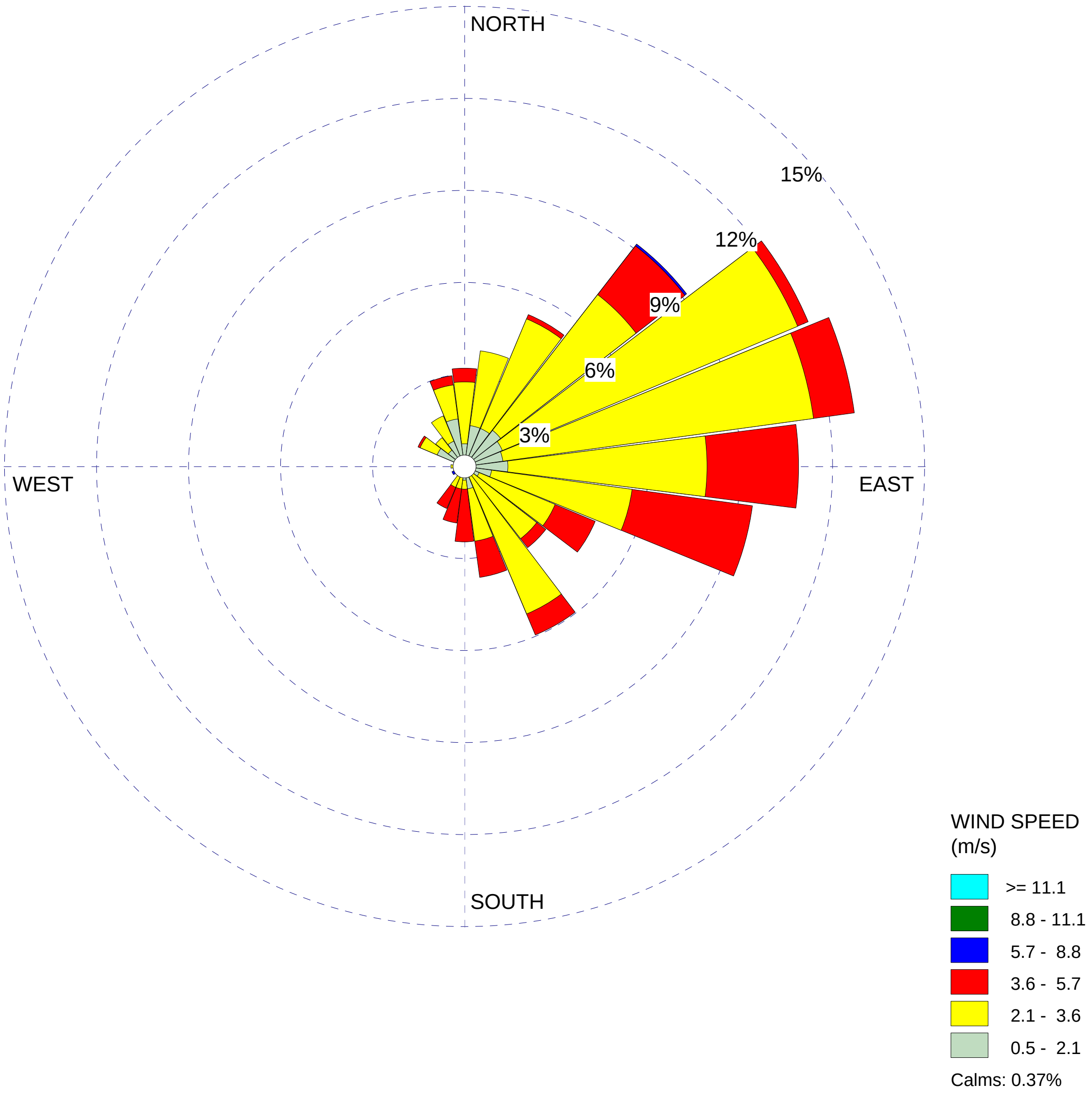
101105

WIND ROSE PLOT:

SGCP - Alpha

DISPLAY:

Wind Speed
Direction (blowing from)



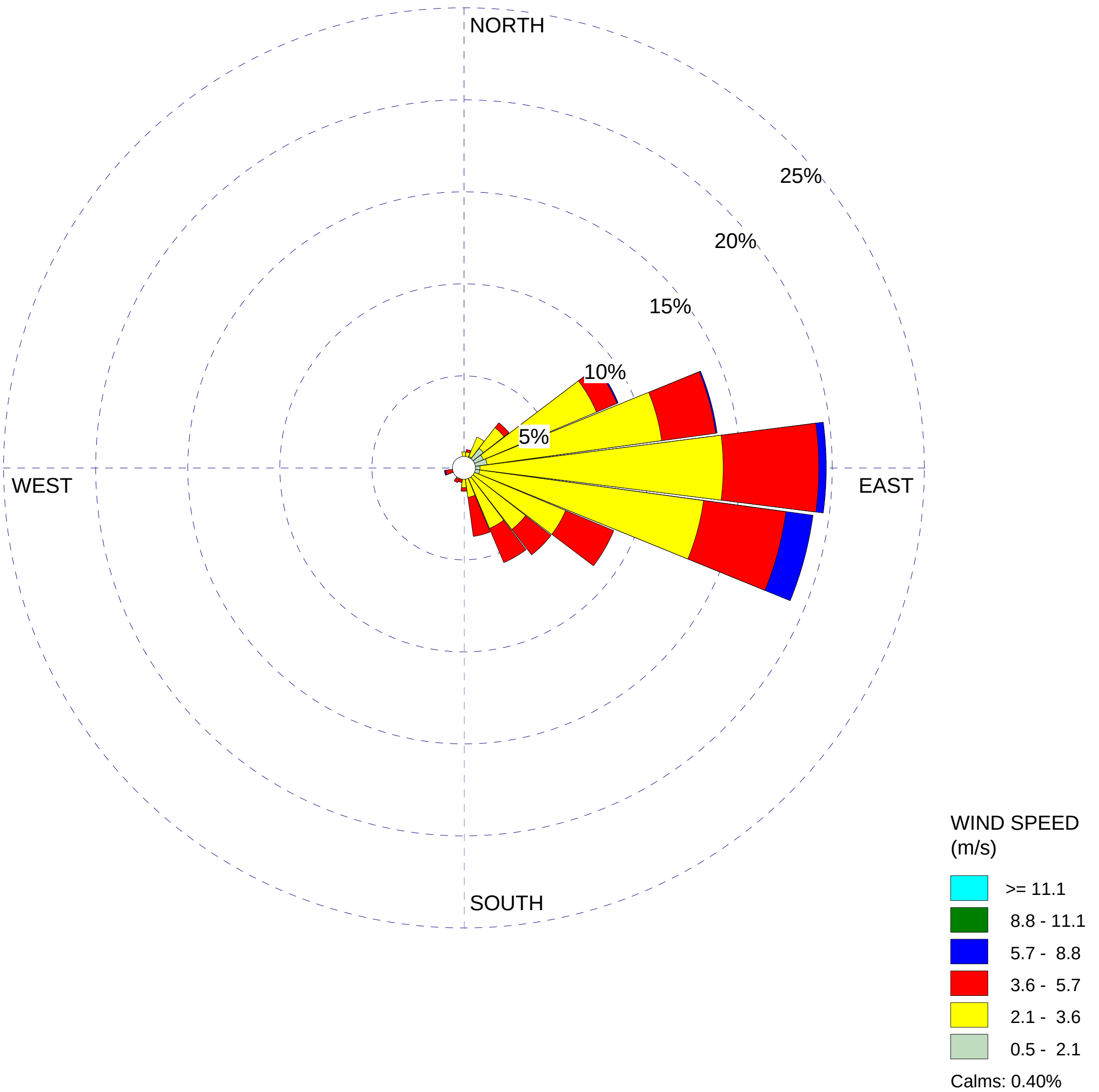
COMMENTS: Wind Rose for February	DATA PERIOD: **Start Date: 1/02/2004 - 00:00** **End Date: 28/02/2005 - 23:00**	COMPANY NAME: **Noise Mapping Australia**	
		MODELER: **C Simpson**	
	CALM WINDS: **0.37%**	TOTAL COUNT: **1344 hrs.**	
	AVG. WIND SPEED: **2.85 m/s**	DATE: **2/02/2012**	PROJECT NO.: **101105**

WIND ROSE PLOT:

SGCP - Alpha

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
Wind Rose for March	**Start Date: 1/03/2004 - 00:00** **End Date: 31/03/2005 - 23:00**	**Noise Mapping Australia**	
		MODELER: **C Simpson**	
	CALM WINDS: **0.40%**	TOTAL COUNT: **1488 hrs.**	
	AVG. WIND SPEED: **3.19 m/s**	DATE: **2/02/2012**	PROJECT NO.: **101105**

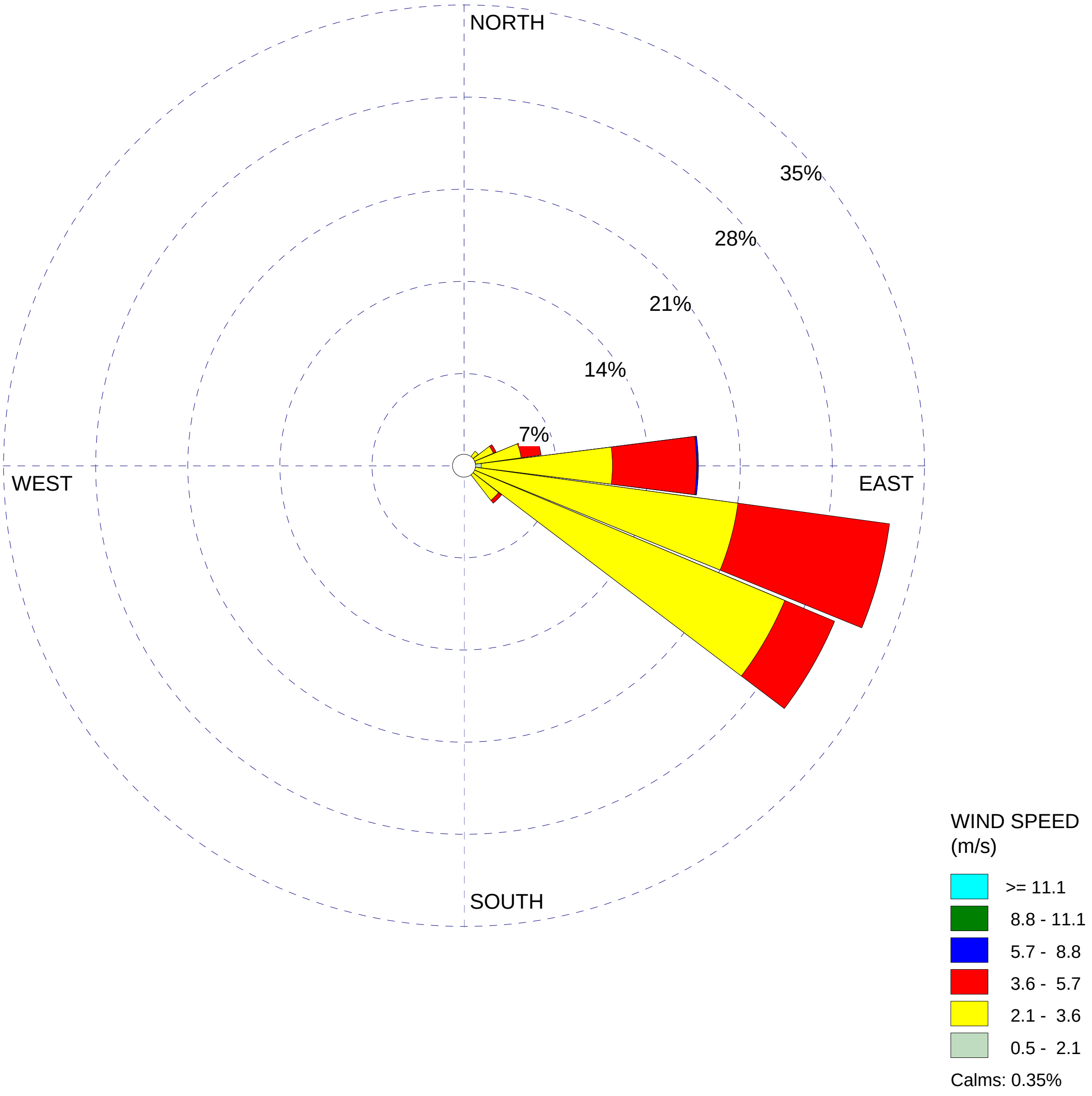
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

SGCP - Alpha

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:

Wind Rose for April

DATA PERIOD:

Start Date: 1/04/2004 - 00:00
End Date: 30/04/2005 - 23:00

COMPANY NAME:

Noise Mapping Australia

MODELER:

C Simpson

CALM WINDS:

0.35%

TOTAL COUNT:

1440 hrs.

AVG. WIND SPEED:

3.23 m/s

DATE:

2/02/2012

PROJECT NO.:

101105

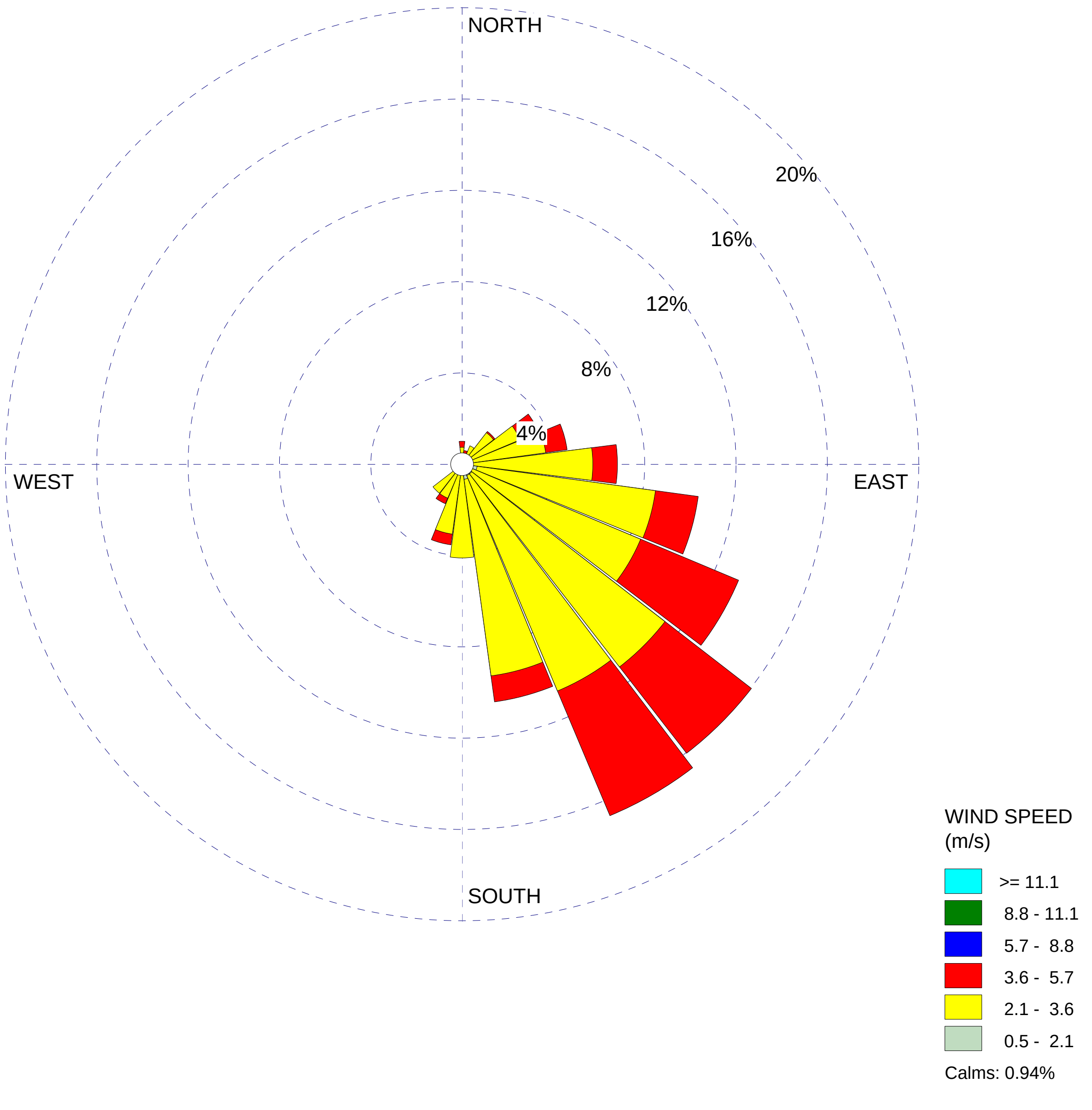
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

SGCP - Alpha

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
Wind Rose for May	**Start Date: 1/05/2004 - 00:00** **End Date: 31/05/2005 - 23:00**	**Noise Mapping Australia**	
		MODELER: **C Simpson**	Noise Mapping Australia
	CALM WINDS: **0.94%**	TOTAL COUNT: **1488 hrs.**	
	AVG. WIND SPEED: **3.11 m/s**	DATE: **2/02/2012**	PROJECT NO.: **101105**

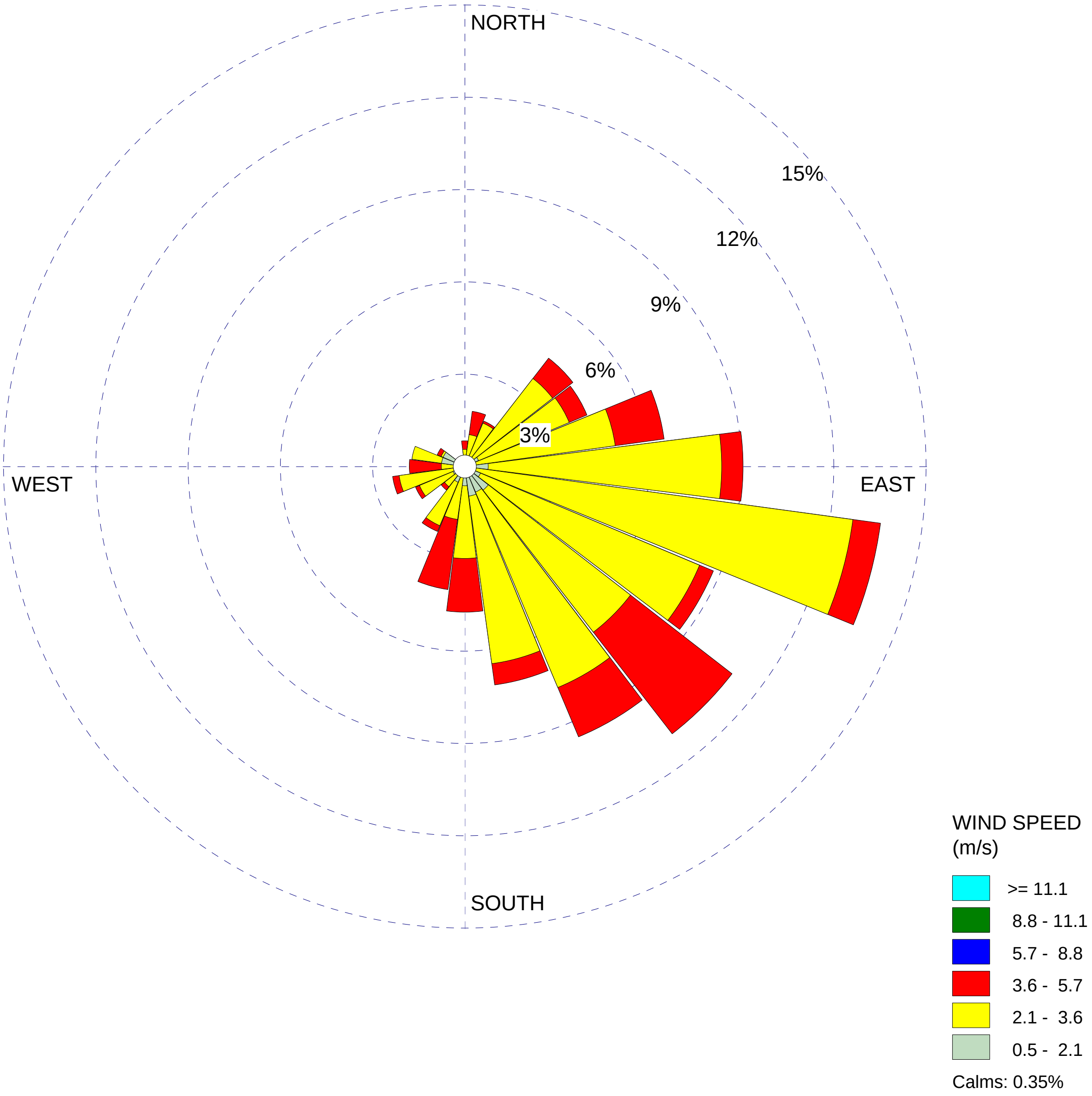
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

SGCP - Alpha

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:

Wind Rose for June

DATA PERIOD:

Start Date: 1/06/2004 - 00:00
End Date: 30/06/2005 - 23:00

COMPANY NAME:

Noise Mapping Australia

MODELER:

C Simpson

CALM WINDS:

0.35%

TOTAL COUNT:

1440 hrs.

AVG. WIND SPEED:

2.99 m/s

DATE:

2/02/2012

PROJECT NO.:

101105

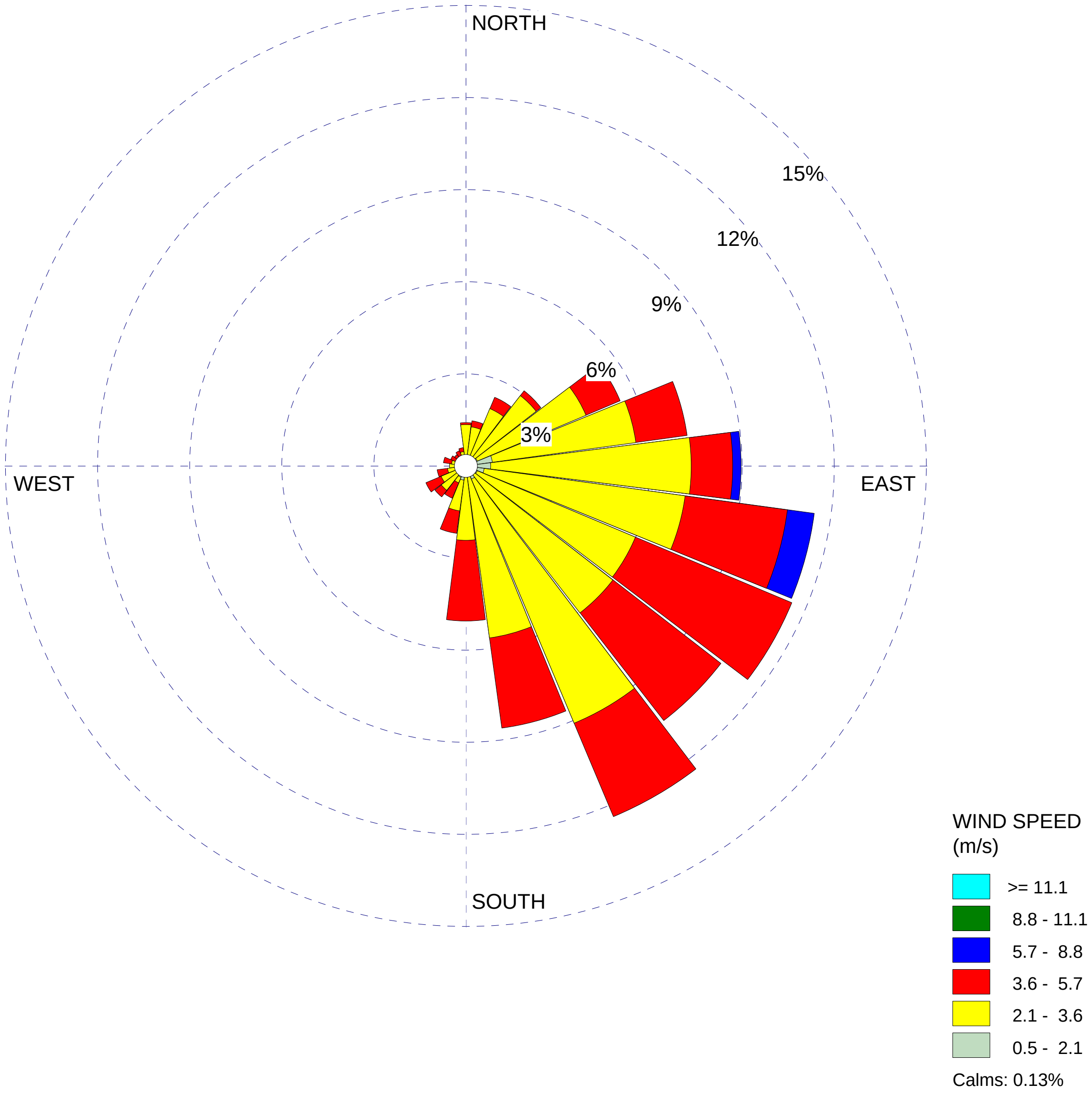
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

SGCP - Alpha

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
Wind Rose for July	**Start Date: 1/07/2004 - 00:00** **End Date: 31/07/2005 - 23:00**	**Noise Mapping Australia**	
		MODELER: **C Simpson**	Noise Mapping Australia
	CALM WINDS: **0.13%**	TOTAL COUNT: **1488 hrs.**	
	AVG. WIND SPEED: **3.24 m/s**	DATE: **2/02/2012**	PROJECT NO.: **101105**

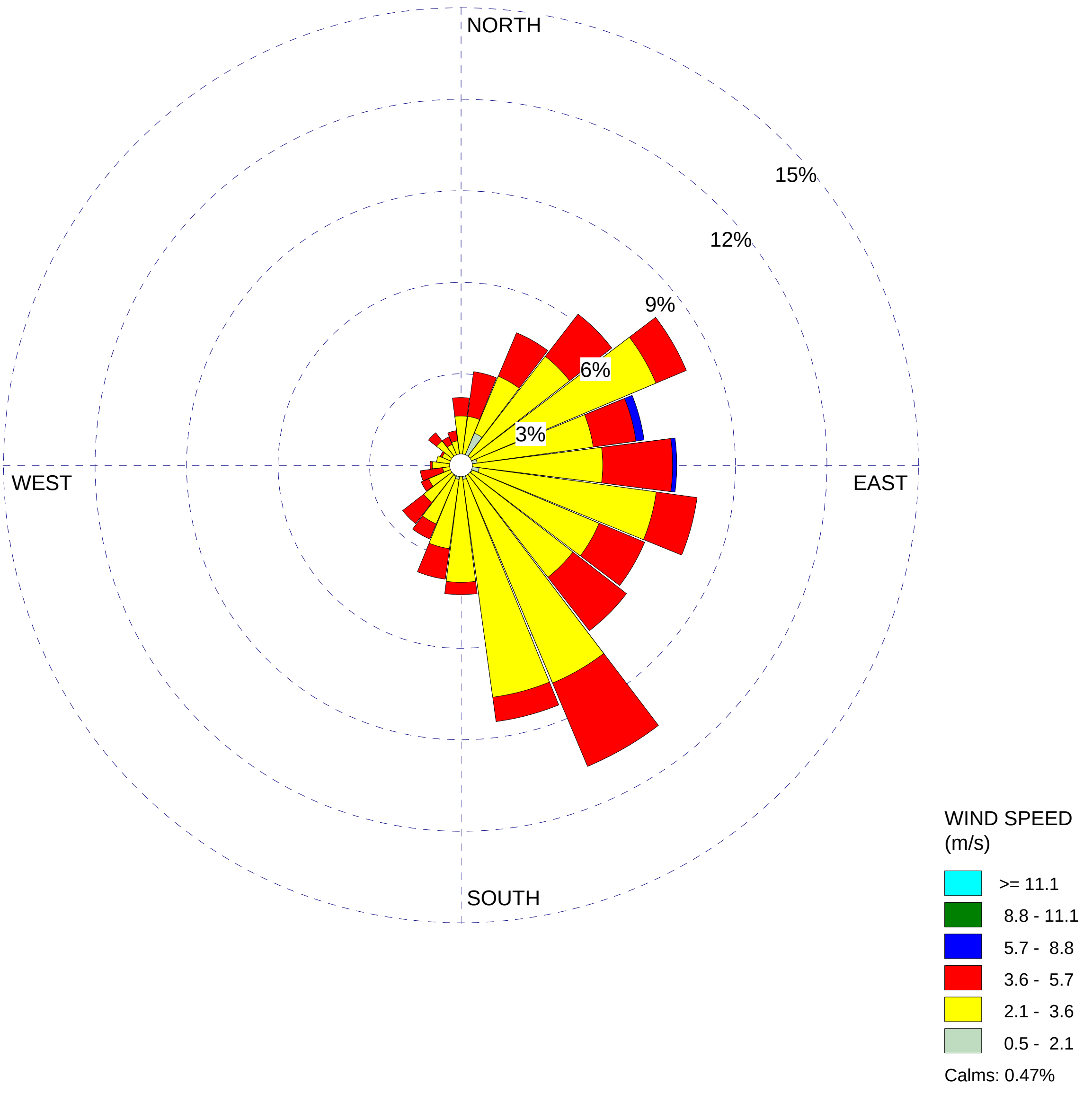
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

SGCP - Alpha

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS: Wind Rose for August	DATA PERIOD: **Start Date: 1/08/2004 - 00:00** **End Date: 31/08/2005 - 23:00**	COMPANY NAME: **Noise Mapping Australia**	
		MODELER: **C Simpson**	
	CALM WINDS: **0.47%**	TOTAL COUNT: **1488 hrs.**	
	AVG. WIND SPEED: **3.17 m/s**	DATE: **2/02/2012**	PROJECT NO.: **101105**

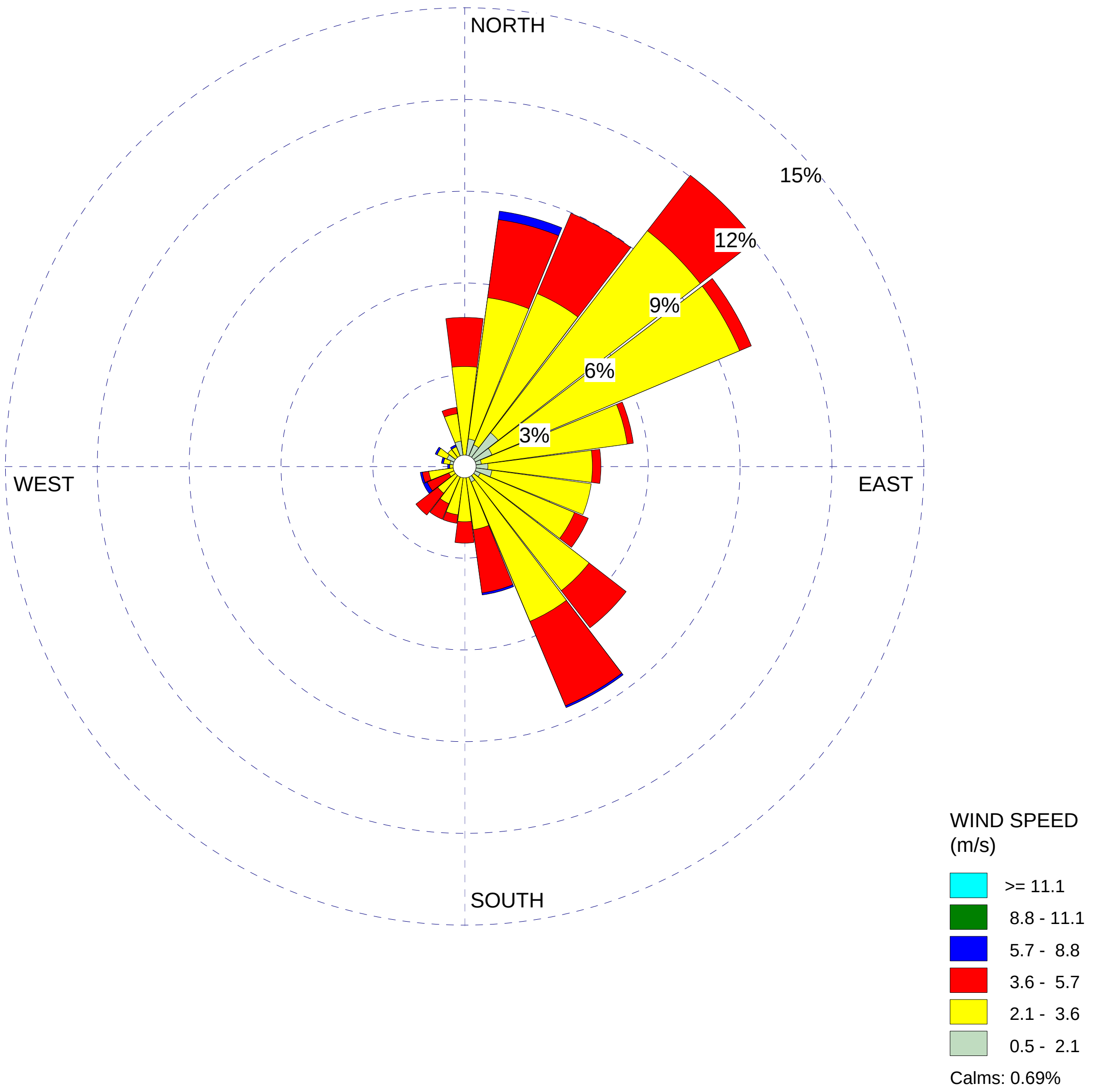
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

SGCP - Alpha

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS: Wind Rose for September	DATA PERIOD: **Start Date: 1/09/2004 - 00:00** **End Date: 30/09/2005 - 23:00**	COMPANY NAME: **Noise Mapping Australia**	
		MODELER: **C Simpson**	
	CALM WINDS: **0.69%**	TOTAL COUNT: **1440 hrs.**	
	AVG. WIND SPEED: **3.02 m/s**	DATE: **2/02/2012**	PROJECT NO.: **101105**

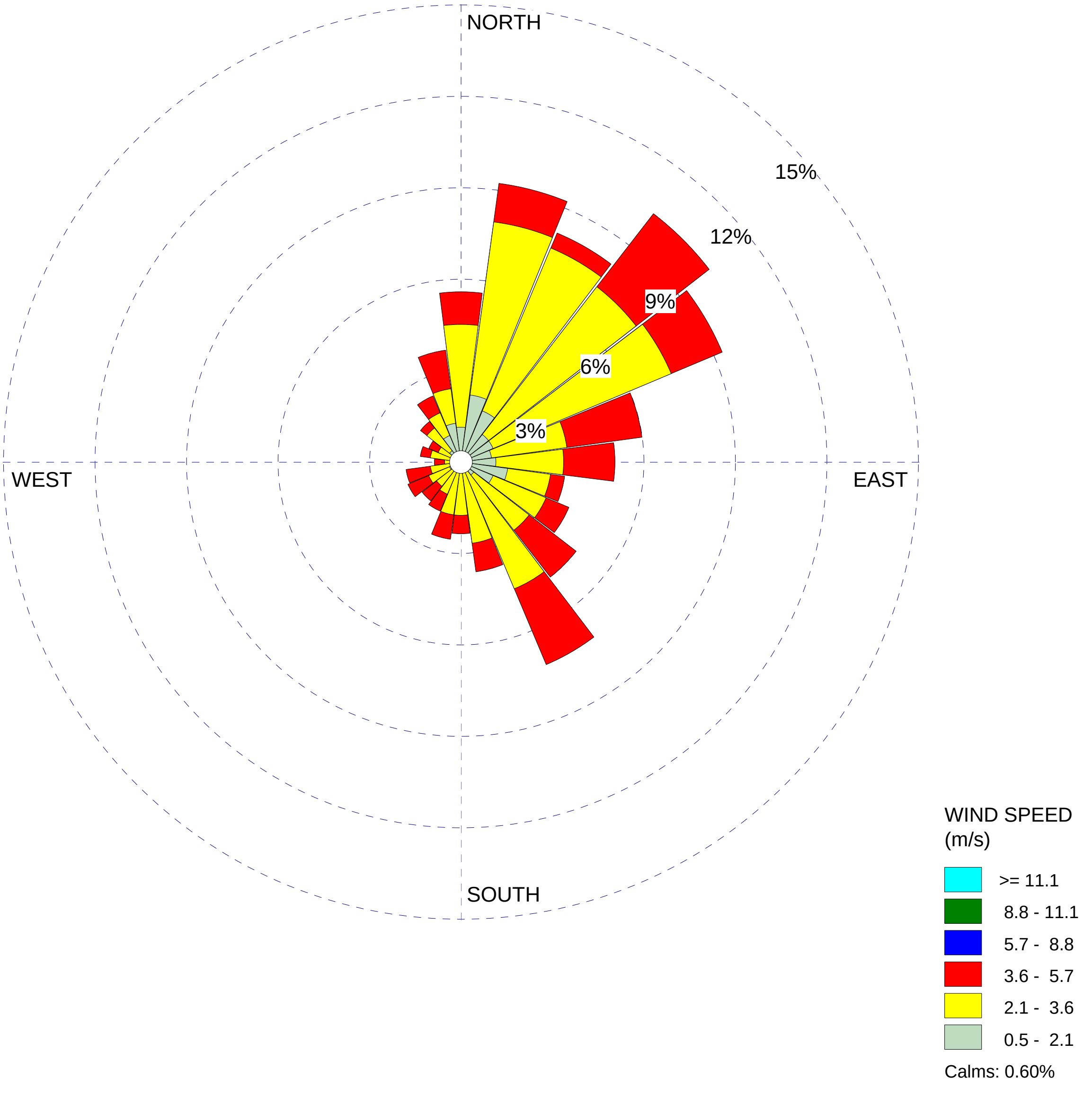
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

SGCP - Alpha

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS: Wind Rose for October	DATA PERIOD: **Start Date: 1/10/2004 - 00:00** **End Date: 31/10/2005 - 23:00**	COMPANY NAME: **Noise Mapping Australia**	
		MODELER: **C Simpson**	Noise Mapping Australia
	CALM WINDS: **0.60%**	TOTAL COUNT: **1488 hrs.**	
	AVG. WIND SPEED: **2.91 m/s**	DATE: **2/02/2012**	PROJECT NO.: **101105**

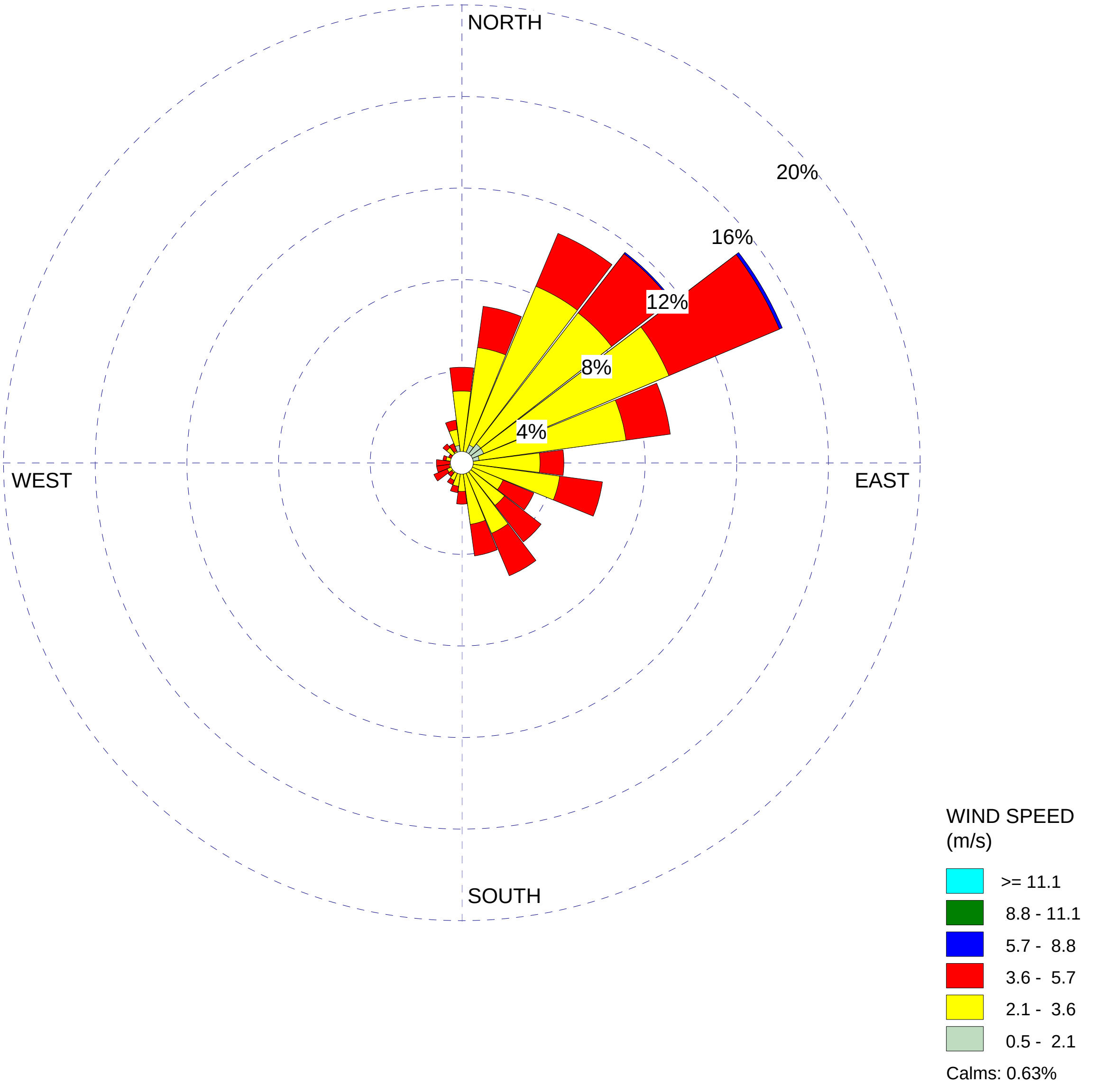
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

SGCP - Alpha

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:

Wind Rose for November

DATA PERIOD:

Start Date: 1/11/2004 - 00:00
End Date: 30/11/2005 - 23:00

COMPANY NAME:

Noise Mapping Australia

MODELER:

C Simpson

CALM WINDS:

0.63%

TOTAL COUNT:

1440 hrs.

AVG. WIND SPEED:

3.16 m/s

DATE:

2/02/2012

PROJECT NO.:

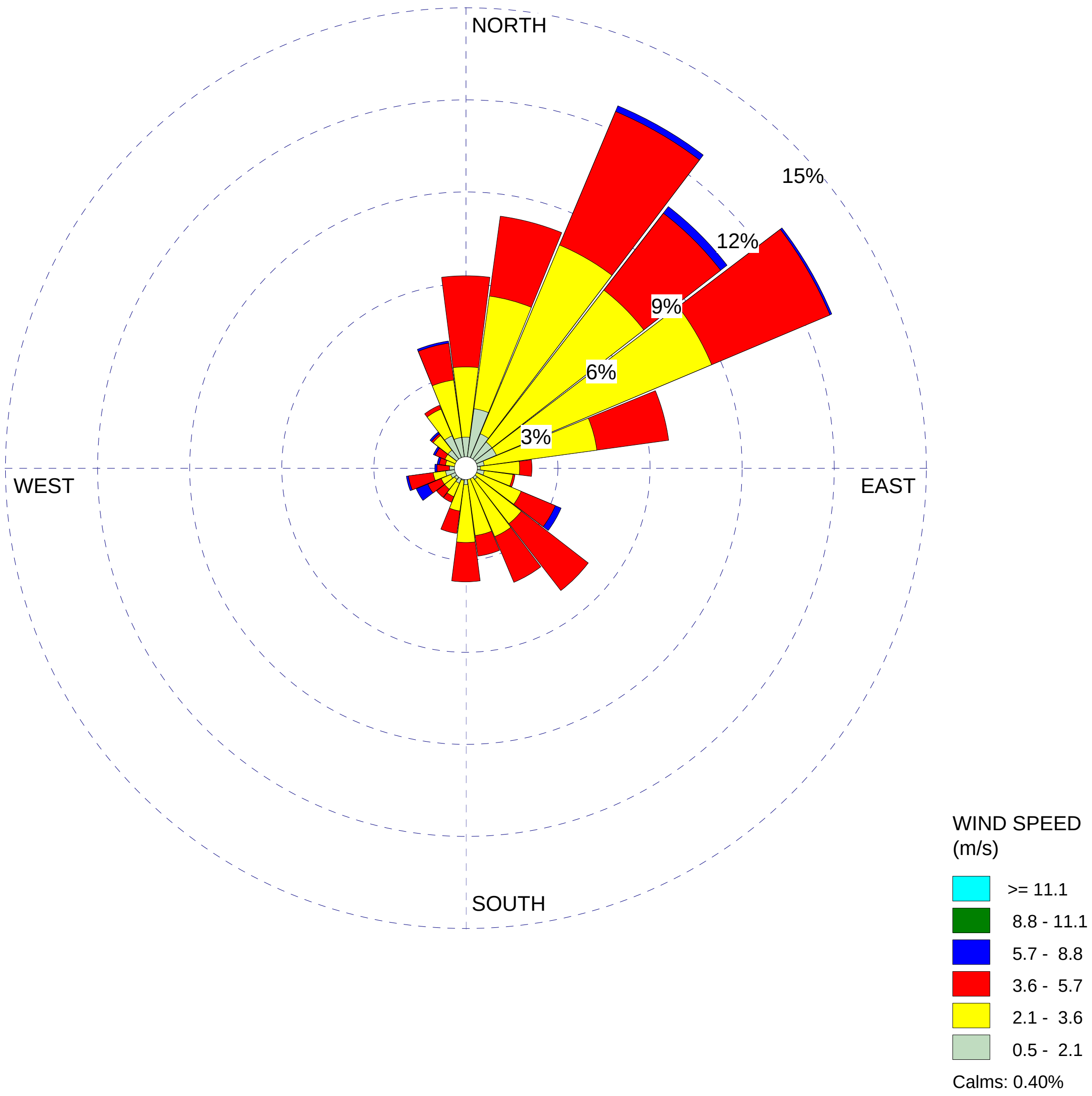
101105

WIND ROSE PLOT:

SGCP - Alpha

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:

Wind Rose for December

DATA PERIOD:

Start Date: 1/12/2004 - 00:00
End Date: 31/12/2005 - 23:00

COMPANY NAME:

Noise Mapping Australia

MODELER:

C Simpson

CALM WINDS:

0.40%

TOTAL COUNT:

1488 hrs.

AVG. WIND SPEED:

3.13 m/s

DATE:

2/02/2012

PROJECT NO.:

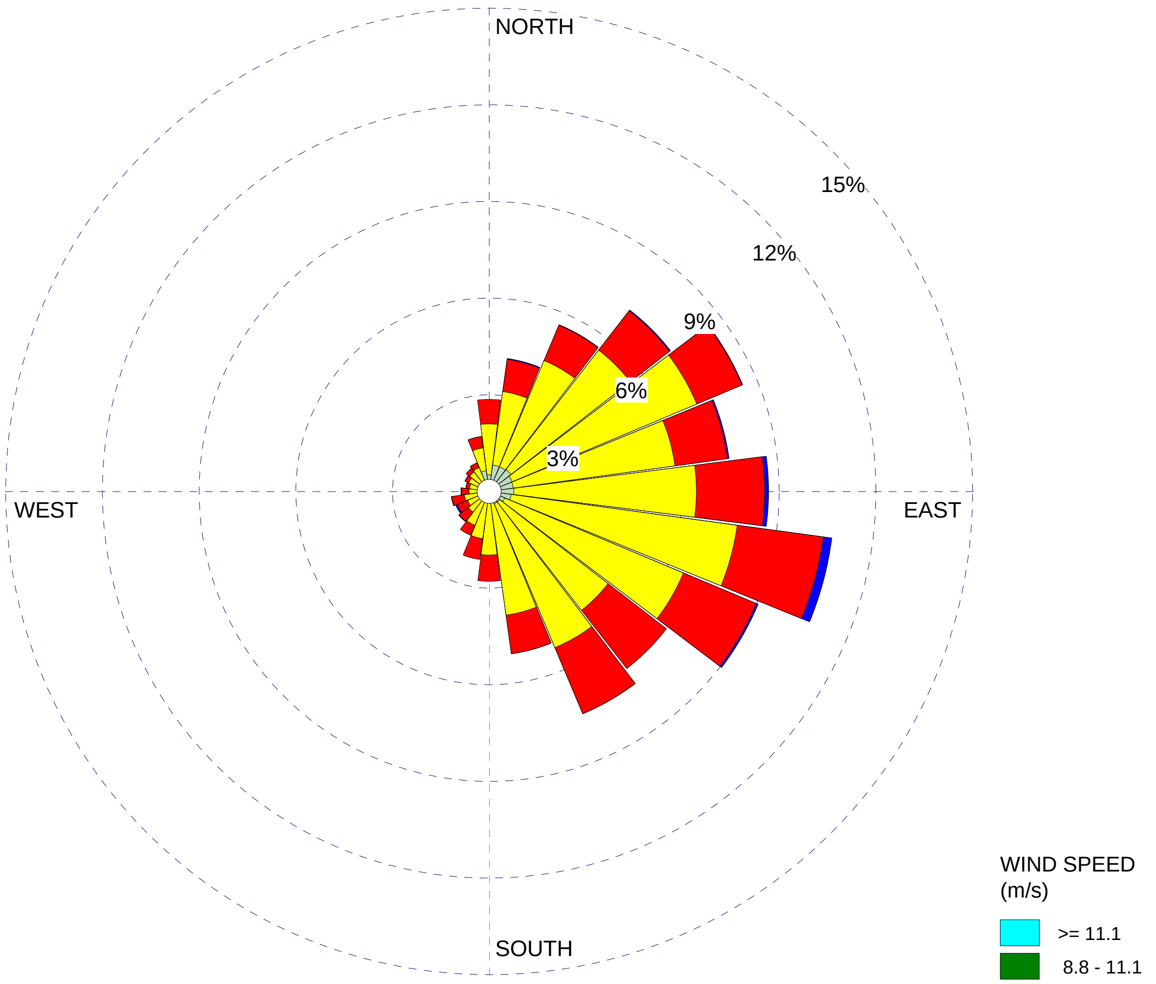
101105

WIND ROSE PLOT:

SGCP - Alpha

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
Wind Rose for All Months	**Start Date: 1/01/2004 - 00:00** **End Date: 31/12/2005 - 23:00**	**Noise Mapping Australia**	
		MODELER: **C Simpson**	Noise Mapping Australia
	CALM WINDS: **0.47%**	TOTAL COUNT: **17544 hrs.**	
	AVG. WIND SPEED: **3.08 m/s**	DATE: **2/02/2012**	PROJECT NO.: **101105**

WRPLOT View - Lakes Environmental Software