Centennial Coal

Springvale Colliery

Springvale Mine Extension Project

Air Quality and Greenhouse Gas Assessment

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Springvale Mine Extension Project
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Executive Summary

Introduction

SLR Consulting Australia Pty Ltd (SLR Consulting) has been commissioned by Springvale Coal Pty Ltd (Springvale Coal) to undertake an Air Quality and Greenhouse Gas (GHG) Impact Assessment for the proposed Springvale Mine Extension Project (SMEP).

Key objectives of the SMEP relevant to air quality issues are as follows:

- continue to extract up to 4.5 million tonnes per annum (Mtpa) of ROM coal from the Lithgow Seam underlying the Project Application Area;
- develop underground access headings and roadways from the current mining area to the east to allow access to the proposed mining areas;
- undertake secondary extraction by retreat longwall mining technique for the proposed longwalls LW416 to LW432 and LW501 to LW503;
- continue to use the existing ancillary surface facilities at the Springvale pit top;
- continue to manage the handling of ROM coal through a crusher and screening plant at the Springvale pit top, and the subsequent loading of the coal onto the existing overland conveyor system for despatch to offsite locations;
- continue to operate and maintain the existing ancillary surface infrastructure for ventilation, electricity, water, materials supply, and communications at the Springvale pit top and on Newnes Plateau;
- install and operate two additional dewatering bore facilities (Bores 9 and 10) on Newnes Plateau and the associated power and pipeline infrastructure, and upgrade the existing and construct two new sections of access tracks to Bores 9 and 10 facilities;
- construct a downcast ventilation borehole at the Bore 10 facility location;
- establish a services borehole area;
- upgrade the existing Springvale Delta Water Transfer Scheme (SDWTS) comprising construction of new sections of the trenched pipelines to increase the water delivery capacity of SDWTS from the existing 30 ML/day to up to 50 ML/day;
- manage mine inflows using a combination of direct water transfer to the Wallerawang Power Station, via the SDWTS, and discharge through Angus Place Colliery's licensed discharge point LDP001 and Springvale Colliery's LDP009;
- continue to undertake existing and initiate new environmental monitoring programs;
- continue to operate 24 hours per day seven days per week;
- continue to provide employment to a full time workforce of up to 310 persons;
- progressively rehabilitate disturbed areas at infrastructure sites no longer required for mining operations;
- undertake life-of-mine rehabilitation at the Springvale pit top and the Newnes Plateau infrastructure disturbance areas to create final landforms commensurate with the surrounding areas and the relevant zonings of the respective areas;
- transfer the operational management of coal processing and distribution infrastructure to the proposed Centennial Western Coal Services Project.

Executive Summary

The aim of this assessment is to quantify the air quality impacts on surrounding sensitive receivers associated with the SMEP (construction and operation). The assessment also estimates GHG emissions for the Project. Furthermore, an estimation of the likely air quality impacts resulting from Project rehabilitation has also been performed within this assessment.

Methodology

The air quality impact assessment has been completed in accordance with the "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" (OEH, 2005) (the Approved Methods) issued by the New South Wales Office of Environment and Heritage (NSW OEH). Air quality criteria specified by the NSW OEH were adopted as stipulated in the Approved Methods. In the absence of criteria applicable to $PM_{2.5}$ in the Approved Methods, the NEPM advisory reporting standard (2003) was adopted.

Dispersion modelling was conducted for the identified sources for the proposed SMEP (construction, operation and site rehabilitation). The pollutants assessed were particulate matter as Total Suspended Particulate (TSP), particulate matter with an aerodynamic diameter of 10 microns (PM_{10}), 2.5 microns ($PM_{2.5}$) and deposited dust. The particulate emissions from SMEP activities were calculated for existing and proposed activities using default or calculated emission factors for the relevant emission sources. Emission factors were sourced from the National Pollutant Inventory (NPI) *EETM for Mining* version 3.1 (DSEWPC 2012), or from the US EPA AP-42 Emission Factor Handbook (US EPA, 2006) where suitable factors do not exist within the NPI documentation. The particulate emissions from ventilation fans were based on particulate monitoring conducted on the Angus Place Colliery ventilation fans in February 2013.

In order to assess the background air quality of the region, a review of High Volume Air Sampling (HVAS) monitoring data collected on site was reviewed and compared against HVAS data collected at the nearby Angus Place Colliery and continuous PM_{10} monitoring data collected by NSW OEH at Bathurst. This review indicated that use of the continuous ambient monitoring data from Bathurst for 2010 would provide a conservative and appropriate approach for the assessment of potential cumulative impacts for the SMEP.

The assessment also considers emissions of Greenhouse Gases (methane (CH_4), carbon dioxide (CO_2) and sulphur hexafluoride (SF_6)) from the SMEP and includes estimates of direct and indirect GHG emissions.

Results

The predicted results showed that the proposed SMEP is unlikely to cause any exceedences of the relevant ambient air quality criteria for TSP, PM_{10} and $PM_{2.5}$ concentrations or dust deposition at any identified surrounding sensitive receptors when considering Project construction, operation and site rehabilitation.

The total lifetime direct (Scope 1) emissions from the Project are estimated to be approximately 22,697 CO_2-e in any one year.

Indirect (Scope 2 and 3) emissions would be released in the process of mining coal, and through the transport and end use of the coal. The total lifetime indirect emissions (Scope 2 and 3) from mining coal and end use of the coal are estimated to be 1,176,743 t CO_2-e per annum.

Executive Summary

Comparison of Project emissions with State and National GHG emission totals indicates that the SMEP is likely to represent approximately 0.01% of NSW GHG emissions (Scope 1) when compared to the latest available emissions data (2010) (Scope 1) and 0.004% of Australian GHG emissions (Scope 1).

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FIGURES

ABBREVIATIONS

%	percent
°C	degrees Celsius
µg	Microgram
$µg/m^3$	microgram per cubic metre of air
$µg/Nm^3$	microgram per normalised cubic metre of air (273K, 101.3kPa)
µm	micrometre or micron
AGL	above ground level
AHD	Australian Height Datum
AP-42	US EPA Emission Factor Handbook
AQIA	air quality impact assessment
AWS	automatic weather station
DECC	NSW Department of Environment and Climate Change (see OEH)
DECCW	NSW Department of Environment, Climate Change and Water (see OEH)
DDG	dust deposition gauge
EETM	Emission Estimation Technique Manual
EF	Emission Factor
EIS	Environmental Impact Statement
g	gram
$g/m^2/month$	grams per square metre per month
ha	hectare
kg	kilogram
kg/hr	kilogram per hour
km	kilometre
km E	kilometres east
km N	kilometres north
L	litre
m	metre
M	million
m/s	metre per second
m^2	square metre
m^3	cubic metre
min	minute
mm	millimetre
MPPS	Mount Piper Power Station
Mt	million tonnes
Mtpa	million tonnes per annum
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NPI	National Pollutant Inventory (Australia)
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PM	Particulate Matter
PM_{10}	particular matter with an equivalent aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particular matter with an equivalent aerodynamic diameter of 2.5 microns or less
ROM	run of mine
SMEP	Springvale Mine Expansion Project
t	tonne
TEOM	tapered element oscillating microbalance
tpa	tonnes per annum
TSP	total suspended particulate matter
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
WPS	Wallerawang Power Station

GLOSSARY

air dispersion model	A computer-based software program which provides a mathematical prediction of how pollutants from a source will be distributed in the surrounding area under specific conditions of wind, temperature, humidity and other environmental factors
airshed	The geographical area associated with a given air supply
algorithms	A step-by-step problem-solving procedure, especially an established, recursive computational procedure for solving a problem in a finite number of steps
ambient	Pertaining to the surrounding environment or prevailing conditions
anemometer	An instrument for measuring wind force and velocity
atmosphere	A gaseous mass surrounding the planet Earth that is retained by Earth's gravity. It is divided into five layers. Most of the weather and clouds are found in the first layer
atmospheric stability	The tendency of the atmosphere to resist or enhance vertical motion
atmospheric pressure	The force per unit area exerted against a surface by the weight of air above that surface in the Earth's atmosphere
background	The existing air quality in the Project area excluding the impacts from the proposed development
CALMET	A meteorological model that develops wind and temperature fields on a three-dimensional gridded modelling domain
CALPOST	A post-processor used to process CALPUFF files, producing tabulations that summarize results of the simulation for user-selected averaging periods
CALPUFF	A transport and dispersion model that advects “puffs” of material emitted from modelled sources, simulating dispersion and transformation processes
climatological	The science dealing with climate and climatic phenomena
combustion	The process of thermal oxidation (burning). A chemical change accompanied by the production of heat and conversion of chemical species.
crushers	A machine designed to reduce large rocks into smaller rocks, gravel, or rock dust
dust deposition	Settling of particulate matter out of the air through gravitational effects (dry deposition) and scavenging by rain and snow (wet deposition)
dispersion	The spreading and dilution of substances emitted in a medium (e.g. air or water) through turbulence and mixing effects
diurnal	Relating to or occurring in a 24-hour period; daily
downwash	The grounding of an air pollution plume as it flows over nearby buildings or other structures due to turbulent eddies being formed in the downwind side of the building, resulting in elevated ground level concentrations.
downwind	The direction in which the wind is blowing
emission factor	A measure of the amount of a specific pollutant or material emitted by a specific process, fuel, equipment, or source based on activity data such as the quantity of fuel burnt, hours of operation or quantity of raw material consumed.
emissions inventory	A database that lists, by source, the amount of air pollutants discharged into the atmosphere from a facility over a set period of time (e.g. per annum, per hour)
erodible	A term used to describe a soil that is vulnerable to erosion by the agents of wind, water, ice

evapotranspiration	The process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces
epidemiological	The branch of medicine that deals with the study of the causes, distribution, and control of disease in populations
fossil fuel	A natural fuel such as coal, diesel or gas, formed in the geological past from the remains of living organisms
fugitive emissions	Pollutants which escape from an industrial process due to leakage, materials handling, transfer, or storage
guideline	A general rule, principle, or piece of advice. A statement or other indication of policy or procedure by which to determine a course of action.
materiality threshold	Represents the amount of insignificant emissions allowed which do not need to be quantified and accounted for.
meteorological	The science that deals with the phenomena of the atmosphere, especially weather and weather conditions
mixing height	The height to which the lower atmosphere will undergo mechanical or turbulent mixing, producing a nearly homogeneous air mass
modelling domain	The area over which the model is making predictions
particulate	Of, relating to, or formed of minute separate particles. A minute separate particle, as of a granular substance or powder
plume	A space in air, water, or soil containing pollutants released from a point source
point source	A pollution source that is fixed and/or uniquely identifiable, such as a stack, chimney, outlet pipe or vent
pollutant	A substance or energy introduced into the environment that has undesired effects, or adversely affects the usefulness of a resource
prognostic	A prediction of the value of variables for some time in the future on the basis of the values at the current or previous times
qualitative assessment	An assessment of impacts based on a subjective, non-statistical oriented analysis
quantitative assessment	An assessment of impacts based on estimates of emission rates and air dispersion modelling techniques to provide estimate values of ground level pollutant concentrations.
receptor	Coordinate locations specified in an air dispersion model where ground level pollutant concentrations are calculated by the model
sensitive receptor	Locations such as residential dwellings, hospitals, churches, schools, recreation areas etc where people (particularly the young and elderly) may often be present, or locations with sensitive vegetation and crops.
spatial variation	Pertaining to variations across an area
standard	The prescribed level of a pollutant in the outside air that should not be exceeded during a specific time period to protect public health
synoptic meteorological data	A surface weather observation, made at periodic times (usually at 3-hourly and 6-hourly intervals), of sky cover, state of the sky, cloud height, atmospheric pressure reduced to sea level, temperature, dew point, wind speed and direction, amount of precipitation, hydrometeors and lithometeors, and special phenomena that prevail at the time of the observation or have been observed since the previous specified observation
temporal variation	Pertaining to variations with time

topography	Detailed mapping or charting of the features of a relatively small area, district, or locality
wind direction	The direction from which the wind is blowing
wind erosion	Detachment and transportation of loose topsoil or sand due to action by the wind
wind rose	A meteorological diagram depicting the distribution of wind direction and speed at a location over a period of time

1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR Consulting) has been commissioned by Springvale Coal Pty Ltd (Springvale Coal) to undertake an Air Quality and Greenhouse Gas Impact Assessment for the proposed Springvale Mine Extension Project (SMEP or the Project).

Springvale Coal proposes to continue its coal mining operations, using longwall mining techniques, to the east, the southeast and the southwest of its existing workings at Springvale Mine (Springvale) located 15 kilometres (km) northwest of Lithgow NSW (refer **Figure 1**). The SMEP will fall within Springvale's existing Colliery Holding. The SMEP Application Area is also shown in **Figure 1**. Springvale's current development consent will expire on 28 September 2014, and Springvale Coal is seeking approval to continue mining beyond this date.

Broadly, the objective of this assessment was to identify the potential impacts of air quality and greenhouse gas emissions associated with the SMEP, the cumulative impacts of the SMEP with existing Springvale mining operations and the cumulative impacts of the Project (i.e. the modified or proposed Springvale operations) with other activities/operations in the proximity of the mine.

The air quality impact assessment has been prepared in accordance with the Office of Environment and Heritage (OEH) document Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (OEH, 2005), hereafter referred to as 'The Approved Methods'. This assessment involves the modelling of local meteorology and the dispersion of potential emissions from the Project Application Area to predict the level of impact that may be experienced in the surrounding environment. The sections of this report where the requirements of the Approved Methods are met are as follows:

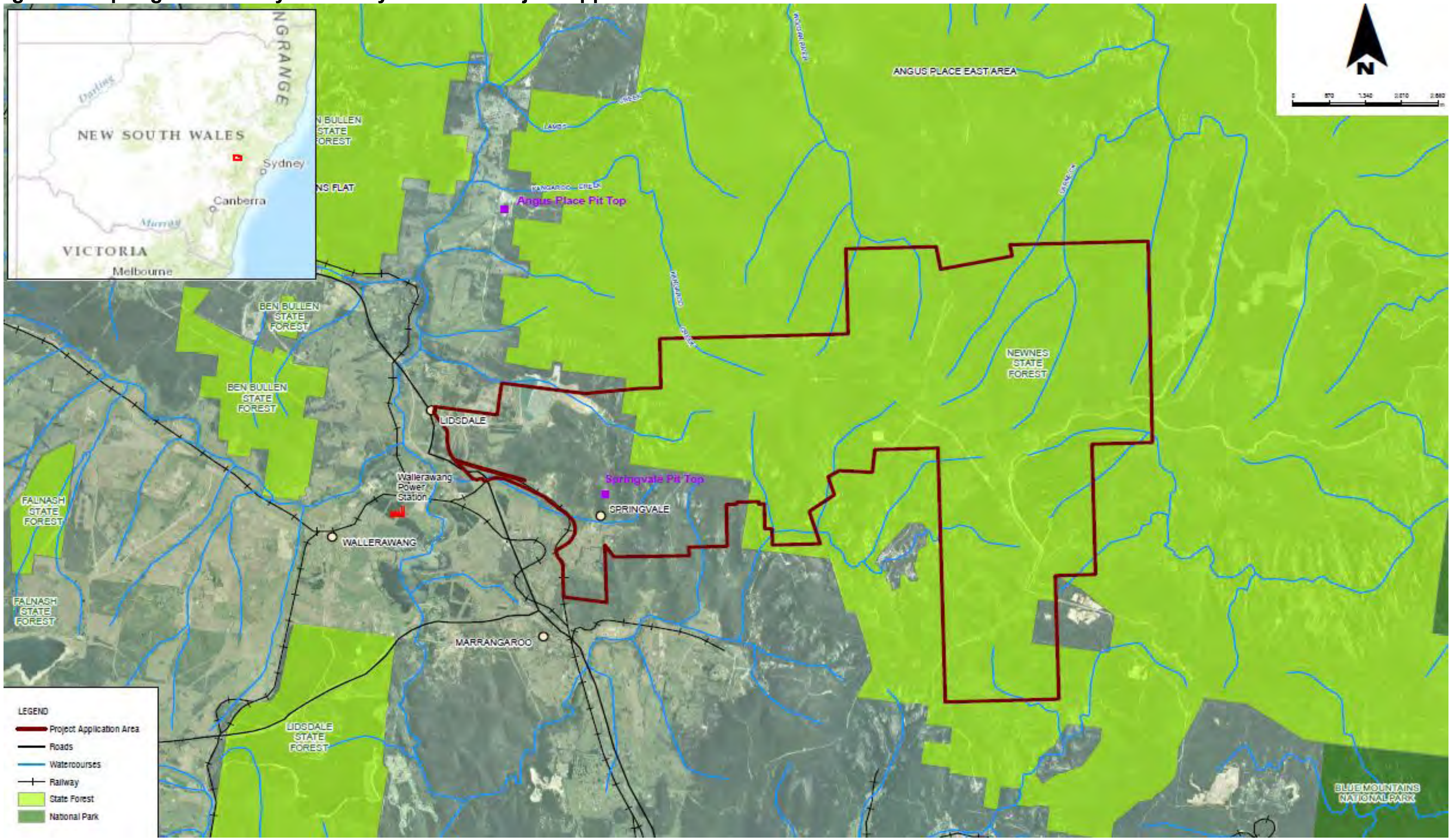
- Description of local topographic features and sensitive receptor locations (**Section 4**).
- Establishment of air quality assessment criteria (**Section 3**).
- Analysis of climate and dispersion meteorology for the region (**Section 6.3**).
- Description of existing air quality environment (**Section 7**).
- Compilation of a comprehensive emissions inventory for the existing and proposed activities (**Section 5.5**).
- Completion of atmospheric dispersion modelling and analysis of results (**Section 6** and **Section 8**).
- Preparation of an air quality impact assessment report comprising the above.

The scope of the air and greenhouse gas assessments was also designed to address the Director-Generals Requirements (DGRs) for the Project (issued 6 November 2012). A synopsis of these requirements is provided in **Table 1**.

Table 1 Director-General's Requirements

Director-General's Requirement	Section Addressed
Air Quality	
Air Quality – including a quantitative assessment of potential:	
- Construction and operational impacts, with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10} emissions and dust generation from coal transport	**Section 5** and **Section 8**
- Reasonable and feasible mitigation measures to minimise dust emissions, including evidence that there are no such other available measures	**Section 5.3**
- Monitoring and best practice management measures, in particular real time air quality monitoring	**Section 5.3** and **Section 8.3**
Greenhouse Gas	
Greenhouse Gases – including:	
- A quantitative assessment of potential Scope 1, 2 and 3 greenhouse gas emissions	**Section 9**
- A qualitative assessment of the potential impacts of these emissions on the environment	**Section 9.6**
- An assessment of reasonable and feasible measures to minimise greenhouse gas emissions and ensure energy efficiency	**Section 9.7**
Attachment 1 Technical & Policy Guidelines **Air Quality**	
- Protection of the Environment Operations (Clean Air) Regulation 2002	**Section 3**
- The Assessment and Management of Odour from Stationary Sources in NSW: Technical Framework and Notes (OEH)	**Not Applicable**
- Approved Methods for the Modelling and Assessment of Air Pollutants in NSW	**Section 6**
- Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DEC)	**Section 5**
Greenhouse Gas	
- National Greenhouse Accounts Factors (Australian Department of Climate Change (DCC))	**Section 9**
- Guidelines for Energy Savings Action Plans (DEUS)	**Section 9**

Figure 1 Springvale Colliery – Locality Plan and Project Application Area



2 PROJECT DESCRIPTION

2.1 Background

Springvale Mine (Springvale) is an underground coal mine producing high quality thermal coal which is supplied to both domestic and international markets. Domestically, Springvale Coal Pty Limited (Springvale Coal) has established long term contracts with two (2) local power stations: Wallerawang Power Station (WPS) and Mount Piper Power Station (MPPS). All coal is distributed to these sites via dedicated overland conveyors. The international market is accessed via Centennial's Lidsdale Siding rail loading facility.

The main components of Springvale's operations are an underground longwall mine and supporting surface infrastructure within the pit top area and in the Newnes State Forest. Currently the run-of-mine (ROM) coal processing and distribution is handled at the Springvale Coal Services site, located at Blackmans Flat under Springvale's current consent. In the future the coal processing and handling, and the transport logistics will be managed under the consent of the proposed Centennial Western Coal Services Project.

2.2 Project Objectives and Overview

The overall objective of the SMEP is to obtain approval for the continuation of mining at Springvale Colliery beyond 28 September 2014.

Specific objectives of the SMEP are as follows:

- continue to extract up to 4.5 million tonnes per annum (Mtpa) of ROM coal from the Lithgow Seam underlying the Project Application Area;
- develop underground access headings and roadways from the current mining area to the east to allow access to the proposed mining areas;
- undertake secondary extraction by retreat longwall mining technique for the proposed longwalls LW416 to LW432 and LW501 to LW503;
- continue to use the existing ancillary surface facilities at the Springvale pit top;
- continue to manage the handling of ROM coal through a crusher and screening plant at the Springvale pit top, and the subsequent loading of the coal onto the existing overland conveyor system for despatch to offsite locations;
- continue to operate and maintain the existing ancillary surface infrastructure for ventilation, electricity, water, materials supply, and communications at the Springvale pit top and on Newnes Plateau;
- install and operate two additional dewatering bore facilities (Bores 9 and 10) on Newnes Plateau and the associated power and pipeline infrastructure, and upgrade the existing and construct two new sections of access tracks to Bores 9 and 10 facilities;
- construct a downcast ventilation borehole at the Bore 10 facility location;
- establish a services borehole area;
- upgrade the existing Springvale Delta Water Transfer Scheme (SDWTS) comprising construction of new sections of the trenched pipelines to increase the water delivery capacity of SDWTS from the existing 30 ML/day to up to 50 ML/day;
- manage mine inflows using a combination of direct water transfer to the Wallerawang Power Station, via the SDWTS, and discharge through Angus Place Colliery's licensed discharge point LDP001 and Springvale Colliery's LDP009;

- continue to undertake existing and initiate new environmental monitoring programs;
- continue to operate 24 hours per day seven days per week;
- continue to provide employment to a full time workforce of up to 310 persons;
- progressively rehabilitate disturbed areas at infrastructure sites no longer required for mining operations;
- undertake life-of-mine rehabilitation at the Springvale pit top and the Newnes Plateau infrastructure disturbance areas to create final landforms commensurate with the surrounding areas and the relevant zonings of the respective areas;
- transfer the operational management of coal processing and distribution infrastructure to the proposed Centennial Western Coal Services Project.

A comparison of the existing operation at Springvale and the proposed SMEP is presented in **Table 2**.

Table 2 Comparison of Existing and Proposed Operational Activities

Activity	Existing Operation	SMEP (including construction)
Annual throughput (Mtpa)	4.5	4.5
Exposed area (ha)	2.3	6.3[1]
Vehicle movement on unpaved pit top roads (VKT/annum)	15,768	15,768
Dozer operation at pit top(hr)	8,760	8,760
Trucks on Borehole access roads (km/year)	0	18,250
Upcast ventilation (m^3/s)	221.1	221.1

Note 1: Additional area associated with access roads to dewatering boreholes and dewatering borehole sites considered.

2.3 Project Elements with Potential for Air Quality Impacts

2.3.1 Construction

Construction activities associated with the SMEP will involve site preparation and clearance, drilling of the downcast ventilation shaft and dewatering boreholes, construction of the foundations, installation of the borehole infrastructure and commissioning within the proposed site compounds.
The SMEP has considered the operation of an additional two (2) dewatering boreholes, Bore 9 and Bore 10.

As part of the Springvale Ventilation Shaft No.3 Project Air Quality Impact Assessment (submitted in November 2011, approved in May 2012), and Springvale Dewatering Bore 8 Project Air Quality Impact Assessment (submitted in September 2012, approved in March 2013) a quantitative assessment of construction and operation activities associated with the upgraded upcast ventilation facility and new dewatering bore was performed. Maximum particulate concentrations associated with these activities were well below relevant criteria at all receptor locations shown in **Figure 3**.

To satisfy the DGR's (refer **Table 1**) a quantitative assessment of the proposed construction activities has been performed. Further detail is provided in **Section 5**.

2.3.2 Operations

Springvale Mine Pit Top

No modifications are proposed to the existing Springvale pit top as part of the SMEP. Given the proximity of the pit top operations to the sensitive receptor locations, a quantitative assessment of particulate emissions (TSP, deposited dust, PM_{10} and $PM_{2.5}$) has been performed as required by the DGR's (**Table 1**).

A temporary crusher may be in operation at the pit top during periods when the conveyor from the Springvale coal handling plant is not operational. In these cases (which has never occurred to date), up to 50,000 tonnes of coal would be crushed using a temporary crusher located on the ROM coal stockpile and loaded to trucks before being transported off site to either the MPPS or WPS by road. Given that coal crushing within this temporary plant would be at or lower than the rate crushed through the coal handling plant, it is considered that emissions of particulate would not increase during these periods, and no specific quantitative assessment of these operations has been performed. Emissions and subsequent impacts resulting from this rare occurrence are considered to be encompassed in the modelling results for normal operations.

Ventilation Facilities

Mine planning has identified that additional ventilation capacity may be required to ensure compliance with Clause 13(h) of the *NSW Coal Mine Health and Safety Regulation 2006*. To optimise the existing ventilation system an additional air intake borehole at one of the dewatering borehole sites (Bore 10) may be constructed to deliver fresh air to the underground mine. This has not been assessed within this AQIA.

For the existing upcast ventilation shaft, the assessment has used particulate emissions monitoring data recently collected at the nearby Angus Place Colliery. This is considered to be appropriate given that both mines access the Lithgow coal seam. Emissions of carbon monoxide (CO) and odour from the ventilation shaft during operation were previously assessed as not having any significant off-site impacts and have not been considered further.

Dewatering Boreholes

Dewatering bores will be used for the management of mine inflows as part of safety and operational requirements. As noted above, this assessment has considered the operation of an additional two (2) dewatering boreholes as part of the SMEP.

The proposed plant and equipment associated with each borehole facility is as follows:

- Submersible pump(s).
- 11 kV to 3.3 kV transformers.
- High Voltage switching and control equipment.

No air quality impacts will be experienced during the operation of the boreholes and they are not considered further within this assessment. The construction of each has been considered however and further detail is provided in **Section 5**.

2.3.3 Site Rehabilitation

Following the finalisation of mining activities at Springvale, the site will be completely rehabilitated. Although emissions from all coal processing and ancillary operations will cease, during the rehabilitation phase emissions relating to infrastructure removal, land clearance, earth moving and shaping and topsoil spreading will occur.

A quantitative assessment of the potential air quality impacts associated with site rehabilitation is presented within this report. Further detail is provided in **Section 5**.

3 AIR QUALITY CRITERIA

3.1 Air Pollutants Considered

Given the foregoing discussion relating to the current development consent and previously performed assessments, only emissions of particulate matter (TSP, deposited particulate, PM_{10} and $PM_{2.5}$) are considered within this assessment. It is not considered necessary to re-assess already approved infrastructure where no additional impacts are envisaged due to the proposed Project operation.

3.2 Review of Air Quality Criteria

State air quality guidelines adopted by the NSW EPA are published in the Approved Methods (OEH, 2005).

As specified within the DGRs, the Approved Methods has been consulted during the preparation of this assessment report. The Approved Methods lists the statutory methods that are to be used to model and assess emissions of air pollutants from stationary sources in NSW. Section 7.1 of the Approved Methods clearly outlines the impact assessment criteria for the Project. The criteria listed in the Approved Methods are derived from a range of sources (including NHMRC, NEPC, WHO and ANZECC). The criteria specified in the Approved Methods are the defining ambient air quality criteria for NSW, and are considered to be appropriate for the setting.

3.2.1 Suspended Particulate Matter

Airborne contaminants that can be inhaled directly into the lungs can be classified on the basis of their physical properties as gases, vapours or particulate matter. In common usage, the terms “dust” and “particulates” are often used interchangeably. The term “particulate matter” refers to a category of airborne particles, typically less than 30 microns (µm) in diameter and ranging down to 0.1 µm and is termed total suspended particulate (TSP). The annual goal for TSP recommended by the NSW EPA is 90 micrograms per cubic metre of air (µg/m^3).

The TSP goal was developed before the more recent results of epidemiological studies which suggested a relationship between health impacts and exposure to concentrations of finer particulate matter.

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

The NSW EPA PM_{10} assessment goals set out in the Approved Methods are as follows:

- a 24-hour maximum of 50 µg/m^3.
- an annual average of 30 µg/m^3.

The World Health Organisation (WHO) also provide guidelines for PM_{10} in the 2005 document “WHO Air Quality Guidelines” which are designed to offer global guidance on reducing the health impacts of air pollution.

The WHO guidelines are as follows:

- a 24-hour maximum of 50 µg/m^3.
- an annual average of 20 µg/m^3.

The WHO 24 hour PM_{10} guideline is identical to that set out in the Approved Methods. The annual average guideline is more stringent than that set out in the Approved Methods. Both annual average guidelines of 30 µg/m^3 (NSW EPA) and 20 µg/m^3 (WHO) are assessed within this assessment.

The Approved Methods do not set any assessment goals for $PM_{2.5}$. In December 2000, the National Environment Protection Council (NEPC) initiated a review to determine whether a national ambient air quality criterion for $PM_{2.5}$ was required in Australia, and the feasibility of developing such a criterion. The review found that:

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

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

As such, in July 2003, a variation to the Ambient Air Quality NEPM was made to extend its coverage to $PM_{2.5}$, setting the following Interim Advisory Reporting Standards for $PM_{2.5}$:

- a 24-hour average concentration of 25 µg/m^3; and
- an annual average concentration of 8 µg/m^3.

It is noted that the Advisory Reporting Standards relating to $PM_{2.5}$ particles are reporting guidelines only at the present time and not intended to represent air quality criteria.

The WHO also provide guideline values for $PM_{2.5}$ which are as follows:

- a 24-hour average concentration of 25 µg/m^3; and
- an annual average concentration of 10 µg/m^3.

The NEPM advisory standards are more stringent than the WHO guidelines (for annual average $PM_{2.5}$ concentration) and therefore the NEPM guidelines will be evaluated within this assessment.

A summary of the particulate guidelines is shown in **Table 3**.

Table 3 Project Goals for Suspended Particulates

Pollutant	Averaging Time	Goal
TSP	Annual	90 µg/m^3
PM_{10}	24 Hours Annual	50 µg/m^3 30 µg/m^3 (NSW EPA) 20 µg/m^3 (WHO)
$PM_{2.5}$	24 Hours Annual	25 µg/m^3 (interim advisory reporting standard only) 8 µg/m^3 (interim advisory reporting standard only)

3.2.2 Deposited Particulate

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

Table 4 presents the impact assessment goals set out in the Approved Methods for dust deposition to avoid dust nuisance.

Table 4 EPA Goals for Allowable Dust Deposition

Averaging Period	Maximum Increase in Deposited Dust Level	Maximum Total Deposited Dust Level
Annual	2 g/m^2/month	4 g/m^2/month

Source: Approved Methods, OEH 2005.

3.3 Summary of Project Air Quality Goals

The air quality goals adopted for this assessment, which confirm to current EPA and Federal air quality criteria, are summarised in **Table 5**.

Table 5 Project Air Quality Goals

Pollutant	Averaging Time	Goal
TSP	Annual	90 µg/m^3
PM_{10}	24 Hours Annual	50 µg/m^3 30 µg/m^3 (NSW EPA) 20 µg/m^3 (WHO)
$PM_{2.5}$	24 Hours Annual	25 µg/m^3 (interim advisory reporting standard only) 8 µg/m^3 (interim advisory reporting standard only)
Dust Deposition	Annual	Maximum Incremental (Project only) increase of 2 g/m^2/month Maximum Total of 4 g/m^2/month (Project and other sources)

Source: Approved Methods, OEH 2005.

4 LOCAL TOPOGRAPHY AND SENSITIVE RECEIVERS

The topographical data used in the meteorological and dispersion modelling was sourced from the United States Geological Service's Shuttle Radar Topography Mission database that has recorded topography across Australia with a 3 arc second (~90 m) spacing. The topography of the local region surrounding the SMEP area is presented in **Figure 2**.

Springvale is located within a region of significant topographical variation as shown in **Figure 2**. The Springvale boundary lies along the western edge of the Great Dividing Range and is situated at an altitude of between approximately 900 m to 1100 m AHD. It is bordered by the Wolgan Valley to the north and the Newnes Plateau to the east.

A number of residences are located in the area surrounding the SMEP. A list of the identified nearest residences in the immediate vicinity of Springvale is presented in **Table 6** and **Figure 3**.

Concentrations of particulate matter have been assessed at each of these receptors, for relevant averaging periods as discussed in **Section 3**.

Given that construction of dewatering boreholes 9 and 10 is to occur in proximity to areas of recreational use, it is considered appropriate to estimate concentrations of particulate matter at these locations. It is noted that air quality impact assessment criteria as outlined in **Section 3** are also applicable to areas where a transient population of primarily recreational users may be located, and it is therefore considered to be appropriate to present predicted impacts at these locations. The locations of these receptors are presented in **Table 7** and **Figure 3**.

Figure 2 Topography of the Surrounding Area

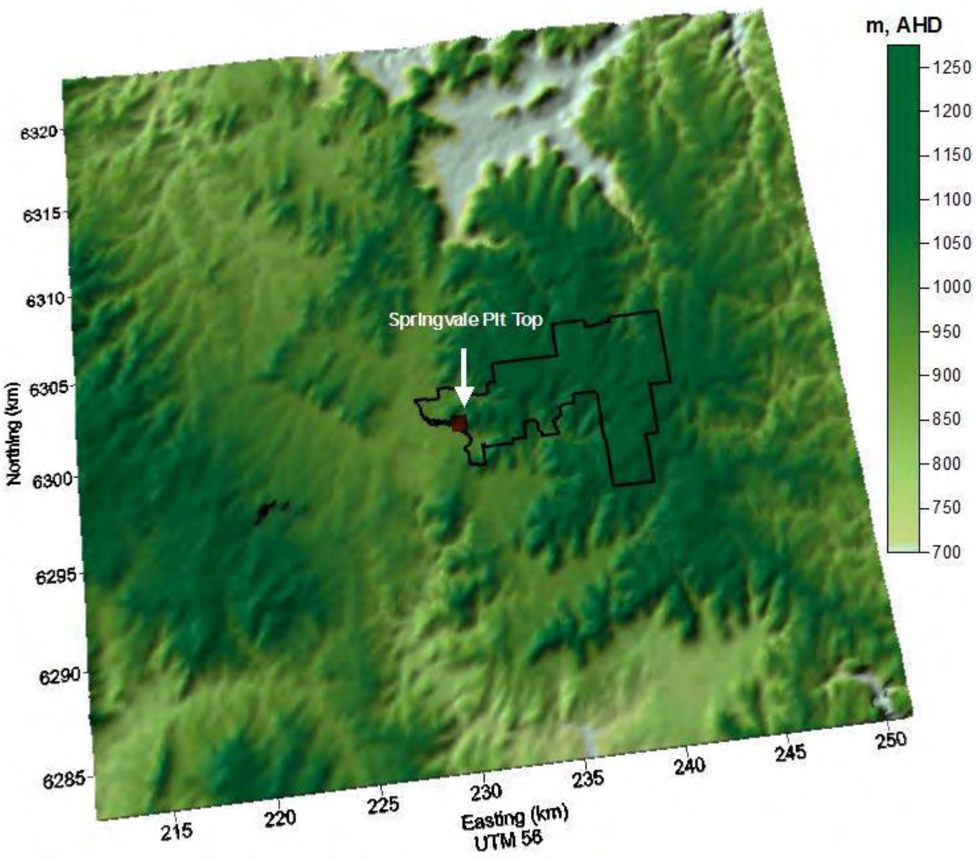


Figure 3 Sensitive Receptor Locations

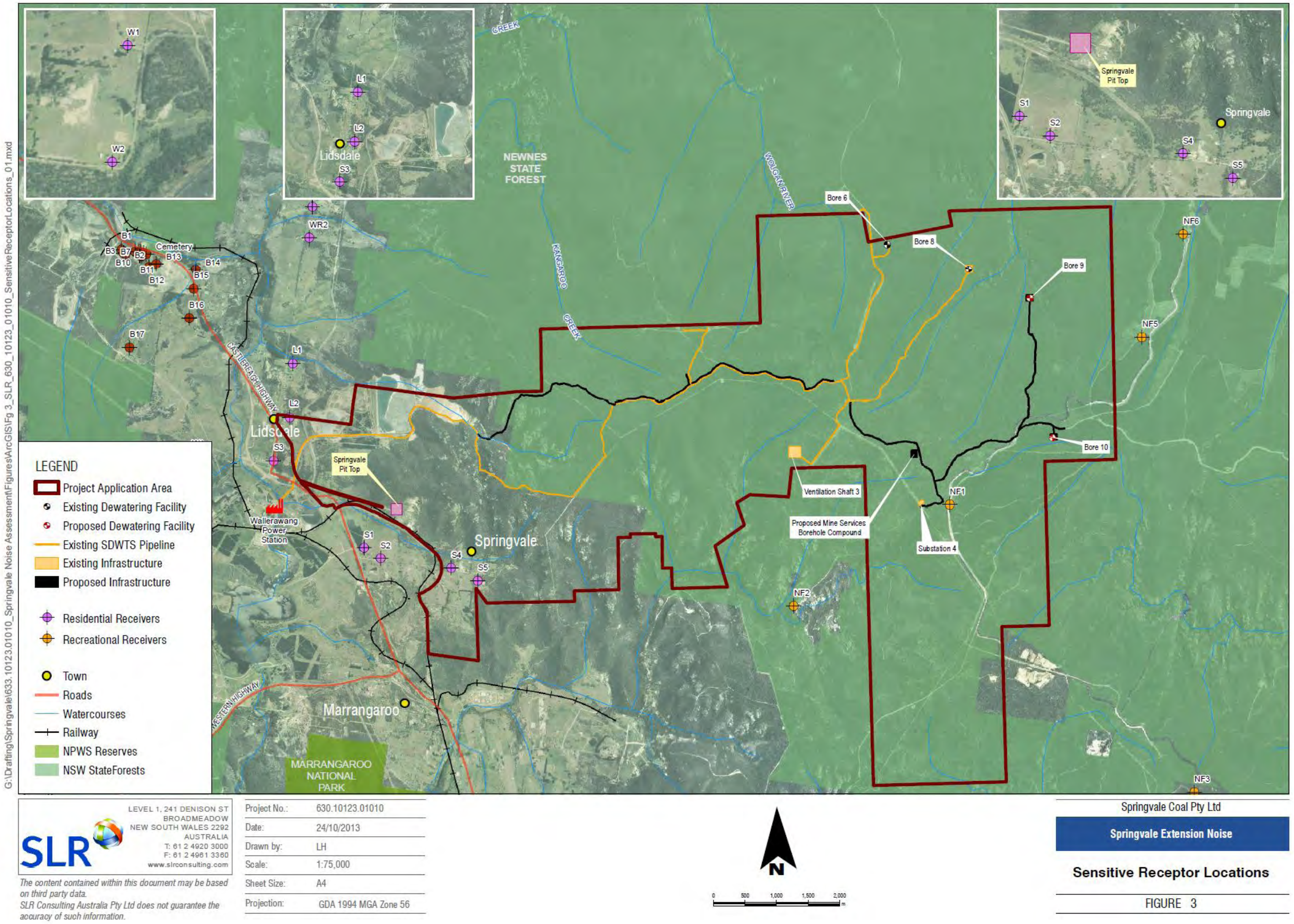


Table 6 Locations of Nearest Residential Receivers to Springvale Pit Top

Receptor	Easting (m)	Northing (m)	Zone	Elevation (m)	Approximate Distance to Nearest Site Component
S1	230,230	6,299,725	56H	905	750 m (Springvale Pit Top)
S2	230,456	6,299,541	56H	910	700 m (Springvale Pit Top)
S3	228,775	6,301,089	56H	880	2.1 km(Springvale Pit Top)
S4	231,589	6,299,387	56H	915	930 m (Springvale Pit Top)
S5	232,009	6,299,182	56H	940	1.4 km (Springvale Pit Top)
W1	227,484	6,301,148	56H	900	3.8 km (Springvale Pit Top)
W2	227,420	6,300,654	56H	887	3.9 km (Springvale Pit Top)
L1	229,078	6,302,626	56H	905	2.8 km (Springvale Pit Top)
L2	229,028	6,301,777	56H	912	2.4 km (Springvale Pit Top)

Table 7 Approximate Location of Nearest Sensitive Receivers on Newnes Plateau

Receptor	Easting (m)	Northing (m)	Zone	Elevation (m)	Approximate Distance to Nearest Site Component
NF1	239,483	6,300,390	56H	1,165	1.9 km (Bore 10 site)
NF2	237,015	6,298,782	56H	1,060	2.4 km (Shaft 3 site)
NF3	243,358	6,295,836	56H	1,160	6.3 km (Bore 10 site)
NF4	245,304	6,297,921	56H	970	5.4 km (Bore 10 site)
NF5	242,528	6,303,041	56H	1,080	1.9 km (Bore 10 site)
NF6	243,182	6,304,671	56H	1,045	2.6 km (Bore 9 site)
NF7	242,516	6,307,266	56H	925	3.9 km (Bore 8 site)
NF8	238,709	6,308,496	56H	1110	4.5 km (Bore 8 site)
NF9	235,079	6,309,656	56H	1030	7.3 km (Bore 8 site)

5 EMISSION ESTIMATION

5.1 Particulate Emission Sources

5.1.1 Construction

Activities associated with the construction of SMEP elements that are likely to generate dust emissions include:

- Land clearance (compounds and roadways);
- Wind erosion of exposed areas;
- Construction of Bore 9 and Bore 10 dewatering boreholes;
- Construction of downcast shaft at Bore 10 dewatering boreholes compound;
- Construction of associated infrastructure;
- Shaft spoil emplacement area.

Particulate emissions from these activities have been estimated as discussed in **Section 5.2.1**.

5.1.2 Operation

Activities associated with the SMEP that are likely to generate dust emissions include:

- Material handling (conveyor transfer points);
- Crushing;
- Dozers;
- Wheel generated dust;
- Ventilation shaft emissions; and
- Wind erosion.

Particulate emissions from these activities have been estimated as discussed in **Section 5.2.2**.

5.1.3 Site Rehabilitation

Following the end of mining activities at Springvale, the site will be rehabilitated. Activities associated with this rehabilitation will have the potential to generate particulate emissions and include (at the surface):

- Demolition and removal of roads, buildings and footings;
- Excavation and removal of contaminated material;
- Reshaping of landforms;
- Spreading of topsoil and revegetation of entire site.

Particulate emissions from these activities have been estimated as discussed in **Section 5.2.3**.

5.2 Activity Data and Assumptions

5.2.1 Construction

The fugitive particulate emissions from SMEP construction were estimated based on emission estimation techniques listed in the NPI EET Manual for Mining, v 3.1 (DEH, 2012) and USEPA AP-42 emission factors.

The assumptions used in the generation of the construction emissions inventory are summarised in **Table 8**.

Table 8 Summary of Activity Data used to Estimate Particulate Emissions - Construction

Parameter	Activity Data
Dozers clearing access roads to Borehole 9 and 10 sites[1] Dozers clearing Borehole 9 and 10 drill pad sites	2 operating for 10 hours/day
Graders operating on access roads	1 trip/day
Trucks used to move material	5 trips/day
Material handling rate (excavator)	100 tonne/hour
Wind erosion	4 ha active in total (roads and borehole compounds)

[1]It is understood that concurrent operation of 2 dozers at each access road is unlikely. However to predict the worst case impact concurrent operation of two dozers at each site was used in estimating potential particulate emissions.

For the purpose of developing the emission inventories, the following assumptions have also been applied.

- 3% silt content for all material handled; and
- 4% moisture content for all material handled.

No appropriate emission factor exists for drilling of boreholes or sinking of ventilation shafts within either the NPI or AP 42 documentation. To provide an approximation of these activities, an assumption has been made that the NPI emission factor for blast hole drilling is appropriate. A rate of drilling of 5 holes per hour is considered to be appropriate to provide an estimation of borehole and ventilation shaft borehole during the construction phase of the Project.

Note that construction activities have been assumed to run concurrently with Springvale pit top operations. It is also acknowledged that the construction of the dewatering boreholes may take up to 120 days, however for the purposes of estimating the maximum 24-hour average particulate concentrations, construction has been assumed to occur for all days of the year.

5.2.2 Operation

The fugitive particulate emissions from SMEP operation were estimated based on emission estimation techniques listed in the NPI EET Manual for Mining, v 3.1 (DEH, 2012) and USEPA AP-42 emission factors. In the absence of any site-specific monitoring data, measured data from the nearby Angus Place Colliery ventilation shaft was used to estimate the potential particulate emissions from the upcast ventilation shaft at Springvale. Given that coal is extracted from the Lithgow seam from both Springvale and Angus Place Collieries, it is considered appropriate to use the same emissions data for the ventilation fan at Springvale.

A monitoring campaign was performed at the existing Angus Place vent shaft on 5 February 2013 and data relevant to this assessment is provided in **Table 9**.

Table 9 Emission Parameters – Upcast Ventilation Shaft

Parameter	Unit	Measured Value
Temperature	°C	25.4
Velocity	m/s	12.1
Volumetric Flow	Nm^3/s	221.06
Moisture	%	1.6
Oxygen	%	20.7
Total Solid Particulates	mg/Nm^3	0.6
PM_{10}	mg/Nm^3	<0.04
$PM_{2.5}$	mg/Nm^3	0.03

Note: Data used for both existing upcast and proposed APC-VS2 upcast
Note: A different method was used for $PM_{2.5}$ analysis than for PM_{10} and TSP analysis. The limit of reporting (LOR) for the $PM_{2.5}$ analysis method is lower than for the PM_{10} method, A value at the LOR for PM_{10} has been used in the assessment.

The activity data used in the emission estimation calculations are summarised in **Table 10**. For the purpose of developing the emission inventories, the following assumptions have also been applied.

- 6% silt content for coal in stockpile (SLR, 2012);
- 10% moisture content for coal in stockpile (SLR, 2012);
- Heavy vehicle frequency on the on-site unsealed road is two trips per hour;
- Crushing operation is enclosed;

- Ventilation rate at the upcast ventilation shaft is similar to the existing upcast ventilation shaft at Angus Place Colliery; and
- Potential dust emissions from borehole construction activities are minimal and unlikely to have any significant impact at surrounding residential receptors.

Table 10 Summary of Activity Data used to Estimate Particulate Emissions - Operation

Parameter	Activity Data
Coal throughput	4.5 Mtpa
Dozer operation	24 hours per day
Average number of heavy vehicle traffic on unsealed road	2 trips per hour
Potential wind erosion area	2.3 ha
Upcast ventilation fan ventilation rate	221.1 m^3/s

5.2.3 Rehabilitation

The fugitive particulate emissions from the Project Application Area rehabilitation were estimated based on emission estimation techniques listed in the NPI EET Manual for Mining, v 3.1 (DEH, 2012) and USEPA AP-42 emission factors.

The assumptions used in the construction of the rehabilitation emissions inventory are summarised in **Table 11**.

Table 11 Summary of Activity Data used to Estimate Particulate Emissions - Construction

Parameter	Activity Data
Dozers clearing site and shaping material	5 operating for 10 hours/day
Graders operating on site	1 trip/day
Trucks used to move material	10 trips/day
Material handling rate (excavator)	100 tonne/hour
Wind erosion	2.3 ha active in total (pit top area)

For the purpose of developing the emission inventories, the following assumptions have also been applied.

- 3% silt content for all material handled; and
- 4% moisture content for all material handled.

Note that site rehabilitation is assumed to occur as a stand-alone activity. No mining will be in operation at the time of site rehabilitation

5.3 Emission Controls

Based on the information provided by Springvale Coal, the following emission control techniques employed on site have been incorporated into the emission estimation. No particular design measures can be incorporated into the Project to avoid impacts associated with particulate emissions. The measures detailed below are generally management measures.

5.3.1 Construction

Although a range of best practice measures will be implemented during the construction of the dewatering and ventilation shaft boreholes and associated infrastructure, no such controls have been assumed in the generation of the construction emissions inventory. In this way, a conservative estimation of air quality impacts on surrounding sensitive receivers can be determined.

5.3.2 Operation

Coal Conveying Transfer Points

There are four coal transfer points at Springvale that have been considered within this assessment. These include:

- the conveyor exiting the drift;
- unloading from the conveyor onto the ROM stockpile;
- transfer of ROM coal from the conveyor into the screen/primary crusher; and
- transfer of crushed material onto the conveyor to Wallerawang Power Station, Springvale Coal Services Site and Mount Piper Power Station.

The transfer points are enclosed on three sides. It has been estimated that this will reduce the particulate emissions by 40% (Table 96, Katestone 2011).

The above controls will continue to be in operation throughout the Project.

Crushing

The crusher operation is enclosed. It has been estimated that this will reduce the particulate emissions by 70% (Table 4, DSEWPC 2012). These controls will continue to be in operation throughout the Project.

Wind Erosion

Water sprays are used to suppress emissions of dust from coal stockpiles. It has been estimated that this will reduce the particulate emissions by 50% (Table 72, Katestone 2011). These controls will continue to be in operation throughout the Project.

5.3.3 Rehabilitation

As for the construction scenario, although a range of best practice measures will be implemented during the rehabilitation of the Project Application Area, no such controls have been assumed in the generation of the rehabilitation emissions inventory. In this way, a conservative estimation of air quality impacts on surrounding sensitive receivers can be determined.

5.4 Emission Estimation Techniques

The emission factors used for the estimation of TSP and PM_{10} emissions from the Project Application Area are presented overleaf in **Table 12**.

The National Pollutant Inventory Manual for Mining, Version 3.1 (DSEWPC, 2012) and US EPA AP-42 Compilation of Emission Factors contain emission factors for TSP and PM_{10}. $PM_{2.5}$ emission factors are provided for some activities, however no $PM_{2.5}$ emission factors are provided for wind erosion within the NPI or US EPA AP-42. Some research has been conducted by the Midwest Research Institute (MRI) on behalf of the Western Regional Air Partnership (WRAP) with findings published within the document entitled *'Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors'* (MRI, 2006). This document provides a proposed $PM_{2.5}/PM_{10}$ ratio of 0.15 for wind erosion sources. This ratio was used within this assessment to calculate the emissions of $PM_{2.5}$ attributable to wind erosion at the Project Application Area.

Table 12 Summary of Emission Factors Used to Estimate Emissions

Activity	Emission Factor Equation	Units	Source	Variables	Controls Applied
Dozers on coal	$EF_{TSP} = 35.6 \times \frac{(s)^{1.2}}{M^{1.4}}$ $EF_{PM_{10}} = 0.75 \times 8.44 \times \frac{(s)^{1.5}}{M^{1.4}}$ $EF_{PM2.5} = 0.022 \times 35.6 \times \frac{(s)^{1.2}}{M^{1.3}}$	kg/h/vehicle	AP42	M = moisture content (%) s = silt content (%)	No Control
Dozers on overburden (representing land clearance, material movement during construction and rehabilitation)	$EF_{TSP} = 2.6 \times \frac{(s)^{1.2}}{M^{1.3}}$ $EF_{PM_{10}} = 0.75 \times 0.45 \times \frac{(s)^{1.5}}{M^{1.4}}$ $EF_{PM2.5} = 0.105 \times 2.6 \times \frac{(s)^{1.2}}{M^{1.3}}$	kg/h/vehicle	AP42	M = moisture content (%) s = silt content (%)	No Control
Miscellaneous Transfer Points and Excavator	$EF = k \times 0.0016 \times \frac{\frac{U}{2.2}^{1.3}}{\frac{M}{2}^{1.4}}$	kg/t	AP42	k = 0.74 (TSP) k = 0.35 (PM_{10}) k = 0.053 ($PM_{2.5}$) U = mean wind speed (m/s) M = moisture content (%)	Enclosed on three sides– 40%
Primary Crusher	$EF_{TSP} = 0.01$ $EF_{PM10} = 0.004$ $EF_{PM2.5} = 0.0004$	kg/t	NPI EETM v3.1	Assumed $PM_{2.5}/PM_{10}$ ratio of 0.1	Enclosed – 70%
Wheel generated dust from unpaved roads (used by light duty vehicles)	$EF = \frac{0.4536}{1.6093} * k \times \left(\frac{s}{12}\right)^{a} \times \left(\frac{W}{3}\right)^{b}$	kg/VKT	NPI EETM v3.1	k = 4.9 (TSP) k = 1.5 (PM_{10}) k = 0.15 ($PM_{2.5}$) a = 0.7, b = 0.45 (TSP) a = 0.9, b = 0.45 (PM_{10}) S = mean wind speed (m/s) M = moisture content (%) s = silt content (%)	Level 2 Watering – 50% control for construction and rehabilitation. No control for operation

Activity	Emission Factor Equation	Units	Source	Variables	Controls Applied
Grading	$EF_{TSP} = 0.0034 \times (s)^{2.5}$ $EF_{PM10} = 0.0056 \times 0.6 \times (s)^{2.0}$ $EF_{PM10} = 0.031 \times EF_{TSP}$	Kg/VKT	AP42	s = silt content (%)	No Control
Drilling	$EF_{TSP} = 0.59$ $EF_{PM10} = 0.23$ $EF_{PM2.5} = 0.03$	Kg/VKT	AP42		No Control
Wind Erosion	$EF_{TSP} = 0.4$ $EF_{PM10} = 0.2$ $EF_{PM2.5} = 0.03$	kg/ha/yr	NPI EETM v3.1	Assumed $PM_{2.5}/PM_{10}$ ratio of 0.15	Water Sprays – 50%

5.5 Emission Inventory

Based on the information presented above, a particulate emissions inventory has been compiled for the proposed Project construction (**Table 13**), operation (**Table 14**) and site rehabilitation (**Table 15**). Details of the emission calculations and emission factors used in estimating emissions are presented in **Appendix B**. Note that the SMEP construction and operation are assumed to occur concurrently.

Table 13 Emission Inventory for the SMEP - Construction

Activity	Estimated Emissions (kg/annum)		
	TSP	PM_{10}	$PM_{2.5}$
Dozers on access roads	17,549	2,757	1,843
Grader on access roads	97	69	3
Trucks on access roads	33,875	3,930	393
Dozers clearing borehole sites	17,549	2,757	1,843
Excavator at borehole sites	1,461	691	105
Drilling of boreholes	32,303	12,624	526
Wind erosion from exposed areas	14,016	7,008	526
Total Particulate Emissions	**109,842**	**26,332**	**4,670**

Table 14 Emission Inventory for the SMEP - Operation

Activity	Estimated Emissions (kg/annum)		
	TSP	PM_{10}	$PM_{2.5}$
Conveyor transfer points	2,996	1,417	215
Crushing	13,500	5,400	540
Dozers	134,935	32,444	2,952
Vehicle movements on unpaved roads	29,268	6,790	679
Wind erosion from exposed areas	4,030	2,015	302
Ventilation fan	4,183	279	209
Total Particulate Emissions	**188,912**	**48,345**	**4,897**

Table 15 Emission Inventory for the SMEP – Rehabilitation (Includes entire Project Application Area)

Activity	Estimated Emissions (kg/annum)		
	TSP	PM_{10}	$PM_{2.5}$
Dozers moving and shaping material	70,196	11,029	7,371
Grading of site	10	7	0
Haulage of material	3,388	786	79
Material handling	730.36	345.44	52.31
Wind erosion from exposed areas	8,059	4,030	604
Total Particulate Emissions	**82,383**	**16,197**	**8,106**

6 ATMOSPHERIC DISPERSION MODELLING

6.1 Model Selection

Emissions from the proposed operations have been modelled using the US EPA's CALPUFF (Version 6.267) modelling system. CALPUFF is a transport and dispersion model that ejects "puffs" of material emitted from modelled sources, simulating dispersion and transformation processes along the way. In doing so it typically uses the fields generated by a meteorological pre-processor CALMET, discussed further below. Temporal and spatial variations in the meteorological fields selected are explicitly incorporated in the resulting distribution of puffs throughout a simulation period. The primary output files from CALPUFF contain either hourly concentration or hourly deposition fluxes evaluated at selected receptor locations. The CALPOST post-processor is then used to process these files, producing tabulations that summarise results of the simulation for user-selected averaging periods.

The advantages of using CALPUFF (rather than using a steady state Gaussian dispersion model such as AUSPLUME) is its ability to handle calm wind speeds (<0.5 m/s) and the effects of complicated terrain on plume dispersion. Steady state models assume that meteorology is unchanged by topography over the modelling domain and may result in significant over or under estimation of air quality impacts. More advanced dispersion models (such as CALPUFF) are approved for use by many regulatory authorities in situations where these models may be more appropriate than use of the Ausplume model. Such situations include those noted above (i.e. high frequency of calm wind conditions and/or complicated terrain).

6.2 Meteorological Modelling Methodology

To adequately characterise the dispersion meteorology of the Project Application Area, information is needed on the prevailing wind regime, ambient temperature, rainfall, relative humidity, mixing depth and atmospheric stability. The meteorology of the Project Application Area was characterised based on a 3-dimensional prognostic meteorological dataset for the region surrounding the Project Application Area.

6.2.1 MM5

The three dimensional prognostic dataset generated by the Pennsylvania State University/National Centre for Atmospheric Research, or MM5, model was created and assimilated in the CALMET modelling process. The MM5 model is a prognostic mesoscale wind field model with four-dimensional data assimilation. CALMET's wind model allows MM5 generated data to be used as initial pseudo-observations (Scire *et al.*, 2006).

For this study, an MM5 meteorological dataset was obtained for a 120 km x 120 km domain for the 2009 and 2010 calendar years, centred over the Project Application Area, with a spatial grid resolution of 12 km. The model has 40 vertical levels, with the lowest level beginning at 11 m above ground level ranging to 3,500 m. The MM5 dataset contains the two-dimensional and three-dimensional parameters listed in **Table 16**.

Table 16 MM5 Dataset Parameters

Hourly 3-Dimensional Parameters	Hourly 2-Dimensional Parameters
Wind speed and direction	Sea-level pressure
Temperature	Rainfall amount
Pressure	Snow cover
Geopotential height	Short wave and long wave radiation at the surface
Vertical velocity	Air temperature and specific humidity at 2m
Relative humidity	Wind speed and direction at 10m
Mixing ratios for water vapour, cloud water, rain and other precipitation	Sea surface temperature

6.2.2 CALMET

CALMET is a meteorological model that develops wind and temperature fields on a three-dimensional gridded modelling domain. Associated two-dimensional fields such as mixing height, surface characteristics, and dispersion properties are also included in the file produced by CALMET. The interpolated wind field is then modified within the model to account for the influences of topography, as well as differential heating and surface roughness associated with different land uses across the modelling domain. These modifications are applied to the winds at each grid point to develop a final wind field. The final wind field thus reflects the influences of local topography and land uses.

The MM5 data generated by the Pennsylvania State University/National Centre for Atmospheric Research was used for input into CALMET. The CALMET model was run for both the 2009 and 2010 calendar years. **Table 17** details the parameters used in the meteorological modelling. No surface, upper air or buoy observations were used in the CALMET model ('No-Obs Mode' hereafter). This approach is recommended by NSW EPA (2010) as:

- No-Obs mode allows the important benefits of the non-steady-state approach in CALPUFF to be included in the dispersion modelling (e.g., spatially varying meteorology and dispersion, causality, recirculation, stagnation, pollutant build-up, fumigation, etc.);
- No-Obs mode makes use of three-dimensional, hourly prognostic meteorological data often available at high resolution to drive CALMET and CALPUFF;
- No-Obs mode greatly simplifies the preparation of the CALMET inputs because a large number of input variables dealing with observational data are not required and the difficulties of dealing with potentially incomplete observational datasets are eliminated;
- No-Obs mode provides a relatively straightforward approach that facilitates agency review and approval of the CALMET/CALPUFF simulations;

It was concluded from the meteorological analysis for the years 2009 and 2010, that there was no apparent trend in the meteorological parameters suggesting the suitability of one year over the other. Therefore the meteorological conditions in the most recent year of available data (2010) were used for CALPUFF dispersion modelling. The modelled data for year 2010 for Springvale Colliery are presented in the following sections. The data for 2009 and 2010 can be found in **Appendix C**.

Table 17 CALMET Configuration Used for this Study

Meteorological grid domain	40 km x 40 km
Meteorological grid resolution	0.2 km
Vertical Resolution (Cell Heights)	10 (0 m, 20 m, 40 m, 80 m, 160 m, 320 m, 640 m, 1,200 m, 2,000 m, 3,000 m and 4,000m)
Modelling Year	2010
Initial guess field	3D output from MM5 data

6.3 Meteorological Data Used in Modelling

6.3.1 Wind Speed and Direction

A summary of the annual wind behaviour predicted by CALMET for the site is presented as windroses in **Figure 4**. The frequency of wind speed variation is presented in **Figure 5**.

Figure 4 Wind Roses for the Project Site, as Predicted by CALMET (2010)

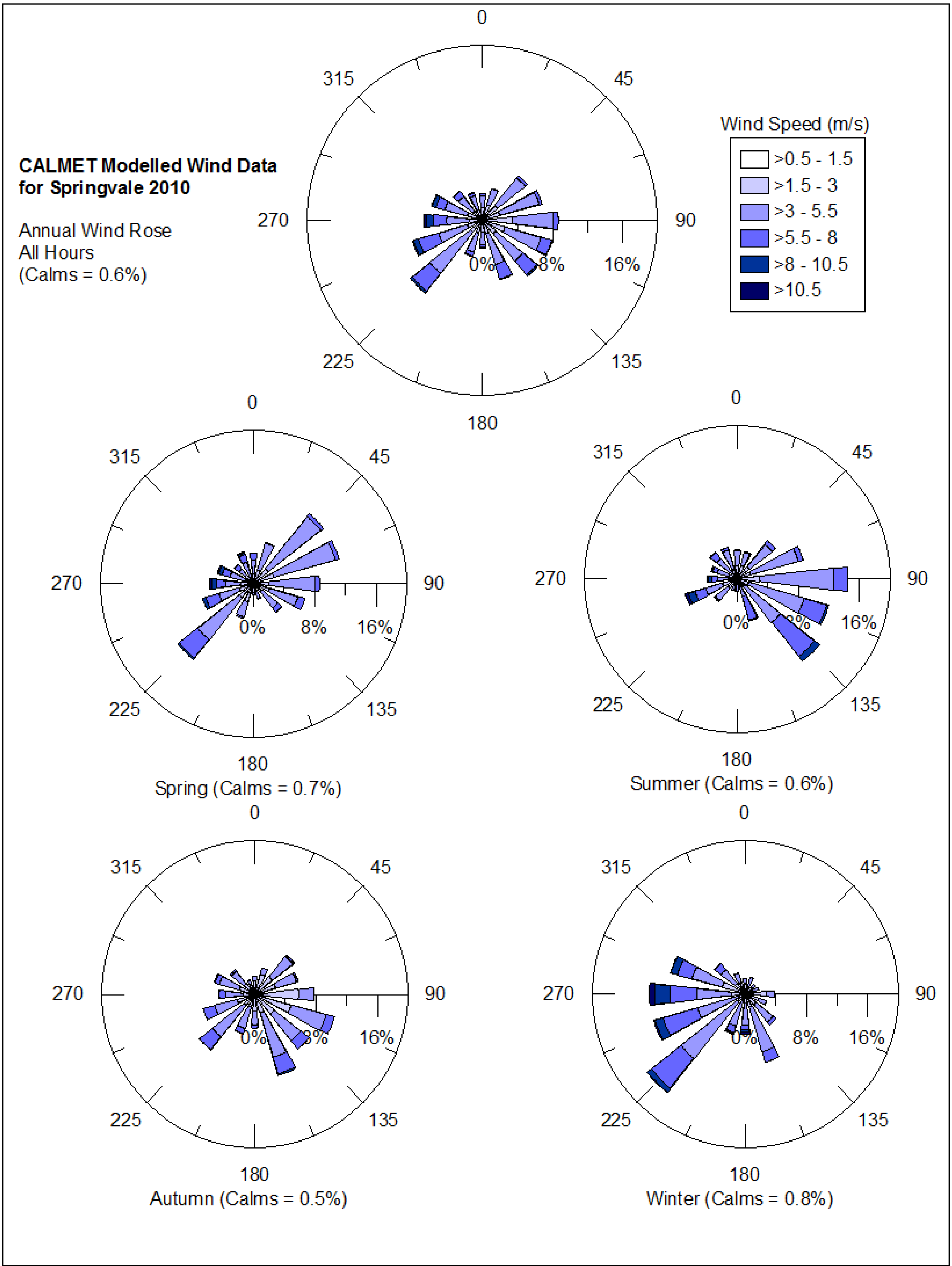


Figure 5 Wind Speed Distribution Predicted by CALMET for the Project Application Area (2010)

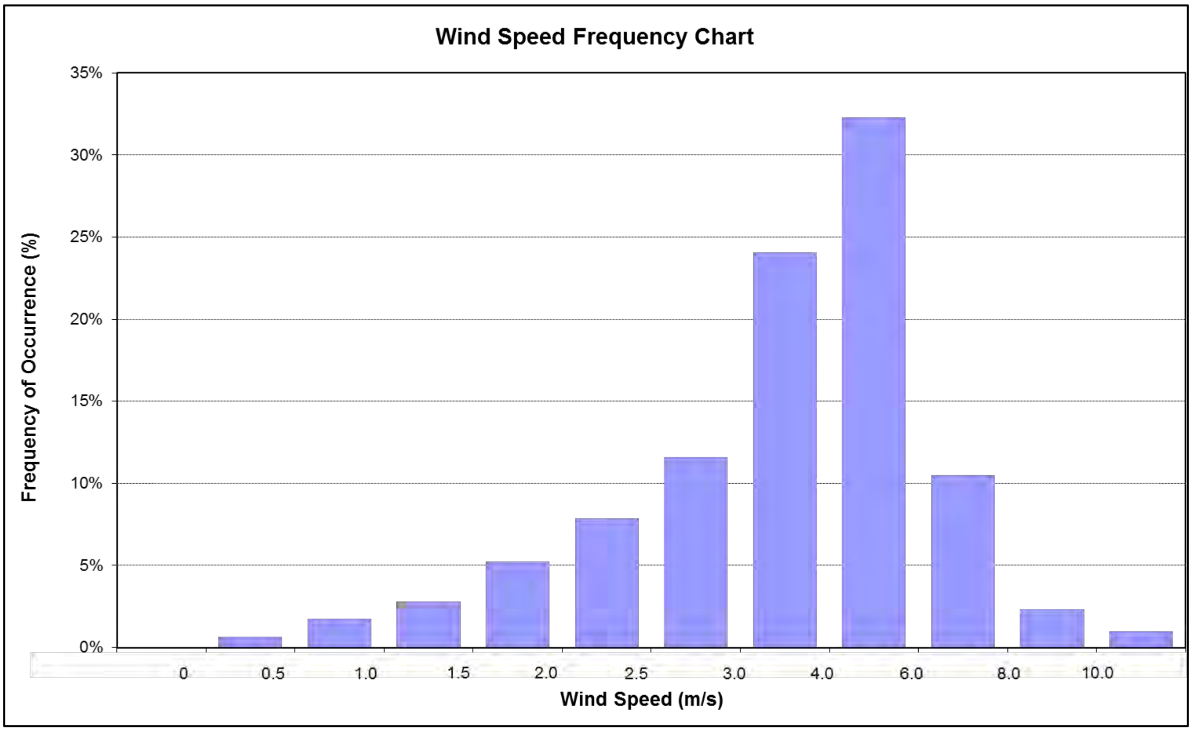


Figure 4 and **Figure 5** indicate that the site experienced predominantly light to moderate winds (between 1.5 m/s and 8 m/s), with the prevailing wind direction from the southwest and southeast quadrants. Calm wind conditions (wind speed less than 0.5 m/s) were predicted to occur 0.6% of the year during 2010.

The seasonal wind roses indicate that:

- In spring, winds are light to moderate (1.5 m/s to 8 m/s) from the southwest and the north-eastern quadrant.
- In summer, the winds are light to high (1.5 m/s to 10.5 m/s) from the southeastern quadrant.
- In autumn, winds are light to moderate from the southeastern quadrant.
- In winter, winds are light to high and are predominantly from the southwest.

6.3.2 Atmospheric Stability

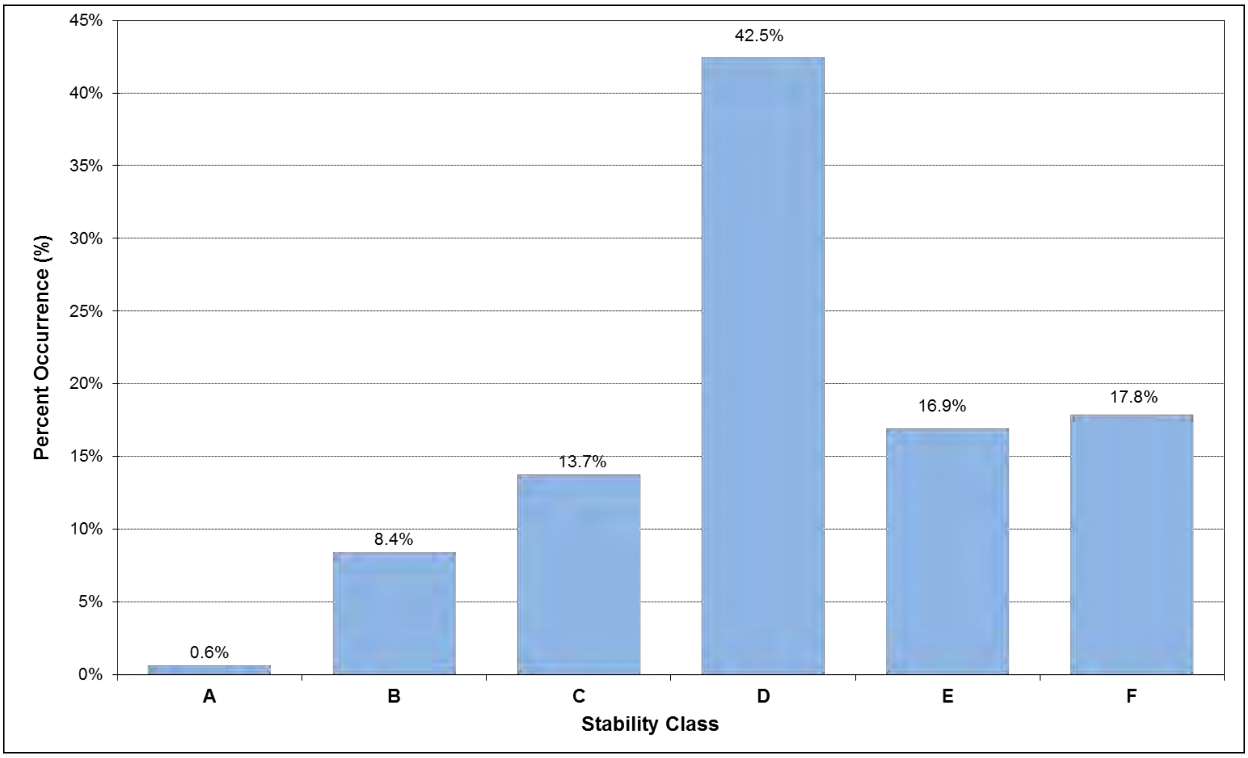
Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Turner assignment scheme identifies six Stability Classes, A to F, to categorise the degree of atmospheric stability (see **Table 18**). These classes indicate the characteristics of the prevailing meteorological conditions and are used as input into various air dispersion models.

The frequency of each stability class predicted by CALMET is presented in **Figure 6**. The results indicate a high frequency of conditions typical to Stability Class D. Stability Class D is indicative of neutral conditions, conducive to a moderate level of pollutant dispersion due to mechanical mixing.

Table 18 Description of Atmospheric Stability Classes

Atmospheric Stability Class	Category Description
A	Very unstable, low wind, clear skies, hot daytime conditions
B	Unstable, clear skies, daytime conditions
C	Moderately unstable, moderate wind, slightly overcast daytime conditions
D	Neutral, high winds or cloudy days and nights
E	Stable, moderate wind, slightly overcast night-time conditions
F	Very stable, low winds, clear skies, cold night-time conditions

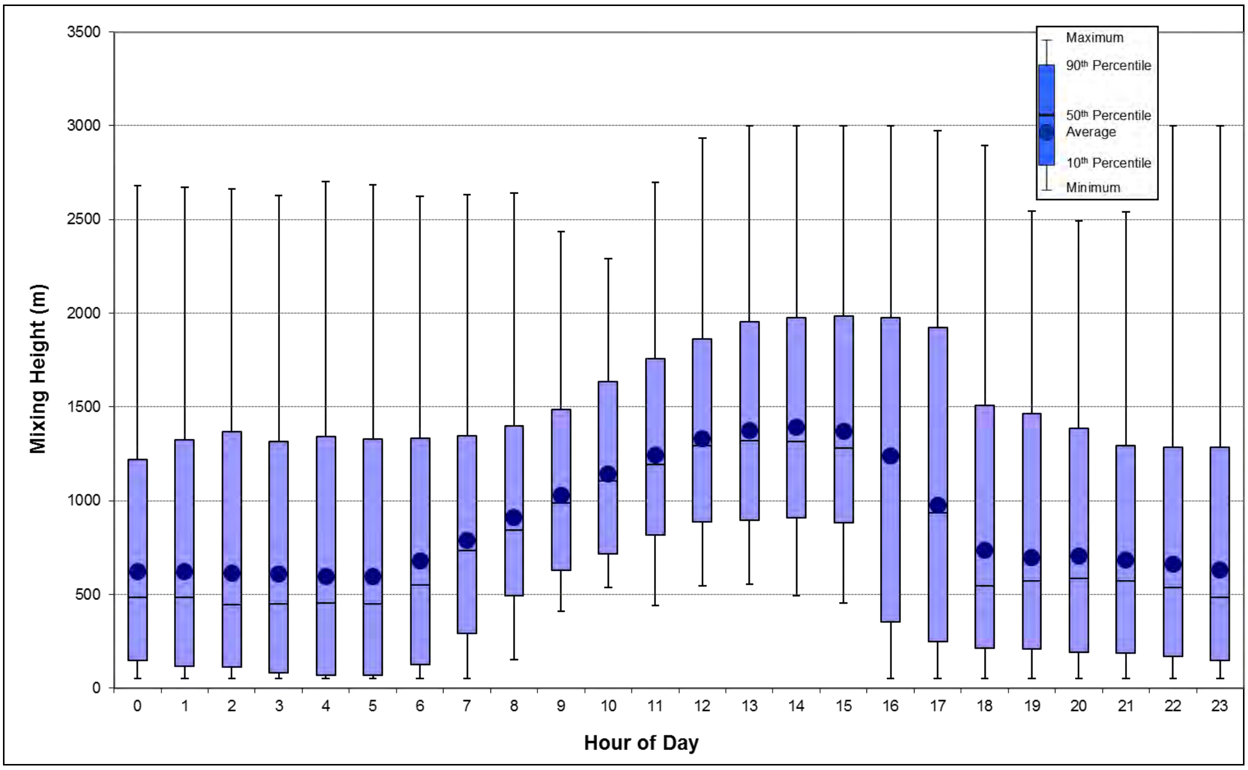
Figure 6 Stability Class Distribution Predicted by CALMET for the Project Application Area (2010)



6.3.3 Mixing Heights

Diurnal variations in maximum and average mixing depths predicted by CALMET at the Project Application Area during 2010 are illustrated in **Figure 7**. As would be expected, an increase in the mixing depth during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground-based temperature inversions and the growth of the convective mixing layer.

Figure 7 Mixing Heights Predicted by CALMET for the Project Application Area (2010)



6.4 Modelling of Wind Erosion Emissions

An hourly-variable emission file was developed for the wind erosion sources from the total estimated annual emissions using a relationship between the cube of the hourly averaged wind speeds and sum of the hourly cubic wind speeds contained in the meteorological file. This cubic relationship provides a more realistic distribution of emissions with the peak emissions being modelled during high wind speed events and lower emissions being modelled during lower wind speed events.

7 EXISTING BACKGROUND PARTICULATE LEVELS

The main focus of this report is the assessment of the potential impacts of the SMEP on the closest sensitive receptors to the pit top and the existing and proposed infrastructure on Newnes Plateau. In this case, these sensitive receptors include nine residences, identified in **Section 4**. The purpose of assessing background air quality is to determine the concentrations of air pollutants currently experienced at these residences, with the predicted concentrations from the SMEP operation added to these background concentrations to identify the likely future air quality impacts. It is therefore important to gain an understanding of current background air quality at these residential locations.

The air quality in the region surrounding Springvale is influenced by emissions generated by a range of sources, originating from both within and outside of the local area. Specifically, air quality will be influenced by traffic-generated pollution (e.g. motorised recreational vehicles travelling in the Newnes State Forest), emissions from power stations and associated ash dams in the area, other coal mining operations, pollution transported into the area from more distant sources and pollution generated by the Project itself.

To determine the incremental impact of particulate emissions from the Project on the surrounding environment and sensitive receptors, a dispersion modelling exercise has been performed, as detailed in **Section 5** and **Section 6**. To appropriately assess the *cumulative* impact of the Project, this incremental impact needs to be added to a dataset which includes the influences of all other sources of particulate in the region, and is representative of the air quality likely to be experienced at sensitive receptor locations without the impact of the Project.

As required by the Approved Methods, this background dataset is required to be contemporaneous with the meteorological data used within the assessment, and (for PM_{10}) include daily measurements. Given the limited availability of datasets in the area which meet both of these criteria, data from Bathurst has been selected for use within the assessment where appropriate, with justification for its use detailed below.

7.1 Suspended Particulate Matter

TSP and PM_{10}

On-site ambient TSP and PM_{10} monitoring has been performed at Springvale since December 2010. The ambient air quality monitoring program has been incorporated into a wider environmental monitoring campaign, and includes PM_{10} and TSP measurements using two co-located High Volume Air Samplers (HVAS, refer **Figure 8**). The monitoring is undertaken in accordance with AS3580.9.3:2003 and AS3580.9.6:2003 for TSP and PM_{10}, respectively.

The measured 24-hour average PM_{10} and TSP concentrations are presented graphically in **Figure 9**, while the annual average TSP and PM_{10} concentrations recorded during 2011 are summarised in **Table 19**.

Of note, the ratio of mean TSP to PM_{10} measurements in 2010 is of the order of 2.5 to 1. This ratio is the same as that measured at the nearby Angus Place Colliery which indicates that the mining operations occurring at both sites results in the same ratio of TSP/PM_{10} emissions Also, it is noted that the monitored TSP and PM_{10} concentrations at Springvale HVAS includes contributions from existing activities at Springvale as well as other industrial facilities in the region.

The monitoring data was measured on a 1-in-6-day cycle and is also collected during a different year to the meteorological data used in this study, and therefore is not suitable for use in a contemporaneous cumulative impact analysis.

Figure 8 Location of the HVAS and Dust Deposition Gauges at Springvale Colliery

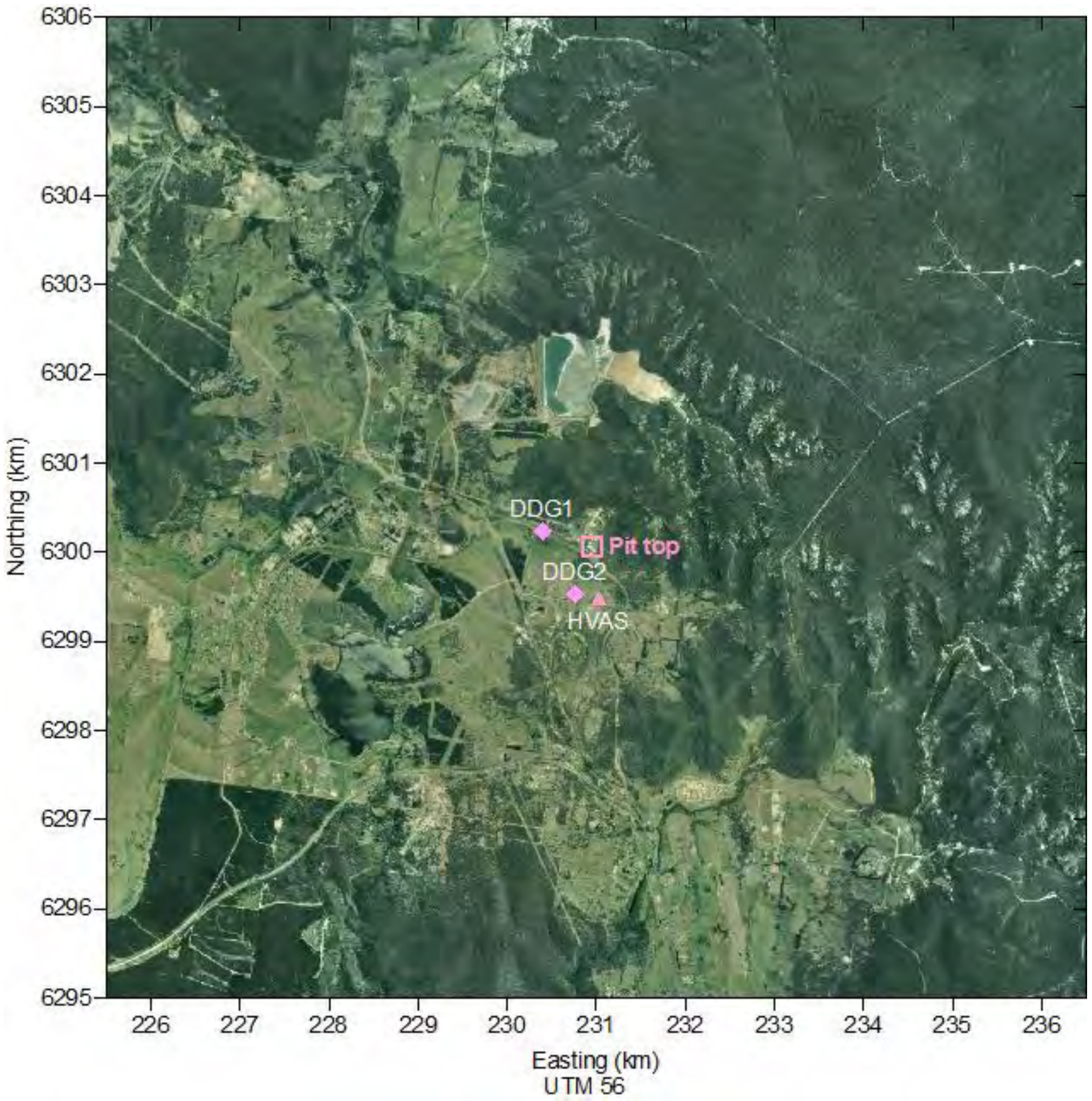


Figure 9 24-Hour Average TSP and PM_{10} Concentrations Measured by the Springvale HVAS

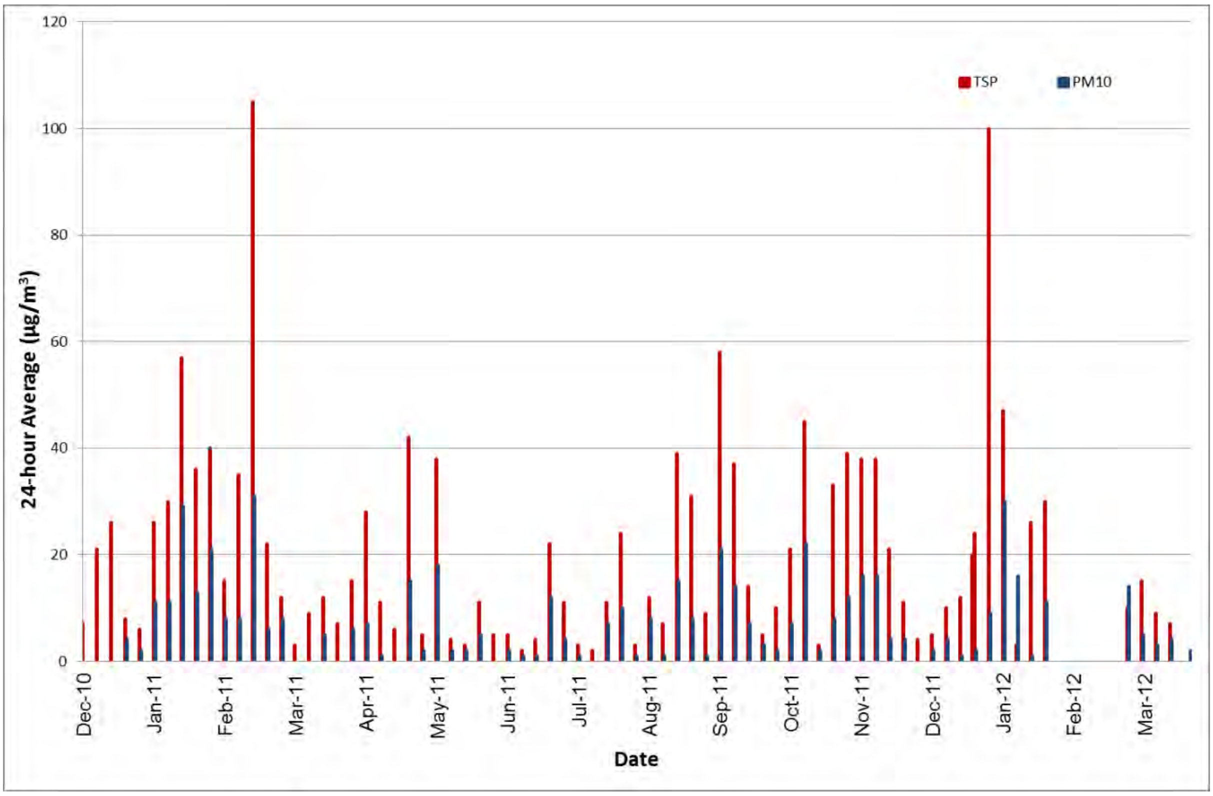


Table 19 Springvale HVAS 2011 Annual Average Particulate Concentrations

Particulate Size	2011 Annual Average (µg/m^3)
TSP	19.7
PM_{10}	8.2

The nearest OEH monitoring station measuring continuous PM_{10} concentrations is located in Bathurst, approximately 50 km northwest of the Project Application Area. It is recognised that local dust-generating activities surrounding the SMEP and Bathurst are significantly different. Mining, coal processing activities and Wallerawang Power Station are the key local potential suspended particulate sources in the area surrounding Springvale. Residential activities (such as lawn mowing, wood heaters) and vehicle emissions are the likely local sources of suspended particulate in the Bathurst area. Since the intensity and type of potential dust generating activities at Bathurst and the area surrounding Springvale are different, a further investigation was carried out to justify the use of ambient monitoring data recorded at OEH operated Bathurst monitoring site in this assessment.

Since ambient monitoring data at Springvale HVAS are not available for 2010 calendar year, data from the Angus Place HVAS (located approximately 5 km north of SMEP) are also included in this study for investigation purposes. **Figure 10** and **Figure 11** present comparisons of the 24-hour average PM_{10} concentrations measured at Bathurst, Springvale HVAS and Angus Place HVAS. It is noted that the monitoring data at Springvale HVAS includes the contribution from the existing operations at Springvale.

It can be observed from **Figure 10** and **Figure 11** that measured data at Springvale Colliery is consistently lower than that measured at the Bathurst monitoring station. It is difficult to identify any trend between the two datasets but from examination of **Figure 12**, which shows a scatter plot of contemporaneous PM_{10} measurements at Springvale and Bathurst, the Bathurst data can be seen to provide a conservative approximation of the background air quality experienced at the Springvale Colliery and surrounding receptors.

Based on the comparison shown in **Figure 10** and **Figure 12**, the use of continuous ambient monitoring data from Bathurst for 2010 is concluded to be a conservative and appropriate approach for the assessment of potential cumulative impacts for the Springvale Colliery.

Figure 10 Comparison of Measured 24-Hour Average PM_{10} Concentrations – All days

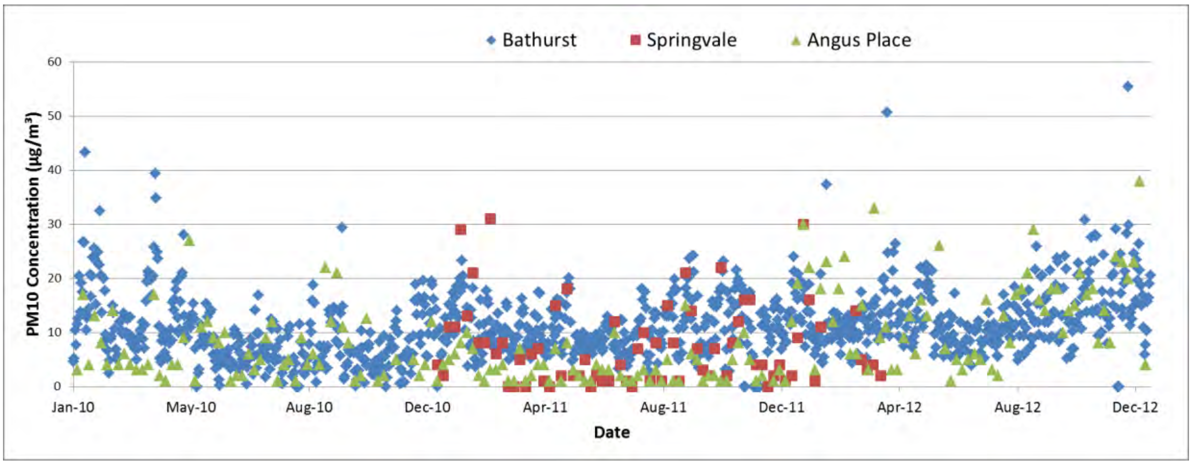


Figure 11 Comparison of Measured 24--Hour Average PM_{10} Concentrations – HVAS Sampling Days Only

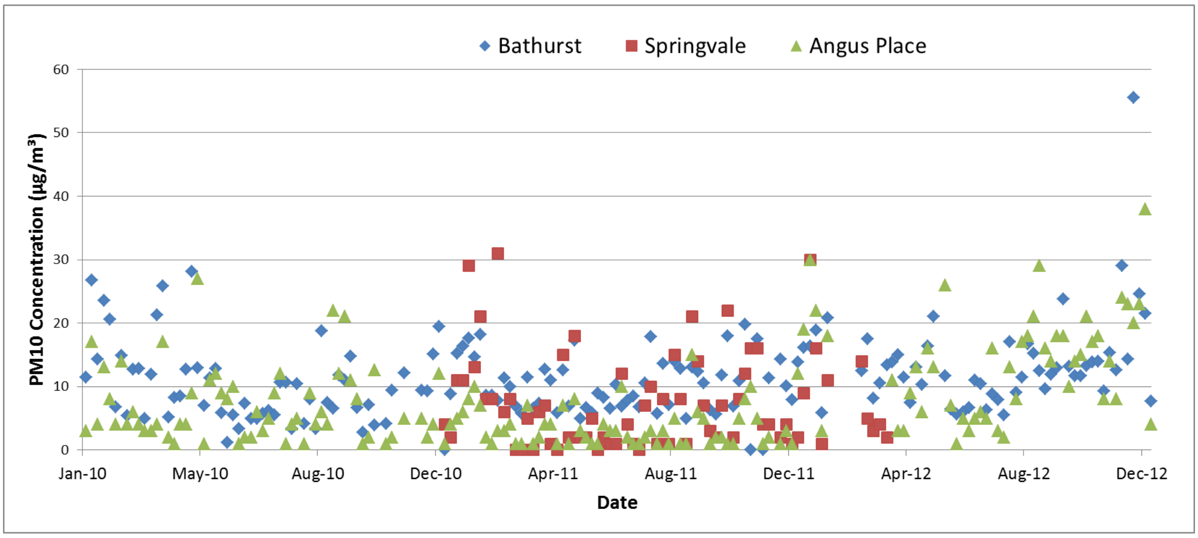
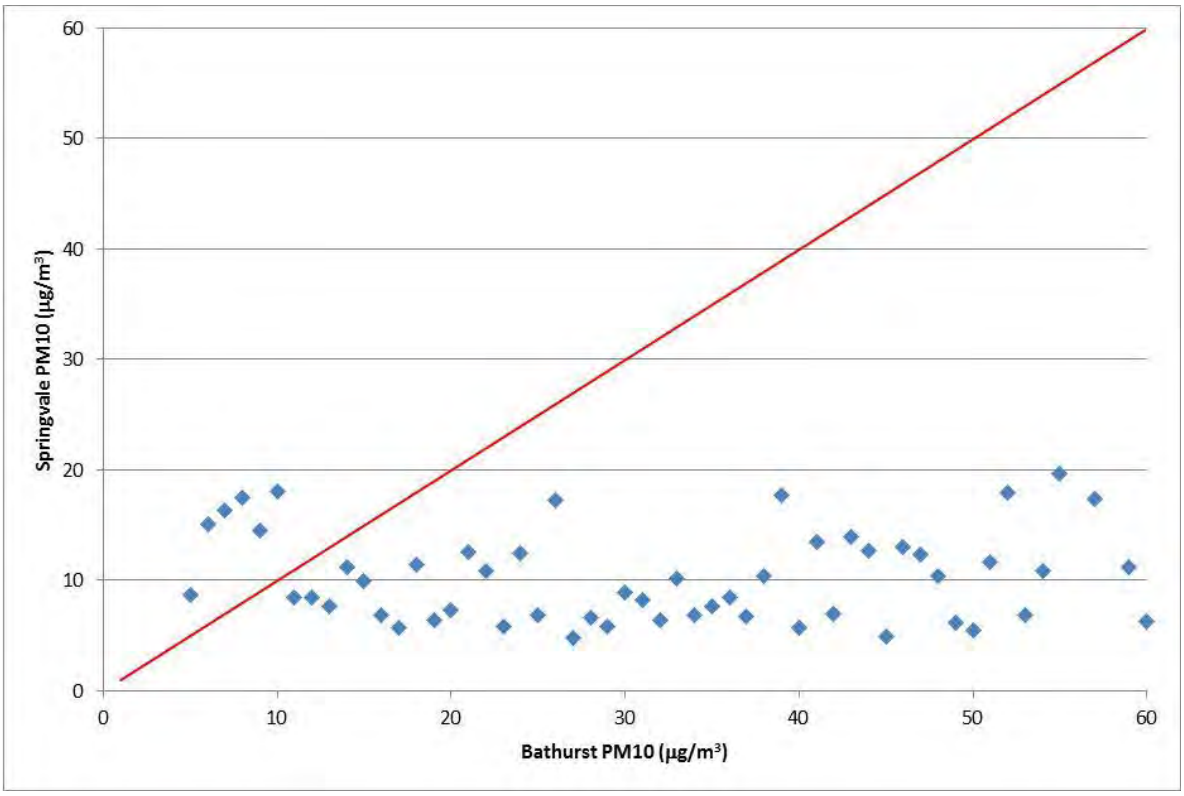


Figure 12 Bathurst PM_{10} versus Springvale PM_{10} data (2010 to 2012)



Note: Red line denotes 1:1 relationship

A summary of the 24-hour average PM_{10} concentrations measured by the Bathurst monitoring site is presented in **Table 20**. All data is presented as 24-hour average concentrations in µg/m^3, except averaging period (hours), monitoring start and end dates (dates), skew and kurtosis (dimensionless), and data capture (percentage of the monitoring period).

Table 20 indicates that the mean PM_{10} 24-hour concentrations for both 2010, 2011 and 2012 calendar years range between 9.5 µg/m^3 and 13.5 µg/m^3. The maximum PM_{10} 24-hour concentration for 2010 (43.3 µg/m^3) is significantly higher than 2011 (24.3 µg/m^3) but approximately 12 µg/m^3 lower than for 2012.

Table 20 Statistical Summary of Measured 24-Hour Average PM_{10} Concentration at Bathurst

Statistic				
Averaging period		24 hours	24 hours	24 hours
Monitoring data start		01-01-2010	01-01-2011	01-01-2012
Monitoring data end		31-12-2010	31/12/2011	31-12-2012
Data points		357	355	364
Mean		9.5	11.0	13.4
Standard deviation		6.5	4.4	6.3
Skew[1]		1.6	0.6	2.0
Kurtosis[2]		3.8	-0.2	8.5
Minimum		0.1	2.8	3.9
Percentiles	1	0.5	3.4	4.7
	2	0.7	3.8	5.2
	3	1.3	4.5	5.5
	5	1.9	5.2	5.8
	10	3.1	5.9	6.8
	25	5.0	7.8	9.2
	50	8.0	10.3	12.2
	75	12.5	13.8	16.3
	90	18.3	17.5	21.3
	95	21.1	18.6	24.1
	97	24.8	20.0	26.4
	98	26.5	21.0	27.9
	99	30.8	22.3	30.2
Maximum		43.3	24.3	55.5
Data Capture		98%	97%	99%

Notes 1 Skew represents an expression of the distribution of measured values around the derived mean. Positive skew represents a distribution tending towards values higher than the mean, and negative skew represents a distribution tending towards values lower than the mean. Skew is dimensionless.

2 Kurtosis represents an expression of the value of measured values in relation to a normal distribution. Positive skew represents a more pointed distribution, and negative skew represents a distribution more flattened than a normal distribution. Kurtosis is dimensionless.

$PM_{2.5}$

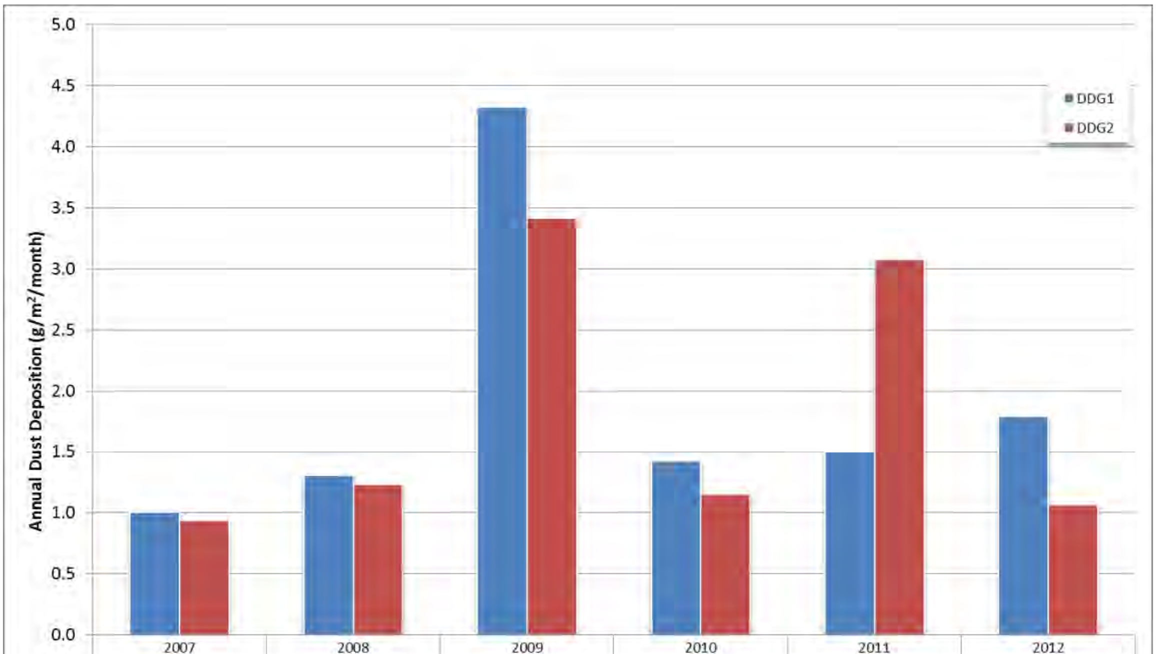
No ambient background monitoring data for $PM_{2.5}$ are available in the local area or at nearest OEH monitoring sites. Therefore a background $PM_{2.5}$ dataset cannot be used within this assessment and comparison of the incremental concentrations to the criteria has been performed.

7.2 Deposited Dust

Static dust monitoring commenced in January 2007 at two monitoring locations (DDG1 and DDG2) surrounding the Project Application Area. The locations of the two dust deposition gauges are shown in **Figure 8**.

Monitoring results for dust deposition are presented in **Figure 13** for the years 2007 to 2011. All dust deposition results met the assessment criterion of 4 g/m^2/month with the exception of 2009. Monthly dust deposition results were shown to be elevated in September 2009 (between 10 g/m^2/month and 28 g/m^2/month) and October 2009 (between 7 g/m^2/month and 10 g/m^2/month) due to several dust storms experienced at the end of September 2009.

Figure 13 Monitoring Results for Dust Deposition – Springvale Mine



	2007	2008	2009	2010	2011	2012
DDG1	1.0	1.3	4.3	1.4	1.5	1.8
DDG2	0.9	1.2	3.4	1.2	3.1	1.1

7.3 Assessment of Cumulative Impacts

A number of other industrial facilities located in the vicinity of Springvale Colliery may contribute to the cumulative impacts on the local airshed. The identified industrial facilities which are likely to have a cumulative impact on the local airshed are identified in **Table 21**.

Table 21 Identified Industrial Facilities in the Vicinity of the Springvale Mine

Industrial Facility	Location (Figure 14)	Impact Assessment
Springvale Pit Top	A	**Section 8**
Springvale Coal Services, north of Blackmans Flat	B	**Section 7.3.1**
Mount Piper Power Station (Mt Piper A)	C1	**Section 7.3**
New Base Load Power Station (Mt Piper B)	C2	**Section 7.3**
Western rail coal unloader	C3	**Section 7.3.2**
Wallerawang Power Station (WPS)	D	**Section 7.3**
Angus Place Colliery	E	**Section 7.3.3**
Lidsdale Siding Coal Loading Facility (LSCLF)	F	**Section 7.3.4**
Pine Dale Coal Mine (Yarraboldy extension)	G	**Section 7.3.5**
Clarence Colliery	Not Shown	**Section 7.3.6**

The location of the Springvale Pit Top with respect to the location of other identified industrial facilities in its vicinity is shown in **Figure 14**.

It is noted that the Western rail coal unloader (C3) associated with Mount Piper Power Station was approved in June 2009 but construction is yet to start on this facility. Also included in this assessment is the Mount Piper Base Load power station which was approved in January 2010.

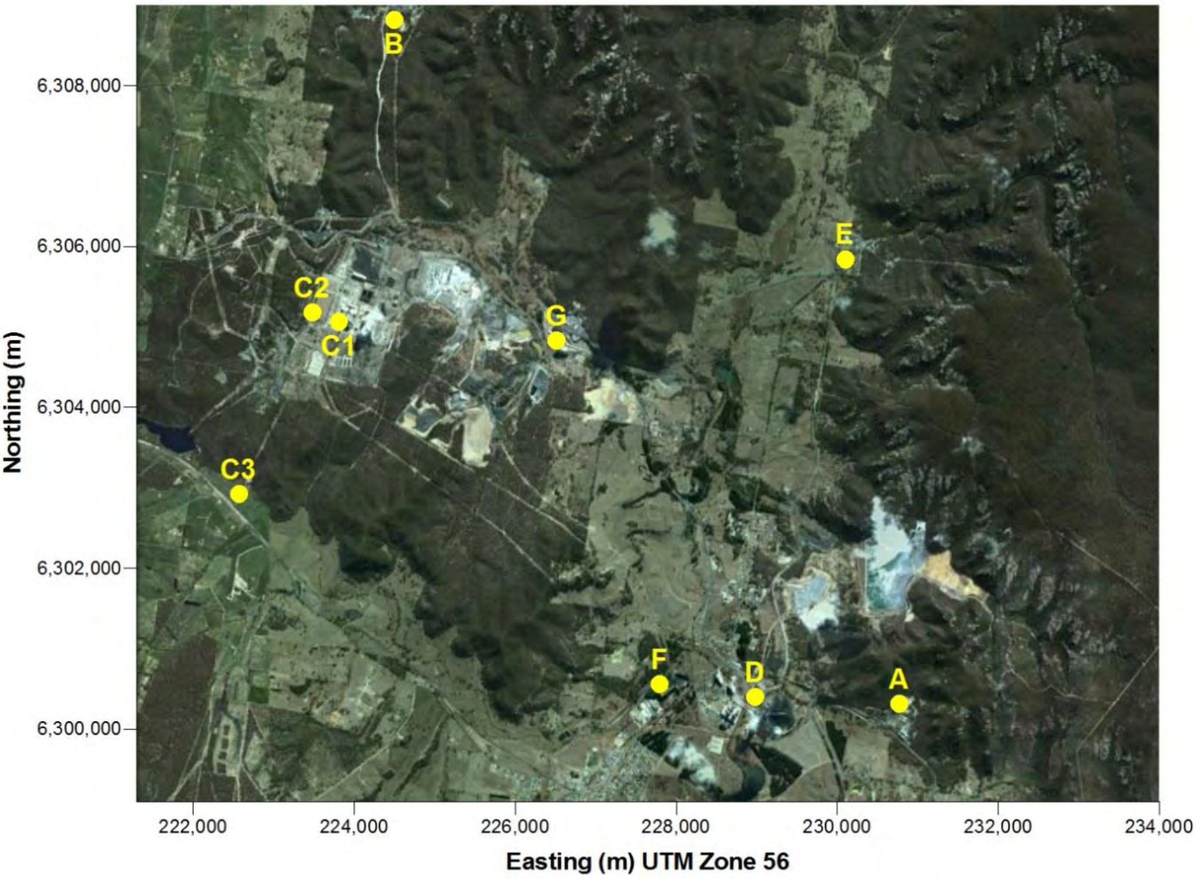
Given that the continuous particulate monitoring data obtained from the Bathurst OEH site is clearly shown in **Section 7.1** to be a conservative estimation of the actual particulate environment (as monitored) surrounding Springvale, it can be confidently considered that the following existing activities and projects located in the area surrounding the SMEP are taken into account within the AQIA.

- Wallerawang Power Station (coal-fired, 1,000 MW).
- Mount Piper Power Station (Mt Piper A).

The above also include associated infrastructure such as coal stockpiles and ash dams.

- Haul roads to Mount Piper and Wallerawang Power Stations.
- Existing Angus Place Colliery.
- Current Lidsdale Siding and Springvale Coal Services Site Operations.
- Clarence Colliery.
- Surrounding forestry activities and recreational activities (e.g. vehicles within the Newnes State Forest).

Figure 14 Location of Springvale Colliery and other Industrial Facilities



Given the conservatism in the adoption of the Bathurst particulate data it can also be considered that applications not approved, but advanced within the planning system may also be appropriately taken into account within the AQIA. Further discussion of each of the following projects is considered below:

- Wallerawang Power Station Development Application (024/11DA) for new storage silos.
- Mount Piper Power Station (Mt Piper B) approved in January 2010 and new rail coal unloader (new rail line of 5 km length and coal conveyor 4 km length) approved June 2009.
- Part 3A application for new ash placement areas at the existing Mount Piper Power Station.
- Part 3A application for an open cut mining extension to the Pine Dale Coal Mine (located near Blackmans Flat 17 km northwest of Lithgow).
- An approved (being constructed) new upcast ventilation shaft at Angus Place Colliery.
- Lidsdale Siding Upgrade Project – a Centennial project to improve rail loading facilities including a reclaim tunnel and train track extension, near Wallerawang.
- Centennial Western Coal Services Project – a Centennial project for a new washery, a private haul road (linking, via a bridge, the existing Angus Place to Mount Piper private haul road with the Springvale Coal Services Site), and new reject emplacement areas.

7.3.1 Springvale Coal Services

Springvale Coal Services is located to the immediate west of Springvale and processes and handles ROM coal from Springvale's operations. All processing operations within the Springvale Coal Services site are enclosed and it is not considered that cumulative impacts would occur between that operation and the Project Application Area, especially given the 10.5 km separation distance between these two operations.

7.3.2 Mount Piper Power Station Western Coal Unloader

The Western Coal Unloader (WCU) associated with the Mt Piper Power Station gained Project Approval in June 2009. The WCU is designed to enable the supply of coal by rail to the Power Station from a number of mines, mainly to the north of the Power Station (SKM, 2007). The WCU will be located approximately 2 km to the south of the Mt Piper Power Station and approximately 9 km northwest of the Project Application Area. The Environmental Assessment (SKM, 2007) for the WCU assessed the impact of particulate matter for the construction and operational scenarios.

It was concluded that during the operational scenario, maximum predicted 24-hour average incremental PM_{10} concentration at 'Receiver 1' was 9 µg/m^3 (SKM, 2007). The location of 'Receiver 1' is approximately 6 km from the Springvale Pit Top.

Given such low concentrations at these distances from the Springvale Pit Top, it is considered that the WCU will not have a cumulative impact on particulate concentrations associated with the Project. The WCU has therefore not been considered further within this report.

7.3.3 Angus Place Colliery

Angus Place Colliery is located approximately 6 km north of the Springvale Pit Top as shown in **Figure 14**. Angus Place Colliery is currently examining options to include seven additional bores to extract water in the longwall. These bores will include surface infrastructure, with air pollutant emissions being likely during bore pad construction over a short period. The assessment currently being performed examines particulate impacts during construction, operation and rehabilitation, and indicates predicted maximum incremental 24 hour PM_{10} concentrations during the Angus Place Mine Extension Project construction (and concurrent operation) of between 0.1 µg/m^3 and 6 µg/m^3 at locations which are approximately 5 km to the north of the Springvale Pit Top (refer **Figure 14**). At the closest receptor to the Springvale operations (1.9 km to the northwest of the Springvale pit top), maximum 24 hour average PM_{10} concentrations are approximately 0.3 µg/m^3.

Given the small predicted incremental impact from the Angus Place Colliery at locations close to the Springvale pit top, it has not been considered further within this report.

7.3.4 Lidsdale Siding

A dispersion modelling exercise has been performed by SLR Consulting (SLR 2012c) and the impacts from the upgraded Project operations were assessed at ten identified sensitive receptors in the vicinity of the Lidsdale Siding Coal Loading Facility (LSCLF). The maximum incremental (Project only) 24-hour average PM_{10} concentrations (17.1 µg/m^3) were predicted to occur at a receptor which is approximately 4 km to the west of the Springvale Colliery.

Further investigation of the potential cumulative impacts from this Project on the receptors closest to the Springvale pit top was performed during the AQIA for the *"Springvale Colliery Bore 8 Dewatering Facility Project"* (SLR 2012d). Predicted maximum 24 hour average PM_{10} concentrations from the operation of the LSCLF were 0.5 µg/m^3 at Receptor S2 (refer **Figure 3**).

Considering the small incremental concentration resulting from the proposed operation of the LSCLF at receptors surrounding the Project Application Area, it is considered that the background data from Bathurst (refer **Section 7.4**) will appropriately include such impacts. The operation of the LSCLF is not considered further within this assessment.

7.3.5 Pine Dale Coal Mine Stage 2 Extension Project

The Pine Dale Coal Mine is located approximately 5 km northwest of the Springvale pit top operations. The Pine Dale Yarraboldy Extension has been approved and is currently operational. Planning is currently underway for the Pine Dale Stage 2 Extension Project, although no detailed air quality modelling has been performed for this proposed expansion to date. For the purposes of this assessment, it has been assumed that impacts experienced at nearby receptors due to the Stage 2 Extension Project may be similar to those experienced during the Yarraboldy Extension operations.

Dispersion modelling predictions of the proposed operations (Yarraboldy extension) indicated predicted maximum incremental 24-hour average PM_{10} concentrations of between 2 $\mu g/m^3$ and 5 $\mu g/m^3$ at a receptor located approximately 6.5 km northeast of the Springvale Colliery pit top. Given the small predicted incremental impact from the Pine Dale Yarraboldy Extension, the proposed Stage 2 Extension Project has not been considered further within this report.

7.3.6 Clarence Colliery

Clarence Colliery is located approximately 13 km to the southeast of the Springvale pit top. Given the separation distance between the Clarence Colliery and the Springvale pit top, it is not considered that cumulative impacts would occur between the two operations.

7.3.7 Forestry and Recreation Activities

Forestry and recreation activities occur within the Newnes State Forest although in the immediate area surrounding the Project will be limited to unsealed road use by 4WD vehicles and occasional forestry vehicles. Given the likely infrequent nature of these activities, it is not considered that these will have cumulative effects with the Project operation.

7.4 Adopted Background for this Assessment

To provide an assessment of potential cumulative pollutant concentrations at surrounding sensitive receptors, measured long term (≥1 year) ambient air quality data are required. However, as stated in **Section 7**, no long term continuous ambient monitoring data are available in the vicinity of the Project Application Area.

Following the analysis presented in **Section 7.1**, it has been established that the use of continuous PM_{10} monitoring data (2010) from the OEH operated monitoring site at Bathurst provides a conservative estimate of regional background levels and includes the impact of surrounding industries as discussed in **Section 7.3**.

The annual average background TSP concentration was calculated based on the annual average PM_{10} concentration at Bathurst and the TSP to PM_{10} ratio derived from Springvale HVAS data (presented in **Section 7.1**). An annual average background dust deposition rate was calculated based on the average of 2010 data measured at the five dust deposition gauges surrounding the Springvale Colliery. 94cm. The adopted background data are presented in **Table 22**.

Table 22 Adopted Background Data

Pollutant	Averaging Period	Background Concentration ($\mu g/m^3$)	Basis
PM_{10}	24-hours	Daily varying background	Monitoring data at Bathurst (2010)
	Annual	9.5	Monitoring data at Bathurst (2010)
TSP	Annual	23.4	TSP to PM_{10} ratio of 2.5
Dust Deposition	Annual	1.4 g/m^2/month	Average of dust deposition monitoring data in 2010

8 AIR DISPERSION MODELLING RESULTS

The ground level particulate concentrations and deposition rates predicted by the modelling at the nearest sensitive receptors are presented and discussed below.

8.1 Dust Deposition

Table 23 shows the results of the dispersion modelling for dust deposition from the Project Application Area at each of the identified receptors using the emission rates calculated in **Section 5**. Contour plots of the predicted incremental increase in dust deposition rates are also presented in **Appendix D**.

Table 23 Predicted Annual Average Dust Deposition Rates

Receptor ID	Annual Average Dust Deposition Rate (g/m²/month)						
	Background	Increment			Cumulative		
		Construction	Operation	Rehabilitation	Construction	Operation	Rehabilitation
S1	1.4	0.2	0.2	<0.1	1.6	1.6	<1.5
S2	1.4	0.1	0.1	<0.1	1.5	1.5	<1.5
S3	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
S4	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
S5	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
W1	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
W2	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
L1	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
L2	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
NF1	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
NF2	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
NF3	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
NF4	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
NF5	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
NF6	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
NF7	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
NF8	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
NF9	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
Criteria		**2.0**	**2.0**	**2.0**	**4.0**	**4.0**	**4.0**

The results indicate that incremental and cumulative annual average dust deposition rates at all nominated residences/properties/sensitive areas surrounding the Project Application Area are predicted to be well below the criterion of 2 g/m^2/month (incremental increase in dust deposition) and below 4 g/m^2/month (cumulative dust deposition). The incremental increase predicted as a result of the proposed SMEP operations including the construction and final rehabilitation of the Project Application Area are negligible and would not result in a measureable increase above existing levels.

8.2 Suspended Particulate

8.2.1 TSP

Table 24 presents the annual average TSP concentrations predicted by the dispersion modelling at each of the nominated residences/properties using the emission rates calculated in **Section 5**. The calculated background TSP concentrations have been discussed in detail in **Section 7.1**. Contour plots of the predicted cumulative increase in TSP concentrations are presented in **Appendix D**.

Table 24 Predicted Annual Average TSP Concentrations

Receptor ID	Annual Average TSP Concentration (µg/m³)						
	Background	Increment			Cumulative		
		Construction	Operation	Rehabilitation	Construction	Operation	Rehabilitation
S1	23.4	3.2	3.2	0.8	26.6	26.6	24.2
S2	23.4	2.7	2.7	0.8	26.1	26.1	24.2
S3	23.4	0.7	0.7	0.2	24.1	24.1	23.6
S4	23.4	1.0	1.0	0.3	24.4	24.4	23.7
S5	23.4	0.5	0.5	0.2	23.9	23.9	23.6
W1	23.4	0.5	0.5	0.1	23.9	23.9	23.5
W2	23.4	0.5	0.5	0.1	23.9	23.9	23.5
L1	23.4	0.4	0.4	0.1	23.8	23.8	23.5
L2	23.4	0.9	0.8	0.2	24.3	24.2	23.6
NF1	23.4	0.3	<0.1	<0.1	23.7	<23.5	<23.5
NF2	23.4	<0.1	<0.1	<0.1	<23.5	<23.5	<23.5
NF3	23.4	<0.1	<0.1	<0.1	<23.5	<23.5	<23.5
NF4	23.4	<0.1	<0.1	<0.1	<23.5	<23.5	<23.5
NF5	23.4	0.3	<0.1	<0.1	23.7	<23.5	<23.5
NF6	23.4	0.1	<0.1	<0.1	23.5	<23.5	<23.5
NF7	23.4	<0.1	<0.1	<0.1	<23.5	<23.5	<23.5
NF8	23.4	<0.1	<0.1	<0.1	<23.5	<23.5	<23.5
NF9	23.4	<0.1	<0.1	<0.1	<23.5	<23.5	<23.5
Criterion					**90**	**90**	**90**

Annual average TSP concentrations are predicted to be well below the criterion of 90 µg/m^3 at all nominated residences/properties/sensitive areas surrounding the Project Application Area. The incremental increase predicted as a result of the SMEP operations including the construction and final rehabilitation of the Project Application Area are very low and are not predicted to give rise to a significant increase above existing levels.

8.2.2 PM_{10}

Annual Average PM_{10} Concentrations

Table 25 presents the annual average PM_{10} concentrations predicted by the dispersion modelling at each of the nominated residences/properties/sensitive areas using the emission rates calculated in **Section 5**. The calculated background PM_{10} concentrations have been discussed in detail in **Section 7.1**. Contour plots of the predicted cumulative increase in annual average PM_{10} concentrations are presented in **Appendix D**.

Table 25 Predicted Annual Average PM_{10} Concentrations

Receptor ID	Annual Average PM_{10} Concentration (µg/m³)						
	Background	Increment			Cumulative		
		Construction	Operation	Rehabilitation	Construction	Operation	Rehabilitation
S1	9.5	1.3	1.2	0.2	10.8	10.7	9.7
S2	9.5	1.1	1.1	0.2	10.6	10.6	9.7
S3	9.5	0.3	0.3	<0.1	9.8	9.8	<9.6
S4	9.5	0.4	0.4	<0.1	9.9	9.9	<9.6
S5	9.5	0.2	0.2	<0.1	9.7	9.7	<9.6
W1	9.5	0.2	0.2	<0.1	9.7	9.7	<9.6
W2	9.5	0.2	0.2	<0.1	9.7	9.7	<9.6
L1	9.5	0.2	0.2	<0.1	9.7	9.7	<9.6
L2	9.5	0.4	0.4	<0.1	9.9	9.9	<9.6
NF1	9.5	0.1	<0.1	<0.1	9.6	<9.6	<9.6
NF2	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
NF3	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
NF4	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
NF5	9.5	0.1	<0.1	<0.1	9.6	<9.6	<9.6
NF6	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
NF7	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
NF8	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
NF9	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
Criterion					**30**	**30**	**30**

Annual average PM_{10} concentrations are predicted to be well below the criterion of 30 µg/m^3 (NSW EPA criterion) and 20 µg/m^3 (WHO guideline) at all nominated residences/properties/sensitive areas surrounding the Project Application Area. The incremental increase predicted as a result of the SMEP operations including the construction and final rehabilitation of the Project Application Area are very low and are not predicted to give rise to a significant increase above existing levels.

Maximum 24-Hour Average PM_{10} Concentrations

To assess the cumulative maximum 24-hour average PM_{10} concentrations at each of the identified sensitive receptors, a contemporaneous analysis was performed following the Approved Methods. At each receptor, each individual incremental prediction was added to the corresponding measured background concentration to obtain cumulative 24-hour average PM_{10} concentrations.

Construction

Table 26 presents the summary of the contemporaneous analysis at each surrounding sensitive receptor listed in **Table 6** and **Table 7** during Project construction.

Table 26 Summary of Contemporaneous Analysis during Construction

Receptor ID	Date	PM_{10} 24-Hour Average (µg/m³)			Date	PM_{10} 24-Hour Average (µg/m³)		
		Highest Background	Increment	Total		Background	Highest Increment	Total
S1	13-01-2010	43.3	<0.1	<43.4	18-04-2010	10	15.9	25.9
S2	13-01-2010	43.3	<0.1	<43.4	18-03-2010	21.3	20.8	42.1
S3	13-01-2010	43.3	<0.1	<43.4	02-06-2010	6.4	4.6	11.0
S4	13-01-2010	43.3	0.6	43.9	02-05-2010	13.3	10.6	23.9
S5	13-01-2010	43.3	0.3	43.6	02-05-2010	13.3	5.7	19.0
W1	13-01-2010	43.3	<0.1	<43.4	25-07-2010	4.6	3.3	7.9
W2	13-01-2010	43.3	<0.1	<43.4	15-02-2010	5.7	3.2	8.9
L1	13-01-2010	43.3	0.4	43.7	23-09-2010	14.6	4.7	19.3
L2	13-01-2010	43.3	0.3	43.6	23-09-2010	14.6	8.3	22.9
NF1	13-01-2010	43.3	<0.1	<43.4	17-02-2010	12	1.7	13.7
NF2	13-01-2010	43.3	<0.1	<43.4	17-02-2010	12	0.8	12.8
NF3	13-01-2010	43.3	<0.1	<43.4	15-04-2010	17.9	0.5	18.4
NF4	13-01-2010	43.3	<0.1	<43.4	02-05-2010	13.3	0.2	13.5
NF5	13-01-2010	43.3	0.2	43.5	18-03-2010	21.3	1.3	22.6
NF6	13-01-2010	43.3	<0.1	<43.4	22-01-2010	25.5	0.9	26.4
NF7	13-01-2010	43.3	<0.1	<43.4	18-11-2010	3.7	0.2	3.9
NF8	13-01-2010	43.3	<0.1	<43.4	02-06-2010	6.4	0.6	7.0
NF9	13-01-2010	43.3	<0.1	<43.4	18-11-2010	3.7	0.3	4.0
Criterion				**50**				**50**

The results presented in **Table 26** show that the predicted cumulative 24-hour average PM_{10} concentrations are below the criterion of 50 µg/m³ and therefore the proposed construction is unlikely to cause any exceedences at any surrounding sensitive receptor locations. Contour plots of the predicted cumulative 24-hour average PM_{10} concentrations are presented in **Appendix D**.

Operation

Table 27 presents the summary of the contemporaneous analysis at each surrounding sensitive receptor listed in **Table 6** and **Table 7** during project operation. The results presented in **Table 27** show that the predicted cumulative 24-hour average PM_{10} concentrations are below the criterion of 50 µg/m³ and therefore the proposed operation is unlikely to cause any exceedences at any surrounding sensitive receptor locations. Contour plots of the predicted cumulative 24-hour average PM_{10} concentrations are presented in **Appendix D**.

Table 27 Summary of Contemporaneous Analysis during Operation

Receptor ID	Date	PM_{10} 24-Hour Average (µg/m³)			Date	PM_{10} 24-Hour Average (µg/m³)		
		Highest Background	Increment	Total		Background	Highest Increment	Total
S1	13-01-2010	43.3	<0.1	<43.4	18-04-2010	10	15.9	25.9
S2	13-01-2010	43.3	<0.1	<43.4	18-03-2010	21.3	20.8	42.1
S3	13-01-2010	43.3	<0.1	<43.4	02-06-2010	6.4	4.5	10.9
S4	13-01-2010	43.3	0.6	43.9	02-05-2010	13.3	10.6	23.9
S5	13-01-2010	43.3	0.3	43.6	02-05-2010	13.3	5.7	19.0
W1	13-01-2010	43.3	<0.1	<43.4	25-07-2010	4.6	3.3	7.9
W2	13-01-2010	43.3	<0.1	<43.4	15-02-2010	5.7	3.2	8.9
L1	13-01-2010	43.3	0.4	43.7	23-09-2010	14.6	4.7	19.3
L2	13-01-2010	43.3	0.3	43.6	23-09-2010	14.6	8.3	22.9
NF1	13-01-2010	43.3	<0.1	<43.4	17-02-2010	12	0.5	12.5
NF2	13-01-2010	43.3	<0.1	<43.4	02-05-2010	13.3	0.8	14.1
NF3	13-01-2010	43.3	<0.1	<43.4	02-05-2010	13.3	0.2	13.5
NF4	13-01-2010	43.3	<0.1	<43.4	02-05-2010	13.3	0.1	13.4
NF5	13-01-2010	43.3	<0.1	<43.4	15-09-2010	3.1	0.3	3.4
NF6	13-01-2010	43.3	<0.1	<43.4	15-09-2010	3.1	0.2	3.3
NF7	13-01-2010	43.3	<0.1	<43.4	12-07-2010	7.6	0.2	7.8
NF8	13-01-2010	43.3	<0.1	<43.4	18-11-2010	3.7	0.3	4.0
NF9	13-01-2010	43.3	<0.1	<43.4	18-11-2010	3.7	0.3	4.0
Criterion				**50**				**50**

Rehabilitation

Table 28 presents the summary of the contemporaneous analysis at each surrounding sensitive receptor listed in **Table 6** and **Table 7** during Project rehabilitation. The results presented in **Table 28** show that the predicted cumulative 24-hour average PM_{10} concentrations are below the criterion of 50 µg/m³ and therefore the rehabilitation of the Project at the end of life is unlikely to cause any exceedences at any surrounding sensitive receptor locations. Contour plots of the predicted cumulative 24-hour average PM_{10} concentrations are presented in **Appendix D**.

The receptors predicted to experience the greatest impacts from the proposed SMEP activities are S1 and S2 during project construction and operation although incremental impacts are less than 42% of the criterion at these locations and no exceedances of the criterion (cumulative) are predicted at any receptor during any of the three modelled scenarios.

Table 28 Summary of Contemporaneous Analysis during Rehabilitation

Receptor ID	Date	PM_{10} 24-Hour Average (µg/m³)			Date	PM_{10} 24-Hour Average (µg/m³)		
		Highest Background	Increment	Total		Background	Highest Increment	Total
S1	13-01-2010	43.3	<0.1	<43.4	07-03-2010	8.7	2.6	11.3
S2	13-01-2010	43.3	<0.1	<43.4	18-03-2010	21.3	3.4	24.7
S3	13-01-2010	43.3	<0.1	<43.4	02-06-2010	6.4	0.8	7.2
S4	13-01-2010	43.3	0.1	43.4	02-05-2010	13.3	2.3	15.6
S5	13-01-2010	43.3	<0.1	<43.4	02-05-2010	13.3	1.2	14.5
W1	13-01-2010	43.3	<0.1	<43.4	25-07-2010	4.6	0.6	5.2
W2	13-01-2010	43.3	<0.1	<43.4	15-02-2010	5.7	0.6	6.3
L1	13-01-2010	43.3	<0.1	<43.4	23-09-2010	14.6	0.9	15.5
L2	13-01-2010	43.3	<0.1	<43.4	23-09-2010	14.6	1.5	16.1
NF1	13-01-2010	43.3	<0.1	<43.4	17-02-2010	12	0.1	12.1
NF2	13-01-2010	43.3	<0.1	<43.4	02-05-2010	13.3	0.2	13.5
NF3	13-01-2010	43.3	<0.1	<43.4	02-05-2010	13.3	<0.1	<13.4
NF4	13-01-2010	43.3	<0.1	<43.4	02-05-2010	13.3	<0.1	<13.4
NF5	13-01-2010	43.3	<0.1	<43.4	15-09-2010	3.1	<0.1	<3.2
NF6	13-01-2010	43.3	<0.1	<43.4	15-09-2010	3.1	<0.1	<3.2
NF7	13-01-2010	43.3	<0.1	<43.4	12-07-2010	7.6	<0.1	<7.7
NF8	13-01-2010	43.3	<0.1	<43.4	18-11-2010	3.7	<0.1	<3.8
NF9	13-01-2010	43.3	<0.1	<43.4	18-11-2010	3.7	<0.1	<3.8
Criterion				**50**				**50**

8.2.3 $PM_{2.5}$

Table 29 presents the maximum 24-hour and annual average $PM_{2.5}$ concentrations predicted by the dispersion modelling at each of the nominated residences/properties using the emission rates calculated in **Section 5**. As discussed in **Section 7.1**, no ambient background monitoring data for $PM_{2.5}$ are available in the local area or at the nearest OEH monitoring sites hence the modelling results have been assessed by comparison of the incremental concentrations against the criteria.

Table 29 shows that the incremental increase in 24-hour average and annual average $PM_{2.5}$ concentrations predicted as a result of the proposed SMEP construction, operation and rehabilitation of the Project Application Area at the end of mine life are minor and are unlikely to cause any exceedences at any surrounding sensitive receptor locations.

Table 29 Predicted 24-Hour and Annual Average $PM_{2.5}$ Concentrations

Receptor ID	Annual Average $PM_{2.5}$ Increment (µg/m^3)			24-Hour $PM_{2.5}$ Increment (µg/m^3)		
	Construction	Operation	Rehabilitation	Construction	Operation	Rehabilitation
S1	0.1	0.1	0.1	1.5	1.5	1.7
S2	0.1	0.1	0.1	2.0	2.0	2.2
S3	<0.1	<0.1	<0.1	0.4	0.4	0.5
S4	<0.1	<0.1	<0.1	1.1	1.1	1.4
S5	<0.1	<0.1	<0.1	0.6	0.6	0.8
W1	<0.1	<0.1	<0.1	0.3	0.3	0.4
W2	<0.1	<0.1	<0.1	0.3	0.3	0.4
L1	<0.1	<0.1	<0.1	0.5	0.5	0.6
L2	<0.1	<0.1	<0.1	0.9	0.9	1.0
NF1	<0.1	<0.1	<0.1	0.4	<0.1	0.1
NF2	<0.1	<0.1	<0.1	0.1	<0.1	0.1
NF3	<0.1	<0.1	<0.1	0.1	<0.1	<0.1
NF4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
NF5	<0.1	<0.1	<0.1	0.3	<0.1	<0.1
NF6	<0.1	<0.1	<0.1	0.2	<0.1	<0.1
NF7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
NF8	<0.1	<0.1	<0.1	0.1	<0.1	<0.1
NF9	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Advisory Reporting Standards		**8 (Cumulative)**			**25 (Cumulative)**	

8.3 Air Quality Monitoring

Given the foregoing minor impacts relating to Project construction, operation and rehabilitation predicted by the dispersion modelling exercise, it is not considered to be justifiable to install and operate real-time particulate monitoring equipment near to the geographically disperse sensitive receptor locations. Impacts can be mitigated through the implementation of management measures such as water spraying, minimisation of exposed areas and ceasing work during adverse weather conditions.

Continuation of the HVAS monitoring at the Springvale pit top will be continued, as will be the monitoring of dust deposition.

9 GREENHOUSE GAS ASSESSMENT

The Director-General's Requirements issued for the Project in relation to greenhouse gas (GHG) emissions are as follows:

- A quantitative assessment of potential Scope 1, 2 and 3 GHG emissions;
- A qualitative assessment of the potential impacts of these emissions on the environment; and,
- An assessment of reasonable and feasible measures to minimise GHG emissions and ensure energy efficiency.

This GHG assessment has been performed with reference to the Australian Department of Climate Change and Energy Efficiency (DCCEE) document "*National Greenhouse Accounts Factors*" (July, 2013), the NSW Department of Energy, Utilities and Sustainability (DEUS) document "*Guidelines for Energy Savings Action Plans*" (2005), the National Greenhouse and Energy Reporting Act 2007, the Centennial Coal Greenhouse Gas Assessment Guidance Notes (Centennial Coal, 2010) and Climate Change Response Policy (Centennial Coal, 2012b).

This assessment considers the impact of the proposed Project and compares this predicted impact to that currently experienced at the Project Application Area.

Activity data for the following have been obtained from Centennial for the period 1 July 2011 to 31 June 2012:

- Total Run of Mine (ROM) Coal Production (tonnes [t]);
- Total Electricity Consumption (kilowatt-hours [kWh]);
- Total Diesel Consumption (litres [L]);
- Solid Waste to Landfill (t);
- Fugitive Emissions of Coal Seam Methane (CH_4) and CO_2 via ventilation shafts (m^3 and percentage content of CO_2 and CH_4 in ventilation return air);
- Emissions from the use of Liquid Petroleum Gas (LPG); and
- Emissions from the use of oils and greases (consumed without combustion).

Data have been sourced from the Centennial provided spreadsheet 'SPJ Greenhouse Report 1112 (covering the period 1 July 2011 to 31 June 2012).

Data was made available for the period July 2011 to June 2012, being the most recent complete financial year of data which has been independently audited and verified to meet the requirements of the National Greenhouse and Energy Reporting System (NGERS) legislation. Data presented in this report for Scope 1 and 2 emissions is directly extracted from Springvale NGERS reports for the July 2011 to June 2012 period (which was associated with a ROM production rate of 2.2 Mtpa) and utilises NGERS emission factors, and other acceptable NGERS emission calculation methodologies. Scope 3 emissions have been calculated using data provided by Springvale.

Although this report is concerned with the installation and operation of Dewatering Bore 9 and 10, data for all greenhouse gas generating processes are presented. A Development Application was approved in May 2012 in relation to the construction of an upgraded ventilation shaft (No. 3 Ventilation Shaft) and a GHG assessment was performed for this proposed upgrade. Furthermore, an application to modify the existing consent for the construction and operation of a new dewatering bore (Bore 8) was approved in March 2013. Baseline GHG emissions are therefore considered to be current site operations plus emissions associated with the approved No. 3 Ventilation Shaft and Dewatering Bore 8.

9.1 Activity Data

9.1.1 Baseline for Comparison of Project Impacts

In this report the baseline against which the Project impacts are assessed is the currently approved ROM extraction and processing rate of 4.5 Mtpa. Data has been provided by Springvale Coal for the NGERS reporting period of July 2011 to June 2012. The product extracted during this reporting period was 2.2 Mt. Data has therefore been scaled appropriately (described further below) to enable a comparison of approved versus proposed activities occurring as part of the SMEP.

A GHG assessment is presented for the following:

1 Baseline GHG emissions (Approved site operations plus No. 3 Ventilation Shaft plus Dewatering Bore 8 – hereafter “Baseline Operations”).

2 Baseline GHG emissions plus dewatering Bore 9 and 10 (hereafter “Proposed Operations”) and construction operations and operational traffic.

9.1.2 Approved Upgrades

Relevant information relating to the approved upgrade to the No. 3 Ventilation Shaft plus Dewatering Bore 8 is presented in **Table 30**.

Table 30 Activity Data relating to Approved Upgrade to No. 3 Ventilation Shaft and Bore 8 Dewatering Facility

Upgrade	Activity Data	Data Source
No. 3 Ventilation Shaft	Electricity Consumption to increase by 15,592,800 kWh Diesel Consumption to increase by 22,114 L	*“Springvale Coal Pty Ltd, Springvale Vent Shaft, Air Quality and GHG Assessment”*, November 2011
Dewatering Bore 8	Electricity Consumption to increase by 11,216,822 kWh Diesel Consumption to increase by 17 kL	*“Springvale Coal Pty Ltd, Springvale Colliery Dewatering Bore 8 Project, Air Quality and GHG Assessment”*, September 2012

Relevant information relating to the recent Springvale Mine Modification is presented in **Table 31**

Table 31 Activity Data relating to Approved Springvale Mine Modification

Upgrade	Activity Data	Data Source
Additional continuous mining unit	Electricity Consumption to increase by 517,017 kWh	Submission to DoP&I (October 2013)
Additional longwall miner operation	Electricity Consumption to increase by 930,630 kWh	Submission to DoP&I (October 2013)

Relevant information relating to the proposed SMEP Project is presented in **Table 32**.

Table 32 Activity Data relating to Proposed Project

Upgrade	Activity Data	Data Source
Dewatering Bore 9	Electricity Consumption to increase by 11,216,822 kWh Diesel Consumption to increase by 17 kL	Assumed consistency with Dewatering Bore 8 Project
Dewatering Bore 10	Electricity Consumption to increase by 11,216,822 kWh Diesel Consumption to increase by 17 kL	

Note: Only one dewatering bore is proposed to be operational at any one time and therefore electricity and diesel consumption has been calculated to be applicable to one bore site only.

Information for the No. 3 Ventilation Shaft upgrade is taken directly from the DA documentation (Springvale Coal Pty Ltd, Springvale Vent Shaft, Air Quality and GHG Assessment, November 2011).

Information relating to the anticipated electricity use as a result of the installation of Bore 8 was provided by Springvale Coal. Electricity use at the existing Bore 6 is available within the provided NGERS data for Springvale, although approximately 25% of the electricity usage reported for this bore is associated with a dewatering bore at Angus Place Mine. Therefore, 75% of the reported value is taken to be associated with Bore 6. Furthermore, Bore 8 is likely to deal with approximately 5% more mine inflow than Bore 6, and therefore the electricity consumption is assumed to be 5% higher. A figure of 11,216,822 kWh has been taken to be representative of the annual electricity consumption of Bores 8, 9 and 10. Springvale Coal has also advised that that a backup diesel generator will be associated with Bore 8, a similar generator used 17 kL of diesel at the Bore 6 site in the year 2010 – 2011, assumed to remain consistent for 2011 - 2012. A similar diesel backup generator will be required at Dewatering Bores 9 and 10.

Contractor diesel consumption, fugitive emissions through the ventilation shaft, LPG use and oil and grease consumption is not anticipated to change following either the approved ventilation shaft upgrade and Bore 8 dewatering facility or the proposed Bore 9 and 10 operation.

To assess the impact of ROM extraction at 4.5 Mtpa (baseline and proposed), some scaling of activity data is required, and assumptions are required to be made. These assumptions are outlined below:

- Electricity consumption
  - Electricity consumption at Springvale Colliery is associated with longwall and continuous mining units, conveyors, boreholes pumps (existing) and current ventilation requirements, as well as bath house operations etc. It is assumed that these requirements will increase only due to additional usage through the Bore site(s).
- Diesel consumption
  - Diesel consumption will not be linearly linked to production and it has therefore been assumed that diesel consumption will not increase as a result of the SMEP.

    However, to assess the impact of the approved 4.5 Mtpa extraction rate versus the 2011/2012 extraction rate of 2.2 Mtpa, a 5% increase in diesel consumption is assumed to be realised.
- Ventilation requirements
  - It has been assumed that no increase in the ventilation rate, or composition of ventilation air will change as a result of the SMEP.
- Solid waste
  - Given the proposed full time workforce is to remain at 310 persons the quantity of solid waste generated has been assumed to remain constant.
- Oil and grease and LPG usage is assumed to remain constant.

9.1.3 Construction Traffic

There will be an increase in traffic (along public roads and Forest NSW tracks) and personnel during the dewatering bore and services borehole construction period. Three borehole sites are anticipated (Bore 9, Bore 10 and Services Borehole area). The anticipated construction traffic movements are as follows:

- Borehole Construction (per site)
  - 6 light vehicle movements per day including crews and management.

- 10-12 semi-trailer truckloads of equipment.
- 5 concrete truck loads (10 movements) per day during foundation construction.

These additional construction related vehicles will be owned and operated by contractors, likely originating from Lithgow. Emissions of GHG associated with these contractor vehicles are reportable under Scope 3 emissions and have been calculated within this assessment (see **Section 9.3.3**). It is noted that these emissions are likely to have occurred *without* the construction of the SMEP, rather the location of the emission is dependent upon the SMEP. To provide a conservative assessment, these emissions are taken into account within this GHG assessment.

Assumptions regarding the likely fuel usage in contractor vehicles are required to be made, and within this assessment, it is assumed that all contractor vehicles (light and heavy) have a fuel consumption of 10 l/100 km. It is also assumed that the distance travelled by each contractor vehicle per day is 50 km (Lithgow to SMEP (all bore sites) to Lithgow). The construction period is assumed to be 24 months, with construction occurring 6 days per week. It is also assumed that peak vehicle generation occurs throughout the construction period. Based on these assumptions, total fuel usage by contractor construction vehicles per annum is estimated to be 1,560 L.

9.1.4 Operational Traffic

Outside of this period, traffic and personnel movements associated with the dewatering sites will be minimal with the occasional light vehicle trip required for maintenance and inspection purposes only. It is anticipated that these vehicles would be owned and operated by Springvale Coal and the additional emissions of GHG would be considered to be a Scope 1 (direct) emission. It has been assumed that these additional operational trips (assuming a 40 km round trip once per week and 10 L/100km fuel efficiency) would result in an additional 200 L of diesel combustion per year.

9.1.5 Summary of Activity Data

A summary of activity data related to the baseline and proposed Project is provided in **Table 33**.

Table 33 Summary of Project Related Activity Data Relevant to GHG Emissions (Current and Proposed Operations)

Activity	Baseline Project Operations	Proposed Project Operations
Annual ROM production (Mt)	4.5 Mtpa	4.5 Mtpa
Annual Electricity Consumption (kWh)	90,299,290[1]	90,299,290[2]
Annual Diesel Consumption (litres) – Springvale Coal	1,608,184[3]	1,608,184[4]
Annual Diesel Consumption (litres) - Contractor	697,452[5]	697,452
Annual Fugitive Emissions from Mine Ventilation Shaft (Million m^3)	4,792	4,792
Solid Waste to Landfill (t)	678	678
Liquid Petroleum Gas (LPG) (kg)	32,323	32,323
Petroleum Based Oil/ greases used (L)	244,663	244,663
Construction vehicles (L)	-	1,560
Operational vehicles (L)	-	200

Note1: Includes 62,042,021 kWh (SPJ Greenhouse Report 1112), 15,592,800 kWh (assumed *additional* electricity consumption through Ventilation Shaft No.3), 11,216,822 kWh for Bore 8 operation plus 517,017 kWh for additional continuous miner unit plus 930,630 kWh for additional longwall miner operation.

Note 2: Not additional electricity consumption added as only one Dewatering Bore (8, 9 or 10) will be in use at any one time. The Baseline data includes Bore 8 electricity consumption.

Note 3: Scaling factor of 1.05 (5% increase) applied to “2011/2012 Project Operations” diesel usage (769,152 litres [SPJ Greenhouse Report 1112]) plus additional 22,114 litres for ventilation shaft number 3 and 17,000 litres for Dewatering Bore 8

Note 4: Scaling factor of 1.05 (5% increase) applied to “2011/2012 Project Operations” diesel usage (769,152 litres [SPJ Greenhouse Report 1112]) plus additional 22,114 litres for ventilation shaft number 3 and 17,000 litres for one of Dewatering Bores 8, 9 and 10

Note 5: Scaling factor of 1.05 (5% increase) applied to current contractor diesel usage of 341,888 litres (SPJ Greenhouse Report 1112).

Values for are different to those quoted in “Springvale Dewatering Bore 8, Air Quality and GHG Assessment, September 2012”. NGER data was updated since this time following audit.

9.2 Direct and Indirect Emissions (Emissions Scope)

National Greenhouse and Energy Reporting Regulations 2008 defines scope 1 and scope 2 emissions as:

Division 2.5 Meaning of *emissions*, production and consumption: section 10

2.23 Meaning of *emissions*, *production* and *consumption*

(1) ***Emissions*** of greenhouse gas, in relation to a facility, means the release of greenhouse gas into the atmosphere as a direct result of one of the following:

(a) an activity, or series of activities (including ancillary activities) that constitute the facility (***scope 1 emissions***);

(b) 1 or more activities that generate electricity, heating, cooling or steam that is consumed by the facility but that do not form part of the facility (***scope 2 emissions***).

(2) ***Production*** of energy, in relation to a facility, means 1 of the following:

(a) the extraction or capture of energy from natural sources for final consumption by or from the operation of the facility or for use other than in the operation of the facility;

(b) the manufacture of energy by the conversion of energy from 1 form to another form for final consumption by or from the operation of the facility or for use other than in the operation of the facility.

(3) ***Consumption*** of energy, in relation to a facility, means the use or disposal of energy from the operation of the facility including own-use and losses in extraction, production and transmission.

The NGERS legislation does not include scope 3 emissions.

The National Greenhouse Accounts workbook (NGA) the methodology used for estimating scope 3 emissions in this assessment is defined as follows:

- Various emission factors can be used to calculate scope 3 emissions. For ease of use, this workbook reports specific ‘scope 3’ emission factors for organisations that:

  (a) burn fossil fuels: to estimate their indirect emissions attributable to the extraction, production and transport of those fuels; or

  (b) consume purchased electricity: to estimate their indirect emissions from the extraction, production and transport of fuel burned at generation and the indirect emissions attributable to the electricity lost in delivery in the T&D network.

It is noted that Springvale Coal has a restricted capacity to reduce their GHG emissions under Scope 3 at Springvale. Reductions in the emissions of GHG resulting from the extraction and transport of fossil fuels for use in electricity production or onsite diesel combustion are beyond the control of Springvale Coal but are reported here for completeness, as required by the Department of Planning and Infrastructure.

9.3 Greenhouse Gas Calculation Methodology

Quantification of potential Project emissions has been undertaken in relation to both carbon dioxide (CO_2) and other non-CO_2 greenhouse gas emissions.

For comparative purposes, non-CO_2 greenhouse gases are awarded a "CO_2-equivalence" (CO_2-e) based on their contribution to the enhancement of the greenhouse effect. The CO_2-e of a gas is calculated using an index called the Global Warming Potential (GWP). The GWPs for a variety of non-CO_2 greenhouse gases are contained within the Intergovernmental Panel on Climate Change (IPCC), (1996) document "*Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*".

The GWPs of relevance to this assessment are:

- methane (CH_4): GWP of 21 (21 times more effective as a greenhouse gas than CO_2);
- nitrous oxide (N_2O): GWP of 310 (310 times more effective as a greenhouse gas than CO_2); and,
- Sulphur hexafluoride (SF_6): GWP of 23,900 (23,900 times more effective as a greenhouse gas than CO_2).

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

It is noted that at the United Nations Framework Convention on Climate Change meeting in November-December 2011 in Durban (South Africa), countries agreed to adopt updated GWPs including new greenhouse gases published in the Intergovernmental Panel on Climate Change's (IPCC) 2007 Fourth Assessment Report (AR4) from 2015 onwards (reporting emissions for the 2013 inventory year) and for commitments under a second commitment period. These GWPs replace those used from the IPCC's Second Assessment Report (AR2).

The most significant change is the increase in methane's GWP from 21 to 25. A new greenhouse gas has been added, nitrogen trifluoride, as well as new species of hydrofluorocarbons. As these updated GWP's are related to reporting from 2015 onwards, the GWP's for each GHG from the AR2 report are adopted within this assessment.

The greenhouse gas emissions associated with the Project have been assessed in terms of direct (Scope 1) emission potential, indirect (Scope 2) emission potential and significant upstream/downstream (Scope 3) emission potential.

A summary of the potential Project GHG emission sources is provided in **Table 34**.

Table 34 Summary of Potential Project Greenhouse Gas Emissions

Project Component	Direct Emissions	Indirect Emissions	
	Scope 1	Scope 2	Scope 3
Fugitive Emissions	Emissions from the release of coal seam methane and carbon dioxide as a result of extraction activities.	N/A	N/A
Diesel	Emissions from the combustion of diesel at the Project in both mobile and fixed plant and equipment	N/A	Emissions associated with contractor diesel usage. Estimated emissions attributable to the extraction, production and transport of diesel consumed at the Project Site.
Liquid petroleum gas	Emissions from the combustion of LPG at the Project in mobile equipment	N/A	N/A
Use of Oils and Greases	Consumption (non-combustion) of oils and greases	N/A	N/A
Electricity	N/A	Emissions associated with the consumption of generated and purchased electricity at the mine.	Estimated emissions from the extraction, production and transport of fuel burned for the generation of electricity consumed at the mine and the electricity lost in delivery in the transmission and distribution network.
Solid Waste	N/A	N/A	Emissions associated with the disposal of solid waste to landfill
Coal Combustion	N/A	N/A	Emissions from the combustion of coal from the Project.

N/A = Not applicable

9.3.1 Scope 1 (Direct) Emissions

Fugitive emissions - Coal Seam Methane and Carbon Dioxide

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

Fugitive emissions from extraction of coal as defined by NGERS were estimated for the 2011-2012 financial year using Method 4, subdivision 3.2.2.2 of the NGERS Measurement Determination 2008.

Based on information provided by Springvale Coal, the Ventilation Shaft 3 currently results in ventilation emissions of:

- 4,792 Mm^3/yr at 0.11% CO_2 and 0.02% CH_4

The molecular weight of CO_2 and CH_4 have been taken to be 44.01 and 16.04, respectively. Temperature of the gas stream has been provided by Springvale Coal to be 290 K.

The proposed construction of underground roadways will result in the exposure of coal seams which will have the capacity to release CH_4 which will be required to be extracted through the proposed ventilation system. However, in concert with this seam exposure, other mined longwall areas will be sealed, resulting in effectively no net change in coal seam exposure in the Springvale underground mine. It may therefore be assumed that the rate of CH_4 release into the underground workings will remain relatively constant over the course of the Project, and therefore the quantity of CH_4 to be removed through the ventilation system will also remain relatively constant.

Furthermore, information on the ROM coal production at Springvale Mine for the 2010/2011, 2011/2012 and 2012/2013 NGER reporting period, plus the NGER reported fugitive emissions indicates that no relationship exists between production and fugitive emissions.

Scope 1 emissions calculated are as presented in **Table 35** for the current operations, using information on the temperature, gas volumes and composition of the ventilation gas stream (provided within the NGER data).

Table 35 Calculated Fugitive Emissions from Ventilation (tonnes) SCOPE 1

Source	Fugitive Emissions (tonnes CO_2-e)
Existing Ventilation Systems	20,056

Diesel Usage

The primary fuel source for the vehicles operating at Springvale is diesel. Diesel consumption for all mobile and fixed equipment is calculated as 1,111,040 L used in the underground operation in the baseline year (July 2011 to June 2012). 769,152 L is used by Centennial owned vehicles and equipment and 341,888 L used by contractors. An additional 22,114 L of diesel is calculated to be consumed by the fan at the Ventilation Shaft No. 3 upgrade and a further 17,000 L through the Dewatering Bore 8 Project. These values have been scaled using the scaling factor of 1.05 (5% increase) to obtain likely diesel consumption due to a 4.5 Mtpa ROM extraction rate as discussed previously.

As part of the SMEP Borehole usage, up to 17,000 L per annum of diesel is expected to be required due to the operation of Dewatering Bores 9 or 10 as discussed previously. These Bores will not be operational concurrently.

Diesel fuel used by contractors at the Springvale Mine is included as Scope 3 emissions (refer **Section 9.1.3**).

Diesel fuel will be used in the construction of the Bore 9 and 10 facility although it is assumed that this will be attributable to contractor vehicles and is included in Scope 3 emissions (refer **Section 9.1.3**). Scope 1 emissions due to ongoing Springvale Coal vehicle use are included within Scope 1 emissions (refer **Section 9.1.4**)

Scope 1 emissions from use of diesel fuel as defined by NGERS were estimated for the 2010-11 financial year using Method 1, Division 2.4.2 section 2.41 of the NGERS Measurement Determination 2008. The energy content of diesel fuel is taken to be 38.6 GJ/kL with a Scope 1 emission factor of 69.9 kg CO_2-e/GJ (DCCEE, 2013).

Scope 1 emissions of CO_2-e from the combustion of diesel fuel are presented in **Table 36** for the baseline and proposed operations.

Table 36 Calculated Emissions from Diesel Combustion (tonnes) SCOPE 1

Source	Emissions (tonnes CO_2-e)

Baseline	
Springvale Coal	2,290
Total	**2,290**
Proposed	
Springvale Coal	2,290
Total	**2,290**

Liquid Petroleum Gas

LPG consumption is estimated as 32,323 kg per annum, which is not expected to change due to the modified Project operations. It has been assumed that 1 kg LPG is equal to 1.76 L and contains 25.7 GJ/kL with a Scope 1 emission factor of 59.9 kg CO_2-e/GJ (DCCEE, 2013).

Scope 1 emissions from use of LPG as defined by NGERS were estimated for the 2010-11 financial year using Method 1, Division 2.4.2 section 2.41 of the NGERS Measurement Determination 2008.

Emissions of GHG due to LPG use are not expected to change due to the Project upgrade.

Scope 1 emissions of CO_2-e from the use of oils and greases are presented in **Table 37**.

Table 37 Calculated Emissions from LPG Consumption (tonnes) SCOPE 1

Source	Emissions (tonnes CO_2-e)
Baseline	
LPG consumption	88
Total	**88**
Proposed	
LPG consumption	88
Total	**88**

Oils and Greases

Oils and greases are used for lubrication of equipment and machinery. Oil and grease consumption are estimated as presented in **Table 33**. Scope 1 emissions from use of oils and greases as defined by NGERS were estimated for the 11-12 financial year using the method detailed in Section 2.68 part b (iii) of the NGERS Measurement Determination 2008. The energy content of oil and grease is taken to be 38.6 GJ/kL with a Scope 1 emission factor of 27.9 kg CO_2-e/GJ (DCCEE, 2011).

Scope 1 emissions of CO_2-e from the use of oils and greases are presented in **Table 37**.

Table 38 Calculated Emissions from Oil and Grease Consumption (tonnes) SCOPE 1

Source	Emissions (tonnes CO_2-e)
Baseline	
Oil and Grease consumption	263
Total	**263**
Proposed	
Oil and Grease consumption	263
Total	**263**

9.3.2 Scope 2: Indirect Emissions through the Consumption of Purchased Electricity

Scope 2 GHG emissions as defined by NGERS were estimated for the 2010-11 financial year using Method 1, Chapter 7, section 7.2 of the NGERS Measurement Determination 2008.

State emission factors are used because electricity flows between states are significantly constrained by the capacity of the inter-state interconnectors and in some cases there are no interconnections.

Electricity consumption at Springvale has been calculated as (approximately) 62 Megawatt-hours (MWh) in July 2011 to June 2012 year of mining. An additional 15 MWh has been assumed for the operation of the upgraded Ventilation Shaft No. 3 and a further 11 MWh attributable to the operation of Dewatering Bore 8. Further to this, an additional 1.4 MWh is attributable to additional longwall and continuous miner operation (Springvale Mine Modification) resulting in a total baseline electricity consumption of 90.3 MWh.

It is not expected that this will increase due to Project upgrade (addition of Dewatering Bores 9 and 10) as electricity consumption due to either Bore 9 or 10 will replace that used at Bore 8.

The emission factor for Scope 2 (0.87 tonnes of CO_2-equivalents per kilowatt hour [t CO_2-e/kWh]) represents the consumption of purchased electricity in NSW.

Scope 2 emissions of CO_2-e from the consumption of purchased electricity are presented in **Table 39**.

Table 39 Calculated Emissions from Electricity Consumption (tonnes) SCOPE 2

Source	Emissions (tonnes CO_2-e)
Baseline	
Electricity consumption	78,560
Total	**78,560**
Proposed	
Electricity consumption	78,560
Total	**78,560**

9.3.3 Scope 3: Other Indirect Emissions

As discussed previously, Scope 3 emissions of GHG attributable to the Project are reported for completeness. Springvale Coal has a restricted capacity to reduce their GHG emissions under Scope 3 at Springvale Mine. Reductions in the emissions of GHG resulting from the extraction and transport of fossil fuels for use in electricity production or onsite diesel combustion are beyond the control of Springvale Coal. Also beyond the control of Springvale Coal are the operations of coal consumers.

Combustion of Product Coal

Indirect emissions of GHG from the combustion of product coal are expected “downstream” due to the combustion of coal produced by the Project. Up to 4.5 Mtpa of ROM coal may be produced by Springvale Mine.

This calculation assumes that 100% of ROM coal produced by the Project is combusted to produce electricity.

The GHG emissions from combustion of product coal by other (non-Springvale Coal) entities have been based on a coal energy content of 27 GJ/t for thermal (black coal) (Table 1 of the NGA Factors).

It is noted that no Scope 3 emission factor exists for black coal used for electricity generation purposes within the most recent (July 2011) version of the NGA Factors. In this instance, the Scope 3 emission factor for “Black coal” published in Table 1 of the July 2011 version of the NGA Factors has been used within this assessment.

Scope 3 emissions of CO_2-e from the combustion of saleable product coal are presented in **Table 40**.

Table 40 Calculated Emissions from Combustion of Product Coal (tonnes) SCOPE 3

Source	Emissions (tonnes CO_2-e)
Combustion of Product Coal (4.5 Mtpa) – Baseline Operations	1,057,050
Combustion of Product Coal (4.5 Mtpa) – Proposed Operations	1,057,050

Extraction, Production and Transport of Fuel Burned for the Generation of Electricity and Electricity Consumed in the Transmission and Distribution System

The NGA Factors provides Scope 3 emission factors for the consumption of purchased electricity by each state. State emission factors are used because electricity flows between states are significantly constrained by the capacity of the inter-state interconnectors and in some cases there are no interconnections.

The NSW Scope 3 emission factor (0.19 kg CO_2-e/kWh) covers both the emissions from the extraction, production and transport of fuels used in the production of the purchased electricity (i.e. fugitive emissions and stationary and mobile fuel combustion emissions) and also the emissions associated with the electricity lost in transmission and distribution on route to the customer. In this report, Scope 2 and 3 emissions for the consumption of purchased electricity have been reported separately so that the share of the transport and distribution loss can be correctly attributed under Scope 3 emissions - Generation of Electricity Consumed in a transmission and distribution system.

Scope 3 emissions of CO_2-e from the consumption of purchased electricity are presented in **Table 41**.

Table 41 Calculated Emissions from Electricity Consumption (tonnes) SCOPE 3

Source	Emissions (tonnes CO_2-e)
Baseline	
Electricity consumption	17,157
Total	**17,157**
Proposed	
Electricity consumption	17,157
Total	**17,157**

Extraction, Production and Transport of Diesel Consumed at the Project

Scope 3 GHG emissions attributable to diesel used at the Project relate to its extraction, production and transport.

The annual emissions of CO_2 and other GHG from this source have been estimated using Table 38 of the NGA Factors, an emission rate of 5.3 kg CO_2-e/GJ and an assumed energy content of Diesel of 38.6 GJ/kL.

Scope 3 emissions of CO_2-e from the combustion of diesel fuel are presented in **Table 42**. These also include the use of contractor vehicles and equipment at the Springvale Mine (Scope 3 only), contractor construction vehicles (Scope 3 only) and Centennial operational vehicles (Scope 1 and Scope 3).

Table 42 Calculated Emissions from Diesel Combustion (tonnes) SCOPE 3

Source	Emissions (tonnes CO_2-e)
Baseline	
Springvale Coal	174
Contractor	73
Total	**247**
Proposed	
Springvale Coal	174
Contractor	73
Total	**247**

Extraction, Production and Transport of Oils and Greases Consumed at the Project

Scope 3 GHG emissions attributable to oils and greases used at the Project relate to its extraction, production and transport.

The annual emissions of CO_2 and other GHG from this source have been estimated using an emission rate of 5.3 kg CO_2-e/GJ and an assumed energy content of 38.8 GJ/kL.

Scope 3 emissions of CO_2-e from the use of oils and greases are presented in **Table 43**.

Table 43 Calculated Emissions from Oil and Grease Consumption (tonnes) SCOPE 3

Source	Emissions (tonnes CO_2-e)
Baseline	
Oil and Grease consumption	50
Total	**50**
Proposed	
Oil and Grease consumption	50
Total	**50**

Waste Generation

Solid waste generated at the Project Application Area and disposed of in landfill is estimated as presented in **Table 33**. It has been assumed that generation of waste will remain at 678 tonnes per annum.

Waste sent to landfill results in emissions of CH_4 as waste is degraded. Table 42 of the NGA Factors provides GHG emission factors based on broad waste streams (municipal solid waste, commercial and industrial waste and construction and demolition waste). To provide a worst case assessment of GHG emissions from waste sent to landfill, the emission rate for municipal solid waste (1.2 t CO_2-e / tonne waste) has been used within this assessment.

Scope 3 emissions of CO_2-e from the disposal of solid waste are presented in **Table 44**.

Table 44 Calculated Emissions from Waste Disposal (tonnes) SCOPE 3

Source	Emissions (tonnes CO_2-e)
Baseline	
Waste Disposal	814
Total	**814**
Proposed	
Waste Disposal	814
Total	**814**

Liquid Petroleum Gas

Scope 3 GHG emissions attributable to LPG used at the Project relate to its extraction, production and transport. It has been assumed that 1 kg LPG is equal to 1.76 L and contains 25.7 GJ/kL with a Scope 3 emission rate of 5.3 kg CO_2-e/GJ.

Scope 3 emissions of CO_2-e from the use of LPG are presented in **Table 45**.

Table 45 Calculated Emissions from LPG Consumption (tonnes) SCOPE 3

Source	Emissions (tonnes CO_2-e)
Baseline	
LPG consumption	8
Total	**8**
Proposed	
LPG consumption	8
Total	**8**

Employees Commuting To and From Work

Fuel usage and consequent GHG emissions attributable to company employees commuting to and from work can be reported under Scope 3 GHG emissions. Data has been provided by Springvale Coal on the assumed number of mine employees (310 as part of the SMEP). It has been assumed that the number of trips will be 310 vehicle movements per day or 113,150 movements per year (one way) as approved and 310 vehicle movements per day or 113,150 movements per year (one way) as part of the SMEP.

It is assumed that 50% of staff originate from Lithgow. It has therefore been assumed that 50% of employee vehicle trips originate in Lithgow, approximately 13 km to the southeast of the Project Application Area, with the remaining 50% of staff trips originating in Bathurst, approximately 56 km to the west of the Project Application Area. Assuming that all employee-owned vehicles have a fuel efficiency of 10 L/100 km and operate on diesel as a *worst case assumption*, the total annual diesel consumption by employee owned vehicles would be 781 kL per annum as approved and as part of the SMEP.

The annual emissions of CO_2 and other GHG from this source have been estimated using Table 38 of the NGA Factors, an emission rate of 5.3 kg CO_2-e/GJ and an assumed energy content of diesel of 38.6 GJ/kL.

Scope 3 emissions of CO_2-e from the combustion of diesel fuel in employee vehicles are presented in **Table 46**.

Table 46 Calculated Emissions from Diesel Combustion (tonnes) SCOPE 3

Source	Emissions (tonnes CO_2-e)
Baseline	
Employee Vehicles	159
Total	**159**
Proposed	
Employee Vehicles	159
Total	**159**

Sources not Included

The following Scope 3 GHG emission sources were not included within the assessment:

- Employee business travel; and
- Outsourced activities.

9.4 Greenhouse Gas Calculation Results

Calculated Scope 1, Scope 2 and Scope 3 emissions of greenhouse gas resulting from the emissions sources outlined are presented in **Table 47**.

Emissions relating to emissions in the 2011/2012 NGER reporting period (2.2 Mtpa ROM production) are also presented for comparison.

Table 47 Summary of Scope 1, 2 and 3 GHG Emissions (tonnes CO_2-e per annum)

Source	2011/2012 NGER Reporting Period	Baseline Operations	Proposed Operations	Increase from Baseline to Proposed
Scope 1				
Fugitive Emissions	20,056	20,056	20,056	0
Diesel Combustion	2,181	2,290	2,290	0
LPG Combustion	88	88	88	0
Oil and Grease Consumption	263	263	263	0
Sub Total	*22,588*	*22,697*	*22,697*	*0*
Scope 2				
Electricity Consumption	77,301	78,560	78,560	0
Sub Total	*77,301*	*78,560*	*78,560*	*0*
Scope 3				
Product Coal Combustion	516,780	1,057,050	1,057,050	0
Diesel Combustion	235	247.1	247.4	0.3
Oil and Grease Consumption	50	50	50	0
Electricity Consumption	16,882	17,157	17,157	0
LPG Combustion	8	8	8	0

Waste Disposal	739	814	814	0
Employee Travel	144	160	160	0
Sub Total	*534,838*	*1,075,485*	*1,075,485*	*0*
TOTAL	**634,727**	**1,176,742**	**1,176,743**	**0.3**

9.4.1 Scope 1 Emissions Estimations

Direct (Scope 1) GHG emissions (CO_2-e) resulting from modified Project operations are estimated to be 22,697 t per annum, no increase on baseline operations. It is noted that no net increase in coal seam methane generation is anticipated as a result of the proposed Project.

9.4.2 Scope 2 Emissions Estimations

Indirect (Scope 2) GHG emissions (CO_2-e) resulting from modified Project operations are estimated to be 78,560 tonnes per annum, no increase on baseline operations.

9.4.3 Scope 3 Emissions Estimations

Indirect (Scope 3) GHG emissions (CO_2-e) resulting from modified Project operations are estimated to be 1,075,484 tonnes per annum, an increase of approximately 0.3 tonnes per annum on baseline operations. The increase is due to contractor diesel usage during construction.

9.5 Comparison with National and State GHG Emissions

The estimated annual emissions associated with the modified Project are presented in **Table 48**.

Table 48 GHG Emissions Estimated to Result from Modified Project Operation

Emission Scope	Estimated Emissions (t CO_2-e/annum)
1	22,697
2	78,560
3	1,075,485
TOTAL	**1,176,743**

Emissions of GHG in NSW were reported to be 157.4 Mt in 2010, 28% of the Australian total GHG emissions of 560.8 Mt. Comparison of the emissions attributable to the Project with NSW and Australia emission totals is presented in **Table 49**.

Table 49 Comparison of Modified Project GHG Emissions with State and National Totals 2010

Emission Scope	Estimated Emissions (tCO_2-e/annum)	Percentage of NSW 2010 GHG Emission Total	Percentage of Australian 2010 GHG Emission Total
Scope 1	22,697	0.01	0.004
TOTAL (1,2 and 3)	1,176,743	0.75	0.2

9.6 Potential Impacts of Greenhouse Gas Emissions on the Environment

Increased emissions of GHG are widely accepted to exert a warming influence on climate. Increasing concentrations of the long-lived GHG's (CO_2, CH_4, N_2O, halocarbons and SF_6 have led to a combined radiative forcing (RF) of +2.63 [±0.26] Watts per square metre (W m^{-2}). A 9% increase in this RF since the publication of the Third Assessment Report of the IPCC (IPCC, 2001) is the result of concentration changes since 1998 (IPCC, 2007). The IPCC state that it is very likely that there has been a substantial anthropogenic (man-made) contribution to surface temperature increases in every continent except Antarctica since the middle of the 20th Century, although difficulties exist in the attribution of temperature changes on smaller than continental scales and on timescales of less than 50 years.

Scientists at the 2005 conference, 'Avoiding Dangerous Climate Change: Symposium on Stabilisation of Greenhouse Gases' concluded that at the level of 550 parts per million (ppm) CO_2 concentration, a 2°C increase in global mean temperature above present levels would be experienced, and that stabilisation at a concentration of 400 ppm would be necessary to avoid a 2°C warming. IPCC reports (IPCC, 2007) have suggested that stabilising concentrations at 450 ppm by 2020 would only result in a 50% likelihood of limiting global warming to 2°C.

The linkages between emissions of CO_2 from an individual project, resulting global CO_2 concentrations and climate warming (as required within the DGRs for the Project) is not possible due to a host of uncertainties and a lag in the climate system. However, action by National Governments aimed at reducing GHG emissions by sector and national totals will result in mitigation of climate change, and accurate quantification of GHG emissions will aid the ongoing assessment of climate impacts and will reduce the impact on global climate warming influenced by all countries.

9.7 Greenhouse Gas Mitigation Measures

Springvale Coal is currently implementing a number of measures to minimise to the greatest extent practicable GHG emissions from the Springvale operations. Relevant measures are described below:

- Maximising energy efficiency as a key consideration in the development of the mine plan. For example, significant savings of greenhouse gas emissions (through increased energy efficiency) are achieved by mine planning decisions.
- The mine has developed and implemented an Energy and Greenhouse Management System and monitors and reports energy usage at the mine. Key Performance Indicators including energy demand and GHG emissions per tonne of ROM coal produced are tracked.

Additional measures that Springvale Coal are striving to achieve include:

- Identify and implement cost effective measures to improve energy efficiency;
- Regular maintenance of plant and equipment to minimise fuel consumption; and
- Consideration of energy efficiency in plant and equipment selection/phase.

Springvale Coal is currently investigating at a corporate level the measures which may be taken to offset Scope 1 emissions from their operations. This work is ongoing, but measures may include (but not limited to) alignment with biodiversity offsets, purchase of greenpower and switching to biodiesel fuel if considered feasible. These measures are being investigated and all measures taken to offset GHG emissions associated with the Project will be in alignment with the highest standards, such as the National Carbon Offset Standard).

No particular design measures can be incorporated into the Project to avoid impacts associated with GHG emissions.

10 CONCLUSIONS

SLR Consulting was commissioned by Springvale Coal Pty Ltd (Springvale Coal) to undertake an Air Quality Impact Assessment and Greenhouse Gas Assessment for the proposed Springvale Mine Extension Project.

The surface operations at the SMEP include receipt and processing of coal from the underground mine. It is noted that transferring the processed coal to Springvale Coal Services Washery, or Mt Piper or Wallerawang Power stations via an overland conveyor system has not been included in this assessment. The coal is currently being crushed using a rotary breaker and the crushing plant located on-site and is handled using bulldozers.

Potential dust emissions from the SMEP operation were estimated based on published emission factors and measured data from Angus Place Colliery's Ventilation Shaft. Dispersion modelling was performed for construction and operation of the proposed SMEP to predict the future incremental and cumulative impacts from the SMEP operation. An estimation of emissions and corresponding air quality impacts due to Project Application Area rehabilitation was also performed within this assessment.

Ambient air quality monitoring data from the OEH-operated Bathurst monitoring station were used as background to assess the cumulative impact from the SMEP.

The predicted results showed that the proposed SMEP or rehabilitation activities are unlikely to cause any exceedences of the relevant ambient air quality criteria for TSP, PM_{10} and $PM_{2.5}$ concentrations or dust deposition at any identified surrounding sensitive receptors.

The assessment also considers emissions of Greenhouse Gases (CH_4, CO_2 and SF_6) from the SMEP and includes estimates of direct and indirect GHG emissions.

The total lifetime direct (Scope 1) emissions from the Project are estimated to be approximately 22,697 CO_2-e in any one year.

Indirect (Scope 2 and 3) emissions would be released in the process of mining coal, and through the transport and end use of the coal. The total lifetime indirect emissions (Scope 2 and 3) from mining coal and end use of the coal are estimated to be 1,176,743 t CO_2-e per annum.

Comparison of Project emissions with State and National GHG emission totals indicates that the SMEP is likely to represent approximately 0.01% of NSW GHG emissions (Scope 1) when compared to the latest available emissions data (2010) (Scope 1) and 0.004% of Australian GHG emissions (Scope 1).

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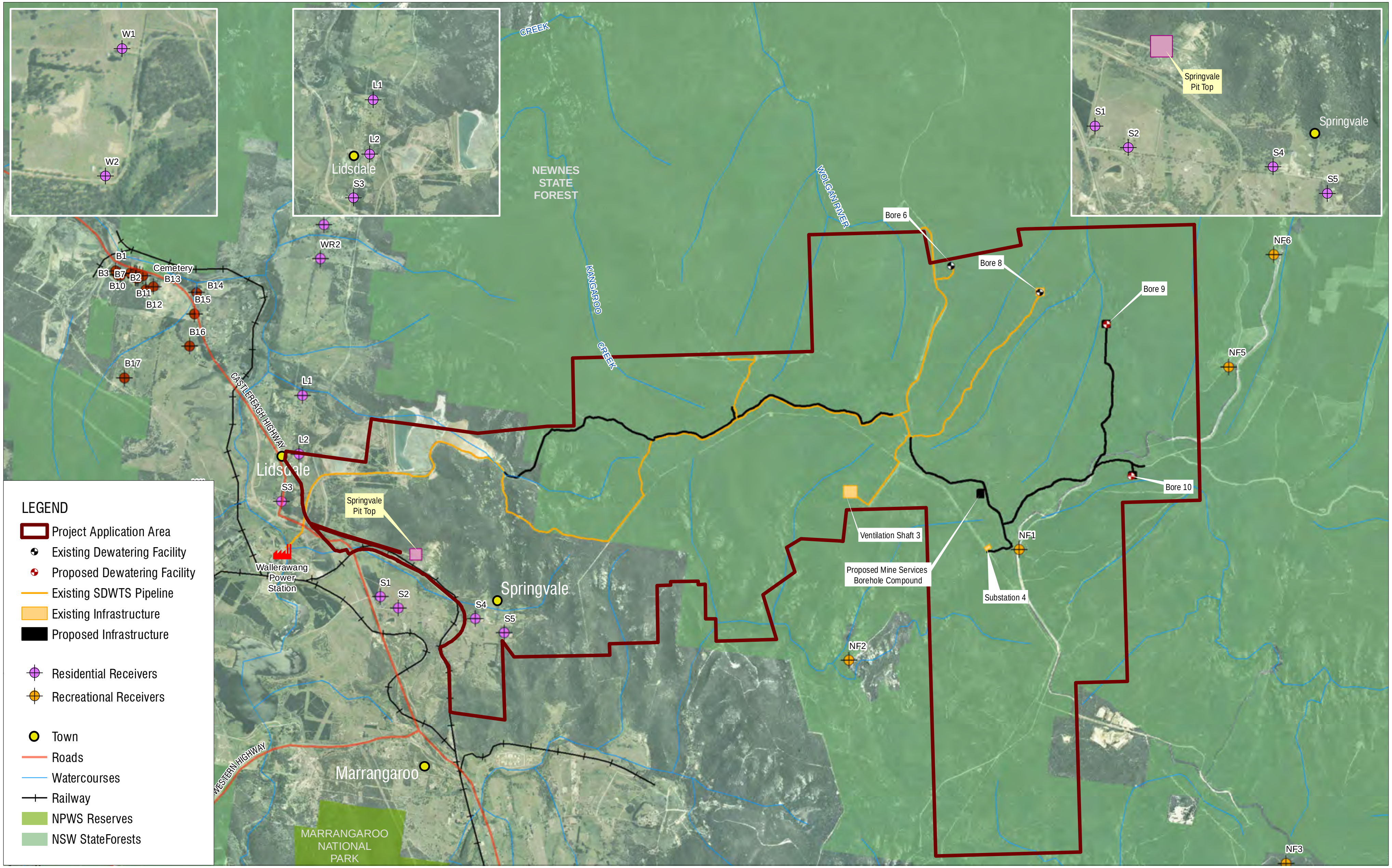
ESA Areas, Proposed Infrastructure and Sensitive Receptor Locations



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Scale:	1:75,000
Sheet Size:	A4
Projection:	GDA 1994 MGA Zone 56

Springvale Coal Pty Ltd

Springvale Extension Noise

Sensitive Receptor Locations

FIGURE 3

Table B-1 Emission Estimation - Operation

Activity	Intensity		Emission Factor				Variables		Ref
	Value	Units	TSP	PM_{10}	$PM_{2.5}$	Units	Parameter	Value	
Conveyor transfer points	18,000,000	tpa	0.0003	0.0001	0.00002	kg/t	Wind speed factor [1]	2.23	AP42
							Moisture content	10%	
							Control efficiency	40%	
Crushing	4,500,000	tpa	0.0100	0.0040	0.00040	kg/t	Control efficiency	70%	AP42
Dozers	8,760	hr/yr	15.3	3.7	0.34	kg/h	Silt content	6%	AP42
							Moisture content	10%	
Vehicle movement on unpaved roads	15,768	VKT/yr	1.856	0.431	0.04	kg/VKT	Silt content	3%	AP42
							Average gross mean vehicle weight	50 tonnes	
							Control efficiency	50%	
Wind erosion - Exposed areas	2.3	ha	0.40	0.20	0.03	kg/ha/hr	Hours per year	8,760 hours	NPI
							Control efficiency	50%	
Ventilation fan (Vertical)	221.1	m³/s	0.60	0.04	0.03	mg/m³			

Note: Wind Speed Factor = average of $(\text{wind speed}/2.2)^{1.3}$

Table B-2 Emission Estimation - Construction

Activity	Intensity		Emission Factor				Variables		Ref
	Value	Units	TSP	PM_{10}	$PM_{2.5}$	Units	Parameter	Value	
Dozers	35,098	Hr/yr	1.6	0.3	0.03	kg/hr	Silt content	3%	AP42
							Moisture content	4%	
							Control efficiency	None	
Graders	1825	VKT/yr	0.1	0.04	0.002	kg/t	Silt content	3%	AP42
Vehicle movement on unpaved roads	18,250	VKT/yr	1.856	0.431	0.04	kg/VKT	Silt content	3%	AP42
							Average gross mean vehicle weight	50 tonnes	
							Control efficiency	50%	
Excavators	1,460,000	tpa	0.0010	0.0005	0.00007	Kg/t	Wind speed factor [1]	2.23	AP42
							Moisture content	4%	
Drilling	54,750	holes/yr	0.59	0.23	0.03	Kg/hole			AP42
Wind erosion - Exposed areas	4	ha	0.40	0.20	0.03	kg/ha/hr	Hours per year	8,760 hours	NPI

Note: Wind Speed Factor = average of $(\text{wind speed}/2.2)^{1.3}$

Table B-3 Emission Estimation - Rehabilitation

Activity	Intensity		Emission Factor				Variables		Ref
	Value	Units	TSP	PM_{10}	$PM_{2.5}$	Units	Parameter	Value	
Dozers	43,800	Hr/yr	1.6	0.3	0.03	kg/hr	Silt content	3%	AP42
							Moisture content	4%	
							Control efficiency	None	
Graders	183	VKT/yr	0.1	0.04	0.002	kg/t	Silt content	3%	AP42
Vehicle movement on unpaved roads	3,650	VKT/yr	1.856	0.431	0.04	kg/VKT	Silt content	3%	AP42
							Average gross mean vehicle weight	50 tonnes	
							Control efficiency	50%	
Excavators	730,000	tpa	0.0010	0.0005	0.00007	Kg/t	Wind speed factor [1]	2.23	AP42
							Moisture content	4%	
Wind erosion - Exposed areas	2.3	ha	0.40	0.20	0.03	kg/ha/hr	Hours per year	8,760 hours	NPI

Note: Wind Speed Factor = average of $(\text{wind speed}/2.2)^{1.3}$

Windroses

Figure C-1 Annual and Seasonal Windroses (2009)

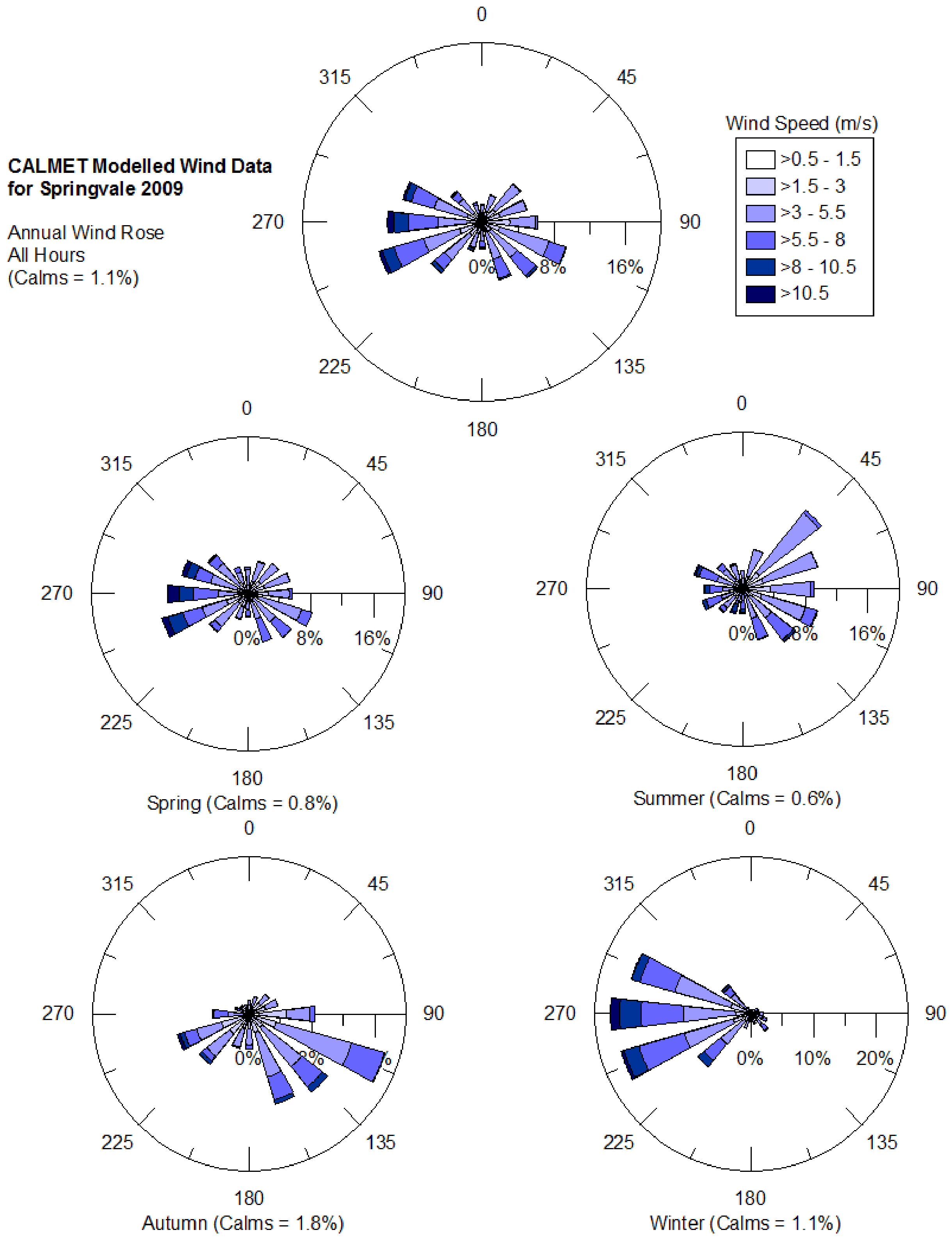
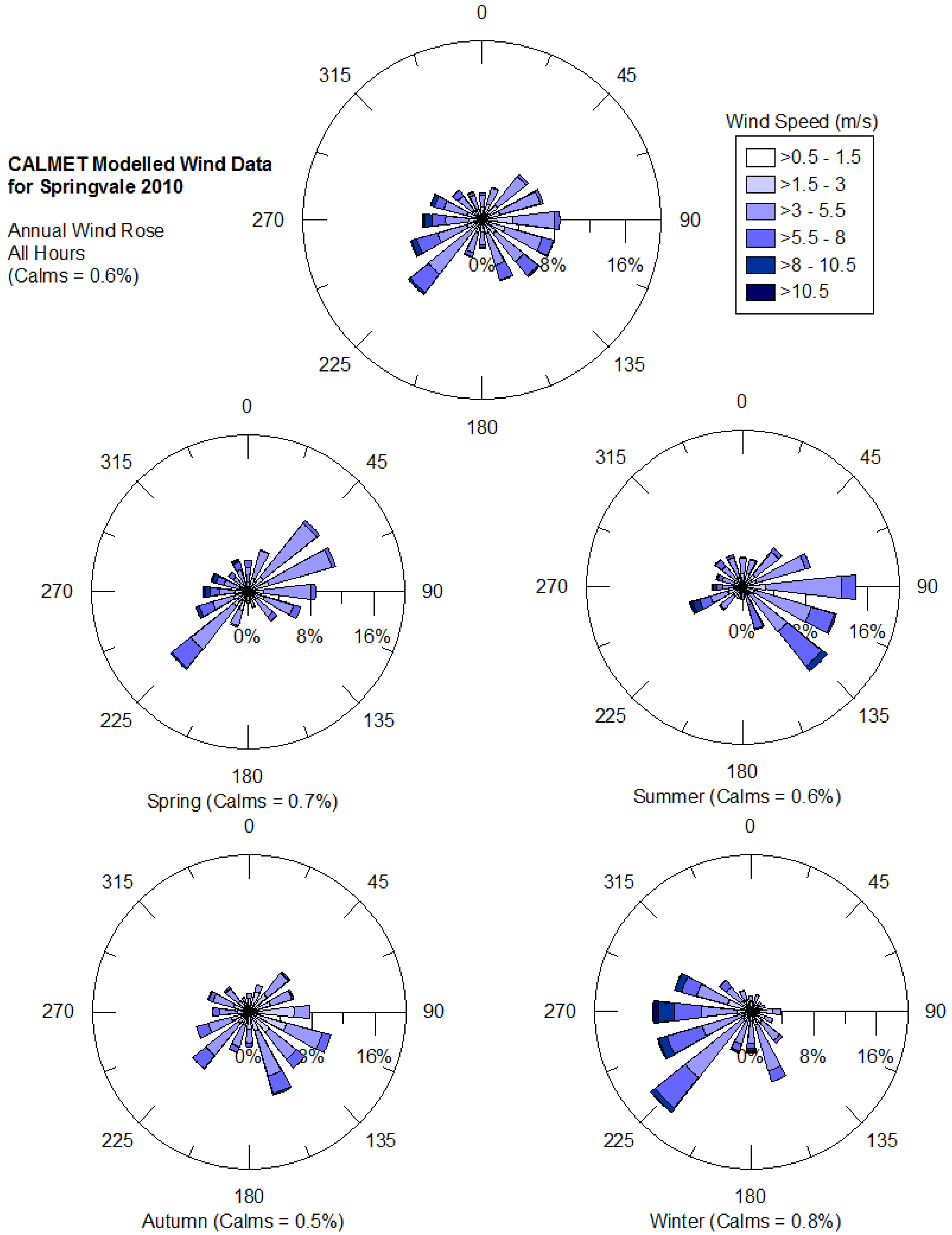


Figure C-2 Annual and Seasonal Windroses 2011

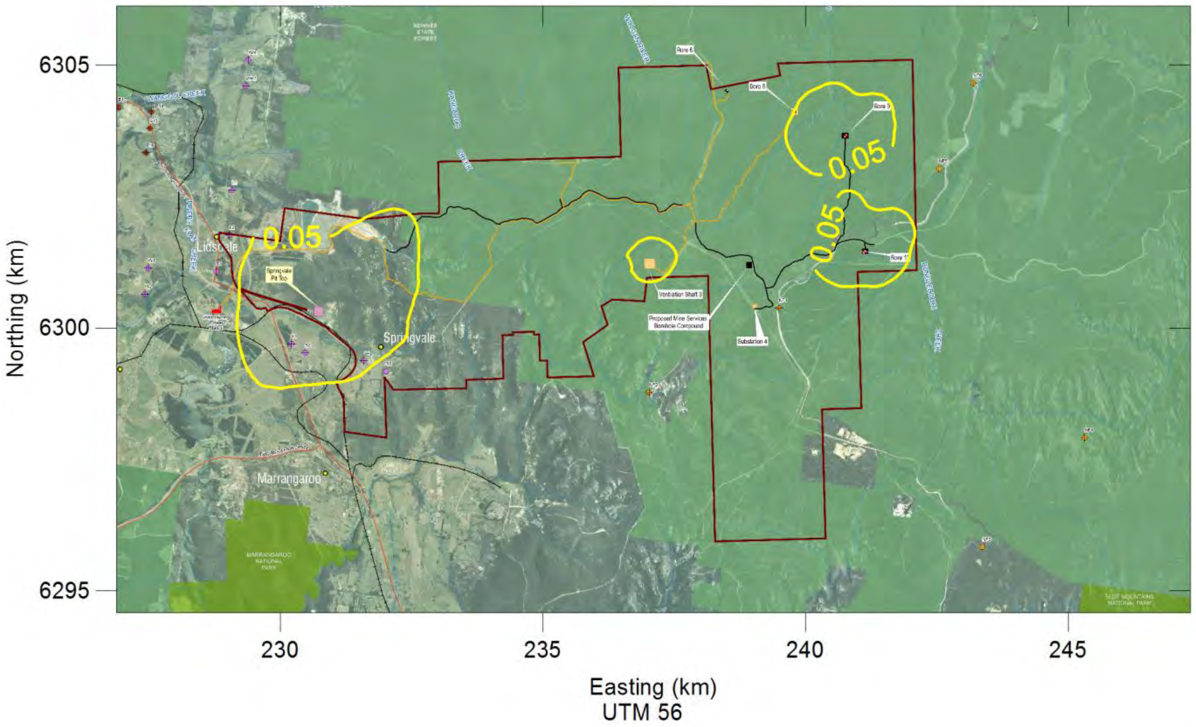


Appendix D

Contour Plots

CONSTRUCTION MODELLING RESULTS – CONTOUR PLOTS

Figure 1 Predicted Annual Average Dust Deposition Rate – Construction



Predicted Annual Average Dust Deposition Rate (g/m²/month)

LEGEND

- Residential Receivers
- Recreational Receivers
- Project Application Area

NOTES

Dispersion Model: Calpuff V6.267
Meteorological Year: 2010
Modeller: FR

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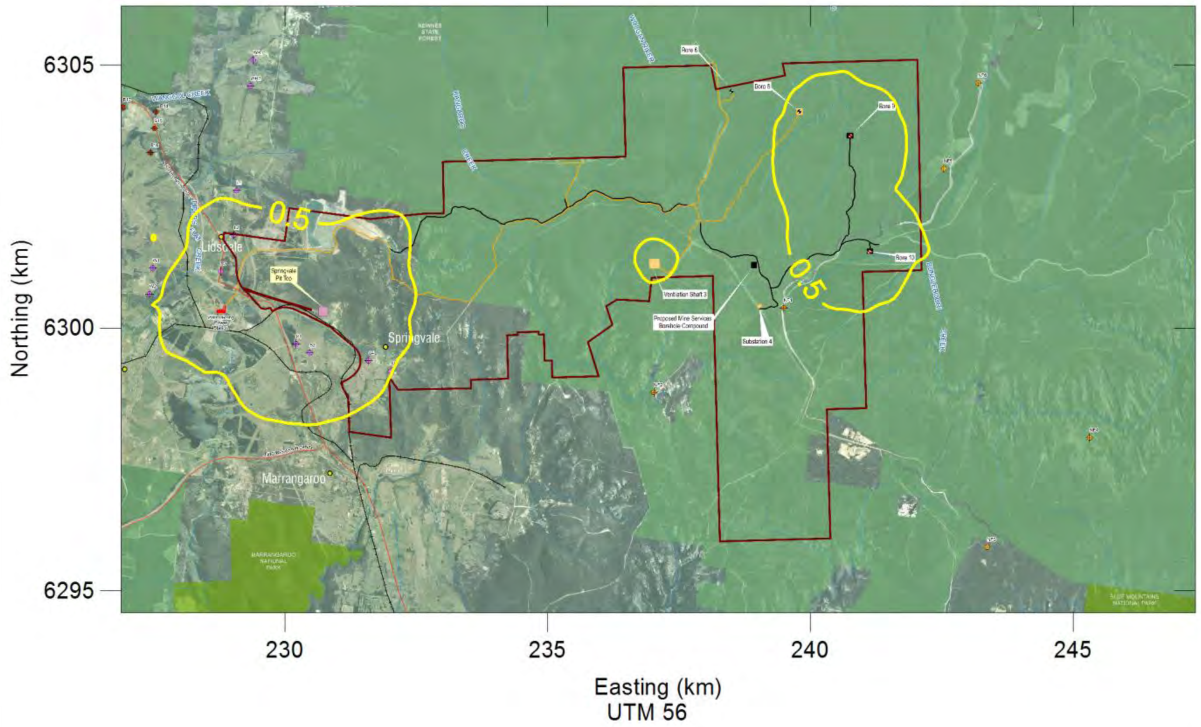
INCREMENTAL - Construction

Project No. 620.10123	Date 26/08/2013

CONSTRUCTION MODELLING RESULTS – CONTOUR PLOTS

Figure 2 Predicted Annual Average Incremental TSP Concentrations – Construction



Predicted Annual Average TSP Concentrations (µg/m³)

LEGEND

- Residential Receivers
- Recreational Receivers
- Project Application Area

NOTES

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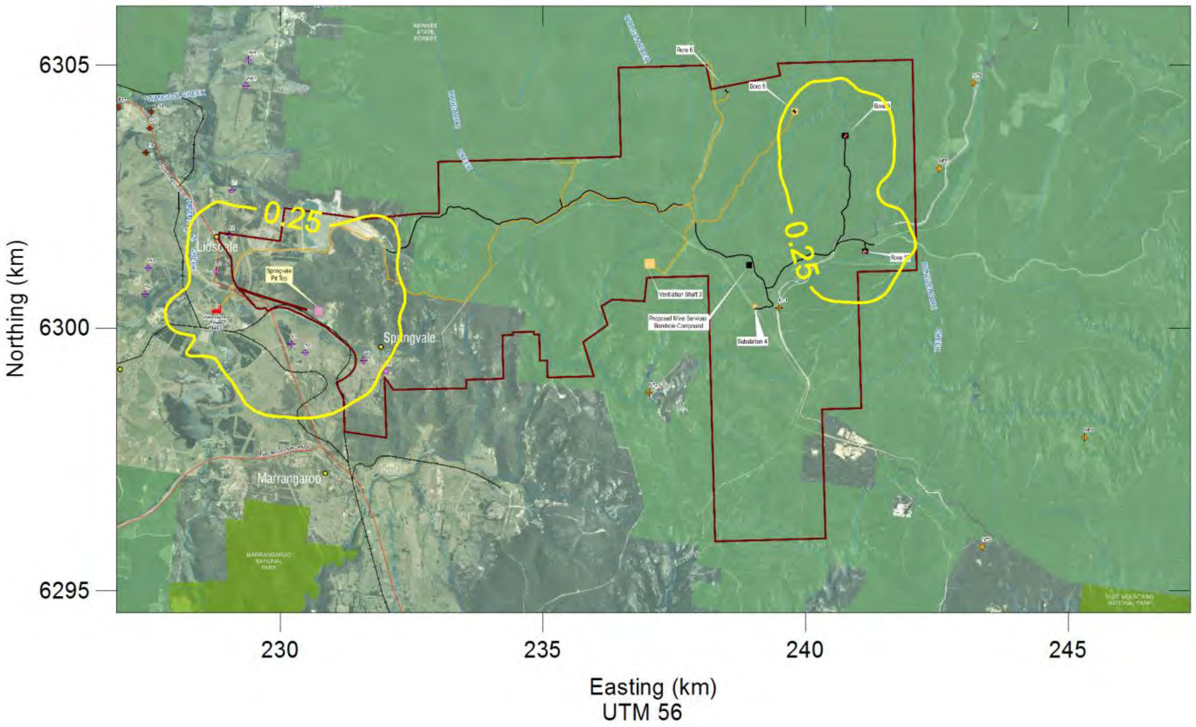
CONSTRUCTION MODELLING RESULTS – CONTOUR PLOTS

Figure 3 Predicted Annual Average Incremental PM_{10} Concentrations – Construction



Predicted Annual Average PM10 Concentrations (µg/m³)

LEGEND

- Residential Receivers
- Recreational Receivers
- Project Application Area

NOTES

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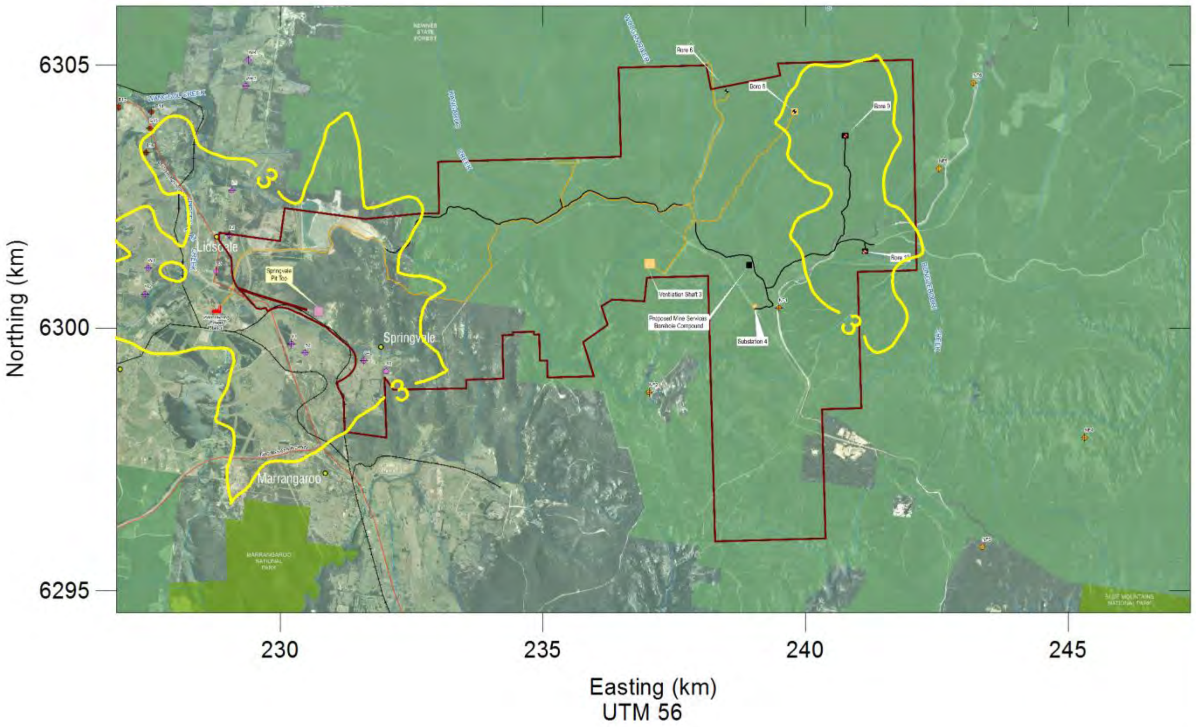
CONSTRUCTION MODELLING RESULTS – CONTOUR PLOTS

Figure 4 **Maximum Predicted 24-Hour Average Incremental PM_{10} Concentrations – Construction**



Maximum Predicted 24-Hour Average PM10 Concentrations (µg/m³)

LEGEND

- Residential Receivers
- Recreational Receivers
- Project Application Area

NOTES

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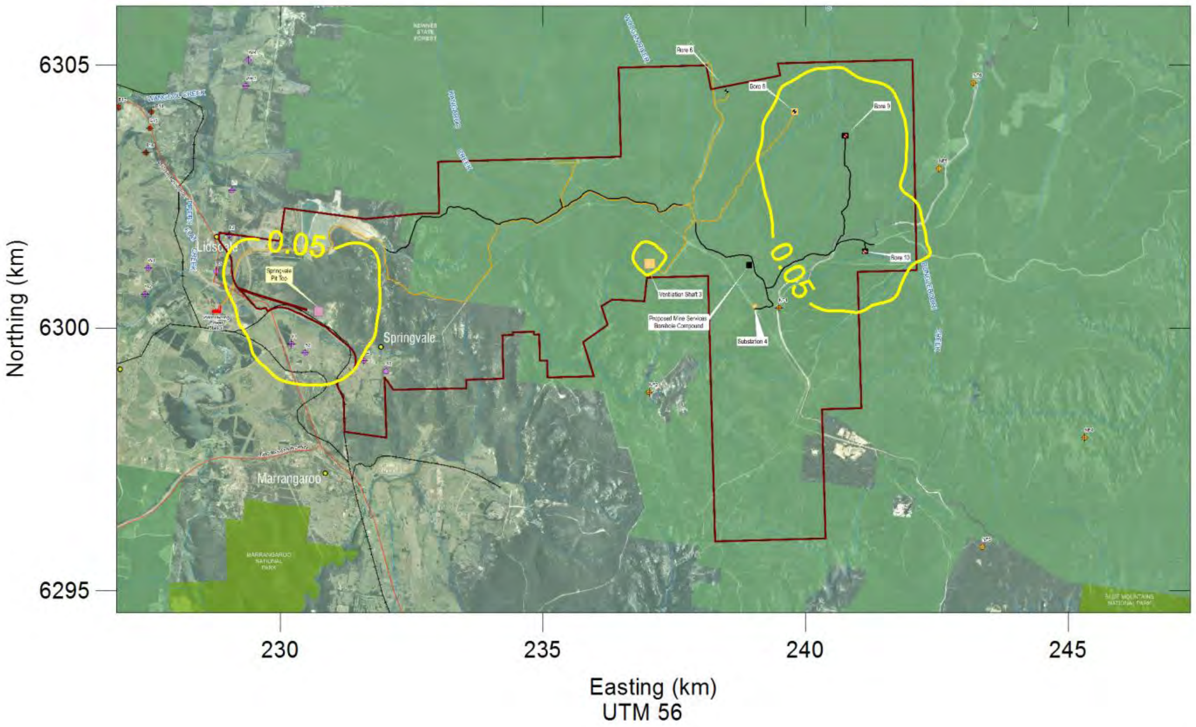
INCREMENTAL - Construction

Project No.	Date
620.10123	26/08/2013

Figure 5 Predicted Annual Average Incremental $PM_{2.5}$ Concentrations – Construction



Predicted Annual Average PM2.5 Concentrations (µg/m³)

LEGEND
- Residential Receivers
- Recreational Receivers
- Project Application Area

NOTES
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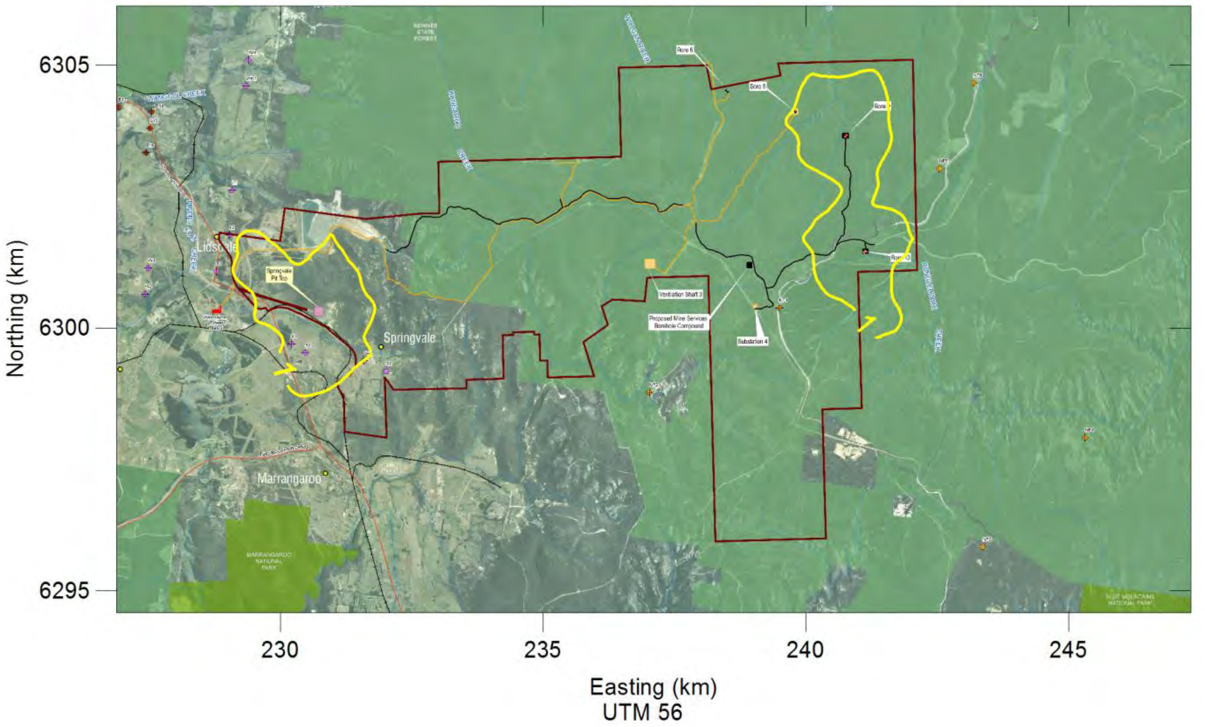
INCREMENTAL - Construction

Project No. 620.10123	Date 26/08/2013

CONSTRUCTION MODELLING RESULTS – CONTOUR PLOTS

Figure 6 Maximum Predicted 24-Hour Average Incremental $PM_{2.5}$ Concentrations – Construction



Maximum Predicted 24-Hour Average PM2.5 Concentrations (µg/m³)

LEGEND

- Residential Receivers
- Recreational Receivers
- Project Application Area

NOTES

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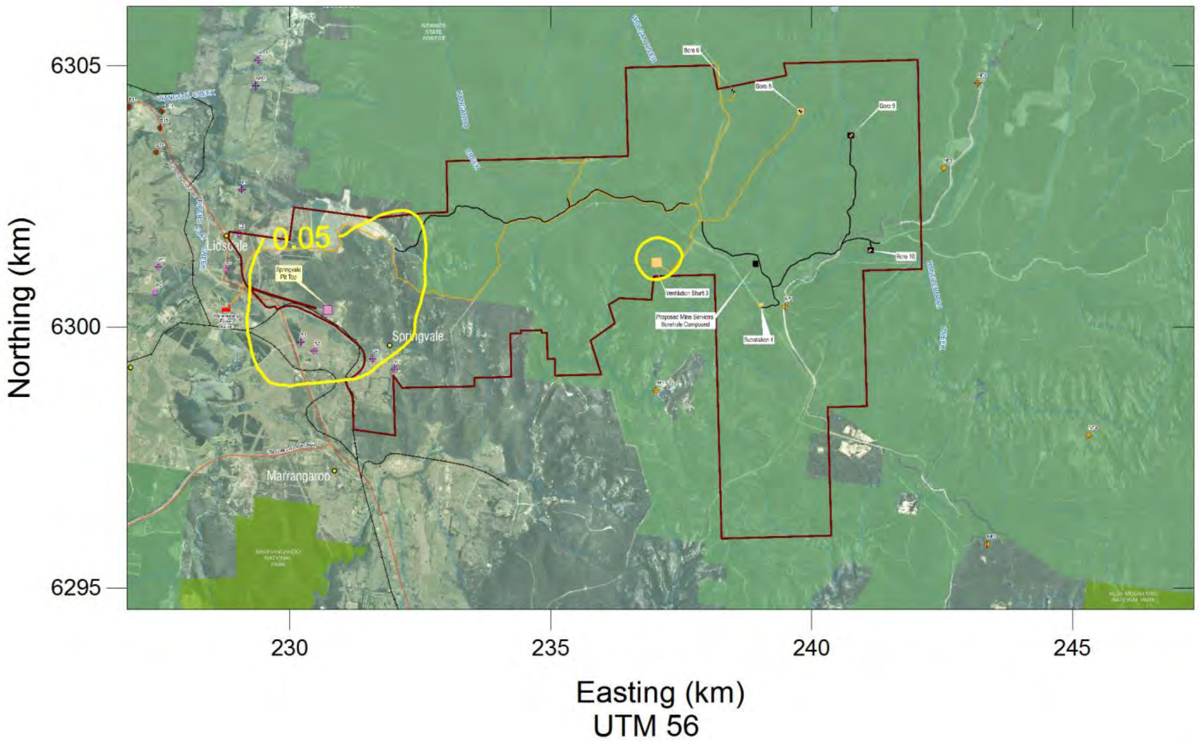
INCREMENTAL - Construction

Project No. 620.10123	Date 26/08/2013

OPERATION MODELLING RESULTS – CONTOUR PLOTS

Figure 7 **Predicted Annual Average Dust Deposition Rate – Operation**



Predicted Annual Average Dust Deposition Rate ($g/m^2/month$)

LEGEND

- Residential Receivers
- Recreational Receivers
- Project Application Area

NOTES

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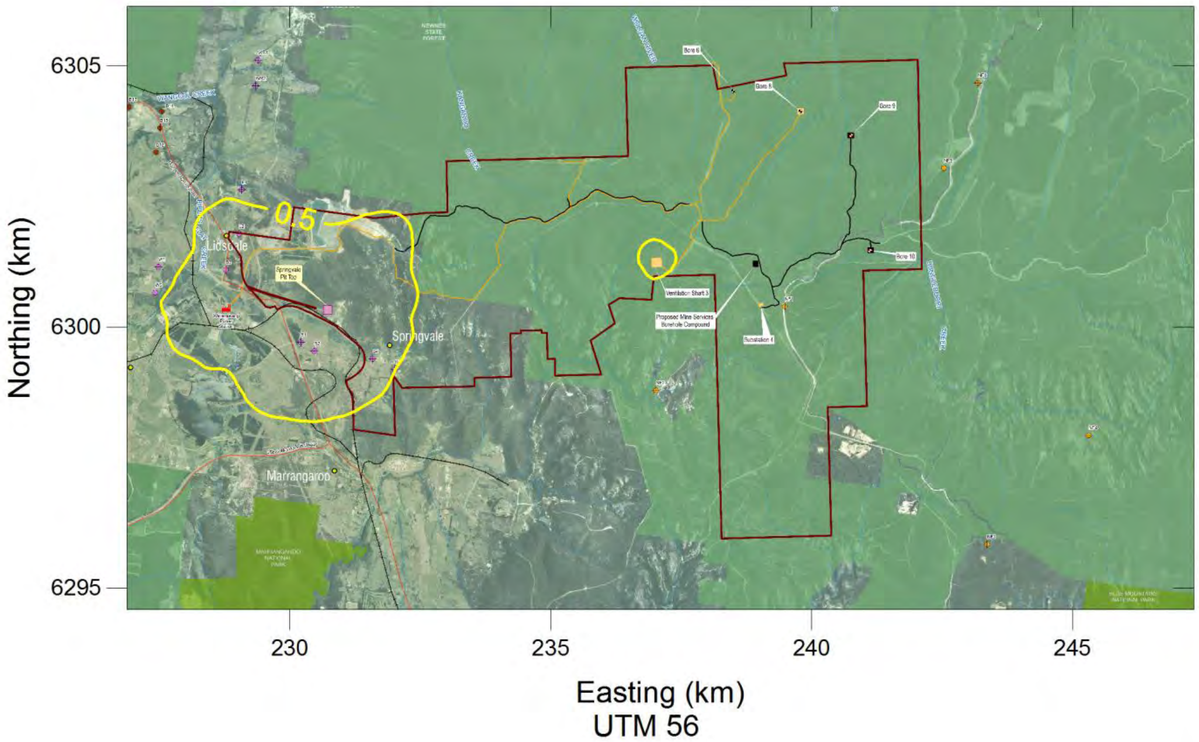
INCREMENTAL - Operation

Project No. 620.10123	Date 26/08/2013

OPERATION MODELLING RESULTS – CONTOUR PLOTS

Figure 8 Predicted Annual Average Incremental TSP Concentrations – Operation



Predicted Annual Average TSP Concentrations (µg/m³)

LEGEND

- Residential Receivers
- Recreational Receivers
- Project Application Area

NOTES

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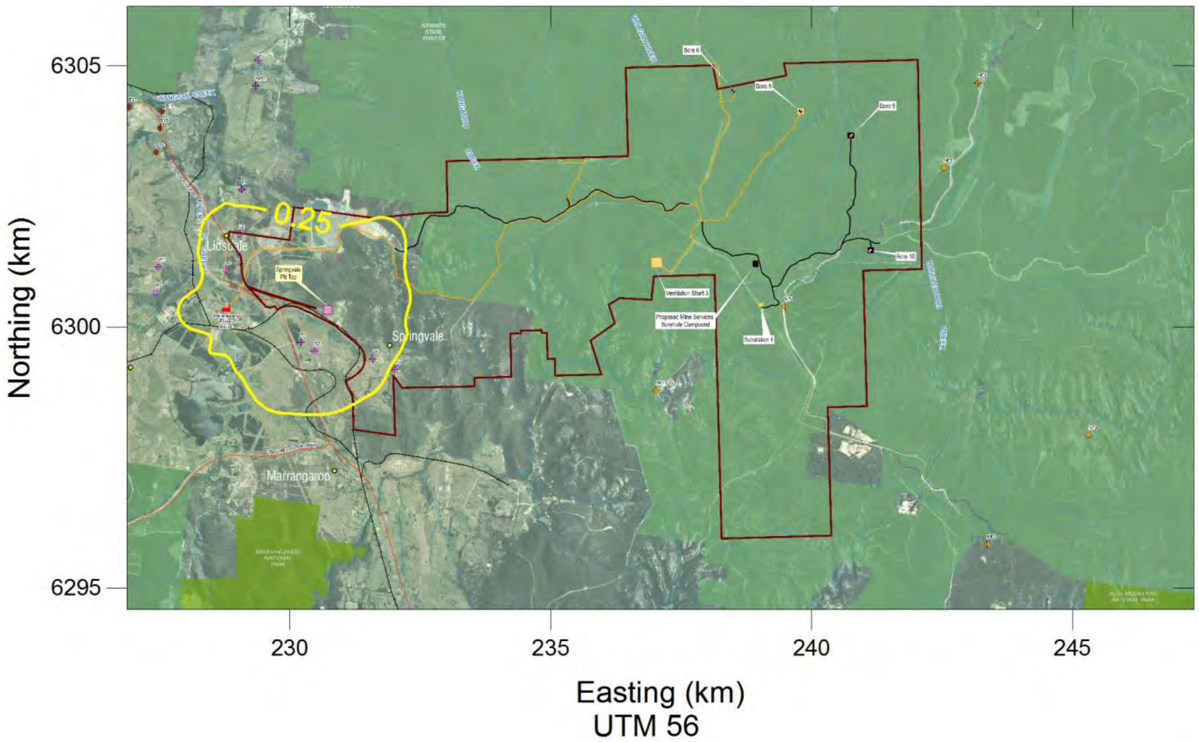
INCREMENTAL - Operation

Project No. 620.10123 Date 26/08/2013

OPERATION MODELLING RESULTS – CONTOUR PLOTS

Figure 9 Predicted Annual Average Incremental PM_{10} Concentrations – Operation



Predicted Annual Average PM10 Concentrations (µg/m³)

LEGEND

- Residential Receivers
- Recreational Receivers
- Project Application Area

NOTES

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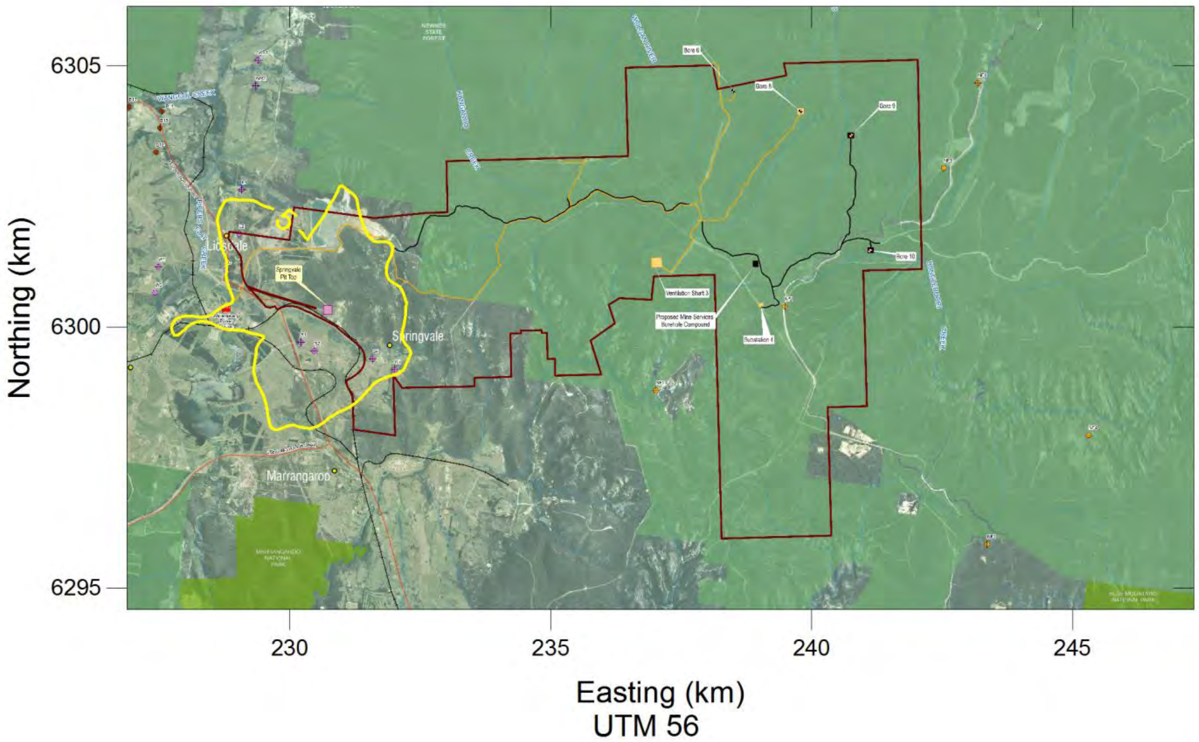
INCREMENTAL - Operation

Project No. 620.10123	Date 26/08/2013

OPERATION MODELLING RESULTS – CONTOUR PLOTS

Figure 10 Maximum Predicted 24-Hour Average Incremental PM_{10} Concentrations – Operation



Maximum Predicted 24-Hour Average PM10 Concentrations (µg/m³)

LEGEND

- Residential Receivers
- Recreational Receivers
- Project Application Area

NOTES

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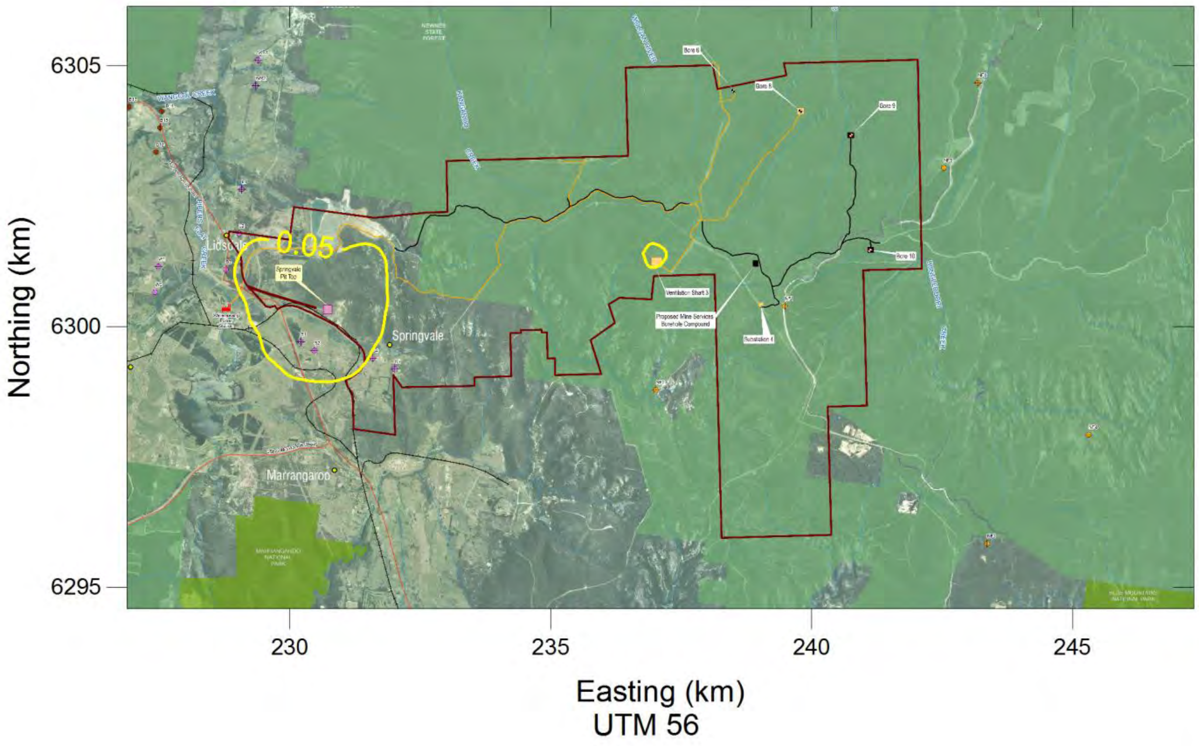
Project No. 620.10123 | Date 26/08/2013

OPERATION MODELLING RESULTS – CONTOUR PLOTS

Figure 11 Predicted Annual Average Incremental $PM_{2.5}$ Concentrations – Operation



Predicted Annual Average PM2.5 Concentrations (µg/m³)

LEGEND

- Residential Receivers
- Recreational Receivers
- Project Application Area

NOTES

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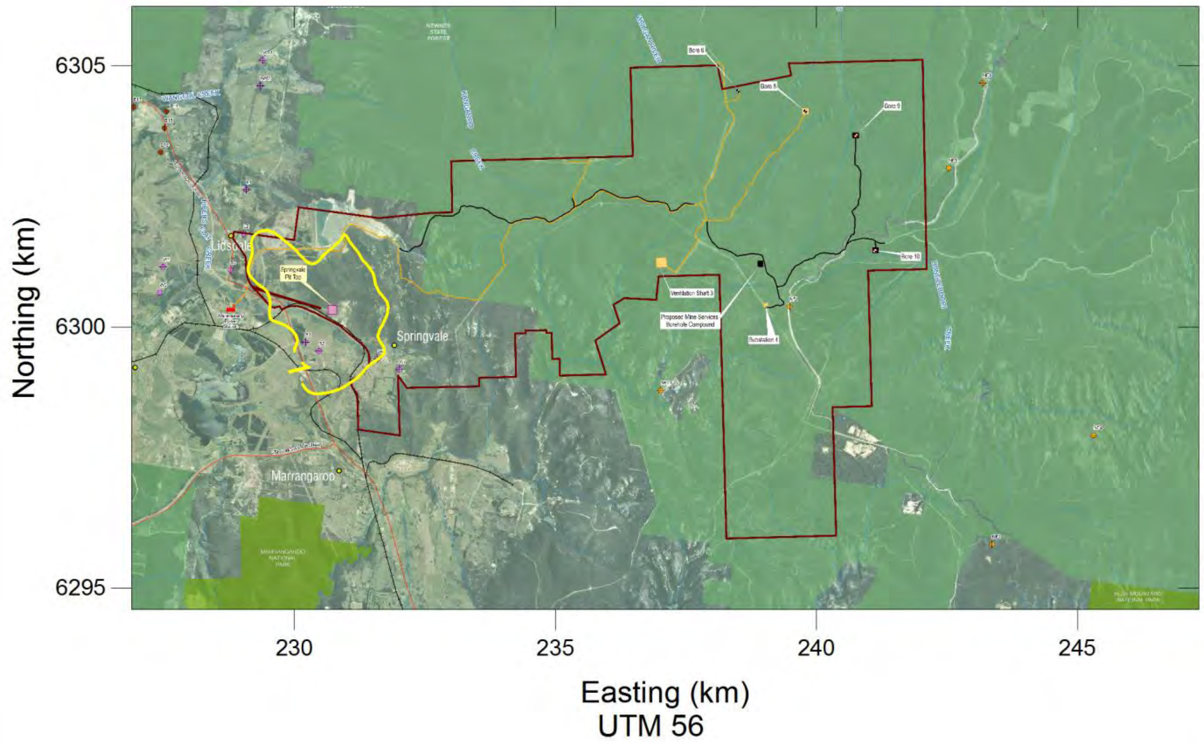
INCREMENTAL - Operation

Project No.	620.10123	Date	26/08/2013

Figure 12 Maximum Predicted 24-Hour Average Incremental $PM_{2.5}$ Concentrations – Operation



Maximum Predicted 24-Hour Average PM2.5 Concentrations (µg/m³)

LEGEND

- Residential Receivers
- Recreational Receivers
- Project Application Area

NOTES

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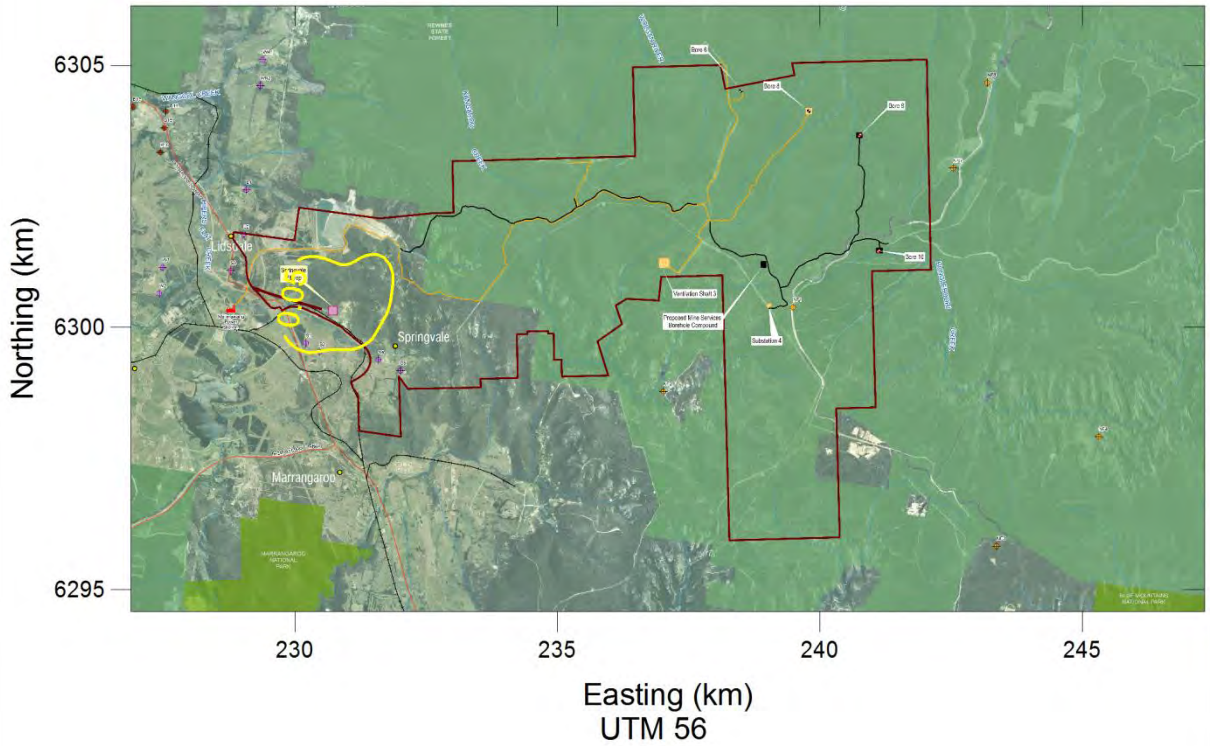
INCREMENTAL - Operation

Project No. 620.10123 | Date 26/08/2013

REHABILITATION MODELLING RESULTS – CONTOUR PLOTS

Figure 13 Predicted Annual Average Dust Deposition Rate – Rehabilitation



Predicted
Annual Average
Dust Deposition Rate (g/m²/month)

LEGEND

- Residential Receivers
- Recreational Receivers
- Project Application Area

NOTES

Dispersion Model: Calpuff V6.267
Meteorological Year: 2010
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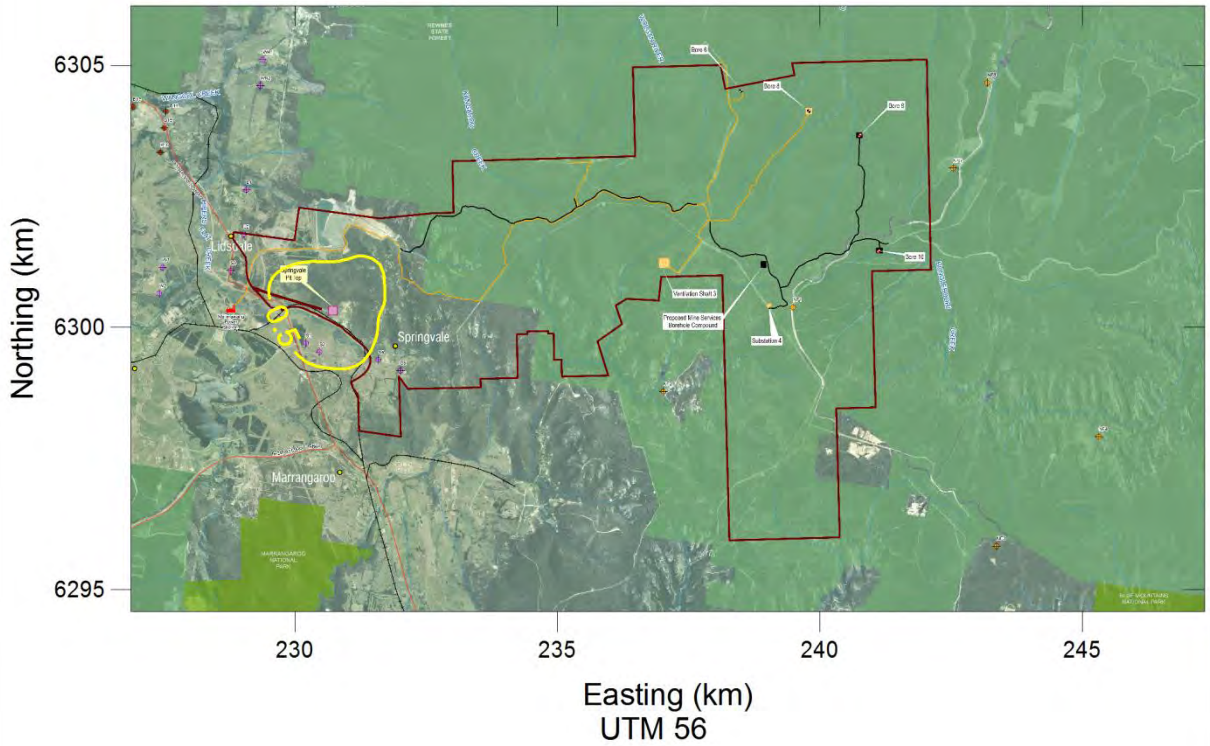
AIR DISPERSION MODELLING STUDY FOR SPRINGVALE MINE EXTENSION PROJECT

INCREMENTAL - Rehabilitation

Project No. 620.10123	Date 26/08/2013

REHABILITATION MODELLING RESULTS – CONTOUR PLOTS

Figure 14 Predicted Annual Average Incremental TSP Concentrations – Rehabilitation



Predicted Annual Average TSP Concentrations (µg/m³)

LEGEND

- Residential Receivers
- Recreational Receivers
- Project Application Area

NOTES

Dispersion Model: Calpuff V6.267
Meteorological Year: 2010
Modeller: FR

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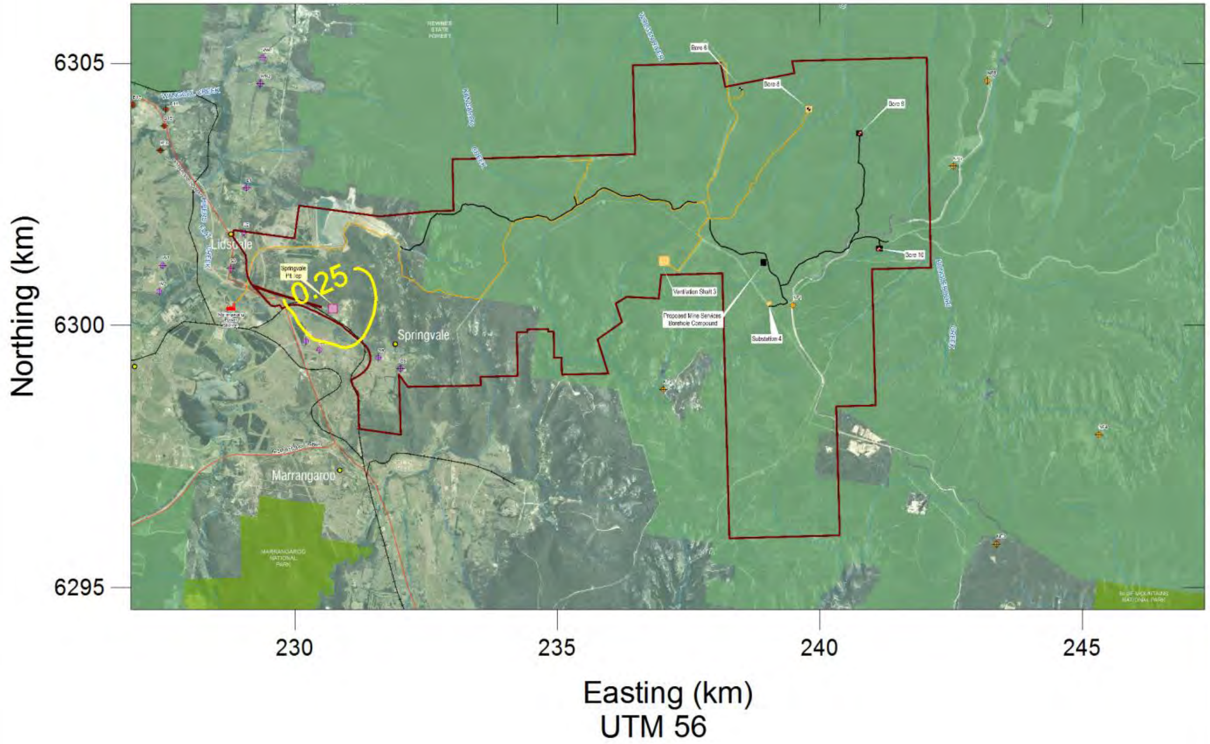
AIR DISPERSION MODELLING STUDY FOR SPRINGVALE MINE EXTENSION PROJECT

INCREMENTAL - Rehabilitation

Project No. 620.10123	Date 26/08/2013

REHABILITATION MODELLING RESULTS – CONTOUR PLOTS

Figure 15 **Predicted Annual Average Incremental PM_{10} Concentrations – Rehabilitation**



Predicted Annual Average PM10 Concentrations (µg/m³)

LEGEND

- Residential Receivers
- Recreational Receivers
- Project Application Area

NOTES

Dispersion Model: Calpuff V6.267
Meteorological Year: 2010
Modeller: FR

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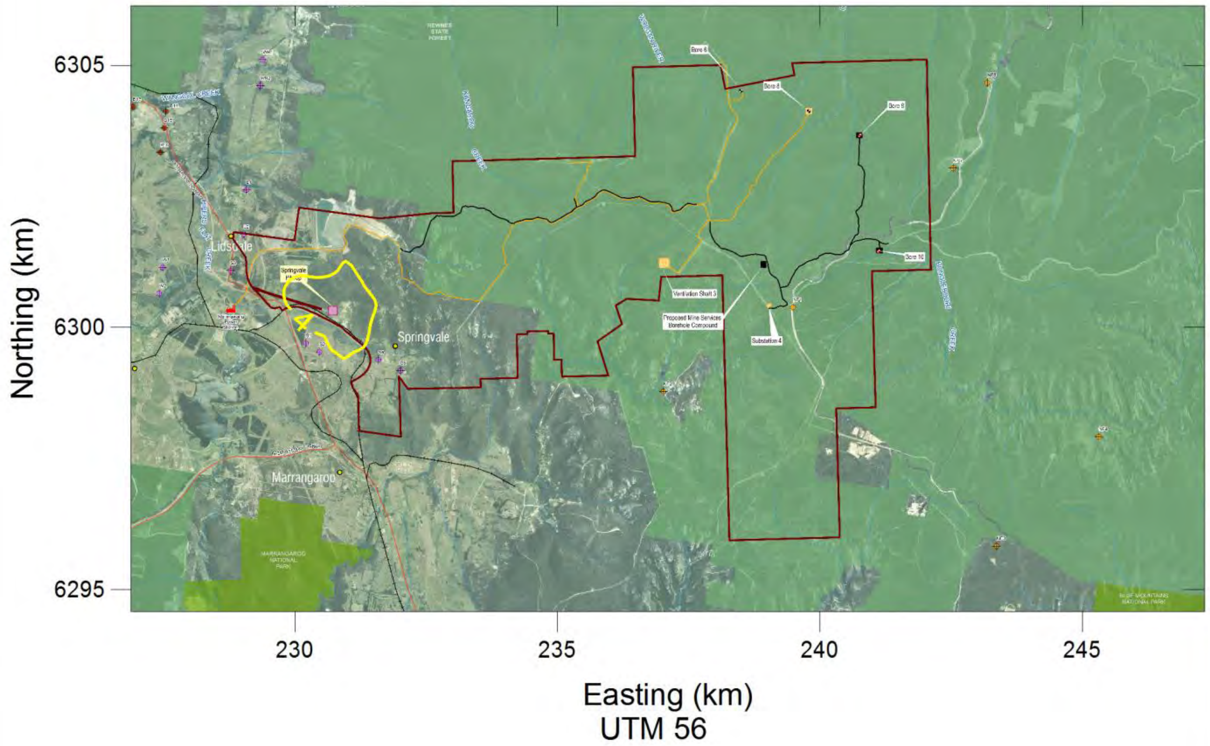
AIR DISPERSION MODELLING STUDY FOR SPRINGVALE MINE EXTENSION PROJECT

INCREMENTAL - Rehabilitation

Project No. 620.10123	Date 26/08/2013

REHABILITATION MODELLING RESULTS – CONTOUR PLOTS

Figure 16 Maximum Predicted 24-Hour Average Incremental PM_{10} Concentrations – Rehabilitation



Maximum Predicted 24-Hour Average PM10 Concentrations (µg/m³)

LEGEND

- Residential Receivers
- Recreational Receivers
- Project Application Area

NOTES

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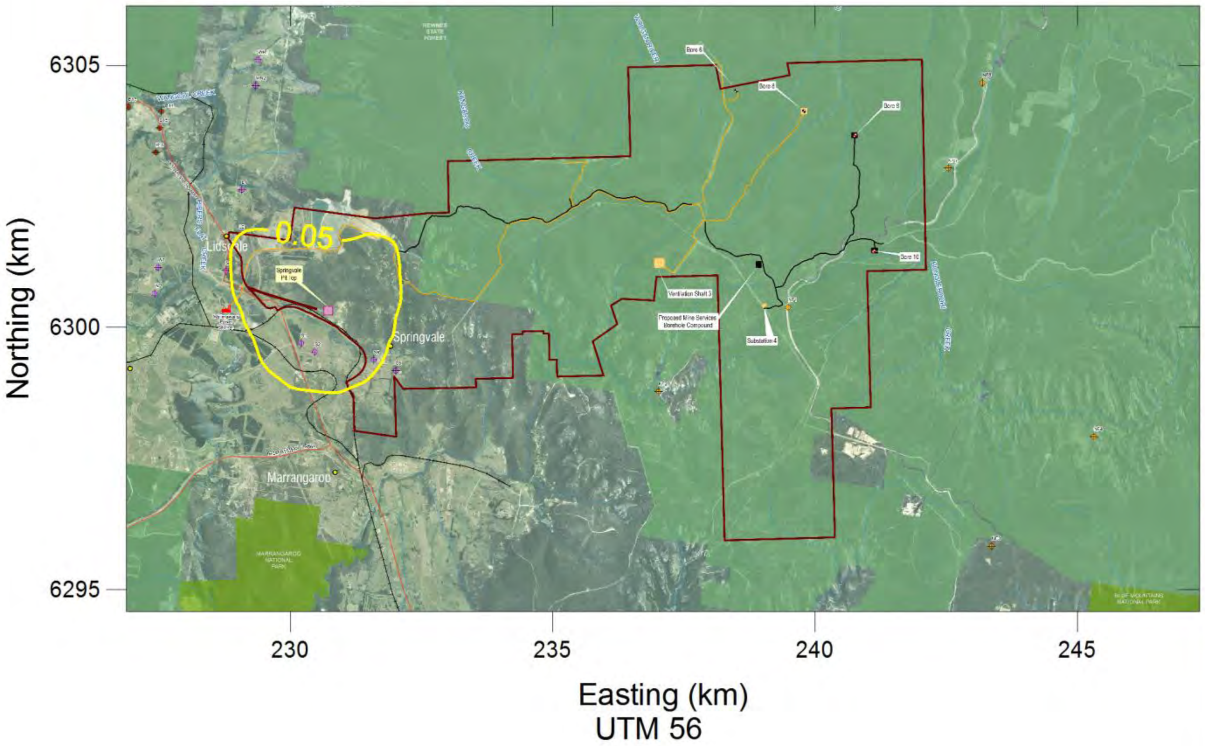
AIR DISPERSION MODELLING STUDY FOR SPRINGVALE MINE EXTENSION PROJECT

INCREMENTAL - Rehabilitation

Project No. 620.10123	Date 26/08/2013

Figure 17 **Predicted Annual Average Incremental $PM_{2.5}$ Concentrations – Rehabilitation**



Predicted Annual Average PM2.5 Concentrations (µg/m³)

LEGEND

- Residential Receivers
- Recreational Receivers
- Project Application Area

NOTES

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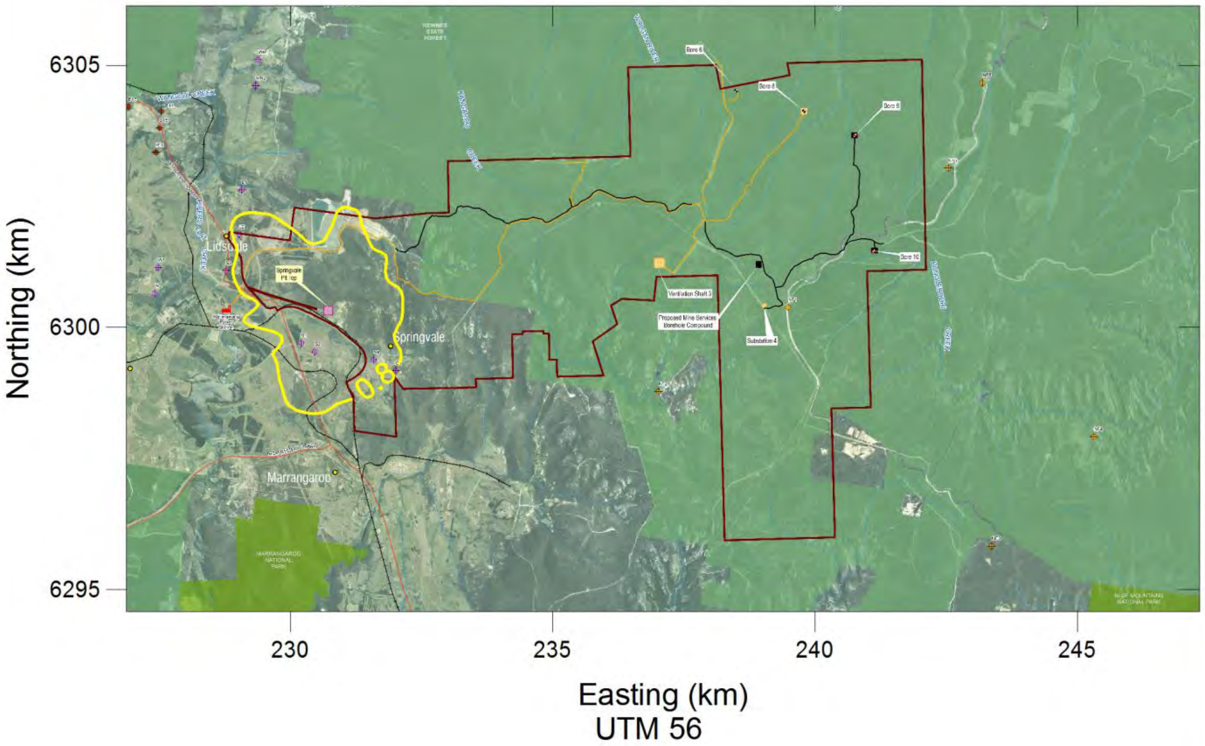
AIR DISPERSION MODELLING STUDY FOR SPRINGVALE MINE EXTENSION PROJECT

INCREMENTAL - Rehabilitation

Project No. 620.10123 | Date 26/08/2013

Figure 18 Maximum Predicted 24-Hour Average Incremental $PM_{2.5}$ Concentrations – Rehabilitation



Maximum Predicted 24-Hour Average PM2.5 Concentrations (µg/m³)

LEGEND

- Residential Receivers
- Recreational Receivers
- Project Application Area

NOTES

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Modeller: FR

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AIR DISPERSION MODELLING STUDY FOR SPRINGVALE MINE EXTENSION PROJECT

INCREMENTAL - Rehabilitation

Project No. 620.10123	Date 26/08/2013

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