



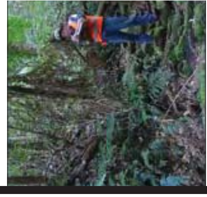


APPENDIX 9

Newstan Colliery Air Quality Impact Assessment

Report Number 630.10002

06-May-2011

Centennial Coal Company Limited
PO Box 1000TorontoNSW 2283

Version: Final

Newstan Colliery Air Quality Impact Assessment

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EXECUTIVE SUMMARY

SLR Consulting Ltd (SLR, formerly Heggies Pty Ltd) has been commissioned by Centennial Newstan Pty Limited (Centennial Newstan) to undertake an Air Quality Impact Assessment for the Newstan Colliery underground coal mine located northwest of Fassifern on the western side of Lake Macquarie, New South Wales.

The objective of the air quality assessment was to identify the potential air quality impacts from operation of the Newstan Colliery and to provide advice with regard to effective mitigation strategies where necessary.

Project Description

The Newstan Colliery is an existing underground coal mining operation located in Fassifern on the western side of Lake Macquarie in the Newcastle Coalfield of New South Wales. Surface facilities at the Newstan Colliery include workforce amenities, mining support infrastructure, coal stockpiles, coal handling facilities, coal preparation plant (CPP) and a rail loop. The Newstan Colliery ceased underground mining production in 2009 however continues to operate the surface facilities to process and handle coal from other Centennial Coal operations.

Operational Dust Predictions

Emissions of Total Suspended Particulate (TSP), Particulate Matter less than 10 µm (PM_{10}) and Particulate Matter less than 2.5 µm ($PM_{2.5}$) from the proposed activities at the site were estimated using emission estimation techniques published by the National Pollutant Inventory (NPI) and the US EPA.

The estimated emission rates were then used as inputs into the CALPUFF dispersion modelling suite to predict spatial impacts of pollutant dispersion as a result of the Newstan Colliery operation. The predicted spatial impacts were assessed against New South Wales Department of Climate Change and Water (DECCW) and National Environmental Pollutant Measure (NEPM) guidelines for particulate matter.

The dispersion modelling predicted a likelihood of exceedances at the nearest sensitive receptors of regulatory guidelines for:

- PM_{10} as a 24 hour average;

Annual average TSP, PM_{10}, $PM_{2.5}$, deposited dust (the fraction of dust that settles out of the airborne dust due to gravitation) and 24 hour average $PM_{2.5}$ were not predicted to exceed DECCW guidelines at any of the receptors. It should be noted that the NEPM $PM_{2.5}$ guidelines have not formally been adopted by DECCW and have been included for reference only.

The major emission sources on site are the front end loaders and wind erosion from the rail loop area. Background concentrations of PM_{10} also contribute significantly to predicted offsite 24 hour PM_{10} concentration exceedances. The dispersion modelling resulting in exceedances of PM_{10} as a 24 hour average was developed based on a worst case operational scenario. To ensure exceedances of air quality criteria are avoided, Centennial Newstan will implement a range of best practice dust mitigation measures and develop a reactive management program to monitor and react to elevated PM_{10} concentrations.

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1 INTRODUCTION

SLR Consulting Ltd (SLR, formerly Heggies Pty Ltd) has been commissioned by Centennial Newstan Pty Limited (Centennial Newstan) to undertake an Air Quality Impact Assessment (AQIA) for the Newstan Colliery. Newstan Colliery is located in the township of Fassifern 16 km southwest of Newcastle, in NSW.

The NSW Department of Environment, Climate Change and Water (DECCW) "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" (DECCW, 2005) (the Approved Methods) outline the requirements for conducting an AQIA, as follows:

1) Description of local topographic features and sensitive receptor locations (**Section 3**).
2) Establishment of air quality assessment criteria (**Section 4**).
3) Analysis of climate and dispersion meteorology for the region (**Sections 8.2 and 8.3**).
4) Description of existing air quality environment (**Section 5**).
5) Compilation of a comprehensive emissions inventory for proposed operations (**Section 7**).
6) Completion of atmospheric dispersion modelling and analysis of results (**Section 9)**.
7) Preparation of an air quality impact assessment report comprising the above.

This assessment report describes the existing environment of the area surrounding the Newstan Colliery and contains detailed information relating to items 1 to 6 above in the sections noted.

1.1 Limitations

The key limitations of this study are associated with:

- The representativeness of the published emission rates used to estimate emissions from proposed activities at the site for the purposes of predicting dust impacts at the receptor locations; and
- The limitations inherent to the use of numerical modelling tools such as TAPM, CALMET and CALPUFF. It is important to note that all numerical models that are based on approximating a governing set of equations will inherently be associated with some degree of error. The more complex the physical model, the greater the number of physical processes which must be parameterised. This frequently results in a large number of adjustable parameters within the model. There exists extensive in-house expertise in the use of TAPM, CALMET and CALPUFF within SLR and our modellers make every reasonable attempt to ensure that model results are of the highest possible quality.

This study necessarily relies on the accuracy of the following data sets:

- Information including material properties, production volumes and operational practices provided by the Proponent;
- Ambient monitoring data obtained from site monitoring network;
- Ambient monitoring data obtained from the DECCW; and
- Terrain and landuse information for the region sourced from the databases described in Section **8.3**.

A number of assumptions have been applied within this assessment. These include:

- Dust emission rates derived from published emission factors are representative of emissions from proposed activities at Newstan Colliery;
- Default values of parameters (in association with the development of emission factors) are representative of on-site conditions; and
- Simulated meteorology adequately represents local conditions.

2 NEWSTAN COLLIERY OVERVIEW

2.1 Overview of Site Location and Operations

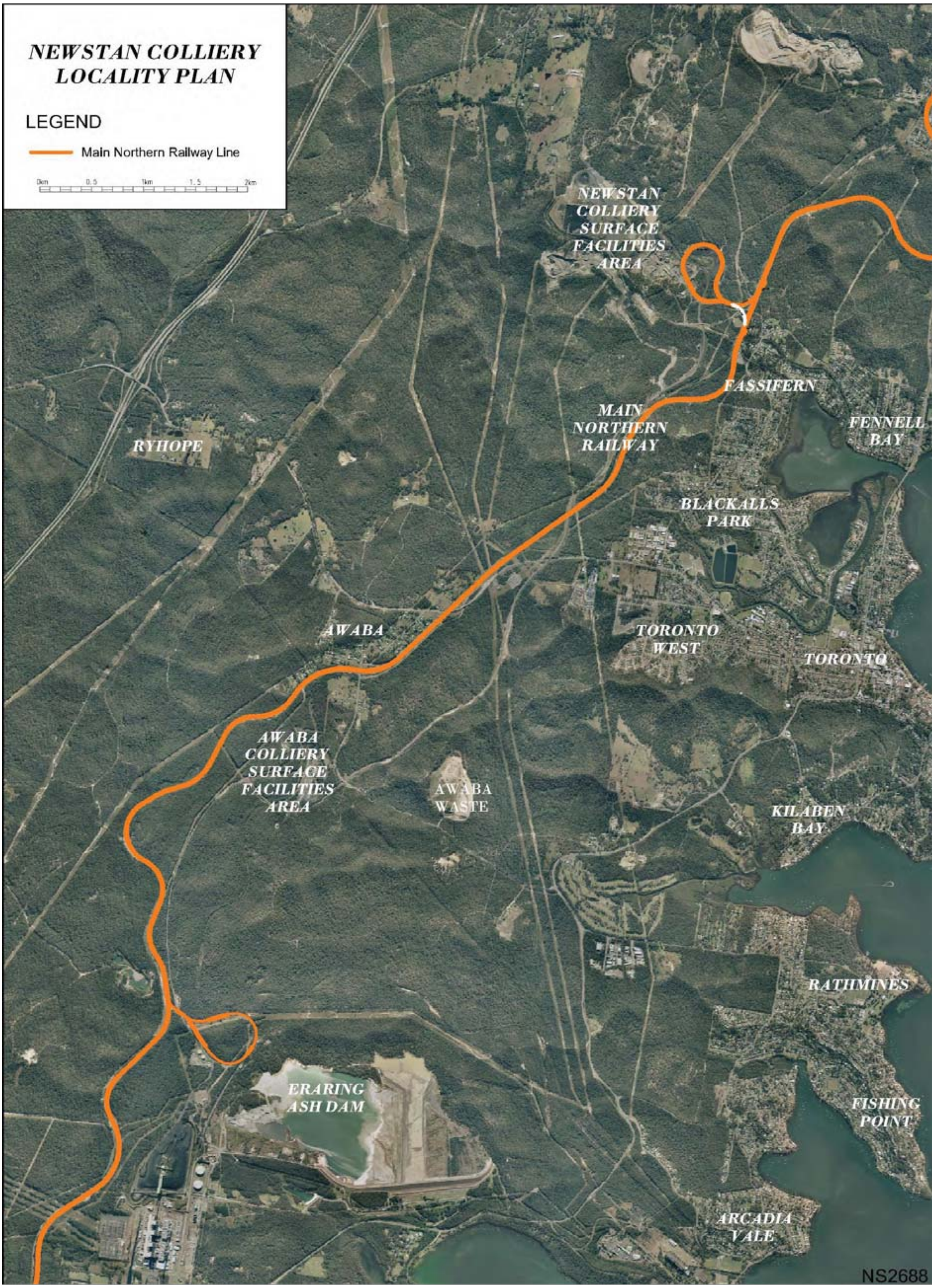
Newstan Colliery is an existing underground coal mining operation located in Fassifern on the western side of Lake Macquarie in the Newcastle Coalfield of New South Wales. It is located in gently undulating terrain bordered by vegetation. The site has an approximate elevation of 30 m at the surface facilities and an approximate elevation of 72 m (highest point) at the tailings dam west of the surface facilities. The township of Fassifern is situated approximately 1.5 km southeast and Wakefield is approximately 2.6 km northwest of the site. The western shore of Lake Macquarie is approximately 1.7 km southeast of the site. **Figure 1** illustrates the location of the Newstan Colliery.

Surface facilities at the Newstan Colliery include workforce amenities, mining support infrastructure, coal stockpiles, coal handling facilities, a coal preparation plant (CPP) and a rail loop. The Newstan Colliery ceased underground mining production in 2009 however continues to operate the surface facilities to process and handle coal from other Centennial Coal operations. The site is approved to process up to a maximum of 4 Mtpa of Run of Mine (ROM) coal.

Activities at the site are summarised as follows:

- Operate activities 24 hours per day 7 days a week;
- Extract up to 4 Mtpa of ROM coal;
- Receive up to 2 Mtpa of coal from the Cooranbong Colliery;
- Receive up to 888,000 tpa of coal from the Awaba Colliery;
- Process up to 4 Mtpa of ROM coal through CPP;
- Load up to 5 trains per day using front end loaders at a rate of 800 tonnes per hour;
- Export up to 3 Mtpa through rail loading facilities by train (average train size 2,100 to 3,000 tonnes);
- Transport 2 Mtpa of coal to Eraring Power Station by truck using the Eraring-Newstan private haul road;
- Transport coarse reject from the CPP to the Northern Reject Emplacement Area by truck;
- Transport coarse reject from the CPP to the Southern Reject Emplacement Area by truck;
- Construction of Southern Reject Emplacement Area to RL60; and
- Rehabilitation of the Northern Reject Emplacement Area.

Figure 1 Location of Newstan Colliery



2.2 Existing Air Quality Mitigation and Management Measures

To ensure that relevant air quality criteria are satisfied in accordance with the operational conditions of consent for the Newstan Colliery, it is understood that the following mitigation measures have been implemented to control air emissions:

- Use of designated haul routes by trucks;
- Sealing of some haul roads;
- Speed limit restrictions on all vehicles and equipment on the mine site;
- Application of water to exposed surfaces, with emphasis on those areas subject to frequent vehicle and equipment movements which may cause dust generation and dispersal;
- Progressive capping of exposed fine tailings;
- Maintenance of stockpiles and handling areas to minimise windblown or traffic-generated dust;
- Vacuum sweeping of hard stand areas and sealed roads;
- Conveyor cleaning and collection devices to minimise amount of material falling from the return conveyor belt;
- Water application at the feed hopper, crusher and at all conveyor transfer and discharge points;
- ROM and product coal stockpile watering;
- Use of covers on all loaded coal trucks;
- Regular locomotive maintenance to ensure compliance with exhaust emission standards; and
- Progressive shaping and rehabilitation of areas once they are no longer required for operational purposes.

3 PROJECT SETTING

3.1 Non-Project Related Properties and Residences

A number of residences and sensitive receivers are located in the area surrounding the Newstan Colliery. The nearest sensitive receivers have been identified to be taken into account in this assessment.

A list of the nearest sensitive receivers identified in the vicinity of the site and their respective distances from the site are presented in **Table 1** and **Figure 2**. **Figure 3** presents the receptor locations overlain on a graphical representation of the local terrain.

Table 1 Nearest Sensitive Receivers

ID	Location	Distance From Site (m)	Location (m, UTM)		Elevation (m, AHD)
			Easting	Northing	
R1	Davis Dwelling - 35 Jefferson Road, Wakefield	877	365,780	6,351,882	40
R2	Culgan Dwelling - Fassifern Road, Fassifern	345	365,720	6,351,115	58
R3	Orrock Dwelling - 4 Wallsend Road, Fassifern	413	367,463	6,349,487	12
R4	Phelps Dwelling - 33 Narara Street, Fassifern	521	367,399	6,348,880	27
R5	Parnell Dwelling - 51 Reynolds Street, Fassifern	466	366,904	6,348,626	72
R6	Fassifern Primary School - Fassifern Street, Fassifern	549	367,581	6,349,694	11

Figure 2 Surrounding Sensitive Receiver Locations Used in this Assessment

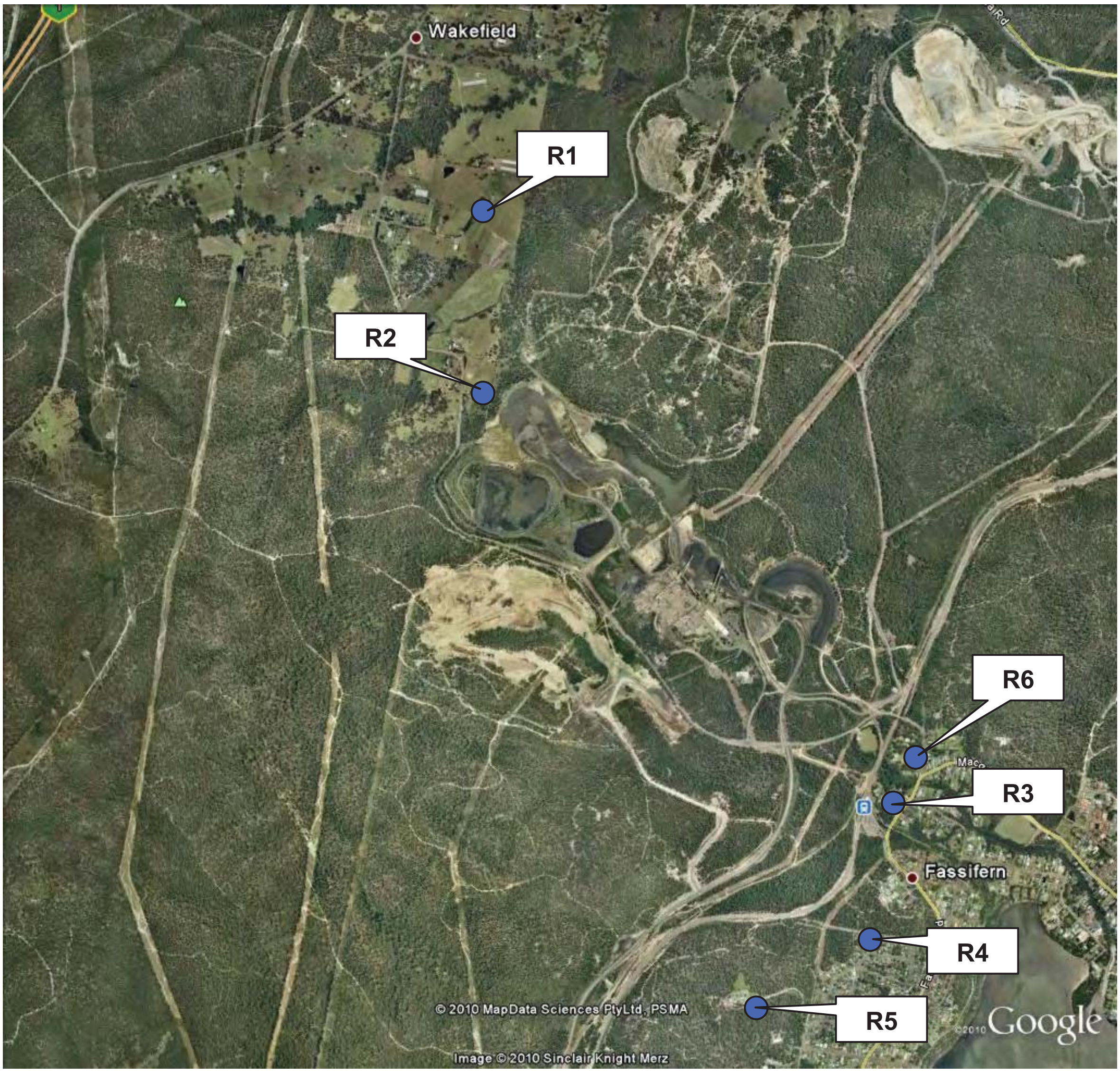
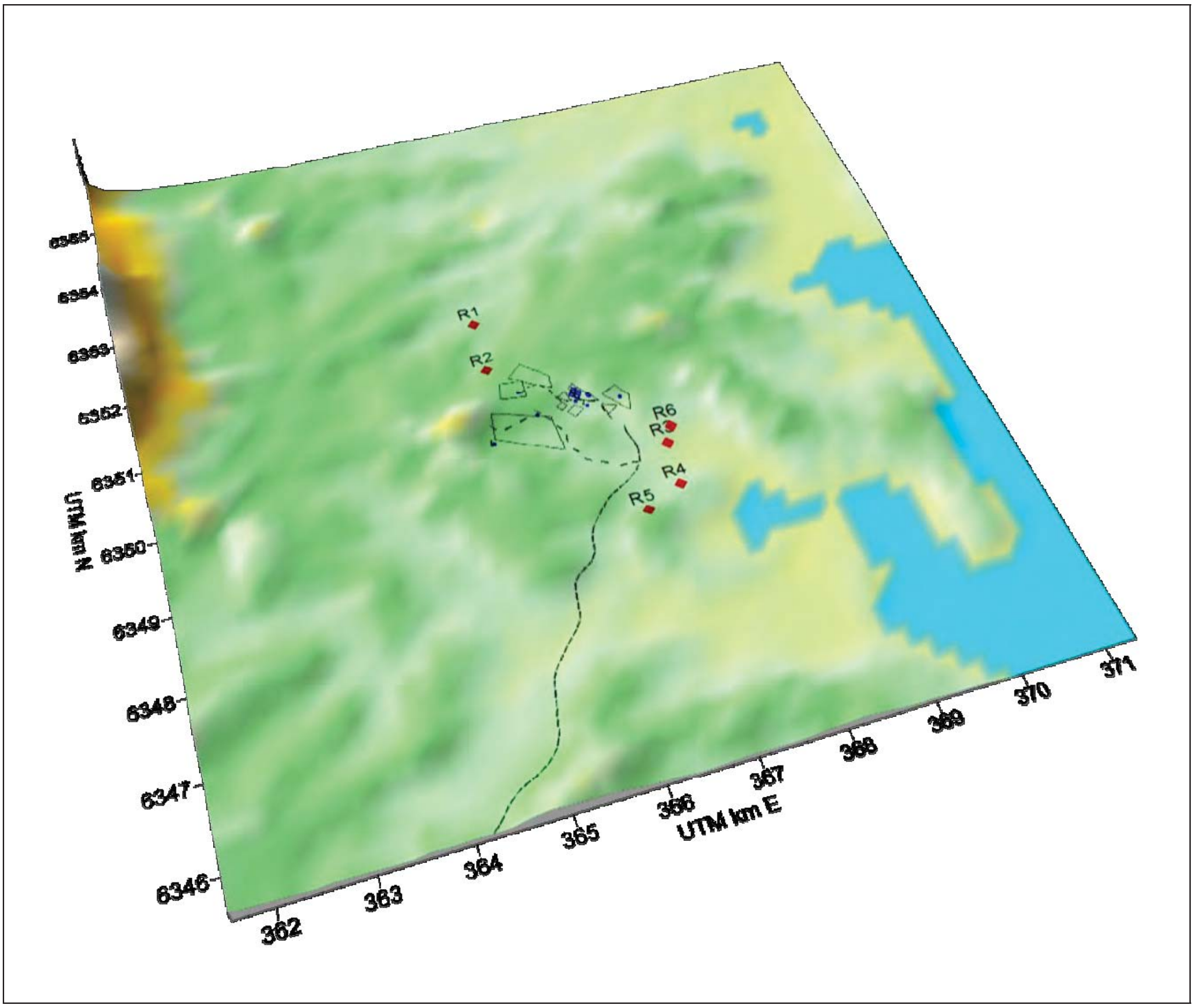


Image Source: Google Earth

Figure 3 Location of Surrounding Sensitive Receptors with Overlain Topographical Features



Notes: Topography shown with vertical exaggeration of x1.5 to emphasise terrain features.
Red diamonds mark receptors, blue dots are volume sources, black outlines are area sources.

3.2 Other Pollutant Sources

3.2.1 Local Sources

Within the wider region of the Hunter Valley, there are a number of coal mining-related operations (as shown in **Table 2**) that would have the potential to contribute to cumulative impacts at sensitive receptors surrounding Newstan Colliery.

Table 2 Local Pollutant Sources (<10 km)

Business	Business Type	Location (m, UTM)	
		Easting	Northing
Works Infrastructure Teralba	Other Petroleum and Coal Product Manufacturing	368,321	6,352,309
Westside Open Cut Mine	Coal Mining	366,684	6,354,670
Macquarie Coal Preparation Plant	Coal Mining	369,781	6,353,907
West Wallsend Colliery	Coal Mining	369,781	6,353,907
Awaba Colliery	Coal Mining	363,440	6,348,465
Eraring Power Station	Fossil Fuel Electricity Generation	361,896	6,340,857
Tasman Underground	Coal Mining	365,280	6,360,540
Myuna Colliery	Coal Mining	366,464	6,340,950
Incitec Pivot Cockle Creek Works	Fertiliser Manufacturing	371,910	6,353,555
Inghams Cardiff Feedmill	Prepared Animal and Bird Feed Manufacturing	373,688	6,354,594
Metromix	Quarry	368,121	6,352,286
RailCorp	Main Northern Railway	-	-

Note: NPI emission estimates are available at www.npi.gov.au/

3.2.2 Regional Sources

There is potential for concentrations of pollutants in the region to be elevated under certain conditions, such as bushfires or dust storms. Although these events are relatively unusual, they do occur and can result in elevated concentrations of pollutants, such as suspended particulates, over several days in some instances. These events are easily identified through the use of a network of air quality monitors as simultaneous elevations of particulate will be noted across an area (refer Section **5**).

Other significant regional pollutant sources (refer **Table 3**) include power stations to the south of the site and mining-related activities in the nearby Hunter Valley.

Table 3 Significant Regional Pollutant Sources

Business	Business Type	Location (m, UTM)	
		Easting	Northing
Vales Point Power Station - Delta Electricity	Fossil Fuel Electricity Generation	364,125	6,329,906
Munmorah Power Station - Delta Electricity	Fossil Fuel Electricity Generation	364,048	6,324,286

Note: NPI emission estimates are available at www.npi.gov.au/

4 AMBIENT AIR QUALITY CRITERIA

4.1 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 Total Suspended Particulate (or TSP) recommended by DECCW is 90 µg/m^3. It was developed before the more recent results of epidemiological studies suggested a relationship between health impacts and exposure to concentrations of finer particulate matter.

Emissions of particulate matter less than 10 and 2.5 microns 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 PM_{10} assessment goals as expressed in the Approved Methods are:

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

The 24-hour PM_{10} reporting standard of 50 µg/m^3 is numerically identical to the 24-hour average National Environment Protection Measure (or NEPM) reporting standard for PM_{10}, except that the NEPM reporting standard allows for five exceedances per year. These NEPM goals were developed by the National Environmental Protection Council (NEPC) in 1998 to be achieved within 10 years of commencement (i.e. by 2008).

In December 2000, the NEPC initiated a review to determine whether a new 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 $PM_{2.5}$. This document references the following reporting goals 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 goals relating to $PM_{2.5}$ particles are reporting guidelines only at the present time.

4.2 Nuisance Impacts of Fugitive Emissions

The preceding sections are concerned in large part with the health impacts of 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 g/m^2/month.

Table 4 presents the DECCW impact assessment goals for dust deposition, showing the allowable increase in dust deposition level over the ambient (background) level which would be acceptable so that dust nuisance could be avoided.

Table 4 DECCW 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, DECCW 2005.

4.3 Project Air Quality Goals

In view of the foregoing, the air quality goals adopted for this assessment, which conform to current DECCW and federal air quality criteria, are summarised in **Table 5**.

Table 5 Project Air Quality Goals

Pollutant	Averaging Time	Goal
TSP	Annual	90 $\mu g/m^3$
PM_{10}	24 hours	50 $\mu g/m^3$
	Annual	30 $\mu g/m^3$
$PM_{2.5}$	24 hours	25 $\mu g/m^3$
	Annual	8 $\mu g/m^3$
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, DECCW 2005.

5 EXISTING AIR ENVIRONMENT

5.1 Site Monitoring Stations

Newstan Colliery maintains two high volume air sampler (HVAS) monitoring stations (Hilltop and Watertank) for TSP and PM_{10}. These are run on a one in six day monitoring cycle, as per the Australian Standard.

5.2 DECCW Ambient Air Monitoring Station

A DECCW air quality monitoring station, which includes a continuous PM_{10} monitor, has been established at the Newcastle City Council Swimming Pool off Frances Street in Wallsend. The location of this monitoring station with respect to the Newstan Colliery is presented **Figure 4**. PM_{10} monitoring data has been obtained from this station for use in this assessment to provide an indication of the existing air quality environment.

No monitoring data is currently available for the area for $PM_{2.5}$.

Figure 4 Location of Nearest DECCW Air Quality Monitoring Station

Image source Google Earth

5.3 Analysis of Monitoring Data

5.3.1 TSP and PM_{10}

A summary of the ambient TSP and PM_{10} concentrations measured at these monitoring sites during the period October 2007 to January 2010 is presented in **Figure 5**. It shows that the average suspended particulate concentrations were measured to be below the annual average guidelines for both TSP and PM_{10} at both stations. It also shows that the 24-hour average TSP and PM_{10} concentrations measured at both sites occasionally exceeded the DECCW guidelines, but this occurred less than five times per year.

The results of the 24-hour PM_{10} monitoring at Wallsend and the two site HVAS monitoring locations, conducted between January - December 2008, are summarised in **Table 6**. Concurrent concentrations recorded at the DECCW Wallsend air quality monitoring station and the one-in-six day concentrations recorded surrounding the Project Site during the modelling period are also presented in **Figure 6**.

The data indicates that the highest 24-hour average PM_{10} concentration measured by the DECCW's Wallsend air quality monitoring site was 56.5 $\mu g/m^3$, recorded on 16 September 2008. During this mid-September period in 2008 there were several major regional dust storms and the single exceedance is almost certainly associated with one of these events. 24-hour average PM_{10} concentrations recorded at the two HVAS locations, Hilltop and Watertank, are often greater than concentrations recorded at the Wallsend station throughout the comparison period, particularly during late summer and early spring.

Figure 5 Summary of Results from Newstan TSP and PM_{10} Monitoring Program

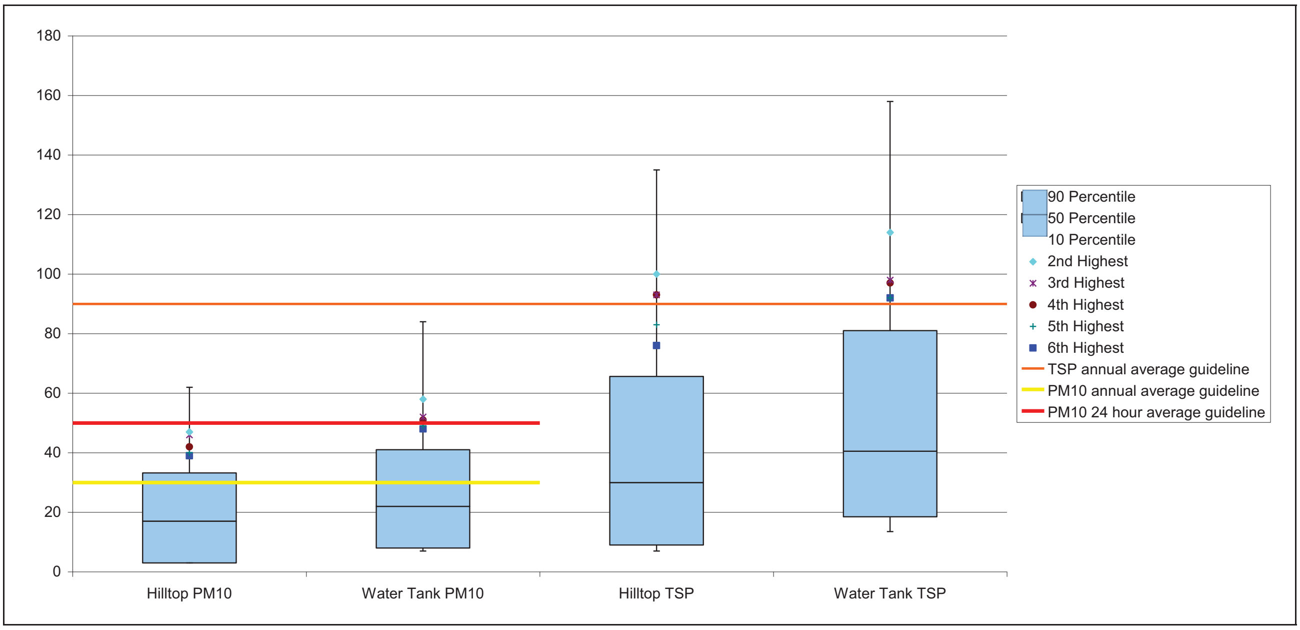
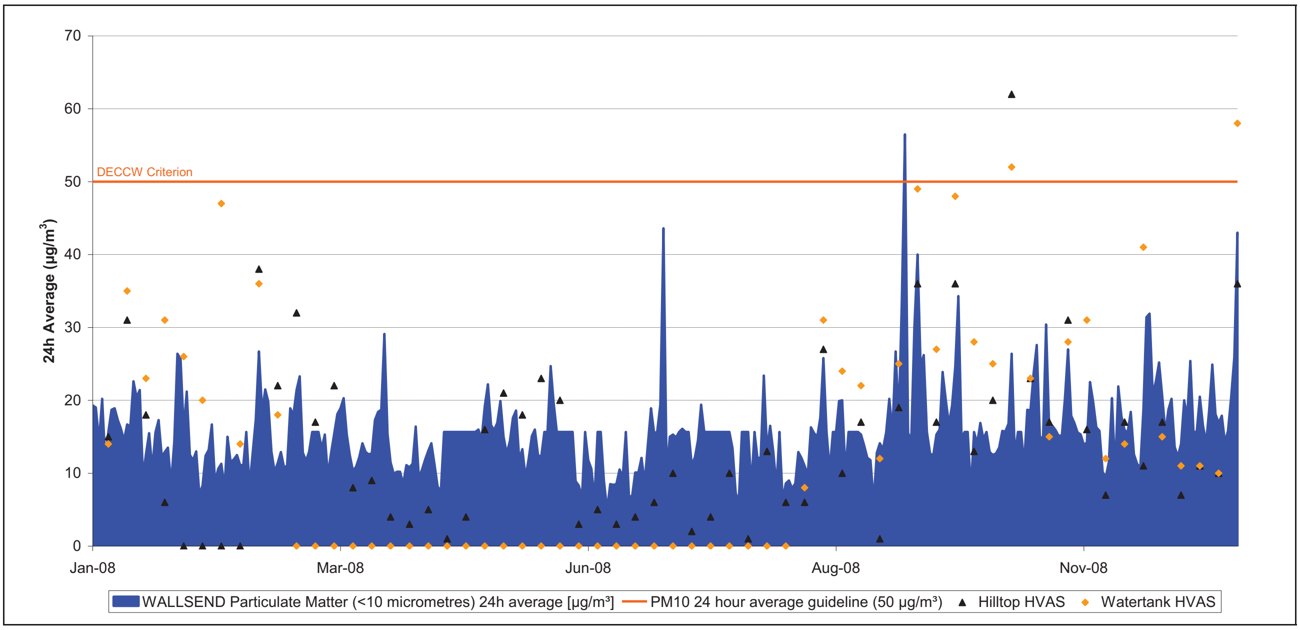


Table 6 24-Hour Average PM_{10} Monitoring Results: January – December 2008

Station	Maximum Measured Concentration ($\mu g/m^3$)	6^{th} Highest Measured Concentration ($\mu g/m^3$)	Average Concentration ($\mu g/m^3$)	Days with No Results
Wallsend	57	33	16	63
Hilltop	62	32	15	4[a]
Watertanks	58	41	26	27[a]

[a] HVAS are run on a one day in six cycle. On this basis, there are a maximum of 61 possible monitoring events in 2008.

Figure 6 24-Hour Average PM_{10} Monitoring Results: January - December 2008



Note: During periods of missing data, the average of the dataset has been substituted.

Figure 7 shows that the Hilltop monitoring station loosely correlates with the Wallsend monitoring station with a roughly one to one relationship. Further, **Figure 8** shows that the Watertank monitoring location is typically 15% higher than the Hilltop location indicating that it is more affected by the existing Newstan Colliery operations than is Hilltop. If the data recorded at Hilltop is considered a reasonable reflection of existing ambient concentrations of PM_{10} excluding emissions from the existing Newstan Colliery operations, it can therefore be concluded that the Wallsend DECCW PM_{10} dataset provides a conservative daily-varying representation of existing concentrations of PM_{10} in the vicinity of the Newstan Colliery. The use of the Wallsend dataset to account for existing PM_{10} concentrations without double counting emissions from existing operations is therefore considered appropriate.

Regional dust storm events have been excluded from the Wallsend dataset.

The annual average PM_{10} concentration for 2008 Wallsend dataset was 15.7 µg/m^3 compared to an average of 15.2 µg/m^3 for the Hilltop data and 26 µg/m^3 for the Watertank data for the same year. Watertank has a higher annual average concentration as it was not operating during the winter months when Hilltop was recording lower than average concentrations (refer **Figure 6**). Based on the above information, the 24-hour average PM_{10} Wallsend data for the 2008 period is considered a reasonable estimate of background ambient levels for the dispersion modelling study.

Figure 7 Comparison of 24-Hour Average PM_{10} Concentrations Measured at Hilltop and Watertank

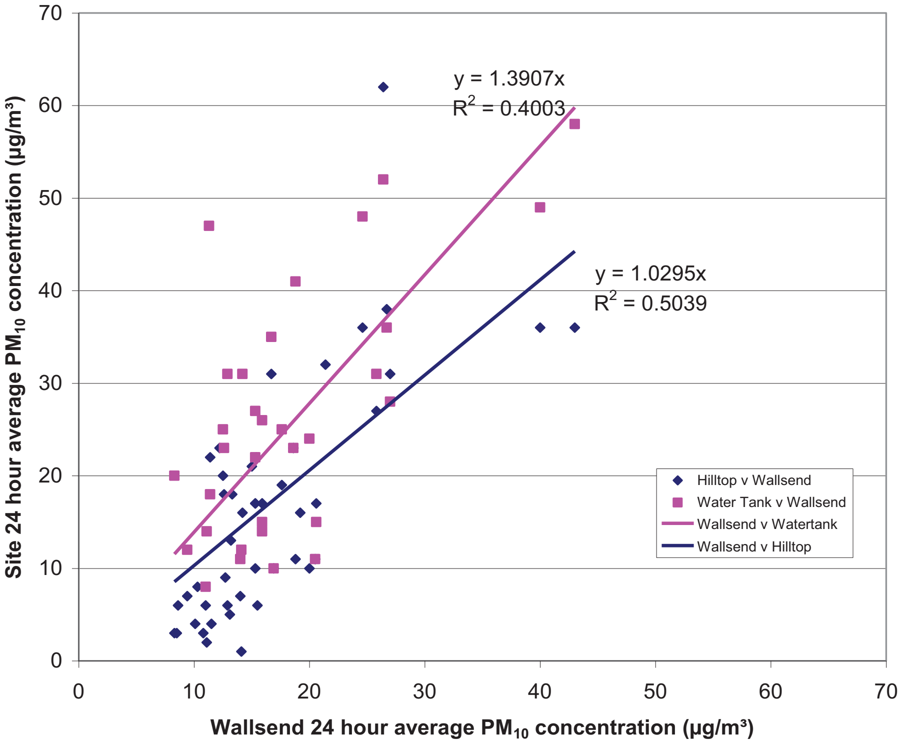
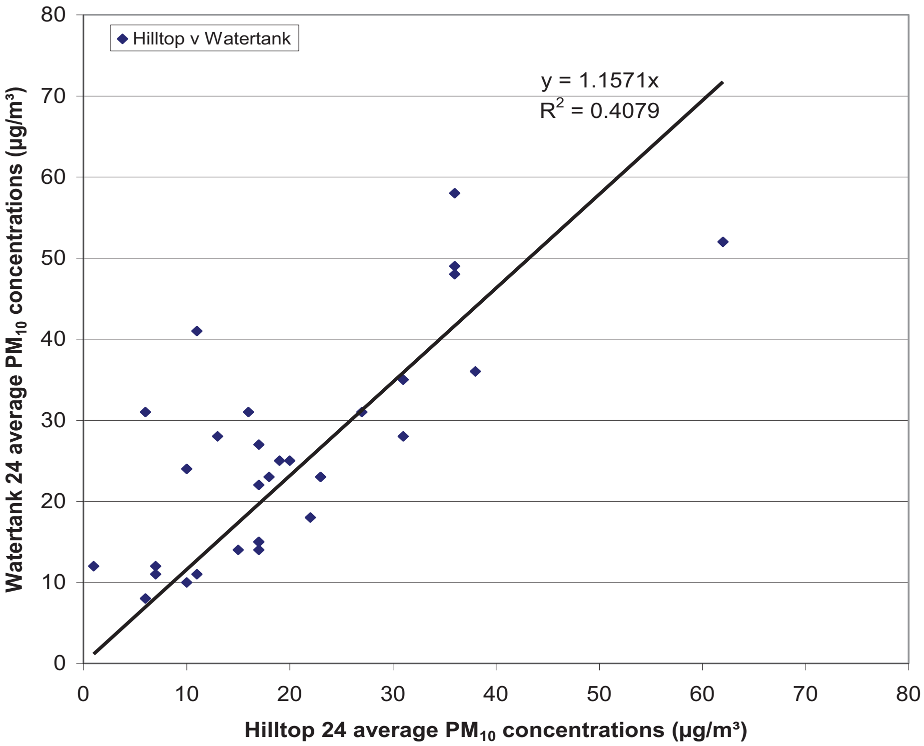


Figure 8 Comparison of 24-Hour Average PM_{10} Concentrations Measured at Hilltop and Watertank



5.3.2 $PM_{2.5}$

No $PM_{2.5}$ monitoring data is available for the Project Site or for the wider region. Although $PM_{2.5}$ is a sub-set of PM_{10} (and TSP) particles, assigning an appropriate ratio of $PM_{10}/PM_{2.5}$ to a single PM_{10} concentration or ranges of concentrations is generally not possible due to the wide range of sources contributing (soil erosion, industrial activities, combustion etc.). Given that $PM_{2.5}$ is not a DECCW adopted assessment criterion, no $PM_{2.5}$ background concentration has been assumed.

5.4 Background Concentrations Used in this Assessment

For the purposes of assessing the potential cumulative air quality impacts from the Project, an estimation of background air quality levels is required. The site-specific background air quality levels adopted for this assessment are summarised in **Table 7** and are based on the discussion above.

Table 7 Background Particulate Levels Used in this Assessment

Air Quality Parameter	Averaging Period	Assumed Background Ambient Level	Data Source
TSP	Annual	34 µg/m^3	Newstan Hilltop HVAS
PM_{10}	24-Hour	Daily varying file	DECCW Wallsend
	Annual	15.7 µg/m^3	
$PM_{2.5}$	24-Hour	None assumed	no data available
	Annual	None assumed	no data available
Dust Deposition	Annual	None assumed [1]	-

[1] Guideline used is based in the incremental impact, so no background required.

6 PARTICULATE SOURCES AND MODELLED SCENARIOS

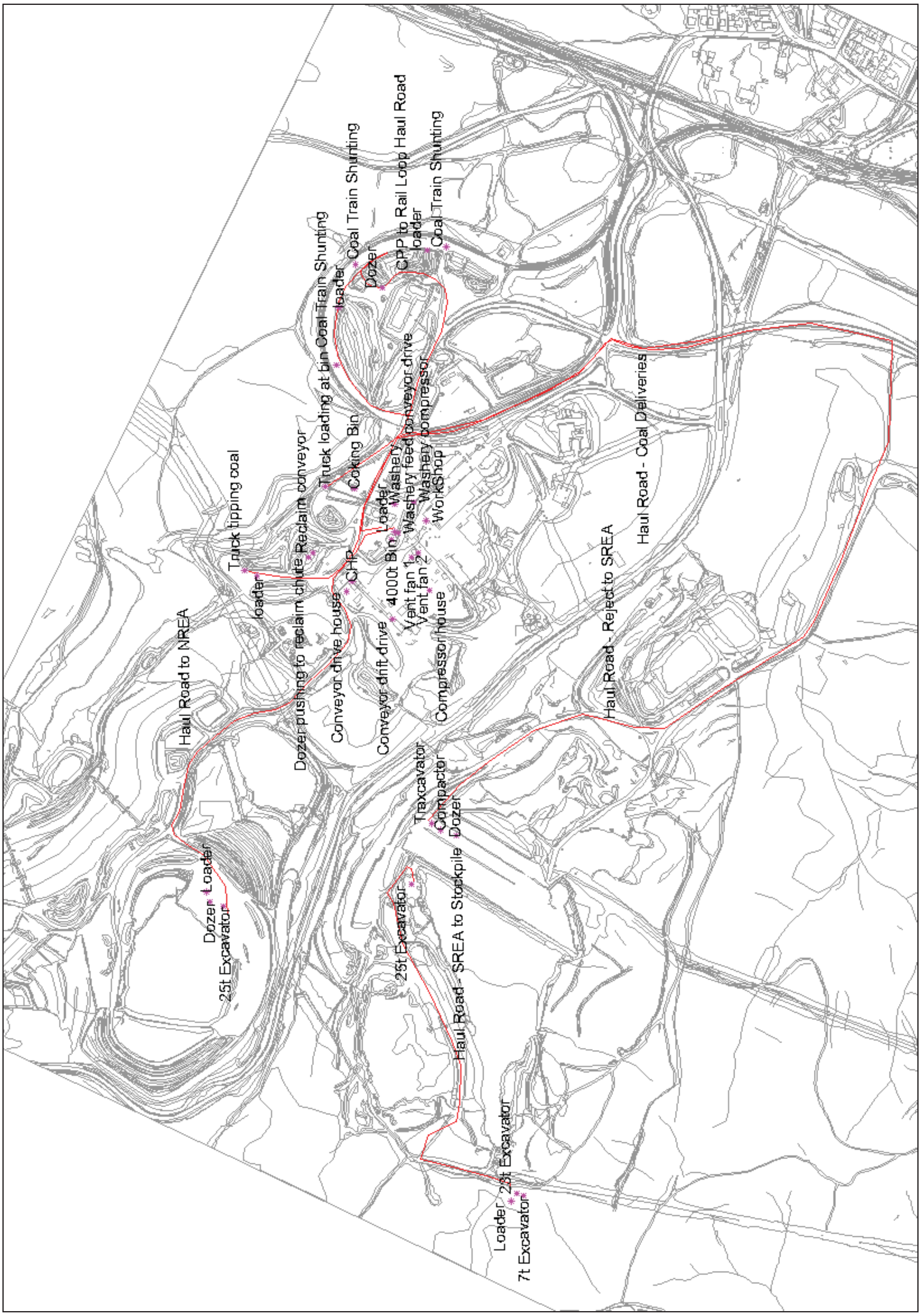
This assessment has considered emissions of particulate matter from:

- Coal handling activities (trucks dumping, front end loaders, bulldozers, conveyors, coal washing and crushing);
- Rail loading facilities (trucks dumping, front end loaders, bulldozers, and conveyors);
- Reject Emplacement Areas (front end loaders, excavators, bulldozers and trucks dumping);
- Vehicle movements on paved and unpaved roads; and
- Wind erosion from disturbed areas.

These sources all relate to activities associated with the approved operations of the Newstan Colliery. This assessment has been therefore prepared based on a single proposed operational scenario that has been selected to give rise to maximum expected air quality impacts at the sensitive residences/properties identified in **Section 3.1**.

A site layout plan for the modelling scenario is presented in **Figure 9**. A full equipment list for the scenario is provided in **Section 7.**

Figure 9 Location of Plant and Equipment



6.1 Activity Rates and Material Composition

6.1.1 Material Process Rates

The Newstan Colliery is approved to produce and process up to 4 Mtpa of ROM coal and export up to 3 Mtpa of coal through the rail loading facility. In addition to the 4 Mtpa produced from the Newstan Colliery, a further 2 Mtpa of coal is approved to be transported from the Cooranbong Colliery and 0.88 Mtpa from the Awaba Colliery. Newstan Colliery is approved to transport up to 2 Mtpa of coal directly to Eraring Power Station using the privately owned Newstan-Eraring haul road.

Coal from the Newstan Colliery is transported directly to the CPP via the Newstan Colliery coal handling facilities. Excess coal may be stacked out onto the ROM stockpile area via the stack-out conveyor for reclaiming and processing at a later date. The reclaim process involves the use of dozers to push coal into reclaim feeders.

Coal transported by truck from the Cooranbong and Awaba Collieries may also be tipped and stockpiled onto the ROM stockpile for processing through the CPP via the same coal handling facilities.

The coal from the mine or the ROM stockpile is fed into the CPP at a rate of 725 tonnes/hour where it is processed, resulting in a reduction of ash in the product coal and the generation of a high-ash reject material.

The coarse reject material is trucked to the Newstan Southern Reject Emplacement Area (SREA) or Northern Reject Emplacement Area (NREA). The tailings are pumped to a tailings dam located within the SREA.

Product coal from the CPP is transported by enclosed conveyors to two truck loading bins. Trucks haul the coal from the truck loading bins to the Newstan rail loop or the Eraring Power Station using the privately owned Newstan- Eraring haul road.

Coal haulage is undertaken 24 hours per day, 7 days per week.

The coal has been assumed to contain 6% moisture and 6.6% silt as per AP-42 (2006) and confirmed by the Proponent.

Water sprays have been assumed on the conveyor systems in the processing plant area.

6.1.2 Haulage Distances

The haulage distances assumed in the dispersion modelling are provided in. These distances are based on the layout provided in **Figure 9**.

Unsealed haul roads have been assumed to contain 1.1% moisture and 6.4% silt as per the standard conditions published in US EPA AP-42 (2006).

Table 8 Haul Route Distances

Route	Road Type	Haul Route Length (m)	Vehicles per Hour (VPH)	Vehicle Kilometers Travelled per Hour (VKT)
CPP to Eraring Haul Road	Paved Roads	704	14.0	9.9
Eraring Haul Road to SREA	Unpaved Roads	1000	16.5	16.5
SREA Internal Haul Road	Unpaved Roads	3300	2.5	8.3
CPP to Coal Deliveries Area	Paved Roads	450	14.0	6.3
CPP to NREA	Unpaved Roads	695	2.5	1.7
Truck Loading Bin to Eraring Haul Road	Paved Roads	542	42.0	22.8
Rail loop	Paved Roads	60	21.0	1.3
Eraring Haul Road	Paved Roads	4160	14.0	58.2
Total Paved Haul Roads		**3995**	**5.0**	
Total Unpaved Haul Roads		**6916**	**121.5**	
Total Haulage Distance		**10911**	**126.5**	**125**

6.1.3 Open Areas

Open areas subject to wind erosion are presented in **Table 9**.

Table 9 Areas Exposed to Wind Erosion

Area	Source Area (ha)
Wind Erosion 1	1.25
Wind Erosion 2	3.66
Wind Erosion 3	0.78
Wind Erosion 4	29.29
Wind Erosion 5	7.92
Wind Erosion 6	1.08
Wind Erosion 7	10.20
Wind Erosion 8	1.78
Wind Erosion 9	5.16
Total Area	61.12

Figure 10 Wind Erosion Source Locations

6.2 Emission Controls

As detailed in **Section 2.2**, Newstan Colliery currently implements specific measures to ensure that relevant air quality criteria are satisfied, in accordance with the operational conditions of consent for the project. The mitigation measures incorporated into the modelling assessment are shown in **Table 10** along with the percentage reduction in particulate emissions assumed in the emission inventory and dispersion modelling, where applicable. No emission reductions have been applied to active areas, nor as a result of the policy of ceasing mining activities during periods of concurrent high winds and temperatures which cause coal dust dispersal, independent of water applications.

Table 10 Mitigation Measures

Mitigation Measure	Control Assumed
• Application of water to exposed surfaces, with emphasis on those areas subject to frequent vehicle/equipment movements which may cause dust generation and dispersal. • Regular watering of internal haul roads. • Speed limit restrictions on all vehicles and equipment on the Project Site	• 50% reduction in particulate emissions based on Level 1 Watering (2 litres/m2/hour) on all unsealed haul roads on-site (NPI, 2001). • Further 44% reduction in estimated particulate emissions based on limiting vehicle speeds on site to 40 km/hour (MRI, 2001).
• Water application at the conveyor transfer and discharge points	• 50% reduction in particulate emissions (NPI, 2001).

7 EMISSIONS INVENTORY

7.1 Methodology

Based on the information presented in **Section 6**, a particulate emissions inventory has been compiled for the proposed site operations.

Emission factors for TSP and PM_{10} have been sourced from the Commonwealth of Australia Document "*National Pollutant Inventory (NPI) for Mining*, Version 2.3 (2001)" and the US EPA's AP-42 Emission Factors where suitable factors do not exist within the NPI documentation. The emission factors used are presented overleaf in **Table 12**, which were derived using the assumptions discussed in **Section 6.1**.

While the National Pollutant Inventory for Mining, Version 2.3 (2001) and US EPA's AP-42 contain emission factors for TSP and PM_{10}, no factors are provided within these documents for $PM_{2.5}$. This is because there is little data available on the fraction of PM_{10} that is typically emitted as $PM_{2.5}$ from the wide range of sources involved.

Some limited 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 proposed $PM_{2.5}/PM_{10}$ ratios for a number of fugitive dust source categories, as presented in **Table 11**. The $PM_{2.5}$ / PM_{10} ratios presented in **Table 11** have been used within this assessment to calculate the emissions of $PM_{2.5}$. The most appropriate ratio has been applied to each emission source.

Table 11 Particle Size Ratios Proposed for Inclusion in US EPA AP-42

Fugitive Dust Source	AP-42 Section	Proposed $PM_{2.5}$ / PM_{10} Ratio
Paved Roads	13.2.1	0.15
Unpaved Roads	13.2.2	0.10
Aggregate Handling and Storage Piles	13.2.4	0.10
Industrial Wind Erosion	13.2.5	0.15
Open Area Wind Erosion	-	0.15

Table 12 Emission Factor Equations

Activity	Emission Factor Equation	Units	Source	Variables	Controls Applied*
Excavator / Front End Loader on waste rock / overburden	$= k \times 0.0016 \times (U/2.2)^{1.3} \times (M/2)^{-1.4}$	kg/t	NPI EETM v2.3 (p11)	k = 0.74 (TSP) k = 0.35 (PM_{10}) U = mean wind speed (m/s) M = Moisture content (%)	
Excavator / Front End Loader on coal	$= k \times 0.00596 \times M^{-0.9}$	kg/t	NPI EETM v2.3 (p11)	k = 1.56 (TSP) k = 0.75 (PM_{10}) M = Moisture content (%)	
Unpaved haul route wheel dust	$EF = k \times \left(\frac{s}{12}\right)^{0.7} \times \left(\frac{W}{3}\right)^{0.45} \times \left(\frac{281.9}{1000}\right) \times \left(\frac{365-p}{365}\right)$	kg/vehicle kilometres travelled (VKT)	USEPA AP42 - Wheel Generated Dust from Unpaved Roads (2003)	k = 4.9 (TSP) k = 1.5 (PM_{10}) s = silt content (%), W = vehicle gross mass (tonnes) p = number of days in year with rainfall greater than 0.25mm	Level 1 watering (2 l/m2/hr) - (50%) Speed restriction (40 km/h) – (44%)
Paved haul route wheel dust	$EF = k \times \left(\frac{sL}{2}\right)^{0.65} \times \left(\frac{W}{3}\right)^{1.5} - C$	kg/vehicle kilometres travelled (VKT)	USEPA AP42 - Wheel Generated Dust from Paved Roads (2006)	k = 24 (TSP) k = 4.6 (PM_{10}) sL = silt loading (g/m^2), W = vehicle gross mass (tonnes) C = emission factor for fleet vehicle exhaust, brake and tyre wear (0.2119 for TSP and PM_{10})	Level 1 watering (2 l/m2/hr) - (50%) Street weeping – (MRI 26%) 100 ft apron (MRI 42%)
Trucks dumping coal	Default of 0.01 for TSP Default of 0.0042 for PM_{10}	kg/t	NPI EETM v2.3 (p11)		
Trucks dumping waste rock / overburden	Default of 0.012 for TSP Default of 0.0043 for PM_{10}	kg/t	NPI EETM v2.3 (p11)		
Dozer on coal	TSP $= 35.6 \times s^{1.2} \times M^{-1.4}$ $PM_{10} = 6.33 \times s^{1.5} \times M^{-1.4}$	kg/hr	NPI EETM v2.3 (p11)	s=silt content (%) M=Moisture content (%)	Pit Retention - (50% for TSP, 5% for PM_{10})
Dozer on material other than coal	TSP $= 2.6 \times s^{1.2} \times M^{-1.3}$ $PM_{10} = 0.34 \times s^{1.5} \times M^{-1.4}$	kg/hr	NPI EETM v2.3 (p11)	s=silt content (%) M=Moisture content (%)	
Grader	TSP $= 0.0034 \times S^{2.5}$ $PM_{10} = 0.0034 \times S^{2.0}$	kg/VKT	NPI EETM v2.3 (p12)	S=mean vehicle speed (km/h)	Level 1 watering (2 $l/m^2/hr$) - (50%)

Activity	Emission Factor Equation	Units	Source	Variables	Controls Applied*
Primary Crusher (includes emissions from screens, crusher, feeder, surge bin and conveyor transfer points)	Default of 0.01 for TSP (Emission Factor for Primary Crushing, High Moisture Ore)	kg/t	NPI EETM v2.3 (p14)		Total Enclosure – 100%
	Default of 0.004 for PM_{10} (Emission Factor for Primary Crushing, High Moisture Ore)				
Loading to trains	Default of 0.0004for TSP	kg/t	NPI EETM v2.3 (p12)		
	Default of 0.00017 for PM_{10}				
Miscellaneous transfer points	$EF = k \times 0.0016 \times \left(\frac{U}{2.2}\right)^{1.3} \times \left(\frac{M}{2}\right)^{-1.4}$	kg/t	NPI EETM v2.3 (p12)	k = 0.74 (TSP) k = 0.35 (PM_{10}) U = mean wind speed (m/s) M = moisture content (%)	Water sprays and enclosure (70%)
	$PM_{2.5}$= 15% PM_{10}				
Wind Erosion	Default of 0.4 for TSP	kg/ha/h	NPI EETM v2.3 (p12)	Only for wind speeds greater than 5.4 m/s	
	Default of 0.2 for PM_{10}				

7.2 Estimated Emissions

Total calculated emissions of TSP, PM_{10} and $PM_{2.5}$ are presented in **Table 13** for plant and equipment sources, **Table 14** for haul routes and **Table 15** for wind erosion sources.

Table 13 Estimated Annual Particulate Emissions from Plant and Equipment Sources

Area	Equipment	TSP	PM_{10}	$PM_{2.5}$
		(kg per annum)		
SREA operations	Trucks Dumping	402	169	25
	Excavator	17,827	8,586	1,291
	25 Tonne Excavator	5,402	2,602	391
	25 Tonne Excavator	216	102	15
	Traxcavator	22	11	2
	Compactor	17,573	4,741	387
	Trucks dumping	10,640	4,469	670
Rail Loop	FEL to train	13,198	6,342	952
	Dozer	2,197	593	48
	FEL to train	19,798	9,513	1,428
	Truck loading at bin	349	165	25
	Bin filling	349	165	25
	Stockpile	848	424	64
Coal delivery area	Truck tipping	19,272	8,094	51
	Reclaim conveyor	2.4	1.1	0.2
	Dozers	26,359	7,111	581
	Stockpiles	245	123	18
NREA operations	Dozer	11144	2,452	367
	Excavator	23	11	2
	950 Loader	23	11	2
Coal handling plant	Conveyor	3	1	0
	4000 tonne bin	1017	480	90
	CPP	305	144	27
	Loader	1237	595	640
	Feed conveyors	305	144	27
	Crusher [b]	-	-	-
	Screening [a]	-	-	-
Total		**148,756.4**	**57,049.1**	**7,128.2**

a High moisture content screening – zero emission
b Total enclosure – zero emission

Table 14 Estimated Annual Particulate Emissions for Haul Routes

Haul Route	**TSP**	**PM_{10}**	**$PM_{2.5}$**
		(kg per annum)	
Washery to Eraring Haul Road	3,569	686	171
Eraring Haul Road to SREA	2,988	574	143
SREA Internal Haul Road	28,608	6,954	695
Washery to Coal Deliveries Area	2,282	438	109
Washery to NREA	6,025	1,465	146
Truck Loading Bin to Eraring Haul Road	8,244	1,584	394
Rail loop	456	88	22
Eraring Haul Road	27,336	5,253	1,307
Grader	2,081	1,150	65
Total	**81,589**	**18,192**	**3,052**

Table 15 Estimated Particulate Emissions from Wind Erosion Sources

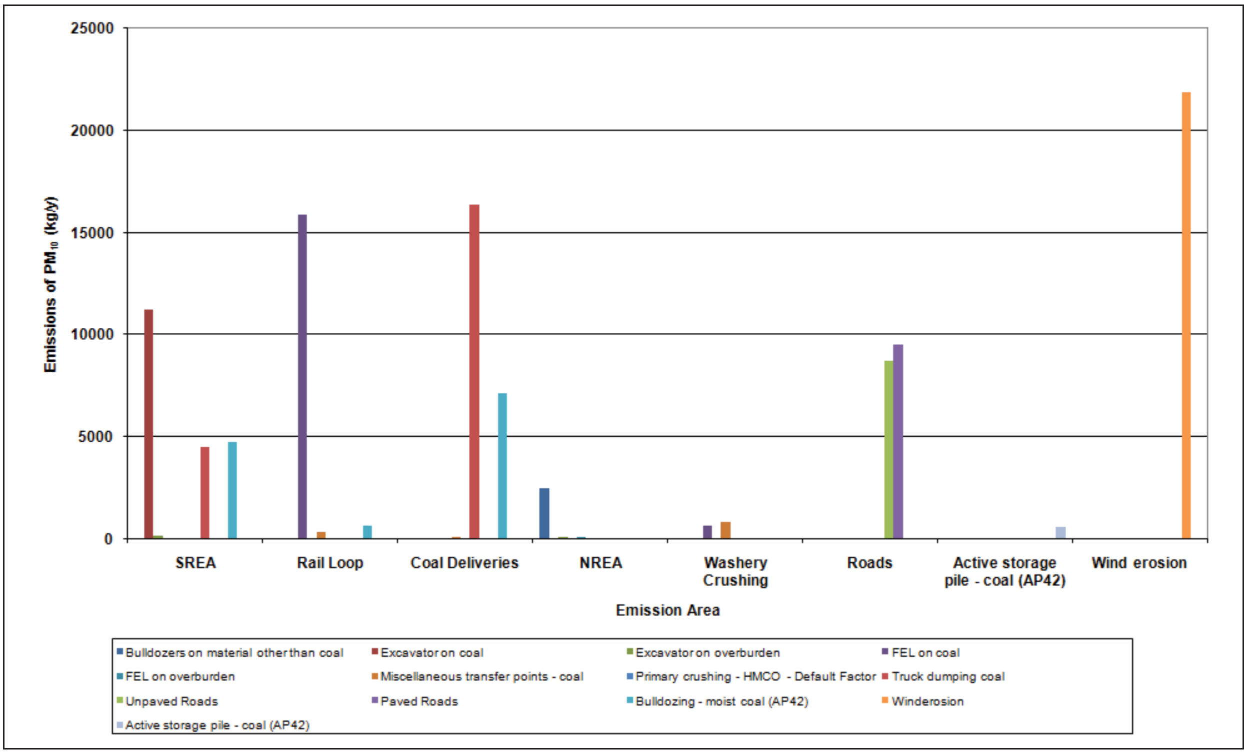
Area	**TSP**	**PM_{10}**	**$PM_{2.5}$**
		(kg per annum)	
Wind Erosion 1	1,955	978	4
Wind Erosion 2	2,744	1,372	5
Wind Erosion 3	1,167	583	2
Wind Erosion 4	1,393	696	3
Wind Erosion 5	6,244	,5932	22
Wind Erosion 6	33,428	16,714	61
Wind Erosion 7	12,488	6,244	23
Wind Erosion 8	5,771	2,886	11
Wind Erosion 9	7,569	3,784	14
Total	**72,759**	**39,189**	**145**

Summaries of the emission estimates are presented in **Table 16** and **Figure 11**. **Figure 11**, which presents a breakdown of the estimated PM_{10} emissions by activity area, clearly shows that the unpaved road, paved roads and bulldozers operating in the coal delivery area are the major emission sources. Given that the road sources are spread across a wide area and hence will have a more diffuse impact, it is concluded that the bulldozer operations are potentially the highest impact source.

Table 16 Total Estimated Particulate Emissions from Newstan

Size Fraction	Annual Emissions (kg/annum)
TSP	696,000
PM_{10}	224,000
$PM_{2.5}$	38,100

Figure 11 PM_{10} Emissions from Newstan Colliery by Source



8 AIR DISPERSION MODELLING METHODOLOGY

8.1 Model Selection

Emissions from Newstan Colliery have been modelled using the US EPA's CALPUFF (Version 6.267) modelling system. CALPUFF is a transport and dispersion model that advects "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.

More advanced dispersion models (such as CALPUFF) are approved for use by the DECCW in situations where these models may be more appropriate than use of the Ausplume model.

For this study, CALPUFF was run using a sub-domain of the CALMET domain (see **Section 8.2.2**) that had a southwest corner located at 361.468 km E and 6345.444 km S, extended 10 km east-west and 10 km north-south, and had a grid spacing of 200 m.

8.2 Meteorological Data

8.2.1 TAPM

In the absence of adequate meteorological monitoring data in the vicinity of Newstan Colliery, meteorological modelling using The Air Pollution Model (TAPM) meteorological model (Version 4.3) has been performed. TAPM, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a prognostic model which may be used to predict three-dimensional meteorological data and air pollution concentrations.

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

Additionally, the TAPM model may assimilate actual local wind observations so that they can optionally be included in a model solution. The wind speed and direction observations are used to realign the predicted solution towards the observation values. However, in this situation there were no available monitoring stations to include in the modelling. **Table 17** details the parameters used in the TAPM meteorological modelling for this assessment.

Table 17 Meteorological Parameters used for this Study (TAPM v 4.3)

Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Number of grid points	25 x 25 x 25
Year of analysis	2009
Centre of analysis	366,468m E, 6,350,444m S (-32° 58.5', 151° 34')
Data assimilation	No data assimilation

8.2.2 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.

CALMET was configured using a 10 km x 10 km model domain with a 200 m grid spacing, with the southwest corner of the domain located at 361.468 km E and 6345.444 km S in Universal Transverse Mercator (UTM) zone 56.

Due to an absence of local meteorological monitoring data, CALTAPM was used to create three dimensional gridded data from TAPM to provide an initial guess field across the modelling domain for use by CALMET.

8.2.3 Wind Speed and Direction

A summary of the annual wind behaviour predicted by TAPM for the site is presented as wind roses in **Figure 12** and as a wind speed frequency distribution plot in **Figure 13**.

Figure 12 and **Figure 13** indicate that winds experienced at Newstan Colliery are predominantly light to moderate (between 1.5 m/s and 3 m/s) and wind direction is seasonally dependent. Winds occur more frequently from the west, especially during autumn and winter. Calm wind conditions (wind speed less than 0.5 m/s) were predicted to occur approximately 5% of the time throughout 2009.

The seasonal wind roses indicate that:

- In spring, winds are light to moderate with winds from all direction but with a higher frequency of winds from the north northwest;
- In summer, light winds are most common with wind directions from around the compass;
- In autumn, winds are light with wind directions from the west dominating; and
- In winter, winds are light to moderate and are experienced predominantly from the west.

Figure 12 Wind Roses for Newstan, as Predicted by TAPM (2009)

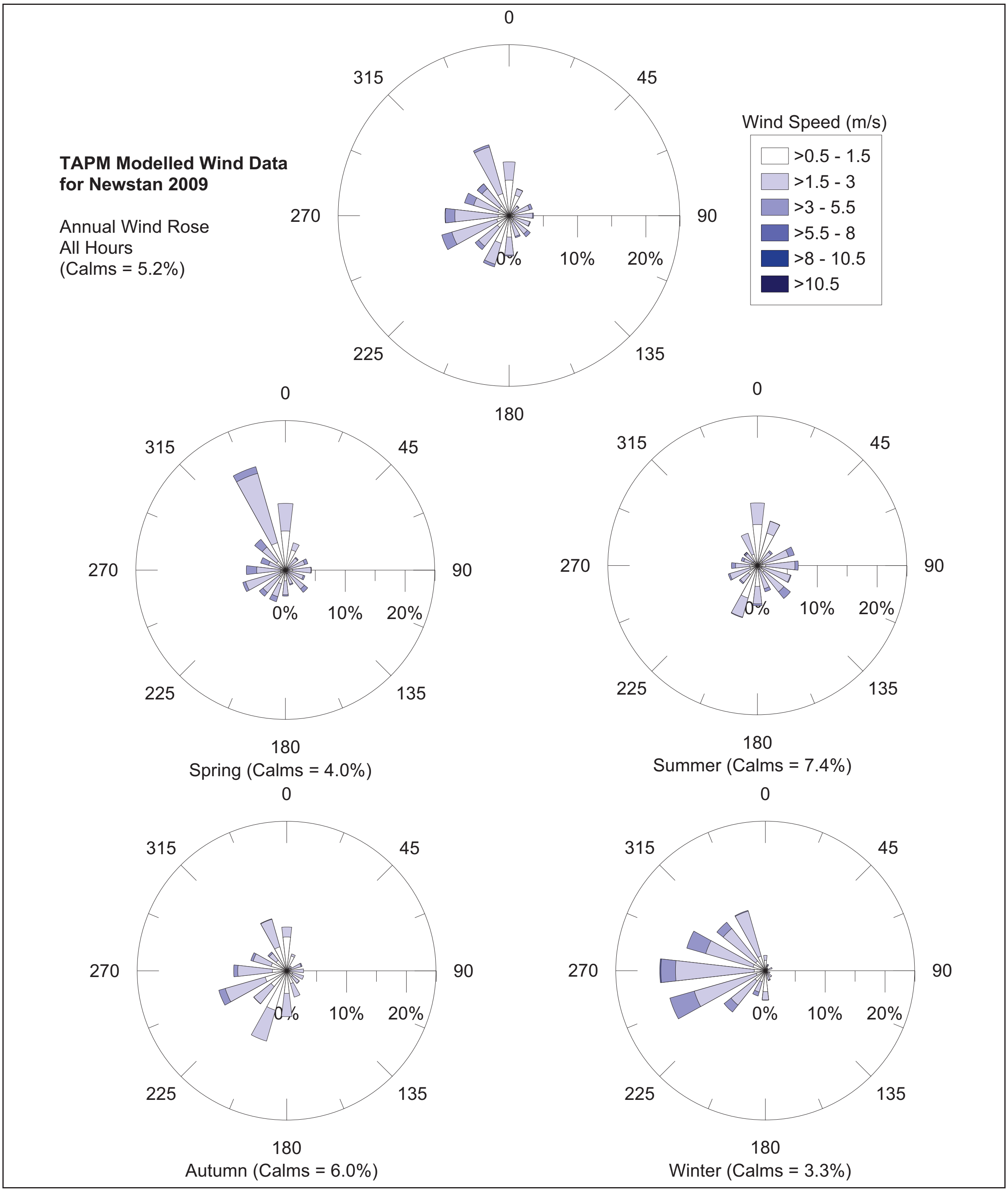
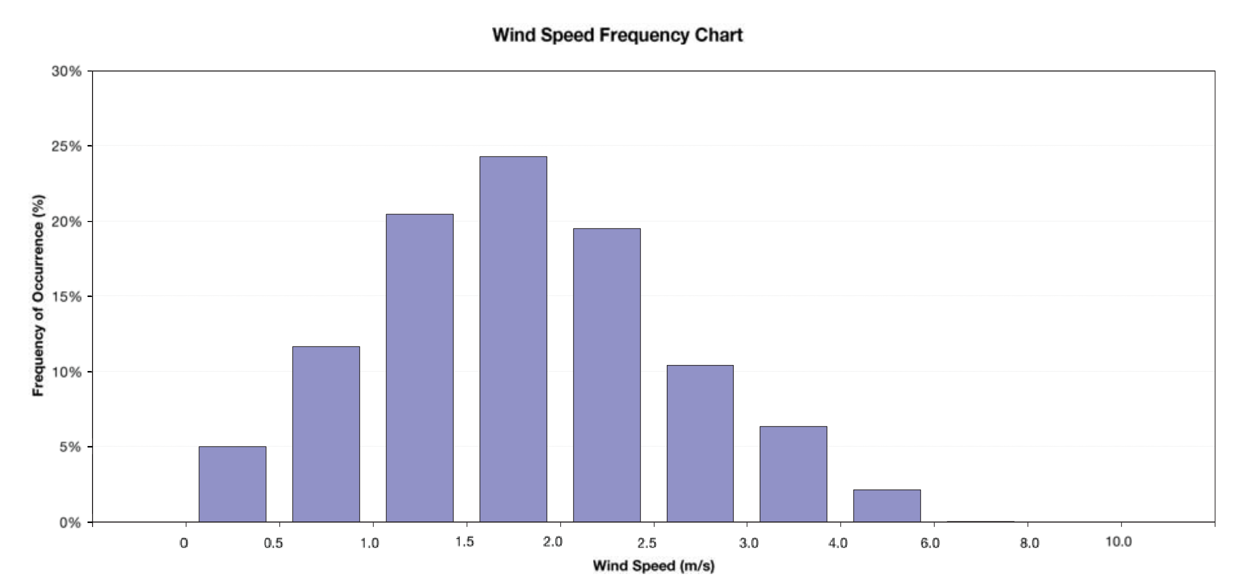


Figure 13 Wind Speed Frequency for Newstan (2009)



8.2.4 Atmospheric Stability

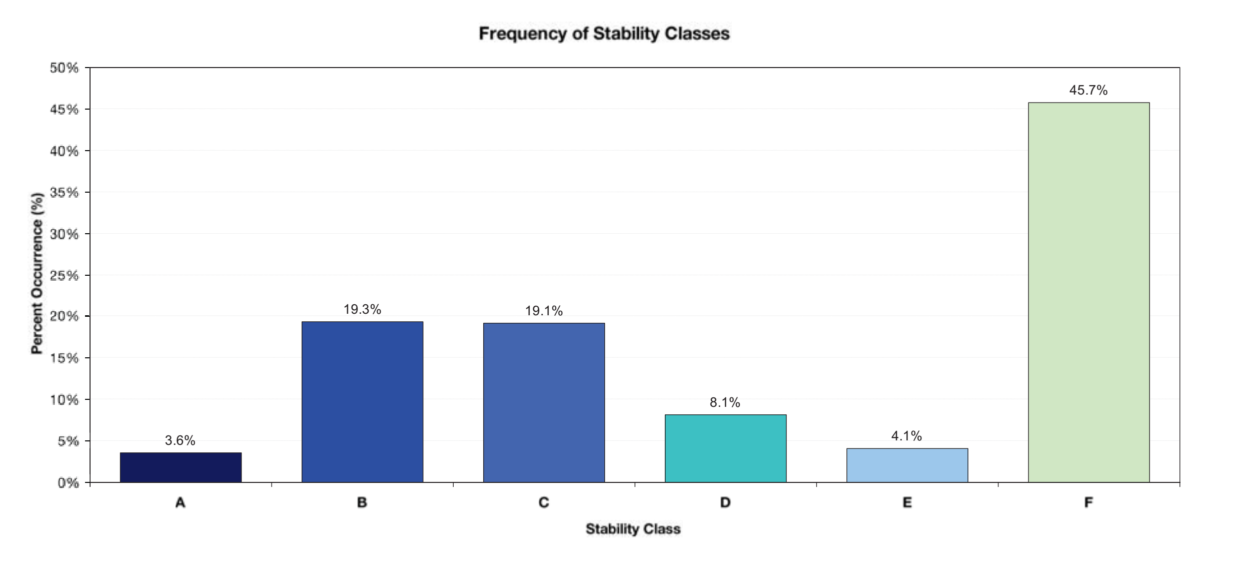
Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Turner assignment scheme identifies six Stability Classes, A to F, to categorise the degree of atmospheric stability (see **Table 18**). These classes indicate the characteristics of the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

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

The frequency of each stability class predicted by TAPM at the project site during 2009 is presented in **Figure 14**. The results indicate a high frequency of conditions typical to Stability Class F. Stability Class F is indicative of very stable conditions typically found during night time, conducive to a low level of pollutant dispersion due to mechanical mixing. Daytime frequency classes are distributed across classes A to D with most occurring in Classes B and C (38% out of 50%).

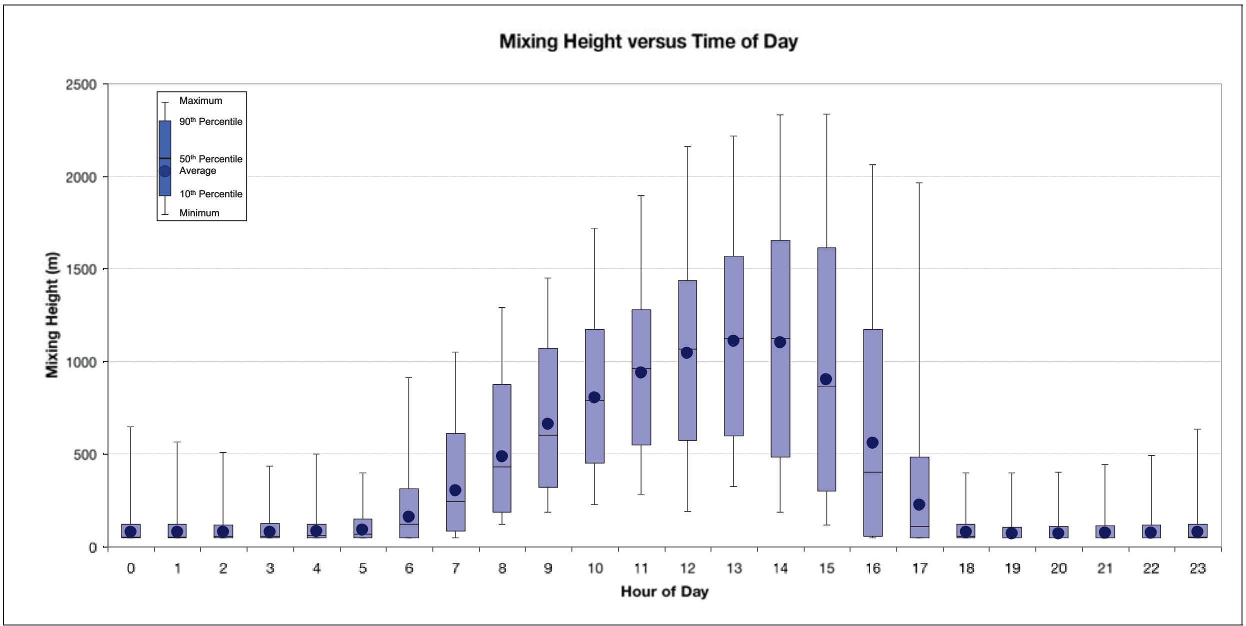
Figure 14 Stability Class Distribution Predicted by TAPM for Newstan (2009)



8.2.5 Mixing Heights

Diurnal variations in maximum and average mixing depths predicted by TAPM at the project site during 2009 are illustrated in **Figure 15**. 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. This is followed by a rapid collapse of the mixing height after 3 PM as the temperatures start to drop and thermally generated convective mixing decreases.

Figure 15 Mixing Heights Predicted by TAPM for Newstan (2009)



8.3 Topography and Land Use Data

The topographical data used in the model was sourced from the United States Geological Service's Shuttle Radar Topography Mission[1] database that has recorded topography across Australia with a 3 arc second (~90 m) spacing.

Land use data was generated using approximately 1 km resolution data sets taken from the providers of the Calpuff software TRC (www.src.com, accessed 11/10/10).

8.4 Source and Emission Data

The source and emission data entered into the model was based on the emission inventory presented in Section **7**.

CALPUFF requires particle distribution data (geometric mass mean diameter, standard deviation) to compute the dispersion of particulates. Alternatively, hourly varying deposition velocity data can be used. Deposition velocity data for TSP, PM_{10} and $PM_{2.5}$ have been taken from the VISTAS (2005) report (complied to provide guidance to US CALPUFF modellers when predicting pollutant concentrations in sensitive areas), with constant values of 1 m/min (0.0167 m/s) for TSP and PM_{10} and 1 cm/min (0.000167 m/s) for $PM_{2.5}$ used.

9 Air Dispersion Modelling Results

Dispersion modelling predictions of dust deposition rates and TSP, PM_{10} and $PM_{2.5}$ concentrations at the privately-owned residences/properties nominated in **Section 3.1** attributable to Newstan Colliery are presented in **Section 9.1** to **Section 9.4.2**.

Pollutant isopleth plots are also provided in **Appendix A** which show the maximum predicted cumulative (mining and background combined) concentrations and deposition rates of the pollutants assessed.

9.1 Dust Deposition

Table 19 shows the results of the dispersion modelling for dust deposition from Newstan Colliery at each of the identified receptors using the emission rates calculated in **Section 7**. Contour plots of the incremental increase in dust deposition are also presented in **Appendix A**.

The results indicate that annual average dust deposition rates at all nominated residences/properties surrounding the Newstan Colliery are predicted to be well below the criterion of 2 g/m^2/month (incremental dust deposition). As the nominated residences/properties were chosen as being indicative of all surrounding residences/properties, it can be concluded that cumulative dust deposition levels at residences/properties surrounding those modelled would also be below the relevant criterion of 2 g/m^2/month.

[1] Sourced from http://www.src.com/datasets/datasets_terrain.html#SRTM_DATA

Table 19 Predicted Incremental Annual Average Dust Deposition Rates

Receptor ID	Description	Annual Average Dust Deposition (g/m^2/month)
R1	Davis Dwelling	0.2
R2	Culgan Dwelling	0.4
R3	Orrock Dwelling	0.7
R4	Phelps Dwelling	0.8
R5	Parnell Dwelling	0.6
R6	Fassifern Primary School	0.8
Guideline (Incremental Impact)		**2.0**

9.2 TSP

Table 20 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 7**. As discussed in **Section 5.4**, a conservative background concentration of 34 µg/m^3 has been assumed.

Annual average TSP concentrations predicted to be well below the criterion of 90 µg/m^3 at the Davis and Culgan residences. In the case of the Orrock, Phelps and Parnell residences and Fassifern Primary School, the predicted concentrations are significantly lower than the guideline concentrations. As the nominated residences/properties were chosen as being indicative of ambient levels at surrounding residences/properties, it is unlikely that annual average TSP concentrations at other residences and properties surrounding these modelled residences would exceed the DECCW criterion of 90 µg/m^3.

Contour plots of the predicted cumulative increase in TSP concentrations are presented in **Appendix A**.

Table 20 Predicted Annual Average TSP Concentrations

Receptor ID	Description	Annual Average TSP Concentration – Incremental (µg/m³)	Background (µg/m³)	Annual Average TSP Concentration – Cumulative (µg/m³)
R1	Davis Dwelling	2	34	36
R2	Culgan Dwelling	6	34	40
R3	Orrock Dwelling	8	34	42
R4	Phelps Dwelling	7	34	41
R5	Parnell Dwelling	10	34	44
R6	Fassifern Primary School	8	34	42
Guideline				**90**

9.3 PM_{10}

9.3.1 Annual Averages

Presented in **Table 21** are the annual average PM_{10} concentrations predicted at each of the nominated residences/properties using the emission rates calculated in **Section 7**. A daily varying background file was used in the modelling based on data collected by DECCW at Wallsend in order to obtain an indication of the potential cumulative impacts associated with Newstan Colliery and to allow comparison with the annual average PM_{10} criterion of 30 µg/m^3.

The annual average PM_{10} concentrations predicted by the modelling to comply with the criterion of 30 µg/m^3 at all nominated residences/properties surrounding the Newstan Colliery. As the nominated residences/properties were chosen as being indicative of ambient levels at surrounding residences/properties, it is unlikely that annual average PM_{10} concentrations at other residences and properties surrounding these modelled residences would exceed the DECCW criterion of 90 µg/m^3.

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Contour plots of the predicted cumulative annual average PM_{10} concentrations are presented in **Appendix A**

Table 21 Predicted Annual Average PM_{10} Concentrations

Receptor ID	Description	Annual Average PM_{10} Concentration – Incremental (µg/m³)	Annual Average PM_{10} Concentration – Cumulative* (µg/m³)
R1	Davis Dwelling	2	17
R2	Culgan Dwelling	4	19
R3	Orrock Dwelling	2	20
R4	Phelps Dwelling	4	19
R5	Parnell Dwelling	2	19
R6	Fassifern Primary School	7	21
Guideline			**30**

* Cumulative impacts derived using an hourly-varying background file based on data recorded during 2009 at the DECCW's Wallsend ambient monitoring station

9.3.2 Maximum 24-hour Averages

Presented in **Table 22** are the maximum 24-hour average PM_{10} concentrations predicted at each of the nominated residences/properties using the emission rates calculated in **Section 7**. As for the annual average predictions, these results include daily-varying background PM_{10} concentrations based on data recorded at Wallsend during 2009.

As shown in the table, the maximum 24-hour PM_{10} concentrations show a potential to exceed the criterion of 50 µg/m^3 at one of the modelled residence/properties (as highlighted). The dispersion modelling resulting in exceedances of PM_{10} as a 24 hour average was developed based on a worst case operational scenario. To ensure exceedances of air quality criteria are avoided, Centennial Newstan will implement a range of best practice dust mitigation measures and develop a reactive management program to monitor and react to elevated PM_{10} concentrations.

Contour plots of the maximum predicted cumulative 24-hour average PM_{10} concentrations are presented in **Appendix A**.

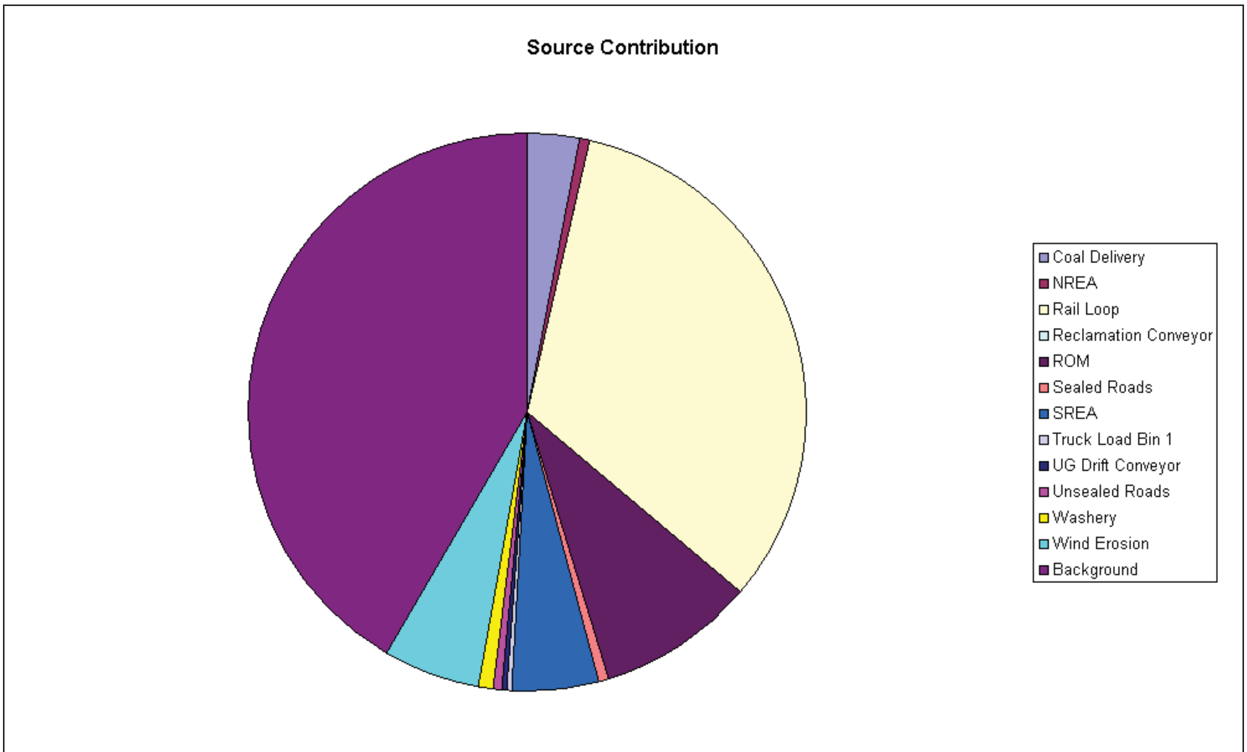
Table 22 Maximum (6th Highest) Predicted 24-Hour Average PM_{10} Concentrations

Receptor ID	Description	Maximum 24 hour Average PM_{10} Concentration - Incremental (µg/m³)	Maximum 24 hour Average PM_{10} Concentration - Cumulative (µg/m³)
R1	Davis Dwelling	9	40
R2	Culgan Dwelling	19	40
R3	Orrock Dwelling	27	50
R4	Phelps Dwelling	27	49
R5	Parnell Dwelling	21	46
R6	Fassifern Primary School	35	56[a]
Guideline			**50**

a There is a possible two occasions when the 24 hour PM_{10} concentration are at or above the 50 µg/m³ guideline concentration.

An analysis of the average contributions of various source groups (see **Figure 16**) at the worst-affected receptor (R6) shows that for the top three 24-hour average PM_{10} concentrations, background PM_{10} is the major contributing source (42%) followed by activity in the rail loop. Impacts from the rail loop, which contributes approximately 33% of the total impacts (for the three highest concentrations), are driven primarily by front end loaders and wind erosion. Therefore it can be concluded that when background concentrations are high there is a potential for the site to exceed the 24 hour PM_{10} guidelines at and around the Fassifern Primary School.

Figure 16 Average Source Contributions for Top Three 24-Hour PM_{10} Concentrations at R6



9.4 $PM_{2.5}$

9.4.1 Annual Averages

Presented in **Table 23** are the annual average $PM_{2.5}$ concentrations predicted at each of the nominated sensitive residences/properties using the emission rates calculated in **Section 7**.

As discussed in Section **5.3.2**, there are no $PM_{2.5}$ monitoring data available for the area or studies providing an appropriate ratio with which to estimate background $PM_{2.5}$ concentrations from measured PM_{10} or TSP concentrations. Therefore, the predicted incremental impact of the site's activities on downwind $PM_{2.5}$ concentrations has been compared to the annual average Project criterion of 8 µg/m^3. Background levels have not been assumed.

Annual average incremental $PM_{2.5}$ concentrations are not predicted to exceed the criterion of 8 µg/m^3 at any of the modelled residences/properties. Background concentrations greater than 5.8 µg/m^3 would need to be experienced before receptor R6 would be predicted to exceed the guideline.

Contour plots of the incremental increase in annual average $PM_{2.5}$ concentrations are presented in **Appendix A**.

Table 23 Predicted Incremental Annual Average $PM_{2.5}$ Concentrations

Receptor ID	Description	Annual Average Incremental $PM_{2.5}$ Concentration (µg/m³)
R1	Davis Dwelling	0.6
R2	Culgan Dwelling	1.4
R3	Orrock Dwelling	2.0
R4	Phelps Dwelling	1.8
R5	Parnell Dwelling	2.0
R6	Fassifern Primary School	2.2
Guideline (Cumulative)		**8.0**

Note: No background $PM_{2.5}$ data available for area

9.4.2 Maximum 24-hour Averages

Presented in **Table 24** are the maximum predicted 24-hour average $PM_{2.5}$ concentrations at each of the nominated residences/properties using the emission rates calculated in **Section 7**. As discussed above, no background $PM_{2.5}$ data was available for the area that could be used to perform a cumulative $PM_{2.5}$ assessment.

As shown in the table, the maximum predicted ground level 24-hour average $PM_{2.5}$ concentrations due to emissions from Newstan Colliery are not predicted to exceed the criterion of 25 µg/m^3 at any of the modelled residences/properties, excluding background concentrations. For an exceedance of the 24 hour $PM_{2.5}$ guideline to occur a $PM_{2.5}$ background concentration of greater than 10 µg/m^3 would have to occur in the same 24 hour period as the predicted highest contribution from Newstan Colliery.

Contour plots of the incremental increase in maximum 24-hour average $PM_{2.5}$ concentrations are presented in **Appendix A**.

Table 24 Predicted Incremental 24 Hour Average $PM_{2.5}$ Concentrations

Receptor ID	Description	Maximum 24 hour Average $PM_{2.5}$ Concentration – Incremental (µg/m³)
R1	Davis Dwelling	4
R2	Culgan Dwelling	9
R3	Orrock Dwelling	13
R4	Phelps Dwelling	12
R5	Parnell Dwelling	11
R6	Fassifern Primary School	15
Guideline		**25**

Note: No background $PM_{2.5}$ data available for area

It is noted that there is some uncertainty associated with the estimation of $PM_{2.5}$ emissions from PM_{10} estimates using broad ratios for ranges of sources. The dispersion modelling predictions for $PM_{2.5}$ should therefore be viewed as indicative only, with an appropriate level of uncertainty attached.

To address these limitations, it is recommended that the Proponent undertake $PM_{2.5}$ monitoring on a 1-in-6 day cycle (concurrent with the PM_{10} monitoring) for a period of approximately 12 months to collect data on background $PM_{2.5}$ concentrations and also to determine site specific PM_{10} / $PM_{2.5}$ ratios associated with the current Newstan Colliery operations. This data will be invaluable in validating the findings of this assessment. Should $PM_{2.5}$ concentrations be shown to be consistently below the criterion, monitoring can be ceased. If $PM_{2.5}$ concentrations are shown to be consistently above the criterion, then a detailed assessment of the monitoring data and concurrent meteorological data should be performed to identify the most likely sources of the $PM_{2.5}$ particles. Targeted management measures may then be applied to the identified key sources, with success of the implemented measures to be validated through continued monitoring.

10 BEST PRACTICE CONTROL OF PARTICULATE EMISSIONS FROM MINING

The following discussion of best practice control measures for the minimisation of particulate emissions from various mining activities has been sourced for a recent review of international best practice completed by Katestone Environmental for the NSW DECCW.[2]

10.1 Haul Roads

Wheel-generated particulate matter associated with trucks travelling on unpaved haul roads is a major source of particulate emissions for coal handling operations. The design, maintenance and management of haul roads is therefore fundamental to the minimisation of particulate emissions from coal handling operations.

Best practice haul road design should include:

- Minimisation of the distance travelled by taking the most direct route to the destination;
- Road safety (minimise steepness of ramps to less than 8%, eliminate sweeping intersections and avoid potential for equipment interactions);

[2] *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining*, Prepared by Katestone Environmental Pty Ltd for DECCW, December 2010.

- Optimise surface drainage, particularly at intersections;
- Optimise base materials to reduce silt content and increase the retention of larger aggregates, particularly at intersections;
- Restrict vehicle speeds on all roads to 40 km/hr or less; and
- Use larger trucks to minimise number of trips.

Best practice haul road maintenance should include:

- Scheduled grading and gravelling of heavy traffic areas such as intersections;
- Watering, application of chemical suppressants or paving of light traffic areas, such as the Coal Handling and Processing Plant (CHPP), underground mine portals and workshop and administrative areas;
- Regular resurfacing of high traffic areas such as intersections to reduce silt build up; and
- Regular maintenance of drainage design features at intersections (cross fall or camber).

Best practice haul road management should include:

- Diligent monitoring and application of controls as surface dries out to avoid excessive emissions. Real-time triggers should be used to identify problem areas for targeted application of controls;
- Regular watering of haul roads and at the direction of haul truck operators;
- Do not allow haul roads to become saturated as this will increase emissions once it dries out; and
- Regular grading and maintenance of intersections.

Alternatives to hauling using trucks on unpaved roads (e.g. the use of conveyors to replace haul routes should also be considered.

With respect to grading emissions, there is very little information available in the literature that would provide a basis to define best practice. However, the NPI handbook for mining recommends a control factor of 50% for scrapers working on topsoil where the soil is naturally or artificially moist. A similar reduction would be expected to be achieved for graders. The emission factors for graders suggest that a 75% reduction could be achieved by reducing the speed of the grader from 16 km/hr to 8 km/hr.

10.2 Wind Erosion

The following subsections deal separately with measures to control emissions of particulate matter due to wind erosion of exposed areas and stockpiles. The reason for this separation is that stockpiles tend to be more exposed to the ambient wind due to their height and shape and stockpiles are continuously active, meaning that extra attention needs to be paid to stockpiles to minimise emissions. Notwithstanding this, the key techniques for minimising emissions of particulate matter from stockpiles and exposed areas are:

- Stabilise the erodible surface (e.g. by increasing the moisture content of the aggregate material being stored); and
- Shield the erodible surface from the prevailing wind.

10.2.1 Exposed Areas and Overburden Emplacements

The two fundamental drivers of particulate matter emissions caused by wind erosion are the area exposed to wind erosion and the strength of the wind. To mitigate emissions of particulate matter due to wind erosion of open exposed areas the following techniques are therefore recommended in the literature:

- Paving – usually feasible for small areas in and around workshops;
- Fencing, bunding or shelterbelts to reduce ambient wind speeds;
- Adding gravel to the surface to reduce surface fines content and to reduce the surface wind speed;
- Spillage clean-up;
- Watering;
- Chemical suppressants; and
- Revegetation – use of vegetation as an interim measure to minimise emissions of particulate matter from areas that may be exposed for extended period of time.

Avoidance of particulate matter emissions from exposed areas can be achieved by minimising areas exposed to the wind.

Mobile tankers can be used to successfully reduce emissions from accessible exposed site areas. These essentially un-trafficked areas can be sprayed with water containing suppressant chemical to achieve a reduction in emissions lasting several weeks before the need to respray the surface.

One of the most effective control measures for exposed areas is the revegetation of exposed soil or the rehabilitation of land that is not currently in use. It may be appropriate to consider the use of interim vegetation, for exposed areas that will not be used for a period time, such as hydraulic mulch seeding or (for broad and otherwise inaccessible areas) aerial seeding.

10.2.2 Coal Stockpiles

Best practice measures to control emissions of particulate matter from coal stockpiles include:

- Shaping and orientation to minimise emissions of particulate matter; and
- Stockpile watering on continuous cycle with modification of cycle depending on prevailing weather conditions to allow greater or lesser watering intensity.

10.3 Bulldozers

Best practice measures to control emissions of particulate matter from bulldozers include:

- Minimise travel speed and distance; and
- Keep travel routes and materials moist.

10.4 Loading and Dumping of Material Other Than Coal

Best practice measures for minimising emissions from loading and dumping of material other than coal include:

- Use of water sprays or water carts with boom spray;
- Cease or modify activities on dry windy days; and
- Minimise dump height.

10.5 Loading and Dumping ROM Coal

Best practice measures for minimising emissions from loading and dumping ROM coal include:

- Avoidance (i.e. bypass ROM stockpiles);
- Minimise drop height (reduce to 5 m);

- Water sprays on ROM pad or ROM bin
- Three sided and roofed enclosure of ROM bin; and
- Enclosure of ROM bin with control device.

10.6 Conveyors and Transfers

Best practice measures for minimising emissions from conveyors and transfers include:

- Application of water or enclosure at transfer points
- Wind shielding – roof and/or side wall
- Belt cleaning and spillage minimisation
- Transfers Enclosure

10.7 Stacking and Reclaiming Product Coal

The following measures are applied to minimise emissions of particulate matter from stacking:

- Bypass coal stockpile;
- Variable height luffing stacker to allow drop height to be minimised and stacking to occur without dozer push;
- Use of chutes or wind shields to shroud falling coal from static trippers; and
- Water application – boom tip sprays.

The following measures are applied to minimise emissions of particulate matter from reclaiming:

- Use of bucket-wheel, portal or bridge reclaimer;
- Water application – boom tip sprays;
- Reclaim tunnel with minimal mechanical disturbance;
- Minimise residence time in stockpiles; and
- Coal moisture management.

10.8 Train and Truck Load Out and Transportation

Best practice measures to control emissions of particulate matter from truck and train loader are the use of volumetric loading from an overhead silo or bin with a telescopic chute with the entire activity enclosed within a building. Clam-shell or front-end loaders should be avoided where possible due to the potential for spillage during loading operations. Spilled coal can be a source of particulate matter emissions particularly as the coal dries and where it is deposited on tracks and trafficked areas can be pulverised to produce a very fine and easily eroded particulate matter.

Best practice measures to control emissions of particulate matter from rail corridors include:

- Use of profilers to manage overloading or underloading of wagons;
- Maintain a consistent profile. (Loading via front-end loaders and clam shells produces uneven loads that are susceptible to spillage and reduce the effectiveness of suppressants);
- Maintaining the 100 mm freeboard around the edge of the wagon;
- Application of a suppressant to the surface of the coal profile;
- Removing parasitic coal from the surface of the wagons before leaving the site;
- Covering load (e.g. tarpaulins or lid); and

- Wagon wheel wash.

Best practice measures to control emissions of particulate matter from trucks include:

- Limit load size to ensure coal is not above the level of the sidewalls;
- Maintain a consistent profile;
- Use bedliners to minimise seepage and spillage from bottom dumping trucks;
- Covering load with a tarpaulin; and
- Utilise a truck wheel wash ensuring that truck is clean and free of loose material.

Table 25 provides an overview of those best practice dust management measures currently implemented at the Newstan Colliery and identifies additional dust management measures that will be implemented. The ability to implement the additional dust management measures has been determined following a review of the currently implemented and best practice dust management measures with SLR consultants and Centennial Newstan staff. The review identified additional areas where dust management measures can be implemented that are achievable and feasible for the current Newstan Colliery operations.

Table 25 Best Practice Dust Mitigation Measures Implemented and Proposed for the Newstan Colliery

Activity	Currently implemented	Modelled	Will be implemented
Haul Roads			
Best practice haul road design should include:			
Minimisation of the distance travelled by taking the most direct route to the destination.	Yes		
Road safety (minimise steepness of ramps to less than 8%, eliminate sweeping intersections and avoid potential for equipment interactions).	Yes		
Optimise surface drainage, particularly at intersections.	Yes		
Optimise base materials to reduce silt content and increase the retention of larger aggregates, particularly at intersections.	No		
Restrict vehicle speeds on all roads to 40 km/hr or less.	For internal but not long distance haul roads	Yes for internal	Yes for internal haul roads
Use larger trucks to minimise number of trips.	Yes		
Best practice haul road maintenance should include:			
Scheduled grading and gravelling of heavy traffic areas such as intersections.	Yes		
Watering, application of chemical suppressants or paving of light traffic areas, such as the Coal Handling and Processing Plant (CHPP), underground mine portals and workshop and administrative areas.	Yes	Yes	
Regular resurfacing of high traffic areas such as intersections to reduce silt build up.	Yes		
Regular maintenance of drainage design features at intersections (cross fall or camber).	Yes		

Activity	Currently implemented	Modelled	Will be implemented
Best practice haul road management should include:			
Diligent monitoring and application of controls as surface dries out to avoid excessive emissions. Real-time triggers should be used to identify problem areas for targeted application of controls.	No		Yes
Regular watering of haul roads and at the direction of haul truck operators	Yes	Yes	
Do not allow haul roads to become saturated as this will increase emissions once it dries out.	Yes		
Regular grading and maintenance of intersections.	Yes		
Alternatives to hauling using trucks on unpaved roads (e.g. the use of conveyors to replace haul routes should also be considered.)	No		
Grading			
Reducing the speed of the grader from 16 km/hr to 8 km/hr.	No		Yes
Working on topsoil where the soil is naturally or artificially moist.	Yes	Yes	
Wind Erosion			
Stabilise the erodible surface (e.g. by increasing the moisture content of the aggregate material being stored); and	Yes	Yes	
Shield the erodible surface from the prevailing wind.	No		Not practical or achievable
Exposed Areas			
Minimise exposed areas as far as is practicable	Yes		
Paving – usually feasible for small areas in and around workshops	Yes	Yes	
Fencing, bunding or shelterbelts to reduce ambient wind speeds	Yes (some areas)	Yes	
Adding gravel to the surface to reduce surface fines content and to reduce the surface wind speed	Yes	Yes	
Spillage clean-up	Yes		
Watering	Yes	Yes	
Chemical suppressants	Yes	Yes	
Revegetation of unused areas	Yes	Yes	
Coal Stockpiles			
Shaping and orientation to minimise emissions of particulate matter	Yes		
Stockpile watering on continuous cycle with modification of cycle depending on prevailing weather conditions to allow greater or lesser watering intensity	Yes - water cart has been equipped with a water cannon for applying water to stockpiles.	Yes	Yes – will be implemented more vigilantly
Bulldozers			
Minimise travel speed and distance	Yes		
Keep travel routes and materials moist	Yes		

Activity	Currently implemented	Modelled	Will be implemented
Loading and Dumping Material Other Than Coal			
Use of water sprays or water carts with boom spray	Yes	Yes	
Cease or modify activities on dry windy days	Yes	Yes	
Minimise dump height	Yes		
Loading and Dumping ROM Coal			
Avoidance (i.e. bypass ROM stockpiles)	No		
Minimise drop height (reduce to 5 m)	No		
Water sprays on ROM pad or ROM bin	Yes	Yes	
Three sided and roofed enclosure of ROM bin	Yes	Yes	
Enclosure of ROM bin with control device	Yes	Yes	
Conveyors and Transfers			
Application of water or enclosure at transfer points	Yes	Yes	
Wind shielding – roof and/or side wall	Yes	Yes	
Belt cleaning and spillage minimisation	Yes		
Transfers Enclosure	Yes	Yes	
Stacking and Reclaiming Product Coal			
Bypass coal stockpile	No		
Variable height luffing stacker to allow drop height to be minimised and stacking to occur without dozer push	No		
Use of chutes or wind shields to shroud falling coal from static trippers	Yes	Yes	
Water application – boom tip sprays	Yes (some areas)		
Reclaiming:			
Use of bucket-wheel, portal or bridge reclaimer	No		
Water application – boom tip sprays	Yes	Yes	
Reclaim tunnel with minimal mechanical disturbance	Yes		
Minimise residence time in stockpiles	Yes		
Coal moisture management	Yes	Yes	
Train and Truck Load Out and Transportation			
Use of volumetric loading from an overhead silo or bin	Yes (for trucks)		
Telescopic chute with the entire activity enclosed within a building.	No		
Front-end loaders avoidance	No		
Rail Corridors:			
Use of profilers to manage overloading or underloading of wagons	No		
Maintain a consistent profile.	No		
Maintaining the 100 mm freeboard around the edge of the wagon	Yes		

Activity	Currently implemented	Modelled	Will be implemented
Application of a suppressant to the surface of the coal profile	No		
Removing parasitic coal from the surface of the wagons before leaving the site	No		
Covering load (e.g. tarpaulins or lid)	No		
Wagon wheel wash	No		
Trucks:			
Limit load size to ensure coal is not above the level of the sidewalls	Yes		
Maintain a consistent profile	No		
Use bedliners to minimise seepage and spillage from bottom dumping trucks	No		
Covering load with a tarpaulin	Yes		
Utilise a truck wheel wash ensuring that truck is clean and free of loose material	No		Yes

11 Conclusions and Recommendations

SLR Consulting Ltd was commissioned by Centennial Newstan to conduct an air quality impact assessment of the current approved operations of the Newstan Colliery. Atmospheric dispersion modelling of fugitive emissions of particulate matter (TSP, PM_{10} and $PM_{2.5}$) from the site was undertaken using the CALPUFF dispersion model. Emissions from coal transport, storage, the washery and rail loading and transport activities were addressed in the study. Local meteorological conditions were predicted using The Air Pollution Model (TAPM) for the year 2009. Topography and land use data were sourced from published databases.

The results of the dispersion modelling conducted for Newstan Colliery indicate no potential for exceedance of the DECCW annual average TSP, PM_{10} and $PM_{2.5}$ assessment criteria at the nearest non-project related receptors. However, there exists the potential under conditions of high 24 hour PM_{10} background concentrations for exceedances of the 24 hour PM_{10} guideline at one of the nearest receptors. Analysis of the model results indicates that the major contributors to these predicted impacts are front end loaders and wind erosion from the rail loop area. The dispersion modelling resulting in exceedances of PM_{10} as a 24 hour average was developed based on a worst case operational scenario. 24 hour $PM_{2.5}$ concentrations were not predicted to exceed the DECCW guidelines.

Deposited dust (the fraction of dust that settles out of the airborne dust due to gravitation) was not predicted to exceed DECCW guidelines at any of the receptors.

A review of the best practice dust mitigation measures has been undertaken as part of this assessment and Centennial Newstan has identified areas where improved dust management measures will be implemented. These additional dust management measures are identified in **Table 25**.

Monitoring of TSP, PM_{10}, and deposited dust should be continued in order to provide verification of the dispersion modelling of proposed operations. It is also recommended that the Proponent commence $PM_{2.5}$ monitoring on a 1-in-6 day cycle (concurrent with the PM_{10} monitoring) for a period of approximately 12 months to collect data on background $PM_{2.5}$ concentrations and also to determine site specific PM_{10} / $PM_{2.5}$ ratios associated with the current Newstan Colliery operations.

Additionally a reactive monitoring program will be put in place to allow dust generating activities to be modified or ceased if conditions are such that exceedance of 24 hour PM_{10} concentrations guidelines are likely.

12 REFERENCES

The following documents have been referenced in the preparation of this report

- Commonwealth of Australia (2001) "*National Pollutant Inventory Emission Estimation Technique Manual for Mining Version 2.3*".
- Department of Environment and Climate Change (2008) "*National Environment Protection (Ambient Air Quality) Measure New South Wales Annual Compliance Report 2007*".
- Department of Environment and Climate Change (2008) "*National Environment Protection (Ambient Air Quality) Measure New South Wales Annual Compliance Report 2008*".
- National Environmental Protection Council (1998) "*Ambient Air Quality National Environment Protection Measure*".
- NSW Department of Environment, Climate Change and Water (2010), PM_{10} data from the DECCW's Wallsend monitoring site for December 2007 to December 2009.
- NSW Department of Environment, Climate Change and Water (2007) "*Approved Methods for the Sampling and Analysis of Air Pollutants in NSW*".
- NSW Department of Environment, Climate Change and Water (2005) "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*".
- United States Environmental Protection Authority (2003) *Compilation of Air Pollutant Emission Factors AP-42 - Chapter 13.2.2 Unpaved Roads*.
- United States Environmental Protection Authority (2006) *Compilation of Air Pollutant Emission Factors AP-42 - Chapter 13.2.1 Paved Roads*.
- United States Environmental Protection Authority (2006) *Compilation of Air Pollutant Emission Factors AP-42 - Chapter 13.2.5 Industrial Wind Erosion*.

13 CLOSURE

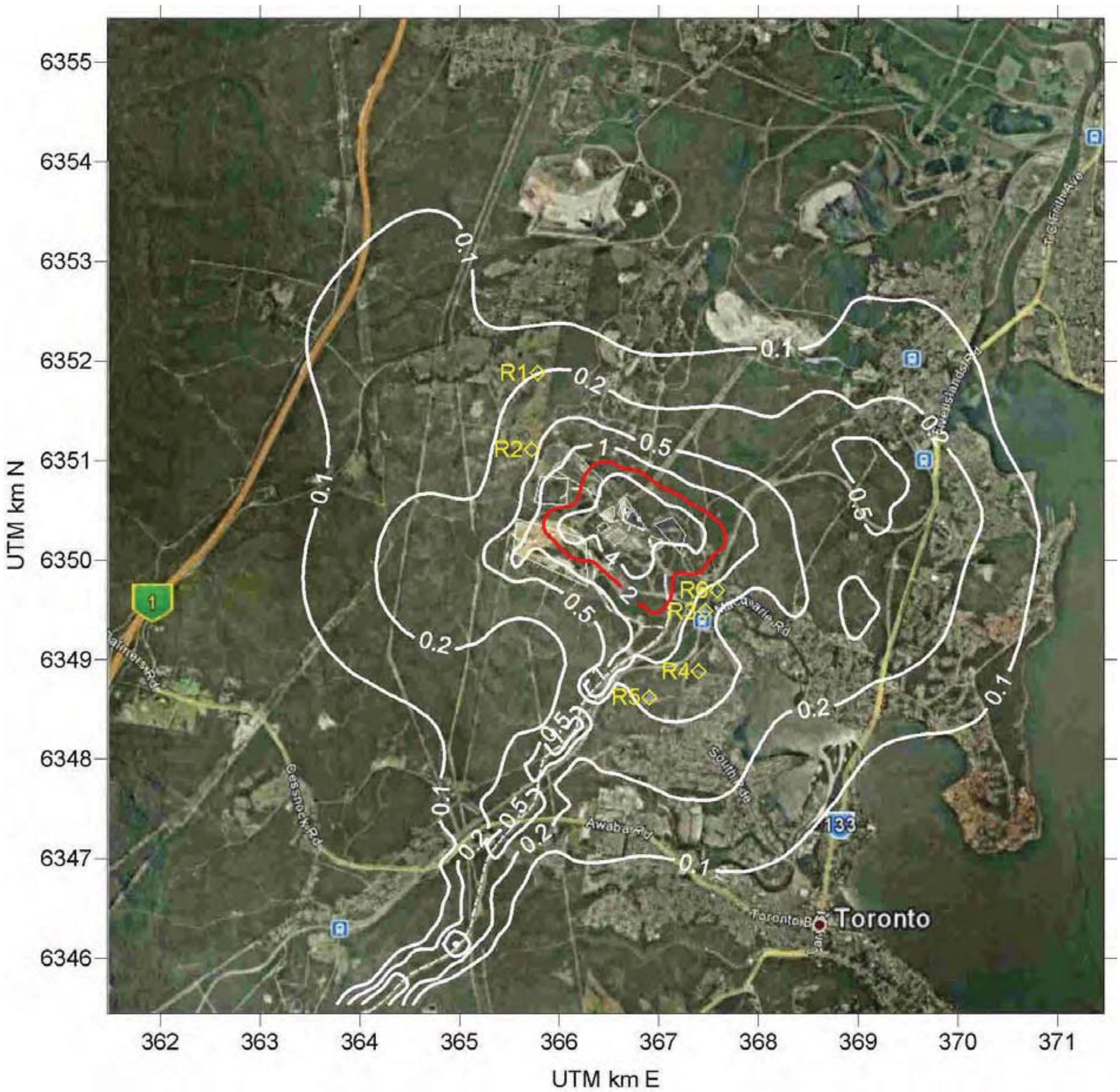
This report has been prepared by SLR with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of Centennial Coal Company Limited; no warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

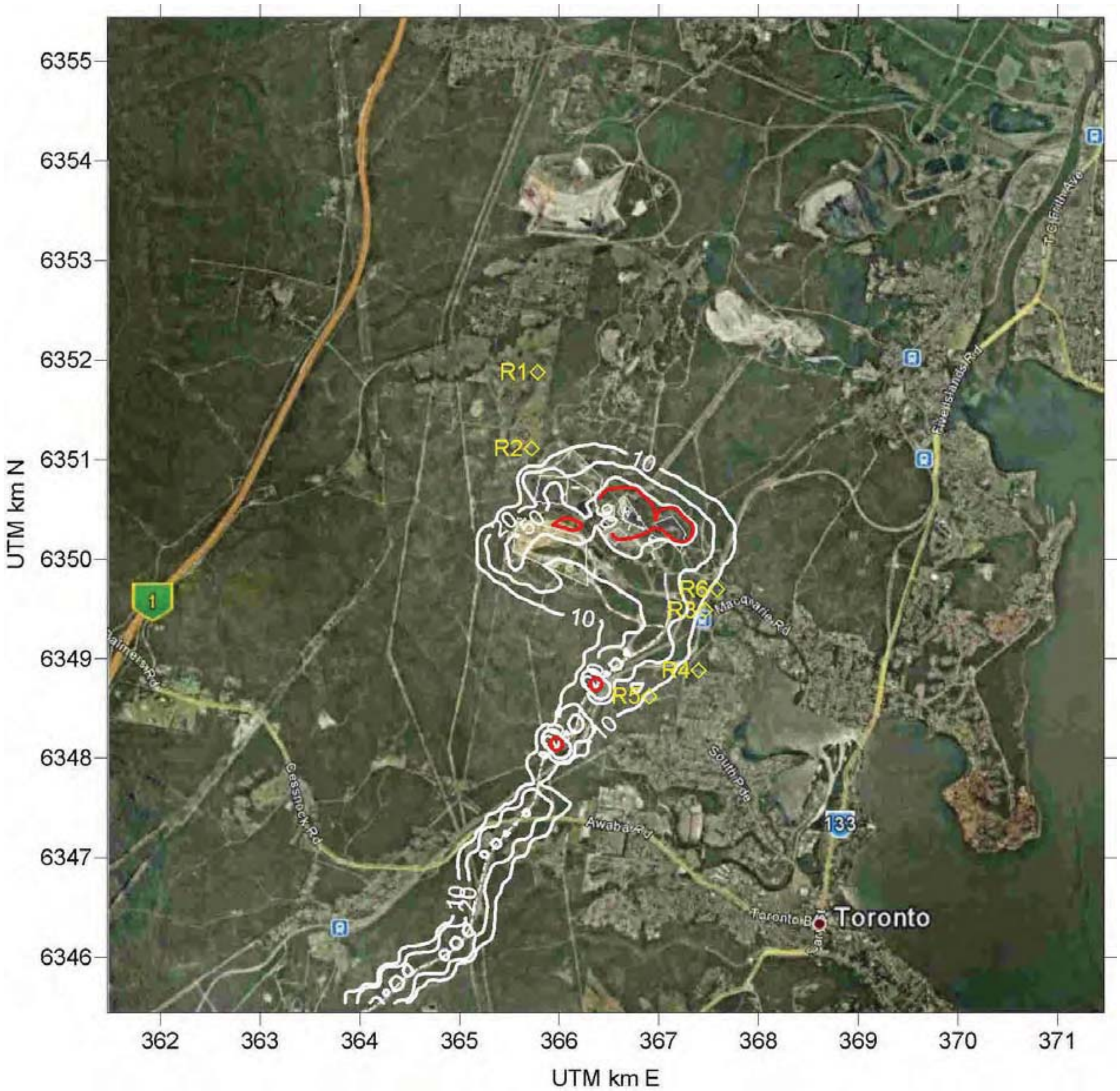
APPENDIX A – DISPERSION MODELLING CONTOUR PLOTS

Figure 17 Predicted Annual Average Incremental Deposited Dust (g/m²/month)



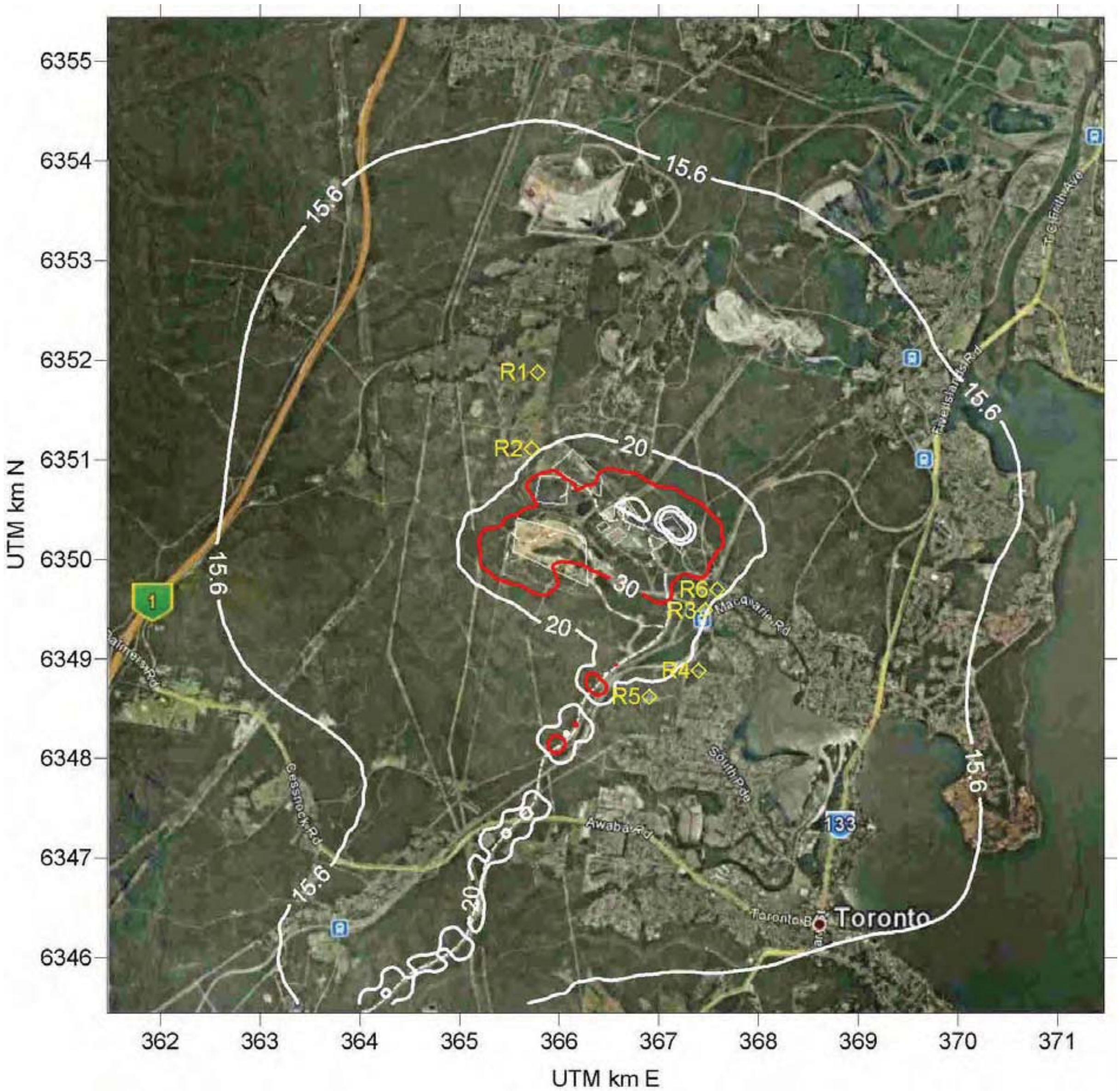
Modelled using Calpuff V6.267.
Guideline concentration (red line) = 2 g/m²/month (Incremental) or 4 g/m²/month (Cumulative)

Figure 18 Predicted Annual Average Cumulative TSP Concentrations (µg/m³)



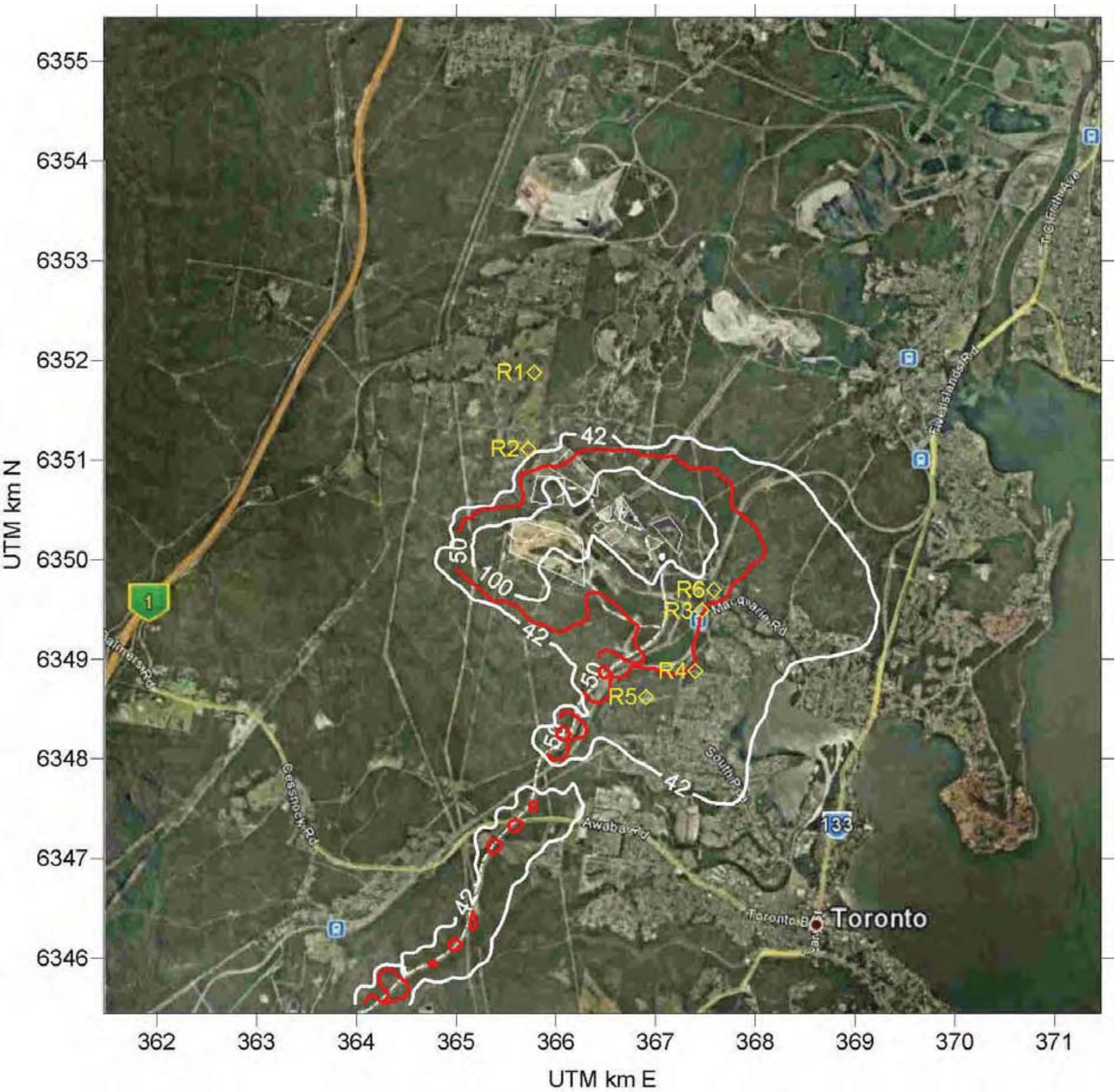
Modelled using Calpuff V6.267.
Guideline concentration = 90 µg/m³ (Cumulative)

Figure 19 Predicted Annual Average Cumulative PM_{10} Concentrations (µg/m³)



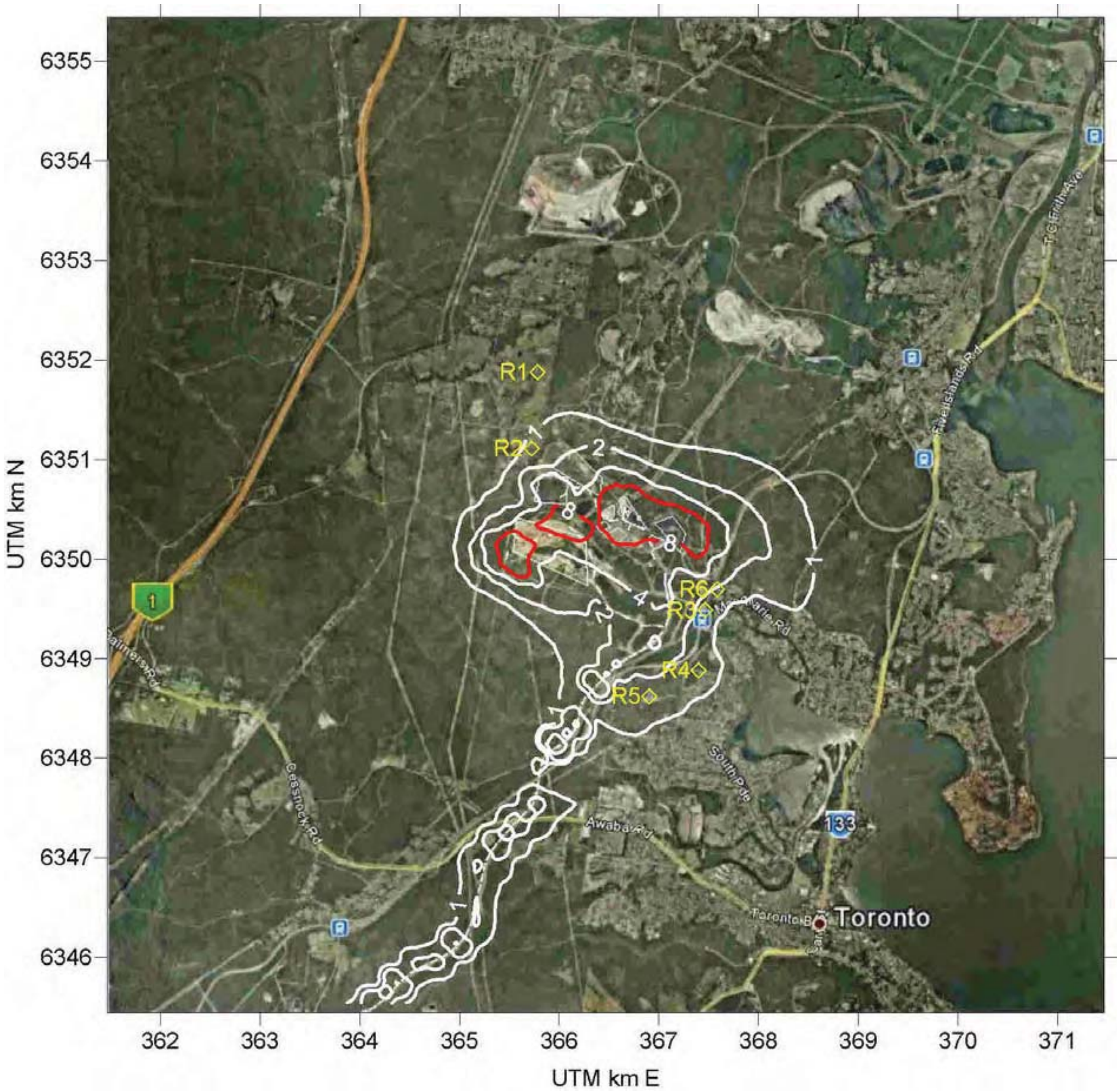
Modelled using Calpuff V6.267.
Guideline concentration = 30 µg/m³ (Cumulative)

Figure 20 Predicted Maximum 24-Hour Average Cumulative PM_{10} Concentration (µg/m³)



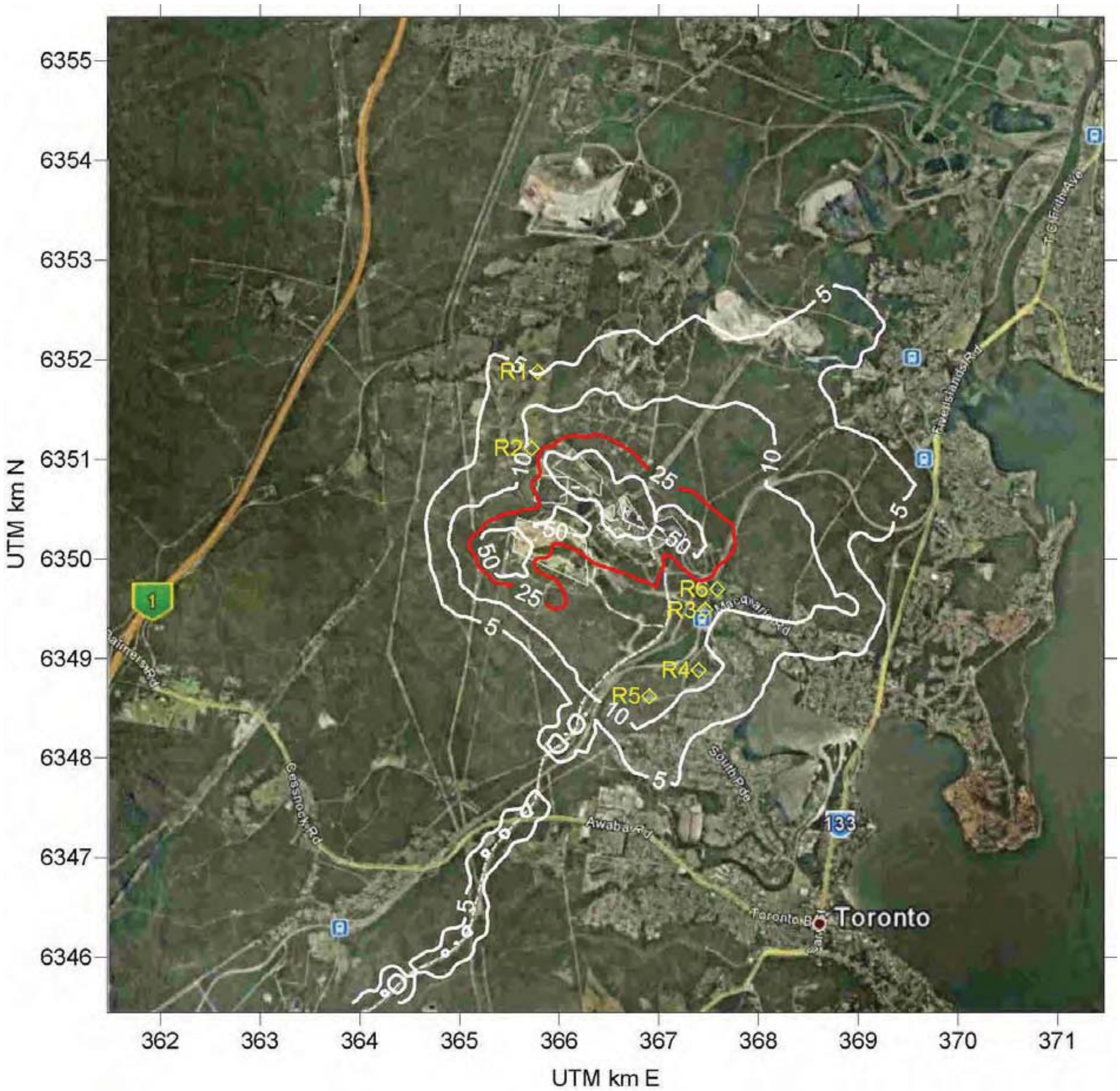
Modelled using Calpuff V6.267.
Guideline concentration = 50 µg/m³ (Cumulative)

Figure 21 Predicted Annual Average Incremental $PM_{2.5}$ Concentrations (µg/m³)



Modelled using Calpuff V6.267.
Guideline concentration = 8 µg/m³ (Cumulative)

Figure 22 Predicted 24-Hour Average Incremental $PM_{2.5}$ Concentrations (µg/m³)



Modelled using Calpuff V6.267.
Guideline concentration = 25 µg/m³ (Cumulative)

					Operation			Control efficiency applied			Annual emission rate (kpy)		
Area	**Descriptor**	**Source Type**	**Activity**	**Units**	**Hr/Day**	**Day/Year**	**OpHrs**	**TSP**	**PM10**	**PM2.5**	**TSP**	**PM_{10}**	**$PM_{2.5}$**
Coal Deliveries Area	Dump truck	Truck dumping coal	55	tonnes	2	365	730	100%	100%	100%	402	170	304
SREA Operations	A 7t Excavator	Excavator on coal	330	tonnes	8	365	2920	100%	100%	100%	17,800	8,590	3,870
SREA Operations	A 25 Tonne Excavator	Excavator on coal	100	tonnes	8	365	2920	100%	100%	100%	5,400	2,600	1,170
SREA Operations	B 25 Tonne Excavator	Excavator on overburden	330	tonnes	8	365	2920	100%	100%	100%	216	102	46
SREA Operations	B Traxcavator	Excavator on overburden	34	tonnes	8	365	2920	100%	100%	100%	23	11	5
SREA Operations	B Compactor	Bulldozing - moist coal (AP42)	1	VKT	8	365	2920	100%	100%	100%	17,600	4,740	1,160
SREA Operations	B Trucks dumping	Truck dumping coal	364	tonnes	8	365	2920	100%	100%	100%	10,600	4,470	2,010
Rail Loop	C FEL to train	FEL on coal	400	tonnes	8	365	2920	100%	100%	100%	13,200	6,340	2,860
Rail Loop	C Dozer	Bulldozing - moist coal (AP42)	1	VKT	1	365	365	100%	100%	100%	2,200	593	48
Rail Loop	C FEL to train	FEL on coal	400	tonnes	12	365	4380	100%	100%	100%	19,800	9,510	2,860
Rail Loop	C Truck loading at bin	Miscellaneous transfer points - coal	200	tonnes	24	365	8760	100%	100%	100%	349	165	25
Rail Loop	C Bin filling	Miscellaneous transfer points - coal	200	tonnes	24	365	8760	100%	100%	100%	349	165	25
Coal Deliveries Area	D Truck tipping	Truck dumping coal	220	tonnes	24	365	8760	100%	100%	100%	19,300	8,090	1,210
Coal Deliveries Area	D Reclaim conveyor	Miscellaneous transfer points - coal	450	tonnes	24	365	8760	0%	0%	0%	2	1	0
Coal Deliveries Area	D Dozer	Bulldozing - moist coal (AP42)	1	VKT	12	365	4380	100%	100%	100%	26,400	7,110	1,160
Coal Deliveries Area	D Truck tipping	Truck dumping coal	220	tonnes	24	365	8760	100%	100%	100%	19,300	8,090	1,210
NREA Operations	E Dozer	Bulldozers on material other than coal	1	hrs	8	365	2920	100%	100%	100%	11,100	2,450	1,100
NREA Operations	E Excavator	Excavator on overburden	35	tonnes	8	365	2920	100%	100%	100%	23	11	5
NREA Operations	E 950 Loader	FEL on overburden	35	tonnes	8	365	2920	100%	100%	100%	23	11	5
Coal handling plant	F Conveyor	Miscellaneous transfer points - coal	700	tonnes	20	365	7300	0%	0%	0%	3	1	0
Coal handling plant	F 4000 tonne bin	Miscellaneous transfer points - coal	700	tonnes	20	365	7300	100%	100%	100%	1,020	480	86
Coal handling plant	F CHP	Miscellaneous transfer points - coal	700	tonnes	20	365	7300	30%	30%	30%	305	144	26
Coal handling plant	F Loader	FEL on coal	75	tonnes	4	365	1460	100%	100%	100%	1,240	595	535
Coal handling plant	F Feed conveyors	Miscellaneous transfer points - coal	700	tonnes	20	365	7300	30%	30%	30%	305	144	26
Coal handling plant	Crusher	Primary crushing - HMCO - Default Factor	700	tonnes	20	365	7300	0%	0%	0%	0	0	0
Active storage pile - coal (AP42)	A-EROS1	Active storage pile - coal (AP42)	3416.4	ha	50	ha		100%	100%	100%	245	122	840
Active storage pile - coal (AP42)	A-EROS2	Active storage pile - coal (AP42)	11826	ha	50	ha		100%	100%	100%	848	424	2,909

Roads	Washery to Eraring Haul Road	Paved Roads	10	VKT/hr	24	365	8760	37%	37%	37%	3,570	686	171
Roads	Eraring Haul Road to SREA	Unpaved Roads	17	VKT/hr	12	365	4380	37%	37%	37%	2,990	574	143
Roads	SREA Internal Haul Road	Unpaved Roads	8	VKT/hr	12	365	4380	28%	28%	28%	28,600	6,950	695
Roads	Washery to Coal Deliveries Area	Paved Roads	6	VKT/hr	24	365	8760	37%	37%	37%	2,280	438	109
Roads	Washery to NREA	Paved Roads	2	VKT/hr	12	365	4380	28%	28%	28%	6,030	1,460	146
Roads	Truck Loading Bin to Eraring Haul Road	Paved Roads	23	VKT/hr	24	365	8760	37%	37%	37%	8,240	1,580	394
Roads	Rail loop	Paved Roads	1	VKT/hr	24	365	8760	37%	37%	37%	456	88	22
Roads	Eraring Haul Road	Paved Roads	58	VKT/hr	24	365	8760	43%	43%	43%	27,300	5,250	1,310
Roads	Grader	Unpaved Roads	5	VKT/hr	12	365	4380	50%	50%	50%	2,080	1,150	65
Wind Erosion 1			1.2	ha				50%	50%	50%	1,086	543	81
Wind Erosion 2			1.7	ha				50%	50%	50%	1,524	762	114
Wind Erosion 3			0.7	ha				50%	50%	50%	648	324	49
Wind Erosion 4			1.1	ha				50%	50%	50%	929	464	70
Wind Erosion 5			7.9	ha				25%	48%	48%	3,469	3,296	494
Wind Erosion 6			21.2	ha				50%	50%	50%	18,571	9,286	1,393
Wind Erosion 7			7.9	ha				50%	50%	50%	6,938	3,469	520
Wind Erosion 8			3.7	ha				50%	50%	50%	3,206	1,603	240
Wind Erosion 9			4.8	ha				50%	50%	50%	4,205	2,102	315
Total Emission									**30.42**	**290,175**	**290,175**		