HANCOCK GALILEE PTY LTD

Kevin's Corner Project Environmental Impact Statement

O | Air Quality

Report

Air Quality Assessment for the Kevin's Corner EIS Project

6 APRIL 2011

Prepared for

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Date: **6 April 2011**
Reference: 42626679/001/001
Status: Final

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Abbreviations

Abbreviation	Description
the Act	Environment Protection Act 1994
BMA	BHP Billiton Mitsubishi Alliance
BOM	Bureau of Meteorology
CALMET	Meteorological pre-processor for CALPUFF
CALPUFF	USEPA approved atmospheric dispersion model
CHPP	Coal Handling and Preparation Plant
CO	Carbon monoxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEM	Digital Elevation Model
DERM	Department of the Environment and Resource Management
DMC	Dense medium cyclone
EIS	Environmental Impact Statement
EPA	Environmental Projection Agency
EET	Emission Estimation Technique Manual
EPP (Air)	Environmental Protection (Air) Policy 2008
HGPL	Hancock Galilee Pty Ltd
LOM	Life Of Mine
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NEPM (AAQ)	National Environment Protection Measure (Ambient Air Quality)
NO_2	Nitrogen dioxide
NPI	National Pollutant Inventory
NSW	New South Wales
O_3	Ozone
Pb	Lead
PM	Particulate Matter
PM_{10}	Particulate matter less than 10 micrometres (µm) in aerodynamic diameter
$PM_{2.5}$	Particulate matter less than 2.5 micrometres (µm) in aerodynamic diameter
the Regulation	The Environmental Protection Regulation 2008
ROM	Run Of Mine
SO_2	Sulphur dioxide
TAPM	The Air Pollution Model
TSP	Total Suspended Particulates
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
VKT	Vehicle Kilometres Travelled

Executive Summary

URS was commissioned by Hancock Galilee Pty Ltd (HGPL) to undertake an Air Quality Impact Assessment for the proposed Kevin's Corner Coal Mine (the Project). The Project is proposed to consist of two open pits, and three independent underground longwall operations. The assessment has focused on dust emissions associated with the handling of coal from underground mines, and emissions from earthworks associated with the construction and operation of the open pits.

An emissions inventory was prepared which quantified dust emissions for Year 1, Year 5, Year 15 and Year 25 of the life of the mine. These stages are considered to best represent the proposed variations in the spatial extent of mining activities, whilst also capturing years in which a greater level of emissive activities are planned to take place.

The CALPUFF atmospheric dispersion modelling package was used in conjunction with regional and site-specific meteorology, to estimate potential air quality impacts associated with the proposed mine development. Modelling was undertaken using two separate particle classes, these being PM_{10}, and Total Suspended Particulate (TSP) matter.

The model predictions were then compared to the regulatory criteria contained in DERM EPP (air) 2008. Where an appropriate criterion was not contained in the EPP (Air), a relevant criterion was nominated as a Project Goal.

The results of the dispersion modelling indicated that when considered in conjunction with existing (background concentrations), dust emissions from the project would result in an exceedance of the 24 hour PM_{10} criterion at a single receptor during Year 1 and Year 5 of the Project operations. This receptor is located to the north of the site at the Forrester Homestead.

The cumulative effect of the Project and the proposed Alpha Coal project was also assessed. Given the larger scale of the Alpha coal project, cumulative impacts were predicted to be significantly higher than those from the Kevin's Corner Project in isolation. For the two years considered in the cumulative assessment (Year 5 and 25) it was predicted that dust emissions from the adjacent Project would result in exceedances of the 24 hour PM_{10} criterion at eight of ten receptors during Year 1 and Year 5 (worst case impact years of the Project) of the Project operations. Therefore, the Kevin's Corner Coal Mine is not predicted to cause new exceedances of the EPP (Air) objectives or Project Goals at off-site locations in the air shed in addition to those predicted for the Alpha Coal Project mine.

HGPL will implement an air quality management plan, which would include specific measures for the monitoring and mitigation of potential particulate and dust impacts to minimise the on-site generation of particulates.

Introduction

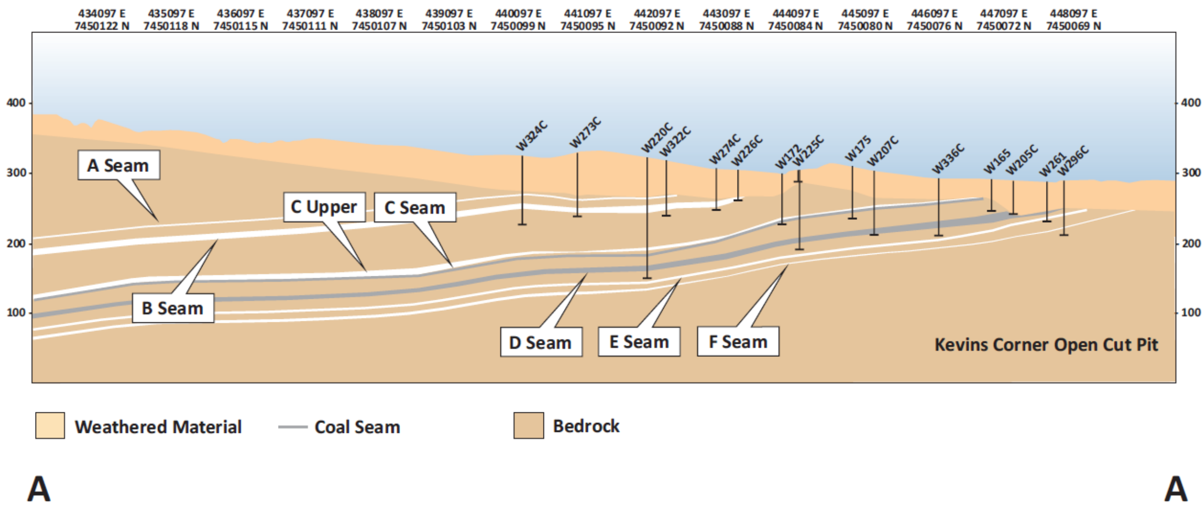
URS Australia Pty Ltd (URS) was commissioned by Hancock Galilee Pty Ltd (HGPL) to undertake an air quality assessment of the Kevin's Corner Coal Project (the Project). The project is to be located approximately 65 kilometres (km) north of the town of Alpha, 110 km south-west of the township of Clermont and approximately 340 km south-west of Mackay in Central Queensland, Australia. The location of the Project is shown on Figure 1-2

1.1 Project Description

The Galilee Basin is an extensive, undeveloped, coal resource, consisting of seams of predominately thermal coal. Within the Project area the coal seams dip gently from east to west and vary in thickness from 3 to 8 m. This is suitable for high production, open-cut and underground mining. The Project will produce up to 30 Mtpa of coal, with two open-cut and three underground longwall mining operations undertaken concurrently. Figure 1-3provides the layout of the mine.

Figure 1-1 illustrates the four predominant, economic coal seams in the area; the upper A and B seams, and the lower C and D seams. Two other seams, E and F, are considered uneconomic to mine. There is approximately 13 m of interburden between seams A and B, 60 m between B and C, and 20 m between seams C and D. Seams D and C are the primary focus for the Project, although seams A and B will also be mined later in the life of the project.

Figure 1-1 Cross-Section of Project Coal Seams



For the open-cut planning, the box cuts are located at the start of full D seam thickness which is to be mined using open cut techniques involving draglines, shovels and trucks to expose the coal. As the open cut mine moves deeper along seam D, seams A, B and C will also be mined.

Underground long wall mining techniques are to be used to mine coal seam D as it progresses 'down dip'. The underground section of coal seam D is proposed to be worked as three independent mines commencing immediately to the west of the open-cut. The mines would be distinct and developed from portals independent of the open cut operations. The D seam at this point is approximately 90 m below surface for the Northern Longwall, a level which can comfortably be accessed through the excavation of drifts.

The mined coal will be transferred by conveyors to a Coal Handling and Preparation Plant (CHPP). The CHPP would incorporate remote Run Of Mine (ROM) sizing facilities transferring crushed raw coal to a tertiary sizing facility and a multi-module Dense Medium Cyclone (DMC) reflux classifier plant. The coal would then conveyed to an automated rail load-out facility at a rate of 6,000 tph.

HGPL has applied for a mining lease (ML) to cover at least a 30-year mine plan.

1.2 Alpha Coal Project

The Project is located immediately north of the Alpha Coal Project proposed by Hancock Coal Pty Ltd. The Alpha Coal Project is also a 30 Mtpa thermal coal mine, with a life of mine (LOM) of 30 years. The mine will consist of six open cut pits (approximately 25 km in total length) orientated in a north-south direction along the centre of MLA 70426.

The two projects share a number of proposed operation and design concepts due to the common parent company, locality and underlying geology. As a result of the proximity of the two mines, the potential cumulative impact of pollutants in the air shed has been considered in this assessment.

1.3 Assessment Methodology Overview

Emissions from the Project are generated primarily from activities that move overburden and coal. The main emission of concern is particulates, and to a lesser extent, emissions associated with the combustion of diesel fuel in mobile equipment.

Dust particles emitted to the atmosphere may be characterised by particle size according to the legislative assessment requirements of the Project Goals for air quality. These are:

- Particulate matter less than 30 micrometres (µm) in diameter - Total suspended particulates (TSP);
- Particulate matter less than 10 µm in diameter (PM_{10}); and
- Particulate matter less than 2.5 µm in diameter ($PM_{2.5}$).

Particulate matter less than 10 µm in diameter has the potential to enter the human respiratory system, whilst particles between 10 µm and 30 µm are related to nuisance dust through deposition on property.

The emissions and impacts of dust from mine-related activities considered in this assessment are related to:

- Deposition of TSP;
- Ambient concentrations of TSP, PM_{10}; and $PM_{2.5}$.

Emissions to atmosphere that result from the combustion of diesel fuel in and are released as exhaust gases from mine vehicles, include the following species:

- Nitrogen dioxide (NO_2);
- Particulate matter (PM);
- Sulphur dioxide (SO_2), and
- Trace quantities of volatile organic compounds (VOC).

Emissions from vehicles result in elevated concentrations of these species in the area surrounding the road. At locations beyond approximately 200 m from the road centreline, ambient concentrations return to background levels (DMRB, 2007). Due to the proximity of the sensitive receptors to the Project (Figure 3-7) and the number of vehicle movements, these species are not considered to be emitted in sufficient quantities to impact significantly on air quality at these locations. Therefore, air

1 Introduction

quality impacts associated with, NO_2, PM, SO_2 and VOCs from vehicular emissions have not been considered further.

The assessment considers the impacts on air quality by predicting future ground level concentrations and rates of deposition of dust at sensitive receptors of emissions from the Project. Predictions have been for the following years of the Project:

- Life of mine Year 1;
- Life of mine Year 5;
- Life of mine Year 15; and
- Life of mine Year 25.

To predict pollutant concentrations, an inventory of emissions and simulated meteorological fields were developed and used as inputs into the US EPA approved atmospheric dispersion modelling software package CALPUFF.

The detailed emissions inventory for dust emissions from the Project was developed using information provided by the proponent in conjunction with emission factors from both the Australian National Pollutant Inventory (NPI) emission estimation technique manual (EETM) and US EPA AP-42 emission estimation manual.

Site-specific meteorological fields were developed for 2009 using a combination of meteorological data for the Emerald Airport (approximately 170 km from the Project site), the Commonwealth Scientific and Industrial Research Organisation's (CSIRO) prognostic meteorological model The Air Pollution Model (TAPM), and the US EPA approved meteorological model CALMET.

A comparison between predicted ground-level concentrations of dust associated with the Project and regulatory ambient air quality objectives at identified receptor locations have been presented in this report.

Whilst predicted ground level concentrations at sensitive receptor locations are presented in tabular form for all years modelled, contour plots are presented for years 5 and 25 as predictions for these years were identified as representing worst-case impacts.

1 Introduction

1 Introduction

Figure 1-2 Location of the Kevin's Corner Coal Project (Mine)

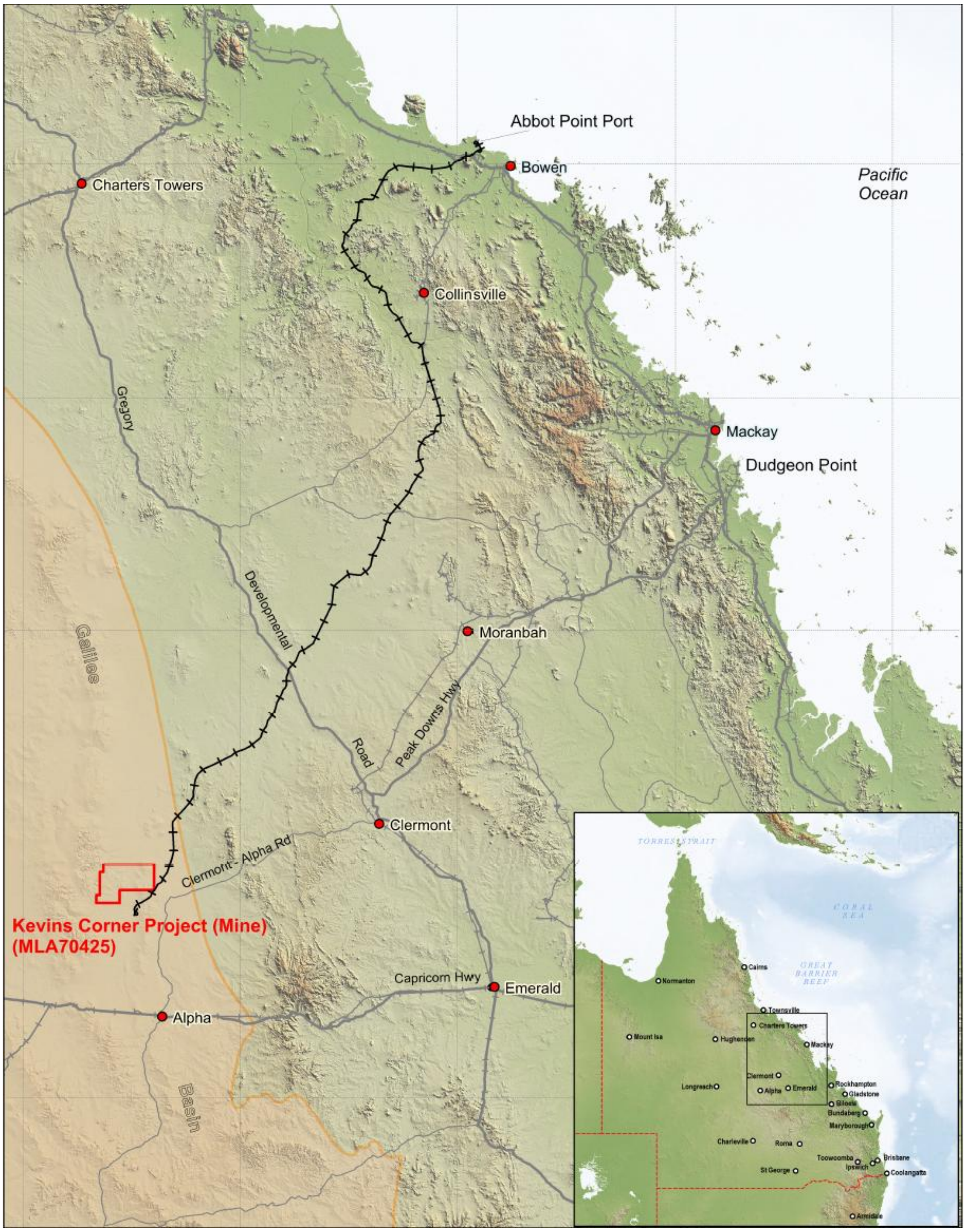


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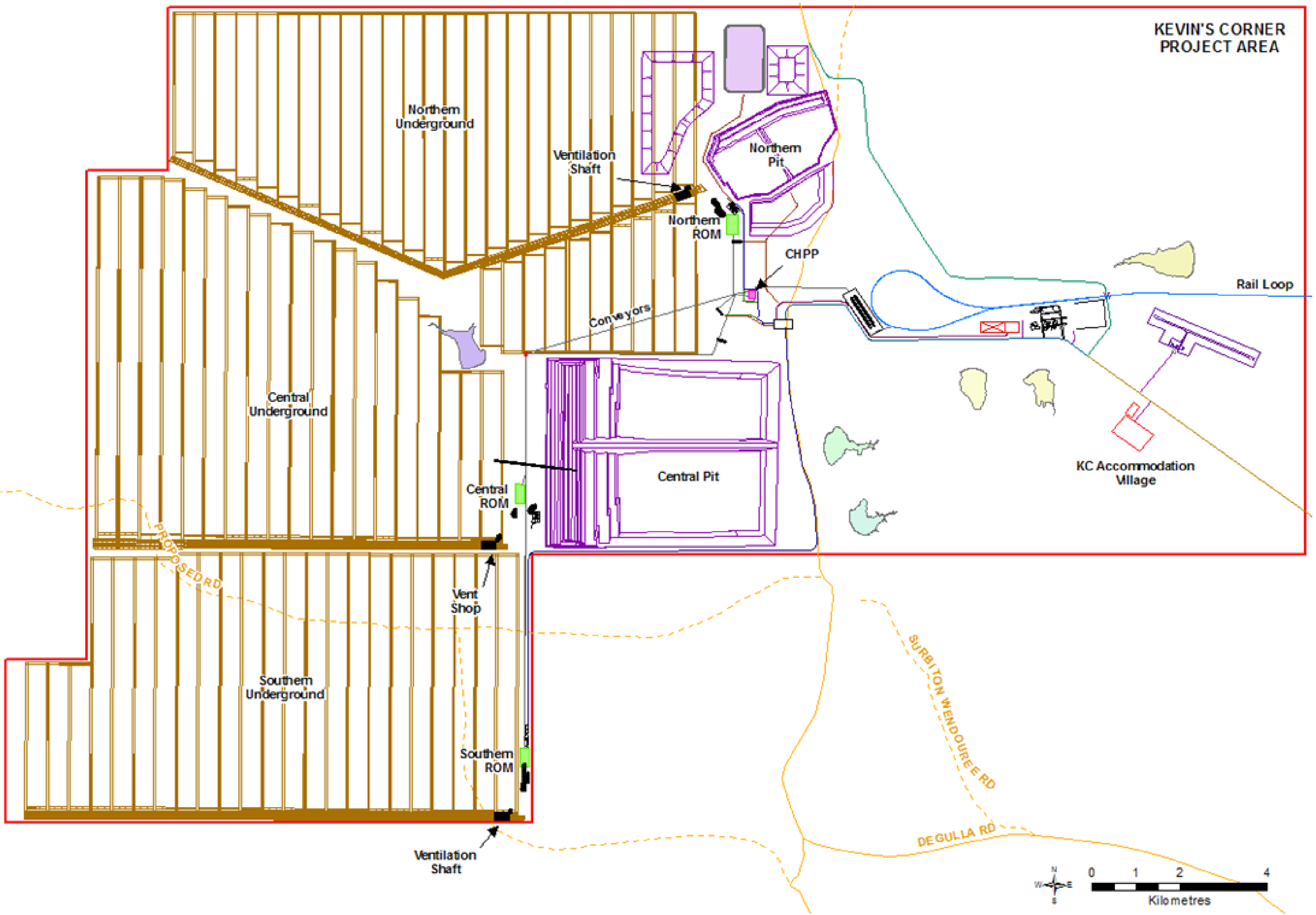
Figure 1-3 Layout of the Kevin's Corner Coal Project (Mine)



2 Legislative Framework

Air emissions from the mine comprise mainly PM, also referred to as dust. PM for this mine is described in three size categories:

- Particulate matter less than 30 µm – Total suspended particulates (TSP).
- Particulate matter less than 10 µm in diameter (PM_{10}), and
- Particulate matter less than 2.5 µm in diameter ($PM_{2.5}$).

The assessment has been conducted in consideration of the following legislative framework.

2.1 National Legislation

National air quality guidelines are specified by the National Environment Protection Council (NEPC). The National Environment Protection Measure (Ambient Air Quality) (NEPM (AAQ)) was released in 1998 (with an amendment in 2003), and sets standards for ambient air quality in Australia.

The NEPM (AAQ) specifies national ambient air quality standards and goals for the following common anthropogenic emission species:

- Carbon monoxide (CO),
- Nitrogen dioxide (NO_2),
- Sulphur dioxide (SO_2),
- Ozone (O_3),
- Particulates (as PM_{10} and $PM_{2.5}$), and
- Lead (Pb).

In 2004 the NEPM (Air Toxics) was released which included monitoring investigation guidelines for five compounds classified as air toxics: benzene, benzo(a)pyrene, formaldehyde, toluene and xylenes. These toxic species are not expected to be released in significant quantities from the Project and have not been addressed further in the air quality assessment.

Potential particulate emissions and their impacts are addressed through consideration of the impacts of fractions TSP, PM_{10} and $PM_{2.5}$.

2.2 State Legislation

Air quality in Queensland is managed under the Environment Protection Act 1994 (the Act), the Environmental Protection Regulation 2008 (the Regulation) and the Environmental Protection (Air) Policy 2008 (EPP (Air)) which came into effect on January 1, 2009.

The Act provides for long-term protection for the environment in Queensland in a manner that is consistent with the principles of ecologically sustainable development. The primary purpose of the EPP (Air) is to achieve the objectives of the Act in relation to Queensland's air environment. This objective is achieved by the EPP (Air) through:

- Identification of environmental values to be enhanced or protected;
- Specification of air quality indicators and goals to protect environmental values; and
- Provision of a framework for making consistent and fair decisions about managing the air environment and involving the community in achieving air quality goals that best protect Queensland's air environment.

2 Legislative Framework

The EPP (Air) applies to 'Queensland's air environment', however the air quality objectives specified in the EPP (Air) do not extend to workplaces covered by the Workplace Health and Safety Act (1995) (Section 8 of the EPP (Air)).

The air quality assessment presented in this report addresses off-site ambient air quality impacts only and does not cover workplace health and safety exposure.

Schedule 1 of the EPP (Air) specifies the air quality objectives that are to be (progressively) achieved though no timeframe for achievement of these objectives is specified. The Schedule includes objectives designed to protect the environmental values of:

- Health and well being;
- The aesthetic environment;
- Health and biodiversity of ecosystems; and
- Agriculture.

In addition to the requirements of the EPP (Air), the Department of the Environment and Resource Management (DERM) has also adopted a guideline for dust deposition of 4 g/m²/month to ensure adequate protection from nuisance levels of dust. This level was derived from ambient monitoring of dust conducted in the Hunter Valley, New South Wales (NSW) in the 1980's. The former NSW State Pollution Control Commission set the level to avoid a loss of amenity in residential areas, based on the levels of dust fallout that cause complaints. The current guideline level adopted in NSW is that the maximum total dust deposition level should not exceed 4 g/m²/month, and that the maximum increase in deposited dust is 2 g/m²/month expressed as an annual average[1]. DERM did not adopt the guideline that the maximum increase in deposited dust is 2 g/m²/month expressed as an annual average.

Schedule 1 of the EPP (Air) 2008 indicates an allowance of five exceedances of the 24-hour average PM_{10} air quality objective of 50 µg/m^3. This assessment presents the 5th highest predicted 24-hour average ground level concentration of PM_{10} at each receptor location. This provides a conservative approach as exceedance of the criteria is not considered until the 6th highest predicted value. The maximum 24-hour average ground-level concentration of $PM_{2.5}$ is presented.

[1] In NSW, where the criteria were developed, both of these criteria are applied as an annual average i.e. as the numerical average of 12 monthly deposition results. In this assessment this criteria has been applied to the peak monthly results for ease of comparison with the monthly dust deposition gauge results.

2 Legislative Framework

2.2.1 Ambient Air Goals

The Project Goals adopted for the Project for TSP, PM_{10}, $PM_{2.5}$ and dust deposition are included in Table 2-1.

Table 2-1 Summary of Project Goals for Particulate Matter

Particulate	Averaging Period	Objective or Goal	Jurisdiction
TSP	Annual	90 µg/m^3	EPP (Air)
PM_{10}	24-hour	50 µg/m^3 (5 exceedances allowed per year)	EPP (Air)
$PM_{2.5}$	24-hour	25 µg/m^3	EPP (Air)
	Annual	8 µg/m^3	EPP (Air)
Dust Deposition	Monthly	4 g/m^2/month	Queensland DERM

Environmental Values

The environmental values of the air environment to be enhanced or protected are:

- The qualities that make the air environment suitable for the life, health and wellbeing of humans; and
- The aesthetic environment.

The following sections address the climate and meteorology, the existing air quality, and sensitive receptor locations.

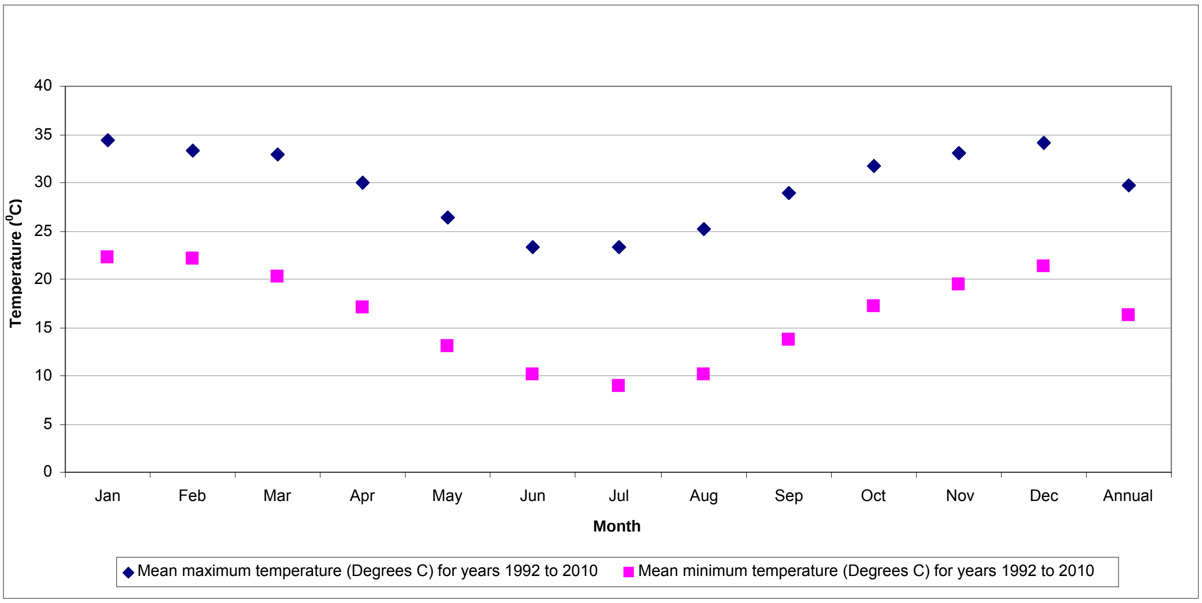
3.1 Climate and Meteorology

This section provides a brief summary of rainfall patterns, humidity, air temperature and wind in the region of the Project. The data used to represent the region has been sourced from the Bureau of Meteorology (BOM) climate statistics for the Emerald Airport monitoring site (Latitude: 23.57°S, Longitude: 148.18°E) (BOM, 2010), which is located approximately 170 km south-east of the Project site (Figure 1-2). Other BOM monitoring sites are located closer to the Project area, such as the Clermont Sirius Street monitoring site at approximately (130 km), however, the Emerald Airport data has been adopted due to the higher frequency of collection and data set completion. In addition, a summary of meteorological parameters specific to dispersion modelling are provided in Appendix Section A.1.

Temperature

The region of the Project typically has hot days during summer, with mean maximum daytime temperatures around 35°C falling to 23°C during the winter months. Overnight temperatures are generally cool throughout the year and cold during the winter months, with mean minimum daily temperatures of 9°C in July, and over 22°C between December, January and February. The long-term temperature statistics for the period of record, 1992 to 2010, are provided in Figure 3-1.

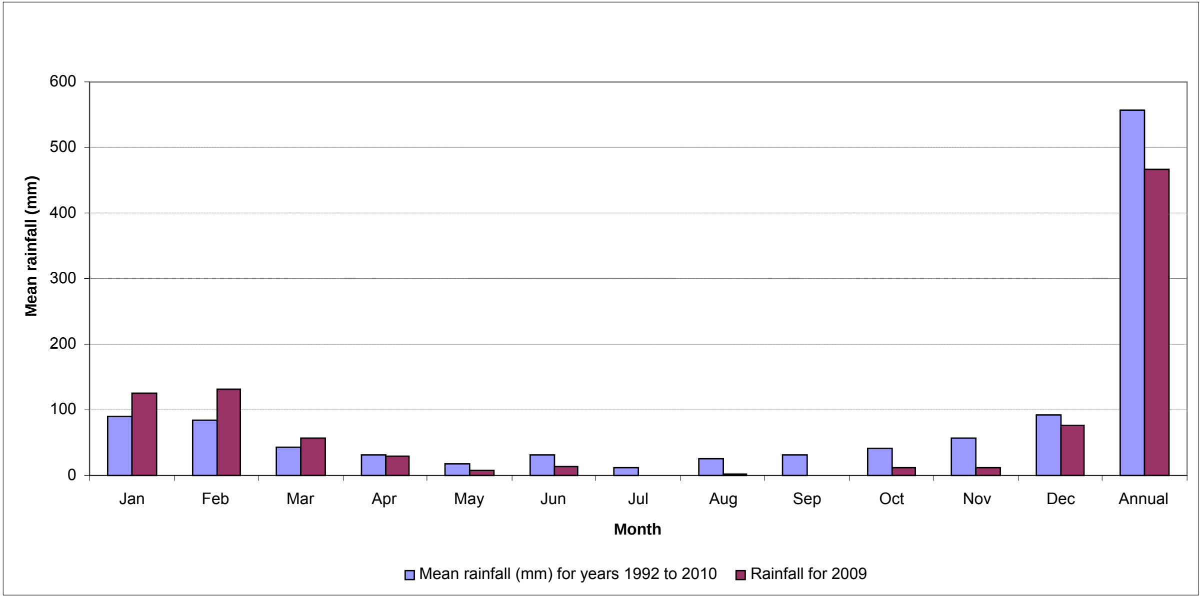
Figure 3-1 BOM Emerald Airport Air Temperature Statistics (1992 to 2010)



Rainfall and Humidity

Monthly mean rainfall values for the period of record 1870 to May 2010 from the Emerald Airport monitoring site are compared to data for 2009 in Figure 3-2. The data indicate a mean annual rainfall of 556 mm, with approximately 48% of rainfall occurring in summer.

Figure 3-2 BOM Emerald Airport Rainfall Statistics (1992 to 2010)



The 9am and 3pm relative humidity long-term statistics for the period of records between 1992 to 2010 are provided in Figure 3-3.

Figure 3-3 BOM Emerald Airport Humidity Statistics (1992 to 2010)

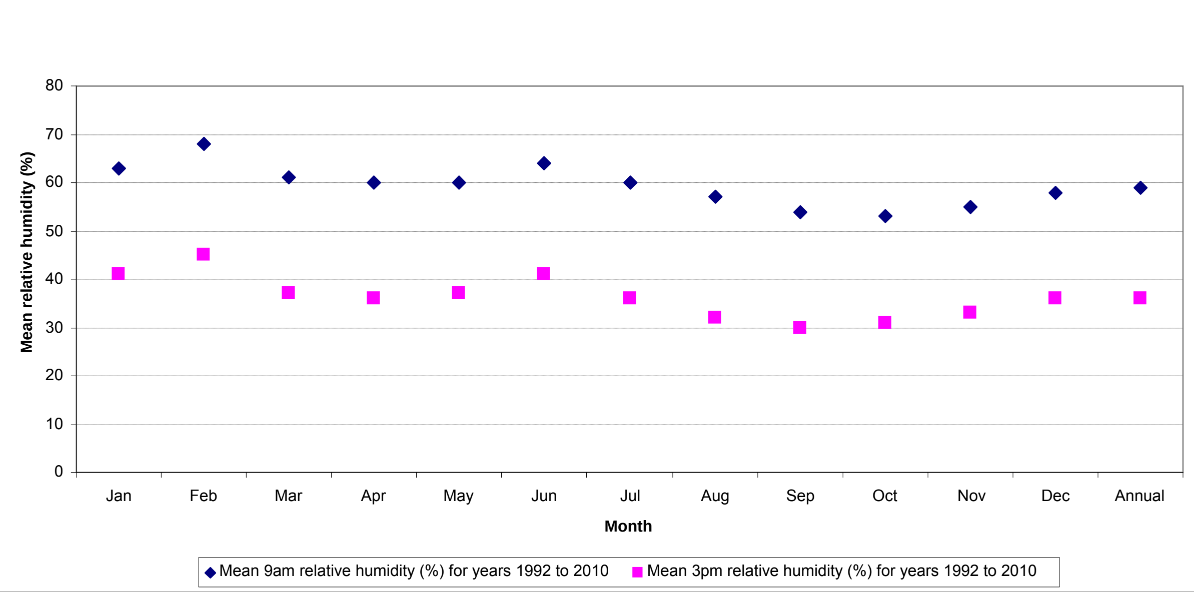
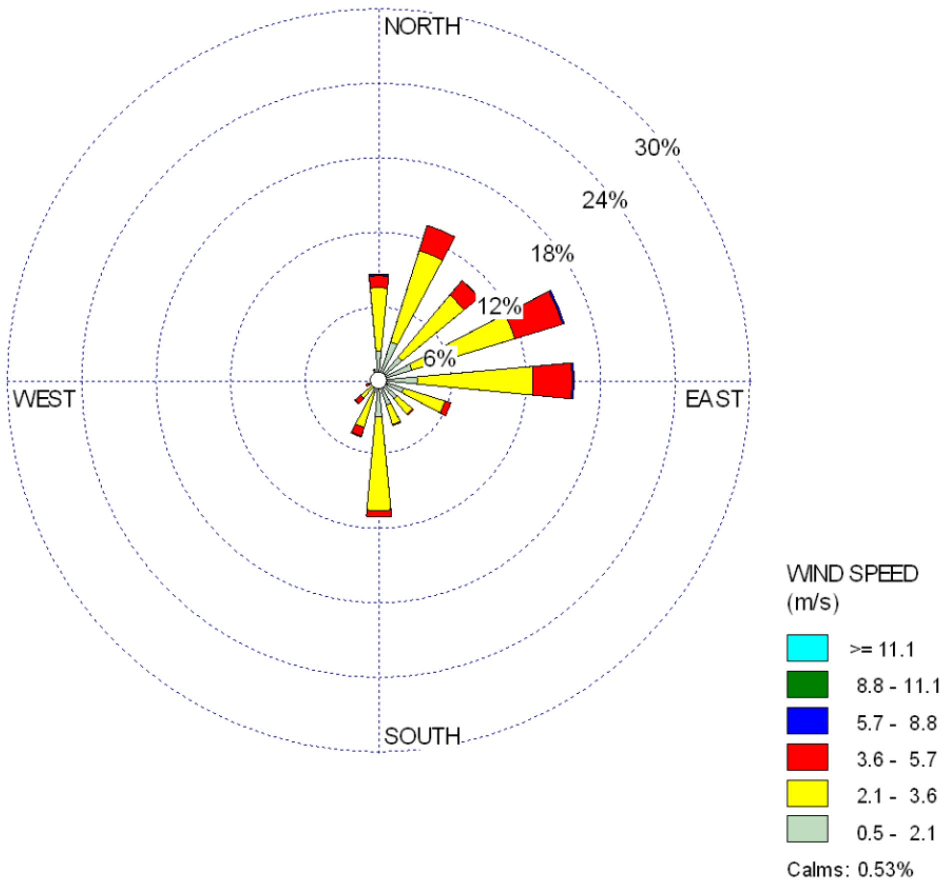


Figure 3-3 shows that mean 9am relative humidity is generally higher from February to July and lower from September to December. Mean 3pm relative humidity is lower than 9am relative humidity throughout the year, ranging from 30% in September up to 45% in February. The lowest 3pm relative humidity is from August to October.

Wind Speed and Direction

In the absence of site representative meteorological data, records of wind speed and direction were predicted using a combination of the TAPM meteorological model, observational data from Emerald Airport and the CALMET meteorological pre-processor. Figure 3-4 is a wind rose showing the cumulative frequency of wind speed and direction records for all hours of 2009**.** The meteorological modelling suggests that typical winds at the Project site are predominately from the east through to north-northeast. The hourly averaged wind speed reaches 6.6 metres per second (m/s) from the east, and is on average 2.6 m/s. The site is characterised by occasional light winds from the southeast and very infrequent winds from the west.

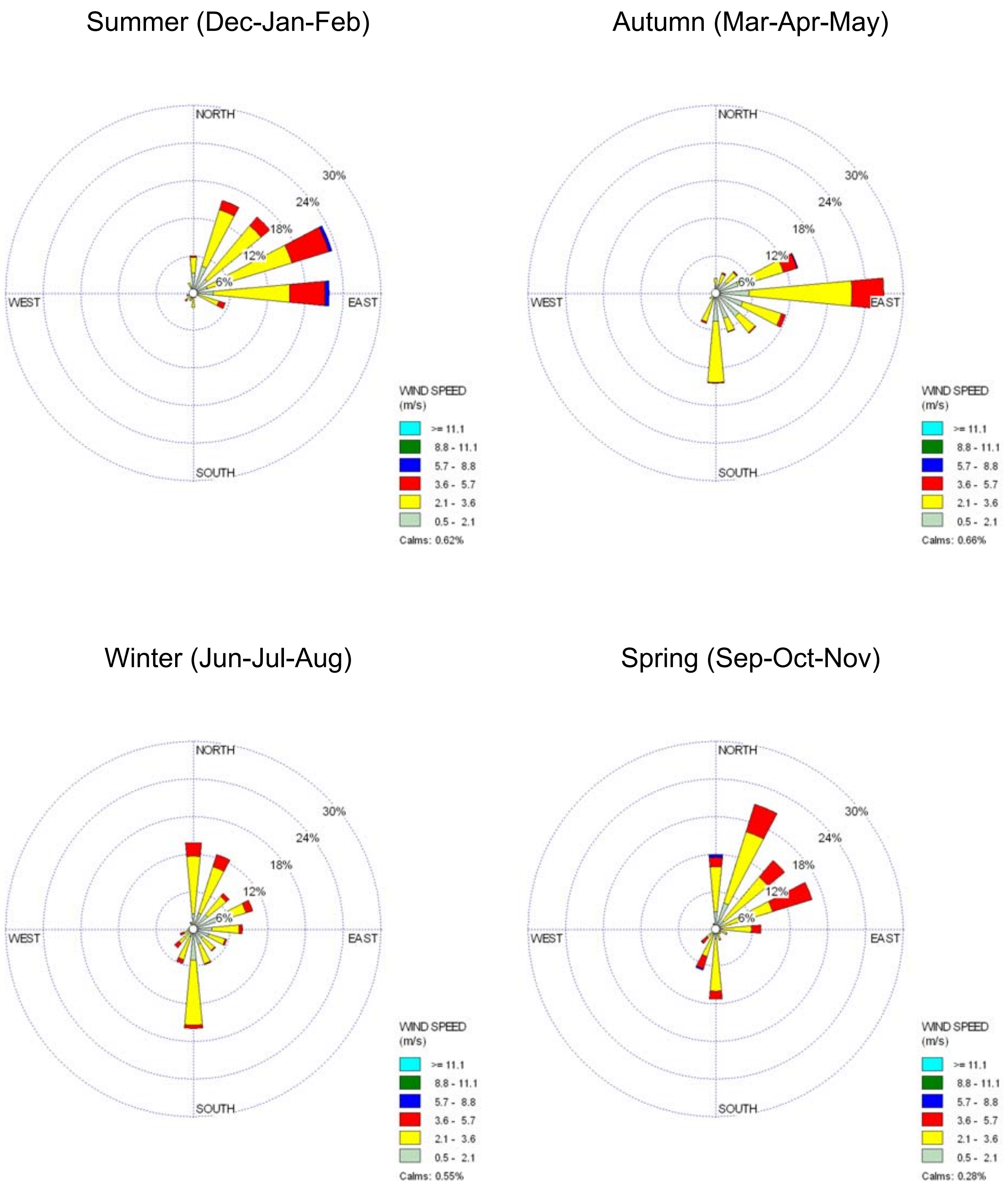
Figure 3-4 Wind rose for all hours- Kevin's Corner Project (Mine), CALMET 2009



Wind roses of seasonal wind speed and direction predictions are shown in Figure 3-5. Average winter wind speeds were predicted to be 2.4 m/s, with wind directions varying from the north, northeast and southerly directions. Average spring wind speeds were 2.9 m/s, with a predominant northeast wind direction. Summer winds tend to be from the northeast through to the east direction, with an average wind speed of 2.7 m/s. Average wind speed in the region in autumn was 2.3 m/s, with the majority of winds predicted from the east.

3 Environmental Values

Figure 3-5 Seasonal wind roses- Kevin's Corner Project (Mine), CALMET 2009



3.2 Existing Air Quality

The region of the Project is predominantly rural in character supporting cattle grazing and low density farming. In addition to natural sources such as dust storms and bush fires, anthropogenic emission sources in the region consist of activities such as crop cultivation and harvesting. Therefore, air quality in the region can generally considered to be typical of this area of central Queensland.

In general, the background concentration of a particular species represents that which would exist in the absence of the proposed project. Thus the background concentration includes impacts from all naturally occurring emission sources and existing anthropogenic sources within the region. In practice, the interpretation of background air quality varies from assessment to assessment. Here “background” air quality is used to represent the existing air quality environment.

In Queensland a conservative approach to estimating background levels has typically been adopted where a single value corresponding to the 95th percentile of the data has been applied to the entire project area. Approaches vary however, with the Environmental Protection Authority Victoria (EPA Victoria) recommending the use of a time variable background, or the 70th percentile where a time series is unavailable[2]. The approach in NSW is different again with a time variable background utilised when available[3] or other justifications made on a case by case basis.

The ‘appropriate’ percentile to apply may depend on a number of factors including (but not be limited to):

- Representativeness of the data set in terms of location and local influences;
- The degree of wind direction dependence of higher background concentration levels recorded at the site;
- The dominance of a dust emission source(s) that is not explicitly accounted for in the dispersion modelling (this may suggest a spatially varying background level is more representative than a single value applied to all sites within the study region); and
- The degree of contribution from emission source(s) that are explicitly accounted for in the dispersion modelling.

There are no regulatory-controlled ambient air quality monitoring stations in the vicinity of the Project site. Hence, data from similar mining projects have been used to represent background concentrations.

Changes in the existing air quality may occur prior to the commissioning of the Project due to the contribution of emissions from the Alpha Coal Project to the air shed. Therefore, the cumulative impact of emissions from the Alpha Coal Project and the Project on local and regional air quality has been considered through the application of atmospheric dispersion modelling.

Estimates of Ambient Background

For the purposes of this assessment, an estimate of the background concentration is required for the annual average (TSP and $PM_{2.5}$), and the 24-hour average (PM_{10} and $PM_{2.5}$). The monthly background rate of dust deposition is also required.

[2] Victorian Government Gazette, Special, Friday 21 December 2001
[3] NSW Department of Environment and Conservation, *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, August 2005

3 Environmental Values

The DERM monitors ambient concentrations and rates of deposition of dust at numerous sites across Queensland.

The nearest DERM monitoring site to the Project site is located at West Mackay in a light industrial area, approximately 400 km to the north-east. The annual average PM_{10} concentration[4] at this site is 21 µg/m³. As the Project site is located in a rural area, without any light industries or operating mines in the vicinity, the existing dust levels are expected to be lower than those recorded at West Mackay.

The Toowoomba monitoring site located approximately 700 km southeast of the Project has been identified as a better representation of a rural land use at the Project site. However, due to its proximity to residential and light industry and distance from the Project, it is considered that air quality at this location is not representative of the Project site.

The Ensham Central Project Environmental Impact Statement (EIS) contains 3 months of site-specific monitoring data for TSP and PM_{10} concentrations from Ensham Coal Mine located approximately 40 km east of Emerald and 200 km east southeast of the Project site. The data reported in the vicinity of the Ensham Coal Mine are reported in Table 3-1 for TSP, PM_{10}, $PM_{2.5}$ and dust deposition.

Table 3-1 Ambient background levels of particulate matter, Ensham Coal Mine

Particulate	Averaging Period	Concentration	Source
TSP	Annual	28 µg/m³	Ensham Coal Mine Project EIS
PM_{10}	24-hour	27 µg/m³	
$PM_{2.5}$	24-hour	5.4 µg/m³	
	Annual	2.8 µg/m³	
Dust Deposition	Monthly	54 mg/m^2/day	

Based on the publicly available EIS for the BHP Billiton Mitsubishi Alliance (BMA) Daunia Coal Mine Project, BMA monitored 24-hour PM_{10} concentrations at Olive Downs and Winchester Downs from April 2007 to August 2008. Dust deposition monitoring was also conducted by BMA at these locations from May 2007 to April 2008.

The annual average TSP concentration was assumed to be double the annual average PM_{10} concentration. The background particulate levels adopted for the purposes of the Daunia Mine EIS assessment are presented in Table 3-2.

[4] http://www.epa.qld.gov.au/environmental_management/air/air_quality_monitoring/air_quality_reports/monthly_bulletins/ (accessed February 2011)

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Table 3-2 Ambient background concentrations of Particulate Matter, Daunia Coal Mine EIS

Particulate	Averaging Period	Concentration	Source
TSP	Annual	20 µg/m³	Daunia Mine EIS
PM_{10}	24-hour	20 µg/m³	
$PM_{2.5}$	24-hour	NA	
	Annual	NA	
Dust Deposition	Monthly	145 mg/m²/day	

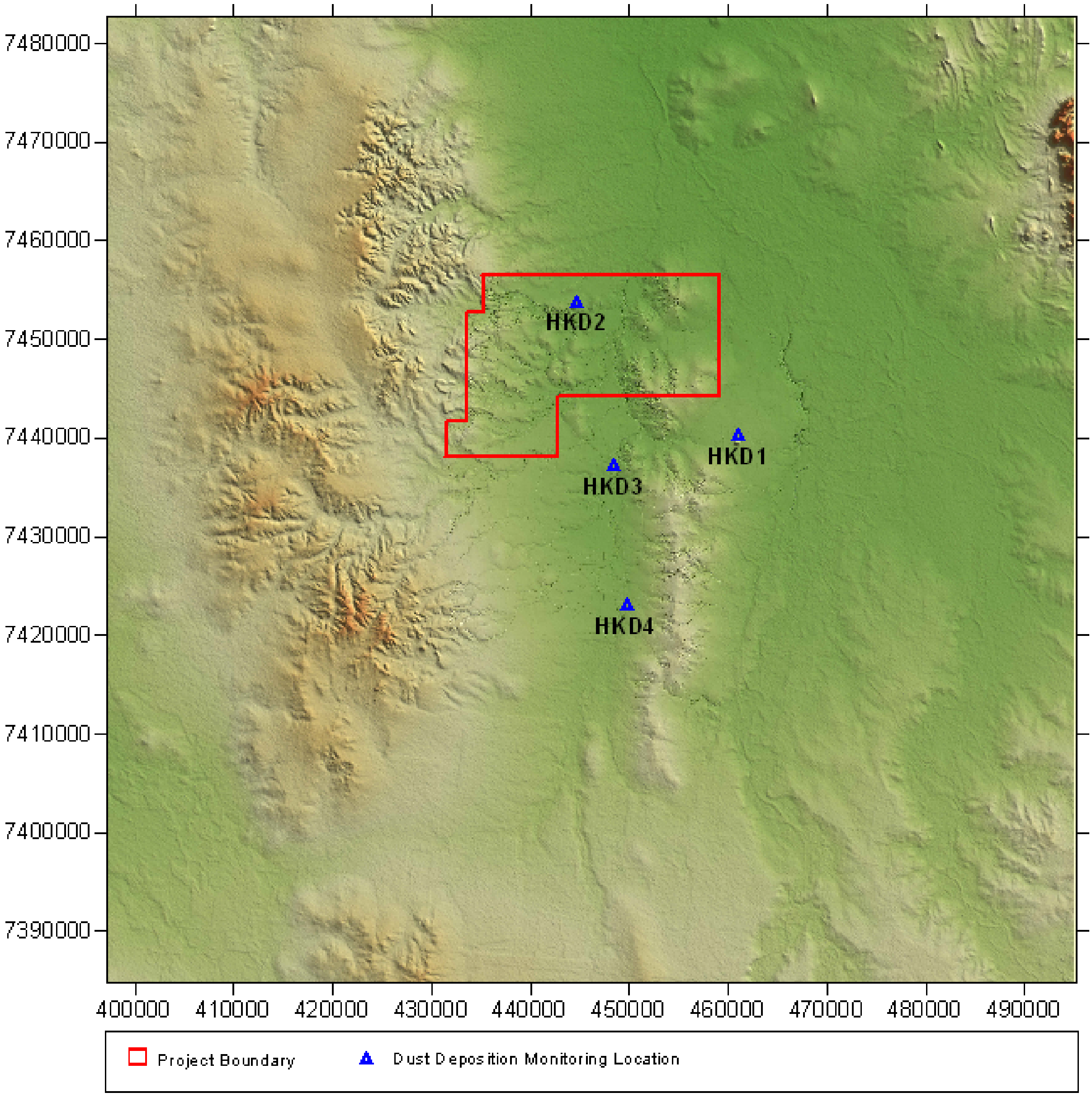
Estimates of Background Dust Deposition

Site-specific dust deposition monitoring (data provided by the Proponent) was conducted at four locations during 2009. Data for approximately 12 months has been made available for this assessment. Locations HKD3 and HKD4 are within the mining lease application MLA 70426, HKD1 located just outside the eastern boundary of MLA 70426 and HKD2 is located north of MLA 70426. These dust deposition monitoring locations are shown in Figure 3-6.

URS understands that potentially three of the dust deposition gauges have been sited adjacent to dirt roads, therefore the background concentrations are elevated by the contribution from this local source. Thus the dust deposition rates are expected to be a conservative representation of regional rates of deposition away from the dirt roads.

3 Environmental Values

Figure 3-6 Location of dust deposition monitoring sites



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3 Environmental Values

Table 3-3 Site-Specific Dust Deposition Data

Start Date	End Date	Sample Period (days)	Total Insoluble Matter (mg/m²/day)			
			HKD1	HKD2	HKD3	HKD4
23/12/2008	20/01/2009	28	207.0	26.0	37.0	19.0
20/01/2009	17/02/2009	28	75.0	46.4	50.0	--
17/02/2009	19/03/2009	30	26.7	50	73.3	46.7
19/03/2009	14/04/2009	--	--	--	--	--
14/04/2009	12/05/2009	28	35.7	17.9	21.4	200.0
12/05/2009	13/06/2009	32	56.3	40.6	118.8	128.1
13/06/2009	8/07/2009	25	16.0	24.0	28.0	32.0
8/07/2009	28/07/2009	20	20.0	20.0	20.0	20.0
28/07/2009	28/08/2009	31	74.2	19.4	45.2	87.1
28/08/2009	26/09/2009	29	48.3	69.0	55.2	58.6
26/09/2009	30/10/2009	34	85.3	102.9	61.8	267.6
30/10/2009	10/12/2009	41	34.1	61.0	56.1	100.0
10/12/2009	8/01/2010	29	79.3	89.7	110.3	189.7
Average over monitoring program			**63.2**	**47.2**	**56.4**	**104.4**
Average for all four sites over entire monitoring program			**67.8**			
Project Goal			**140**			

-- no dust deposition data available for the monitoring period.

Adopted Background Levels

In the absence of site-specific data, estimates of background ambient concentrations and dust deposition rates used in the assessment have been adopted from the Ensham Mine (ambient) and Hancock (deposition) datasets respectively (Table 3-4). The adoption of these datasets represents the inclusion of the highest or most conservative background concentrations available which are considered representative of the Project locality and region. For the cumulative element of the assessment, the contribution from the Alpha Coal Project has also been incorporated into this background.

Due to the uncertainty surrounding the representativeness of the estimated background concentrations and rates of deposition, and the approval of the Alpha Coal Mine Project, the following scenarios will be reported:

- Project only (i.e. incremental);
- Project plus background; and
- Total (Project plus background plus cumulative impacts).

Table 3-4 Summary of estimates of background and cumulative impact levels for particulate matter

Particulate	Averaging Period	Background	Source
TSP	Annual	28 µg/m^3	Ensham Coal Mine Project (EIS)
PM_{10}	24-hour	27 µg/m^3	Ensham Coal Mine Project (EIS)
$PM_{2.5}$	24-hour	5.4 µg/m^3	Ensham Coal Mine Project (EIS)
	Annual	2.8 µg/m^3	Ensham Coal Mine Project (EIS)
Dust Deposition	Monthly	68 mg/m^2/day	Proponent

3.3 Sensitive Receptor Locations

Dispersion modelling has been used to assess the likelihood of adverse air quality impacts at sensitive receptor locations surrounding the Project. Presented in Table 3-5 are the locations of the sensitive receptors for which results of the dispersion modelling will be presented. These receptors are shown in Figure 3-7.

There are currently two other residences within the study area (Hobartville and Wendouree homesteads), however these two residences are within the boundary of MLA 70426 (the adjoining Alpha Mine MLA, also owned by HCPL) and will be acquired by the Proponent.

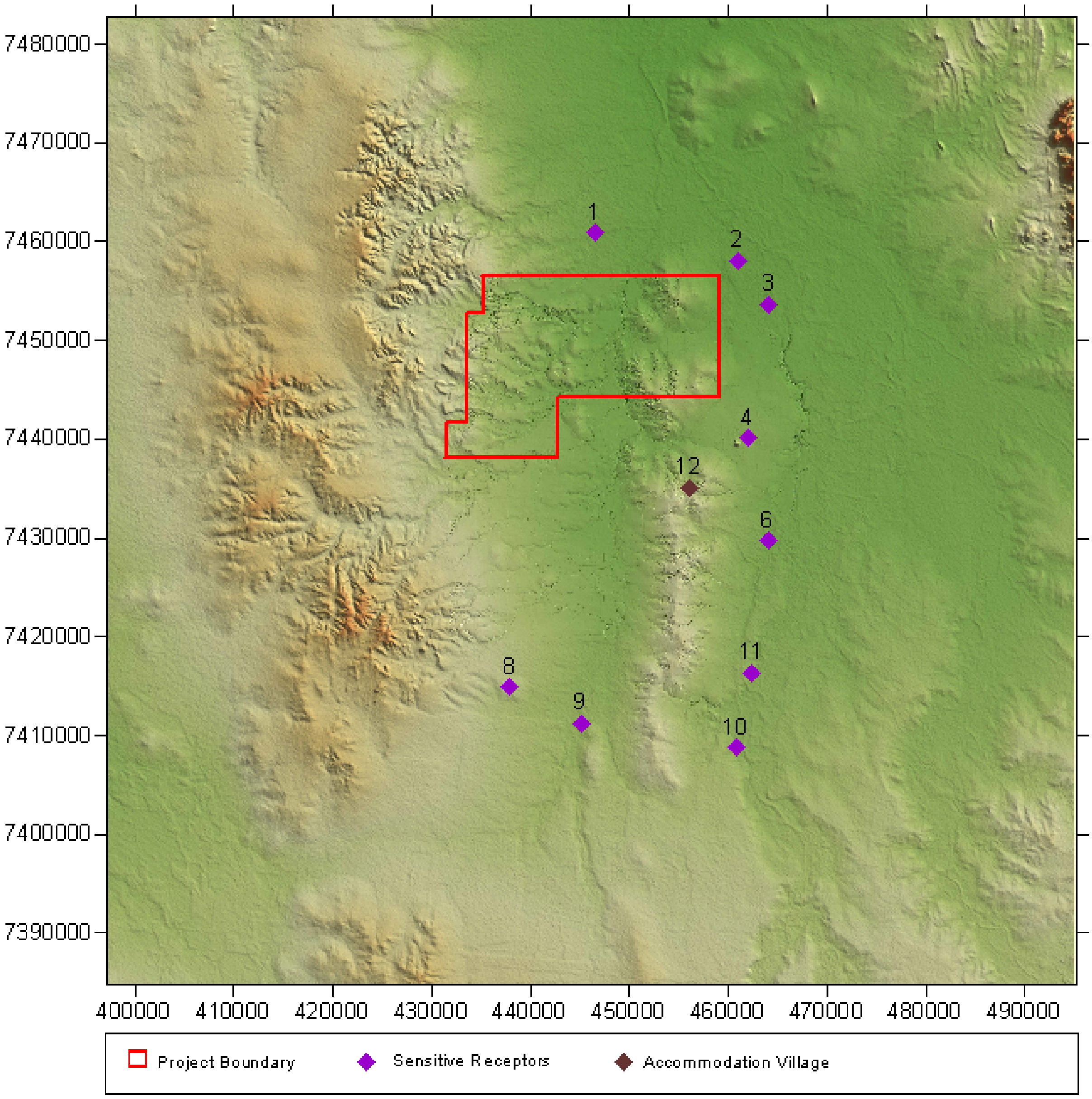
Table 3-5 Sensitive Receptor Locations in the Vicinity of the Project

Receptor ID	Receptor Description	UTM Easting (m)	UTM Northing (m)
1	Forrester Homestead	446462	7460888
2	Surbiton Station	460936	7458001
3	Eullmbie Homestead	464135	7453631
4	Surbiton Homestead (Surbiton South Station)	461950	7440055
6	Burtle Homestead	464057	7429716
8	Kia Ora Homestead	437918	7414891
9	Monklands Homestead	445097	7411185
10	Mentmore Homestead	460780	7408727
11	Tressillian Homestead	462419	7416374
12	Alpha Coal Project Accommodation Village[1]	455734	7435283

Note: (1) The location of the Alpha Coal Project Accommodation Village has been updated since the lodgement of the Alpha Coal EIS.

3 Environmental Values

Figure 3-7 Sensitive Receptor Locations



3 Environmental Values

Assessment Methodology

4.1 Sources of Air Emissions

A range of the mining activities proposed by HGPL are likely to be dust emission sources that must be represented in the atmospheric dispersion model. The following activities have been identified as sources of dust:

- Clearing of vegetation;
- Infrastructure construction (processing area, haul roads etc);
- Topsoil disturbance and removal;
- Transport of materials to site; and
- Graders;
- Scrapers;
- Dozers operating on overburden, interburden and coal;
- Blasting;
- Front end loading (FEL) of material to trucks;
- Excavators and shovels;
- Truck dumping of material;
- Loading and unloading of stockpiles;
- Draglines;
- Transport of material (overburden, coal, rejects);
- Conveying of coal to:
  - ROM dumps;
  - CHPP;
- Wind erosion from
  - The product coal stockpiling area,
  - Exposed surfaces, and
  - Tailings dam;
- The train load-out facility;
- Rehabilitation areas; and
- Transfer points in conveyor system.

4.2 Emission Estimation

The quantity of emissions of dust from the proposed mine cannot be determined from direct measurement, as the mine is not yet operational. Therefore, PM emissions from the Project have been estimated based on; mine plan and activity data provided by HGPL, emission factors provided in the National Pollutant Inventory (NPI) and the Emission Estimation Technique (EET) Manuals. The emission factors contained in the NPI EET manuals have been developed from measurements of dust emissions from other operational coal mines in Australia and the United States during typical operations.

The NPI EET Manual for Mining (NPI, 2001) has been used to provide data to estimate the amount of TSP and PM_{10} emitted from the various activities on a mine site, based on the amount of coal and overburden material mined as provided by the Proponent. Site-specific parameters were used to derive emission factors for trucks on unpaved roads, draglines, excavators, shovels, graders, dozers and blasting. Detail of these calculations is provided in Appendix D. Emissions from haul roads have

4 Assessment Methodology

incorporated Level 2 watering (greater than 2 l/m^2/hr), which has been assumed to result in a 75% reduction in emissions.

4 Assessment Methodology

Table 4-1 Dust Emission Inventory for four separate years of the proposed mine life

Activity	Year 1		Year 5		Year 15		Year 25	
	PM_{10}	TSP	PM_{10}	TSP	PM_{10}	TSP	PM_{10}	TSP
Disturbance & Rehabilitation	92,562	185,123	3,797	7,594	8,204	16,408	14,139	28,277
Drilling and Blasting	5,994	11,509	7,632	14,659	3,166	6,082	4,981	9,573
Dragline Operation	-	-	-	-	268,111	1,656,097	294,442	1,818,745
FEL of Overburden into Trucks	12,243	25,884	20,269	42,854	6,218	13,147	16,543	34,977
Transport of Overburden to dumps (Level 2 Watering)	115,425	526,913	174,802	797,967	91,692	418,573	193,509	883,365
Truck Dumping at Overburden Dumps	267,861	637,764	443,471	1,055,882	136,051	323,931	361,951	861,788
FEL of coal trucks	64,012	133,145	93,684	194,863	83,677	174,048	172,827	359,479
Dozers	86,055	350,211	66,932	272,386	64,200	261,268	73,761	300,181
Graders	243,236	910,106	243,236	910,106	145,942	546,063	194,589	728,085
Wind Erosion from Pits	70,284	140,568	82,881	5	38,400	2	37,932	2
Wind Erosion from Overburden Stockpiles	107,971	215,942	107,971	215,942	107,971	215,942	107,971	215,942
Processing	7,339	17,930	11,999	29,312	-	-	-	-
Truck Dumping at ROM	11,653	93,810	16,625	94,266	18,515	128,076	38,240	175,042
Dozer - Coal at ROM (total)	48,408	83,994	48,408	83,994	48,408	83,994	48,408	83,994
Coal Conveyors	172	323	128	323	128	323	128	323
Conveyor Transfer Points	1,400	2,960	30,317	64,098	43,200	91,336	43,069	91,059
Coal Processing	5,601	14,209	37,025	93,919	55,935	141,887	68,375	173,442
Loading of Coal Stockpiles	678	1,500	7,879	17,429	10,126	22,400	10,067	22,270
Misc Transfer Points	1,934	4,088	22,465	47,497	28,873	61,047	28,705	60,691
Wind Erosion from Stockpiles	3,082	6,163	3,082	6,163	3,082	6,163	3,082	6,163
Transport of Coal to ROM (Level 2 Watering)	14,692	36,091	27,960	128,279	40,178	261,251	103,710	552,923
Transport of Rejects to Dumps (Level 2 Watering)	2,065	32,402	23,990	78,807	30,834	93,292	30,655	92,912
Wind Erosion from Tailings Storage Facility	56,064	112,128	56,064	112,128	56,064	112,128	56,064	112,128
Total (kg/a)	1,218,731	3,542,763	1,530,615	4,268,473	1,288,973	4,633,458	1,903,148	6,611,362

4.3 Dispersion Modelling

A brief overview of the methodology for meteorological modelling using TAPM and CALMET and atmospheric dispersion using CALPUFF is provided. A more detailed description is included in Appendix E.

4.3.1 Meteorological Modelling Methodology

Atmospheric dispersion modelling using CALPUFF requires detailed data on surface and upper air meteorology in the model domain. Surface and upper air data were incorporated into the meteorological pre-processor CALMET to develop a three dimensional grid of meteorology for the model domain.

Emerald Airport (approximately 170 km from the project site) and Mackay Airport (approximately 420 km from the project site) were the closest locations with respective surface and upper air meteorological measurements observed with sufficient frequency for inclusion in CALMET. Given the coastal location of Mackay, compared to the inland location of the Project, the inclusion of upper air meteorology from Mackay was not considered appropriate.

Meteorological modelling using CALMET was therefore undertaken in a three stage process:

- TAPM modelling to derive an upper air dataset;
- Regional meteorological modelling at a coarse resolution incorporating:
  - Surface observations from Emerald Airport; and
  - Upper air data from TAPM.
- Project area meteorological modelling at a finer resolution incorporating:
  - Results from regional modelling as initial guess estimates for Project area.

The three-dimensional prognostic meteorological model TAPM incorporates detailed historical synoptic analyses of surface and upper air data collected in Australia to determine the wind flows over a chosen model domain and time period. The assessment included the assimilation of the observed data from Emerald Airport which was used to improve the results for meteorological parameters in the vicinity of the Project site. TAPM also contains databases on the vegetation types, land use, soil moisture content and terrain elevation (from 9-second Digital Elevation Model (DEM) data) that are used to specify the surface parameters for the selected model domain.

TAPM was set up for the region around the Project to simulate upper air and surface wind flows around the location to 1 km resolution.

The resultant three-dimensional wind fields from CALMET were used as inputs to the dispersion model CALPUFF.

This approach relies on the use of data from a location distant from the Project and from synoptic analysis processed by a model. Incorporation of site specific meteorological data would have allowed a more accurate representation of local meteorology to be incorporated to the dispersion modelling.

4.3.2 Dispersion Modelling Methodology

Modelled Species

The modelled species in the assessment were TSP, PM_{10} and deposited dust. Emission rates for each dust source on site were derived using the methodology described in Section 4.2. Predictions for PM_{10} were used to determine the impact of emissions of $PM_{2.5}$ from mine-related dust generating activities based on a conversion ratio.

PM_{10} to $PM_{2.5}$ ratio

Dust emitted from an emission source consists of a range of particle sizes (Section 1.3) that are dependent on the source characteristics.

Dust from overburden and coal handling operations is generated using mechanical means and thus the majority of dust emitted from coal mines consists of larger-sized particles (i.e. greater than $PM_{2.5}$) when compared with PM generated during combustion processes which contain more ultrafine particles. Dust from roads can be finer than that generated by material handling due to the repeated pulverising of PM into smaller fragments and the resultant creation of fine particles which can easily become airborne.

The proportion of dust released from the site as either TSP or PM_{10} has been represented in the emission factors used to generate the emission data. These emission factors indicate that PM_{10} emission rates are typically less than 50% of the TSP emission rates (examples: Table C-10).

Based on data collected in the vicinity of coal mines and presented in The Australian Coal Review[5], an average of 40% of TSP was found to consist of particles in the size range of PM_{10}. Particles in the size range of $PM_{2.5}$ were found to comprise only 4% of TSP or approximately 10% of PM_{10}.

Studies conducted by the Midwest Research Institute[6] into a wide-range of dust generating activities for the purposes of developing emission factors for the US EPA, have resulted in proposed $PM_{2.5}$ to PM_{10} ratios as outlined in Table 4-.

Table 4-2 Midwest Research Institute's Proposed $PM_{2.5}$ to PM_{10} Ratios

Source Category	$PM_{2.5}/PM_{10}$ Ratio
Paved Roads	0.15
Unpaved Roads	0.1
Construction & Demolition	0.1
Aggregate handling & Storage Piles	0.1 (traffic), 0.15 (transfer)
Industrial Wind Erosion	0.15
Agricultural Tilling	0.2
Open Area Wind Erosion	0.15

In the absence of additional information, it has been assumed that $PM_{2.5}$ concentrations resulting from Project activities are equal to 20% of PM_{10} concentrations from the Project.

[5] Richardson, C., *Fine Dust: Implications for the Coal Industry*, The Australian Coal Review, April 2000
[6] C. Cowherd & D. Ono (2005) *Proposed revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors.* http://www.epa.gov/ttn/chief/conference/ei15/session14/cowherd_pres.pdf

4 Assessment Methodology

It should be noted that as particles move away from a source, the larger particles with greater mass will deposit first, with smaller lower mass particles able to be transported further. The ratio between PM_{10} and $PM_{2.5}$ therefore changes with distance from the source. The approach adopted in this assessment assumed that the source ratio is equally applied throughout the model domain. This may have resulted in an under estimation of $PM_{2.5}$ concentrations at distance from the sources.

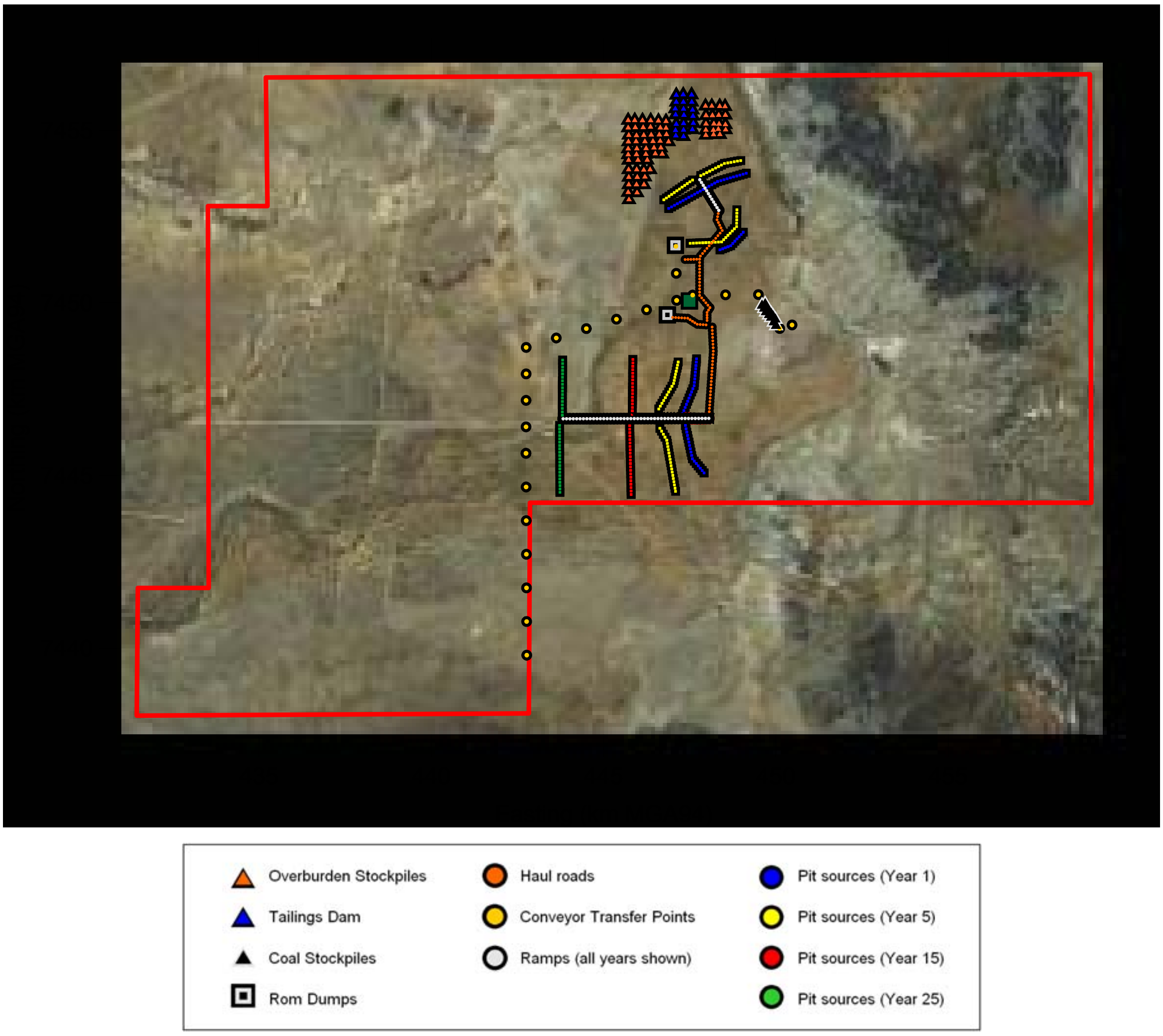
Receptor Locations Modelled

Sensitive receptor locations were included in the CALPUFF modelling for the prediction of air quality impacts as described in Section 3.3.

Emission Source Locations

The location of dust emission sources relative to project area is shown in Figure 4-1.

Figure 4-1 Location of dust emission sources relative to project area



4.3.3 Limitations of Dispersion Modelling

General Limitations

Modelling of complex physical systems is based on the use of numerical techniques to solve a set of governing equations. In general, the more complicated the system modelled, the more parameterisations (or approximations) are required in order to solve these equations; particularly in relation to the representation of sub-grid scale processes. Thus, there are inherently a number of ‘tuneable’ parameters that are required as input into the models. Model developers often suggest default values for these parameters which may be based on observational data, laboratory experiments or professional experience. Depending on the scale of the mine, assessing the sensitivity of model results to input data and/or the value of tuneable parameters can be prohibitive, either in terms of computational requirements, timeframes for completion of the assessment and/or budgetary constraints.

Validation is a critical component to both model development and application. Rarely however does a suitable data set exist with which to conduct a detailed, statistically meaningful model validation study. The CALPUFF dispersion model has been developed to estimate the impact of emissions from a range of source types including: point sources (tall and short stacks), buoyant line sources (aluminium smelters), buoyant area sources (i.e. forest fires), area sources and volume sources. Model validation exercises have tended to focus on the impacts of emissions from point sources (i.e. stacks). Non-buoyant line sources such as haul roads are not explicitly included as a source type in CALPUFF. Instead, these types of sources are typically represented as a series of volume sources whose separation distance is taken as a function of the minimum distance to the nearest receptor. This follows the simulated line source methodology used in the regulatory approved dispersion model AUSPLUME developed by the EPA Victoria. Model validation of low level air emissions of pollutants (such as dust generated by large-scale mining activities) is additionally complicated by the near-surface release of emissions, the non-stationality of emission sources and the variability in the locale of activities (such as blasting events).

In general, models have difficulty in accurately predicting dispersion under light wind speeds (i.e. less than 1 m/s) due to the dominance of physical processes other than advection and or turbulent diffusion under such conditions. The inability to accurately predict the minimum mixing height is another limiting factor of dispersion modelling and is particularly important when dealing with low level, non-buoyant (or low buoyancy) emission sources such as those present on a coal mine.

Further limitations in dispersion modelling are the uncertainties relating to the precision and applicability of input data, and the lack of observational data with which to validate the predicted concentrations.

Project Specific Limitations

This assessment relies on the completeness, accuracy and/or representativeness of a number of input data sets including:

- Kevin’s Corner Coal Project information;
- Regulatory supplied ambient air and meteorological monitoring data;
- Client and supplied monitoring data;
- NPI emission factors; and

- Non site-specific default parameters used in the development of the emission factors.

Other limitations of the assessment include (but may not be limited to):

- The accuracy of the characterisation of the background environment;
- The accuracy of the characterisation of source emissions;
- The accuracy of the characterisation of the local meteorology;
- The assumption of $PM_{2.5}$ being 20% of PM_{10} concentrations;
- The sensitivity of the dispersion modelling results to variable model input parameters; and
- The lack of monitoring data with which to calibrate the atmospheric dispersion model results.

4.3.4 Refinements to the Assessment Methodology

The assessment methodology includes a number of assumptions that may lead to unnecessarily conservative dispersion modelling results. As such, there are a number of opportunities for refinement of the assessment methodology including (but not limited to):

- Refinement of input parameters such as the estimates of tailing storage facility areas that are dry;
- Use of additional and/or most recent parameters values for Project-specific information in order to refine emissions estimation including:
  - Blasting hole depth
  - Moisture content of in situ coal, ROM coal and product coal
  - Moisture content of overburden and interburden
  - Silt content of materials (of tailings, coal, overburden, haul roads);
- Development of site-specific emission factors (for example):
  - Truck dumping; and
  - Dozers operations on overburden and interburden;
- Develop an estimate of background levels based on site-specific monitoring data (if available);
- Investigate opportunities for revised Project definition with improved air quality outcomes for example:
  - Reduction in vehicle kilometres travelled (VKT)
    - Optimise material handling to reduce the number of VKT travelled by empty vehicles
    - Transport via conveyors as opposed to truck and shovel
  - Reduce equipment fleet such as the number of dozers; and
- Incorporation of a pit retention factor for activities below 50 m, and/or incorporation of the mining landforms into the meteorological pre-processor. This would reflect the tendency of emissions to be largely contained within the pit during worst case (stable) dispersion conditions, where winds are calm, and vertical dispersion is restricted by the absence of turbulence.

Dispersion Modelling Results

Predicted concentrations from the atmospheric dispersion modelling have been analysed at discrete receptor locations in the locality of the Project. These are supplemented with regional predictions through the use of contour plots.

5.1 Interpretation of Results

When reviewing dispersion model outputs, it is important to interpret the results presented in the context of the limitations outlined in Section 4.3.3. In particular, the limitations associated with validating the relevance and applicability of both the model input data sets and model output should be considered. Dispersion modelling should be regarded as a tool for the identification of potential air quality issues within the study region. However, the confirmation of a model-predicted impact (either adverse or beneficial) can only be definitively assessed by detailed comparison against observational data.

The following issues should also be considered when interpreting the dispersion model results:

- The software graphics package SURFER has been used in this assessment to develop the regional contour plots. Contouring techniques involve the interpolation of results onto a grid which is a source of spatial uncertainty. The results presented in tabular form are extracted directly from model output and are thus a better representation of predicted impacts at receptor locations;
- Tabulated results are reported to the nearest whole number. However, this suggests a level of accuracy of model predictions which is not realisable, nor verifiable. Reporting (for example) a concentration of 24 µg/m^3 implies an accuracy of ±1 µg/m^3. Quantifying the uncertainty in the results presented is in general, not undertaken for the reasons discussed in Section 4.3.3.
- Results presented in the following sections include both the Project-related incremental contribution to ground level concentrations of dust at receptor locations as well as combined impacts that incorporate estimates of background levels of dust.

5.2 Results

This section provides predicted concentrations for Year 5 and Year 25. The results for Years 1 and 15 are included as Appendix D.

Adjustment of estimated background concentrations may be warranted should sufficient additional information such as site-specific monitoring data become available.

5.2.1 Particulate Matter as PM_{10}

A summary of fifth highest predicted 24-hour average ground-level concentration of PM_{10} is presented in Table 5-1.

Table 5-1 Predicted 5th highest 24-hour Average Ground Level Concentration of PM_{10} (µg/m^3).

Receptor	Y5			Y25		
	Project	Total2	% of EPP (Air)	Project	Total2	% of EPP (Air)
1	35	**62**	**124%**	16	43	87%
2	3	30	60%	3	30	60%
3	2	29	58%	2	29	58%
4	2	29	58%	3	30	60%
6	1	28	57%	1	28	56%
8	7	34	69%	13	40	81%
9	6	33	67%	8	35	71%
10	1	28	56%	1	28	56%
11	1	28	56%	1	28	57%
12	7	34	67%	6	33	65%
Project Goal	50		100%	50		100%

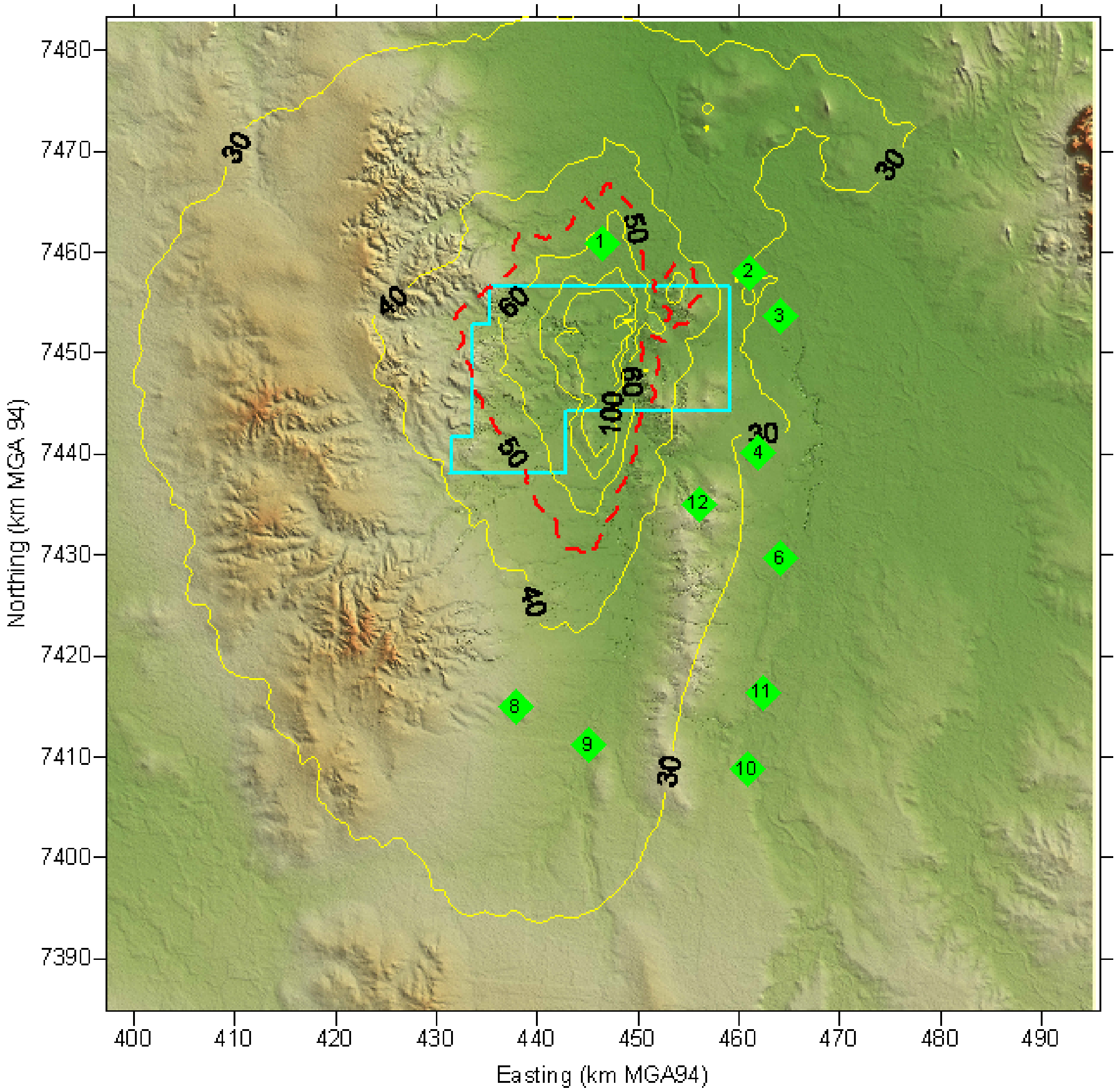
Note (1): Numbers highlighted in bold exceed the relevant Project Goal
Note (2): Background concentration estimated at 27 µg/m^3.

The table shows an exceedance of the Project Goal at Receptor 1 during Year 5 by 24%. The predicted concentrations at the remaining receptors are under the Objective. In year 25, it is predicted that concentrations will be compliant at all sensitive receptors.

Contour plots for year 5 and year 25 are presented in Figure 5-1 and Figure 5-2 (respectively) and highlight the extent of the region predicted to exceed the Project Goal of 50 µg/m^3.

5 Dispersion Modelling Results

Figure 5-1 Year 5: The predicted fifth highest 24-hour average ground-level concentration of PM_{10}. The Project Goal is 50 µg/m³ (background concentration estimated at 27 µg/m³ has been included).



5 Dispersion Modelling Results

Figure 5-2 Year 25: The predicted fifth highest 24-hour average ground-level concentration of PM_{10}. The Project Goal is 50 µg/m^3 (background concentration estimated at 27 µg/m^3 has been included).

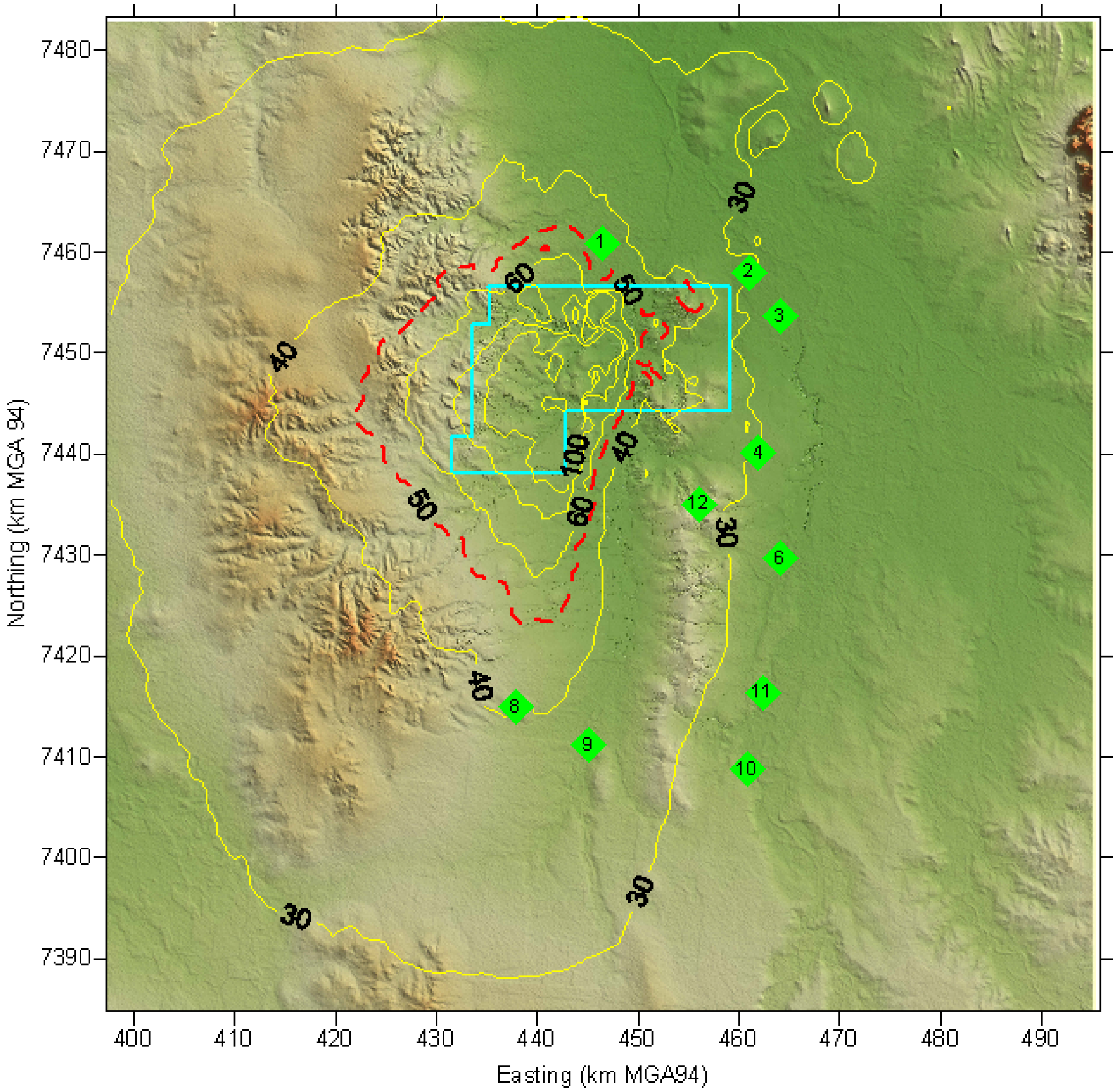


Figure 5-1 and Figure 5-2 show that the PM_{10} is dispersed in a broadly southerly direction from the Project site and the highest concentrations are predicted within the immediate Project boundary.

5.2.2 Particulate Matter as $PM_{2.5}$

Table 5-2 shows the predicted maximum 24-hour average ground-level concentration of $PM_{2.5}$ at receptor locations.

Table 5-2 Predicted maximum 24-hour average ground level concentration of $PM_{2.5}$ (μg/m³).

Receptor	Y5			Y25		
	Project	Total[1]	% of EPP (Air)	Project	Total[1]	% of EPP (Air)
1	8.0	13.4	54%	4.4	9.8	39%
2	1.8	7.2	29%	1.4	6.8	27%
3	0.8	6.2	25%	0.8	6.2	25%
4	2.2	7.6	30%	2.1	7.5	30%
6	0.9	6.3	25%	0.6	6.0	24%
8	1.8	7.2	29%	3.1	8.5	34%
9	1.7	7.1	28%	1.8	7.2	29%
10	0.4	5.8	23%	0.7	6.1	24%
11	0.6	6.0	24%	0.7	6.1	25%
12	2.3	7.7	31%	3.7	9.1	37%
Project Goal	25		100%	**25**		100%

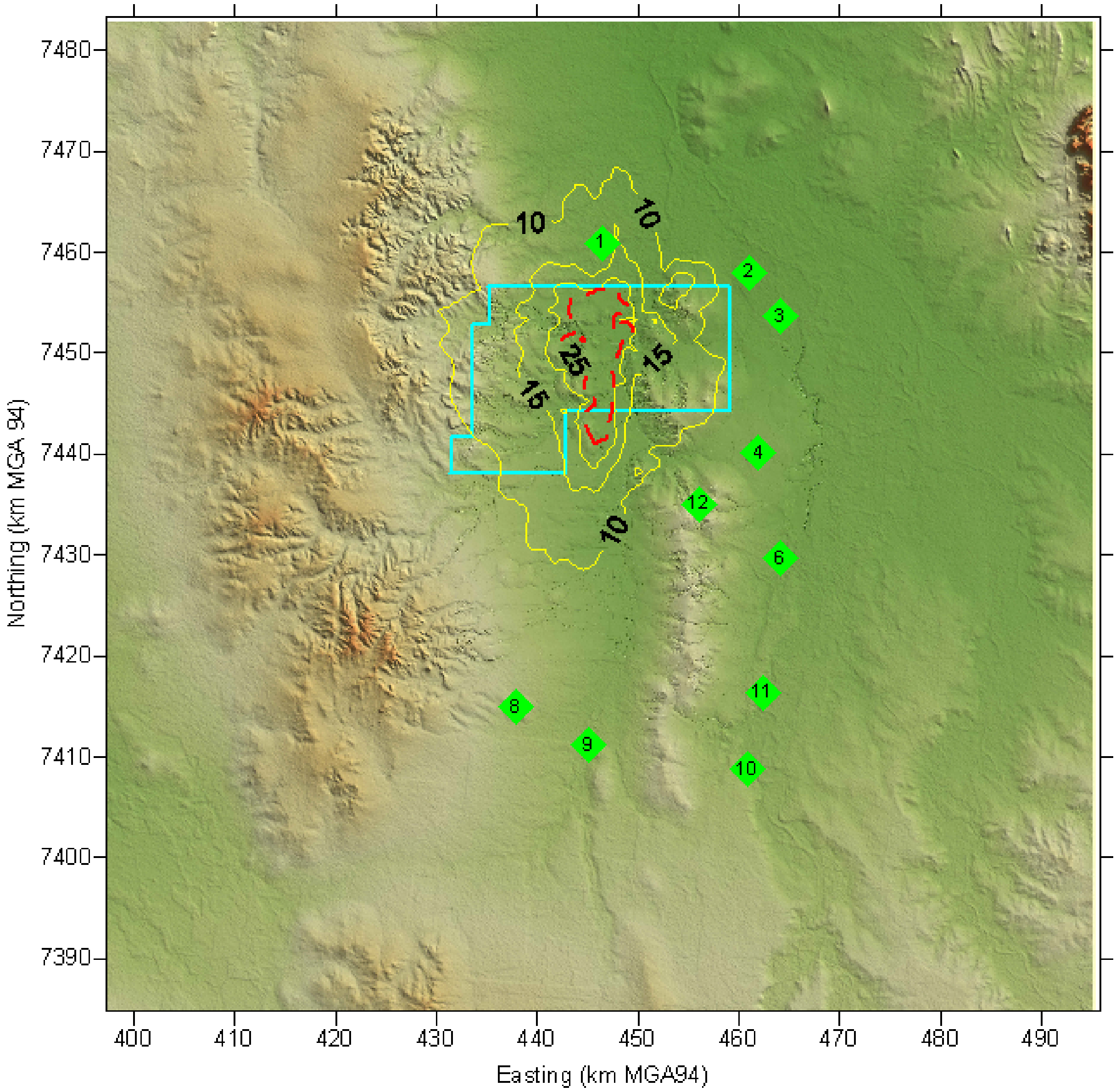
Note: Includes background concentration estimated at 5.4 μg/m³.

Table 5-2 shows that no exceedances were predicted to occur at sensitive receptors for years 5 and 25.

The 24-hour average contour plots for Year 5 and Year 25 (respectively) are presented in Figure 5-3 and Figure 5-4. The remaining results are presented in Appendix D.

5 Dispersion Modelling Results

Figure 5-3 Year 5: The predicted maximum 24-hour average ground-level concentration of $PM_{2.5}$. The Project Goal is 25 µg/m^3 (background concentration estimated at 5.4 µg/m^3 has been included)



5 Dispersion Modelling Results

Figure 5-4 Year 25: The predicted maximum 24-hour average ground-level concentration of $PM_{2.5}$. The Project Goal is 25 µg/m^3 (background concentration estimated at 5.4 µg/m^3 has been included)

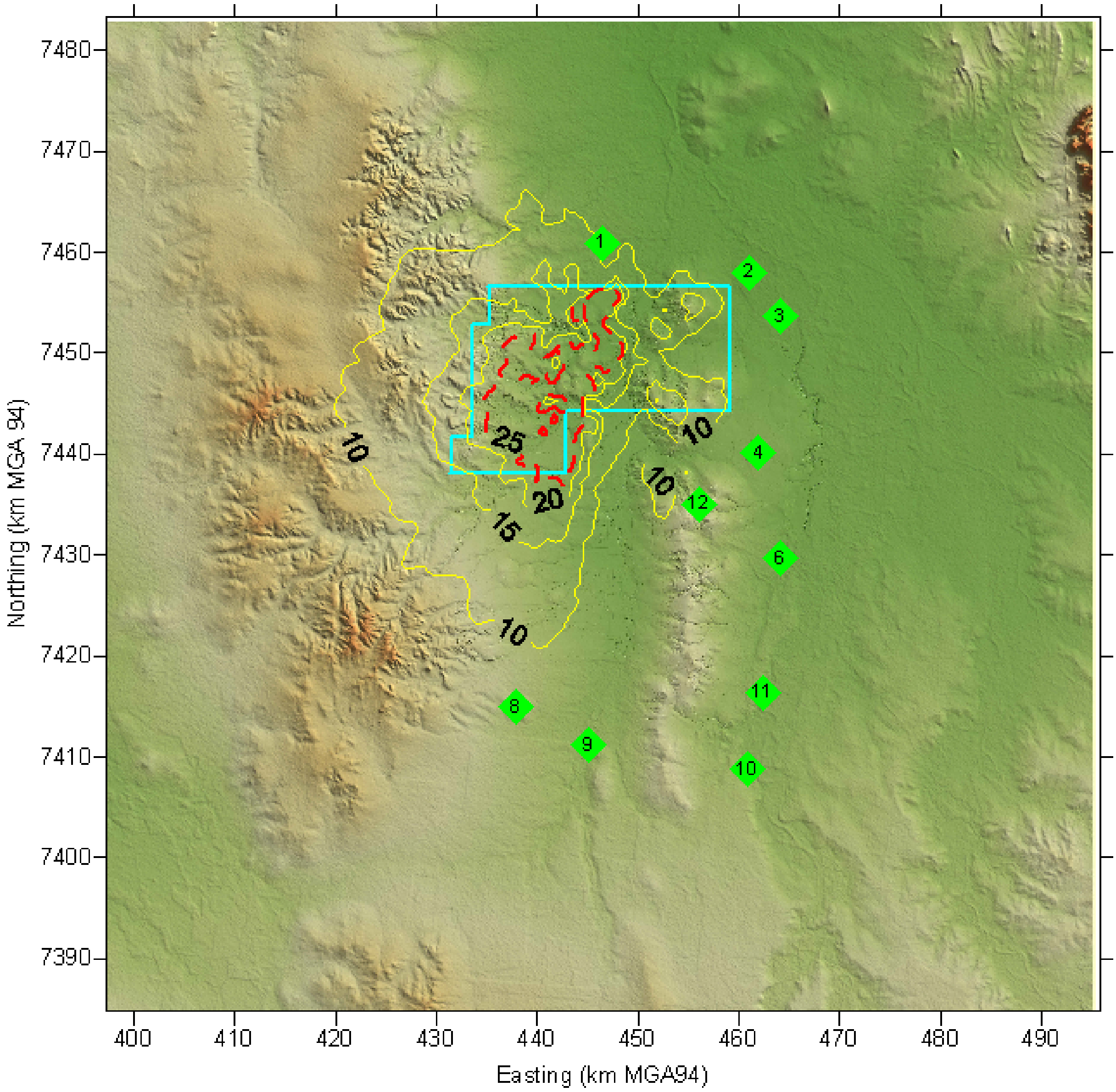


Figure 5-3 and Figure 5-4 show that for years 5 and 25, the exceedance area for $PM_{2.5}$ is elongated north to south and is almost entirely contained within the Project boundary.

The results for the annual average ground-level concentration of $PM_{2.5}$ are presented in Table 5-3.

Table 5-3 Predicted annual average ground level concentration of $PM_{2.5}$ (µg/m³).

Receptor	Y5			Y25		
	Project	Total[1]	% of EPP (Air)	Project	Total[1]	% of EPP (Air)
1	1.3	4.1	51%	0.6	3.4	42%
2	0.04	2.8	35%	0.03	2.8	35%
3	0.02	2.8	35%	0.02	2.8	35%
4	0.03	2.8	35%	0.03	2.8	35%
6	0.01	2.8	35%	0.01	2.8	35%
8	0.21	3.0	38%	0.36	3.2	40%
9	0.15	3.0	37%	0.17	3.0	37%
10	0.02	2.8	35%	0.02	2.8	35%
11	0.02	2.8	35%	0.02	2.8	35%
12	0.06	2.9	36%	0.07	2.9	36%
Project Goal	8		100%	8		100%

Note (1): Background concentration estimated at 2.8 µg/m³.
Note (2): Numbers highlighted in bold exceed the relevant Project Goal

Table 5-3 shows that no exceedances of the Project Goal for $PM_{2.5}$ were predicted to occur at sensitive receptors for years 5 and 25. The highest prediction was made at Receptor 1 in year 5, which was 51% of the Project Goal.

5.2.3 Particulate Matter as TSP

Presented in Table 5-4 are the predicted annual average ground level concentrations of TSP for years 5 and 25.

Table 5-4 Predicted annual average ground level concentration of TSP (µg/m³).

Receptor	Y5			Y25		
	Project	Total[1]	% of EPP (Air)	Project	Total[1]	% of EPP (Air)
1	10.8	39	43%	4.3	32	36%
2	0.3	28	31%	0.3	28	31%
3	0.1	28	31%	0.1	28	31%
4	0.2	28	31%	0.2	28	31%
6	0.1	28	31%	0.1	28	31%
8	1.1	29	32%	2.1	30	33%
9	0.8	29	32%	1.0	29	32%
10	0.1	28	31%	0.1	28	31%
11	0.1	28	31%	0.1	28	31%
12	0.4	28	32%	0.6	29	32%
Project Goal	90		100%	90		100%

Note (1) Background concentration estimated at 28 µg/m³ has been included.

Table 5-5 shows that no exceedances of the Project Goal for TSP were predicted to occur at sensitive receptors for years 5 and 25. The results for the other modelled years are provided in Appendix D.

5.2.4 Dust Deposition

Table 5-5 provides a summary of the predicted rates of dust deposition at sensitive receptors.

Table 5-5 Predicted Dust deposition ($mg/m^2/day$)

Receptor	Y5			Y30		
	Project	Total	% of EPP (Air)	Project	Total	% of EPP (Air)
1	11.0	79	56%	4.0	72	52%
2	0.3	68	49%	0.3	68	49%
3	0.1	68	49%	0.1	68	49%
4	0.2	68	49%	0.2	68	49%
6	0.1	68	49%	0.1	68	49%
8	1.0	69	49%	2.0	70	50%
9	1.0	69	49%	1.0	69	49%
10	0.1	68	49%	0.1	68	49%
11	0.1	68	49%	0.1	68	49%
12	0.4	68	49%	0.6	69	49%
Project goal	140		100%	140		100%

Note (1): Background concentration estimated at 68 $mg/m^2/day$ has been included.

Table 5-5 shows that no exceedances of the dust deposition rate Project Goal are predicted at receptor locations for years 5 and 25. The highest exceedance was predicted at Receptor 1 in year 5 which was 56% of the Project Goal with the inclusion of background. The results for the other modelled years are given in **Appendix D**.

5.3 Potential Cumulative Impacts

In September 2010, HGPL placed mine lease application 70426 to develop the Alpha Coal Project (Mine), an open cut coal mine adjacent to the Project. The Alpha Coal Project is proposed to consist of six open cut pits, oriented in a north-south direction, of approximately 25 km in total length. Given the large scale and exposed nature of emission sources relating to the open cut mine of Alpha Coal Project (Mine), dust emissions from the Alpha Coal Project (Mine) are higher than those associated with the Project. As an indication, derived from the comparison of the two project emission inventories, PM_{10} emissions from the Project are estimated to be approximately 20% of those from the Alpha Coal Project (Mine).

Details of the most recent air quality impact assessment for Alpha Coal are provided in *Alpha Coal Mine Project Air Quality Assessment - Supplementary Report* (URS, 2011), hereafter referred to as the Alpha SEIS AQIA. This section has been prepared in order to present the potential cumulative impacts of the Kevin's Corner and Alpha Coal Projects, should they both proceed simultaneously. The dispersion modelling contained in the Alpha SEIS AQIA is for the same modelling domain as that used in this assessment, and also considers a range of common discrete receptor locations. Cumulative impacts have been calculated by adding the Alpha and Kevin's Corner dispersion modelling output files, and processing for the relevant averaging period, rank, and particulate type. Cumulative assessment has been limited to Years 5 and 25 considered, and PM_{10} and $PM_{2.5}$ in this assessment.

In the tabulated cumulative assessment results, the 'Projects' column represents the combined contribution from Alpha Coal Project (Mine) and the Kevin's Corner Project. The 'total' column represents the Projects column plus background. The '% of EPP (Air)' is the percentage of total proportion of the Project Goal.

Table 5-6 shows the predicted cumulative 5th highest 24-hour average ground-level concentration of PM_{10} at receptor locations.

Table 5-6 Predicted cumulative (Alpha and Kevin's Corner) 5th highest 24-hour average ground level concentration of PM_{10} ($\mu g/m^3$).

Receptor	Y5			Y25		
	Projects	Total[1]	% of EPP (Air)	Projects	Total[1]	% of EPP (Air)
1	121	**148**	296%	124	**151**	302%
2	39	**66**	132%	39	**66**	131%
3	30	**57**	113%	32	**59**	118%
4	73	**100**	199%	61	**88**	176%
6	26	**53**	106%	19	46	92%
8	173	**200**	400%	303	**330**	660%
9	265	**292**	584%	155	**182**	364%
10	16	43	87%	14	41	83%
11	16	43	86%	17	44	88%
12	131	**158**	316%	147	**174**	349%
Project Goal	50		100%	50		100%

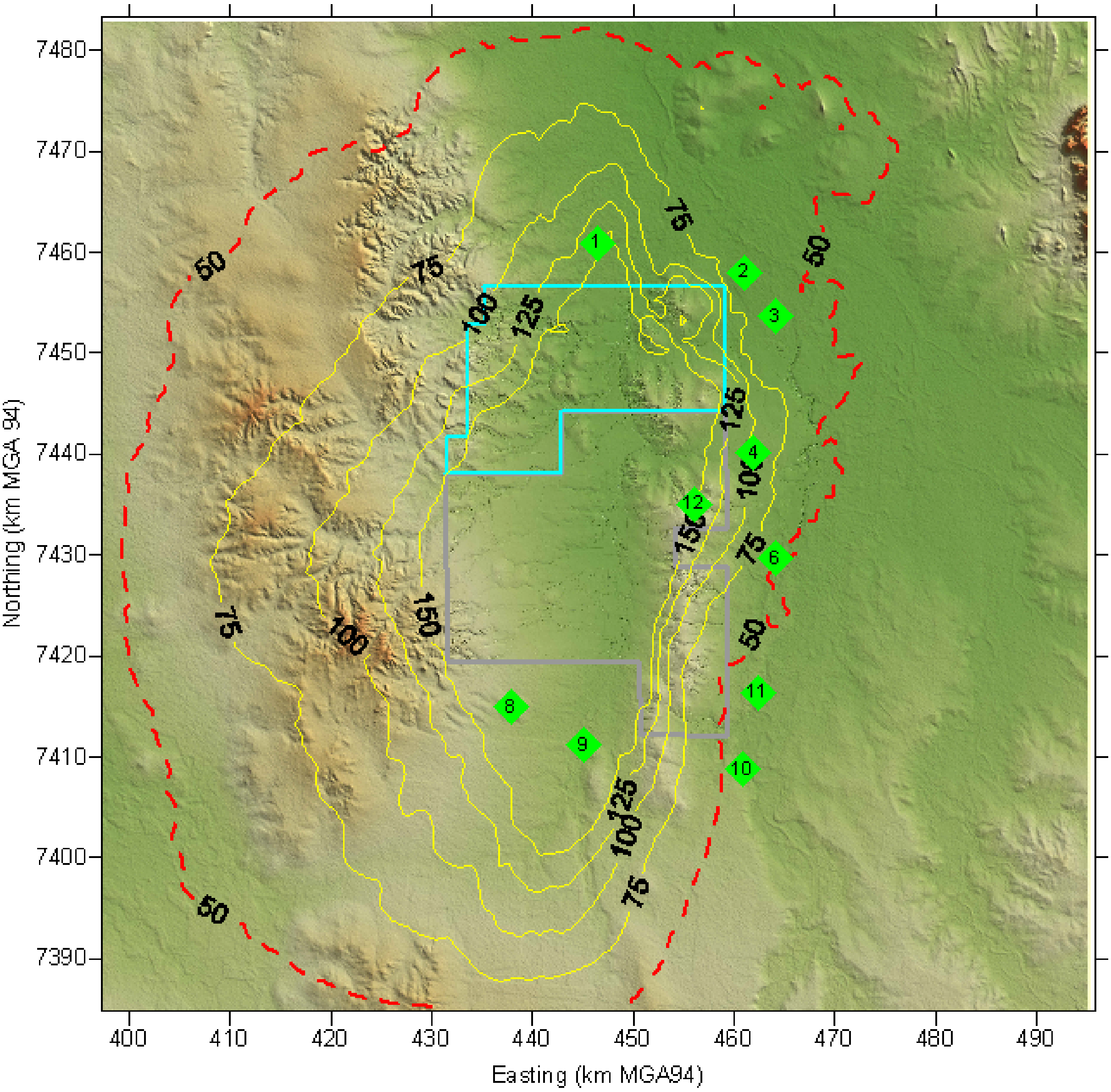
Note (1) Background concentration estimated at 27 $\mu g/m^3$ has been included.
Note (2): Numbers highlighted in bold exceed the relevant Project Goal

Table 5-6 shows that with the exception of receptors 10 and 11, the Project Goal is predicted to be exceeded at all receptors in year 5. In year 25 the Project Goal is predicted to be exceeded at all receptors except 6, 10 and 11. The highest exceedances are predicted at receptors 8 (400% and 660%) and 9 (584% and 364%) in year 5 and 25.

The cumulative 24-hour average PM_{10} contour plots for Year 5 and Year 25 (respectively) are presented in Figure 5-5 and Figure 5-6. The remaining results are presented in Appendix D.

5 Dispersion Modelling Results

Figure 5-5 Year 5: The predicted 5th highest cumulative (Alpha Coal and Kevin's Corner) 24-hour average ground-level concentration of PM_{10}. The Project Goal is 50 µg/m^3 (background concentration estimated at 27 µg/m^3 has been included)



5 Dispersion Modelling Results

Figure 5-6 Year 25: The predicted 5th highest cumulative (Alpha Coal and Kevin's Corner) 24-hour average ground-level concentration of PM_{10}. The Project Goal is 50 µg/m^3 (background concentration estimated at 27 µg/m^3 has been included).

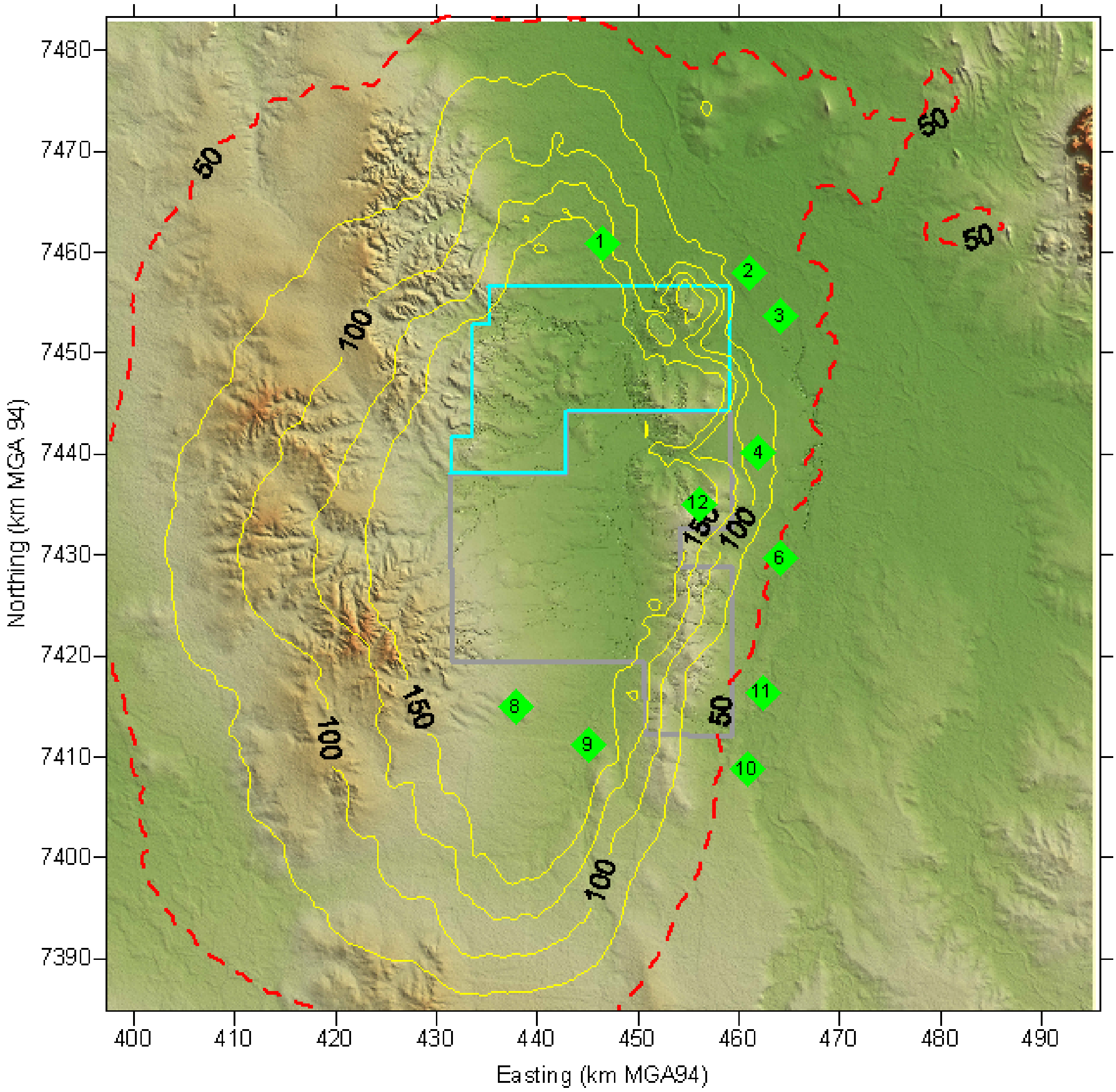


Figure 5-5 and Figure 5-6 show that the predicted cumulative impact of emissions from the Alpha Coal Project (Mine) and the Project will produce PM_{10} concentrations in excess of the Project Goal to a significant distance from both Project boundaries. The contours in both plots are elongated broadly west, north and south which indicates that winds with an easterly, northerly and southerly component were dominant in producing the peak concentration (5th highest) during the year at each grid point. The plots show that all receptors lie inside the red 50 µg.m^{-3} exceedance contour except receptors 11 and 12. Receptor 6 is predicted to be close to this indicative exceedance line.

Table 5-7 shows the predicted cumulative annual average ground level concentration of $PM_{2.5}$:

5 Dispersion Modelling Results

Table 5-7 Predicted highest cumulative (Alpha Coal and Kevin's Corner) 24-hour average ground level concentration of $PM_{2.5}$.

Receptor	Y5			Y25		
	Projects	Total	% of EPP (Air)	Projects	Total	% of EPP (Air)
1	28.7	**34.1**	136%	29.5	**34.9**	139%
2	10.3	15.7	63%	8.7	14.1	56%
3	9.7	15.1	60%	8.8	14.2	57%
4	24.4	**29.8**	119%	19.5	24.9	100%
6	11.3	16.7	67%	8.5	13.9	55%
8	40.9	**46.3**	185%	70.4	**75.8**	303%
9	66.0	**71.4**	286%	39.1	**44.5**	178%
10	10.5	15.9	64%	10.7	16.1	64%
11	15.1	20.5	82%	13.2	18.6	74%
12	40.9	**46.3**	185%	35.8	**41.2**	165%
Project Goal	25		100%	25		100%

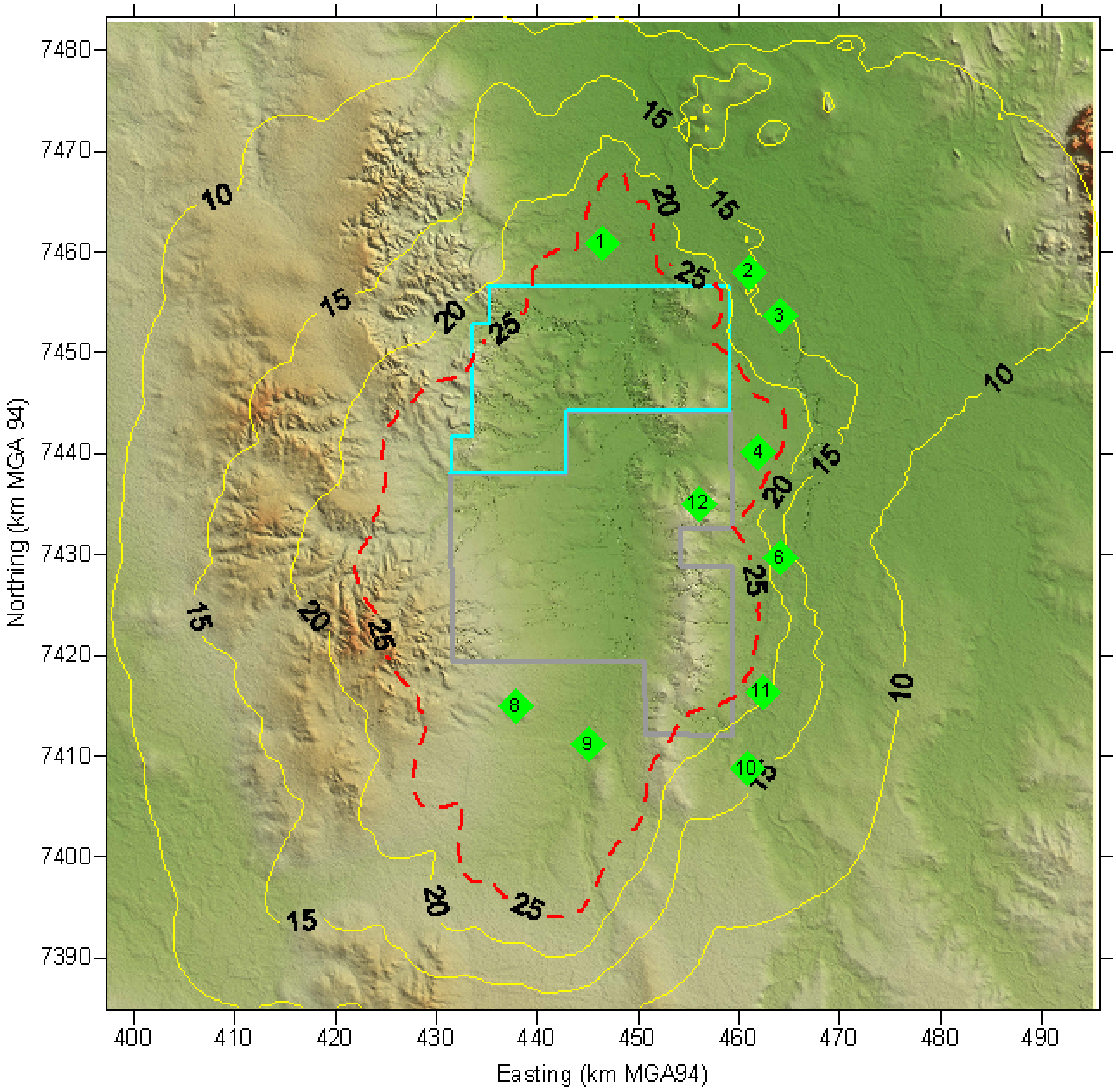
Note (1): Background concentration estimated at 5.4 µg/m^3.
Note (2): Numbers highlighted in bold exceed the relevant Project Goal

Table 5-7 shows that Project Goal for 24-hour $PM_{2.5}$ is predicted to be exceeded at receptors 1, 4, 8, 9 and 12 in year 5 and 1, 8, 9 and 12 in year 25. The highest exceedance in year 5 is at receptor 9 to the south of the Alpha Coal Project (Mine). The highest exceedance in year 25 is predicted to be at Receptor 8 to the south-west.

The cumulative 24-hour average $PM_{2.5}$ contour plots for Year 5 and Year 25 (respectively) are presented in Figure 5-7 and Figure 5-8.

5 Dispersion Modelling Results

Figure 5-7 Year 5: The predicted maximum cumulative 24-hour average ground-level concentration of $PM_{2.5}$. The Project Goal is 25 µg/m^3 (background concentration estimated at 5.4 µg/m^3 has been included)



5 Dispersion Modelling Results

Figure 5-8 Year 25: The predicted maximum cumulative 24-hour average ground-level concentration of $PM_{2.5}$. The Project Goal is 25 µg/m^3 (background concentration estimated at 5.4 µg/m^3 has been included)

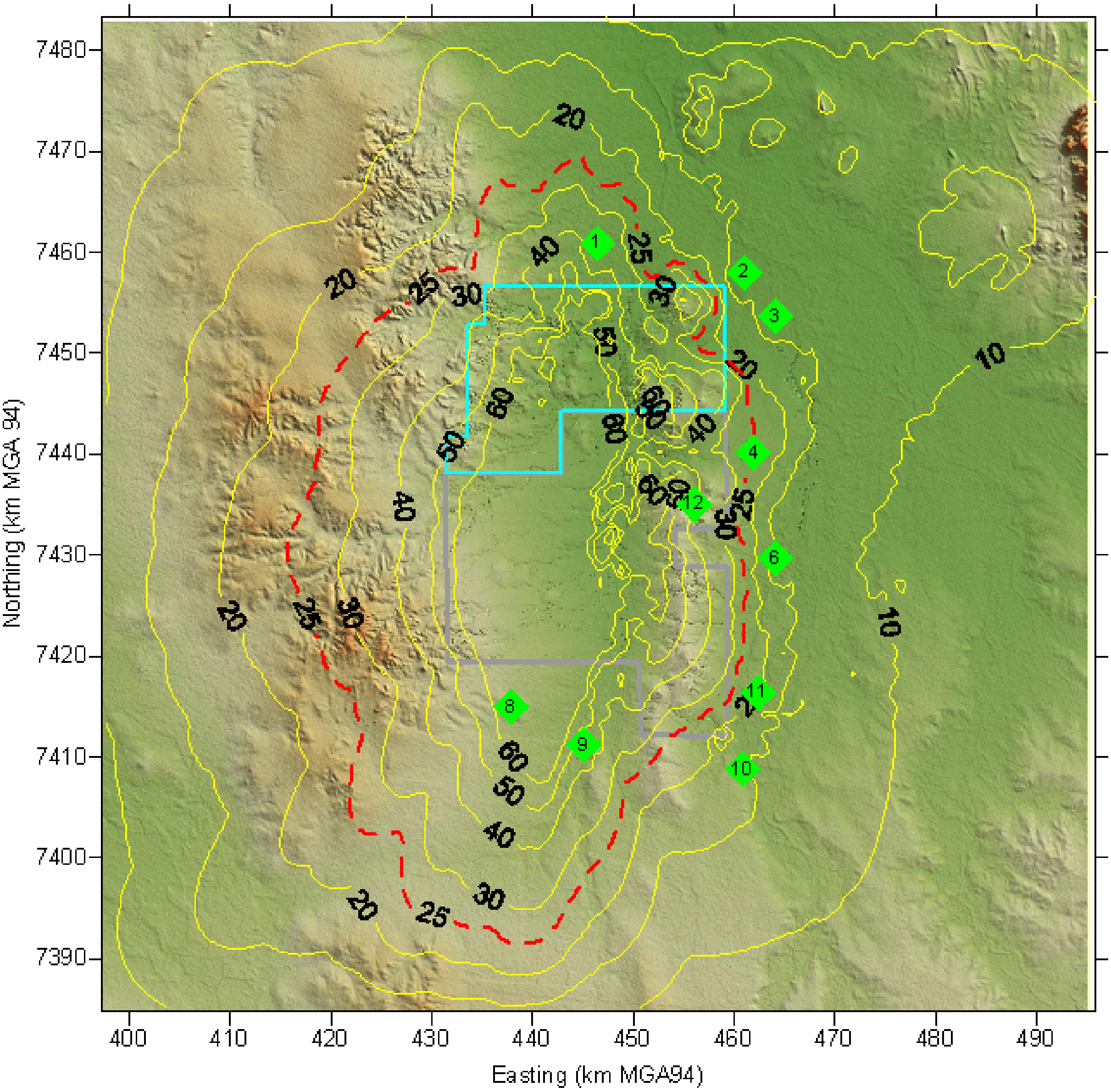


Figure 5-7 and Figure 5-8 show the spatial extent of the ground level concentrations of $PM_{2.5}$, with exceedances of the Project Goal predicted to occur at receptors 1, 8, 9 and 12. Receptor 4 is predicted to exceed in Year 5, and is close to the indicative exceedance line in Year 25.

Table 5-8 Predicted cumulative (Alpha Coal and Kevin's Corner) annual average ground level concentration of $PM_{2.5}$ (µg/m^3).

Receptor	Y5			Y25		
	Projects	Total	% of EPP (Air)	Projects	Total	% of EPP (Air)
1	4.0	6.8	85%	3.2	6.0	75%
2	0.5	3.3	41%	0.4	3.2	40%
3	0.4	3.2	40%	0.3	3.1	39%
4	0.8	3.6	45%	0.6	3.4	43%
6	0.2	3.0	38%	0.2	3.0	38%
8	7.2	**10.0**	125%	12.2	**15.0**	188%
9	7.0	**9.8**	123%	3.5	6.3	79%
10	0.2	3.0	38%	0.2	3.0	38%
11	0.2	3.0	38%	0.2	3.0	38%
12	1.7	4.5	56%	1.5	4.3	54%
Project Goal	8		100%	8		100%

Note (1): Background concentration estimated at 2.8 µg/m^3.
Note (2): Numbers highlighted in bold exceed the relevant Project Goal

Table 5-8 shows that Project Goal for 24-hour $PM_{2.5}$ is predicted to be exceeded at receptors 8 and 9 in year 5 and 8 in year 25.

5.4 Discussion

The proposed Project is a 30 Mtpa coal mine in central Queensland, located approximately 65 km north of the township of Alpha. Whilst the scale of the project is significant, predictive atmospheric dispersion modelling has shown that the impacts (including background) of the mine at sensitive receptors are predominantly within the Project Goals. Exceptions to this were exceedances of the 24 hour PM_{10} Project Goal at a single receptor during Year 1 and Year 5 of the Project operations.

The magnitude of the impacts was found to be a result of the majority of extraction and some processing activities occurring underground. Major contributors to impacts included the transport and dumping of overburden associated with the open cut pits, and use of graders (Table C-10).

While the predicted concentrations from the Project were found to be predominantly under the Project Goals, the cumulative concentrations with the proposed Alpha Coal Project (Mine) were predicted to exceed at receptors 1, 4, 8, 9 and 12 in year 5 and 1, 8, 9 and 12 in year 25. However, it was also noted that the Project's contribution to cumulative concentrations is not likely to produce new exceedances when combined with the impacts from Alpha Coal Project (Mine), i.e. the Alpha project provides a larger contribution to cumulative concentrations. This is demonstrated in Table 5-9.

5 Dispersion Modelling Results

Table 5-9 Comparison of Alpha, Kevin's Corner, and Cumulative Exceedances at Sensitive Receptors for 5th highest 24-hour average ground level concentration of PM_{10} ($\mu g/m^3$)

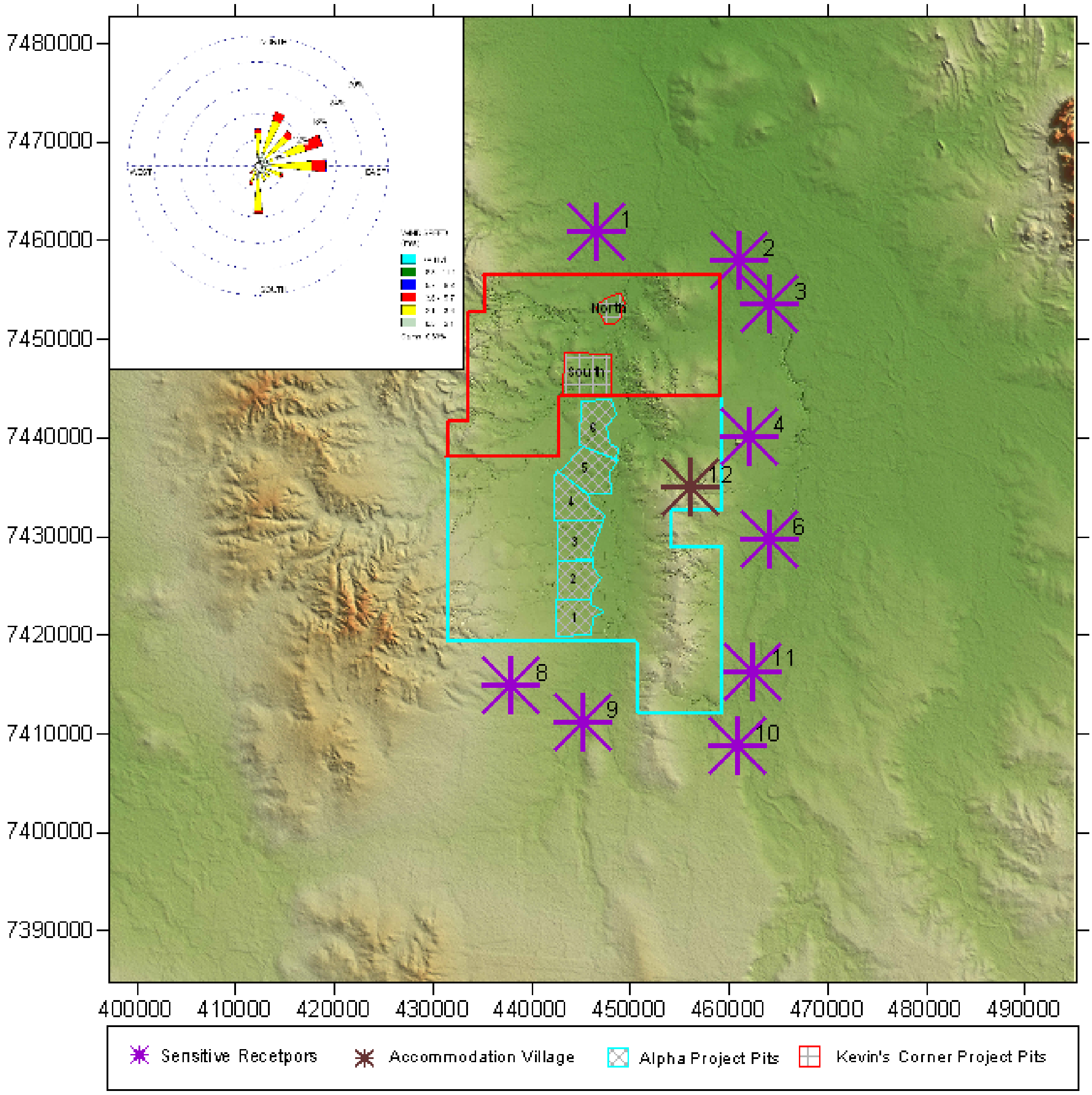
Receptor	Y5			Y25		
	Alpha[1]	Kevin's Corner[2]	Cumulative[3]	Alpha	Kevin's Corner[2]	Cumulative[3]
1	**115.8**	**62**	**148**	**132.5**	43	**151**
2	**63.8**	30	**66**	**62.7**	30	**66**
3	**56.7**	29	**57**	**56.8**	29	**59**
4	**97.7**	29	**100**	**85.9**	30	**88**
6	**52.8**	28	**53**	45.9	28	46
8	**198.2**	34	**200**	**327.3**	40	**330**
9	**285.9**	33	**292**	**174.6**	35	**182**
10	42.9	28	43	40.1	28	41
11	42.5	28	43	43.3	28	44
12	**157.9**	34	**158**	**172.2**	33	**174**
Project Goal	50		100%	50		100%

Note (1): Alpha project emissions including background concentration at 27 µg/m^3.
(2): Kevin's Corner project emissions including background concentration at 27 µg/m^3.
(3): Alpha project and Kevin's Corner project emissions including background concentration at 27 µg/m^3.
(4): The Cumulative column will not be equal to the sum of the Alpha and Kevin's Corner columns. The 5th highest 24-hour averages have been reported for each receptor independently, and hence are likely to occur on different days for Alpha and Kevin's Corner due to the wind direction relative to the projects and receptors.
(5): Numbers highlighted in bold exceed the relevant Project Goal

Figure 5-9 demonstrates geographically that emissions from both projects will seldom be received by a sensitive receptor at the same time due to the alignment of sources with sensitive receptors. Hence if the Project Goal is not being exceeded by either project, cumulatively it is also unlikely to occur. It also shows that due to the predominant wind directions (as per the wind rose in which it should be noted that bars infer the direction that the wind comes from) the Project is unlikely to impact on receptors other than 1, 8 and 9.

5 Dispersion Modelling Results

Figure 5-9 Influence of Predominant Wind Direction on Contribution to Source Emissions at Sensitive Receiver Concentrations



As can be seen in Figure 5-9, when the wind direction aligns from the north, the wind will pick up the particulates as the wind passes over the pits of the Project and cumulatively with the pits of the Alpha Project before it impacts on Receptor 9. Accordingly, when the wind aligns from the south, Receptor 1 will also be impacted by particulates from the pits of both mines. When the wind direction is from the north-northeast, Receptor 8 will be impacted by emissions from some of Alpha's pits, and potentially the Project's pits. For each of the other receptors, and under easterly and westerly wind conditions for receptors 1, 8 and 9, the receptors do not align with the major source contributors from both the Alpha and Kevin's Corner projects.

5 Dispersion Modelling Results

Even though the Project independently does not exceed the Project Goals and is not likely to produce new exceedances even in combination with the Alpha Coal Project (Mine), the Proponent has committed to undertaking up to the highest level of control (level 2 watering) to manage cumulative particulate emissions. This additional level of control is to ensure the impact to sensitive receptors is not exacerbated by the Project.

Please note the following limitations when considering the findings in this report:

- All results should be considered in the light of the limitations described in Section 4.3.3. Dispersion modelling should be regarded as a tool for the identification of potential air quality issues within the study region. However, the best prediction of model-predicted concentrations (either adverse or beneficial) can only be definitively assessed by detailed comparison of the predictions against observational data collected at sensitive receptors.
- It is therefore recommended that monitoring is used to calibrate the model against data which will be collected in the field from 2011 (Section 6). This calibration should be undertaken with a minimum of 1-year of observational data and the resulting concentrations should be comprehensively validated to determine the model performance.

Air Quality Monitoring Program

This section describes the monitoring program that has been designed to monitor emissions from the Alpha Coal and Kevin's Corner projects.

6.1.1 Objectives

The objective of the proposed operational monitoring program is to monitor particulates (TSP, PM_{10} and $PM_{2.5}$) and dust deposition within the region predicted to be directly impacted upon by particulate generating activities. This will apply to the construction and operational phases of the Project. The monitoring program will allow the Proponent to identify the effectiveness of proposed mitigation actions and implement additional actions dependent on the impacts measured. It will also allow calibration and validation of the dispersion modelling undertaken to predict the impacts.

Data from the operational monitoring programme will be used to demonstrate compliance with the EPP (Air) Objectives and Project Goals.

6.1.2 Monitoring Standards

Ambient air monitoring will be conducted in accordance with and/or in consideration of:

- AS/NZS 3580.1.1:2007, Methods for sampling and analysis of ambient air – Guide to siting air monitoring equipment;
- AS/NZS 3580.9.10:2006, Methods for sampling and analysis of ambient air Method 9.10: Determination of suspended particulate matter—$PM_{2.5}$ low volume sampler— Gravimetric method;
- AS/NZS 3580.9.9:2006, Determination of suspended particulate matter – PM_{10} Low volume sampler – Gravimetric method;
- AS/NZS 3580.10.1:2003, Methods for sampling and analysis of ambient air – Determination of ambient air - Determination of suspended particulate matter – Deposited matter – Gravimetric method;
- Queensland Government, Air Quality Sampling Manual; and
- A method determined in consultation with the QLD DERM.

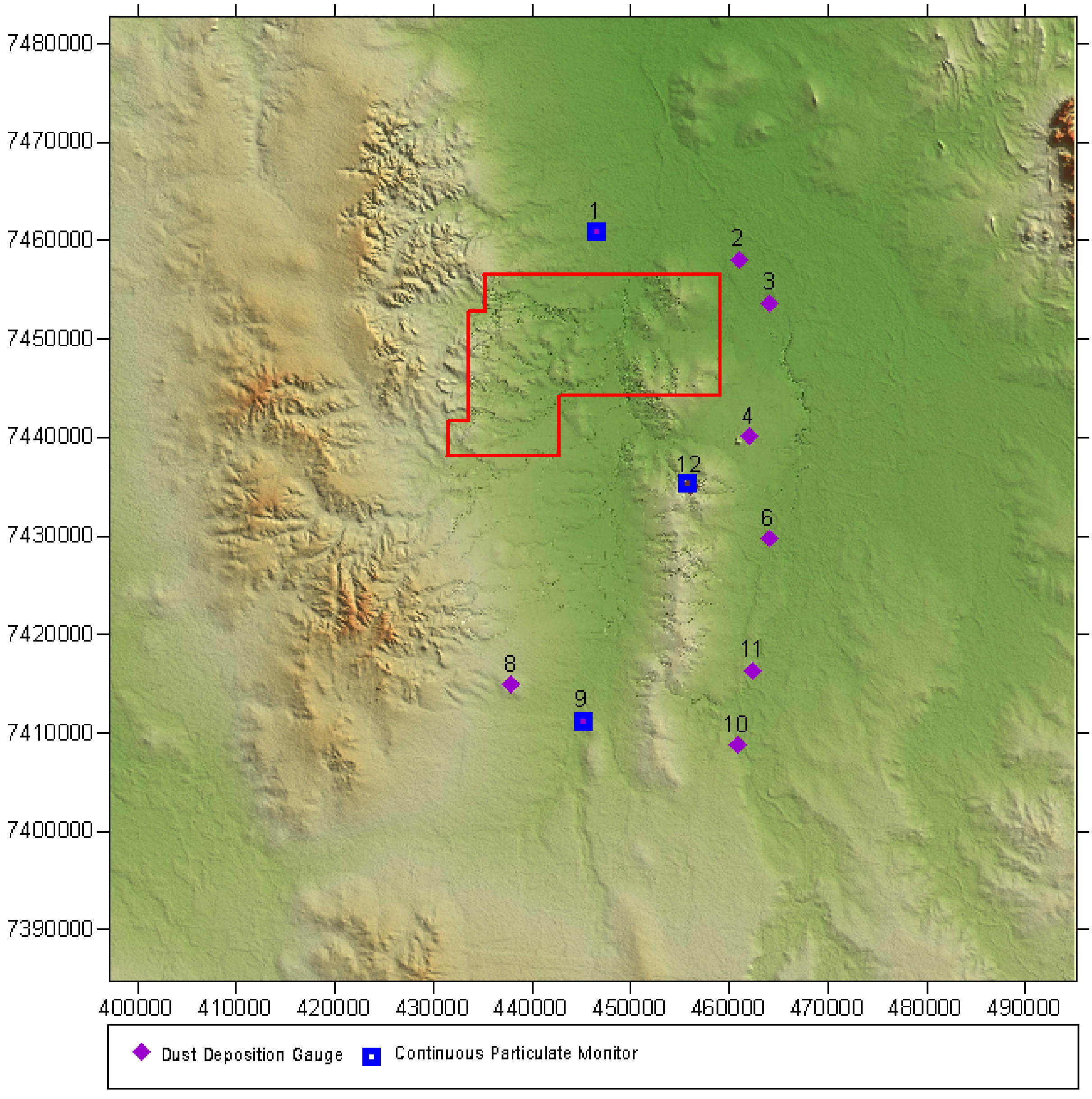
6.1.3 Monitoring Locations

The precise location of monitoring equipment will be dependent on Australian Standard siting requirements (Section 6.1.2) specific to the instrumentation to be implemented at each site.

Presented in Figure 6-1 and Table 6-1 are proposed monitoring locations for the Project which are approximate and subject to field inspection. The proposed monitoring locations correspond to receptor locations and the on-site Alpha Coal Project Accommodation Village which are locations where human exposure is likely. It should be noted that the re-location of the Alpha Coal Project Accommodation Village (location 12) has been reflected in the monitoring programme in the SEIS. The revision of the site monitoring program may be warranted based on future development within the regional airshed.

6 Air Quality Monitoring Program

Figure 6-1 Proposed Monitoring Locations (indicative only)



6 Air Quality Monitoring Program

Table 6-1 Proposed monitoring locations (indicative only)

ID	Receptor Description	Description
1	Receptor 1	Forrestor Homestead
2	Receptor 2	Surbiton Station
3	Receptor 3	Eullmbie Homestead
4	Receptor 4	Surbiton Homestead
6	Receptor 6	Burtle Homestead
8	Receptor 8	Kia Ora Homestead
9	Receptor 9	Monklands Homestead
10	Receptor 10	Mentmore Homestead
11	Receptor 11	Tressillian Homestead
12	Receptor 12	Alpha Coal Project Accommodation Village

* Monitoring locations are indicative only. Actual siting of the monitoring stations is subject to field inspection.

6.1.4 Ambient Air Monitoring Program

Presented in Table 6-2 is a summary of the proposed frequency of monitoring for particulate concentrations and dust deposition.

Monitoring of particulates is proposed to be undertaken using the TEOM sampling methodology at the specified locations. Dust deposition gauges will be used to monitor dust amenity.

Table 6-2 Recommended frequency of particulate monitoring at specified locations (indicative only)

ID	Description	Particulates	Dust Deposition
1	Forrestor Homestead	Continuous	Monthly
2	Surbiton Station	--	Monthly
3	Eullmbie Homestead	--	Monthly
4	Surbiton Homestead	--	Monthly
6	Burtle Homestead	--	Monthly
8	Kia Ora Homestead	--	Monthly
9	Monklands Homestead	Continuous	Monthly
10	Mentmore Homestead	--	Monthly
11	Tressillian Homestead	--	Monthly
12	Alpha Coal Project Accommodation Village	Continuous	Monthly

Monitoring of ambient particulate concentrations and dust deposition will commence as soon as possible in order to establish a representative baseline prior to the commencement of construction. Although not the same as a proper validation study, monitored ambient particulate concentrations during construction (particularly of the box cut) and operation will provide some insight into the relative level of conservatism that is inherent in the modelling methodology. Based on the results of the dispersion modelling for the Project in isolation, effective management of mine-related particulates and dust as determined by measurements at Receptor 1 are likely promote improved air quality outcomes at other locations. Similarly, for cumulative impacts the effective management of mine-related particulates and dust as determined by measurements at locations 8 (Kia Ora Homestead), 9

(Monklands Homestead) and the 12 (Alpha Coal Project Accommodation Village) are also likely to promote improved air quality outcomes at other receptor locations.

6.1.5 Operational and On-Site Meteorological Monitoring Program

Presented in Table 6-3 is a summary of the proposed frequency of meteorological monitoring for the purposes of minimising off-site impacts. Particulate monitoring at location 12 (Alpha Coal Project Accommodation Village) will assist in the assessment of the effectiveness of implemented dust mitigation measures.

It is noted that due to the prevailing wind direction and the relative location of receptors and mining activities, the Alpha Coal Project Accommodation Village is not predicted to be the most affected sensitive receptor. Thus air quality within the Alpha Coal Project Accommodation Village will not be representative of worst-case impacts which are predicted to occur to the south of the mine and would be reflected at monitoring location 9 (Figure 6-1).

Meteorological monitoring is proposed to include (as a minimum):

- Wind speed;
- Wind direction;
- Relative humidity; and
- Air temperature.

Additional meteorological parameters may include (but may not be limited to):

- Solar radiation;
- Rainfall;
- Differential temperature; and
- Differential wind speed.

Table 6-3 Operational Meteorological Monitoring Program

ID	Particulate	Dust Deposition	Meteorology
1	Continuous	Monthly	Continuous
9	Continuous	Monthly	Continuous
12	Continuous	Monthly	Continuous
CHPP	--	--	Continuous

It should be noted that on-site meteorological monitoring will also be undertaken at the CHPP but this is not marked in Figure 6-1 and Table 6-1 as no particulate monitoring is proposed at this location.

Due to the level of impacts predicted at the location of receptors 8 and 9 in the Alpha SEIS AQIA, particular attention will be afforded to the particulate and meteorological monitoring data from the corresponding monitoring location 9. If the data indicates that the Project Goals are being exceeded by Project activities, the appropriate reporting procedures to DERM will be followed and further operational and or engineering controls will be considered to reduce deposition at off-site locations. This would likely include the incorporation of actions based upon real time particulate and meteorological monitoring data.

Conclusion

URS was commissioned by HGPL to undertake an Air Quality Impact Assessment for the proposed Kevin's Corner Coal Mine (the Project).

An emissions inventory was prepared which quantified dust emissions for Year 1, Year 5, Year 15 and Year 25 of the life of the mine. These stages are considered to best represent the proposed variations in the spatial extent of mining activities, whilst also capturing years in which a greater level of emissive activities are planned to take place.

The CALPUFF atmospheric dispersion modelling package was used in conjunction with regional and site-specific meteorology, to estimate potential air quality impacts associated with the proposed mine development. The model predictions were then compared to the regulatory criteria contained in DERM EPP (Air) 2008. Where an appropriate criterion was not contained in the EPP (Air), a relevant criterion was nominated as a Project Goal.

The results of the dispersion modelling indicated that when considered in conjunction with existing (background concentrations), dust emissions from the project would result in an exceedance of the 24 hour PM_{10} criterion at a single receptor during Year 1 and Year 5 of the Project operations. This receptor is located to the north of the site at the Forrester Homestead. It has also been demonstrated geographically that emissions from both projects will seldom be received by a sensitive receptor at the same time due to the alignment of sources with sensitive receptors. Therefore, if the Project Goal is not being exceeded by either project, cumulatively it is also unlikely to occur.

The cumulative effect of the Project and the proposed Alpha Coal Project was also assessed. Given the larger scale of the Alpha coal project, cumulative impacts were predicted to be significantly higher than those from the Kevin's Corner Project in isolation. For the two years considered in the cumulative assessment (Year 5 and 25) it was predicted that dust emissions from the adjacent Project would result in exceedances of the 24 hour PM_{10} criterion at eight of ten receptors during Year 1 and Year 5 (worst case impact years of the Project) of the Project operations. Therefore, the Kevin's Corner Coal Mine is not predicted to cause new exceedances of the EPP (Air) objectives or Project Goals at off-site locations in the air shed in addition to those predicted for the Alpha Coal Project (Mine).

HGPL will implement an air quality management plan, which would include specific measures for the monitoring and mitigation of potential particulate and dust impacts to minimise the on-site generation of particulates.

8 Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Hancock Galilee Pty Ltd and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 23 July 2010.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between September 2010 and April 2011 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

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A

Appendix A Modelling Methodology – Additional Details

A.1 Meteorological Modelling

Dispersion modelling using CALPUFF requires detailed data on surface and upper air meteorology in the model domain. Surface and upper air data are incorporated to the meteorological pre-processor CALMET to develop a three dimensional grid of meteorology for the model domain.

Emerald Airport (approximately 170 km from the Site) and Mackay Airport (approximately 420 km from the Site) are the closest locations with respective surface and upper air meteorological measurements with sufficient frequency for inclusion in CALMET. Given the coastal location of Mackay, compared to the inland location of the Project, the inclusion of upper air meteorology from Mackay was not considered appropriate.

Meteorological modelling using CALMET was therefore undertaken in a three stage process:

- TAPM modelling to derive an upper air dataset;
- Regional meteorological modelling at a coarse resolution incorporating:
  - Surface observations from Emerald airport; and
  - Upper air dataset from TAPM.
- Project area meteorological modelling at a finer resolution incorporating:
  - Results from regional modelling as initial guess estimates for Project area.

A.1.1 TAPM Observation Generation

The Air Pollution Model (TAPM) developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a prognostic model which may be used to predict three-dimensional meteorological data and the atmospheric concentration of emissions.

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

Additionally, the TAPM model may assimilate actual local wind observations so that they can be included in a model solution. The wind speed and direction observations are used to weight the predicted solution towards the observed values. This function of accounting for actual meteorological observations within the region of interest is referred to as data assimilation. Data from the Bureau of Meteorology's (BOM) Emerald Airport monitoring site for 2009 were assimilated into TAPM in order to provide improved results for the meteorological parameters in the vicinity of the study site.

TAPM was set up for the region around the Alpha Coal Project to simulate wind flows around the location to a 1 km resolution. The table below details the parameters used in the meteorological modelling for this assessment.

Table A-1 TAPM Model Parameters

Parameter	Value
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Number of grid points	99 x 99 x 25
Year of analysis	2009
Centre of analysis	446250m E, 7433750m N (UTM zone 55)
Data assimilation	Emerald Airport Meteorological Station (BOM)

TAPM has limitations which are a result of the necessity to simplify many of the processes within the atmosphere, subgrid-scale parameterisation and the application of boundary conditions. The earth curvature is not included in TAPM and hence any weather phenomena resulting from earth curvature are not represented. TAPM uses climate average sea-surface temperature and hence may not adequately simulate land and/or sea breezes.

A.1.2 CALMET Meteorological Modelling

CALMET is a meteorological model that is used to generate gridded three-dimensional wind fields from observational meteorological measurements. It allows treatment of local terrain effects on wind flows with calculation of convergence/divergence parameters. It also calculates atmospheric mixing height and stability conditions caused by differential heating and cooling of the land surface depending on the angle and intensity of the solar insolation, in conjunction with the amount of cloud cover present. The TAPM output data files were used as direct inputs to the CALMET meteorological model by extracting the modelled data at the centre of the grid for the surface and upper air data files. CALMET outputs hourly atmospheric parameters such as wind speed and direction (three-dimensional), mixing height and stability class. The outputs from CALMET were used as inputs to the dispersion model CALPUFF.

In order to improve the accuracy of the model, two CALMET models were run nesting a higher level regional grid down into a local project specific grid. The CALMET model parameters specified for these two grids are presented below.

Table A-2 CALMET Model Parameters

Parameter	Regional Grid	Local Grid
Grid Spacing	10 km	1 km
Number of grid points	49 x 49 x 25	99 x 99 x 25
Year of analysis	2009	2009
Centre of analysis	446250m E, 7433750m N (UTM zone 55)	446250m E, 7433750m N (UTM zone 55)
Data Assimilation	Surface data from Emerald Airport Meteorological Station (BOM) Upper Air data from centre of TAPM grid Landuse from USGS Landsat database Terrain from Shuttle Ray Topography Mission	Meteorology from Regional Grid outputs Landuse from USGS Landsat database Terrain from Shuttle Ray Topography Mission

The CALMET model domain is of sufficient size to include all mining activities and the individual homesteads that may be affected by the proposed mining operations. The CALMET model features enhanced treatment of terrain effects around the site and allows the wind fields to be influenced by the differential heating of the land surface depending on the angle of the sun. Its non steady-state formulation also allows the wind fields to travel around or over obstacles such hills, depending on the strength of the wind and to recirculate emissions within the model domain as the prevailing wind directions change through the day. CALMET calculates parameters such as mixing height and stability class that are used in the model to determine the dispersion conditions for every hour of the year.

The limitations associated with the use of CALMET are related to sub-grid scale parameterisation, grid resolution, domain sizes and boundary conditions. For example, sub-grid scale terrain effects may not be fully captured and the minimum mixing height of 50 m used in the modelling may vary in the project area, depending on the weather condition.

A.1.3 Meteorological Modelling Results

Stability Class

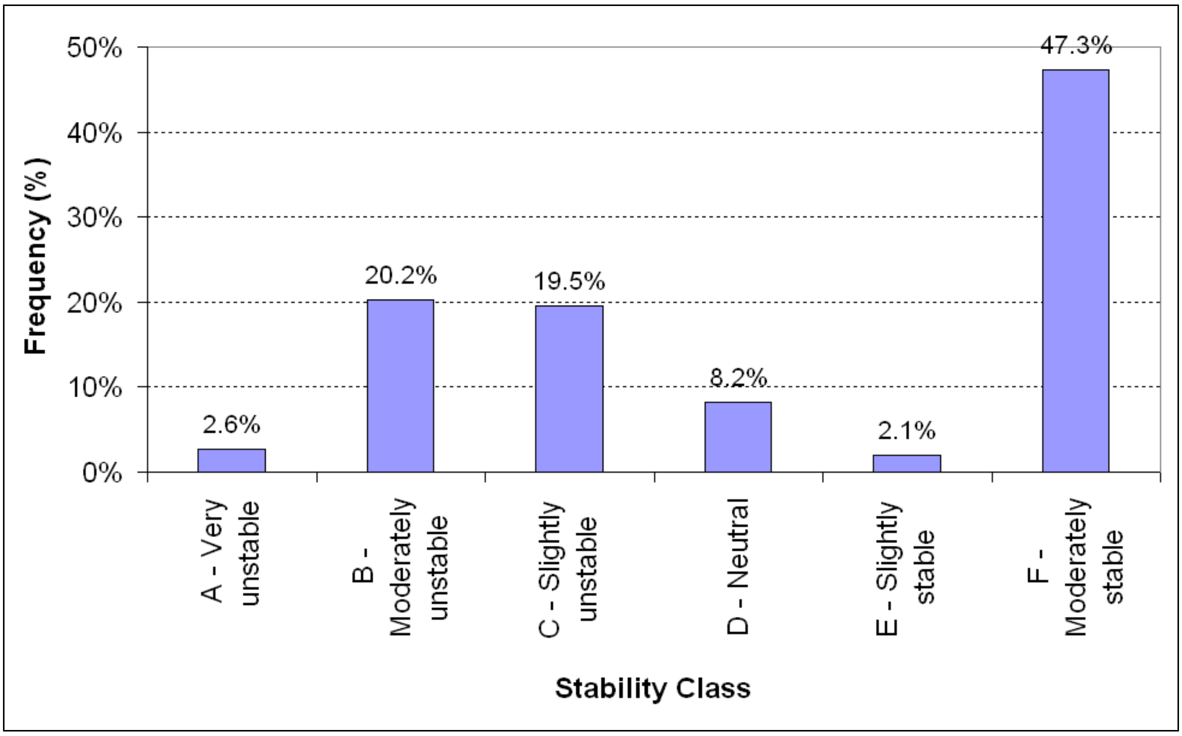
Atmospheric stability is determined by the balance of mechanical turbulence (caused by the wind) and thermal turbulence caused by the solar heating of the ground surface. Stability cannot be measured directly; instead it must be inferred from either measured or model-generated data.

The Pasquill-Gifford scale defines stability on a scale from A to G, with stability class A being the least stable, occurring during strong daytime sun and low winds, and stability class G being the most stable condition, occurring during low wind speeds on nights with little or no cloud cover. For any given wind speed the stability category may be characterised by two or three categories, depending on the time of day and the amount of cloud present.

In air quality models such as CALMET, the stability classes F and G are combined. Stability class data for 2009, as generated by CALMET have been summarised in Figure A-1. This shows that for the Project, stability class F occurred most frequently (47.3%) in 2009, indicating that the dominant conditions were moderately to very stable, with very little lateral and vertical diffusion. Typically under class F stability, the wind direction tends to deviate by only a small amount, resulting in poor dispersion conditions.

The frequency of strongly convective (unstable) conditions at the site of the Kevin’s Corner Coal Project (Mine), represented by stability class A, is relatively low, at 2.6% of hours in the year.

Figure A-1 Frequency of stability class for Kevin's Corner Coal Project (Mine), CALMET 2009

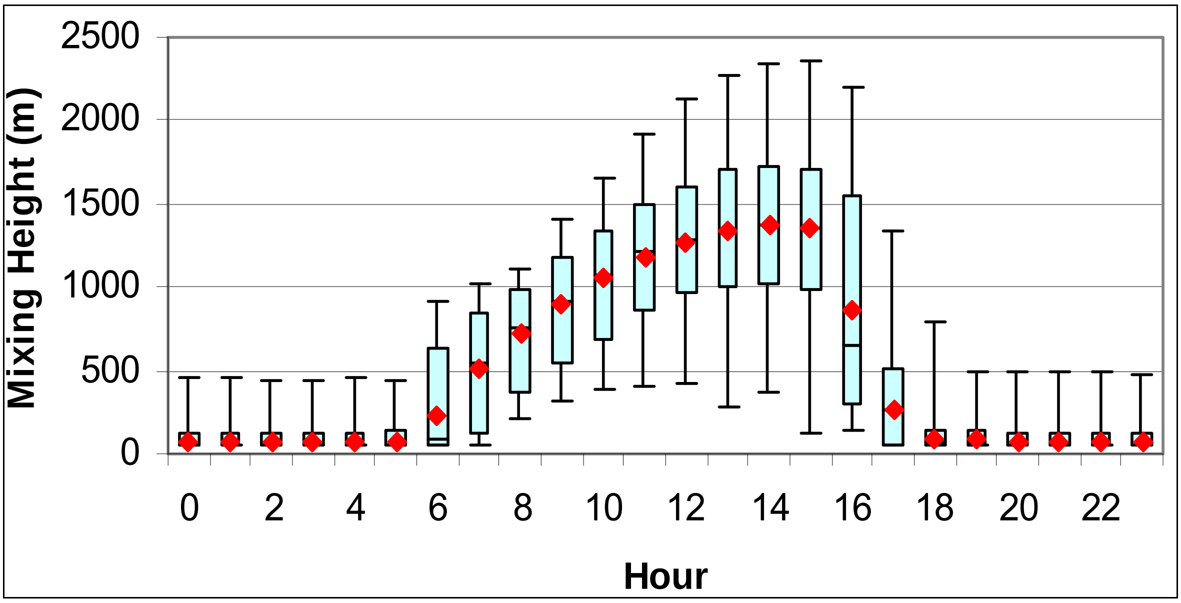


Mixing Height

Mixing height quantifies the vertical height of mixing in the atmosphere and is a model parameter that is not typically measured. The mixing height data generated by CALMET for 2009 have been summarised in Figure A-2. The graph shows the typical growth of the boundary layer throughout the day, whereby mixing height is generally lowest late at night/early morning and highest during early afternoon (in this case 2:00 pm). The mixing height decreases in the afternoon, and particularly after sunset, due to the change from surface heating from the sun to a net radiative heat loss overnight.

On average, mixing heights during the morning hours range from 225 m to 1,335 m above ground level, while the average afternoon mixing heights range from 1,466 m to 73 m above ground level. Low mixing heights typically translate to stagnant air with low vertical motion, whilst high mixing heights are associated with greater levels of vertical mixing and greater dilution of emissions.

Figure A-2 Mixing height by time of day for Kevin's Corner Coal Project (Mine), CALMET 2009



A.2 Dispersion Model Setup

The model domain was 99 km by 99 km, with the dispersion results calculated at a resolution of 1 km and at identified sensitive receptors. The dispersion parameters specified in the model include the use of dispersion coefficients based on turbulence data determined from the modelled micrometeorology and partial plume path adjustment for terrain correction of plume impacts.

A.2.1 Source Types and Locations

The selection of source type to represent an air emission source is matched by the nature of the particulate generating activities and release. The source type options in CALPUFF are point, area, volume and lines. Volume sources have been used for dispersion modelling of all sources of particulates from the site, which best represent the scale of the activities conducted at open-cut mines. Activities such as excavating of coal or dropping of overburden from a dragline bucket result in the instantaneous creation of a cloud of particulates, which is clearly visible from the edge of an operating open-cut pit.

Likewise, the plume of particulates that is generated by a truck moving on unpaved roads is mixed in the wake of the vehicle to form a visible cloud that rises above the vehicle height. The volume source is the most representative of the nature of these activities, as it accounts for the dispersion of an amount of particulate that is well mixed in the air immediately at the source.

The sensitive receptor locations are at some distance from the mining activities (a minimum of approximately 2.5 km from the mine boundary). This separation of the sources and receptors lessens the influence of the initial source type selection and results over 1 km from the source should be relatively independent of this selection for near-surface sources such as those in coal mines.

Source emission parameters, such as the height of release and the initial spread of the plume from each release point, were estimated from data provided by the proponent on the height of sources and the source types. These data have been used to derive the source height and initial spread of the plume, used in the dispersion modelling setup, as noted in Table A-3.

Table A-3 Source Height and Initial Horizontal and Vertical Spread of Plumes as used in Dispersion Modelling

Source Type	Source Height Above Ground Level (m)	Initial Horizontal Spread (m)	Initial Vertical Spread (m)
In-Pit Activities	20	50	10
Blasting	25	20	12.5
Wind erosion	3	50	1.5
CHPP	10	20	4
ROM stockpiles	4	50	2
ROM processing	5	10	2.5
Conveyor transfer points	3	3	1.5
Product stockpiles	10	50	5
Haul roads	10	20	4
Tailing dams	3	50	1.5

The location of each source was derived from the mine plan that was developed for the site. Haul road locations do not change throughout operation of the mine, however the progression of the mine westward results in an increase in the length of ramps within the pits.

Haul roads were modelled as individual volume sources spread along the haul routes at approximately 100 m intervals. The emissions for each road section were determined from the number of vehicle movements on the section and the vehicle kilometres travelled (VKT) travelled for the two-way return journey.

Sources that are located in the pit, including draglines, truck and shovel, coaling equipment and blasting, were modelled as volume sources. For modelling of typical operations from the mine, the source locations were spread out along the pit length at 100 m intervals, with emission rates corresponding to the appropriate pit activities.

Activities at the CHPP, such as ROM coal dumping and stockpile movements were modelled as volume sources located at the centre of each particulate-generating activity.

In addition to the modelled sources, the underground section of the mine will have ventilation shafts that will generate small amounts of particulate emissions to the ambient environment. Emissions from these ventilation shafts are considered to be minimal compared to emissions from the open cut section of the mine, and have therefore been excluded from the dispersion modelling.

Appendix B Emission Estimation Methodology

B.1 Emissions Estimation

The quantity of emissions of particulates from the Project cannot be determined from direct measurement, as the mine is not yet operational. Particulate emissions from the Project have been estimated based on mine plans and activity data provided by HGPL, in conjunction with emission factors provided in the National Pollutant Inventory (NPI) Emission Estimation Technique (EET) Manuals. The emission factors contained in the NPI EET manuals have been developed from measurements of particulate emissions from other operational coal mines in Australia and the United States during typical operations.

The NPI Emission Estimation Technique Manual for Mining (NPI, 2001) has been used to provide data to estimate the amount of TSP and PM_{10} emitted from the various activities on a mine site, based on the amount of coal and overburden material mined as provided by the Proponent. The emission factor for truck movements on haul roads has been derived from the US EPA's AP42 emission estimation manual for unpaved roads.

B.1.1 Input Parameters

Site-specific parameters were used to derive emission factors for trucks on unpaved roads, draglines, excavators, shovels, graders, dozers and blasting. The input parameters used for the assessment are listed in Table B-4. Silt content data were obtained from publicly available information for a similar coal mine in the Bowen Basin (BMA's Caval Ridge Mine Project). For estimation of dust emissions from unpaved roads, the average loaded and unloaded vehicle masses for the various hauling operations on site are listed in Table B-5.

Table B-4 Emission Factor Input Parameters

Parameter	Material					Units
	Overburden	Coal			Road Material	
		In Situ	ROM	Product		
Moisture Content	5	6.9	6.9	6.9	6.9	%
Silt Content	14	5	5	5	4	%
Blasting Area	Variable					m^2
Dragline Drop Distance	15					m
Mean Wind Speed	2.6					m/s
Density	2.4	1.4			-	t/bcm

Table B-5 Vehicle Masses for Hauling Fleet

Vehicle Mass	Overburden Hauling CAT797B	Interburden Hauling CAT785C	Coal Hauling K200 C II	Reject Hauling CAT793 D	Units
Empty	279	113	308	166	Tonnes
Payload	345	136	280	218	Tonnes
Full	624	259	588	384	Tonnes

Table B-6 Wind Erosion Source Areas

Source	Area (ha)
Tailing storage facility- South	129
Stockpiles- Product	20
Overburden Stockpiles	531
Exposed surface areas in pits (Year 1)	177 (North) /169 (South)
Exposed surface areas in pits (Year 5)	179 (South)
Exposed surface areas in pits (Year 15)	189 (South)
Exposed surface areas in pits (Year 25)	187(South)

B.1.2 Emission Factors

Dragline operation

For TSP, the following NPI equation is used:

$$EF = 0.0046 \times \frac{d^{1.1}}{M^{0.3}}, \qquad kg/bcm$$

where

- d = drop distance in metres
- M = moisture content of overburden in %
- bcm = bank cubic metre

For PM_{10}, the following NPI equation is used:

$$EF = 0.0022 \times \frac{d^{0.7}}{M^{0.3}}, \qquad kg/bcm$$

For the Project, a 15 m dragline drop height and 5% overburden moisture content was used.

Loading truck with overburden using excavators/shovel/front-end loaders

The following NPI equation is used to estimate dust emission:

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

where

- k = 0.74 for TSP and 0.35 for PM_{10}
- U = mean wind speed (m/s)
- M = moisture content of overburden (%)

For the Project, a mean wind speed of 2.6 m/s and moisture content of 5% was used.

Loading truck with coal using excavators/shovel/front-end loaders

The following NPI equation is used to estimate dust emission:

$$EF = k \times 0.0596 \times M^{0.9} \qquad kg/t$$

where

- k = 1.56 for TSP and 0.75 for PM_{10}
- M = moisture content of coal (%)

For the Project, a moisture content of 6.9% was used.

Bulldozer on coal

For TSP, use the following NPI equation

$$EF = 35.6 \frac{s^{0.9}}{M^{1.4}} \qquad kg/h$$

where

- s = silt content (%)
- M = moisture content of overburden (%)

For PM_{10}, use the following NPI equation

$$EF = 6.33 \frac{s^{1.5}}{M^{1.4}} \qquad kg/h$$

Using values of 5% for silt content and 6.9% for moisture content gives an emission rate of 16.4 kg/h for TSP and 4.7 kg/h for PM_{10}.

Bulldozer on overburden

For TSP, use the following NPI equation

$$EF = 2.6 \frac{s^{1.2}}{M^{1.3}} \qquad kg/h$$

For PM_{10}, use the following NPI equation

$$EF = 0.34 \frac{s^{1.5}}{M^{1.4}} \qquad kg/h$$

Using values of 14% for silt content and 5% for moisture content gives an emission rate of 7.6 kg/h for TSP and 1.9 kg/h for PM_{10}.

Trucks dumping (unloading) overburden or coal

For trucks dumping overburden, a default NPI value of 0.012 kg/t for TSP and of 0.0043 for PM_{10} was used. For trucks dumping coal, the default values applied were 0.01 kg/t for TSP and of 0.0042 for PM_{10}. No equations are recommended by NPI.

Drilling

Emissions from drilling are a relatively minor component from of the Project. Default NPI emission factors have been used for drilling, which are 0.59 kg/hole for TSP and 0.31 kg/hole for PM_{10}.

Clearly other variables such as the depth and diameter of the hole and moisture and silt content of the material are also relevant. However, no equations are available in the NPI.

Blasting

Due to the limited information available, estimates of dust emissions associated with blasting were developed using the following formula from the current USEPA-AP42 - Vol.1, 5th edition Section 13.2.2.

$$EF = 0.00022 * A^{1.5} \qquad kg/blast$$

where

- A = area of blasting (m²)

For PM_{10}, the value calculated for TSP is multiplied by 0.52.

For the Project, information associated with the average blast area plus the number of blasts per year was provided by the Proponent.

Wheel-generated dust from unpaved roads

The USEPA-AP42 formula has been used to estimate particulate emissions from wheel generated dust over unpaved roads:

$$EF = 1.381\left(\frac{s}{12}\right)^{A}\left(\frac{W}{3}\right)^{B} \qquad kg/VKT$$

where

- s = silt content in % of road material = 4%
- W = vehicle gross mass in tonnes as per truck below

Truck	W (Vehicle Gross Mass)
Overburden truck (full)	624 tonnes
Overburden truck (empty)	279 tonnes
Interburden truck (full)	250 tonnes
Interburden truck (empty)	114 tonnes
Coal truck (full)	588 tonnes
Coal truck (empty)	308 tonnes
Reject truck (full)	384 tonnes
Reject truck (empty)	166 tonnes

Exponents are

- A = 0.7 (TSP) and 0.9 (PM_{10})
- B = 0.45 (TSP) and 0.45 (PM_{10})

Use of grader

The following NPI formulas have been used to estimate grader dust emission:

$$EF = 0.0034S^{2.5} \qquad kg/VKT \qquad \text{for TSP}$$

$$EF = 0.0034S^{2.0} \qquad kg/VKT \qquad \text{for } PM_{10}$$

Where:

- S = mean vehicle speed in km/h (5 km/h)
- VKT = vehicle kilometres travelled

Miscellaneous transfer and conveying

For conveyor belt transfer points, the following NPI formula has been used:

$$EF = k0.0016\left(\frac{U}{2.2}\right)^{1.3}\left(\frac{M}{2}\right)^{-1.4} \qquad kg/t$$

where

- U = mean wind speed (m/s)
- M = material moisture content (%)
- k = 0.74 for TSP and 0.35 for PM_{10}

For this assessment, a mean wind speed of 2.6 m/s and moisture content of 6.9% results in emission factors of 0.00026 kg/t for TSP and 0.00012 kg/t for PM_{10}.

Coal crushing and screening

The NPI does not provide methods to estimate emissions from crushing and screening of coal. US EPA's AP42 emission estimation manual for Mineral Products Industry (Chapter 11.19.2) provides emission factors for crushing stone – tertiary crushing, which are 0.0027 kg/t for TSP and 0.0012 kg/ton for PM_{10}. Note that in AP42, the emission factors for primary and secondary crushing stone are not determined. Hence the tertiary crushing is a conservative value for primary and secondary crushing activities. In the absence of more representative information, emission factors of 0.0034 kg/t (TSP) and 0.00135 kg/t (PM_{10}) have been adopted for this assessment based on those used in the assessment of the Metropolitan Coal Project NSW (Holmes Air, 2008). It is noted that the contribution to the site emission inventory is c.0.25% and is considered immaterial.

B.1.3 Production Data

Production data were provided by the Proponent. This provided detailed data for Project on the following items for each year of operation:

- Tonnes of ROM and product coal moved;
- Volume of overburden removed by dragline, dozer and truck and shovel;
- Area of disturbed land;
- Volume of coal and overburden material blasted;
- Total metres of coal and overburden material drilled; and
- Tonnes of reject material from the CHPP.

B.2 Wind Speed Dependent Wind Erosion

B.2.1 Introduction

In an evaluation of fugitive particulate matter emission estimation techniques, Sinclair Knight Mertz (SKM) (2005) recommended not using the current default emission factors in the NPI Mining Manual (2001), which are a constant value of 0.4 kg/ha/h for TSP and 0.2 kg/ha/hr for PM_{10}, as crucial environmental factors such as wind and surface wetness are not considered. SKM (2005) suggested retaining the current NPI equation, presented here as Equation 1, to account for the climate variations across Australia while recognising the uncertainty and indicative nature of the NPI equation.

$$E = 1.9(\frac{s}{1.5})365(\frac{365-p}{235})(\frac{f}{15})$$ **Equation 1**

Where:

- s is the silt content (%);
- f is the percentage of time that wind speed is greater than 5.4 m/s at the mean height of the stock pile; and
- p is the number of days when rainfall is greater than 0.25 mm.

Equation 1 is used in the revised modelling of the impacts of dust emissions from the Project to provide an estimate for the annual total emissions of particulates associated with wind erosion. The local meteorological data was then used to distribute the total annual emissions equally to those hours for which the wind speed is greater than a critical wind speed using the methodology outlined in the following sections.

B.2.2 Wind Erosion for Stockpiles

The NPI Mining Manual (2001) suggests the use of **Equation 1** to calculate annual dust emission from active coal stockpiles. Equation 1 is for estimating emissions for total suspended particles (TSP). Emissions of PM_{10} are estimated from TSP using a PM_{10} to TSP ratio of 0.5. **Equation 1** represents the annual total emissions.

Equation 2 (SKM, 2005, Eq 5.14) was then used to distribute the total annual emissions into hourly emissions

$$F = ku^3(1-\frac{u^2}{u_0^2}) \text{ when } u > u_0 \text{, otherwise F = 0} \qquad \textbf{Equation 2}$$

Where:

- k is a calculated constant;
- u is hourly average wind speed at root mean square height of the stockpile (m); and
- u_0 is a wind speed threshold velocity.

The critical wind speed u_0 is calculated based on a critical wind speed of 5.4 m/s at the root mean square height of the stockpile, corrected to 10 m based on logarithmic wind speed profile as shown in Equation 3.

$$u_0 = 5.4\ln(\frac{10-z_0}{z-z_0}) \qquad \textbf{Equation 3}$$

Where:

- z is the root mean square height of a stockpile (m)
- z_0 is the surface roughness (0.05 m)

The constant k in **Equation 2** is used to normalise the annual total of the power law relationship to the annual emissions calculated by **Equation 1**. In practice, this constant is calculated after the sum of the power law is calculated. The result is a wind speed dependent emission rate, that increases in accordance with the power law in **Equation 2,** whilst agreeing with the annual emissions quantity calculated in **Equation 1**.

B.2.3 Wind Erosion for Exposed Areas

The methodology for the development of wind speed dependent dust emissions for exposed areas is identical to that for stockpiles with a critical wind speed of 5.4 m/s at 10 m height used in **Equation 2**.

B.2.4 Wind Speed Dependent Emission Factors

Presented in Figure B-3 is an example of the wind speed dependent wind erosion emission factors used in the Project air quality assessment. A summary of the annual wind speed dependent erosion for stockpiles and exposed areas is presented in Table B-7.

Figure B-3 (Example) Wind Speed Dependent Emission Factor for Stockpiles

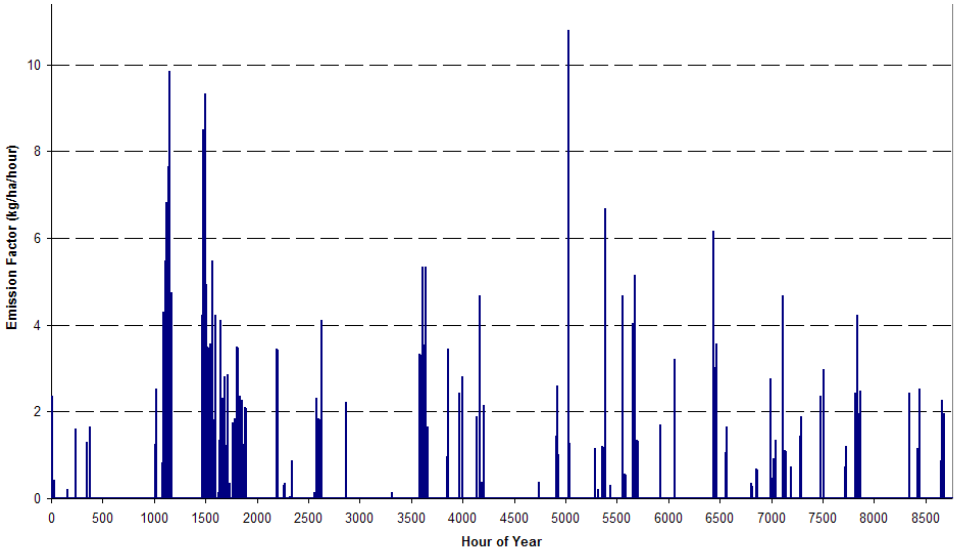


Table B-7 Summary of Parameters used to Calculate Wind Erosion Emission Factors

Parameter	Units	Product Stockpiles	ROM Stockpiles	Tailing Dams	Exposed Areas
Source height	m	20	4	-	-
Root mean square height	m	14.1	2.8	10	10
Wind speed at source height	m/s	5.4	4.1	5.4	5.4
Critical wind speed @ 10m (m/s)	m/s	5.1	5.4	5.4*	5.4*
Hours over critical wind speed	%	1.5	0.7	0.7	0.7
Silt content	%	5	5	30	14
F (kg/ha/year)	kg/ha/year	299.9	145.3	871.7	406.8
k	-	0.06	0.06	0.36	0.17

*A conservative approach has been adopted which will overestimate the frequency of emissions from tailings dams and exposed areas.

B.2.5 Particle size distributions

TSP and PM_{10} represent the particles emitted from a source of less than 30 μm and less than 10 μm in diameter respectively. The deposition rate, as the particles disperse away from the source, is dependant on the particle size distribution within each particle size.

In CALPUFF, the particle size distribution is described in terms of:

- Geometric mass mean diameter; and
- Geometric standard deviation.

These parameters describe the average particle size based on mass within the size fraction, and the distribution of other size fractions within the particle type.

As demonstrated in Appendix C, the fraction of PM_{10} to TSP is different for various sources. In order to account for this in the dispersion modelling, the PM_{10} inventory was subtracted from the TSP inventory, and the upper portion particle sizes 10 μm to 30 μm modelled. These results where then added to the results of the PM_{10} dispersion modelling (less than 10 μm). This allowed for the appropriate proportioning of the particle sizes for the various sources. Accordingly, the TSP model particle size distribution reflects this upper portion of particle sizes.

This assessment used the particle size distributions shown in Table B-8 as a typical distribution for TSP and PM_{10}.

Table B-8 Parameters used to describe particle size distribution in CALPUFF

Particle Size Class	Geometric Mass Mean Diameter (µm)	Geometric Standard Deviation (µm)
TSP (10 µm to 30 µm)	3.16	2.19
PM_{10} (less than 10 µm)	17.32	1.46

As discussed in Section 4.3.2, due to the absence of additional information it has been assumed that $PM_{2.5}$ concentrations resulting from Project activities are equal to 20% of PM_{10} concentrations from the Project.

C

Appendix C Site Emissions Inventory

Presented in this appendix are the site-specific emissions inventory as the percentage contribution of dust from each of the activities to the site total given in kg/year.

Table C-9 Ratio of PM_{10} to TSP by Emission Type

Activity	Ratio of PM_{10}:TSP
Topsoil	
Disturbance & Rehabilitation	0.50
Overburden & In-Pit	
Drilling & Blasting	0.52
Dragline	0.16
FEL of Overburden into Trucks	0.47
Transport of Overburden to dumps	0.25
Truck Dumping at Overburden Dumps	0.36
FEL of coal trucks	0.48
Dozers	0.25
Graders	0.45
ROM Activities	
Processing	0.39
Truck Dumping at ROM	0.42
FEL at ROM	0.48
Dozer hours – Coal at ROM (total)	0.29
Wind Erosion from Stockpiles	0.50
ROM to CHPP Conveyor	
Conveyors	0.50
Misc Transfer Points	0.47
CHPP Activities	
Processing	0.39
FEL at CHPP	0.48
Dozer hours – Coal at CHPP	0.29
Loading Stockpiles	0.43
Unloading from Stockpiles	0.43
CHPP Conveyors	0.50
Misc Transfer Points	0.47
Wind Erosion from Stockpiles	0.50
Main Haul Roads	
Transport of Coal to ROM	0.25
Transport of Rejects to Dumps	0.25
Tailing Storage Facility	
Wind Erosion from Tailing Storage Facility	0.50

Table C-10 Relative Contribution of Dust Generating Activities to the Overall Site Emissions Inventory for PM_{10} and TSP

Area	Activity	Year 1		Year 5		Year 15		Year 25	
		PM_{10}	TSP	PM_{10}	TSP	PM_{10}	TSP	PM_{10}	TSP
Topsoil	Disturbance and rehabilitation	8%	5%	0%	0%	1%	0%	1%	0%
Overburden & Pit Activities	Drilling and blasting	0%	0%	0%	0%	0%	0%	0%	0%
	Dragline	0%	0%	0%	0%	21%	36%	15%	28%
	Loading of overburden	1%	1%	1%	1%	0%	0%	1%	1%
	Transport of overburden	9%	15%	11%	19%	7%	9%	10%	13%
	Trucks dumping overburden	22%	18%	29%	25%	11%	7%	19%	13%
	FEL of coal trucks	5%	4%	6%	5%	6%	4%	9%	5%
	Dozers	7%	10%	4%	6%	5%	6%	4%	5%
	Graders	20%	26%	16%	21%	11%	12%	10%	11%
	Wind erosion from pits	6%	4%	5%	0%	3%	0%	2%	0%
	Wind erosion of overburden	9%	6%	7%	5%	8%	5%	6%	3%
ROM Activities	Processing at northern ROM pad	0.6%	0.5%	0.8%	0.7%	-	-	-	-
	Truck dumping at ROM pads	1%	3%	1%	2%	1%	3%	2%	3%
	Dozer at ROM pads	4%	2%	3%	2%	4%	2%	3%	1%
Coal Conveying	Conveyors	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.00%
	Transfer points	0%	0%	2%	2%	3%	2%	2%	1%
Coal Preparation and Loading	Northern ROM processing	0%	0%	2%	2%	4%	3%	4%	3%
	Loading of stockpiles	0.1%	0.0%	0.5%	0.4%	0.8%	0.5%	0.5%	0.3%
	Conv. transfer points	0.2%	0.1%	1.5%	1.1%	2.2%	1.3%	1.5%	0.9%
	Wind erosion of stockpiles	0.3%	0.2%	0.2%	0.1%	0.2%	0.1%	0.2%	0.1%
Haul Roads	Hauling of coal to ROM pads	1%	1%	2%	3%	3%	6%	5%	8%
	Transport of rejects to dumps	0%	1%	2%	2%	2%	2%	2%	1%
Tailings	Wind erosion of tailings storage	5%	3%	4%	3%	4%	2%	3%	2%
Total		100%	100%	100%	100%	100%	100%	100%	100%

Appendix D Results of the Dispersion Modelling

Presented in this appendix are the results of the dispersion modelling for:

- The 5th highest 24-hour average ground-level concentration of PM_{10};
- The maximum 24-hour average ground-level concentration of $PM_{2.5}$;
- The annual average ground-level concentration of $PM_{2.5}$;
- The annual average ground-level concentration of TSP; and
- Dust deposition.

These predictions correspond to the Project Goals. Predictions are presented for the receptor locations for Year 1 and Year 15, which are not presented in Section 5.3.

Table D-11 The 5th Highest 24-hour Average Ground-level Concentration of PM_{10} (ug/m^3)

Receptor	Y1			Y15		
	Project	Total	% of EPP (Air)	Project	Total	% of EPP (Air)
1	25	**52**	**103%**	19	46	92%
2	2	29	58%	3	30	60%
3	1	28	57%	2	29	58%
4	1	28	57%	3	30	61%
6	1	28	56%	1	28	56%
8	5	32	64%	8	35	69%
9	5	32	63%	6	33	66%
10	1	28	55%	1	28	56%
11	1	28	56%	1	28	56%
12	5	32	64%	5	32	64%
Project Goal	50		100%	50		100%

Note (1): Numbers highlighted in bold exceed the relevant Project Goal

Table D-12 The Maximum 24-hour Average Ground-level Concentration of $PM_{2.5}$ (ug/m^3)

Receptor	Y1			Y15		
	Project	Total	% of EPP (Air)	Project	Total	% of EPP (Air)
1	5.8	11.2	45%	5.2	10.6	42%
2	1.1	6.5	26%	1.1	6.5	26%
3	0.5	5.9	24%	0.7	6.1	24%
4	1.5	6.9	28%	2.0	7.4	30%
6	0.6	6.0	24%	0.6	6.0	24%
8	1.2	6.6	27%	1.7	7.1	28%
9	1.4	6.8	27%	1.3	6.7	27%
10	0.3	5.7	23%	0.4	5.8	23%
11	0.4	5.8	23%	0.5	5.9	24%
12	1.7	7.1	28%	2.3	7.7	31%
Project Goal	25		100%	25		100%

Table D-13 The Annual Average Ground-level Concentration of $PM_{2.5}$ (ug/m^3)

Receptor	Y1			Y15		
	Project	Total	% of EPP (Air)	Project	Total	% of EPP (Air)
1	0.89	3.7	46%	0.61	3.4	43%
2	0.02	2.8	35%	0.03	2.8	35%
3	0.01	2.8	35%	0.01	2.8	35%
4	0.02	2.8	35%	0.03	2.8	35%
6	0.01	2.8	35%	0.01	2.8	35%
8	0.14	2.9	37%	0.21	3.0	38%
9	0.11	2.9	36%	0.13	2.9	37%
10	0.01	2.8	35%	0.01	2.8	35%
11	0.01	2.8	35%	0.01	2.8	35%
12	0.04	2.8	36%	0.05	2.8	36%
Project Goal	8		100%	8		100%

Table D-14 The Annual Average Ground-level Concentration of TSP (ug/m^3)

Receptor	Y1			Y15		
	Project	Total	% of EPP (Air)	Project	Total	% of EPP (Air)
1	8	36	40%	5	33	37%
2	0.2	28	31%	0.2	28	31%
3	0.1	28	31%	0.1	28	31%
4	0.1	28	31%	0.2	28	31%
6	0.1	28	31%	0.1	28	31%
8	1	29	32%	1	29	32%
9	1	29	32%	1	29	32%
10	0.1	28	31%	0.1	28	31%
11	0.1	28	31%	0.1	28	31%
12	0.3	28	31%	0.3	28	31%
Project Goal	90		100%	90		100%

Table D-15 Dust Deposition (mg/m²/day)

Receptor	Y1			Y15		
	Project	Total	% of EPP (Air)	Project	Total	% of EPP (Air)
1	8	76	54%	5	73	52%
2	0.2	68	49%	0.2	68	49%
3	0.1	68	49%	0.1	68	49%
4	0.1	68	49%	0.2	68	49%
6	0.06	68	49%	0.05	68	49%
8	0.8	69	49%	1	69	49%
9	1	69	49%	0.7	69	49%
10	0.1	68	49%	0.1	68	49%
11	0.1	68	49%	0.1	68	49%
12	0.3	68	49%	0.3	68	49%
Project Goal	140		100%	140		100%

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